Section 700
MATERIALS and MANUFACTURING

SECTION 701 - HYDRAULIC CEMENTS

701-01 PORTLAND CEMENT

SCOPE. This Specification covers five types of portland cement as follows:

Type 1. For use in general concrete construction where low heat of hydration is not required and where no sulfate action is anticipated.

Type 2. For use in general concrete construction.

Type 3. For use when high early strength is required.

Type 5. For use when high sulfate resistance is required.

Type 6. For use in white concrete or white mortar.

For uniformity with recognized industry terminology, Types 1, 2, 3 and 5 may also be designated as Types I, II, III and V respectively. Type I/II is defined as a cement that meets the requirements of both Types I and II cement.

Type of cement to be used will be as shown in the plans or specifications for each contract.

MATERIAL REQUIREMENTS. Portland cement, Types 1, 2, 3 and 5 shall conform to the chemical and physical requirements of those respective types as contained in AASHTO M 85 with the following:

Type 6 cement shall meet the requirements for Type 1 cement except the color shall be white.

Any cement with an alkali content in excess of 0.70% is restricted for use as per the requirements of §501.

The Department reserves the right to impose the "Optional Chemical and Physical Requirements" of AASHTO M 85 when, in the Department's opinion, a cement contains undesirable constituents.

The temperature of the cement, measured immediately prior to entering the mixing unit at a batching facility, shall not exceed 76°F.

Manufacturer. The gypsum shall be added to the clinker by means of an approved automatic mechanical device. At the option of the manufacturer, additions of those commercial products known as "grinding aids" will be permitted as provided for by AASHTO M 85. The manufacturer shall declare the commercial name of the product used and the amount thereof in writing to the Materials Bureau.

Storage. The cement shall be stored at its source of supply in approved weather-tight silos. Facilities shall be provided for maintaining such silos under Department seal control when and as directed by the Materials Bureau.

All silos shall be completely empty and clean before cement is deposited therein unless the silo contains Department specification cement of the same type.

Cement remaining in bulk storage at the mill and/or distribution terminal for a period greater than one year after completion of tests shall be resampled and retested before shipment. However, cement which has been in bulk storage at mills and/or distribution terminals more than two years from the time of original manufacture shall not be used. No cement stored by the Contractor over the winter shall be used until retested by the Materials Bureau.

Bagged cement shall not be stored at mill or terminal locations for a period longer than that time considered reasonable by the Department for preparing an order for shipment.
Shipment. All shipments of cement shall be made in accordance with procedural directives issued by the Materials Bureau. Conveyances for bulk cement shipment shall be of a type approved by the Department. The compartments of all such conveyances shall be completely empty and clean before any cement is loaded therein. Cement may be shipped in paper bags which conform to industry standards and which have the brand name, type of cement, and the name of the manufacturer plainly marked thereon.

Inspection and Testing. All inspection and testing shall be in accordance with procedural directives issued by the Materials Bureau. When required by the Materials Bureau, cement shall be sampled by means of an automatic sampling device constructed so as to obtain continuous samples across the full stream of cement and deliver such samples into a sealed container approved by the Materials Bureau. Tests for chemical and physical properties shall be in accordance with test methods stipulated by AASHTO M 85.

BASIS OF ACCEPTANCE. Portland cement will be considered for acceptance at mill or terminal locations in accordance with procedural directives issued by the Materials Bureau.

701-02 MASONRY AND MORTAR CEMENT

SCOPE. Masonry and mortar cement, used to make masonry mortar.

MATERIALS
Masonry Cement ASTM C91
Mortar Cement ASTM C1329

BASIS OF ACCEPTANCE. The Engineer will base acceptance on each package being labeled to show ASTM conformance and its contents being in good condition.

701-03 BLENDED PORTLAND CEMENT

SCOPE. This specification covers blended portland cement, for use in portland cement concrete, using Class F fly ash, microsilica, ground granulated blast furnace slag or a combination of fly ash and microsilica. The cement, and percent of each material in the blended cement, shall be at an appropriate quantity to achieve the desired percentage in the concrete mix as shown in the plans or specifications without further addition of any cementitious component.

GENERAL. Blended portland cements, as described in AASHTO M 240 shall conform to the chemical and physical requirements described herein, or as modified in the concrete mix as shown in the plans or specifications of each contract. Acceptable blended portland cements are defined as follows:

Portland/ fly ash cement (IP). A product consisting of portland cement and fly ash in which the fly ash content does not exceed 22 percent by mass.

Portland/ microsilica cement (SF). A product consisting of portland cement and microsilica in which the microsilica content does not exceed 10 percent by mass.

Portland/ ground granulated slag cement (SM). A product consisting of portland cement and finely ground, granulated blast furnace slag in which the slag content does not exceed 22 percent by mass.

Ternary blend cement. A product consisting of portland cement, fly ash, and microsilica in which the total supplementary cementitious content does not exceed 30 percent by mass. The fly ash portion shall range from 15 -20 percent of the total mass. The microsilica portion shall range from 6-10 percent of the total mass.

Blending may be completed by means of intergrinding or by mechanical means. The blended cement shall remain homogeneous from the point of blending to the point of use at a portland cement concrete
batching facility. The ability and means of maintaining homogeneity shall be demonstrated to the satisfaction of the Department.

MATERIAL REQUIREMENTS. The individual components, before blending, shall meet the following requirements:

Portland Cement 701-01 Type I, II or I/II only
Fly ash 711-10
Microsilica 711-11
Ground, Granulated Blast Furnace Slag 711-12

Blended portland cements shall meet the chemical requirements specified in Table 701-1 and the physical requirements specified in Table 701-2.

STORAGE. The blended cement shall be stored at its source of supply in approved weather-tight silos. Facilities must be provided for maintaining such silos under Department seal control when and as directed by the Materials Bureau.

| TABLE 701-1 CHEMICAL REQUIREMENTS - BLENDED PORTLAND CEMENTS (ASTM C114) |
|---------------------------------|-----------------|-----------------|-----------------|
|                                 | Portland/flyash | Portland/microsilica | Ternary Blend |
| Loss on Ignition                | 5.0 % max.³     | 3.4 % max.       | 3.6 % max.     |
| SiO₂                           | ---             | 22.0 % min.      | 31.5 % min.    |
| MgO                            | 6.0 % max.³     | 6.0 % max.       | 6.0 % max.     |
| SO₃                            | 4.0 % max.³     | 3.1 % max.³      | 3.5 % max.³    |
| Total Alkalinity                | 0.85 % max.³    | 0.80 % max.³     | 0.95 % max.³   |

Note 1- As per chemical requirements of AASHTO M 240 for Type IP blended cement.
Note 2- As per chemical requirements of AASHTO M 240 for Type I(SM) blended cement.
Note 3- There are cases where the optimum SO₃ (using ASTM test method C563) for a particular cement is close to or in excess of the limit in this specification. In such cases where the properties of a cement can be improved by exceeding the SO₃ limits stated in this table, it is permissible to exceed the values in the table, provided it has been demonstrated by ASTM test method C1038 that the cement with the increased SO₃ will not develop expansion under water exceeding 0.020 % at 14 days. When the manufacturer supplies cement under this provision, the supporting data will be supplied, on request, to the Materials Bureau.
Note 4- Any blended cement where the portland cement portion contains an alkali content in excess of 0.70% may be either rejected, accepted, or have use limitations imposed as directed by the Materials Bureau.

<table>
<thead>
<tr>
<th>TABLE 701-2 PHYSICAL REQUIREMENTS - BLENDED PORTLAND CEMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passing 45µm (ASTM C430)</td>
</tr>
<tr>
<td>Time of setting, Vicat test (ASTM C191) (minutes)</td>
</tr>
<tr>
<td>Autoclave contraction (ASTM C151)</td>
</tr>
<tr>
<td>Autoclave expansion</td>
</tr>
<tr>
<td>Compressive strength (AASHTO T 106) (MPa)</td>
</tr>
<tr>
<td>3 days</td>
</tr>
<tr>
<td>7 days</td>
</tr>
<tr>
<td>28 days</td>
</tr>
</tbody>
</table>

All silos shall be completely empty and clean before blended cement is deposited therein unless the silo contains Department specification blended cement of the same type.

Blended cement remaining in bulk storage at the mill and/or distribution terminal for a period greater than one year after completion of tests must be resampled and retested before shipment. However, blended cement which has been in bulk storage at mills and/or distribution terminals more than two years
§701

from the time of original manufacture shall not be used. No blended cement stored by the Supplier over the winter may be used until retested by the Materials Bureau.

Bagged blended cement shall not be stored at mill or terminal locations for a period longer than that time considered reasonable by the Department for preparing an order for shipment.

SHIPMENT. All shipments of blended cement shall be in accordance with procedural directives issued by the Materials Bureau. Conveyances for bulk shipment must be of a type approved by the Department.

The compartments of all such conveyances must be completely empty and clean before any blended cement is loaded therein. Blended cement may be shipped in paper bags which conform to industry standards and which have the brand name, type of blended cement, and the name of the manufacturer plainly marked thereon.

INSPECTION AND TESTING. All inspection and testing shall be in accordance with procedural directives issued by the Materials Bureau. When required by the Materials Bureau, blended cement shall be sampled by means of an automatic sampling device constructed so as to obtain continuous samples across the full stream of blended cement and deliver such samples into a sealed container approved by the Materials Bureau. Tests for chemical and physical properties will be in accordance with test methods stipulated herein.

BASIS OF ACCEPTANCE. Blended portland cement will be considered for acceptance at mill or terminal locations in accordance with procedural directives issued by the Materials Bureau.

701-04 CONCRETE REPAIR MATERIAL

SCOPE. This specification covers a portland cement based concrete mix generally used in the repair of precast concrete products such as pipe, cribbing, manholes, etc.

MATERIAL REQUIREMENTS. This material shall have a maximum initial setting time of 1 hour. Compressive strength shall be a minimum of 14 MPa after 1 day and 35 MPa after 28 days. The material shall be able to withstand 25 cycles of freeze-thaw (10% NaCl) with a maximum loss of 4%. The material may exhibit expansion at no more than 0.40% and shrinkage of no more than 0.05% such that no cracks are produced. The bond strength shall be a minimum of 1.5 MPa after 5 days air cure without the use of a special bonding agent. The material shall exhibit no appreciable heat of hydration. The color of the repair after it cures will be of substantially the same color as the item being repaired.

BASIS OF ACCEPTANCE. Application for approval of concrete repair material shall be submitted to the Materials Bureau accompanied by a labeled 23 kg standard production sample. Upon approval, the name of the product will be placed on an approved list. Such product will then be accepted on the basis of the brand name labeled on the containers. The manufacturer is required to print the date of manufacture on the container in the following format “month, year.” Inclusion of the day of manufacture in the date is optional. The expiration date of acceptance for this material shall be one calendar year from the date of manufacture or as stated in the Approved List, whichever is less. If in the opinion of the Engineer the material is determined to be unsuitable for Department work, the material will be rejected.

701-05 CONCRETE GROUTING MATERIAL

SCOPE. This specification covers a grouting material for use in grouting anchor bolts, dowels and other miscellaneous items in concrete.

GENERAL. The material shall be a non-metallic, non-shrink grout which, when mixed with water, will harden rapidly to produce a permanent anchoring bond. It shall contain no metals nor rust or corrosion promoting agents. The color shall be light gray matching approximately the color of hardened concrete.

MATERIAL REQUIREMENTS. The material when prepared in accordance with the manufacturers instructions, shall be of a trowelable consistency. It shall also have the following properties.
A. **Shrinkage.** The material shall exhibit no shrinkage on setting but may exhibit slight expansion of no more than 0.40%.

B. **Compressive Strength.** Cubes cast in accordance with AASHTO T 106 shall be cured as shown and have a minimum three cube compressive strength average as follows:

<table>
<thead>
<tr>
<th>Cure</th>
<th>Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 hour air cure @ 24°C</td>
<td>28 MPa Min.</td>
</tr>
<tr>
<td>7 day air cure @ 24°C</td>
<td>42 MPa Min.</td>
</tr>
<tr>
<td>7 day air, 10-day water submersion</td>
<td>42 MPa Min.</td>
</tr>
<tr>
<td>7 day air, 24 hour, 10% NaCl solution</td>
<td>42 MPa Min.</td>
</tr>
<tr>
<td>submersion, 25 cycles freeze-thaw</td>
<td></td>
</tr>
</tbody>
</table>

C. **Initial Set.** The material shall have a minimum initial set of 30 minutes.

D. **Pull-out Strength.** A No. 15 reinforcement bar grouted 152 mm deep in a 22 mm diameter hole in saturated, surface-dried concrete shall have a pull-out strength of 45 kN.

E. **Impurities.** The material shall contain not more than 0.05% chlorides or 5% sulfates.

F. **Durability.** The material shall withstand 25 cycles of freeze-thaw (10% NaCl) with a maximum loss of 4%.

**BASIS OF ACCEPTANCE.** Application for approval of a Concrete Grouting Material by the producer shall be submitted to the Materials Bureau accompanied by a labeled 23 kg standard production sample of the product. Upon approval by the Materials Bureau, the name of the product will be placed on an approved list. Such product shall then be accepted on the basis of the brand name labeled on the container. The manufacturer is required to print the date of manufacture on the container in the following format “month, year.” Inclusion of the day of manufacture in the date is optional. The expiration date of acceptance for this material shall be one calendar year from the date of manufacture or as stated in the Approved List, whichever is less. If in the opinion of the Engineer the material is determined to be unsuitable for Department work, the material will be rejected.

**701-06 CEMENT BASED GROUT MATERIALS FOR SHEAR KEYS**

**SCOPE.** This specification covers the requirements for cement based grouts for placement in shear keys between prestressed concrete box beam and hollow slab units.

**GENERAL.** The material shall be cement-based, non-metallic, non-shrink and pre-packaged which when mixed with water will become a grout that hardens and develops strength rapidly. The material shall contain no rust, or corrosion promoting agents and shall require only the addition of water in the field. No additional aggregate will be allowed when field mixing. The Department's approved products list titled: Cement Based Grout Materials for Shear Keys will state the precise water-cement (w/c) ratio by weight. This ratio shall not be altered.

**MATERIAL REQUIREMENTS.** Following the manufacturer's instructions, the Department will test all cement based grout materials to ensure that the following properties are attainable. If the material attains these properties, the Department will place the material on its approved list together with the precise water cement ratio (by weight) required to attain the properties. The properties are:

A. **Compressive Strength.** Three cubes shall be cast and cured in accordance with AASHTO T 106. The average strength of the 3 cubes at 7 days age shall be a minimum of 42 MPa.

B. **Freeze-Thaw (FT) Resistance.** Three cubes shall be molded and cured for 7 days in accordance with AASHTO T 106. Upon completion of cure, they will be subjected to 25 FT cycles
in accordance with test method NY 502-3P. Material shall not exhibit a weight loss greater than 3.0%, based on the average loss of the 3 cubes.

**C. Expansion-Contraction.** The grout shall be tested in accordance with CRD C621. Measurements shall be made at 4 hours, 1, 2, 3 and 4 days age after molding. The tolerance for the measurement ages shall be ±15 minutes. The material shall exhibit a 4-day expansion between 0 - 5% inclusive, with no subsequent contraction.

**D. Pourability.** The grout shall be thoroughly mixed and immediately poured into a container with the approximate shape of a standard shear key. To be considered pourable, the grout shall completely fill the container without excess air entrapment.

**BASIS OF ACCEPTANCE.** Application for material approval shall be submitted to the Materials Bureau by the manufacturer. The application shall be accompanied by a labeled 23 kg standard production sample of the product. Upon approval, the name, and manufacturer, of the product will be placed on the Department's approved list. Products so listed will be accepted at the work site on the basis of the brand name labeled on the container. The manufacturer is required to print the date of manufacture on the container in the following format "month, year." Inclusion of the day of manufacture in the date is optional. The expiration date of acceptance for this material shall be one calendar year from the date of manufacture or as stated in the Approved List, whichever is less. If in the opinion of the Engineer the material is determined to be unsuitable for Department work, the material will be rejected.

### 701-07 ANCHORING MATERIALS - CHEMICALLY CURING

**SCOPE.** This specification covers polymer anchoring materials for installing anchor bolts and other miscellaneous items in concrete.

**GENERAL.** The material shall be a non-metallic, non-shrink polymer resin supplied in prepackaged and/or premeasured containers. It shall contain no rust or corrosion promoting agents and shall be moisture insensitive. Packaged stability of each component in original unopened containers stored in temperatures between 5°C and 32°C shall be a minimum of six months. The mixing instructions, setting time and expiration date of the material shall appear on each container.

**CHEMICAL RESISTANCE.** Cured sealer shall be resistant to most chemicals and solvents. The manufacturer shall certify that the sealant meets the following chemical resistances when tested in accordance with ASTM D471 (22°C for 24 hours):

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline</td>
<td>Slight Swell</td>
</tr>
<tr>
<td>Hydraulic Brake Fluid</td>
<td>No Effect</td>
</tr>
<tr>
<td>Motor Oil</td>
<td>No Effect</td>
</tr>
<tr>
<td>Sodium Chloride (5%)</td>
<td>No Effect</td>
</tr>
<tr>
<td>Calcium Chloride (5%)</td>
<td>No Effect</td>
</tr>
</tbody>
</table>

**MATERIAL REQUIREMENTS.** Manufacturers must supply test results performed in accordance with the procedural directives of the Materials Bureau, using 24 mm diameter fully threaded rods embedded 250 mm deep in unreinforced concrete. Results from testing using lesser embedment depths will be accepted provided they achieve the pullout strength required for the 250 mm embedment. Testing must be performed by an independent testing agency and approved by the Materials Bureau. A minimum of three tests shall be performed and each test result must meet the minimum required pullout value. Concrete with a compressive strength greater than 28 MPa is recommended. The minimum required pullout values for various concrete strengths are shown below:

<table>
<thead>
<tr>
<th>Concrete Strength (MPa)</th>
<th>Minimum Pullout Load (kN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥28</td>
<td>221</td>
</tr>
<tr>
<td>31</td>
<td>233</td>
</tr>
<tr>
<td>35</td>
<td>247</td>
</tr>
<tr>
<td>38</td>
<td>258</td>
</tr>
</tbody>
</table>
The Materials Bureau will inform the Manufacturer when the test results are accepted. The Manufacturer shall then supply six 16 mm diameter fully threaded rods, a minimum of 18 mm long, and sufficient material for testing by the Materials Bureau. Tensile pullout testing will be performed on the 16 mm diameter rods embedded 100 mm deep in unreinforced concrete. Two sets of three tests shall be performed and each test shall meet the minimum required load. The minimum required pullout values for various concrete strengths are shown below:

<table>
<thead>
<tr>
<th>Concrete Strength (MPa)</th>
<th>28</th>
<th>31</th>
<th>35</th>
<th>38</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Pullout Load (kN)</td>
<td>37</td>
<td>39</td>
<td>42</td>
<td>44</td>
</tr>
</tbody>
</table>

Copies of Procedural Directives may be obtained from the Materials Bureau upon request.

**BASIS OF ACCEPTANCE.** Application for approval of Anchoring Materials - Chemically Curing shall be made by the manufacturer or supplier to the Materials Bureau and shall include the material safety data sheets and independent test data. The manufacturer or supplier shall prepare and submit the appropriate material in accordance with the procedural directives of the Materials Bureau and the requirements of this specification. Upon approval by the Materials Bureau, the name of the product will be placed on the Approved List. Such product will then be accepted on the basis of the brand name labeled on the container.

**701-08 VERTICAL AND OVERHEAD PATCHING MATERIAL**

**SCOPE.** This specification covers the requirements for Vertical and Overhead Patching Material for placement in structural concrete repairs.

**GENERAL.** The material shall consist of a cementitious material to which water or an emulsified component is added. The material shall be pre-packaged with the product name, manufacturer and mixing instructions printed clearly on the package.

**MATERIAL REQUIREMENTS.** Following the manufacturer's instructions, the Department will test the patching materials to ensure that the following properties are attainable. If the material attains these properties, the Department will place the material on its Approved List. The properties are:

A. **Compressive Strength.** The material shall exhibit a minimum 7 day compressive strength of 14 MPa and a minimum 28 day strength of 21 MPa when tested under NYSDOT Test Method 701-13F.

B. **Flexural Bond Strength.** The material shall exhibit a minimum bond strength of 1.5 MPa when tested under NYSDOT Test Method 701-13F.

C. **Freeze-Thaw Resistance.** Three cubes shall be molded of the material and cured for 7 days in accordance with AASHTO T 106. Upon completion of cure, they shall be subject to 50 Freeze-Thaw cycles in accordance with NYSDOT Test Method 502-3P. Materials shall not exhibit a weight loss greater than 3.0% based on the average loss of the 3 cubes.

D. **Expansion-Contraction.** The material may exhibit expansion of no more than 0.40% and shrinkage of no more than 0.01% when tested in accordance with NYSDOT Test Method 701-13F.

E. **Material Consistency.** The material shall be placeable in layers of at least 25 millimeters on overhead applications without the use of formwork or anchoring devices.

F. **Color.** The material shall produce a finished patch, concrete grey in color.

**BASIS OF ACCEPTANCE.** Application for material approval shall be submitted to the Materials Bureau by the manufacturer. The application shall be accompanied by a labeled 23 kg standard production sample of the product. Upon approval, the product name and manufacturer will be placed on
the Department's Approved List. Products so listed will be accepted at the worksite on the basis of the brand name labeled on the container. The manufacturer is required to print the date of manufacture on the container in the following format “month, year.” Inclusion of the day of manufacture in the date is optional. The expiration date of acceptance for this material shall be one calendar year from the date of manufacture or as stated in the Approved List, whichever is less. If in the opinion of the Engineer the material is determined to be unsuitable for Department work, the material will be rejected.

701-09 RAPID HARDENING CONCRETE REPAIR MATERIAL (Normal Weather)

**SCOPE.** This specification covers a rapid hardening concrete mix, consisting of a dry component made up of the cementing medium and fine aggregate to which water or an emulsified component is added. The resulting mixture is generally used in the repair of portland cement concrete pavements.

**GENERAL.** The rapid hardening concrete shall be of a high strength, have rapid strength gain characteristics in normal weather (above 10°C ambient temperature), bond to the existing concrete, and be durable. The rapid hardening concrete shall be able to accept coarse aggregate to extend the yield and result in a workable mixture.

**MATERIAL REQUIREMENTS.** The material, as delivered without additional coarse aggregate, and mixed in accordance with the manufacturer's instructions, shall have the following properties when tested under NYSDOT Test Method 701-13F:

- A minimum one hour compressive strength of 18 MPa, a 24 hour strength of 25 MPa and a 28 day strength of 35 MPa.
- A minimum bond strength of 1.5 MPa after 24 hours.
- A minimum initial setting time of 5 minutes at 24 ± 1°C.
- The ability to withstand 50 cycles of freeze-thaw (10% NaCl solution) with a maximum loss of 6%.
- Expansion of no more than 0.40% and contraction of no more than 0.05%.
- A workable mixture when extended with a minimum 60% CA1 coarse aggregate by weight of dry R.S.C. component.

The material delivered from the manufacturer in moisture proof bags shall weigh within ±3% of the labeled bag weight, the manufacturer's name, address, mixing instructions, and manufacturing date shall be printed on each bag.

**BASIS OF ACCEPTANCE.** Application for material approval shall be submitted to the Materials Bureau by the manufacturer. The application shall be accompanied by a labeled 45 kg standard production sample of the product. Upon approval, the name and manufacturer of the product will be placed on the Department's Approved List. Products so listed will be accepted at the worksite on the basis of the brand name labeled on the container. The manufacturer is required to print the date of manufacture on the container in the following format “month, year.” Inclusion of the day of manufacture is optional. The expiration date of acceptance for this material shall be one calendar year from the date of manufacture or as stated in the Approved List, whichever is less. If in the opinion of the Engineer the material is determined to be unsuitable for Department work, the material will be rejected.

701-10 (VACANT)

701-11 ELASTOMERIC CONCRETE

**SCOPE.** This specification covers the material requirements for elastomeric concrete.

**GENERAL.** Supply elastomeric concrete components and primer materials in prepackaged and/or premeasured containers with the product name, manufacturer, VOC content, and mixing instructions clearly marked on each container.
MATERIAL REQUIREMENTS.

Physical Test Requirements. Elastomeric concrete will conform to the following physical test requirements:

<table>
<thead>
<tr>
<th>TESTS</th>
<th>PROCEDURE</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resilience</td>
<td>ASTM C579-01</td>
<td>70%</td>
</tr>
<tr>
<td>5-Hr. Compressive Strength</td>
<td>ASTM C579-01 (modified)</td>
<td>3.45 MPa</td>
</tr>
<tr>
<td>24-Hr. Compressive Strength</td>
<td>ASTM C579-01 (modified)</td>
<td>14 MPa</td>
</tr>
<tr>
<td>7-Day Tensile</td>
<td>ASTM D638</td>
<td>1 MPa</td>
</tr>
<tr>
<td>7-Day Tear</td>
<td>ASTM D624</td>
<td>7 kN/m</td>
</tr>
<tr>
<td>Pot Life</td>
<td>Gardco GT-S Gel Timer</td>
<td>5 minutes</td>
</tr>
</tbody>
</table>

Materials Details. The manufacturer will submit Material Detail Sheets to the Materials Bureau for approval. Upon approval, the manufacturer, product name, and the Material Detail Number will be placed on the Department’s Approved List.

Field Evaluation. To maintain Approved List status, the elastomeric concrete will be evaluated by the Materials Bureau or a designated representative at six-month intervals for a period of two years from the date of installation. If the material is performing as designed at the end of the two-year evaluation approved status will continue.

BASIS OF ACCEPTANCE. Acceptance of this material will be based on the manufacturer's name appearing on the Department's Approved List for Materials and Equipment. The supplier shall provide two copies of the Approved Material Detail Sheets and Material Safety Data Sheets through the Contractor to the Engineer as part of the evidence of acceptability for the material at least 14 days prior to shipment of the product to the job site.

SECTION 702 - BITUMINOUS MATERIALS

SCOPE. These specifications cover the material requirements and methods of testing bituminous materials used in highway construction and classified into the following five groups:

1. Asphalt Cements.
2. Liquid Asphalts (Rapid Curing, Medium Curing)
3. Asphalt Emulsions (Anionic, Cationic, Polymer Modified Cationic).
4. Synthetic Resins.
5. Asphalt Emulsion Tack Coat.

GENERAL. The bituminous material volume shall be measured at 16°C. Information as to the specific gravity at 16°C shall be included with each shipment of bituminous material to a plant or project.

MATERIAL REQUIREMENTS. The bituminous materials furnished shall meet the requirements

A. Performance Graded Binders For Paving. A Performance Graded Binder (PGB), designated PG XX-YY, is defined as the range of pavement temperatures expressed in degrees Celsius, maximum to minimum, over which the PGB can be expected to provide acceptable performance. PGBs shall meet the requirements of AASHTO Designation MP1 - Standard Specification For Performance Graded Asphalt Binder and Table 702-1, Performance Graded Binders for Paving. The PGB shall be prepared from refining crude petroleum by suitable methods with the addition of a modifier, if necessary, to meet the required Performance Grade. The PGB Supplier shall certify that the PGB meets NYSDOT quality requirements for a Primary Source appearing on the Department's Approved List of Performance Graded Binders for Paving. The PGB Supplier shall provide the design mixing and compaction temperatures on a NYSDOT BR-320. Also, provide MP1 test data and all necessary shipping documents in accordance with Department written instructions.
TABLE 702-1 PERFORMANCE GRADED BINDERS FOR PAVING

<table>
<thead>
<tr>
<th>MATERIAL DESIGNATION</th>
<th>702-5828</th>
<th>702-5834</th>
<th>702-6422</th>
<th>702-6428</th>
<th>702-7022</th>
<th>702-7622</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERFORMANCE GRADE</td>
<td>PG 58</td>
<td>PG 64</td>
<td>PG 70</td>
<td>PG 70</td>
<td>PG 70</td>
<td>PG 70</td>
</tr>
<tr>
<td></td>
<td>-28</td>
<td>-22</td>
<td>-22</td>
<td>-22</td>
<td>-22</td>
<td>-22</td>
</tr>
</tbody>
</table>

Original Binder

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flash Point Temp, T48: Min °C</td>
<td>230</td>
<td>Viscosity, ASTM D 4402:</td>
<td>135</td>
</tr>
<tr>
<td>Maximum, 3 Pa·s (3000 cP)</td>
<td></td>
<td>Dynamic Shear, TP5:</td>
<td></td>
</tr>
<tr>
<td>G*sin α, Min., 1.00 kPa Test Temp @ 10 rad/s, °C</td>
<td>58</td>
<td>64</td>
<td>70</td>
</tr>
</tbody>
</table>

Rolling Thin Film Oven (T240) or Thin Film Oven (T179) Residue

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass Loss, Maximum, %</td>
<td>1.00</td>
</tr>
<tr>
<td>Dynamic Shear, TP5:</td>
<td></td>
</tr>
<tr>
<td>G*sin α, Min., 2.20 kPa Test Temp @ 10 rad/s, °C</td>
<td>58</td>
</tr>
</tbody>
</table>

Pressure Aging Vessel Residue (PP1)

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAV Aging Temp, °C</td>
<td>100</td>
</tr>
<tr>
<td>Dynamic Shear, TP5:</td>
<td></td>
</tr>
<tr>
<td>G*/sin *, Max.,5000kPa Test Temp @ 10 rad/s, °C</td>
<td>19</td>
</tr>
</tbody>
</table>

Physical Hardening 3 Report

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creep Stiffness, TP1:</td>
<td></td>
</tr>
<tr>
<td>S, Maximum, 300 MPa</td>
<td>-18</td>
</tr>
<tr>
<td>m-value,Minimum,0.300 Test Temp, @ 60 sec, °C</td>
<td>-24</td>
</tr>
<tr>
<td>Direct Tension, TP3:</td>
<td></td>
</tr>
<tr>
<td>Failure Strain, Min, 1.0%</td>
<td>-18</td>
</tr>
<tr>
<td>Test Temp @ 1.0 mm/min, °C</td>
<td>-24</td>
</tr>
</tbody>
</table>

NOTES:

1. This requirement may be waived by the Director, Materials Bureau if the supplier warrants that the PGB can be adequately pumped and mixed at temperatures that meet all applicable safety standards.

2. For quality control of unmodified PGB production, measurement of the viscosity of the original PGB may be substituted for dynamic shear measurements of G*/Sin α at test temperatures where the PGB is a Newtonian fluid. Any suitable standard means of viscosity measurement may be used, including capillary or rational viscometry (AASHTO T 201 or T 202).

3. Physical Hardening - TP 1 is performed on a set of PGB beams according to Section 13.1, except the conditioning time is extended to 24 hours ± 10 minutes at 10 °C above the minimum performance temperature. The 24-hour stiffness and m-value are reported for information purposes.

4. If the creep stiffness is below 300 MPa, the direct tension test is not required. If the creep stiffness between 300 and 600 MPa the direct tension failure strain requirement can be used in lieu of the creep stiffness requirement. The m-value requirement must be satisfied in both cases.

Silicone additives will be permitted in paving binders. Silicone may be introduced into the PGB in accordance with the manufacturer's recommendations either at the refinery, terminal or at a mixing plant storage tank. PGB treated with silicone shall conform to the specifications for untreated PGB. Any previously approved PGB that has been stored in the mixing plant tank over the winter shall be resampled and accepted by the Department before it is used.

B. Miscellaneous Asphalt Cements. Asphalt cements shall meet the requirements of Table 702-2 Miscellaneous Asphalt Cements. The asphalt shall be prepared by refining crude petroleum using suitable methods. The asphalt cement shall be homogeneous, free from water and shall not foam when heated to 175 °C. The supplier shall maintain the identity of the asphalts in accordance with the Department's written instructions from the point of refining to the point where the asphalt is incorporated into the work. Test data and shipping documents shall be provided by the supplier in accordance with the Department’s written instructions.
### TABLE 702-2 MISCELLANEOUS ASPHALT CEMENTS

<table>
<thead>
<tr>
<th>MATERIAL DESIGNATION</th>
<th>702-0700</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRADE</td>
<td>18-60</td>
</tr>
<tr>
<td><strong>Test Requirements</strong></td>
<td><strong>Min.</strong></td>
</tr>
<tr>
<td>Penetration, 25°C, 100g, 5s (AASHTO T49)</td>
<td>18</td>
</tr>
<tr>
<td>Flash Point, COC, °C (AASHTO T48)</td>
<td>200</td>
</tr>
<tr>
<td>Solubility in Trichlorethylene, % (AASHTO T44)</td>
<td>99.5</td>
</tr>
<tr>
<td>Softening Point, °C (AASHTO T53)</td>
<td>55</td>
</tr>
<tr>
<td>Loss on Heating, 163°C, 5h, % (AASHTO T47)</td>
<td>-</td>
</tr>
<tr>
<td>Penetration of Residue, % of Original (AASHTO T49)</td>
<td>60</td>
</tr>
<tr>
<td>Ductility, 25°C, 5 cm/min, cm (AASHTO T51)</td>
<td>5</td>
</tr>
<tr>
<td><strong>Typical Uses</strong></td>
<td>Joint and Crack Filler</td>
</tr>
</tbody>
</table>

**C. Liquid Asphalts (Rapid Curing, Medium Curing).** Rapid Curing and Medium Curing liquid asphalts shall meet the requirements of Table 702-3 and Table 702-4, respectively.

#### TABLE 702-3 RAPID CURING LIQUID ASPHALTS

<table>
<thead>
<tr>
<th>MATERIAL DESIGNATION</th>
<th>702-11</th>
<th>702-12</th>
<th>702-13⁽¹⁾</th>
<th>702-14⁽¹⁾</th>
<th>702-15⁽¹⁾</th>
<th>702-16</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRADE</td>
<td>RC-70</td>
<td>RC-250</td>
<td>RC-800</td>
<td>RC-3000</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>REQUIREMENTS</strong></td>
<td>ASTM D-2028 or AASHTO M 81</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(¹)The Materials 702-13 and 702-15 shall contain an anti-stripping additive and shall meet the stone coating requirements.

#### TABLE 702-4 MEDIUM CURING LIQUID ASPHALTS

<table>
<thead>
<tr>
<th>MATERIAL DESIGNATION</th>
<th>702-20</th>
<th>702-21</th>
<th>702-22⁽¹⁾</th>
<th>702-24</th>
<th>702-25</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRADE</td>
<td>MC-30</td>
<td>MC-70</td>
<td>MC-250</td>
<td>MC-800</td>
<td>MC-3000</td>
</tr>
<tr>
<td><strong>REQUIREMENTS</strong></td>
<td>ASTM D-2027 or AASHTO M 82</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(¹)The Materials 702-23 shall contain an anti-stripping additive and shall meet the stone coating requirements.

The liquid asphalts shall show no separation or curdling prior to use and shall not foam when heated to the application temperature.

When required on the plans or in the specifications, an additive shall be added to the bituminous material which will cause the bituminous material to coat and adhere more effectively to wet and unheated aggregates. The additive shall have no deleterious effect upon the bituminous material and shall be completely miscible and thoroughly blended throughout the bituminous materials. The anti-stripping additive shall be added to the bituminous material only during the process when the asphalt cement and the solvent materials are blended to make the liquid asphalt. Material containing an anti-stripping additive shall conform to the specifications for untreated material.

**D. Asphalt Emulsions (Anionic, Cationic, Polymer Modified Cationic).** The emulsion shall be homogeneous and show no separation of asphalt, after thorough mixing, within 30 days after delivery, provided separation has not been caused by freezing. Material that is separated due to freezing is unacceptable at any time. During production of polymer modified emulsions, mill or blend the polymer modifier into the base asphalt or emulsifying agent prior to the emulsification process.

Anionic asphalt emulsions (702-3001, 702-3101, 702-3102, 702-3201, 702-3301, 702-3401, 702-3402, 702-3501, and 702-3601) shall meet the requirements shown in Table 702-5, Asphalt Emulsions. Cationic asphalt emulsions (702-4001, 702-4101, 702-4201, 702-4301, 702-4401, 702-4501, and 702-4601) shall meet the requirements shown in Table 702-6, Cationic Asphalt Emulsions.
Polymer modified cationic emulsions (702-4701 and 702-4801) shall meet the requirements shown in Table 702-6, Cationic Asphalt Emulsions.

E. Synthetic Resins. The synthetic resins covered under these specifications are two types: synthetic resin binder, §702-70, and rapid curing synthetic resin liquid, §702-71. The synthetic resin binder §702-70, is a light insensitive liquid used in the colored synthetic resin binder concrete. The rapid curing synthetic resin liquid, §702-71, is a tack coat for the resin binder concrete and shall be light colored and compatible with the resin binder concrete placed over it.

The synthetic resin shall be homogeneous and shall meet requirements specified in Table 702-8.

<table>
<thead>
<tr>
<th>MATERIAL DESIGNATION</th>
<th>TYPE</th>
<th>RAPID SETTING</th>
<th>MEDIUM SETTING</th>
<th>SLOW SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Grade</td>
<td>702-3001</td>
<td>702-3101</td>
<td>702-3201</td>
</tr>
<tr>
<td></td>
<td></td>
<td>702-3301</td>
<td>702-3401</td>
<td>702-3402</td>
</tr>
<tr>
<td></td>
<td></td>
<td>702-3501</td>
<td>702-3601</td>
<td></td>
</tr>
<tr>
<td>Tests on Emulsion</td>
<td>Min</td>
<td>Max</td>
<td>Min</td>
<td>Max</td>
</tr>
<tr>
<td>Viscosity, Saybolt Furol, 25°C, Sec.</td>
<td>20</td>
<td>100</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Viscosity, Saybolt Furol, 50°C, Sec.</td>
<td>-</td>
<td>75</td>
<td>75</td>
<td>400</td>
</tr>
<tr>
<td>Storage Stability Test, 1 Day (Difference in % Residue)</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Demulsibility, 35ml. 0.02N CaCl₂, %</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Cement Mixing Test</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sieve Test, percent</td>
<td>0.10</td>
<td>-</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Residue by distillation, %</td>
<td>55</td>
<td>63</td>
<td>63</td>
<td>63</td>
</tr>
<tr>
<td>Oil Distillate, Volume Total Emulsion, %</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Tests on Residue from Distillation Test</td>
<td>100</td>
<td>200</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>Penetration, 25°C, 100g, 5 Sec.</td>
<td>100</td>
<td>200</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>Float Test, 60°C Note (2), Sec.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tests on Asphalt Base for Emulsion Penetration 25°C, 100g, 5 Sec.</td>
<td>100</td>
<td>200</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>Solubility or trichloroethylene, %</td>
<td>99.0</td>
<td>99.0</td>
<td>99.0</td>
<td>99.0</td>
</tr>
<tr>
<td>Ductility, 25°C, 5cm/min, cm</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Flash Point, °C</td>
<td>177</td>
<td>177</td>
<td>177</td>
<td>177</td>
</tr>
<tr>
<td>Typical Applications: Note (3)</td>
<td>Spray Patch, Penetration Macadam</td>
<td>Penetration Macadam</td>
<td>Surface Treatment Penetratin Macadam</td>
<td>Surface Treatment Penetratin Macadam</td>
</tr>
<tr>
<td>Suggested Temperature Range</td>
<td>Mixing, °C</td>
<td>25-60</td>
<td>55-75</td>
<td>55-75</td>
</tr>
<tr>
<td>Spaying, °C</td>
<td>25-60</td>
<td>55-75</td>
<td>55-75</td>
<td>55-75</td>
</tr>
</tbody>
</table>

NOTES:
1. This viscosity requirement at 50°C applies to emulsion used for shoulder sealing.
2. Float Test AASHTO T-50, except that the residue from distillation shall be poured immediately into the float collar at 260°C.
3. These typical applications are intended only as a guide for selecting the proper emulsion grade.

F. Asphalt Emulsion Tack Coat. The asphalt emulsion tack coat shall be homogeneous at the time of application. Homogeneity of the tack coat may be maintained by agitation providing that separation is not caused by freezing. The consistency of the tack coat shall be appropriate for pumping and uniform spraying.

The asphalt emulsion tack coat shall meet the requirements in Table 702-9.
**TESTS.** When anti-stripping additives are added to the bituminous material, a stone coating test performed on a mixture of stone and bituminous material shall have at least 95 percent of the stone area coated.

Details of all test methods may be obtained from the Materials Bureau.

**BASIS OF ACCEPTANCE.** Acceptance of the bituminous material is based on the name of the primary source appearing on the Department's Approved List for the specific group of bituminous material; and acceptance of the bituminous material is contingent upon satisfactory test results from samples taken, as required by the Department's procedural directives, at the location where the material is incorporated into the work. A primary source is defined as a firm that samples, tests, and certifies that the bituminous material is in conformance with the specifications. The procedural directives for sampling, testing, and certifying the bituminous material, and for achieving and maintaining approved list status, are available from the Materials Bureau.

### TABLE 702-6 CATIONIC ASPHALT EMULSIONS

<table>
<thead>
<tr>
<th>MATERIAL DESIGNATION</th>
<th>702-4001</th>
<th>702-4101</th>
<th>702-4201</th>
<th>702-4301</th>
<th>702-4401</th>
<th>702-4501</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRADE</td>
<td>CRS-1</td>
<td>CRS-2</td>
<td>CMS-2</td>
<td>CMS-2h</td>
<td>CSS-1h</td>
<td>CSS-1</td>
</tr>
<tr>
<td>TEST on Emulsion:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viscosity, Saybolt Furol, 25°C, second</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>50°C, second</td>
<td>20 100</td>
<td>100 400</td>
<td>50 450</td>
<td>50 450</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Storage Stability Test, 1 Day (Difference in % Residue)</td>
<td>- 1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Residence by Distillation</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Oil Distillate,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volume Total Emulsion, %</td>
<td>- 3</td>
<td>3</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>on Residue from Distillation Penetration, 25°C, 100 g, 5 sec</td>
<td>100</td>
<td>200</td>
<td>100</td>
<td>200</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>Asphalt Base for Emulsion Penetration, 25°C, 100 g, 5 sec</td>
<td>100</td>
<td>200</td>
<td>100</td>
<td>200</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>Solubility or Trichloroethylene, %</td>
<td>99.0</td>
<td>99.0</td>
<td>99.0</td>
<td>99.0</td>
<td>99.0</td>
<td>99.0</td>
</tr>
<tr>
<td>Ductility, 25°C, 5 cm/min., cm</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Flash Point, °C</td>
<td>177</td>
<td>177</td>
<td>177</td>
<td>225</td>
<td>225</td>
<td>225</td>
</tr>
<tr>
<td>Typical Application:</td>
<td>Spray, P.M.</td>
<td>S.T., P.M.</td>
<td>Cold Mixes, P.M.</td>
<td>Cold Mixes, P.M.</td>
<td>B &amp; S. S.</td>
<td>B &amp; S. S.</td>
</tr>
<tr>
<td>Suggested Temp. Range:</td>
<td>Mixing, °C</td>
<td>- 40</td>
<td>75</td>
<td>40</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>Spraying, °C</td>
<td>25 - 60</td>
<td>55 - 75</td>
<td>55 - 75</td>
<td>55 - 75</td>
<td>25 - 65</td>
<td>25 - 65</td>
</tr>
</tbody>
</table>

(1) If the Particle Charge Test result is inconclusive, material having a maximum pH value of 6.7 will be acceptable.
(2) According to AASHTO T 53
(3) According to AASHTO T 59
(4) These typical applications are intended only as a guide for selecting the proper emulsion grade.

Abbreviations: B & S. S. - base and shoulder stabilization; P.M. - penetration macadam; S.T. - surface treatment.

### TABLE 702-7 (VACANT)
### TABLE 702-8 SYNTHETIC RESINS

<table>
<thead>
<tr>
<th>Material Designation</th>
<th>Test Requirements</th>
<th>Min.</th>
<th>Max.</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Penetration, 25°C, 100g 5s</td>
<td>75</td>
<td>100</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Viscosity, 60°C, m²/s (x10-6)</td>
<td>-</td>
<td>-</td>
<td>8</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Flash Point, COC, °C</td>
<td>204</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Solubility in trichlorethylene, %</td>
<td>99.5</td>
<td>-</td>
<td>99.5</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Loss of Heating, 163°C, 5 hr., (AASHTO T47) %</td>
<td>-</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Water, %</td>
<td>-</td>
<td>0.0</td>
<td>-</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>Color, (30% binder/70% toluene)</td>
<td>-</td>
<td>16</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Gardner Standard Color Scale, ASTM D1544</td>
<td>-</td>
<td>16</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Test on residue from Thin-film Oven Test (AASHTO T179) Penetration, % of original</td>
<td>47</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Residue from evaporation, 105°C</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Typical Uses</td>
<td>Hot Plant Mix</td>
<td>Tack Coat</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Suggested Spraying Temperature, °C</td>
<td>-</td>
<td>10-50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### TABLE 702-9 ASPHALT EMULSION TACK COAT

<table>
<thead>
<tr>
<th>Material Designation</th>
<th>Test Requirements</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sieve Test, %</td>
<td>-</td>
<td>0.10</td>
</tr>
<tr>
<td></td>
<td>Residue by Distillation, %</td>
<td>28</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Oil Distillate, Volume of Total Emulsion, %</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Test on residue from Distillation: Penetration, 25°C, 100g, 5s</td>
<td>40</td>
<td>90</td>
</tr>
</tbody>
</table>

The asphalt emulsion tack coat shall be produced by diluting one of the following bituminous materials with a suitable emulsifier solution and thoroughly mixing into a homogeneous liquid:

- **Asphalt Emulsion**
  - Grade: HFMS-2h
  - Material Designation: 702-3401
- **Asphalt Emulsion**
  - Grade: SS-1h
  - Material Designation: 702-3601
- **Cationic Asphalt Emulsion**
  - Grade: CSS-1h
  - Material Designation: 702-4501

### SECTION 703 - AGGREGATES

#### 703-01 FINE AGGREGATE

**SCOPE.** The specification covers the material details, quality requirements and methods for sampling and testing fine aggregate generally used in portland cement concrete and bituminous concrete.

**SAMPLING.** Samples of fine aggregates shall be obtained by and submitted to the Materials Bureau by a representative of the Department under the following conditions:

**A. Sampling Approved Operating Sources.** All approved operating sources shall be sampled when:

- The latest test for a source is two (2) years old.
- A change in the character of processed fine aggregate occurs.
- The location of the course of raw material is shifted, or a change in the character of raw material occurs.
- Considered necessary by the Department.
B. Sampling Non-approved or Rejected Operating Sources. Non-approved or rejected operating sources, equipped with adequate processing facilities, may be sampled upon favorable recommendation by a Regional Director and approved by the Director, Materials Bureau. Approval action on such sources may be conditioned on the results obtained by periodic sampling and testing as prescribed by the Materials Bureau.

C. Sampling Proposed Unopened Sources of Material. Proposed unopened sources of material may be sampled upon the favorable recommendation of a Regional Director and approved by the Director, Materials Bureau. The results of tests on such samples shall be for information only and shall be indicative of the potential quality of the source. Action in regard to acceptance or rejection of a source will be taken only after processing facilities have been installed and approved.

Stripping. All sources of fine aggregate shall be thoroughly stripped of all inferior and objectionable material before processing operations are started and shall be kept stripped far enough from the working face to insure against undesirable material becoming mixed with the output. If undesirable material is furnished from accepted sources through faulty operations or any other cause whatsoever, the source and any objectionable material therefrom may be rejected by the Regional Director.

Annual Reports. As part of the acceptance requirements, the following information shall be submitted to the Department annually for each operating source:

A. Geologic Source Report. A geologic source report that describes the characteristics of the material to be processed during the coming year.

B. Plant Flow Information. Plant flow information describing the processing equipment and the products to be furnished for Departmental use.

The details of these requirements may be obtained from the Materials Bureau. These annual reports shall be received and approved by the Department before the start of the year's operations. Approval of the reports by the Department does not relieve the supplier of its responsibility to provide a uniform and acceptable product.

MATERIAL REQUIREMENTS. Fine aggregate shall consist of natural sand or manufactured sand, conforming to the requirements of these specifications. All fine aggregate shall consist of hard, strong, durable particles which are free from a coating or any injurious material and injurious amounts of clay, loam, or other deleterious substances. In addition, the fine aggregate shall not contain substances, which, when mixed in portland cement concrete, produce an unacceptable level of chloride ions in the final product. Substances that produce chloride ions shall be considered deleterious material. Any fine aggregate may be rejected if it is determined by the Department to contain sufficient amounts of unsound or deleterious material to be harmful.

Fine aggregates from more than one source or of more than one type of material may be blended. Blending procedures shall be approved by the Department.

Fine aggregates meeting the requirements of Table 703-1, “Fine Aggregate Requirements (Testing)” shall be accepted unless service records indicate that it is unsound, or that the material is otherwise determined to be unsatisfactory by the Director, Materials Bureau.

<table>
<thead>
<tr>
<th>TABLE 703-1 FINE AGGREGATE REQUIREMENTS (TESTING)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Method</td>
</tr>
<tr>
<td>Magnesium Sulfates (NYSDOT 207)</td>
</tr>
<tr>
<td>Max. percent loss by weight at 5 cycles</td>
</tr>
<tr>
<td>Organic Impurities (NYSDOT 202, AASHTO T-21)</td>
</tr>
<tr>
<td>Organic Plate, Lighter Than</td>
</tr>
<tr>
<td>Gardner Color, Lighter Than</td>
</tr>
</tbody>
</table>
Fine aggregate not meeting the requirement of Table 703-1 may be further evaluated by additional testing, petrographic examination, geologic studies, review of performance history and plant flow information. If the results of the evaluation indicate that the aggregate should perform satisfactorily, the source may be accepted by the Director, Materials Bureau.

If fine aggregate is found unsatisfactory when examined for organic impurities, it shall be rejected unless it passes the mortar strength test for compression. Fine aggregates so tested shall achieve a compressive strength of at least one hundred percent when tested according to methods prescribed by the Material Bureau (NYSDOT 204).

TESTS. The details of all test methods for fine aggregates may be obtained from the Materials Bureau.

BASIS OF ACCEPTANCE. Acceptance of the source is determined on the basis of tests performed by the Materials Bureau on samples representing the sources; review of Geologic Source Reports and Plant Flow Information; petrographic examination and other geologic studies; and performance histories where applicable. The material is incorporated into the work on the basis that it is from an approved source conforming to procedural directives of the Department and the aggregate shall meet the gradation requirement at the point of use.

Aggregate for use in the manufacture of precast concrete units may be accepted on the basis of stockpile approval at a location acceptable to the Department on a per job basis. Requests for stockpile approval shall be made in writing to the Materials Bureau. The manufacturer shall allow at least ninety (90) days for the testing and evaluation of the aggregate.

703-02 COARSE AGGREGATE

SCOPE. This specification covers the material details, requirements and methods for sampling and testing coarse aggregate generally used in portland cement concrete, bituminous concrete and surface treatments.

SAMPLING. Samples of coarse aggregates shall be obtained by and submitted to the Materials Bureau by a representative of the Department under the following conditions:

A. Sampling Approved Operating Sources. All approved operating sources shall be sampled when:
   • The latest test for a source is two (2) years old.
   • A change in the character of processed coarse aggregate occurs.
   • The location of the source of raw material is shifted or a change in the character of raw material occurs.
   • Considered necessary by the Department.

B. Sampling Non-approved or Rejected Operating Sources. Non-approved or rejected operating sources, equipped with adequate processing facilities, may be sampled upon favorable recommendation by a Regional Director and approval by the Director, Materials Bureau. Approval action on such sources may be conditioned on the results obtained by periodic sampling and testing as prescribed by the Materials Bureau.

C. Sampling Proposed Unopened Sources of Material. Proposed unopened sources of material may be sampled upon the favorable recommendation of a Regional Director and approval by the Director, Materials Bureau. The results of tests on such samples shall be for information only and shall be interpreted as indicative of the potential quality of the source. Action in regard to acceptance or rejection of a source will be taken only after processing facilities have been installed and approved.

Stripping. All sources of coarse aggregate shall be thoroughly stripped of all inferior and objectionable material before processing operations are started and shall be kept stripped far enough from the working face to insure against undesirable material becoming mixed with the output. If undesirable material is furnished from accepted sources through faulty operation or any other cause whatsoever, the source and any objectionable material therefrom may be rejected by the Regional Director.
**Annual Reports.** As part of the acceptance requirements, the following information shall be submitted to the Department annually for each operating source:

**A. Gravel Operations**

1. A Geologic Source Report that describes the characteristics of the material to be processed during the coming year.
2. Plant Flow Information describing the processing equipment and the products to be furnished for Departmental use.

**B. Quarry Operations.** A Quarry Report describing the characteristics and uniformity of rock to be quarried during the coming year.

All details of these report requirements may be obtained from the Materials Bureau. The annual reports shall be received and approved by the Department before the start of the year's operations. The approval of a report does not relieve the supplier of its responsibility to provide a uniform and acceptable product.

**MATERIAL REQUIREMENTS.** Coarse aggregates shall consist of crushed stone, crushed gravel, screened gravel or crushed air-cooled blast furnace slag, conforming to the requirements of these specifications. All coarse aggregates shall meet the requirements for these materials as outlined in Tables 703-2, “Physical Requirements (Testing),” 703-3, “Physical Requirements (Deleterious Materials),” and 703-4, “Size of Stone, Gravel and Slag.”

A coarse aggregate meeting the requirements of Tables 703-2, and 703-3 shall be accepted unless service records indicate that it is unsound or that the material is otherwise determined to be unsatisfactory by the Director, Materials Bureau. Coarse aggregate not meeting the requirements of these tables may be further evaluated by additional testing, petrographic examination, geologic studies, review of Plant Flow Information and performance history. If the results of the evaluation indicate that the aggregate should perform satisfactorily, the source may be accepted by the Director, Materials Bureau.

<table>
<thead>
<tr>
<th>TABLE 703-2 PHYSICAL REQUIREMENTS (TESTING)(^{(5)})</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Material Designation</strong></td>
</tr>
<tr>
<td>Magnesium Sulfate Test (703-07 P,G)(^{(2)})</td>
</tr>
<tr>
<td>Freezing and Thawing Test (703-08 P,G)(^{(3)})</td>
</tr>
<tr>
<td>Los Angeles Abrasion Test (703-11 P,G)</td>
</tr>
<tr>
<td>Maximum percent by weight (Grading A or B) Flat</td>
</tr>
<tr>
<td>Flat and Elongated Particles (ASTM D 4791)</td>
</tr>
<tr>
<td>Maximum percent by weight Flat and Elongated to the</td>
</tr>
<tr>
<td>Degree of 5:1</td>
</tr>
<tr>
<td>Crushed Particles in any primary size(ASTMD 5821)</td>
</tr>
<tr>
<td>Minimum percent by weight Larger than 12.5mm (1</td>
</tr>
<tr>
<td>fractured face)</td>
</tr>
<tr>
<td>Smaller than 12.5mm (2 fractured faces)</td>
</tr>
<tr>
<td>Minimum unit weight (703-10 P,G) kg/m3</td>
</tr>
</tbody>
</table>

1. To determine its conformance to specification limits, processed coarse aggregate may be tested at any point after completion of processing. The manufactured material shall be separated into the primary sizes indicated in Table 703-5, “Primary Size.” Each size fraction shall conform to the requirements of §703-02 Coarse Aggregate.
2. Loss applies to No. 2 size fraction.
3. The freeze-thaw requirement applies only to aggregate used in Portland cement concrete. The loss applies to the No. 2 size fraction.
4. Loss applies to all materials excepting marble, granite, and other similar materials.
5. Loss applies to marble, granite, and other similar materials.
6. Requirement applies to coarse aggregate for use in hot mix asphalt with design ESALs of 0.3 million or greater.
7. Gravel which has not been processed through a crusher shall not be combined with crushed gravel.

**A. Crushed Stone.** Crushed stone shall be Material Designation 703-0201 and shall consist of clean, durable, sharp-angled fragments of rock of uniform quality. The crushed stone used as coarse aggregate for all items shall be obtained from sources conforming to the requirements of the Department as to sampling, testing methods, Quarry Reports and any other required procedures.

**B. Crushed Gravel.** Crushed Gravel shall be Material Designation 703-0202 and shall consist of clean, durable, sharp-angled fragments of gravel free from coatings. A crushed particle shall be defined as one in which the total area of face fracture exceeds 25% of the maximum cross-sectional area of the particle. When two fractured faces are designated, the total area of each fractured face shall exceed 25% of the maximum cross-sectional area of the particle.

A naturally fractured face shall be acceptable providing that the sharp angular portion of the particle consists of sound material and is free from unsound or injurious coatings.

<table>
<thead>
<tr>
<th>Material Designation</th>
<th>Crushed Stone 703-0201</th>
<th>Crushed Gravel 703-0202</th>
<th>Screened Gravel 703-0203</th>
<th>Crushed Slag 703-0204</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shale and shale-like materials(2)</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
<td>-</td>
</tr>
<tr>
<td>Coal/Lignite/Sulfides(3)</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>-</td>
</tr>
<tr>
<td>Clay lumps or Wood</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>-</td>
</tr>
<tr>
<td>Metal Ore(4)</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Other Deleterious Materials(5)</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Total Deleterious Materials</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
</tbody>
</table>

(1) Coarse aggregates containing more than the specified maximum amounts of deleterious materials may be washed or otherwise processed until such specifications are satisfied.
(2) Shale, slate, phyllite, argillite, schist, and similar shale-like fissile rocks that have been identified by performance or by test to be unsound and deleterious. Such shale-like fissile rocks may be tested separately from the rest of the aggregate by freezing and thawing according to NYSDOT Test Method 703-08 P,G. If the loss is 20% or greater, that material will be designated as deleterious shale or shale-like material.
(3) Pyrite, marcasite, pyrrhotite, bog iron, and similar material.
(4) Magnetite, ilmenite, etc. Percentages above 3.0% may be accepted by the Director, Materials Bureau, when appropriate adjustments to yield have been made.
(5) Cemented clusters, weathered particles, and similar material.
### TABLE 703-4(1) SIZES OF STONE, GRAVEL AND SLAG

<table>
<thead>
<tr>
<th>Screen Sizes</th>
<th>100</th>
<th>75</th>
<th>63</th>
<th>50</th>
<th>37.5</th>
<th>25</th>
<th>12.5</th>
<th>6.3</th>
<th>3.2</th>
<th>180</th>
<th>75</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screenings(2)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>90-100</td>
<td>-</td>
<td>-</td>
<td>0-1.0</td>
</tr>
<tr>
<td>1B</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>90-100</td>
<td>0-15</td>
<td>0-1.0</td>
<td></td>
</tr>
<tr>
<td>1A</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>90-100</td>
<td>-</td>
<td>-</td>
<td>0-1.0</td>
</tr>
<tr>
<td>1ST</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>0-15</td>
<td>-</td>
<td>-</td>
<td>0-1.0</td>
</tr>
<tr>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>90-100</td>
<td>0-15</td>
<td>-</td>
<td>-</td>
<td>0-1.0</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>90-100</td>
<td>0-15</td>
<td>-</td>
<td>-</td>
<td>0-1.0</td>
</tr>
<tr>
<td>3A</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>90-100</td>
<td>0-15</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0-0.7</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>90-100</td>
<td>35-70</td>
<td>0-15</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0-0.7</td>
</tr>
<tr>
<td>4A</td>
<td>-</td>
<td>100</td>
<td>90-100</td>
<td>-</td>
<td>0-20</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0-0.7</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
<td>90-100</td>
<td>-</td>
<td>0.15</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0-0.7</td>
</tr>
<tr>
<td>5</td>
<td>90-100</td>
<td>0-15</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0-0.7</td>
</tr>
</tbody>
</table>

(1) Percentage by weight passing the following square openings.
(2) Screenings shall include all of the fine material passing a 6.3 mm screen.
(3) The minus 75 μm material requirements apply only to aggregate for use in portland cement concrete, surface treatment, cold mix bituminous pavements and underdrain filter material. The test (NYSDOT 201) will be performed on the entire sample of the designated size aggregate. Primary size does not apply in the determination of the minus 75 μm material.

### TABLE 703-5(1) SIZES OF CRUSHED GRAVEL, STONE, AND SLAG FOR SLURRY

<table>
<thead>
<tr>
<th>Screen Sizes</th>
<th>9,5 mm</th>
<th>4,75 mm</th>
<th>2,36 mm</th>
<th>1,18 mm</th>
<th>0.600 μm</th>
<th>0.300 μm</th>
<th>0.150 μm</th>
<th>75 μm(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2MS</td>
<td>100</td>
<td>90-100</td>
<td>65-90</td>
<td>45-70</td>
<td>30-50</td>
<td>18-30</td>
<td>10-21</td>
<td>5-20.0</td>
</tr>
<tr>
<td>3MS</td>
<td>100</td>
<td>70-90</td>
<td>45-70</td>
<td>28-50</td>
<td>19-34</td>
<td>12-25</td>
<td>7-20</td>
<td>5-20.0</td>
</tr>
</tbody>
</table>

(1) Percentage by weight passing the following square openings.
(2) Determine percent passing 75 μm sieve according to AASHTO T 11, Materials Finer than 75μm Sieve in Mineral Aggregates by Washing.

The crushed gravel used as coarse aggregate for all items shall be obtained from sources conforming to the requirements of the Department as to sampling, testing methods, Geologic Source Reports, Plant Flow Information, and any other required procedures.

#### C. Screened Gravel.
Screened gravel shall be Material Designation 703-0203 and shall consist of clean, durable gravel free from coatings.
Screened gravel may consist of all uncrushed particles and shall be obtained from sources conforming to the requirements for crushed gravel.

### TABLE 703-6 PRIMARY SIZES

<table>
<thead>
<tr>
<th>Size Designation</th>
<th>Primary Passing</th>
<th>Screen Sizes</th>
<th>Primary Passing</th>
<th>Screen Sizes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1B</td>
<td>3.2 mm</td>
<td>180 mm</td>
<td>37.5 mm</td>
<td>25.0 mm</td>
</tr>
<tr>
<td>1A</td>
<td>6.3 mm</td>
<td>3.2 mm</td>
<td>50 mm</td>
<td>25.0 mm</td>
</tr>
<tr>
<td>1ST</td>
<td>12.5 mm</td>
<td>6.3 mm</td>
<td>63 mm</td>
<td>37.5 mm</td>
</tr>
<tr>
<td>1</td>
<td>12.5 mm</td>
<td>6.3 mm</td>
<td>75 mm</td>
<td>50 mm</td>
</tr>
<tr>
<td>2</td>
<td>25.0 mm</td>
<td>12.5 mm</td>
<td>100 mm</td>
<td>75 mm</td>
</tr>
</tbody>
</table>

#### D. Crushed Slag.
Crushed slag particles shall be Material Designation 703-0204 and shall consist of hard, durable, angular fragments which are reasonably uniform in density and quality; free from
injurious amounts of sulphur; and reasonably free from thin, elongated pieces, dirt, or other objectional matter. All crushed slag shall be obtained from approved sources conforming to the requirements of the Department as to sampling, test methods and any other required procedures.

**Gradation.** The sizes of all stone, gravel or slag used under these specifications shall conform to the gradation requirements for the various sizes tabulated in Table 703-4. All crushing plants shall be fitted with tailing chutes so that no aggregate will reach the bins other than that which passes through the proper screens.

**Primary Size.** For the purposes of this specification, the term “Primary Size” shall be defined for each size designation as all of the material passing and retained on the screens specified in Table 703-5 “Primary Sizes.”

**TESTS.** The details of test methods for coarse aggregate may be obtained from the Materials Bureau.

**BASIS OF ACCEPTANCE.** Acceptance of the source is determined on the basis of tests performed by the Materials Bureau on samples representing the source; review of Quarry Reports; Geologic Source Reports and Plant Flow Information; petrographic examination and other geologic studies; and performance history where applicable. The material is incorporated into the work on the basis that it is from an approved source conforming to procedural requirements of Department and that the aggregate shall meet gradation at the point of use.

Aggregate for use in the manufacture of precast concrete units may be accepted on the basis of stockpile approval at a location acceptable to the Department on a per job basis. Requests for stockpile approval shall be made in writing to the Materials Bureau. The manufacturer shall allow at least ninety (90) days for the testing and evaluation of the aggregate.

### 703-03 MORTAR SAND

**SCOPE.** This specification contains the requirements for sand used in mortar.

**GENERAL.** §703-01, Fine Aggregate shall apply except as modified herein.

**MATERIAL REQUIREMENTS.** When dry, mortar sand shall meet the following gradation requirements:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.75 mm</td>
<td>100</td>
</tr>
<tr>
<td>2.36 mm</td>
<td>95-100</td>
</tr>
<tr>
<td>300 µm</td>
<td>10-40</td>
</tr>
<tr>
<td>150 µm</td>
<td>0-15</td>
</tr>
</tbody>
</table>

Concrete sand, §703-07, will be permitted as an alternative to mortar sand.

**TEST.** Test methods may be obtained from the Materials Bureau.

**BASIS OF ACCEPTANCE.** The provisions of §703-01, Fine Aggregate, shall apply.

### 703-04 GROUT SAND

**SCOPE.** This specification contains the requirements for sand used in grout.

**GENERAL.** §703-01, Fine Aggregate, shall apply except as modified herein.

**MATERIAL REQUIREMENTS.** When dry, the grout sand shall meet the following gradation requirements:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.18 mm</td>
<td>100</td>
</tr>
<tr>
<td>150 µm</td>
<td>0-10</td>
</tr>
</tbody>
</table>
The sand may be determined to be unacceptable for grout sand if it contains more than 6 percent by volume of loam and silt.

**TEST.** Test methods may be obtained from the Materials Bureau.

**BASIS OF ACCEPTANCE.** The provisions of §703-01, Fine Aggregate, shall apply.

### 703-05 FINE AGGREGATE FOR WHITE PORTLAND CEMENT CONCRETE

**SCOPE.** This specification contains the requirements for white fine aggregate used in the white portland cement concrete.

**MATERIAL REQUIREMENTS.** Material Specification 703-01, Fine Aggregate, shall apply except as modified herein. The aggregate shall be white, having a Munsell color with a value of 8 or greater and a chroma saturation of 2 or less, when compared to a set of standard color chips. Gradation shall conform to the specification requirement under § 703-07, Concrete Sand.

**TEST.** The details of the test methods may be obtained from the Materials Bureau.

**BASIS OF ACCEPTANCE.** The provisions of §703-01 Fine Aggregate, shall apply except that the color will be accepted on a per stockpile basis by the Director, Materials Bureau.

### 703-06 CUSHION SAND

**SCOPE.** This specification contains the requirements for cushion sand used for concrete block slope paving.

**GENERAL.** Material for cushion sand shall meet the requirements specified herein.

**MATERIAL REQUIREMENTS.** Cushion sand shall consist of clean, hard, durable, uncoated particles, free from lumps of clay and all deleterious substances.

When dry, the cushion sand shall meet the following gradation requirements:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>6.3 mm</th>
<th>300 µm</th>
<th>150 µm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent Passing by Weight</td>
<td>100</td>
<td>0-35</td>
<td>0-10</td>
</tr>
</tbody>
</table>

The sand may be determined to be unacceptable for cushion sand if it contains more than 10 percent by volume of loam or silt.

**TEST.** Test methods may be obtained from the Materials Bureau.

**BASIS OF ACCEPTANCE.** The cushion sand is accepted on the basis of gradation tests and visual inspection, unless otherwise specified, at the point of use.

### 703-07 CONCRETE SAND

**SCOPE.** This specification contains the requirements for sand used in portland cement concrete.

**GENERAL.** §703-01, Fine Aggregate, shall apply except as modified herein.

**MATERIAL REQUIREMENTS.** When dry, the fine aggregate for portland cement concrete shall conform to the following gradation requirements:
**703-08 MINERAL FILLER**

**SCOPE.** This specification contains the requirements for mineral filler used in bituminous concrete mixtures.

**MATERIAL REQUIREMENTS.** Mineral filler shall conform to the requirements of the standard specification for Mineral Filler for Bituminous Paving Mixture, ASTM D242.

When dry, the mineral filler shall meet the following gradation requirements:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>600 µm</th>
<th>300 µm</th>
<th>75 µm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent Passing by Weight</td>
<td>100</td>
<td>95-100</td>
<td>70-100</td>
</tr>
</tbody>
</table>

**BASES OF ACCEPTANCE.** Acceptance of this material will be based on the producer's certification of compliance with these specification requirements.

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**703-09 RECLAIMED ASPHALT PAVEMENT (RAP)**

**SCOPE.** This specification covers the material requirements for reclaimed asphalt pavement (RAP) for use in asphalt pavement recycling.

The provisions of Section 403 - Hot Mix Asphalt Concrete Pavement shall apply except that the Contractor has the option of recycling reclaimed asphalt pavement (RAP). RAP may be recycled in any of the following mixes or applications:

- Asphalt Concrete - Type 1 Base
- Asphalt Concrete - Type 3 Binder
- Asphalt Concrete - Type 6 Top (for shoulders)
- Asphalt Concrete - Truing and Leveling

If the contractor chooses the recycling option, the following modifications to the specification requirements shall apply:

**MATERIAL REQUIREMENTS.** RAP shall consist of asphalt pavement recovered from an asbestos free pavement by cold milling or other removal techniques approved by the Regional Director or his/her representative.

The aggregate component of the RAP shall meet the requirements of Section 703, Aggregates. The bitumen component of the RAP shall be asphalt cement and shall be free of significant contents of solvents, tars or other contaminating substances that will make the RAP unacceptable for recycling as determined by the Department. The RAP shall be separated according to specific pavement source by the Contractor unless otherwise permitted by the Regional Director or his/her representative.

The Department will use one of the following procedures to approve the RAP quality:
A. RAP obtained from an asbestos-free pavement which was constructed with asphalt cement, and with aggregates that meet the current requirements of Section 703, Aggregates, will be approved by the Regional Director or his/her representative.

B. If the source of the RAP or its quality is not known, the Contractor shall submit the following to the Department at least 30 calendar days prior to the start of paving:

1. Designated use of the RAP and approximate proportions.
2. A 2.5 kilogram (minimum) sample representing the RAP to be incorporated into the recycled mixture.
3. A 2.5 kilogram (minimum) sample of the aggregate extracted from the RAP for petrographic examination.
4. The penetration test result ($25^\circ$C, 100 g, 5 s) of the bituminous material recovered from the RAP. The Department will determine the acceptability of the RAP for the designated use. Details for sampling and testing the RAP are available from the Materials Bureau.

**Composition of Mixtures.** The blend percentage of RAP shall be selected within the limits shown in Table 703-09A:

<table>
<thead>
<tr>
<th>Plant Type</th>
<th>% Reclaimed Material, Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drum Mixer</td>
<td>70</td>
</tr>
<tr>
<td>Batch</td>
<td>50</td>
</tr>
</tbody>
</table>

The recycled mixture of RAP, new aggregate and added asphalt cement shall meet the requirements specified in Table 401-1, Composition of Bituminous Plant Mixtures for aggregate gradation, asphalt cement content and temperature range.

Mix Design for bituminous mixtures containing RAP shall be submitted in accordance with the procedures outlined by Department written instructions. The mix design shall be submitted to the Regional Director or his/her representative a minimum of fourteen (14) calendar days prior to the scheduled start of work.

**Bituminous Materials.** The added asphalt cement may be AC 20, AC 15, AC 10, AC 5, AC 2.5 or other asphalt cement grades approved by the Director, Materials Bureau. The resultant penetration of the combined asphalt cement (reclaimed bitumen and added asphalt cement) prior to plant mixing shall be between 70 and 105. The grade of asphalt cement selected by the Contractor shall be in accordance with Department written instructions.

**Stockpile Materials.** RAP from each pavement source shall be stockpiled on a free draining base separately from other aggregate or RAP sources. Department accepted RAP stockpiles shall be positively identified. The RAP shall be reclaimed from the stockpiles without contamination by foreign materials. Prior to entry into the RAP feed bin, the RAP shall have a reasonably uniform gradation from coarse to fine with 100 percent passing the 50 mm sieve.

The maximum allowable RAP blend percentages for given RAP stockpile moisture contents are given in Table 703-9B. These limits shall apply to all plants as indicated.

**Plant Equipment.** RAP shall be fed into the plant by equipment specifically designed for recycling and shall be approved by the Director of the Materials Bureau. Scalping screens, grizzlies or similar devices shall be installed on the RAP feed bin(s) to remove any debris or other foreign material in excess of 100 mm.
TABLE 703-9B ALLOWABLE RAP BLENDING PERCENTAGES

<table>
<thead>
<tr>
<th>RAP MOISTURE CONTENT (%)</th>
<th>MAXIMUM RAP (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Batch Plant)</td>
</tr>
<tr>
<td>0.0 - 0.9</td>
<td>50</td>
</tr>
<tr>
<td>1.0 - 1.9</td>
<td>45</td>
</tr>
<tr>
<td>2.0 - 2.9</td>
<td>40</td>
</tr>
<tr>
<td>3.0 - 3.9</td>
<td>35</td>
</tr>
<tr>
<td>4.0 - 4.9</td>
<td>30</td>
</tr>
<tr>
<td>5.0 - 5.9</td>
<td>25</td>
</tr>
<tr>
<td>6.0 and over</td>
<td>20</td>
</tr>
</tbody>
</table>

Batch Plants. RAP shall be last in the aggregate weighing sequence. RAP draw weight(s) shall be increased to compensate for the moisture content. Total mix time shall be 60 seconds minimum. In addition, all requirements pertaining to aggregates shall apply to RAP including the equipment requirements for automatic proportioning and recordation stipulated for aggregates in §401-3.02.

Drum Mix Plants. The RAP shall be fed into the drum so that it will not come in direct contact with the burner flame. Mixing of RAP with new aggregate shall occur before the bituminous material introduction point. All requirements pertaining to aggregates shall apply to RAP. The equipment for automatic proportioning and recordation of RAP shall meet the requirements for aggregates in §401-3.02. In addition, RAP shall be added with a maximum variation of 0.5 percent of the total weight of bituminous mixture per interval of time. The recordation shall also record accumulated dry RAP weights separately from aggregates.

Retained Moisture in Mixture. The moisture content of the mixture upon discharge from the mixer shall not exceed 0.5 percent when tested in accordance with Department written instructions.

METHOD OF MEASUREMENT. The provisions of subsection 401-4, Method of Measurement shall apply except that recorded batch weights will not be permitted for determination of the metric tons of mixture being delivered to the work site.

BASIS OF ACCEPTANCE. The RAP will be accepted on the basis of one of the following:

1. Certification from the Contractor that the RAP from a specific pavement which was constructed with asphalt cement and aggregates that meet current specification requirements.
2. Analysis of RAP and its components by the Department.

703-10 LIGHTWEIGHT AGGREGATES

SCOPE. This specification covers the material details and quality requirements for lightweight aggregates generally used in structural portland cement concrete.

GENERAL. The provisions of Sampling, Stripping and Annual Reports under §703-02 Coarse Aggregate shall apply, except that in addition under 2. Quarry Operations, plant flow information describing the processing equipment shall be provided.

MATERIAL REQUIREMENTS. The lightweight aggregates shall be prepared by expanding or sintering materials such as shale, slate, clay, fly ash or blast furnace slag. The requirements of ASTM C330 shall apply except as modified in these specifications. In addition to ASTM C330, the lightweight aggregates shall meet the requirements given in Table 703-10, Lightweight Aggregate Requirements (Testing). The Durability Factor of concrete made from lightweight aggregates shall not be less than 80 percent.

A lightweight aggregate meeting the requirements of this specification shall be accepted unless service records indicate that the aggregate is unsound or that the material is otherwise determined to be
unsatisfactory by the Director, Materials Bureau. Lightweight aggregates not meeting these requirements may be further evaluated by additional testing, petrographic examination, geologic studies, a review of the lightweight aggregate processing and the performance history. If the results of the evaluation indicate that the lightweight aggregate should perform satisfactorily, the material may be accepted by the Director, Materials Bureau.

**Test.** Sampling procedure instructions and test methods may be obtained from the Materials Bureau.

**BASIS OF ACCEPTANCE.** Acceptance of lightweight aggregates is determined by the Director, Materials Bureau on the basis of tests performed by the Materials Bureau on representative samples of the materials; review of Quarry Reports and Plant Flow Information; petrographic examination and other geologic studies; and performance histories where applicable. The material is incorporated into the work on the basis that it is accepted and conforms to procedural directives of the Department and the aggregate shall meet the gradation requirement at the point of use.

### TABLE 703-10 LIGHTWEIGHT AGGREGATE REQUIREMENTS (TESTING)

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Fine Aggregate</th>
<th>Coarse Aggregate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnesium Sulfate (NYSDOT 207).</td>
<td>30</td>
<td>18</td>
</tr>
<tr>
<td>Loss by Weight 5 cycles, % Max.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Los Angeles Abrasion Test (ASTM C131).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss by Weight (Grading B or C), % Max.</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

**SECTION 704 - MASONRY UNITS**

**704-01 COMMON BRICK**

**SCOPE.** This specification covers the material and quality requirements for common brick, made from clay or shale, used in the construction of drainage structures and manholes.

**MATERIAL REQUIREMENTS.** Brick shall conform to the requirements of ASTM C32, Grade MS, including the requirement for saturation coefficient. Common brick may be furnished in any of the designated standard sizes that will produce the required dimensions in the completed structure, and the bricks shall be solid.

**SAMPLING AND TESTING.** Samples, when requested by the Department, shall be randomly selected from production-run material. A minimum of 10 full-size bricks of the same size and style will be required. Samples will be tested for the physical properties identified in ASTM C32. Tests will be performed in accordance with ASTM 67.

**BASIS OF ACCEPTANCE.** Common brick will be accepted on the basis of a material certification that specifies the product conforms to this specification.

**704-02 CONCRETE BRICK**

**SCOPE.** This specification covers the material and quality requirements for concrete brick used in brick masonry construction.

**MATERIAL REQUIREMENTS.** Concrete brick shall conform to the requirements of ASTM C55 Grade N, except as noted herein. Materials used in the manufacture of concrete brick shall meet the requirements of the following subsections:

- Portland Cement 701-01
- Coarse Aggregate 703-02
- Mortar Sand 703-03
- Grout Sand 703-04
- Concrete Sand 703-07
Fly ash or ground, granulated blast-furnace slag may be substituted up to a maximum of 20% by weight of the total amount of cement plus pozzolan in the mix. Pigments used for integral coloring shall meet the requirements of ASTM C979. Other materials may be used in the manufacture as approved by the Director, Materials Bureau.

The nominal dimensions of the brick shall be 205 mm long, 100 mm wide, and 70 mm in height.

**SAMPLING AND TESTING.** Samples, when requested by the Department, shall be randomly selected from production-run material. A total of 10 full-size bricks of the same size and style will be required. Five samples will be tested for compressive strength and five for absorption, in accordance with ASTM C140.

The manufacturer shall be responsible for having brick tested for linear drying shrinkage in accordance with ASTM C55. A copy of the test report shall be included with the samples submitted to the Department for compression and absorption testing.

**BASIS OF ACCEPTANCE.** Concrete brick will be accepted on the basis of the manufacturer's name and location appearing on the Department’s Approved List and a material certification that specifies the product conforms to this specification.

### 704-03 PRECAST CONCRETE - GENERAL

**SCOPE.** This specification covers the general material and quality requirements for precast concrete items produced in accordance with the current Materials Procedure for precast concrete QC/QA titled “Procedures For Achieving And Maintaining Precast Concrete Manufacturer’s Approved List Status”. It is intended for use in conjunction with the individual item specifications.

**MATERIAL REQUIREMENTS.** The Portland Cement Concrete shall meet the requirements in §501, Portland Cement Concrete - General; §501-2.02, §501-2.03 and §501-3.02 except as noted herein.

Type 1, 2 or 3 cement may be used. The manufacturer may substitute pozzolans up to a maximum of 20% by weight of the total amount of cement plus pozzolan in the mix. Certain aggregates appear in the Approved List of Sources of Fine & Coarse Aggregates that have use limitations with a high alkali portland cement. When requested, the Materials Bureau may approve this combination when 15-20% by mass of the cement in the mix is replaced with fly ash.

The concrete shall have an air content of 5.0 to 9.0%. Unless noted otherwise in the contract documents, approved fabrication drawings or item specification, the minimum compressive strength of concrete used in precast units shall be 25 MPa @ 28 days.

Threaded inserts used to connect reinforcing steel to precast concrete shall be non-corrosive and shall have a tensile capacity of at least 50% of the yield strength of the reinforcing steel.

Additional materials, listed below, shall meet the requirements of the following subsections:

<table>
<thead>
<tr>
<th>Material</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Repair Material</td>
<td>701-04</td>
</tr>
<tr>
<td>Bar Reinforcement, Grade 420</td>
<td>709-01</td>
</tr>
<tr>
<td>Wire Fabric For Concrete Reinforcement</td>
<td>709-02</td>
</tr>
<tr>
<td>Epoxy Coated Bar Reinforcement, Grade 420</td>
<td>709-04</td>
</tr>
<tr>
<td>Epoxy Coated Wire Fabric Reinforcement</td>
<td>709-08</td>
</tr>
<tr>
<td>Cold-Drawn Wire For Concrete Reinforcement</td>
<td>709-09</td>
</tr>
<tr>
<td>Mechanical Connectors for Reinforcing Bar Splices (Epoxy Coated)</td>
<td>709-10</td>
</tr>
<tr>
<td>Quilted Covers (for curing)</td>
<td>711-02</td>
</tr>
<tr>
<td>Plastic Coated Fiber Blankets (for curing)</td>
<td>711-03</td>
</tr>
<tr>
<td>Polyethylene Curing Covers (White Opaque)</td>
<td>711-04</td>
</tr>
<tr>
<td>Membrane Curing Compound (Clear w/Fugitive Dye)</td>
<td>711-05</td>
</tr>
<tr>
<td>Burlap</td>
<td>711-06</td>
</tr>
<tr>
<td>Corrosion Inhibitor</td>
<td>711-13</td>
</tr>
</tbody>
</table>
**DRAWINGS.** Precast concrete units shall be fabricated to conform to the details contained in the plans and contract documents. Fabrication Drawings shall be one of the following:

**A. Contract Plan Sheets.** When the contract plans contain enough detail to properly fabricate and inspect the precast element they may be used as the fabrication drawings. The Materials Bureau will determine whether or not the contract plans contain enough detail.

**B. Department Standard Sheets.** When Department Standard Sheets are referenced in, and are in compliance with the contract plans, the Standard Sheet shall be used as the fabrication drawing.

**C. Fabricator Working Drawings.** When the contract plans do not contain enough detail to be used as fabrication drawings and there is no Department Standard Sheet for the precast element or the Standard Sheet is not in compliance with the contract plans, Fabricator Working Drawings shall be used as the fabrication drawings.

**D. Fabricator Standard Drawing.** Fabricator Standard Drawings, previously approved by the Director, Materials Bureau, which meet the requirements of the contract plans, may be used as the fabrication drawings in place of Contract Plan Sheets, Department Standard Sheets or Fabricator Working Drawings.

Fabrication Drawings shall be prepared and processed in accordance with the current Materials Procedure for Preparing And Processing Fabrication Drawings For Precast Concrete Products.

**FABRICATION.** The manufacturer shall produce precast units that conform to the details of the approved fabrication drawings. The precast units shall be uniform in appearance. All concrete surfaces which will be exposed to view after installation shall be flat and smooth, free from irregularities and uniform in color and texture. The Department, and its representatives, shall have free access to the manufacturing facility and all products produced for the Department.

**Formwork.** Concrete shall be cast in rigidly constructed forms which will maintain the units within specified tolerances to the shapes, lines and dimensions shown on the approved fabrication drawings. Forms shall be constructed from flat, smooth, non-absorbent material and shall be sufficiently tight to prevent the leakage of mortar. When wood forms are used all faces in contact with the concrete shall be laminated with a non-absorbent material. All worn or damaged forms which cause irregularities on the concrete surface or damage to the concrete during form removal shall be repaired or replaced before being reused. Form coatings, appearing on the Department's Approved List, shall be applied to all forms.

**Lifting Devices.** Lifting devices shall be a recessed type designed for use in precast concrete. The precast manufacturer shall ensure that the lifting devices selected for use have an adequate capacity to safely handle the precast product. Reinforcing steel shall not be used as a lifting device. Lifting devices that are used for turning or rotating a unit at the precast facility but are not necessary for further handling or installation shall be filled with concrete repair material before the unit is shipped. All other lifting devices shall be filled with concrete repair material after the unit is installed.

**Reinforcing.** Unless noted otherwise in the contract documents, approved fabrication drawings or item specification, the minimum concrete cover over reinforcing steel shall be 38 mm. Reinforcing steel shall be tied and supported to keep it in position during the concrete placement. The ends of chairs or spacers, used to support or locate reinforcing steel, that bear on the faces of forms, shall be made of, or coated with, non-corrosive material so that no discoloration will show on the face of the units. Chairs, tie wires and other devices used to support, position or fasten epoxy coated reinforcement shall be made of or coated with a dielectric material. Tack welding or any other welding of specified steel reinforcement will not be allowed. Welding for cage stability will be permitted provided that redundant steel is added in each direction and tied to the cage. The redundant steel shall be thirty (30) bar diameters, minimum, in length and shall be positioned so that the midpoint is located at the weld. All welds to epoxy coated steel shall be repaired with an epoxy repair material meeting the requirements of §709-04 or §709-08.
Corrosion Inhibitor. When allowed by the individual item specification, corrosion inhibitor may be used in lieu of epoxy coated reinforcing. When corrosion inhibitor is selected for use it shall be clearly noted on the fabricator working drawing or in the fabrication request when standard sheets, contract plan sheets, etc are used as the fabrication drawings. When selected for use, corrosion inhibitor shall be used in all units produced to the referenced fabrication drawings. The corrosion inhibitor shall be added to the concrete as an aqueous solution at a dosage rate of 20.0 liters per cubic meter.

The calcium nitrite, which acts as an accelerator, may be used in conjunction with compatible retarding admixtures to control setting time and workability of the concrete, however the use of a formulation of calcium nitrite solution which includes a set control ingredient may be used if setting times and increased water demands are of concern, consult the manufacturer of the product. The corrosion inhibitor must be added to the mix immediately after air entraining and retarding admixtures have been introduced into the batch.

When a batching problem exists or is perceived the Department reserves the right to test the hardened concrete at any time to verify the quantity of calcium nitrite present. Units with less than the specified amount of calcium nitrite shall be subject to rejection. If hardened concrete is tested, 100 mm diameter cores shall be drilled by the manufacturer under the supervision of a Department representative. Cores shall be a minimum of 100 mm in length unless otherwise approved by the Materials Bureau. Core holes shall be plugged and repaired in accordance with the requirements of repair indicated below.

Concrete Placement And Consolidation. Suitable means shall be used for placing concrete to prevent segregation. The concrete shall be thoroughly consolidated by external or internal vibrators or a combination of both, unless otherwise approved by the Materials Bureau. Vibrators shall not be used to move concrete within the forms. Concrete shall be placed and consolidated in a way that minimizes the presence of surface voids or bug holes on the formed surfaces.

Cold Weather. When concrete is cast in ambient temperatures less than 10°C the following requirements shall apply:

A. Immediately before concrete placement the minimum temperature inside the forms shall be 5°C.
B. Immediately following completion of the placement the requirements of the chosen curing method shall be followed.
C. Concrete temperatures required by the chosen curing method shall be maintained by means of an external indirect heat supply or by utilizing the heat of hydration. Curing temperatures shall not exceed 30°C unless units are steam cured in accordance with this specification. When an external heat supply is used the enclosure shall be properly vented to prevent surface disintegration of the fresh concrete due to an accumulation of carbon dioxide gas.
D. The plastic concrete shall not be exposed to freezing temperatures after it has been placed into the forms or during the curing period.

Dimensional Tolerances

A. Unit dimensions shall not vary by more than 5 mm from those shown on the approved fabrication drawings unless noted otherwise in the contract documents, approved fabrication drawings or item specification.
B. Variations in the required spacing of reinforcing steel shall not be more than 50 mm and are not cumulative. Concrete cover over reinforcing steel shall not be more than 10 mm greater than, and in no case be less than, the amount specified in the contract documents, approved fabrication drawings, or item specification.

Architectural Treatments

A. Architectural Patterned And Textured Precast Concrete. The architectural pattern or textured effect called for in the contract plans shall be obtained by using form liners, stamping equipment or other texturing tools recommended by the manufacturer. Details of the architectural pattern or texture and the fabrication method used shall be shown on the fabrication drawings for the precast item. Concrete surfaces treated with form liners or by stamping shall have a repeatable,
seamless pattern such that when installed the units will form a continuous, natural looking, matching and repeatable pattern. Surfaces treated with texturing tools shall be uniform in appearance. When form liners are used, a high quality release agent compatible with the form liner material shall be used. Form liners which are worn or damaged resulting in a non-uniform appearance or damage to the concrete during form removal shall be replaced. Fabrication drawings shall clearly show the design thickness of the precast element and the thickness being added by the architectural pattern or texturing. The architectural pattern or texturing shall not penetrate into the required concrete cover over the reinforcing steel at any point.

B. Exposed Aggregate Precast Concrete. Coarse aggregate shall meet the color and size requirements in the plans. When no size is specified a Type CA1 gradation, or equal approved by the Director, Materials Bureau, shall be used. A set retarder designed for use in exposed aggregate applications shall be used. Surfaces requiring an exposed aggregate finish shall be uniform in appearance with the surface completely covered with exposed aggregate. A set retarder shall be applied, in accordance with the manufacturers recommendations, to the surfaces receiving the exposed aggregate finish. Alternate methods of obtaining the exposed aggregate finish require prior approval of the Director, Materials Bureau. Unless otherwise shown in the contract plans, the depth of exposure shall be 30% of the primary size of the coarse aggregate. The depth of exposure shall be measured by laying a straight edge across the plane of the concrete face and measuring back to the concrete matrix.

C. Integral Coloring. Integrally colored concrete shall be produced by use of a pigment coloring system meeting the requirements of ASTM C979. For each color used the pigment shall be from the same batch or lot unless otherwise approved by the Director, Materials Bureau. Pigment will be approved based on a manufacturers certification of compliance with these requirements. Type 6 white cement, meeting the requirements of §701-01, may be used to achieve the desired color. Coloring pigment shall be added to the concrete mix per manufacturer’s recommendations, at a dosage rate to achieve the desired color as specified in the contract documents. The manufacturer’s recommended maximum dosage rate shall not be exceeded.

D. Visual Standards. The Contractor shall construct visual samples that are the same general size and shape as the production units they represent. The samples must be submitted to the Regional Landscape Architect for written approval. Each of the patterns, textures and colors identified in the plans shall be represented by the samples. Only one pattern or texture shall be used per sample face. When multiple patterns or textures are called for, additional samples will be required. Materials and fabrication techniques used in the samples, including curing, concrete pigment and sealers, shall be the actual materials and techniques to be used in the construction of the final product. If the samples are rejected by the Landscape Architect, the Contractor shall construct additional samples as required to obtain the Landscape Architect’s approval. The approved samples shall be made available at the precast plant, for use by the inspector as visual standards, throughout production of the units. When surface coatings are to be field applied additional samples, without the surface coatings, shall be prepared and retained at the precast plant for use as visual standards. The fabrication of precast concrete units shall not begin until written approval of the visual standards has been received from the Department.

E. Visual Evaluation. When comparing production units against the visual standards there shall be minimal color and texture variations, from the standard, when viewed in good typical lighting at a 6m distance. When viewed alone, production units shall show no obvious imperfections or evidence of repairs other than minimal color and texture variations when viewed in good typical lighting at a 6m distance.

Curing. All precast concrete units shall be subjected to curing by any one of the methods described in the following paragraphs. The manufacturer shall provide minimum/maximum temperature thermometers to monitor curing temperatures unless otherwise specified. If, at any time, curing temperatures fall below the specified minimum for the chosen curing procedure, the curing period shall be increased accordingly.
Except as noted under D. Moisture Retention Curing, no unit shall be subjected to freezing temperatures until the following two conditions are met:

- The chosen curing cycle has been completed.
- The specified 28 day compressive strength or 21 MPa, whichever is less, has been reached.

Cylinders shall be cured in the same manner and maintained in the same temperature and environmental conditions as the units they represent until being tested.

**A. Steam Curing.** The units shall be cured in a suitable enclosure. The enclosure shall be designed to minimize the loss of heat and moisture while allowing the uniform circulation of steam around the entire unit. The interior surfaces of the enclosure and the surface of the unit shall be moist at all times. Steps shall be taken to prevent localized "hot spots" caused by the steam lines. The enclosure shall be free from outside drafts.

Steam curing shall not begin until a preset period has been completed. The preset period begins when the last concrete has been placed and continues until the concrete obtains initial set. Prior written approval from the Director, Materials Bureau is required when preset periods of less than two hours are to be used. During the preset period, moderate heat may be applied to the enclosure to maintain the initial temperature of the concrete. The maximum temperature inside the enclosure during the preset period shall be the initial temperature of the concrete +5°C.

After the preset period is complete, steam shall be injected into the curing enclosure. The temperature inside the enclosure shall not be increased at a rate greater than 20°C per hour. A moist atmosphere shall be maintained at a temperature between 40°C and 85°C for a period of not less than 12 hours. The temperature inside the enclosure shall then be decreased at a rate not exceeding 20°C per hour until the ambient temperature outside the enclosure is reached. The manufacturer shall provide automatic temperature recorders to continuously record the curing temperature inside the enclosure.

**B. Water Spray Curing.** Curing shall begin as soon as the concrete has hardened sufficiently to prevent surface damage from the water spray but not more than 2 hours after the completion of finishing. All exposed surfaces of the precast unit shall be kept wet with a continuous fine spray of water in an enclosure maintained at a temperature of not less than 20°C for a period of not less than 72 hours. Additional curing time may be necessary to meet the 28 day strength requirements.

**C. Saturated Cover Curing.** The saturated covers used under this method shall be burlap. Curing shall begin as soon as the concrete has hardened sufficiently to prevent surface damage from the saturated burlap but not more than 2 hours after the completion of finishing. All exposed concrete surfaces on the precast unit shall be covered with burlap, saturated with water before applying. The burlap shall be kept saturated and the units kept at a temperature of not less than 20°C for a period of not less than 72 hours. Additional curing time may be necessary to meet the 28 day strength requirements.

**D. Moisture Retention Curing.** Units cured in accordance with these methods shall be maintained at a temperature of not less than 10°C for a period of not less than 7 days except as noted below. Additional curing time may be necessary to meet the 28 day strength requirements. When the specified 28 day compressive strength or 21 MPa, whichever is less, has been reached the unit may be exposed to freezing temperatures however the membrane curing compound or curing covers must still be maintained for a minimum of 7 days.

1. **Membrane Curing Compound.** The membrane curing compounds used under this method must appear on the Department's current Approved List of Membrane Curing Compounds under B. Clear (with fugitive dye). The compound shall be properly agitated immediately before each use. A minimum coverage rate of one liter per 3.5 square meters shall be used.

The membrane curing compound shall be applied to the concrete surface after finishing as soon as the free water on the surface has disappeared and no water sheen is visible, but not so late that the liquid curing compound will be absorbed into the concrete. When curing compound
cannot be applied within the above requirements, the manufacturer shall instead immediately begin curing the unit in accordance with one of the other curing methods contained in this specification, until curing compound can be applied.

If the forms are left on for a minimum of 7 days, curing compound is not required on any formed surfaces. When the forms are removed prior to 7 days, the exposed concrete surfaces shall be wet with water within one half hour of form removal and shall be kept moist until the curing compound is applied. Before application, the concrete shall be allowed to reach a uniformly damp appearance with no free water on the surface and then the compound shall be applied immediately.

This method of curing shall not be used on any concrete surface which is to have plastic concrete, grout or mortar bonded to it or on any concrete surface that will have a penetrating or coating type treatment such as a sealer or stain applied to it. Another approved method of curing shall be used when this condition exists.

2. Curing Covers. The curing covers used under this method shall be either Plastic Coated Fiber Blankets, §711-03, appearing on the Department's Approved List or Polyethylene Curing Covers meeting the requirements of §711-04. Curing covers shall be placed immediately following the finishing operation or form removal, whichever is applicable. Care shall be taken not to damage any exposed concrete surfaces during cover placement. Curing covers shall be placed and secured and be of such condition as to minimize the loss of moisture and temperature. When it is necessary to use more than one curing cover the edges shall be lapped a minimum of 300 mm.

E. Other Methods. Other Methods of curing are subject to approval by the Director, Materials Bureau.

Repair. Precast concrete units that contain minor defects caused by manufacture or mishandling shall be repaired at the manufacturing site. In addition, units that contain minor defects caused by mishandling during shipment or installation shall be repaired at the project site. When repairs are made to a unit that has been sprayed with curing compound, the compound must be removed from the repair area before making the repair as it will act as a bond breaker between the precast concrete and the repair material. Major defects and non repairable defects in a unit will be cause for rejection of the unit. Defects are defined as follows:

A. Surface Defects. Surface voids or bugholes which are less than 15 mm in diameter and less than 5 mm deep are acceptable, except as noted under D. of this section. Surface defects need not be repaired.

B. Minor Defects. Minor defects are defined as: spalls, honeycombing and surface voids which have no dimension greater than 300 mm, when measured along a straight line, and do not expose the reinforcing steel. Minor defects shall be repaired by removing all unsound concrete from the defect, square cutting the edges of the defect to prevent feather edging of the repair and then filling the void with concrete repair material meeting the requirements of §701-04. Concrete repair material shall have a color similar to that of the precast unit. The repair shall be finished to the proper shape and cured in accordance with the repair material manufacturer's recommendations. It shall withstand a moderate blow with a 450 g hammer. The blow shall produce a sharp ring indicating proper bonding of the repair.

C. Major Defects. Major defects are defined as: spalls, honeycombing and surface voids which have any dimension greater than 300 mm, when measured along a straight line, or expose the reinforcing steel. Cracks which go through the section or are greater than 0.25 mm in width are also major defects.

No major defect shall be repaired without prior approval of the Department. Requests to repair major defects shall be made in accordance with the requirements contained in the current Materials Procedure for precast concrete.
§704

D. Non Repairable Defects. Non repairable defects are defined as: cracks in a concrete surface, which will be exposed to view after installation, that are visible when viewed in good typical lighting with the naked eye at a 3 m distance; minor defects which in total make up more than 5% of the surface area of the unit and excessive surface defects on more than 5% of the surface area which will be exposed to view after installation.

SAMPLING AND TESTING. Sampling and testing shall be done by the precast manufacturer in accordance with Materials Bureau requirements contained in the current Materials Procedure for precast concrete.

MARKING. All precast units shall be clearly marked with permanent waterproof paint. Unless noted otherwise in the item specification, units shall be marked on an inside or back surface which will not be exposed to view after installation. The following information shall be included:

Name or trademark of the manufacturer.
Date of manufacture.
Unique piece identification number.
NYSDOT Contract number.

FINAL PRODUCTION INSPECTION. A final production inspection shall be performed by the precast manufacturer on every precast unit produced for the Department. An inspection will be considered satisfactory when it verifies that the precast unit is in compliance with the appropriate Department specifications. The specific requirements and procedures for the inspection are contained in the precast manufacturer’s Department approved Quality Control Plan.

SHIPPING. Upon completion of a satisfactory final production inspection the precast unit may be shipped from the manufacturing location except that units produced between the dates of October 31st and April 1st shall not be shipped for a minimum of 72 hours following the completion of casting.

BASIS OF ACCEPTANCE. Precast units will be accepted at the job site based on the following:
The manufacturer’s name must appear on the Department’s Approved List for the item being supplied.
A manufacturer’s certification.
An acceptable product evaluation made by the Engineer.

704-04 CONCRETE BLOCK (SLOPE PAVING)

SCOPE. This specification covers the material and quality requirements for solid concrete block for use in concrete block slope paving.

MATERIAL REQUIREMENTS. Materials used in the manufacture of concrete block shall meet the requirements of the following subsections:

- Portland Cement 701-01
- Coarse Aggregate 703-02
- Mortar Sand 703-03
- Grout Sand 703-04
- Concrete Sand 703-07
- Fly Ash 711-10
- Ground, Granulated Blast-Furnace Slag 711-12
- Water 712-01

Fly ash or ground granulated blast furnace slag may be substituted for up to a maximum of 20% by weight of the total amount of cement plus pozzolan in the mix. Pigments used for integral coloring shall meet the requirements of ASTM C979. Other materials may be used in the manufacture as approved by the Director, Materials Bureau.
Physical Properties. The average compressive strength of five full-size blocks shall be not less than 20 MPa, with no individual block less than 15 MPa. The average freeze/thaw loss of five block samples, subjected to 42 freeze/thaw cycles in a 3% NaCl solution, shall not exceed 1.0%, with no individual sample exceeding 1.5%.

Block dimensions shall be as required in the contract documents. Dimensions shall not vary by more than 5 mm from those specified. Blocks shall be sound and free from cracks or other defects that would interfere with their proper placement or performance.

SAMPLING AND TESTING. Samples, when requested by the Department, shall be randomly selected from production-run material. A minimum of 5 full-size blocks of the same size and style will be required for compression testing. A minimum of five samples, prepared by the manufacturer in accordance with ASTM C1262, will be required for freeze/thaw testing.

Samples will be tested for compressive strength in accordance with ASTM C140. Samples will be tested for freeze/thaw durability in accordance with ASTM C1262.

BASIS OF ACCEPTANCE. Concrete block will be accepted on the basis of the manufacturer's name and location appearing on the Department’s Approved List and a material certification that specifies the product conforms to this specification.

704-05 PRECAST CONCRETE BARRIER

SCOPE. This specification covers the material and quality requirements for precast concrete barrier used in highway applications and precast concrete barrier for structures.

MATERIAL REQUIREMENTS. The Material Requirements contained in §704-03 shall apply except as noted herein.

Unless noted otherwise in the contract documents or approved fabrication drawings the compressive strength of concrete used in precast concrete barrier shall be as follows:

Concrete Barrier 25 MPa (minimum) @ 28 days
Concrete Barrier for Structures 35 MPa (minimum) @ 28 days

Concrete mixtures used under this specification shall have a maximum cement content of 445 kg per cubic meter.

Reinforcing steel shall be epoxy coated meeting the requirements of §709-04.

DRAWINGS. The drawing requirements contained in §704-03 shall apply except as noted herein.

Concrete Barrier For Structures. Units shall be fabricated to conform to the details shown on DCES approved Fabricator Standard Drawings for the barrier system. When site conditions require modification of the approved Fabricator Standard Drawings, job specific Fabricator Working Drawings are required.

FABRICATION. The Fabrication requirements contained in §704-03, along with the following shall apply.

Dimensional Tolerances. The requirements of §606-3.05 A. Precast Concrete Barrier shall apply.

SAMPLING AND TESTING. The Sampling and Testing requirements contained in §704-03 shall apply.

MARKING. The Marking requirements contained in §704-03 shall apply except as noted herein.

Markings shall be placed on one end of each barrier unit such that they will not be exposed to view after installation.
FINAL PRODUCTION INSPECTION. The Final Production Inspection requirements contained in §704-03 shall apply.

SHIPPING. The Shipping requirements contained in §704-03 shall apply.

BASIS OF ACCEPTANCE. The Basis of Acceptance requirements contained in §704-03 shall apply.

704-06 PRECAST CONCRETE CRIBBING

SCOPE. This specification covers the material and fabrication requirements for precast concrete cribbing.

MATERIAL REQUIREMENTS. The Material Requirements contained in §704-03 shall apply.

DRAWINGS. The Drawing requirements contained in §704-03 shall apply.

FABRICATION. The Fabrication requirements contained in §704-03 shall apply.

SAMPLING AND TESTING. The Sampling And Testing requirements contained in §704-03 shall apply.

MARKING. The Marking requirements contained in §704-03 shall apply.

FINAL PRODUCTION INSPECTION. The Final Production Inspection requirements contained in §704-03 shall apply.

