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.

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

GENERAL. Portland cement Types 1, 2, 3 and 5 shall conform to the chemical and physical requirements of those respective types as contained in ASTM C150. Portland cement Type 6 shall conform to the chemical and physical requirements of ASTM C150 Type 1, except that the color shall be white. For all types, any cement possessing an alkali content in excess of 0.70% may be either accepted, rejected or have use limitations imposed as directed by the Materials Bureau. In addition, the requirement for False Set as stipulated under ASTM C150, Table 2a “Optional Physical Requirements”, shall apply for all types.

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 ASTM C150. 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
§ 701-01

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 ASTM C150.

**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 Cement

**Scope.** This specification covers masonry cement used in the mixing of mortar, for laying up dimension masonry and for drainage units constructed with concrete blocks or brick.

**Material Requirements.** Masonry cement shall conform to the requirements of ASTM C91.

**Basis of Acceptance.** Masonry cement shall be accepted on the basis of the Engineer’s visual determination that a printed legend appears on each package portraying conformance to ASTM C91.

### 701-03 (Vacant)

### 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.

1. The material shall exhibit no shrinkage on setting but may exhibit slight expansion of no more than 0.40%.

2. Compressive Strength - Cubes cast in accordance with ASTM C-109 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 @ 24EC</td>
<td>28 M pa M in.</td>
</tr>
<tr>
<td>7 day air cure @ 24EC</td>
<td>42 M pa M in.</td>
</tr>
<tr>
<td>7 day air, 10-day water submersion</td>
<td>42 M pa M in.</td>
</tr>
<tr>
<td>7 day air, 24 hour, 10% NaCl solution</td>
<td>42 M pa M in.</td>
</tr>
<tr>
<td>submersion, 25 cycles freeze-thaw</td>
<td></td>
</tr>
</tbody>
</table>

3. The material shall have a minimum initial set of 30 minutes.

4. Pull-out Strength - a No. 15 concrete 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.

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

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:
1. **Compressive Strength.** Three cubes shall be cast and cured in accordance with ASTM C109. The average strength of the 3 cubes at 7 days age shall be a minimum of 42 Mpa.

2. **Freeze-Thaw (FT) Resistance.** Three cubes shall be molded and cured for 7 days in accordance with ASTM C109. 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.

3. **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 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.

4. **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 chemically curing anchoring materials for use in grouting anchor bolts and other miscellaneous items in concrete.

**GENERAL.** The material shall be a non-metallic, non-shrink grout or polymer resin supplied in prepackaged and/or premeasured containers. It shall contain no metals, rust or corrosion promoting agents and shall be moisture insensitive. 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. The mixing instructions, cure time and expiration date of the material shall appear on each container.

**Chemical Resistance.** When cured, the grouting material shall be resistant to most chemicals and solvents, including salts, acids, hydrocarbons, etc.

**MATERIAL REQUIREMENTS.** Manufacturers must supply test results performed in accordance with Test Method 701-14E, Part A, using M 24x3 ASTM F 568 Class 8.8 fully threaded rods embedded 250 millimeters deep in unreinforced concrete with compressive strength between 28 and 38 Mpa. Testing must be performed by an independent testing agency as approved by the Materials Bureau. Acceptable pullout values for various concrete strengths are shown below.

<table>
<thead>
<tr>
<th>Concrete Strength (Mpa)</th>
<th>Acceptable Load (Kn)</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>227</td>
</tr>
<tr>
<td>31</td>
<td>241</td>
</tr>
<tr>
<td>35</td>
<td>254</td>
</tr>
<tr>
<td>38</td>
<td>266</td>
</tr>
</tbody>
</table>

Upon acceptance of the test results from Part A, the Manufacturer shall supply six M16x2 fully threaded rods, a minimum of 180 millimeters long, and sufficient grout for testing by the Materials Bureau.
Bureau in accordance with Part B of Test Method 701-14E, which calls for six M 16x2 fully threaded rods embedded 100 millimeters deep in unreinforced concrete with compressive strength between 28 and 38 Mpa. Acceptable pullout values for various concrete strengths are shown below.

<table>
<thead>
<tr>
<th>Concrete Strength (Mpa)</th>
<th>Acceptable Load (Kn)</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>38</td>
</tr>
<tr>
<td>31</td>
<td>40</td>
</tr>
<tr>
<td>35</td>
<td>42</td>
</tr>
<tr>
<td>38</td>
<td>44</td>
</tr>
</tbody>
</table>

The grouting material shall be able to withstand 50 cycles of freeze thaw (10% NaCl) with a maximum loss of 4%.

Copies of Test Method 701-14E may be obtained from the Materials Bureau upon request.

**BASIS OF ACCEPTANCE.** Application for approval of Anchoring Material-Chemically Curing by the manufacturer or supplier shall be submitted to the Materials Bureau along with material safety data sheets. 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 an Approved List. Such product shall 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:

1. **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.

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

3. **Freeze-Thaw Resistance.** Three cubes shall be molded of the material and cured for 7 days in accordance with A.S.T.M. C109. 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.

4. **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.

5. **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.

6. **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 SETTING CONCRETE REPAIR MATERIAL (Normal Weather)

SCOPE. This specification covers a rapid setting 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 setting concrete shall be of a high strength, have rapid strength gain characteristics in normal weather (above 10EC ambient temperature), bond to the existing concrete, and be durable. The R.S.C. 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:

1. A minimum one hour compressive strength of 18 Mpa, a 24 hour strength of 25 Mpa and a 28 day strength of 35 Mpa.
2. A minimum bond strength of 1.5 Mpa after 24 hours.
3. A minimum initial setting time of 5 minutes at 24 ± 1EC.
4. The ability to withstand 50 cycles of freeze-thaw (10% NaCl solution) with a maximum loss of 6%.
5. Expansion of no more than 0.40% and contraction of no more than 0.05%.
6. 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.

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).
4. Synthetic Resins.
5. Asphalt Emulsion Tack Coat.