SHIPPING. The Shipping requirements contained in §704-03 shall apply.

BASIS OF ACCEPTANCE. The Basis Of Acceptance requirements contained in §704-03 shall apply.

704-07 SEGMENTAL RETAINING WALL BLOCKS

SCOPE. This specification covers the material details and quality requirements for segmental retaining wall blocks.

MATERIAL REQUIREMENTS. Provide segmental retaining wall block meeting the style and color requirements in the contract documents. Use materials, meeting the following requirements, in the manufacture of segmental retaining wall blocks:

- Portland Cement 701-01
- Coarse Aggregate 703-02
- Mortar Sand 703-03
- Grout Sand 703-04
- Concrete Sand 703-07
- Fly Ash 711-10
- Ground, Granulated Blast-Furnace Slag 711-12
- Water 712-01

Fly ash or ground, granulated blast-furnace slag may be substituted for up to a maximum of 20% by weight of the total amount of cement plus pozzolan in the mix. Use integral coloring pigments, when required, meeting the requirements of ASTM C979. Other materials may be used in the manufacture as approved by the Director, Materials Bureau.

Physical Properties. The minimum acceptable average compressive strength of five-block samples is 28 MPa, with no individual block sample less than 24 MPa. The maximum acceptable average
freeze/thaw loss of five-block samples, subjected to 42 freeze/thaw cycles in a 3% NaCl solution, is 1.0%, with no individual sample exceeding 1.5%.

The formed dimensions of concrete retaining wall block units will not differ more than 5 mm from the nominal dimensions shown on the approved Materials Detail Drawing. Provide sound blocks, free from cracks or other defects that would interfere with the proper placing, performance, or appearance of the blocks.

**Materials Details.** At the time of application to the Approved List, submit Materials Details Drawings to the Director, Materials Bureau for approval. Prepare and submit drawings in accordance with Departmental procedural directives. Submit a unique drawing(s) for each block style under consideration.

**SAMPLING AND TESTING.** When samples are requested by the Department, randomly select them from production-run material. A minimum of 5 samples, prepared by the manufacturer in accordance with ASTM C140, will be required for compression testing. A minimum of five samples, prepared by the manufacturer in accordance with ASTM C1262, will be required for freeze/thaw testing.

Samples will be tested for compressive strength in accordance with ASTM C140. Samples will be tested for freeze/thaw durability in accordance with ASTM C1262.

**BASIS OF ACCEPTANCE.** Segmental retaining wall blocks will be accepted on the basis of the manufacturer’s name and block style appearing on the Department’s Approved List, a material certification that specifies the product conforms to this specification, and conformance to the approved materials detail drawing(s).

### 704-08 BRICK SIDEWALK AND DRIVEWAY PAVERS

**SCOPE.** This specification covers the material and quality requirements for brick pavers made from extruded fire clay or shale for use in brick paving.

**MATERIAL REQUIREMENTS.** Brick pavers shall conform to the requirements of ASTM C902, Class SX, Type I. Brick pavers shall be the shape, size, and color shown in the contract documents.

**SAMPLING AND TESTING.** Samples, when requested by the Department, shall be randomly selected from production-run material. A minimum of 10 full-size bricks of the same size and style will be required. Samples will be tested for the physical properties identified in ASTM C902. Tests will be performed in accordance with ASTM C67.

**BASIS OF ACCEPTANCE.** Brick sidewalk and driveway pavers will be accepted on the basis of a material certification that specifies the product conforms to this specification.

### 704-09 STONE BLOCKS

**SCOPE.** This specification covers the material and quality requirements for stone blocks for use in Grouted Stone Block Paved Sidewalks and Driveways.

**MATERIAL REQUIREMENTS.** Stone blocks shall be new or used granite or other stone as specified. The blocks shall be sound and durable, reasonably uniform in quality and texture throughout, free from shale, excess mica, seams, scaling or evidence of disintegration. Color shall be as specified.

Samples of stone blocks shall be submitted to and be approved by the Engineer prior to beginning of work. The blocks shall be rectangular in shape, with the following approximate dimensions: 200 mm - 300 mm in length, 75 mm - 125 mm in depth, unless otherwise specified or approved, and so dressed that they may be laid with a maximum of 30 mm joints or as specified. All blocks shall have one reasonably smooth split face with no projections or depressions over 5 mm. Cutting of blocks to meet the pattern requirements will be permitted subject to the approval of the Engineer.
BASIS OF ACCEPTANCE. Stone blocks shall be inspected, by the Engineer, for dimensional and color compliance upon arrival at the project location. Blocks not in compliance with the contract documents may be rejected by the Engineer.

704-10 SPLIT-FACED CONCRETE BRICK

SCOPE. This specification covers the material and quality requirements for split-faced concrete brick for use in facing structural walls.

MATERIAL REQUIREMENTS. Split-faced concrete brick shall conform to the requirements of ASTM C55, Grade N, except as noted herein. The shape, size, and color of split-faced concrete brick shall be as shown in the contract documents. The splitting operation shall leave relatively sharp, straight, and parallel edges. Materials used in the manufacture of split-faced concrete brick shall meet the requirements of the following subsections:

Portland Cement 701-01
Coarse Aggregate 703-02
Mortar Sand 703-03
Grout Sand 703-04
Concrete Sand 703-07
Fly Ash 711-10
Ground, Granulated Blast-Furnace Slag 711-12
Water 712-01

Fly ash or ground, granulated blast-furnace slag may be substituted for up to a maximum of 20% by weight of the total amount of cement plus pozzolan in the mix. Pigments used for integral coloring shall meet the requirements of ASTM C979. Other materials may be used in the manufacture as approved by the Director, Materials Bureau.

SAMPLING AND TESTING. Samples, when requested by the Department, shall be randomly selected from production-run material. A minimum of 10 full-size, split-faced bricks of the same size and style will be required. Five samples will be tested for compressive strength and five for absorption, in accordance with ASTM C140.

The manufacturer shall be responsible for having brick tested for linear drying shrinkage in accordance with ASTM C55. A copy of the test report shall be included with the samples submitted to the Department for compression and absorption testing.

BASIS OF ACCEPTANCE. Split-faced concrete brick will be accepted on the basis of a material certification that specifies the product conforms to this specification.

704-11 PRECAST CONCRETE COPING

SCOPE. This specification covers the material and quality requirements for precast concrete coping.

MATERIAL REQUIREMENTS. The Material Requirements contained in §704-03 shall apply.

DRAWINGS. The Drawing requirements contained in §704-03 shall apply.

FABRICATION. The Fabrication requirements contained in §704-03 shall apply except as noted herein.

Coping shall be produced with a dense, smooth, uniform finished surface without rubbing or additional treatment. Corners shall have a maximum radius of 3 mm and grinding will not be allowed. Coping shall be removed from the forms and handled in a manner that will prevent chipping of the edges and faces of the concrete.

Repair. Surface defects, regardless of size, shall be repaired by wetting the surface to achieve a damp condition with no standing water in the holes and then filling the holes with a mortar composed of an
appropriate proportion of sand and cement having the same color and physical characteristics of the original mix. The mortar shall be allowed to partially harden and then be rubbed until a clean, uniform appearance, with no visible coating of mortar on the concrete, is obtained. The mortar repair shall be cured in the same manner as the coping unit.

**SAMPLING AND TESTING.** The Sampling and Testing requirements contained in §704-03 shall apply.

**MARKING.** The Marking requirements contained in §704-03 shall apply except as noted herein.

Markings shall be placed on one end of each unit such that they won’t be exposed to view after installation.

**FINAL PRODUCTION INSPECTION.** The Final Production Inspection requirements contained in §704-03 shall apply.

**SHIPPING.** The Shipping requirements contained in §704-03 shall apply

**BASIS OF ACCEPTANCE.** The Basis Of Acceptance requirements contained in §704-03 shall apply.

### 704-12 DECORATIVE CONCRETE BLOCK

**SCOPE.** This specification covers the material and quality requirements for decorative concrete block for use in facing structural walls.

**MATERIAL REQUIREMENTS.** Decorative concrete block shall conform to the requirements of ASTM C90 except as noted herein. The shape, size, and color of decorative concrete block shall be as shown in the contract documents. Materials used in the manufacture of decorative concrete block shall meet the requirements of the following subsections:

- Portland Cement 701-01
- Coarse Aggregate 703-02
- Mortar Sand 703-03
- Grout Sand 703-04
- Concrete Sand 703-07
- Fly Ash 711-10
- Ground, Granulated Blast-Furnace Slag 711-12
- Water 712-01

Fly ash or ground, granulated blast-furnace slag may be substituted for up to a maximum of 20% by weight of the total amount of cement plus pozzolan in the mix. Pigments used for integral coloring shall meet the requirements of ASTM C979. Other materials may be used in the manufacture as approved by the Director, Materials Bureau.

**SAMPLING AND TESTING.** Samples, when requested by the Department, shall be randomly selected from production-run material. A minimum of 10 full-size decorative concrete blocks of the same size and style will be required. Five samples will be tested for compressive strength and five for absorption, in accordance with ASTM C140.

The manufacturer shall be responsible for having block tested for linear drying shrinkage in accordance with ASTM C90. A copy of the test report shall be included with the samples submitted to the Department for compression and absorption testing.

**BASIS OF ACCEPTANCE.** Decorative concrete block will be accepted on the basis of a material certification that specifies the product conforms to this specification.
704-13 PRECAST CONCRETE DRIVEWAY AND SIDEWALK PAVERS

SCOPE. This specification covers the material and quality requirements for precast concrete pavers used for driveway and sidewalk paving.

MATERIAL REQUIREMENTS. Precast concrete pavers shall meet the requirements of ASTM C936 except as noted herein. The shape, size, and color of precast concrete pavers shall be as shown in the contract documents. Materials used in the manufacture of precast concrete pavers shall meet the requirements of the following subsections:

- Portland Cement 701-01
- Coarse Aggregate 703-02
- Mortar Sand 703-03
- Grout Sand 703-04
- Concrete Sand 703-07
- Fly Ash 711-10
- Ground, Granulated Blast-Furnace Slag 711-12
- Water 712-01

Fly ash or ground, granulated blast-furnace slag may be substituted for up to a maximum of 20% by weight of the total amount of cement plus pozzolan in the mix. Pigments used for integral coloring shall meet the requirements of ASTM C979. Other materials may be used in the manufacture as approved by the Director, Materials Bureau.

Physical Properties. Precast concrete pavers shall meet the compressive strength and absorption requirements in ASTM C936. In addition, the maximum acceptable average freeze/thaw loss of five paver samples, subjected to 25 freeze/thaw cycles in a 10% NaCl solution, is 1.0%, with no individual sample exceeding 1.5%.

SAMPLING AND TESTING. Samples, when requested by the Department, shall be randomly selected from production-run material. A total of 15 precast concrete pavers of the same size and style will be required. Five samples will be tested for compressive strength and five for absorption, in accordance with ASTM C140. Five samples will be tested for freeze/thaw durability in accordance with NYSDOT test methods.

BASIS OF ACCEPTANCE. Precast concrete driveway and sidewalk pavers will be accepted on the basis of the manufacturer's name and location appearing on the Department’s Approved List and a material certification that specifies the product conforms to this specification.

704-14 PRECAST CONCRETE PANEL UNITS (Mechanically Stabilized Earth System)

SCOPE. This specification covers the material and quality requirements for precast concrete panel units used to construct a mechanically stabilized earth system.

MATERIAL REQUIREMENTS. The Material Requirements contained in §704-03 shall apply except as noted herein.

Unless noted otherwise in the contract documents or approved fabrication drawings the concrete used to fabricate panel units shall have a minimum compressive strength of 35 MPa @ 28 days.

Reinforcing steel shall be epoxy coated meeting the requirements of §709-04 or §709-08.

Embedded items shall be as detailed on the fabrication drawings. Acceptance of embedded items will be based on manufacturer’s certification, unless otherwise directed by the Materials Bureau. When steel embeddings are required, they shall be galvanized to §719-01.

DRAWINGS. The drawing requirements contained in §704-03 shall apply.
§704

FABRICATION. The Fabrication requirements contained in §704-03, along with the following, shall apply.

A. Corrosion Inhibitor. When required in the contract plans the concrete used shall contain a corrosion inhibitor. The use of corrosion inhibitor does not replace the requirement for epoxy coated reinforcing.

B. Dimensional Tolerances

- Panel dimensions (edge-to-edge of concrete). ±5 mm
- Panel thickness. ±5 mm
- Length difference between two diagonals (squareness). ±10 mm
- Distance between the centerline of dowel and dowel sleeve. ±5 mm
- Dimension from the face of panel to centerline of dowel and dowel sleeve, and to centerline of reinforcing steel. ±5 mm.
- Warping of the exposed panel face 5 mm in 1.5 m.
- Location of tie strips. ±25 mm
- Location of coil embeds. ±5 mm
- Location of connection slots. ±25 mm
- Contact surfaces of each fabricated embedment assembly. ±2 mm from a straight line.
- Miscellaneous tolerances. as detailed on the fabrication drawings.

C. Coating of Concrete Units. When required in the contract plans, panel units shall be coated on all surfaces with a penetrating sealer meeting the requirements of §717-03 Penetrating Type Protective Sealers. Surfaces to be coated must be prepared by blast cleaning, removing all laitance, loose particles, etc. The surface shall be allowed to dry for 24 hours after wetting for any reason. All surface preparation work shall be completed before sealer application can commence. The coating of units shall take place prior to shipping unless otherwise approved by the Engineer.

Sealer materials shall not be applied during wet weather conditions. Any unit exposed to wetting within 12 hours of being sealed shall be recoated. Ambient and surface temperatures shall be a minimum of 4°C during application and until the sealed concrete is dry to the touch. Application by spray methods shall not be used during windy conditions.

The sealer shall be used as supplied by the manufacturer without thinning or alterations, unless specifically required in the manufacturer’s instructions. Thorough mixing of the sealer before and during use shall be accomplished as recommended by the manufacturer. Equipment for sealer application shall be clean of foreign materials. A minimum of two coats of sealer shall be applied. The total quantity of sealer applied by each coat shall be equal to the quantity required at the application rate specified in the Approved List. Each coat shall be allowed to dry before the next coat is applied. On sloping and vertical surfaces, sealer application shall progress from the bottom to the top. Care shall be taken to ensure that the entire surface of the concrete is covered and all pores filled.

SAMPLING AND TESTING. The Sampling and Testing requirements contained in §704-03 shall apply.

MARKING. The Marking requirements contained in §704-03 shall apply.

FINAL PRODUCTION INSPECTION. The Final Production Inspection requirements contained in §704-03 shall apply.

SHIPPING. The Shipping requirements contained in §704-03 shall apply.

BASIS OF ACCEPTANCE. The Basis Of Acceptance requirements contained in §704-03 shall apply.

704-15 THRU 704-22 (VACANT)
§704

704-23 PRECAST CONCRETE STREET PAVERS

SCOPE. This specification covers the material and quality requirements for precast concrete pavers used for street paving.

MATERIAL REQUIREMENTS. Precast concrete pavers shall meet the requirements of ASTM C936 except as noted herein. The shape, size, and color of precast concrete pavers shall be as shown in the contract documents. Materials used in the manufacture of precast concrete pavers shall meet the requirements of the following subsections:

<table>
<thead>
<tr>
<th>Material</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portland Cement</td>
<td>701-01</td>
</tr>
<tr>
<td>Coarse Aggregate*</td>
<td>703-02</td>
</tr>
<tr>
<td>Mortar Sand*</td>
<td>703-03</td>
</tr>
<tr>
<td>Grout Sand*</td>
<td>703-04</td>
</tr>
<tr>
<td>Concrete Sand*</td>
<td>703-07</td>
</tr>
<tr>
<td>Fly Ash</td>
<td>711-10</td>
</tr>
<tr>
<td>Ground, Granulated Blast-Furnace Slag</td>
<td>711-12</td>
</tr>
<tr>
<td>Water</td>
<td>712-01</td>
</tr>
</tbody>
</table>

*Aggregates used in precast concrete street pavers shall meet the friction requirements of §501-2.02 B. 2.

Fly ash or ground, granulated blast-furnace slag may be substituted up to a maximum of 20% by weight of the total amount of cement plus pozzolan in the mix. Pigments used for integral coloring shall meet the requirements of ASTM C979. Other materials may be used in the manufacture as approved by the Director, Materials Bureau.

Physical Properties. Precast concrete pavers shall meet the compressive strength and absorption requirements in ASTM C936. In addition, the maximum acceptable average freeze/thaw loss of five paver samples, subjected to 25 freeze/thaw cycles in a 10% NaCl solution, is 1.0%, with no individual sample exceeding 1.5%.

SAMPLING AND TESTING. Samples, when requested by the Department, shall be randomly selected from production-run material. A total of 15 precast concrete pavers of the same size and style will be required. Five samples will be tested for compressive strength and five for absorption, in accordance with ASTM C140. Five samples will be tested for freeze/thaw durability in accordance with NYSDOT test methods.

BASIS OF ACCEPTANCE. Precast Concrete Street pavers will be accepted on the basis of the manufacturer's name and location appearing on the Department’s Approved List and a material certification that specifies the product conforms to this specification.

SECTION 705 - JOINT MATERIALS

705-01 PREFORMED CORK JOINT FILLER

SCOPE. This specification contains the material requirements pertaining to preformed cork joint filler.

GENERAL. The Joint Filler shall be of the dimensions shown on the plans or listed in the specifications. Each piece shall be plainly marked with the manufacturer's name.

MATERIAL REQUIREMENTS. Preformed Cork Joint Filler shall conform to the requirements of ASTM D1752, Type III (Self-expanding Cork).

BASIS OF ACCEPTANCE. Acceptance of this material will be based on the manufacturer’s certification of compliance with these specification requirements.
705-02 HIGHWAY JOINT SEALANTS

SCOPE. Material requirements for hot-applied joint and crack sealants.

MATERIAL REQUIREMENTS. ASTM D 6690, Types II and/or IV, except the bond, non-immersed requirement for Type IV is 3 cycles at 100% extension at -29°C.

SAMPLING AND TESTING. Deliver sealant sampled, packaged, and marked in accordance with ASTM D 6690, to:

The New York State DOT Laboratories
1220 Washington Avenue
Albany, NY, 12206

Include the following information along with the sample:
- Manufacturer’s address, telephone number, fax number, and e-mail address.
- Type (II or IV) for which testing is requested.

BASIS OF ACCEPTANCE. Highway joint sealants will be accepted at the contract based on the product name appearing on the appropriate Approved List entitled “Highway Joint Sealants (ASTM D 6690, Type II)” or “Highway Joint Sealants (ASTM D 6690, Type IV)” under “Joint Materials, Pavements.”

705-03 PREFORMED RUBBER JOINT FILLER

SCOPE. This specification contains the material requirements pertaining to preformed rubber joint filler.

GENERAL. The joint filler shall be of the dimensions shown on the plans or in the specifications.

MATERIAL REQUIREMENTS. Preformed Rubber Joint Filler shall conform to the requirements of the Standard Specifications for ASTM D1752, Type (Sponge Rubber), except that the use of reclaimed rubber or factice will be permitted.

BASIS OF ACCEPTANCE. Acceptance of this material will be based on the manufacturer's certification of compliance with these specification requirements.

705-04 ARMORLESS BRIDGE JOINTS

SCOPE. This specification covers the material requirements for armorless bridge joint systems.

MATERIAL REQUIREMENTS. The materials used to construct the armorless bridge joint system will appear as approved materials on the Department’s Approved List for Materials and Equipment for use on NYSDOT Projects.

BASIS OF ACCEPTANCE. Acceptance of this material will be based on the manufacturer’s name and system appearing on the Department’s Approved List and a Manufacturer’s certification of conformance of the system to the approved Materials Detail Sheet (MDS.) The supplier will provide two copies of the approved Materials Details through the Contractor to the Engineer as part of the evidence of acceptability for the material at least 10 days prior to shipment of the product to the job site.

705-05 SILICONE JOINT SEALANTS FOR PAVEMENTS

SCOPE. This specification covers the material requirements for silicone joint sealants for pavements.
§705

GENERAL. Use equipment meeting §502-2.04 J, Joint Sealing (Silicone). Install the sealant in accordance with the manufacturer’s written instructions.

MATERIAL REQUIREMENTS. Silicone Joint Sealant shall conform to the following requirements:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Specification ASTM D 5893</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tack-Free Time, min.</td>
<td>ASTM C 679</td>
<td>5 hrs. ± 10 min.</td>
</tr>
<tr>
<td>Accelerated Weathering</td>
<td>ASTM C 793</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Flow</td>
<td>ASTM C 639</td>
<td>No Flow</td>
</tr>
<tr>
<td>Modulus of Elongation</td>
<td>ASTM D 412</td>
<td>600% (Minimum)</td>
</tr>
<tr>
<td>Bond, Non-Immersed</td>
<td>ASTM D 5329</td>
<td>Satisfactory</td>
</tr>
</tbody>
</table>

BASIS OF ACCEPTANCE. Acceptance of this material will be based on the manufacturer's name appearing on the Approved List for Joint Materials, Pavement for Silicone Joint Sealants (705-05).

705-06 CAULKING COMPOUND FOR STRUCTURES

SCOPE. This specification covers the material requirements for caulking compound for structures.

GENERAL. Caulking compound shall be applied with either a pneumatic or ratchet hand gun.

MATERIAL REQUIREMENTS. Caulking compound shall be a material which complies with Federal Specification TT-S-230 Sealing Compound, Synthetic-Rubber Base, Single Component, Chemically Curing. The color of the compound shall be cement mortar grey when tested in the manner described in TT-S-230 and compared against a color standard in possession of the Materials Bureau. This standard will be made available upon written request.

BASIS OF ACCEPTANCE. Acceptance of this material will be based on the manufacturer's certification of compliance with these specification requirements.

705-07 PREMOULDED RESILIENT JOINT FILLER

SCOPE. This specification contains the material requirements for premoulded resilient joint filler.

GENERAL. The joint filler shall be of the dimensions shown on the plans or listed in the specifications. When the material is delivered cut to dimension, it shall be banded in bundles of convenient size.

MATERIAL REQUIREMENTS. The premoulded resilient joint filler shall conform to the requirements of ASTM D1751. The asphalt content requirement may be waived if the material meets other requirements of D1751 based on supplementary testing performed by the Materials Bureau.

BASIS OF ACCEPTANCE. Application for approval of premoulded resilient joint filler shall be submitted to the Director, Materials Bureau. Upon approval, the product name and its manufacturer will be placed on the Department's Approved List. Each lift or bundle of joint filler shall be tagged by the manufacturer; the product will be accepted at the work site on the basis of the name and manufacturer of the product appearing on the tag and the Approved List.

The Department reserves the right to sample and test the material after delivery at the project site.

705-08 PREFORMED, CLOSED-CELL FOAM MATERIAL

SCOPE. This specification covers the requirements for preformed, closed-cell foam material.
MATERIAL REQUIREMENTS

General. Closed-cell foam material is used primarily as the joint seal in structural expansion joint systems. The joint material shall remain unaffected by road salts and petroleum products. The material shall also be capable of maintaining a waterproof joint within the range of 50% compression and 25% tension. The joint material shall have grooves along the entire length of the bond surfaces for enhanced bonding performance. The grooves shall be 3 mm deep × 3 mm wide and spaced from 6 mm -13 mm apart.

Installation. Install the preformed, closed-cell foam material according to the manufacturer’s recommended procedure. If a bonding agent is required, it shall be one which is recommended by the manufacturer.

Physical Properties. The joint material shall be a closed-cell, cross linked, expanded polyethylene. Material will meet the properties of Table 705-1.

<table>
<thead>
<tr>
<th>TABLE 705-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Extrusion</td>
</tr>
<tr>
<td>Compression Deflection</td>
</tr>
<tr>
<td>Density</td>
</tr>
<tr>
<td>Water Absorption</td>
</tr>
<tr>
<td>Compression Set</td>
</tr>
</tbody>
</table>

DIMENSIONS. The joint material shall be of the thickness and width described in the contract documents within a tolerance of +10% and -2%. Joint material shall be heat welded to the proper dimensions by the manufacturer. No glue or chemical agents shall be used to join pieces together. No laminations in width shall be allowed.

BASIS OF ACCEPTANCE. Acceptance of this material will be based on the product name appearing on the Department’s Approved List for Preformed Closed-Cell Foam Material.

705-09 PREFORMED ELASTIC BRIDGE JOINT SEALER

SCOPE. This specification covers the material requirements for preformed elastic bridge joint sealer for use in bridge joints.

MATERIAL REQUIREMENTS. The preformed elastic joint sealer material shall be vulcanized elastomeric compound using polymerized chloroprene as the only basic elastomer.

Flexibility. The sealer shape shall be capable of withstanding compression, rotation, or other joint movements without change in the position of the point of foldability, misalignment, or other conditions felt detrimental by the Director, Materials Bureau. The sealer shall exhibit sufficient sealing pressures throughout its expected compression range to assure that no deleterious materials enter the joint.

The joint sealer material shall be tested in accordance with AASHTO M297 except that Compression Deflection properties shall be determined in accordance with Department written instructions. Compression Deflection Properties, LCmin and LCmax, shall comply to that specified in Table 705-2. Test specimens shall be cut and/or buffed from joint seal samples.
TABLE 705-2  COMPRESSION DEFLECTION PROPERTIES

<table>
<thead>
<tr>
<th>Nominal Seal Size(mm)</th>
<th>LC Min.%</th>
<th>LC Max.%</th>
</tr>
</thead>
<tbody>
<tr>
<td>76 or less</td>
<td>85</td>
<td>55</td>
</tr>
<tr>
<td>89</td>
<td>85</td>
<td>50</td>
</tr>
<tr>
<td>102</td>
<td>85</td>
<td>48</td>
</tr>
<tr>
<td>127</td>
<td>85</td>
<td>45</td>
</tr>
<tr>
<td>152</td>
<td>90</td>
<td>45</td>
</tr>
</tbody>
</table>

DIMENSIONS. The measured width and depth of joint seal material shall meet the minimum and maximum allowable dimensions as determined from the original drawings and the applied tolerances.

Dimensional Tolerances. The nominal height of the uncompressed sealer shall be greater than or equal to the nominal uncompressed width.

The measured width and height of joint material shall satisfy the minimum and maximum allowable dimensions as determined from the nominal dimensions shown on the approved drawings and the following dimensional tolerances.

A dimensional tolerance of ±5% of the nominal dimensions shall be applied to seals less than 102 mm in width. A dimensional tolerance of ±6.4 mm shall be applied to the nominal dimensions for seals greater than or equal to 102 mm in width.

SERVICEABILITY

Installation and Performance Requirements. Each lot of joint sealer submitted for Department approval shall demonstrate that it possesses the properties necessary for satisfactory field installation.

The sealer shall not exhibit any twisting, rolling, misalignment of opposite top edges, tendencies to trap incompressibles or any other qualities which shall be deemed detrimental by the Department to the sealer's proper installation and performance.

Joint Wall Contact with Sealer. The top edges of the vertical walls shall remain in contact with the joint sealer faces throughout the compression range to which the sealer will be subjected in use.

Lubricant. The lubricant used to install the sealer shall conform to the requirements of §705-13, Lubricant for Preformed Elastic Joint Sealer, unless otherwise specified in the proposal.

BASIS OF ACCEPTANCE. Preformed elastic bridge joint sealer will be accepted on the basis of the manufacturer's name and location appearing on the Department’s Approved List and a material certification that specifies the product conforms to this specification.

705-10 PREFORMED ELASTIC LONGITUDINAL JOINT SEAL

SCOPE. This specification covers the material requirements for preformed elastic joint seal for use in longitudinal concrete pavement joints.

GENERAL. The preformed elastic material shall be a Vulcanized elastomeric compound using polymerized chloroprene as the only basic elastomer. The shape of any joint seal shall be approved by the Director of the Materials Bureau prior to the submission of any individual production lot for approval.

Such approval shall be requested in writing and be accompanied by a detailed drawing of the shape and a 4.5 m length of the proposed seal. The lubricant used to install the joint seal shall conform to §705-13, Lubricant for Preformed Elastic Joint Sealer, unless otherwise specified.

MATERIAL REQUIREMENTS

Physical Requirements. The joint seal material shall be tested in accordance with AASHTO M220 and meet the physical requirements therein. The requirements for compression-deflection, ozone resistance, and low-temperature recovery @ -10°C are waived.
The minimum percentage requirements for low-temperature recovery at -29°C, and for high temperature recovery at 100°C, shall be modified to 75%. Measurements for recovery may be made using an electronic caliper in addition to methods specified. The following exceptions shall be made to the recovery test when the seal shape has lips (a small protrusion on the top longitudinal edge). The seal shall be compressed to 50% of the nominal width of the seal. The denominator for the percent recovery calculation, however, shall be the width between the outer edges of the lips provided on the manufacturer's drawing. The numerator or recovered width shall be measured between the outer edges of the lips.

BASIS OF ACCEPTANCE. Preformed elastic longitudinal joint sealer will be accepted on the basis of a material certification that specifies the product conforms to this specification.

705-11 POLYVINYL CHLORIDE EXTRUDED SHAPES AND SHEET MATERIAL

SCOPE. This specification covers the quality requirements for polyvinyl chloride extruded shapes and sheet material for use in expansion, contraction, construction joints and drainage troughs.

GENERAL. The PVC material from which the shapes shall be extruded shall not contain any reclaimed, reground or reworked material whatsoever, but shall be compounded from virgin PVC resins, plasticizers, stabilizers and such materials that when compounded it shall meet the physical requirements contained in this specification.

Material shall be extruded in such a manner that all cross sections shall be dense, homogeneous and free from porosity or other imperfections.

The dimensional tolerances shall be as shown on the plans.

All splices shall be heat welded as approved by the Engineer.

Each extrusion shall be plainly marked at 1.5 m intervals with the manufacturer's name, lot number, and type.

MATERIAL REQUIREMENTS. The material for the extruded shapes shall meet the following performance requirements:

<table>
<thead>
<tr>
<th>Property</th>
<th>ASTM Test Method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile strength, kPa</td>
<td>D412, Die C</td>
<td>9650 min.</td>
</tr>
<tr>
<td>Ultimate elongation, percent</td>
<td>D412, Die C</td>
<td>250 min.</td>
</tr>
<tr>
<td>Hardness, Type A durometer</td>
<td>D2240 *</td>
<td>65-88</td>
</tr>
<tr>
<td>Resistance to alkali</td>
<td>D543 **</td>
<td>-</td>
</tr>
<tr>
<td>Weight change, percent</td>
<td></td>
<td>-0.10 to +0.25</td>
</tr>
<tr>
<td>Hardness, Type A durometer points change</td>
<td>-</td>
<td>+5</td>
</tr>
<tr>
<td>Tensile strength, percent change</td>
<td></td>
<td>-15 max.</td>
</tr>
<tr>
<td>Water absorption, 48 hours percent</td>
<td>D570</td>
<td>0.5 max.</td>
</tr>
<tr>
<td>Specify gravity</td>
<td>D792</td>
<td>1.42 max</td>
</tr>
</tbody>
</table>

* The hardness test shall be performed in accordance with D2240 except that the material is pressed to the durometer by thumb.
** Resistance to alkali. A specimen, weighing about 75 g, will be cut from the sample. The specimen will be washed in tap water, rinsed with distilled water, wiped with a clean cloth, and allowed to dry in laboratory air for approximately 1 hour. The weight of each specimen, to the nearest 0.001 g, will be recorded. The duremeter reading will be taken as noted above. The specimen will be completely immersed in a freshly made solution containing 5.0 g of chemically pure potassium hydroxide and 5.0 g of chemically pure sodium hydroxide in one liter of distilled water, kept at 21°C to 24°C. After 7 days the specimen will be removed, rinsed with distilled water, the surfaces wiped with a clean cloth, and allowed to dry in laboratory air for approximately 1 hour. The weight and durometer hardness will be measured and recorded. Tensile strength shall be determined as noted above. The weight and tensile strength change shall be reported as a percentage of the original readings. The hardness change will be reported as the change relative to the original reading.

Cold Bend Test. A cold bend test shall be made by subjecting a 13 mm by 152 mm by 3 mm strip of extrusion material to a temperature of -29°C for 2 hours. The strip shall immediately thereafter be bent 180 degrees around a rod of 6 mm diameter by applying sufficient force to hold the sample in intimate contact with the rod. The sample shall then be examined for evidence of cracking. There shall be no cracking of the samples.
Basis of Acceptance. Polyvinyl chloride extruded shapes and sheet material will be accepted on the basis of the manufacturer's name and location appearing on the Department’s Approved List and a material certification that specifies the product conforms to this specification.

705-12 Preformed Elastic Transverse Contraction and Expansion Joint Seal

Scope. This specification covers the material requirements for preformed elastic joint seal for use in transverse contraction joints and transverse expansion joints in concrete pavement.

General. The preformed elastic material shall be a vulcanized elastomeric compound using polymerized chloroprene as the only basic elastomer. The shape of any joint seal, from any manufacturer, shall be approved by the Director of the Materials Bureau prior to the submission of any individual production lot for approval. Such approval shall be requested in writing and be accompanied by a detailed drawing of the shape and a 4.5 m length of the proposed seal. The lubricant used to install the joint seal shall conform to §705-13, Lubricant for Preformed Elastic Joint Sealer, unless otherwise specified.

Materials Requirements

Geometric Requirements. Joint seals shall meet the geometric requirements in the following table:

<table>
<thead>
<tr>
<th>PROPERTY OR REQUIREMENT AT SPECIFIED WIDTH</th>
<th>TYPE OF SEAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall width, min.</td>
<td>17 mm Transverse Contraction, 20 mm Transverse Contraction, 32 mm Transverse Contraction, 41 mm Transverse Expansion</td>
</tr>
<tr>
<td>Contact Dimension, min.</td>
<td>17 mm @ 16 mm width, 20 mm @ 16 mm width, 22 mm @ 25 mm width, 22 mm @ 32 mm width</td>
</tr>
<tr>
<td>Overall depth, max.</td>
<td>50 mm @ 13 mm width, 50 mm @ 13 mm width, 50 mm @ 16 mm width, 50 mm @ 22 mm width</td>
</tr>
</tbody>
</table>

Physical Requirements. For all properties except compression-deflection, low-temperature recovery @ -10°C, and ozone resistance, the joint seal material shall be tested in accordance with AASHTO M220 and meet the physical requirements therein. The requirements for compression-deflection, low-temperature recovery @ -10°C and ozone resistance are waived. Measurements for recovery may be made using an electronic caliper in addition to methods specified.

The following exceptions shall be made to the recovery test when the seal shape has a lip (a small protrusion at the top longitudinal edge). The seal shall be compressed to 50% of the nominal width of the seal. The denominator for the percent recovery calculation, however, shall be the width between the outer edges of the lips on the manufacturer's drawing. The numerator or recovered width shall be measured between the outer edges of the lips.

Force-Deflection Requirements. Force-Deflection properties shall be determined in accordance with the force-deflection test established by the Materials Bureau. A description of this test is available on request from the Materials Bureau.

The preformed elastic transverse joint seal shall conform to the following force-deflection requirements:
The seal shall not creep more than 6 mm horizontally during force-deflection testing, nor shall there be any loss of contact between the top edges of the seal and the compression plates.

All test sections used in the above procedures shall be cut and/or buffed from the joint seal specimens.

**BASIS OF ACCEPTANCE.** Preformed elastic transverse contraction expansion joint sealers will be accepted on the basis of a material certification that specifies the product conforms to this specification.

### 705-13 LUBRICANT FOR PREFORMED ELASTIC JOINT SEALER

**SCOPE.** This specification covers the lubricant used for the installation of preformed elastic joint sealers.

**GENERAL.** The lubricant shall be a one-component polychloroprene compound containing only soluble phenolic resins blended together with anti-oxidants and acid acceptors in an aromatic hydrocarbon solvent mixture.

**MATERIAL REQUIREMENTS.** The lubricant shall meet the following physical requirements:

- For use with concrete pavement sealers the lubricant shall conform to the requirements of ASTM D2835.
- For use with bridge sealers the lubricant shall conform to the requirements of ASTM D4070.

**PACKAGING.** Each lot of the lubricant shall be delivered in containers plainly marked with the manufacturer's name or trademark, lot number and date of manufacture.

**BASIS OF ACCEPTANCE.** The basis of acceptance for the lubricant shall be the manufacturer's certification as to compliance with this specification which shall accompany the material delivered to the job site. Any lubricant not used within 270 days of its manufacture shall be unacceptable. The Department reserves the right to sample and test this material subsequent to delivery at the project site.

### 705-14 LONGITUDINAL JOINT TIES

**SCOPE.** This specification details the requirements for longitudinal joint ties (LJTs) and their support assemblies used at longitudinal joints in portland cement concrete (PCC) pavement.

**GENERAL.** LJTs are either one-piece deformed bar reinforcement or multiple-piece systems consisting of deformed bar reinforcement with 1 or 2 threaded ends and a coupler. For longitudinal joints between lanes placed simultaneously, one-piece LJTs must be supported by an assembly that secures them in position when the assembly is affixed to the underlying pavement layer. For longitudinal joints between lanes placed separately, the LJTs are either:

- Loose, one-piece, deformed bars drilled and anchored into the vertical placement edge.
- Loose, multiple-piece systems.
In the latter case, the first piece is bolted to the paving forms in the initial concrete placement and the second piece threaded into the first piece after form removal from the initial placement. Refer to Section 502, PCC Pavement, to identify which method is used.

All LJTs not referenced on the Department’s Approved List entitled “Longitudinal Joint Ties (705-14),” under “Joint Materials, Pavement,” will be subject to approval testing before their use is allowed on Department contracts. Submit approval applications to the Director, Materials Bureau, at least 120 days before their intended use. Approved LJTs and their support assemblies will be placed on the Approved List and referenced by the drawing number and approval date. Any change to a previously approved LJT requires approval by the Director, Materials Bureau, before its use.

In case of conflict between the requirements of this specification and specifications referenced herein, the requirements of this specification or the instructions of the Director, Materials Bureau, will apply.

The Department may perform supplementary sampling and testing of the LJTs that arrive at Department contracts.

MATERIAL REQUIREMENTS

A. Deformed Bar Reinforcement. Obtain deformed bar reinforcement from a manufacturer appearing on the Department’s Approved List entitled “Reinforcing Bars (709-01),” under “Reinforcing, Steel.” Use number 19 deformed bars made of Grade 420 steel. Materials other than steel may be proposed, but their use is subject to the approval of the Director, Materials Bureau.

Use one-piece LJTs having lengths as required by Section 502, PCC Pavement, and the associated 502 Standard Sheets for PCC Pavement, i.e.:

- 900 mm between travel lanes placed simultaneously (in support assemblies).
- 700 mm between travel lanes placed separately (drill and anchor method).
- 500 mm between a travel lane and PCC shoulder placed simultaneously (in support assemblies).
- 450 mm between a travel lane and PCC shoulder placed separately (drill and anchor method).

Use multiple-piece LJTs having lengths of 900 mm between travel lanes placed separately and 500 mm between a travel lane and a PCC shoulder placed separately. The length of a multiple-piece LJT includes only the deformed bar segment lengths, not the thread lengths nor the coupling length. When assembled, the coupler must cover all threads in the threaded ends.

B. Coatings. All LJT components must be epoxy-coated steel except for threaded connections. Coatings other than epoxy (and their applicators) may be proposed, but their use is subject to the approval of the Director, Materials Bureau. Use an epoxy coating appearing on one of the following Approved Lists under, “Reinforcing, Epoxy and Coating:”

- Epoxy Coatings for Steel Reinforcing Bars (709-04).
- Epoxy Coatings for Longitudinal Joint Ties (705-14).

Apply the epoxy coating in accordance with “Coating Application” in §709-04, Epoxy Coated Bar Reinforcement, by an epoxy coating applicator appearing on one of the following Approved Lists under “Reinforcing, Epoxy and Coating:”

- Applicators for Steel Reinforcing Bars (709-04).
- Epoxy Coatings for Longitudinal Joint Ties (705-14).

Coatings must be continuous over the bar length, including couplers for multiple-piece ties, and 0.20 mm - 0.30 mm thick. Coatings must be within 6 mm of threaded ends in multiple-piece ties. The cross-sectional ends of the bars may be uncoated.

Damaged coatings may be repaired at the epoxy coating applicator’s facility or at the fabricator’s facility in accordance with “Repair of Coated Bars” in §709-04, Epoxy Coated Bar Reinforcement. Field repair of damaged coating is allowed, provided the damage is less than 25 mm long in any direction and more than 100 mm from the center of the bar or the threaded ends. Use a patching material supplied by the epoxy coating manufacturer that is compatible with the epoxy coating and inert in concrete.
Follow the manufacturer’s written recommendations regarding surface preparation and application. Provide those recommendations to the Engineer before field repairs are made. Apply the patching material to the damaged area only. Dipping the bar into the patching material, or liberally coating undamaged areas, is not allowed. Epoxy-coated bars with perforations, cracks, other damage, or improperly applied coatings will be rejected.

C. LJT Support Assemblies. Support one-piece LJTs in longitudinal joints between lanes placed simultaneously in assemblies or “baskets” that securely hold more than 1 LJT in position as detailed in Geometric Requirements below. Fabricate the assemblies using steel wire as depicted in the approved Materials Details. Affix 1 or both ends of each LTD to the assembly by welding or mechanical fixation within 50 mm of the end of the LJT.

D. Corrosion Inhibitors for Threaded Connections (Multiple-piece LJTs Only). Use one of the following:
- Medium setting asphalt emulsion meeting Table 702-5, Asphalt Emulsions.
- Thread-sealing compound approved by the Materials Bureau.

Apply the corrosion inhibitor to all threaded connections before the LJTs are assembled such that all surfaces of the assembled LJT are covered with an unbroken seal of epoxy coating or corrosion inhibitor. Do not apply corrosion inhibitors to bolts that hold multiple-piece LJTs to forms.

GEOMETRIC REQUIREMENTS. Unless otherwise indicated in the contract documents, fabricate the support assemblies or bolt multiple-piece LJTs to forms such that the:
- Assembly holds at least 2 LJTs.
- Entire longitudinal axis of each bar is located at the middepth of the pavement slab (25 mm).
- Longitudinal axes of the bars are aligned perpendicular to the pavement centerline and parallel with the pavement surface such that the maximum misalignment of 1 bar end relative to the other is 25 mm.
- Midpoint of the longitudinal axis of each bar is at the center of the joint (25 mm).
- Longitudinal axes of adjacent bars do not exceed the maximum spacing identified in the contract documents.
- Bars are 75 mm (minimum) away from other LJTs or transverse joint supports.

TESTS

A. Materials Details – LJT Support Assemblies. The LJT manufacturer must submit 3 Materials Details (shop drawings) to the Director, Materials Bureau, for review and approval before any other testing begins. The Materials Details must depict the following minimum information:
- Manufacturer’s name, address, telephone number, fax number, and e-mail address.
- Drawing number.
- Support assembly dimensions and tolerances.
- LJT positioning within the joint support assembly.
- LJT ASTM steel grade designation.
- A cross section showing the relative positioning of LJTs to their support legs.
- Method used to affix LJTs to the support assembly and the locations of points of fixation.
- Methods used to affix wires together in the support assembly and the locations of points of fixation.
- Diameter of wires used in joint support assembly fabrication including wires used as assembly frames, LJT support legs, stakes, and spacer wires, if any.
- A detail of wire legs that hold LJTs to the support assembly.
- A detail of the stakes used to hold the supports to the underlying pavement layers during construction.
- The positioning and number of stakes required to hold the supports to the underlying pavement layers during construction. The minimum number of stakes must equal the number of LJTs in the assembly.
**B. Materials Details – Multiple-Piece LJTs.** The LJT manufacturer must submit 3 Materials Details (shop drawings) to the Director, Materials Bureau, for review and approval before any other testing begins. The Materials Details must depict the following minimum information:

- Manufacturer’s name, address, telephone number, fax number, and e-mail address.
- Drawing number.
- Length of threaded ends.
- Thread size designations.
- LJT ASTM steel grade designation.
- Coupler dimensions and tolerances.
- Method used to affix LJTs to forms.

**C. Joint Support Assemblies.** Submit 2 complete LJT support assemblies and 6 loose, epoxy-coated LJTs to the Director, Materials Bureau, for conformance verification with the submitted Materials Details and this specification.

**D. One-Piece LJTs.** In addition to meeting Grade 420 yield strength requirements of the ASTM designation indicated on the Materials Details, epoxy-coated deformed bars must meet the Chemical Resistance, Cathodic Disbondment, Salt Spray Resistance, Coating Flexibility, Relative Bond Strength in Concrete, and Impact Test requirements of AASHTO M284 (ASTM A775), Epoxy Coated Steel Reinforcing Bars.

**E. Multiple-Piece LJTs.** Submit 12 multiple-piece LJTs to the Director, Materials Bureau, for conformance verification with the submitted Materials Details and this specification. When assembled, the multiple-piece ties shall have minimum yield strengths of 410 MPa. Also, multiple-piece LJTs must meet the Chemical Resistance, Cathodic Disbondment, Salt Spray Resistance, Coating Flexibility, Relative Bond Strength in Concrete, and Impact Test requirements of AASHTO M284 (ASTM A775), Epoxy Coated Steel Reinforcing Bars.

**BASIS OF ACCEPTANCE.** Longitudinal Joint Ties will be accepted at the contract based on the Manufacturer’s appearance on the Department’s Approved List entitled “Longitudinal Joint Ties (705-14),” under “Joint Materials, Pavement.” The contractor shall provide 2 copies of each of the following to the Engineer:

- Approved Materials Details identified by drawing number and approval date as shown on the Approved List.
- Manufacturer’s certification that the LJTs were manufactured in accordance with this specification and the submitted Materials Details.
- The name, address, telephone number, and e-mail address of the rolling mill that manufactured the LJTs and the mill’s certification as to the type, grade, and ASTM designation of steel used in the LJTs.
- The brand name of the epoxy coating used on the LJTs and the name, address, telephone number, and e-mail address of the manufacturer.
- The name, address, telephone number, and e-mail address of the epoxy coating applicator and the applicator’s certification that the coatings were applied in conformance to this specification.
- The brand name of the corrosion inhibitor for threaded coatings used on multiple-piece LJTs and the name, address, telephone number, and e-mail address of the manufacturer.

**705-15 TRANSVERSE JOINT SUPPORTS**

**SCOPE.** This specification details the requirements for load transfer devices (LTDs) and their support assemblies used at transverse joints in portland cement concrete (PCC) pavement.

**GENERAL.** All Transverse Joint Supports not referenced on the Department’s Approved List entitled “Transverse Joint Supports (705-15),” under “Joint Materials, Pavement,” will be subject to approval testing before their use is allowed on Department contracts. Submit approval applications to the
Director, Materials Bureau, at least 120 days before their intended use. Approved supports will be placed on the Approved List and referenced by the drawing number and approval date. Any change to a previously approved transverse joint support requires approval by the Director, Materials Bureau before its use.

In case of conflict between the requirements of this specification and specifications referenced herein, the requirements of this specification or the instructions of the Director, Materials Bureau, will apply.

The Department may perform supplementary sampling and testing of the joint supports assemblies that arrive at Department contracts.

MATERIAL REQUIREMENTS

A. Dowels. Dowels are the LTD component of transverse contraction and expansion joint support assemblies. They are also used at transverse construction joints. Obtain dowels from a manufacturer appearing on the Department’s Approved List entitled “Reinforcing Bars (709-01),” under “Reinforcing, Steel.”

Use 460 mm long dowels made of plain, Grade 420 steel bar reinforcement having uniform circular cross sections for their entire lengths. Saw cut dowel ends such that they are free of burrs or projections. Materials other than steel may be proposed, but their use is subject to the approval of the Director, Materials Bureau. Dowel diameters vary with pavement thickness as detailed in the Section 502 Standard Sheets. Coating thickness is not included in the dowel diameter.

B. Deformed Bar Reinforcement. Deformed bar reinforcement is the LTD component of transverse hinge joint support assemblies. Obtain bars from a manufacturer appearing on the Department’s Approved List entitled “Reinforcing Bars (709-01),” under “Reinforcing, Steel.” Use number 19 deformed bars, 600 mm long, made of Grade 420 steel. Materials other than steel may be proposed, but their use is subject to the approval of the Director, Materials Bureau.

C. Coatings. Steel LTDs (dowels and deformed bars) must be epoxy coated. Coatings other than epoxy (and their applicators) may be proposed, but their use is subject to the approval of the Director, Materials Bureau. Use an epoxy coating appearing on one of the following Approved Lists under, “Reinforcing, Epoxy and Coating:”

- Epoxy Coatings for Steel Reinforcing Bars (709-04).
- Epoxy Coatings for Longitudinal Joint Ties (705-14).

Apply the epoxy coating in accordance with “Coating Application” in §709-04, Epoxy Coated Bar Reinforcement, by an epoxy coating applicator appearing on one of the following Approved Lists under “Reinforcing, Epoxy and Coating:”

- Applicators for Steel Reinforcing Bars (709-04).
- Epoxy Coatings for Longitudinal Joint Ties (705-14).
- Epoxy Coatings for Dowel Bars for Transverse Joint Supports (705-15).

Coatings must be continuous over the length of the LTD and 0.25 mm – 0.45 mm thick, except for the cross-sectional ends, which may be uncoated. Field repair of damaged coatings is not allowed. Plant or facility repairs are not allowed unless the damage results from welding or mechanical fixation to the support assembly and is within 25 mm of the weld or fixation point. Such damage must be repaired before visible rust occurs. Use a patching material supplied by the epoxy coating manufacturer that is compatible with the epoxy coating and inert in concrete. Apply the patching material to the damaged area only. Dipping the LTD into the patching material, or liberally coating undamaged areas, is not allowed. Supports containing LTDs with perforated, cracked, otherwise damaged, or improperly applied coatings will be rejected.

Completely coat each dowel with a bond breaker applied at the epoxy coating applicator facility or the joint support assembly facility. The bond breaker is subject to approval by the Materials Bureau. Do not apply a bond breaker to deformed bar reinforcement.
D. Premoulded Resilient Joint Filler (§705-07). Use 10 mm – 15 mm thick filler in transverse expansion joint assemblies only.

E. Joint Support Assemblies. Support LTDs in assemblies or “baskets” that securely hold them in position as detailed in Geometric Requirements below. Fabricate the assemblies using steel wire as depicted in the approved Materials Details. Affix 1 end of each LTD to the assembly by welding or mechanical fixation. Affix alternating ends of adjacent LTDs to the assembly such that the point of fixation is within 50 mm of the end of the LTD.

GEOMETRIC REQUIREMENTS

A. Transverse Contraction Joints. Unless otherwise indicated in the contract documents, fabricate the support assemblies such that the:

• Entire longitudinal axis of each dowel is located at the middepth of the pavement (± 6 mm).
• Longitudinal axes of the dowels are aligned parallel with the pavement centerline and pavement surface such that the maximum misalignment of one dowel end relative to the other is 4 mm.
• Midpoint of the longitudinal axis of each dowel is at the center of the joint (± 25 mm).
• Longitudinal axes of the two end dowels are 100 mm - 200 mm from the longitudinal joints.
• Longitudinal axes of the dowels are spaced 100 mm - 300 mm apart.

B. Transverse Expansion Joints. Fabricate the support assemblies such that the dowels are positioned in accordance with paragraph A, Transverse Contraction Joints. Include a one-piece premoulded resilient joint filler in the assembly that extends completely across the slab width. The joint filler must either equal the full depth of the slab, or extend from the bottom of the slab to within 40 mm - 50 mm of the top of the slab with a finishing cap that extends to the top of the slab.

Vertically support the filler at the longitudinal midpoints of the dowels and perpendicular to the longitudinal axes of the dowels. Depict support mechanisms in the Materials Details. Do not weld the dowels to filler supports.

Place plastic expansion caps on the free ends of the dowels (the ends opposite the fixed ends). Use expansion caps with essentially the same inner diameter as the outer diameter of the dowel plus coating thickness (+ 1 mm).

C. Transverse Hinge Joints. Unless otherwise indicated in the contract documents, fabricate the support assemblies such that the:

• Entire longitudinal axis of each deformed bar is located at the middepth of the pavement slab (± 25 mm).
• Longitudinal axes of the deformed bars are aligned parallel with the pavement centerline and pavement surface such that the maximum misalignment of one bar end relative to the other is 25 mm.
• Midpoint of the longitudinal axis of each bar is at the center of the joint (± 25 mm).
• Longitudinal axes of the two end bars are 100 mm - 300 mm from the longitudinal joints.
• Longitudinal axes of the bars are spaced 100 mm - 450 mm apart.

TESTS

A. Materials Details. The transverse joint support manufacturer must submit 3 Materials Details (shop drawings) to the Director, Materials Bureau, for review and approval before any other testing begins. Depict only one type of joint on each detail submitted for approval. The Materials Details must depict the following minimum information:

• Manufacturer’s name, address, telephone number, fax number, and e-mail address.
• Type of support (contraction, expansion, or hinge joint).
• Drawing number.
• Joint support assembly dimensions and tolerances.
• LTD length, spacing, and positioning within the joint support assembly.
• LTD ASTM steel grade designation.
• Bond breaker brand name and manufacturer.
• A cross section showing the relative positioning of LTDs to their support legs.
• Method used to affix LTDs to the support assembly and the locations of points of fixation.
• Methods used to affix wires together in the joint support assembly and the locations of points of fixation.
• Diameter of wires used in joint support assembly fabrication including wires used as assembly frames, LTD support legs, premoulded resilient joint filler supports (expansion joints only), stakes, and spacer wires that hold cages in place during transport.
• A detail of wire legs that hold LTDs to the support assembly.
• A detail of the stakes used to hold the supports to the underlying pavement layers during construction.
• The positioning and number of stakes required to hold the supports to the underlying pavement layers during construction.
• Methods used to support premoulded resilient joint fillers (expansion joints only).
• Expansion cap material and dimensions (expansion joints only).

B. Joint Support Assemblies. Submit 2 complete joint support assemblies and 6 loose, epoxy-coated LTDs to the Director, Materials Bureau, for conformance verification with the submitted Materials Details and this specification.

C. Epoxy-Coated Dowels. In addition to meeting the Grade 420 yield strength requirements of the ASTM designation indicated on the Materials Details, epoxy-coated dowels must meet the Load-Deflection, Pull-out, Abrasion, Corrosion, Chemical Resistance, Cathodic Disbonding, Coating Hardness, and Coating Impact Resistance requirements of AASHTO M254, Corrosion-Resistant Coated Dowel Bars, when tested in accordance with AASHTO T253, Coated Dowel Bars.

D. Epoxy-Coated Deformed Bar Reinforcement. In addition to meeting Grade 420 yield strength requirements of the ASTM designation indicated on the Materials Details, epoxy-coated deformed bars must meet the Chemical Resistance, Cathodic Disbondment, Salt Spray Resistance, Coating Flexibility, Relative Bond Strength in Concrete, and Impact Test requirements of AASHTO M284 (ASTM A775), Epoxy Coated Steel Reinforcing Bars.

E. Field Test. Only joint support assemblies meeting the above test requirements will be considered for trial installation in a field test. The supplier or manufacturer is responsible for coordinating the field test. The field test location may be:
• Part of a Department contract.
• Part of a contract under the jurisdiction of an agency other than the Department.
• A test site arranged by the supplier or manufacturer.

If the field test is outside New York State, the location must meet the approval of the Director, Materials Bureau.

If the field test is part of a Department contract, the Contractor must obtain the Engineer’s approval before any support assemblies are installed. If the field test is at a test site arranged by the supplier/manufacturer, install the joint support assemblies in a 200 m long (minimum) pavement constructed in accordance with Section 502, Portland Cement Concrete Pavement. In any case, a minimum of 50 joints must be constructed using the joint supports.

Conduct field tests in the presence of Materials Bureau personnel. Specific attention will be given to handling, coating integrity, damage, alignment before and after paving, fixation failure, securing to underlying layers, contraction joint formation, and general specification conformance. Failing assemblies, and the pavement they are constructed into if part of a Department contract, will be rejected and removed and replaced at no cost to the State.

The Director, Materials Bureau, may waive field tests for hinge and expansion joint assemblies or from manufacturers who have an established history of successful contraction joint assembly installations with the Department.
§705

BASIS OF ACCEPTANCE. Transverse joint supports will be accepted at the contract based on the Manufacturer’s appearance on the Department's Approved List entitled “Transverse Joint Supports (705-15),” under “Joint Materials, Pavement.” The contractor shall provide 2 copies of each of the following to the Engineer:

- Approved Materials Details identified by drawing number and approval date as shown on the Approved List.
- Manufacturer’s certification that the joint supports were manufactured in accordance with this specification and the submitted Materials Details.
- The name, address, telephone number, and e-mail address of the rolling mill that manufactured the LTDs and the mill’s certification as to the type, grade, and ASTM designation of steel used in the LTD.
- The brand name of the epoxy coating used on the LTDs and the name, address, telephone number, and e-mail address of the manufacturer.
- The name, address, telephone number, and e-mail address of the epoxy coating applicator and the applicator’s certification that the coatings were applied in conformance to this specification.
- The brand name of the bond breaker used on the dowels and the name, address, telephone number, and e-mail address of the manufacturer.

705-16 CONCRETE PIPE JOINT SEALING COMPOUND

SCOPE. This specification covers a flexible/rubber sealer used for joints in elliptical pipe, cattle pass and drainage units.

MATERIAL REQUIREMENTS. Concrete pipe joint sealing compound shall conform to the requirements of either AASHTO M198 Type B or ASTM C990.

BASIS OF ACCEPTANCE. Label stating conformance to either AASHTO M198 Type B or ASTM C990. Labels shall be either attached directly to the sealing compound or to the packaging in which the compound arrives at the project site.

705-17 CONCRETE PIPE JOINT ELASTOMERIC GASKETS

SCOPE. This specification covers elastomeric gaskets used for joints in round pipe.

MATERIAL REQUIREMENTS. Concrete pipe joint elastomeric gaskets shall conform to the requirements of either ASTM C443 or ASTM C361.

BASIS OF ACCEPTANCE. Label stating conformance to either ASTM C443 or ASTM C361. Label shall be either stenciled on the elastomeric gaskets, attached directly to the gaskets or attached to the packaging in which the gaskets arrive at the project site.

705-18 THRU 705-20 (VACANT)

705-21 MASONRY MORTAR

SCOPE. Requirements for the 3 common types of masonry mortar (N, S and M - increasing in strength, respectively). Use these mortars to bind masonry units together to construct masonry structures, repair masonry structures (tuck pointing), or bed and bond masonry or concrete units together. For historic masonry structures made with soft hydrated lime mortars, use a specially designed lime mortar as shown in the Contract Documents or as approved by the Engineer.

Type N Masonry Mortar- for tuck pointing repair of structures made with fired clay bricks
Type S Masonry Mortar- for new structures made with all types of masonry, including brick
“ ” - for tuck pointing repair of structures made with masonry other than clay brick
Type M Masonry Mortar— for new and tuck pointing repair of rigid masonry riding surfaces, such as bridge decks, pavements, sidewalks, and other roadway areas subject to severe weathering and abrasion conditions

MATERIAL REQUIREMENTS

<table>
<thead>
<tr>
<th>Material Requirement</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portland Cement, Type II or VI</td>
<td>§701-01</td>
</tr>
<tr>
<td>Masonry or Mortar Cement, Type N, S or M</td>
<td>§701-02</td>
</tr>
<tr>
<td>Blended Portland Cement</td>
<td>§701-03</td>
</tr>
<tr>
<td>Mortar Sand</td>
<td>§703-03</td>
</tr>
<tr>
<td>Concrete Sand</td>
<td>§703-07</td>
</tr>
<tr>
<td>Water</td>
<td>§712-01</td>
</tr>
</tbody>
</table>

Proportion the N, S or M mortar type by loose volume parts as follows:

<table>
<thead>
<tr>
<th>PORTLAND OR BLENDED PORTLAND CEMENT</th>
<th>MASONRY OR MORTAR CEMENT</th>
<th>SAND</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type N Mortar (make with Type N Masonry or Mortar Cement)</td>
<td>0</td>
<td>1 (Type N)</td>
</tr>
<tr>
<td>Type S Mortar (make with Type S or N Masonry or Mortar Cement)</td>
<td>0</td>
<td>1 (Type S)</td>
</tr>
<tr>
<td></td>
<td>½</td>
<td>1 (Type N)</td>
</tr>
<tr>
<td>Type M Mortar (make with Type M or N Masonry or Mortar Cement)</td>
<td>0</td>
<td>1 (Type M)</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1 (Type N)</td>
</tr>
</tbody>
</table>

After adding all ingredients (including water) to a mechanical mixer, mix for 3 to 5 minutes to entrain air and produce a workable and uniform consistency. Discard all unused mortar 2½ hours after initial mixing. Mortar that has stiffened may be re-tempered up to 2½ hours after initial mixing by adding water to restore the original workable consistency.

Use a uniform layer of mortar, 6 to 18 mm thick, for joints between uniform masonry units. For a tuck pointing (raking out and repointing) mortar, add the minimum water to the dry ingredients to produce a mortar that retains its form when hand squeezed and released. Allow this mortar to stand covered (prehydrate) for 1 to 1½ hours to greatly reduce shrinkage. Then mix with sufficient water to produce a stiff, but workable consistency, and use within 2½ hours of initial mixing.

Avoid re-tempering the mortar when tuck pointing, matching a color, or to avoid color variations between batches (mix smaller quantities, if needed).

No admixtures, except for mortar coloring agents made from light-fast, durable, alkali-resistant minerals, will be permitted without written permission of the Director, Materials Bureau. If colored mortar is specified, submit samples of hardened mortar to the Engineer. Upon approval, use the same, uniform, mortar color throughout the work.

BASIS OF ACCEPTANCE. Inspection and approval by the Engineer.

705-22 PORTLAND CEMENT MORTAR BONDING GROUT

SCOPE. This specification covers the material requirements for portland cement mortar grout used for bonding fresh concrete to hardened concrete in both vertical and horizontal planes.

MATERIAL REQUIREMENTS. The ingredients for the portland cement mortar grout shall comply with the following:

<table>
<thead>
<tr>
<th>Material Requirement</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portland Cement, Type 1 or Type 2</td>
<td>§701-01</td>
</tr>
<tr>
<td>Mortar Sand</td>
<td>§703-03</td>
</tr>
<tr>
<td>Concrete Sand</td>
<td>§703-07</td>
</tr>
<tr>
<td>Water</td>
<td>§712-01</td>
</tr>
</tbody>
</table>
**Proportioning.** The mortar grout shall have the cement and mortar or concrete sand proportioned 1:1 in separate volumetric containers. The sand shall be deposited into an approved mechanical grout mixer prior to the cement. Both the sand and cement shall be dry mixed for one (1) minute. After dry mixing, water shall be added in sufficient quantity to result in a workable consistency. An additional three (3) minutes of mixing is required after adding desired water. Workable consistency is defined as a grout that will not run on vertical faces or puddle in low spots. Any grout that has dried or become unworkable, as determined by the Engineer, shall not be incorporated in the work. Hand mixing of the mortar may be permitted only for small quantities as approved by the Engineer.

**BASIS OF ACCEPTANCE.** The mortar grout shall be accepted on the basis of inspection and approval by the Engineer.

### SECTION 706 - CONCRETE, CLAY AND PLASTIC PIPE

#### 706-01 NON-REINFORCED CONCRETE PIPE

**SCOPE.** This specification covers the material and quality requirements for non-reinforced concrete pipe 600 mm and smaller used for culverts.

**GENERAL.** The provisions of §706-02, Reinforced Concrete Pipe, shall apply except that all references to reinforcing steel shall be deleted. In addition, physical and dimensional requirements of concrete pipe under 300 mm in diameter shall be as stated in Table 1, Class 1, of ASTM C14. Plain concrete pipe 300 mm to 600 mm in diameter shall conform to Table 1, Class 2, of ASTM C14.

**MATERIAL REQUIREMENTS.** The Material Requirements contained in §706-02 shall apply except that all references to reinforcing steel shall be deleted.

**FABRICATION REQUIREMENTS.** The Fabrication Requirements contained in §706-02 shall apply except as noted herein.

**Marking.** No pipe class or wall designation shall be marked on the pipe.

**PHYSICAL REQUIREMENTS.** The Physical Requirements contained in §706-02 shall apply except as noted herein.

**Strength.** The strength requirements for the respective diameter pipe sizes shall be as stated in Table 1 of ASTM C14M. Details of the three-edge bearing test shall comply with ASTM C14M.

**SAMPLING AND TESTING.** The Sampling And Testing requirements contained in §706-02 shall apply.

**FINAL PRODUCTION INSPECTION.** The Final Production Inspection requirements contained in §706-02 shall apply.

**SHIPPING.** The Shipping requirements contained in §706-02 shall apply.

**BASIS OF ACCEPTANCE.** The Basis Of Acceptance requirements contained in §706-02 shall apply.

#### 706-02 REINFORCED CONCRETE PIPE CLASSES II, III, IV, V

**SCOPE.** This specification covers the material, fabrication, and physical requirements of reinforced concrete pipe and cattle pass.

**GENERAL.** Apply the requirements of AASHTO M 170M, Reinforced Concrete Culvert, Storm Drain and Sewer Pipe, Classes II, III, IV, and V, except as modified by this specification. Produce reinforced
concrete pipe by either machine made or wet cast methods in accordance with working drawings approved by the Department and in full compliance with the details of this specification. Pipe manufactured for a specific class will be acceptable for any class having a lower design strength.

Methods of manufacture include the following:

**A. Wet Cast Pipe And Cattle Pass.** Wet cast units are those made from concrete placed and consolidated by conventional equipment. These units develop resistance to freeze-thaw damage through the use of entrained air in the concrete. Air content in wet cast concrete shall range between 5.0% and 9.0%.

Manufacture wet cast pipe, for Department acceptance, in accordance with this specification and the current Materials Procedure for precast concrete titled “Procedures For Achieving And Maintaining Precast Concrete Manufacturer’s Approved List Status”.

**B. Machine Made Pipe.** Machine made units use very low slump concrete and methods of consolidation which produce a dense product with low permeability and good resistance to freeze-thaw damage.

Manufacture machine made pipe, for Department acceptance, in accordance with this specification and the current Materials Method titled “Quality Assurance Procedure For Concrete Pipe Items”.

**MATERIAL REQUIREMENTS**

**A. Materials**

- Portland Cement (Type 1, Type 2 or Type 3) 701-01
- Concrete Repair Material 701-04
- Coarse Aggregate 703-02
- Concrete Sand 703-07
- Bar Reinforcement, Grade 420 (Reinforcement & Stirrups) 709-01
- Wire Fabric for Concrete Reinforcement 709-02
- Bar Reinforcement, Grade 300 709-03
- Cold Drawn Wire for Concrete Reinforcement 709-09
- Admixtures 711-08
- Water 712-01
- Concrete Pipe Joint Sealing Compound 705-16
- Concrete Pipe Joint Elastomeric Gaskets 705-17
- Fly Ash 711-10
- Ground Granulated Blast Furnace Slag 711-12

**B. Cementitious Content.** Use a minimum combined cementitious content of 335 kilograms per cubic meter. This includes the Portland Cement and pozzolan (fly ash and/or ground granulated blast furnace slag). The maximum allowable total chloride content in concrete shall not exceed 0.10 percent by weight of cementitious material tested in accordance with written procedural directives of the Materials Bureau.

**C. Pozzolans.** Fly ash and/or ground granulated blast furnace slag may, in total, be substituted for cement up to a maximum of 20% by weight of the total amount of cement plus pozzolan in the mix.

**D. Admixtures.** Calcium Chloride is not allowed in concrete. Admixtures, other than an approved Air Entraining agent for wet cast pipe, are not allowed unless otherwise approved by the Materials Bureau.

**E. Reinforcement.** Sample the reinforcement in accordance with the written directives of the Materials Bureau. Accept stirrups based on the manufacturer's certification, unless otherwise directed by the Materials Bureau.
§706

F. Pipe Joint Materials

1. Elastomeric Gaskets. The gaskets used in the installation of round pipe shall meet the specification requirements of §705-17 and only those types and sizes designated by the pipe manufacturer on the approved drawings of the particular pipe.

2. Sealing Compounds. Concrete pipe joint sealing compound, meeting the specification requirements of §705-16, shall be used only on elliptical pipe and reinforced cattle pass.

FABRICATION REQUIREMENTS

Drawings. Submit detailed working drawings conforming to the Materials Bureau concrete pipe templates. All diameter sizes of a particular geometric shape can be included on one drawing. Separate drawings are required for cattle pass, jacking pipe and special designs.

Full approval of the working drawings is required prior to the manufacture of any concrete pipe.

Design, Reinforcement and Dimensions

A. General. Apply the Design, Reinforcement and Permissible Variations requirements of AASHTO M 170M for Class II, III, IV and V pipe, walls B & C. The AASHTO tables show minimum reinforcement. The manufacturer may submit drawings detailing alternatives to the specified reinforcement and/or wall thickness for Materials Bureau consideration. To gain full approval of alternate designs, manufacture and test pipe samples in accordance with the written procedural directives of the Materials Bureau.

B. Reinforced Concrete Cattle Pass. Apply the requirements of NYSDOT Standard Sheet M603-4 with the following modification. A minimum length of 1200 mm is required for each section. The maximum allowable variation in laying lengths of two opposite sides of a cattle pass section is 3 mm per 300 mm of diameter, not to exceed 16 mm in any length of cattle pass, except where beveled or curved cattle pass lengths have been specified.

Concrete Batch Placement

A. Machine Made Pipe. Clean and properly assemble the forms prior to placing any concrete. Transport and place the concrete mixture such that no segregation of the concrete materials or displacement of the reinforcing steel occurs within the form.

B. Wet Cast Pipe And Cattle Pass. Apply the Concrete Placement And Consolidation requirements contained in §704-03.

Curing. Include the type of curing, curing time and any temperature requirements on the drawing.

A. Machine Made Pipe. Cure the pipe in accordance with AASHTO M 170M. Other methods of curing are subject to approval by the Director, Materials Bureau.

B. Wet Cast Pipe And Cattle Pass. Apply the Curing requirements contained in §704-03.

Joints. Use either bell and spigot or tongue and groove design. Design the joints so as to permit effective jointing to reduce leakage and infiltration and to permit placement without irregularities.

Marking. The pipe markings must be identified on the inside barrel for pipe diameters of 450 mm and greater. If the diameter is less than 450 mm the markings may be stenciled on the outside of the pipe. Mark each piece of pipe with the following information, as applicable.

1. Name or trademark of manufacturer.
2. Date of manufacture.
3. Pipe class.
4. Wall designation.
5. Pipe diameter.
6. NYSDOT lot number ("NYSDOT " ) (Machine made pipe only.)
7. Indelibly mark the word "TOP" on the inside and outside of the barrel at the appropriate location on each pipe length with elliptical or quadrant reinforcing.

Repair

A. Machine Made Pipe. Pipe may be repaired at the plant or in the field using 701-04 Concrete Repair Material. Repairs to more than 10% of a lot will not be permitted. Repairs will be acceptable if, in the opinion of the Department, the repairs are sound, properly finished and cured, and the repaired pipe conforms to the requirements of these Specifications and the written procedural directives of the Materials Bureau.

B. Wet Cast Pipe And Cattle Pass. Apply the Repair requirements contained in §704-03.

PHYSICAL REQUIREMENTS

Strength. Apply the requirements of AASHTO M 170M except that the compressive strength requirements do not apply except for cattle pass. Conduct such number and type of three edge bearing tests as the Materials Bureau deems necessary to establish the quality of pipe. Reinforced concrete cattle pass will not require a three-edge bearing test. The minimum 28 day compressive strength for cattle pass, as determined by concrete cylinders, is 25 MPA.

Absorption Requirements For Machine Made Pipe. The maximum average absorption for all pipe is 8.0% by weight for the last three specimens tested.

Freeze-Thaw Requirements. The Materials Bureau reserves the right to test the pipe for durability by freeze-thaw testing. The test will be run in accordance with written procedural directives of the Materials Bureau.

SAMPLING AND TESTING. It is required that each manufacturer have a testing machine, of a type approved by the Materials Bureau, to carry out three edge bearing tests. Employ a commercial testing agency to calibrate the testing machine according to ASTM E4 at a minimum of once a year. Upon request of the Materials Bureau, furnish a record of this calibration. Sample and test reinforced concrete pipe and cattle pass units, manufactured under the requirements of this specification, as follows.

A. Machine Made Pipe. Separate machine made reinforced concrete pipe into specific and identifiable production lots. Follow the written procedural directives of the Materials Bureau to determine the maximum number and type of units in a lot and the number of samples to be taken per lot. Test each lot of machine made reinforced concrete pipe as follows:

1. Three Edge Bearing Test. Follow the requirements for strength testing indicated above using the test procedure identified in the procedural directives issued by the Materials Bureau. Perform tests in the presence of a representative of the Department.

2. Absorption Test. Cores from each lot, drilled by the manufacturer in the presence of a representative of the Department, will be used for this test. The cores will be tested by the Materials Bureau in accordance with the test method specified in ASTM C497 except that under "absorption test" the drying period will be 48 hours at a temperature of 110°C. Plug the holes when cores are taken. Ensure that plugs are sound, properly finished and cured according to the requirements of “Pipe Repair.”
In addition to the above tests, pipe will be subject to inspection at any time prior to placing, and rejection may be made through failure to comply with the criteria shown in the written procedural directives of the Materials Bureau.

**B. Wet Cast Pipe And Cattle Pass.** Sample and test wet cast reinforced concrete pipe and cattle pass in accordance with Materials Bureau requirements contained in the current Materials Procedure for precast concrete, titled “Procedures For Achieving And Maintaining Precast Concrete Manufacturer’s Approved List Status”.

**FINAL PRODUCTION INSPECTION.** For wet cast units only, follow the Final Production Inspection requirements contained in §704-03.

**SHIPPING**

**A. Machine Made Pipe.** No units will be considered for shipment unless the units are free from defects as noted under Pipe Repair in this specification and according to the written procedural directives of the Materials Bureau.

**B. Wet Cast Pipe And Cattle Pass.** Follow the Shipping requirements contained in §704-03.

**BASIS OF ACCEPTANCE**

**A. Machine Made Pipe.** Units will be accepted in stock lot quantities at the manufacturing location in accordance with the current version of Materials Method 1 titled “Quality Assurance Procedure For Concrete Pipe Items”.

**B. Wet Cast Pipe And Cattle Pass.** Follow the Basis Of Acceptance requirements contained in §704-03.

**706-03 REINFORCED CONCRETE ELLIPTICAL PIPE; CLASSES HE-II, HE-III, HE-IV, VE-IV, VE-V AND VE-VI**

**SCOPE.** This specification covers the material and quality requirements for both horizontal and vertical elliptical reinforced concrete pipe of the classes noted above for use as culvert pipe. Pipe designed for placement with the major axis horizontal is designated as horizontal elliptical pipe. Pipe designed for placement with the major axis vertical is designated as vertical elliptical pipe.

**GENERAL.** The provisions of §706-02, Reinforced Concrete Pipe Classes II, III, IV, V shall apply except as noted herein.

All references to AASHTO M 170M, contained in §706-02, shall be replaced with AASHTO M 207M. All reference to Classes II, III, IV and V, contained in §706-02, shall be deemed to include all classes of elliptical pipe.

**MATERIAL REQUIREMENTS.** The Material Requirements contained in §706-02 shall apply except that the pipe joint material shall be a sealing compound meeting the requirements of §705-16.

**FABRICATION REQUIREMENTS.** The Fabrication Requirements contained in §706-02 shall apply except as noted herein.

**Design, Reinforcement and Dimensions.** In the case of elliptical pipe, the working drawings indicate the equivalent round pipe diameter, rise, span and class. A tolerance of plus or minus 2% from the nominal rise and span of the pipe, as shown on the approved working drawing, will be permitted.

Variations in laying lengths of two opposite sides of a pipe section shall not be more than 10 mm/m of equivalent diameter, with a maximum of 16 mm in any length of pipe, except where beveled or curved lengths have been specified.
Marking. No wall designation shall be marked on the pipe. An equivalent round pipe diameter shall be used for markings.

PHYSICAL REQUIREMENTS. The Physical Requirements contained in §706-02 shall apply.

SAMPLING AND TESTING. The Sampling And Testing requirements contained in §706-02 shall apply.

FINAL PRODUCTION INSPECTION. The Final Production Inspection requirements contained in §706-02 shall apply.

SHIPPING. The Shipping requirements contained in §706-02 shall apply.

BASIS OF ACCEPTANCE. The Basis Of Acceptance requirements contained in §706-02 shall apply.

706-04 PRECAST CONCRETE DRAINAGE UNITS

SCOPE. This specification covers the material and fabrication requirements for precast concrete drainage units including transverse drainage interceptors.

MATERIAL REQUIREMENTS. The Material Requirements contained in §704-03 shall apply except as noted herein.

The concrete used to fabricate round precast concrete drainage units shall have a minimum compressive strength of 30 Mpa @ 28 days. The concrete used to produce machine made units shall have a maximum absorption of 8.0% by weight and is not required to be air entrained.

Additional materials listed below shall meet the requirements of the following subsections:

Frames And Grates 655
Concrete Grouting Material 701-05
Concrete Pipe Joint Sealing Compound 705-16
Concrete Pipe Joint Elastomeric Gaskets 705-17
Mortar For Concrete Masonry 705-21
Steps For Manholes 725-02

DRAWINGS. The Drawing requirements contained in §704-03 along with the following shall apply.

Fabricator Working Drawings are required for all round drainage structures. Cut sheets, showing structure heights, the size and location of pipe openings and step locations are required for all drainage structures.

FABRICATION. The Fabrication requirements contained in 704-03, along with the following shall apply.

Manufacturing Process. Precast concrete drainage units shall be wet cast or machine made.

A. Wet Cast. Wet cast units are manufactured from concrete, placed and consolidated by conventional equipment, containing entrained air to develop resistance to freeze-thaw damage.

B. Machine Made. Machine made units are manufactured with very low slump concrete, consolidated to produce a dense product with low permeability and good resistance to freeze-thaw damage. Machine made units are those made by the following methods:

- Packerhead
- Roller suspension
- Centrifugal
- Machine tamped
- Machine vibrated
- Other methods as approved by the Materials Bureau
Reinforcing. Reinforcing bar splices shall be lapped a minimum of 30 bar diameters and tied securely. Wire fabric splices shall be secured by one of the following methods:

**A. Tying.** Under this method the ends shall lap to a length of not less than 30 diameters of the reinforcement and the lap shall contain a longitudinal member. A sufficient number of laps shall be tied to maintain continuity of the cage through the period of placement and curing of the concrete.

**B. Welding.** Each circular member shall be lapped a minimum of 50 mm and welded. The weld shall develop a minimum of 50 percent of the specified strength of the wire.

Round Units. Precast bases, floors, risers, conical top sections, grade rings and flat slab tops shall conform to the design, dimension and reinforcement requirements of ASTM C478M. The C478M requirements for splices, laps and welds shall not apply.

Transverse Drainage Interceptors. Bar reinforcement shall be epoxy coated meeting the requirements of §709-04.

Joints. Joints between precast riser sections shall be formed with male and female ends so that when the sections are assembled they will make a continuous and uniform unit.

Joint Sealant Materials. Joints between precast sections are to be sealed with flexible watertight Elastomeric Gaskets, Pipe Joint Sealing Compounds, Mortar for Concrete Masonry, Concrete Grouting Material or Concrete Repair Material meeting the requirements of the Standard Specifications. If elastomeric Gasket Sealers are used the shape, size and placement shall be recommended by the precast manufacturer.

Steps for Drainage Units. Steps for drainage units shall conform to §725-02, Steps for Manholes. Steps in risers and conical top sections shall be aligned to form a continuous ladder with rungs equally spaced vertically in the completed unit at a maximum spacing of 400 mm. All steps in a completed drainage unit shall be the same size. Steps shall be embedded into the walls of the section a minimum of 75 mm. The rung shall project a minimum clear distance of 100 mm from the walls of the section measured from the point of embedment. If the steps are grouted, the grouting material shall conform to §701-04 Concrete Repair Materials or §701-05 Concrete Grouting Material. If plastic inserts are used for installing steps, they shall be approved by the Materials Bureau. Steps which are damaged during installation or handling shall be replaced.

Frames for Grates. Frames cast into the top slab or top of the uppermost riser shall be secured and held in place by a minimum of 4 stirrups or studs per frame, welded to the frame near the corners. Parallel bar frames shall contain shear stud anchors, for the purpose of transferring loads, as required and detailed on the standard sheet for parallel bar grates and frames. Shear stud anchors, when required, shall replace the frame securing stirrups or studs.

Dimensional Tolerances. The inside width and length dimensions shall not vary by more than 10mm from the design dimensions.

**SAMPLING AND TESTING.** The sampling and testing requirements contained in 704-03 shall apply except as noted herein.

**A. Machine Made Units.** Testing for air content is not required. Cores shall be taken from the hardened concrete and tested for absorption. A minimum of 3 cores per 5 batches of a single mix with a minimum of three cores per day per mix shall be used to measure absorption. The average absorption of the 3 cores shall not exceed the maximum absorption specified herein. Testing shall be in accordance with ASTM C497 M except that the drying period shall be 48 hours at a temperature of 110° C.
MARKING. The Marking requirements contained in §704-03 shall apply except as noted herein. Markings shall be placed on the inside face of all precast pieces. Each flat slab top that doesn't have an integral frame or a design that readily indicates the top surface shall have the words “INSTALL THIS SIDE UP” placed on its top surface.

The markings on rectangular drainage units, including base slabs, bases and risers, shall include the maximum placement depth in mm (“MPD...mm”). The maximum placement depth is based on wall thickness and reinforcement and shall be in accordance with the Department’s Standard Sheets or the contract plans.

Instead of marking the contract number on each unit they may be marked with “NYSDOT”.

FINAL PRODUCTION INSPECTION. The Final Production Inspection requirements contained in §704-03 shall apply.

SHIPPING. The Shipping requirements contained in §704-03 shall apply.

BASIS OF ACCEPTANCE. The Basis Of Acceptance requirements contained in 704-03 shall apply.

706-05 POROUS CONCRETE PIPE UNDERDRAIN

SCOPE. This specification covers the material and quality requirements for porous concrete pipe and extra strength concrete porous concrete pipe underdrains.

GENERAL. Porous concrete pipe and extra strength porous concrete pipe shall be manufactured in accordance with approved working drawings and in compliance with details set forth below.

MATERIAL REQUIREMENTS. All materials shall comply with the requirements of §706-02, Reinforced Concrete Pipe, except that reinforcement shall not be used.

Drawings. Drawings shall be furnished in accordance with the provisions of §706-02.

FABRICATION. Porous concrete pipe and extra strength porous concrete pipe shall conform in size and shape to the details shown on the standard sheet for porous concrete pipe underdrain and the approved working drawing.

The inside surface of the pipe shall be straight and true to dimensions with a permissible variation from the true form of not more than 1 ½ percent. A tolerance of 5% will be permitted in the diameter of the pipe. The wall thickness of the pipe may be greater than shown on the standard sheet, but it shall not be less than 95% of the stipulated wall thickness.

High early strength cement, calcium chloride or any other additive shall not be used unless otherwise approved by the Materials Bureau.

Concrete mix proportions will be such that will produce a concrete mix of such quality that the pipe will conform to the test and design requirements of these specifications.

Each length of pipe shall be clearly marked on the outside with the name or trademark of the manufacturer. Extra strength porous concrete pipe underdrain shall be clearly marked, "Extra Strength".

Curing. All pipe shall be cured in accordance with the provisions of §706-02.

Strength Requirements. The minimum ultimate strength for the size of the pipe being tested shall be as specified on the standard sheet. Requirements of §706-02 shall apply except that no determination of a 0.25 mm crack will be required and the ultimate strength values as determined on full length specimens shall be as specified on the standard sheet.

Infiltration Requirements. Pipe shall be tested for rate of infiltration in accordance with the method of test outlined in AASHTO Designation M176. The minimum rate of infiltration shall not be less than 0.15 liters per minute per millimeters of internal diameter per 300 millimeters of pipe for all sizes.
All tests shall be performed by the manufacturer at their plant and shall be witnessed by a representative of the Department. The number of samples for test shall be as directed by the Materials Bureau.

Other Requirements. In addition to the above tests, the pipe shall be subject to inspection at all times prior to placing and rejection will be made through failure to comply with any of the following conditions:

A. Dimensions. The pipe shall not vary in any dimensions more than permitted by this specification.

B. Fractures or Cracks. The pipe shall have no fractures or cracks passing through the shell or socket of the pipe, except that a single crack not exceeding 50 mm in length at either end of a pipe shall not be considered cause for rejection unless the defect exists in more than 5% of the lot offered for sampling and testing.

C. Quality. There shall be no defects that indicate imperfect mixing and molding.

D. Strength. There shall be no cracks that are sufficient to impair the strength, durability or serviceability of the pipe.

E. Shape. The shape of the pipe shall be such that there shall be no variation in alignment of more than 10 mm per linear meter.

BASIS OF ACCEPTANCE. The material will be considered for acceptance in stock lot quantities at the manufacturing location in accordance with procedural directives of the Materials Bureau.

In addition, the manufacturer shall furnish the Department representative at the plant a certification for each lot manufactured certifying that all pipe in the lot was manufactured in accordance with the terms of this specification and that the pipe details conform to drawings previously approved by the Department. Pipe shall be considered ready for acceptance when a lot conforms to the indicated test requirements. The manufacturer shall be permitted to retest to determine specification compliance. Pipe not used within two years after its original acceptance shall be retested by the Department before it can be used.

706-06 POLYESTER FORMED IN PLACE PIPE LINER

SCOPE. This specification covers the material requirements for polyester formed in place pipe liners used in rehabilitation applications of culverts and storm drains.

GENERAL. The flexible liner will be fabricated from one or more layers of polyester felt. An impermeable polyurethane or polyvinyl chloride material will be bonded to the outside of the felt liner. Once inverted, the impermeable plastic membrane will become the inside of the pipe liner.

MATERIAL REQUIREMENTS. Supply a resin system material conforming to the following:

<table>
<thead>
<tr>
<th>Property</th>
<th>Standard</th>
<th>Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Stress, MPa</td>
<td>ASTM D638</td>
<td>20</td>
</tr>
<tr>
<td>Flexural Stress, MPa</td>
<td>ASTM D790</td>
<td>30</td>
</tr>
<tr>
<td>Flexural Modulus, MPa</td>
<td>ASTM D790</td>
<td>1700</td>
</tr>
</tbody>
</table>

BASIS OF ACCEPTANCE. Acceptance of this material will be based on the manufacturer's name appearing on the Approved List for rehabilitation of Culverts and Storm Drains.
706-07 REINFORCED CONCRETE PIPE END SECTIONS

SCOPE. This specification covers the material and fabrication requirements for reinforced concrete pipe end sections.

MATERIAL REQUIREMENTS. The Material Requirements contained in §704-03 shall apply.

DRAWINGS. The Drawing requirements contained in §704-03 shall apply.

FABRICATION. The Fabrication requirements contained in §704-03, along with the following, shall apply:

The barrel portion of the end section shall meet the Design, Reinforcement and Permissible Variations requirements of AASHTO M 170M for Class III Pipe, Wall Designation B.

SAMPLING AND TESTING. The Sampling and Testing requirements contained in §704-03 shall apply, unless otherwise approved by the Director, Materials Bureau.

MARKING. The Marking requirements contained in §704-03 shall apply.

FINAL PRODUCTION INSPECTION. The Final Production Inspection requirements contained in §704-03 shall apply, unless otherwise approved by the Director, Materials Bureau.

SHIPPING. The Shipping requirements contained in §704-03 shall apply, unless otherwise approved by the Director, Materials Bureau.

BASIS OF ACCEPTANCE. The Basis Of Acceptance requirements contained in §704-03 shall apply, unless otherwise approved by the Director, Materials Bureau.

706-08 AND 706-09 (VACANT)

706-10 POLYVINYL CHLORIDE PIPE (relining)

SCOPE. This specification covers the material requirements for polyvinyl chloride pipe when used in rehabilitation applications of culverts and storm drains.

General. The polyvinyl material from which the pipe and fittings are extruded or molded will not contain any reclaimed, reground or reworked material and will be comprised of virgin polyvinyl resins only. The resins used will meet the requirements contained in this specification. The pipe and fittings will be manufactured in such a manner so that all cross sections will be dense, homogeneous, and free from any imperfections.

MATERIAL REQUIREMENTS. The Polyvinyl Chloride pipe materials must conform to ASTM F1803 (Profile Wall) or ASTM F949 (Corrugated). All materials supplied will be clearly marked with the appropriate ASTM as certified.

BASIS OF ACCEPTANCE. Acceptance of this material will be based on the manufacturer's name appearing on the Approved List for Rehabilitation of Culverts and Storm Drains.

706-11 HIGH DENSITY POLYETHYLENE PIPE (relining)

SCOPE. This specification covers the material requirements for high density polyethylene pipe when used in rehabilitation applications of culverts and storm drains.

General. The high density polyethylene material from which the pipe and fittings are extruded will not contain any reclaimed, reground or reworked material and will be comprised of virgin high density polyethylene resins only. The resins used will meet the requirements contained in this specification.
The pipe and fittings will be manufactured in such a manner so that all cross sections will be dense, homogeneous, and free from any imperfections.

**MATERIAL REQUIREMENTS.** The high density polyethylene pipe material must conform to ASTM F894 (Profile Wall) or ASTM F714 (Smooth Wall). All materials supplied will be clearly marked with the appropriate ASTM as certified.

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based on the manufacturer’s name appearing on the Approved List for rehabilitation of Culverts and Storm Drains.

### 706-12 SMOOTH INTERIOR CORRUGATED POLYETHYLENE PIPE

**SCOPE.** This specification covers the material and quality requirements for smooth interior corrugated polyethylene pipe and fittings.

**MATERIAL REQUIREMENTS.** The polyethylene material for the pipe and fittings shall meet the requirements of A.A.S.H.T.O. M294, Type S or Type SP. In addition, when checked with a 300 mm straight edge the smoothness of the interior liner shall not deviate more than 6 mm.

**BASIS OF ACCEPTANCE.** Smooth interior, corrugated polyethylene pipe will be accepted on the basis of the manufacturer's name and location appearing on the Department’s Approved List and a material certification that specifies the product conforms to this specification.

The supplier shall provide two copies of the approved Materials Details through the Contractor to the Engineer as part of the evidence of acceptability for the material at least 10 days prior to shipment of the product to the job site.

### 706-13 PERFORATED CORRUGATED POLYETHYLENE UNDERDRAIN TUBING

**SCOPE.** This specification covers the material and quality requirements for corrugated polyethylene tubing and fittings.

**MATERIAL REQUIREMENTS.** The corrugated polyethylene tubing and fittings 100 mm thru 250 mm in diameter shall meet the requirements of A.A.S.H.T.O. Designation: M252, Corrugated Polyethylene Drainage Tubing except that tubing manufactured from material meeting A.S.T.M. Designation D1248, Class B, shall also be acceptable.

Corrugated polyethylene tubing and fittings 300 mm in diameter shall meet the requirements of A.A.S.H.T.O. M252 except the pipe stiffness requirement shall be 310 kPa at 5% deflection.

**BASIS OF ACCEPTANCE.** Perforated corrugated polyethylene underdrain tubing will be accepted on the basis of the manufacturer's name and location appearing on the Department’s Approved List and a material certification that specifies the product conforms to this specification.

### 706-14 CORRUGATED INTERIOR POLYETHYLENE PIPE

**SCOPE.** This specification covers the material and quality requirements for corrugated interior polyethylene pipe and fittings.

**MATERIAL REQUIREMENTS.** The polyethylene material for the pipe and fittings shall meet the requirements of A.A.S.H.T.O. M294, Type C.

**BASIS OF ACCEPTANCE.** Corrugated interior polyethylene pipe will be accepted on the basis of the manufacturer's name and location appearing on the Department’s Approved List and a material certification that specifies the product conforms to this specification.
706-15 PVC PLASTIC DRAIN PIPE SYSTEM

SCOPE. This specification covers the material and quality requirements for poly (vinyl chloride) plastic drain pipe, fittings and solvent cement when used as a drain pipe system.

GENERAL. The PVC material from which the pipe and fittings shall be extruded or molded shall not contain any reclaimed, reground or reworked material whatsoever, but shall be compounded from virgin PVC resins, plasticizers, stabilizers, and such materials that when compounded, it shall meet the requirements contained in this specification.

The pipe and fittings shall be extruded or molded in such a manner that all cross sections shall be dense, homogeneous, and free from porosity or other imperfections.

The solvent cement shall be a solution of unplasticized PVC tetrahydrofuran and cyclohexanone.

MATERIAL REQUIREMENTS. The PVC material for the pipe and fittings shall meet the requirements of ASTM D1784 for Rigid Poly (Vinyl Chloride) Compounds and Chlorinated Poly (Vinyl Chloride) Compounds, Class 12444-B.

The molded or extruded pipe shall conform to ASTM D1785 for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedule 80, PVC 1120.

The molded or extruded fittings shall conform to ASTM D2467 for Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80, PVC 1.

The solvent cement shall meet the requirements of ASTM D2564 for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

<table>
<thead>
<tr>
<th>Nominal Size</th>
<th>Outside Diameter (Millimeters)</th>
<th>Inside Diameter (Millimeters)</th>
<th>Wall Thickness Schedule 80 (Millimeters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>114.3</td>
<td>97.2</td>
<td>8.6</td>
</tr>
<tr>
<td>125</td>
<td>141.3</td>
<td>122.3</td>
<td>9.5</td>
</tr>
<tr>
<td>150</td>
<td>168.3</td>
<td>146.3</td>
<td>11.0</td>
</tr>
<tr>
<td>200</td>
<td>219.1</td>
<td>193.7</td>
<td>12.7</td>
</tr>
<tr>
<td>250</td>
<td>273.1</td>
<td>242.9</td>
<td>15.1</td>
</tr>
</tbody>
</table>

DIMENSIONS. The dimensions and tolerances of the pipe and fittings shall conform to ASTM D1785 and D2467 respectively.

MARKING. All material furnished shall be plainly marked in accordance with ASTM D1785, D2467, and D2564 for the pipe, fittings and solvent cement, respectively.

BASIS OF ACCEPTANCE. All pipe, fittings and solvent cement shall be accepted on the basis of the manufacturer's certification that the material conforms to this specification.

706-16 CELLULAR POLYSTYRENE PROTECTIVE COVER

SCOPE. This specification covers the material and quality requirements for cellular polystyrene when used as protective cover for pipes.

GENERAL. The protective cover shall be fabricated from rigid extruded cellular polystyrene such that it shall meet the requirements contained in this specification.

The polystyrene shall be extruded in such manner that all cross sections shall be uniform and free from imperfections.

MATERIALS REQUIREMENTS. The fabricated cellular polystyrene protective cover shall meet the following requirements:
### Property ASTM Test Procedure Requirement

<table>
<thead>
<tr>
<th>Property</th>
<th>ASTM Test Procedure</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density, kg/m³</td>
<td>D1622</td>
<td>32 ± 2</td>
</tr>
<tr>
<td>Compressive Strength, kPa</td>
<td>D1621</td>
<td>205 ± 35</td>
</tr>
<tr>
<td>Flammability</td>
<td>D1692</td>
<td>Self-Extinguishing</td>
</tr>
</tbody>
</table>

**DIMENSIONS.** The protective cover shall be fabricated in cylindrical half-sections of any convenient length for application to straight pipe and half-sections of suitable shape and length to protect any non-linear portions of the pipe or fittings. The thickness of the protective cover shall be maintained within ±1.5 mm of the thickness shown on the plans. The protective cover shall be fabricated such that it mates with the pipe without leaving gaps at the seams. It shall have the following maximum clearance between outside diameter of nominal pipe and inside diameter of protective cover:

<table>
<thead>
<tr>
<th>Nominal Pipe Size, Millimeters</th>
<th>Maximum Clearance, Millimeters</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 to 38 incl.</td>
<td>.397</td>
</tr>
<tr>
<td>50 to 100 incl.</td>
<td>.794</td>
</tr>
<tr>
<td>125 to 280 incl.</td>
<td>1.984</td>
</tr>
<tr>
<td>300 and over</td>
<td>2.381</td>
</tr>
</tbody>
</table>

**BASIS OF ACCEPTANCE.** All protective cover furnished shall be marked with the following information: manufacturer's name, type of material, and nominal size. All protective cover shall be accepted on the basis of the Manufacturer's certification that the material conforms to this specification.

**706-17 PRECAST CONCRETE BOX CULVERTS**

**SCOPE.** This specification covers the material and quality requirements for precast concrete box culverts.

**MATERIAL REQUIREMENTS.** The Material Requirements contained in §704-03 shall apply except as noted herein. The concrete used to fabricate precast concrete box culverts shall have a minimum compressive strength of 35 MPA @ 28 days. Joint gasket material shall meet the requirements of ASTM D1056, Grade # 2A1 or # 2A2.

**DESIGN.** When the contract plans contain complete design details for the culvert, alternate designs will not be considered. When the contract plans do not contain complete design details for the culvert the Contractor shall be responsible for providing them. Precast concrete box culvert designs shall meet the requirements of the “NYSDOT Reinforced Concrete Box Culvert Design Guidelines”. Design details for bridge size culverts shall also include load rating information. Design calculations shall be stamped by a Professional Engineer licensed, and registered, to practice in New York State. The transmittal, processing and approval of box culvert designs will be in accordance with procedural directives of the Materials Bureau.

**DRAWINGS.** The Drawing requirements contained in §704-03, along with the following shall apply. All fabrication drawings for Contractor provided designs shall be stamped by a Professional Engineer licensed, and registered, to practice in New York State. Fabrication drawings for bridge size culverts shall include load rating information. Reproducible drawings are required for bridge size culverts only.

**FABRICATION.** The Fabrication requirements contained in §704-03, along with the following shall apply.

**Reinforcing.** Unless noted otherwise in the contract plans or approved fabrication drawings the concrete cover over reinforcing steel shall be 25 mm minimum on the walls, floor slab and roof slab of

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NEW YORK STATE DEPARTMENT OF TRANSPORTATION
STANDARD SPECIFICATIONS of May 4, 2006
culverts and 38 mm minimum on wingwalls. When fill heights over the box culvert are less than 600 mm the concrete cover on the outside face of the roof slab shall be 50 mm minimum and all reinforcing steel in the top mat of the roof slab shall be epoxy coated or the concrete shall contain corrosion inhibitor. Fill heights shall be measured from the top of pavement to the top of the culvert roof slab. All reinforcing steel in the wall section of wingwalls shall be epoxy coated or the concrete shall contain corrosion inhibitor.

**Joints.** Precast concrete box culvert sections shall be fabricated with a female joint on the upstream end and male joint on the downstream end. Joint depth shall be a minimum of 50 mm and a maximum of 105 mm. The ends of longitudinal reinforcing steel shall have 15 mm minimum concrete cover at the mating surface of the joint. The circumferential reinforcing steel shall have 25 mm minimum concrete cover, as measured to the outermost bars, at the mating surface of the joint. When interferences occur which prevent this, the concrete cover shall be increased accordingly as shown on the approved fabrication drawings. Joints shall be fabricated such that when box culvert sections are fully drawn together the gap between adjacent culvert sections is 20 mm maximum. The outside mating surface of the joint shall have a continuous 25 mm x 25 mm gasket installed at the precast plant.

**Corrosion Inhibitor.** Corrosion inhibitor may be used in lieu of epoxy coated reinforcing.

**Dimensional Tolerances**
- Internal and external unit dimensions shall not vary by more than 10 mm from the design dimensions.
- Slab and wall thickness shall not vary from the design dimension by more than 5 mm for thicknesses less than 250 mm and 10 mm for thicknesses of 250 mm or greater.
- The length of section shall not vary more than 10 mm from the design dimension.
- Variations in laying lengths of two opposite surfaces of the box section shall not be more than 10 mm.

**Repair.** Minor defects in the mating surface of the joint, that do not come in contact with the joint gasket material and are 5 mm or less in depth, do not require repair.

**SAMPLING AND TESTING.** The Sampling and Testing requirements contained in §704-03 shall apply.

**MARKING.** The Marking requirements contained in §704-03 shall apply except as noted herein. Markings shall be placed on the inside face of one wall of each culvert barrel section.

**FINAL PRODUCTION INSPECTION.** The Final Production Inspection requirements contained in §704-03 shall apply.

**SHIPPING.** The Shipping requirements contained in §704-03 shall apply.

**BASIS OF ACCEPTANCE.** The Basis of Acceptance requirements contained in §704-03 shall apply.

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**706-18 PERFORATED POLYVINYL CHLORIDE UNDERDRAIN PIPE**

**SCOPE.** This specification covers the material and quality requirements for smooth-wall perforated polyvinyl chloride (PVC) plastic pipe, couplings and fittings intended for use in underdrains.

**MATERIAL REQUIREMENTS.** Perforated polyvinyl chloride underdrain pipe and fittings shall conform to A.A.S.H.T.O. M278 Class PS46.

**BASIS OF ACCEPTANCE.** Acceptance of the perforated polyvinyl chloride underdrain pipe will be based on the manufacturer's certification of compliance with these specifications.
SECTION 707 - METAL PIPE

707-02 CORRUGATED STEEL PIPE

SCOPE. The material requirements of corrugated steel pipe with metallic, bituminous, portland cement concrete/or polymer coating intended for use in construction of culverts and drainage systems.

GENERAL. The corrugated steel pipe covered by this specification is classified as follows:

1. Type I. A full circular cross-section, with a single thickness of corrugated sheet.
2. Type IR. A full circular cross-section, with a single thickness of smooth sheet, fabricated with helical ribs projecting outwardly.
3. Type II. A Type I pipe which has been reformed into a pipe-arch, having an approximately flat bottom.
4. Type IIR. A Type IR pipe which has been reformed into a pipe-arch having an approximately flat bottom.
5. Type III. A Type I pipe which has been perforated to permit the in-flow or out-flow of water.

MATERIAL REQUIREMENTS. Apply the requirements of AASHTO M 36M Types I, IR, II, IIR, and III except as modified herein for all metallic coated corrugated steel pipe. Apply the requirements of AASHTO M 190M except as modified herein for all bituminous coated corrugated steel pipe. Apply the requirements of AASHTO M 245M Types I and II except as modified herein for all polymer coated steel pipe.

When Type IR or Type IIR corrugated steel pipe (spiral rib) is specified, the nominal dimension of the ribs shall be 19 mm by 19 mm at 190 mm pitch.

A. Coatings. Coat pipe with one of the following:

1. Metallic. The steel sheet will have a protective coating of zinc galvanizing (AASHTO M 218M) or of Aluminum-Coated (Type 2) (AASHTO M 274M).

2. Fully bituminous coated and paved invert (AASHTO M 190M, Type C). In addition to one of the metallic coatings, the pipe will be fully bituminous coated and have a bituminous paved invert.

3. Fully bituminous coated and 100 percent paved (AASHTO M 190M, Type D). In addition to one of the metallic coatings, the pipe will be fully bituminous coated and have a fully paved, smooth bituminous interior.

4. Polymer coated. The steel sheet will have a protective coating of zinc (galvanizing). In addition, the pipe will have a minimum interior polymer coating thickness of 0.25 mm and an optional exterior polymer coating. If an exterior polymer coating is applied, it will have a minimum thickness of 0.08 mm.

5. Polymer coated with a bituminous paved invert. In addition to the zinc and polymer coatings, the pipe will have a bituminous paved invert.
6. **Portland Cement Concrete Lined.** The steel sheet will be covered with dense, homogeneous, nonsegregating concrete lining. The concrete will be a minimum thickness of 13 mm over the crest of the corrugations of the carrier pipe. In no case will the amount of portland cement, blended cement, or portland cement plus flyash be less than 275 kg/m³. Flyash in the mix may not exceed 20% by weight of the cementitious material. When type IP cement is used, no flyash will be added in batching. All concrete will have a water-cement ratio not exceeding 0.50 by weight. Cure the concrete lining prior to installation as per manufacturers instructions.