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

**TABLE 702-1**

ASPHALT CEMENTS FOR PAVING

<table>
<thead>
<tr>
<th>MATERIAL DESIGNATION</th>
<th>702-0100</th>
<th>702-0200</th>
<th>702-0300</th>
</tr>
</thead>
<tbody>
<tr>
<td>VISCOSITY</td>
<td>AC-2.5</td>
<td>AC-5</td>
<td>AC-10</td>
</tr>
<tr>
<td>Viscosity, 60EC, Pa@</td>
<td>200</td>
<td>300</td>
<td>400</td>
</tr>
<tr>
<td>Viscosity, 135EC, m²/s (x10⁻⁶)</td>
<td>125</td>
<td>-</td>
<td>175</td>
</tr>
<tr>
<td>Penetration, 25EC, 100 g, 5 s</td>
<td>200</td>
<td>325</td>
<td>120</td>
</tr>
<tr>
<td>Flash point, COC, EC</td>
<td>163</td>
<td>-</td>
<td>177</td>
</tr>
<tr>
<td>Solubility in Trichlorethylene, %</td>
<td>99.0</td>
<td>-</td>
<td>99.0</td>
</tr>
<tr>
<td>Tests on Residue from Thin film oven test:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viscosity, 60EC, Pa@</td>
<td>100</td>
<td>125</td>
<td>-</td>
</tr>
<tr>
<td>Ductility, 25EC, 5 cm/min, cm</td>
<td>-</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>TYPICAL USES (intended only as a general informational guide)</td>
<td>Recycled Mix</td>
<td>Hot plant mix very cold climate.</td>
<td>Recycled Mix</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MATERIAL DESIGNATION</th>
<th>702-0400</th>
<th>702-0500</th>
</tr>
</thead>
<tbody>
<tr>
<td>VISCOSITY</td>
<td>AC-15</td>
<td>AC-20</td>
</tr>
<tr>
<td>Test Requirements</td>
<td>Min.</td>
<td>Max.</td>
</tr>
<tr>
<td>Viscosity, 60EC, Pa@</td>
<td>1200</td>
<td>1800</td>
</tr>
<tr>
<td>Viscosity, 135EC, m²/s (x10⁻⁶)</td>
<td>275</td>
<td>-</td>
</tr>
<tr>
<td>Penetration, 25EC, 100 g, 5 s</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>Flash point, COC, EC</td>
<td>225</td>
<td>-</td>
</tr>
<tr>
<td>Solubility in Trichlorethylene, %</td>
<td>99.0</td>
<td>-</td>
</tr>
<tr>
<td>Tests on Residue from Thin film oven test:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viscosity, 60EC, Pa@</td>
<td>-</td>
<td>750</td>
</tr>
<tr>
<td>Ductility, 25EC, 5 cm/min, cm</td>
<td>60</td>
<td>-</td>
</tr>
<tr>
<td>TYPICAL USES (intended only as a general informational guide)</td>
<td>Hot plant mix moderate climate.</td>
<td>Hot plant mix moderate climate. Sheet mixes.</td>
</tr>
</tbody>
</table>

**MATERIAL REQUIREMENTS.** The bituminous materials furnished shall meet the requirements indicated in this specification for the kind of material required in the work.
§ 702

1. Asphalt Cements. Asphalt Cements shall meet the requirements of Table 702-1, Asphalt Cements for Paving and Table 702-2, Miscellaneous Asphalt Cements. The asphalt shall be prepared by refining crude petroleum by suitable methods. The asphalt cement shall be homogeneous, free from water and shall not foam when heated to 175EC. 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. Approved temperature-viscosity charts, test data and shipping documents shall be provided by the supplier in accordance with the Department’s written instructions.

<table>
<thead>
<tr>
<th>MATERIAL DESIGNATION</th>
<th>702-0600</th>
<th>702-0700</th>
<th>702-0800</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GRADE</strong></td>
<td>85-100</td>
<td>18-60</td>
<td>15-30</td>
</tr>
<tr>
<td><strong>Test Requirements</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penetration, 25EC, 100g, 5s</td>
<td>Min.</td>
<td>Max.</td>
<td>Min.</td>
</tr>
<tr>
<td>Viscosity, 135EC, m²/s (x10⁶)</td>
<td>280</td>
<td>-</td>
<td>18</td>
</tr>
<tr>
<td>Flash point, COC, EC</td>
<td>230</td>
<td>-</td>
<td>200</td>
</tr>
<tr>
<td>Solubility in trichlorethylene, %</td>
<td>99.5</td>
<td>-</td>
<td>99.5</td>
</tr>
<tr>
<td>Softening Point, EC (AASHTO T53)</td>
<td>-</td>
<td>-</td>
<td>55</td>
</tr>
<tr>
<td>Loss on Heating, 163EC, 5h, % (AASHTO T47)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Penetration of Residue, % of Original</td>
<td>-</td>
<td>-</td>
<td>60</td>
</tr>
<tr>
<td>Ductility, 25EC, 5 cm/min, cm</td>
<td>-</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>Ductility, 4EC, 1 cm/min, cm</td>
<td>6</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tests on Residue from Thin-film Oven Test (AASHTO T179)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss on Heating, 163EC, 5h, %</td>
<td>-</td>
<td>85</td>
<td>-</td>
</tr>
<tr>
<td>Penetration, % of original</td>
<td>47</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ductility, 25EC, 5 cm/min, cm</td>
<td>75</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Typical Uses**

- Hot plant mix
- Joint and Crack Filter
- Subsealing

Silicone additives will be permitted in paving asphalts. Silicone may be introduced into the asphalt in accordance with the manufacturer’s recommendations either at the refinery, terminal or at a mixing plant storage tank. Asphalt treated with silicone shall conform to the specifications for untreated asphalt.

Any previously approved asphalt cement that has been stored in the mixing plant tank over the winter shall be resampled and accepted by the Department before it is used.

2. 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. 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.

### 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</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>REQUIREMENTS</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</th>
<th>702-23(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>
<td></td>
</tr>
<tr>
<td>REQUIREMENTS</td>
<td>ASTM D-2027 or AASHTO M 82</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

3. **Asphalt Emulsions (Anionic, Cationic).** The emulsified asphalt shall be homogeneous. It shall show no separation of asphalt after thorough mixing, within 30 days after delivery, provided separation has not been caused by freezing. A asphalt separation caused by freezing is unacceptable at any time.

   (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. Cationic asphalt emulsions 702-4001, 702-4101, 702-4201, 702-4301, 702-4301, and 702-4501 shall meet the requirements shown in Table 702-6.

4. **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 the requirements specified in Table 702-8.

5. **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.
## TABLE 702-5
### ASPHALT EMULSIONS

<table>
<thead>
<tr>
<th>GRADE</th>
<th>TYPE</th>
<th>RAPID SETTING</th>
<th>MEDIUM SETTING</th>
<th>SLOW SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MATERIAL DESIGNATION</td>
<td>702-3001</td>
<td>702-3101</td>
<td>702-3102</td>
</tr>
<tr>
<td>Viscosity, Saybolt Furol, 25EC, Sec.</td>
<td>20</td>
<td>100</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Viscosity, Saybolt Furol, 50EC, Sec.</td>
<td>-</td>
<td>-</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>-</td>
<td>1</td>
</tr>
<tr>
<td>Demulsibility, 35ml. 0.02N CaCl₂, %</td>
<td>60</td>
<td>-</td>
<td>60</td>
<td>-</td>
</tr>
<tr>
<td>Cement Mixing Test</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sieve Test, percent</td>
<td>-</td>
<td>0.10</td>
<td>-</td>
<td>0.10</td>
</tr>
<tr>
<td>Residue by distillation, %</td>
<td>55</td>
<td>63</td>
<td>63</td>
<td>65</td>
</tr>
<tr>
<td>Oil Distillate, Volume Total Emulsion, %</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>Tests on Residue from Distillation Test</td>
<td>Penetration, 25EC, 100g, 5 Sec.</td>
<td>100</td>
<td>200</td>
<td>100</td>
</tr>
<tr>
<td>Float Test, 60EC Note (2), Sec.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tests on Asphalt Base for Emulsion</td>
<td>Penetration 25EC, 100g, 5 Sec.</td>
<td>100</td>
<td>200</td>
<td>100</td>
</tr>
<tr>
<td>Ductility, 25EC, 5cm/min, cm</td>
<td>100</td>
<td>-</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>Flash Point, EC</td>
<td>177</td>
<td>-</td>
<td>177</td>
<td>-</td>
</tr>
<tr>
<td>Typical Applications: Note (3)</td>
<td>Spray Patch, Penetration Macadam</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ductility, 25EC, 5cm/min, cm</td>
<td>100</td>
<td>-</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>Flash Point, EC</td>
<td>177</td>
<td>-</td>
<td>177</td>
<td>-</td>
</tr>
<tr>
<td>Typical Applications:</td>
<td>Note (3)</td>
<td>Spray Patch, Penetration Macadam</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Base and Shoulder Stabilization, Cold Mixes, Shoulder Seal</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Penetrat-ion Macadam, Hot and Cold Mixes</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Stockpile Patching Mix</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Base and Shoulder Stabilization-ion</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**NOTES:**
1. This viscosity requirement at 50EC 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 260EC.
3. These typical applications are intended only as a guide for selecting the proper emulsion grade.