The bituminous material for coating and/or paving will be homogeneous and have the following properties in addition to those specified by AASHTO M 190M:

<table>
<thead>
<tr>
<th>Penetration at 25°C, 110 g, 5 seconds</th>
<th>AASHTO T49</th>
<th>25-50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penetration Ratio (4°C/25°C x 100)</td>
<td>AASHTO T49</td>
<td>80-90</td>
</tr>
<tr>
<td>Softening Point °C (Ball &amp; Ring)</td>
<td>AASHTO T53</td>
<td>88-110</td>
</tr>
</tbody>
</table>

Apply the requirements of AASHTO M 246M for polymer material. Polymer coating materials must appear on the Department's Approved List.

Apply the material requirements of §501-2.02 Materials for portland cement concrete liner material.

**B. Gauge.** The nominal metal thickness corresponding to any gauge is shown in Table 707-2-1.

**C. End Finish.** To facilitate field joining, reroll the ends of all helical corrugated steel pipe with diameters of 300 mm or greater to form a minimum of two annular corrugations of no less than 68 mm pitch by 13 mm depth. Reroll the ends of Type IR and IIR pipe to form only two corrugations.

**D. Coupling Bands.** Supply annular corrugated steel coupling bands for all round pipe sections (Types I, IR, and III) 300 mm or greater in diameter. The band corrugations will have the same dimensions as the pipe ends. Mesh the band with at least one full corrugation and lap it equally on each pipe end. The band width will be a minimum of 180 mm for pipe diameters up to and including 800 mm. The band width will be a minimum of 265 mm for pipe diameters greater than 800 mm.
The thickness of the band cannot be less than 2 nominal sheet thicknesses thinner than the pipe and in no case thinner than 1.30 mm.

Pipe arches (Type II and IIR) may be joined by the annular corrugated bands described above or by special projection type coupling bands. The special projection bands will consist of two rows of projections at 75 mm center-to-center that will mesh with at least one full corrugation and will lap equally on each pipe end. The thickness of the special projection bands will not be less than 2 nominal sheet thicknesses thinner than the pipe and in no case thinner than 1.60 mm.

Regular projection type coupling bands (dimpled bands) will not be acceptable for 300 mm in diameter pipe and larger. Dimpled bands may be used on pipe diameters smaller than 300 mm, all sizes of perforated underdrain pipe (Type III), and for connecting pipe extensions to existing helical corrugated metal pipe without rerolled ends, unless otherwise shown on the plans.

Coupling bands may be one or two piece. Use two piece coupling bands on pipe 1200 mm or greater in diameter.

Use one of the following coupling band connectors:
- Galvanized steel angles, 50 mm x 50 mm x 5 mm
- Lug connectors
- Bar and strap connectors

Rivet, bolt, or weld these connectors to the coupling bands. Any evidence of loose bolts or rivets, bearing failure, or weld or band tearing are cause for rejection and replacement of that coupling band. As an alternate to the coupling band connectors stated above, a corrugated angle which conforms to an approved Materials Detail may be used.

Coat the steel sheet used for coupling bands with a polymer or metallic coating. If polymer or metallic coated corrugated steel pipe is being joined, the bands must have the same coating as the pipe.

Joints for concrete lined pipe will meet the requirements of §603-3.06 Joints.

E. Coating Repair. Repair damaged metallic, bituminous, portland cement concrete and/or polymer coating.

Metallic coating field repairs will be allowed only when the total damaged area on each piece is less than 0.20 m² of coated surface, excluding aluminum coated rerolled ends. Any piece having damaged areas totaling more than 0.20 m², excluding aluminum coated rerolled ends, will be rejected. Repair metallic coatings as follows:
- Power disk sand or mechanically wire brush areas of damaged coating to bright metal
- Remove oil, grease, and corrosion products from repair areas
- Spray or brush a zinc-rich paint on clean, dry repair areas. The paint brand must appear on the Department's Approved List, Materials for Use in Repairing Galvanized Surfaces §719-01. The dry film paint thickness shall be at least 0.13mm. Do not apply paint below 4°C.

Repair aluminum coatings damaged during rerolling at the manufacturing location. The rerolled ends may be either spot repaired or completely painted to repair small areas of damaged coating. Make repairs to the rerolled ends of aluminum coated pipe as referenced above. These rerolled end repairs, when properly completed, will not be counted toward the 0.20 m² of allowable damaged coating described above.

Repair damaged interior bituminous coatings using the original material or a Corrugated Metal Pipe Bituminous Coating Repair Material appearing in the Department's Approved List. Exterior damage to a bituminous coated pipe requires repair to the metallic coating only.

Repair damaged interior polymer coatings using Polymer Repair Materials for Steel Sheet used for Corrugated Pipe appearing in the Department's Approved List. Exterior damage to a polymer coated pipe requires repair to the metallic coating only.

Repair damaged portland cement concrete linings with Item 701-08, vertical and overhead patching material. The lining will be free of cracks exceeding 1 mm in width or the pipe will be rejected.

F. Marking. Mark or tag each length of corrugated steel pipe over the coating as approved by the Department to properly cross-reference the supplier's certification.
G. Additional Defects. In addition to coating damage and other criteria established in Materials Bureau procedural directives, the following additional defects along with those listed in AASHTO will be cause for rejecting the pipe when inspected at the project:

- Variation from a straight centerline of more than 20 mm in 6 m.
- Any dents greater than 75 mm in diameter
- Any punctures
- Loosely formed or cracked lock seams
- Cracks through the metal
- Sharp bends in pipe arches that are less than the specified minimum corner radius for that size.

BASIS OF ACCEPTANCE. Corrugated steel pipe will be accepted on the basis of certified documentation issued by a supplier appearing on the Department's Approved List. Certification will accompany all shipments arriving at the project in accordance with Materials Bureau procedural directives. Shipments arriving without certification, or with improper certification will be rejected.

The Engineer will measure gauge and coating thicknesses at the project. The pipe will be rejected if the metal and/or coating thickness is less than required or certified. The Contractor will supply equipment required to measure metal and coating thicknesses as detailed in §603-3.02H, Thickness Measuring Equipment.

Acceptance requirements including thickness measurements, visual inspection instructions, certification format, and fabrication shop approval will be in accordance with Materials Bureau procedural directives. At the option of the Department, this material may be subjected to shop inspection. Polymer coatings, coating applicator facilities, and application methods are subject to Materials Bureau approval. Samples are required for laboratory and field testing. Field testing will be a minimum of two years duration. Upon approval, the brand of polymer coating and applicator will be placed on the Department's Approved List. Certifications for polymer coated pipe received at the project will include the brand and applicator of polymer coating, which must appear on the Department's Approved List. Corrugated connecting angles will be accepted provided an approved Materials Detail appears on the Department's Approved List from that supplier.

707-03 DUCTILE IRON PIPE (NON-PRESSURE)

SCOPE. This specification covers the material and quality requirements for 350 mm to 1375 mm Ductile Iron Culvert Pipe.

GENERAL. Ductile Iron Pipe. (Non-Pressure) shall be a centrifugally cast iron pipe conforming to the requirements of ASTM A716, Ductile Iron Culvert Pipe.

BASIS OF ACCEPTANCE. Ductile Iron Pipe (Non-Pressure) shall be accepted on the basis of the Manufacturer's certification that the material conforms to this specification. The certification shall accompany the material delivered to the job site.

The Department reserves the right to sample and test this material subsequent to delivery at the project site.

707-04 DUCTILE IRON PIPE (PRESSURE)

SCOPE. This specification covers the material, and quality requirements for 75 mm to 1375 mm Ductile Iron Pipe (Pressure).

GENERAL. Ductile Iron Pipe (Pressure) shall be a centrifugally cast iron pipe conforming to the requirements of ANSI A21.51., Ductile-Iron Pipe, Centrifugally Cast In Metal Molds or Sandline Molds, for Water or Other Liquids.

BASIS OF ACCEPTANCE. Ductile Iron Pipe (Pressure) shall be accepted on the basis of the Manufacturer's certification that the material conforms to this specification. The certification shall accompany the material delivered to the job site.
A complete text of the document is not provided, but the text is approximately as follows:

The Department reserves the right to sample and test this material subsequent to delivery at the project site.

707-05 TUNNEL LINER PLATE (relining)

SCOPE. This specification covers the material and fabrication requirements for tunnel liner plate.

MATERIAL REQUIREMENTS. Tunnel liner plate steel must conform to ASTM A569. Tunnel liner plate aluminum must conform to AASHTO M219 (ASTM B746). Before cold forming into tunnel liner plate the plates must conform to the following mechanical requirements:

<table>
<thead>
<tr>
<th></th>
<th>STEEL</th>
<th>ALUMINUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>(3.17-3.81 mm)</td>
<td>(4.44-6.35 mm)</td>
<td></td>
</tr>
<tr>
<td>Tensile Strength, MPa</td>
<td>290 min.</td>
<td>240 min.</td>
</tr>
<tr>
<td>Yield Point, MPa</td>
<td>193 min.</td>
<td>165 min.</td>
</tr>
<tr>
<td>Elongation in 50 mm, percent</td>
<td>30 min.</td>
<td>6 min.</td>
</tr>
</tbody>
</table>

Prepare test specimens in accordance with ASTM A570 for steel sheets or ASTM A283 for steel plates and ASTM B209M for aluminum plates. Deliver the Mill test reports, for each heat and thickness to the Engineer with each shipment of liner plates.

Galvanizing. Galvanize steel plates in accordance with AASHTO M167 M. Galvanize after the plates are formed, punched and curved. Hot dip galvanize all bolts and nuts, when used with galvanized tunnel liner plate in accordance with ASTM A153.

Liner Plate. Punch all plate for bolting on both the longitudinal and circumferential seams or joints and fabricate so as to permit complete erection from the inside of the tunnel liner plate structure. The minimum edge distance from the center of a bolt hole to the edge of a plate will be in accordance with the manufacturer’s standard spacing. Provide a sufficient number of plates with 50 mm, or larger, grouting holes with pipe plugs, and spaced so that when the plates are installed there will be one line of holes at the crown of the pipe and one line on each side at approximately the midpoint. The holes in each line will not be more than two (2) meters apart, and they will be staggered along the tunnel length.

Tunnel Liner Plate (Two-Flange). The minimum moment of inertia in mm$^4$ per mm of plate width, based on the average of one ring of plates is as follows:

<table>
<thead>
<tr>
<th>STEEL</th>
<th>ALUMINUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncoated Plate Thickness (mm)</td>
<td>Moment of Inertia (mm$^4$/mm)</td>
</tr>
<tr>
<td>3.43</td>
<td>1049</td>
</tr>
<tr>
<td>4.17</td>
<td>1295</td>
</tr>
<tr>
<td>4.55</td>
<td>1426</td>
</tr>
<tr>
<td>5.31</td>
<td>1688</td>
</tr>
<tr>
<td>6.07</td>
<td>1934</td>
</tr>
</tbody>
</table>

The longitudinal seams will be of the lap type. The depth of the offset will be equal to the thickness of the metal for the full width of plate, including flanges. Fabricate the lap to allow the cross section of the plates to be continuous through the seam. The lapped longitudinal joints will contain at least five (5) bolts per 450 mm plate width, with bolts in ridges and valleys staggered. Circumferential bolt spacing will be in accordance with the manufacturer’s standard spacing and will be a multiple of the plate length so that the plates having the same curvature are interchangeable. Bolts and nuts for liner plate assemblies will not be less than 16 mm in diameter. Circumferential (flange) seams will conform to ASTM A307, with chemical and mechanical requirements conforming to Grade A and dimensions conforming to Grade B. Bolts and nuts for longitudinal seams will have square heads with a square shoulder to engage the plate. Longitudinal seams of plates 2 mm to 4.5 mm thick, inclusive will conform to ASTM A307, with
chemical and mechanical requirements conforming to Grade A. Bolts for longitudinal seams of plates 5.3 mm to 6.1 mm or thicker will conform to the chemical and mechanical requirements of ASTM A449. Nuts, for use on ASTM A449 bolts, will conform to ASTM A307, with chemical and mechanical requirements conforming to Grade A, and dimensions conforming to Grade B.

BASIS OF ACCEPTANCE. Acceptance of this material will be based on the manufacturer's name appearing on the Approved List.

707-06 THRU 707-08 (VACANT)

707-09 CORRUGATED STRUCTURAL STEEL PLATE FOR PIPE, PIPE ARCHES AND UNDERPASSES

SCOPE. This specification covers corrugated structural steel plates intended for use in the construction of pipe, pipe arches and underpasses.

MATERIAL REQUIREMENTS. Structural steel plate, nuts and bolts shall conform to the requirements of AASHTO M167 except as herein specified, and shall be of the thickness and shape shown of the plans. When a gauge number is specified in the contract documents it shall conform to Table 707-2-1. Plates shall have approximately a 50 mm lip beyond each end crest, which will result in the actual length of a given structure being approximately 100 mm longer than the nominal length, except where skewed or beveled.

If directed by the Engineer, the Contractor shall, at its own expense, repair damaged spelter on plate items as directed under §719-01, Galvanized Coatings and Repair Methods. This repair method shall be allowed only when it is in the best interest of the Department. All repairs shall be made at no cost to the State.

BASIS OF ACCEPTANCE. This material will be accepted on the basis of certified documentation issued by a fabrication shop appearing on the Department's Approved List. Certification format and fabrication shop approval shall be in accordance with procedural directives issued by the Materials Bureau. At the option of the Department, this material may be subjected to shop inspection.

707-10 GALVANIZED STEEL END SECTIONS

SCOPE. This specification covers galvanized steel end sections to be attached to the inlet and outlet ends of corrugated steel pipe.

MATERIAL REQUIREMENTS. Galvanized steel end sections shall be manufactured from material meeting the requirements of AASHTO M218. The units shall conform to the shape, dimensions, and thickness shown on the applicable standard sheet and/or contract plans. The nominal metal thickness corresponding to any gauge shall be as shown in Table 707-2-1. Marking and coating repair shall meet the requirements of §707-02, Corrugated Steel Pipe.

BASIS OF ACCEPTANCE. End sections will be accepted on the basis of certified documentation issued by a fabrication shop appearing on the Department's Approved List. All shipments shall arrive at the project with certification prepared in accordance with Materials Bureau procedural directives. Shipments arriving without certification, or with improper certification, will be rejected.

Metal and coating thicknesses will be measured at the project by project inspectors. If the metal and/or coating thickness is less than required or certified, the material shall be rejected. Equipment required to measure metal and coating thickness shall be supplied by the contractor as detailed in §603-3.02G, Thickness Measuring Equipment.

Acceptance requirements including thickness measurements, visual inspection instructions, certification format, and fabrication shop approval shall be in accordance with Materials Bureau procedural directives. At the option of the Department, this material may be subjected to shop inspection.
§707

707-11 ALUMINUM END SECTIONS

SCOPE. This specification covers aluminum end sections to be attached to the inlet and outlet ends of corrugated aluminum pipe.

MATERIAL REQUIREMENTS. Aluminum end sections shall be manufactured from material meeting the requirements of AASHTO M197M. The units shall conform to the shape, dimensions, and thickness shown on the standard sheet for galvanized steel end sections and/or contract plans. The nominal metal thickness corresponding to any gauge shall be as shown in Table 707-2-1. Marking shall meet the requirements of §707-13, Corrugated Aluminum Pipe.

BASIS OF ACCEPTANCE. End sections will be accepted on the basis of certified documentation issued by a fabrication shop appearing on the Department's Approved List. All shipments shall arrive at the project with a certification prepared in accordance with Materials Bureau procedural directives. Shipments arriving without certification, or with improper certification, will be rejected.

Metal thickness will be measured at the project by project inspectors. If the metal thickness is less than required or certified, the material shall be rejected. Equipment required to measure thickness shall be supplied by the contractor as detailed in §603-3.02H, Thickness Measuring Equipment.

Acceptance requirements including thickness measurements, visual inspection instructions, certification format, and fabrication shop approval shall be in accordance with Materials Bureau procedural directives. At the option of the Department, this material may be subjected to shop inspection.

707-12 (VACANT)

707-13 CORRUGATED ALUMINUM PIPE

SCOPE. This specification covers corrugated aluminum pipe intended for use in the construction of culverts and drainage systems. The corrugated aluminum pipe covered by this specification is classified as follows:

Type I. This pipe shall have a full circular cross-section with a single thickness of corrugated sheet fabricated with annular (circumferential) or helical corrugations.

Type IA. This pipe shall have a full circular cross-section with an outer shell of corrugated sheet fabricated with helical corrugations and an inner liner of smooth (uncorrugated) sheet attached to the shell at helical lock seams.

Type IR. This pipe shall have a full circular cross-section with a single thickness of smooth sheet fabricated with helical ribs projecting outwardly.

Type II. This pipe shall be a Type I pipe which has been reformed into a pipe-arch having an approximately flat bottom.

Type IIR. This pipe shall be a Type IR pipe which has been reformed into a pipe-arch having an approximately flat bottom.

Type III. This pipe, intended for use as underdrains or for underground disposal of water, shall be a Type I pipe which has been perforated to permit the in-flow or out-flow of water.

MATERIAL REQUIREMENTS. Corrugated aluminum pipe shall conform to the requirements of AASHTO M196M Types I, IA, IR, II, IIR, and III except as modified herein. When Type IR and Type IIR corrugated aluminum pipe (spiral rib) is specified, the nominal dimension of the ribs shall be 19 mm by 19 mm at 190 mm spacing.

Gauge. The nominal metal thickness corresponding to any gauge shall be as shown in Table 707-2-1.
End Finish. To facilitate field joining, the ends of all helical corrugated aluminum pipe with 300 mm or greater diameters shall be rerolled to form a minimum of two annular corrugations of no less than 68 mm pitch by 13 mm depth. When the ends of Type IR or Type IIR pipe are rerolled, there shall be only two such corrugations. Rerolled pipe ends shall be uniquely and indelibly labeled so the pipe may be assembled in the field in the same order it was manufactured.

Coupling Bands. All round pipe sections (Types I, IA, IR, and III) 300 mm or greater in diameter shall be field joined with aluminum coupling bands. Helical corrugated pipe without rerolled ends may be joined with helical corrugated bands. Pipe with rerolled ends or annular corrugations shall be joined with annular corrugated coupling bands.

All bands shall have corrugations with the same dimensions as the pipe ends. Annular corrugated bands shall mesh with at least one full corrugation and shall lap equally on each pipe end. The band widths shall be a minimum of 180 mm for pipe diameters up to and including 800 mm. The band widths shall be a minimum of 265 mm for pipe diameters greater than 800 mm.

The bands shall not be more than 2 nominal sheet thicknesses thinner than the pipe and in no case thinner than 1.30 mm.

Pipe arches (Type II and Type IIR) may be joined by the annular corrugated bands described above or by special projection type coupling bands. The special projection bands shall consist of two rows of projections at 75 mm center-to-center that will mesh with at least one full corrugation and will lap equally on each pipe end. The special projection bands shall not be more than 2 nominal sheet thicknesses thinner than the pipe and in no case thinner than 1.60 mm.

Regular projection type coupling bands (dimpled bands) will not be acceptable for pipe 300 mm in diameter and larger. Dimpled bands may be used on pipe smaller than 300 mm in diameter, all sizes of perforated underdrain pipe, and for connecting pipe extensions to existing helical corrugated pipe without rerolled ends, unless otherwise shown on the plans.

Coupling bands may be one or two piece. Two piece coupling bands shall be used on pipe 1200 mm or greater in diameter.

Coupling band connectors shall be one of the following types:
- Aluminum angles, 50 mm x 50 mm x 5 mm
- Aluminum lug connectors
- Aluminum bar and strap connectors.

These connectors shall be riveted, bolted, or welded to the coupling bands. Evidence of loose bolts or rivets, bearing failure, or weld or band tearing shall be cause for rejection and replacement of that coupling band. As an alternate to the coupling band connectors stated above, an aluminum corrugated angle which conforms to an approved Materials Detail may be used.

MARKING. Each length of corrugated aluminum pipe shall be marked or tagged as approved by the Department to properly cross-reference the supplier's certification.

Additional Defects. In addition to criteria established in Materials Bureau procedural directives and defects listed in AASHTO, the following defects will be cause for rejecting the pipe when inspected at the project:
- Variation from a straight centerline of more than 20 mm in 6 m.
- Any dents greater than 75 mm in diameter
- Any punctures
- Loosely formed or cracked lock seams
- Cracks through the metal
- Sharp bends in pipe arches that are less than the specified minimum corner radius for that size.

BASIS OF ACCEPTANCE. Corrugated aluminum pipe will be accepted on the basis of certified documentation issued by a supplier appearing on the Department's Approved List. All shipments shall arrive at the project with certification prepared in accordance with Materials Bureau procedural directives. Shipments arriving without certification, or with improper certification, shall be rejected.
Gauge shall be measured at the project by project inspectors. If the gauge is less than required, the pipe shall be rejected. Equipment required to measure gauge shall be supplied by the contractor as detailed in §603-3.02H, Thickness Measuring Equipment. Acceptance requirements including thickness measurements, visual inspection instructions, certification format, and fabrication shop approval shall be in accordance with Materials Bureau procedural directives. At the option of the Department, this material may be subjected to shop inspection. Corrugated connecting angles will be accepted provided an approved Materials Detail appears on the Department's Approved List from that supplier.

707-14 CORRUGATED ALUMINUM STRUCTURAL PLATE FOR PIPE AND PIPE ARCHES

SCOPE. This specification covers corrugated aluminum structural plates for use in the construction of pipe and pipe arches.

MATERIAL REQUIREMENTS. Structural plate, nuts and bolts shall conform to the requirements of AASHTO M219 except as herein specified, and shall be of the thickness and shape shown on the plans. When a gauge number is specified in the contract documents, it shall conform to Table 707-2-1.

The corrugations shall run at right angles to the longitudinal axis of the structure. Plates shall have approximately a 45 mm lip beyond each end crest, which will result in the actual length of a given structure being approximately 90 mm longer than the nominal length, except where skewed or beveled.

All sections which are damaged from any cause, including handling, or where any dimension varies from that specified, shall be replaced at the Contractor's expense in a manner approved by the Engineer.

BASIS OF ACCEPTANCE. This material will be accepted on the basis of certification by the fabricator. Each fabricator shall furnish upon request by the Materials Bureau a certified analysis and guarantee executed by the manufacturer of the base metal as described in AASHTO M219.

At the option of the Department, structural plates may be subjected to shop inspection or may be shipped to the project site accompanied by certified documentation executed in a form prescribed by the Department.

707-15 THRU 707-19 (VACANT)

707-20 ANCHOR BOLTS FOR CORRUGATED CULVERTS

SCOPE. This specification covers the material details and quality requirements for the anchorage system securing the ends of corrugated metal pipe, arch pipe, and structural plate to reinforced or plain concrete headwalls.

MATERIAL REQUIREMENTS. Anchor bolts shall be 19 mm diameter heavy hex bolts, ASTM A307. Grip shall be 140 mm threaded over at least first 63 mm. The bolts shall be fitted with two nuts, ASTM A563 heavy hex. Nuts shall be chamfered on at least one face using a 25 mm spherical radii. The nuts and bolts shall be so assembled that in the final assembly, the bolt and one of the nuts is embedded in concrete, that the chamfered faces of the nuts face each other, and secure the pipe between them. Nuts and bolts shall be galvanized as per ASTM A153 after all machining operations are completed. Following galvanization, threads shall be cleaned to produce a free running fit.

When 485 mm hook bolts are used as anchor bolts they shall be detailed on the plans and shall conform to the requirements of ASTM A36.

Anchor bolts shall be spaced around the periphery of the pipe at intervals not exceeding 460 mm. At least two anchor bolts shall be provided.

BASIS OF ACCEPTANCE. Anchor bolts and nuts for corrugated metal pipes, pipe arches, and structural plate pipe will be accepted on the Manufacturer's Certification that they conform with these specifications.
SECTION 708 - PAINTS

708-01 STRUCTURAL STEEL PAINTS CLASS 1

SCOPE: This specification defines the requirements for materials appearing on the Department’s Approved List, “Structural Steel Paints, Class 1.”

MATERIAL REQUIREMENTS: The system shall be able to be applied as a shop or a field-applied coating over an SSPC SP-10 cleaned surface.

The primer shall be an organic zinc-rich epoxy with pigment primarily consisting of zinc dust. The paint shall have undergone National Transportation Product Evaluation Program (NTPEP). The coating manufacturer shall submit NTPEP results, field histories of the coating, Material Safety Data Sheets, and Technical Data Sheets to the Materials Bureau. Any formulation or technical data sheet change may affect approval status, and shall be reported to the Materials Bureau. Failure to notify the Materials Bureau shall result in the removal of the system from the Approved list.

The system’s Technical Data Sheets shall contain the following information;

- Temperature Range for Storage
- Profile Range
- Temperature for Application
- Cure to Handle/Overcoat Schedule
- Humidity and Dew Point Restrictions
- Mixing Recommendations
- Thinnners allowed and resulting VOC levels
- Recoat Window
- Paint Film Thickness Range, Wet and Dry-Film Values
- Surface preparation requirements
- Application Requirements

If the data sheet does not have all of the above information, the manufacturer will be required to submit a letter to the Engineer with the above information. The letter will be considered an addendum to the technical data sheet.

BASIS OF ACCEPTANCE: Contract acceptance will be based on the appearance of the product on the Approved List.

708-02 STRUCTURAL STEEL PAINTS CLASS 2

SCOPE: This specification defines the requirements for materials appearing on the Department’s Approved List, “Structural Steel Paints, Class 2.”

MATERIAL REQUIREMENTS: The system shall be able to be applied in the field over an SSPC SP-11 cleaned surface or a previously painted surface.

The paint shall have undergone National Transportation Product Evaluation Program (NTPEP) or NYSDOT approved alternative testing. The coating manufacturers shall submit NTPEP results and field histories of the coating to the Materials Bureau.

Any formulation or technical data sheet change may affect approval status and shall be reported to the Materials Bureau. Failure to notify the Materials Bureau shall result in the removal of the system from the Approved list.

The system’s Technical Data Sheets shall contain the following information:

- Temperature Range for Storage
- Profile Range
- Temperature for Application
- Cure to Handle/Overcoat Schedule
- Humidity and Dew Point Restrictions
- Mixing Recommendations
If the data sheet does not have all of the above information, the manufacturer will be required to submit a letter to the Engineer with the above information. The letter will be considered an addendum to the technical data sheet.

**BASIS OF ACCEPTANCE**: Contract acceptance will be based on the appearance of the product on the Approved List.

**708-03 (VACANT)**

**708-04 ZINC CHROMATE PRIMER**

**SCOPE.** This paint is used as a prime coat on aluminum in contact with fresh concrete to reduce the effect of alkali attack.

**MATERIAL REQUIREMENTS.** The composition of this paint shall be as shown in the following table using ingredients conforming to the requirements of the applicable specifications indicated.

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
<th>Grams Per Liter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zinc Yellow</td>
<td>(TT-P-465)</td>
<td>324</td>
</tr>
<tr>
<td>Titanium Dioxide, Rutile, Chalk Resistant</td>
<td></td>
<td>90</td>
</tr>
<tr>
<td>Zinc Oxide (American Process Type)</td>
<td>(ASTM D79)</td>
<td>114</td>
</tr>
<tr>
<td>Sienna, Raw</td>
<td>(ASTM D765)</td>
<td>30</td>
</tr>
<tr>
<td>Magnesium Silicate</td>
<td>(ASTM D605)</td>
<td>90</td>
</tr>
<tr>
<td>Aluminum Stearate</td>
<td>(MIL-A-15206A)</td>
<td>7.2</td>
</tr>
<tr>
<td>Resin, alkyd Solution</td>
<td>(TT-R-266C, Type I)</td>
<td>413</td>
</tr>
<tr>
<td>Dipentine</td>
<td>(TT-D-376)</td>
<td>26.3</td>
</tr>
<tr>
<td>Petroleum Spirits</td>
<td>(TT-T-291, Type I, Grade A)</td>
<td>281.4</td>
</tr>
<tr>
<td>Lead Napthenate</td>
<td>(ASTM D600, Class B)</td>
<td>14.4</td>
</tr>
<tr>
<td>Cobalt Napthenate</td>
<td>(ASTM D600, Class B)</td>
<td>1.4</td>
</tr>
<tr>
<td>Magnesium Napthenate</td>
<td>(ASTM D600, Class B)</td>
<td>1.4</td>
</tr>
</tbody>
</table>

The quantitative requirements of zinc chromate primer shall be as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigment</td>
<td>45.0%</td>
<td>49.0%</td>
</tr>
<tr>
<td>Vehicle</td>
<td>51.0%</td>
<td>55.0%</td>
</tr>
<tr>
<td>Volatile by weight of paint</td>
<td>29.5%</td>
<td>33.5%</td>
</tr>
<tr>
<td>Weight (kg/L)</td>
<td>1.32</td>
<td>1.39</td>
</tr>
<tr>
<td>Water</td>
<td>-</td>
<td>0.5%</td>
</tr>
<tr>
<td>Coarse particles &amp; skins (total residue retained on 45 um sieve based on paint)</td>
<td>-</td>
<td>0.5%</td>
</tr>
<tr>
<td>Fineness of Grind (North Standard)</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Viscosity at 25°C (Stormer-Krebs Units)</td>
<td>62</td>
<td>82</td>
</tr>
<tr>
<td>Zinc oxide (ZnO), by weight of pigment</td>
<td>34.0%</td>
<td>39.0%</td>
</tr>
<tr>
<td>Titanium Dioxide (TiO2), by weight of pigment</td>
<td>12.0%</td>
<td>14.5%</td>
</tr>
<tr>
<td>Chromium Trioxide (CrO3), by weight of pigment</td>
<td>20.0%</td>
<td>-</td>
</tr>
<tr>
<td>Phthalic Anhydride, by weight of non-volatile vehicle</td>
<td>23.0%</td>
<td>-</td>
</tr>
<tr>
<td>Flash Point</td>
<td>30°C</td>
<td>-</td>
</tr>
</tbody>
</table>
The percentages noted relate to mixture by weight. The paint shall dry set to touch within two hours and dry hard within 6 hours. No resin and resin derivatives shall be present in the paint. The paint shall show no evidence of cracking when subjected to a 3 mm “mandrel flexibility test.”

708-05 STANDARD PAINT COLORS

SCOPE: This specification defines commonly used colors.

DEFINITIONS:

Color Reference Standard
Sage Green Paint Munsell 7.5 GY 5/4
Light Gray Paint Munsell 10B 6/1
Blue Paint Federal Color Standard 595, # 35177
Brown Paint Federal Color Standard 595, # 30111
Brown-Gray Paint Federal Color Standard 595, # 36306
Dark Blue Paint Federal Color Standard 595, # 15090
Textured Concrete Finish Paint Federal Color Standard 595, # 36440
Weathered Brown Guide Rail Paint Federal Color Standard 595, # 20059

Assistance in providing definitions for other colors is offered by the Materials Bureau.

BASIS OF ACCEPTANCE: The Engineer may require manufacturer’s certification that the color provided meets the requirements of this specification.

708-06 PAINT FOR GALVANIZED SURFACES

SCOPE. This specification covers the materials requirements for paints to be applied over galvanized surfaces.

PAINT. Paint shall be a two-coat system with a polyamide epoxy primer and an aliphatic urethane, suitable for exterior use. The paints shall have a VOC level below 340 g/L, shall be produced by the same manufacturer, and the prime and top coat shall be compatible. The primer shall be specifically formulated for use over galvanized surfaces.

BASIS OF ACCEPTANCE. The material shall be accepted with the submission of the technical data sheets and the manufacturer’s certification ensuring compliance with this specification.

708-07 PAINT FOR ALUMINUM SURFACES

SCOPE. This specification covers the materials requirements for paints to be applied over aluminum surfaces not in contact with concrete.

PAINT. Paint shall be a two-coat system with an epoxy primer and an aliphatic urethane, suitable for exterior use. The paints shall have a VOC level below 340 g/L, shall be produced by the same manufacturer, and the prime and top coat shall be compatible. The primer shall be specifically formulated for use over aluminum surfaces.

BASIS OF ACCEPTANCE. The material shall be accepted with the submission of the technical data sheets and the manufacturer’s certification ensuring compliance with this specification.

708-08 THRU 708-29 (VACANT)

708-30 WOOD PRESERVATIVE - CREOSOTE OIL

SCOPE. These specifications cover creosote used in the treatment of piles, timber and lumber.
**MATERIAL REQUIREMENTS.** The requirements of American Wood Preservers' Association Standards shall apply except as modified herein. Creosote used in the treatment of piles, timber and lumber shall conform to the requirements of the following American Wood Preservers' Association Standards:

<table>
<thead>
<tr>
<th>Type of Preservative</th>
<th>AWPA Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal-Tar Creosote</td>
<td>P 1 Land &amp; Fresh Water</td>
</tr>
<tr>
<td></td>
<td>P13 Marine (Coastal Water)</td>
</tr>
<tr>
<td>Creosote-Coal Tar Solution</td>
<td>P 2 Standard Creosote-Coal Tar-Grade C</td>
</tr>
<tr>
<td></td>
<td>P12 Marine (Coastal Waters) Piles and Timber</td>
</tr>
</tbody>
</table>

Method of application shall be in conformance with American Wood Preservers' Association Standards C1, C2, C3, C4, C5, C14 and C18. Minimum net retention shall be as required for material in contact with soil.

**BASIS OF ACCEPTANCE.** Acceptance of this material shall be in accordance with procedural directives of the Department.

**708-31 WOOD PRESERVATIVE - WATERBORNE**

**SCOPE.** These specifications cover waterborne wood preservatives used in the treatment of piles, timber, and lumber.

**MATERIAL REQUIREMENTS.** Waterborne wood preservatives shall be Alkaline Copper Quarternary (ACQ), Copper Azol, Ammoniacal Copper Arsenite (ACA) or Chromated Copper Arsenate (CCA) conforming to the requirements of American Wood-Preservers' Association Standard P5.

Waterborne wood preservatives shall be applied in conformance with American Wood Preservers' Association Standards C1, C2, C3, C4, C5, C14 and C18. Minimum net retention shall be as required for material in contact with soil.

**BASIS OF ACCEPTANCE.** Acceptance of this material shall be in accordance with procedural directives of the Department.

**708-32 WOOD PRESERVATIVE - OIL BORNE**

**SCOPE.** These specifications cover oil-borne wood preservative used in the treatment of timber and lumber.

**MATERIAL REQUIREMENTS.** Pentachlorophenol for pressure treatment shall conform to American Wood-Preservers' Association Standard P8.

Oil-borne wood preservative shall be applied in conformance with American Wood-Preservers' Association Standards C1, C2, C5 and C14. The net retention of pentachlorophenol shall be as required for material in contact with soil.

**BASIS OF ACCEPTANCE.** Acceptance of this material shall be in accordance with procedural directives of the Department.

**SECTION 709 - REINFORCING STEEL**

**709-01 BAR REINFORCEMENT, GRADE 420**

**SCOPE.** This specification covers the material requirements for deformed billet steel and deformed rail steel reinforcing bars used in portland cement concrete. Plain and deformed steel for the fabrication of spirals is included.
MATERIALS REQUIREMENTS

A. Deformed Bar Reinforcement. Steel reinforcing bars shall be deformed billet steel bars meeting the requirements of ASTM A615, Grade 420, or deformed rail steel bars meeting the requirements of ASTM A996M, Grade 420 including Supplementary Requirement S1.

B. Spirals. Spirals shall be plain wire meeting the requirements of ASTM A82, or plain or deformed bars in coils or cut lengths, meeting the requirements of ASTM A615, Grade 420. When specified the spirals shall be epoxy coated in accordance with the applicable requirements of §709-04 or §709-08.

BASIS OF ACCEPTANCE. Bar reinforcement and spirals will be accepted on the basis of the manufacturer's name and location appearing on the Department’s Approved List and a material certification that specifies the product conforms to this specification. Buy America requirements apply.

709-02 WIRE FABRIC FOR CONCRETE REINFORCEMENT

SCOPE. This specification covers the material requirements for wire fabric reinforcement used in portland cement concrete pavement, precast concrete products and other concrete construction.

MATERIALS REQUIREMENTS. Wire fabric reinforcement shall conform to the requirements of either ASTM A185 or ASTM A497, exclusive of the portions pertaining to rejection, retests and rehearing, except as indicated on the plans, in the proposal or as modified herein. The weld shear test will not be required for acceptance of wire fabric for concrete pipe.

BASIS OF ACCEPTANCE. Welded wire fabric for concrete reinforcement will be accepted on the basis of the manufacturer's name and location appearing on the Department’s Approved List and a material certification that specifies the product conforms to this specification. Buy America requirements apply.

709-03 (VACANT)

709-04 EPOXY-COATED BAR REINFORCEMENT

SCOPE. This specification covers bar reinforcement with protective epoxy coatings applied by the electrostatic spray method.

MATERIAL REQUIREMENTS

A. Bar Reinforcement. Steel reinforcing bars shall conform to the requirements of §709-01, Bar Reinforcement, Grade 420 or §709-14, Bar Reinforcement, Grade 520.

B. Epoxy Coating Material. The epoxy coating material shall be an organic, powdered-epoxy resin that is applied by electrostatic methods. Epoxy coating material shall be approved by the Materials Bureau. Detailed requirements and procedures for the acceptance of epoxy coating materials are available from the Materials Bureau. Upon approval of the product, the epoxy coating will be placed on a Department “Approved List” of materials. The epoxy coating manufacturer shall supply written certification to the coating applicator that the coating material is the same as that approved by the Materials Bureau.

C. Patching Material. Patching or repair materials shall be supplied by the epoxy coating manufacturer. The patching material shall be compatible with the epoxy coating, inert in concrete, and suitable for use in making shop or field repairs.
Coating Application

A. Coating Applicator. The coating applicator's facilities shall be approved by the Materials Bureau. Applications for approval of facilities shall be made to the Materials Bureau by the coating applicator. Upon approval, the name and address of the coating applicator will be placed on the Department's list of "Approved Applicators."

B. Surface Preparation

1. The surface of bars to be coated shall be blast cleaned in accordance with the Steel Structures Painting Council - Surface Preparation Specification No. 10 (SSPC-SP10), Near White Blast Cleaning. After blasting, the cleaned surface of the bar shall be defined by SSPC-Vis 1-89, Pictorial Standards A SP 10, B SP 10, or C SP 10, as applicable.
2. A suitable anchor pattern shall be produced by the cleaning media. A target profile of approximately (1/3) the coating thickness shall be considered suitable as an anchor pattern. Measurements shall be taken using a surface profile gage, or replica tape, approved by the Materials Bureau.
3. The powdered epoxy resin coating shall be applied to the cleaned surface as soon as possible after cleaning and before visible oxidation occurs. In no case shall more than 8 hours elapse between cleaning and coating.

C. Coating Application. The powdered epoxy resin coating shall be electrostatically applied to pre-heated bars, and cured in accordance with the recommendations of the coating manufacturer. The epoxy coating may be applied before or after fabrication (bending) of the reinforcement bars.

D. Coating Thickness

1. The epoxy coating shall be applied as a uniform, smooth coat. After curing, the coating thickness shall be 0.25 ± 0.05 mm.
2. Coating thickness shall be determined by taking measurements on a minimum of five coated bars from each production lot. Five spot measurements shall be obtained from evenly spaced locations along each side of the test bar (a minimum of 10 spot measurements per bar). A spot measurement is defined as the average of three individual readings obtained from three adjacent areas on the body, or on the deformations of the bar.
3. For acceptance purposes at least ninety (90) percent of all spot thickness measurements shall be 0.20 mm to 0.30 mm after cure, and no spot measurement of coating thickness shall be less than 0.20 mm or greater than 0.38 mm.
4. Coating thickness shall be measured by the method outlined in ASTM G12, except that the number and location of thickness measurements shall be in accordance with this specification. All magnetic gages shall be approved by the Materials Bureau.

E. Continuity of Coating

1. The coating shall be checked visually after cure for continuity. It shall be free from holes, voids, contamination, cracks and damaged areas.
2. The coating shall have not more than two holidays (pinholes not visible to the naked eye) in any 0.3 m length of the coated bar. A 67.5 volt, 80,000 ohm, d-c holiday detector shall be used in-line to check the coating for holidays at all times during the application of epoxy protective coating. Bar reinforcement that is coated when the in-line detector is inoperable shall be automatically rejected.

F. Coating Cure. The coating applicator shall check each production lot to determine that the entire production lot of coated bars is in a fully-cured condition.
G. Adhesion of Coating

1. The adhesion of the coating shall be evaluated on a minimum of two bars from each production lot. The coated bar shall be bent 120 degrees (after rebound) around a mandrel of specified size as designated in Table 709-4. The bend shall be done at a uniformly slow rate and may take up to 45 seconds to complete. The bend test specimen shall be positioned so that the two longitudinal deformations are in a plane perpendicular to the mandrel radius. The test specimens shall be between 20°C and 30°C at the time of testing.
2. No cracking, disbondment, or other coating defect shall be visible to the naked eye on the outside, or on the inside radius of the bent bar.
3. If both test specimens show evidence of cracking or disbondment, the production lot represented by the samples shall be rejected.
   If only one of the two test specimens shows evidence of cracking or disbondment of coating, two additional random samples shall be tested. If the test results from both retests show no defects, the production lot represented by the samples shall be accepted. If the test results of either retest fails, the production lot represented by the samples will be rejected.

<table>
<thead>
<tr>
<th>TABLE 709-4 BEND TEST REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bar Number</td>
</tr>
<tr>
<td>Bar Size (in)</td>
</tr>
<tr>
<td>Mandrel Diam. (mm)</td>
</tr>
</tbody>
</table>

NOTE: Numbers in parenthesis are bar sizes marked in eighths of inches

SAMPLING AND TESTING

A. Lot Size. For test purposes a production lot is the smallest number of reinforcement bars of the same type, heat and size as determined by the following requirements:

1. A lot shall not exceed a single order.
2. A lot shall consist of the number of bars as defined by the coating applicator, except that it shall not exceed the number of reinforcement bars coated within a single working shift.

B. Quality Control. The coating applicator shall be responsible for performing quality control and test. This will include inspection for compliance with the requirements of Coating Thickness, Continuity of Coating, and Coating Cure, and the testing required under Adhesion of Coating.

C. Plant Inspection

1. The Department reserves the right to have its authorized representative observe the preparation, coating, and testing of the reinforcement bars. The representative shall have free access to the plant. Any work done when access has been denied shall be automatically rejected.
2. If the representative elects, lengths of coated bars may be taken from the production run, on a random basis, for test, evaluation and check purposes by the Materials Bureau.

Repair of Coated Bars

A. Repairs at the Coating Applicator’s Facility

1. Repairs will not be allowed on epoxy-coated reinforcement bars that do not meet the requirements for Coating Thickness, Continuity of Coating, Coating Cure, or Adhesion of Coating. Reinforcement bars exhibiting any one of these defects shall be replaced, or stripped of epoxy coating, recleaned, and recoated in accordance with this specification.
2. All other damage that occurs from handling, or for other reasons, at the coating applicator’s facility shall be repaired with patching material. All repairs shall be performed as soon as possible.
and before visible rust (oxidation) appears on the steel surface. All repairs shall be performed in accordance with the recommendations of the manufacturer of the patching material.

3. The coating applicator shall be responsible for repair to the coating due to damage at the coating applicator's facility.

**B. Repair at the Fabrication Facility**

1. The fabricator shall be responsible for repair to the coating due to damage during fabrication and handling at the fabricator's facility.
2. All coating damage due to fabrication, or handling, or for other reasons that occurs at the fabricator's facility shall be repaired with patching material.
3. Wherever bond loss or damaged areas of coating exist, they shall be cleaned and repaired. The cleaning shall remove loose or deleterious material, or both. In cases where rust is present it shall be removed by blast cleaning prior to repairs. The requirements of Surface Preparation, part 2a., shall apply.
4. Visible cracks, including hairline cracks without bond loss that occur due to fabrication of the bars, shall be repaired with patching material.
5. When coated bars are sheared, saw-cut, or cut by other means during the fabrication process, the exposed ends shall be coated with patching material.
6. All repairs shall be performed as soon as possible and before visible rust (oxidation) appears on the steel surface.

**HANDLING AND STORAGE.** All systems for handling coated bars shall have padded contact areas for the bars. All bundling bands shall be padded and all bundles shall be lifted with a strong back, multiple supports or a platform bridge so as to prevent bar to bar abrasion from sags in the bar bundle. The bars or bundles shall not be dropped or dragged.

Epoxy-coated bar reinforcement shall be stored above the ground on wooden or padded supports. Epoxy-coated bar reinforcement shall not be stored unprotected outdoors. All coated bars that are stored outdoors shall be protected from sunlight and moisture, using opaque waterproof covers. The covers shall be placed in a manner that will permit constant air circulation so as to minimize the formation of condensation on the epoxy-coated bar surface.

**BASIS OF ACCEPTANCE.** Epoxy-coated bar reinforcement, grade 420 or grade 520, will be accepted on the basis of the names and locations of the reinforcing bar manufacturer and the epoxy reinforcing bar applicator appearing on the Department’s Approved List and a material certification from the epoxy reinforcing bar applicator that specifies the product conforms to this specification. In addition, fabricated, epoxy-coated bar reinforcement will be supplied by a fabricator appearing on the Department’s Approved List, Fabricators for Epoxy-Coated Steel Reinforcing Bars. *Buy America requirements apply.*

**709-05 STUD SHEAR CONNECTORS**

**SCOPE.** This specification covers the material requirements for stud shear connectors used in bridge structures.

**MATERIALS REQUIREMENTS.** Steel used for the manufacture of stud shear connectors shall conform to the Specification for Steel Bars, Carbon, Cold Finished, Standard Quality, ASTM A108, UNS Designation G10100 thru G10200, either Semi-Killed, or Killed Deoxidation.

Stud shear connectors shall be furnished in the dimension shown on the Contract Plans.

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based on the manufacturer's certification of compliance with these specification requirements.

ASTM quality control tests shall have been made not more than six months prior to the date of manufacture of the studs.
709-06 LOW-RELAXATION PRESTRESSING STEEL, GRADE 1860

SCOPE. This specification covers the material requirements for low-relaxation prestressing steel used in the fabrication of prestressed concrete units.

MATERIAL REQUIREMENTS. Low-relaxation prestressing steel shall conform to the requirements of ASTM A416M, Grade 1860. Low-relaxation prestressing steel shall be free of dirt, oil, paint, mill scale, corrosion, coatings, lubricants, or any other foreign material that may prevent an acceptable bond between the steel and the concrete.

BASIS OF ACCEPTANCE. Low-relaxation prestressing steel will be accepted on the basis of the manufacturer's name and location appearing on the Department’s Approved List and a material certification that specifies the product conforms to this specification. Buy America requirements apply.

709-07 STONE CURB ANCHOR BARS

SCOPE. This specification covers the material requirements for stone curb bars used in bridge construction.

MATERIAL REQUIREMENTS. Anchor bars for Types F1, G1, M, R1, R2, S and T1 curbs shall meet the requirements of ASTM A615M, Grade 420 or Grade 520, deformed billet-steel bars shall be galvanized in accordance with §719-01, Galvanized Coatings and Field Repair Methods, Type I. As an alternate to galvanizing, the bars may be treated with a protective epoxy coating. This coating shall be applied by either the electrostatic spray method of the electrostatic fluidized bed method, as specified in §709-04 Epoxy Coated Bar Reinforcement or in accordance with the applicable requirements of §705-14 Longitudinal Joint Ties.

BASIS OF ACCEPTANCE. The stone curb anchor bars will be accepted when on the basis of evaluation by the Engineer, the product complies with these specification requirements.

709-08 EPOXY COATED WIRE FABRIC REINFORCEMENT

SCOPE. This specification covers sheets of wire fabric reinforcement with protective epoxy coatings that are applied by the electrostatic spray method or electrostatic fluidized bed method.

MATERIAL REQUIREMENTS

A. Wire Fabric Reinforcement. Wire fabric reinforcement shall conform to the requirements of §709-02.

B. Epoxy Coating Material

1. The epoxy coating material shall be an organic, powered epoxy resin that is applied by electrostatic methods. Epoxy coating materials shall be approved by the Materials Bureau. Detailed requirements and procedures for the acceptance of epoxy coating materials are available from the Materials Bureau. Upon approval of the product, the epoxy coating will be placed on a Department Approved List of materials.

2. The epoxy coating manufacturer shall supply written certification to the coating applicator that the coating material is the same as that approved by the Materials Bureau.

C. Patching Material. Patching or repair materials shall be supplied by the epoxy coating manufacturer. The patching material shall be compatible with the epoxy coating, inert in concrete, and shall be suitable for use in making field repairs.
Coating Application

A. Coating Applicator. The coating applicator's facilities shall be approved by the Materials Bureau. Applications for approval of facilities shall be made to the Materials Bureau by the coating applicator. Upon approval, they will be placed on the Department's list of "Approved Applicators For Epoxy Coated Wire Fabric Reinforcement."

B. Surface Preparation
1. The surface wire fabric to be coated shall be blast cleaned in accordance with the Steel Structures Paint Council - Surface Preparation Specification No. 10 (SSPC-SP10), near White Blast Cleaning. After blasting, the cleaned surface of the bar shall be defined by SSPC-Vis 1-89, Pictorial Standards A SP 10, B SP 10, or C SP 10, as applicable.
2. The powdered epoxy resin coating shall be applied to the cleaned surface as soon as possible after cleaning and before visible oxidation occurs. In no case shall more than 8 hours elapse between cleaning and coating.

C. Coating Application. The powdered epoxy resin coating shall be electrostatically applied in accordance with the recommendations of the coating manufacturer.

D. Coating Thickness. The epoxy coating shall be applied as a smooth, uniform coat. After curing, the coating thickness shall be a minimum of 0.10 mm. Coating thickness shall be controlled by taking measurements on a representative sample from each production lot. Coating thickness measurements shall be conducted by the method outlined in ASTM B499.

E. Continuity of Coating
1. The coating shall be checked visually after cure for continuity. It shall be free from holes, voids, contamination, cracks and damaged areas.
2. The coating shall not have more than two holidays (pinholes visible to the naked eye) in any 0.3 m length of a coated single wire. A holiday detector shall be used, in accordance with the manufacturer's instructions, to check the coating for holidays. Sharp edges at the welded intersection of the wires shall not be considered to be holidays.

F. Coating Cure. The coating applicator shall check each production lot to determine that the entire production lot of coated fabric is in a fully-cured condition.

G. Flexibility of Coating
1. The flexibility of the coating shall be evaluated on two representative sections of wire fabric from each production lot or two #16, Grade 420 reinforcing bars that have been coated simultaneously with the wire fabric. A representative wire from the wire fabric shall be bent 120 degrees (after rebound) around a pin or mandrel of 10 diameters or alternately, a reinforcing bar shall be bent 120 degrees around a 150 mm diameter pin or mandrel. Bending shall be done at a minimum rate and may take up to one minute to complete. The test specimens shall be a thermal equilibrium between 20°C and 30°C at the time of testing.
2. When examined by the naked eye, the outside radius of the bent wire or bar shall be free of cracks in the coating.

TESTING AND SAMPLING

A. Lot Size. For test purposes a production lot is the smallest number of sheets of wire fabric of the same style (gauge, spacing size) from a given manufacturer as determined by the following requirements:
1. A lot shall not exceed a single order, or delivered load of 1500 sheets, whichever is smaller.
2. A lot shall consist of the number of sheets as defined by the coating applicator except that it shall not exceed the number of sheets coated within a single working shift.
3. A lot shall consist of the number of sheets of mesh coated with the same batch or lot of epoxy.
B. Quality Control. The coating applicator shall be responsible for performing quality control and tests. This will include inspection for compliance with the requirements of Coating Thickness, Continuity of Coating and Coating Cure and the testing required under Flexibility of Coating.

C. Plant Inspection.

1. The Department reserves the right to have its authorized representative observe the preparation, coating and testing of wire fabric. The representative shall have free access to the plant. Any work done while access was denied will be rejected.

2. If the representative elects, samples of coated fabric may be taken from the production run, on a random basis, for test, evaluation and check purposes by the Materials Bureau.

REPAIR. Epoxy coated wire fabric reinforcement which does not meet the requirements of Coating Thickness, Continuity of Coating, Coating Cure or Flexibility of Coating shall not be repaired. Reinforcement with these defects shall be replaced or stripped of epoxy coating, recleaned and recoated in accordance with the requirements of this specification.

Any damage to the coated reinforcement, occurring at the coating applicator's facility shall be cleaned and repaired with patching material. The cleaning shall remove loose or deleterious material or both. If rust is present, it shall be removed by blast cleaning prior to patching.

HANDLING. All systems for coated wire fabric shall have padded contact areas, wherever possible. All bundling bands shall be padded and all bundles shall be lifted with a strong back, multiple supports or a platform bridge so as to prevent sheet to sheet abrasion from sags in the bundle. The sheets or bundles shall not be dropped or dragged.

BASIS OF ACCEPTANCE. Epoxy-coated wire fabric will be accepted on the basis of the names and locations of the welded wire fabric manufacturer and the epoxy applicator appearing on the Department’s Approved List and a material certification from the epoxy applicator that specifies the product conforms to this specification. Buy America requirements apply.

709-09 COLD-DRAWN WIRE FOR CONCRETE REINFORCEMENT

SCOPE. This specification covers the material requirements for cold-drawn wire for concrete reinforcement used in portland cement concrete pavement, precast concrete products and other concrete construction.

MATERIAL REQUIREMENTS. Cold-drawn wire shall conform to the requirements of either ASTM A82 or ASTM A496, exclusive of the portions pertaining to rejection, retests and rehearing, except as indicated on the plans or in the proposal.

BASIS OF ACCEPTANCE. Cold-drawn wire will be considered for acceptance on the basis of the Manufacturer's name appearing on the Approved List and certification in accordance with procedural directives of the Materials Bureau.

Alternate cold-drawn wire from a Manufacturer not appearing on the Approved List may be considered for acceptance in stock lot quantities at manufacturing locations based on sampling and testing in accordance with procedural directives of the Materials Bureau.

709-10 MECHANICAL CONNECTORS FOR REINFORCING BAR SPLICES

SCOPE. This specification covers the material requirements for mechanical connectors for splicing reinforcing bars.

GENERAL. Mechanical connectors for use on epoxy coated reinforcing bars shall be epoxy coated. Mechanical connectors coated prior to installation shall be coated in conformance with the applicable requirements for epoxy coatings contained in §709-04, Epoxy Coated Reinforcement. Mechanical connectors coated after installation shall be coated with an epoxy repair material compatible with the
reinforcing bar epoxy coating. The assembled connection on epoxy coated reinforcing bars shall have no exposed uncoated steel. Any damage to the epoxy on the mechanical connector or reinforcing bars shall be repaired with a compatible epoxy repair material.

Mechanical connectors used on Galvanized Bar Reinforcement shall be galvanized in accordance with §719-01 Galvanized Coatings and Repair Methods.

Mechanical connectors for Stainless Clad Reinforcement and Stainless Steel Reinforcement shall be fabricated from stainless steel meeting the requirements of ASTM A959 UNS S31600.

**MATERIAL REQUIREMENTS.** Mechanical connectors will be tested for the following three parameters:

- The maximum slip, at 50% of the yield strength of the reinforcing bar, shall be 0.254 mm. At least 70% of the maximum slip shall have occurred on the first cycle.
- The maximum slip, at 90% of the yield strength of the reinforcing bar, shall be 0.457 mm.
- The tensile strength of the splice shall be at least 90% of the specified minimum tensile strength of the reinforcing bar.

**BASIS OF ACCEPTANCE.** Application for approval of mechanical connectors shall be submitted to the Materials Bureau. Detailed requirements and procedures for approval are available from the Materials Bureau. Upon approval the name of the mechanical connector will be placed on an Approved List.

Project acceptance will be based on the manufacturer's name and type of mechanical connector appearing on the Department's Approved List titled "Mechanical Connectors for Reinforcing Bar Splices."

### 709-11 GALVANIZED BAR REINFORCEMENT

**SCOPE.** This specification covers bar reinforcement with a hot dipped galvanized coating. Bar reinforcement will be coated before or after bending, as required by the payment specification.

**MATERIAL REQUIREMENTS**

**A. Reinforcing Steel.** The material for the reinforcing steel shall meet the requirements of §709-01 Bar Reinforcement, Grade 420 or §709-14, Bar Reinforcement, Grade 520.

**B. Galvanizing.** The bar reinforcement shall be galvanized in accordance with ASTM A767 “Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement” to a Class I Coating.

**C. Embrittlement Testing.** The coating applicator shall take the necessary precautions to prevent embrittlement by conforming to the requirements of STM A-143 “Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedures for Detecting Embrittlement”. The test for embrittlement shall be conducted by the coating applicator or his representative according to the bend test described in ASTM A-615 “Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement”. The coating applicator shall include one reinforcing bar test specimen at least 1 meter long for each lot for this testing. The test specimen shall have the same diameter as the lot members and shall be quenched, and galvanized in the same manner and at the same time as the bars whose characteristics it is intended to represent. If the test specimen cracks or otherwise fails the bend test, the entire lot it represents shall be rejected.

For test purposes, a lot is any one of the following:

- Reinforcing bars of the same diameter comprising a single order
- A number of reinforcing bars of the same diameter identified as a lot by the coating applicator, providing the bars are all been coated within a single production shift
- One thousand reinforcing bars of the same diameter. Notwithstanding the above two, no lot shall exceed one thousand bars.

**D. Identification.** The Contractor shall coordinate the tagging and identification requirements for the project and for lot identification and shall provide a non-destructive metal tag system for bent reinforcing bars.
E. Inspection. The materials Bureau shall be notified 30 days prior to the beginning of the coating application. The Materials Bureau representative and any other Department authorized representative shall have free access to the plant for inspection. Work done while any Department representative has been refused access shall be automatically rejected.

If the Department representative so elects, preparation of the bars, quenching and coating shall be done in his presence. On a random basis, lengths of coated bars may be taken by the representative from the production run at the point of coating application for test, evaluation and check purposes.

F. Zinc Rich Paint. Zinc rich paint used for field repairs of galvanized coatings shall meet the following requirements:
- One application of the material shall provide a dry film thickness of 50 mm
- The dried fill shall have a minimum zinc dust content of 94% by mass
- The paint shall be compatible with the galvanizing and shall be inert in concrete
- The brand of material used shall be approved by the galvanizer.

BASIS OF ACCEPTANCE. The coating applicator shall furnish a Certificate of Compliance with each shipment of coated bars. The Certificate of compliance shall state the representative samples of the coated bars have been tested and that the test results conform to the requirements described herein. Test results shall be retained and made available, if requested. The Certificate of Compliance and the documentation required for uncoated reinforcement bars by §709-01 Bar Reinforcement, Grade 420 or §709-14, Bar Reinforcement, Grade 520, shall accompany each shipment to the job site.

709-12 STAINLESS-CLAD-BAR REINFORCEMENT

SCOPE. This specification covers composite bar reinforcement consisting of a mild steel core with a bonded exterior layer of stainless steel.

MATERIAL REQUIREMENTS

Mechanical Properties. The composite bar reinforcement shall meet the mechanical property requirements of ASTM A615M, Grade 420 or ASTM A615M, Grade 520.

Stainless-Steel-Cladding. The stainless-steel-cladding shall meet the requirements of ASTM A959 UNS S31600. The completed composite bar reinforcement shall have a minimum stainless-steel-cladding thickness of 180 µm.

Quality Control. The manufacturer shall provide a quality control plan for review and approval by the Director, Materials Bureau a minimum of thirty (30) days prior to delivery. The plan shall clearly demonstrate the ability to manufacture, test, certify, maintain, and assure the identity of bars from manufacture to placement.

Inspection. The receipt of the manufacturer’s quality control plan will serve as Department notification of the manufacturer’s intention to supply reinforcing bars to Department work. The Materials Bureau will arrange for the inspection and sampling of bars by a Department representative. Department representatives shall have free access to the plant for inspection and/or sampling to verify specification compliance. Work done while any Department representative has been refused access shall be automatically rejected.

Randomly selected lengths of clad bars will be taken by the representative from the production run for test, to assure specification compliance. The manufacturer shall allow fourteen (14) days from the receipt of the samples in the Materials Bureau’s laboratory for evaluation to verify the acceptability of the bars and subsequent authorization for shipment.

BASIS OF ACCEPTANCE. Subsequent to the review and approval of the manufacturer’s Quality Control Plan, stainless clad reinforcing bars will be considered for acceptance in mill-banded, stock-lot quantities at manufacturing sites in accordance with procedural directives of the Materials Bureau.
709-13 STAINLESS STEEL BAR REINFORCEMENT

SCOPE. This specification covers steel bar reinforcement consisting of stainless steel.

MATERIAL REQUIREMENTS

Material Properties. The stainless steel shall meet the requirements of ASTM A955 M and its designated grade, either 420 or 520, and shall also meet the requirements of either ASTM A 276 UNS S31653 or UNS S31803.

Quality Control. The manufacturer shall provide a quality control plan for review and approval by the Director, Materials Bureau, a minimum of thirty (30) days prior to delivery. The plan shall clearly demonstrate the ability to manufacture, test, certify, maintain, and assure the identity of bars from manufacture to placement.

Inspection. The receipt of the manufacturer’s quality control plan will serve as Department notification of the manufacturer’s intention to supply reinforcing bars to Department work. The Materials Bureau will arrange for the inspection and sampling of bars by a Department representative. Department representatives shall have free access to the plant for inspection and/or sampling to verify specification compliance. Work done while any Department representative has been refused access shall be automatically rejected.

Randomly selected lengths of stainless bars will be taken by the representative from the production run for test, to assure specification compliance. The manufacturer shall allow fourteen (14) days from the receipt of the samples in the Materials Bureau’s laboratory for evaluation to verify the acceptability of the bars and subsequent authorization for shipment.

BASIS OF ACCEPTANCE. Subsequent to the review and approval of the manufacturer’s quality control plan, stainless reinforcing bars will be considered for acceptance in mill-banded, stock-lot quantities at manufacturing sites in accordance with procedural directives of the Materials Bureau.

709-14 BAR REINFORCEMENT, GRADE 520

SCOPE. This specification covers the material requirements for deformed billet steel reinforcing bars used in portland cement concrete. Plain and deformed steel for the fabrication of spirals is included.

MATERIAL REQUIREMENTS

Deformed Bar Reinforcement. Steel reinforcing bars shall be deformed billet steel bars meeting the requirements of ASTM A615, Grade 520.

BASIS OF ACCEPTANCE. Bar Reinforcement and spirals will be accepted on the basis of the manufacturer’s name and location appearing on the Department’s Approved List and a material certification that specifies the product conforms to this specification. Buy America requirements apply.

SECTION 710 - FENCE AND GUIDE RAIL

710-01 ALUMINUM FENCE FABRIC

SCOPE. This specification covers the requirements for aluminum alloy, chain link fence fabric.

MATERIAL REQUIREMENTS. Aluminum chain link fence fabric shall conform to the requirements of AASHTO M181, Chain Link Fence, Type III, except as modified herein.

A. Wire. The aluminum alloy wire shall be 6061-T94 conforming to the applicable chemical composition limits of ASTM B211M.
**§710**

**B. Mesh Size and Wire Diameter.** The size of the mesh and the wire diameter shall be 50 mm and 9 gage (3.759 mm) respectively unless otherwise specified in the plans or proposal.

**SHIPPING.** Fabric shall be furnished in a clean condition free of all foreign material, including oil, dust, film, etc.

**BASIS OF ACCEPTANCE.** Aluminum fence fabric will be accepted on the basis of a material certification that specifies the product conforms to this specification.

**710-02 GALVANIZED STEEL FENCE FABRIC**

**SCOPE.** This specification covers the requirements for galvanized steel chain link fence fabric.

**MATERIALS REQUIREMENTS.** Galvanized steel chain link fence fabric shall conform to the requirements of AASHTO M181, Chain Link Fence, Type I, except as modified herein.

- **A. Mesh Size Coated Wire Diameter.** The size of the mesh and the coated wire diameter shall be 50 mm and 9 gage (3.759 mm) respectively unless otherwise specified in the plans or proposal.

- **B. Zinc-Coating.** The 50 mm mesh shall be galvanized with a Class D coating (610 g/m²) by the hot-dip process after weaving. When 25 mm mesh is specified, it shall be galvanized with Class D Coating (610 g/m²) before weaving by the electrolytic process.

**SHIPPING.** Fabric shall be furnished in a clean condition free of all foreign material, including oil, dust, film, etc.

**BASIS OF ACCEPTANCE.** Galvanized steel fence fabric will be accepted on the basis of a material certification that specifies the product conforms to this specification. *Buy America requirements apply.*

**710-03 VINYL COATED STEEL FENCE FABRIC**

**SCOPE.** This specification covers the material requirements for Class A-Extruded Polyvinyl Chloride (PVC)-Coated Steel Fence Fabric, and Class B-Bonded Polyvinyl Chloride (PVC)-Coated Steel Fence Fabric.

**MATERIAL REQUIREMENTS.** Vinyl coated steel chain link fence fabric shall conform to the requirements of AASHTO M181, Chain Link Fence, Type IV, except as modified herein.

- **A. Mesh Size.** The size of the mesh shall be 50 mm unless otherwise specified in the contract documents.

- **B. Wire Diameter.** The wire diameter shall be as follows unless specified otherwise in the contract documents:
  
  1. **Class A-** Extruded Polyvinyl Chloride (PVC)-Coated Steel shall have a 9-gage (3.759 mm) metallic coated core wire.
  
  2. **Class B-** Bonded Polyvinyl Chloride (PVC)-Coated Steel shall have an 11-gage (3.048 mm) metallic coated core wire.

- **C. Vinyl Coating.** The color of the vinyl coating shall be dark green unless shown otherwise in the contract documents. The Engineer shall have the option of approving an alternate color if the specified color is unavailable. An adhesion test is not required for coatings which are extruded or extruded and bonded.
§710

SHIPPING. Fabric shall be furnished in a clean condition, free of all foreign material, including oil, dust, film, etc.

BASIS OF ACCEPTANCE. Vinyl-coated steel fence fabric will be accepted on the basis of a material certification that specifies the product conforms to this specification. Buy America requirements apply.

710-04 ALUMINUM COATED STEEL FENCE FABRIC

SCOPE. This specification covers the requirements for Aluminum Coated Chain Link Fence Fabric.

MATERIAL REQUIREMENTS. Aluminum coated steel fabric shall conform to the requirements of AASHTO M181, Chain Link Fence, Type II, except as modified herein.

Mesh Size and Coated Wire Diameter. The size of the mesh and the coated wire diameter shall be 50 mm and 9 gage (3.759 mm) respectively unless otherwise specified in the contract documents.

SHIPPING. Fabric shall be furnished in a clean condition free of foreign material including oil, dust, film, etc. except that a methacrylate lacquer may be used to protect it under storage conditions.

BASIS OF ACCEPTANCE. Aluminum-coated steel fence fabric will be accepted on the basis of a material certification that specifies the product conforms to this specification. Buy America requirements apply.

710-05 COATED STEEL FENCE FABRIC, (95% ZINC 5% ALUMINUM - MISCHMETAL ALLOY)

SCOPE. This specification covers the requirements for coated steel fence fabric (95% zinc 5% aluminum - mischmetal alloy).

MATERIAL REQUIREMENTS. Coated steel fence fabric (95% zinc 5% aluminum - mischmetal alloy) shall conform to the dimensional and strength requirements of AASHTO M 181 Chain Link Fence Type I, except as modified herein.

A. Mesh Size. The size of the mesh shall be 51 mm unless otherwise specified in the contract documents.

B. Coated Wire Diameter. The size of the coated wire diameter shall be 9 gage (3.759 mm) unless otherwise specified in the contract documents.

C. Coating. The coating shall meet the requirements of ASTM F 1345 Class 2 (305 g/m2).

SHIPPING. Fabric shall be furnished in a clean condition, free of all foreign material including oil, dust, film, etc.

BASIS OF ACCEPTANCE. Coated steel fence fabric will be accepted on the basis of a material certification that specifies the product conforms to this specification. Buy America requirements apply.

710-06 THRU 710-09 (VACANT)

710-10 STEEL AND IRON POSTS, RAILS, BRACES, AND FITTINGS FOR CHAIN LINK FENCE

SCOPE. This specification covers the requirements for steel and iron posts, rails, braces and fittings used in erecting chain link fence. The contractor shall have the option of supplying any one of the post sections shown on the Standard Sheets.
MATERIALS REQUIREMENTS. The following specifications cover the material requirements for each of the sections, fittings, and tension wires shown in the Post and Rail schedule on the Standard Sheets for Chain Link Fence:

A. Class A, Schedule 40 Pipe. Posts, rails and braces shall be standard weight Schedule 40 Pipe, manufactured in accordance with ASTM F1083, except that the protective coating system shall be as specified herein.

B. Class B, Steel Tubing. Posts, rails and braces shall be manufactured by one of the following methods with the steel conforming to ASTM A1011 or ASTM A1008 and A1011/A1011M with a minimum yield strength of 345 MPa:
- Furnace butt welded, continuous welded
- Cold rolled and electric resistance welded
- Seamless

The tubing shall conform to the following dimensions:

<table>
<thead>
<tr>
<th>Nominal Size</th>
<th>Outside Diameter, mm</th>
<th>Minimum Wall Thickness, mm</th>
<th>Mass Kg/m</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/4 NPS</td>
<td>42.16</td>
<td>2.819</td>
<td>2.732</td>
</tr>
<tr>
<td>1 1/2 NPS</td>
<td>48.26</td>
<td>3.048</td>
<td>3.394</td>
</tr>
<tr>
<td>2 NPS</td>
<td>60.32</td>
<td>3.302</td>
<td>4.639</td>
</tr>
<tr>
<td>2 1/2 NPS</td>
<td>73.02</td>
<td>4.064</td>
<td>6.904</td>
</tr>
</tbody>
</table>

C. Class C, Rolled-Formed Shapes. Posts, rails and braces shall be roll formed shapes which meet the requirements of ASTM F1043.

D. H-Posts. H Posts shall be fabricated from hot-rolled steel sections which meet the requirements of ASTM F1043.

E. Fittings. Fittings shall be manufactured of weldable steel, malleable iron, cast steel, cast iron, or aluminum alloy.

1. Weldable Steel. Weldable steel shall be commercial quality or better, produced by one of the following processes: Open-Hearth, Electric Furnace, or Basic Oxygen.


3. Cast Iron. Cast iron shall conform to the requirements of §715-05.

4. Cast Steel. Cast steel shall conform to the requirements of §715-02.

5. Aluminum Alloy. Aluminum alloy shall meet the material requirements of §710-11.

F. Tension Wire. Tension wire shall meet the requirements of ASTM A641M, as modified herein. The wire shall be a no. 7 gauge minimum 4.50 mm in diameter, having a minimum tensile strength of 550 MPa, with a minimum galvanized coating of 240 g/m² or a minimum aluminum coating of 120 g/m².

Protective Coating Systems. Posts, rails and braces shall be coated with a protective coating system conforming to one of the following depending on structural member.
A. Class A Schedule 40 Pipe; Class B Steel Tubing

1. Galvanized Coatings. Galvanized both inside and out in accordance with ASTM F1083.

2. Combined Coatings

   a. External surfaces. The external surfaces shall be coated with the following combined coating system:

      (1) Hot Dip Galvanizing. The external surface shall be hot-dip galvanized with “Special High Grade” or “High Grade” slab zinc conforming to ASTM B6. The weight of the coating shall be a minimum 275 g/m².

      (2) Chromate Conversion Coating. Chromate conversion coating shall be specifically designed for use as a pretreatment of galvanized surfaces. The coating shall be applied prior to the application of the thermoplastic acrylic coating at the manufacturer’s recommended rate.

      (3) Clear Coating. A thermoplastic acrylic or cross linked polyester coating shall be applied with a minimum dry film thickness of 7.62 µm.

   b. Internal Surfaces. The internal surfaces of the pipe or tubing shall be coated with one of the following:

      (1) Zinc rich coating. The zinc rich coating shall contain not less than 87% zinc dust by weight and shall be capable of providing galvanic protection. The minimum coating thickness shall be 7.62 µm.

      (2) Cross linked polyester coating containing a corrosion inhibitor

      (3) Hot-dip galvanized coating. The hot-dipped galvanized coating shall average not less than 105 g/m² and no single specimen shall show less than 75 g/m².

B. Class C Roll Formed Shapes and H Posts. All surfaces shall be hot-dip galvanized in accordance with the requirements of §719-01, Type I.

C. Class A Schedule 40 Pipe; Class B Steel Tubing; Class C Roll Formed Shapes, H-Posts.

1. Aluminum with Chromate Coatings. All surfaces shall be given a hot-dipped 99% pure aluminum, Type II coating. The aluminum coating shall average 200 g/m² and no single specimen shall show less than 185 g/m² when tested in accordance with ASTM A428. The coating shall meet the adherence and quality requirements of §719-03. The aluminum coated surfaces shall be given a colorless chromate chemical treatment. The external surfaces shall be given a colorless protective resin coating to protect the material from abrasion in shipment and storage.

2. Mischmetal Alloy Coating (95% Zinc 5% Aluminum). Coating shall meet the requirements of ASTM F 1043 Protective Coatings on Steel Framework for Fences Type C, except the coating weight shall be 305 g/m².

BASIS OF ACCEPTANCE. Steel and iron posts, rails, braces, and fittings for chain link fence will be accepted on the basis of a material certification that specifies the product conforms to this specification. Buy America requirements apply.
710-11 ALUMINUM POSTS, RAILS, BRACES AND FITTINGS FOR CHAIN LINK FENCE

SCOPE. This specification covers the requirements for aluminum posts, rails, braces and fittings to be used in erecting chain link fencing.

MATERIAL REQUIREMENTS. Posts, Rails, Braces and Fittings shall conform to the following materials specifications, alloy, temper and dimensional requirements in Table below.

BASIS OF ACCEPTANCE. Aluminum posts, rails, braces and fittings for chain link fence will be accepted on the basis of a material certification that specifies the product conforms to this specification.

<table>
<thead>
<tr>
<th>Material</th>
<th>Material Spec.</th>
<th>Alloy &amp; Temper</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fabric Ties</td>
<td>715-04</td>
<td>5052-H-38, 1100-H18 or 3003-H14</td>
<td>3.50 mm nom.dia.or 12.70 mm wide X 1.5 mm thick</td>
</tr>
<tr>
<td>Top &amp; Bottom Tension Wires</td>
<td>715-04</td>
<td>6061-T94</td>
<td>4.90 mm nom. dia.</td>
</tr>
<tr>
<td>Hog Rings</td>
<td>715-04</td>
<td>6061-T94</td>
<td>2.80 mm nom. dia.</td>
</tr>
<tr>
<td>Stretcher Bars</td>
<td>715-04</td>
<td>6063-T5 or 6063-T6</td>
<td>6 mm X 19 mm</td>
</tr>
<tr>
<td>Truss Rods</td>
<td>715-04</td>
<td>6061-T6 or 6063-T6</td>
<td>9.50 mm nom. dia.</td>
</tr>
<tr>
<td>Cast Tumblers</td>
<td>715-03</td>
<td>356.0-T6</td>
<td></td>
</tr>
<tr>
<td>Wrought Turnbuckles</td>
<td>715-04</td>
<td>6061-T6 or 6063-T6</td>
<td></td>
</tr>
<tr>
<td>Brace &amp; Stretcher Bands</td>
<td>715-04</td>
<td>3003-H14 or 6063-T6</td>
<td>3.20 mm X 22.20 mm</td>
</tr>
<tr>
<td>Carriage Bolts</td>
<td>715-04</td>
<td>2024-T4</td>
<td></td>
</tr>
<tr>
<td>Brace Ends &amp; Rail Ends</td>
<td>715-03</td>
<td>356.0-T6, 360.0, D712.0, or ZG 61A-T5</td>
<td></td>
</tr>
<tr>
<td>Expansion Sleeves</td>
<td>715-04</td>
<td>6063-T6 or 6063-T832</td>
<td>See Note 1</td>
</tr>
<tr>
<td>Nuts</td>
<td>715-04</td>
<td>2024-T4 or 6061-T6</td>
<td>-</td>
</tr>
<tr>
<td>Line Posts</td>
<td>715-04</td>
<td>6063-T6</td>
<td>Sched. 40 pipe NPS 2</td>
</tr>
<tr>
<td>End, Corner &amp; Intermediate</td>
<td>715-04</td>
<td>6063-T6</td>
<td>Sched. 40 pipe NPS 2 1/2</td>
</tr>
<tr>
<td>Posts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post Tops</td>
<td>715-03</td>
<td>356.0-F, 360.0, D712.0, or ZG61A-T5</td>
<td>-</td>
</tr>
<tr>
<td>Top Rails</td>
<td>715-04</td>
<td>6063-T6</td>
<td>Sched. 40 pipe NPS 1/4</td>
</tr>
<tr>
<td>Brace Rails</td>
<td>715-04</td>
<td>6063-T6</td>
<td>Sched. 40 pipe NPS 1/4</td>
</tr>
</tbody>
</table>

NOTE: 1. Modified Schedule 40 pipe, NPS 1½, 42.9 mm Inside Diameter, 1.98 mm Minimum Wall Thickness, 152.4 mm long.

710-12 PLASTIC COATED POSTS, RAILS, BRACES AND FITTINGS FOR CHAIN LINK FENCE

SCOPE. This specification covers the requirements for plastic coated posts, rails, braces and fittings used for erection of chain link fencing.

MATERIAL REQUIREMENTS. Posts, rails, braces, fittings, and accessories shall comply with the requirements of §710-10, except for the galvanized coatings. Post, rails, braces, fittings and accessories shall be resin-clad with either an epoxy modified ply (vinyl chloride), or a thermoplastic polyester resin. The coating shall have a minimum thickness of 0.178 mm and shall be of the same color as the fabric.

Fabrication Requirements. The epoxy modified poly (vinyl chloride) coating shall be chemically bonded to heated pipe, fittings, etc., or the fitting and pipe, etc., shall be clad with a heavy molecule, saturated, linear thermoplastic polyester resin applied by electrostatic spray and fusing or equal method. Each length of pipe shall be sealed with two snug-fitting polyethylene plug-type seals to prevent condensation and eliminate internal corrosion.
§710

BASIS OF ACCEPTANCE. Plastic-coated posts, rails, braces, and fittings for chain link fence will be accepted on the basis of a material certification that specifies the product conforms to this specification. Buy America requirements apply.

710-13 WOOD AND TIMBER POSTS AND TIMBER BLOCKOUTS

SCOPE. This specification covers wood posts used as witness posts, timber posts, and blockouts used in guiderail construction.

MATERIALS REQUIREMENTS. Wood posts, timber posts, and timber blockouts shall comply with the requirements of §712-14, Stress Graded Timber and Lumber, except that not every timber blockout in the lot need be branded, provided that approximately 10% of the blockouts are branded, and that the un-branded blockouts are visually similar, as determined by the engineer, to the branded blockouts. Using the clean wood properties of ASTM D2555, the bending stress (Modulus of Rupture) shall not be less than 28 MPa. They shall be surfaced on four sides and the dimensions shall be actual or nominal as indicated on the plans. If the dimensions are indicated to be nominal, the actual dimensions provided shall be in accordance with current trade practice. Surface dried redwood, red cedar, cypress or black locust may be used untreated. Other lumber including Douglas fir, pine, oak, birch, apple, and beech may also be used but shall be pressure treated in accordance with §708-31, Wood Preservative-Water borne after all the holes have been drilled and all other woodworking operations have been performed.

Bituminous preservative treatments will not be permitted. Before using, the Contractor shall submit to the Engineer, for approval, information as to the species of timber to be used and method of preservative treatment to be employed.

BASIS OF ACCEPTANCE. Wood and timber posts and timber blockouts will be accepted on the basis of a material certification that specifies the product conforms to this specification.

710-14 GALVANIZED STEEL BARRIER POSTS

SCOPE. This specification covers galvanized steel posts used as guiderail and median barrier posts, I-beam posts for existing guide railing and median barrier, and required soil plates and slip impact bases.

MATERIAL REQUIREMENTS. Galvanized steel barrier post shall conform to the following:

Galvanizing §719-01 Galvanized Coatings and Repair Methods, Type I
Steel ASTM A36M

Posts. Steel posts used as guiderail and median barrier posts or I-beam posts for existing guide railing and median barrier, shall be fabricated from steel conforming to the ASTM A6M shape specified on the standard sheet for the guide railing or median barrier being utilized.

Soil Plates, Slip Impact Bases, and Other Post Components. Soil plates, slip impact bases, and other post components shall be fabricated from steel conforming to the dimensions shown on the standard sheet for the guide railing or median barrier being utilized.

FABRICATION. Guiderail and median barrier posts or I-beam posts for existing guide railing and median barrier shall be fabricated with all required welding, punching, drilling, or cutting of the post or any component of the post completed prior to galvanizing. Welding shall be done in accordance with the requirements of the New York State Steel Construction Manual, except that radiographic inspection of shop welds will not be required.

BASIS OF ACCEPTANCE. Galvanized steel barrier posts will be accepted on the basis of a material certification that specifies the product conforms to this specification. Buy America requirements apply.”

710-15 THRU 710-19 (VACANT)
SCOPE. This specification covers corrugated beam guide railing and median barrier including corrugated beams, posts, anchorage units and accessory hardware.

MATERIAL AND FABRICATION REQUIREMENTS

Posts. Posts shall meet the requirements of §710-14 Galvanized Steel Barrier Posts

Beams, Terminal Sections and Hardware. Corrugated beams, terminal sections and all hardware shall be fabricated in accordance with the details shown on the standard sheets. Bolt holes in the beam at the post hole and elsewhere, as necessary, shall be enlarged or slotted to permit expansion and contraction, and to facilitate erection. The beams shall be of uniform section and straight, unless shop curved beams are required by the plans or specifications. The edges shall be rolled to eliminate sharp edges. When shop curving of corrugated beams is required the radius of curvature shall be stamped into the base metal of the beam. The stamping shall be on the back, at or near both ends of the beam, and in a location where it will be visible to a worker after erection.

Beams and terminal sections shall be rolled from 12 gage (nominal thickness 2.67 mm -0.23 mm tolerance) or heavier sheet or coil stock. The sheet or coil stock shall be new billet open hearth, electric furnace, or basic oxygen steel sheet. The minimum yield point and elongation of the steel used in the beam sections shall be 345 MPa and 12% in 50 mm gage length respectively. Terminal sections, used for finishing-off or ornamental purposes, may be of mild steel, 227 MPa yield point.

Plates and Anchorage Units. Plates and Anchorage Units shall be as detailed on the standard sheet for corrugated beam type guide railing and median barrier. They shall conform to ASTM A36M.

Splices. Splices shall be made with flat, roundheaded, grippable, galvanized bolts, nuts and washers conforming to the following unless specified otherwise in the contract documents: Bolts ASTM F568 Class 4.6, Nuts ASTM A563M Grade A or better, and Washers ASTM F844. They shall be galvanized in accordance with the requirements of §719-01 Galvanized Coatings and Repair Methods, Type II (ASTM A153) unless another coating is specified.

Fabrication Welding. Fabrication welding shall be done in accordance with the New York State Steel Construction Manual, except radiographic inspection of shop welds will not be required.

Galvanizing. The rail element shall be galvanized in accordance with §719-01, Galvanized Coatings and Repair Methods, Type I (ASTM A123) or Type IV (ASTM A525M) of the standard specifications, except that the minimum check limits for the weight of coating as determined by the triple spot and single spot tests for §719-01, Galvanized Coatings and Repair Methods, Type IV (ASTM A525M), shall be 1220 g/m² and 915 g/m² respectively, (total amount both sides of sheet). Posts, plates, and anchorage units shall be galvanized in accordance with §719-01, Galvanized Coatings and Repair Methods, Type I (ASTM A123). Hardware shall be galvanized in accordance with §719-01, Galvanized Coatings and Repair Methods, Type II (ASTM A153).

When beams are to be galvanized in accordance with §719-01, Galvanized Coatings and Repair Methods, Type I (ASTM A123), they shall be blanked to the proper shape, fabricated and ready for assembly before galvanizing. No punching, drilling, cutting or welding will be permitted after galvanizing. When galvanizing in accordance with §719-01, Galvanized Coatings and Repair Methods, Type IV (ASTM A525M), the beam may be fabricated, cut, punched or drilled from galvanized sheet or coil stock. The exposed edges resulting from this process do not have to be repaired or touched up in any way.

BASIS OF ACCEPTANCE. All components of the corrugated beam type guide railing and median barrier shall be accepted in accordance with directives issued by the Department.
§710-21 BOX BEAM GUIDE RAILING AND MEDIAN BARRIER

SCOPE. This specification covers box beam guide railing and median barrier including the guide rail, posts, end assembly units and accessory hardware.

MATERIAL REQUIREMENTS

Posts. Posts shall meet the requirements of §710-14 Galvanized Steel Barrier Posts.

Rails. Rails shall be cold-formed welded and seamless structural tubing. The rails shall conform to ASTM A500, Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes, Grade B, except as modified below. Splice plates and plates welded to tubes for splice assemblies shall be Charpy V-Notch tested. Splice tubes need not be tested.

All rail shall be tested in accordance with ASTM E436 “Drop-Weight Tear Tests of Ferritic Steels” except as modified below.

The tests shall be done after all galvanizing and associated operations have been performed on the rail. The testing shall be conducted at a temperature of -18°C, without removing the galvanizing, on 51 x 229 mm specimens supported to achieve a 178 mm span.

The percent shear area will be determined by testing nine (9) specimens, three (3) from each of three (3) sides not containing a weld. The shear areas of the three specimens from the side with the lowest average shear area shall be disregarded and the final average based on the remaining six specimens. If the average percent shear area falls below 50, the material represented by these tests shall be rejected.

To facilitate acceptance and rejection of material the manufacturer of the structural shape shall, before galvanizing, identify the product with the steel heat number, or some number which is traceable to the heat number, and its own unique identification code. The identification method shall be such that it can be read after the structural shape is galvanized. The identification information shall be placed on the structural shape at intervals not to exceed 1.2m.

When shop curving of box beams is required, the radius of curvature shall be stamped into the base metal of the beam. The stamping shall be the vertical faces, at or near both ends of the beam, and in a location where it will be visible to a worker after erection.

No mill transverse welds will be permitted on the rail sections. Longitudinal welds shall be made by the resistance, gas shielded arc, submerged arc or plasma arc welded process; shall be sound, free from defects, and shall not be repaired. The welded joint, in cold-formed welded rail, shall have a minimum tensile strength specified for the railing when tested according to the tensile strap test of ASTM Method E8M. All fabrication shall be done in accordance with the requirements of the Steel Construction Manual.

Rails shall be galvanized in accordance with §719-01, Type I, Galvanized Coatings and Repair Methods. Slots and round holes may be subsequently drilled, punched, burned, or cut and regalvanized according to the paragraph below on “Regalvanizing Iron and Steel Using a Flame Sprayed Coating System.” This repair procedure shall also apply to curved rail sections and splice plates as required.

Regalvanizing Iron and Steel Using a Flame Sprayed Coating System. Those areas to be regalvanizing shall be blasted with silica sand or crushed garnet of such gradation that sand shall be mesh size 850 µm to 425 µm (# 20 to # 40 U.S. Standard Sieve) with a minimum of 40% retained on a 600 µm mesh screen (# 30 U.S. Standard Sieve). Pressure of not less than 520 kPa shall be maintained at the blast generator.

A sample steel plate shall be blasted until the surface cannot be further cleaned or roughened. This plate shall be used for visual comparison and any areas that do not meet this standard as to roughness or cleanliness shall be reblasted.

The wire used in spraying shall be 3.2 or 4.8 mm diameter, zinc 99.0% purity. Air pressure at the Air Control Unit shall be 415 kPa and there shall be no more than 10 m of 9.5 mm I.D. hose between the Air Control Unit and the gun.

The metal coating shall be applied at a minimum thickness of 0.11 mm. At least one coating shall be applied within 4 hours of blasting and the surface shall be completely coated within 8 hours of blasting. The specified thickness of coating shall be applied in multiple layers and in no case shall less than two passes be made over every part of the surface.
Fasteners. Fasteners shall be galvanized and conform to the following unless specified otherwise in the contract documents. Bolts ASTM F568 M Class 4.6, nuts ASTM A563M Grade A or better, and washers ASTM F844.

BASIS OF ACCEPTANCE. All components of the box beam guide railing and median barrier shall be accepted in accordance with directives issued by the Department.

710-22 CABLE GUIDE RAILING

SCOPE. This specification covers cable guide railing including cable, posts, anchorage units, and accessory hardware.

MATERIAL REQUIREMENTS. Cable Guide Railing shall conform to the following:

<table>
<thead>
<tr>
<th>Piece</th>
<th>ASTM Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posts, Soil Plates</td>
<td>§710-14 Galvanized Steel Barrier Posts</td>
</tr>
<tr>
<td>Reflectors</td>
<td>§730-01 Aluminum Sign Panels</td>
</tr>
<tr>
<td>Reflective Sheeting</td>
<td>§730-05 Reflective Sheeting</td>
</tr>
<tr>
<td>Cable</td>
<td>AASHTO M30 or ASTM A741 Type I Construction, Class A Coating</td>
</tr>
<tr>
<td>Anchor Angle</td>
<td>ASTM A36M</td>
</tr>
<tr>
<td>Bolts</td>
<td>ASTM F568 Class 4.6</td>
</tr>
<tr>
<td>Nuts</td>
<td>ASTM A563M Grade A</td>
</tr>
<tr>
<td>Washers</td>
<td>ASTM F844</td>
</tr>
</tbody>
</table>

Reflectors. The alloy for the aluminum used for the reflectors shall be as specified on the standard sheet for cable guide railing.

Reflective Sheeting. The material designation for the reflective sheeting used for the reflectors shall be as specified on the standard sheet for cable guide railing.

Galvanizing. The bolts, including the “J” bolt used to mount the cable, nuts, washers, anchor rods, spring compensator components, steel turnbuckle cable end assembly, and all cast steel or malleable iron hardware, except the wedge shown in “Detail X” on the standard sheet, shall be galvanized in accordance with the requirements of §719-01 Galvanized Coatings and Repair Methods, Type II, unless another coating is specified. The wedge shown in “Detail X” shall be ungalvanized (black).

The anchor angles shall be galvanized in accordance with the requirements of §719-01 Galvanized Coatings and Repair Methods, Type I.

Welding. Welding shall be performed in accordance with the requirements of the New York State Steel Construction Manual, except radiographic inspection of shop welds will not be required.

BASIS OF ACCEPTANCE. Acceptance shall be based on the manufacturer's certification and in accordance with directives issued by the Department.

710-23 STEEL BRIDGE RAILING

SCOPE. This specification covers the material requirements for Steel Bridge Railing and its component parts.

MATERIAL REQUIREMENTS. Steel Bridge Railing materials shall conform to the following requirements:

<table>
<thead>
<tr>
<th>Piece</th>
<th>ASTM Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail Tubes</td>
<td>A500 Grade B 1</td>
</tr>
<tr>
<td>Rail End Caps</td>
<td>A36M or A588M (A709 Grade 250 or 345W)</td>
</tr>
<tr>
<td>Base Plates ²</td>
<td>A588M or A572M Grade 345 (A709M Grade 345 or 345W)</td>
</tr>
</tbody>
</table>
Anchor Studs    F568M Class 8.8
Splice Bolts,    F568M Class 8.8 or Class 8.8.3
Round Head Bolts F568M Class 8.8 or Class 8.8.3
Nuts 3  A563M
Washers 3  F436M
Lock Washers    High carbon Heat Treated Spring Steel: ASME B18.21.1
Anchor Plates    A36M (A709M Grade 250)
Plate Shims      A588M or A572M (A709M Grade 345 or 345W)
Tube Rail Splices A500 Grade B
Solid Rail Splices A588M or A572M Grade 345 (A709M Grade 345 or 345W)
Angle 2          A588M or A572M Grade 345 (A709M Grade 345 or 345W)
Splice Plates    A588M or A572M Grade 345 (A709M Grade 345 or 345W)
Railing Post 2   A588M or A572M Grade 345 (A709M Grade 345 or 345W)
Tubular Posts    ASTM A500, Grade B

1 Where unpainted A588M (A709M Grade 345W) steel is used for the post, the tube shall be unpainted A500 Grade B with the chemical properties of either A588M (A709M Grade 345W) or A606, Type 4. Railing tube meeting the foregoing requirements will be acceptable if its elongation is a minimum of 21% in 50 mm.
2 All post material, including base plates, shall be furnished to minimum Charpy V-Notch Toughness requirements as required by §715-01, under Charpy V-Notch Impact test.
3 Use the following nut and washers for the given bolt class:

<table>
<thead>
<tr>
<th>BOLT or STUD class</th>
<th>NUT (F563M class &amp; dimension style of nut)</th>
<th>WASHER (A563M type)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.6</td>
<td>5 H1</td>
<td>1 or 3</td>
</tr>
<tr>
<td>8.8</td>
<td>10S HH</td>
<td>1 or 3</td>
</tr>
<tr>
<td>8.8.3</td>
<td>8S3 HH</td>
<td>3</td>
</tr>
</tbody>
</table>

Beveled shims may be machined from the same type of metal as in the post base plates or may be cast from material conforming to the requirements of §715-02, Steel Castings, or §715-09, Malleable Iron Castings.

All rail, except bicycle and pedestrian rail, shall be tested in accordance with ASTM E436 - "Drop-Weight Tear Tests of Ferritic Steels", except as modified below.

The tests shall done after all galvanizing and associated operations have been performed on the rail. The testing shall be conducted at a temperature of \(-18^\circ C\), without removing the galvanizing, on 50 mm x 230 mm specimens supported to achieve a 180 mm span.

The percent shear will be determined by testing nine (9) specimens, three (3) from each of three (3) sides not containing a weld. The shear areas of the three specimens from the side with the lowest average shear area shall be disregarded and the final average based on the remaining six specimens. If the average percent shear area falls below 50 the material represented by these tests shall be rejected.

Splice plates and plates welded to tubes for splice assemblies shall be Charpy V-notch tested. Splice tubes need not be Charpy V-notch tested.

To facilitate acceptance and rejection of material, the manufacturer of the structural shape shall, before galvanizing, identify the product with the steel heat number, or some number which is traceable to the heat number, and its own unique identification code. The identification method shall be such that it can be read after the structural shape is galvanized. The identification information shall be placed on the structural shape at intervals not to exceed 1.2 m.

**FABRICATION.** Bridge Railing shall be fabricated to the dimensions shown in the contract plans and in compliance with the specifications.

**A. Shop Drawings.** Shop drawings, when required by the contract documents, shall be provided in accordance with the requirements of the S.C.M., except that: 1) the drawings shall be submitted to the Engineer for review and approval and 2) the computed weights need not be shown.
B. Welding. Shop welding shall be performed only where specifically noted on the contract documents. Transverse welds shall not be permitted unless directly called for on the contract plans. All welding shall be done in accordance with the requirements of the SCM.

C. Cutting. All exposed flame cut surfaces shall have a surface roughness not to exceed 250, as defined by the ANSI standard specification B46.1. Grind all edges of Posts and Post Base Plates so that all sharp edges are removed.

D. Bending. Rails for curved structures shall be curved in the shop prior to galvanizing. To facilitate bending, rails may be heated to a temperature not exceeding 650°C. 

E. Galvanizing. Galvanizing shall conform to the requirements of §719-01, Galvanized Coatings and Repair Methods, Type I. All components of the railing, including anchor studs, nuts and washers, shall be galvanized. The rails, post assemblies, splices and all hardware shall be fabricated and ready or assembly prior to galvanizing.

   All galvanized bolts and galvanized anchor studs shall have a Class 6g Thread. All galvanized nuts shall have a standard oversized tap to allow for the galvanizing on the bolts and nuts.

   Shop galvanizing repair of uncoated areas will be permitted on localized areas. Repair of localized areas is limited to a total of 1300 mm² on any post or rail. A post or rail which contains galvanizing defects totaling more than 1300 mm² shall be stripped and regalvanized.

   Shop repair shall be made in accordance with the methods given in §719-01.

   The following areas will not require galvanizing repair: One 3 mm maximum dimension spot of tight flux remaining in the fusion line of any 180 mm length of weld after blast cleaning picking and galvanizing.

   When paint is used to obtain a rustic appearance, all components of the railing system shall be galvanized and then the visible portions of the system shall be painted in accordance with §657 Painting Galvanized and Aluminum Surfaces. Paint color shall be ‘Weathered Brown’ as defined by 708-05 Standard Paint Colors.

BASIS OF ACCEPTANCE. The manufacturer shall furnish the Department with three (3) certified copies of physical test and chemical analysis of the materials used in the manufacture of the railing. Check analysis may be made by the Department from delivered material.

   Inspection will be performed in accordance with the provisions of the SCM, except that mill inspection will not be done.

   Materials that do not bear the Inspector's mark of acceptance shall not be accepted at the project site.

710-24 BOX BEAM GUIDE RAIL END ASSEMBLY, TYPE III; AND BOX BEAM MEDIAN BARRIER END ASSEMBLY, TYPE C

SCOPE. These specifications cover the material and quality requirements for Box Beam Guide Rail End Assembly Type III and Box Beam Median Barrier End Assembly, Type C. These end assemblies are manufactured articles requiring federal approval as Test Level 3 end terminals for box beam guide rail and median barrier. They function by absorbing energy either through crushing of fiberglass elements or by splitting the beam element at the corners of the box beam. When specified, these end assemblies are used to terminate the ends of box beam guide rails and box beam median barriers. Box Beam Guide Rail End Assembly Type III and Box Beam Median Barrier End Assembly, Type C are fabricated in accordance with these specifications, the manufacturer's instructions, and the manufacturer's drawings. They are available in two styles. These are Wyoming style and another style that uses a box beam splitting mandrel.

MATERIALS REQUIREMENTS.

A. GENERAL. Soil plates, struts, bearing plates shall meet the requirements of ASTM A36 or ASTM A36 M. All metal components shall be hot dip galvanized in accordance with §719-01, Galvanized Coatings and Repair Methods.
Rustic versions of box beam bursting style Type III End Assembling shall comply with the above requirements except the metal parts exposed to view shall be painted in accordance with §740-03 Painting Galvanized Surfaces.

Reflective sheeting pre-mounted on a frangible material shall be provided by the manufacturer for the free end of the end assembly. If approaching traffic will be permitted on one side only, reflectorization shall consist of alternating reflectorized 100 mm yellow and non-reflectorized 115 mm black stripes oriented at a 45 degree angle, with the lower edge of the stripes near the traveled way to be used by the approaching traffic. The reflective material shall meet the requirements of §730-05, Reflective Sheeting, Class B. If approaching traffic will be permitted on both sides of the end assembly reflectorization shall be upward pointing chevrons of the same dimensions.

B. END ASSEMBLIES USING CRUSHABLE FIBERGLASS ELEMENTS (WYOMING STYLE): Materials used in the fabrication of the Box Beam Guide Rail End Assemblies Type III and Box Beam Median Barrier End Assembly, Type C (Wyoming style) shall conform with the following requirements:

Wood and Timber Post Posts and Timber Blockouts §710-13
Foundation Tubes, Nose Assembly, Outer Tube,
    Telescoping Section and Intermediate Spacer Block §710-21
Fasteners, except shear bolts on posts 6, 7, & 8 ASTM A307
Shear bolts on posts 6, 7, & 8 SAE Grade 0
Rubber Pad Hard Rubber Division II Sect18.2
Steel Posts, Shelf Angles, and other metal parts ASTM A36M
Galvanized Coatings and Repair Methods §719-01

The Cable Assembly shall consist of galvanized steel cable, 6 X 19 mm, with 19 mm threaded rod swaged to both ends.

The composite tube shall be MMFG Extren series 500 pulltruded fiberglass structural tubes and shall exhibit the following properties:

1. Composite tubing shall be manufactured using the pulltrusion process. Tubing shall be manufactured of glass fiber reinforced resin with a glass resin ratio of 50%. The resin shall be isophthalic polyester. Glass reinforcement shall include the following three varieties:

A. Surface mat shall be used on all exterior surfaces.
B. Continuous glass strand rovings shall be used internally.
C. Continuous strand mats shall be used internally.

2. The composite material shall exhibit the following minimum mechanical properties:

A. Ultimate Tensile Strength: Ultimate Tensile strength shall be longitudinally 207 MPa and transversely 48.3 MPa measured from coupons. Bending strength of the full section shall be 138 MPa.
B. Ultimate Compressive Strength shall be as given above except Transversely shall be 105.5 MPa.
C. Ultimate Shear Strength shall be 31 MPa.
D. Modulus of Elasticity shall be 17 300 MPa
E. Barcol Hardness shall be 50.

3. The energy dissipation properties of the alternate fiberglass epoxy composite tube shall be evaluated using static compressive testing. Each test specimen shall be 610 mm long with a 102 mm long tulip shape cut into one end of the test specimen. The test specimen shall be crushed statically at a rate of 50 mm per minute and the total crush length shall be not less than 305 mm. A minimum of three static compressive tests shall be conducted. The results of each test shall meet the following static energy dissipation properties:
First Stage Energy Absorber
Average Crush Force \(80 \text{kN} \pm 9 \text{kN}\)
Maximum Compressive Force \(115 \text{kN}\)
Allowable Compressive Force Variation \(\pm 11 \text{kN}\)
Second Stage Energy Absorber
Average Crush Force \(182 \pm 13 \text{kN}\)
Maximum Compressive Force \(245 \text{kN}\)
Allowable Compressive Force Variation \(\pm 22.3 \text{kN}\)

**C. END ASSEMBLIES USING BOX BEAM BURSTING MANDREL:**

Materials used in the fabrication of the Box Beam Guide Rail End Assemblies Type III (BEAT) shall conform with the following requirements:

Mandrel Tube, Box Beam rail
Impact Head and components, including face plate, top and bottom plates, lower and upper support boxes, Gussets
Steel post, guide plates and mandrel support block, gusset plate, guide support, bent and front guide plates, and all metal parts

Mandrel Plate shall be ASTM A514, with Brinell hardness number of 250, min.

Ordinary box beam guide rail and ordinary box beam median barrier included within the pay limits for the bursting style Type III End Assembly for guide rail and Type C End Assembly for median barrier shall conform to the same specifications as box beam guide rail to which the Type III or Type C bursting style end assembling is attached.

**BASIS OF ACCEPTANCE.** Box Beam Guide Rail End Assembly Type III and Box Beam Median Barrier End Assembly, Type C will be accepted at the site of the work by the Engineer on the basis of conformance of the delivered articles with the manufacturer's drawings, and upon the manufacturer's certification of compliance with these specifications.

**710-25 GUIDE RAIL AND MEDIAN BARRIER SYSTEMS (RUSTIC)**

**SCOPE.** This specification covers the material and quality requirements for rustic barrier systems fabricated from structural and high-strength low alloy structural steel that in a reasonable time after erection in a rural environment of average atmosphere, will develop a uniform, permanent, and tightly adhering protective oxide coating.

**MATERIAL REQUIREMENTS.** Except as modified herein, all requirements of §710-20-Corrugated Beam Guide Railing and Mall Barrier and §710-21 - Box Beam Guide Railing and Median Barrier shall apply including Drop Weight Tear Testing. Galvanizing shall not be required unless specifically stated otherwise in the contract documents.

**A. Box Beam Rail.** The base metal for the structural shape, plate and bar components of box beam guide rail and median barrier shall meet the requirements of ASTM A242M or A588M. The fabrication of structural tube shall comply with ASTM A500, Grade B. The mechanical properties of the finished tube shall conform to the requirements of ASTM A500, Grade B except that the minimum elongation in 50.8 mm shall be 21 percent. Splice plates shall be fabricated of ASTM A36M steel ready for assembly before galvanizing and galvanized in accordance with §719-01, Type 1 (ASTM A123).