**BASIS OF ACCEPTANCE.** A 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
<table>
<thead>
<tr>
<th>TYPE</th>
<th>RAPID SETTING</th>
<th>MEDIUM SETTING</th>
<th>SLOW SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATERIAL DESIGNATION</td>
<td>702-4001</td>
<td>702-4101</td>
<td>702-4201</td>
</tr>
<tr>
<td>Grade</td>
<td>CRS-1</td>
<td>CRS-2</td>
<td>CMS-2</td>
</tr>
<tr>
<td></td>
<td>CRS-2</td>
<td>CMS-2h</td>
<td>CSS-1</td>
</tr>
<tr>
<td></td>
<td>CRS-2</td>
<td>CSS-1h</td>
<td></td>
</tr>
<tr>
<td>Tests on Emulsion:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viscosity, Saybolt Furol, 25EC, Sec.</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Viscosity, Saybolt Furol, 50EC, Sec.</td>
<td>20</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Storage Stability Test, 1 Day (Difference in percent Residue)</td>
<td>-</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Classification Test</td>
<td>Passes Positive</td>
<td>Passes Positive</td>
<td>Positive</td>
</tr>
<tr>
<td>Particle Charge Test</td>
<td>-</td>
<td>0.10</td>
<td>-</td>
</tr>
<tr>
<td>Sieve Test, percent</td>
<td>-</td>
<td>0.10</td>
<td>-</td>
</tr>
<tr>
<td>Cement Mixing</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Residue by Distillation, percent</td>
<td>60</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>Oil Distillate, Volume Total Emulsion, %</td>
<td>-</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Tests on Residue from Distillation Test: Penetration, 25EC, 100g, 5 Sec.</td>
<td>100</td>
<td>200</td>
<td>100</td>
</tr>
<tr>
<td>Tests on Asphalt Base for Emulsion: Penetration 25EC, 100g, 5 Sec.</td>
<td>100</td>
<td>200</td>
<td>100</td>
</tr>
<tr>
<td>Solubility or trichloroethylene, percent</td>
<td>99.0</td>
<td>99.0</td>
<td>99.0</td>
</tr>
<tr>
<td>Ductility, 25EC, 5cm/min, cm</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Flash Point, EC</td>
<td>177</td>
<td>177</td>
<td>177</td>
</tr>
<tr>
<td>Typical Application: Note (2)</td>
<td>Spray Patch, Penetration Macadam</td>
<td>Surface Treatment, Penetration Macadam</td>
<td>Cold Mixes Penetration Macadam</td>
</tr>
<tr>
<td>Suggested Temperature Range</td>
<td>Mixing, EC</td>
<td>Spraying, EC</td>
<td>-</td>
</tr>
</tbody>
</table>

NOTE:
1. If the Particle Charge Test result is inconclusive, material having a maximum Ph value of 6.7 will be acceptable.
2. These typical applications are intended only as a guide for selecting the proper emulsion grade.
### TABLE 702-7
(Vacant)

### TABLE 702-8
SYNTHETIC RESINS

<table>
<thead>
<tr>
<th>Material Designation</th>
<th>702-70</th>
<th>702-71</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Requirements</td>
<td>Min.</td>
<td>Max.</td>
</tr>
<tr>
<td>Penetration, 25EC, 100g 5s</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>Viscosity, 60EC, m²/s (x10⁻⁶)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Flash Point, COC, EC</td>
<td>204</td>
<td>-</td>
</tr>
<tr>
<td>Solubility in trichlorethylene, %</td>
<td>99.5</td>
<td>-</td>
</tr>
<tr>
<td>Loss of Heating, 163EC, 5 hr., % (AASHTO T47)</td>
<td>-</td>
<td>1.0</td>
</tr>
<tr>
<td>Water, %</td>
<td>-</td>
<td>0.0</td>
</tr>
<tr>
<td>Color, (30% binder/70% toluene) Gardner Standard Color Scale, ASTM D1544</td>
<td>-</td>
<td>16</td>
</tr>
<tr>
<td>Test on residue from Thin-film Oven Test (AASHTO T179) Penetration, % of original</td>
<td>47</td>
<td>-</td>
</tr>
<tr>
<td>Residue from evaporation, 105EC 3 hr. (ASTM D1644), %</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Typical Uses</td>
<td>Hot Plant Mix</td>
<td>Tack Coat</td>
</tr>
<tr>
<td>Suggested Spraying Temperature, EC</td>
<td>-</td>
<td>10-50</td>
</tr>
</tbody>
</table>

### TABLE 702-9
ASPHALT EMULSION TACK COAT

<table>
<thead>
<tr>
<th>Material Designation</th>
<th>702-90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Requirements</td>
<td>Minimu m</td>
</tr>
<tr>
<td>Sieve Test, %</td>
<td>-</td>
</tr>
<tr>
<td>Residue by Distillation, %</td>
<td>28</td>
</tr>
<tr>
<td>Oil Distillate, Volume of Total Emulsion, %</td>
<td>-</td>
</tr>
<tr>
<td>Test on residue from Distillation: Penetration, 25EC, 100g, 5s</td>
<td>40</td>
</tr>
</tbody>
</table>

**Requirements of Undiluted Asphalt Emulsion**

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:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Material Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt Emulsion</td>
<td>HFMS-2h</td>
</tr>
<tr>
<td>Asphalt Emulsion</td>
<td>SS-1h</td>
</tr>
<tr>
<td>Cationic Asphalt Emulsion</td>
<td>CSS-1h</td>
</tr>
</tbody>
</table>

| Suggested Spraying Temperature, EC | 25-65 |
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:

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

2. 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.

3. 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:

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

2. 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 must 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,
§ 703-01

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 703-1**

**FINE AGGREGATE REQUIREMENTS (TESTING)**

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Portland Cement Concrete</th>
<th>BituminousConcrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnesium Sulfates (NYSDOT 207)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. percent loss by weight at 5 cycles</td>
<td>30</td>
<td>45</td>
</tr>
<tr>
<td>Organic Impurities (NYSDOT 202, AASHTO T-21)</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Organic Plate, Lighter Than</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gardner Color, Lighter Than</td>
<td>11</td>
<td>-</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 Materials 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 must 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:

1. **Sampling Approved Operating Sources.** All approved operating sources shall be sampled when:
   
   (a) The latest test for a source is two (2) years old.

   (b) A change in the character of processed coarse aggregate occurs.

   (c) The location of the source of raw material is shifted or a change in the character of raw material occurs.

   (d) Considered necessary by the Department.

2. **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.

3. **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:

1. **Gravel Operations.**
   
   (a) A Geologic Source Report that describes the characteristics of the material to be processed during the coming year.

   (b) Plant Flow Information describing the processing equipment and the products to be furnished for Departmental use.

2. **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 must 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.”
### TABLE 703-2
#### PHYSICAL REQUIREMENTS (TESTING)\(^{(1)}\)

<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>Magnesium Sulfate Test (NYSDOT 207) (^{(2)})</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M ax. percent loss by weight at 10 cycles</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>6</td>
</tr>
<tr>
<td>Freezing and Thawing Test (NYSDOT 208) (^{(3)})</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M ax. percent loss by weight at 25 cycles</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>Los Angeles Abrasion Test (AASHTO T96)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M ax. percent loss by weight (Grading A or B)</td>
<td>35(^{(4)})</td>
<td>45(^{(5)})</td>
<td>35</td>
<td>40</td>
</tr>
<tr>
<td>Flat and Elongated Pieces (ASTM C125)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M aximum percent by weight</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flat or Elongated to the Degree of 3:1</td>
<td>30</td>
<td>30</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Flat or Elongated to the Degree of 5:1</td>
<td>10</td>
<td>10</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Crushed Particles in any primary size</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M inimum percent by weight</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. 2 size and larger (1 fractured faces)</td>
<td>-</td>
<td>-</td>
<td>75(^{(6)})</td>
<td>-</td>
</tr>
<tr>
<td>Smaller than No. 2 size (2 fractured faces)</td>
<td>-</td>
<td>-</td>
<td>85(^{(6)})</td>
<td>-</td>
</tr>
<tr>
<td>M inimum dry rodded weight (NYSDOT 213) kg/m(^3)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>70</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 for stone and gravel. Loss applies to 63 mm - 4.75 mm material when slag is tested according to ASTM C88.

\(^{(3)}\) The freeze-thaw requirement applies only to aggregate used in portland cement concrete. The loss applies to the No. 3 size fraction, but the Department reserves the option to test the No. 2 size fraction.

\(^{(4)}\) Loss applies to limestone, dolostone, sandstone and trap rock.

\(^{(5)}\) Loss applies to marble, granitic, and other crystalline materials.

\(^{(6)}\) Crushed particles for each primary size smaller than the No. 2 size shall have a minimum of 85% by weight of the particles with at least two fractured faces.

Gravel which has not been processed through a crushing operation shall not be combined with crushed gravel.

---

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 5

---

7-16
TABLE 703-3
PHYSICAL REQUIREMENTS
DELETERIOUS MATERIALS

<table>
<thead>
<tr>
<th>Material Designation</th>
<th>Maximum percent by weight in any primary size&lt;sup&gt;(2)&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Crushed Stone 703-0201</td>
</tr>
<tr>
<td>Shale or other light materials&lt;sup&gt;(1)&lt;/sup&gt;</td>
<td>1.0</td>
</tr>
<tr>
<td>Coal or Lignite</td>
<td>1.0</td>
</tr>
<tr>
<td>Clay Balls or Lumps</td>
<td>0.2</td>
</tr>
<tr>
<td>Metallic Ore</td>
<td>-</td>
</tr>
<tr>
<td>Glassy Pieces</td>
<td>-</td>
</tr>
<tr>
<td>Other Deleterious Substances</td>
<td>1.0</td>
</tr>
</tbody>
</table>

<sup>(1)</sup> This requirement may not apply if service records and/or abrasion and soundness tests indicate to the Department that the aggregate is satisfactory.

<sup>(2)</sup> Coarse aggregate containing more than the above specified amounts of deleterious substances, to be accepted by the Department, shall be washed or otherwise processed until such specifications are satisfied.

<sup>(3)</sup> Coarse aggregate shall not contain substances which, when mixed in portland cement concrete, produce an unacceptable level of chloric ions in the final product.

### 1. 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.

### 2. 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.

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.

### 3. 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.
4. 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 must 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.

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.

### Table 703-4

**SIZES OF STONE, GRAVEL AND SLAG**

<table>
<thead>
<tr>
<th>Size Designation</th>
<th>Screen Sizes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100 mm</td>
</tr>
<tr>
<td>Screenings(2)</td>
<td></td>
</tr>
<tr>
<td>1B</td>
<td>-</td>
</tr>
<tr>
<td>1A</td>
<td>-</td>
</tr>
<tr>
<td>1ST</td>
<td>-</td>
</tr>
<tr>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3A</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>4A</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>90-100</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, and cold mix bituminous pavements. 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.

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.

**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 must 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
TABLE 703-5
PRIMARY SIZES

<table>
<thead>
<tr>
<th>Size Designation</th>
<th>Primary Screen Sizes</th>
<th>Size Designation</th>
<th>Primary Screen Sizes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Passing</td>
<td>Retained</td>
<td></td>
</tr>
<tr>
<td>1B</td>
<td>3.2 mm</td>
<td>180 µm</td>
<td>3A</td>
</tr>
<tr>
<td>1A</td>
<td>6.3 mm</td>
<td>3.2 mm</td>
<td>3</td>
</tr>
<tr>
<td>1ST</td>
<td>12.5 mm</td>
<td>6.3 mm</td>
<td>4A</td>
</tr>
<tr>
<td>1</td>
<td>12.5 mm</td>
<td>6.3 mm</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>25.0 mm</td>
<td>12.5 mm</td>
<td>5</td>
</tr>
</tbody>
</table>

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. Material Specifications 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, Materials Specification 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 Materials Specification 703-01, Fine Aggregate, shall apply.

703-04 GROUT SAND

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

GENERAL. Materials Specification 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.
§ 703-04

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

BASIS OF ACCEPTANCE. The provisions of Materials Specification 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.

MATERIALS REQUIREMENT. 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 Materials Specification 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>Percent Passing by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.3 mm</td>
<td>100</td>
</tr>
<tr>
<td>300 µm</td>
<td>0-35</td>
</tr>
<tr>
<td>150 µm</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. Materials Specification 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:
Basis of Acceptance. The provision of Materials Specification 703-01, Fine Aggregates, shall apply.

703-08 MINERAL FILLER

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


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

Basis of Acceptance. Acceptance of this material will be based on the producer’s certification of compliance with these specification requirements.

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
§ 703-09

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

MATERIAL REQUIREMENTS. 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:

1. RAP obtained from the asbestos free pavement which was constructed with asphalt cement, and aggregates that meet the current requirements of Section 703, Aggregates, will be approved by the Regional Director or his/her representative.

2. If the source of the RAP or its quality is not known the Contractor shall submit to the Department at least 30 calendar days prior to the start of paving the following:
   a. Designated use of the RAP and approximate proportions.
   b. A 2.5 kilogram (minimum) sample representing the RAP to be incorporated into the recycled mixture.
   c. A 2.5 kilogram (minimum) sample of the aggregate extracted from the RAP for petrographic examination.
   d. The penetration test result (25EC, 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. 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. RAP shall meet the requirements stated in §703-09 Reclaimed Asphalt Pavement.