**B. Corrugated Beam Rail.** The base metal for the corrugated beam rail shall meet the requirements of ASTM A606, Type 4.
§710

C. Welds. All welds shall develop the strength of, and exhibit the same corrosion resistance characteristics as, the base metal used for the structural shape, plate and bar components.

D. Soil Plates. Soil plates of high strength, low alloy steel guide rail system shall be made of either ASTM A36M, ASTM A242M, ASTM A588M, or ASTM A606 Type 4 and shall be galvanized or epoxy coated in accordance with the applicable requirements in this specification.

E. Miscellaneous Hardware. The base metal of all accessory hardware of high strength, low alloy steel guide rail system including blockouts, backup plates, rail connecting angles, bolts, nuts and washers shall be fabricated from steel having corrosion resistance of approximately 4 times carbon structural steel without copper. Hardware to be excepted from this requirement is listed below and shall be supplied in conformance to the requirements as detailed on the standard sheets, and galvanized in accordance with §719-01, Type 1 (ASTM A123).
- All bolts less than 13 mm diameter and their associated washers and nuts.
- 44 mm x 44 mm square washers; 76 mm x 44 mm washers.
- 20 mm diameter anchor rods, nuts and washers associated with concrete anchors.
- Other miscellaneous nuts, bolts, washers and connectors not exposed to view.

High strength bolts, nuts and washers specified on the standard sheets as ASTM A325 shall conform to ASTM A325M, Type 3. Commercially available anti-seizing compound shall be applied to the threads of corrosion resistant bolts used in rail splices.

F. Epoxy Coating Material

1. The epoxy coating materials shall be powdered polyamide epoxy resin suitable for fusion bonding. The finish shall not be glossy. A dull or matted finish shall be supplied.
2. The color of the epoxy coating shall be a reasonable visual match to the brown color of Federal Color Standard 595 - plate numbers 10075, 10079, and 10091. Fifteen (15) days prior to commencement of coating operations, three (3) 100 mm x 150 mm coated metal plates shall be submitted to the Director, Materials Bureau for determination as to acceptability of the color match. The epoxy coating shall not fade, change color or chalk appreciably when subjected to a 30 hour exposure (20 minute cycle) in the high intensity ultra violet weatherometer model DMC-RHC. Each cycle (continuously repeating) starts with 17 minutes of light followed by 3 minutes of light and waterspray.
3. Upon approval of the product and the color match, the epoxy coating will be placed on a Department Approved List of Materials.

G. Posts. Posts shall conform to any of the following requirements:

1. ASTM A36M steel with a fusion bonded polyamide epoxy coating throughout meeting the epoxy requirements of this specification.
2. ASTM A588M steel with the embedded portion of the post galvanized in accordance with §719-01, Type 1 (ASTM A123). The posts shall be prepared in accordance with standard galvanizing industry practice. The lower 0.8 m of light posts and the lower 1 m of heavy posts shall be galvanized.
3. ASTM A588M steel with the embedded portion of the post having a fusion bonded polyamide epoxy coating meeting the epoxy requirements of this specification. The lower 1 m of the posts, regardless of rail type, shall be epoxy coated.

FABRICATION REQUIREMENTS

Epoxy Coating

A. Coating Applicator. The facilities of the coating applicator and method of application for the epoxy shall be subject to approval by the Director, Materials Bureau. Approval shall be obtained in accordance with the written procedures of the Materials Bureau. Upon approval, the complete name

NEW YORK STATE DEPARTMENT OF TRANSPORTATION
STANDARD SPECIFICATIONS of May 4, 2006
and address of the coating applicator will be placed on the Department's List of Approved Products titled “Fusion Bonded Coating Applicators.”

Coating applicators on the “approved list” for Longitudinal Joint Ties and Steel Reinforcing Bars are approved applicators for epoxy coated posts as described in this specification.

**B. Plant Inspection.** The Department reserves the right to have its authorized representative observe the preparation coating and testing of the posts. The representative shall have free access to the plant. Any work done while access was denied will be rejected.

If the representative elects, lengths of coated posts may be taken from the production run, on a random basis, for test, evaluation and check purposes by the Materials Bureau.

**C. Quality Control.** The coating applicator shall be responsible for performing quality control and tests. This will include inspection for compliance with the requirements of Coating Thickness, Continuity of Coating and Coating Cure.

**D. Preparation.** Posts shall be pickled according to accepted industry standards and then rinsed in a slightly basic solution to remove all traces of pickling residue. The cleaned surfaces shall be free of all residue and millscale. Only the portion of post to be coated needs to be cleaned. In lieu of the pickling process, posts may be blast cleaned in accordance with the Steel Structures Painting Council - Surface Preparation Specification No. 6 (SSPC-SP 6), Commercial Blast Cleaning. The cleaned surface shall be defined by SSPC-Vis 1-89, Pictorial Standards B SP 6 or C SP 6 as applicable.

**E. Coating Thickness.** 0.127 mm minimum dry film thickness. Coating thickness measurements shall be conducted by the method outlined in ASTM G12.

**F. Continuity of Coating.** The coating shall be checked visually after cure for continuity. It shall be free from holes, voids, contamination and damaged areas.

**G. Coating Cure.** The coating applicator shall check each shipment to determine that the epoxy coating is in fully-cured condition.

Field Repair of Damaged Coatings. Posts with coating breaks, due to handling, that exceed 13 mm in any dimension shall not be incorporated into the work. The Contractor shall set aside such damaged units and may effect a field repair. Coating breaks may be repaired with a patching material approved by the epoxy coating manufacturer. The patching material shall be an epoxy compatible with the epoxy coating. The patching epoxy shall be a color match to the coating epoxy.

**BASIS OF ACCEPTANCE.** All components of the box beam or corrugated beam guide railing and median barrier shall be accepted in accordance with directives issued by the Department and in conformance with the standard sheets.

All epoxy coated posts shall be accepted by the Engineer at the contract site on the basis of the following:

- The epoxy coating manufacturer's certification that the coating material is identical to that approved by the Materials Bureau.
- The coating applicator's certification that the posts have been coated and that they conform to the requirements of this specification.
- The appearance of the name of the coating applicator and epoxy coating material on the Department's Approved List of Products.

The manufacturer's certification that the metal used conforms to the requirements of this specification. The ASTM designation and Grade shall be included.
710-26 PLASTIC AND SYNTHETIC BLOCK-OUTS FOR HEAVY POST GUIDERAIL SYSTEMS

SCOPE. This specification describes plastic and synthetic material block-outs used to provide uniform offset distance from the corrugated beam rail to the heavy post.

GENERAL. The block-out shall have the same general dimensions as detailed in the Department Standard Sheets. The block-out shall not contain excessive voids that would compromise its physical strength. The material shall be designed for outdoor exposure and shall include chemical additives to resist UV degradation. If the product contains recycled materials, they shall be environmentally friendly and non-hazardous. Blocks shall contain no materials that will negatively affect their field performance, such as materials that absorb moisture.

BASIS OF ACCEPTANCE. Manufacturers or suppliers may submit their product for evaluation to the Director of the Materials Bureau. This submission shall include copies of drawings, specifications, test reports, the quality control procedure and Federal Acceptance Letters. At the Department's discretion, the material will be evaluated for conformance to these specifications, and product samples will be tested in accordance with procedural directives of the Materials Bureau.

The product will be accepted at the job site based on its appearance on the Approved List. In addition, the contractor shall provide manufacturer certification that the supplied product has the same chemical composition, mechanical properties as the product used in the testing accepted for Federal Approval. Modifications to this product are acceptable, provided the resulting product is an equivalent or of higher level of quality, and supporting documentation is provided.”

710-27 THRU 710-29 (VACANT)

710-30 RIGHT-OF-WAY FENCING

SCOPE. These specifications cover the material requirements required for the construction of right-of-way fences comprised of (a) galvanized steel or aluminum coated steel fence fabric, and (b) posts, braces and hardware designed to support and retain the fencing.

MATERIAL REQUIREMENTS

Fence Fabric. Right-of-way fencing fabric shall conform to the requirements of ASTM A116 “Zinc Coated (Galvanized) Steel Woven Wire Fence Fabric” or ASTM A584 “Aluminum-Coated Steel Woven Wire Fence Fabric.” The fabric shall be woven in accordance with Design Number 1047-6-9 or 1047-6-11 as shown in Table 1 of both ASTM A116 and ASTM A584. The weight of the coating on the Zinc-Coated (Galvanized) Fence Fabric shall conform to the coating weight requirements of Class 3 shown in Table 3 of ASTM A116.

Fence Posts and Braces. Posts and brace sizes shall be as indicated on the Standard Sheets. Steel line posts shall conform to the requirements of ASTM A702. Steel end, corner or intermediate post and braces shall conform to the requirements of Section 6.5 through Section 6.5.4 of ASTM A702; or the requirements for Class A, Schedule 40 Pipe or Class B, Steel Tubing of §710-10.03 of the Standard Specifications. Posts and braces conforming to the requirements of ASTM A702 shall be galvanized in accordance with the requirements of §719-01 Type I. Type A Schedule 40 Pipe and Type B Steel Tubing shall use one of the protective coating system specified in 7A of §710-10.03.

Wood posts and braces shall be seasoned southern yellow pine, red (Norway) pine, spruce, douglas fir, hemlock, larch, or redwood. All wood posts and braces shall be pressure treated with a water-borne wood preservative conforming to the requirements of §708-31. The wood posts shall be subject to inspection before and during treatment at the option of the Department. They shall be sound, free from loose knots or decay, and with no through checks on tops or butts. Posts shall be machine peeled to a smooth uniform appearance and free from all inner bark. The preservative pressure treatment shall be by the empty cell process in accordance with C5 of the American Wood-Preservers' Association Standards.
Fittings. Fittings shall be manufactured of weldable steel, malleable iron, cast steel, cast iron, or aluminum alloy. Fittings other than aluminum shall be galvanized in accordance with the requirements of §719-01 Type II.

Fasteners. Bolts, nuts, and washers shall conform to the following, unless specified otherwise in the contract documents:

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bolts</td>
<td>ASTM F568 Class 4.6 or A307</td>
</tr>
<tr>
<td>Nuts</td>
<td>ASTM A563M or A568, Grade A or better</td>
</tr>
<tr>
<td>Washers</td>
<td>ASTM F844</td>
</tr>
</tbody>
</table>

The fasteners shall be galvanized in accordance with the requirements of §719-01 Type II.

Gates. Gates shall be constructed of Class A Schedule 40 Pipe conforming to §710-10 welded at all corners or assembled with corner fittings. The size of the pipe used to fabricate the gate shall be as shown on the Standard Sheets. When corner fittings are used the gates shall have truss rods of minimum 9.50 mm diameter to prevent sag or twist. Gate leaves shall have vertical intermediate bracing so that no vertical members are more than 2.50 m apart. Gate leaves over 3 m shall have a truss rod of minimum 9.50 mm minimum diameter even if the corners are welded. The fence fabric used on the gate shall conform to the fence fabric in the remainder of the fence.

A. Hinges. Hinges shall be weldable steel, cast steel, or malleable iron 180° offset industrial type. The hinges shall not twist or turn under the action of the gate. The gate shall be able to be opened by one person. The hinges shall be galvanized in accordance with the requirements of §719-01 Type I.

B. Latches. Latches, stops, and keepers shall be provided for all gates. Latches for single leaf gates may be a forked latch type. Double leaf gates shall have a plunger bar type latch arranged to engage a stop. Latches shall be capable of being locked and the Contractor shall provide a lock with triplicate keys for each gate. Keepers shall consist of a mechanical device for securing the free end of a gate when in the full open position.

C. Gate Posts. Gate posts shall conform to the dimensions shown on the Standard Sheets. Steel gate posts shall be fabricated from either Class A Schedule 40 Pipe or Class B Steel Tubing conforming to the requirements of §710-10. Wood gate posts shall be made from wood conforming to the requirements for wood posts and braces as specified in “Fence Posts and Braces”.

BASIS OF ACCEPTANCE. Right-of-way fencing will be accepted on the basis of a material certification that specifies the product conforms to this specification. Buy America requirements apply.

SECTION 711 - CONCRETE CURING MATERIALS AND ADMIXTURES

711-01 (VACANT)

711-02 QUILTED COVERS (FOR CURING)

SCOPE. These specifications cover cotton mats to be used for curing Portland Cement concrete pavements and bases, and concrete structures.

GENERAL. The mats shall consist of a filling material of cotton “bat" or “bats” covered with unsized cloth, and tufted or stitched to maintain the shape and stability of the unit under job conditions of handling.
MATERIALS REQUIREMENTS

Cotton. Cotton cloth covering shall weigh not less than 213.6 grams per square meter and shall have an average of not less than 32 threads in warp and not less than 28 threads in filling, having a minimum average breaking strength (grab method) of 265 newtons in the warp and of 265 newtons in the filling.

The weight of the cotton cloth covering shall not fall below the specified weight by more than 5 percent. The raw materials used in the manufacture of the cotton cloth shall be raw cotton, cotton comber waste, cotton card strip waste, or combination thereof. The other physical characteristics of the cloth shall be equal to those in such material for industrial purposes.

Burlap or Jute. Burlap or jute covering for cotton mats shall weigh not less than 227.2 grams per square meter and shall have not less than 8 threads per 25 mm of warp and not less than 8 threads per 25 mm of filling. It shall be the grade known commercially as “firsts” and shall be free from avoidable imperfections in manufacture and from defects or blemishes affecting the serviceability. A tolerance in weight of minus 5 percent will be permitted.

Filling Material. The filling material for the mats shall be cotton bat, or bats, made of raw cotton, cotton waste, cotton linters, or combinations thereof, and shall weigh not less than 406.9 grams per square meter. The batting used shall not be lower in quality than a batting made of U. S. Standard Grade No. 3 Linters.

Thread

A. Tufting. The cotton thread for tufting shall be not less than 4-cord number 12's.

B. Sewing or Stitching. The thread used for all sewing or stitching shall be at least equivalent in size and strength to standard 3-cord number 30 cotton thread.

DIMENSIONS

A. Mats. Mats shall have a filler of 1750 mm in width and shall have a flap 150 mm or more in width, consisting of an extension of two thicknesses of the covering material, extending along one longitudinal edge of the mat. The length of the mats shall be 760 mm greater than the width of pavement slab to be cured.

B. Tolerance. The length or width of the mats shall not be less than that specified by more than 2 percent.

FABRICATION

A. Covering Material. The covering material for each surface of the mat shall consist of two widths of cloth joined by a lapped seam or by a seam formed by superimposing the two widths and uniting them by one row of stitches. If the seam of the latter type, the edges shall be on the inside of the finished mat.

B. Filling. The cotton filling materials in the form of a bat or bats shall be held in place between the coverings by sewing or tufting all around the periphery of the mat within 25 mm of each of the four edges of the filler, and by sewing or quilting longitudinally at intervals not greater than 100 mm, or by tufting at intervals both longitudinally and transversely, not greater than 75 mm. The sewing or tufting shall be sufficiently loose to permit substantially all of the surface of the mat to come in contact with a flat surface when in use, but not so loose as to permit the filling material to shift.

C. Flap and Ends. The flap shall be constructed by sewing the upper and lower covering together longitudinally within 25 mm of the outer edges of the flap. Along the edge of the mat opposite the flap, the filling materials shall be within 25 mm of the edges of the covering material, and the covering material shall be sewn together so as to enclose the filling material. The ends of the mats
shall be finished by running an additional seam (i.e., a seam in addition to the seam holding the filling material in place) across the mats. This seam shall not be closer to the seam holding the filling material in place than 6 mm and not closer to the end of either covering than 12 mm, unless the ends of the mat are finished with an overlying or whip stitch, or in a manner which will not leave a raw edge.

**D. Stitching.** All longitudinal sewing or quilting shall average at least three stitches per 25 mm and shall have not less than five stitches in any 50 mm. All other sewing shall average six stitches per 25 mm and shall have not less than nine stitches in any 50 mm.

**BASIS OF ACCEPTANCE.** Quilted covers (for curing) will be accepted on the basis of a material certification that specifies the product conforms to this specification.

**711-03 PLASTIC COATED FIBER BLANKETS (FOR CURING)**

**SCOPE.** These specifications cover white plastic coated fiber blankets or white plastic coated absorbent synthetic fabric blankets.

**MATERIAL REQUIREMENTS.** The blankets shall conform to the test requirements of A.S.T.M. C171, for White burlap - polyethylene sheets, for Moisture Loss and Reflectance.

**BASIS OF ACCEPTANCE.** Application for approval of plastic fiber blankets shall be submitted to the Director, Materials Bureau. Upon approval, the name and manufacturer of the product will be placed on the Department's Approved List. Each roll of the blankets shall be marked with an indelible marking, every 3 meters, with the following.

- Manufacturer's name and/or logo
- Product name
- Meet ASTM C171, White Burlap - Polyethylene Sheets, for Moisture Loss and Reflectance

The product shall be accepted at the work site on the basis of the appearance of the name and manufacturer of the product on the Approved List and marking as required herein.

**711-04 POLYETHYLENE CURING COVER (WHITE OPAQUE)**

**SCOPE.** This specification covers the material requirements for polyethylene curing covers (white opaque) to be used for curing of Portland Cement concrete.

**MATERIAL REQUIREMENTS.** The blankets shall conform to the material requirements of AASHTO M171 (ASTM C171) for Polyethylene Film: White Opaque. Rolls shall be wound on serviceable handling members which extend beyond the edges of the roll, forming handles to facilitate applying the covers over concrete.

**BASIS OF ACCEPTANCE.** Each shipment shall be accompanied by the manufacturer's certificate attesting to the fact that the shipment meets the specified standards. Upon request, the manufacturer shall supply a record of the results of the prescribed tests as made on the samples.

**711-05 MEMBRANE CURING COMPOUND**

**SCOPE.** This specification covers white-pigmented and clear membrane curing compound material and quality requirements for spray application on surfaces of newly placed Portland Cement concrete.

**GENERAL.** Samples of membrane curing compound shall be submitted to the Materials Bureau by the manufacturer upon application for approval. Approved material shall be delivered to the work site in clean containers. The curing compound shall be agitated mechanically to a uniform consistency throughout the container immediately before use.
MATERIAL REQUIREMENTS

A. White Pigmented. The compound shall consist of finely ground white pigment and wax-free vehicle, ready mixed for immediate use without alteration. When applied to freshly placed damp concrete at the rate of one liter per 3.5 square meters, the compound shall adhere and present a uniform white appearance and effectively obscure the original color of the concrete. The compound applied at the specified rate shall provide a curing compound displaying the following properties:

1. Drying. The compound shall produce a uniform coating at a minimum temperature of 5°C and shall dry track-free within 4 hours.

2. Permeability. The moisture loss through the membrane shall be no more than 0.04 grams per square centimeter of surface area after three days.

3. Reflectivity. The membrane shall have a reflectance value of 60 percent, minimum based on Magnesium Oxide as a standard.

4. Durability. The membrane shall remain intact for at least seven days before becoming powdery and non-adherent due to weathering.

B. Clear. The compound shall consist of a wax-free vehicle, ready mixed for immediate use without alteration containing a fugitive dye that will fade uniformly. When applied to freshly placed, damp concrete, at the rate of 1 liter per 3.5 m², it shall provide a curing membrane displaying the following properties:

1. Drying. The compound shall produce a uniform coating at a minimum temperature of 5°C and shall dry tack-free within 4 hours.

2. Permeability. The moisture loss through the membrane shall be no more than 400 grams per square meter of surface after three days.

3. Durability. The membrane shall remain intact for at least 7 days.

4. Fugitive Dye. The membrane-forming compounds with fugitive dye shall be readily distinguishable upon the concrete surface for at least 4 hours after application, but shall become inconspicuous within 7 days after application.

TESTS. The properties of a membrane curing compound shall be tested on laboratory specimens. Details of the tests may be obtained from the Materials Bureau.

BASIS OF ACCEPTANCE. The approval of the membrane curing compound shall be based upon tests performed by the Materials Bureau. Upon approval by the Materials Bureau, the name of the product will be placed on an Approved List. Such products shall then be accepted on the basis of the brand name labeled on the container.

711-06 BURLAP

SCOPE. This specification covers requirements for burlap for use in curing concrete.

MATERIAL REQUIREMENTS. Burlap shall conform to the requirements of AASHTO M182. The burlap shall be made from jute or kenaf and shall weigh 310 to 372 grams per meter. Burlap shall be cleaned and free from cuts, tears, uneven weaving and contaminants.

BASIS OF ACCEPTANCE. The burlap will be accepted on the basis of a visual inspection by the Engineer and weighing of a sample at the point of use.
711-07 FORM INSULATING MATERIALS FOR WINTER CONCRETING

SCOPE. This specification covers the material details, quality requirements, and method of application for approval of form insulating materials used for winter concreting operations.

MATERIAL REQUIREMENTS. Each insulating material will be judged on its ease and practicability of installation, durability and imperviousness to moisture penetration and absorption. The minimum thickness for any foam board and blanket insulation considered shall be 25 mm. The thermal conductivity (k) of any proposed insulating material shall not exceed 0.046 watt per meter kelvin (W/mK).

Application of approval of an insulating material shall be made to the Materials Bureau. Certified laboratory test results for thermal conductivity (k) and thermal resistance (R), kelvin meter2/watt (KAm2/W), measured at the nominal product thickness shall be required for evaluation. A one square meter (minimum) sample shall accompany each request for approval. The sample shall exhibit all major features of the insulating product such as covers, seams, fasteners, grommets, etc. All necessary and normal product information shall accompany the sample. If there is a specific process required to apply the insulating material, complete details of the process shall accompany the sample.

If sprayed foam is the material in question, the Contractor shall also be required to send the applicator's name plus a list of jobs done by the applicator during the last 12 months. If investigation of these jobs demonstrates quality workmanship, the applicator shall be issued a temporary approval good for one contract. Based upon its subsequent performance, a decision will be made as to whether or not to place the applicator's name on the Approved List.

BASIS OF ACCEPTANCE. Insulating materials for winter concreting shall be accepted on the basis of Approved List issued by the Materials Bureau.

711-08 ADMIXTURES

SCOPE. These specifications cover the material requirements for air-entraining, water-reducing and retarding and water-reducing admixtures used in the manufacture of Portland Cement concrete. The specification also covers the requirements for water-reducing (high range) admixtures.

GENERAL. All admixtures shall be in liquid form having a consistency that flows readily. The admixtures shall not contain chemicals which, when mixed with concrete, produce a condition that is injurious to the quality and durability of the concrete or reinforcing steel. This applies specifically to compounds which, when used in manufacturing process, produce a significant amount of chloride ions in the final product. The pH shall be equal to or greater than 7 for all admixtures used at a dosage rate of four liters per cubic meter. (Total chloride ion content shall be less than 1000 ppm.) Admixtures manufactured from carbohydrates such as sucrose (table sugar), glucose, and maltose when used alone will not be permitted.

MATERIAL REQUIREMENTS

Air-Entraining. The air-entraining agent shall entrain air in the concrete and the concrete containing an air-entraining agent shall conform to the following requirements:

A. Bleeding. The bleeding of the concrete made with the admixture under test shall not exceed that of concrete made with the reference admixture by more than 2 percentage points, the bleeding being computed as a percentage of the net amount of mixing water in each concrete. The net mixing water is the water in excess of that present as absorbed water in the aggregate.

B. Time of Setting. The initial time of setting of concrete containing the admixture under test shall not deviate from that of the concrete made with the reference admixture by more than ±1 hour and 15 minutes.
C. Compressive Strength. The compressive strength of concrete containing the admixture under test shall be not less than 90 percent of the control concrete, at the same air content, containing the reference admixture at 48 hours, 7 days and 28 days.

D. Resistance to Freezing and Thawing. The hardened concrete containing the admixture under test shall not exceed a weight loss of 4.0 percent in 25 cycles in a 10% NaCl solution.

E. Length Change. Length changes shall be based on initial measurements taken at the time of removal of the specimens from the molds and final measurements taken at the end of 14 days of air drying. The specimens shall be moist-cured for 14 days followed by 14 days of air drying. Length change shall not be greater than ± 20% of similar concrete containing the reference admixture.

Water-Reducing and Retarding Admixtures (ASTM TYPE D). The water-reducing and retarding admixtures shall reduce the quantity of mixing water required to produce concrete of a given consistency, and retard the setting of concrete. Concrete containing this admixture shall conform to the following requirements:

A. Water Reduction. The mixing water required for concrete containing the admixture under test shall be reduced at least 5.0 percent when compared to that of the reference concrete without the admixture under test.

B. Time of Setting. The initial set time of the concrete containing the admixture under test shall be increased by at least 50 percent when compared to that of the reference concrete without the admixture under test.

C. Compressive Strength. The compressive strength of the concrete containing the admixture under test, when compared to concrete without the admixture under test, shall be equal or greater at 48 hours, 7 days and 28 days.

D. Resistance to Freezing and Thawing. The hardened concrete containing the admixture under test shall not exceed a weight loss of 4.0 percent, in 25 cycles in a 10% NaCl solution.

E. Length Change. Length changes shall be based on initial measurements taken at the time of removal of the specimens from the molds and final measurements taken at the end of 14 days of air drying. The specimens shall be moist-cured for 14 days followed by 14 days of air drying. Length change shall not be greater than ± 35% of similar concrete containing the reference admixture.

Water-Reducing Admixtures (ASTM TYPE A). The water-reducing admixtures shall reduce the quantity of mixing water required to produce concrete of a given consistency. Concrete containing this admixture shall meet the requirements of the water reducing and retarding admixtures above except that the time of setting of the concrete containing the admixture under test shall not deviate from that of similar concrete without the admixture under test used as a reference by more than ±1 hour and 15 minutes.

Water-Reducing (High Range) Admixtures (ASTM TYPE F). The water-reducing (High Range) admixture shall reduce the quantity of mixing water required to produce concrete of a given consistency. Concrete containing this admixture shall conform to the following requirements:

A. Water Reduction. The mixing water required for concrete containing the admixture under test shall be reduced at least 12.0 percent when compared to that of the reference concrete without the admixture under test.

B. Time of Setting. The initial set time of the concrete containing the admixture under test when compared to that of the reference concrete shall not be more than 1 hour earlier nor 1 hour, 30 minutes later.
C. Compressive Strength. The compressive strength of the concrete containing the admixture under test when compared to concrete without the admixture under test shall be as follows:

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<tr>
<td>1 day</td>
<td>140%</td>
<td>7 days</td>
<td>115%</td>
</tr>
<tr>
<td>3 days</td>
<td>125%</td>
<td>28 days</td>
<td>110%</td>
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</tbody>
</table>

The compressive strength of the concrete containing the admixture under test at any test age shall be not less than 100% of that attained at any previous age.

D. Resistance to Freezing and Thawing. The hardened concrete containing the admixture under test shall not exceed a weight loss of 4.0 percent in 25 cycles in a 10% NaCl solution.

E. Length Change. Length changes shall be based on initial measurements taken at the time of removal of the specimens from the molds and final measurements taken at the end of 14 days of air drying. The specimens shall be moist-cured for 14 days followed by 14 days of air drying. Length change shall not be greater than ± 35% of similar concrete containing the reference admixture.

SAMPLING AND TESTING. A liter sample of admixture shall be submitted to the Materials Bureau by the manufacturer applying for approval except that for Water-Reducing (High Range) Admixtures two liters will be required. Along with the sample the manufacturer shall include data from test performed in accordance with these specifications. Data from tests performed in accordance with ASTM C260 for air-entraining agents and ASTM C494 for water-reducing and retarding admixtures and water-reducing admixtures may be substituted.

In addition to the sample and test data, information on the formulation of the product, including the raw materials from which it is compounded and a description of the manufacturing process, shall be submitted.

The Department will test the submitted admixture sample according to written Department instructions. The test procedures are available from the Materials Bureau upon request.

The Department reserves the right to monitor the performance of any previously approved admixture. Samples of admixture may be taken from actual concrete operations and retested by the Materials Bureau.

BASIS OF ACCEPTANCE. The approval of the admixture shall be based upon the submitted information and tests performed by the Materials Bureau. Upon approval by the Materials Bureau, the name of the product will be placed on the Approved List. Such products shall then be accepted on the basis of the brand name labeled plainly on the containers.

Any admixtures sampled from actual concrete operations and retested in the Materials Bureau shall give substantially the same results, at the same dosage rate, as the original tests. Any significant change will be cause for rejection of that material and may require a resubmission of the admixture by the manufacturer for a complete retest to determine specification compliance. The admixture may be withdrawn from the Approved List during the retest period.

711-09 EMULSIFIED CARBON BLACK

SCOPE. This specification covers the material requirements for Emulsified Carbon Black, which is used as a coloring agent in mortar or concrete.

GENERAL. The method of test shall conform to the requirements of AASHTO T 106, the standard method of test for compressive strength of hydraulic cement mortars.

MATERIAL REQUIREMENTS. Emulsified Carbon Black shall be a uniform colloidal dispersion of standard carbon black in a liquid medium. The air content of the concrete shall not be changed by more than 10% by addition of 2%, by weight of cement, of the dispersed carbon black. The ash content shall not exceed 3% by weight of the finished product. At least 25% of the commercial product shall be carbon black.
The Emulsified Carbon Black shall be stable and shall have the same effect on the air entrainment, after standing for a period of 28 days, as specified above.

The color produced on the broken surface after the seven day test shall be equal to that produced by a previously established standard of color.

The Emulsified Carbon Black shall show uniform dispersion in mortars or concrete when used in concentrations necessary to produce the desired pigmentation.

**TEST.** Test specimens shall be prepared as follows: Portland Cement Type 2 containing 2% by weight of Emulsified Carbon Black shall be used with standard Ottawa Sand to prepare 1:2.75 compressive cubes. The compressive strength of these cubes at the age of seven days and thereafter shall be not less than 85% of the strength of similar cubes with no pigment added.

**BASIS OF ACCEPTANCE.** This material will be considered for acceptance in stock lot quantities at manufacture of supply locations in accordance with procedural directives of the Materials Bureau.

### 711-10 FLY ASH

**SCOPE.** This specification covers the material requirements for fly ash when used as a partial replacement for Portland Cement in Portland Cement concrete.

**MATERIAL REQUIREMENTS.** Fly ash shall conform to the chemical and physical requirements for Mineral Admixture, Class F listed in AASHTO M 295 including Table 2 (except for Footnote A). Loss of Ignition shall not exceed 4.0%.

**A. Storage.** The fly ash shall be stored at its source of supply in weather-tight silos approved by the Director, Materials Bureau. All silos shall be completely empty and clean before fly ash is deposited therein unless the silo contains fly ash of the same type.

Fly ash remaining in bulk storage at the source of distribution terminal for a period greater than one year after completion of tests will be resampled and retested by the Materials Bureau before shipment or use. However, fly ash which has been in bulk storage at sources or distribution terminals more than two years from the time of original manufacture shall not be used.

**B. Shipment.** All shipments of fly ash shall be made in accordance with procedural directives issued by the Materials Bureau. Conveyances for bulk fly ash shipment shall be of a type approved by the Director, Materials Bureau. The compartments of all such conveyances shall be completely empty and clean before any fly ash is deposited therein.

**C. Inspection and Testing.** Inspection and testing shall be in accordance with procedural directives by the Materials Bureau. Tests for chemical and physical properties shall be in accordance with test methods stipulated by AASHTO M 295 as modified in test methods prescribed by the Materials Bureau.

**Special Note.** The Department will consider requests to evaluate alternate classes of fly ash, such as Class C or N. The Department's evaluation may include laboratory testing, field trials and other related work required to determine equivalency with specified materials, mix designs, and performance. Use of alternates is subject to approval by the Director, Materials Bureau.

**BASIS OF ACCEPTANCE.** Fly ash will be considered for acceptance at the source or terminal locations in accordance with procedural directives issued by the Materials Bureau.

### 711-11 MICROSILICA

**SCOPE.** This specification covers the material requirements for microsilica admixture for use in portland cement concrete and other mixes.
GENERAL. Supply microsilica admixture as a dry powder or slurry. When necessary for testing purposes, microsilica slurries will be dried to obtain a representative sample of dry powder.

MATERIAL REQUIREMENTS. The microsilica powder shall conform to the requirements of AASHTO M 307* (including optional chemical and optional physical requirements) and the following:

Uniformity of Silicon Dioxide Content. Maximum ±7.0% from the acceptance value.

Chloride Content. Maximum 0.20% as determined by AASHTO T 260, Procedure B.

Fineness. Maximum 5.0% retained on a 45-µm sieve (wet method).

Uniformity of Percent Solids (Slurry). Maximum ±5.0% from the acceptance value.

* For Materials other than Silica fume as defined by AASHTO M307, the requirement for SiO2 may be reduced if the combined quantity of reactive SiO2+AlO2+FeO2 is at least 85%, and all other chemical and physical requirements are met as determined by the Materials Bureau.

SAMPLING AND TESTING. Submit two - 1 liter samples of microsilica to the Materials Bureau for approval, with the following:

Supplier and Manufacturer's Names and Addresses. If the material will be manufactured at several locations, identify each location and submit a separate sample representing each location.

Product Label, Product Information Sheets and Material Safety Data Sheets. Include the date of manufacture and shelf life of the supplied sample.

Test Results. Submit laboratory test results indicating the product meets all specification requirements. The testing laboratory must be acceptable to the Director, Materials Bureau. The Department will test the submitted microsilica sample in accordance with the specification and Department instructions. Test procedures are available from the Materials Bureau upon request. Upon approval by the Materials Bureau, the name of the product will be placed on the Approved List. The Department reserves the right to monitor the performance of any approved microsilica. Samples of microsilica may be taken from actual concrete operations and tested by the Materials Bureau. If these test results indicate that the sampled microsilica does not meet this specification, concrete incorporating the microsilica represented by the sample may be rejected.

BASIS OF ACCEPTANCE. Each shipment of microsilica will be considered for acceptance where it will be incorporated into the concrete. Acceptance will be based on the product name appearing on the Approved List and Manufacturer's certification of conformance to this specification.

711-12 GROUND GRANULATED BLAST-FURNACE SLAG

SCOPE. This specification covers the material requirements for ground granulated blast-furnace slag when used as a partial replacement for portland cement in portland cement concrete.

MATERIAL REQUIREMENTS. Ground granulated blast-furnace slag (GGBFS) shall conform to the chemical and physical requirements for Grade 100 slag as described in AASHTO M 302.

Storage. The ground granulated blast-furnace slag shall be stored at its source of supply in approved weather-tight silos. Facilities shall be provided for maintaining such silos under Department seal control when and as directed by the Materials Bureau. All silos shall be completely empty and clean before GGBFS is deposited therein unless the silo contains Department specification GGBFS of the same type. GGBFS remaining in bulk storage at the mill and/or distribution terminal for a period greater than one year after completion of tests shall be resampled and retested before shipment. However, GGBFS which has been in bulk storage at mills and/or distribution terminals more than two years from the time of original manufacture shall not be used. No GGBFS stored by the Contractor over the winter shall be used until retested by the Materials Bureau.
§711

**SHIPPING.** All shipments of ground granulated blast-furnace slag shall be made in accordance with procedural directives issued by the Materials Bureau. Conveyances for bulk shipment shall be of a type approved by the Department. The compartments of all such conveyances shall be completely empty and clean before any GGBFS is loaded therein.

**INSPECTION AND TESTING.** All inspection and testing shall be in accordance with procedural directives issued by the Materials Bureau. When required by the Materials Bureau, GGBFS shall be sampled by means of an automatic sampling device constructed so as to obtain continuous samples across the full stream of GGBFS and deliver such samples into a sealed container approved by the Materials Bureau.

Tests for chemical and physical properties shall be in accordance with test methods stipulated by AASHTO M 302.

**BASIS OF ACCEPTANCE.** Ground granulated blast-furnace slag will be considered for acceptance at mill or terminal locations in accordance with procedural directives issued by the Materials Bureau.

### 711-13 CALCIUM NITRITE BASED CORROSION INHIBITORS

**SCOPE.** This specification covers the material requirements for corrosion inhibitors used in the manufacture of Portland Cement Concrete.

**GENERAL.** The corrosion inhibitor shall consist of a calcium nitrite solution. The admixture shall not contain chemicals which, when mixed with concrete, produce a condition that is injurious to the quality and durability of the concrete or reinforcing steel.

**MATERIALS REQUIREMENTS.** The corrosion inhibitor shall consist of a calcium nitrite solution, containing 30 +/-2% calcium nitrite solids by mass and having a specific gravity of 1.27 +/-0.02. The corrosion inhibitor when used in the manufacturing process shall not produce a significant amount of chloride ions in the final product (Less than 1000 ppm, as determined by the Department). The pH shall be greater than 8.

**SAMPLING AND TESTING.** A two liter sample of admixture shall be submitted to the Materials Bureau by the manufacturer applying for approval. Along with the sample, the Manufacturer shall provide information to include the manufacturer's name and address, a copy of the product literature, material safety data sheets, and written certification stating that the material meets the physical and chemical requirements of this specification (711-13, Calcium Nitrite Based Corrosion Inhibitors).

The Department will test the sample for specific gravity and percent calcium nitrite in accordance with written Department instructions. The Sampling and testing procedure is available from the Materials Bureau upon request. Upon testing by the Materials Bureau, if the sample submitted is within tolerance, it will be placed on the Department's Approved List of Materials for corrosion inhibitors. In order to ensure their quality, regular monitor sampling and testing will be performed at the point of use. The concrete batching facility is typically the point of use.

**BASIS OF ACCEPTANCE.** The initial approval of the admixture shall be based upon the submitted information and tests performed by the Materials Bureau. Upon approval by the Materials Bureau, the name of the product will be placed on the Approved List. Such products shall then be accepted on the basis of the brand name labeled plainly on the containers.

### SECTION 712 - MISCELLANEOUS

#### 712-01 WATER

**SCOPE.** This specification contains the requirements for water used in Portland Cement concrete, mortar, concrete curing, treated subgrade, soil cement and for application to plants, seeded or sodded areas and planted areas.
MATERIAL REQUIREMENTS. Water used for mixing and curing Portland Cement concrete, mortar, treated subgrade and soil cement shall meet the requirements indicated in Table 712-1, Water. NYSDOT Test Method No. 712-01P shall apply to all Physical tests.

Water for curing concrete shall not contain any impurities in sufficient amount to cause discoloration or surface deterioration.

Water applied to seeded or sodded areas, plants or planted areas shall be free from oil, have a Ph not less than 6.0 nor greater than 8.0 and shall be free from impurities injurious to vegetation.

BASIS OF ACCEPTANCE. Municipal water supplies are considered acceptable sources. Acceptance of questionable sources of water, as determined by the Regional Director or his/her representative, shall be determined by the Materials Bureau on samples taken by Department representatives.

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<th>TABLE 712-1 WATER</th>
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<tr>
<td>Air Content of Mortar, percent by volume</td>
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<tr>
<td>Soundness, Autoclave Expansion, percent</td>
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<tr>
<td>Compressive Strength,</td>
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<td>7 day, 28 day (optional) percent of compressive strength of mortar cubes made with standard water</td>
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<td>Time of Setting, Vicat Test,</td>
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<td>Final Set, hours</td>
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<td>Presence of Oil</td>
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<td>Total Inorganic Solids, AASHTO T26, ppm</td>
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<tr>
<td>Chloride Ion Content, ppm</td>
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<td>Sulphate Ion Content, ppm</td>
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712-02 CALCIUM CHLORIDE

SCOPE. This specification covers the material requirements for calcium chloride for use in dust control, stabilization, ice control and for other highway construction related purposes.

Calcium chloride material shall be either Type A - Solid Flake Calcium Chloride or Type B - Liquid Calcium Chloride Solution.

MATERIAL REQUIREMENTS

**Type A - Solid Flake Calcium Chloride.** Solid Flake Calcium Chloride shall meet the requirements of ASTM D98 and upon analysis shall show not less than 77.0% CaCl₂. The calcium chloride shall be supplied in the form of dry, loose flakes, pellets or granules and shall be fine enough to feed through the common types of spreaders used in roadwork. The Engineer reserves the right to reject any material that has become caked or otherwise damaged.

**Type B - Liquid Calcium Chloride Solution.** Liquid Calcium Chloride shall be supplied as a mixed solution which upon analysis shall show not less than 30.0% of CaCl₂.

Equivalent Spreading Rates. For purposes of these specifications 0.6 kg/m² of Type A, Solid Flake CaCl₂ is equivalent to 1.0 L/m² of Type B, Liquid CaCl₂ Solution. These factors shall be used as the basis for determining other rates of application.

PACKAGING, MARKING & SHIPPING

**Type A - Solid Flake Calcium Chloride.** Solid Calcium chloride shall be packaged in moistureproof bags containing not more than 45 kg each, or in airtight drums weighing not more than 205 kg each, or it may be delivered in bulk in tank cars, covered hopper cars, or covered trucks. All bulk shipments that are to be stored and stockpiled on the job site shall be protected with waterproof
§712

covers. The location and protection of stockpiled material shall be approved by the Engineer prior to shipment.

The name of the manufacturer, name of the product, net weight, and the percentage of calcium chloride (CaCl₂) guaranteed by the manufacturer shall be legibly marked on each container, except in the case of bulk shipments where the invoice shall be accepted as evidence of compliance with these requirements.

**Type B - Liquid Calcium Chloride Solution.** Liquid calcium chloride shall be delivered in bulk shipments on a supplied-and-applied basis. The delivery equipment shall be capable of applying the liquid solution at the specified rate(s). The delivery equipment shall be subject to approval by the Engineer and shall be equipped with suitable calibration devices to insure the correct rate of application. Each bulk shipment shall be accompanied with the manufacturer's invoice.

**BASIS OF ACCEPTANCE.** Calcium chloride will be accepted based on its use as follows:

**A. For dust control, ice control and other highway construction related purposes.** Type A and Type B calcium chloride will be accepted based on the Engineer's approval.

**B. For soil stabilization.** Type A and Type B calcium chloride will be accepted on the basis of the manufacturer's certification that the product conforms to the above specifications. The certification shall reference the number of containers shipped, or in the case of bulk deliveries, the invoice numbers associated with each delivery.

**712-03 SODIUM CHLORIDE**

**SCOPE.** This specification covers the material requirements for sodium chloride to be used as a soil admixture or deicing agent for maintenance.

**MATERIAL REQUIREMENTS.** Sodium chloride shall meet the requirements of ASTM D632, Sodium Chloride - Type 1, Grade 1.

   Sodium chloride shall be packaged in moistureproof bags containing not more than 45 kg each, or in airtight drums weighing not more than 205 kg each, or it may be delivered in bulk in tank cars, covered hopper cars, or covered trucks. All bulk shipments that are to be stored and stockpiled on the job site shall be protected with waterproof covers. The location and protection of stockpiled material shall be approved, by the Engineer, prior to shipment.

**BASIS OF ACCEPTANCE.** Sodium chloride will be accepted based upon the Engineer's approval. The Department reserves the right to sample and test this material subsequent to delivery at the project site.

**712-04 HYDRATED LIME**

**SCOPE.** This specification contains the material requirements pertaining to Hydrated Lime.

**MATERIAL REQUIREMENTS.** Hydrated Lime shall meet the requirements of ASTM C207, Hydrated Lime for Masonry Purposes - Type NA or SA.

**BASIS OF ACCEPTANCE.** The manufacturer's certification shall constitute sufficient documentation for acceptance of this material at the site of the work. The Department reserves the right to sample this material to test for conformance to these specifications.

**712-05 PRECAST CONCRETE RIGHT-OF-WAY MARKERS**

**SCOPE.** This specification covers the material and fabrication requirements for precast concrete right-of-way markers.
MATERIAL REQUIREMENTS. The Material Requirements contained in §704-03 shall apply.

DRAWINGS. The Drawing requirements contained in §704-03 shall apply.

FABRICATION. The Fabrication requirements contained in §704-03, along with the following shall apply.

Precast right-of-way markers shall be fabricated to conform to the size and shape shown on the standard sheet unless otherwise shown on the plans.

SAMPLING AND TESTING. The Sampling And Testing requirements contained in §704-03 shall apply.

MARKING. The Marking requirements contained in §704-03 shall apply except as noted herein.

Markings shall be placed on the bottom end face of each unit such that they won’t be exposed to view after installation. Instead of marking the contract number on each unit they may be marked with “NYSDOT”.

FINAL PRODUCTION INSPECTION. The Final Production Inspection requirements contained in §704-03 shall apply.

SHIPPING. The Shipping requirements contained in §704-03 shall apply.

BASIS OF ACCEPTANCE. The Basis of Acceptance requirements contained in §704-03 shall apply.

712-06 MOBILE CONSTRUCTION ZONE IMPACT ATTENUATORS

SCOPE. This specification covers the material and testing requirements for crash cushions or impact attenuators mounted on the rear of designated work vehicles. These devices are commonly called truck mounted attenuators or TMAs.

MATERIALS REQUIREMENTS. Truck Mounted Attenuators having initial purchase dates on or before October 1, 1998 shall have been satisfactorily tested in accordance with the National Cooperative Highway Research Program (NCHRP) Report 350 or 230 or other testing protocol acceptable to the State. Those purchased new after that date shall be only those that have been satisfactorily tested in accordance with NCHRP Report 350. Testing shall consist of full scale crash testing conducted by recognized testing agencies. TMAs meeting the requirements of NCHRP 350 Test Level 2 or, for devices originally purchased on or before October 1, 1998, NCHRP 230 are the standard TMA, and shall be acceptable for all circumstances except as stated in this specification or in the Contract Documents.

NCHRP 350 Test Level 3 TMAs shall be required, however, whenever indicated in the Contract Documents or whenever the posted speed limit within 335 meters upstream of the TMA is sixty five miles per hour (65 mph.)

An NCHRP 350 Test Level 3 TMA may be substituted for a NCHRP 350 Test Level 2 TMA or NCHRP 230 TMA, but a NCHRP 350 Test Level 2 TMA or NCHRP 230 TMA may not be substituted when a NCHRP 350 Test Level 3 TMA is required.

BASIS OF ACCEPTANCE. The Director of the New York State Department of Transportation's Materials Bureau maintains an Approved List, which lists TMAs which have successfully passed the above requirements. Acceptance of NCHRP 350 Test Level 2 or 3 Mobile Construction Zone Impact Attenuators shall be at the contract site based on compliance with these specifications and either the product's appearance on the Approved List or a letter from the Department to the vendor indicating the TMA is approved.

Acceptance of NCHRP 230 qualified devices shall be on the basis of compliance with these specifications, appearance of the TMA on the Approved List, or letter from the Department indicating approval of the TMA, plus the provision of certification satisfactory to the Engineer. This certification shall indicate that the NCHRP 230 qualified TMA was sold new to a user on or prior to October 1, 1998. The current owner and the original purchaser need not be the same.
Manufacturers or Vendors wishing to have products considered for inclusion on the *Approved List* shall provide copies of drawings, specifications, test reports, and Federal Acceptance Letters to the Director of the Materials Bureau. The review process requires thirty (30) days minimum.

### §712 INERTIAL BARRIER MODULES

**SCOPE.** This specification covers the material and performance requirements for sand-filled inertial barrier systems used for site hazard protection.

**GENERAL.** Modules composing the array shall be free-draining with respect to residual moisture in the fill sand. Their lids shall be such that they divert precipitation and stop moisture from seeping into the shell. Lids shall be fastened with a minimum of six equally spaced pop rivets or secured by other approved fasteners so as to provide a reasonably vandal resistant, closed barrel.

**MATERIAL REQUIREMENTS.** The modules shall be federal yellow or as shown on the plans. They shall be durable, waterproof, resistant to deterioration from ultra-violet rays, deformation from dynamic loadings due to vibration in the placement area and long-term stresses induced by thermal expansion and contraction and fill settlement.

The fill sand shall conform to the requirements of either §703-06, Cushion Sand, or §703-07, Concrete Sand. Sodium chloride, as dry rock salt, equal to 3-5 percent by weight of the sand, shall be thoroughly mixed into the sand. Sodium chloride shall meet the requirements of §712-03, Sodium Chloride.

**TESTS.** To determine the crash worthiness of inertial barrier modules not on the NYSDOT’s Approved List, an array containing each size module shall be subjected to crash tests to verify that the barrier system can safely decelerate an impacting vehicle. These tests shall be done in accordance with the National Cooperative Highway Research Program Report 350, test numbers, 3-40, 3-41, 3-42, 3-43 and 3-44. Evaluation criteria shall conform to the safety evaluation guidelines found in Table 5.1, as specified in Table 3.2.

Crash cushion arrays shall be designed to conform to the occupant risk values found in NCHRP Report 350, Table 5.1, Criteria D, H and I.

Any values deviating from these shall be justified by site and/or shape limitations, or cost, and approved by the Director, Materials Bureau.

**BASIS OF ACCEPTANCE.** The Department requires the submission of Materials Details. The manufacturer or supplier shall prepare and submit the appropriate material in accordance with the procedural directives of the Materials Bureau. Upon approval by the Materials Bureau, the name of the product and/or supplier, and the reference number assigned to the approved Materials Details will be placed on the Approved List. Such products shall then be accepted on the basis of their brand and conformance to the approved Materials Details.

### §712-08 THRU §712-11 (VACANT)

### §712-12 ASPHALT ROOFING FELT

**SCOPE.** These specifications contain the material requirements pertaining to Asphalt Roofing Felt.

**MATERIAL REQUIREMENTS.** Roofing shall conform to the requirements of the standard specifications for Asphalt-Saturated Roofing Felt for use in Waterproofing and in Constructing Built-Up Roofs, ASTM D226.

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based on the manufacturer's certification of compliance with these specification requirements.
712-13 TIMBER AND LUMBER

GENERAL. Unless otherwise specified or noted upon the plans or in the itemized proposal, timber and lumber shall be of any kind acceptable to the Engineer. The material shall be sound, square-edged, free from shakes, loose knots or decay.

712-14 STRESS GRADED TIMBER AND LUMBER

GENERAL. Stress graded timber and lumber shall be graded for the stress grade selected, in accordance with grading rules for the indicated stress grade, developed from ASTM D245.

Commercial stress grades of timber and lumber, with grade descriptions providing material which will meet the indicated stress requirements under rules conforming to ASTM D245, will be acceptable.

MATERIAL REQUIREMENTS. The manufacturer shall inspect and grade the timber and lumber. Each piece shall be clearly branded with the stress grade mark of the manufacturer's inspector. Stress graded timber and lumber will be subject to inspection by representatives of the Department, to whom the manufacturer shall supply three copies of its certification of inspection and piece tally.

The Contractor shall furnish all facilities for the inspection of this material by the Department's representatives and shall allow them free access to all premises where inspections can be made.

BASIS OF ACCEPTANCE. This material will be accepted on the basis of certification by the manufacturer that the timber and lumber has been inspected and stress graded under grading rules which conform to the requirements of ASTM D245. The certification shall show the identifying stress grade mark used by the manufacturer's inspector.

712-15 GABIONS

SCOPE. This specification covers the material and quality requirements for galvanized gabions and galvanized with polyvinyl chloride (PVC) gabions.

GENERAL. The materials used in fabricating and filling of gabions shall comply to specifications and tests set forth below.

MATERIAL REQUIREMENTS.

Gabions. Gabions produced from twisted wire shall conform to the requirements of ASTM A 975. Gabions produced from welded wire shall conform to the requirements of ASTM A 974. The physical properties of the PVC coating shall conform to the requirements of ASTM A 975 or ASTM A 974, as appropriate.

Tiewire or Lacing Wire. Tiewire or lacing wire shall conform to the requirements of ASTM A 975 or ASTM A 974, as appropriate.

Stone Fill. The baskets shall be filled with approved stone of the following sizes:

<table>
<thead>
<tr>
<th>Basket Depth or Height</th>
<th>Minimum Stone Size</th>
<th>Maximum Stone Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 mm</td>
<td>100 mm</td>
<td>200 mm</td>
</tr>
<tr>
<td>Greater than 300 mm</td>
<td>100 mm</td>
<td>300 mm</td>
</tr>
</tbody>
</table>

The soundness of all stone used for gabions shall be approved on the basis of a geologic evaluation in accordance with the control procedure in effect on the date of advertisement for bids. Prior to the evaluation, the Contractor shall stockpile the material. Where the State elects to conduct tests, a material will be rejected if it fails to meet the following criteria:
A. Freeze-Thaw Test. A maximum 10 percent loss, by weight, after 25 cycles of freezing and thawing.
B. Magnesium Sulfate Soundness Test. A maximum 10 percent loss, by weight, after 10 cycles of the magnesium sulfate soundness test.
**Fabrication.** Gabions shall be supplied, as specified, in various lengths and heights. The lengths shall be multiples (2, 3, or 4) of the horizontal width. The heights shall be fractions (1, 1/2, or 1/3) of the horizontal width. The horizontal width shall not be less than one meter. However, all gabions furnished by a manufacturer shall be uniform width. Dimensions for height, lengths and widths are subject to a tolerance limit of ±5% of manufacturer's stated sizes.

Gabions shall be fabricated in such a manner that the front, back, sides, ends, lid and diaphragms can be assembled at the construction site into a rectangular basket of the specified sizes. Gabions shall be of single-unit construction. The base, lid, ends, front and back shall be either woven into a single unit or one edge of these members connected to the base section of the gabion in such a manner that strength and flexibility at the point of connection is at least equal to that of the mesh. Where the length of the gabion exceeds its horizontal width, the gabion shall be equally divided by diaphragms of the same mesh and gage as the body of the gabion, forming cells such that the length does not exceed the horizontal width.

The gabion shall be furnished with the necessary diaphragms secured in proper position on the base in such a manner that no additional tying at this juncture will be necessary. All perimeter edges of the mesh forming the gabion shall be securely selvedged so that the joints formed by tying the selvedges have at least the same strength as the body of the mesh.

**BASIS OF ACCEPTANCE.** Each shipment of gabions to a job site shall be accompanied by a certification which states that the material conforms to the requirements of this specification. A shipment shall consist of all material arriving at the job site at substantially the same time. The certification shall be on company letterhead and shall be signed by an officer of the company having legal authority to bind the company.

**712-16 PIGMENT FOR COLORED SYNTHETIC RESIN BINDER CONCRETE**

**SCOPE.** This specification covers the material requirements for pigment used in colored synthetic resin binder concrete.

**MATERIAL REQUIREMENTS.** The pigment shall be compatible with the synthetic resin binder material and shall provide the colored synthetic resin binder concrete with a non-fading, heat stable color. When the color specified is white, the pigment shall be Rutile Titanium Dioxide.

**BASIS OF ACCEPTANCE.** Acceptance of this material shall be in accordance with procedural directives of the Department.

**712-17 WOOD CROSS TIES**

**SCOPE.** This specification covers the material requirements for wood cross ties for railroads.

**MATERIAL REQUIREMENTS**

**A. Species.** The following kinds of wood suitable for cross ties will be accepted.

<table>
<thead>
<tr>
<th>Ash</th>
<th>Elm</th>
<th>Sassafras</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beech</td>
<td>Hackberry</td>
<td>Sycamore</td>
</tr>
<tr>
<td>Birch</td>
<td>Locust</td>
<td>Walnut</td>
</tr>
<tr>
<td>Black Gum</td>
<td>Maple</td>
<td></td>
</tr>
<tr>
<td>Catalpa</td>
<td>Mulberry</td>
<td></td>
</tr>
<tr>
<td>Cherry</td>
<td>Oak</td>
<td></td>
</tr>
</tbody>
</table>

**B. Manufacture.** Cross ties shall be well sawed in top, bottom and sides. A cross tie shall be considered well sawed as long as score marks are not more than 6.4 mm deep and the surfaces are even.
Cross ties shall be straight, cut square at the ends, have bottom and top parallel, and have all bark entirely removed. A cross tie shall be considered straight only if it meets both of the following requirements:

1. A straight line drawn along the top of the tie from the middle of one end to the middle of the other end of the tie, falls entirely within the width of the tie.
2. A straight line drawn along a side of the tie from the middle of one end to the middle of the other end of the tie, is everywhere more than 51 mm from the top and 51 mm from the bottom of the tie.

The top and bottom of a tie will be considered parallel if any difference in the thickness at the sides or ends does not exceed 13 mm.

**C. Dimensions.** All thicknesses and widths apply to areas of the tie defined as the `rail bearing area(s)'. The rail bearing areas are those areas which lie between 508 mm and 1016 mm on both sides of the mid-point of the tie length. The rail bearing area for switch ties is the area between 305 mm from each end of the switch tie.

All determinations of width shall be made on the top of the tie. The top is defined as the narrower of the horizontal surfaces, or the surface with the least or no heartwood if both surfaces are the same width.

Standard size thickness and width dimensions are shown in Table 712-17, and apply to the rail bearing areas. The dimensions of the tie shall not be averaged. All ties shall be 2591 mm long, or as required.

**TABLE 712-17**

<table>
<thead>
<tr>
<th>Size</th>
<th>Dimensions in Rail Bearing Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>177.8 mm thick by 228.6 mm wide (top)</td>
</tr>
<tr>
<td>4</td>
<td>177.8 mm thick by 203.2 mm wide (top)</td>
</tr>
<tr>
<td>3A</td>
<td>177.8 mm thick by 177.8 mm wide (on top, minimum 203.2 mm wide through body)</td>
</tr>
<tr>
<td>3</td>
<td>152.4 mm thick by 203.2 mm wide (top)</td>
</tr>
<tr>
<td>2</td>
<td>152.4 mm thick by 177.8 mm wide (top)</td>
</tr>
<tr>
<td>1</td>
<td>152.4 mm thick by 152.4 mm wide (on top, minimum 177.8 mm wide through body)</td>
</tr>
</tbody>
</table>

**D. Tolerances.** Individual untreated ties shall have the following tolerances applied to the thickness and width dimensions shown in Table 712-17.

<table>
<thead>
<tr>
<th></th>
<th>Length:</th>
<th>Thickness:</th>
<th>Width:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>plus 51 mm,</td>
<td>plus 51 mm,</td>
<td>plus 25 mm,</td>
</tr>
<tr>
<td></td>
<td>minus 25 mm</td>
<td>minus 6.4 mm</td>
<td>minus 6.4 mm</td>
</tr>
</tbody>
</table>

It is not the intent of this specification that all ties shall be manufactured to the minimum allowable dimensions. A minimum of 75% of the ties presented for inspection shall conform to the dimensions shown in Table 712-17 without the application of the minus tolerances.

**E. Defects.** The occurrence of any of the following defects in an individual tie shall be the cause for rejection.

1. **Shakes.** A separation along the grain, occurring between the annual growth rings. A shake length more than one-third the nominal width of the tie shall not be allowed.

2. **Slant or Slope of Grain.** Except in the case of woods with interlocking grain, a slant or slope of grain in excess of 1 in 15 shall not be allowed.

3. **Holes.** Large holes shall not be allowed. A large hole is more than 12.7 mm in diameter and 76.2 mm deep within the rail bearing areas, or more than one-fourth the width of the surface on
which it appears and 76.2 mm deep outside the rail bearing area. Numerous holes shall not be allowed. Numerous holes are any number equalling a large hole in size.

4. Knots. Large knots shall not be allowed. A large knot is one whose average diameter exceeds one-fourth the width of the face on which it appears. Numerous knots shall not be allowed. Numerous knots are any number equalling a large knot in size.

5. Checks. A separation along the grain of the wood occurring across the annual rings. Fully seasoned and treated ties with check depths greater than one-fourth the thickness and longer than one-half the length of the tie shall not be allowed.

6. Decay. Ties shall contain no decay. Although blue stain is not considered decay and is not a defect, ties shall be inspected with extra care for presence of decay in heavily stained areas.

7. Wane. The lack of wood on the edge or corner of the tie due to the natural curvature of the log from which the tie is cut. Wane which reduces the face dimension greater than 76 mm outside the rail bearing area shall not be allowed. In the rail bearing area, dimensions given in Table 712-17 apply.

8. Splits. A split is a separation of the wood extending from one surface to an opposite or adjacent surface. In unseasoned ties, a split more than 3.2 mm wide or longer than 127 mm shall not be allowed.

After treatment, a split in either end of the tie greater than 3.2 mm wide or longer than 127.0 mm is not acceptable without an anti-splitting device. A split tie which has had an anti-splitting device applied but which re-opens after treatment to exceed 12.7 mm in width is not acceptable.

9. Twist. The deviation from a flat plane of all four faces by a spiraling or torsional action. A rotation of more than 3.5° from end face to end face shall not be allowed.

F. Anti-Splitting Devices. Anti-Splitting devices are to be installed prior to preservative treatment.

1. Dowelling. Dowels are anti-splitting devices driven or pushed into pre-bored holes. The length of dowel embedded shall not be less than half the width or thickness through which it is placed. Use of lubricants to facilitate driving of dowels is prohibited.

   a. Equipment. These specifications are based on dowelling by mechanical dowel machines. Alternate methods may be used if the results are equal to those obtained by mechanical devices that press the tie together, drill and dowel in one or two operation. Dowelling by mechanical means is considered satisfactory as long as sufficient pressure is applied to completely close the split. Substitution of hand drills and pneumatic hammers for drilling dowels in switch ties is satisfactory as long as splits are held closed during dowelling by the use of clamps or other devices.

   b. Pre-Drilled Holes. The maximum diameter of the pre-drilled holes is 3.2 mm less than the diameter of dowel. The minimum length of the hole shall be equal to the length of the dowel, except that holes drilled from the face opposite the face where the dowel enters shall be completely through the tie.

   c. Location of Dowels. Dowels shall be driven perpendicular to the face most parallel to the split. Two dowels shall be used to close each split. They shall be located a minimum of 100 mm and a maximum of 152 mm from the end of the tie. Where the tie is split parallel to the narrow faces, the 197 mm long dowels shall be located 38.1 mm plus or minus 6.4 mm from each wide face. Where the tie is split parallel to the wide faces, 146 mm long dowels are driven 51 mm plus or minus 6.4 mm from each narrow face.
d. **Protruding Dowels.** Dowels not completely driven by dowelling machines shall be driven flush with the wood with a hammer. Dowels which protrude more than 6.4 mm after driving should be burned off with an oxyacetylene torch. However, dowels bent over flush with the surface of the wood will be accepted, provided this is done without splitting the wood.

2. **Irons.** Anti-splitting irons are driven into the ends of ties and shall be placed to cross at right angles and the greatest possible number of radial lines of the wood. Irons shall be placed far enough from the wide faces to prevent splitting of the tie.

   a. **Design.** Anti-splitting irons shall be made from a strip of steel formed to an “S” iron or “C” iron design. They will be of adequate size to prevent splitting of the tie.

   b. **Material.** Irons shall conform to specifications for anti-splitting irons given in the AREA Manual, Chapter 3, Section 1.9.2.1.

3. **Nail Plates.** Anti-splitting nail plates shall be applied to the ends of the ties.

   a. **Design.** Anti-splitting nail plates shall be rectangular and perforated to form multiple nails.

   b. **Material.** Nail plates shall be stamped from 1.214 mm galvanized sheet steel.

   c. **Size.** The area of anti-splitting nail plates shall not be less than 60% of the nominal end area of the tie.

G. **Conditioning.** Ties shall be dried before preservative treatment until the amount of moisture in the wood will not prevent adequate penetration and retention of preservative. The producer may use any of the following methods as long as satisfactory results are obtained.

1. **Air Seasoning.** Ties shall be stacked for air seasoning in accordance with the American Wood Preservers Association (AWPA) Standard C6, Cross Ties and Switch Ties - Preservative Treatment by Pressure Process. Stacking dates during the period of stacking shall be painted on the front of the stack. A maximum of 60 days age spread shall be allowed between the dates of the first ties stacked and the last ties stacked.

   Ties shall be stacked as grouped below:

<table>
<thead>
<tr>
<th>Group Ta</th>
<th>Group Tc</th>
<th>Group Td</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Locust</td>
<td>Black Gum</td>
<td>Ash</td>
</tr>
<tr>
<td>Black Walnut</td>
<td></td>
<td>Hackberry</td>
</tr>
<tr>
<td>Honey Locust</td>
<td></td>
<td>Beech</td>
</tr>
<tr>
<td>Red Oaks</td>
<td></td>
<td>Hard Maples</td>
</tr>
<tr>
<td>White Oaks</td>
<td></td>
<td>Catalpa</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sassafras</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cherries</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sycamores</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Elms</td>
</tr>
<tr>
<td></td>
<td></td>
<td>White Walnut</td>
</tr>
</tbody>
</table>

2. **Accelerated Seasoning.** Ties may be conditioned by the Boulton drying process, kiln drying, vapor drying or controlled air seasoning in accordance with AWPA Standard C6, Cross ties and Switch Ties - Preservative Treatment by Pressure Process.

H. **Preservative Treatment.** Plants used for the treatment of wood shall conform to AWPA Standard 3, Standard Quality Control Procedures for Wood Preserving Plants.

   All cross ties shall be treated with creosote-coal tar solution conforming to AWPA Standard P2, Standard for Creosote and Creosote Solutions, Grade C. Grades A or B may be substituted for Grade C.

   Preservative treatment shall be carried out in accordance with AWPA Standard C1, All Timber Products - Preservative Treatment by Pressure Processing or C6, Cross Ties and Switch Ties -
Preservative Treatment by Pressure Processes. The method used shall be the empty cell process by use of initial air to control retention.

Retention of preservative shall be 112.1 kg/m³ of preservative of wood. Retention shall be determined by gauge in accordance with paragraph 3.1 of AWPA Standard C1.

When specified, pentachlorophenol in heavy AWPA Standard P9A solvent may be used as a preservative. Minimum retention shall be 6.4 kilograms of preservative per cubic meter of wood.

INSPECTION AND TESTING. The Contractor shall give the Materials Bureau thirty days written notice prior to the start of preservative treatment. This notice shall include at the minimum, the name of the tie treater, the location of the treating plant and that date of the initial treatment.

The treating company is responsible for performing quality control in accordance with AWPA M3, Standard Quality Control Procedures for Wood Preserving Plants. All records required to be maintained in accordance with the quality control procedure shall be made available to the Department upon request. A Department representative may be assigned, at the option of the Materials Bureau, to perform sampling and inspection in accordance with Materials Bureau directives and AWPA M2, Standard For Inspection of Treated Timber Products. The producer shall furnish all facilities and equipment for the inspection and testing of the materials and workmanship.

In the event plant inspection is waived, written notice will be provided to the tie treater by the Materials Bureau. The tie treater shall then supply the Materials Bureau with all preservative charge reports, which describe the treatment process and preservative retention, and written certification that the treatment and ties conform to these specifications.

All treated ties shipped to the project site shall bear in legible form, the inspector's stamp of approval; however, in the event plant inspection has been waived, ties shall be shipped only if they are accompanied by a copy of the Materials Bureau notification waiving plant inspection.

Treated ties shall be subject to final inspection and approval by the Engineer after arrival at the project site.

SHIPMENT AND STORAGE. Ties delivered at the job site shall be stacked not less than 3048 mm from the nearest rail of any track at suitable and convenient places. They shall not be stacked at public crossing or where they will interfere with the view of trainmen or of people approaching the railroad.

Where room for spaced stacking is not available, ties may be piled together provided the lowest layer is at least 150 mm above the ground.

BASIS OF ACCEPTANCE. The wood cross ties will be considered for acceptance in stock lot quantities at the treatment facility in accordance with procedural directives of the Materials Bureau.

712-18 IMPACT ATTENUATOR, HDPE CYLINDER AND CABLE TYPE

SCOPE. Impact Attenuators, HDPE Cylinder and Cable Type are manufactured, NCHRP 350 crash tested products intended for the protection of narrow objects having width of 610 mm or less. These impact attenuators are four, six, or nine cylinders in length. They are suitable in situations where frequent frontal impacts are expected.

MATERIALS REQUIREMENTS. Impact Attenuator, HDPE Cylinder and Cable Type components shall meet the following requirements:

Cylinders. Cylinders shall be black, high molecular weight polyethylene conforming to ASTM D3350 cell class 345434C. Dimensions and wall thicknesses of all cylinders shall be as given on the manufacturer’s drawings.

Cables. Cables shall be approved 6 X 25 FW plow steel conforming to API STD-9A, galvanized, prestretched and nominally 260 kN minimum breaking strength of the size and lengths indicated on the manufacture’s drawings. Cables shall be fitted both ends with galvanized fittings of the type indicated on the approved manufacture’s drawings.
Other Steel Parts. Anchor plates and structural angles shall be ASTM A36M steel, galvanized after fabrication. Structural tube used to construct the back up structure, used in the rear section of the rail unit of the six (6) and nine (9) cylinder units and in the railing for the four (4) cylinder units shall be ASTM A 500, Grade B. Chain shall be high strength steel linked chain of the indicated sizes, galvanized and fitted each end with screw pin anchor shackles. Fasteners, anchor bolts and anchor pins and other parts not specified herein shall be as given on the manufacturer's drawings or in the fabricators instructions.

All metal parts shall be galvanized after fabrication in accordance with §719-01 Galvanized Coatings and Repair Methods, Type I. Welding shall be in accordance with the Steel Construction Manual.

Reflectorization. Reflectorization, consisting of Class B (High Intensity) sheeting conforming to §730-05 directly applied to aluminum sheeting, shall be affixed to the front cylinder of the impact attenuator in a manner satisfactory to the Engineer. Aluminum sheeting shall be 6061T6, 0.81mm thick. The pattern and color of the reflectorization shall be as indicated on the plans.

If no pattern is provided, the pattern shall be approximately square, 450 mm on a side. Whenever approaching traffic is allowed to pass on both sides of the unit, the pattern shall be upward pointing chevrons formed with alternating 100 mm reflectorized stripes and black opaque non-reflectorized stripes. When traffic will be permitted on only one side, the pattern shall be diagonal 100 mm stripes, downward sloping to the side traffic is to be permitted, formed as indicated above. If no color is given, color shall be yellow.

BASIS OF ACCEPTANCE. Impact Attenuator, HDPE Cylinder and Cable Type will be accepted at the project site on the basis of the manufacturer's name appearing on the Approved List, conformance of the delivered article with the manufacturer's drawings, and the manufacturer's certification that the product delivered is in conformance with these specifications.

712-19 IMPACT ATTENUATOR, QUAD BEAM TYPE WITH EXPENDABLE MODULES

SCOPE. Impact Attenuator, Quad Beam Type With Expendable Modules are manufactured, NCHRP 350 crash tested products intended for the protections of objects having widths of 610 mm to 2290 mm. These attenuators are three, four, five, six, and nine bays in length, and may transition to concrete barriers, vertical walls, corrugated barrier, and thrie beam corrugated barrier.

MATERIALS REQUIREMENTS Each Impact Attenuator, Quad Beam Type With Expendable Modules shall contain all external and internal parts necessary to give satisfactory service at the indicated site. Components shall meet the following requirements:

Cartridges. The cartridge boxes shall be Type I and Type II cartridge boxes and shall be of the number and arrangement indicated by the manufacturer for the intended application. Cartridge boxes shall be manufactured from a weather resistant plastic material. Type I cartridges shall contain paper honeycomb material. Type II cartridges shall contain steel honeycomb material which shall be coated to minimize the effects of corrosion.

Cartridge Brackets. Each bay shall be equipped with cartridge brackets.

Diaphragms. Diaphragms shall be made from 10 gage ASTM A 36 M steel quadruple corrugated beam. The length of each diaphragm shall be as required for each application. Two support legs shall be welded to a channel which, in turn, shall be welded to the quadruple corrugated beam. Ski shaped plates shall be welded to the bottom of the support legs. The diaphragms shall be designed to lock onto, and be guided by, an anchored and mounted center monorail support structure.

Fender Panels. Fender panels shall be fabricated from 10 gage steel quadruple corrugated beam guide rail sections. Each fender panel shall be drilled and slotted so that when assembled in the field, the front end shall be bolted to a diaphragm by means of the three horizontally placed 16 mm bolts, one of which shall be a “mushroom bolt.” The back end of each quadruple corrugated beam fender panel shall overlap and be connected to the fender panel of the next bay by means of mushroom bolts which shall fit through the long horizontal slot in the forward fender panel and the short vertical slot in the overlapped fender.
panel. (The bolt shall have a nut and square washer on the inside.) This permits movement, front to back, of one set of fender panels relative to the panels in the following bay.

**Monorail Assembly.** The monorail assembly shall be fabricated to the dimensions shown on the manufacturer's or working drawings.

**Tension Strut Back-up.** If a concrete back-up structure is not to be provided, a tension strut back-up assembly shall be provided. The details of this assembly shall be as indicated in the manufacturer's or working drawings.

**Nose Cover.** The nose cover shall be made from a high density polyethylene plastic material of the color indicated in the plans or directed by the Engineer.

**Metal Work.** All metal work, except transition panels, shall be fabricated from either M1020 Merchant Quality or ASTM A36M steel. After fabrication, all metal work shall be hot dip galvanized in accordance with §719-01 Galvanized Coatings and Repair Methods. Welding shall be in accordance with the New York State Steel Construction Manual.

**Fasteners.** All bolts shall be American Standard Regular Bolts, unless indicated otherwise in the Plans. Anchor bolts shall be ASTM A193 grade B7 grouted into the concrete slab with polyester grout.

**Transition Panels.** Transition panels shall be fabricated from steel conforming to ASTM A36 M, hot dip galvanized in accordance with ASTM A123. Five standard transition panels shall be available. These shall transition to: Jersey Barrier; W-rail Corrugated Beam; Thrie Beam; vertical surfaces; and Single Slope Concrete Barrier.

**Reflectorization.** Reflectorization, consisting of Class B (High Intensity) sheeting conforming to §730-05 directly applied to aluminum sheeting, shall be affixed to the nose cover of the Quad Beam Type Impact Attenuator in a manner satisfactory to the engineer. Aluminum sheeting shall be 6061T6, 0.81mm thick. The pattern and color of the reflectorization shall be as indicated on the plans.

If no pattern is provided, the pattern shall be approximately square, 450 mm on a side. Whenever approaching traffic is allowed to pass on both sides of the unit, the pattern shall be upward pointing chevrons formed with alternating 100 mm reflectorized stripes and black opaque non-reflectorized stripes. When traffic will be permitted on only one side, the pattern shall be diagonal 100 mm stripes, downward pointing to the side traffic is to be permitted, formed as indicated above. Unless otherwise noted, the color shall be yellow.

**BASIS OF ACCEPTANCE.** Impact Attenuator, Quad Beam Type With Expendable Modules will be accepted at the site of the work on the basis of appearance of the product on the Approved List, conformance of the delivered product with the manufacturer's or working drawings, and receipt of the manufacturer's certificate of compliance with these specifications.

**712-20 IMPACT ATTENUATOR, CORRUGATED BEAM TYPE WITH METAL TEARING STRIPS**

**SCOPE.** Impact Attenuator, Corrugated Beam Type With Metal Tearing Strips are fabricated, NCHRP 350 crash tested products intended for the protection of narrow objects 610 mm or less in width and for the protection of concrete jersey shaped median barrier barrier. These impact attenuators are available in six and nine bay lengths.

**MATERIAL REQUIREMENTS.** Each Impact Attenuator, Corrugated Beam Type with Metal Tearing Strips shall contain all external and internal parts necessary to give satisfactory service at the indicated site.

The major components of the Each Impact Attenuator, Corrugated Beam Type with Metal Tearing Strips are - 1 sled assembly, 7 (nine bay) or 4 (six bay) intermediate frames, 1 backup frame, base assembly, cross ties and 20 (nine bay) or 12 (six bay) fender panels. One or more of the following
components may also be required- metal transition panels, wood or plastic block outs, backup frame adapter and W-beam end shoes.

Fender Panels. Fender panels shall be fabricated from 10 gage steel, double corrugated beam guide rail sections.

Nose Cover. The nose cover shall be made from a high density polyethylene plastic material of the color indicated in the contract documents. If no color is given, the color of the nose cover shall be yellow, or the color directed by the Engineer.

Metal Work. All metal work except fasteners shall be fabricated from ASTM A36M steel. After fabrication, all metal work shall be galvanized in accordance with §719-01, Galvanized Coatings and Repair Methods, Type I. Welding shall be in accordance with the New York State Steel Construction Manual.

Fasteners. All bolts shall be American Standard Regular Bolts, unless indicated otherwise in the Plans. Anchor studs shall be ASTM A193 grade B7, grouted into the concrete or asphalt.

Grout. Anchors requiring grouting shall be grouted with material approved under §701-05 Concrete Grouting Material or §701-07 Anchoring Materials - Chemically Curing.

Transition Panels. Standard transition panels between Impact Attenuator, Corrugated Beam Type with Metal Tearing Strips and Jersey Barrier shall be available. Transition panels shall be fabricated from 12 gage steel, double corrugated beam guide rail sections. They shall be terminated at the concrete barrier end with W-beam end shoes. Details of the transition shall be provided by the manufacturer.

Plastic Block Outs. Plastic block outs shall conform to §710-26 Plastic and Synthetic Block Outs for Heavy Post Guiderail System, except the dimensions shall be as per the approved manufacturer's or working drawings.

Wood Block Outs. Wood block outs shall conform to §710-13 Wood and Timber Posts and Timber Block outs, except the dimensions shall be as per the approved manufacturer's or working drawings. Pressure treatment shall be done after all cutting, sawing, trimming and drilling has been completed.

Reflectorization. Reflectorization, consisting of Class B (High Intensity) sheeting conforming to §730-05 directly applied to aluminum sheeting, shall be affixed to the front face of the sled assembly in a manner satisfactory to the engineer. Aluminum sheeting shall be 6061T6, 0.81 mm thick. The pattern and color of the reflectorization shall be as indicated on the plans.

For no pattern is provided, the pattern shall be approximately square, minimum 625 mm on a side. Whenever approaching traffic is allowed to pass on both sides of the unit, the pattern shall be upward pointing chevrons formed with alternating 100 mm reflectorized stripes and black opaque non-reflectorized stripes. When approaching traffic is permitted on only one side, the pattern shall be diagonal 100 mm stripes, downward pointing to the side traffic is to be permitted, formed as indicated above. If no color is given, color shall be yellow.

BASIS OF ACCEPTANCE. Each Impact Attenuator, Corrugated Beam Type with Metal Tearing Strips will be accepted at the project site on the basis of the manufacturer's name appearing on the Approved List, its conformance with the manufacturer's drawings, and the manufacturer's certificate of compliance with these specifications.

712-21 IMPACT ATTENUATOR, THRIE BEAM TYPE WITH EXPENDABLE MODULES

SCOPE. Impact Attenuators, Thrie Beam Type With Expendable Modules are manufactured, NCHRP 350 crash tested products intended for the protection of objects having widths of up to 2.6 m. These attenuators are configured with a varying number of bays (4-12), and may transition to vertical walls,
safety-shape concrete barriers, thrie beam corrugated barrier, and corrugated beam (when using an intermediate thrie beam transition).

**MATERIAL REQUIREMENTS.** Each Impact Attenuator, Thrie Beam Type with Expendable Modules shall contain all external and internal parts necessary to give satisfactory performance at the indicated site. Components shall meet the following requirements:

**Modules.** The module shall be Type A and Type B and shall be of the number and arrangement indicated by the manufacturer for the intended application. The modules shall be manufactured from a weather-resistant, high-density, cross-linked, polyethylene plastic material. The modules shall be designed to collapse under a manufacturer-defined critical loading consistent with the designed system requirements.

**Front Support and Diaphragms.** The diaphragms and front supports shall be rectangular frame structures constructed of ASTM A36 M steel C 75 x 7 channels, or equal. They shall include centrally-located, horizontal and vertical cross bracing. They shall have provisions to retain and support the modules.

**A. Diaphragms.** The top width of each interior diaphragm shall vary based on the design configuration and shall include 13 mm lips on both sides to reduce fender panel ride up during and immediately after an impact. Attached to the bottom horizontal support channel shall be two support legs connected to a ski-shaped base plate with turned up ends. The diaphragms shall include cable guide mounts for the anchor cables.

**B. Front Support.** The top width of the front support shall vary based on the design configuration. Two rubber or polyurethane support legs shall be attached to the bottom horizontal channel

**Fender Panels.** Fender panels shall be fabricated from 10-gage, steel thrie beam guide rail sections. Each fender panel shall be factory drilled and slotted for field assembly. The front end shall be fastened to a diaphragm using 20 mm stainless steel hex bolts. The back end of each thrie beam fender panel shall overlap and be connected to the fender panel of the next bay using sliding mushroom bolts inserted through the long horizontal slot in the forward fender panel and the short vertical slot in the overlapped fender panel, thus permitting movement, front to back, of one set of fender panels relative to the panels in the following bay. The rear panel is fixed to the rear support using a through bolt connection, through a 150 mm diameter, 6 mm thickness, steel pipe with cut out conical sections on the front end.

**Cable.** Two cables, of the length required for the particular installation according to the manufacturer’s instructions, shall provide tension in the system to support the diaphragms and guide them during and immediately after impact. The cables shall be 25 mm diameter steel wire rope, galvanized in accordance with ASTM A603. Both cable ends shall have steel reinforcement eyes formed using a swaged steel connector. A threaded eye bolt shall be connected to one of these eyes during its fabrication for field connection to the rear anchor lugs. The cable tension is adjusted by rotating the nut attached to this bolt.

**Front Anchor Plate.** The front cable anchor shall consist of a rectangular ASTM A36 steel plate, 25 mm thickness, 508 mm x 305 mm, with welded 100 mm lugs to connect to fasteners to cables. Eight holes, four along each longitudinal edges, shall be provided to accept anchor bolts.

**Rear Diaphragm.** The rear diaphragm shall be constructed of fabricated C 75 x 7 channels, or equal, with both horizontal and vertical bracing. The height shall be approximately 800 mm. The width of the support will vary based on the design configuration. The diaphragm shall be attached to the rear support structure in accordance with the manufacturer’s drawings.

**Rear Support Structure and Cable Anchorage for Transitions to Concrete Barriers and Concrete Structures.** When the attenuator is transitioned to a concrete barrier, the barrier may provide rear structural support. In such a case, the cables shall be anchored to a built-up steel plate
connection bolted to the barrier. The transition to the concrete barrier shall be in accordance with the manufacturer’s details. The attenuating system shall be in accordance with the manufacturer’s details when protecting concrete piers, concrete parapets, concrete walls, or other rigid objects.

**Rear Anchor Plate and Backstop.** For designs using steel backup structure, the fabricated steel support structure shall be as detailed on the manufacturer’s drawings.

**Nose Cover.** The nose cover shall be made from a polyurethane material of the color indicated in the contract documents. The cover shall be bolted to the front support.

**Metal Work.** All metal work, except transition panels, shall be fabricated from ASTM A36M steel. After fabrication, all metal work shall be hot-dip galvanized in accordance with §719-01 Galvanized Coatings and Repair Methods. Welding shall be in accordance with the New York State Steel Construction Manual.

**Fasteners.** All bolts shall be ANSI Standard Regular Bolts, unless indicated otherwise in the plans.

**A. Anchor Bolts.** Anchor bolts shall be 20 mm diameter, ASTM A193, Grade B7 grouted into the concrete slab with polyester grout. The length of the anchor bolts shall be 210 mm for installations.

**B. Front Cable Fastener.** A shackle with screw pin shall attach the cable to the front anchor.

**Transitions.** Transition panels shall be standard AASHTO fabricated panels from steel conforming to ASTM A36 M and hot-dip galvanized in accordance with ASTM A123. Transitions can be made directly to thrie beam guide rail; to corrugated beam using a thrie beam transition to corrugated beam; and to safety-shape concrete barrier and vertical walls using an additional thrie beam section and a thrie beam bridge shoe.

**Reflectorization.** Reflectorization, consisting of Class B (High-Intensity) sheeting conforming to §730-05 directly applied to aluminum sheeting, shall be affixed to the nose cover of the Thrie Beam Type Impact Attenuator. Aluminum sheeting shall be 6061T6, 0.81mm thick. The pattern and color of the reflectorization shall be as indicated in the contract documents.

If no pattern is provided, the pattern shall be approximately square, 450 mm on a side. Whenever approaching traffic is allowed to pass on both sides of the unit, the pattern shall be upward-pointing chevrons formed with alternating 100 mm reflectorized stripes and black opaque nonreflectorized stripes. When traffic will be permitted on only one side, the pattern shall be diagonal 100 mm stripes, downward pointing to the side traffic is to be permitted, formed as indicated above. Unless otherwise noted, the color shall be yellow.

**BASIS OF ACCEPTANCE.** Impact Attenuator, Thrie Beam Type With Expendable Modules will be accepted at the site of the work on the basis of appearance of the product on the Approved List, conformance of the delivered article with the manufacturer’s drawings, and the manufacturer’s certification that the product delivered is in conformance with these specifications.

**712-22 IMPACT ATTENUATOR, HDPE CYLINDERS WITH MONORAIL AND DIAPHRAGMS**

**SCOPE.** Impact Attenuator, HDPE Cylinders with Monorail and Diaphragms are manufactured, NCHRP 350 Test Level 3 crash-tested products intended for the protection of objects having width of 3000 mm or less. These impact attenuators have 27 HDPE cylinders arranged in 14 rows or 29 arranged in 15 rows. They are suitable in situations where frequent frontal impacts are expected.

**MATERIALS REQUIREMENTS.** The components shall meet the following requirements:

**Cylinders.** Cylinders shall be black, high-molecular-weight polyethylene conforming to ASTM D3350 cell class 345434C. Dimensions and wall thicknesses of all cylinders shall be as given on the manufacturer’s drawings.
Steel Parts. Metal parts shall be fabricated from M1020 Merchant Quality or ASTM A36 steel. Chain shall be high-strength-steel-linked chain of the indicated sizes, galvanized, and fitted each end with screw-pin anchor shackles. Fasteners, anchor bolts and anchor pins, and other parts not specified herein shall be as given on the manufacturer’s drawings or in the fabricator’s instructions.

All metal parts shall be galvanized after fabrication in accordance with §719-01 Galvanized Coatings and Repair Methods, Type I. Welding shall be in accordance with the Steel Construction Manual.

Reflcorized Sheeting. Class B (High-Intensity) sheeting conforming to §730-05, premounted on a weatherproof substrate, shall be affixed to the front cylinder of the impact attenuator. Aluminum sheeting, if used, shall be 6061T6, 0.81 mm thick. The pattern and color of the reflectorization shall be as indicated on the plans.

If no pattern is provided, the pattern shall be approximately square, 450 mm on a side. Whenever approaching traffic is allowed to pass on both sides of the unit, the pattern shall be upward-pointing chevrons formed with alternating 100 mm reflectorized stripes and black-opaque-nonreflectorized stripes. When traffic will be permitted on only one side, the pattern shall be diagonal 100 mm stripes, downward sloping to the side traffic is to be permitted, formed as indicated above. If no color is given, the color shall be yellow.

BASIS OF ACCEPTANCE. Impact Attenuator, HDPE Cylinder with Monorail and Diaphragms will be accepted at the project site on the basis of the manufacturer’s name appearing on the Approved List, conformance of the delivered article with the manufacturer’s drawings, and the manufacturer’s certification that the product delivered is in conformance with these specifications.

SECTION 713 - LANDSCAPE DEVELOPMENT MATERIALS

713-01 TOPSOIL

SCOPE. This specification covers the material requirements for topsoil for use in turf and wildflower establishment, sodding or planting.

MATERIAL REQUIREMENTS. Topsoil may be naturally occurring or may be manufactured. Topsoil shall be free from refuse, material toxic or otherwise deleterious to plant growth, subsoil, woody vegetation and stumps, roots, brush, stones, clay lumps or similar objects. Manufactured topsoil shall consist of a mineral component and amendments to meet the specified organic content, pH and other requirements. Sod and herbaceous growth such as grass and weeds need not be removed but shall be thoroughly broken up and mixed with the soil during handling or manufacturing operations. Topsoil shall meet the following requirements unless otherwise specifically stated in the contract documents:

- The pH of the material shall be between 5.5 and 7.6.
- The organic content shall be not less than 2% or more than 20%.
- Gradation:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.0 mm</td>
<td>100</td>
</tr>
<tr>
<td>25.0 mm</td>
<td>85 to 100</td>
</tr>
<tr>
<td>6.3 mm</td>
<td>65 to 100</td>
</tr>
<tr>
<td>75 µm</td>
<td>20 to 80</td>
</tr>
</tbody>
</table>

The maximum size of objects other than stones shall be 50.0 mm.

- The Contractor may amend topsoil with approved materials and by approved methods to meet the above specifications. Materials used to amend the organic content of topsoil shall conform with the requirements of 713-15 Organic Material. Amendments shall not contain any material that is deleterious to soil structure, plant growth or seed germination.
STOCKPILING. Topsoil may be acquired from sites that are designated in the contract documents or approved by the Engineer. If no topsoil sites are designated in the contract documents, the material proposed for use as either naturally occurring topsoil or manufactured topsoil must be stockpiled, sampled and tested prior to its use. Topsoil deficient in organic content and/or pH may be used prior to amending and retesting only when used for turf and wildflower establishment or sodding.

Stockpiles shall contain not less than 150 cubic meters, or the minimum required for the contract, shall have a height of at least 1.2 meters unless otherwise approved, and shall be trimmed to uniform surfaces and slopes.

SAMPLING. Samples of naturally occurring topsoil, manufactured topsoil or amended soil mixture will be taken by a representative of the Department. Samples taken for topsoil that has been amended or manufactured with approved composted sewage sludge shall be identified as such. Topsoil containing foreign material may be rejected on the basis of a visual examination prior to testing. The topsoil sampling procedure shall be as required in the Department's "Sampling Procedures for Topsoil."

Contractors may obtain copies of the procedures from the Engineer. Contractors who believe that an error was made in sampling the topsoil shall, within one work day, indicate the alleged error in writing to the Engineer.

TESTING. All material tests required by this section, except for the testing of composted sewage sludge and topsoil containing composted sewage sludge, will be done by the Department in conformance with the procedures contained in the appropriate Department publications or test methods current on the date of advertisement for bids.

Composted sewage sludge used to amend or manufacture topsoil shall conform to the applicable requirements of §713-15 Organic Material. Composted sewage sludge shall require a certificate, from a laboratory approved by the DEC, verifying compliance with all applicable laws, rules and regulations. The certification shall be supplied by the Contractor, at the Contractor's sole expense, and prior to the delivery of any composted sewage sludge, topsoil containing composted sewage sludge or other such regulated material to the contract site. The material shall be approved before it is used. A copy of the specifications shall be furnished to the laboratory by the Contractor.

Topsoil that has been amended with approved composted sewage sludge or other such regulated material shall be tested by an established Engineering or Agronomy firm which provides soils laboratory services. The test is to assure compliance with the pH, organic content and gradation requirements of this section. A copy of the specification and the Department's current test methods shall be furnished to the laboratory by the Contractor. The testing of topsoil amended with approved composted sewage sludge shall be done at the Contractor's sole expense. Samples shall be taken by a representative of the Department and the laboratory results shall be returned to the Regional Landscape Architect.

The Contractor shall notify the Engineer of the intended source of the material at least three weeks in advance of the scheduled use of the material to allow time for sampling, shipping of the sample and testing.

BASIS OF ACCEPTANCE. Acceptance of topsoil will be based upon the test results unless otherwise specified. Tested topsoil must be approved in writing by the Engineer before any material is used, except that topsoil used for establishing turf and wildflowers or sodding may be placed at the Contractor's option, prior to amending it to correct deficiencies in its organic content and/or pH. Acceptance of topsoil placed prior to correcting organic content and/or pH deficiencies will be based on retest results of samples taken after the placed topsoil has been amended.

713-02 LIMESTONE

SCOPE. This specification covers the material requirements for limestone.

MATERIAL REQUIREMENTS. Limestone shall be ground limestone having a minimum total neutralizing value of 88% calcium carbonate equivalence. A minimum of 90% shall pass the 0.85 mm mesh sieve and a minimum of 60% shall pass the 0.15 mm mesh sieve.
§713

PACKAGING. Agricultural limestone packed in the manufacturer's standard containers shall weigh not over 45 kg each, with the name of the material, net weight of contents and the manufacturer's name and guaranteed analysis appearing on each container.

DELIVERY. Bulk shipments shall be accompanied by a certificate providing the names, weight and analysis as specified herein for packaged material.

BASIS OF ACCEPTANCE. The manufacturer's label or certificate indicating compliance with these specifications shall be the basis of acceptance.

713-03 FERTILIZER

SCOPE. This specification covers the material requirements for fertilizers.

MATERIAL REQUIREMENTS. Fertilizers may be either fluid or dry formulations of commercial carriers of available plant nutrients.
The following mixed commercial fertilizers shall contain total nitrogen, phosphoric acid and soluble potash in the ratios stated:
- Type No. 1. 1-2-1 (approximate analysis)
- Type No. 2. 1-1-1 (approximate analysis)

The following fertilizers shall be as specified:
- Type No. 3. 10-6-4 (50% N/UF). 50% of total nitrogen shall be derived from ureaform furnishing a minimum of 3.5% water insoluble nitrogen (3.5%WIN). The balance of the nitrogen shall be present as methylene urea, water soluble urea, nitrate and ammoniacal compounds.
- Type No. 4. Nitrate of soda, shall contain a minimum of 16% nitrogen.
- Type No. 5. Ammonium sulfate shall contain a minimum of 20.5% nitrogen.
- Type No. 6. Ammonium nitrate shall contain a minimum of 33% nitrogen, one-half of which is in the ammonium form and one-half of which is in the nitrate form.
- Type No. 7. A nitrogen carrier containing a minimum of 45% nitrogen such as Urea or equivalent.
- Type No. 8. Bonemeal shall contain a minimum of 1.0% nitrogen and a minimum of 20% phosphoric acid.
- Type No. 9. Superphosphate shall contain a minimum of 18% available phosphoric acid.
- Type No. 10. Vacant
- Type No. 11. A fertilizer in standardized packets designed to control the release of their contents over a specified period of time. The minimum guaranteed analysis shall be 16-8-8.
- Type No. 12. Shall be as specified in the contract documents.

PACKAGING. Fertilizers shall be in the manufacturer's standard containers. Containers shall not weigh more than 45 kg and shall include a label stating the name of the material, the net weight of the contents, the manufacturer's name, and the guaranteed analysis of the fertilizer. Labels on containers of fluid fertilizers shall state the net volume of the container.

DELIVERY. Bulk delivery of fertilizer shall be accompanied by the manufacturer's certificate stating the name of the manufacturer, the guaranteed analysis and the weight of the shipment. Certificates accompanying bulk deliveries of fluid fertilizers shall also state the net volume of the shipment.

BASIS OF ACCEPTANCE. The manufacturer's label or certificate indicating compliance with these specifications shall be the basis of acceptance. The Engineer reserves the right to reject any material that has become caked or otherwise damaged.

713-04 SEEDS

SCOPE. This specification covers the material requirements for seeds.
MATERIAL REQUIREMENTS. Each species, variety and strain of grasses, legumes, wildflowers and cereals and the minimum percentage of germination of each shall be as specified in the contract documents unless otherwise approved.

Material other than pure live seed shall comprise only nonviable seed, chaff, hulls, live seed of crop plants other than those specified, harmless inert matter and weed seeds except that weed seeds other than seeds of noxious weeds will be permitted up to 1% of the gross weight of each kind of seed. Legume seeds requiring inoculation shall be accompanied by adequate amounts of their proper inoculants unless accompanied by certification of preinoculation.

The percentage of purity shown on the label will be acceptable. The percentage of germination for each of the species, variety or strains of seeds shown on the label shall not be less than the minimum percentage specified in the contract documents. The percentage of pure live seed of each kind in each container or bag of seeds delivered will be computed by multiplying the percent germination by percent purity and dividing by 100. The percentage of pure live seed of each kind multiplied by the net weight of the container or bag will indicate the number of kilograms of pure live seed of each kind in the container or bag.

Nomenclature. The common and scientific names of grasses, legumes, wildflowers and cereals specified in the contract documents shall conform to one or more of the authorities on botanical nomenclature recognized by the American Association of Nurserymen.

Legume Inoculants. Inoculants for treating legume seeds shall be a standard culture of nitrogen fixing bacteria that is not more than one year old. Each inoculant shall be the specific culture required for each legume. It shall be supplied only from manufacturers licensed to sell legume inoculants in New York State.

Packaging. Seeds shall be furnished and delivered in labeled containers or bags that are acceptably sealed or sewn tight.

When seeds are to be accepted by certification, they may be mixed prior to delivery.

When sampling and testing is specified, seeds shall not be sown until written approval is issued. Approved seeds may be mixed prior to delivery.

LABELING. All seed and seed labels shall be in accordance with State and Federal Laws, Rules and Regulations, including Article 9 Section 137 of the Agriculture and Markets Law.

SAMPLING AND TESTING

A. Certification. Seeds will be accepted on the basis of certification unless otherwise specified in the contract documents. The certification shall consist of the label that shall be attached to each container of seed in accordance with the provisions of the New York State Agriculture and Markets' Law. Seeds will not be accepted by certification unless the test dates shown on the seed container labels are within the same calendar year that the seeds are sown.

Seeds will not be accepted if seed container labels are removed prior to the time of sowing nor will seeds be accepted if container labels have been altered, are obliterated or are otherwise illegible.

B. Sampling and Testing. Seeds will be subject to sampling and testing when specified in the contract documents and/or whenever the Engineer determines that seed damage or deterioration may have occurred as a result of handling, transit or storage.

Seeds specified for sampling and testing, and other seeds to be sampled and tested as determined by the Engineer, shall not be sown until test results are received and written approval is issued.

Sampling shall be done by a representative of the New York State Department of Transportation. Testing shall be done by the Department of Seed Investigations, New York State Agricultural Experiment Station, Geneva, New York, and the test results obtained will be considered final.

Tolerances established by the Agricultural Experiment Station will be used to determine if the seeds conform to the specifications.
Basis of Acceptance. The seeds shall meet the minimum specified requirements regardless of the guarantee of qualities or dates of testing and after the application of tolerances approved by the Department of Seed Investigations, New York State Agricultural Experiment Station, Geneva, New York. Seed that has become wet, moldy or otherwise damaged in transit or storage will not be acceptable. After delivery to the Contractor, seed shall be stored so that it is protected from damage or deterioration from any source. Provisional acceptance of seeds shall be obtained before the seeds are sown. Final acceptance may be subject to the results of official sampling and testing. The Contractor shall furnish the vendor with the specifications for the material.

713-05 Wood Chips

Scope. This specification covers the material requirements for wood chips used as mulch, landscape bedding or erosion control.

Material Requirement. Wood chips used for mulch, landscape bedding or erosion control may be either of the following, unless otherwise specified in the contract documents. Wood chips shall not exceed 80 mm in the greatest dimension.

A. Type A. This shall be derived from green hardwood or softwood. The chips shall be free from leaves, young growth, unchipped branches, twigs 50 mm or less in diameter, wood shavings, sawdust or foreign materials such as stones, nails, plastic, etc.

B. Type B. Shall be either Type A green wood chips or wood chips derived from unadulterated construction and/or demolition waste wood. Wood chips derived from construction and/or demolition waste wood shall not be contaminated with paint, chemicals, shingles, glass, nails, etc.

Basis of Acceptance. Acceptance shall be based on inspection, upon delivery, by the Engineer for compliance with the materials requirements and applicable certification of compliance with 6 NYCRR Part 360.

713-06 Trees, Shrubs and Vines

Nomenclature. The common and scientific nomenclature for plants shall be in conformity with the American Association of Nurserymen's currently recognized authorities on botanical nomenclature.

Quality and Size. Plants, including root spread and ball size, shall be in accordance with the current edition of “American Standard for Nursery Stock (ANSI Z60.1),” unless otherwise specified in the contract documents. All plants shall have a normal habit of growth and be typically characteristic of their respective kinds. The specified plant sizes shall be the minimum size allowed and shall include plants from that size up to but not including the next larger size. Plants shall not be pruned at the time of digging or before delivery and no plants shall be cut back from larger sizes to meet the sizes specified. Plants shall be free from injury, insect damage, infestation and disease. Plants shall be nursery grown unless otherwise specified and bear evidence of proper nursery care, including adequate transplanting and root pruning. Plants specified from collected sources shall be clean, sound stock, free from decayed stumps and from fire injury.

Container grown material, including container sizes and soil, shall be as specified in the Contract Documents.

Containers shall be sufficiently rigid to hold the ball shapes and protect the root balls during handling and shipping. Container grown plants shall have been grown in the container long enough for new fibrous roots to have developed so that the root ball is firm and will retain its shape and hold together when removed from the container. The plants shall be in a healthy growing condition with tops which are of good quality, and shall have been adequately hardened off before shipment.

Specimen plants shall be as specified in the Contract Documents.

Digging Plants. Plants shall be dug with care and skill immediately before shipment. Digging shall avoid all possible injury to, or loss of roots, but when required, roots cut shall be cleanly cut. No cold
storage plants will be accepted unless approved in writing prior to delivery. Plants stored temporarily shall be properly heeled in or otherwise protected from injury.

**Root Protection.** After plants are dug, their roots shall be protected from injury such as caused by heat, sun, wind and freezing temperatures. All bare roots of trees, shrubs and vines shall be puddled at the time of digging unless otherwise approved. Puddling shall be done in a wet clay mixture, of a quality to adhere to all parts of the root system. Roots of bare root plants which have been thoroughly covered at the time of digging with an anti-desiccant as specified under §713-08 will not require puddling. Bare roots shall be further protected by wrapping in wet straw, moss, burlap or other suitable material.

**Transportation.** Tarpaulins or other covers shall be placed over plants transported by open trucks or by open freight cars. Closed trucks and closed railroad cars shall be ventilated to avoid overheating and the doors shall be kept closed during shipment to prevent plants from drying. The heads of trees shall be tied-in carefully to prevent fracturing or breaking the branches. Trunks and branches shall be adequately supported and padded to avoid scraping or bruising.

**GENERAL.**

**Trees.** Nursery grown trees shall have no pruning cuts which are not healing and no cuts over 20 mm which have not completely calloused over, no cut back crowns or leaders and no abrasions of the bark. Trees must have good fibrous root systems characteristic of the kind. Deciduous trees shall have normal spread of crowns unless otherwise specified.

Bare root trees shall not require earth adhering to the roots except as required for puddling as specified. Any trees specified as bare root will be accepted balled and burlapped at the unit price bid for bare root trees.

Balled and burlapped trees shall be properly dug and protected to preserve the natural earth in contact with the roots. No manufactured balls will be accepted. The balls shall be of the required size, firmly wrapped and tied with approved materials. No balled plants will be acceptable if the ball is cracked or broken.

Balled and platformed trees shall be balled as specified for balled and burlapped trees. Platforms shall be square or octagonal shaped in a size slightly larger than the diameter of the bottom of the soil mass, inserted under each ball and securely lashed to the ball by means of ties from the platform corners to the rope collar on top of the ball.

Container grown trees shall be as specified in the contract documents.

The tops of trees shall be well formed structurally, but they are not required to have more than reasonably straight trunks, nor better than average well balanced crowns, nor be of specimen quality unless the requirements for “specimen” trees are specified on the plans.

When “street trees” are specified, they shall be consistent with the current American Standard For Nursery Stock standards for street trees, and the branching heights shall be as specified in the contract documents.

**Shrubs.** Shrubs shall have good fibrous root systems. The quality of balled and burlapped and balled and platformed shrubs shall be as specified for balled and burlapped and balled and platform trees herein.

Container grown shrubs shall be as specified in the contract documents.

Plants specified as sods or clumps shall be dug from good soil which has produced a fibrous root system typical of the nature of the plant. The sods shall be dug with earth and incidental vegetation adhering to the roots. If the soil or habit of the root growth is such that the roots are not adequately protected, the sods shall be wrapped in burlap or other suitable material.

**Vines.** Vines shall be vigorous, well-furnished plants with good vigorous root systems. Vines shall be field grown unless otherwise specified. Pot grown plants shall be vigorous, well-developed plants, well established in pots with sufficient roots to hold the earth intact after removal from containers but they shall not be rootbound.

**Substitutions.** No change of size, kind or quality of plants as specified will be accepted except upon written approval of the engineer.
Labeling. Labeling shall be in accordance with currently accepted nursery labeling practice except that the Contractor may be required at any time to supply positive identification of any plant.

Inspection. The Contractor shall be responsible for all certificates of inspection of plant materials which may be required by federal, state, provincial or other authority to accompany shipments of plants. When nursery inspections are specified in the contract documents, they shall be limited to inspections of plants specified elsewhere in the contract documents. Unless otherwise specified in the contract documents, the Contractor shall provide at least 15 days notice to the Engineer stating the date, time and place where specified nursery inspections may be conducted. The Contractor shall be represented at all inspections. The Department’s expenses associated with inspections, will be paid for by the Department under the provisions of Section 106 Control of Material of the Standard Specifications. The Department reserves the right and option to place Department seals on any or all materials selected. Selection and/or tagging of material shall cover the type and body quality of the plant only, but shall not constitute acceptance nor preclude the right of rejecting plants not fully meeting the requirements of the specifications.

The Department reserves the right to identify by suitable non-injurious means such as painting, marking by various methods, etc. all plant material rejected upon delivery to the contract site.

BASIS OF ACCEPTANCE: Acceptance shall be based on inspection, upon delivery, by the Engineer for compliance with the materials requirements.

713-07 ROLLED EROSION CONTROL PRODUCTS AND SOIL STABILIZERS

SCOPE. This specification covers the material requirements for Rolled Erosion Control Products and Soil Stabilizers.

MATERIAL REQUIREMENTS

Class I (Short-Term) Light-duty, organic, or synthetic erosion control products.

Type A. Products for use where the slopes do not exceed 1:4. No minimum shear stress is required. The product shall be capable of withstanding moderate foot traffic without tearing or puncturing.

Type B. Products for use on slopes 1:3 and flatter. No minimum shear stress is required.

Type C. Products for use on slopes 1:3 or flatter, or in channels. Products shall have the ability to protect soil from hydraulically induced shear stresses under bench scale conditions for at least 70 Pa at 13 mm soil loss.

Class II (Intermediate) Erosion-control products.

Type A. Jute-Mesh. For use on slopes 1:2 or flatter. Jute-mesh shall be of a uniform, open, plain weave of undyed and unbleached, single-jute yarn. Jute-mesh shall be woven as follows:
- Approximately 55 warp ends per meter width.
- Approximately 37 weft ends per linear meter.
- Mass of jute mesh shall average 0.5 (± 5%) kilogram per square meter

Type B. Organic or nonorganic products for use on slopes 1:2 or flatter, or in channels. Products shall have the ability to protect soil from hydraulically induced shear stresses under bench scale conditions for at least 95 Pa at 13 mm soil loss.

Type C. Products made entirely of organic materials. For use on slopes 1:2 or flatter, or in channels. Only 100% organic materials are allowed. Products shall have the ability to protect soil from hydraulically induced shear stresses under bench scale conditions for at least 95 Pa at 13 mm soil loss.
Class III (Permanent Nondegradable synthetic products [fibers, filaments, or nettings] which may be supplemented with degradable natural fiber components).

**Type A.** Products for use on slopes 1:2 or flatter, or in channels. Products shall have the ability to protect soil from hydraulically induced shear stresses under bench scale conditions for at least 95 Pa at 13 mm soil loss.

**Type B.** Products for slopes 1:2 or flatter, or in channels. Products have the ability to protect soil from hydraulically induced shear stresses under bench scale conditions for at least 170 Pa at 13 mm soil loss.

**Type C.** Products for slopes 1:1 or flatter, or in channels. Products shall have the ability to protect soil from hydraulically induced shear stresses under bench scale conditions for at least 240 Pa at 13 mm soil loss.

**Type D.** Products for slope 1:1 or flatter, or in channels. Products shall have the ability to protect soil from hydraulically induced shear stresses under bench scale conditions for at least 380 Pa at 13 mm soil loss.

Class IV Soil Stabilizers. Soil stabilizers are short-term duration, erosion control products. When used alone, they shall be used on slopes 1:2 or flatter. They shall not be used in channels.

**Type A.** A cementitious soil binder which is added to wood cellulose fiber mulch, a Flexible Growth Medium(FGM), or a Bonded Fiber Matrix(BFM). Intended to form a thick, heavy-bodied crust or mat-like barrier that controls water-, and wind-induced erosion. Type A products may be used alone and are approved for use with Class III, Types A, B, and C rolled erosion control products where those products are used on slope applications.

**Type B.** A polyacrylamide (PAM) and calcium solution intended to reduce the erodibility of bare soils during construction activities or to enhance the performance of mulching on permanent slopes. Soil stabilizer, Type B, shall bond soil particles and shall effectively increase the soil particle size to 1.0 mm or larger. Soil stabilizers, Type B shall reduce the movement of soil through chemical bonding, increase the particle size thus making silt fence more effective, and increase the water absorption of the soil.

BASIS OF ACCEPTANCE. Acceptance of this material shall be in accordance with procedural directives of the Department.

713-08 MATERIALS FOR PROTECTION OF PLANTS

SCOPE. This specification covers the material requirements for materials used in planting operations. For methods of installation, see current standard sheet, as applicable.

MATERIAL REQUIREMENTS

Rodent Guards. Rodent guards shall be capable of protecting plants from girdling by rodents and shall be as specified in the contract documents or as approved by the Engineer.

Stakes for Supporting Trees

**A. Above Ground Support.** Stakes for supporting trees shall be of white or red cedar, or other approved material. Stakes 2.5 m to 3.0 m long shall have a minimum diameter of 50 mm to 60 mm. Stakes 3.75 m long shall have a minimum diameter of 80 mm. The maximum diameter of stakes shall not exceed 100 mm. Stakes shall be pointed at one end and shall have a maximum allowable
deflection of 40 mm for every meter of length. All stakes shall be sound and free from insects and fungi.

B. Underground Support. Stakes for supporting trees shall be of approved hardwood or other approved material. Hardwood stakes shall be 50 mm by 100 mm nominal size, approximately 1.25 m long. Stakes shall be pointed at one end. All stakes shall be sound and free from insects and fungi.

Deadmen and Guy Stakes. Deadmen and guy stakes used to anchor guy wires or cables, which support trees, shall be of the quality and sizes required.

Wire. Wire for guying plants shall be new annealed steel wire (either galvanized or ungalvanized) or aluminum wire of the A.S. & W. gauge specified.

Bracing Materials. The size and quality of cables, turnbuckles, thimbles, leg hooks, eye bolts, rods, washers and nuts shall be as specified on the plans or as approved.

Jute Burlap. Jute burlap shall be in 100 mm wide strips and weigh 265 g/m2.

Hose. Hose for protecting the bark from guy wires shall be good quality braided rubber, plastic hose as approved, or reinforced materials. Hose shall be at least 20 mm outside diameter.

Twine. Twine for use in wrapping trees shall be jute twine not less than two ply for trees 80 mm or less in diameter, and three ply for trees over 80 mm in diameter.

Paper. Wrapping paper for trees shall be waterproof paper 30-30-30 krinklecraft or equal in 100 mm wide strips.

Anti-Desiccants. Anti-desiccants shall be emulsions or other materials which will provide a protective film over plant surfaces, permeable enough to permit transpiration.

BASIS OF ACCEPTANCE. Acceptance shall be based on inspection by the Engineer for compliance with the material requirements.

713-09 AND 713-10 (VACANT)

713-11 WOOD FIBER MULCH

SCOPE. This specification covers the material requirements for wood fiber for use as a mulch in conjunction with turf establishment or erosion control.

MATERIAL REQUIREMENTS. Wood fiber shall be a first generation product manufactured directly from 100 percent wood which has been recovered or diverted from solid waste. Wood fiber shall be manufactured from unadulterated wood that is not contaminated with paint, chemicals, shingles, plastic or other foreign materials. Wood fiber mulch shall not be manufactured from or include paper.

Wood fiber mulch shall be manufactured so that the wood fibers will remain uniformly suspended in water under agitation and will blend with seeds, fertilizer and other additives to form a homogeneous slurry. It shall have the characteristics which, upon hydraulic application, shall form a blotter-like ground coating with moisture absorption and percolation properties and the ability to cover and hold seeds in contact with the soil.

Wood fiber mulch shall contain no growth or germination inhibiting factors, and shall contain a non-permanent green dye. Wood fiber mulch shall be supplied in the manufacturer's standard containers, with the name of the material, net weight of contents, the manufacturer's name and the air dry weight of fiber (equivalent to 10% moisture) appearing on each container.
BASIS OF ACCEPTANCE. The Engineer’s acceptance of wood fiber mulch shall be based on the manufacturer’s product label, including methods and rates of applications, and certification indicating compliance with these specifications and any applicable regulatory requirements pertaining to solid waste management.

713-12 MULCH ANCHORAGE

SCOPE. This specification covers the material requirements for mulch anchorage.

MATERIAL REQUIREMENTS. Mulch anchorage shall be Type A, unless otherwise specified in the contract documents.

**Type A:** Shall be approved non-asphaltic commercially available products that are specifically formulated for the purpose of anchoring or tacking hay or straw mulch. Mulch anchorage shall include a non-permanent green dye. The paper content of paper-based hydraulic mulch anchorage shall be 100 percent post consumer recovered from solid waste. At least 98 percent of such paper shall be recovered newsprint. The materials shall be mixed and applied in accordance with the manufacturer's instructions.

**Type B:** Shall be either Type A or asphalt emulsion meeting the requirements of either 702-3201 Asphalt Emulsion or 702-90 Asphalt Emulsion Tack Coat. When asphalt emulsion is used it shall be uniformly applied at the rate of 0.02 L/m², unless otherwise specified in contract documents.

PACKAGING. Mulch Anchorage Type A shall be furnished in the manufacturer's standard containers with the name of the material, net weight of contents, the manufacturer's name and the dry weight of fiber (equivalent to 10% moisture) appearing on each container. The instructions for mixing and application shall also appear on each container.

Asphalt emulsion used for Mulch Anchorage Type B has no packaging requirements. The Engineer shall reject any asphalt material that is not homogenous or has separated. Asphalt separation caused by freezing unacceptable.

The Engineer shall reject any materials that have become wet, caked, frozen, separated or otherwise unfit for use.

BASIS OF ACCEPTANCE. The basis of acceptance for Mulch Anchorage Type A shall be the manufacturer's product label or product literature that indicates compliance with this specification. The basis of acceptance for asphalt emulsion used as Mulch Anchorage Type B shall be as specified under Section 702 Bituminous Materials.

713-13 PESTICIDES

SCOPE. This specification covers the material requirements for pesticides used to manage vegetation, insects, rodents and/or other target pests.

MATERIAL REQUIREMENTS. Pesticides shall be approved commercially available products that are currently registered by the United States Environmental Protection Agency and the New York State Department of Environmental Conservation. Pesticides shall also have all required labels indicating that they are approved for the intended use.

Pesticides shall be mixed and used in strict conformance with the instructions on the label or supplemental labels.

PACKAGING. Pesticides shall be delivered and securely stored until used in the manufacturer's standard containers that have legible labels affixed in accordance with the provisions of the federal and state pesticides laws, rules and regulations in effect at the time of delivery.

Pesticides that do not meet these packaging requirements, at any time, will be rejected by the Engineer and shall be removed from the Contract site immediately.

The Engineer shall reject any pesticides that have become wet, caked or otherwise unfit for use.
§713

BASIS OF ACCEPTANCE. The basis of acceptance shall be original, sealed, and properly labeled pesticide containers; and two copies of sample labels and supplemental labels that include instructions for the intended use of the pesticide.

The Department reserves the right to inspect the condition of pesticides and pesticide containers at any time while they are on the Contract site and to direct immediate removal of any pesticides and/or containers that do not meet these specifications.

713-14 SOD

SCOPE. This specification covers the material requirements for sod.

MATERIAL REQUIREMENTS. Sod shall be commercially grown sod and shall be accompanied by a certificate indicating compliance with the regulations of the New York State Department of Agriculture and Markets.

Sources of sod shall be made known to the Engineer at least five days before cutting. Sod shall be cut into squares or rectangular portions which shall be 300 mm wide, or as approved, and may vary in length, but shall be of a size which will permit them to be lifted without breaking. The sod, when delivered to the contract site, shall be sufficiently moist so the soil will adhere firmly to the roots when it is handled.

Height of the grass shall not exceed 80 mm. The sod shall be cut to a minimum thickness of 20 mm. The sod shall be reasonably free from weeds in conformance with accepted commercial practice and shall consist of a mixture of permanent grasses such as bluegrass and/or fine leaved fescues, unless otherwise specified.

BASIS OF ACCEPTANCE. Acceptance shall be based on inspection by the Engineer for compliance with the material requirements.

713-15 ORGANIC MATERIAL

SCOPE. This specification covers the material requirements for organic material used in conjunction with amending or manufacturing topsoil.

GENERAL. Organic materials regulated by the New York State Department of Environmental Conservation shall meet all applicable regulatory requirements.

MATERIAL REQUIREMENTS

A. Humus or Peat. The material shall be commercially produced natural humus or peat from freshwater sources and may contain sedge peat, sphagnum peat or reed peat. The material shall be free from hard lumps, roots, stones and other objectionable materials. There shall be no admixture of refuse or material toxic to plant growth. It shall be in a shredded or granular form able to pass through a 12.5 mm sieve. According to methods of testing of A.O.A.C. in effect on the date of the invitation of bids, the acidity shall be not less than 3.5 pH and the organic matter shall be not less than 85% as determined by loss on ignition. The minimum water holding capacity shall be 200% by weight on an oven-dry basis.

B. Peat Moss. Peat moss shall be commercially produced and shall be composed of the partly decomposed stems and leaves of any or several species of sphagnum moss. It shall be free from wood, decomposed colloidal residue and other foreign matter. It shall have an acidity range of 3.5 pH to 5.5 pH as determined in accordance with methods of testing of A.O.A.C. in effect on the date of advertisement for bids. Its water absorbing ability shall be a minimum of 1100% by weight on an oven-dry basis.

C. Source-Separated Compost. Source-separated compost shall be commercially produced and may contain sedge peat, sphagnum peat or reed peat. It shall be in a shredded or granular form able to pass through a 12.5 mm sieve. According to methods of testing of A.O.A.C. in effect on the date of the invitation of bids, the acidity shall be not less than 3.5 pH and the organic matter shall be not less than 85% as determined by loss on ignition. The minimum water holding capacity shall be 200% by weight on an oven-dry basis.
generation. Source-separated compostable materials may include, but are not limited to, leaves and yard trimmings, food scraps, food processing residues, manure and/or other agricultural residuals, forest residues and bark, and soiled and/or unrecyclable paper.

Source-separated compost shall be reasonably free of sticks, stones, refuse, materials deleterious to soil structure, or any material toxic or detrimental to plant germination and growth. Source-separated compost shall also meet the following additional specifications:

A) Minimum organic matter shall be 30% (dry weight basis) as determined by loss on ignition;
B) Product shall be loose and friable, not dusty, and have a moisture content of 35% - 60%;
C) Particle size shall be <12.5 mm.
D) Soluble salts content shall be < 4.0 mmhos/cm (ds/m);
E) Compost shall be stable to very stable according to the test method current on the date of advertisement for bids.
F) pH shall be between 6.0-8.0.

**D. Composted Sewage Sludge.** Composted sewage sludge is regulated by the New York State Department of Environmental Conservation (DEC) and must meet all applicable regulatory requirements.

**TESTING.** Source separated compost will be subject to testing by the Department to assure it is stable. Composted sewage sludge used to amend or manufacture topsoil shall have a certificate, from a laboratory approved by the DEC, verifying compliance with all applicable laws, rules and regulations. Only facilities permitted to compost sewage sludge under 6 NYCRR Part 360, Solid Waste Management Facilities, shall be allowed to furnished finished compost for use in topsoil. The certification shall be supplied by the Contractor, at the Contractor's sole expense, and prior to the delivery of any composted sewage sludge, topsoil containing composted sewage sludge or other such regulated material to the contract site. The material shall be approved before it is used. A copy of the specifications shall be furnished to the laboratory by the Contractor.

**BASIS OF ACCEPTANCE.** Acceptance of humus, peat and peat moss will be based on the Producer's label or certificate of analysis by an established laboratory indicating compliance with the material requirements.

Acceptance of source-separated compost shall be based upon the Producer's label or certificate of analysis by an established laboratory indicating compliance with the material requirements; and a delivery inspection by the Engineer. Source-separated compost may be sampled and tested by the Department to assure compliance with the material requirements.

Acceptance of composted sewage sludge shall be based on certification by a DEC approved laboratory indicating compliance with the material requirements and all applicable regulations.

**713-16 AND 713-17 (VACANT)**

**713-18 HAY**

**SCOPE.** This specification covers the material requirements for hay.

**MATERIAL REQUIREMENTS.** Hay for mulching shall be mowings of acceptable herbaceous growth which is free from noxious weeds. Materials which are low grade and unfit for farm use such as "U.S. sample grade" will be acceptable. Weight shall be calculated on the basis of material having not more than 15% of moisture content.

**BASIS OF ACCEPTANCE.** Acceptance shall be based on inspection by the Engineer for compliance with material requirements.

**713-19 STRAW**

**SCOPE.** This specification covers the materials requirements for straw.
MATERIAL REQUIREMENTS. Straw for mulching shall be stalks of oats, wheat, rye or the approved crops which are free from noxious weeds. Materials which are low grade and unfit for farm use, such as "U.S. sample grade" will be acceptable. Weight shall be calculated on the basis of the materials having not more than 15% of moisture content.

BASIS OF ACCEPTANCE. Acceptance shall be based on inspection by the Engineer for compliance with the material requirements.

SECTION 714 - CURBING AND GUTTER

714-01 STONE CURB

SCOPE. This specification covers the material and fabrication requirements for stone curb used in highway and bridge construction.

MATERIAL REQUIREMENTS. Stone curb shall be either a bluestone, sandstone or granite. The stone shall be sound and durable, free from seams which impair its structural integrity and of a smooth splitting and machining character. Natural color variations that are characteristic of the deposit will be permitted. Any curb containing discoloration other than cleanable surface stains shall be sampled and submitted to the Materials Bureau for evaluation.

Dimensions

A. General. Curb shall be cut to conform to the shape and size shown on the standard sheets and contract plans.

B. Curbs on Straight Sections. Minimum lengths of straight segments of Economy and Sloped curbs shall be 600 mm. All other straight curb types shall have 900 mm minimum lengths.

C. Curbs on Curved Sections. No minimum length requirements are specified for curb segments on curves with radii of 60 meters or less. When directed by the Engineer, curb segments on curves with radii 31 to 60 meters shall be cut in 900 mm to 1200 mm straight lengths. With exception of Economy and Sloped curbs, segments on curves with radii of 30 meters or less shall be shaped to the required curvature and the ends cut on radial lines. Economy and Sloped curbs shall be furnished only in straight segments and on curves with radii less than 3 meters, their ends shall be cut on radial lines.

D. Transition Curb for Bridge to Roadway Curb. A transition curb for bridge curb to roadway curb shall be furnished, if required. Where an 200 mm exposed face is desired for a roadway curb, the appropriate curb sections with a 150 mm exposed face shown on the appropriate section of the standard sheet shall be increased 50 mm in depth.

E. Curb Widths. The bottom width of the various types of curbing shall be as follows:

<table>
<thead>
<tr>
<th>Type</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, B, C, D, E, T2 and Economy</td>
<td>100 mm minimum for 2/3 of length</td>
</tr>
<tr>
<td>F1, G1, M and T1</td>
<td>100 mm minimum for entire length</td>
</tr>
<tr>
<td>R1 and R2</td>
<td>200 mm minimum for entire length</td>
</tr>
<tr>
<td>S</td>
<td>125 mm minimum for entire length</td>
</tr>
</tbody>
</table>

Finish

A. General. Curb surfaces shall be finished as indicated on the plans or standard sheets.
B. Top Surfaces.  Top surfaces shall be finished to approximately true planes. When sawed, hammered or thermal finishes are applied, no projection or depression shall be greater than 5 mm. Saw marks normal to the sawing process will be permitted if within the 5 mm tolerance.

C. Arris Lines.  Top front arris lines shall be straight and true with no variations greater than 3 mm measured from a 600 mm straightedge placed along the arris line.

Back arris lines on curb types E,F1,M,T1, and T2 curb and the lower front arris lines on types E,F1,M,R1,R2,S,T1 and T2 curbs shall be straight and true with no variations from a straight line greater than 6 mm measured in the same manner. Back arris lines are not required for types R1,R2 and S curbs.

Exposed arris lines at the joints shall not project beyond the plane of a split face and shall not fall under the plane of a split face more than 6 mm.

D. Back Surfaces.  Back surfaces shall have no projection or depression which exceeds a batter of 25 mm in 75 mm for a distance of 75 mm from the top.

E. Front Exposed Faces.  Front exposed faces of straight Types A, F1, and G1 curbs, when split, shall have no projection greater than 25 mm or depression greater than 13 mm measured from a vertical plane passing through the arris line at the top of the split face. For radius units the front exposed faces when split, shall have no projection greater than 30 mm. The entire face of Type G1 curb shall be considered as exposed face. Front exposed faces of types M, R1, R2, S, T1 and T2 curbs, when split, shall have no projection or depression greater than 13 mm measured from a vertical plane passing through the arris line at the top of the split face. Front faces below grade shall have no projection or depression greater than 25 mm measured in the same manner.

No projection on the exposed face of type C curb shall extend over 6 mm beyond a vertical plane extending from the intersection of the pavement grade line and the curb face. The exposed face of type C curb shall have no depression greater than 13 mm measured from the plane of the face through the top arris line.

F. Ends.  Ends of curbs shall be approximately square with the planes of the exposed curb surfaces and shall be finished so that when curbs are set, no space greater than 20 mm shall show in the joints for the full length of the exposed joint. The curb ends below the pavement surface or shoulder shall break not over 200 mm from the joint plane on curb types A, B, C, D, E and T2 curbs and not more than 50 mm on types G1, R2, and T1.

Ends of types F1, G1, M, R1, R2, S and T1 curbs shall be sawed at locations called for on the contract plans.

G. Drill Holes.  Drill holes will not be permitted in exposed curb surfaces.

Exceptions to Finish Requirements

A. Economy Type Curbs.  Top surfaces shall be split so that no projections or depressions are greater than 13 mm. Front arris lines shall not vary from a straight line more than 13 mm. Exposed joint openings shall not exceed 40 mm. Drill holes will be permitted in top and face surfaces.

B. Sloped Type Curb.  Exposed faces shall be smooth and quarry split to an approximately true plane having no projection or depression greater than 25 mm from a 600 mm straightedge placed as closely as possible to the plane of the curb face.

Drill holes not more than 75 mm long and 13 mm deep will be permitted in the face. Arris lines at joints shall not project beyond the plane of the split face and shall not fall more than 13 mm under the plane of the split face.

Curb ends shall be approximately square with the plane of the exposed curb surfaces and finished so that when curbs are set, no space greater than 40 mm shall show in the joints for the full width of the face.
BASIS OF ACCEPTANCE. Stone curb shall be from a source appearing on the Department's Approved List and will be accepted in accordance with procedural directives of the Materials Bureau. In addition, the stone curbing will be inspected for dimensional compliance at the project site by the Engineer. Curbing not in compliance with the dimensions on the standard sheets or contract plans will be rejected by the Engineer.

714-02 AND 714-03 (VACANT)

714-04 PRECAST CONCRETE CURB

SCOPE. This specification covers the material and fabrication requirements for precast concrete curb.

MATERIAL REQUIREMENTS. The Material Requirements contained in §704-03 shall apply.

DRAWINGS. The Drawing requirements contained in §704-03 shall apply.

FABRICATION. The Fabrication requirements contained in §704-03, along with the following shall apply. Precast curb shall be fabricated to conform to the size and shape shown on the standard sheet unless otherwise shown on the plans.

- Minimum curb lengths shall be 1.75 meters except for radial curb and closures. Maximum curb lengths shall be 3.05 meters. Curb to be set on a radius of 30 meters or less shall be cast to the curve required and the ends shall be formed or sawed on radial lines. Curbs to be set on a radius of 31 meters to 60 meters may be cast or cut in 1 or 1.25 meter straight lengths, if approved by the Engineer.

Reinforcing. Reinforcement is optional, however if the manufacturer chooses to reinforce the curb for handling the reinforcement shall be epoxy coated or the concrete shall contain corrosion inhibitor.

SAMPLING AND TESTING. The Sampling And Testing requirements contained in §704-03 shall apply.

MARKING. The Marking requirements contained in §704-03 shall apply except as noted herein.

- Markings shall be placed on an end face of each unit such that they won’t be exposed to view after installation. Instead of marking the contract number on each unit they may be marked with “NYSDOT”.

FINAL PRODUCTION INSPECTION. The Final Production Inspection requirements contained in §704-03 shall apply.

SHIPPING. The Shipping requirements contained in §704-03 shall apply.

BASIS OF ACCEPTANCE. The Basis Of Acceptance requirements contained in §704-03 shall apply.

714-05 (VACANT)

714-06 ASPHALT CONCRETE CURB

SCOPE. This specification covers the material requirements for asphalt concrete curb.

MATERIAL REQUIREMENTS. The Contractor shall have the option of supplying the mix specified herein or he may elect to furnish an alternate mixture subject to prior approval by the Director, Materials Bureau. The requirements of Section 401 - Hot Mix Asphalt Production shall apply with the following modifications:

- Automatic batching and recording equipment will not be required.
B. The asphalt concrete mix shall include a powdered, devulcanized tire rubber which is moisture free, black in color, free flowing and containing no fabric or cord material. The gradation shall conform to the following sieve analysis; percent passing of total weight:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>% Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.75 mm</td>
<td>100</td>
</tr>
<tr>
<td>2.36 mm</td>
<td>85-100</td>
</tr>
<tr>
<td>1.70 mm</td>
<td>65-100</td>
</tr>
<tr>
<td>850 µm</td>
<td>35-80</td>
</tr>
<tr>
<td>600 µm</td>
<td>15-40</td>
</tr>
</tbody>
</table>

C. The asphalt cement used in the mix shall comply with either material specification §702-0400, §702-0500, or §702-0600.

D. The aggregate gradation shall be as follows:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>% Passing (1)</th>
<th>Job Mix Tolerances (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.5 mm</td>
<td>100</td>
<td>--</td>
</tr>
<tr>
<td>6.30 mm</td>
<td>90-100</td>
<td>±5</td>
</tr>
<tr>
<td>3.15 mm</td>
<td>80-100</td>
<td>±6</td>
</tr>
<tr>
<td>850 µm</td>
<td>30-70</td>
<td>±7</td>
</tr>
<tr>
<td>425 µm</td>
<td>15-45</td>
<td>±6</td>
</tr>
<tr>
<td>180 µm</td>
<td>5-23</td>
<td>±3</td>
</tr>
<tr>
<td>75 µm</td>
<td>2-10</td>
<td>±2</td>
</tr>
<tr>
<td>Asphalt Cement (2)</td>
<td>6-9</td>
<td>±0.4</td>
</tr>
<tr>
<td>Tire Rubber (2)</td>
<td>½ - 2</td>
<td>±0.1</td>
</tr>
</tbody>
</table>

(1) Based on total aggregate weight.
(2) Based on total weight of mix.

**BASIS OF ACCEPTANCE.** The acceptance of the asphalt concrete used in asphalt curb shall be in accordance with the Department written instructions.

**714-07 PRECAST CONCRETE GUTTER**

**SCOPE.** This specification covers the material and fabrication requirements for precast concrete gutter.

**MATERIAL REQUIREMENTS.** The Material Requirements contained in §704-03 shall apply.

**DRAWINGS.** The Drawing requirements contained in §704-03 shall apply.

**FABRICATION.** The Fabrication requirements contained in §704-03, along with the following shall apply:

- Precast concrete gutter shall be fabricated to conform to the size and shape shown on the standard sheet unless otherwise shown on the plans.

**Reinforcing.** Wire mesh reinforcement shall consist of one layer of Size 102x102 - MW26 x MW26 embedded midway between the upper and lower surfaces, unless otherwise shown on the plans. Reinforcing bars of equivalent area may be substituted for the wire mesh reinforcement. Reinforcement shall be epoxy coated or the concrete shall contain corrosion inhibitor.

**SAMPLING AND TESTING.** The Sampling And Testing requirements contained in §704-03 shall apply.

**MARKING.** The Marking requirements contained in §704-03 shall apply except as noted herein.

Markings shall be placed on an end face of each unit such that they won’t be exposed to view after installation. Instead of marking the contract number on each unit they may be marked with “NYSDOT”.

**FINAL PRODUCTION INSPECTION.** The Final Production Inspection requirements contained in §704-03 shall apply.

**SHIPPING.** The Shipping requirements contained in §704-03 shall apply.
BASIS OF ACCEPTANCE. The Basis Of Acceptance requirements contained in §704-03 shall apply.

SECTION 715 - CASTINGS, FORGINGS AND METALS

715-01 STRUCTURAL STEEL

SCOPE. This specification covers structural steels used in bridge construction that have a minimum specified yield point of 345 MPa, or less. Steel ordered under this specification may be subject to stress in any direction; longitudinal, transverse and/or through-thickness.

MATERIAL REQUIREMENTS. The manufacture, testing, delivery, and requirements for mill inspection of structural steel shall comply with the requirements of the applicable ASTM Specifications except as modified herein.

Requirements for shop inspection of plates and shapes, and provisions for rejection or shop repair of plates and shapes because of rejectable surface or internal discontinuities, are described in the New York State Steel Construction Manual.

Steels to be Furnished. The contract plans or specifications will indicate, by the proper ASTM Designation, the steel to be used in specific portions of the structure. If the steel type is not indicated on the plans or specifications, the type to be furnished shall meet the requirements of ASTM A36M.

All structural steel plates and shapes used in areas subject to tensile stress as designated on the plans or as listed herein shall be furnished to minimum Charpy V-Notch toughness requirements as provided in this specification. Structural Steel furnished to minimum notch toughness requirements shall include but not necessarily be limited to the following:

- Tension flanges and webs of stringers and girders, splice plates, and lateral gusset plates welded to the members in areas subject to tensile stress.
- Structural shapes used as main stress carrying members including attached cover plates and gusset plates welded to the members in areas subject to tensile stress.
- All truss web and chord members and attached gusset and splice plates.
- Truss lateral bracing
- Portions of Arches, Bents, Towers and Rigid Frames, plus attached gusset and splice plates, designated on the plans as being subject to tensile stress.

TESTS. Physical (mechanical) tests and chemical analysis shall be conducted by the steel manufacturer as required by the specifications.

The method of sampling, preparing test specimens and testing shall be in accordance with the applicable ASTM Designation, except as modified herein.

Charpy V-Notch Impact Test. When the provisions of these specifications require that steel be furnished with specified impact properties, and the steel is not "fracture-critical" as defined in Section 9 of the SCM, the steel shall be accepted on the basis of heat-lot qualification tests as described herein. The tests shall be performed as described for V-Notch test specimens under the heading, "Charpy Impact Testing" of ASTM Designation A370. Full size (10 mm x 10 mm) specimens shall be used whenever thickness permits. When plate thickness requires that subsize specimens be used, the specimens shall be 10 mm x 7.5 mm, or 10 mm x 5 mm. The largest possible specimens shall be used in each case.

When steel thickness is 25 mm or greater, Charpy specimens shall be taken midway between the center and the surface of the plate.

The manufacturer shall conduct and report the results of Charpy V-Notch impact tests to the State. For heat qualification, sampling and testing shall be in conformance with ASTM A673 using the “H” testing frequency.

For any heat to qualify, the average energy, as defined in ASTM A370, absorbed by a full-size specimen shall not be less than that shown for the type of steel in the Table 715-01-1.

If test specimens fail to meet the heat qualification impact requirements, the plate thickness represented by the failed specimens shall be rejected. The producer may test specimens from the next thinner material proposed to be furnished from the same heat and if they meet specification requirements,
the heat will be considered qualified for those thicknesses equal to or less than that tested and found acceptable in the retest.

Any thickness that fails to qualify in the as-rolled condition may be normalized and retested provided that all required mechanical tests are remade on the normalized material. Those thicknesses that passed the test above described in the as-rolled condition need not be normalized even though they were rolled from the same heat of steel.

<table>
<thead>
<tr>
<th>TABLE 715-01-1 CHARPY V-NOTCH IMPACT REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPE OF STEEL</td>
</tr>
<tr>
<td>A36M, A242M</td>
</tr>
<tr>
<td>A572M Grade 345</td>
</tr>
<tr>
<td>A588M (up to 100 mm mechanically fastened)</td>
</tr>
<tr>
<td>A588M (up to 50 mm welded)</td>
</tr>
<tr>
<td>A588M (50 mm to 100 mm welded)</td>
</tr>
<tr>
<td>Sign Structure steel plates and shapes greater than 13 mm thick</td>
</tr>
</tbody>
</table>

NOTE:
1. If the yield strength of the material exceeds 448 MPa, the temperature for the Charpy V-Notch tests for acceptability shall be reduced by 8°C for each increment of 69 MPa above 448 MPa.
2. Samples shall be taken after galvanizing.

If the plate thickness requires that subsize specimens be used, Table 715-01-2 shall be used to find the equivalent absorbed energy for the full size specimen:

Impact tests for fracture-critical members shall be as described in section 9 of the SCM.

<table>
<thead>
<tr>
<th>TABLE 715-01-2 EQUIVALENT ABSORBED ENERGY (Joules)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Size (10 x 10 mm)</td>
</tr>
<tr>
<td>27</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>18</td>
</tr>
<tr>
<td>16</td>
</tr>
<tr>
<td>14</td>
</tr>
<tr>
<td>10</td>
</tr>
</tbody>
</table>

BASIS OF ACCEPTANCE. A certified copy of test results of chemical analyses and physical (mechanical) tests required shall be furnished for all steel. These test data shall be given to the shop inspector for submittal to the Deputy Chief Engineer (Structures) with his/her final inspection report.

When steel is furnished under an item which does not require shop inspection, these data shall be submitted to the Engineer-in-Charge who will perform the visual inspection required by this specification and the payment item.

A manufacturer’s certification of the results of chemical and physical (mechanical) tests conducted as required by the specifications will be interpreted to mean that the manufacturer has tested the product as required by the specifications, and has found both materials and workmanship to conform to the specification designation listed on the report of physical and chemical test results that are certified to be accurate. Workmanship as defined herein shall include dimensional accuracy, surface finish, temper and any other physical and/or mechanical property which may be affected by manufacturing procedures.

715-02 STEEL CASTINGS

SCOPE. This specification covers the material requirements for steel casting for highway bridges.

GENERAL. Steel castings shall conform to the requirements of ASTM A27M. Unless otherwise specified, all steel castings shall be Grade 485-275 Class 1.

MATERIAL REQUIREMENTS

Fracture. Test specimens shall show a fracture having a silky or fine granular structure throughout.
§715

Structural Defects. Steel castings shall be true to pattern in form and dimensions, without sharp unfilleted angles, or corners, and shall be free of pouring faults, sponginess, cracks, blow holes and other defects in positions affecting their strength and value for the service intended.

Blow holes appearing upon finished castings shall be so located that a straight line laid in any direction will not cut a total length of cavity greater than 25 mm in any 300 mm, nor shall any single blow hole exceed 25 mm in any dimension or have an area greater than 325 square millimeters. Blow holes shall not have a depth injuriously affecting the strength of the casting as determined by the Deputy Chief Engineer (Structures). Minor defects which do not impair the strength may, with the approval of the Deputy Chief Engineer (Structures), be welded by an approved process. The defects shall be removed to solid metal by drilling, grinding, or air-carbon arc gouging followed by grinding. After welding, the castings shall be heat treated again if required by the approved repair procedure.

Castings which have been, or are being, welded without prior approval of the repair welding procedure will be rejected.

Large castings may be subjected to non-destructive tests if required by the Contract Documents.

BASIS OF ACCEPTANCE. Acceptance shall be based upon shop inspection at the manufacturing plant by representatives of the Department, or on the basis of inspection at the project site by the Engineer-in-Charge. Certified copies of the results of the chemical and physical tests required by the specifications shall be submitted as required under the provisions of “Basis of Acceptance” in 715-01, Structural Steel.

715-03 ALUMINUM CASTINGS

SCOPE. This specification covers the requirements for various aluminum alloys and shapes.

GENERAL. Aluminum castings shall conform to the requirements of ASTM Specifications as shown in the following table, and as modified herein and by the plans and specifications.

<table>
<thead>
<tr>
<th>Commercial Specification</th>
<th>ASTM Alloy &amp; Temper</th>
<th>ASTM Alloy &amp; Temper</th>
<th>ASTM Specification</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>B443.0-F</td>
<td>S5A-F</td>
<td>B108</td>
<td>Permanent Mold Castings</td>
<td></td>
</tr>
<tr>
<td>B443.0-F</td>
<td>S5A-F</td>
<td>B26M</td>
<td>Sand Castings</td>
<td></td>
</tr>
<tr>
<td>A356.0(modified)1</td>
<td>SG 70-B(modified)1</td>
<td>B108</td>
<td>Permanent Mold Castings</td>
<td></td>
</tr>
<tr>
<td>356.0-T6</td>
<td>SG 70A-T6</td>
<td>B26M</td>
<td>Sand Castings</td>
<td></td>
</tr>
<tr>
<td>356.0-F</td>
<td>SG 70A-F</td>
<td>B26M</td>
<td>Sand Castings</td>
<td></td>
</tr>
<tr>
<td>360.0</td>
<td>SG 100-B</td>
<td>B85</td>
<td>Die Castings</td>
<td></td>
</tr>
<tr>
<td>A712.0</td>
<td>ZG 61-B</td>
<td>B26M</td>
<td>Sand Castings</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: 1. Where this material is required, castings shall be solution treated and aged to produce the following mechanical properties (Yield strength need not be determined unless ordered by the Deputy Chief Engineer (Technical Services)):

Ultimate Tensile Strength         172 MPa min.
Yield Strength (0.2 percent offset) 124 MPa min.²
Elongation (measured with gage length of four times the diameter of the specimen.) 6 percent min.

MATERIAL REQUIREMENTS

Quality. The castings shall be of uniform quality and condition, free from cracks, blow holes, porous places, hard spots, or shrinkage defects which affect the suitability of the castings for their intended use. Before inspection the castings shall be smooth and clean.

Heat Treatment. Casting shall be heat treated in such a manner as to produce material which will conform to the properties specified herein with the approved uniformity.

Castings to be used as bridge railing posts shall be produced under radiographic control. This shall consist of radiographic examination of castings until proper foundry technique, which will produce castings consistently free from harmful internal defects, is established for each mold. Production castings shall be examined as necessary to insure maintenance of satisfactory quality.
Tension test specimens shall be machined from integrally cast test coupons extending sufficiently from one side of the base of the posts to obtain a 8.89 mm diameter test specimen as defined in “Methods of Tension Testing of Metallic Materials" ASTM E8M, with the exception that the radii at the ends of the reduced section shall not be less than 12.5 mm.

The method of test and determination of tensile properties shall be in accordance with ASTM E8. A minimum of one percent of the posts in any lot, but not less than one, shall be sampled for tensile testing. For the purpose of sampling, a lot shall consist of not more than 450 kg of clean castings when produced from a batch type furnace charged with one heat of ingot of known analysis or not more than 900 kg of clean castings when produced from one continuous furnace in not more than 8 consecutive hours.

If the results of any tensile test do not conform to the requirements prescribed, two additional tests shall be taken from the same group of castings, and the average of the three tests must meet the requirements.

**BASIS OF ACCEPTANCE.** This material is accepted on the basis of a manufacturer’s certification of compliance as described in “Basis of Acceptance,” 715-01 except as follows, when the material is used in:

**Bridge Railings.** Accepted on the basis of shop inspection by the Department in accordance with Department directives.

**Fencing.** Accepted on the basis of samples secured in accordance with Department directives.

### 715-04 WROUGHT ALUMINUM

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>ALLOY &amp; TEMPER</th>
<th>ASTM SPEC.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheet and Plate</td>
<td>1100-0</td>
<td>B209M</td>
</tr>
<tr>
<td></td>
<td>2024-T4</td>
<td>B209M</td>
</tr>
<tr>
<td></td>
<td>3003-H14</td>
<td>B209M</td>
</tr>
<tr>
<td></td>
<td>3004-H38</td>
<td>B209M</td>
</tr>
<tr>
<td></td>
<td>5052-H32,-H38</td>
<td>B209M</td>
</tr>
<tr>
<td></td>
<td>5154-H38</td>
<td>B209M</td>
</tr>
<tr>
<td></td>
<td>6061-T6</td>
<td>B209M</td>
</tr>
<tr>
<td></td>
<td>7075-T6</td>
<td>B209M</td>
</tr>
<tr>
<td></td>
<td>ALCLAD 2024-T3,-T42</td>
<td>B209M</td>
</tr>
<tr>
<td></td>
<td>ALCLAD 6061-T6</td>
<td>B209M</td>
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<tr>
<td>Wire</td>
<td>1100-H38</td>
<td>B211M</td>
</tr>
<tr>
<td></td>
<td>3003-H14</td>
<td>B211M</td>
</tr>
<tr>
<td></td>
<td>5052-H38</td>
<td>B211M</td>
</tr>
<tr>
<td></td>
<td>6061-T941</td>
<td>B211M</td>
</tr>
<tr>
<td>Bars and Rod</td>
<td>2024-T4</td>
<td>B211M</td>
</tr>
<tr>
<td></td>
<td>6061-T6</td>
<td>B211M</td>
</tr>
<tr>
<td>Extruded Bars and Rods and Shapes</td>
<td>5154-0</td>
<td>B221M</td>
</tr>
<tr>
<td></td>
<td>6061-T6</td>
<td>B221M</td>
</tr>
<tr>
<td></td>
<td>6063-T5</td>
<td>B221M</td>
</tr>
<tr>
<td>Extruded Shapes</td>
<td>6063-T6</td>
<td>B211M</td>
</tr>
<tr>
<td></td>
<td>6005-T5</td>
<td>B211M</td>
</tr>
<tr>
<td></td>
<td>6351-T6</td>
<td>B211M</td>
</tr>
<tr>
<td>Drawn Seamless Tube</td>
<td>6061-T6</td>
<td>B210M</td>
</tr>
<tr>
<td></td>
<td>6063-T832</td>
<td>B210M</td>
</tr>
<tr>
<td>Extruded Tube</td>
<td>6061-T6</td>
<td>B241M</td>
</tr>
<tr>
<td>Pipe</td>
<td>6061-T6</td>
<td>B241M</td>
</tr>
<tr>
<td></td>
<td>6063-T6</td>
<td>B241M</td>
</tr>
<tr>
<td>Structurals, Rolled or Extruded</td>
<td>6061-T6</td>
<td>B308M</td>
</tr>
<tr>
<td>Welding Rods and Bare Electrodes</td>
<td>4043-O</td>
<td>Not ASTM²</td>
</tr>
<tr>
<td></td>
<td>5154-0</td>
<td>Not ASTM²</td>
</tr>
</tbody>
</table>

**NOTES:**
1. See Mechanical Properties.
SCOPE. This specification covers the requirements for various aluminum alloys and shapes.

MATERIAL REQUIREMENTS

Physical & Chemical Requirements. Wrought aluminum shall conform to the requirements of ASTM specifications as shown in Table 715-04-1 and as modified herein and by the plans and specifications.

   Each piece shall be marked with the manufacturer's name or trade mark and with alloy and temper designations in the manner described in the pertinent ASTM specifications.

   When a clad material is specified, it shall be clad on both sides unless specified otherwise.

Mechanical Properties. When alloy 6061-T94 is required by the plans or specifications, it shall be defined as that temper which will produce in the wire the following mechanical properties after weaving:

- minimum ultimate tensile strength: 375 MPa
- minimum tensile yield strength: 325 MPa

BASIS OF ACCEPTANCE. This material shall be accepted on the basis of a manufacturer's certification of compliance except when this material is used in Bridge Railing when it shall be accepted on the basis of shop inspection by the Department in accordance with Department directives, or Fencing when it shall be accepted on the basis of samples received in accordance with Departmental directives.

715-05 IRON CASTINGS

SCOPE. This specification covers material requirements for iron castings.

MATERIAL REQUIREMENTS. Iron castings shall conform to the requirements of AASHTO M 105, Class 30B or Class 35B.

FABRICATION. Castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes and other defects at locations affecting their strength and value for the service intended. Castings shall be boldly filleted at angles and the arises shall be sharp and perfect. Castings having blow holes plugged or filled with putty or cement of any kind will be rejected.

Grates, covers and curb boxes shall have continuous, full, and uniform bearing contact with their corresponding frames and shall be non-rocking when in place and under the influence of traffic or other loads. Methods that are permissible to achieve secure non-rocking fit between grates, covers and their corresponding frames are:

- Ground mating surfaces
- Machined and milled mating surfaces (horizontal and/or vertical).

All cast gratings, covers, frames and curb boxes shall be delivered to the work site free of any coatings unless specified otherwise.

Castings that fail to meet the requirements of this specification shall be rejected and immediately removed from the work site.

BASIS OF ACCEPTANCE. Iron castings shall be accepted in accordance with the procedural directives of the Department.

715-06 STEEL FORGINGS

MATERIAL REQUIREMENTS. Steel forgings shall conform to the requirements of ASTM A 668/A 668M, Class C, or other class approved by the DCES.

BASIS OF ACCEPTANCE. Acceptance of this material shall be in accordance with procedural directives of the Department.
715-07 PROOF LOADED IRON CASTINGS

SCOPE. This specification covers material and testing requirements for proof loaded iron castings.

MATERIAL REQUIREMENTS. Iron castings shall conform to the requirements of AASHTO M 105, Class 30B or Class 35B. Castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes and other defects at locations affecting their strength and value for the service intended.

Grates, covers and curb boxes shall have continuous, full, and uniform bearing contact with their corresponding frames and shall be non-rocking when in place and under the influence of traffic or other loads. Methods that are permissible to achieve secure non-rocking fit between grates, covers and their corresponding frames are:

- Ground mating surfaces
- Machined and milled mating surfaces (horizontal and/or vertical).

All gratings, covers, frames and curb boxes shall be delivered to the work site free of any coatings unless specified otherwise.

Castings shall be boldly filleted at angles, and the arises shall be sharp and perfect.

Castings having blow-holes plugged or filled with putty or cement of any kind will be rejected.

Castings that fail to meet the requirements of this specification shall be rejected and immediately removed from the work site.

Approved List. All iron castings conforming to the requirements of Standard Sheets "Cast Manhole Frames, Grates and Covers" and "Cast Frames and Curb Boxes and Welded Frames" will be approved without any proof load requirements. No Materials Details need be prepared for those articles.

For all other iron castings Materials Details shall be prepared and submitted to the Director of Materials Bureau for approval. All dimensions shall conform to those depicted on the standard sheets - "Proof Loaded Cast Steel or Iron Manhole Frames, Grates, Covers" and "Welded Frames and Proof Loaded Cast Steel or Iron Frames and Curb Boxes." Also the articles will be proof-load tested in accordance to the Department's Test Method "Proof Loading of Cast Iron Frames, Grates, Covers and Curb Boxes", a copy of which may be obtained from the Director of Materials Bureau. After the proof-load tests are successful and the drawings are approved, the manufacturer's name, material details reference number and approval date will be placed on the Department's Approved List.

DETAILS. All dimensions, including specified tolerances, in the Material Details shall be within the limits specified on the standard sheets - "Proof Loaded Cast Steel or Iron Manhole Frames, Grates, Covers" and "Welded Frames and Proof Loaded Cast Steel or Iron Frames and Curb Boxes."

Corresponding section thicknesses of frames F1, F2 and F3 shall be same unless load tested.

Corresponding section thicknesses and number of stiffeners of the mountable curb boxes (CMs) and unmountable curb boxes (CUs) shall be same. Also corresponding section thicknesses and number of stiffeners of all curb boxes, CUs and CMs, shall be same unless load tested. The class of iron to be used shall be clearly identified. Payment areas as indicated on the standard sheets shall be included.

Testing Facility. The Department's laboratory will conduct the proof load testing for acceptance of the design.

SAMPLES AND SUBMISSIONS. The manufacturer/supplier shall provide the following to the Materials Bureau before any testing can begin:

- Two (2) copies of the Material Details for each iron casting to be approved
- Two (2) samples of each cast iron article to be load tested as directed by the Materials Bureau
- One (1) sample of corresponding reticuline grate and any nuts and bolts required for assembly
- Two (2) B-Bar test specimens cast within an hour of casting each of the test samples and machined as per AASHTO M 105. Both ends of the specimen shall be machined to 28.5 mm X 7 threads per 25 mm.
§715  

It is the manufacturer/supplier's responsibility to remove in an expedient manner all supplied material from the Department's premises after the tests are done.

**Failure Criteria.** The design of an iron casting will be rejected if the following conditions are not met:

**A. Permanent Set.** This criterion applies to cast iron grate and cover. The maximum permanent set in any article, measured relative to a fixed horizontal plane, shall not exceed the lesser of 3.0 mm or 1/150 of the clear opening.

**B. Cracks.** All articles will be inspected after the completion of each test. No part of any article shall break or have any cracks.

**Retests and Re-submissions.** If the dimensions of the article(s) do not fall within the limits of the Material Details, either new article(s) or new Details shall be submitted at the manufacturer's option.

Upon failure under proof loading no retests will be allowed. Complete new designs shall be submitted for further testing.

**Quality Assurance During Production.** The B-Bar test results for each lot of castings (a lot is defined as per AASHTO M 105) shall be maintained by the foundry for a period of seven (7) years and shall be made available to the Department upon request. Although proof load testing is not required during the production phase, the Department reserves the right to test any piece at any time.

**BASIS OF ACCEPTANCE.** Cast iron frames, grates, covers and curb boxes shall be accepted at the project site based on the manufacturer's name appearing on the Approved List, conformance to the approved Materials Details or standard sheets, and the required manufacturer's certifications. For each contract supplied, the following shall be provided to the Engineer:

**A. Manufacturer's Certification.** The manufacturer shall provide certification that every piece of cast iron frame, grate, cover and curb box supplied was manufactured in accordance with these specifications and the approved Materials Details or Standard Sheets - "Cast Manhole Frames, Grates and Covers" (M655-9r1) and "Cast Frames and Curb Boxes and Welded Frames" (M655-11r1).

**B. Materials Details.** Two (2) copies of the approved Material Details, identified by reference number and approval date as shown on the Approved List.

715-08 (VACANT)

715-09 MALLEABLE IRON CASTINGS

**SCOPE.** Malleable Iron Castings shall conform to the requirements of ASTM A 47/A 47M. The Grade shall be Grade 22010 unless Grade 24018 is required by the plans or specifications.

**MATERIAL REQUIREMENTS.** Castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes and other defects in positions affecting their strength and value for the service intended.

The casting shall be boldly filleted at angles and the arises shall be sharp and perfect. The surface shall have a standard quality finish.

When galvanizing is required, it shall be in accordance with 719-01, Galvanized Coatings and Repair Methods, Type II. Particular care shall be exercised so as not to embrittle malleable castings when galvanizing. All galvanized castings shall meet specification requirements after galvanizing.

**BASIS OF ACCEPTANCE.** Acceptance of this material shall be in accordance with procedural directives of the Department.

715-10 (VACANT)
**SCOPE.** This specification covers the material and quality requirements for metal bin-type retaining walls.

**MATERIAL REQUIREMENTS**

**Base Metal.** The base metal for all components except fasteners shall be manufactured by the open hearth, basic oxygen process or electric furnace process and shall conform to the requirements of AASHTO M218. Base metal for the fasteners shall conform to the requirements of ASTM A307.

**FABRICATION**

**Details.** All members shall be so fabricated that members of the same nominal size shall be freely interchangeable. No drilling, punching or drifting to correct defects in manufacture shall be permitted. Any units having holes improperly punched shall be replaced by the Contractor at no expense to the State.

The members in the wall shall conform to the gages, surface treatments and descriptions in Table 715-11, as well as the gages and dimensions shown in the plans. All materials receiving the Type IV surface treatment shall have a nominal zinc coating weight of 0.61 kg/m² such that the minimum check limits for the triple-spot and single-spot tests shall be 0.61 kg/m² and 0.55 kg/m² respectively.

**Configuration.** Walls shall consist of a series of pairs of columns, one column in each pair being in the plane of the wall face and the other column being in the plane of the rear of the wall, with the pair of columns spaced longitudinally with overlapping S-shaped facing and rear members (stringers) and transversely with overlapping U-shaped tie-members (spacers). All necessary bolts and appurtenances shall be furnished to form a continuous closed-face wall of connected bins.

**BASIS OF ACCEPTANCE.** The metal bin-type retaining wall members shall be accepted on the basis of the manufacturer's certified analysis and guarantee for the metal and the Engineer's inspection.

**TABLE 715-11**

<table>
<thead>
<tr>
<th>Name</th>
<th>Gage</th>
<th>Surface Treatment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Column</td>
<td>8</td>
<td>719-01 Type IV</td>
<td>Vertical Member, Front &amp; Back</td>
</tr>
<tr>
<td>Column Cap</td>
<td>12</td>
<td>719-01 Type IV</td>
<td>Cover for front Column</td>
</tr>
<tr>
<td>Stringer Stiffener</td>
<td>8</td>
<td>719-01 Type IV</td>
<td>Top flange return</td>
</tr>
<tr>
<td>Stringer</td>
<td>16,14,12,10</td>
<td>719-01 Type IV</td>
<td>Horizontal Longitudinal members, front &amp; rear</td>
</tr>
<tr>
<td>Connecting Channel</td>
<td>8</td>
<td>719-01 Type I</td>
<td>Connector, Stringer to Column</td>
</tr>
<tr>
<td>Spacer</td>
<td>16,14,12</td>
<td>719-01 Type IV</td>
<td>Horizontal Transverse member</td>
</tr>
<tr>
<td>Bottom Spacer</td>
<td>16,14,12</td>
<td>719-01 Type IV</td>
<td>Special bottom transverse member</td>
</tr>
<tr>
<td>Base Plate</td>
<td>1</td>
<td>719-01 Type I</td>
<td></td>
</tr>
<tr>
<td>16 mm dia. nuts</td>
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<td>719-01 Type II</td>
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</tr>
<tr>
<td>16 mm dia. Spring nuts</td>
<td></td>
<td>719-01 Type II</td>
<td>All connections</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Name</th>
<th>Gage</th>
<th>Surface Treatment</th>
<th>Description</th>
</tr>
</thead>
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<tr>
<td>715-12 (VACANT)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>715-13 PREFABRICATED ADJUSTMENT RINGS, FRAMES AND UTILITY VALVE RISERS FOR DRAINAGE UNITS, MANHOLES AND UTILITIES</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SCOPE.** This specification covers the material requirements and fabrication of adjustment rings, frames and utility valve risers for drainage structures, manholes and utilities. The adjustment rings, frames and utility valve risers shall consist of one of the following types unless otherwise approved by the Director, Materials Bureau:
RINGS
Type AR1 - Single Height Segmented Unit
Type AR2 - Single Height - One Cut Unit
Type AR3 - Single Height - Solid Unit

FRAMES
Type AF1 - Single Height Segmented Unit
Type AF2 - Single Height Solid Unit

UTILITY VALVE RISERS
Type UVR1 - Single Height - Solid Ring Unit
Type UVF1 - Single Height - Solid Frame Unit

MATERIAL REQUIREMENTS All adjustment rings, frames and utility valve risers shall be fabricated from steel, iron castings, a combination of these two materials, or an alternative material or materials as approved by the Director of the Materials Bureau. The steel used for fabrication of rings, frames and utility valve risers shall meet the requirements of ASTM A36, A108, A242 or equivalent. If cast iron is used, the cast iron units shall be iron castings meeting the requirements of §715-05, IRON CASTINGS. All welding shall meet the requirements of the New York State Steel Construction Manual. All bolts, nuts, washers and threaded studs shall be stainless steel meeting the requirements of ASTM A240 or equivalent.

FABRICATION. All adjustment rings, frames and utility valve risers shall be designed to allow full bearing of the unit on the existing frame seat. Designs shall include a clamping device capable of securing the adjustment ring, frame or utility valve riser to the existing frame. Alternate methods of securing the rings, frames and utility valve risers to the existing frame shall be approved by the Director, Materials Bureau. All adjustment rings, frames and utility valve risers shall be reinforced to prevent bending during construction and routine service.

Steel rings, frames and utility valve risers shall be galvanized in accordance with §719-01 Galvanized Coatings and Repair Methods. When steel rings, frames and utility valve risers contain no component parts which are less than 6 mm in thickness, they may be coated with a bituminous base or coal tar product and will not require galvanizing. Any alternate coating system shall be approved by the Director, Materials Bureau. Cast iron rings, frames and utility valve risers do not require any galvanizing, but may instead be coated with a bituminous based or coal tar product approved by the Director, Materials Bureau.

Rings

Type AR1 - Single Height Segmented Unit. This ring shall consist of two or more radial segments which may be adjusted to open and close the diameter of the ring. When fully expanded the ring shall bear firmly against the sidewalls and seat of the existing manhole frame.

Type AR2 - Single Height - One Cut Unit. This ring shall consist of a single circular unit which is cut through its circumference at one point. The ring shall include an adjusting device that shall enable the ring to be expanded to bear firmly against the sidewalls and seat of the existing manhole frame.

Type AR3 - Single Height - Solid Unit. This ring shall consist of a solid unit with no cuts or openings in its circumference. The diameter of this ring is not field adjustable, unless approved by the Materials Bureau.

Frames

Type AF1 - Single Height Segmented Unit. This frame shall consist of a rectangular, segmented unit which is adjustable for length and width. When expanded the frame shall bear firmly against the sidewalls and seat of the existing frame.
Type AF2 - Single Height Solid Unit. This frame shall consist of a solid rectangular unit with fixed lengths and widths.

Utility Valve Risers
Type UVR1 - Single Height Solid Ring Unit. This unit shall consist of a solid ring with no cuts or openings along its length.

Type UVF1 - Single Height Solid Frame Unit. This unit shall consist of a solid rectangular with fixed lengths and widths.

Basis of Acceptance. The Department requires the submission of Materials Details. The manufacturer or supplier shall prepare and submit the appropriate material in accordance with the procedural directives of the Materials Bureau. Upon approval by the Materials Bureau, the name of the manufacturer or supplier along with the drawing number and date assigned to the approved Materials Details will be placed on the Approved List. Such products shall then be accepted on the basis of their appearance on the Approved list and conformance to the approved Materials Details.

The manufacturer or supplier shall provide two copies of the approved Materials Details through the Contractor to the Engineer as part of the evidence of acceptability for the product at least 10 days prior to its use.

715-14 High Strength Bolts, Nuts and Washers

Scope. This specification covers the requirements for high-strength steel bolts, nuts and washers used for structural steel connections.

Material Requirements. The bolts, nuts and washers shall conform to the provisions of ASTM A325M and §715-01 except as modified herein.

Bolt and Nut Dimensions. Bolt and nut dimensions shall conform to the current requirements of the American National Standard for Metric Heavy Hexagon Structural Bolts (ANSI B18.2.3.7M), and Metric Heavy Hexagon Nuts (ANSI B18.2.4.6M). Alternate fasteners which differ in dimensions from those specified by the ANSI may be used provided that the body diameter and bearing areas under the head and nut, or their equivalent areas, are not less than those of the same nominal dimensions specified by the ANSI, and that approval for the use is given by the DCES.

<table>
<thead>
<tr>
<th>Bolt Size</th>
<th>Circular Washers</th>
<th>Beveled Washer for American Standard Beams and Channels</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nominal Outside Diam.</td>
<td>Nominal Diam. of hole</td>
</tr>
<tr>
<td>M16</td>
<td>33</td>
<td>18</td>
</tr>
<tr>
<td>M20</td>
<td>41</td>
<td>22</td>
</tr>
<tr>
<td>M22</td>
<td>43</td>
<td>24</td>
</tr>
<tr>
<td>M24</td>
<td>49</td>
<td>26</td>
</tr>
<tr>
<td>M27</td>
<td>55</td>
<td>30</td>
</tr>
<tr>
<td>M30</td>
<td>59</td>
<td>33</td>
</tr>
<tr>
<td>M36</td>
<td>71</td>
<td>39</td>
</tr>
<tr>
<td>M42</td>
<td>83</td>
<td>45</td>
</tr>
<tr>
<td>M48</td>
<td>94</td>
<td>51</td>
</tr>
<tr>
<td>Over M48 to M100 incl.</td>
<td>2D-1</td>
<td>D+3</td>
</tr>
</tbody>
</table>

Notes: 1. Dimensions in mm.
2. May be exceeded by 5 mm
3. 5 mm nominal.
4. 6.5 mm nominal.
**Washer Dimensions.** Circular washers shall be flat and smooth and their nominal dimensions shall conform to the dimensions given in Table 715-14. Beveled washers for American Standard beams and channels shall be square or rectangular, shall have an average thickness of 8 mm, and shall conform to the dimensions and taper in thickness given in Table 715-14.

**TESTS AND ACCEPTANCE.** Tests and acceptance of high strength bolts, nuts and washers shall be as described in section 10 of the SCM.

715-15 PINS AND ROLLERS

**SCOPE.** This specification covers steel pins and rollers used in bridge construction.

**GENERAL.** The material furnished for pins and rollers shall conform to the following requirements:
- Pins and rollers designed for a minimum yield stress of 248 MPa shall conform to ASTM A668, Class D
- Pins and rollers designed for a minimum yield stress of 344 MPa shall conform to the requirements of ASTM A668, Class F
- Any pin or roller greater than 300 mm in diameter shall be furnished in conformance with the requirements of ASTM A668, Class G.

**Tests and Acceptance.** Tests are to be performed as required in the applicable ASTM Designation. Certified copies of the results of the specified tests are to be furnished as described in “Basis of Acceptance,” of §715-01. Acceptance of material will be based on satisfactory test results and dimensional compliance with the contract plans and specifications.

715-16 STAINLESS STEEL CONNECTING PRODUCTS

**SCOPE.** This specification covers stainless steel bolts, nuts, washers, and set screws used in the construction of sign structures.

**MATERIAL REQUIREMENTS.** Stainless steel connecting products shall conform to the following:
- Hex bolts designed for 585 MPa minimum yield strength shall conform to the requirements of ASTM A193, Grade B6 (AISI 410).
- Nuts for Grade B6 bolts shall conform to the requirements of ASTM A194, Grade B6 (AISI 416).
- Hex bolts and U-bolts designed for 205 MPa minimum yield strength shall be either AISI 304 or 305 stainless steel conforming to the requirements of ASTM A193, Grade B8 or Grade B8P, Class 1.
- Hex bolts and U-bolts designed for 690 MPa minimum yield strength shall be either AISI 304 or 305 stainless steel conforming to the requirements of ASTM A193, Grade B8 or Grade B8P, Class 2.
- Nuts for Grade B8 or Grade B8P bolts shall conform to the requirements of ASTM A194, Grade B8 (AISI 304).
- Flat washers shall be circular, flat, smooth, and fabricated from material conforming to the requirements of ASTM A167 (AISI 302B (UNS S30215) or ASTM A240 (AISI 302 or 304 (UNS S30200 or S30400))).
- Lock washers shall be fabricated in accordance with ANSI B18.21.1 from material conforming to the requirements of ASTM A313 (AISI 302, 304, or 305 (UNS S30200, S30400, or S30500)) with a hardness Rc 35-43.
- Set screws shall conform to the requirements of ASTM A320, Grade B8F (AISI 303).

**Cleaning.** Following heat treatment, all stainless steel connecting products shall be descaled and cleaned in accordance with the requirements of ASTM A380. After cleaning and descaling the stainless steel hardware shall be passivated. Stainless steel hardware with a black or speckled rusty appearance is acceptable provided the discoloration does not run when installed, as determined by the Engineer.
Delivery. All stainless steel connecting products shall be delivered to the project site no less than 30 days prior to utilization of the hardware to allow ample time for sampling and testing.

SAMPLING AND TESTING. Stainless steel connecting products will be sampled at the project site or supply location. Sampling and testing will be in accordance with procedural directives of the Materials Bureau.

BASIS OF ACCEPTANCE. Stainless steel connecting products will be accepted in stock-lot quantities at the project site or supplier's location in accordance with procedural directives of the Materials Bureau. Grade B8 bolts less than 9.52 mm in diameter will be accepted based on chemical properties only.

SECTION 716 - BEARINGS AND EXPANSION PLATES

716-01 THRU 716-04 (VACANT)

716-05 SELF-LUBRICATING BRONZE PLATES

SCOPE. This specification covers requirements for self-lubricating bronze plates used as bearing plates in expansion bearings.

MATERIAL REQUIREMENTS. Self-lubricating bronze shall conform to the requirements of ASTM B22, Alloy 911.

The lubricant shall be of the solid type and shall consist of graphite, metallic substances having lubricating properties and a lubricating binder. Materials which do not have lubricating qualities or promote chemical or electrolytic reactions, shall not be acceptable. The lubricant shall be integrally molded and compressed into the lubrication recesses with hydraulic pressure of at least five times the maximum design unit loading to form a dense, non-plastic lubricant which shall project above the surface of the bronze a minimum of 0.125 mm.

The recesses for the lubricant shall consist of annular rings with or without central circular recess with a depth at least equal to the width of the ring or diameter of hole for proper containment of lubricant. The recesses shall be arranged in a geometrical pattern such that successive rows shall overlap in the direction of motion and the distance between extremities of recesses shall be closer in the direction of motion than that perpendicular to motion. The entire bearing area of all surfaces which have provision for motion shall be lubricated by means of these lubricant filled recesses. The total area of these recesses shall comprise not less than 25 percent nor more than 35 percent of the total bearing area of the plate.

The bearing plates shall be furnished to the sizes and shapes specified on the plans. The maximum permissible variation in the specified thickness of bronze plates shall be ±0.25 mm. The lay of the tool marks shall be in the direction of motion or shall be omnidirectional.

On flat faces the machined surface shall be flat to a tolerance of 15 µm in each 30 mm of length and width.

On curved faces the radius of the machined surface shall have the following tolerances:

<table>
<thead>
<tr>
<th>Positive tolerance</th>
<th>Negative tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concave Surface</td>
<td>0.25 mm</td>
</tr>
<tr>
<td>Convex Surface</td>
<td>Zero</td>
</tr>
<tr>
<td></td>
<td>0.25 mm</td>
</tr>
</tbody>
</table>

The curved surface shall be machined to a tolerance of 15 µm in each 30 mm length perpendicular to the circular section.

Surfaces of bronze plates in contact with machined surfaces of steel plates shall be machine finished in accordance with the requirements of the SCM, Section 6, Part 612 (When the SCM requires DCES approval, delete the term “DCES” and replace it with “the Regional Director.”). Machining shall be of the same surface roughness as that required for sliding bearings.

The coefficient of friction between the self-lubricating bronze plates and the steel plates in contact with them shall not exceed 0.10 when subjected to the maximum designed unit loading and also at twice the maximum design unit loading.
§716

BASIS OF ACCEPTANCE. The manufacturer shall supply the Engineer with certification that the bronze plate was manufactured in accordance with this specification. This certification must be received by the Engineer prior to the placement of the bronze plate or any fabricated piece containing the bronze plate into any construction work.

716-06 DISC-DESIGN STRUCTURAL BRIDGE BEARINGS

SCOPE. This specification covers the material requirements for disc-design structural bridge bearings. Bearings furnished under this specification shall adequately provide for the thermal expansion and contraction, rotation, camber changes, and creep and shrinkage of structural members, where applicable.

GENERAL. Disc-design structural bridge bearings shall consist of a polyether urethane structural element (disc) confined by upper and lower steel bearing plates. The bearings shall be equipped with a shear restriction mechanism to prevent movement of the disc.

Disc-design structural bridge bearings shall be supplied as fixed bearings; guided expansion bearings; and non-guided expansion bearings as designated by the Contract Documents.

Fixed Bearings. Fixed bearings shall allow rotation but no longitudinal or transverse movement in the bearing plane.

Guided Expansion Bearings. Guided expansion bearings shall allow rotation and longitudinal movement in the bearing plane; transverse movement shall be restricted. To allow longitudinal movement, the upper steel bearing plate shall be faced with polytetrafluoroethylene (PTFE) sheet and support a sliding steel top bearing plate. The mating surface of the sliding steel top bearing plate shall be faced with polished stainless steel. To restrict transverse movement, either a guide bar or keyway system shall be used. If required, the guide bar or keyway systems and their mating steel surfaces shall be faced with strips of either PTFE or PTFE-stainless steel.

Non-Guided Expansion Bearings. Non-guided expansion bearings shall allow rotation, longitudinal, and transverse movement in the bearing plane. To allow longitudinal and transverse movement, the upper steel bearing plate shall be faced with polytetrafluoroethylene (PTFE) sheet and support a sliding steel top bearing plate. The mating surface of the sliding steel top bearing plate shall be faced with polished stainless steel.

MATERIAL REQUIREMENTS. All material shall be new and unused, with no reclaimed material incorporated in the finished bearing.

<table>
<thead>
<tr>
<th>Physical Property</th>
<th>ASTM Test Method</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardness, Type D Durometer</td>
<td>D2240</td>
<td>57</td>
</tr>
<tr>
<td>Tensile Stress, MPa1</td>
<td></td>
<td>14 67</td>
</tr>
<tr>
<td>At 100% elongation</td>
<td>D412</td>
<td>14</td>
</tr>
<tr>
<td>At 300% elongation</td>
<td></td>
<td>26</td>
</tr>
<tr>
<td>Tensile Strength, MPa1</td>
<td>D412</td>
<td>34.5</td>
</tr>
<tr>
<td>Ultimate Elongation, %1</td>
<td>D412</td>
<td>220</td>
</tr>
<tr>
<td>Compression Set(^{1,2}), %</td>
<td>D395</td>
<td>--- 40</td>
</tr>
</tbody>
</table>

NOTES: 1. A 10% deviation from specified values is permissible.
2. 22 hours at 70\(^\circ\)C

Polyether Urethane Structural Element. The polyether urethane structural element used in the construction of disc-design bearings shall be molded from a polyether urethane compound. The physical properties of the polyether urethane shall conform to the requirements of Table 716-06-1.
Steel. All steel except stainless steel components of the bearing shall conform to the requirements of the type of steel designated on the Contract Plans and applicable provisions of the New York State Steel Construction Manual.

Stainless Steel. Stainless steel shall conform to the requirements of ASTM A167, or ASTM A240, Type 304. Stainless steel in contact with PTFE shall be polished to a No. 8, bright mirror finish. The minimum thickness of the stainless steel shall be 1.25 mm.

Polytetrafluoroethylene Sheet and Strip. Polytetrafluoroethylene (PTFE) sheet and strip shall be manufactured from pure virgin (not reprocessed) unfilled TFE resin; or from TFE resin uniformly blended with either 15% glass fiber or 25% carbon (maximum, percent by weight).

PTFE sheet shall be bonded to or recessed into its steel substrate. Bonded PTFE sheet shall be etched on its bonding side, and shall have a minimum thickness of 1.6 mm. Recessed PTFE sheet shall have a minimum thickness of 3.0 mm and be recessed for at least one-half its thickness into its steel substrate. The surface of filled PTFE sheet in contact with stainless steel shall be polished or burnished to insure smooth and low friction movement of the bearing.

Finished PTFE sheet and strip shall be resistant to all acids, alkalis and petroleum products, stable at temperatures from -215°C to +260°C, non-flammable, non-absorbing of water, and shall conform to the physical requirements of Table 716-01-2.

<table>
<thead>
<tr>
<th>TABLE 716-06-2 PHYSICAL REQUIREMENTS OF PTFE SHEET AND STRIP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical Property</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Ultimate Tensile Strength, MPa</td>
</tr>
<tr>
<td>Ultimate Elongation, %</td>
</tr>
<tr>
<td>Specific Gravity</td>
</tr>
</tbody>
</table>

FABRICATION. The finish of the mold used to produce the bearing elements shall conform to good machine shop practice. Every bearing shall have the Project Identification Number, NYSDOT Lot Number and individual bearing number indelibly marked with ink on a side that will be visible after erection.

The PTFE sheet shall be bonded to its grit blasted steel substrate using an epoxy resin adhesive under controlled factory conditions in accordance with the instructions of the adhesive manufacturer. Alternately, the PTFE sheet may be recessed into its steel substrate for one-half its thickness. The bearing manufacturer shall have the option of bonding recessed PTFE sheet.

All steel surfaces exposed to the atmosphere, except stainless steel surfaces and metal surfaces to be welded, shall be shop painted with one coat of coal-tar epoxy. Coal-tar epoxy paint shall meet the requirements of SSPC Paint Specification No. 16, and be applied at a minimum wet film thickness of 0.25 mm. Prior to painting, the exposed steel surfaces shall be cleaned in accordance with the recommendations of the coating's manufacturer. Metal surfaces to be welded shall be given a coat of clear lacquer, or other protective coating approved by the Engineer, if exposure is to exceed three months prior to welding. The coating shall be removed at the time of welding. No painting will be done to these surfaces prior to the completion of welding.

Except as noted, all bearing surfaces of steel plates shall be finished or machined flat within 0.25 mm. Out-of-flatness greater than 0.25 mm on any plate shall be cause for rejection. The bottom surfaces of lower bearing plates (masonry plates) designed to rest on bearing pads shall not exceed an out-of-flatness value of 1.6 mm. Oxygen cut surfaces shall not exceed a surface roughness value of 25 µm, as defined by ANSI B46.1. Repair, when necessary, shall conform to the requirements of the New York State Steel Construction Manual (When the SCM requires DCES approval, delete the term “DCES" and replace it with "the Regional Director.").

The steel base pot of all bearings shall be either integrally machined or continuously welded to its bottom steel masonry plate. Unless otherwise approved by the Regional Director, all welding shall conform to, and all welders shall be qualified in accordance with the requirements of the New York State Construction Manual (When the SCM requires DCES approval, delete the term "DCES" and replace it with "the Regional Director.").
with "the Regional Director."). Gross bearing dimensions shall have a tolerance of -0, +3.0 mm.

**PERFORMANCE CHARACTERISTICS**

**Compression Strain.** The compression stress is based on the net area of the rotational element using the total overall diameter. The compression strain is measured as a percentage of the original thickness of the rotational element.

A load equal to 150% of the bearing's design capacity shall first be applied to seat the bearing components. The 150% load shall then be gradually reduced, over a time period of 30 to 90 seconds, to a pre-load equal to 3% of the bearing's design capacity. Each compression strain shall be recorded relative to the initial 3% pre-load deflection, one minute after the desired stress level has been reached, on dial indicators, at four locations 90° apart on the perimeter of the bearing.

The test results will be evaluated as follows:
- The bearing will be visually examined both during and after the test. Any resultant visual defects (such as extruded elastomer, damaged seals, or cracked steel) shall be cause for rejection
- Non-uniform compression deflections at a desired stress level shall be cause for rejection
- The compression strain of each bearing shall conform to the following requirements:

<table>
<thead>
<tr>
<th>Compression Stress (MPa)</th>
<th>Compression Strain, Max. %</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.9</td>
<td>5.0</td>
</tr>
<tr>
<td>13.8</td>
<td>8.5</td>
</tr>
<tr>
<td>20.7</td>
<td>11.0</td>
</tr>
<tr>
<td>27.6</td>
<td>13.2</td>
</tr>
<tr>
<td>35.0</td>
<td>16.0</td>
</tr>
</tbody>
</table>

**Sliding Coefficient of Friction.** For all guided and non-guided expansion disc-design bearings, the coefficients of friction shall be measured at the bearing's design capacity, on the fifth and fiftieth cycles, at a sliding speed of 25 mm per minute.

The sliding coefficient of friction shall be calculated as the horizontal load required to maintain continuous sliding of one bearing, divided by the bearing's design capacity vertical load. The vertical load shall have been applied continuously for a minimum of 12 hours prior to testing.

The test results will be evaluated as follows:
- The measured sliding coefficients of friction shall not exceed 75% of the maximum design coefficient of friction
- The bearing will be visually examined both during and after the test. Any resultant visual defects (such as bond failure, physical destruction, cold flow of PTFE, or damaged components) shall be cause for rejection.

**Rotation.** For all disc-design bearings, the polyether urethane element shall be capable of maintaining its initial uniform contact with the steel bearing plates throughout a rotation range of 0.02 radians under a compressive load equal to 150% of the design capacity of the bearing.

The test results will be evaluated as follows:
- The bearing will be visually examined both during and after the test. Any resultant visual defects shall be cause for rejection
- Continuous and uniform contact between the polyether urethane element and bearing plates, and between the sliding steel top and upper bearing plates shall be maintained for the duration of the test. Any observed "lift-off" shall be cause for rejection.

**DRAWINGS.** The Contractor shall submit detailed shop drawings, drawn by the Manufacturer only, in conformance with the applicable requirements of the New York State Steel Construction Manual, for approval by the Regional Director prior to the start of fabrication.

In addition to the above requirements, the Manufacturer shall note the following on the shop drawings:
- The total quantity of each kind of disc-design bearing required, i.e., fixed, guided expansion, or non-guided expansion, grouped first according to type (load range) and then by actual design capacity
- The thickness and plan area of the polyether urethane structural elements required
• The maximum design coefficient of friction as noted on the Contract Plans
• The type of PTFE sheet (filled or unfilled) and, if applicable, the type and amount (by weight) of
  filler
• The type(s) of steel(s) to be used
• If applicable, any welding process used in the bearing manufacture that does not conform to the
  approved processes of New York State Steel Construction Manual shall be clearly described and
detailed
• The location of the fabrication plant
• The Manufacturer's name and the name of the manufacturer's representative who will be responsible
  for coordinating production, inspection, sampling and testing with the Materials Bureau.

The Contractor shall also provide the Materials Bureau with written notification thirty (30) days prior
to the start of bearing fabrication. This notification shall include all of the information required by
numbers 1 through 8 above. A copy of this notification shall be sent to the Regional Director.

**SAMPLING AND TESTING.** The manufacturer shall furnish the required number of samples to
perform testing in accordance with Table 716-06-3.

**Lot Size.** Sampling, testing and acceptance consideration will be made on a lot basis. A lot shall be
defined as those bearings presented for inspection at a specific time or date. A lot shall be further defined
as the smallest number of bearings as determined by the following criteria:
• A lot shall not exceed a single contract or project quantity
• A lot shall not exceed 25 bearings
• A lot shall consist of those bearings that can be manufactured with polyether urethane rotation
  elements from one batch of polyether urethane material. The mass of one batch shall not exceed 205
  kg
• A lot shall consist of those bearings of the same type, regardless of load capacity. Bearing types shall
  be fixed type bearings or expansion type bearings. Guided and non-guided expansion bearings will
  be considered as a single type.

<table>
<thead>
<tr>
<th>TABLE 716-06-3 DISC BEARING SAMPLING AND TESTING REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test</td>
</tr>
<tr>
<td>Rotation</td>
</tr>
<tr>
<td>Coefficient of Friction</td>
</tr>
<tr>
<td>Compression Strain</td>
</tr>
<tr>
<td>Physical Properties Polyether</td>
</tr>
<tr>
<td>Urethane Rotational Element</td>
</tr>
<tr>
<td>(except compression set)</td>
</tr>
<tr>
<td>Compression Set of Polyether</td>
</tr>
<tr>
<td>Urethane Rotation Element</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Physical Properties</td>
</tr>
<tr>
<td>of PTFE Sheet</td>
</tr>
</tbody>
</table>

**NOTES:**
1. Sample production bearings of such size that cannot be tested by the manufacturer at 150% design capacity for rotation shall
be tested at actual design capacity. Bearings which are tested at actual design capacity will be tested at that capacity because it is
not possible, or not practical in the Department's opinion to test them at a higher capacity. Therefore, bearings tested at 150%
design capacity which are rejected, will not be retested below 150% design capacity for the purpose of rendering such bearings
acceptable. Sample production bearings that cannot be tested by the manufacturer at their actual design capacity for rotation
and/or friction shall be tested by an outside laboratory selected by the Materials Bureau. The Manufacturer shall assume the cost
of this testing and submit the certified test results to the Materials Bureau.
2. Bearings with load capacities greater than 2650 kN will be tested by an outside laboratory approved by the Materials Bureau.
The Department will assume the cost of this testing. The Contractor shall be responsible for transportation, scheduling and
related costs. All bearings will be made available for return to the Contractor.
3. All submitted sample sheets of polyether urethane material shall be certified by the bearing manufacturer as having been taken from the same batch of polyether urethane material as was used in the actual production bearings.

4. The manufacturer shall have the option of supplying four (4) die cut specimens in accordance with ASTM D-395, Method B. All submitted specimens of polyether urethane material shall be certified by the bearing manufacturer as having been taken from the same batch of polyether urethane material as was used in the actual production bearings.

5. Single sheets of PTFE Material from which the bearing has been fabricated may be submitted to the Materials Bureau for consideration of multiple lot acceptance, provided that the thickness of the material does not vary from lot to lot. All submitted sample sheets shall be certified by the bearing manufacturer as having been taken from the same batch of PTFE material as was used in the actual production bearings.

Schedule. The manufacturer shall complete the required testing and determine compliance with this specification before submitting the lot(s) for inspection, sampling and acceptance consideration.

A minimum of thirty (30) days shall be allowed for the Department's inspection, sampling and testing of production bearings and component materials.

Sampling Method. The manufacturer shall select, at random, the required sample bearing(s) from the completed lots of bearings for testing by the manufacturer.

The Department's representative shall select, at random, the required sample bearing(s) from completed lots of bearings, and samples of the polyether urethane and the PTFE materials for testing by the Materials Bureau. All samples shall be taken in accordance with the Department's written instructions.

Finish and Accessories. All exterior surfaces of sampled production bearings shall be smooth and free from irregularities or protrusions that might interfere with testing procedures.

Bearings with tapered sole plates which are selected for testing by the Materials Bureau, shall be delivered to the test site accompanied by a single unattached matching beveled plate. This plate shall be made of the same material and be the same size and thickness as the tapered plate. Additionally, the single beveled plate shall be so constructed that when placed in contact with the tapered sole plate the two shall from a single body, rectangular in shape and uniform in thickness.

Shipping Costs. The Contractor shall assume the cost of transporting all samples from the place of manufacture to the Materials Bureau and return, or, if applicable, to the project site.

BASIS OF ACCEPTANCE. Bearings will be considered for acceptance in project lot quantities, or portions thereof, at the manufacturing site in accordance with the procedural directives of the Materials Bureau.

716-07 POT-DESIGN STRUCTURAL BRIDGE BEARINGS

SCOPE. This specification covers the material requirements for pot-design structural bridge bearings. Bearings furnished under this specification shall adequately provide for the thermal expansion and contraction, rotation, camber changes, and creep and shrinkage of structural members, where applicable.

GENERAL. Pot-design structural bridge bearings shall be supplied as fixed bearings; guided expansion bearings; and non-guided expansion bearings as designated by the Contract Documents.

Fixed Bearings. Fixed bearings shall allow rotation but no longitudinal or transverse movement in the bearing plane. Fixed bearings shall consist of an elastomeric rotational element, confined and sealed by a steel piston and steel base pot.

Guided Expansion Bearings. Guided expansion bearings shall allow rotation and longitudinal movement in the bearing plane; transverse movement shall be restricted. Guided expansion bearings shall consist of an elastomeric rotational element, confined and sealed by a steel piston and steel base pot. To allow longitudinal movement, the upper surface of the steel piston shall be faced with polytetrafluoroethylene (PTFE) sheet and support a sliding steel top bearing plate. The mating surface of the sliding steel bearing plate shall be faced with polished stainless steel. To restrict transverse movement, either a guide bar or keyway system shall be used. If required, the guide bar or keyway systems and their mating steel surfaces shall be faced with strips of either PTFE or PTFE-stainless steel.
Non-Guided Expansion Bearings. Non-guided expansion bearings shall allow rotation, longitudinal, and transverse movement in the bearing plane. Non-guided expansion bearings shall consist of an elastomeric rotational element, confined and sealed by a steel piston and steel base pot. To allow longitudinal and transverse movement, the upper surface of the steel piston shall be faced with polytetrafluoroethylene (PTFE) sheet and support a sliding steel top bearing plate. The mating surface of the sliding steel bearing plate shall be faced with polished stainless steel.

MATERIAL REQUIREMENTS. All material shall be new and unused, with no reclaimed material incorporated in the finished bearing.

Elastomeric Rotational Element. The elastomeric rotational element used in the construction of pot-design bearings shall contain only virgin crystallization resistant polychloroprene (neoprene) or virgin natural polyisoprene (natural rubber) as the raw polymer. The physical properties of neoprene and natural rubber used in these bearings shall conform to ASTM or AASHTO requirements, with modifications as noted, in Table 716-07-1.

<table>
<thead>
<tr>
<th>Elastomeric Compound</th>
<th>ASTM Requirement</th>
<th>AASHTO Standard Specifications for Bridge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neoprene</td>
<td>D2000, Line Call Out</td>
<td>Section 2.25.2, Materials, 50</td>
</tr>
<tr>
<td></td>
<td>M2BC517A14B34</td>
<td>Durometer Hardness.</td>
</tr>
<tr>
<td>Natural Rubber</td>
<td>D2000, Line Call Out</td>
<td>Section 2.25.2, Materials, 50</td>
</tr>
<tr>
<td></td>
<td>M4AA517A13B33</td>
<td>Durometer Hardness.</td>
</tr>
</tbody>
</table>

NOTES:
1. The Shore A Durometer hardness shall be 50±10 points.
2. Samples for compression set tests shall be prepared using a Type 2 die. The compression set of the neoprene specimens shall not exceed 35%. The compression set of the natural rubber specimens shall not exceed 25%.
3. For the purpose of determining conformance with these specifications, an observed or calculated value shall be rounded off to the nearest 10 kPa for tensile strength, to the nearest 10% for elongation, and to the nearest 1% for the change in aged tensile and aged elongation. Hardness and aged hardness shall be rounded off to the nearest point.

Sealant. If used, the type of sealant between the steel base pot and the top steel bearing plate shall be as recommended by the Manufacturer.

Sealing Rings. The sealing rings between the steel piston and the elastomeric rotational element shall be brass formed to the size recommended by the Manufacturer.

Steel. All steel except stainless steel components of the bearing shall conform to the requirements of the type of steel designated on the Contract Plans and applicable provisions of the New York State Steel Construction Manual (When the SCM requires DCES approval, delete the term “DCES” and replace it with “the Regional Director.”).

Stainless Steel. Stainless steel shall conform to the requirements of ASTM A167, or ASTM A240, Type 304. Stainless steel in contact with PTFE sheet shall be polished to a No. 8. bright mirror finish. The minimum thickness of the stainless steel shall be 1.25 mm.

Polytetrafluoroethylene Sheet and Strip. Polytetrafluoroethylene (PTFE) sheet and strip shall be manufactured from pure virgin (not processed) unfilled TFE resin; or from TFE resin uniformly blended with either 15% glass fiber or 25% carbon (maximum filler, percent by weight).

PTFE sheet shall be bonded to or recessed into its steel substrate. Bonded PTFE sheet shall be etched on its bonding side, and shall have a minimum thickness of 1.6 mm. Recessed PTFE sheet shall have a minimum thickness of 3.0 mm and be recessed for at least one-half its thickness into its steel substrate. The surface of filled PTFE sheet in contact with stainless steel shall be polished or burnished to insure smooth and low friction movement of the bearing.
Finished PTFE sheet and strip shall be resistant to all acids, alkalis and petroleum products, stable at temperatures from -215°C to +260°C, non-flammable, non-absorbing of water, and shall conform to the physical requirements of Table 716-07-2.

<table>
<thead>
<tr>
<th>Physical Property</th>
<th>ASTM Test Method</th>
<th>Unfilled</th>
<th>Filled 15% Glass</th>
<th>Filled 25% Carbon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultimate Tensile Strength, MPa</td>
<td>D638M</td>
<td>19.3</td>
<td>13.8</td>
<td>9.0</td>
</tr>
<tr>
<td>Ultimate Elongation, %</td>
<td>D638M</td>
<td>200</td>
<td>150</td>
<td>75</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>D792</td>
<td>2.13</td>
<td>2.18</td>
<td>2.05</td>
</tr>
</tbody>
</table>

**FABRICATION.** The finish of the mold used to produce the elastomeric rotational elements shall conform to good machine shop practices. Every bearing shall have the Contract D#, Project Identification Number, NYSDOT Lot Number and individual bearing number indelibly marked with ink on a side that will be visible after erection.

The PTFE shall be bonded to its grit blasted steel substrate using an epoxy resin adhesive under controlled factory conditions in accordance with the instructions of the adhesive manufacturer. Alternately, the PTFE sheet may be recessed into its steel substrate for one-half its thickness. The bearing manufacturer shall have the option of bonding recessed PTFE sheet.

All steel surfaces exposed to the atmosphere, except stainless steel surfaces and metal surfaces to be welded shall be shop painted with one coat of coal-tar epoxy. Coal-tar epoxy paint shall meet the requirements of SSPC Paint Specification No. 16, and be applied at a minimum wet film thickness of 0.25 mm. Prior to painting, the exposed steel surfaces shall be cleaned with the recommendations of the coating's manufacturer. Metal surfaces to be welded shall be given a coat of clear lacquer, or other protective coating approved by the Engineer, if exposure is to exceed three months prior to welding. The coating shall be removed at the time of welding.

Except as noted, all bearing surfaces of steel plates shall be finished or machined flat within 0.25mm. Out-of-flatness greater than 0.25 mm on any plate shall be cause for rejection. The bottom surface of lower bearing plates (masonry plates) designed to rest on bearing pads shall not exceed an out-of-flatness value of 1.6 mm. Oxygen cut surfaces shall not exceed a surface roughness value of 25 µm, as defined by ANSI B46.1. Repair, when necessary shall conform to the requirements of the New York State Steel Construction Manual.

The steel base pot of all bearings shall be either integrally machined or continuously welded to its bottom steel masonry plate. Unless otherwise approved by the Regional Director, all welding shall conform to, and all welders shall be qualified in accordance with, the requirements of the New York State Steel Construction Manual (When the SCM requires DCES approval, delete the term “DCES” and replace it with “the Regional Director.”).

Gross bearing dimensions shall have a tolerance of -0, +3.0 mm.

**PERFORMANCE CHARACTERISTICS**

**Sliding Coefficient of Friction.** For all guided and non-guided expansion type pot-design bearings, the sliding coefficients of friction shall be measured at the bearing’s design capacity, on the fifth and fiftieth cycles, at a sliding speed of 25 mm per minute.

The sliding coefficient of friction shall be calculated as the horizontal load required to maintain continuous sliding of one bearing, divided by the bearing’s design capacity vertical load. The vertical load shall have been applied continuously for a minimum of 12 hours prior to testing.

The test results will be evaluated as follows:

- The measured sliding coefficients of friction shall not exceed 75% of the maximum design coefficient of friction
- The bearing will be visually examined both during and after the test. Any resultant visual defects (such as bond failure, physical destruction, cold flow of PTFE, or damaged bearing components) shall be cause for rejection.
Rotation. For all pot-design bearings, the elastomeric rotational element shall be capable of maintaining its initial uniform contact with the steel piston and steel base pot throughout a rotation range of 0.02 radians, under a compressive load equal to 150% of the design capacity of the bearing.

The test results will be evaluated as follows:
- The bearing will be visually examined both during and after the test. Any resultant defects shall be cause for rejection
- The sole plate, top bearing plate, and steel piston shall maintain continuous and uniform contact for the duration of the test. Any observed “lift-off” will be cause for rejection.

DRAWINGS. The Contractor shall submit detailed shop drawings, drawn by the Manufacturer only, in conformance with the applicable requirements of the New York State Steel Construction Manual, for approval by the Regional Director prior to the start of the fabrication. (When the SCM requires DCES approval, delete the term “DCES” and replace it with “the Regional Director.”).

In addition to the above requirements, the Manufacturer shall note the following on the shop drawings.
- The total quantity of each kind of pot-design bearing required, (i.e. fixed, guided expansion, or non-guided expansion), grouped first according to type (load range) and then by actual design capacity
- The thickness and plan area of the elastomeric rotational elements and the internal diameters of the steel base pots required
- The maximum design coefficient of friction as noted on the Contract Plans
- The type of PTFE sheet (filled or unfilled) and, if applicable, the type and amount (by weight) of filler
- The type(s) of steel(s) to be used
- If applicable, any welding process used in the bearing manufacture that does not conform to the approved processes of the New York State Steel Construction Manual shall be clearly described and detailed. (When the SCM requires DCES approval, delete the term “DCES” and replace it with “the Regional Director.”).
- The location of the fabrication plant
- The Manufacturer's name and the name of the manufacturer's representative will be responsible for coordinating production, inspection, sampling and testing with the Materials Bureau.

The Contractor shall also provide the Materials Bureau with written notification thirty (30) days prior to the start of the bearing fabrication. This notification shall include all of the information required by numbers 1 through 8 above. A copy of this notification shall be sent to the Regional Director.

SAMPLING AND TESTING

Lot Size. Sampling, testing and acceptance consideration will be made on a lot basis. A lot shall be defined as the smallest number of bearings as determined by the following criteria:
- A lot shall not exceed a single contract or project quantity
- A lot shall not exceed 25 bearings
- A lot shall consist of those bearings of the same type, regardless of load capacity. Bearing types shall be fixed type bearings or expansion type bearings. Guided and non-guided expansion bearings will be considered a single type.

Sampling and Testing Requirements. The manufacturer shall furnish the required number and size of samples to perform testing in accordance with Table 716-07-3.

A minimum of thirty (30) days shall be allowed for the Department's inspection, sampling and testing of production bearings and component materials.

All exterior surfaces of sampled production bearings shall be smooth and free from irregularities or protrusions that might interfere with testing procedures.

The manufacturer shall select, at random, the required sample bearing(s) from completed lots of bearings for testing by the manufacturer. The manufacturer shall complete the required testing and determine compliance with this specification before submitting the lot(s) for inspection, sampling and acceptance consideration.

The Department's representative shall select, at random, samples of elastomeric and PTFE materials for testing by the Materials Bureau. All samples shall be taken in accordance with the Department's
written instructions. The Contractor shall assume the cost of transporting all samples from the place of manufacture to the Materials Bureau and return, or, if applicable, to the project site.

### TABLE 716-07-3 POT BEARING SAMPLING AND TESTING REQUIREMENTS

<table>
<thead>
<tr>
<th>Test</th>
<th>Performed By</th>
<th>Samples Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotation</td>
<td>Manufacturer</td>
<td>One production bearing per lot¹</td>
</tr>
<tr>
<td>Coefficient of Friction</td>
<td>Manufacturer</td>
<td>One production bearing per lot¹</td>
</tr>
<tr>
<td>Physical Properties of Elastomeric</td>
<td>Materials Bureau</td>
<td>One Elastomeric element per lot.²</td>
</tr>
<tr>
<td>Rotational Element</td>
<td>Materials Bureau</td>
<td>One 250 x 375 mm sheet of polyether urethane material per lot.³</td>
</tr>
<tr>
<td>Physical Properties of PTFE Sheet</td>
<td>Materials Bureau</td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**
1. Sample production bearings of such size that cannot be tested by the manufacturer at 150% design capacity for rotation shall be tested at actual design capacity. Bearings which are tested at actual design capacity will be tested at that capacity because it is not possible, or not practical in the Department's opinion to test them at a higher capacity. Therefore, bearings tested at 150% design capacity which are rejected, will not be retested below 150% design capacity for the purpose of rendering such bearings acceptable. Sample production bearings that cannot be tested by the manufacturer at their actual design capacity for rotation and/or friction shall be tested by an outside laboratory selected by the Materials Bureau. The Manufacturer shall assume the cost of this testing and submit the certified test results to the Materials Bureau.
2. At the time of sampling the Department representative shall remove an elastomeric rotational element from a production bearing (not from a bearing that requires compressive strain testing) and forward it to the Materials Bureau for test. This testing will be destructive and the manufacturer shall, at the cost of the manufacturer, replace the sample elastomeric element.
3. The sample sheet of PTFE material shall be certified by the Manufacturer as having been taken from the same batch of material as was used in the actual production bearings.

**BASIS OF ACCEPTANCE.** Bearings will be considered for acceptance in project lot quantities, or portions thereof, at the manufacturing site in accordance with the procedural directives of the Materials Bureau.

### 716-08 AND 716-09 (VACANT)

### 716-10 PLAIN ELASTOMERIC BRIDGE BEARINGS

**SCOPE.** This specification covers the material requirements for plain elastomeric bridge bearings. Bearings furnished under this specification shall be adequate for the specified design load, and provide for the thermal expansion and contraction, rotation, camber changes, creep, and shrinkage of structural members.

**GENERAL.** Plain elastomeric bridge bearings (Type EP bearings) are composed entirely of elastomeric material. They may be used for both fixed and expansion applications without changes in details. The bearings will accommodate longitudinal, transverse, and rotational movements.

Elastomeric bridge bearings shall be designed in accordance with New York State Standard Specifications for Highway Bridges.

**MATERIAL REQUIREMENTS.** All materials shall be new with no reclaimed material incorporated in the finished bearing. The elastomeric compound used in the construction of these bearings shall contain only virgin crystallization resistant polychloroprene (neoprene) or virgin natural polyisoprene (natural rubber) as the raw polymer. The resulting product shall be free of porous areas, weak sections, bubbles, foreign matter, or other defects affecting serviceability. The physical properties of the cured elastomeric compound shall meet the requirements of Table 716-10-1. The manufacturer shall certify that the elastomeric compound passes Grade 3 Low - Temperature Brittleness as determined by ASTM D746 - Brittleness Temperature of Plastics and Elastomers by Impact Procedure B.

**DRAWINGS.** Shop drawings are not required for Type EP bearings.

**FABRICATION.** The finish of the mold used to produce these bearings shall conform to good machine shop practice. Each bearing shall be marked in indelible ink or flexible paint. The marking
The bearings shall be cast in a mold under pressure and heat to the specified thickness. They may be molded and vulcanized in large sheets and cut to size. Cutting shall not heat the material, and the finish produced shall be equal to a surface roughness average of 6.3 μm as defined by ANSI B46.1. A type EP bearing that has been cut from a larger piece of material and fabricated to the finished size by bonding or plying smaller pieces together will not be acceptable.

Bearing Tolerances. Finished elastomeric bearings shall conform to the design dimensions, with the tolerances listed in Table 716-10-2.

### TABLE 716-10-2 BEARING TOLERANCES

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Vertical</td>
<td>-0, +3 mm</td>
</tr>
<tr>
<td>Overall Horizontal</td>
<td>-0, +6 mm</td>
</tr>
<tr>
<td>Position of Holes and Slots centerline</td>
<td>±1.6 mm from centerline</td>
</tr>
<tr>
<td>Size of Holes, Slots and Internal Steel Plates</td>
<td>-0, +1.6 mm</td>
</tr>
</tbody>
</table>

**PERFORMANCE CHARACTERISTICS**

**Compression Deflection.** The compression deflection of each bearing shall not exceed 10.0% of the design effective rubber thickness at a compressive load equal to the actual design load.

The compression deflection shall be determined by loading the bearings to 3.4 MPa and 5.5 MPa. At each load a deflection reading will be taken and the readings used to calculate the slope between the two loads. The slope shall then be used to determine the deflection at the bearing’s design load.

The bearing and ambient temperature shall be 23°C ± 2°C at the time of testing.

**NOTE:** For conformance to this specification an observed or calculated value shall be rounded off (ASTM E29) to the nearest 0.1% for compression deflection.

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based upon the manufacturer’s name appearing on the Department’s Approved List for Elastomeric Bridge Bearings, and a manufacturer’s certification stating conformance with these specifications.

### 716-11 STEEL LAMINATED ELASTOMERIC BRIDGE BEARINGS

**SCOPE.** This specification covers the material requirements for steel laminated elastomeric bridge bearings without external load plates. Bearings furnished under this specification shall be adequate for the specified design load, and provide for the thermal expansion and contraction, rotation, camber changes, creep, and shrinkage of structural members.
GENERAL. Steel laminated elastomeric bridge bearings (Type EL bearings) are composed of multiple layers of elastomeric material separated by steel plates. They may be used for both fixed and expansion applications without changes in details. The bearings will accommodate longitudinal, transverse, and rotational movements.

Elastomeric bridge bearings shall be designed in accordance with New York State Standard Specifications for Highway Bridges.

MATERIALS REQUIREMENTS. All materials shall be new with no reclaimed material incorporated in the finished bearing.

Elastomeric Material. The elastomeric compound used in the construction of these bearings shall contain only virgin crystallization resistant polychloroprene (neoprene) or virgin natural polyisoprene (natural rubber) as the raw polymer. The resulting product shall be free of porous areas, weak sections, bubbles, foreign matter, or other defects affecting serviceability. The physical properties of the cured elastomeric compound shall be determined by using samples taken from bearings and shall meet the requirements of Table 716-10-1.

The manufacturer shall certify that the elastomeric compound passes Grade 3 Low-Temperature Brittleness as determined by ASTM D746 - Brittleness Temperature of Plastics and Elastomers by Impact Procedure B.

Internal Steel Plates. Steel plates for internal laminates shall be rolled mild steel conforming to the requirements of ASTM A36M, ASTM 1008/A 1008/M or ASTM 1011/A 1011/M (Grade 33, 36 and 40).

DRAWINGS. Shop drawings are not required for Department approval unless a change in the details shown on the plans is proposed. When Department approved shop drawings are required, they shall be furnished in accordance with the Steel Construction Manual (SCM), Section 2, except that in place of two sets of Department approved drawings submitted to the designated Shop Inspection Agency, five sets of Department approved drawings shall be submitted to the Materials Bureau. The Contractor shall submit one copy of these drawings to the Engineer.

When the bearing details are identical to the plans, the Contractor shall be responsible for supplying shop drawings prepared by the Manufacturer. The Manufacturer shall certify that the bearings depicted on the drawings are in conformance with the contract documents. The Contractor shall submit one copy of the certified drawings to the Engineer and five copies of their certified drawings to the Materials Bureau. The Department's acceptance procedures will commence subsequent to receipt of these drawings. The Manufacturer shall note the following on all shop drawings:

- The Contract number, bridge identification number (BIN), feature carried/feature crossed, specification pay item no. and the type, size and quantity of bearings being produced.
- The design load (dead load plus live load) for each type and size bearing. If bearings of the same type and size are designed for differing load conditions the maximum design load shall be noted.
- The effective rubber thickness, typical laminate thickness, compressive area, shear area and shape factor.
- The Manufacturer's name, the location of the fabrication plant and the name and phone number of the Manufacturer's representative who will coordinate production, inspection, and sampling and testing with the Materials Bureau.
- The specification reference and grade of steel used.

FABRICATION. The finish of the mold used to produce these bearings shall conform to good machine shop practice. Each bearing shall be marked in indelible ink or flexible paint. The marking shall consist of the manufacturer's name, contract number, lot number, and individual bearing number. The marking shall be placed on at least one side or face that will be visible after erection and, if possible, on two sides or faces.

Type EL bearings shall be cast as a single unit in a mold and bonded and vulcanized under pressure and heat to the specified size and thickness. The internal steel plate(s) shall be commercially blast cleaned to a condition matching that of SSPC-Vis1, Pictorial Standards A SP6, B SP6 or C SP6, and cleaned of all oil or grease before bonding.
Bearing Tolerances. Finished elastomeric bearings shall conform to the design dimensions, with the tolerances listed in Table 716-11 and the following details:

**TABLE 716-11 BEARING TOLERANCES**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Vertical</td>
<td>-0, +3 mm</td>
</tr>
<tr>
<td>Overall Horizontal</td>
<td>-0, +6 mm</td>
</tr>
<tr>
<td>Position of Holes and Slots centerline</td>
<td>±1.6 mm from centerline</td>
</tr>
<tr>
<td>Size of Holes, Slots and Internal Steel Plates</td>
<td>-0, +1.6 mm</td>
</tr>
<tr>
<td>Edge Cover over External Steel Plates¹</td>
<td>3 mm min.</td>
</tr>
<tr>
<td>Bedding Surface (Top and Bottom) Over Internal Steel Plates</td>
<td>6 mm min.</td>
</tr>
</tbody>
</table>

**NOTES:**
1. No edge cover will be required over internal details that will not be exposed after erection (i.e.- vertical holes covered by bearing seats or flanges).
2. For 716-12, With external load plate(s) there shall be an effective rubber laminate between the load plate(s) and internal steel plate(s).