Composition of Mixtures. The blend percentage of RAP shall be selected within the limits shown in Table 1:

<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 2. 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.

**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 section 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.

<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>

**BASIS OF ACCEPTANCE.** The RAP will be accepted on the basis of one of the following:
§ 703-09

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 Subsection 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 703-6, 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.

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

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.

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 for use in the construction of drainage structures.
MATERIAL REQUIREMENTS. The brick shall conform to the requirements of AASHTO Specification M 91 Grade MM, except as modified herein. 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

1. Sampling. The brick shall be sampled by the Department's Representative, from production lot quantities in accordance with the following:

<table>
<thead>
<tr>
<th>Lot Size (Number of Units)</th>
<th>Number of Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 250,000</td>
<td>10</td>
</tr>
<tr>
<td>250,001 - 500,000</td>
<td>15</td>
</tr>
<tr>
<td>500,001 - 1,000,000</td>
<td>20</td>
</tr>
<tr>
<td>For each additional 500,000 or fraction thereof</td>
<td>5 additional samples</td>
</tr>
</tbody>
</table>

In no case shall less than 10 bricks be selected as samples. Additional specimens may be required at the discretion of the Department.

2. Testing. The brick shall exhibit a saturation coefficient not exceeding 0.80 except that if the average compressive strength of a lot submitted for test is greater than 55 M Pa or the average water absorption is less than 8.0% after 24-hour submersion in cold water, the requirement for saturation coefficient shall be waived.

In addition, at the project site, individual brick may be culled and rejected by the Engineer for failure to satisfy the following:

A. General Appearance. Brick shall be rectangular in cross section with substantially straight edges and square corners. Kiln marks or depressions not exceeding 5 mm in depth shall be permitted on the backside of the brick.

B. Finish and Appearance.

1. Sewer brick may have plain or smooth surfaces on both ends and on the face side.
2. Manhole brick may have plain, slightly or moderately textured surfaces.

C. Surface Requirements. Minor indications and surface cracks incidental to the usual method of manufacture, or the small chipping resulting from the customary methods of handling in shipment and delivery will not be grounds for rejection.

D. Soundness. The brick shall exhibit a clear metallic ring when any two bricks are struck together.

BASIS OF ACCEPTANCE. The material will be considered for acceptance either in stock for quantities at the manufacturing location in accordance with the procedural directives of the Department or on the basis of job sampling in the event samples are not taken at the plant.

704-02 CONCRETE BRICK

SCOPE. This specification covers the material and quality requirements for concrete building brick intended for use in brick masonry.

MATERIAL REQUIREMENTS. The subsections entitled “General and Material Requirements” of § 706.02, Reinforced Concrete Pipe, shall apply except that all references to approved working drawings and reinforcement shall not apply.
§ 704-02

The concrete brick shall be manufactured in an approved plant. The nominal dimensions of the brick shall be 205 mm long, 100 mm wide, and 70 mm in height. The standard dimensions of the concrete brick shall be the nominal dimension minus 10 mm. No over-all dimension (width, height, and length) shall differ more than 5 mm from the specified standard dimensions.

Concrete mix proportions shall be such that the minimum compressive strength as determined on the units themselves shall be as stated in this specification.

The transportation and placement of concrete shall be done by methods that will prevent segregation of the concrete materials.

The use of high early strength cement, calcium chloride, or any other concrete additive, not expressly approved, is prohibited.

Concrete brick shall be sound and free from cracks or other defects that would interfere with proper placing.

All concrete brick shall be subjected to curing which shall be accomplished to the satisfaction of the Department by any one of the methods described in the subsection entitled “Curing” of §706-02 Reinforced Concrete Pipe, except Controlled Atmospheric Curing shall not be allowed. Units shall be protected from freezing from the time the concrete is placed, and until curing is completed.

Sampling and Testing

1. Sampling. The brick shall be sampled by the Department’s Representative, from production lot quantities in accordance with the following:

<table>
<thead>
<tr>
<th>Lot Size (Number of Units)</th>
<th>Number of Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 10,000</td>
<td>6</td>
</tr>
<tr>
<td>10,001 - 99,999</td>
<td>12</td>
</tr>
<tr>
<td>100,000 - 150,000</td>
<td>18</td>
</tr>
<tr>
<td>For each additional 50,000 or fraction thereof</td>
<td>6 additional samples</td>
</tr>
</tbody>
</table>

In no case shall less than 6 brick be selected as samples. Additional specimens may be required at the discretion of the Department.

2. Testing. The minimum average compressive strength of concrete brick samples representing any lot, as determined on full size brick(s), shall be 20 MPa of average gross area (brick flatwise). The compressive strength of any individual unit shall not be less than 15 MPa.

The maximum average absorption of concrete brick samples representing any lot shall not exceed 240 kilograms per cubic meter.

All test procedures shall be conducted in accordance with ASTM C140.

BASIS OF ACCEPTANCE. The material will be considered for acceptance in accordance with procedural directives of the Department for either stock lot quantities at the manufacturing location, or on the basis of job sampling in the event samples are not taken at the plant.

704-03 PRECAST CONCRETE - GENERAL

SCOPE. This specification covers the general material and quality requirements for precast concrete items. 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, §501-3.02 and §501-3.03 except as noted herein.
The requirements of §501-2.01 shall not apply. Type 1, 2 or 3 cement may be used. The manufacturer may substitute fly ash meeting the requirements of §711-10 up to a maximum of 15% by weight of the total amount of cement plus pozzolan in the mix. The concrete shall have an air content of 5.0 to 9.0%. Unless noted otherwise in the contract documents, approved working drawings or item specification, the minimum compressive strength of concrete used in precast units shall be 25 MPa @ 28 days.

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

- Concrete Repair Material 701-04
- Bar Reinforcement, Grade 400 709-01
- Wire Fabric For Concrete Reinforcement 709-02
- Epoxy Coated Bar Reinforcement, Grade 400 709-04
- Epoxy Coated Wire Fabric Reinforcement 709-08
- Cold-Drawn Wire For Concrete Reinforcement 709-09
- Quilted Covers (for curing) 711-02
- Plastic Coated Fiber Blankets (for curing) 711-03
- Polyethylene Curing Covers (White Opaque) 711-04
- Membrane Curing Compound 711-05
- Burlap 711-06

Fabrication

1. **Drawings.** Precast concrete units shall be fabricated to conform to the details contained in the plans and contract documents. When contract documents specify precast units conforming to Department Standard Sheets, working drawings are not required and will not be processed. On such contracts, Department Standard Sheets or Pre-A approved Fabricator Standard Sheets shall be used as the working drawings. When contract documents contain details that deviate from the Department Standard Sheets or Pre-A approved Fabricator Standard Sheets, working drawings are required. The incorporation of lifting devices into a unit shall not be considered a deviation from the standard sheet. Working drawings, when required for fabrication of the units shall be prepared by the precast manufacturer in accordance with procedural directives of the Materials Bureau.