**A. Internal Steel Plates.** The internal steel plates shall be checked for parallelism by measuring the distance between each individual steel plate, and between the top or bottom edge of the bearing to the first adjacent steel plate. For rectangular bearings, take measurements for each plate along the vertical surface of the bearing, located 25 mm from the edge of the four alternate corners. For round bearings, measurements will be taken at four points located at 90° intervals around the perimeter. The smallest of the four measurements shall be recorded for each plate. The cumulative total of these measurements shall not be less than 75% of the design effective rubber thickness.

**B. Elastomeric Laminae.** The average thickness of individual layers of elastomer in steel laminated elastomeric bearings shall not vary more than ±20% of the design thickness and in no case exceed the design thickness by 3 mm. Average thickness will be calculated from measurements taken at four points, located at 25 mm from the edge of the four alternate corners for rectangular bearings and at 90° intervals around the perimeter for round bearings.

**PERFORMANCE CHARACTERISTICS**

**Compression Deflection.** The compression deflection of each bearing shall not exceed 10.0% of the design effective rubber thickness at a compressive load equal to the actual design load.

The compression deflection shall be determined by loading the bearings to 3.4 MPa and 5.5 MPa. At each load a deflection reading will be taken and the readings used to calculate a slope between the two loads. The slope shall then be used to determine the deflection at the bearing's design load.

The bearing and ambient temperature shall be 23°C ± 2°C at the time of testing.

**Adhesion.** The adhesion of the elastomer to the internal plates shall be demonstrated by subjecting the bearing to a compressive load equal to 150% of the actual design load. Upon visual examination, the bearing shall be free of visual defects.

The bearing and ambient temperature shall be 23°C ± 2°C at the time of testing.

**NOTE:** For conformance to this specification an observed or calculated value shall be rounded off (ASTM E29) to the nearest 0.1% for compression deflection.

**SAMPLING AND TESTING**

**Lot Size.** Sampling, testing and acceptance consideration will be made on a lot basis. A lot shall be defined as those bearings presented for inspection at a specific time or date. A lot shall be further defined as the smallest number of bearings as determined by the following criteria:
- A lot shall not exceed a single contract quantity.
- A lot shall consist of bearings with the elastomer being of the same dimensions and configuration.
- A lot shall consist of bearings produced in a continuous manner.

**Procedure.** The Department's representative shall select at random the required sample bearings from completed lots of bearings for testing by the Materials Bureau. Bearings with a plan area of less than 0.4 m² shall be tested for performance characteristics by the Materials Bureau. Bearings with a plan area greater than 0.4 m² shall be tested by an outside laboratory approved by the Materials Bureau. The Department shall assume the cost of testing the sampled bearings and the Contractor shall assume the responsibility and cost of transporting the sampled bearings from the place of manufacture to the testing laboratory. After testing, the Contractor has the responsibility for the cost of transporting the sampled bearings back to the bearing manufacturer or, if applicable, to the project site. All samples shall be taken and delivered for tests in accordance with the Department's written instructions. A minimum of thirty (30) days shall be allowed for inspection, sampling and testing by the Materials Bureau. This thirty days is exclusive of shipping time which is the Contractor's responsibility. The sampling procedure and test methods may be obtained from the Materials Bureau.

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based on the manufacturer's name appearing on the Department's Approved List for Elastomeric Bridge Bearings and in accordance with the procedural directives of the Materials Bureau.

### 716-12 ELASTOMERIC BRIDGE BEARINGS WITH EXTERNAL LOAD PLATES

**SCOPE.** This specification covers the material requirements for elastomeric bridge bearings with external load plates. Bearings furnished under this specification shall be adequate for the specified design load, and provide for the thermal expansion and contraction, rotation, camber changes, and creep and shrinkage of structural members.

**GENERAL.** Elastomeric bridge bearings with external load plates (Type EB bearings) are composed of either plain elastomeric or laminated elastomeric bearings with external steel load bearing plates. The steel load bearing plates are bonded to the elastomer by vulcanization during the primary molding process. These bearings may be used for both fixed and expansion applications with appropriate changes in details, as shown on the contract plans. The bearings will accommodate longitudinal, transverse, and rotational movements.

Elastomeric bridge bearings with external load plates shall be designed in accordance with New York State Standard Specifications for Highway Bridges.

**MATERIALS REQUIREMENTS.** All materials shall be new with no reclaimed material incorporated in the finished bearing.

**Elastomeric Material.** The elastomeric compound used in the construction of these bearings shall contain only virgin crystallization resistant polychloroprene (neoprene) or virgin natural polyisoprene (natural rubber) as the raw polymer. The resulting product shall be free of porous areas, weak sections, bubbles, foreign matter, or other defects affecting serviceability. The physical properties of the cured elastomeric compound shall be determined by using samples taken from bearings and shall meet the requirements of Table 716-10-1.

The manufacturer shall certify that the elastomeric compound passes Grade 3 Low - Temperature Brittleness as determined by ASTM D746 - Brittleness Temperature of Plastics and Elastomers by Impact Procedure B.

**Internal Steel Plates.** Steel plates for internal laminates shall be rolled mild steel conforming to the requirements of ASTM A36M, or ASTM 1008/A 1008/M ASTM 1011/A 1011/M (Grade 33, 36 and 40).

**External Load Bearing Plates and Steel Backing Plates.** External load bearing plates shall conform to the requirements of ASTM A36M and to the requirements of the Steel Construction Manual (SCM), unless otherwise provided for in the contract documents.
Except as noted, all bearing surfaces of external load plates shall be finished or machined flat within 0.25 mm. Out-of-flatness greater than 0.25 mm on any plate, except the bottom surface of the lower external plates (masonry plates), shall be cause for rejection. The bottom surface of lower external load plates (masonry plates) shall not exceed an out-of-flatness value of 1.6 mm. Oxygen cut surfaces shall not exceed a surface roughness average of 25 μm as defined by ANSI B46.1. Repairs shall conform to the requirements of the SCM.

External load bearing plate surfaces to be welded shall be painted with one coat of lacquer or other protective coatings approved by the Director of the Materials Bureau. This coating shall be removed before welding. All surfaces shall be cleaned and painted in accordance with §572, Structural Steel Paint System, Shop Applied. Color shall match that of the finish coat of other structural steel. For bearing used in conjunction with unpainted steel, the finish coat shall match “Weathered Brown” as defined by 708-05 Standard Paint Colors.

**DRAWINGS.** Department approval of shop drawings are not required unless a change in the details shown on the plans is proposed. When Department approved drawings are required, they shall be furnished in accordance with SCM, Section 2, except that in place of two sets of Department approved drawings submitted to the designated Shop Inspection Agency, five sets of Department approved drawings shall be submitted to the Materials Bureau. The Contractor shall submit one copy of these drawings to the Engineer.

When the bearing details are identical to the plans, the Contractor shall be responsible for supplying shop drawings prepared by the manufacturer. The manufacturer shall certify that the bearings depicted on the drawings are in conformance with the contract documents. The Contractor shall submit one copy of the certified drawings to the Engineer and five copies of their certified drawings to the Materials Bureau. The Department's acceptance procedures will commence subsequent to receipt of these drawings. The Manufacturer shall note the following on all shop drawings:

- The Contract number, bridge identification number (BIN), feature carried/feature crossed, specification pay item no. and the type, size and quantity of bearings being produced.
- The design load (dead load plus live load) for each type and size bearing. If bearings of the same type and size are designed for differing load conditions the maximum design load shall be noted.
- The effective rubber thickness, typical laminate thickness, compressive area, shear area and shape factor.
- The Manufacturer's name, the location of the fabrication plant and the name and phone number of the manufacturer's representative who will coordinate production, inspection, and sampling and testing with the Materials Bureau.
- All welding procedures to be used in the manufacture of the bearings.
- The specification references and grades of steel to be used.
- The designation of the mold used to produce these bearings shall conform to good machine shop practice. Each bearing shall be marked in indelible ink or flexible paint. The marking shall consist of the manufacturer's name, contract number, lot number, and individual bearing number. The marking shall be placed on at least one side or face that will be visible after erection and, if possible, on two sides or faces.

- The bearings shall be cast as a single unit in a mold and bonded and vulcanized under pressure and heat to the specified size and thickness. They shall be cast as a single unit with the external load plate(s) bonded to the elastomer by vulcanization during the primary molding process. If internal steel plate(s) are required, they shall be commercially blast cleaned to a condition matching that of SSPC-Vis1, Pictorial Standards A SP6, B SP6 or C SP6, and cleaned of all oil or grease before bonding.

- During any welding, the temperature of the steel adjacent to the elastomer shall not exceed 90°C. Temperature shall be controlled by welding procedures and temperature indicating crayons,
or other devices approved by the Engineer. Unless otherwise approved by the DCES, all welding shall conform to, and all welders shall be qualified in accordance with the requirements of the SCM.

**Bearing Tolerances.** Finished elastomeric bearings shall conform to the design dimensions, with the tolerances listed in Table 716-11 and the following details:

**A. Internal Steel Plates.** The internal steel plates shall be checked for parallelism by measuring the distance between each individual steel plate, and between the top or bottom edge of the bearing to the first adjacent steel plate. For rectangular bearings, take measurements for each plate along the vertical surface of the bearing, located 25 mm from the edge of the four alternate corners. For round bearings, measurements will be taken at four points located at 90° intervals around the perimeter. The smallest of the four measurements shall be recorded for each plate. The cumulative total of these measurements shall not be less than 75% of the design effective rubber thickness.

**B. Elastomeric Laminae.** The average thickness of individual layers of elastomer in steel laminated elastomeric bearings shall not vary more than ±20% of the design thickness and in no case exceed the design thickness by 3 mm. Average thickness will be calculated from measurements taken at four points, located at 25 mm from the edge of the four alternate corners for rectangular bearings and at 90° intervals around the perimeter for round bearings.

**Performance Characteristics**

**Compression Deflection.** The compression deflection of each bearing shall not exceed 10.0% of the design effective rubber thickness at a compressive load equal to the actual design load.

The compression deflection shall be determined by loading the bearings to 3.4 MPa and 5.5 MPa. At each load a deflection reading will be taken and the readings used to calculate a slope between the two loads. The slope shall then be used to determine the deflection at the bearing's design load.

The bearing and ambient temperature shall be 23°C ± 2°C at the time of testing.

**Adhesion.** The adhesion of the elastomer to the internal plates shall be demonstrated by subjecting the bearing to a compressive load equal to 150% of the actual design load. Upon visual examination, the bearing shall be free of visual defects.

The bearing and ambient temperature shall be 23°C ± 2°C at the time of testing.

**NOTE:** For conformance to this specification an observed or calculated value shall be rounded off (ASTM E29) to the nearest 0.1% for compression deflection.

**SAMPLING AND TESTING**

**Lot Size.** Sampling, testing and acceptance consideration will be made on a lot basis. A lot shall be defined as those bearings presented for inspection at a specific time or date. A lot shall be further defined as the smallest number of bearings as determined by the following criteria:

- A lot shall not exceed a single contract quantity
- A lot shall consist of bearings with the elastomer being of the same dimensions and configuration
- A lot shall consist of bearings produced in a continuous manner.

**Procedure.** The Department's representative shall select at random the required sample bearings from completed lots of bearings for testing by the Materials Bureau. The manufacturer shall supply the Department's representative with a copy of an approved Welding Procedure for each welding process used in the manufacture of the bearings. Bearings with a plan area greater than 0.4 m² shall be tested by an outside laboratory approved by the Materials Bureau. The Department shall assume the cost of testing the sampled bearings and the Contractor shall assume the responsibility and cost of transporting the sampled bearings from the place of manufacture to the testing laboratory. After testing the Contractor has the responsibility for the cost of transporting the sampled bearings back to the bearing manufacturer or, if applicable, to the project site. All
samples shall be taken and delivered for test in accordance with the Department's written
instructions. A minimum of thirty (30) days shall be allowed for inspection, sampling and testing
by the Materials Bureau. This thirty days is exclusive of shipping time which is the Contractor's
responsibility. The sampling procedure and test methods may be obtained from the Materials
Bureau.

BASIS OF ACCEPTANCE. Acceptance of this material will be based on the manufacturer's
name appearing on the Department's Approved List for Elastomeric Bridge Bearings and in
accordance with the procedural directives of the Materials Bureau.

SECTION 717 - CONCRETE PROTECTIVE COATINGS

717-01 AND 717-02 (VACANT)

717-03 PENETRATING TYPE PROTECTIVE SEALERS

SCOPE. This specification covers the material requirements of penetrating type protective sealers for
use on portland cement concrete.

GENERAL. The material shall be a one component material consisting of a penetrating sealer which
does not alter the color or texture of portland cement concrete.

MATERIAL REQUIREMENTS. Penetrating sealers shall be a one-part liquid, composed of a
minimum of 40 percent (40%) silane or siloxane material, with no petroleum distillates. The Department
will test the sealers as delivered, in accordance with Department written instructions, to ensure that the
following properties are attainable. If the material attains these properties, the Department will place the
material on its Approved List. The properties are:

Water Absorption. The final average percent water absorbed, for concrete coated with the protective
sealer, shall not be greater than 20.0% of the final average percent water absorbed by the uncoated
reference concrete.

Moisture Vapor Transmission. The final average percent moisture loss, for concrete coated with the
protective sealer, shall not be less than 75.0% of its final average percent water absorption.

Chloride Ion Penetration. The final average absorbed chloride ion content, for concrete coated with
the protective sealer, shall not be greater than 15.0% of the final average absorbed chloride ion content of
the uncoated reference concrete.

Durability. The protective sealer shall not show any signs of weathering, discoloration, or deterioration
after six (6) months of exposure to atmospheric conditions.

PACKAGING. All materials shall be packaged in strong, substantial containers. Each container shall be
plainly marked with the following information: name of the product; name and address of Manufacturer;
application instructions; lot/batch number; date of manufacture; quantity of material; and date of
expiration or shelf life. The printed shelf life shall not exceed one year from the date of manufacture.

BASIS OF ACCEPTANCE. Acceptance of penetrating type sealers will be based upon the product
appearing on the Department's Approved List, and the Manufacturer's certification that the material meets
the requirements of this section. The shelf life of this material shall not exceed one year from the date of
manufacture printed on the product label. The Department reserves the right to sample and test the
material at its discretion.
§717-04 COATING TYPE PROTECTIVE SEALERS

SCOPE. This specification covers the material requirements of coating type protective sealers for use on portland cement concrete.

GENERAL. The coating system shall be either a single coating material or a primer coat followed by a top coat. After application, the sealer shall be opaque and uniform in color.

MATERIAL REQUIREMENTS. The Department will test the sealers as delivered, in accordance with Department written instructions, to ensure that the following properties are attainable. If the material attains these properties, the Department will place the material on its Approved List. The properties are:

Water Absorption. The final average percent water absorbed, for concrete coated with the protective sealer, shall not be greater than 25.0% of the final average percent water absorbed by the uncoated reference concrete.

Moisture Vapor Transmission. The final average percent moisture loss, for concrete coated with the protective sealer, shall not be less than 50.0% of its final average percent water absorption.

Chloride Ion Penetration. The final average absorbed chloride ion content, for concrete coated with the protective sealer, shall not be greater than 25.0% of the final average absorbed chloride ion content of the uncoated reference concrete.

Durability. The protective sealer shall not show any signs of weathering, discoloration, or deterioration after six (6) months of exposure to atmospheric conditions.

PACKAGING. All materials shall be packaged in strong, substantial containers. Each container shall be plainly marked with the following information: name of the product; name and address of Manufacturer; mix proportions(if applicable) and application instructions; lot/batch number; date of manufacture; quantity of material; and date of expiration or shelf life. The printed shelf life shall not exceed one year from the date of manufacture.

BASIS OF ACCEPTANCE. Acceptance of coating type sealers will be based upon the product appearing on the Department's Approved List, and the Manufacturer's certification that the material meets the requirements of this section. The shelf life of this material shall not exceed one year from the date of manufacture printed on the product label. The Department reserves the right to sample and test the material at its discretion.

SECTION 718 - PRESTRESSED CONCRETE UNITS

718-01 PRESTRESSED CONCRETE UNITS (STRUCTURAL)

SCOPE. This specification covers the material and fabrication requirements for prestressed concrete units.

GENERAL. Prestressed concrete units provided under this specification shall meet all design requirements for the structure for which they are being fabricated.

MATERIAL REQUIREMENTS

Concrete. The concrete shall meet the requirements of §501-2, under 501, Portland Cement Concrete, General, with the following modifications:

- Cement shall be either Type 1, Type 2 or Type 3. Only one type of cement shall be used to fabricate units for any one structure
- Coarse aggregate gradation shall be No. 1 Size or ASTM D448, No. 67
- Concrete requirements for Classes A and C concrete shall not apply
Air content shall be 7 percent + 2 percent
The use of calcium chloride, or an admixture containing calcium chloride will not be permitted.

Steel.

Bar Reinforcement 709-01
Wire Fabric 709-02
Chairs or other devices to ensure proper placement of steel items 556-2.02
Prestressing steel 709-06
Bearing plates, if required 715-01

Epoxy. Epoxy shall meet the requirements of §721-01, Epoxy Resin System; §721-03, Epoxy Polysulfide Grout, or §721-05, Epoxy Repair Paste.

Fine Aggregate. Fine aggregate shall meet the requirements of §703-03, Mortar Sand or §703-04, Grout Sand. Fine aggregate shall be absolutely dry.

DRAWINGS

Contract Drawings. Drawings which accompany the contract proposal are designated as contract drawings. These drawings are not intended to be working drawings.

Working Drawings. Complete and accurate drawings shall be made by the Contractor, indicating how each prestressed concrete unit is to be fabricated. The Contractor shall be responsible for modifying the dimensions of units to compensate for elastic shortening, shrinkage, grade correction and other phenomena that make in-process fabricating dimensions different from those shown on the contract drawings. Approval of the working drawings by the DCES shall not relieve the Contractor from the responsibility for the correctness of all dimensions shown on these drawings. These drawings shall be made as soon as possible after the award of contract and they shall be designated as working drawings.

A. Size and Type. Working Drawings shall be neatly drawn and clearly legible to produce microfilm negatives. The drawings shall be made in ink, or reproduced from the pencil drawings by a process subject to the approval of the DCES, on tracing cloth or mylar of acceptable quality. Working drawings shall be cut to a standard size of 560 mm x 860 mm (nominal) and arranged to conform to the contract drawings.

Failure to submit working drawings of the required size will be cause for their return without examination. The margin line shall be drawn 13 mm from the top, bottom, and right-hand edges and 50 mm from the left-hand edge to permit binding. A space 75 mm x 280 mm, and parallel to the length of the sheet shall be reserved in the lower right-hand corner for title and approval signature. Each working drawing shall have an identical (top right) corner box to the one shown on the contract drawings. The sheets shall be arranged so that, as far as possible, the notes will appear above each other near the right edge of the sheet.

B. Information Required on Working Drawings. The working drawings shall include the following information:

- Plan layout of superstructure indicating the piece mark assigned to each prestressed unit
- Fabricating plant production schedule
- Description of the fabricating plant, including any backup concrete mixing facilities, original design mix and proposed method of placement. Modifications or deviations from the original mix at any time after the working drawings have been approved, shall be submitted, in writing to the DCES
- Proposed admixture to be added to the concrete mix
- Quality control tests and procedures
- Method and outline of unit and cylinder curing procedure, as required by “Curing”
• The name of the manufacturer of the prestressing steel, including any alternate source
• Material and manner of sealing the exposed portions of the prestressing steel
• Transfer of prestress procedure for all unit types to be fabricated
• Complete details, including anticipated camber, tensioning force (initial and final), concrete
  strength (transfer and 28 day), and type and location of lifting device for all prestressed concrete
  units to be fabricated.
• Proposed method of handling and transporting prestressed concrete units to the project site
• Working drawings shall clearly indicate any proposed deviations from the prestressed concrete
  unit shown on the contract drawings
• Winter concreting procedures, if need is anticipated.

Submission of Working Drawings. When the working drawings, prepared by the Contractor, as
specified, are completed, check prints shall be submitted to the DCES, who will indicate thereon such
corrections as may be necessary to secure the completion of the contract in accordance with the
requirements of the contract documents. The Contractor shall submit three sets of check prints for the
DCES and two additional sets of check prints for each Railroad or other Agency involved with the
contract. All sets of check prints shall be submitted to the DCES, who will make the distribution to the
Railroad and other Agencies involved. One set of check prints or sepias with desired corrections
indicated thereon in colored crayon or pencil, will be returned to the Contractor. When the revisions have
been completed to the satisfaction of the DCES, the original drawings shall be forwarded to the DCES for
written approval, after which a set of approved drawings will be returned. The original drawings shall
remain the property of the State.

The DCES shall be allowed two work days for the examination of each drawing in a set of working
drawings, or ten work days minimum per set. A set of working drawings shall be considered to be all
drawings received by the DCES from any given Contractor for a particular contract on any calendar day.
If the working drawings are detained for examination for a period longer than that previously stated, such
detention will be taken into account when considering application by the Contractor for an extension of
time for the completion of the contract. All working drawings are time and date stamped as they are
received and recorded in a log at the office of the DCES. This log shall be the basis for determining when
drawings must be returned without consideration for an adjustment of the completion date as described
herein.

Approval of working drawings shall not constitute approval for the following information required on
the working drawings 2B(3) and 2B(7). This data is required for information only.

FABRICATION

Approval of Working Drawings. No fabrication shall be started until after the working drawings
have been approved and the Inspector has received prints made from the original drawings.

Data Required with Working Drawings. Data required by the DCES prior to approval of the
working drawings shall be as follows:
• Calculations of strand elongation for each unique casting length (grip-to-grip)
• A calibration certificate indicating the load calibration of each gage and hydraulic jack combination
  used for tensioning. The gage shall be calibrated from zero, throughout its entire load range. The
  gage shall have clearly marked divisions that are easily readable at the initial and final tensioning
  force. The calibration date of each combination gage and hydraulic jack shall be within the 12 month
  period immediately prior to the start of the work.
• A calibration certificate attesting to the fact that the concrete cylinder testing machine to be used has
  been calibrated within the 12 month period immediately prior to the first date of actual use of the
  machine.

Data for Inspector. Data required to be submitted to the Inspector for approval prior to the inclusion
of the respective materials in the unit, shall be as follows:
A. Prestressing Steel Certification. A certificate from the prestressing steel manufacturer stating that the prestressing steel has been manufactured in accordance with §709-06.

B. Load-Strain Curves. Typical load-strain curves made during the processing of steel from which the elongation appropriate to the required prestressing force can be determined, including the following information:
- The breaking strength
- The elongation at rupture
- The load at one percent elongation
- The test dates

The aforesaid information shall be submitted to the Inspector, in triplicate, for each 20 metric ton lot, or fraction thereof, of prestressing steel.

C. Other Certifications. Certificates indicating acceptance of bar reinforcement, concrete materials and any other material used in the prestressed concrete unit.

Inspection. Fabrication of units shall be inspected by an Inspector designated by the State. The Contractor shall inform the State 72 hours prior to:
- Commencement of work
- Commencement of work after a work suspension of 48 hours or more
- Unit shipping

The Contractor shall keep the Inspector informed of the day-to-day scheduling of operations. The Inspector shall have free access throughout the fabrication plant to see that the work being done is in conformance with the contract documents. Work done while the Inspector has been refused access shall be automatically rejected. The Inspector shall be present when necessary tests are made on the prestressing steel at the place of manufacture.

Concrete Forms

A. General. Forms shall be well-constructed, carefully aligned, clean, substantial and firm, securely braced and fastened together and sufficiently tight to prevent leakage of mortar. They shall be strong enough to withstand the action of mechanical vibrators. All forms for each unit shall be approved by the Inspector prior to placing concrete.

All form surfaces that come in contact with the concrete shall be thoroughly treated with an approved form coating in the manner and at the rate specified by the manufacturer. Forms so treated shall be protected against damage and dirt prior to placing concrete.

Any form coating material that will stick to or discolor concrete shall not be used.

B. Void-Producing Forms. Void forms shall be coated with a waterproofing material on the outside and shall have a 20 mm (nominal) diameter drain placed at each end of each void.

When units are steam-cured, all voids shall be vented.

Reinforcement and Prestressing Steel. Prior to installation in the units, reinforcement and prestressing steel shall be free of frost, dirt, oil, paint, mill scale, corrosion, or any foreign material that may prevent bond between the steel and the concrete.

Tack welding of bar reinforcement shall not be allowed under any circumstances.

Welded wire fabric, smooth or deformed, may be substituted for the required bar reinforcement provided that:
- The required cover is maintained
- The design steel area of the fabric equals that of the bar reinforcement
- Splices to the fabric are made in accordance with the requirements of the N.Y.S.D.O.T. Standard Specifications for Highway Bridges, §1.5.22D and §1.5.22E as applicable.
If wire fabric is used, the details shall be indicated on the working drawings. Design computations shall also be included.

**Tensioning of Prestressing Strands.** A calibrated force of 13.0 kN shall be applied initially to each strand. Consideration will be given by the DCES to a different initial force for special cases. This force shall be the starting point for additional tensioning by elongation.

For draped strands, the additional tensioning or prestressing force induced in the prestressing steel shall be measured by jacking gages and by elongation of the steel. The jacking gages shall read within 5 percent of the force theoretically calculated to be induced by elongation.

For straight strands, elongation only shall determine the prestressing force.

During tensioning of any one strand, the process shall be so conducted that the applied load and the elongation of the strand may be measured at all times.

Two copies of recorded gage pressures and measured elongations, as required for the tensioning of prestressing strands in each unit, shall be submitted to the Inspector.

The use of load cells or other tension measuring devices may be required. They shall be furnished by the Inspector and used in accordance with his/her instructions.

**Concrete Mix Design and Proportioning.** The Contractor shall be responsible for designing a concrete mix to produce the strength and other requirements specified on the contract plans. If no strength is indicated, the required minimum strength shall be 28 MPa at transfer and 35 MPa at 28 days. Maximum cement content for any proposed mix shall be 445 kg/m³. Proposed mixes shall be submitted in accordance with the requirements of Drawings, Paragraph 2B(3). Automatic proportioning equipment will not be required.

The Contractor may request permission from the DCES to incorporate a High Range Water Reducing (HRWR) admixture into the concrete mix. The DCES will grant such permission only if deemed to be in the best interests of the State and then only under such conditions as the DCES requires.

**Placing Concrete.** No concrete shall be placed without the Inspector's approval. Compliance with the precasting tolerances is a prerequisite for casting approval by the Inspector.

When the atmospheric temperature is below 4°C, the fabrication of the units shall be in accordance with the winter concrete procedures as approved on the working drawings.

Suitable means shall be used for placing concrete without segregation. The concrete mixture shall not be dropped from a height greater than 300 mm above the top of the forms. Special care shall be taken to deposit the concrete in its final position in each part of the form.

The plastic concrete shall be consolidated in place by either external or internal vibration methods, or both, if necessary. The vibrators shall be of a type and design approved by the Inspector and the size of the vibrating head will be governed by the spacing of the prestressing steel and reinforcement. Vibrators shall be used only to consolidate the concrete after it has been properly placed.

The internal vibrator shall be slowly inserted and removed from the concrete.

The following quality control tests shall be performed, by the Contractor in the presence of the Inspector from the same concrete sample as that used for the Concrete Strength Requirements of this specification:

- Slump
- Air content
- Temperature
- Unit mass.

**Finishing.** To assure production of well-formed matching beams with overall pleasing appearance, all surfaces of concrete shall be true and even, free from rough, open or honeycombed areas, depressions or projections. After all the concrete has been placed and thoroughly compacted as required under Placing Concrete, the tops of units shall be magnesium-float finished, or finished as shown on the Working Drawings. If required, all exposed surfaces shall be finished by bagging.

All exposed reinforcement shall be coated with neat cement paste prior to placement in the storage area.
Curing. The Contractor shall indicate on the working drawings, for approval, the method of cure and complete outline of the proposed procedure under each of the phases of the curing cycle. The full curing cycle consists of an Initial Curing Phase and Final Curing Phase. The Contractor may choose any one of the following acceptable curing methods, however only one curing method will be allowed for the units of a single structure.

To ensure complete hydration of cement, and to prevent the formation of cracks, moisture must be retained within the concrete. Therefore, immediately upon the completion of concrete placement for each unit, an enclosure shall be placed over the casting bed. The Contractor shall submit all covers for inspection prior to the commencement of work.

A. Accelerated Cures. Acceptable methods for accelerated cures are by application of low pressure steam or by application of radiant heat and moisture.

1. Initial Curing Phase. The initial curing phase for each unit shall be that period beginning from the time each unit is completely covered and continuing until the final curing phase commences.

The Contractor shall indicate the duration of the initial curing phase for each unit. However, the initial curing phase shall not exceed eight hours. During this phase, the enclosure temperature shall be maintained at approximately the concrete placing temperature; artificial heat shall be applied if necessary.

2. Final Curing Phase. The final curing phase for each unit shall be that period required to raise the initial curing phase temperature to the selected temperature range at a rate not exceeding 30°C per hour and continuing until the concrete has attained the minimum transfer strength as noted on the contract plans or as noted in this specification, under the paragraph Concrete Mix Design and Proportioning, whichever is applicable.

The selected curing temperature range shall be as approved on the working drawings.

B. Non-Accelerated Cure. The acceptable method of non-accelerated cure is by the application of a saturated cover.

1. Initial Curing Phase. The requirements of A1 above, shall apply.

2. Final Curing Phase. The final curing phase may begin at anytime after commencement of the initial curing phase. Each unit shall be covered with heavy, water saturated burlap, or other material acceptable to the Inspector. The burlap shall be kept saturated, and the concrete surface temperature shall not drop below 20°C. These conditions shall be maintained until either of the following has occurred:

   a. Seventy-two hours have passed from the time of burlap placement; or
   b. Minimum transfer strength has been reached.

Record of Curing Time - Temperature. The Contractor shall provide one (1) automatic temperature recorder for every 30 m of casting bed. The recorder shall continuously record curing temperatures for the initial and final curing phases. Temperature sensors shall be carefully placed within the curing enclosure to ensure that ambient temperatures are measured at the designated locations. Recorder accuracy shall be certified once every 12 months and the certificate displayed with each recorder. In addition, random temperature checks of each recorder shall be made by the Inspector.

Each temperature chart shall indicate the casting bed, date of casting, time of commencing graphic plot and units represented by chart. The start of artificial heat and the transfer of prestress shall be indicated on each graphic record.

After completion of the final curing phase, the charts shall be properly marked and given to the Inspector. Temperatures recorded on the charts shall be considered as verification of whether the units have been cured in accordance with the approved working drawings.
Transfer of Prestress. Transfer of prestress shall be accomplished as soon as the final curing phase is complete.

Concrete Strength Requirements

A. Test Cylinders. The concrete strength shall be determined from concrete test cylinders made in conformance with ASTM C31, except that all cylinders shall be vibrated. All cylinders shall be tested in conformance with ASTM C39, on an approved testing machine. All cylinders shall be made and tested by the Contractor in the presence of the Inspector.

The cylinders shall be made from concrete actually placed in the units. The Inspector shall be the sole judge of which cylinders are defective or damaged and are not to be included in the determination of the strength class. Test cylinders used to determine required strengths for detensioning shall be cured as specified on the working drawings.

All cylinders used to test for concrete strength shall be cured in the same manner as the units they represent unless otherwise indicated on the working drawings.

The Contractor shall cast a sufficient number of concrete test cylinders to fulfill the concrete strength test requirements as stated in 2 below. This testing procedure may be altered by the DCES. If an alternate procedure is to be followed, it shall be indicated on the contract drawings. The number of test cylinders to be cast for each unit shall be shown on the working drawings.

B. Testing for Concrete Strength. The strength requirements for each unit shall be certified by the Contractor, as follows, before the unit is accepted for strength:

1. Transfer Strength. Two cylinders from each unit shall be tested in immediate succession to verify prestress transfer strength. One of the two cylinders tested to determine the strength of the last unit cast in any bed shall be taken from the last batch of concrete placed in that unit. The strength of each cylinder shall be at least 95 percent of the required prestress transfer strength. The average strength of the two cylinders shall be equal to or greater than the required prestress transfer strength.

2. 28 Day Strength

a. Two cylinders from each unit shall be tested in immediate succession at 28 days of age to verify the required 28 day strength of the concrete. The average strength of the two cylinders shall be equal to or greater than the required 28 day strength. If this requirement is not met, any remaining cylinders representing the unit shall be tested at 28 days of age. The average strength of all cylinders representing the 28 day strength of any one unit shall be equal to or greater than the required 28 day strength.

b. The Contractor may elect to test two cylinders from each unit in immediate succession, prior to the 28 day age limit. If this option is exercised sufficient cylinders shall be made to ensure that at least two cylinders are available for the 28 day test. Each cylinder shall have a strength of at least 95 percent of the required 28 day strength. The average of the two cylinders must be equal to or greater than the required 28 day strength. If these requirements are met, the cylinder test at 28 days of age shall be waived.

Rejection of Units. Any unit not fabricated in accordance with the contact documents or displaying any of the following defects shall be subject to rejection:

A. Strength Requirement. Any unit represented by cylinders not meeting the required strengths, as specified in Concrete Strength Requirements.

B. Exposed Prestressing Steel. Any unit that has one (1) prestress strand exposed in excess of 24 diameters, or two (2) or more exposed strands.
C. Honeycombing.  Honeycombing of the unit to such an extent that chipping away from the honeycombed concrete results in the conditions described in the above paragraph 2, Exposed Prestressing Steel.

All honeycombed areas in a unit must be chipped until sound concrete is detected. Sound concrete is defined as that point at which chipping causes fracture of the aggregates.

D. Stress Cracks.  Any unit that has a stress crack in the area beginning 100 mm from the unit end to the center line of the unit that is greater than 13 mm in depth and 63 µm in width.

E. Injurious Materials.  Materials used for the manufacture of concrete shall not contain, nor cause concentration of, chemicals, or other materials injurious to concrete.

Concentrations of total chloride ions in excess of 0.05% by mass of cement are considered injurious.

Other material and concentration injury potential will be determined by the D.C.E.T.S. according to Department written instructions.

Damaged units.  The Inspector shall determine whether spalled, honeycombed, or otherwise defective concrete shall be repaired or be subject to rejection.  The decision to repair a unit or reject a unit shall require the concurrence of the DCES.

Removal of Unsuitable Material.  Prior to beginning the repair, all spalled, honeycombed or disintegrated concrete shall be removed by chipping the unsuitable material away until sound concrete is reached.  Sound concrete shall be as defined under Rejection of Units, Subparagraph 3.  Chipping tools shall be pneumatic.  The type and size of tools and the depth at which sound concrete is reached shall be determined by the Inspector.

Blast Cleaning Surfaces.  All surfaces to be repaired shall be thoroughly blast-cleaned with No. 40 boiler slag grit or No. 2 sandblast sand, or as ordered by the Inspector.

REPAIR.  Repair shall be designated as “structural repair” or “nonstructural repair” by the Deputy Chief Engineer (Structures).  Repair to a unit shall be done in accordance with the following.

Structural Repair.  Repair, designated as “structural” by the DCES, shall be made with an epoxy grout comprised of an epoxy resin system (721-01), or an epoxy polysulfide grout (721-03), mixed with fine aggregate.  The grout shall be mixed and placed in accordance with the following:

A. Mixing.  No mixing shall be started until all preparations have been made to use the grout.  The Contractor shall be familiar with the pot life limitations of the epoxy being used, and its operations shall be governed accordingly.  Mixing shall be carried out in strict accordance with the manufacturer's instructions and the following:

- Mixing shall be done as close as possible to the portion to be repaired.
- All necessary equipment for mixing and placing shall be present at the site, and in good working order, prior to the start of mixing.
- The grout shall be proportioned by volume in the approximate ratio of two (2) parts fine aggregate to one (1) part epoxy.  The exact ratio of sand to epoxy resin system shall be determined on-site to produce a dense void-free grout.
- Dry, fine aggregate shall be placed in the mix container first.  It shall be thoroughly agitated prior to the addition of the epoxy.
- The two components of the epoxy system shall be thoroughly mixed together before being added to the fine aggregate.
- The epoxy shall be added to the fine aggregate slowly, but mixing time shall not exceed three minutes.
- All grout, in any individual batch, shall be used within 25 minutes after the start of mixing of the two components to create the epoxy system.  All grout not used within the time limit shall be discarded.
§718

- The epoxy grout shall not be retempered.

**B. Placing.** The epoxy grout shall be placed against a clean, primed, receiving surface, in accordance with the following:

- The receiving surface shall be cleaned of all oil, grease, or other material which may prevent effective bond, immediately prior to priming the surface with neat epoxy (epoxy without aggregate).
- The priming of the receiving surface shall be done immediately prior to the placement of the epoxy grout.
- The epoxy grout shall be placed quickly and continuously. It shall not be overworked.
- The temperature of the receiving surface shall be above 10°C at the time of grout placement.
- Grout placement shall not be permitted when ambient temperatures are 10°C or lower, unless methods of protection, acceptable to the Inspector, are employed. Methods of protection, if permitted, shall be continued for a period of 15 hours following grout placement. The 15 hour period may be shortened, at the discretion of the Inspector, but under no circumstances will it be less than 12 hours. Methods of protection, if permitted, are conveniences granted by the State. As such, they are not considered extra work, and therefore they are not entitled to extra compensation.
- Upon completion of grout placement, the new surface of the repaired area shall be flush with the adjacent surfaces, unless the design of the unit specifically requires otherwise.
- On surfaces which will be exposed to view after installation, the repaired area shall be color matched to the adjacent surfaces by use of cement dust, or other means acceptable to the Inspector.

**Nonstructural Repair.** Repair, designated as “nonstructural” by the DCES shall be made with either of the following:

- Epoxy grout composed of §721-01 Epoxy Resin System or §721-03 Epoxy Polysulfide Grout, and fine aggregate; or,
- §721-05 Epoxy Repair Paste.

The Contractor has the choice of materials.

**A. Mixing.** Epoxy grout shall be mixed in accordance with the requirements of A. Mixing as given under Structural Repair.

Epoxy repair paste shall be mixed in strict accordance with the manufacturer's instructions.

**B. Placing.** Placing of either material shall be done in accordance with the requirements of B. Placing as given under Structural Repair.

**TOLERANCES.** Tolerances of the Prestressed Concrete Units shall meet the requirements specified in the Contract Documents.

Units which fail to meet the tolerances shall be rejected with the concurrence of the DCES.

**SHIPPING.** Units shall not be shipped until the minimum 28 day strength has been attained, but in no case, before 72 hours' storage time has elapsed following transfer of prestress.

**BASIS OF ACCEPTANCE.** The Inspector's stamp of approval shall constitute the basis of acceptance for shipment to the job site. The Inspector's stamp shall be placed on the unit after loading for shipment.

Application of the Inspector's acceptance stamp indicates that at the time of shipment, it was the Inspector's opinion that the unit was fabricated from accepted materials, by approved processes, and was properly loaded for shipment.

Such application does not imply that the material will not be rejected by the State if it is subsequently found to be defective.

718-02 THRU 718-04 (VACANT)
718-05 PRESTRESSED CONCRETE FORM UNITS

SCOPE. This specification contains the requirements for prestressed concrete form units. These units are used to form the lower portion of a structural slab. They act compositely with the cast-in-place portion of the slab and become an integral part of the structural slab.

GENERAL. §718-01 Prestressed Concrete Units (Structural) shall apply except for the following modifications to the FABRICATION, REPAIR and TOLERANCES:

FABRICATION. §718-01 shall apply except as follows:

Reinforcement and Prestressing Steel. §718-01 shall apply. In addition, devices which will be used as hold-down points for outside reinforcing steel shall be placed prior to concrete placement in the forms. Devices used to lift the units are acceptable for this purpose. The maximum spacing between hold-down devices shall be 1.2 meters center-to-center of device.

Finishing. §718-01 shall apply except the tops of units do not have to be magnesium float finished.

Concrete Strength Requirements. §718-01 shall apply except the testing shall be as follows:

   Testing for Concrete Strength. The strength requirements for each day's production shall be certified by the Contractor before that day's production is accepted for strength. Certification shall be done in accordance with the terms of this subsection. All cylinders cast shall be cast in sets of three. One set shall be cast from the first concrete placement of the day. One set shall be cast from the last concrete placement of the day. In addition to those, there shall be a set cast for each 10 m$^3$ of concrete, or major fraction thereof, placed in any one day.

   1. Transfer Strength. Three cylinders from each day's production shall be tested in immediate succession to verify prestress transfer strength. One cylinder shall be taken from the first set cast; one cylinder shall be taken from the last set cast. The strength of each cylinder shall be at least 95 percent of the required prestress transfer strength. The average strength of the three cylinders shall be equal to, or greater than, the required prestress transfer strength.

   2. 28-Day Strength. Three (3) cylinders representing each day's production shall be tested in immediate succession at twenty-eight (28) days of age to verify the required 28-day strength. The strength of each cylinder shall be at least ninety-five (95) percent of the required 28-day strength. The average strength of the three cylinders shall be equal to, or greater than, the required 28-day strength. If these requirements are not met, any remaining cylinders representing the day's production shall also be tested at 28 days of age. The average strength of all cylinders representing the 28-day strength of any one day's production shall be equal to, or greater than, the required 28-day strength.

   3. Option. The Contractor may test three (3) cylinders, representing each day's production in immediate succession, prior to the 28-day age limit. Each cylinder shall have a strength of at least ninety-five (95) percent of the required 28-day strength. The average strength of the three cylinders shall be equal to, or greater than, the required 28-day strength. If these requirements are met, the cylinder test at 28 days of age shall be waived. If this option is exercised, sufficient cylinders shall be made to ensure that at least 3 cylinders are available for the 28-day test.

Rejection of Units. Any unit not fabricated in accordance with the Contract Documents, or displaying any of the following defects, shall be subject to rejection:

   A. Strength Requirements. Any unit represented by cylinders not meeting the required strengths, as specified in Concrete Strength Requirements, of this specification.
§718

**B. Exposed Prestressing Steel.** Any unit which exhibits one or more exposed prestressing strand(s) on a top or bottom surface.

**C. Honeycombing.** Honeycombing of the unit to such an extent that chipping away from the honeycombed concrete results in the exposure of one, or more, prestressing strands on a top, or bottom, surface.

All honeycombed areas shall be chipped until sound concrete is reached. Sound concrete is defined as that point at which chipping causes fracture of the aggregates. If chipping of the honeycombed portion results in a hole more than one-half the thickness of the unit, the unit will be rejected.

**D. Cracks.** Any unit which exhibits a crack that is greater than 13 mm in depth, and 64 µm in width.

**REPAIR.** Repair, if allowed by the DCES, shall be made with §721-05 Epoxy Repair Paste. Epoxy repair paste shall be mixed and placed in strict accordance with the manufacturer's instructions.

**Form Supports** Form supports for installation of the units shall be supplied as part of this work. They shall conform to the latest specification for ASTM A446, Grades A through E. Fabrication shall be in conformance with ASTM A653/A653M, Coating Class G165.

The Contractor shall supply the Engineer with certification that the form supports meet the foregoing requirements.

**TOLERANCES.** All units shall be checked for compliance with the tolerances listed below, after the units have completed the final curing phase and within three (3) days prior to shipping. The Inspector shall document to the DCES any unit with dimensions out of tolerance. Any unit which fails to meet these tolerances shall be rejected with the concurrence of the DCES.

<table>
<thead>
<tr>
<th>Finished Dimensions</th>
<th>Position of Strands</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Width ± 6 mm</td>
<td>Vertical ± 6 mm</td>
</tr>
<tr>
<td>Length ± 13 mm</td>
<td>Horizontal ± 13 mm</td>
</tr>
<tr>
<td>Depth ± 6 mm</td>
<td></td>
</tr>
</tbody>
</table>

*Width is defined as the dimension measured parallel to the prestressing strands.

**718-06 HIGH PERFORMANCE CONCRETE FOR PRECAST AND PRESTRESSED BRIDGE BEAMS**

**SCOPE.** This specification covers the material requirements for high performance concrete for precast and prestressed bridge beams.

**MATERIAL REQUIREMENTS.** The concrete shall meet the requirements of the approved Mix Design Sheet, described below, and the PCCM. The concrete mix shall contain a minimum of 5% microsilica measured as a percent of the total cementitious material.

**MIX DESIGN SHEETS (MDS).** These sheets shall contain all the information on the mix design, materials, material sources, production facilities, quality control, curing, and preproduction testing of the mix. Once approved for production, the MDS may be used in any contract requiring high performance concrete for precast and prestressed bridge beams.

The MDS will have a two-step approval process. The first submittal shall contain all the information required in A. through N. Complete submittals that meet the specification requirements will be examined according to Section 2.5 of the PCCM and, if found acceptable, it will be returned with the notation “APPROVED FOR TESTING.” Section 2.5.7 of the PCCM does not apply.

Following required testing of the mix, the MDS shall be submitted to the DCES with the information in O. through Q. added to the sheet. If the test results meet the requirements of this specification, the MDS will be returned with the notation “APPROVED.” After approval for production, no changes in materials sources, production, curing, or mix design shall be made, except those changes necessitated by a change in the fineness modulus of the aggregate.

906

NEW YORK STATE DEPARTMENT OF TRANSPORTATION
STANDARD SPECIFICATIONS of May 4, 2006
If changes are required after the approval of the MDS, a revised MDS with all the required changes shall be submitted to the DCES. After examining the revised MDS, the DCES will determine if repetition of any testing is required for the approval of the revised MDS. If it is determined that some or all tests shall be repeated, the revised MDS will be returned marked up, specifying the required tests to be repeated and stamped “APPROVED FOR TESTING.” Remaining portions of the approval process will exactly follow the procedure used for the initial approval of the MDS except that the tests to be performed will be limited to the tests to be repeated marked up by the DCES.

If it is determined that there is no need for repeating the preproduction testing and if the proposed changes are acceptable to the DCES, the revised MDS will be approved and returned.

**Information Required on MDS.** The MDS shall include the following information:

A. The source and type of cement.
B. The specific source of the coarse aggregate.
C. The specific source of the fine aggregate and the fineness modulus of the material proposed for use in the preproduction testing.
D. The brand and type of all admixtures that will be used.
E. The complete mix design including all ingredient and quantities proposed for the production concrete.
F. The maximum water-to-total-cementitious-material ratio that is proposed for production.
G. Description of the concrete batching and mixing facilities, including the date of last annual inspection and date of last scale calibration check.
H. Description of the concrete transport equipment.
I. The method of concrete placement.
J. Outline of the curing procedure to be used for the production units and test samples.
K. Quality control tests and procedures that the fabricator will perform.
L. Detailed description of the preproduction testing procedure to establish that concrete made from the proposed mix design meets the required performance criteria.
M. The name and address of the testing laboratory(s) conducting the tests.
N. A fabricator selected identifier for the mix.
O. Test results for the preproduction test mix.
P. Actual fineness modulus of the fine aggregate used in the preproduction test mix.
Q. Graph of compressive strength versus age.

**TESTING.** The concrete mix design shall be tested prior to making any bridge beams and shall meet the following performance criteria.

**TABLE 718-06-1 TESTING REQUIREMENTS FOR HP CONCRETE**

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>TEST METHOD</th>
<th>ACCEPTANCE CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressive Strength (at 56 days)</td>
<td>AASHTO T22</td>
<td>&gt; 70MPa (all tests)</td>
</tr>
<tr>
<td>Freeze/Thaw Durability (x=relative dynamic modulus of elasticity after 300 cycles)</td>
<td>AASHTO T161 Procedure A</td>
<td>x (\geq 80%)</td>
</tr>
<tr>
<td>Scaling Resistance (y= visual rating of surface after 50 cycles)</td>
<td>ASTM C672</td>
<td>y (\leq 3)</td>
</tr>
<tr>
<td>Elasticity ((E = ) modulus of elasticity)</td>
<td>ASTM C469 (Note C)</td>
<td>(E \geq 30\text{GPa})</td>
</tr>
<tr>
<td>Shrinkage ((s = ) microstrain)</td>
<td>AASHTO T160-97 (at 56 days)</td>
<td>(s &lt; 600)</td>
</tr>
<tr>
<td>Creep ((c = ) microstrain/pressure unit)</td>
<td>ASTM C512 (at 56 days, 40% (f_c'))</td>
<td>(c \leq 60/\text{MPa})</td>
</tr>
<tr>
<td>Chloride Penetration ((p = ) increase in percent of chloride ion by weight of concrete)</td>
<td>AASHTO T259 modified (Note A)</td>
<td>(p \leq 0.025%) at 25 mm</td>
</tr>
<tr>
<td>Air Content</td>
<td>AASHTO T 152</td>
<td>(A = %) selected by contractor, (A \geq 3%)</td>
</tr>
<tr>
<td>Water/Cementitious-Materials ratio ((W = ) mass ratio)</td>
<td>AASHTO TP23-93 (Note B)</td>
<td>Supplier selects (W), (W &lt; 0.40)</td>
</tr>
</tbody>
</table>

Note A: The test specimens are to be cured under the same conditions and for the same time as proposed for production. They shall then be stored for 28 days in the drying room specified by the AASHTO T259.
§718

Note B: The AASHTO TP23 test shall be corrected for the absorbed water in the aggregate. This correction shall be made using the mass percentage of absorption shown under “ABS” in the Approved List of Sources of Fine and Coarse Aggregates (or as determined by AASHTO T-84 for fine aggregates and AASHTO T-85 for coarse aggregate) by an A.A.S.H.T.O. accredited testing laboratory.

Note C: Test two samples. Each sample is to be loaded at 40% of the load required to break a companion sample cast from the same mix at the same time as the test sample. Sample 1 is to be loaded when the strength of a companion sample achieves a strength of 49 MPa ± 3 MPa. Sample 2 is to be loaded when the strength of a companion sample achieves a strength of 70 MPa ± 5 MPa.

PREPRODUCTION TESTING

The Contractor shall engage an A.A.S.H.T.O. Accredited testing laboratory for testing of all preproduction concrete specimens except compressive strength, air content, and water/cementitious-materials ratio. These tests shall be performed in the presence of the Quality Assurance (QA) Inspector. The DCES may approve laboratories with equivalent certification from another organization. The testing laboratory shall send a copy of the test results directly to the DCES.

The Contractor shall notify the Department at least three work days prior to casting preproduction test specimens. No test specimens shall be cast unless the QA Inspector is present to witness the mixing, casting, and curing of the specimens. The test specimens shall be prepared of concrete made using materials from sources shown on the “Approved For Testing” MDS.

The water-to-total-cementitious-materials ratio for concrete mix for purposes of preparing specimens for chloride penetration testing shall be 0.03 higher than the maximum water-to-total-cementitious-materials ratio that is proposed for production. In addition to those specimens needed for AASHTO T259 testing, the fabricator shall cast eighteen 100 mm x 200 mm cylinders from the chloride penetration test mix, cure the cylinders in accordance with the approved production curing procedures for long-term independent testing and research. These cylinders shall be delivered to the testing laboratory designated by the DCES.

The test mix for all other tests shall be the water-to-total-cementitious-materials ratio that is proposed for production within a tolerance of 0.01. Include the total aggregate moisture, as determined according to AASHTO T 255, in the calculation of the water-to-total-cementitious-materials ratio with appropriate adjustments. (See Note B in Material Requirements.)

Using the test mix, cast and test compressive strength cylinders at 18 hours, 3 days, 7 days, 28 days, and 56 days. Present the test results in a graph.

Acceptance of Test Specimens. All test specimens shall be prepared in accordance with an “Approved for Testing” MDS. The preparation, casting, and curing of the test specimens shall be done in the presence of the QA Inspector. The QA Inspector shall indicate the procedures on the MDS were followed by affixing the inspection agency stamp on the samples prior to shipping to the Independent Testing Laboratories.

FABRICATION. The requirements of the PCCM shall apply with the following modifications:

1. Submitted Shop Drawings shall include approved Mix Design Sheets.
2. The required 56-day strength is 70 MPa, unless shown otherwise in the Contract Documents.
3. The required minimum strength for imparting prestressing force into the concrete is 49 MPa unless shown otherwise in the Contract Documents.
4. The fineness modulus of the fine aggregate shall not vary more than 0.2 from the actual fineness modulus used in the preproduction test mix.
5. Water/Cementitious-materials ratio shall be measured by the Fabricator for the first batch of concrete in a day’s placement and monitored by slump tests throughout production. If the QA Inspector has reason to believe the water/cementitious-materials ratio is changing, or if the slump increases by more than the allowed increase in the table below, additional water/cementitious-materials ratio tests may be ordered.

<table>
<thead>
<tr>
<th>Slump of First Batch</th>
<th>Allowed Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 100 mm</td>
<td>25 mm</td>
</tr>
<tr>
<td>100 mm or more</td>
<td>37 mm</td>
</tr>
</tbody>
</table>

6. Batch tickets shall be provided to the Inspector to verify the concrete mix contents.
BASIS OF ACCEPTANCE. Units will be considered for acceptance at the manufacturing location in accordance with the PCCM.

718-07 THRU 718-29 (VACANT)

SECTION 719 - METAL COATINGS

719-01 GALVANIZED COATINGS AND REPAIR METHODS

SCOPE. These specifications cover the galvanized coatings applied to various materials and the repair thereto.

MATERIAL REQUIREMENTS. Materials shall be galvanized in accordance with the specification indicated by Type on the plans or in the specifications.

Type I. ASTM A123 Zinc (Hot-Dip Galvanized) Coating on Iron and Steel Products.

Type II. ASTM A153, Zinc Coating (Hot Dip) on Iron and Steel Hardware. As an alternate to the hot dip method of ASTM A153, nuts, bolts, washers and other miscellaneous hardware, approved by the Engineer, may be mechanically galvanized. The mechanically zinc-coated product(s) shall conform to the applicable coating thickness, adherence and quality requirements of ASTM A153. Mechanically zinc-coated nuts for assembly with mechanically zinc-coated bolts shall be tapped oversize prior to coating and need not be re-tapped afterwards.

Type III. ASTM A123 Zinc (Hot-Dip Galvanized) Coating on Iron and Steel Products, except as modified herein. A minimum weight of coating (g/m² of surface) for base metal less than 1.6 mm thickness shall be as follows:

<table>
<thead>
<tr>
<th>Average of Specimen</th>
<th>Any Individual Specimen or Computed Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>460</td>
<td>380</td>
</tr>
</tbody>
</table>

Type IV. ASTM A653/A653M, Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process, Coating Designation G 210 unless otherwise specified.

Type V. Flame Sprayed Coating System.

A. Preparation of Base. Those areas to be coated shall be sand blasted with silica sand or crushed garnet of such gradation that sand shall be mesh size 20 to 40 with a minimum of 40% retained on a 600 µm mesh screen (U.S. Standard Sieve series). Pressure of not less than 520 kPa shall be maintained at the blast generator. A sample steel plate shall be blasted until the surface cannot be further cleaned or roughened. This plate shall be used for visual comparison and any areas that do not meet this standard as to roughness or cleanliness shall be reblasted.

B. Zinc Application. The wire used in spraying shall be 15 ga., 3.2 mm or 4.8 mm diameter, zinc 99.0% purity. Air pressure at the Air Control Unit shall be 410 kPa and there shall be no more than 11 m of 9.5 mm I.D. hose between the Air Control Unit and the gun.

The metal coating shall be applied at a minimum thickness of 0.076 mm. At least one coating shall be applied within 4 hours of blasting and the surface must be completely coated within 8 hours of blasting. The specified thickness of coating shall be applied in multiple layers and in no case shall less than two passes be made over every part of the surface.

C. Finish Coat. The zinc coating shall be given a finish coating consisting of two coats of Aluminum Vinyl sealer. This sealer shall consist of a volatile vehicle containing a minimum of 20% Vinyl Copolymer and plasticizer and a minimum of 10% Non-Leafing Aluminum Flake.
REPAIR. The Contractor shall be required to repair damaged areas of galvanized zinc coating. Damage may result from wet storage (white rust), welding or cutting (flame), or from excessive rough handling during shipping or erection. In general, only field repairs will be allowed. Shop repairs shall only be permitted when the total area of damage on any single piece is less than 2% of the coated surface or 10,000 mm², whichever is less. Any coated piece on which the total area of damage exceeds these amounts in the shop shall be rejected.

Materials for field repair shall be selected from Department’s Approved List of Galvanized Repair Materials. Zinc solders shall be zinc-cadmium and zinc-tin-lead alloys supplied in stick or paste form, and that liquidize for application at temperature ranges of from 270 to 275°C and 230 to 260°C, respectively. Zinc paints shall contain not less than 65% zinc dust (by weight) in the dried paint film and shall meet current standards for the emission of volatile organic compounds. Detailed requirements for the approval of galvanized repair materials are available from the Materials Bureau.

Corrosion deposits shall be removed in a manner satisfactory to the Department prior to incorporation of the material in the work. After removal of these deposits, the coating shall have a uniform appearance free from uncoated spots, lumps, blisters, gritty areas, acid, flux and black spots. Materials with these defects will be rejected and shall be immediately removed from the worksite. Acceptable material shall be provided to replace rejected material at no additional expense to the State.

Damaged areas of loose and deteriorated galvanized zinc coating shall be cleaned by power sanding, power grinding, or abrasive blast cleaning to bright metal.

If zinc solder is used for repairs the cleaned area shall be preheated in accordance with the manufacturers instructions for use. The heated surface shall then be rubbed with a repair stick to evenly distribute a layer of zinc alloy, or if zinc paste is used it shall be spread evenly using a spatula or similar tool. Zinc solder shall be deposited in a uniform layer at a minimum dry film thickness of 75 µm.

If zinc paint is used for repairs it shall be applied in accordance with the manufacturers instructions for use, using a brush or by spray methods. Zinc paint shall be applied in such quantity as to produce a minimum dry film thickness of 75 µm.

BASIS OF ACCEPTANCE. The acceptance of galvanized coating and repairs is included in the acceptance of the materials receiving the coating.

719-02 ALUMINUM ANODIC COATINGS

SCOPE. This specification covers the material requirements for Anodic Coatings for Aluminum and Aluminum Alloys.

<table>
<thead>
<tr>
<th>TABLE 719-02-1 MINIMUM COATING THICKNESS AND WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coating Designation</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Type 202</td>
</tr>
<tr>
<td>Type 302</td>
</tr>
<tr>
<td>Type 204</td>
</tr>
<tr>
<td>Type 205</td>
</tr>
<tr>
<td>Type 210</td>
</tr>
<tr>
<td>Type 215</td>
</tr>
<tr>
<td>Type 226</td>
</tr>
</tbody>
</table>

MATERIAL REQUIREMENTS. Anodic coatings for Aluminum and its alloys shall conform to the requirements of Table 719-02-1 for the coating designation shown on the plans or in the proposal:
719-03 ALUMINUM COATING (HOT DIP)

**SCOPE.** This specification covers the material requirements for hot dip aluminum coatings applied to steel appurtenances in contact with aluminum surfaces, or where applied as shown on the contract plans.

**MATERIAL REQUIREMENTS.** The material used shall be 99 percent pure aluminum conforming to the specifications for Aluminum Alloy Number 1100 according to ANSI H 35.1.

Thickness of the coating shall not be less than 51 µm on any individual specimen and the average of the specimens tested shall not be less than 58 µm. The thickness of coating may be determined by the use of a Magna-Gage.

The aluminum coating on threads, except on topped threads, shall not be subjected to a cutting, rolling, or finishing tool operation, unless specifically authorized by the Engineer.

The coating shall be continuous and uniform in thickness. The coating shall adhere tenaciously to the surface of the base metal. When the coating is cut or pried into, such as with a stout knife applied with considerable pressure in a manner tending to remove a portion of the coating, it shall only be possible to remove small particles of the coating by paring or whittling, and it shall not be possible to peel any portion of the coating so as to expose the steel.

The aluminum coated articles shall be free from uncoated spots and other defects not consistent with good aluminum coating practice.

**SECTION 720 - PILES**

720-01 UNTREATED TIMBER PILES

**SCOPE.** This specification covers the material requirements for untreated timber piles.

**GENERAL.** Timber piling shall consist of any species of wood that will withstand driving, except white or gray birch, poplar or basswood.

Piles shall be clean-peeled and shall conform to the requirements of ASTM D25.

**BASIS OF ACCEPTANCE.** The inspector's indelible stamp of approval shall constitute sufficient basis of acceptance at the job site.

720-02 TREATED TIMBER PILES

**SCOPE.** This specification covers the material requirements for treated timber piles.

**GENERAL.** The requirements for treated timber piles shall conform to the applicable provisions of §720-01 Untreated Timber Piles with the following additions and modifications:

Piles shall be Southern Yellow Pine or Douglas Fir containing a minimum thickness of sapwood of not less than 40 mm in Southern Yellow Pine and not less than 25 mm of Douglas Fir at the butt ends.

Piles shall be peeled clean of bark, including the inner bark, soon after cutting, so that the piles are smooth and clean. Care shall be taken to remove as little sapwood as possible in the bark peeling operation.

The preservative used in the treatment of piles shall conform to the requirements of §708-30, Wood Preservative Creosote Oil, American Wood Preservers' Association Standard P-1 for land and fresh water use; P-13 for Marine (Coastal Waters) or §708-31 Wood Preservative-Water Borne.

**Conditioning and treatment.** The conditioning before treatment and the preservative treatment shall conform to the requirements of American Wood Preservers' Association Standards C-1, C-3, C-12, C-14, or C-18.

**Inspection of piles.** The Contractor shall give the Department ample notice relative to the location of, and time when treating operations will take place. Inspection of piles will be made by inspectors designated by the Department, before, during and after the piles are treated at the treatment plant. No piles shall be shipped which do not bear, in legible form, the inspector's stamp of approval.
§720

The piles shall be subject to inspection by the Engineer after arrival at the site and no previous approval at the plant shall bar rejection in the field for injury, breakage, or defects discovered after the piles have left the treatment plant.

Piles shall be free from damage or defects which would impair their usefulness or durability for the purpose intended. The use of “S” irons or other devices for repairing or preventing checks, splits, or other defects will not be permitted.

STORAGE AND HANDLING. All treated timber piles shall be carefully handled and properly stored. Any surface breaks which do not warrant the rejection of the pile shall be treated in accordance with AWPA M4 with the addition that at least three coats of preservative shall be applied.

Treatment of Pile Heads and Bolt Holes. The heads of piles shall be treated as follows: The sawed surface shall be treated in accordance with AWPA M4 with the addition that at least three coats of preservative shall be applied followed by a thick application of a mixture of 30% creosote and 70% pitch. The application of the pitch coat shall not apply to pile heads encased in concrete. All bolt holes bored subsequent to treatment shall be treated with preservative by means of an approved pressure bolt hole treater.

Any unfilled holes, after being treated with preservative shall be plugged with preservative treated plugs.

The Contractor shall obtain all necessary permits pertaining to the purchase and field application of wood preservatives from the U.S. Environmental Protection Agency (EPA) and the New York State Department of Environmental Conservation.

BASIS OF ACCEPTANCE. The Inspector's indelible stamp of approval shall constitute basis of acceptance at the job site.

720-03 CASINGS FOR CAST-IN-PLACE CONCRETE PILES

SCOPE. This specification covers the material requirements for casings used for cast-in-place concrete piles.

GENERAL. When the diameter and thickness of pipes are shown on the plans, the material used shall conform to the requirements of ASTM A252, Grade 2, unless otherwise specified. The Contractor will be required to furnish the Engineer with two certified copies of the records of the physical tests performed on the newly manufactured pipe in accordance with the above ASTM requirements. In addition, a manufacturer's statement of certification, which explicitly verifies that the material and workmanship comply with the current ASTM standards for ASTM A252, Grade 2, must accompany each heat.

Thickness Requirements. The metal of shells which are directly driven shall have a thickness sufficient to withstand the driving without fracture or failure, but in no case shall the thickness be less than 2.67 mm. Shells driven with a mandrel shall have a thickness not less than 1.37 mm.

Pipes shall have a thickness sufficient to withstand driving without fracture or failure but in no case shall the thickness of pipes be less than 4.76 mm unless otherwise shown on the plans.

BASIS OF ACCEPTANCE. The manufacturer's certification shall constitute sufficient basis of acceptance at the job site.

720-04 STEEL BEARING PILES

SCOPE. This specification covers the material requirements for steel bearing piles.

GENERAL. All steel bearing piles shall be rolled HP sections of standard dimensions. Steel for bearing piles shall be new and unused and shall conform to the requirements of §715-01, Structural Steel. Stock steel may be used.
§720

BASIS OF ACCEPTANCE. Material acceptance will be by manufacturer's certification. The certifying statement must accompany each heat and must verify that the material and workmanship comply with the current ASTM standards for ASTM A36. Two copies shall be furnished to the Engineer.

720-05 PILE SHOES

SCOPE. This specification covers the material requirements for pile shoes.

GENERAL. The pile shoes shall consist of ASTM A36 steel or equivalent material capable of withstanding driving without excessive deformation.

BASIS OF ACCEPTANCE. Approval by the DCES shall constitute acceptance.

720-06 MECHANICAL PILE SPLICES

SCOPE. This specification covers the requirements for mechanical splices for steel bearing piles.

GENERAL. Steel used in the mechanical pile splices shall meet the requirements of §715-01.

BASIS OF ACCEPTANCE. The product will be accepted at the job site based on its appearance on the Approved List. The Contractor shall provide the Engineer with an installation drawing approved by the DCES showing the sizes and types of welds that are required. In addition, the Contractor shall provide manufacturer certification that the supplied product has the same chemical composition and mechanical properties as the product used in the testing.

At the Department’s discretion, the material will be evaluated for conformance to the stated specifications, and product samples may be required to be submitted for testing.

Manufacturers may submit their product for evaluation to the DCES. The submission shall include copies of installation drawings, specifications, welding procedures meeting the requirements of the Steel Construction Manual, engineering calculations, test results, and quality control procedures for the splice manufacture.

Stamped engineering calculations, performed by a New York State Licensed Professional Engineer with current registration, shall show that the spliced pile has a theoretical bending capacity of at least 95% of the unspliced pile.

Test results by an independent testing agency shall show that the bending strength on both the strong and weak axes of the spliced pile is at least as great as the calculated capacity of the splice. The tests shall be third point loadings of a spliced pile with the splice in the middle of the span. The tests shall be continued to failure. A minimum of two pile sizes shall be tested in each direction to prove the engineering calculations.

If the submission is acceptable, the installation drawings will be stamped approved, returned to the manufacturer and the product will be placed on the Approved List. Any changes to the product, product manufacturing, or installation procedure will require re-submission and re-approval.

SECTION 721 - CONCRETE ADHESIVES AND REPAIR MATERIALS

721-01 EPOXY RESIN SYSTEM

SCOPE. This specification covers the material requirements of a two-component, rapid setting, high strength epoxy resin system for use as an adhesive and for making epoxy mortar for the repair of minor damaged areas of hardened concrete. This material should not be used when the temperature is below 5°C or when there is moisture present in any of the materials or surfaces it will be in contact with while in the uncured state.
MATERIAL REQUIREMENTS

Component A. Component A shall consist of a blend of epoxy resin, plasticizer and fillers so that when mixed with component B the mix will have the characteristics described under “Characteristics of the Mixture”.

Component B. Component B shall consist of an amine adduct curing agent capable of curing the epoxy system from 5°C and above when mixed according to the manufacturer's recommendations.

<table>
<thead>
<tr>
<th>TABLE 721-01-1 EPOXY RESIN MIXTURE REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property</td>
</tr>
<tr>
<td>Pot life for 0.5 liter unit, minutes</td>
</tr>
<tr>
<td>Viscosity, PaCs @ 23±2°C</td>
</tr>
</tbody>
</table>

Characteristics of the Mixture. Mixture shall meet the requirements of Table 721-01-1.

Cured Materials. Mixed with three (3) parts by volume of Ottawa silica sand conforming to the requirements for graded standard sand in ASTM C778, the resulting mortar shall have the following characteristics after being cured at 23°±2°C for 24 hours:

<table>
<thead>
<tr>
<th>TABLE 721-01-2 COMPRESSIONS AND TENSILE STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property</td>
</tr>
<tr>
<td>Compressive Strength, MPa</td>
</tr>
<tr>
<td>Tensile Splitting Strength, MPa</td>
</tr>
</tbody>
</table>

PACKAGING. All material furnished must be shipped in strong, substantial containers. The containers shall be identified as “Part A - contains epoxy resin” and “Part B - contains curing agent” and shall be plainly marked with the following information:
- N.Y.S.D.O.T. materials specification number
- Name of product
- Mixing proportions and instructions
- Name and address of the manufacturer
- Lot number and batch number
- Date of manufacture
- Quantity
- Date of expiration of acceptance

SAMPLING. Material shall be sampled and inspected at the place of manufacture or in warehouse lots as determined by the Department. Samples submitted to the Materials Bureau shall be taken as directed by the Department.

TESTING

Pot Life. The pot life shall be determined as follows: The mixed components shall be set on a bench top and probed with a small flat stick every two (2) minutes. The time at which a soft ball forms in the center of the container is the pot life.

Initial Viscosity. Components A and B shall be conditioned at 23°±2°C prior to mixing and the reading taken two (2) minutes after mixing. The viscosity shall be measured with a Brookfield Model RVT viscometer, spindle No. 3 at 20 RPM.
BASIS OF ACCEPTANCE. This material will be considered for acceptance in stock lot quantities at manufacture or supply locations in accordance with procedural directives of the Materials Bureau. The expiration date of acceptance of this material shall be one year after the date of manufacture. Any unauthorized tampering or breaking of the seals on the containers between the time of sampling and delivery to the job site will be cause for rejection of the material.

721-02 (VACANT)

721-03 EPOXY POLYSULFIDE GROUT

SCOPE. This specification covers the material requirements of a two-component, flexible, polysulfide modified epoxy grout containing an inert mineral filler. This material is used for bonding fresh concrete to hardened concrete in both vertical and horizontal planes; grouting studs, etc. into hardened concrete; and making epoxy mortar for the repair of minor damaged areas on hardened concrete. This material should not be used when the temperature is below 10°C.

GENERAL. The two-component epoxy system shall have a maximum ratio of epoxy resin to polysulfide polymer of 2:1 by weight (Min. 1 3/4:1). In addition, the ratio of epoxy resin to curing agent shall be 11:1 by weight (Max. 12:1, Min. 10:1). The fine inert mineral filler when incorporated into the carrying component(s) shall be nonsettling.

MATERIAL REQUIREMENTS

Component A. This component shall consist of an unmodified epoxy resin and may contain a portion of fine inert mineral filler. It shall not contain solvents or reactive diluents. The epoxy resin shall be the condensation product of the reaction of bisphenol A with epichlorohydrin, shall be translucent, and shall have the following physical characteristics:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color, Hellige</td>
<td>ASTM D1544</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Epoxide equivalent</td>
<td>ASTM D1652</td>
<td>180</td>
<td>200</td>
</tr>
</tbody>
</table>

Component B. This material shall consist of a blend of a low viscosity polysulfide polymer and a tertiary amine catalyst. The “B” component shall include a fine inert mineral filler. The component shall not contain solvents or diluents. When mixed with Component “A” as directed by the manufacturer, the resulting characteristics shall be as specified in “Characteristics of the Mixture.”

The polysulfide polymer flexibilizer shall be a dichloroethyl formal polysulfide in the 1000-molecular weight range having the following characteristics:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color, Hellige</td>
<td>ASTM D1544</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>Sulphur Content, percent</td>
<td>ASTM D129</td>
<td>36</td>
<td>40</td>
</tr>
<tr>
<td>Shelf Life</td>
<td>---</td>
<td>1 year</td>
<td>---</td>
</tr>
</tbody>
</table>

Characteristics of the Mixture. When the two components are mixed in accordance with the manufacturer's instructions, the mixture shall have the physical characteristics in Table 721-03-3.
### TABLE 721-03-3 MIXTURE REQUIREMENTS

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pot Life at 25°C, minutes</td>
<td>See TESTING</td>
<td>30</td>
<td>---</td>
</tr>
<tr>
<td>Initial Viscosity at 25°C, PaCs</td>
<td>See TESTING</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>Spray applications</td>
<td></td>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td>Other applications</td>
<td></td>
<td>2</td>
<td>---</td>
</tr>
<tr>
<td>Tack free time at 25°C, hrs</td>
<td>---</td>
<td>2</td>
<td>---</td>
</tr>
<tr>
<td>Degree of temporary gelation, mm</td>
<td>See TESTING</td>
<td>3.5</td>
<td>---</td>
</tr>
<tr>
<td>Ash content, percent</td>
<td>ASTM D482</td>
<td>—</td>
<td>50</td>
</tr>
<tr>
<td>Volatiles, percent</td>
<td>ASTM D1259</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

### Properties of Cured Materials

The grout, when mixed according to the manufacturer's instructions, shall harden into a solid having the physical characteristics in Table 721-03-4.

### TABLE 721-03-4 CURED MATERIALS REQUIREMENTS

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressive Shear</td>
<td>Federal Specification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Double Strength, MPa</td>
<td>MMM-B-350 Paragraph 4.4.3</td>
<td>2.75</td>
<td>---</td>
</tr>
<tr>
<td>Beam Break Test, MPa</td>
<td>Described under &quot;Test&quot;</td>
<td>5.5</td>
<td>---</td>
</tr>
</tbody>
</table>

### PACKAGING

All material furnished must be shipped in strong substantial containers. The containers shall be identified as “Part A - contains epoxy resin” and “Part B- contains curing agent” and shall be plainly marked with the following information:
- N.Y.S.D.O.T. materials specification number
- Name of product
- Mixing proportions and instructions
- Name and address of the manufacturer
- Lot number and batch number
- Date of manufacture
- Quantity
- Date of expiration of acceptance

### SAMPLING

Material shall be sampled and inspected at the place of manufacture or in warehouse lots as determined by the Department. Samples submitted to the Materials Bureau shall be taken as directed by the Department.

### TESTING

**Pot Life.** The pot life shall be determined as follows: The two components are conditioned to 25°C and mixed in accordance with the manufacturer's instructions. The pot life of the material shall be considered to have ended when the viscosity reaches 85 Pa•s (Brookfield Model MBT with Helipath Attachment) at 25°C ambient. The time from initial mixing of the components until the mixture reaches 85 Pa•s shall be recorded as the pot life.

**Initial Viscosity.** The initial viscosity shall be measured with a Brookfield Model HBT, Spindle No. 3 at 20 RPM.

**Tack Free Time.** The epoxy mixture shall remain tacky and capable of bonding during a contact period of at least two hours at 25°C ambient measured from the time of spreading.
Degree of Temporary Gelation. The epoxy grout mixture shall have a degree of temporary gelation such that a 3.5 mm film can be maintained on the surface of a standard 50 mm x 125 mm paint panel after dripping ceases.

Compressive Shear Test. The test shall be performed in accordance with Federal Specification MMM-B-350 Paragraph 4.4.3 except that hand mixing of the epoxy will be permitted.

Beam Break Test. The specimens shall be tested for flexural strength using a simple beam with third point loading. The specimen shall be prepared and tested in accordance with ASTM Methods C192 and C78 except that the concrete shall be designed for 5.50 to 6.25 MPa flexural strength and shall be cast in 75 mm x 100 mm x 405 mm molds using a well-graded coarse aggregate all of which passes a 25 mm square sieve. Each beam to be tested shall be sawed transversely at midpoint, the sawed faces etched with a 10 percent aqueous solution of HCl and then thoroughly washed, and bonded with a 0.25 mm thickness of the epoxy adhesive under test. The surface to be bonded shall be maintained in a vertical position during application and cure of epoxy adhesive and plastic concrete. The hardened specimens shall be cured for a total time of at least 96 hours. During the last 24 hours of the curing period, they shall be immersed in water.

The result reported shall be the average of two tests. Any result below 2.75 MPa which fails outside the plane of adhesion will be disregarded and a retest performed. Any result below 5.50 MPa and above 2.75 MPa, of which 80% of the failure occurs outside the plane of adhesion, shall be considered acceptable. Any result above 5.50 MPa will be considered acceptable regardless of where the failure occurs.

BASIS OF ACCEPTANCE. This material will be considered for acceptance in stock lot quantities at manufacture or supply locations in accordance with procedural directives of the Materials Bureau. The expiration date of acceptance of this material shall be one year after the date of manufacture. Any unauthorized tampering or breaking of the seals on the containers between the time of sampling and delivery to the job site will be cause for rejection of the material.

721-04 (VACANT)

721-05 EPOXY REPAIR PASTE

SCOPE. This specification covers the material requirements of a two-component, flexible, rapid-hardening epoxy resin paste for making epoxy mortar. This material is used for the repair and sealing of cracks and other minor damaged areas in hardened concrete. It is suitable for patching on horizontal, vertical, and overhead applications. It develops high early strengths and achieves final cure in seven (7) days. This material shall not be used when the concrete or ambient temperature is below 10°C or above 40°C. It is suitable for damp, moist, and underwater applications.

MATERIAL REQUIREMENTS

Component A. Component A shall be the condensation product of the reaction of bisphenol A with epichlorohydrin. It may contain fillers but shall not contain non-reactive diluents. When mixed with Component B the mixture shall have the characteristics described under Characteristics of the Mixture.

Component B. Component B shall be the curing agent for the system and shall be capable of curing the system from 5°C and above when mixed according to the manufacturer's instructions. It shall contain no non-reactive diluents but may contain flexibilizers or fillers. Component B shall be completely reactive with Component A.

Components A and B shall each have a shelf life of one (1) year.

Characteristics of the Mixture. When Components A and B are mixed according to the manufacturer's instructions, the mixture will have a paste or gel consistency such that a 12.5 mm thick layer of the mixture will not sag or drip from an overhead surface throughout the temperature range from 10°C to 40°C. It shall also have the following characteristics:
§721

Property | Requirement
--- | ---
**Pot Life @ 25°C, minutes** | 10 min.- 60 max.

**Properties of Cured Material.** For testing purposes the Components A and B shall be mixed with ASTM C109 Ottawa Silica Sand in the ratio of 1 part sand to 1 part epoxy by volume. This paste shall also be non-sagging and non-dripping as stated under Characteristics of the Mixture. The cured material shall have the following physical properties:

![TABLE 721-05-1 CURED MATERIAL REQUIREMENTS](image)

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressive Strength, MPa</td>
<td>AASHTO T 106</td>
<td>21</td>
</tr>
<tr>
<td>Bond Test Modulus of Rupture, MPa</td>
<td>See Testing</td>
<td>5.5</td>
</tr>
<tr>
<td>Freeze-Thaw</td>
<td>See Testing</td>
<td>80% Bond Strength</td>
</tr>
</tbody>
</table>

**NOTE:** 1. 50 mm cubic samples conditioned 24 hrs.

**PACKAGING.** All materials furnished shall be shipped in strong, substantial containers. The containers shall be identified as “Part A contains epoxy resin” and “Part B contains curing agent.” It shall also be plainly marked with the following information:
- N.Y.S.D.O.T. materials specification number
- Name of product
- Mixing proportions and instructions
- Name and address of manufacturer
- Lot number and batch number
- Date of manufacturer
- Quantity
- Date of expiration of acceptance.

**TESTING**

**Pot Life.** The components will be conditioned to 25°C and mixed according to the manufacturer's instructions. A 60±0.4 g. total mass will be placed in an unwaxed paper cup and placed on a work bench. The mixture will be probed every 2 minutes with a small stick starting 8 minutes from the time of mixing. The time at which a small ball forms in the center of the container is recorded as the pot life.

**Bond Test.** The epoxy will be tested for flexural strength using a simple beam with third point loading. The concrete will be designed for 5.50 to 6.25 MPa flexural strength and will be cast in 75 mm × 100 mm × 405 mm molds using a well-graded coarse aggregate all of which passes a 25 mm square sieve. Each beam to be tested will be sawed transversely at midpoint, the sawed faces etched with a 10% aqueous solution of HCL and then thoroughly washed. A 0.25 mm thickness of the epoxy adhesive under test will be applied to both wet etched surfaces while in a vertical position and worked into the surface. One of the prism halves will be inverted and placed on the matching half and allowed to cure for 72 hours.

The result reported will be the average of two tests. Any result below 2.75 MPa which fails outside the plane of adhesion will be disregarded and a retest performed. Any result below 5.50 MPa and above 2.75 MPa, of which 80% of the failure occurs outside the plane of adhesion, will be considered acceptable. Any result above 5.5 MPa will be considered acceptable regardless of where the failure occurs.

**Freeze-Thaw.** Testing will be conducted in accordance with New York Test Method 216. In addition bond test specimens will be subjected to 25 freeze-thaw cycles before breaking in third point loading. A bond strength of 80% of the original average bond strength will be considered acceptable.

**BASIS OF ACCEPTANCE.** This material will be considered for acceptance in stock lot quantities at the manufacture or supply locations in accordance with procedural directives of the Materials Bureau.

The expiration date of acceptance of this material shall be one year after the date of manufacture. Any
unauthorized tampering or breaking of the seals on the containers between the time of sampling and delivery to the job site will be cause for rejection of the material.

721-06 THRU 721-19 (VACANT)

721-20 RAPID HARDENING POLYMER CONCRETE

SCOPE. This specification covers the material requirements of a two component, rapid hardening, methyl methacrylate based polymer concrete repair material. The material is used with a primer to repair hardened concrete.

MATERIALS REQUIREMENTS

Polymer Concrete Mortar. The polymer concrete mortar shall be a two component methyl methacrylate based system. One component shall be a premixed powder consisting of catalyst, fine fillers, and fine aggregate not to exceed 1.5 mm in size. The other component shall be a methyl methacrylate monomer liquid capable of chemically reacting with the powder component such that the mixture hardens to a completely cured condition within three (3) hours at temperatures between 2°C and 40°C inclusive.

The working life of the mixture shall be a minimum of 10 minutes and its workability shall be consistent throughout the above temperature range. The shelf life of the unopened components, stored at room temperature and in a dry atmosphere, shall be 6 months, minimum. Material older than 12 months from the date of manufacture shall not be used.

Properties of Cured Polymer Concrete. Polymer Concrete Mortar specimens, when prepared in accordance with the manufacturer's mixing instructions, shall exhibit the following properties when cured 168±2 hours at 23°C ± 3°C:

| TABLE 721-20-1 CURED POLYMER CONCRETE REQUIREMENTS |
|-----------------|-----------------|-----------------|-----------------|
| Property                  | Test Method   | Min.     | Max.     |
| Modulus of Rupture,       | ASTM C580     | 10       | ---      |
| Elastic Modulus,          | ASTM C580     | 3450     | 6900     |
| Thermal Expansion Coefficient, | ASTM C531   | (1.8 to 3.6) x 10^-5 | ---  |

The material also exhibit the following properties when tested under NYSDOT Test Method 701-13F:

A minimum one hour compressive strength of 17 MPa, a 24 hour strength of 24 MPa, and a 28 day strength of 35 MPa.

Be able to withstand 50 cycles of freeze-thaw (10% NaC1 solution) with a maximum loss of 4%.

Primer. The primer shall be a two component methyl methacrylate resin system capable of enhancing the bond between the polymer concrete and the substrate. It shall have a curing time of 20 to 60 minutes at temperatures between 20°C and 40°C inclusive.

Flammability. The polymer concrete shall not support or sustain combustion within five (5) minutes after mixing.

PACKAGING. The material delivered from the manufacturer shall be in moisture proof bags and the contents shall weigh within ±3% of the labeled bag weight. The manufacturer's name, address, date of manufacture and mixing instructions shall be printed on each bag.

BASIS OF ACCEPTANCE. Application for material approval shall be submitted to the Director of the Materials Bureau accompanied by at least a 25 kg, production run, sample of material. Upon approval, the name of the product will be placed on the Department's Approved List. Products so listed will be acceptable at the work site on the basis of the brand name labeled on the container. The Department reserves the right to sample and test the material at any time.
SECTION 722 - WATER SUPPLY

722-01 DUCTILE IRON WATER PIPE, FITTINGS AND ENCASEMENT

SCOPE. This specification covers the material and quality requirements for ductile iron water pipe, miscellaneous fittings, coatings and encasement.

GENERAL. Ductile iron water pipe, fittings and encasement shall conform to the requirements of the following:

- Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water (AWWA C104 / ANSI A21.4)
- Polyethylene Encasement for Ductile-Iron Pipe Systems (AWWA C105 / ANSI A21.5)
- Ductile Iron and Gray Iron Fittings, 3 NPS through 48 NPS for Water (AWWA C110 / ANSI A21.10)
- Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings (AWWA C111 / ANSI A21.11)
- Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges (AWWA C115 / ANSI A21.15)
- Thickness Design of Ductile-Iron Pipe (AWWA C150 / ANSI A21.50)
- Ductile-Iron Compact Fittings, 3 NPS through 24 NPS and 54 NPS through 64 NPS, for Water Service (AWWA C153 / ANSI A21.53)

BASIS OF ACCEPTANCE. Ductile iron water pipe and fittings will be accepted on the basis of the Manufacturer's certification that the material conforms to this specification. The certification for iron fittings shall list a fitting description, quantity, bare fitting weight and source, (AWWA Standard C110, C153 or Manufacturer, if fitting is not listed in either standard). The certification shall accompany the material delivered to the project site.

The Department reserves the right to sample and test this material subsequent to delivery at the project site.

722-02 STEEL WATER PIPE AND FITTINGS

SCOPE. This specification covers the material and quality requirements for steel water pipe and miscellaneous fittings.

GENERAL. Steel water pipe and fittings shall conform to the requirements of the following:

- Steel Water Pipe - 6 NPS and Larger (AWWA C200)
- Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied (AWWA C203)
- Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 NPS and Larger - Shop Applied (AWWA C205)
- Field Welding of Steel Water Pipe (AWWA C206)
- Steel Pipe Flanges for Waterworks Service - Sizes 4 NPS to 144 NPS (AWWA C207)
- Dimensions for Fabricated Steel Water Pipe Fittings (AWWA C208)
- Cold-Applied Exterior Tape Coatings for the Exterior of Special Sections, Connections and Fittings for Steel Water Pipelines (AWWA C209)
- Liquid-Epoxy Coatings for Steel Pipelines (AWWA C210)
- Fusion-Bonded Epoxy Coatings Systems for the Interior and Exterior of Steel Water Pipelines (AWWA C213)
Tape Coating Systems for the Exterior of Steel Water Pipelines  
AWWA C214
Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines  
AWWA C215
Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior  
of Fittings for Buried or Submerged Steel Water Pipelines  
AWWA C216
Cold-Applied Petroleum Tape and Petroleum Wax Tape Coatings  
for the Exterior of Special Sections, Connections and Fittings  
for Buried Steel Water Pipelines  
AWWA C217
Coating the Exterior of Aboveground Steel Water Pipelines and Fittings  
AWWA C218
Bolted, Sleeve-Type Couplings for Plain-End Pipe  
AWWA C219
Stainless-Steel Pipe, 4 NPS and Larger  
AWWA C220
Fabricated Steel Mechanical Slip-Type Expansion Joints  
AWWA C221
Polyurethane Coatings for the Interior and Exterior  
of Steel Water Pipe Fittings  
AWWA C222

**BASIS OF ACCEPTANCE.** Steel water pipe and fittings will be accepted on the basis of the  
Manufacturer's certification that the material conforms to this specification. The certification shall  
accompany the material delivered to the project site.

The Department reserves the right to sample and test this material subsequent to delivery at the project  
site.

### 722-03 CONCRETE WATER PIPE

**SCOPE.** This specification covers the material and quality requirements for concrete water pipe.

**GENERAL.** Concrete water pipe shall conform to the requirements of the following:

- Reinforced Concrete Pressure Pipe, Steel Cylinder Type  
  AWWA C300
- Prestressed Concrete Pressure Pipe, Steel Cylinder Type  
  AWWA C301
- Reinforced Concrete Pressure Pipe, Noncylinder Type  
  AWWA C302
- Concrete Pressure Pipe, Bar-Wrapped, Steel Cylinder Type  
  AWWA C303

**BASIS OF ACCEPTANCE.** Concrete water pipe will be accepted on the basis of the Manufacturer's  
certification that the material conforms to this specification. The certification shall accompany the  
material delivered to the project site.

The Department reserves the right to sample and test this material subsequent to delivery at the project  
site.

### 722-04 WATER VALVES AND HYDRANTS

**SCOPE.** This specification covers the material and quality requirements for water valves and hydrants.

**GENERAL.** Water valves and hydrants shall conform to the requirements of the following:

- Metal-Seated Gate Valves for Water Supply Service  
  AWWA C500
- Cast-Iron Sluice Gates  
  AWWA C501
- Dry Barrel Hydrants  
  AWWA C502
- Rubber-Seated Butterfly Valves  
  AWWA C504
- Ball Valves (6 NPS through 48 NPS)  
  AWWA C507
- Swing Check Valves for Waterworks Service (2 NPS through 24 NPS)  
  AWWA C508
- Resilient-Seated Gate Valves  
  AWWA C509
- Double-Check Valve Backflow Prevention Assembly  
  AWWA C510
- Reduced-Pressure Principle Backflow Prevention Assembly  
  AWWA C511
- Air-Release, Air/Vacuum and Combination Air Valves  
  for Waterworks Service  
  AWWA C512
- Open-Channel, Fabricated Metal Slides  
  AWWA C513
- Reduced-Wall, Resilient Seated Gate Valves for Water Supply Service  
  AWWA C515
§722

Power Actuating Devices for Valves and Sluice Gates AWWA C540
Protective Epoxy Interior Coatings for Valves and Hydrants AWWA C550

BASIS OF ACCEPTANCE. Water valves and hydrants will be accepted on the basis of the Manufacturer's certification that the material conforms to this specification. The certification shall accompany the material delivered to the project site.

The Department reserves the right to sample and test this material subsequent to delivery at the project site.

722-05 PLASTIC WATER PIPE AND FITTINGS

SCOPE. This specification covers the material and quality requirements for plastic water pipe and fittings.

GENERAL. Plastic water pipe and fittings shall conform to the requirements of the following:

Polyvinyl Chloride (PVC) Pressure Pipe 4 NPS Through 12 NPS for Water Distribution AWWA C900
Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings (14 NPS through 48 NPS) for Water Transmission and Distribution AWWA C905
Polyethylene Water Pipe and Fittings, 4 NPS through 63 NPS, for Water Distribution and Transmission AWWA C906
Polyvinyl Chloride (PVC) Pressure Fittings for Water, 4 NPS through 8 NPS AWWA C907
PVC Self-Tapping Saddle Tees for Use on PVC Pipe AWWA C908
Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 NPS through 12 NPS AWWA C909
Fiberglass Pressure Pipe AWWA C950

BASIS OF ACCEPTANCE. Plastic water pipe and fittings will be accepted on the basis of the Manufacturer's certification that the material conforms to this specification. The certification shall accompany the material delivered to the project site.

The Department reserves the right to sample and test this material subsequent to delivery at the project site.

722-06 WATER SERVICE PIPE, SERVICE VALVES AND FITTINGS

SCOPE. This specification covers the material and quality requirements for water service pipe, service valves and fittings.

GENERAL. Water service pipe, service valves and fittings shall conform to the requirements of the following:

Underground Service Line Valves and Fittings AWWA C800
Polyethylene (PE) Pressure Pipe and Tubing (½ NPS through 3 NPS) for Water Service AWWA C901
Steel Water Service Pipe (½ NPS to 4 NPS) ASTM A53
Seamless Copper Water Tube, Type K ASTM B88

BASIS OF ACCEPTANCE. Water service pipe, service valves and fittings will be accepted on the basis of the Manufacturer's certification that the material conforms to this specification. The certification shall accompany the material delivered to the project site.

The Department reserves the right to sample and test this material subsequent to delivery at the project site.
722-07 WEDGE TYPE MECHANICAL RESTRAINT GLANDS

SCOPE. This specification covers the material and quality requirements for wedge type mechanical restraint glands.

GENERAL. Wedge type mechanical restraint glands shall have a number of individually activated wedges around the circumference of a pipe which grip the pipe surface and bolts through the gland which are attached to a fitting or a gland that restrains a pipe bell. Glands shall be constructed of high strength ductile iron in accordance with ASTM Standard A536, and shall have a minimum pressure rating exceeding the system test pressure identified in the Owner requirements. Glands shall be specifically manufactured for the type of pipe used, and may be solid or split ring (two piece). Glands shall be manufactured with twist off bolts.

BASIS OF ACCEPTANCE. Wedge type mechanical restraint glands will be accepted on the basis of the Manufacturer's certification that the material conforms to this specification. The certification shall accompany the material delivered to the project site.

The Department reserves the right to sample and test this material subsequent to delivery at the project site.

722-08 INSULATION FOR WATER MAINS

SCOPE. This specification covers the material and quality requirements for insulation for water mains.

GENERAL. Insulation for water mains shall be made of fiberglass, cellular glass, urethane or cellular phenol and shall conform to the requirements of the following:

<table>
<thead>
<tr>
<th>Insulation Type</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiberglass Pipe Insulation</td>
<td>ASTM C547</td>
</tr>
<tr>
<td>Cellular Glass Insulation</td>
<td>ASTM C552</td>
</tr>
<tr>
<td>Urethane Foam Pipe Insulation</td>
<td>ASTM C591</td>
</tr>
<tr>
<td>Spray Applied Urethane Insulation</td>
<td>ASTM C1029</td>
</tr>
<tr>
<td>Rigid Cellular Phenolic Pipe Insulation</td>
<td>ASTM C1126, Type III</td>
</tr>
<tr>
<td>Waterproof Jacket for Insulation</td>
<td>ASTM C1136</td>
</tr>
</tbody>
</table>

BASIS OF ACCEPTANCE. Insulation for water mains will be accepted on the basis of the Manufacturer's certification that the material conforms to this specification. The certification shall accompany the material delivered to the project site.

The Department reserves the right to sample and test this material subsequent to delivery at the project site.

SECTION 723 - LIGHTING

723-01 ALUMINUM LIGHT STANDARDS AND ARMS

SCOPE. This specification covers the material and quality requirements for aluminum light standard shafts and aluminum bracket arms.

MATERIAL REQUIREMENTS

General. All light standards and arms shall be designed in accordance with the latest edition of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals. The ARTBA Guide to Standardized Highway Lighting Pole Hardware may be used in conjunction with the AASHTO Standard Specifications in lieu of actual design computations. Wind pressure for design purposes shall be determined in accordance with the above AASHTO Standard Specifications, utilizing the wind speeds listed below. In addition, the dimensions of all lighting hardware shall also be consistent with the requirements of the appropriate maintenance agency.
Shaft. The shaft shall be a one-piece, seamless, round tapered spun aluminum tube of alloy 6063. The aluminum shaft shall be heat treated for its full length to produce a T6 temper, and an anchor base shall be welded to the bottom of the shaft. Shafts, which are to be mounted without transformer bases, shall be equipped with a 100 mm wide by 150 mm to 200 mm high reinforced handhole centered 0.35 m to 0.45 m above the base of the shaft, and located 90 degrees from the plane of the arm and on the side away from traffic if possible. Each handhole shall have a cover with stainless steel attachment screws to secure the cover. A grounding nut shall be provided inside the shaft opposite the handhole to accommodate a 12 mm threaded bolt or stud. The shaft shall have a satin finish accomplished by mechanical rotary grinding.

An anchor base shall be joined to the shaft by means of complete circumferential welds, externally at top of anchor base and internally at bottom of shaft.

The anchor base shall be a one-piece permanent mold casting, aluminum alloy 356-T6 provided with four (4) slots to receive 25 mm diameter bolts. The casting shall be free of cracks, pits, blow holes and non-metallic inclusions. Each anchor base shall be provided with four anchor bolt covers fabricated from aluminum alloy with stainless steel screws for attaching the covers.

If bracket arm light standards are proposed, a removable ornamental cast aluminum pole cap with stainless steel setscrews to hold it in place shall be provided and installed on the top of each shaft. A 36 millimeter diameter hole shall be furnished near the top of each shaft where the arm is to be attached to provide a cable entrance from the shaft into the bracket arm. The opening shall have an approved metal or rubber grommet placed to provide a smooth cable guide for pulling the electrical cable through. The pole cap and hole are not required for davit arm light standards. Wall thickness and tube diameters for 129 km/h wind zones shall conform to Table 723-01-1 Light Standard Dimensions.

Truss Arms. The upper and lower members shall be fabricated from seamless tubing of 6063-T6 or 6061-T6 aluminum alloy. The upper member shall be the continuous or wiring member and shall have a 3 mm minimum wall thickness. Truss bracket arms shall be designed with the upper and lower members joined near the luminaire end of the arm. The arms shall be braced with one or two vertical pipe struts depending on the arm length. Each truss bracket arm shall be equipped with a 50 mm pipe size slip fitter tenon projecting 125 mm from the luminaire end. The arm shall be secured to the shaft with a bolt type or clamp type attachment similar to those shown in drawings ASA 2-1 or ASA 2-2 of the ARTBA Guide to Standardized Highway Lighting Pole Hardware. Attachments that require welding a fitting directly onto the shaft, similar to ARTBA drawing SPS 2-1, will not be allowed on aluminum light pole shafts. Bolts and nuts shall be fabricated from AISI Type 302 stainless steel according to ANSI B1.1. Washers shall be fabricated from AISI 300 series stainless steel according to the requirements of ANSI B18.21.2. In projects where arm lengths are intermixed, the rise for each length is to be set to keep the upper chord of all arms at approximately equal slopes.

<table>
<thead>
<tr>
<th>Maximum Pole Height (m)</th>
<th>Maximum Arm Lengths (m)</th>
<th>Minimum Wall Thickness (mm)</th>
<th>Minimum Diameter Bottom X Top (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>4.6</td>
<td>4</td>
<td>200 X 150</td>
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<tr>
<td>9</td>
<td>4.6</td>
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<td>200 X 150</td>
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<td>9</td>
<td>6</td>
<td>6</td>
<td>225 X 150</td>
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<tr>
<td>11</td>
<td>4.6</td>
<td>5</td>
<td>200 X 150</td>
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<tr>
<td>11</td>
<td>6</td>
<td>6</td>
<td>250 X 150</td>
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<td>13</td>
<td>4.6</td>
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<td>16</td>
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<td>4.6*</td>
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<td>13</td>
<td>4.6*</td>
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<tr>
<td>14</td>
<td>4.6*</td>
<td>8</td>
<td>250 X 150</td>
</tr>
<tr>
<td>16</td>
<td>4.6*</td>
<td>6</td>
<td>300 X 150</td>
</tr>
</tbody>
</table>

NOTE: *Twin-Arm.
**Single Bracket Arms.** 1.2 to 2.4 meters. The single member arms shall be fabricated from seamless tubing of 6063-T6 or 6061-T6 aluminum alloy. Wall thickness shall not be less than 3 mm. The arms shall be designed in accordance with AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals. Each arm shall be equipped with a 2 NPS pipe size slip fitter tenon projecting 150-200 mm from the luminaire end. The arms shall be secured to the shaft with a bolt type or clamp type attachment similar to those shown in drawings ASA 2-1 or ASA 2-2 of the ARTBA Guide to Standardized Highway Lighting Pole Hardware. Attachments that require welding a fitting directly onto the shaft, similar to ARTBA drawing SPS 2-1, will not be allowed on aluminum light pole shafts. Bolts and nuts shall be fabricated from AISI Type 302 stainless steel according to ANSI B1.1 Washers shall be fabricated from AISI 300 series stainless steel according to the requirements of ANSI B18.21.2.

**Bracket Arms for Wood Utility Poles.** Bracket arms to be mounted on wooden utility poles shall be tapered, seamless tube aluminum with a 3 mm minimum wall thickness. The bracket arm shall be welded to an appropriate connection plate at the pole end and have a 50 mm slip-fitter tenon at the luminaire end. A 32 mm cable opening on the underside near the pole shall be protected with a rubber grommet. Arms over 1.8 meters long shall be trussed, with upper and lower members securely joined by means of vertical strut(s). All aluminum shall be alloy 6063-T6 and all connecting hardware such as nuts, bolts, etc. shall be stainless steel.

**Davit Arm Poles.** For davit arm poles the top of the shaft shall terminate in a tenon (or twin tenons for double arm poles) and be equipped with a friction fit outer sleeve to produce a flush joint with the arms(s). The davit arms(s) shall be constructed of the materials and methods specified for the shaft and as dimensioned on the drawings. The davit arm(s) shall be secured to the shaft in a flush connection with two stainless steel bolts, nuts and lockwashers. The davit arms(s) shall terminate in a cast or fabricated flush tenon for a slipfit connection to the luminaire. The tenon shall be secured to the davit arm by stainless steel bolts.

**SHIPPING.** Shafts and arms shall be tire-wrapped with a heavy water resistant paper, for protection during shipping and installation. All small parts shall be boxed.

**Wind speeds.** Poles, arms and attachments covered by this specification shall be designed for the following wind speeds in accordance with the AASHTO Standard mentioned above.

- **129 km/h** - Counties of Allegany, Bronx, Cattaraugus, Chautauqua, Erie, Genesee, Kings, Livingston, Monroe, Nassau, New York, Niagara, Orleans, Ontario, Queens, Richmond, Rockland, Suffolk, Wayne, Westchester & Wyoming.

- **113 km/h** - All Other Counties.

**Welding.** All aluminum welding on light standards shall be performed in the shop, using the inert metal-arc welding process. Filler metal shall conform to the A.W.S. Specification A5-10. Welders shall be certified by A.S.M.E. Section 9 or A.W.S. D 1.2.

**Vibration Shims.** Vibration shims (dampeners) shall be provided by the pole manufacturer for all aluminum poles nine (9) meters or longer. Vibration shims shall also be provided for poles installed in excessively windy locations or on viaducts with continuous vibration.

**BASIS OF ACCEPTANCE.** Acceptance of the shaft, anchor base, truss bracket arms, and single member arms covered by this specification will be based on:

- Manufacturer's certification of compliance with these specification requirements.
- Submission, to the Engineer, of design and fabrication details for each shaft, anchor base and arm intended for a particular design load as specified in the contract documents. The design and fabrication details being submitted shall have been approved and signed by a professional engineer licensed to practice in New York State. This submission shall be sent in time to be received at least 10 working days prior to the date the Contractor orders the poles, anchor bases and arms.
723-02 HIGH MAST POLE, HEAD FRAME ASSEMBLY WITH LUMINAIRE RING AND LOWERING DEVICE

SCOPE. This specification covers the material and quality requirements for the pole and head frame assembly with luminaire ring and lowering device to be used in a high mast lighting system.

MATERIAL REQUIREMENTS

General. The steel pole, head frame assembly, luminaire ring and lowering system shall be designed to meet or exceed "AASHTO Standard Specifications, for Structural Supports for Highway Signs, Luminaires and Traffic Signals." The design wind loading shall be chosen to be consistent with the location of the structure and the height factor. See §723-01 Aluminum Light Standards and Arms. It shall be the contractor's responsibility to obtain verification of all necessary weights and effective projected areas as required in the plans.

Poles. The steel pole shall be capable of supporting the combined weight and projected area of both lowering system and number of luminaires with built-in ballast as shown on the contract plans. The pole shall consist of sections of tapered steel tubes, round or polygonal (8 or more equal sides) in cross section, which telescope into each other with an overlap of 1.5 diameters. Steel used in fabricating the shaft shall have a minimum yield strength of 345 MPa after all fabricating operations have been completed.

In the base of the pole will be located an adequate size hand hole complete with a weatherproof cover and lock. A plate shall be welded opposite the hand hole for mounting the lowering system winch (unless externally mounted on the portable power drive), circuit breakers and other hardware. The hand hole area shall have a 1.8 meter reinforcing sleeve. The hand hole and plate shall be designed to accommodate the required High Mast Head Frame and Lowering Assembly.

The finished pole shall be galvanized in accordance with §719-01 Coating and Repair Methods, Type I. If A588M weathering steel is used for the pole, all slip joints shall have a barrier coating conforming to the requirements of the Materials Bureau or as stated in the proposal.

Anchor Base. The anchor base shall be fabricated of steel meeting or exceeding the yield strength of ASTM-A-36M. The anchor base shall telescope the butt end of the pole and be welded on the inside bottom and outside top.

Anchor bolts, nuts, and washers. Anchor bolts and nuts shall be fabricated of steel meeting or exceeding ASTM A-572M (minimum yield strength 345 MPa). The top of the anchor bolts shall have a minimum of 230 mm of thread and a minimum of 300 mm of galvanizing in accordance with ASTM-A-153. Each bolt shall be furnished with two (2) heavy duty, galvanized, hex nuts with a strength equal to or exceeding the proof load of the bolts. The Contractor may wish to install pre-assembled anchor bolt cages, subject to approval by the Engineer, in lieu of the design shown on the plans.

Washers shall be plain hardened washers. Nuts, washers and a minimum of the top 300 mm of the anchor bolts shall be hot-dipped galvanized in accordance with the requirements of §719-01 Galvanized Coating and Repair Method, Type II.

The pole manufacturer shall design the anchor bolts and nuts in accordance with "AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaires and Traffic Signals."

Welding. Pole sections shall have no more than two longitudinal welded seam and no transverse seams. All welding shall be performed in accordance with the N.Y.S. Steel Construction Manual. Longitudinal welds shall have a minimum 60% penetration. All circumferential welds for slip joints and shaft to base shall be 100% penetration. All 100% welds shall be inspected ultrasonically by the State.

Reinforcing sleeve. The reinforcing sleeve shall be fabricated of steel meeting or exceeding AISI 1020 steel. The sleeve shall be galvanized under the same ASTM specification as the pole.
**Head Frame.** The head frame shall be capable of supporting the combined weight and projected areas of the luminaire ring assembly and luminaires with built in ballast as shown on the plans. The luminaire ring shall be designed to use the number and configuration of luminaires shown on the plans.

The head frame shall be equipped with a suitable weather resistant and bird proof cover.

The head frame shall be a zinc-coated steel structure attached to the pole by means of a steel slip fitter and secured by at least four (4) stainless steel set screws.

The head frame shall provide at least three point suspension for the luminaire ring assembly.

For raising and lowering the luminaire ring assembly, three 7X19 aircraft-grade stainless steel, hoisting cables, of sufficient size to support the load shall be included. Hoisting cable sheaves shall be grooved to the exact diameter of the hoisting cable for 180° bearing surface and be equipped with suitable guides to prevent jumping the sheaves. Sheave bearings shall be permanently lubricated on stainless steel shafts.

Permanently lubricated power cable sheave(s) shall be provided over a stainless steel shaft. The grooved diameter of the sheave(s) shall be coordinated with the power cable diameter and be equipped with guides to prevent jumping the sheave(s).

The power cable supplied shall be a minimum of 6 meters longer than the street lighting pole installed. It shall be a water proof cable with the necessary number of conductors and sized to properly operate the street lighting system.

Three latching devices shall be provided to support the luminaire ring assembly when in the latched position. There will be no tension on the hoisting cables when the luminaire ring is in the latched position. The latches shall be actuated from the ground. Locking of the luminaire ring shall be signalled by indicators visible from the ground. All moving parts of the latch mechanism shall be serviceable from the ground. The latching mechanism shall not be impaired by the formation of ice and shall not require adjustment. Each of the latches, independently, shall be strong enough to support eight times the weight of the luminaire ring assembly and all luminaires installed.

**Lowering System and Luminaire Assembly.** The luminaire ring assembly shall be fabricated of steel with the appropriate number of 50 mm nominal steel pipe mounting arms. It shall be zinc plated and prewired to distribute the power to the required number of luminaires. Power cables shall be positively attached to the ring assembly through a watertight wiring chamber, with watertight cable connectors. A 600 volt terminal block, completely prewired shall be included in the watertight wiring chamber. A watertight twist lock power receptacle shall be installed in the luminaire ring to allow testing of the luminaires at ground level. A cable support shall be provided to hold the power cable in the luminaire ring.

Attached to the luminaire ring assembly shall be a spring loaded roller contact guidance mechanism with a minimum of three arms that maintain positive contact with the pole surface, centering and guiding the ring assembly during lowering to prevent jamming. Rollers shall be made of water resistant non-marking material with permanently lubricated bearings on stainless steel shafts.

Winch Assembly, if permanently mounted in the pole, shall be a worm-gear self locking type (Torque rated) and designed for both hand operation or operation by means of a portable power unit. Winch Cable shall be 6 mm or greater diameter, stainless steel aircraft cable to support the load. There shall be a take-up guide on the winch assembly to eliminate cable ‘fall-off’. Compression springs shall be used in the connection of the hoisting cables to the luminaire ring assembly, but ultimate support of the luminaire ring will not be sacrificed by individual or total compression spring failure.

The lowering system shall also include circuit breaker assembly, twist-lock receptacle and plugs for the power cable.

**BASIS OF ACCEPTANCE:** Acceptance of the steel poles and appurtenances will be based on the delivery, by the Contractor to the Engineer, of the manufacturer's certification, signed by a N.Y. State P.E., of compliance with the specification requirements and the details of the poles and their appurtenances as indicated in the contract documents. As a condition of acceptance, the Contractor shall submit five copies of the shop drawings, used to fabricate the poles and appurtenances, to the Engineer along with the required certification as per §670-3.02.

When the Contractor proposes to use a shape of pole and/or appurtenances different from that indicated in the contract documents, written approval of the change in shape must be received from the Engineer prior to fabrication of the poles and/or appurtenances. Where the pole and/or appurtenances to
be used are not as indicated in the contract documents, the manufacturer shall certify, in writing, to the
Engineer, that the pole and/or appurtenances are equal to or superior to the pole and/or appurtenances
indicated in the contract documents. Additionally, the differences shall be highlighted on the shop
drawings submitted to the Structures Division for approval.

It will be the responsibility of the Contractor to ensure that the required certifications and shop
drawing copies are received by the Engineer prior to the arrival of the poles and/or appurtenances on the
site. The Engineer will require ten (10) working days, measured from the date of receipt, to approve any
request for a change in shape of poles and/or appurtenances.

723-03 PORTABLE POWER DRIVE FOR HIGH MAST LUMINAIRE LOWERING SYSTEM

SCOPE. This specification covers the functional requirements for a portable power drive unit, and
winch when necessary, issued for a High Mast Luminaire Lowering System.

MATERIAL REQUIREMENTS. The portable power drive unit shall be a heavy duty reversing electric
drill motor and drive shaft coupled with a torque limiter which shall supply all of the necessary driving
power to the winch. A portable winch assembly shall be included with the portable power drive unit
unless the winch has been permanently installed in the base of the high mast pole. The power drive shall
be provided with a step down transformer and a remote control cord which will enable the operator to
stand at least 5 meters from the pole. The unit shall be designed so as to be simply strapped to the base of
the pole with a quick-connect securing mechanism that will accommodate any size or shape pole. The
unit shall be capable of raising or lowering the lowering ring and luminaires at an approximate rate of 3
meters per minute. All aspects of the power drive shall be compatible with the detailing of the pole base
and the lowering system for which it is to be used.

Detail specifications, parts lists, instruction sheets and shop drawings of the portable power drive shall
be submitted in accordance with §670-3.02 Shop Drawings.

BASIS OF ACCEPTANCE: Acceptance of the portable power drive will be based on the
manufacturer's certificate of compliance with these specification requirements, and the Engineer's
approval of the detail specifications and shop drawings.

723-04 THRU 723-09 (VACANT)

723-10 ANCHOR BASE (ALUMINUM)

SCOPE. This specification covers the material and quality requirements for cast aluminum anchor bases
for lighting standards.

MATERIAL REQUIREMENTS. Aluminum anchor bases shall be a one piece casting of 356.0
aluminum alloy. The casting shall be free of cracks, pits, blow holes and non-metallic inclusions. Each
anchor base shall be provided with four anchor bolt covers fabricated from B443.0 aluminum alloy with
stainless steel screws for attaching the covers.

BASIS OF ACCEPTANCE. Anchor bases will be accepted upon the manufacturer's certification that
they meet the requirements of this section.

723-11 THRU 723-14 (VACANT)

723-15 BREAKAWAY TRANSFORMER BASE (ALUMINUM)

SCOPE. This specification covers the material and quality requirements for Breakaway Aluminum
Transformer Bases for Lighting Standards.

GENERAL. Transformer bases shall be one-piece aluminum alloy sand or aluminum alloy permanent-
mold castings. The bases shall be equipped with a removable, aluminum or plastic, trapezoidal shaped
door (approximately 0.33 m high; 0.18 m wide (top); 0.23 m wide (bottom). Each door shall be secured to
the base with a stainless steel screw(s).

For attachment to the shaft anchor base, each transformer base shall be supplied with four (4) loose
bearing plates or other acceptable bearing surfaces and four (4) 25 mm diameter by 95 mm long or longer
hot-dipped galvanized hexhead machine bolts.

A grounding connection, accommodating a 12 mm threaded bolt or nut shall be provided inside each
transformer base.

The light pole manufacturer shall obtain the base and bolt circle dimensions from the plans and shall
then provide the Contractor with a template print, giving complete information for setting the anchor
bolts.

Transformer bases shall be so designed as to minimize the possibility of hooking or snagging an
impacting vehicle.

MATERIAL REQUIREMENTS. Transformer bases shall be cast of Aluminum-Alloy 356.0-T6
(SG70A-T6) in conformance with ASTM B26M, Aluminum-Alloy Sand Castings or ASTM B108,
Aluminum-Alloy Permanent Mold Castings. The trapezoidal shaped door shall be fabricated from B443.0
(S5A) or 356.0-T6 (SG70A-T6) Aluminum Alloy.

Transformer bases and doors may be made of an Aluminum Alloy equivalent to 356.0-T6 (SG70A-
T6) upon approval of the Materials Bureau.

TESTS. To determine acceptable breakaway characteristics, transformer bases shall be subjected to
dynamic laboratory testing. The test shall apply to transformer bases accommodating poles of less than
317 kg in weight (including luminaire and bracket) and poles of less than 15 meter mounting height only.

A full size pole, together with luminaire or a suitable weight to simulate the luminaire, shall be
mounted on the transformer base. A ballistic pendulum, equipped with a crushable nose, as approved by
FHWA, and weighing 820 kg, shall be swung in such a manner so as to strike the transformer base at a
velocity of 35 km/h. The point of impact shall be at a height of 0.5 meters from the bottom of the
transformer base.

Transformer bases shall be considered to have acceptable breakaway features if they produce a change
in velocity of 5.0 meters per second or less. For further specific information concerning the test
equipment and procedure, contact the Materials Bureau.

BASIS OF ACCEPTANCE. The Department requires the submission of Materials Details. The
manufacturer or supplier shall prepare and submit the appropriate material in accordance with the
procedural directives of the Materials Bureau. Upon approval by the Materials Bureau, the name of the
product and/or supplier, and the reference number assigned to the approved Materials Details will be
placed on the Approved List. Such products shall then be accepted on the basis of their brand name and
conformance to the approved Materials Details.

The supplier shall provide two copies of the approved Materials Details through the Contractor to the
Engineer as part of the evidence of acceptability for the material at least 10 days prior to the use of the
product.

723-16 THRU 723-18 (VACANT)

723-19 RIGID PLASTIC CONDUIT

SCOPE. This specification covers the material requirements for rigid plastic conduits (PVC and high-
density PE) for use as raceway for wires or cables of an electrical system. Rigid plastic conduit is
acceptable for up to 75°C wiring service. Rigid PVC (polyvinyl chloride) conduit is suitable for
installation above or below ground and with or without concrete encasement; high-density PE
(polyethylene) conduit is intended for below ground installations only, and with or without concrete
encasement.

GENERAL. Under these requirements either Class 1, Heavy Wall PVC or Class 2, High Density PE
conduit may be supplied for underground installation. For above ground use, only Class 1 conduit shall be
allowed.
MATERIAL REQUIREMENTS. Rigid plastic conduit shall conform to the requirements of UL 651A. All fittings, couplings and expansion fittings shall conform to the applicable requirements of UL514A. Solvent cement for joining Class 1 conduit and conduit fittings shall meet the requirements of ASTM D2564, or alternately be of the type recommended by the conduit manufacturer. Unless otherwise recommended by the manufacturer, fittings for Class 2 conduit shall be of a drive-on type and solvent cement will not be needed for "jointing."

BASIS OF ACCEPTANCE. Rigid plastic conduit shall be accepted upon the basis of the manufacturer's certification that it meets the requirements of this specification, as well as being Underwriters Laboratory Listed. Fittings, couplings and solvent cement shall be accepted upon the manufacturer's certification that they meet the requirements of this specification.

723-20 METAL STEEL CONDUIT, ZINC COATED

SCOPE. This specification covers the material requirements for zinc coated rigid metal steel and intermediate metal steel conduits, used as raceways for wires or cable of an electrical system. Steel conduit may be embedded in concrete or earth; or may be used under all atmospheric conditions, including those locations classified as hazardous; and may be used in high voltage (over 600 volts) installations.

GENERAL. Under these requirements, either Class 1, Rigid Metal Steel Conduit or Class 2, Intermediate Metal Steel Conduit may be supplied. In addition, Class 1 and Class 2 conduits may be interchanged in the same run, providing the ends of both of the conduits are reamed, so as to create beveled edges and a smooth area over which the wires and cables will pass. Where conduit is to be jacked or exposed to the atmosphere, only Class I, Rigid Metal Steel Conduit, is permitted.

Additionally, conduit exposed to the atmosphere shall be PVC coated.

MATERIAL REQUIREMENTS. The zinc coated metal steel conduit shall conform to the requirements of UL 6, Class 1 - Rigid Metal Conduit: or UL 1242, Class 2 - Intermediate Metal Conduit.

All fittings, couplings and expansion fittings shall be zinc coated and shall meet the same specifications as the conduits. Condulets shall be gasketed and shall be furnished with stainless steel or brass screws for the cover. Expansion fittings shall be metallically connected for continuity of grounding on either side.

The zinc coating on the outside surfaces shall be equivalent to a minimum thickness of 0.02 mm.

BASIS OF ACCEPTANCE. Metal steel conduit may be accepted upon the manufacturer's certification that it meets the requirements of this section.

723-21 AND 723-22 (VACANT)

723-23 P.V.C. COATED GALVANIZED STEEL CONDUIT

SCOPE. This specification covers the material and quality requirements for P.V.C. coated galvanized steel conduit.

GENERAL. P.V.C. Coated Galvanized Steel Conduit. The hot-dipped galvanized Rigid Steel Conduit; prior to plastic coating, shall conform to N.E.M.A. Standards Publication No. RN 1, and ANSI C80.1.

Elbows in standard and special radii shall be coated as above except that no coupling will be coated with the elbow. Separate couplings will be furnished as required and ordered.

BASIS OF ACCEPTANCE. P.V.C. coated galvanized steel conduit will be accepted upon manufacturer's certification that it meets the requirements of this section.
723-24 FLEXIBLE LIQUID-TIGHT STEEL CONDUIT

SCOPE. This specification covers the material and quality requirements of flexible liquid-tight steel conduit.

GENERAL. The flexible liquid-tight steel conduit shall be of the size indicated on the plans. It shall conform to the requirements of Underwriters' Laboratory specification UL 360 and shall be listed with Underwriters' Laboratory Inc. Connectors furnished under this specification shall be standard liquid-tight connectors.

BASIS OF ACCEPTANCE. Flexible liquid-tight steel conduit will be accepted upon manufacturer's certification that it meets the requirements of this section.

723-25 AND 723-26 (VACANT)

723-27 HIGH PRESSURE SODIUM VAPOR LUMINAIREs (STANDARD MOUNT)

SCOPE. This specification covers the material and quality requirements for high pressure sodium vapor luminaires.

MATERIAL REQUIREMENTS. The luminaires shall be of the high pressure sodium vapor type designed for use with high pressure sodium vapor lamps, color corrected or clear, and fully weatherproof. The luminaires shall be constructed so they cover a complete self contained insect resistant and shock resistant unit. The entire luminaire assembly shall be completely pre-wired, at the factory, requiring only the connection of the primary circuit wires to the electric power source for its operation. All metallic component parts of the luminaire shall be made of a rust-resistant alloy or coated with an approved rust-resistant finish. Weep holes shall be provided for drainage.

Easy access to the lamp and major electrical components shall be provided requiring no special tools to gain entrance for maintenance purposes. The luminaire shall be provided with a means to prevent accidental exposure of the inner electrical components and accidental separation of the component parts.

The luminaire shall be equipped with an adjustable lamp socket to simplify beam angle setting and an appropriate refractor for the wattage and lighting distribution specified.

The luminaire casing shall be precision die-cast aluminum for the wattage of the lamps specified, and painted inside and out with a coat of baked on epoxy enamel, or polyester powder, virtually pinhole free, leaving no exposed metal. The underside of the luminaire shall be marked with the standard NEMA decal, visible from the ground, indicating the type and wattage of the lamp.

The luminaire shall contain a complete ballast assembly to which are mounted the necessary electrical components for multiple operation including ballast, solid state starting aid, capacitors, adjustable twist-lock three prong receptacle for photo-electric control when specified, and a dead back terminal board with pressure type terminals.

The ballast shall be a high power factor (exceeding 90%) 3 coil lag type (magnetic regulator) capable of operation on a 120 volt, 60 cycle, multiple circuit (unless otherwise shown on the plans) and able to operate the lamp in an open or short-circuit condition for six months without significant loss of ballast life.

The ballast assembly shall be capable of starting and operating the lamp at a temperature of minus twenty nine degrees Celsius.

The entire ballast assembly shall be readily removable as a single unit and utilize quick disconnect plugs.

The slipfitter shall be suitable for mounting on a 50 mm standard pipe bracket and capable of securely fastening flush to the mounting brackets without the need of separate mounting parts or rearrangement of mounting components. Leveling and clamping of the luminaire to the bracket shall be accomplished by the tightening of bolts and capable of adjusting the luminaire at least three degrees above and below horizontal. Bird shields shall be supplied and installed on all slipfitter installations.

The optical assembly shall consist of a die cast aluminum lens holder with a glass or aluminum 'Alzak' finished, hydroformed, gasketed reflector, a heat and impact resistant refractor, and a porcelain or
polyester enclosed mogul socket. The mogul socket shall be equipped with lamp grip and a spring type center contact.

If a photo-electric control is specified, the receptacle shall be provided with a fully weatherproof covering that is readily removable without tools.

Luminaires shall be complete with compatible high pressure sodium lamps having the following characteristics:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Mean lumens at 10 hours/start</td>
<td>90%</td>
</tr>
<tr>
<td>Warm-up time</td>
<td>3 to 4 minutes</td>
</tr>
<tr>
<td>Restart time</td>
<td>1 minute</td>
</tr>
<tr>
<td>Maximum power variance around design center</td>
<td>±5%</td>
</tr>
<tr>
<td>Lowest ambient starting temperature</td>
<td>-29 °C</td>
</tr>
</tbody>
</table>

The unit shall be supplied with an ANSI-IES vertical light distribution as specified on the plans. It shall be adjustable for a Type II, III or IV lateral light distribution and set at the factory for the distribution shown on the plans. For high mast installations a Type V distribution shall be provided. The downward light efficiency shall be at least 73%.

**BASIS OF ACCEPTANCE.** Acceptance of the roadway luminaire will be based on manufacturer's certification of compliance with these specification requirements and on inspection by the Engineer that no damage or defects are evident.

723-28 LOW PRESSURE SODIUM VAPOR LUMINAIRES (UNDERDECK MOUNT)

**SCOPE.** This specification covers the material and quality requirements for Low Pressure Sodium Vapor Underdeck Luminaires.

**MATERIAL REQUIREMENTS.** The luminaire shall be of the low pressure sodium vapor type suitable for underdeck or wall mounting, designed for use with a horizontally mounted lamp, fully weatherproof and watertight. The luminaire shall operate satisfactorily with any appropriately sized low pressure sodium lamp now commercially available.

The luminaire shall be equipped with a built-in ballast, and shall be designed for operation on a 120 volt, 60 hz. multiple circuit unless otherwise shown on the plans.

The luminaire shall provide efficient even illumination and shall be optically sealed and gasketed. It shall be mechanically strong and easy to maintain. The ballast components shall be mounted in a structurally sound manner within the housing of the luminaire, with provision made for optimum heat dissipation of the ballast. The reflector, socket, terminal board, fuse and ballast components shall be readily accessible. When closed for operation, the optical assembly shall be sealed against the entry of all contaminants.

The luminaire shall withstand severe outdoor conditions due to radical seasonal changes in temperature and shall be structurally capable of operating satisfactorily in winds of 129 km/h.

All exposed electrical live parts shall be protected to observe adequate safety precautions, subject to approval of the Engineer.

The whole luminaire assembly shall be completely prewired requiring only the connection of the primary circuit wires for its operation.

All components shall be corrosion resistant. Metals in contact with each other shall be compatible to prevent corrosion. Screws washers and nuts shall be stainless steel.

The luminaire housing shall be constructed of either heavy duty aluminum or heavy duty plastic and shall support the ballast, capacitor component, socket, lamp support, fuse, and terminal board. Those portions of the housing which support the ballast, and to which are connected the mounting hardware and the conduit, shall be aluminum. The underside of the housing shall be marked with the standard NEMA decal indicating the type and wattage of the lamp. All mounting hardware required for attaching the luminaire to the underdeck structure and for adjusting the luminaire about its longitudinal axis through an angle of 45 degrees from horizontal, shall be furnished with the luminaire when required. The luminaire shall be capable of being mounted flush against underdeck or, when required, suspended by rods from the
underdeck. The mounting hardware shall be made of stainless steel, prevent rotation of the luminaire, and be capable of adequately supporting the luminaire in winds of 129 km/h.

The reflector shall be fabricated from an aluminum alloy sheet mechanically polished and electro-chemically processed to a specular finish. It shall not darken to the extent that it cannot be wiped clean with a soft cloth.

The refractor shall be formed of clear, heat resistant, ultra-violet stabilized polycarbonate plastic, free from imperfections and capable of being removed without the use of tools.

It shall be equipped with a latching arrangement and shall be hinged to the housing of the luminaire. Provisions shall be made to prevent accidental detachment of the refractor or any other luminaire part.

The ballast shall be a modified constant wattage type with high power factor (over 90%) and capable of regulating the output power within ±5% when the input voltage fluctuates ±10%. The ballast and lamp shall be capable of starting and operating at ambient temperatures of minus 29 degrees Celsius.

The lamp socket shall be bayonet type provided with a means to hold the lamp against vibration and achieve close contact between lamp and socket terminals.

A means shall be provided to reduce entrance of foreign material through the wiring opening into the optical system.

The terminal board shall be equipped with two clamp type pressure terminals for connection to the phase leg and neutral of the primary circuit. The terminals shall be properly identified for connection, with notations on terminal board, color coding, or wiring diagram.

The fuse holder shall be gasketed and provide external access to the fuse. Photometric distribution shall be symmetric or asymmetric as specified.

BASIS OF ACCEPTANCE. Low pressure sodium vapor underdeck luminaires will be accepted upon the manufacturers certification that they meet the requirements of this section and are U.L. approved and on inspection by the Engineer that no damage or defects are evident.

723-29 HIGH PRESSURE SODIUM VAPOR LUMINAIRES (UNDERBRIDGE MOUNT)

SCOPE. This specification covers the material and quality requirements for High Pressure Sodium Vapor Luminaires (Underbridge Mount).

MATERIAL REQUIREMENTS. The luminaires shall be of the high pressure sodium vapor underbridge type designed for use with high pressure sodium vapor lamps.

The luminaires shall be constructed to be a complete self contained waterproof and shock resistant unit. The entire luminaire assembly shall be completely pre-wired, at the factory, requiring only the connection of the primary circuit wires to the electric power source for its operation. All metallic component parts of the luminaire shall be made of a rust-resistant alloy or coated with an approved rust-resistant finish.

Easy access to the lamp and major electrical components shall be provided requiring no special tools to gain entrance for maintenance purposes. The luminaire shall be provided with a means to prevent accidental exposure of the inner electrical components and accidental separation of the component parts.

The luminaire casing shall be precision die-cast aluminum for the wattage of the lamps specified, and marked with the standard NEMA decal, visible from the ground, indicating the type and wattage of the lamp.

The ballast shall be a high power factor (exceeding 90%) 3 coil lag type (magnetic regulator) capable of operation on a 120 volt, 60 cycle, multiple circuit (unless otherwise shown on the plans) and able to operate the lamp in an open or short-circuit condition for six months without significant loss of ballast life.

The ballast assembly shall be capable of starting and operating the lamp at a temperature of minus twenty nine degrees Celsius.

All mounting hardware required for attaching the luminaire to the underdeck structure and for adjusting the luminaire about its longitudinal axis shall be furnished with the luminaire. The luminaire shall be capable of being mounted flush against underdeck or suspended from the underdeck. The mounting hardware shall prevent rotation of the luminaire and be capable of adequately supporting the luminaire in winds of 129 km/h.
The optical assembly shall consist of a die cast aluminum lens holder with a glass or aluminum 'Alzak' finished, hydroformed, gasketed reflector, a heat and impact resistant refractor, and a porcelain or polyester enclosed mogul socket. The mogul socket shall be equipped with lamp grip and a spring type center contact. Luminaires shall be complete with compatible high pressure sodium lamps having the following characteristics:

<p>| | |</p>
<table>
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</tr>
<tr>
<td>Lowest ambient starting temperature</td>
<td>-29°C</td>
</tr>
<tr>
<td>Bulb finish</td>
<td>Clear</td>
</tr>
</tbody>
</table>

The unit shall be specifically designed and set to produce an ANSI-IES cutoff, type IV light distribution unless otherwise specified on the plans or ordered by the engineer. The downward light efficiency shall be at least 73%.

**BASIS OF ACCEPTANCE.** Acceptance of the underdeck luminaire will be based on manufacturer's certification of compliance with these specification requirements and on inspection by the Engineer that no damage or defects are evident.

**723-30 MERCURY VAPOR LUMINAIRES (STANDARD MOUNT)**

**SCOPE.** This specification covers the material and quality requirements for Mercury Vapor Luminaires.

**GENERAL.** The luminaire shall be of the mercury vapor type designed for use with a horizontally mounted mercury vapor lamp, color corrected or clear and shall be fully weatherproof. The luminaire and lamp combination shall produce Type II, III, or IV light distribution conforming to ASA Standards, and as shown on the plans. The luminaires shall be equipped with a built-in ballast for the wattage and operating voltage shown on the plans. The components comprising the assembly of the upper half of the luminaire shall include a reflector, a porcelain enclosed mogul socket, a twist-lock three prong receptacle for a photo-electric control, and a ballast.

**BASIS OF ACCEPTANCE.** Mercury vapor luminaires will be accepted upon the manufacturer's certification that they meet the requirements of this section.

**723-31 MERCURY VAPOR LUMINAIRES (UNDERBRIDGE MOUNT)**

**SCOPE.** This specification covers the material and quality requirements for Mercury Vapor Luminaires (Underbridge Mount).

**GENERAL.** The luminaire shall be complete for surface or pendent mounting, as shown on the plans. The luminaire shall be equipped with a prismatic refractor, be shock resistant, and protected with a cast guard. The door and guard assembly shall be equipped with stainless steel pressure latches and a safety chain. The housing shall be gasketed against which the door shall seat when closed. The luminaire shall provide a maximum candela beam of 60 degrees from the vertical for roadways up to 15 meters in width, and 70 degrees for wider roadways and approximately 180 degrees horizontal spread. The ballast shall be an integral part of the luminaire and shall be capable of operating a 175 watt or 250 watt mercury vapor lamp at minus 29°C. The lamps shall be included with the luminaire.

**BASIS OF ACCEPTANCE.** Mercury Vapor Luminaires will be accepted upon the manufacturer's certification that they meet the requirements of this section.

**723-32 THRU 723-39 (VACANT)**
723-40 CAST-IRON JUNCTION BOX

SCOPE. This specification covers the material and quality requirements for Cast-Iron Junction Boxes.

GENERAL. Junction boxes shall be hot-dipped galvanized cast-iron with a hot-dipped galvanized cast-iron cover. The cover shall be fastened to the box with brass or stainless steel screws. The box shall be so constructed that when the installation is complete and the cover is secured the box will be watertight.

Galvanizing shall be as specified in §719-01, Type II.

The Manufacturer shall refer to the plans for details and dimensions.

BASIS OF ACCEPTANCE. Junction boxes will be accepted upon the manufacturer's certification that they meet the requirements of this section.

723-41 THRU 723-44 (VACANT)

723-45 PRECAST REINFORCED CONCRETE FOUNDATIONS AND PULLBOXES

SCOPE. This specification covers the material and quality requirements for precast concrete foundations and pullboxes.

MATERIAL REQUIREMENTS. The Material Requirements contained in §704-03 shall apply.

DRAWINGS. The Drawing requirements contained in §704-03 shall apply.

FABRICATION. The Fabrication requirements contained in §704-03 shall apply.

SAMPLING AND TESTING. The Sampling and Testing requirements contained in §704-03 shall apply.

MARKING. The Marking requirements contained in §704-03 shall apply except as noted herein.

Markings shall be placed on the inside face of all pullboxes. Instead of marking the contract number on each unit they may be marked with “NYSDOT”.

FINAL PRODUCTION INSPECTION. The Final Production Inspection requirements contained in §704-03 shall apply.

SHIPPING. The Shipping requirements contained in §704-03 shall apply.

BASIS OF ACCEPTANCE. The Basis of Acceptance requirements contained in §704-03 shall apply.

723-46 THRU 723-49 (VACANT)

723-50 PHOTOELECTRIC CONTROL

SCOPE. This specification covers the material and quality requirements for Photoelectric Controls.

MATERIALS REQUIREMENTS. Photoelectric controls shall function to energize artificial lighting when natural lighting falls to a preset value, and to de-energize when natural lighting rises to a preset value. The photoelectric control shall be factory calibrated to energize the luminaire at approximately thirty (30) lux and de-energize at approximately thirty (30) lux. The photoelectric controls shall be adjustable by means of an outside adjustment system. The adjustment mechanism shall be easily accessible and provide a precise foolproof light level adjustment. Photoelectric controls which cannot be adjusted while the unit is in service or have to be disconnected while making adjustments will not be acceptable.
§723

Photoelectric controls shall be suitable for mounting in all three-pronged locking type receptacles that conform to Electrical Engineering Institute (EEI) or National Electrical Manufacturers Association (NEMA) Standard Specifications.

In the event of failure of any component of the control system, the artificial lighting shall be energized.

The housing for the photoelectric control shall be weather resistant and shall be unaffected by ultraviolet rays. A neoprene sponge gasket shall be cemented to the bottom of the base to seal out weather, dust and insects, and shall conform to EEI-NEMA Standards.

The photocell shall be hermetically sealed to prevent electrolysis from moisture. The manufacturer shall certify that each cell has had 24 hours of light preconditioning before assembly.

The photoelectric control shall be solid state and shall be capable of being faced in any direction except south. Generally, it is recommended that the photo sensitive device face north, as this affords maximum spectrum response.

The photoelectric controls shall have an operating voltage range of 105-285 volts, 50/60 cycle and shall be suitable for operation on nominal distribution voltages of 120, 208, 240, and 277 volts.

The controls shall be temperature compensated, and shall be suitable for operation from \(-40^\circ C\) to \(+71^\circ C\) and shall be completely unaffected by humidity. The switch mechanism shall be snap acting of sufficient capacity to adequately handle loads of 1000 watts of incandescent lighting, or 1800 volt-amperes of ballasted lighting. The photoelectric control shall be able to withstand an inrush current of a maximum of 170 amperes.

Time delay devices shall be built into the photoelectric control to prevent switching of artificial lighting due to transient lighting changes.

The photoelectric controls shall also be equipped with a built-in expulsion-type surge and lightning protection arrester.

**BASIS OF ACCEPTANCE.** Photoelectric controls will be accepted upon the manufacturer's certification that they meet the requirements of this section.

723-51 THRU 723-59 (VACANT)

723-60 ANCHOR BOLTS

**SCOPE.** This specification covers the material and quality requirements for anchor bolts.

**MATERIALS REQUIREMENTS.** Anchor bolts shall meet the requirements of ASTM F568 Class 8.8, or ASTM A449, or they may be manufactured from steel meeting the requirements of ASTM A576, Grades 1020 through 1050 inclusive, having a minimum yield strength of 345 MPa. A hex nut, lock washer, and flat washer shall be supplied with each anchor bolt and their dimensions shall be shown on the plans. The hex nut and flat washer shall be manufactured in accordance with ASTM A325M or A325 and the lock washer shall be manufactured in accordance with Table 730-22-1 Steel Fasteners. The nuts, washers and the top 300 mm of the anchor bolts shall be galvanized in accordance with the requirements for Type II or Type V galvanizing as stated in section 719-01, Galvanized Coatings and Repair Methods. The anchor bolt dimensions shall be shown on the plans.

**SHIPPING.** Anchor bolts, hex nuts, and washers shall be shipped to the construction site at a time convenient to the masonry construction.

**BASIS OF ACCEPTANCE.** Anchor bolts will be accepted upon the manufacturer's certification that they meet the requirements of this section.

723-61 THRU 723-69 (VACANT)

723-70 SINGLE CONDUCTOR CABLE

**SCOPE.** This specification covers the material and quality requirements for single conductor cable used in highway lighting.
MATERIAL REQUIREMENTS. Single conductor cable shall be copper, Type THW, RHW-2, or XHHW-2 (XLP) as designated by Underwriter's Laboratory Specifications. The single conductor cable shall have heat and moisture resistant insulation for a maximum operating temperature of 75°C, in wet and dry conditions.

BASIS OF ACCEPTANCE. Single conductor cable shall be accepted upon the manufacturer's certification that it meets the requirements of this specification as well as being Underwriter's Laboratory approved.

723-71 SINGLE CONDUCTOR DIRECT BURIAL CABLE

SCOPE. This specification covers the material and quality requirements for direct burial 600V type USE cable for use in conduit or in trenches as shown on the plans and as directed by the Engineer.

MATERIAL REQUIREMENTS. Cable shall bear Underwriters Laboratories Label for type USE. It shall consist of copper conductor and insulation constructed to conform to ICEA (Insulated Cable Engineers Association) Pub. S-95-658 and NEMA Pub. No. 7C-70 (Nonshielded 0-2kV Cables) or their equivalent.

Cable shall consist of 7 copper strands up to and including #2 AWG and shall be constructed of 19 copper strands for sizes larger than #2 AWG.

Insulation shall be chemically cross-linked (vulcanized) polyethylene insulating compound.

Cable shall be mechanically spliced and insulated using the highest quality poured splices available for underground 600V cables.

Cable shall be factory or shop twisted in a duplex or a triplex configuration in accordance with the publications listed above or as shown in the contract documents.

BASIS OF ACCEPTANCE. Single Conductor Direct Burial Cable will be accepted upon the manufacturer's certification that it meets the requirements of this specification as well as being Underwriter's Laboratory approved.

723-72 THRU 723-74 (VACANT)

723-75 GROUND WIRE

SCOPE. This specification covers the material and quality requirements for ground wire used in highway lighting.

MATERIAL REQUIREMENTS. Ground wire shall be #6, soft-drawn bare copper wire, 7 strand single conductor.

BASIS OF ACCEPTANCE. Ground wire shall be accepted upon the manufacturer's certification that it meets the requirements of this specification.

SECTION 724 - TRAFFIC SIGNALS

724-01 SIGNAL CABLE

SCOPE. This specification covers the material requirements for signal cable for use with traffic signal systems and for installation in underground ducts or as an aerial cable supported by a messenger.

MATERIALS REQUIREMENTS. The cable shall conform to the requirements of the International Municipal Signal Association (IMSA) Specification 20-1. The gauge and number of conductors shall be as specified in the plans. The conductors shall be stranded copper wire.
§724

BASIS OF ACCEPTANCE. Acceptance of material will be based on the manufacturer's certification of compliance with these specification requirements.

724-02 SPAN WIRE

SCOPE. This specification covers the material requirements for span wires used in the suspension of traffic signal heads. Span wires may be used as a single span wire or a dual span wire including a tether wire. The same wire may be used as messenger wires or guy wires.

MATERIALS REQUIREMENTS. Span wire shall meet the requirements of ASTM B228, Grade 30 EHS.

BASIS OF ACCEPTANCE. Acceptance of span wire will be based on the manufacturer's certificate of compliance with these specification requirements, together with supplementary sampling and testing at the discretion of the Materials Bureau.

724-03 TRAFFIC SIGNAL POLES

SCOPE. This specification covers the material requirements and fabrication details for poles used for traffic signals. Traffic signal poles are classified according to the following applications:

A. Span Wire. Span wire poles are used for supporting a steel cable or cables to which are attached traffic signals and overhead signs.

B. Mast Arm. Mast arm poles consist of a vertical shaft and an approximately horizontal arm to which are attached traffic signals and overhead signs. These poles may also be equipped with more than one mast arm.

C. Post Top Mount Post top mount poles are used for mounting traffic signals directly on the top of the pole.

D. Bracket Mount Bracket mount poles are used to support traffic signals and other items bracketed from or attached to the side of the pole.

Traffic Signal Poles with Lighting Arms - Lighting arms may also be attached to all pole types except post top mount.

DESIGN CRITERIA. The poles shall be designed in accordance with the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (1994), except as modified by this specification. The following elements of a pole shall be designed for the most critical orientation of the loads, applied to a traffic signal pole:

- Any tubular segments of the structure.
- Hand hole reinforcement and other hole reinforcement.
- Device used to connect cable to pole.
- Base plate.
- Mast arm to pole connections.
- Anchor bolts.

The design shall be approved, stamped and signed by a professional engineer licensed in the State of New York.

All necessary holes in the pole below the load attachment point and greater than 18 mm in diameter shall be made by the manufacturer and reinforced according to the fabrication details and contract documents. Hand holes shall be located ninety (90°) degrees clockwise, top view, from the direction of the cable load, unless otherwise specified.

For those poles on which a traffic signal cabinet will be mounted the pole manufacturer will be required to weld a cabinet wiring access coupling into the pole as part of the pole manufacturing process.
This coupling shall be centered 300 mm from the bottom of the base plate and 90° clockwise (top view) from the axis of the hand hole. The coupling shall be designed to accept a standard chase nipple on the inside of the pole, and to accept 38 mm of a standard 4 NPS diameter galvanized pipe from the outside of the pole, and shall protrude no more than 12 mm on the out side of the pole. An insulated chase nipple shall be installed in the coupling on the inside of the pole. The coupling shall be designed to reinforce the hole in which it is installed.

**Wind Loads.** Poles and attachments there to covered by this specification shall be designed for the following wind speeds in accordance with the AASHTO standard in “B” above.

- 129 km/h - Counties of Allegany, Bronx, Cattaraugus, Chautauqua, Erie, Genesee, Kings, Livingston, Monroe, Nassau, New York, Niagara, Orleans, Ontario, Queens, Richmond, Rockland, Suffolk, Wayne, Westchester and Wyoming.
- 113 km/h - All other counties.

**MATERIAL REQUIREMENTS.** The following materials, or approved alternates, as determined by the Deputy Chief Engineer, Design Division, shall be used for fabrication. Span Wire, Mast Arm and Bracket poles shall be galvanized steel. Post top poles may be either galvanized steel or aluminum. Acceptable aluminum materials are those contained in the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals (1994).

The following are the acceptable steel materials for the signal pole components.

**Poles and Arms.** The finished pole shall be galvanized in accordance with subsection 719-01 Galvanized Coatings and Repair Methods, Type 1, and be made of one of the following:

- ASTM A500, Grade B or ASTM A501.
- ASTM A53, Grade B pipe.
- ASTM A53, Grade B pipe, with a minimum yield of 330 MPa guaranteed by the manufacturer and documented by the submission of certified copies of physical tests performed on the lots of material from which the poles were manufactured.
- ASTM A252, Grade 2 or Grade 3.
- ASTM A252, Grade 2, with a minimum yield of 330 MPa guaranteed by the manufacturer and documented by the submission of certified copies of physical tests performed on the lots of material from which the poles were manufactured.
- ASTM A572M, Grades 290, 345, 415 or 450.
- ASTM A595, Grade A.
- ASTM A618, Grade I, II or III.
- ASTM A588M.
- ASTM A513, with a minimum yield strength of 248 MPa guaranteed by the manufacturer, and documented by the submission of certified copies of physical tests performed on the lots of material from which the poles were manufactured.
- ASTM A1008/A1008 M Grade 410 Class 2.
- ASTM A1011/A1011 M Grade 410 Class 2.

**Bases.** The base shall be galvanized under the same specification as the pole, and made of one of the following:

- ASTM A27M, Grade 65-35, mild to medium strength carbon steel castings.
- ASTM A36M.
- ASTM A588M.
- ASTM A572M, Grade 290, 345, 415 or 450.
- ASTM A633M (Any Grade).

**Anchor Bolts, Nuts and Washers**

Bolts and nuts shall meet the requirements of one of the following specifications:

- ASTM F568M Class 4.6 (Bolts and Nuts)
- ASTM F568M Class 8.8 (Bolts)
§724

- ASTM A576 (bolts) Grades 1021 and 1025 with a minimum elongation of 18 percent in 50 mm tested in accordance with ASTM A370. The guaranteed minimum yield strength shall be stated by the manufacturer.
- ASTM A675M Grades 485 through 620 (Bolts).
- ASTM A563M Grades A, B, C, D, or DH (Nuts).
- ASTM F1554 Grades 36, 55 or 105 (Bolts).
- ASTM A36M (Bolts) modified to a minimum yield of 379 MPa, minimum tensile of 448 MPa and minimum elongation of 18 percent in 50 mm, tested in accordance with ASTM A370.
- ASTM A194, Grade 2H (Nuts)

The type and grade of steel for nuts shall be compatible and of comparable strength to the steel used for the bolts. Washers shall be plain hardened washers.

Nuts, washers and a minimum of the top 300 mm of anchor bolts shall be hot-dipped galvanized, in accordance with the requirements of subsection 719-01, Galvanized Coatings and Repair Methods, Type II.

Connection Devices
- ASTM A36M.
- ASTM A588M.
- ASTM A325M.

Pole Caps and Anchor Bolt Covers. Pole caps shall be galvanized steel, galvanized cast iron, aluminum or zinc alloy AG40A. Anchor bolt covers shall be galvanized steel, galvanized cast iron, or aluminum. Galvanizing shall be done in accordance with the requirements of §719-01, Galvanized Coatings and Repair Methods, Type II.

FABRICATION

Bases and Hardware. The base plate shall be welded to the pole by an acceptable weld in accordance with the New York State Steel Construction Manual.

All anchor bolts, nuts and washers required for each pole shall be supplied by the pole manufacturer. Anchor bolts are to be anchored using double nuts and plates or threaded plates and shall be designed by the fabricator. Anchor bolts shall be long enough to embed at least 30 bolt diameters into the concrete foundation. “L” bends will not be allowed. The number of anchor bolts and the bolt circle diameter shall be determined by the fabricator unless specified in the contract documents. Each anchor bolt shall be equipped with 2 nuts and one or more washers for attaching the pole plus those necessary to provide end anchorage to the anchor bolt.

Washers will not be required when the holes on the base plate are within the following tolerances:
- Hole diameter not more than 3mm greater than the bolt, bolt diameters less than 25mm.
- Hole diameter not more than 6mm greater than the bolt, bolt diameters equal to or greater than 25mm.
- Hole diameter not more than 9mm greater than the bolt, bolt diameters equal to or greater than 50mm.

Anchor bolt covers shall be furnished. These shall be affixed to the base or shaft with stainless steel cap screws.

Shafts and arms shall be equipped with end caps secured with stainless steel set screws.

Shafts. Shafts shall be round or multi-sided shapes.

Shafts shall be equipped with hand holes except for poles intended for transformer base mounting. Hand holes shall be centered approximately 600 mm above the base end of the pole. The maximum hand hole size shall not exceed 100 mm x 165 mm. Poles shall be equipped with a grounding terminal accessible through the hand hole. Grounding terminals are not necessary if there is no hand hole.

Holes for wiring fittings shall consist of a pipe coupling of the specified diameter and where feasible shall be shop installed. Hand holes and holes for wiring fittings located near the base of the pole shall be reinforced with metal at least equal to the area removed.

Shafts may be fabricated in any of the following shapes and styles:
**A. Round Continuously Tapered.** Shafts shall be fabricated with not more than one longitudinal seam which shall be continuously welded and ground or rolled flush. Shafts shall have a uniform wall thickness and shall taper uniformly, starting at the butt end, decreasing in diameter at the rate of not more than 12 mm, but not less than 6 mm per meter of length.

**B. Round Step Tapered Construction.** Shafts shall be fabricated from round pipe sections with not more than one longitudinal seam, joined by a hot-swaged shrink fit, continuously seal welded to prevent entrance of water. Stepped, round shafts shall achieve a tapered effect equal to a maximum rate of 12 mm and a minimum of 6 mm per meter of length by use of decreasing diameter round pipe sections.

**C. Multi-sided Continuously Tapered Construction.** The multi-sided pole shall conform to the requirements as set forth above under round continuously tapered construction, except that it shall have no more than 2 longitudinal seams which shall be continuously welded and ground or rolled flush. Square or hexagonal shafts will not be allowed.

**D. Round Untapered.** Poles 8 meters or less in length may be round untapered with not more than one longitudinal seam.

**Welding.** All welding shall be performed in accordance with the New York State Steel Construction Manual.

**Poles with Lighting Arms.** Poles with lighting arms shall be constructed in accordance with the configuration in the contract documents and this specification.

Except for bracket-mount traffic signal poles, lighting arms may be of either the single member type or of the truss type if type is not specified. When specified for bracket-mount traffic signal poles, lighting arms shall be of truss-type design with upper and lower members joined near the luminaire end of the arm. Lighting arms of the truss-type design with upper and lower members joined near the luminaire end of the arm shall be braced with one or two vertical struts depending on the length of the arm. Arms may be either galvanized steel or aluminum.

**Span Wire Poles**

**A. Design Load.** The design load for span wire poles shall be the Group II or III load per AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals (1994) Section 1.2.6, given in the contract documents and applied at a point 450 mm below the top of the pole. Allowable unit stresses shall be as specified in the above AASHTO specification.

**B. Physical and Mechanical Properties.** Span Wire poles shall conform to the following requirements.

- Minimum Wall Thickness - 3 mm
- Maximum Deflection - To be computed at a point 450 mm from the top of the pole, shall be a maximum of 50 mm per meter of pole length and a maximum deflection rate of 17 mm per 500 Newtons.
- Maximum Pole Diameter at the Base - 58 mm per meter of pole length.

**C. Pole Marking.** The following information shall be stamped on the base plate or ground sleeve in 12 mm letters to such a depth as to be clearly visible through subsequent galvanizing:

<table>
<thead>
<tr>
<th>Desired Information</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pole Length in whole meters</td>
<td>10 m</td>
</tr>
<tr>
<td>Load in 10 kN Increments</td>
<td>20 kN</td>
</tr>
<tr>
<td>Manufacturers Name or Logo</td>
<td>-</td>
</tr>
<tr>
<td>Month and Year of Manufacture</td>
<td>1178</td>
</tr>
</tbody>
</table>
D. Span Wire Connecting Hardware. The manufacturer shall supply the necessary device for connecting each span wire to the pole. For polygonal poles this device may be either a galvanized thimble eyebolt or a circumferential pole clamp. For round poles, only thimble eyebolts shall be used. The design strength shall be 70% of yield strength of the connecting device. The yield strength shall be determined using a cable load aligned 85 degrees to the vertical axis of the pole.

Mast Arm Traffic Signal Poles

A. Design Loads. Each part of the structure shall be proportioned for the combination of loads producing the maximum effect, using unit stresses increased for the material and group loads as described in section 1.2.6 of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals (1994). The wind speed, locations, dimensions, weights, and projected areas of the signals, signs, and supports shall be as specified in the contract documents.

B. Mast Arm Shapes. Arms shall be round or multi-sided shapes and have the same cross-sectional shape as the shaft.

C. Arm Construction. Mast arms of any length may be constructed by any of the methods indicated under Material Requirements Shafts. They may be of two piece construction with a telescoping joint secured by thru-bolt and locknut.

D. Mast Arm to Shaft Connection. The mast arm shall be secured to the shaft by a minimum of four bolts. The mast arm shall be equipped with a flange plate welded to the butt end of the mast arm. A flange plate shall be attached to the shaft using vertical and horizontal gusset plates both top and bottom and at each side. Flange plates on shaft and mast arms shall have a hole with a smooth cable guide for wiring.

E. Physical and Mechanical Properties. Mast arms and shafts shall conform to the following requirements:

- Minimum Wall Thickness - 3 mm.
- Maximum Deflection at Design Load.
- Shaft - 42 mm per meter of length.
- Arm - 42 mm per meter of length.
- Maximum Diameter at base of shaft or arm.
- Shaft - 58 mm per meter of length.
- Arm - 58 mm per meter of length.

F. Poles with Multiple Arms. Poles with multiple arms shall be constructed in accordance with the arm configuration in the contract documents.

G. Pole Marking. The following information shall be stamped on the top of the base plate or ground sleeve in 12 mm letters to such a depth as to be clearly visible through subsequent galvanizing.

<table>
<thead>
<tr>
<th>Desired Information</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall Thickness</td>
<td>8 mm</td>
</tr>
<tr>
<td>Minimum Yield Strength</td>
<td>345 MPa</td>
</tr>
<tr>
<td>Manufacturers Name or Logo</td>
<td>-</td>
</tr>
<tr>
<td>Month and Year of Manufacture</td>
<td>10/77</td>
</tr>
</tbody>
</table>

Post Top Mount and Bracket Mount Traffic Signal Poles. These poles shall be proportioned for the combination of loads producing the maximum effect, using unit stresses increased as indicated for the material and group loads as described in section 1.2.6 of AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals (1994). The wind speed, location, weights, dimensions and projected areas shall be as given in the contract documents.


**BASIS OF ACCEPTANCE.** Acceptance for poles and mast arms covered by this specification will be based on the following, as appropriate:

**All Poles and Arms**

- Submission of fabrication details for each pole intended for a worst case configuration of the load as specified in the contract documents approved, stamped and signed by a Professional Engineer licensed and registered to practice in New York State.
- Submission of the manufacturer's certificate of compliance with these specification requirements and the approved fabrication details.

**Span Wire Poles**

- The acceptance requirements for All Poles and Arms, given above, shall apply.
- Submission of mill certifications for all structural materials.
- Appearance of the manufacturer's name on the Department's list of approved manufacturers.

**724-04 TRAFFIC SIGNAL HEADS**

**SCOPE.** This specification covers the material and fabrication requirements for vehicular and pedestrian traffic signal heads, including flashing signals and flashing beacons.

**STANDARD SIGNAL HEADS**

**Material Requirements.** Only virgin metal shall be used in making either sand castings or die castings, and where specified, the manufacturer shall furnish standard test bars, poured of the metal of which the castings are made, and a certified chemical analysis of the ingot from which the castings are made.

**A. Housing.** Unless otherwise specified, all traffic signal head housings shall be made of Aluminum alloy of one of the following compositions:

1. **Aluminum Sand Castings.** All aluminum sand castings shall be made of ingot, in accordance with ASTM B26, Alloy B443.0 or AC72A.

2. **Aluminum Die Castings.** All aluminum die castings shall be made of ingot, in accordance with ASTM B85, Alloys SC84A, SC84B, SG100A, SG100B, or S12B.

**B. Suspension Components.** All suspension components, brackets, clamps, trunnions, arms, elbows, crosses, etc., shall be made of one of the following materials:

1. **Malleable iron.** Malleable iron material shall be made in accordance with ASTM A47/ A47M.

2. **Steel pipe.** Steel pipe shall be made in accordance with ASTM A 53.

3. **Aluminum Sand Castings.** Aluminum sand castings shall be made in accordance with ASTM B26, Alloy 356-T-6.

4. **Aluminum Die Castings.** Aluminum die castings shall be made in accordance with ASTM B85, Alloy SC 84B.

5. **Aluminum pipe.** All aluminum pipe shall be made in accordance with ASTM B429.
§724

C. Fasteners. The following items shall be made of non-magnetic stainless steel, Type 303 or 304, in accordance with ASTM A296 (latest revision).

- All set screws.
- The U/J-bolts, rivet and their related nuts, washers and cotter pin in the span wire lamp.
- The eye-bolt, rivet, tightening bolt and their related nuts, washers, and cotter pin in the balance adjuster.

D. Pipe Arms. Pipe arms shall be made of steel pipe in accordance with ASTM A120 (latest rev.)

Wind Load. Signal heads, mounting brackets, attachments and fittings shall be designed for a wind load pressure for at least a 145 km/h wind in accordance with AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals (1994).

Painting. All aluminum traffic signal heads, bracket arms, and mounting attachments shall be painted by first applying a chromate conversion coating and then electrostatically applying a polyester powder coating.

The chromate conversion coating shall be applied and conform to the requirements of ASTM B449, Standard Practice for Chromate Treatments on Aluminum, Class 2 coating. The conversion coating shall be allowed to dry thoroughly and shall be free of entrapped air and contaminants. After drying the chromated surface shall be coated with a polyester powder coating.

The polyester powder shall be electrostatically applied and cured in accordance with the coating manufacturers recommendations. If preheating of the aluminum substrate is required, care shall be taken to prevent damage to the chromate coated surface by not exceeding a preheat temperature of 71°C. The polyester coating shall be applied at a uniform thickness between 0.060 mm and 0.090 mm. The polyester powder used shall have the following properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>ASTM Test Method</th>
<th>Test Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific Gravity</td>
<td>D3451</td>
<td>1.2 Minimum</td>
</tr>
<tr>
<td>Impact Resistance</td>
<td>D2794</td>
<td>16 N•cm Minimum</td>
</tr>
<tr>
<td>Pencil Hardness</td>
<td>B3363</td>
<td>H - 2H</td>
</tr>
</tbody>
</table>

The color of the finished polyester coating shall be such that a properly prepared color chip shall be a reasonable visual match to Federal Color Standard No. 595A, Color 14056. Viewing shall be done under North Standard Daylight.

Signal Indications. Signal indications shall be as indicated in the proposal or as shown on the plans.

Wiring. All wiring shall consist of No. 18 AWG stranded copper wire with thermoplastic insulation and a 600 volt rating.

Electrical Characteristics. All equipment shall be designed for operation on 115 volts ± 30 volts, 60 Hertz, single phase A.C. power unless otherwise indicated.

Mounting. Signal heads shall be arranged for mounting on span wires, mast arms, post tops or vertical pole bracket mounts as specified in the contract documents. For a span wire mounting the signal head shall be provided with a span wire clamp, balance adjuster and wire outlet fitting. The span wire clamp shall consist of a shoe, lockbar, two “U” or “J” bolts, and a rivet, with cotter pin, nuts, washers, etc., as necessary. The balance adjuster shall consist of a body with threaded eye-bolt, a tightening bolt and a rivet, with cotter pin, nuts washers, etc., as necessary. The wire outlet fitting shall have a continuous opening of a minimum nominal diameter of 40 mm for insertion of signal head wiring. The upper opening shall have a weatherproof insulating composition cover that provides for the insertion of the wiring. The cover shall be securely mounted to the fitting. The bottom opening shall be threaded, and provided with two square or hex drive set screws, located at 180 degrees to each other. The bottom of the fitting shall have integral cast serrations, or shall be notched and provided with a serrated locking ring, or shall be
provided with a slotted check nut and serrated locking ring. A 12 or 18 circuit disconnect hanger shall be supplied if specified in the contract documents. The head shall be assembled so that it hangs plumb.

**A. One-way Signal Head.** Mounting hardware for a one-way signal head shall also include a 40 mm galvanized nipple with cast head, gasket, and steel washer for the connection between the wire outlet fitting and the top of the signal head. A metal weather-resistant cap/plug shall be provided for the unused hole in the bottom of the head. The cap/plug shall be of a threaded or flanged design.

**B. Multi-way Signal Head.** Mounting hardware for multi-way (2, 3 and 4-way) signal heads shall also include a center junction hub and pipe arms with tee or cross end connectors. Tee and cross connectors shall be notched for, and supplied with a serrated locking ring. No pipe/nipple shall be provided for the connection between the center junction hub and the wire outlet fitting. A 40 mm galvanized nipple with cast head, gasket and steel washer shall be supplied for the connection between the tee or cross connector and the top of the signal head. Tees and crosses will not be accepted in place of the center junction hub.

Center junction hubs shall have a threaded openings on the top and sides. The bottom of the hub shall be essentially fully open, except for the necessary thickness of the housing, and shall be securely covered by a flat plate of weather-resistant design. The plate shall be held in place by a minimum of two screws. Center junction hubs shall be provided with a square or hex drive set screw on all threaded openings, except that the top opening shall be provided with two set screws, located at 90 degrees to each other.

Center junction hubs shall have a minimum nominal opening of 90 mm in diameter for round openings, or a minimum nominal side length of 90 mm for rectangular openings.

Tees or crosses shall have threaded openings to accept the necessary pipe arm/signal head connections, plus at least one additional threaded opening to facilitate wiring. The extra opening shall be closed with a threaded metal pipe cap. All threaded openings on the tees and crosses shall be provided with a square or hex drive set screw.

Threaded openings on pipe arms shall be tapered. Threaded openings on other pipe fittings shall be pipe straight threads.

Flat arms or spiders shall be provided for the bottoms of multi-way signal heads, except that bottom hardware shall be omitted for multi-way one section head assemblies. Connections between the bottoms of the signal heads and the arm/spider shall be flanged or threaded to provide a locking, weather-resistant connection.

Signal heads for mast arm mounting shall be furnished with a mount consisting of upper and lower horizontal arms attaching to the top and bottom of the signal head housing. The horizontal arms shall attach to a vertical member which in turn clamps to the mast arm. The mast arm mount shall have provision for adjusting the vertical, angular and rotational positioning of the head in relation to the mast arm so that it is plumb, in line with other signal heads and properly oriented in relation to traffic. Wiring shall be concealed within the mount.

Post top signal heads shall be furnished with a post top type sliplifter mounting. Vertical pole bracket mount signal heads shall be equipped with upper and lower horizontal brackets equipped with pole plates for attachment to the pole with stainless steel bands.

**Housing.** The housing for each face shall be of unitized sectional construction and shall consist of as many sections as necessary to provide the indications shown on the plan. All sections shall be rigidly and securely fastened together into one weather-tight signal face. An adjustable traffic signal head shall consist of two or more signal faces fastened to and supported by a pipe assembly and suitable entrance fitting.

Each housing shall be arranged with openings in the top and bottom so that it may be rotated about a vertical axis between waterproof supporting brackets or trunnions and shall be capable of being securely fastened at increments of not more than 7 degrees of rotation. The top and bottom of each housing shall have integrally cast locking rings or other provisions to provide positive interlocking and indexing.

The top and bottom of each housing shall be provided with tees or crosses equipped with pipe-plug knobs or caps which can be removed to assist in wiring. Flat arms or spiders will be accepted as an alternative for use on the bottom of adjustable signals. One-section adjustable beacons may be supplied without bottom bracket arms.
Each housing shall be so designed that additional sections may be added. The construction shall permit the assembly of 300 mm signal sections with 200 mm sections of the same manufacturer. The assembly shall permit the joining of 200 mm sections either above or below the 300 mm sections.

**Doors.** The door shall be of cast aluminum alloy and shall be provided with four visor mounting holes located equidistant about the lens opening to allow the mounting of the visor in either a vertical or horizontal position. The holes shall be drilled and tapped, and provided with stainless steel mounting screws. Neoprene gasketing shall be provided between the body of the housing and the doors. The doors shall be suitably hinged and shall be forced tightly against the gasket and the housing by simple stainless steel locking devices. All other exterior hardware such as hinge pins, lens clips, etc. shall be of stainless steel. The locking device shall be capable of being operated without the use of tools. Hinges shall be arranged to allow convenient relamping. On the outside of the door, there shall be a rim encircling the lens opening to prevent any light leakage between optical systems.

**Visors.** The visors shall be separate and removable from the doors, held in place by stainless steel fastenings attached to the door in such a manner as to prevent the possibility of any light leakage between the door and hood which might be discernible from the side. Visors shall be of sheet aluminum, not less than 1.27 mm, and shall mount to the signal head through the use of four slotted mounting tabs which inter-mate with the mounting screws on the signal housing door. Unless otherwise specified in the contract documents all signal heads shall be provided with cap-type visors. The insides of visors and the entire surface of louvers or fins used in front of signal lenses shall be painted a flat black to minimize light reflection to the sides of the signals. Visors shall tilt down from the horizontal a minimum of 3.5° and shall be a minimum of 241 mm in length for 300 mm diameter lenses and 177 mm in length for 200 mm diameter lenses.

**Connection Blocks.** Each signal face shall be equipped with a 5-point heat resistant terminal block. It shall have five terminals with connectors for receptacle leads and screw terminals for field wires. The individual connection blocks in the separate faces of a signal head shall be interconnected. In one face of each multi-face head, there shall be an additional nine terminal block to which all field wires are connected. All socket leads of all signal faces shall terminate at this nine terminal block.

**Dust-Tight Optical System.** The optical system shall be properly gasketed to exclude dust and dirt from the reflecting surface of the reflector and the inner surface of the lens. Gaskets shall be placed between the reflector and supporting member, and between the reflector holder and the inner surface of the lens.

**Reflectors.** Reflectors shall conform to the requirements of “Vehicle Traffic Control Signal Heads” published by the Institute of Transportation Engineers (ITE) in ST-017B (Equipment and Material Standards).

Reflectors shall be made of a material that will not distort when subjected to the heat of the specified lamp. Reflectors may be either silvered glass or specular aluminum with anodic coating. Metalized plastic reflectors will not be accepted. The reflecting surface before coating shall be free of flaws. The reflective coating and the reflector shape shall be such that the light distribution and candle power intensity of the combined lamp lens reflector assembly shall meet the specification requirements in “Vehicle Traffic Control Signal Heads.”

**Reflector Rings.** No plastic material will be accepted for the reflector bracket or reflector ring. The reflector ring and complete reflector and socket assembly shall be pivoted between two (2) stainless steel pins in such a manner that it can be swung open for ease in servicing the signal without the use of any tools.

**Lenses.** Each traffic signal head shall be supplied with traffic signal lens. Lenses shall be red, yellow, or green. Lens shall be made of glass and shall conform to the requirements of "Vehicle Traffic Control Signal Heads" published by the Institute of Transportation Engineers. Except for multilane use control signals and pedestrian signals, all lenses shall be circular in shape with nominal diameters of either 200 mm or 300 mm. Each 300 mm lens shall be standard wide angle and clearly marked as such.
Lamp Receptacles. Lamp Receptacles shall conform to the requirements of “Vehicle Traffic Control Signal Heads” published by the Institute of Transportation Engineers.

Lamps. The lamp for the illumination of a 200 mm lens shall be a clear traffic signal lamp which produces a minimum of 595 lumens with an average minimum initial lumen rating of 550 lumens at a working voltage of 120-125 volts AC, has a rated life of at least 8,000 hours and is rated at no more than 60 watts.

The lamp for the illumination of a 300 mm lens shall be a clear traffic signal lamp which produces a minimum of 1,750 lumens with an average minimum initial lumen rating of 1650 lumens at a working voltage of 120-125 volts AC, has a rated life of at least 7000 hours and is rated at no more than 135 watts.

Lamps and the intensity and distribution of light from each illuminated signal lens shall conform to the requirements of “Vehicle Traffic Control Signal Heads”, and “Standards for Traffic Signal Lamps.” Both publications are available from the Institute of Transportation Engineers.

OPTICALLY PROGRAMMED SIGNAL HEADS. The following additional requirements apply to Optically Programmed Signal Heads.

General. The optically programmed signal head shall permit the visibility zone of the indication to be determined optically and require no hoods or louvers. The projected indication may be selectively visible or veiled anywhere within 15° of the optical axis. No indication shall result from external illumination nor shall one light unit illuminate a second.

Optical System. The optical system shall accommodate projection of diverse, selected indicia to separate portions of the roadway such that only one indication will be simultaneously apparent to any viewer. The projected indication shall conform to ITE transmittance and chromaticity standards.

The following components shall comprise the optical system:

A. Lamp and Lamp Collar. The lamp shall be nominal 150 watt, 120 volt AC, three prong, sealed beam having an integral reflector with stippled cover and an average rated life of at least 6000 hours. An equivalent 75 watt lamp shall be used with pedestrian indications. The lamp shall be coupled to the diffusing element with a collar including a specular inner surface.

B. Optical limiter-diffuser. The diffusing element may be discrete or integral with the convex surface of the optical limiter. The optical limiter shall provide an accessible imaging surface at focus on the optical axis for objects 275 m to 370 m distant, and permit an effective veiling mask to be variously applied as determined by the desired visibility zone. The optical limiter shall be provided with positive indexing means and composed of heat resistant glass.

C. Objective lens. The objective lens shall be a high resolution, planar incremental lens hermetically sealed within a flat laminant of weather-resistant acrylic or approved equal. The lens shall be symmetrical in outline and may be rotated to any 90° orientation about the optical axis without displacing the primary image.

Construction. Signal case and lens holder shall be predrilled for backplates and visors. Hinge and latch pins shall be stainless steel. All access openings shall be sealed with weather-resistant rubber gaskets.

Mounting. The signal shall mount to standard 40 mm fittings as a single section, as a multiple section face, or in combination with other signals. The signal section shall be provided with an adjustable connection that permits incremental tilting from 0 to 10 degrees above or below the horizontal while maintaining a common vertical axis through couplers and mounting. Terminal connection shall permit external adjustment about the mounting axis in 5 degree increments. The signal shall be constructed such that it can be installed with ordinary tools and serviced with no tools.

Attachments such as visors, backplates or adapters shall conform and readily fasten to existing mounting surfaces without affecting water and light integrity of the signal.
The programmed signal head shall be arranged for rigid mounting to either a mast arm or a dual span wire assembly. It is important for proper operation of the signal that it be mounted as rigidly as practical to maintain its optical orientation with the roadway. In those cases where span wires are used it should be securely tethered to the lower span wire.

**Electrical.** Lamp fixture shall comprise a separately accessible housing and integral lamp support, indexed ceramic socket and self-aligning, quick-release lamp retainer. Electrical connection between case and lamp housing shall be accomplished with an interlock assembly which disconnects lamp housing when opened.

Each signal section shall include a covered terminal block for clip or screw attachment of field wires. Concealed No. 18 AWG, stranded and coded wires shall interconnect all sections to permit field connection within any section.

**Photo Controls.** Each signal section shall include integral means for regulating its intensity between limits as a function of individual background illumination. Lamp intensity shall not be less than 97% of uncontrolled intensity at 10,764 lx and shall reduce to 15 lx ±2% of maximum at less than eleven (11) lx over the applied voltage and ambient temperature range. Response shall be proportional and essentially instantaneous to any detectable increase from darkness to 10,764 lx and damped for any decrease from 10,764 lx.

The intensity controller shall comprise an integrated, directional light sensing and regulating device interposed between lamp and field wires. The device shall be responsive over an applied voltage of 95 to 130V, 60 Hz. temperature range of -40°C to 74°C and may provide phase controlled output voltage but shall have a nominal open circuit terminal impedance of 1500 ohms. The Photo Control shall not produce sufficient electrical noise or interference to adversely affect the operation of solid state electronic equipment used on traffic signal controllers and associated auxiliary equipment and shall not cause false tripping of conflict monitors.

**STANDARD PEDESTRIAN SIGNAL HEADS.** In addition to applicable items in STANDARD SIGNAL HEADS the following requirements apply to Standard Pedestrian Signal Heads.

**General.** Pedestrian signal indications are traffic indications intended for the exclusive purpose of controlling pedestrian traffic. These indications consist of the illuminated words WALK and DON'T WALK.

When specified, these messages can be replaced with the “MAN” and “HAND” display. The indications shall be single faced and rectangular in shape with letters made visible by internal illumination and with the legend DON’T WALK above or integral with the legend WALK.

When illuminated, the WALK indication shall be lunar white. When illuminated, the DON’T WALK indication shall be portland orange. All except the letters shall be obscured by an opaque material.

When not illuminated, the WALK and DON’T WALK indications shall not be distinguishable by pedestrians at the far end of the controller crossing.

Pedestrian signal construction and indications shall conform to the requirements of “Pedestrian Traffic Control Signal Indications" published by the Institute of Transportation Engineers, with the following modifications:

- Unless otherwise specified, the head shall be a two section unit. Lettering shall be a minimum of 114 mm.
- Lamps for the illumination of each section shall be a clear traffic signal lamp with an average initial rating of 1,280 lumens at a working voltage of 120-125 volts with a rated life of at least 8,000 hours. Lamp fixtures shall not be wired in series.
- Signal head shall be supplied with an 18 AWG, color coded wiring harness, and a four position, barrier type terminal block.
- Lenses shall be made of plastic.

**FIBEROPTIC PEDESTRIAN SIGNAL HEADS.** In addition to applicable items in STANDARD SIGNAL HEADS and STANDARD PEDESTRIAN SIGNAL HEADS the following requirements apply to Fiberoptic Pedestrian Signal Heads.
General. The unit shall consist of a matrix of fiberoptic bundles forming two displayed messages on a rectangular background facing the same direction. One message shall indicate WALK and the other shall indicate DON’T WALK. Both messages shall have a minimum letter height of 114 mm using a series B width. If the “MAN” and “HAND” display are specified both messages shall have a minimum symbol height of 267 mm and 165 mm width.

The messages shall be clearly legible and shall attract the attention of pedestrians and be readable, under any lighting conditions varying from total darkness to bright sunlight or where high intensity background lighting is present, at distances from 3 m to the width of the area to be crossed. A visor or hood shall not be required for legibility, but shall be provided with the housing.

The messages shall be visible at full intensity anywhere within a 90 degree cone centered about the optical axis and perpendicular to the surface of the matrix display. When not energized, the signal shall be blanked out (unreadable) with no phantom images, regardless of solar intensity or direction.

The messages shall be bright in color against a flat black background.

The displays shall be made from a single row of fiberoptic bundles with a nominal 13 mm spacing between centers.

The light source shall be designed and constructed so that in case of an electrical or mechanical failure of the word DON’T the word WALK in the DON’T WALK message will remain dark.

Each message shall be displayed separately and never concurrently.

Material Requirements. One 42 watt, 10.8 volt lamp type EPT or equivalent with a rated average life expectancy of 10,000 hours shall be as the light source for each display. The lamp shall be a multi-mirror reflector quartz halogen bulb operating at an approximate color temperature of 2900 K.

Optical System. The optical system shall consist of the following:

- Weatherproof housing, door, gaskets, and visor
- Fiberoptic module with individual output attached
- Color filters for desired message colors
- Light sources
- Transformers
- Protective back cover for the module
- Electrical system including wiring

Optical Requirements. The optics shall have a glass-on-glass fiber with an 83% core to 17% cladding ratio. It shall have an average numerical aperture of .56 with a maximum transmission attenuation of 800 DB per kilometer. Each fiber shall have a .05 ±.005 mm diameter with an included acceptance angle of 68 degrees. All fiber ends shall be ground smooth and polished to an 8 μm finish minimum, for maximum output and bundle-to-bundle consistency. Bundled fiber strands shall be kept free from the contamination of water and polishing agents. Maximum fiber breakage per fiber bundle shall not exceed 3%. A minimum of five spare fiberoptic output bundles shall be provided for each lamp and built into the unit. Damaged output bundles shall be replaceable using these spares. The output fiber bundles located at the face of the sign shall have a minimum diameter of 1.2 mm for the “DON’T” and 1.7 mm for the “WALK” message. The input fiber bundle located at each light source shall have a maximum diameter of 19 mm. The output bundles shall be protected by a vandal resistant prismatic polycarbonate lens 3.18 mm thick. Individual fiberoptic bundles shall not be jacketed or encased.

Color filters shall be optical quality glass. The filters shall be color fast and in accordance with the I.T.E. Signal Color Specification for Chromaticity.

The prismatic polycarbonate lens shall be mounted at a pre-focused distance in the door, away from the fiberoptic panel.

All optical fiber utilized in the production of the fiberoptic unit shall be tested for:

- Core to clad fusion
- Size
- Roundness of fiber
- Optical transmission
- Brittleness
Results of these tests shall be available upon request.

**Construction.** The front panel shall be flat black aluminum alloy, minimum 3.18 mm thick, and shall have a maintenance-free black anodized, acid tested finish or an equivalent weather resistant polycarbonate.

A heavy plastic mylar water shield shall be used to prevent possible water leaks from dropping onto the lamps.

All fiberoptic transformers and lamps shall be mounted on the door of the unit. All screws, washers, nuts and bolts shall be corrosion resistant. All components shall be readily accessible when the door is opened. The only tool required for maintenance or replacement of components shall be a standard screwdriver.

No moving parts are permitted in the optical system.

**Electrical.** Electrical connection shall be provided by a barrier-type terminal strip for connecting field wires.

Transformers shall be used to reduce the incoming 120 volts AC to 10.8 volts AC.

Transformers shall be rated at 48.5 volt-amps and shall have Class A insulation impregnated with a double coating of epoxy resin so as to preclude intrusion of moisture.

A separate transformer and bulb shall be used for each color, to allow connection with existing controller wiring and conflict monitors.

The transformer bracket shall be an extruded aluminum member and shall provide adequate heat sinking of transformers.

**Environmental Conditions.** The unit shall be capable of continuous operation over a temperature range of -37°C to +75°C.

**FIBEROPTIC DUAL INDICATION ARROW.** In addition to applicable items in STANDARD SIGNAL HEADS, the following additional requirements apply to Fiberoptic Dual Indication 300 mm Turn Arrow.

**General.** The unit shall display alternate indications, consisting of either a green or yellow directional arrow. The indication shall be clearly legible and shall attract the attention of motorists and be visible, under any lighting conditions varying from total darkness to bright sunlight or where high intensity background lighting is present, at a distance of at least 450 m under normal atmospheric conditions. A visor or hood shall not be required for legibility.

The indication shall be visible at full intensity anywhere within a 60-degree cone centered about the optical axis and perpendicular to the surface of the display.

When not energized, the signal shall be blanked out (unreadable) with no phantom images, regardless of solar intensity or direction.

The indication shall be bright in color against a flat black background.

Each indication shall be displayed separately and never concurrently.

The borderline arrow indications shall be comprised of a dual row of fiber bundles. The indication shall be in total conformance with I.T.E. standards for Vehicle Control Signal Heads.

**Material Requirements.** One 42 watt, 10.8 volt lamp type EPT or equivalent with a rated average life expectancy of 10 000 hours shall be used as the light source for each indication. The lamp shall be a multi-mirror reflector quartz halogen bulb operating at an approximate color temperature of 2900 K.

**Optical System.** The optical system shall consist of the following:

- Weatherproof housing, door, gaskets, and visor
- Fiberoptic module with individual output attached
- Color filters for desired message colors
- Light sources
- Transformers
- Protective back cover for the module
- Electrical system including wiring
**Optical Requirements.** The optics shall have a glass-on-glass fiber with a 83% core to 17% cladding ratio. Each fiber shall have a .05 ± .005 mm diameter with an included acceptance angle of 68 degrees.

All fiber ends shall be ground smooth and polished to an 8 µm finish minimum, for a maximum output and bundle-to-bundle consistency. Bundled fiber strands shall be kept free from the contamination of water and polishing agents. Maximum fiber breakage per fiber bundle shall not exceed 3%. At least two (2) spare fiberoptic output bundles shall be provided for and built into each unit. Damaged output bundles shall be replaceable using these spares. A minimum of 56 bundles shall be provided. Each optical output shall have a minimum 3.5 mm (nominal) active bundle area for maximum light transmission. All optical fiber shall be fully bias randomized by individual fiber with approximately 50% fiber allocated to the green arrow indication and 50% to the amber arrow indication for balanced and corrected color output. Individual fiberoptic bundles shall not be jacketed or encased. Color filters shall be optical quality glass. The filters shall be color fast and in accordance with I.T.E. Signal Color Specification for Chromaticity. Any combination of colors shall be available by changing color filters installed in the unit.

All optical fiber utilized in the production of the fiberoptic units shall be tested for:

- Core to clad fusion
- Size
- Roundness of fiber
- Optical transmission
- Brittleness

Results of these tests shall be available upon request.

**Construction.** Complete unit shall be supplied mounted in standard 300 mm vehicle signal section.

The front panel shall be either flat black aluminum alloy, minimum 3.18 mm thick having a maintenance-free black anodized, acid tested finish or an equivalent weather resistant polycarbonate. Output bundles shall be mounted on the front panel at 90 degrees to the surface. Mounting shall be consistent in manufacture and shall be watertight. A heavy plastic mylar (or equivalent) water shield shall be used to prevent possible water leaks from dripping onto the lamps.

All fiberoptic transformers and lamps shall be mounted on the door of the unit. All screws, washers, nuts and bolts shall be corrosion resistant. All components shall be readily accessible when the door is opened. The only tool required for maintenance or replacement of components shall be a standard screwdriver.

No moving parts are permitted in the optical system.

Front panel, with fiberoptic indication shall be rotatable to form a right, left, or vertical arrow.

**Electrical.** Electrical connection shall be provided by a barrier type terminal strip for connecting field wires.

Transformers shall be used to reduce the incoming 120 volts AC to 10.8 volts AC. Transformers shall be rated at 48.5 volt-amps and shall have a Class A insulation impregnated with a double coating of epoxy resin so as to preclude intrusion of moisture.

A separate transformer and bulb shall be used for each color, to allow connection with existing controller wiring and conflict monitors.

**Environmental Conditions.** The unit shall be capable of continuous operation over a temperature range of -37°C to +75°C.

**STROBING SIGNAL INDICATION.** In addition to applicable items in STANDARD TRAFFIC HEADS the following additional requirements apply to Strobing Signal Indications.

**General.** The unit shall consist of a standard red signal indication with the addition of a white bar strobe presented horizontally across the red face. The strobe shall flash at a rate of approximately once per second. The indication shall be single faced and the strobe bulb, control circuitry, and all necessary appurtenances shall be enclosed in and be an integral part of a standard 300 mm aluminum signal housing. The bar strobe shall attract the attention of motorists and be visible, under any lighting conditions.
conditions varying from total darkness to bright sunlight or where high intensity background lighting is present, at a distance of at least 805 meters under normal atmospheric conditions.

When the bar strobe is not energized, the indication shall operate and appear as a standard red indication.

Optical System. The optical system shall consist of the following:
- Weatherproof housing, door, gaskets, and visor.
- Alzak parabolic reflector or equivalent. No plastic material will be accepted for the reflector or reflector bracket.
- One bar strobe bulb with a minimum 5000 hours duty life enclosed in a dustproof, shockproof and watertight enclosure.
- 300 mm glass red lens.
- Power supply.
- Electrical system including wiring and control circuitry.
- The strobe bulb shall be a minimum of 241 mm in length to effectively span the width of the lens.

Construction. The unit shall consist of a standard 300 mm red vehicle signal section with a bar strobe light interposed in front of the red lens.

All power supplies and control circuitry for the strobe shall be mounted to the visor assembly and contained within a watertight enclosure(s) which shall not interfere with mounting additional signal sections to form a multiple section signal head.

The strobe bulb shall be enclosed in a dustproof, shockproof and watertight housing securely mounted in front of the red lens. The strobe housing shall contain only the strobe bulb, terminal strips and necessary connecting wires, and shall not interfere with the general visibility of the red lens, nor the ability to change the red lens in the normal manner.

All screws, washers, nuts and bolts shall be stainless steel.
All components shall be readily accessible. The only tool required for maintenance or replacement of all components shall be a standard screwdriver.

Electrical. Electrical connection shall be provided by a barrier type terminal strip for connecting field wires. The power supply shall be of a capacitive discharge type sufficient to fire the bar strobe bulb at a rate of approximately once per second. The power supply shall be encased in a temperature stable epoxy so as to preclude intrusion of moisture. A door switch shall be provided so that when the housing door is opened the switch shall disconnect AC power to the strobe power supply and circuitry and shall also completely discharge the high voltage DC capacitive charge within 10 seconds.

The high voltage power supply shall be fused using a time delay fuse. The current rating of the fuse shall be no more than 50% above the maximum current expected at 135 V AC. The fuse shall be mounted in the housing and located before the door switch in the strobe circuitry.

The barrier type terminal strip shall be equipped with male quick connect spade terminals. Insulated female spade receiver terminals shall be required for the connection of the strobe circuitry to the terminal strip.

Labeling. A CAUTION or WARNING label should be affixed to the visor assembly near the housing door opening, notifying maintenance or repair personnel of the presence of a high voltage capacitive charge within the visor assembly and that the quick disconnect should be disconnected and a check for AC or DC voltage across the strobe bulb should be performed before servicing the strobe bulb or circuitry.

STANDARD POLYCARBONATE TRAFFIC SIGNAL HEADS

General. In addition to applicable material requirements for STANDARD SIGNAL HEADS and STANDARD PEDESTRIAN SIGNAL HEADS, the following additional requirements apply to Polycarbonate Traffic Signal Heads."
Material Requirements. The traffic signal housing, visor and door shall be made of injection molded polycarbonated resin which shall be capable of withstanding a 95 N•m impact without fracture or permanent deformation.

Material used in the construction of the signal housing door, visor and lens shall be resistant to heat generated by the signal bulb. No deformation or discoloration shall be evidenced when 116 watts bulbs are used in 200 mm signal sections and 150 watt bulbs are used in 300 mm signal sections. The plastics shall be ultra-violet and heat stabilized and flame retardant.

The signal housing, door and visor shall be dark green and the color shall be fully impregnated into the polycarbonate resin.

Visor shall be made of one piece with a minimum thickness of 2 mm. The rear edge of the visor shall be provided with four mounting lugs for attaching the visor to the door using screws. The inside of the visor shall be dull black in color. Unless otherwise specified all signal heads shall be provided with cap-type visors.

Construction. The housing shall have a minimum thickness of 2.3 mm. The housing shall be of one piece construction and the door shall be of one piece construction. Both the 200 mm & 300 mm housings are to be designed in the same manner so when used in combination heads the design will match each other.

The top and bottom opening of each housing shall have integral serrated bosses that will provide positive positioning of the signal head to eliminate undesirable rotation or misalignment of the signal head between sections. Each opening accommodates standard 1.5 NPS pipe fittings and brackets.

Doors shall be hinged by two lugs and mounted to the housing using stainless steel pins. The door of each signal section shall be one-piece with a minimum thickness of 2.3 mm.

A neoprene gasket shall be provided between the body of the housing and the door. The doors shall be forced tightly against the gasket and housing by simple stainless steel locking devices. A slotted air cored neoprene lens gasket shall provide a positive seal between the lens and the signal door and between the lens and the reflector holder.

The gasket shall be an unbroken circular gasket with a "U" shaped cross section. The gasket and lens shall be held tightly into the door by four stainless steel clips and screws that shall allow easy removal of the lens and gasket from the door without removal of the door in the field.

The reflector shall be Alzak aluminum. Reflector rings shall be manufactured from die cast aluminum, hinged from one side to allow the reflector assembly to open without use of tools. The lamp receptacle shall be permanently focused to the reflector and held in place by a corrosion-resistant wire spring bail so that it can be removed without the use of tools. The center section shall contain a terminal barrier block having quick-disconnect terminals for the lamp receptacle leads and screw terminals for field wires.

LED TRAFFIC SIGNAL MODULES. In addition to applicable material requirements for STANDARD SIGNAL HEADS, and STANDARD PEDESTRIAN SIGNAL HEADS, the following additional requirements apply to Ball, Arrow, and Pedestrian LED Traffic Signal modules.

General. This specification refers to definitions and practices described in the Institute of Transportation Engineers (ITE) publication ST-017B "Vehicle Traffic Control Signal Heads" (referred to in this document as "VTCSH"), and "Pedestrian Traffic Control Signal Indications" (referred to in this document as "PTCSI"). LED traffic signal modules designed as retrofit replacements for existing signal lamps shall not require special tools for installation. They shall be a single, self-contained device, not requiring on-site assembly for installation into an existing traffic signal housing. The module shall be sealed to provide a weather tight enclosure and an insulating covering for all electrical connections and electronic components and shall fit securely in the housing. A one piece “U-shaped” cross section rubber gasket shall be provided with each module. This gasket shall fit around the perimeter of the module to ensure a weather tight fit between the door and the housing of the module. The module shall connect directly to existing electrical wiring by means of 6.35 mm (0.25 inch) female quick connect push on type terminals.

Material Requirements. Materials used for the lens and signal module construction shall conform to ASTM specifications for those materials.

Each LED signal module shall be identified on the back side with the manufacturer's trade mark, serial number, voltage rating, Volt-Ampere rating, power consumption (watts and volt amperes) and, if applicable, a vertical indexing indicator (i.e., "up arrow", or the word "UP" or "TOP"). Each LED signal
module shall also be identified on the back side with the part number as shown in the NYSDOT LED Traffic Signal Module QPL and the date of manufacture (month and year minimum). Single units shall have identification markings as to the type and color of the module. Bi-Modals shall be marked with model type.

Each LED signal module shall have a permanent sticker stating compliance to FCC Title 47, Subpart B, Section 15 regulations. The sticker will be located on the rear exterior of the unit.

A. Ball and Arrow Modules (Single and Bi-Modal) Only. Retrofit replacement LED signal modules shall fit into existing traffic signal housings built to the VTCSH Standard without modification to the housing. Installation of the retrofit replacement LED signal module into an existing signal housing shall only require the removal of the existing lamp components (i.e., lens, lamp module, gaskets, and reflector).

Red LED signal module lenses shall be tinted with the appropriate color to enhance on/off contrast. The material used to tint the lens shall not affect the luminous intensity or chromaticity and shall be uniform across the face of the lens. The Yellow and Green units shall be supplied with a clear lens. If a polymeric lens is used, a surface coating or chemical surface treatment shall be used to provide front surface abrasion resistance. The module lens shall be replaceable without the need for replacing the complete module unit.

The Arrow LED signal modules shall produce a pattern that conforms to the VTCSH standard for color, size and shape. The Arrow LED signal modules shall not require a specific orientation or have a variance in light output, pattern or visibility for any mounting orientation.

The lens of the LED signal module shall be capable of withstanding ultraviolet light (direct sunlight) exposure for a minimum time period of five years without exhibiting evidence of deterioration.

Each Ball LED shall have a sticker attached stating compliance to the ITE Standard for Color and Luminous Intensity and each Arrow LED shall have a sticker attached stating compliance to the ITE Standard for Color as specified in the VTCSH.

B. Pedestrian Modules (Single & Bi-Modal) Only.

Pedestrian LED traffic signal modules shall be designed as a retrofit replacement for the message bearing surface of a 300 mm by 300 mm or a 410 mm by 450 mm (with a 60 mm corner radius), pedestrian traffic signal housing built to the PTCSI Standard. The Single Pedestrian module shall be designed to display either a “HAND” or “WALKING MAN” symbol that complies with PTCSI standard for this symbol for the size specified. The Bi-Modal Pedestrian module shall be designed to display both “HAND” and “WALKING MAN” symbols that comply with the PTCSI standard for these symbols for the size specified.

The “HAND” and “MAN” symbols for both the Single and Bi-Modal Pedestrian shall be designed so that the entire area comprising the symbol appears illuminated. Outlined shapes will not be accepted.

The LED signal module shall fit into existing Pedestrian signal housings without the need to modify the housing. Installation of the retrofit replacement Pedestrian LED signal module into pedestrian signal housing shall only require the removal of the existing message bearing surface, existing lamp components (i.e., lens, lamp module, gaskets, and reflector), and insertion of the retrofit replacement into the area once occupied by the removed assembly.

Each pedestrian module shall have a sticker attached stating compliance to the ITE standard for chromaticity as defined in the PTCSI.

Optical

A. Ball and Arrow Modules (Single & Bi-modal) Only. The measured chromaticity coordinates of Ball and Arrow LED signal modules shall conform to the chromaticity requirements of Section 8.04, Limits of Chromaticity Coordinates and the associated Figure 1 of the VTCSH standard.

The light output distribution for Ball LED traffic signal modules shall be as defined in Section 11.04 and Table 1 of the VTCSH standard. The minimum luminous intensity values for Ball LED traffic signal modules shall be, at a line voltage of 120 ±3 volts rms, as listed in Table 1 of the VTCHS standard. Variations in operating line voltage of between 80 and 135 volts rms shall have
minimal effect (less than ±10%) on luminous output of the signal module. Minimum Initial Luminous Intensities of units supplied shall equal or exceed, at 2°C, 117.5% of the values defined in Table 1—Maintained Minimum Luminous Intensity Table—of the VTCSH standard for LED signal modules.

Ball LED signal modules, except for yellow modules, shall be designed so that when operated over the specified operating ambient temperature and voltage ranges during the luminous intensity warranty period, the luminous intensity of the unit shall exceed or equal the values shown in Table 1, “Maintained Minimum Luminous Intensity Table” of the VTCSH standard for LED signal modules.

Yellow modules shall be designed so that when operated at 25°C over the specified voltage range during the luminous intensity warranty period, the luminous intensity of the unit shall equal or exceed the values shown for the color Green.

Arrow LED signal modules shall be designed so that when operated over the specified ambient temperature and voltage ranges, the signal is clearly visible and attracts attention for a distance of at least 400 m under normal atmospheric conditions.

**B. Pedestrian Modules (Single & Bi-Modal) Only.** The measured chromaticity coordinates of Pedestrian LED signal modules shall conform to the chromaticity requirements of Section 5.3, Color and the associated Figure C of the PTCSI standard.

Pedestrian LED signal modules shall be designed so that when operated over the specified ambient temperature and voltage ranges, the signal shall attract the attention of, and be readable to, a viewer (at both day and night) at all distances from 3 m to the full distance to be crossed.

**Performance Tests**

**A. All LED Modules.** Prior to shipment, the vendor shall energize (burn in) each LED signal module for a minimum of 24 hours, at rated voltage, and at a 100 percent on-time duty cycle. This test shall be conducted at the rated voltage in an ambient temperature of 60°C. Any failure within an LED signal module occurring during burn-in shall be cause for rejection.

After burn-in procedure is completed, the following additional tests shall be performed. These tests shall be performed at rated operating voltage and at 25°C unless otherwise specified. All units shall be powered off for a period of 1 second and then powered back on. Any unit failing to turn on after power restoration shall be rejected. This test shall be performed a minimum of 10 times.

A sample of 10% of units of each configuration, Balls or Arrows or Pedestrian signal modules, on the order shall be randomly selected and tested by the vendor in a flashing mode of operation, at 50 percent duty cycle with a 0.5 sec on time, and for a 24 hour period at 60°C. Any unit failing to function properly shall result in failure of the entire lot from which the sample was selected. Should this occur, the entire quantity ordered shall be tested as described above, and units not functioning properly shall be rejected.

Each LED signal module shall be visually inspected for any exterior physical damage or assembly anomalies. Careful attention shall be paid to the surface of the lens to ensure there are no scratches (abrasions), cracks, chips, discoloration, or other defects.

Each LED signal module shall be tested to ensure light output at 80 and 135 volts without adverse operational effects. Each LED signal under test shall be operated at each voltage level for a time period of five minutes. Signal modules illuminating with any adverse operational effects shall be rejected.

Contractors shall provide, with each shipment, a Manufacturer’s Certification of compliance. The certification shall certify that the LED signal modules comply with the requirements of these specifications. In addition to the certification, the modules shall be supplied with a list of the serial numbers of the units, copies of all applicable test reports on the LED signal modules, and signature of the person responsible for certifying the tests.

**B. Ball Modules only.** Each Ball LED signal module shall be tested for rated initial intensity. A single point measurement (at -2.5° V, 2.5° R or L) with a correlation to the minimum intensity requirements specified herein may be used. This test shall be performed after the burn-in procedure is completed, at rated operating voltage and at 25°C unless otherwise specified.
A. All LED modules. All wiring and terminal blocks shall meet the requirements of Section 13.02 Wiring of the VTCSH standard. Each wire shall be approximately 1 m long. Units shall be supplied with color coded wires as defined below:

- Red Balls & Red Arrows-Red & White
- Yellow Balls & Yellow Arrows-Yellow & White
- Green Balls & Green Arrows-Brown & White
- Bi-Modal Arrows-Brown (Green Arrow), Yellow & White (Common)
- Bi-Modal Pedestrians- Red (Hand), Brown (Man) & White (Common)
- Single Pedestrians (Hand)- Red & White
- Single Pedestrians (Walk Man)- Brown & White

The LED signal module shall operate with AC line voltage ranging from 80 volts to 135 volts rms 60±3 Hz. The circuitry shall prevent flicker over this voltage range. Rated voltage for all optical and power measurements shall be 120±3 volts rms.

The signal module on-board circuitry shall include voltage surge protection to withstand high-repetition noise transients and low-repetition high energy transients as stated in Section 2.1.6, NEMA Standard TS-2.

Each LED signal module shall be designed so that there is no noticeable light output when connected to rated voltage through an impedance of 15 kohm (either resistive or capacitive).

The signal module shall be designed so that, under normal operation, an AC voltage of no greater than 10 volts rms shall be developed across the unit when it is connected in series with any value of impedance greater than 15 kohm and for any applied AC voltage between 80 and 135 volts rms that is connected across this series combination. In addition, the signal module shall be designed so that the voltage across the module shall reduce in value to less than 10 volts rms within 100 msec when the module is switched off by any solid state switch or switchpack having an impedance of 15 kohm or greater.

The individual LED light sources shall be wired so that a catastrophic failure of one LED light source will not result in the loss of illumination of more than four LED light sources.

The LED signal module and associated on board circuitry shall meet Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise. All modules shall contain filtering dedicated to prevent inducing electronic noise into the AC power lines.

Modules shall be fused using a time-delay fuse. The fuse shall be located so that it can be easily changed without the need to disassemble the module. If in-line fuses are added into module wire leads, they will be installed in the colored wires of the units. Each individual circuit in the Bi-Modal models shall be fused separately.

All printed circuit boards used in the module shall be coated with a conformal coating containing an ultraviolet tracer.

All unit types shall be operationally compatible with the traffic signal equipment that each type is designed and intended to interface with. This equipment includes all controllers, conflict monitors, current monitors, switchpack and flashers currently in use by the Department.

B. NYSDOT Standard & Type A LED Module Definitions. NYSDOT Standard Units shall be designed so that a normally functioning signal module will generate the needed current to prevent a Model 215 Current Monitor from detecting a loss of current over the voltage range of between 95 and 135 volts rms. The minimum current required to prevent the Model 215 monitor from detecting a loss of current is a 500 milliamp peak AC or pulsed current with a minimum pulse width of 3 msec. Signal modules designed to specifically generate current pulses to prevent the monitor from tripping shall, as a minimum, generate 6 pulses per second. Generated current pulses shall be evenly spaced, with the first pulse generated within 100 msec after the application of AC power. (Additional information regarding the operation of the Model 215 Current Monitor can be obtained in the latest "New York State Transportation Management Equipment Specifications").

NYSDOT Standard Units shall incorporate circuitry to reliably detect the total loss of LED current due to failures such as, but not limited to, open circuits and power supply problems. Upon
detection of this failure, this circuit will disable any current generating circuitry within 400 msec to allow detection of this failure by a Model 215 current monitor.

Type “A” units shall be supplied without the necessary circuitry to function with a Model 215 current monitor.

Total harmonic distortion (current and voltage) induced into an AC power line for Type A units operating at rated voltage shall not exceed 20 percent for units consuming greater than 15 watts at 25°C and 40 percent for units consuming less than 15 watts at 25°C.

All Ball and Single Arrow LED modules may be procured using this specification as either NYSDOT Standard or Type A units. Single Pedestrian, Bi-Modal Pedestrian, and Bi-Modal Arrows will be procured as Type A only.

The maximum power consumption shall not exceed the following wattages at 25 degrees C:

<table>
<thead>
<tr>
<th>Size</th>
<th>LED Colors</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 mm Balls</td>
<td>Red-14 Yellow-24 Green-18</td>
</tr>
<tr>
<td>200 mm Balls</td>
<td>Red-10 Yellow-13 Green-13</td>
</tr>
<tr>
<td>300 mm Arrows</td>
<td>Red-10 Yellow-10 Green-10</td>
</tr>
<tr>
<td>Bi-Modal Arrows</td>
<td>Yellow-10 Green-10</td>
</tr>
<tr>
<td>300 mm by 300 mm Signal Pedestrian</td>
<td>Hand-9 Man-9</td>
</tr>
<tr>
<td>300 mm by 300 mm Bi-Modal Pedestrian</td>
<td>Hand-9 Man-9</td>
</tr>
<tr>
<td>410 mm by 450 mm Bi-Modal Pedestrian</td>
<td>Hand-12 Man-12</td>
</tr>
</tbody>
</table>

NYSDOT standard units supplied will meet the same low distortion standards without the current generating circuitry included in the measurement.

LED signal modules supplied in conformance with this specification shall have power factors of 0.90 or greater without the current generating circuitry included in the calculations for power factors for NYSDOT Standard units.

C. Pedestrian Modules (Single & Bi-Modal) Only. The maximum power consumed by a pedestrian LED unit shall not exceed 15 volt-amps (VA) at 120±3 volts rms.

Environmental. All LED signal modules shall be rated for use in the ambient temperature range of -40°C to +74°C. LED signal modules shall be sealed against dust and moisture intrusion per the requirements of NEMA Standard 250-1991 for Type 4 enclosures to protect all internal LED and electrical components. LED signal modules shall be capable of operating at rated voltage in an environment of +74°C /85% RH for 1000 hours without the formation of internal condensing moisture.

BASIS OF ACCEPTANCE. Acceptance of signal heads, sections, and/or LED signal modules will be based on manufacturer's certification of compliance with these specification requirements, a list of serial numbers of the units being supplied, copies of all applicable test reports on the signal modules, and signature of the person responsible for certifying the tests. In addition, LED module model number and manufacturer's name must be listed on the NYS Signal Qualified Products List (QPL). The QPL can be obtained from the NYSDOT website.

724-05 THRU 724-07 (VACANT)

724-08 SHIELDED COMMUNICATION CABLE

SCOPE. This specification covers the material requirements and fabrication details of shielded communication cable for use with traffic signal systems.

MATERIALS AND CONSTRUCTION. The cable shall conform to the requirements of the International Municipal Signal Association (IMSA) specification 20-2 for polyethylene insulated, polyethylene jacketed communication cable with electrical shielding. The gauge and number of conductors shall be as specified in the plans. The conductors shall be stranded copper wire.

BASIS OF ACCEPTANCE. Acceptance of material will be based on the manufacturer's certification of compliance with these specification requirements.
724-09 SIGNAL CABLE WITH INTEGRAL MESSENGER

SCOPE. This specification covers the material requirements for signal cable with integral messenger for use with traffic signal systems and for aerial installations.

MATERIALS AND CONSTRUCTION. The cable shall conform to the requirements of the International Municipal Signal Association (IMSA) Specification 20-3. The gauge and number of conductors shall be as specified in the plans. The conductors shall be stranded copper wire.

BASIS OF ACCEPTANCE. Acceptance of material will be based on the manufacturer's certification of compliance with these specification requirements.

724-10 SHIELDED COMMUNICATION CABLE WITH INTEGRAL MESSENGER

SCOPE. This specification covers the material requirements for shielded communication cable with integral messenger for use with traffic signal systems and for aerial installations.

MATERIALS AND CONSTRUCTION. The cable shall conform to the requirements of the International Municipal Signal Association (IMSA) Specification 20-4. The gauge and number of conductors shall be as specified in the plans. The conductors shall be stranded copper wire.

BASIS OF ACCEPTANCE. Acceptance of material will be based on the manufacturer's certification of compliance with these specification requirements.

724-11 THRU 724-14 (VACANT)

724-15 FIRE PRE-EMPTION TELL-TALE LIGHT

SCOPE. This specification covers the material requirements for fire pre-emption tell-tale light.

MATERIALS AND CONSTRUCTION. The fire pre-emption tell-tale light shall consist of a Xenon flash tube rated at 10.76 Mlx and 2000 hours life. The flash rate shall be 60 to 80 flashes per minute. The tell-tale light shall be capable of normal operation between outside temperature from -46°C to +60°C. The tell-tale light shall be contained in a vandal resistant weatherproof housing and mounting with a blue heat resistant and shatterproof globe. It shall be visible through 360° horizontally. The fire pre-emption tell-tale light shall operate from a 115 volt 60 Hz. single phase power source.

BASIS OF ACCEPTANCE. Acceptance of the fire pre-emption tell-tale light shall be based on the manufacturer's certification of compliance with these specification requirements.

724-16 THRU 724-19 (VACANT)

724-20 INDUCTANCE LOOP WIRE

SCOPE. This specification covers the material requirements for wire used in inductance loop vehicle detectors.

MATERIALS AND CONSTRUCTION. Loop wire shall be one conductor No. 14 AWG wire loosely encased in a tube in conformance to the requirements of the International Municipal Signal Association (IMSA) Specification 51-5.

BASIS OF ACCEPTANCE. Acceptance of material will be based on the manufacturer's certification of compliance with these specification requirements.
724-21 SHIELDED LEAD-IN CABLE

SCOPE. This specification covers the material requirements for shielded lead-in cable used with inductance loop vehicle detectors.

MATERIALS AND CONSTRUCTION. The cable shall consist of No. 14 AWG conductors in conformance to the requirements of the International Municipal Signal Association (IMSA) Specification 50-2.

BASIS OF ACCEPTANCE. Acceptance of material will be based on the manufacturer's certification of compliance with these specification requirements.

724-22 ROADWAY LOOP EMBEDDING SEALER

SCOPE. This specification covers the material requirements for Roadway Loop Embedding Sealer used when installing inductance loops.

MATERIALS AND CONSTRUCTION. Roadway Loop Embedding Sealer shall be used to encapsulate Traffic Signal Loop Wires embedded in highway materials. The sealer shall be cold applied and may be a one or two component system, the viscosity of which shall be sufficient to allow the material to be either poured or placed under pressure and fully encapsulate the loop wires. The sealer shall be curable at temperatures of 4.5°C and above.

When the sealer is bonded to common paving materials, it shall have sufficient strength and resiliency to withstand stresses due to vibrations and differences in expansion and contraction as a result of temperature changes or traffic conditions. The sealer shall be compatible with the sheathing or covering of loop inductance wires.

TABLE 724-22-1 ROADWAY LOOP EMBEDDING SEALER PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Flexible</th>
<th></th>
<th></th>
<th>Hard</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min.</td>
<td>Max.</td>
<td>Min.</td>
<td>Max.</td>
<td></td>
</tr>
<tr>
<td>Hardness, Shore</td>
<td>ASTM D2240</td>
<td>A15</td>
<td>A40</td>
<td>A50</td>
<td>D65</td>
<td></td>
</tr>
<tr>
<td>Pot Life @22°C, minutes</td>
<td>NYSDOT 724-40E</td>
<td>15</td>
<td>---</td>
<td>15</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Curing Time (tack free surface)</td>
<td>NYSDOT 724-40E</td>
<td>---</td>
<td>2</td>
<td>---</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>(22°C, hours)</td>
<td>ASTMD412</td>
<td>345</td>
<td>---</td>
<td>2800</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Elongation, percent</td>
<td>ASTM D412</td>
<td>150</td>
<td>---</td>
<td>20</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Water Absorption, percent</td>
<td>NYSDOT 724-40E</td>
<td>---</td>
<td>1.0</td>
<td>---</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Adhesion to Asphalt Concrete, kg</td>
<td>NYSDOT 724-40E</td>
<td>91</td>
<td>---</td>
<td>227</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Adhesion to Concrete, kg</td>
<td>NYSDOT 724-40E</td>
<td>23</td>
<td>---</td>
<td>136</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Extension, mm</td>
<td>NYSDOT 724-40E</td>
<td>6.4</td>
<td>---</td>
<td>3</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Accelerated Weathering</td>
<td>NYSDOT 724-40E</td>
<td>No cracking, checking,</td>
<td>Chalking, or shrinking</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Flexible requires additional bend test)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Chemical Resistance. Cured sealer shall be resistant to most chemicals and solvents, including salts, acids, hydrocarbons, etc.