2. **General.** The manufacturer shall produce precast units that conform to the details of the applicable Department Standard Sheets, Approved Fabricator Standard Sheets or approved working 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. 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 Department Standard Sheets, Approved Fabricator Standard Sheets or approved working 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.

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. Vibrators shall not be used to move concrete within the forms.

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. 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.

The Director, Materials Bureau will designate inspection at the precast concrete facility. This designee will hereafter be referred to as the Inspection Authority. The Inspection Authority shall have free access to the manufacturing facility and product produced for Department evaluation.

3. 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. When enclosures are required to maintain this temperature, they shall meet the approval of the Inspection Authority.

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 heat supply or by utilizing the heat of hydration.

d. The plastic concrete shall not be exposed to freezing temperatures after it has been placed into the forms.

4. Dimensional Tolerances.

a. Unit dimensions shall not vary by more than 5 mm from those shown on Department Standard Sheets or approved working drawings unless noted otherwise in the contract documents, approved working 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 working drawings, standard sheets or item specification.

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 4. 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 25 MPa, whichever is less, has been reached.

Units with a compressive strength requirement greater than 25 MPa which are exposed to freezing temperatures before the required 28 day compressive strength is reached may require additional testing for compressive strength as directed by the Materials Bureau. Additional testing, when required, will be performed on cores taken from the hardened concrete.

1. Steam Curing. The units shall be cured in a suitable enclosure as approved by the Inspection Authority. The enclosure shall be designed to minimize the loss of heat and moisture while allowing for 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.

2. Water Spray Curing. Curing shall begin as soon as the concrete has hardened sufficiently to prevent surface damage from the water spray. 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.

3. Saturated Cover Curing. The saturated covers used under this method shall be burlap meeting the requirements of §711-06. Curing shall begin as soon as the concrete has hardened sufficiently to prevent surface damage from the saturated burlap. 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.

4. Moisture Retention Curing. Units cured in accordance with these methods shall be maintained at a minimum temperature of 10°C for 7 days. Additional curing time may be necessary to meet the 28 day strength requirements. When the specified 28 day compressive strength or 25 MPa, whichever is less, has been reached the 10°C minimum curing temperature is no longer required and the unit may be exposed to freezing temperatures.

a. Membrane Curing Compound. The membrane curing compounds used under this method must meet the requirements of §711-05 and 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. When curing compound is to be used in conjunction with any other method of cure the Inspection Authority shall be notified prior to the start of production.

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 bonded to it. Another approved method of curing shall be used when this condition exists.

b. 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.

5. 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. Major defects and non repairable defects in a unit will be cause for rejection of the unit. Defects are defined as follows:

1. 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 4.c. of this section. Surface defects need not be repaired.

2. 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. No minor defect shall be repaired without prior approval of the Inspection Authority. Minor defects shall be repaired by removing all unsound concrete from the defect 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. The repairs shall be made to the satisfaction of the Department.

3. 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.

The Materials Bureau will consider specific requests to repair major defects. No major defect shall be repaired without prior approval of the Materials Bureau. Requests to repair major defects shall be made in writing, through the Inspection Authority, to the Director, Materials Bureau and shall include a complete repair procedure along with detailed sketches of the defect showing all dimensions and any exposed reinforcing steel. The Inspection Authority shall verify the information contained in all such requests and then forward them to the Director, Materials Bureau. The Materials Bureau shall determine whether repairs can be made or the unit will be rejected.

4. 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.
The Inspection Authority will evaluate all defects and determine which of the above defect categories apply.

**Sampling and Testing.** Precast concrete units shall be separated into specific identifiable lots. The maximum number of units in a lot shall be in accordance with Department Quality Assurance Procedures. Precast units shall be sampled and tested to assure that the concrete is in conformance with the specification requirements. The Materials Bureau shall determine the sampling and testing frequencies. Copies of the Department’s quality assurance procedures and test methods may be obtained from the Materials Bureau. Sampling and testing shall be performed by one of the following methods as determined by the Department.

1. **Production Testing:** Testing shall be performed by the manufacturer, subject to the approval and inspection of the Materials Bureau. It shall consist of testing the plastic concrete for compliance to the air content required by the specification and the casting and testing of concrete cylinders for compressive strength determination. Test cylinders used to determine the required compressive strength shall be cured in the same manner and location as the units they represent. Testing equipment and facilities shall meet the approval of the Materials Bureau. The Department reserves the right to test the hardened concrete at any time. 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 200 mm in length unless otherwise approved by the Materials Bureau. Core holes shall be plugged and repaired in accordance with the requirements of Repair, under 2. Minor Defects.

2. **End Product Testing:** The testing of hardened concrete for both air content and compressive strength will be performed by the Materials Bureau on 100 mm diameter cores drilled by the manufacturer under the supervision of a Department representative. Cores shall be a minimum of 200 mm in length unless otherwise approved by the Materials Bureau. Core holes shall be plugged and repaired in accordance with the requirements of Repair, under 2. Minor Defects.

**Shipping.** No units will be considered for shipment until they have been accepted by the Department. This acceptance shall include verification that the units are free from defects as noted under Repairs and all specification requirements including the compressive strength and tolerance requirements have been achieved. In addition units produced between the dates of October 31st and April 1st will not be considered for shipment for a minimum of 72 hours following the completion of casting.

**BASIS OF ACCEPTANCE.** Precast concrete units will be accepted in specific identifiable lots at the manufacturing location in accordance with procedural directives of the Materials Bureau.

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**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.** The subsection entitled “General” and “Material Requirements” of §706-02 Reinforced Concrete Pipe shall apply except that all references to approved working drawings and reinforcement shall not apply.

Concrete mix proportions shall be such that the minimum compressive strength as determined on the units themselves shall be as stated in this specification.

The transportation and placement of concrete shall be done by methods that will prevent segregation of the concrete materials.

The use of high early strength cement, calcium chloride, or any other concrete additive not expressly approved is prohibited.
§ 704-04
Blocks shall be sound and free from cracks or other defects that would interfere with the proper placing of the blocks.

All blocks shall be subjected to curing by any one of the methods described in the subsection entitled “Curing” §706-02, Reinforced Concrete Pipe except Controlled Atmospheric Curing shall not be allowed. Curing shall be accomplished to the satisfaction of the Department. Units shall be protected from freezing from the time the concrete is placed and until curing is completed.

Sampling and Testing

1. Sampling. The block shall be sampled by the Department’s Representative, from production lot quantities in accordance with the following:

<table>
<thead>
<tr>
<th>Lot Size (Number of Units)</th>
<th>Number of Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 10,000</td>
<td>6</td>
</tr>
<tr>
<td>10,001 - 99,999</td>
<td>12</td>
</tr>
<tr>
<td>100,000 - 150,000</td>
<td>18</td>
</tr>
<tr>
<td>For each additional 50,000 or fraction thereof</td>
<td>6 additional samples</td>
</tr>
</tbody>
</table>

In no case shall less than 6 block be selected as samples. Additional specimens may be required at the discretion of the Department.

2. Testing. The minimum average compressive strength of concrete paving block samples shall be 20 MPa. This strength shall be determined on full size block samples, by load application in a direction parallel to the slope upon which the block is to be placed. The compressive strength of any individual unit shall be not less than 15 MPa.