Packaged stability of each component in original unopened containers, stored in temperatures between 0°C and 38°C shall be a minimum of six months.

MATERIAL REQUIREMENTS. The material shall meet the requirements of either the Flexible or Hard designation in Table 724-22-1. Materials designated Flexible require a 180° mandrel bend test @ 26°C with no breaking as part of the accelerated weathering testing.

BASIS OF ACCEPTANCE. Applications for approval of Roadway Loop Embedding Sealer shall be submitted to the Materials Bureau by the manufacturer accompanied by a 4L sample of the product and all pertinent sealer information including, but not limited to, manufacturer's sealant test results, sealant...
application procedures and safety precautions. Upon approval by the Materials Bureau, the name of the product will be placed on an “approved list” of Roadway Loop Embedding Sealers for use on asphalt and/or concrete pavements based on the compatibility of the sealer with the pavement material. The product may then be accepted on the basis of the name brand labeled on the container.

724-23 PEDESTRIAN PUSH BUTTON AND SIGN

SCOPE. This specification covers the material requirements for pedestrian push button and sign.

MATERIAL AND CONSTRUCTION. The push button unit shall be a direct push type having a cast aluminum housing. The unit shall be strongly constructed, rugged, abuse and tamper proof and suitable for operation under all weather conditions. It shall be provided with one normally-opened contact with ample contact area. The contacts shall be a material which will provide low contact resistance throughout the life of the device. The housing shall be of a design or be provided with adaptors to facilitate mounting on poles of different diameters. The unit shall have a convenient means of wiring.

The sign may be either reflectorized or non-reflectorized, with legend as specified on the plans and in accordance with Part 210 of the New York State Manual of Uniform Traffic Control Devices.

BASIS OF ACCEPTANCE. Pedestrian push button and sign shall be accepted upon the manufacturer's certification of compliance with these specification requirements.

SECTION 725 - MISCELLANEOUS METALS AND PLASTICS

725-01 COPPER FLASHING

SCOPE. This specification covers the material requirements for copper flashing.

MATERIAL REQUIREMENTS. Sheet copper for flashing shall be rolled from copper fulfilling the requirements of ASTM B5. This sheet metal shall be cold rolled soft copper.

BASIS OF ACCEPTANCE. Acceptance of this material will be based on the manufacturer's certification that the material meets the specification requirements.

725-02 STEPS FOR MANHOLES

SCOPE. This specification covers the material requirements for steps used in manholes.

GENERAL. The minimum design live load, for steps, appurtenances and fastenings, shall be a single concentrated load of 13.5 kN. The live loads imposed by persons occupying the steps shall be considered to be concentrated at such points as will cause the maximum stress in the structural member being considered.

Steps shall be designed so a worker's foot cannot slide off the end. The minimum length of the rungs shall be 250 mm.

Whenever a combination of dissimilar types of metals are used in the manufacture of steps, appurtenances and fastenings, the materials shall be treated to prevent deleterious effects.

MATERIALS. Manhole steps shall be fabricated from one of the following:

Ferrous Metal. Steps shall conform to one of the following requirements:

Iron Castings Class 25A, 715-05
Malleable Iron Castings Grade 350/18, 715-09
Steel ASTM A575, Grade M 1020 galvanized in accordance with §719-01, Type 1.
The steps shall have a minimum cross sectional dimension of 25 mm exclusive of any coatings placed on them.

**Non-Ferrous Metal.** Steps shall conform to the following requirements:

- **Aluminum Castings**  Alloy 356-T6, 715-03.
- **Wrought Aluminum**  6061-T6, 6005-T5, or 6351-T6, 715-04

  When aluminum steps are used, the portion of the step which will be in direct contact with cement concrete or concrete mortar, shall be coated with a zinc chromate primer or bituminous material approved by the Materials Bureau.

**Reinforced Plastic.** Steps shall consist of polypropylene or other plastic material completely covering a steel core. The plastic may be extruded, cast, or molded into the standard size and shape manhole steps, and provide corrosion protection.

  The plastic material shall have the following characteristics:

  **A. Resistance to Salt and Caustic Solutions.** Resistance to the following solutions when submerged for 30 days:

  - 10% Sodium Chloride
  - 10% Hydrochloric Acid
  - 10% Sodium Hydroxide
  - 10% Sulfuric Acid

  **B. Flow Point.** A flow point of 160\(^\circ\)C or greater.

  **C. Flexibility.** It shall remain flexible over a temperature range of -30\(^\circ\)C to +120\(^\circ\)C upon long aging.

  **D. Fire Resistance.** It shall be non-burning, self-extinguishing, or very slow burning.

  The steel core shall be not less than 12 mm diameter and shall have the following physical characteristics:

  - Tensile Yield, Minimum 275 MPa
  - Tensile Strength, Minimum 482 MPa

  The plastic step, when cast into a concrete block the proper depth, shall withstand a minimum load of 13.5 kN applied on 625 mm\(^2\) area in the center of the step without cracking or breaking the plastic coating, loosening the step in the concrete or permanently deforming the step.

**Basis of Acceptance.** Manhole steps shall be accepted on the basis of the manufacturer’s certification of compliance with this specification. However, the Department reserves the right to take random samples at any time for testing for compliance with the requirements of this specification.

**SECTION 726 (VACANT)**

**SECTION 727 - PAVEMENT MARKING MATERIALS**

**727-01 WHITE AND YELLOW THERMOPLASTIC REFLECTORIZED PAVEMENT MARKINGS**

**SCOPE.** This specification covers the white and yellow thermoplastic reflectorized pavement striping material that is extruded, in a molten state, onto the pavement. Following a surface application of glass beads and upon cooling to normal pavement temperatures, the resultant marking is an adherent reflectorized stripe, of specified thickness and width, that is capable of resisting deformation by traffic.
GENERAL. Methods and requirements for applying thermoplastic markings shall be as specified in section 687, Thermoplastic Reflectorized Pavement Markings.

MATERIAL REQUIREMENTS

Thermoplastic Composition. The thermoplastic composition shall be specifically formulated for application at temperatures greater than 205°C. The components in the composition shall show no significant break-down, or deterioration at 246°C.

The binder component shall be formulated as a hydrocarbon resin; or it shall be formulated as a mixture of high boiling point monohydric primary alcohol and modified maleic resin; or the manufacturer may submit an optional binder formulation to the Materials Bureau for evaluation and approval. The pigment, beads and filler shall be uniformly dispersed in the binder resin.

The thermoplastic composition shall be free from all skins, dirt and foreign objects and shall comply with the following requirements:

<table>
<thead>
<tr>
<th>Component</th>
<th>% by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>White</td>
</tr>
<tr>
<td>Binder</td>
<td>17.0 min</td>
</tr>
<tr>
<td>Titanium Dioxide</td>
<td>10.0 min</td>
</tr>
<tr>
<td>Glass Beads</td>
<td>30-40</td>
</tr>
<tr>
<td>Calcium Carbonate &amp; Inert Fillers</td>
<td>43.0 max</td>
</tr>
<tr>
<td>Yellow Pigments</td>
<td>---</td>
</tr>
</tbody>
</table>

* Amount and type of yellow pigment, calcium carbonate and inert fillers shall be at the option of the manufacturer, providing the other composition requirements of this specification are met.

Physical Properties of Composition.

A. Color. White thermoplastic composition, as placed, shall be white, free from dirt or tint. The color of the white composition shall be defined by the color chip in the possession of the Materials Bureau.

Yellow thermoplastic composition, as placed, shall be yellow, free from dirt or tint and shall be a reasonable visual match to Munsell Book Notation 10YR8/14 (ASTM D1535).

B. Drying Time. When installed at 21°C, and in thickness between 3 mm and 5 mm, the composition shall be completely solid and shall show no damaging effect from traffic after ten (10) minutes.

C. Yellowness Index. White thermoplastic composition shall not exceed a yellowness index of 0.12 when tested in accordance with AASHTO Designation T-250.

D. Softening Point. The composition shall have a softening point of not less than 90°C when tested in accordance with ASTM E28.

E. Specific Gravity. The specific gravity of the composition as determined by a water displacement method of 25°C shall be between 1.8 and 2.2 (referred to water at 25°C).

Reflective Glass Spheres (Pre-mix and Drop-On). Reflective glass spheres for use in the composition and for drop-on shall conform to the following requirements:

The glass spheres shall be colorless; clean; transparent; free from milkiness or excessive air bubbles; and essentially clean from surface scarring or scratching. They shall be spherical in shape and at least 70% of the glass beads shall be true spheres when tested in accordance with ASTM D1155.

The refractive index of the spheres shall be a minimum of 1.50 as determined by the liquid immersion method at 25°C.

The silica content of the glass spheres shall not be less than 60%.
The crushing resistance of the spheres shall be as follows: A 18 kg dead weight, for 850 \(\mu m\) to 600 \(\mu m\) mesh spheres, shall be the average resistance when tested in accordance with ASTM D1213.

The glass spheres shall have the following grading when tested in accordance with ASTM D1214 (Note: Requests for optional gradations may be submitted to the Materials Bureau for evaluation and approval):

<table>
<thead>
<tr>
<th>Standard Sieve</th>
<th>Mass % Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>850 (\mu m)</td>
<td>100</td>
</tr>
<tr>
<td>600 (\mu m)</td>
<td>79-95</td>
</tr>
<tr>
<td>300 (\mu m)</td>
<td>15-60</td>
</tr>
<tr>
<td>180 (\mu m)</td>
<td>0-15</td>
</tr>
</tbody>
</table>

Glass spheres for drop-ons shall be treated with a moisture-proof coating.

**Thermoplastic Primer.** The thermoplastic primer shall be specifically designed to enhance the bond of thermoplastic pavement markings to asphalt cement and/or portland cement concrete pavements.

The primer shall be either a one-component or two-component, cold or hot applied material of the type recommended by the thermoplastic pavement marking manufacturer.

Thermoplastic primers shall conform to current Federal, State and Local air pollution regulations, including those for the control (emission) of volatile organic compounds (VOC) as established by the U.S. Environmental Protection Agency, and the New York State Department of Environmental Conservation.

**PACKAGING AND SHIPPING.** The thermoplastic composition shall be shipped to the job site in containers that are strong, substantial and capable of being sealed in a manner approved by the Department. The containers shall be plainly marked with the manufacturer's name and address, New York State specification designation, date of manufacture and batch number.

The reflective glass spheres for drop-on application shall be shipped in moisture resistant bags. Each bag shall be marked with the name and address of the manufacturer and the name and net weight of the material.

Thermoplastic primers shall be shipped in pails, drums, or other strong substantial containers. Each container shall be plainly marked with the name of the product, the name and address of the manufacturer, the date of manufacture, the quantity of material, and the date of expiration or shelf life. In addition, two-component primer containers shall be identified as "Part A" and "Part B". Primers shall be shipped to the job site accompanied with written instructions for use.

**BASIS OF ACCEPTANCE.** White and yellow, thermoplastic, reflectorized pavement markings will be accepted on the basis of the manufacturer's name and location appearing on the Department's Approved List and a material certification that specifies the product conforms to this specification.

Reflective glass spheres may be accepted at the job site on the basis of the manufacturer's certification, or samples may be submitted to the Materials Bureau for testing.

Thermoplastic primers shall be accepted at the job site on the basis of the manufacturer's certification that they conform to the requirements of this specification.

**727-02 WHITE AND YELLOW REMOVABLE REFLECTORIZED PAVEMENT MARKINGS**

**SCOPE.** This specification covers white and yellow removable reflectorized pavement marking material.

**GENERAL.** Methods and requirements for applying removable reflectorized pavement markings shall be as specified in Section 619 Maintenance and Protection of Traffic.

**MATERIAL REQUIREMENTS**

**General Requirements.** Removable pavement markings shall consist of white and yellow preformed reflectorized tape or white and yellow, raised type, reflectorized markers.
Removable preformed reflectorized marking tape shall be composed of a pigmented plastic or polymeric film, on a reinforced conformable backing. A retroreflective layer of glass spheres shall be bonded to, or embedded in the top surface. The preformed marking shall be pre-coated on its bottom side with a pressure sensitive adhesive and shall be capable of adhering to bituminous or portland cement concrete surfaces without the use of heat, solvents or other means.

Removable raised type reflective markers shall be designed as single units, and consist of an acrylic plastic or another type of durable casing, containing one or two reflective faces. The marker casing shall be approximately square in shape and designed to provide maximum daytime delineation. The removable marker shall be adhered to bituminous or portland cement concrete surfaces using the adhesives and/or methods recommended by the manufacturer.

**Physical Properties**

**A. Color.** White removable markings, as placed, shall be white, free from dirt or tint. Yellow removable markings, as placed, shall be yellow, free from dirt or tint, and conform to Highway Color Tolerance Chart, PR#1 (U.S. Department of Transportation, Federal Highway Administration, December, 1972).

**B. Size.** Removable preformed marking tape shall be of the specified size and shape and conform to the applicable requirements of the M.U.T.C.D. Removable raised type markers shall be fabricated to the following requirements:

1. **Casing dimensions.** The minimum casing dimensions shall be 100 mm x 100 mm x 19 mm.

2. **Area of each reflective lens.** The minimum area of the reflective lens shall be 245 mm².

**C. Reflectance**

1. **White and Yellow Preformed Tape.** Glass spheres for retro-reflectivity shall have a refractive index of not less than 1.50, as determined by the liquid immersion method at 25°C. The spheres shall be firmly bonded, or embedded in the surface of the marking tape.

The quantity of glass spheres shall be such that white and yellow preformed markings have the following initial average reflectance values at 0.2° and 0.5° observation angles and 86.0° entrance angle as measured in accordance with the testing procedures of Federal Test Method Standard 370. The photometric quantity to be measured shall be specific luminance (SL) and it shall be expressed as millicandelas per square meter per lux.

<table>
<thead>
<tr>
<th>TABLE 727-02-1  PREFORMED TAPE REFLECTANCE REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
</tr>
<tr>
<td>Observation Angle</td>
</tr>
<tr>
<td>Specific Luminance, ((mcd•m⁻²)lx⁻¹)</td>
</tr>
</tbody>
</table>

2. **White and Yellow Reflective Marker Lenses.** White and yellow reflective lenses shall have the following initial average reflectance values, when measured with incident light parallel to the base of the marker, at an observation angle of 0.2° and entrance angles of 0° and 20°. The photometric quantity to be measured shall be specific intensity (SI) and it shall be expressed as millicandelas per lux.

<table>
<thead>
<tr>
<th>TABLE 727-02-2  REFLECTIVE MARKER LENSES REFLECTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
</tr>
<tr>
<td>Entrance Angle</td>
</tr>
<tr>
<td>Specific Intensity (mcd/lx)</td>
</tr>
</tbody>
</table>

**NOTES:**

1. Observation Angle. Shall mean the angle at the reflector between the observer's line of sight and the direction of light incident on the reflector.
2. Entrance Angle. Shall mean the angle in the horizontal plane between the direction of incident light and the normal to the leading edge of reflective marker.
3. Specific Intensity. Shall mean the luminous intensity (candelas) of returned light at the chosen observation and entrance angles for each lux of illumination at the reflector on a plane perpendicular to the incident light.
4. Photometric Test Procedure. The reflective marker to be tested shall be located with the center of the reflective lens at a distance of 1.5 m from a uniformly bright light source, having an effective diameter of 5.1 mm. The return of light shall be measured using an annular ring photocell (9.4 mm I.D. x 11.9 mm O.D.). The photocell shall be shielded to eliminate stray light. The distance from the light source center to the photocell center shall be 5.3 mm. If a test distance of other than 1.5 m is used, the source and receiver shall be modified in the same proportion as the test distance.

D. Removability. Preformed marking tapes and raised type markers shall be removable from bituminous and portland cement concrete pavements, intact or in substantially large pieces, either manually or by the use of a mechanical roll-up device, and without the use of heat, solvents, grinding or blasting. After removal, no permanent marks, scars or damage to the pavement surface shall result.

BASIS OF ACCEPTANCE. Removable marking materials shall be approved by the Materials Bureau. Detailed requirements and procedures for approval are available from the Materials Bureau.

Approval of removable markings will be based on engineering analysis for conformance with this specification and controlled field testing prior to their use on a Department project. If the proposed marking meets the specification requirements and performs satisfactorily in the controlled field tests, the product will be placed on the Department's “Approved List” of materials.

In no case shall the appearance of a marking material on the Department's approved list release the Contractor from compliance with the requirements under “Construction Details” of this specification. Neither shall its approval be considered a warranty by the State of satisfactory performance.

Project acceptance will be based on the appearance of the marking material on the Department's "Approved List" of removable reflectorized pavement markings.

727-03 WHITE AND YELLOW EPOXY REFLECTORIZED PAVEMENT MARKINGS

SCOPE. This specification covers white and yellow epoxy reflectorized pavement striping material that is sprayed onto the pavement. Following a surface application of glass beads and upon drying, the resultant marking is a reflectorized stripe of specified thickness and width, that is capable of resisting deformation by traffic.

GENERAL. Methods and requirements for applying epoxy markings shall be as specified in Section 685, Epoxy Reflectorized Pavement Markings.

MATERIAL REQUIREMENTS

Epoxy Material Composition. The epoxy resin composition shall be specifically formulated for use as a pavement marking material and for hot-spray application at elevated temperatures. The type and amounts of epoxy resins and curing agents shall be at the option of the manufacturer, providing the other composition and physical requirements of this specification are met.

The epoxy marking material shall be two-component (Part A and Part B), 100% solids type system formulated and designed to provide a simple volumetric mixing ratio (e.g. two volumes of Part A to one volume of Part B).

The epoxy marking material shall be supplied as either a regular-dry or a slow-dry material. Regular-dry may be used for all marking patterns. Slow-dry material is intended for marking hatchlines, edgelines, and other marking patterns located out of the general path of traffic.

A. Part A. Part A of either white or yellow shall conform to the following requirements:

<table>
<thead>
<tr>
<th>MARKING COLOR</th>
<th>MATERIAL (ASTM REF., TYPE)</th>
<th>PERCENT WEIGHT OF PART A</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>Titanium Dioxide (D476, II)</td>
<td>18 Minimum 75 to 82</td>
</tr>
<tr>
<td>Yellow</td>
<td>Medium Chrome Yellow (D211, Type III)</td>
<td>23 Minimum 70 to 77</td>
</tr>
</tbody>
</table>
ASTM D2371 shall be used to determine the pigment content of Part A, except toluene shall be substituted for benzene in the extraction mixture. No extender pigments are permitted. The white pigment, upon analysis, shall contain a minimum of 16.5% TiO$_2$ (100% purity). The yellow pigment, upon analysis, shall contain a minimum of 20% PbCrO$_4$ (100% purity).

The epoxy content of the epoxy resin in Part A will be tested in accordance with ASTM D1652 and calculated as the weight per epoxy equivalent (WPE) for both white and yellow. The epoxy content will be determined on a pigment free basis. The epoxy content (WPE) shall meet a target value provided by the manufacturer and approved by the Director, Materials Bureau. A ±50 tolerance will be applied to the target value to establish the acceptance range.

**B. Part B.** The amine value of Part B shall be tested in accordance with ASTM D2074 to determine its total amine value. The manufacturer may specify an alternate test method for determining the amine value subject to the approval of the Director, Materials Bureau. The total amine shall meet a target value provided by the manufacturer and approved by the Director, Materials Bureau. A ±50 tolerance will be applied to the target value to establish the acceptance range.

**Physical Properties of Mixed Components (Part A and Part B).** Unless otherwise noted, all samples are to be prepared tested at an ambient temperature of 23 ± 2°C.

**A. Color.** The white epoxy composition shall be an approximate visual color match to Munsell Book Notation N 9.5/0 (ASTM D1535) when viewed under North Standard Daylight.

The yellow epoxy composition shall be within the following chromaticity coordinate limits.

<table>
<thead>
<tr>
<th>TABLE 727-03-1 CHROMATICITY COORDINATES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coordinate</td>
</tr>
<tr>
<td>x</td>
</tr>
<tr>
<td>y</td>
</tr>
</tbody>
</table>

Chromaticity coordinate testing shall be performed in accordance with ASTM E1347 using a color spectrophotometer with a 45° circumferential illumination/0° viewing geometry, illuminant C, and 2° standard observer angle. The color instrument shall measure the visible spectrum from 380 to 720 nm with a wavelength interval and spectral bandpass of 10 nm. The sample port aperture shall be 32 mm.

Yellow epoxy samples that are within the chromaticity coordinate limits but which visually are determined to significantly deviate from the color of normal quality assurance samples shall be compared to a visual color standard. Yellow epoxy samples shall be an approximate visual color match to Munsell Book Notation 10YR 8/14 (ASTM D1535) when viewed under North Standard Daylight.

Test specimens shall be prepared by applying the epoxy at a 0.38 mm ± 0.02 mm wet film thickness (without glass spheres) to a test panel consisting of a smooth rigid material, a smooth paper chart, smooth cardboard, or other suitable material and allowing the specimens to dry for a minimum 24 hours prior to testing.

**B. Directional Reflectance.** The directional reflectance (represented by CIE tristimulus value Y) of the white and the yellow epoxy composition shall be a minimum 84% and 54%, respectively, relative to a white standard.

Testing shall be performed in accordance with ASTM E1347 using a color spectrophotometer with a 45° circumferential illumination/0° viewing geometry, illuminant C, and 2° standard observer angle. The color instrument shall measure the visible spectrum from 380 to 720 nm with a wavelength interval and spectral bandpass of 10 nm. The sample port aperture shall be 32 mm.

The test specimens shall be prepared by applying the epoxy composition (without glass spheres) to black and white contrast panels (Leneta Form 5C or equivalent) to produce a wet film thickness of 0.38 mm ± 0.02 mm. The test specimens shall be allowed to dry for a minimum of 24 hours prior to testing.
C. Drying Time (Laboratory). When tested in accordance with ASTM D711 as modified below, regular-dry epoxy marking material shall reach a no-pick-up time in 30 minutes or less. Under these same test conditions, slow-dry epoxy marking material shall reach a no-pick-up time in 60 minutes or less. A Bird Applicator or other suitable instrument shall be used to spread a nominal 0.38 ± 0.02 mm thick wet film. Reflective glass spheres shall be immediately dropped onto the epoxy film at a rate of 3 kg/L.

D. Drying Time (Field). When installed at 25°C at the specified wet film thickness and reflectorized with glass spheres, regular-dry and slow-dry epoxy markings shall reach a no-track condition in approximately 30 minutes, and 60 minutes, respectively. Dry to “no-tracking” shall be considered as the condition where no visual deposition of the epoxy marking to the pavement surface is observed when viewed from a distance of 15 m, after a passenger car is passed over the line.

E. Hardness. The epoxy composition when tested in accordance with ASTM D2240 shall have a Shore D hardness of between 75 and 100. Samples shall be allowed to cure for not less than 72 hours nor more than 96 hours prior to testing.

F. Infrared Spectrophotometer Analysis (ASTM D2621). Samples of Part A and Part B shall be analyzed by infrared spectrography. The spectrum of each component shall be a reasonable match to the spectrum of the original formulation accepted by the Materials Bureau for the Department of Transportation Approved List of Materials.

Reflective Glass Spheres. Reflective glass spheres for drop-on application shall conform to the following requirements:

The glass spheres shall be colorless, clean, transparent, free from milkiness or excessive air bubbles, and essentially clean from surface scarring or scratching. They shall be spherical in shape and at least 70% of the glass beads shall be true spheres when tested in accordance with ASTM D1155, Procedure A.

The refractive index of the spheres shall be a minimum of 1.50 as determined by the liquid immersion method at 25°C.

The silica content of the glass spheres shall not be less than 60%.

The glass spheres shall have the following gradation when tested in accordance with ASTM D1214.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>850 µm</th>
<th>600 µm</th>
<th>300 µm</th>
<th>180 µm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent Passing</td>
<td>100</td>
<td>80-95</td>
<td>9-42</td>
<td>0-10</td>
</tr>
</tbody>
</table>

The reflective glass spheres shall be treated with either a moisture-resistant coating or with a dual purpose type coating (moisture-resistant and adherence). The treated glass spheres shall flow freely from the dispensing equipment at any time when surface and atmospheric conditions are satisfactory for marking operations.

PACKAGING, SHIPMENT AND MARKING

Epoxy. Epoxy pavement marking materials shall be shipped to the job site in strong, substantial containers. Individual containers shall be plainly marked with the following information:

- Name of Product
- Item Number
- Lot Number
- Batch Number
- Test Number
- Date of Manufacture
- Date of Expiration of Acceptance (6 months from date of manufacture)
- The Statement (as appropriate): “Part A - Contains Pigment and Epoxy Resin,” or “Part B - Contains Catalyst”
Reflective Glass Spheres. Reflective glass spheres shall be shipped in moisture resistant bags or boxes. Each bag or box shall be marked with the name and address of the manufacturer, the brand name or product code of the glass sphere, the lot/batch number, the date of manufacture (mm/yy), and net weight of the material.

BASIS OF ACCEPTANCE. White and yellow, epoxy, reflectorized pavement markings will be accepted on the basis of the manufacturer's name and location appearing on the Department’s Approved List and a material certification that specifies the product conforms to this specification.

All acceptances of uninstalled epoxy marking material shall expire six (6) months after the date of manufacture.

Reflective glass spheres may be accepted at the job site on the basis of the manufacturer's certification, or they may be submitted to the Materials Bureau for testing.

727-04 WHITE AND YELLOW PREFORMED REFLECTORIZED PAVEMENT MARKINGS

SCOPE. This specification covers the white and yellow preformed pavement stripes that are applied to the pavement, resulting in a marking that is capable of resisting deformation by traffic.

GENERAL. Methods and requirements for applying preformed markings are specified in Section 688, Preformed Reflectorized Pavement Markings. White and yellow preformed markings shall be composed of a mixture of plastics or polymeric materials, resins, pigments, and reflective glass and/or ceramic spheres that are uniformly distributed throughout the thickness of the material. In addition, a reflective layer of glass and/or ceramic spheres shall be bonded to, or embedded in the top surface.

The preformed markings shall be pre-coated, on its bottom side, with a pressure sensitive adhesive for adherence to bituminous or portland cement concrete surfaces.

The finished preformed marking material shall be of the specified dimension and shape, of good appearance, and free of cracks or other defects. The edges shall be clean cut and well defined. The material shall be weather resistant and through normal traffic wear shall show no appreciable fading, lifting or shrinkage.

When properly applied, the preformed markings shall be capable of molding itself to the contours, breaks and faults of bituminous or portland cement concrete surfaces; and shall show no significant tearing, roll-back, lifting or other signs of poor adhesion.

PHYSICAL PROPERTIES

Color. White preformed pavement markings, as placed, shall be white, free from dirt or tint. The color of the white marking shall be defined by the color chip in the possession of the Materials Bureau.

Yellow preformed pavement markings, as placed, shall be yellow, free from dirt or tint and shall be a reasonable visual match to Munsell Book Notation 10YR 8/14 (ASTM D1535).

Thickness. Preformed pavement marking material shall be a uniform film having a minimum thickness of 1.5 mm, or it shall be a patterned type material having a minimum thickness of 0.5 mm at the thinnest portions and a minimum thickness of 1.5 mm at the thickest portions of the patterned cross-section. The patterned top surface shall have approximately 50% of the surface area raised, and its design shall provide immediate and continuing retroreflection.

Reflective Glass and Ceramic Spheres. Glass and ceramic spheres for use in the preformed marking composition and for surface application shall have a refractive index of not less than 1.50, as determined by the liquid immersion method at 25°C.
Friction Resistance. The surface of the preformed marking material, with reflective glass and/or ceramic beads, shall provide a minimum friction resistance value of 45 BPN when tested in accordance with ASTM E303.

Tensile Strength. Preformed pavement marking material shall have a minimum tensile strength of 275 kPa when tested in accordance with ASTM D638M. Test specimens shall be Type MII prepared by die cutting with Die C as specified in ASTM D412, Test Method A. The testing machine shall operate at a speed of 5 mm per minute, and tests shall be conducted at an ambient temperature of \(23 \pm 2^\circ\text{C}\). For calculating the tensile strength of patterned type material, the thickness measurements shall be taken in the thinnest portions of the cross-sectional area.

Elongation. Preformed pavement marking material shall have a minimum elongation of 15% when tested in accordance with ASTM D638M, and under the conditions as specified for “e. Tensile Strength.” The chain extensometer shall be a Tinius Olsen Model R-2-1.

Plastic Pull Test. A 25 mm x 150 mm test specimen shall support a dead weight of 1.8 kg for not less than 5 minutes. Tests shall be conducted at an ambient temperature of \(23 \pm 2^\circ\text{C}\).

Primer. Primer or adhesive activators shall be of the type recommended by the manufacturer of the preformed marking material. All primers and adhesives shall conform to Federal, State, and Local regulations for the emission of volatile organic compounds (VOC).

PACKAGING AND SHIPMENT. Preformed reflectorized pavement marking and primer materials shall be shipped and packaged in accordance with commercially accepted standards. The following information shall be plainly marked on each container or on the shipping invoice: the name of the product, the name and address of the manufacturer, the quantity of material, the date of manufacture, and the date of expiration or the shelf life.

BASIS OF ACCEPTANCE. White and yellow preformed reflectorized pavement markings and primer materials shall be approved by the Materials Bureau. Detailed requirements and procedures for approval are available from the Materials Bureau.

Approval of preformed markings will be based on laboratory analysis and field testing prior to their use on a Department project. If the proposed marking passes the requirements for laboratory analysis and initial field tests and it is considered acceptable by the Director, Materials Bureau, the product will be placed on the Department's “Approved List” of materials.

Project acceptance will be based on the appearance of the marking and primer material on the Department's approved list of preformed reflectorized pavement markings.

727-05 GLASS BEADS FOR REFLECTORIZED PAVEMENT MARKING PAINTS

SCOPE. This specification covers reflectorizing glass beads for application to traffic zone paints for the production of a reflective surface.

GENERAL. Methods and requirements for the application of glass beads shall be as specified in 640, Reflectorized Pavement Marking Paints, of these specifications.

MATERIAL REQUIREMENTS. The beads shall be glass of a composition designed to be highly resistant to traffic wear and to the effects of weathering. The beads shall be colorless, clean, transparent, free from milkiness or excessive air bubbles, and essentially free from surface scarring or scratching. They shall be spherical in shape and at least 70% of the glass beads shall be true spheres.

The silica content of the glass beads shall not be less than 60%.

The beads shall have a refractive index between 1.50 and 1.65 when tested by the liquid immersion method at \(25^\circ\text{C}\).

The spheres shall meet the following gradation:
The beads shall show no tendency to absorb moisture in storage and shall remain free of clusters and hard lumps. They shall flow freely, and to the satisfaction of the Engineer, from the dispensing equipment at any time when surface and atmospheric conditions are satisfactory for painting.

The glass beads shall be packed in waterproof plastic lined burlap or plastic lined paper bags. Each bag shall be marked with the name and address of the manufacturer and the name and net weight of the material.

**TESTING.** The properties indicated above shall be determined in accordance with the following methods of test:

**A. Sphericity.** Irregularly shaped particles (out-of-round) shall be tested in accordance with ASTM D1155.

**B. Gradation.** Tested in accordance with ASTM D1214.

**C. Moisture Resistance.** The spheres shall pass the following moisture resistance test:
Place one kilogram of spheres in a washed cotton bag, having a thread count of approximately 8 per square centimeter (warp and woof) and immerse the bag in a container of water for 30 seconds. Remove the bag and force excess water from the sample by squeezing the bag. Suspend and allow to drain for two hours at room temperature (23 ± 2°C). Then, mix the sample in the bag by shaking thoroughly. Transfer sample slowly to a clean, dry glass funnel having a stem 100 mm in length, with a 9.5 mm inside diameter stem entrance opening and a minimum exit opening of 6.4 mm. The entire sample shall flow freely through the funnel without stoppage. When first introduced into the funnel, if the spheres clog, it is permissible to lightly tap the funnel to initiate the flow.

**BASIS OF ACCEPTANCE.** Application for approval of Glass Beads for use in Reflectorized Pavement Marking Paints shall be submitted to the Materials Bureau by the manufacturer, accompanied by one 27 kg bag sample of the product.

Upon approval by the Materials Bureau, the name of the product will be placed on an “approved list” of Glass Beads for Use in Reflectorized Pavement Marking Paints. This product may then be accepted on the basis of the brand name labeled on the container.

**SECTION 728 - COMPRESSIVE LOAD TRANSMITTING DEVICES**

**728-01 RUBBER IMPREGNATED WOVEN COTTON-POLYESTER FABRIC**

**SCOPE.** This specification covers the material requirements, tests and basis of acceptance for rubber impregnated, woven, cotton-polyester fabric.

**MATERIAL REQUIREMENTS.** Rubber impregnated woven cotton-polyester fabric shall be composed of multiple layers of prestressed cotton-polyester duck with a minimum mass of 0.25 kg/m², impregnated and bound with high quality rubber compound, containing rot and mildew inhibitors and anti-oxidants. The duck warp count shall be 50 ± 1 threads per 25 mm and the filling count shall be 40 ± 2 threads per 25 mm. Each thread shall contain 2 yarns. The material shall contain 64 plies per 25 mm. The number of piles in the furnished material shall be such as to produce the specified thickness.

**TEST.** This material shall exhibit a maximum load deflection of 10% at 6.9 MPa when tested in accordance with MIL-C-882.
§728

BASIS OF ACCEPTANCE. This material will be accepted on the basis of the manufacturer's certification of compliance with these specification requirements.

728-02 RUBBER IMPREGNATED RANDOM FIBER PAD

SCOPE. This specification covers the material requirements, tests and basis of acceptance for rubber impregnated random fiber pads.

MATERIAL REQUIREMENTS. Rubber impregnated random fiber pad shall be composed of a high quality elastomer with a random distribution of non-asbestos fibers.

BASIS OF ACCEPTANCE. Rubber impregnated random fiber pad shall be accepted on the basis of the manufacturer's certification of compliance with these specification requirements.

728-03 PLAIN RUBBER PAD

SCOPE. This specification covers the material requirements, tests and basis of acceptance for plain rubber pads.

MATERIAL REQUIREMENTS. Plain rubber vertical load transmitting devices shall contain only polychloroprene as the raw elastomer polymer. The physical properties of the cured material shall comply with ASTM D2000 Line Call Out M2BC514A14B34. The rubber pads shall be cast in a mold under pressure and heat, or may be furnished to Department projects if they have been carefully cut from a larger piece of fully molded material. Shape factors of each device, i.e., net load area divided by the area free to bulge, must exceed twelve (12).

TEST. One plain rubber pad sample per size shall be submitted by the Engineer to the Materials Bureau for destructive test.

BASIS OF ACCEPTANCE. The presence of the appropriate form, validated by the Materials Bureau, shall constitute evidence of acceptability at the job site for plain rubber pads.

728-04 SHEET LEAD

SCOPE. This specification covers the material requirements and basis of acceptance for sheet lead.

MATERIAL REQUIREMENTS. Sheet lead shall be lead plate of nominal 3 mm thickness, meeting the standard specification for Pig Lead, ASTM B29.

BASIS OF ACCEPTANCE. This material shall be accepted on the basis of a manufacturer's certification of compliance with this specification.

728-05 (VACANT)

728-06 SHEET GASKET (TREATED BOTH SIDES)

SCOPE. This specification covers the material requirements for sheet gasket, treated both sides with a parting agent to prevent adhesion to working surfaces. This material is used as a bond breaker and sliding surface in bridge construction.

MATERIAL REQUIREMENTS. The sheet gasket shall have a nominal 1.6 mm thickness and shall be treated on both sides with a parting agent. The material shall meet the following requirements:
### TABLE 728-06-1  SHEET GASKET REQUIREMENTS

<table>
<thead>
<tr>
<th>Property</th>
<th>ASTM Test Method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water absorption, maximum</td>
<td>C642</td>
<td>6.7%</td>
</tr>
<tr>
<td>Coefficient of static friction, maximum</td>
<td>D1894</td>
<td>0.36</td>
</tr>
<tr>
<td>Coefficient of kinetic friction, maximum</td>
<td>D1894</td>
<td>0.24</td>
</tr>
<tr>
<td>Tensile strength, MPa min., in the weakest direction</td>
<td>F152, Type 2</td>
<td>8.3</td>
</tr>
</tbody>
</table>

**BASIS OF ACCEPTANCE.** Application for approval of sheet gasket (treated both sides) shall be submitted to the Director, Materials Bureau. Upon approval, the name and manufacturer of the product shall be placed on the Department's Approved List.

**SECTION 729 (VACANT)**

**SECTION 730 - SIGNS AND DELINEATORS**

**730-01 ALUMINUM SIGN PANELS**

**SCOPE.** These specifications cover aluminum sign panels used as the prepared surface backing in the application of reflective sheeting for location markers, delineators and traffic signs.

**MATERIAL REQUIREMENTS.** The panel material shall be either Aluminum Alloy 6061-T6, 5154-H38, 5052-H38 or 3004-H38 and shall conform to the requirements of material specification §715-04, Wrought Aluminum.

**FABRICATION**

**Preparation of Panel Surface for Reflective Sheetin**g. The surface preparation of panels for the application of Reflective Sheetin, §730-05, shall be performed by Method I or Method II, in strict accordance with the recommendations of the manufacturer of the reflective sheeting.

#### A. Method I

1. **Cleaning (Vapor or Alkaline cleaning)**
   
a. **Vapor Cleaning.** By total immersion of the sheeting or sign panel in a saturated vapor of trichlorethylene or perchlorethylene. Trademark printing shall be removed with lacquer thinner. Follow with a thorough rinse.

   b. **Alkaline Cleaning.** Sheetin shall be immersed in a tank containing alkaline solutions, controlled and titrated to the solution manufacturer's specifications. Immersion time shall depend upon the amount of soil present and the gage of the metal. Follow with a thorough rinse.

   **NOTE:** After cleaning and rinsing and prior to etching, the aluminum sheetin shall be checked with a "Water Break Test" as follows: If the metal is clean, water will completely cover the surface with no breaks. Whenever water breaks, oil is present and the plate shall be re-cleaned until all traces of oil disappear. The surface near the edges shall be examined with extreme care for presence of oil.

2. **Etching (Use Acid or Alkaline Etch)**
   
a. **Acid Etch.** Etch in a 6% to 8% phosphoric acid solution at 38°C. Rinse thoroughly with running cold water followed by hot water rinse.

   b. **Alkaline Etch.** Etch the pre-cleaned aluminum surface in alkaline etching material that is controlled by titration, use time, temperature and concentration specified by the solution manufacturer. Rinse thoroughly, remove smut with an acidic chromium compound type solution as specified by the solution manufacturer and then thoroughly rinse.
B. Method II

Cleaning and Etching. Use a chemical conversion treatment in accordance with the requirements of Military Specification MIL-C-5541A, Chemical Films and Chemical Film Materials for Aluminum and Aluminum Alloys, or later addenda. Following the etching and rinsing, panels shall be dried by a forced hot air dryer or by immersion for one minute, in circulating hot water at 82°C and allowed to air dry.

Application of Reflective Sheeting. The metal shall not be handled between all cleaning operations and applications of the reflective sheeting except by device or clean canvas gloves.

Immediately prior to the application of the reflective sheeting, the aluminum panel shall be prepared as specified in Method I or Method II. The reflective sheeting shall be adhered to the aluminum panel by the vacuum applicator process or mechanical process in strict accordance with the recommendations of the manufacturer of the reflective sheeting.

Basis of Acceptance. Aluminum panels may be accepted on the basis of the manufacturer's certification that his/her product conforms to all of the above specifications. However, the Department reserves the right to conduct tests, upon aluminum panels supplied. When tests are to be made, all test samples without reflective sheeting applied shall be submitted to the Materials Bureau. The number of samples shall comprise approximately one percent of the number of panels. Each sample shall contain a minimum area of 0.1 m² for each thickness of panel used. Failure of the samples to meet all the requirements of the above specifications shall be cause for rejection of the aluminum panels represented by such samples.

730-02 PLYWOOD SIGN PANELS

Scope. These specifications cover plywood sign panels used in the construction of temporary and permanent guide signs.

General. Plywood sign panels for signs shall be 19 mm thick. The edges of all plywood used in sign panels or battens shall be painted with two coats of approved black paint. The overlay faces, on both sides, shall be black in color, hard, smooth, and of such quality that further finishing by paint or varnish is not required. Panels shall consist of a cellulose-fibre or sheets, in which not less than 40 percent by weight of the laminate shall be a thermosetting resin of the phenol or melamine type. The resin-impregnated material shall not be less than 0.2286 mm thick and shall weigh at least 29 kg/100 m² of single face, including both resin and fibre. The resin impregnation shall be sufficient to attach the surfacing material to the plywood. The bond shall be equal in performance to the glue lines between the sheets of veneer which make up the plywood.

Panel Preparation for Reflective Sheeting. In preparing the sign panel for material specification §730-05, Reflective Sheeting, the entire portion of the overlay surface to be covered, shall first be given a light, firm abrasion with steel wool (medium to fine grade) saturated with xylol, V.M.&P. Naphtha or similar commercial solvent. The surface shall then be wiped clean and dry. An alternate method of panel pre-treatment, which consists of a solvent wipe, immediately followed by vapor degreasing (trichloroethylene) for a minimum period of six (6) minutes may be used. After panel preparation, the edges of all panels and battens shall be painted with two coats of approved black paint. Panel and batten surfaces to be glued shall be slightly roughened with waterproof adhesive prior to assembly.

Each plywood shall be grade-marked and certified with the standards adopted by the Douglas Fir Plywood Association.
§730

BASIS OF ACCEPTANCE. Plywood sign panels may be accepted upon the manufacturer's certification that its product conforms to all of the above detailed specifications. However, the Department reserves the right to conduct tests on the plywood panels submitted. When tests are to be made, all test samples without reflective sheeting applied shall be submitted to the Materials Bureau. The number of test samples shall comprise one percent of the contract quantity and each sample shall have a minimum surface area of 0.1 m². Failure of the samples to meet all the requirements of the above specifications shall be cause for rejection of the plywood sign panels represented by such samples.

730-03 AND 730-04 (VACANT)

730-05 REFLECTIVE SHEETING

SCOPE. These specifications cover reflective sheeting for use in the fabrication of highway and construction signs, delineators and other traffic control devices.

GENERAL. The reflective sheeting supplied shall be colored, flexible, weather resistant, and shall have a smooth outer surface. If the reflective sheeting contains spherical lens elements, the lens elements shall be embedded within a transparent plastic, so as to produce a smooth, flat outer surface. All sheeting shall be of good appearance, free from ragged edges, cracks, scales, blisters, or other defects.

The back of the reflective sheeting shall be protected by a removable liner and shall include a precoated pressure-sensitive or a heat-activated adhesive, either of which may be applied without the necessity of additional adhesive tack coats on the reflective sheeting or application surface.

Reflective sheeting shall be one of the following ASTM D4956 types:

730-05.01 - ASTM Type I (Class A). A medium-intensity reflective sheeting often referred to as engineer grade. It is recommended for highway signs, except where high reflectivity is required, and for construction barricades, panels, and other work zone devices.

730-05.02 - ASTM Type III (Class B). A high-intensity reflective sheeting often referred to as high intensity. It is recommended for highway signs, construction signs, delineators, and other work zone devices.

730-05.03 - ASTM Type V (Class C). A super-high-intensity reflective sheeting recommended for delineators, construction barricades, and vertical panels. This material is not recommended for highway or construction zone sign faces.

730-05.04 - Fluorescent Orange (Class D). A fluorescent orange-colored sheeting with reflective properties similar to Class B high intensity. This sheeting is only recommended for use on orange-colored construction signs, and for the orange portions of construction barricades, vertical panels, and other work zone devices with rigid substrates, when a high level of conspicuity or visibility is needed.

730-05.05 - ASTM Type IX (Class E). A very-high-intensity retroreflective sheeting having highest retroreflective characteristics at short road distances. Recommended for permanent signs, delineators, construction zone devices, and vertical panels, when a high level of conspicuity or visibility is needed.

<table>
<thead>
<tr>
<th>Fluorescent Color</th>
<th>Luminance Factor (Y %) Min.</th>
<th>Maximum Spectral Radiance Factor(%)</th>
<th>Color Specification Limits 1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yt</td>
<td>Yf</td>
<td>x</td>
</tr>
<tr>
<td>Orange</td>
<td>25</td>
<td>15</td>
<td>110.0</td>
</tr>
<tr>
<td>Yellow</td>
<td>45</td>
<td>20</td>
<td>------</td>
</tr>
<tr>
<td>Yellow Green</td>
<td>60</td>
<td>20</td>
<td>------</td>
</tr>
</tbody>
</table>

NOTE: Four pairs of chromaticity coordinates determine acceptable color in terms of the CIE, 1931 Standard Colorimetric System measured with Standard Illuminant D₆₅.

NEW YORK STATE DEPARTMENT OF TRANSPORTATION
STANDARD SPECIFICATIONS of May 4, 2006
MATERIAL REQUIREMENTS. Reflective sheeting shall meet the requirements of ASTM D4956 and the following:

1. **Fluorescent Colors.** Shall conform to the requirements of Table 730-05-1.

2. **Fluorescent Orange Class D - 730-05.04.** Class D fluorescent orange reflective sheeting:

   A. **Coefficient of Retroreflection ($R_A$).** The coefficient of retroreflection shall meet or exceed the reflectivity requirements indicated in Table 730-05-2.

<table>
<thead>
<tr>
<th>Observation Angle (°)</th>
<th>Entrance Angle (°)</th>
<th>Minimum $R_A$ (cd/lx/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>- 4</td>
<td>100.0</td>
</tr>
<tr>
<td>0.2</td>
<td>+ 30</td>
<td>34.0</td>
</tr>
<tr>
<td>0.5</td>
<td>- 4</td>
<td>64.0</td>
</tr>
<tr>
<td>0.5</td>
<td>+ 30</td>
<td>22.0</td>
</tr>
</tbody>
</table>

   B. **Daytime Color.** The color shall conform to the requirements for luminance factor, maximum spectral radiance factor (peak reflectance), and color specification limits indicated in Table 730-05-1. Color measurements shall be determined in accordance with ASTM E991, using instrumentation which has circumferential viewing (illumination). Calculations shall be performed in accordance with ASTM E308 for the CIE 1931 2° standard observer.

   C. **Artificial Weathering.** After 1500 hours of artificial weathering performed in accordance with ASTM G 26, Method A, using a Type B weatherometer, the following requirements shall be met:
   - The minimum coefficient of retroreflection shall be 55.0 cd/lx/m² at 0.2 degree observation angle; - 4 degree entrance angle.
   - The luminance factor (Y Percent) shall be from 20.0 to 45.0.
   - The maximum spectral radiance factor (peak reflectance) shall not be less than 60.0 percent.
   - The color specification limits shall conform to the requirements shown above in Class D, B. **Daytime Color.**

3. **Type IX (Class E) - 730-05.05.** All colors shall conform to the requirements of ASTM D4956, except fluorescent colors. Fluorescent colors shall conform to the requirements of Table 730-05-1 and Table 730-05-3 of this specification.

<table>
<thead>
<tr>
<th>Observation Angle (°)</th>
<th>Entrance Angle (°)</th>
<th>0.1</th>
<th>0.2</th>
<th>0.5</th>
<th>1.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluorescent Orange</td>
<td>- 4°</td>
<td>200</td>
<td>115</td>
<td>72</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>+ 30°</td>
<td>110</td>
<td>34</td>
<td>22</td>
<td>14</td>
</tr>
<tr>
<td>Fluorescent Yellow</td>
<td>- 4°</td>
<td>400</td>
<td>240</td>
<td>165</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>+ 30°</td>
<td>250</td>
<td>150</td>
<td>75</td>
<td>24</td>
</tr>
<tr>
<td>Fluorescent Green</td>
<td>- 4°</td>
<td>540</td>
<td>325</td>
<td>235</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>+ 30°</td>
<td>380</td>
<td>200</td>
<td>105</td>
<td>35</td>
</tr>
</tbody>
</table>

FABRICATION. The reflective sheeting shall be so fabricated as to allow easy cutting to specified sizes and shapes.

The sheeting surface shall be solvent resistant and shall permit solvent cleaning. All solvents used for cleaning operations shall be as recommended by the sheeting manufacturer and shall comply with all Federal, State, and Local air quality regulations.
§730

To ensure uniform appearance and brilliance under both nighttime and daytime conditions, the reflective sheeting shall be cut, matched and positioned on the prepared sign panel or other substrate in strict accordance with the recommendations of the sheeting manufacturer. Backgrounds, characters, delineators, etc., shall be coated and/or edge sealed in accordance with the recommendations of the sheeting manufacturer. When performed, coating operations shall be done in a workmanlike manner so as to create an even, clear, uniform coat which shall be free of streaks, drops or other defects which might affect reflectivity.

Reflective sheeting shall be furnished in both rolls and sheets. Rolls shall be packed individually and contain not more than four splices per 46 m linear measurement. Cut sheets shall be packaged flat and in such a manner as to minimize any damage or defacement that may occur to the sheeting during shipment or storage. The sheeting surface shall be capable of being readily processed and be compatible with recommended transparent and opaque process inks. The finished sheeting surface shall show no loss of the color with normal handling, cutting and application.

TESTING. Outdoor test specimen panels shall include both unprocessed reflective sheeting and reflective sheeting processed with the manufacturer’s recommended transparent and opaque inks. Type I (Class A), Type III (Class B), and Type IX (Class E), except Type IX fluorescent orange, reflective sheetings shall be exposed outdoors on a test deck for a minimum 3-year continuous time period. Class D and Type IX (Class E) fluorescent orange sheeting shall be exposed outdoors on a test deck for a minimum 1-year continuous time period. Outdoor exposure testing will not be required for Type V (Class C) reflective sheeting.

Outdoor testing shall consist of exposing reflective sheeting test specimen panels, facing south, and inclined at an angle of 45° from a horizontal position. The test deck facility shall be located in a climate similar to that in which the material is intended to be used, or at a site approved by the Materials Bureau. Testing shall be performed by an independent testing agency or in conjunction with the National Transportation Product Evaluation Program (NTPEP).

Following the specified outdoor exposure time period, all weathered test panels of reflective sheeting shall meet the following performance requirements. The sheeting on the test panels shall show no appreciable adhesion loss, cracking, blistering, crazing, dimensional change, or color change. The minimum percent retained coefficient of retroreflection ($R_{BA}$) shall be as specified below when compared to a control unexposed specimen counterpart. The control specimen reflectivity values ($R_{BA}$) shall be measured at the start of outdoor exposure testing. Measurements shall be taken at 0.2 degree observation angle; -4 degree entrance angle.

| TABLE 730-05-4 MINIMUM PERCENT RETAINED COEFFICIENT OF RETROREFLECTION ($R_{BA}$) |
|---------------------------------|-----------|
| Type I (Class A) Materials Designation 730-05.01 | 50%       |
| Type III (Class B) Materials Designation 730-05.02 | 80%       |
| Class D (Materials Designation 730-05.04) | 50%       |
| Type IX (Class E) Materials Designation 730-05.05 | 60%       |

BASIS OF ACCEPTANCE. Approvals will be based upon independent laboratory analysis and outdoor exposure testing conducted in accordance with this specification. If the reflective sheeting passes the requirements for laboratory and outdoor exposure testing, the product will then be placed on the Department’s “Approved List” of materials. Detailed requirements and procedures for approval are available from the Materials Bureau.

Contract acceptance of Type I (Class A), Type III (Class B), Type IX (Class E), and Class D reflective sheetings will be based on the inclusion of the sheeting material on the Department’s “Approved List” of reflective sheeting materials and the manufacturer’s certification of compliance with this specification.

Contract acceptance of Type V (Class C) reflective sheeting will be based on the manufacturer’s certification of compliance with this specification.

730-06 THRU 730-08 (VACANT)

730-09 TUBULAR MARKERS

SCOPE. This specification covers the material, fabrication, and performance requirements for tubular markers.
MATERIAL REQUIREMENTS. Tubular markers shall be orange in color with a minimum height of 915 mm and a minimum outside diameter of 64 mm. Tubular markers shall be tubular in cross section maintaining either a round or elliptical shape over the entire length. The base and/or any non-flexible portion of the marker shall not extend more than 50 mm above the pavement surface.

The markers shall have two horizontal circumferential stripes of white reflective sheeting a minimum of 75 mm wide. The top edge of the upper band shall be a maximum of 50 mm from the top edge of the marker. The space between shall not exceed 150 mm. Reflective sheeting shall conform to §730-05 Reflective Sheeting, Class B (Materials Designation 730-05.02) or Class C (Materials Designation 730-05.03).

The sheeting shall be bonded to the post with a precoated pressure sensitive adhesive or a tack free heat activated adhesive. Mechanical fasteners to bond reflective sheeting to the post will not be allowed.

The bonding system used to fasten the marker to the pavement shall be any fast setting chemical compound, mastic-type material, or mechanical fastener capable of fixing the tubular marker to either concrete or asphalt pavement. The bonding system shall not present a hazard to traffic if the tubular marker or base unit becomes unfixed from the pavement.

TESTING. Tubular markers shall meet the requirements in the procedural directives of the Materials Bureau.

BASIS OF ACCEPTANCE. Application for approval of tubular markers shall be submitted to the Materials Bureau. The procedural directives outlining detailed requirements and procedures for approval are available from the Materials Bureau. Upon approval the name of the tubular marker will be placed on an Approved List.

Project acceptance will be based on the manufacturer's name and type of tubular marker appearing on the Department's Approved List titled 'Tubular Markers.'

730-10 ACRYLIC PLASTIC REFLEX REFLECTORS

SCOPE. This specification covers acrylic plastic prismatic reflectors for delineators.

MATERIAL REQUIREMENTS

Delineator Reflector Lens. Delineator reflectors shall consist of a clear and transparent acrylic plastic face, herein referred to as the lens, with a heat plastic or plastic coated foil back fused to the lens under heat and pressure around the entire perimeter of the lens, and the central mounting hole, to form a unit permanently sealed against dust, water, and water vapor. The lens shall consist of a smooth front surface, free from projections or indentation, other than a central mounting hole and identification, with a rear surface bearing a prismatic configuration such that it will effect total internal reflection of light. The manufacturer's trademark shall be molded legibly into the reflector.

Definitions and Optical Requirements

A. Entrance Angle. Shall mean the angle at the reflector between the direction of light incident on it and the direction of reflector axis.

B. Observation Angle. Shall mean the angle at the reflector between observers line of sight and direction of light incident on the reflector.

C. Specific Intensity. Shall mean luminous intensity (candelas) returned at the chosen observation angle by a reflector for each lux of illumination at the reflector.

Optical Test Procedure. The reflex reflector to be tested shall be located at a distance of 30.5 m from a single uniformly bright light source having an effective diameter of 50 mm the light source shall be operated at approximately normal efficiency. The return light from the reflector shall be measured by means of a photo-electric photometer having a minimum sensitivity of 1 x 10^-6 lux per scale division.
The photometer shall have a receiver aperture 13 mm diameter shielded to eliminate stray light. The distance from light source center to aperture center shall be 53.1 mm for 1/10 degree observation angle, and 175 mm for a degree observation angle.

If a test distance other than 30.5 m is used, the source and aperture dimensions and the distance between source and aperture shall be modified accordingly.

**Seal Test.** Submerge 50 samples in water bath at room temperature. Subject the submerged samples to a vacuum of 127 mm gage for five minutes. Restore atmospheric pressure and leave sample submerged for five minutes, then examine the samples for water intake. Evidence of moisture or water intake on more than two (2) samples shall be cause for rejection of the lot represented by the samples.

**Heat Resistance.** Three reflectors shall be tested for four hours in a circulating air oven at 79.5 ± 2°C. The test specimens shall be placed in a horizontal position on a grid or perforated shell permitting free air circulation. At the conclusion of the test the samples shall be removed from the oven and permitted to cool to room temperature. The samples after exposure to heat shall show no significant change in shape and general appearance when compared with unexposed control standards. No failures will be permitted.

### TABLE 730-10-1 OPTICAL REQUIREMENTS

<table>
<thead>
<tr>
<th>Observation Angle Degrees</th>
<th>Entrance Angle Degrees</th>
<th>Specific Intensity Candela/lux</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Crystal</td>
</tr>
<tr>
<td>1/10</td>
<td>0</td>
<td>11.1</td>
</tr>
<tr>
<td>1/10</td>
<td>20</td>
<td>4.4</td>
</tr>
<tr>
<td>1/3</td>
<td>0</td>
<td>1.9</td>
</tr>
<tr>
<td>1/3</td>
<td>20</td>
<td>0.7</td>
</tr>
</tbody>
</table>

**NOTE:** Failure of reflectors to equal or exceed the minimum specific intensity value shall constitute failure of the reflector being tested; failure of more than 2 reflectors out of 50 begin subjected to test shall constitute failure to the lot represented by the samples. The specific intensity of delineator reflectors shall meet the above noted values, regardless of reflector orientation.

**BASIS OF ACCEPTANCE.** Acrylic plastic reflex reflectors will be accepted on the basis of the manufacturer's certification that their product conforms to all of the above detailed specifications. However, when the Department requires that tests be made, samples shall be submitted to the Materials Bureau. Fifty-three (53) samples will be selected at random from each shipment received from the reflector manufacturer. Each shipment may contain more than one lot. These samples shall be tested as specified above. Failure of the samples to meet all the requirements of the above specifications shall be cause for rejection of delineators represented by such samples.

**730-11 REFLECTORIZED SHEETING SIGN CHARACTERS (TYPE III)**

**SCOPE.** These specifications cover the material requirements for Type III reflectorized sheeting sign characters.

**MATERIAL REQUIREMENTS.** Type III characters shall consist of white reflective sheeting meeting the requirements of §730-05, Reflective Sheeting, Materials Designation 730-05.02 (Class B).

The reflective sheeting shall be applied to sheet aluminum with mechanical equipment in a manner specified by the sheeting manufacturer. The base material for demountable characters shall be made of sheet aluminum alloy 6061-T6 or 3003-M14 treated with applicable requirements of §730-01, Aluminum Sign Panels.

Characters up to and including 300 mm in height shall be fabricated from 1.0 mm thick sheet aluminum. Sheet aluminum 1.6 mm thick shall be used for characters over 300 mm in height.

Completed characters shall be dip-coated or edge sealed as specified by the sheeting manufacturer.

Character units shall be securely fastened to the sign background with aluminum or stainless steel screws, or pull-through blind rivets. Spacing of screws or rivets shall be determined by character size and shape but in no case shall be more than 200 mm on center.
BASIS OF ACCEPTANCE AND TESTS. Type III characters may be accepted on the basis of the manufacturer's certification that its product conforms to all of the above specifications. This certificate shall include the source or sources of all materials. However, when the Department requires that tests be made, samples for testing by the Materials Bureau shall be taken by a representative of the Department as follows:

Two (2) percent or a minimum of five (5) characters (whichever is the greater) for each size character used.

Two (2) percent or a minimum of 0.6 m of border (whichever is greater) for each width of border used.

These samples are to be tested as specified for §730-01 and 730-05. Failure of samples to meet all the requirements of the above specifications shall be cause for rejection.

730-12 REFLECTORIZED SHEETING AND SIGN CHARACTERS (TYPE IV)

SCOPE. These specifications cover the material requirements for Type IV, reflectorized sheeting sign characters.

MATERIAL REQUIREMENTS. Type IV characters shall consist of cutout reflective sheeting material meeting the requirements of §730-05, Reflective Sheeting, Materials Designation 730-05.02 (Class B).

Characters or borders shall be applied directly to clean, dust-free reflective sheeting background panels. Characters or borders shall be applied mechanically with equipment and in a manner specified by the sheeting manufacturer. Borders shall be cut neatly and butt-joined at corners and panel joints.

After the sign has been completed the entire sign face area shall be clear coated (sprayed or dipped) and/or edge sealed with a clear coating as specified by the sheeting manufacturer.

BASIS OF ACCEPTANCE. The requirements of §730-11 shall apply.

730-13 REFLECTORIZED SHEETING SIGN CHARACTERS (TYPE V)

SCOPE. These specifications cover the material requirements for Type V reflectorized sheeting sign characters.

MATERIAL REQUIREMENTS. Type V characters shall consist of a painted, screened, or reverse-screened application of paint, paste, or transparent color of a type and in a manner recommended by the manufacturer of the reflective material.

Reflective material used for reverse-screened signs shall meet the requirements of §730-05, Reflective Sheeting, Materials Designation 730-05.02 (Class B). Characters shall meet the optical requirements of 730-05.02. Panels shall be clear coated and/or edge sealed with a clear coating as specified by the sheeting manufacturer.

BASIS OF ACCEPTANCE. The requirements of §730-11 shall apply.

730-14 REFLECTORIZED SHEETING SIGN CHARACTERS (TYPE VI)

SCOPE. These specifications cover the material requirement for Type VI reflectorized sheeting sign characters.

MATERIAL REQUIREMENTS. Type VI characters shall consist of embossed aluminum frames meeting the requirements of Types I and II characters of §730-10. When reflective characters are specified, they shall meet the reflective requirements and finish of Type III characters. When non-reflective characters are specified, they shall be prepared in strict accordance with cleaning and etching requirements of §730-01, Aluminum Sign Panels. After preparation, frames shall be coated with one coat of gloss baked enamel per Federal Standard TT-E-489.

BASIS OF ACCEPTANCE. The requirements of §730-11 shall apply.
730-20 SIGN POSTS AND FOOTINGS

SCOPE. These specifications cover the material requirements for Sign Posts and Footings.

MATERIAL REQUIREMENTS. Steel posts for ground mounted signs shall meet the requirements of §715-01, Structural Steel, except that ASTM A1 or rerolled axle steel may be used for small angle posts and ASTM A36, A242, A441, A572, Grade 345 and A588 steel may be used for posts and slip-impact bases as shown on the plans or standard sheets. All steel posts after fabrication (punching, drilling, etc.) shall be galvanized in accordance with the applicable requirements of §719-01, Galvanized Coatings and Repair Methods.

Posts used with slip-impact base and hinge assemblies must be of weldable quality. Welding shall be in accordance with the provisions of section on "Fabrication," in the New York State Steel Construction Manual.

Galvanized Material Repair. All damage to the galvanized surfaces due to handling, shipment, erection, etc., shall be repaired as described in §719-01.

Aluminum Posts. Aluminum posts shall meet the requirements of §715-04, Wrought Aluminum, and shall be fabricated of alloys 6061-T6. Welding shall be in conformance with applicable provisions and general recommendations of the latest edition of the American Welding Society's "Standard Specifications for Welded Highway and Railway Bridges." All aluminum welding shall be performed in the shop using an inert gas arc welding process. Welders shall be qualified in accordance with the latest edition of the ASME Boiler and Pressure Vessel Codes, 6 IX, Welding Qualification, Part B.

Dirt, grease, lubricants or other foreign materials in areas to be welded shall be removed by cleaning with a solvent or by vapor degreasing. Preheating for welding is permissible up to a temperature of 200°C for a period not to exceed 30 minutes.

Any porosity, craters, cracks or undercutting shall be cause for rejection. Defective welds may be repaired by chipping or machining out defective material and rewelding.

Field welding will not be allowed.

The portions of the posts that will be in contact with the concrete shall be coated with a zinc coated primer, and the primer shall be thoroughly dry before the concrete is placed.

Embedded Footings. Embedded footings for signs with metal posts shall be constructed of Class A Concrete without reinforcement. If the sign footings are precast, the concrete shall meet the requirements of Class A Concrete in section 501, Portland Cement Concrete—General, except that the requirements for inspection facilities, automated batching controls and recordation do not apply. The batching, mixing and curing methods, and the inspection facilities shall meet the approval of the Department or its representative. The Contractor may submit, for approval by Director, Materials Bureau, a mix at least equivalent to the specified Class A Concrete, with a minimum cement content of 340 kg/m³.

Wood Posts. Wood posts shall comply with the requirements of §712-14 Stress Graded Timber and Lumber. Using the clean wood properties of ASTM D2555, the bending stress (Modulus of Rupture) shall not be less than 28 MPa. They shall be surfaced four sides and shall be of the dimension shown on the plans before surfacing. Surface dried redwood, red cedar, cypress or black locust may be used untreated. Other lumber including douglas fir, pine, oak, birch, maple and beech may be used but shall be pressure treated in accordance with §708-31, Wood Preservatives-Water Borne.

The requirements for inspections contained in §712-14 and §708-31 are waived and the material will be accepted upon certification of the manufacturer.

A Roadside Delineator, Type IV shall be included with each post.

Slip-Impact Base and Hinge Assemblies. Slip-impact base and hinge assemblies shall be fabricated as shown on the standards sheets. In general, these assemblies will only be used where signs
cannot be located behind existing guide rail and where it is impractical to provide guide rail solely for sign protection.

Post types 1-8 placed behind guide rail will not require slip-impact bases.

**BASIS OF ACCEPTANCE.** Acceptance shall be based on the manufacturer's certification that its product conforms to these specifications.

### 730-21 FLEXIBLE DELINEATOR POSTS

**SCOPE.** This specification covers the material, fabrication, and performance requirements for flexible delineator posts.

**MATERIAL REQUIREMENTS.** Flexible delineator posts shall be supplied with reflective sheeting of a size and color as required by the contract documents. The color of the posts shall match the color of the reflective sheeting unless otherwise specified in the contract documents. Where double unit reflectors are specified, elongated reflective sheeting may be substituted as in accordance with the New York State Manual of Uniform Traffic Control Devices.

Reflective sheeting shall be fabricated of a material conforming to the requirements of §730-05 Reflective Sheeting, Class B or Class C. Sheeting shall be applied in accordance with the sheeting manufacturer's written instructions.

**TESTING.** Flexible delineator posts shall meet the requirements in the procedural directives of the Materials Bureau.

**BASIS OF ACCEPTANCE.** Application for approval of flexible delineator posts shall be submitted to the Materials Bureau. The procedural directives outlining detailed requirements and procedures for approval are available from the Materials Bureau. Upon approval the name of the flexible delineator post will be placed on an Approved List.

Project acceptance will be based on the manufacturer's name and type of flexible delineator post appearing on the Department's Approved List titled 'Flexible Delineator Posts.'

### 730-22 STIFFENERS, OVERHEAD BRACKETS AND MISCELLANEOUS HARDWARE

**SCOPE.** These specifications cover the material requirements for stiffeners, overhead brackets and miscellaneous hardware used for signs.

**MATERIAL REQUIREMENTS**

**Aluminum Components.** Horizontal sign panel stiffeners (Z bars) and overhead panel brackets shall be fabricated of aluminum alloy 6061-T6.

Other miscellaneous hardware including vertical stiffeners, bolts, nuts, washers, screws, rivets, pull-type lockbolts and serrated or knob stem blind rivets shall be fabricated of the materials and in the manner shown on the plans or standard sheets and shall meet the requirements of §715-04, Wrought Aluminum.

Components designated as Alloy 2024-T4 shall be given a Type 205 coating in accordance with §719-02, Aluminum Anodic Coatings.

Certification, Sampling, Testing and Inspection of aluminum components shall be handled as noted in §715-04.

**Steel Components.** Steel bolts, nuts and washers referenced to this specification shall conform to the requirements of Table 730-22-1 unless otherwise specified.

Bolts, nuts and washers to be used in contact with aluminum shall be coated with cadmium or cadmium/tin combination.

All cadmium and cadmium/tin coatings shall be given a chromate treatment in or with an aqueous solution of salts, acids or both to produce a protective chromate coating. The chromate coating shall be distinctly colored iridescent yellow to bronze for cadmium. Cadmium/tin coatings, when given this
iridescent chromate treatment, may remain silver colored. Usual chromic and nitric acid bright dips are not chromate treatments.

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### TABLE 730-22-1 STEEL FASTENERS

<table>
<thead>
<tr>
<th>Bolt (ASTM F568)</th>
<th>Bolt Size</th>
<th>Allowable Bolts</th>
<th>Washer Coating Systems</th>
<th>Plain Washer</th>
<th>Prevailing Torque Hex Nuts And Hex Flange Nuts</th>
<th>Lock Washer</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS 4.6</td>
<td>M5 to M36</td>
<td>5 - H1</td>
<td>P or Z</td>
<td>&lt; M12, use ANSI B18.22M, soft</td>
<td>CLASS 5,9 or 10</td>
<td>General Motors Standard Metric Helical Spring General Specification</td>
</tr>
<tr>
<td>CLASS 8.8</td>
<td>M16 to M36</td>
<td>12 - H2</td>
<td>P</td>
<td>≥ M12, use ASTM F436M IFI 542 or ANSI B18.22M, hard only</td>
<td>CLASS 5,9 or 10</td>
<td>General Motors Standard Metric Helical Spring General Specification</td>
</tr>
<tr>
<td>CLASS 10.9</td>
<td>M5 to M36</td>
<td>10 - H1</td>
<td>P or Z</td>
<td>&lt; M12, use ANSI B18.22M, soft</td>
<td>CLASS 9 or 10</td>
<td>General Motors Standard Metric Helical Spring General Specification</td>
</tr>
<tr>
<td>CLASS 10.9</td>
<td>M4 to M100</td>
<td>12 - HH</td>
<td>P</td>
<td>≥ M12, use ASTM F436M IFI 542 or ANSI B18.22M, hard only</td>
<td>CLASS 9 or 10</td>
<td>General Motors Standard Metric Helical Spring General Specification</td>
</tr>
</tbody>
</table>

### NOTES:
1. Class of nut (5,9,10 and 12):
   - H1  ANSI B18.2.4.1M hex nut, style 1
   - H2  ANSI B18.2.4.2M hex nut, style 2
   - HH  ANSI B18.2.4.6M heavy hex nut
2. P > M9.5: ASTM B695, class 50, type 1
3. P ≤ M9.5: ASTM B695, class 40, type 1, cadmium coating
4. P ≤ M9.5: ASTM B696, class 8, type 2
5. P ≤ M9.5: ASTM B766, class 12, type 2, cadmium/tin coating
6. P ≤ M9.5: ASTM B635, class 8, type 2
7. Z > M9.5: ASTM A153, class C
8. Z ≤ M9.5: ASTM A153, class D
9. ANSI B18.16.1M

### BASIS OF ACCEPTANCE.
Acceptance will be based on the manufacturer's certification that its product conforms to these specifications.

### 730-23 FIBERGLASS REINFORCED PLASTIC SIGN PANELS

#### SCOPE.
This specification covers the material requirements for fiberglass reinforced plastic for use as a sign panel substrate.

#### GENERAL.
The fiberglass reinforced plastic sign panel shall be fiberglass reinforced thermoset polyester laminate. The panel shall be acrylic modified and UV stabilized for outdoor weatherability. The panel shall be stabilized so as not to release migrating constituents (i.e., solvents, monomers, etc.) over time, and shall contain no residual release agents on the surface of the laminate that will interfere with any subsequent bonding operations. The panel shall not contain visible cracks, pinholes, foreign inclusions, or surface wrinkles that would affect implied performance, alter the specific dimensions of the panel or otherwise affect its serviceability.

#### MATERIALS REQUIREMENTS

**Physical Requirements.** The fiberglass reinforced plastic sign panel materials shall conform to the physical requirements in Table 730-23-1:
TABLE 730-23-1 PHYSICAL REQUIREMENTS FOR FRP SIGN PANELS

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength</td>
<td>D638</td>
<td>69 MPa</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Tensile Modulus</td>
<td>D638</td>
<td>8274 MPa</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Flexural Strength</td>
<td>D790</td>
<td>138 MPa</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Flexural Modulus</td>
<td>D790</td>
<td>8274 MPa</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Compression Strength</td>
<td>D695</td>
<td>221 MPa</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Compression Modulus</td>
<td>D695</td>
<td>9653 MPa</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Punch Shear</td>
<td>D732</td>
<td>90 MPa</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Weatherability — Grade II</td>
<td>D3841</td>
<td>26</td>
<td>44</td>
<td></td>
</tr>
<tr>
<td>Impact Resistance</td>
<td>D3841</td>
<td>18 m</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

Panel Flatness Test. Panel flatness shall be determined by supporting a 760 mm by 760 mm panel at two opposite corners, the maximum deflection measured diagonally, parallel and perpendicular to the panel by lines drawn through the center of the panel, shall not exceed 13 mm. The panel shall then be supported in a like manner in an oven for 48 hours at 82°C. The maximum deflection shall again be measured as previously noted, and shall not exceed 13 mm. All measurements shall be made when the panels are at ambient temperature. The fiberglass reinforced plastic panel shall have a maximum Coefficient of Thermal Expansion of 3.24 mm/mm/°C and maintain its strength and impact resistance qualities over a temperature range of -54°C to 100°C.

Application of Reflective Sheeting. The reflective sheeting shall be adhered to the fiberglass reinforced plastic panel in strict accordance with the recommendations of the manufacturer of the reflective sheeting.

BASIS OF ACCEPTANCE. Application for approval of fiberglass reinforced plastic sign panel by the producer shall be submitted to the Materials Bureau accompanied by a 7.5 m² sample of the product. Upon approval by the Materials Bureau, the name of the product will be placed on the Department's Approved List entitled "Fiberglass Reinforced Plastic Sign Panels 730-23.

730-24 TYPE A SIGN SUPPORTS

SCOPE. This specification covers the material and fabrication requirements for breakaway supports used for roadside signs.

MATERIAL, FABRICATION AND PERFORMANCE REQUIREMENTS. Post material, fabrication and performance requirements shall be in accordance with the standard sheets, the appropriate Materials Details and the procedural directives of the Materials Bureau.

BASIS OF ACCEPTANCE. Type A Sign Supports shown on the standard sheets shall be accepted based on the manufacturer's certification that its product conforms to these specifications and the appropriate standard sheets.

All other Type A Sign Supports will be accepted on the basis of their listing on the Department's Approved List of Type A Sign Supports. In addition, the manufacturer or supplier shall provide two copies of the approved Materials Details through the Contractor to the Engineer as part of the evidence of acceptability for the material at least ten days prior to the use of the product.
730-25 TYPE B SIGN POSTS

SCOPE. This specification covers the material requirements for Type B Sign Posts and Rustic Type B Sign Posts. These sign posts shall be equipped with breakaway bases and hinge assemblies per §730-26, Breakaway Bases and Hinge Assemblies, if installed at a location subject to vehicle impact.

MATERIALS AND FABRICATION REQUIREMENTS

Steel Sign Posts. Steel for sign posts and attachments to or components of sign posts shall be ASTM A36M, A242M, A572M Grade 345 and A588M and shall conform to §715-01 Structural Steel. Rustic Type B Sign Posts shall be ungalvanized weathering steel, ASTM A588M or A242M, meeting the requirements of §715-01 Structural Steel.

Sign posts, except Rustic Type B Sign Posts, shall be galvanized after fabrication (punching, drilling, welding, cutting, etc.) in accordance with §719-01, Galvanized Coatings and Repair Methods. Damage to galvanized surfaces of steel posts due to handling, shipment, erection, etc. shall be repaired as described in Repair of §719-01, when directed by the Engineer.

Sign posts with breakaway bases shall be of weldable quality, and all welding shall be in accordance with the provisions of the section on 'Fabrication' of the New York State Steel Construction Manual.

FABRICATION. Sign posts shall be fabricated as indicated on the standard sheets. Breakaway bases shall conform to the requirements of §730-26, Breakaway Bases and Hinge Assemblies.

BASIS OF ACCEPTANCE. Acceptance shall be based on the manufacturer's certification that the product conforms to these specifications.

730-26 BREAKAWAY BASES AND HINGE ASSEMBLIES

SCOPE. This specification covers the material and fabrication requirements for bi-directional and omni-directional breakaway bases and hinge assemblies for use on Type B Sign Posts and for use on Rustic Type B Sign Posts.

Bi-Directional Breakaway Bases and Hinge Assemblies are intended for use when the expected impact angle is within 30 degrees of the axis of the base from the front and rear.

Omn-Directional Breakaway Bases and Hinge Assemblies are intended for use whenever the expected impact angle may be greater than 30 degrees, measured as described above.

MATERIAL AND FABRICATION REQUIREMENTS. Breakaway bases and hinge assemblies shown on standard sheets shall satisfy the following requirements:

Steel for breakaway bases and hinge assemblies shall be A-36M, A242M, A572M Grade 345, A588M and shall meet the requirements of §715-01, Structural Steel. Steel shall be of weldable quality. Fasteners shall be of the size and shape shown on the Standard Sheets and meet the requirements of §730-22, Stiffeners, Overhead Brackets and Miscellaneous Hardware. Breakaway bases and hinge assemblies shall be galvanized in accordance with §719-01, Galvanized Coatings and Repair Methods, after the base is welded to the post. Welding shall be in accordance with the provisions of the section on 'Fabrication' of the 'New York State Steel Construction Manual.' Fabrication details shall be in accordance with the standard sheets.

Breakaway bases and hinge assemblies for use in conjunction with rustic sign posts shall meet the above requirements with the following exceptions:

- The upper slip base plate and attached post shall be ungalvanized weathering steel, ASTM A588M or A242M, meeting the requirements of §715-01, Structural Steel. The lower slip base plate, and the attached stub portion of the post, shall be galvanized steel. The remainder of the slip base shall be as shown on the contract drawings.

- When used on one-way, divided roadways, the back flange hinge plate shall be ungalvanized A588M or A242M steel installed as shown on the contract drawings. When used on two-way, undivided roadways, the back flange hinge plate shall meet the requirements, below, of the front flange hinge plate.
• The front flange hinge plate shall be galvanized steel, except that an additional galvanized steel flat washer meeting the requirements of ASTM F436M shall be installed on all four bolts between the post and the hinge plate to assure proper slippage.

All exposed galvanized surfaces, except in the vicinity of the slots in the hinge plates, shall be painted in accordance with §657 Painting Galvanized and Aluminum Surfaces.

BASIS OF ACCEPTANCE. Breakaway bases and hinge assemblies fabricated as shown on the standard sheets shall be accepted based on the manufacturer's certification that the complete assembly conforms to these specifications.

730-27 PERMANENT VARIABLE MESSAGE SIGNS

SCOPE. This specification gives minimum material, fabrication, fatigue and strength requirements of variable message signs for permanent installation. Other requirements are in the Contract Documents.

Within this specification, "overhead" shall mean to be mounted over the traveled way, or what the plans indicate will become the traveled way.

MATERIAL REQUIREMENTS

Housing. The enclosure housing shall be constructed of aluminum alloy 3003-H14, 6061-T6, 5154-H38 or as specified on approved shop drawings. The minimum thickness shall be 3.2 mm. Seams shall be continuously welded by an inert gas process only in the shop.

The housing shall be completely sealed to prevent the entry of water, insects, dust, dirt and corrosion. Neoprene gaskets shall be utilized as necessary.

Readily-available, changeable filtration devices shall be provided at drain holes and at all points where forced air enters the enclosure.

All hinged access panels and windows shall be equipped with hold-open devices which shall not release accidently or by the action of wind. The hold-open devices shall not interfere with the operation of the display, nor with the repair or replacement of user serviceable components.

Stiffeners, Hardware and Mounting Brackets. Hardware, framing members and mounting brackets shall meet the requirements of §730-22, unless indicated otherwise on the manufacturer's shop drawings approved by the Engineer.

Framing structural members shall be made of aluminum alloy 6061-T6 or an approved equivalent. All hardware shall be corrosion-resistant steel or protected from corrosion by suitable plating. Fasteners for securing access panels shall be captive.

MANUFACTURING

General. Fabrication shall be such that performance will not be impaired after the equipment has been subjected to shock and vibration caused by normal installation, transportation and maintenance handling. Particular attention shall be given to neatness and thoroughness of soldering, wiring, welding, plating, riveting, finishes and machine operations. All parts shall be free from burrs and sharp edges or any other defect that could make the part or equipment unsatisfactory for the operation or function intended in this specification.

Modules shall be designed such that major portions may easily be replaced. Modules of unlike functions shall be mechanically keyed to prevent insertion into the wrong socket or connector. All modules and assemblies shall be clearly identified with name, model number, serial number and any other pertinent information required to facilitate equipment maintenance. They shall be readily accessible for inspection and maintenance, using simple hand-held tools and standard meters.

Housing. The sign enclosure including doors and access panels shall be designed and constructed so as to present a clean, neat appearance; be smooth with exterior corners rounded; be weatherproof and vandal-resistant; and be free of burrs, blemishes and unspecified holes.

Drainage holes shall be drilled near each corner of the base of the enclosure.
The enclosure shall have internal lighting sufficient for all maintenance activity requirements of the VMS and 120 volt power receptacles every 3 m mounted on the rear interior panels.

If the variable message sign is designated as "walk-in," then its access door shall be a minimum of 610 mm wide X 1520 mm high.

Environmental

A. Temperature. Internal temperature shall be continuously monitored whenever electric power is applied to the sign. The internal temperature of the enclosure shall be reported to the local and central controller upon request. Ventilation shall be automatically turned on and off at internal temperatures specified in the Proposal. Exhaust and intake ports shall be protected by filter screens against moisture, dust and insect intrusion. The ventilation system shall be sufficient to circulate three times the volume of air inside the enclosure per minute. Multiple fans or blowers shall be used to provide the specified venting and shall be located within the enclosure to minimize heat stratification.

B. Adverse Conditions. The equipment shall meet all of its specified functions during and after subjection to any combination of the following conditions:

1. Ambient Temperature. Range of \(-30^\circ C\) to \(+62^\circ C\).

2. Temperature Shock. \(17^\circ C\) per hour, during which the relative humidity shall not exceed 95%.

3. Relative Humidity Range. 0 to 95% over the temperature range of \(4^\circ C\) to \(43^\circ C\).


C. Ambient Light. The variable message sign shall be equipped with light sensors so that the display shall be able to automatically adapt its level of light output to maintain readability under varying ambient light conditions. There shall be a minimum of eight (8) levels of dimming, linearly spaced from nighttime to daylight brightness. The sign's automatic dimming control shall be overridable by central control. The dimming circuitry shall automatically compensate for variations in the AC line voltage to maintain the light output constant for the selected brightness level. The levels of lighting shall produce luminance measured on the optic axis, as follows:

1. Daylight. A minimum of 14 candela per pixule for typical daylight environment.

2. Nighttime. Between 1.5 and 2 candela per pixule for nighttime environment.

Electrical Protection. The equipment shall contain readily-accessible, normally resettable or replaceable circuit protection devices (such as circuit breakers or fuses) for equipment and power source protection.

Electronic Components. All components shall be UL listed. All printed circuit boards shall be FR4 or G10 fiberglass epoxy material, with 20oz. copper, double-sided with plated through-holes. All etched connector fingers are to be plated with a minimum thickness of 2.5 \(\mu m\) (100 micro-inches) of gold over nickel.

Board connectors that are not an integral part of the printed circuit are to be plated with a minimum thickness of 0.38 \(\mu m\) (15 micro-inches) of gold over nickel.

Sign Face. In order to increase contrast, the pixules shall be arranged on a black, non-glossy background. All electronic components visible from outside the sign shall be of black color or coated with black, non-glossy paint.

The front of the sign shall be enclosed by a protective, weathertight face, 6 mm thick. Variable spacing between letters shall approximate the recommended spacing for 460 mm Series E sign text found in the Federal Highway Administration Standard Alphabets for Highway Signs.
DESIGN CRITERIA

All Permanent Variable Message Signs. The equipment shall be designed such that the failure of one part shall not cause the failure of any other part. In the event of a power failure of 500 milliseconds or less, proper operation of the equipment shall commence after restoration of power, without creating false information.

Shop drawings and calculations that show the sign's ability to withstand the design loads shall be submitted to the Traffic Engineering and Highway Safety Division for approval, and shall be signed by a Professional Engineer licensed and registered to practice in New York State. If the drawings and calculations are approved by the Department, the manufacturer will be notified, and the manufacturer's name and drawing numbers will be placed on the Approved List.

Approved shop drawings shall be submitted to the Engineer prior to delivery of any variable message signs. The Contractor shall develop and deliver shop drawings signed by a licensed New York State Professional Engineer which illustrate in detail, how to mount and connect the variable message sign enclosure to the structure shown on the Plans.

All variable message signs covered by this specification shall be designed to withstand the following loads, combined in groups in accordance with the latest A.A.S.H.T.O. Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals. Each member and connection shall be designed for the maximum stress of all the different combinations, with the allowable stress increased as indicated in the A.A.S.H.T.O. Group Loading table. Unless noted otherwise, "Ice" load in the table shall mean "Ice and Snow loads simultaneously."

Non-Overhead Permanent Variable Message Signs

A. Dead Load. The weight of the variable message sign including all components, plus consideration of loads imposed during maintenance.

B. Live Load. Variable message signs designated as "walk-in," or otherwise intended to support personnel in service, shall be designed to support a live load of 4.8 kPa applied to the service platform.

C. Ice Load. The ice load shall be 145 Pa, unless historical accretion data for the location the variable message sign will be installed, the slope of a panel, or shielding hoods and the like indicate a different load. This load shall be considered on individual panels and the members and connections supporting only one panel. The load on members and connections supporting more than one panel shall be designed to support an ice load on:

1. The one end panel, and
2. Either the front or back panel, after considering panel slope and/or shielding hoods, which produces the largest load in the member or connection.

D. Snow Load. The snow load shall be 1.9 kPa, unless historical accretion data for the location the variable message sign will be installed, or the shape of a panel indicate that a different load is appropriate. This load shall be applied to the top panel and any hood or other nearly horizontal projection.


1. Individual nonhorizontal panels. Panels, members and connections carrying loads from only one nonhorizontal panel shall be designed for 100% of the Base Wind Load acting normal to the panel along with 20% of the Base Wind Load acting transverse to the panel.
§730

2. Adjacent nonhorizontal panels. Panels, members and connections carrying wind loads from two adjacent, nonhorizontal panels perpendicular to each other shall be designed to withstand a wind load acting on both panels. For the purposes of determining direction of forces, the term "paramount" refers to the panel contributing the greatest load, and the adjacent panel termed the "adjoining" panel. If it is not clear which panel will contribute the greatest load, then analyze with one panel assumed to be paramount, and the adjacent one adjoining, then do a separate analysis with the roles reversed. The center of action of the wind loads shall be the centroid of the panel on which it acts. The magnitude of the components shall be:

   a. Normal to the paramount panel. 100% of the Base Wind Load on the paramount panel, plus 30% of the base wind load on the adjoining panel;

   b. Transverse to the paramount panel. 20% of the Base Wind Load on the paramount panel, plus 60% of the base wind load on the adjoining panel.

Members and connections carrying wind loads from adjacent, nonhorizontal panels at angles other than perpendicular to each other shall be designed to withstand an appropriate wind load coming from the direction producing the greatest stress in the member or connection.

Overhead Permanent Variable Message Signs. Variable message signs to be mounted over a traveled way, or over what the contract documents indicate will become a traveled way, shall be designed for the fatigue loads and using the allowable stresses given in the current version of the NYSDOT Standard Specifications for Overhead Sign Structures.

DELIVERY AND INSTALLATION

The contractor shall deliver, store, handle, and install all materials and equipment in such a manner as not to degrade quality, serviceability or appearance. Material to be stored shall be stored in a clean and dry location free from construction dust, precipitation, and condensing moisture. Any part of the equipment damaged during transportation, handling, or installation shall be repaired, or if determined by the Engineer as unfit for use in the finished work, shall be removed from the site and replaced by the Contractor at no additional cost.

All materials shall be delivered and stored in the manufacturer's original unopened protective packages and protected against soiling, physical damage, or wetting, before and during installation. Unloading and unpacking of all materials shall be done in a manner to prevent misalignment or damage.

The installation shall be performed by factory certified personnel. Installation shall be complete in all respects, including all framing and all related fastenings and anchors required for a complete installation. Equipment shall be placed in accordance with the general arrangement as shown on the Drawings. The general arrangement may be modified only as required to suit specific equipment. Modifications shall not affect the design of components. Layout dimensions as shown on the Drawings may be modified to improve operating efficiency.

MARKING. The contract number, pay-item number, and month and year of installation shall be marked using permanent ink, paint, or stamping into the wall. Characters shall be 25-45 mm high, horizontal when the variable message sign is in its final position, and be located in the following locations:

   - The end panel of the vms, so as to be visible from the shoulder closest to the variable message sign.
   - On the inside of a "walk-in" variable message sign, near the middle of the panel opposite the door.

Also, the manufacturer's name, product name, model number, serial number, and city and state or province of manufacture shall be permanently marked on the outside and an easily accessible location inside the variable message sign.

These markings shall not be visible when viewing the front of the variable message sign straight-on.

TESTS

Design Approval. In order to get on the Approved list, design approval tests shall be conducted by the fabricator on one (1) or more samples of each equipment type, as approved by the Traffic Engineering
and Highway Safety Director, to determine if the design of the equipment meets the requirements of this specification. In the case of standard product line equipment, the Traffic Engineering and Highway Safety Director may waive the design approval tests if:

- The manufacturer's written specifications (functional and environmental) are equal to or better than those specified in the contract documents and the manufacturer so states in writing; or
- The manufacturer provides certification by an independent testing laboratory that these design approval tests have been previously satisfactorily completed.

**Performance.** If specified in the Contract Documents, each variable message sign shall pass these performance tests both alone and fully integrated in the system:

- Factory Tests
- Installation Tests
- Pre-Acceptance Tests
- Project Acceptance Tests

A complete list of all equipment and system tests to be performed, including the testing plan and detailed testing procedures for each type of equipment, shall be submitted to the Engineer for approval. Test procedures shall be in accordance with the manufacturer's recommendations and shall demonstrate all functional requirements.

A minimum of two (2) weeks written notification will be provided for the witnessing of all testing, after approval of the testing plan and the appropriate testing procedures.

If a unit has been modified as a result of a test failure, a report shall be prepared and delivered to the Engineer prior to re-testing of the equipment. The report shall describe the nature of the failure and the corrective action taken. If the Engineer determines that a failure pattern exists, then design and construction modifications shall be made to all equipment without additional cost to the State or extension of the contract period. The Engineer will forward copies of the reports of modifications to the Regional Traffic and Safety Engineer, and to the Materials Bureau.

Rejected equipment may be offered again for retest provided all non-compliances have been corrected and retested by the Contractor. The contractor shall submit evidence that the sign(s) have passed, to the Engineer with the request and the schedule to rewitness the performance tests.

**BASIS OF ACCEPTANCE.** Variable message signs will be accepted based on the following:

- The manufacturer's name, product name or model number, and drawing number and date, appearing on the Department's Approved List.
- Submission of approved shop drawings, for each different variable message sign supplied.
- Manufacturer's written certification of compliance to these specifications and the approved shop drawings.
- If required by the Engineer or the approved shop drawings, submission of mill certifications for structural materials.
- Passing all performance tests in the specification.

Final inspection and acceptance of equipment shall be made after installation at the locations specified on the plans.

**SECTION 731 (VACANT)**

**SECTION 732 - DRILLING**

**732-01 DRILL RIGS**

**SCOPE.** This specification covers the equipment and performance requirements for drill rigs.

**GENERAL.** Drill rigs shall be specifically designed and manufactured for drilling, coring and sampling soil and rock.
§732

EQUIPMENT. Drill rigs shall have adequate capacity and power to accomplish the required work. Each rig shall be supplemented with the necessary auxiliaries, appurtenances, tools and other equipment required for proper operation.

BASIS OF ACCEPTANCE. The rigs and all necessary auxiliaries, appurtenances, tools, barges, platforms, support vessels and equipment shall be acceptable to the Engineer. Drill rigs that are not adequate, as determined by the Engineer, will not be permitted for use. Drill rigs required under the items for furnishing equipment including drive hammers, all necessary auxiliaries, appurtenances, tools, barges, platforms, support vessels and other equipment must be on site, inspected and approved by the Engineer in conjunction with a representative of the Geotechnical Engineering Bureau before any work is done by that rig. Each rig shall be complete and sharing of equipment between rigs will not be permitted.

732-02 DRIVE PIPE

SCOPE. This specification covers the material and quality requirements for drive pipe used in subsurface explorations.

MATERIAL REQUIREMENTS. Drive pipe shall be extra strong steel pipe, 65 mm or 100 mm nominal diameter as specified, with threaded ends in random 1.5 m lengths and shall conform to the requirements of ASTM A120, Schedule 80.

BASIS OF ACCEPTANCE. Drive pipe shall be subject to inspection and approval of the Engineer in conjunction with a representative of the Geotechnical Engineering Bureau.

732-03 CASING

SCOPE. This specification covers the material and quality requirements for casing used in subsurface explorations.

MATERIAL REQUIREMENTS. The casing shall be diamond drill flush-joint or flush coupled type, fabricated from high quality seamless steel tubing conforming to the requirements of the Diamond Core Drill Manufacturer's Association (DCDMA) Standards. The design shall permit any size casing to telescope into the next larger size.

BASIS OF ACCEPTANCE. Casing shall be subject to inspection and approval of the Engineer in conjunction with a representative of the Geotechnical Engineering Bureau.

732-04 SAMPLES

SCOPE. This specification covers the material requirements for split barrel samplers.

MATERIAL REQUIREMENTS. Samplers shall be equipped with a ball check in the head section and have a minimum inside length of 0.5 m. For 50 mm diameter samplers, the outside diameter shall be 50.8 mm and the cutting shoe opening shall be 35.1 mm. For 65 mm samplers the outside diameter shall be 63.5 mm and the cutting shoe opening shall be 47.7 mm. For 75 mm samplers the outside diameter shall be 76.2 mm and the cutting shoe opening shall be 60.4 mm. For 90 mm diameter samplers, the outside diameter shall be 88.9 mm and the cutting shoe opening shall be 73.2 mm.

BASIS OF ACCEPTANCE. Samplers shall be subject to the inspection and approval of the Engineer in conjunction with a representative of the Geotechnical Engineering Bureau.

732-05 THIN WALL SAMPLE TUBES

SCOPE. This specification covers the material and quality requirements for thin wall sample tubes.
MATERIAL REQUIREMENTS. Thin walled sample tubes shall be fabricated from Type 304 stainless steel tubing meeting the requirements of ASTM A276 as specified for a nominal 90 mm O.D. seamless or welded tubing with nominal 1.65 mm wall thickness. Specific dimensions and fabrication details shall comply with the current Geotechnical Engineering Bureau Drawing entitled “Stainless Tube for 90 mm Undisturbed Soil Samples.” Liners for 90 mm samplers shall have an outside diameter of 76.2 mm and shall be 450 mm long. Liners shall be fabricated of brass or stainless steel only.

BASIS OF ACCEPTANCE. Sample tubes shall be subject to the inspection and approval of the Engineer in conjunction with a representative of the Geotechnical Engineering Bureau.

732-06 CORING BITS

SCOPE. This specification covers the material requirements for coring bits used in Subsurface explorations.

MATERIAL REQUIREMENTS. Coring bits shall be four sizes: AX, BX, NX and HX. The bits shall meet the outside diameter requirements specified by the National Bureau of Standards and the Diamond Core Drill Manufacturer's Association.

BASIS OF ACCEPTANCE. Coring bits shall be subject to inspection and approval of the Engineer in conjunction with a representative of the Geotechnical Engineering Bureau.

732-07 SAMPLE STORAGE BAGS

SCOPE. This specification covers the material requirements for sample storage bags used for containing soil samples.

MATERIAL REQUIREMENTS. Sample storage bags shall be moisture-proof, transparent, plastic bags with minimum dimensions 200 mm length, 250 mm width and 0.05 mm thickness.

BASIS OF ACCEPTANCE. Sample storage bags shall be subject to inspection and approval of the Engineer.

732-08 SAMPLE JARS

SCOPE. This specification covers the material requirements for sample jars used for containing soil samples.

MATERIAL REQUIREMENTS. Sample jars shall be glass, or plastic, wide-mouthed jars of one-liter capacity with air-tight screw covers fitted with rubber composited lined caps.

BASIS OF ACCEPTANCE. Sample jars shall be subject to inspection and approval of the Engineer.

732-09 JAR CARTONS

SCOPE. This specification covers the material and fabrication requirements for jar cartons used to contain soil sample jars.

MATERIAL AND FABRICATION REQUIREMENTS. Jar cartons shall consist of corrugated Kraft paper cardboard fabricated into a box with overall nominal dimensions of 300 mm wide, 400 mm long and 180 mm deep. The box shall be partitioned and have sufficient strength to safely support twelve (12) sample jars conforming to §732-08 in a 3 x 4 array.

BASIS OF ACCEPTANCE. Jar cartons shall be subject to inspection and approval of the Engineer.
732-10 BOULDER AND ROCK CORE BOXES

SCOPE. This specification covers the material and fabrication requirements for boxes used to contain core samples of boulders and rock.

MATERIAL AND FABRICATION REQUIREMENTS. Boxes shall be fabricated of white pine, Grade No. 2 common or better, 25 mm stock (finished 20 mm) thickness or an approved equal material. Overall box dimensions for “AX” cores shall be 1.56 m long, 245 mm wide and 70 mm high. Dimensions for “BX” core boxes shall be 1.56 m long, 275 mm wide and 85 mm high. Dimensions for “NX” core boxes shall be 1.56 m long, 275 mm and 95 mm high. Dimensions for “HX” core boxes shall be 1.56 m long, 285 mm wide and 120 mm high. Core rows shall be separated by wooden or tempered hardboard, 3 mm thick strips recessed to 10 mm depth and glued with waterproof glue at the bottom and ends of the box.

Box covers shall be hinged with two, 50 mm steel butt hinges recessed and fastened with flat head wood screws. Box covers shall be secured in a closed position by two, 40 mm hook and eye fasteners. All boxes shall be coated with weatherproof wood preservative. Details are specified on the current Geotechnical Engineering Bureau Drawing entitled “Core Box AX, BX, NX and HX Sizes.”

BASIS OF ACCEPTANCE. Core boxes shall be subject to inspection and approval of the Engineer in conjunction with a representative of the Geotechnical Engineering Bureau.

732-11 OPEN WELL PIEZOMETER

SCOPE. This specification covers the material requirements for open well piezometers.

MATERIAL REQUIREMENTS. Monitoring pipe-riser pipe shall be 25 mm (nominal diameter) threaded PVC schedule 40 pipe. Slotted screen pipe shall be 1.5 m long and be 25 mm (nominal diameter) threaded PVC schedule 40 pipe. Caps shall be 25 mm (nominal diameter) PVC schedule 40 threaded male cap for the top, and 25 mm (nominal diameter) PVC schedule 40 threaded female cap for the bottom.

Sand. Provide well rounded, uniformly graded silica sand, which is correctly sized to the slotted screen. Ottawa sand is acceptable.

Bentonite pellets. Provide 6 mm (nominal diameter) bentonite pellets.

Manhole. Provide a 200 mm (inside diameter) steel flush mount manhole with a 200 mm skirt.

Cement. The material shall meet the requirements of §701-01 Portland Cement Type 1 or 2.

Water. The water for the mix shall conform to the requirements of §712-01 Water.

Bentonite Powder. There are no material requirements for the bentonite, except it shall be supplied in powder form from a reputable manufacturer and pass a 75 μm mesh particle size.

BASIS OF ACCEPTANCE. Materials used for the installation of open well piezometers shall be subject to inspection and approval of the Engineer.

732-12 GROUT

SCOPE. This specification covers the material requirements for the grouting of bore holes.

MATERIAL REQUIREMENTS. For cement, the material shall meet the requirements of §701-01. Portland Cement Type 1 or 2. Water for the mix shall conform to the requirements of §712-01.
**Water.** There are no material requirements for the bentonite, except it shall be supplied in powder form from a reputable manufacturer and pass a 75 \( \mu \)m mesh particle size.

**BASIS OF ACCEPTANCE.** The grout shall be subject to inspection and approval of the Engineer.

**SECTION 733 AND 734 (VACANT)**

**SECTION 735 - CONCRETE CYLINDER CURING BOX**

735-01 CONCRETE CYLINDER CURING BOX

**SCOPE.** This specification covers the material requirements, tests and basis of acceptance for a Concrete Cylinder Curing Box.

**MATERIAL REQUIREMENTS.** The Concrete Cylinder Curing Box shall be constructed of noncorroding materials. A moisture proof seal shall be provided between the lid and body of the box. Provision for automatic control of water temperature to \( 22^\circ C \pm 3^\circ C \) shall be made when the box is located in an uncontrolled environment. A bimetallic thermometer shall be installed with its sensing element in the storage water. The thermometer shall be capable of being read from the outside without opening the box. The thermometer shall have minimum gradations of \( 1^\circ C \) and shall be protected from damage. Electric utility connections shall be made in a lockable switch box securely attached to the outside of the curing box.

A rustproof wire or metal rack shall be set above the bottom of the box to support cylinders in an upright position. This rack and all temperature control elements shall be positioned to allow free circulation of water around the cylinders. A combination hose connection and drain shall be provided at the lower front edge of the box so that it may be drained or water may be circulated. A drain shall also be provided on the box in such a position that when open will drain water to within 25 mm over the top of the cylinders. All areas of the box shall be easily drained and accessible for cleaning.

**Test.** The Concrete Cylinder Curing Box shall be capable of maintaining the required water temperature through an ambient air temperature range of \(-23^\circ C\) to \(+38^\circ C\). The box shall be capable of holding a minimum of nineteen 150 mm X 300 mm cylinders. When filled with water, the box shall not leak.

**BASIS OF ACCEPTANCE.** The Concrete Cylinder Curing Box shall be accepted upon approval of the Engineer.

**SECTION 736 - PERMANENT CORRUGATED METAL FORMS FOR BRIDGE SLABS**

736-01 PERMANENT CORRUGATED METAL FORMS FOR BRIDGE SLABS

**SCOPE.** This specification covers the material requirements, method of manufacturer, tests and basis of acceptance for Permanent corrugated Metal Forms for Bridge Slabs for use as described under §555, Structural Concrete.

**MATERIALS.** Forms and form supports shall conform to the latest specification for ASTM A653/A653M, Grades A thru E, Coating Designation G165. Fabrication shall be in conformance with ASTM A924/A924M.

Prior to fabrication of forms the Contractors shall submit to the Engineer certification for conformity of steel and galvanizing to ASTM A653/A653M.

**DESIGN REQUIREMENTS.** The following shall govern the design of permanent corrugated metal stay-in-place (S. I. P.) forms:

- Design Span shall be the clear span of form plus 50 mm measured parallel to the form flutes.
- Design Load shall be the sum of the weights of form, bar reinforcement, plastic concrete and 2500 Newtons per square meter for construction loads.
• Unit Working Stress shall not exceed 0.725 of the specified minimum yield strength of the material. In no case shall the unit working stress exceed 250 MPa.
• Dead Load Deflection shall not exceed 1/180 of the form span or 13 mm, whichever is less.
• Physical Design Properties shall be computed with the requirements of the American Iron and Steel Institute Specifications for the Design of Cold Formed Steel Structural Members, latest published edition.

**Certification.** For acceptance, the Contractor shall submit Manufacturer certification to the Engineer that all forms meet all design requirements stated in this section and all detail requirements shown on the plans.

**TEST.** No testing will be required.

**BASIS OF ACCEPTANCE.** All forms delivered to the job site must be accompanied by the manufacturer's certification that the materials used conform to ASTM A653/A653M as required by this section. Any forms delivered to the job site without such certification or which do not conform to the approved shop drawings shall be rejected by the Engineer.

**SECTIONS 737 THRU 799 (VACANT)**