The maximum average absorption of concrete paving block samples representing any lot shall not exceed ten percent (10%) by weight. The absorption of any individual unit shall not exceed twelve percent (12%) by weight.

All test procedures shall be in accordance with ASTM C140.

BASIS OF ACCEPTANCE. The material will be considered for acceptance in accordance with procedural directives of the Department for entire stock lot quantities at the manufacturing location, or on the basis of job sampling in the event samples are not taken at the plant.

704-05 PRECAST CONCRETE BARRIER

SCOPE. This specification covers the material and quality requirements for precast concrete barrier 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 working drawings the compressive strength of concrete used in precast concrete barrier shall be as follows:

1. Concrete Barrier 25 MPa (minimum) @ 28 days
2. 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.

Fabrication. The Fabrication requirements contained in §704-03, along with the following shall apply. The manufacturer shall not begin fabrication of any barrier units until an inspection assignment has been made by the Materials Bureau.

7-32
1. **Drawings.** The drawing requirements contained in §704-03 along with the following shall apply:

   a. **Concrete Barrier.** Working drawings, when required for manufacture of the units, shall be approved by the Director, Materials Bureau, prior to the start of fabrication. The Materials Bureau will require at least 30 working days for the evaluation of each drawing submission.

   b. **Concrete Barrier For Structures.** Units shall be fabricated to conform to the details shown on DCES approved precast barrier system drawings. When site conditions require modification of the approved precast barrier system drawings job specific working drawings are required. Working drawings, when required for fabrication of the units, shall be approved by the D.C.E.S. prior to the start of fabrication. The D.C.E.S. will require at least 20 working days for the evaluation of each drawing submission.

2. **General.** All reinforcing steel shall be epoxy coated meeting the requirements of §709-04. Reinforcing steel shall have a minimum of 40 mm of concrete cover unless noted otherwise in the contract plans or approved working drawings.

3. **Dimensional Tolerances.**
   a. Cross sectional dimensions shall not vary by more than 5 mm.
   b. The vertical centerline shall not be out of plumb by more than 5 mm.
   c. When checked with a 3 m straight edge surface irregularities shall not exceed 5 mm.
   d. Longitudinal dimensions shall not vary from the dimensions shown by more than 5 mm per 3 m of barrier.

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

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

**Sampling and Testing.** The Sampling and Testing 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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**704-06 PRECAST CONCRETE CRIBBING**

**SCOPE.** This specification covers the material and fabrication requirements for precast concrete cribbing. Cribbing may consist of one of the following two types:

1. Stretcher and header type.
2. Precast concrete wall unit type.

**MATERIAL REQUIREMENTS.** Materials shall meet the requirements of the following Sections:

- Portland Cement
- Coarse Aggregates
- Concrete Sand
- Bar Reinforcement Grade 400
- Wire Fabric for Concrete Reinforcement
- Admixtures
- Water
§ 704-06

The maximum allowable total chloride content in concrete shall not exceed 0.10 percent by weight of cement. Testing shall be done in accordance with written procedural directives of the Department.

Cement shall be Type 1 or Type 2. Coarse aggregate gradation shall conform to the No. 1 Size Designation §703-02 Coarse Aggregate, Table 703-4.

Pozzolans. The manufacturer may substitute fly ash meeting the requirements of §711-10 up to a maximum of 15 percent of the minimum portland cement by weight.

Concrete Manufacturing: The manufacturer shall formulate a concrete mix design, with a minimum cement content of 360 kilograms per cubic meter, such that the properties of the concrete meet the following requirements:

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Content, %</td>
<td>5.0 - 8.0</td>
</tr>
<tr>
<td>Compressive Strength, M Pa, M in., 28 days</td>
<td>25 M Pa</td>
</tr>
</tbody>
</table>

The manufacturer shall maintain at the manufacturing site a record of material used and their sources, and a copy of the concrete mix design.

Fabrication. Precast concrete cribbing shall be fabricated to conform to the shape and size shown on the standard sheet unless otherwise shown on the plans. The reinforcement shall be the size and configuration shown on the standard sheet. The manufacturer shall produce precast cribbing units that are uniform in appearance. The units shall be straight and the concrete shall be cast in steel forms unless another type of form is approved by the Regional Director or his/her representative. The concrete shall be thoroughly consolidated by external or internal vibrators or a combination of both.

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.

Curing. All cribbing shall be subjected to curing by any one of the methods described in the following paragraphs. After removal of forms and before curing begins, cribbing shall be sheltered from direct sunlight and drafts in a manner satisfactory to the Regional Director or his/her representative. The curing process shall commence no later than eight hours after the removal of the forms. Curing shall be accomplished to the satisfaction of the Regional Director or his/her representative. If at any time curing temperatures fall below the specified minimum for the chosen curing procedure, the curing period shall be increased accordingly.

1. Steam Curing. Cribbing may be placed in a curing chamber, free from outside drafts, and cured in a moist atmosphere maintained at a temperature between 40E and 75EC, by the injection of steam for a period of not less than 12 hours or, when necessary, for such additional time as may be needed to enable the cribbing to meet the strength requirements. Steam curing shall not commence until at least two hours have elapsed since completion of placement of concrete in the forms.

When a curing chamber is not available, cribbing may be placed in an enclosure of canvas and subjected to steam at the temperature and for the time specified above. The enclosure shall be so erected as to allow full circulation of steam around the entire cribbing section. The interior surfaces of the curing room or canvas jackets and the surfaces of the cribbing shall be entirely moist at all times.

2. Water Spray Curing. Under the conditions of enclosure described in the above paragraph on “Steam Curing”, cribbing may be cured by subjecting it to a continuous fine spray of water in an enclosure maintained at a temperature of not less than 20EC for a period of not less than 72 hours or such additional time as may be necessary to meet the strength requirements.
3. **Saturated Cover Curing.** The sides and top of each cribbing section shall be covered with heavy burlap or other suitable material saturated with water before applying and kept at a temperature of not less than 20°C for a period of not less than 72 hours or such additional time as may be necessary to meet the strength requirements.

4. **Other Methods.** Curing by other methods is subject to the approval of the Director, Materials Bureau.

**Repair.** Cribbing sections that contain minor defects caused by manufacture or mishandling may be repaired. Minor defects are defined as those that are small holes or spalls that do not penetrate deeper than the steel reinforcement. Repairs shall be made using a concrete repair material conforming to the requirements of §701-04 and having a color similar to that of the cribbing section. The repair shall be finished to the proper shape and cured. It shall withstand a moderate blow with a 450 gram hammer.

Cribbing sections having honeycombing, cracks, or large spalls are not acceptable and shall not be repaired.

**Sampling and Testing.** Precast concrete cribbing sections manufactured under the requirements of this specification shall be separated into specific and identifiable stock lots. A lot shall consist of only one type of cribbing. However, a variety of sizes may be included in a lot.

The maximum number of sections in a lot shall be in accordance with Department directives. The properties of the concrete will be determined on a stock lot basis, by the Department, in accordance with either of the following methods at the option of the Department:

1. **Production Testing:** Testing will be performed by the manufacturer, subject to the approval and inspection of the Materials Bureau. It will consist of testing the plastic concrete for compliance to the air content required by this specification and the casting and testing of concrete cylinders for compressive strength determination. Test cylinders used to determine the required compressive strength shall be cured with units they represent. The Department reserves the right to test the hardened concrete at any time, in which case the manufacturer will drill 100 mm diameter cores at the direction of a Department representative.

2. **End Product Testing:** The testing of hardened concrete for both air content and compressive strength will be performed by the Materials Bureau on 100 mm diameter cores drilled by the manufacturer under the supervision of a Department representative.

**Shipping.** No units will be considered for shipment unless the units are free from defects as noted under Repairs of this specification and all specification requirements including the compressive strength requirements are achieved.

**BASIS OF ACCEPTANCE.** Precast concrete cribbing will be accepted in stock lot quantities at the manufacturing location according to the procedural directives of the Materials Bureau.

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**704-07 VACANT**

**704-08 BRICK 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 be manufactured from extruded fire clay or shale and shall be the shape, size and color shown on the plans. Samples of the brick pavers shall be submitted to and approved by the Engineer prior to beginning of work.

The brick pavers shall be fired to produce a dense paver with the average water absorption less than 8.0% after 24-hour submersion to cold water and the average compressive strength in excess of 55 Mpa.
§ 704-08
The paver shall be free of chinks, screeding scan, stress cracks or foreign substances. The brick pavers shall also conform to the other requirements outlined in A.S.T.M. C216 and C 62, Grade SW.

BASIS OF ACCEPTANCE. The brick pavers will be considered for acceptance either in stock lot quantities at the manufacturing location in accordance with the procedural directives of the Department, or on the basis of project sampling if samples are not taken at the plant. Samples shall be submitted for testing to the Materials Bureau a minimum of 30 days prior to the beginning of the work. A minimum of ten pavers shall be submitted from each lot of 50,000 pavers or fraction thereof. For lots of more than 50,000 pavers, five individual pavers shall be selected from each 100,000 pavers or fraction thereof contained in the lot. In no case shall less than ten pavers be submitted. Additional specimens may be required at the discretion of the Department.

704-09 STONE BLOCKS

SCOPE. This specification covers the material and quality requirements for stone blocks for use in Grouted Stone Block Paving.

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 must 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

Cement. Cement used shall be Type 2 or Type 6 or combination thereof conforming with the requirements of §701-01 Portland Cement. Shipment shall be accompanied by a cement shipment certification executed by the cement manufacturer in a form and manner directed by the Materials Bureau.

Pozzolans. The manufacturer may substitute fly ash meeting the requirements of §711-10 up to a maximum of 15 percent of the minimum portland cement by weight.

Aggregates.

1. Fine Aggregate. The aggregate used shall conform to the requirements of §703-01 Fine Aggregate and shall be artificial sand made from crushed rock and shall have a gradation suitable to make a unit block meeting the requirements of ASTM Designation: C55, Grade N1.

2. Coarse Aggregate. The aggregate used shall conform to the requirements of §703-02 Coarse Aggregate and shall be Crushed Stone §703-0201 or Crushed Gravel §703-0202 having a gradation suitable to make a unit block meeting the requirements of ASTM C55, Grade N1 with maximum size of 13 mm.
Admixtures. No admixture shall be required other than a coloring agent. All coloring agents used in the mix shall be manufactured from minerals which are light-fast, durable and resistant to alkali.

Proportioning. The proportion of the mix shall be that necessary to secure unit block meeting the requirements of ASTM C55, Grade N1. An automatic proportioning plant will not be required.

Curing. Curing shall meet the requirements indicated for §706-02 Reinforced Concrete Pipe, except Controlled Atmospheric Curing shall not be allowed.

Measurement. The size of the split faced concrete bricks shall be as follows:

<table>
<thead>
<tr>
<th>H</th>
<th>W</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 mm</td>
<td>95 mm</td>
<td>395 mm or 450 mm</td>
</tr>
<tr>
<td>65 mm</td>
<td>95 mm</td>
<td>395 mm or 450 mm</td>
</tr>
<tr>
<td>90 mm</td>
<td>95 mm</td>
<td>395 mm or 450 mm</td>
</tr>
<tr>
<td>140 mm</td>
<td>95 mm</td>
<td>395 mm or 450 mm</td>
</tr>
<tr>
<td>195 mm</td>
<td>95 mm</td>
<td>395 mm or 450 mm</td>
</tr>
</tbody>
</table>

All bricks in each lot shall have the same length (L). The width of unsplit blocks shall be twice that of the split faced concrete bricks.

The width (W) of the split faced concrete bricks shall be the width measured at the quarter points across the top and bottom bearing surfaces from the split line to the back face of the brick.

Splitting Procedure. The splitting of the concrete masonry unit shall be made after the block has attained the required strength but not less than seven days after curing has been completed. The splitting shall be performed on an approved mechanical, self-leveling splitting machine with two steel knives, one directly above the other. The splitting shall leave relatively sharp, straight, and parallel bearing edges. Concrete masonry units prefailed by use of chamfer strips in molds or any other means, shall not be approved for use under this specification.

Sampling and Testing. The brick shall be sampled in accordance with the applicable sections of Methods of Sampling and Testing Concrete Masonry Units (ASTM C140) with the following modifications:

Sampling shall be conducted in a manner directed by the Materials Bureau. All samples shall be wrapped in 0.1 mm polyethylene for submission to the Materials Bureau.

For purposes of test, full size, unsplit concrete bricks shall be selected at the place of manufacture.

For the strength, absorption and moisture content determinations the number of specimens shall be 10 units selected from each lot.

The maximum number of unsplit units in a lot shall be 15,000. From the time of sampling, the concrete brick shall be kept in covered storage or if exposed to the elements shall be stored on pallets and shall be protected from free moisture by a waterproof wrapping of 0.1 mm polyethylene. Concrete brick shall be shipped on pallets, wrapped as described above and remain protected in this manner until incorporated into the work. The brick shall be tested in accordance with the applicable sections of Method of Sampling and Testing Concrete Masonry Units (ASTM C140).

The split faced concrete brick shall be within the range of color, quality, texture and surface finish of the standard samples on display in the office of the D.C.E.S., 1220 Washington Avenue, Albany, New York 12232.

The split faced concrete brick shall meet the physical properties, permissible variation in dimension and visual inspection as set forth in ASTM C55, Grade N1.

Basis of Acceptance. Brick will be considered for acceptance in stock lot quantities at the manufacturer's yard or in job lots consisting of any fraction of the contract quantity at the manufacturer's
§ 704-10
yard. Samples shall be secured for tests by a representative of the Department only from the lots of block they are to represent.

Brick shall be considered ready for acceptance when a lot conforms to the specified test requirements, regardless of age, classification and measurements. The manufacturer shall be permitted one, and only one, retest to determine specification compliance.

The manufacturer must submit to the Materials Bureau for each lot offered for acceptance a copy of typical test results for linear shrinkage of this product. These test results need not be from the lot offered for acceptance but must be from samples of the same product tested no more than 12 months prior to submission of the lot for acceptance. The test must be performed by an independent testing laboratory.

704-11 PRECAST CONCRETE COPING

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

MATERIAL REQUIREMENTS. The requirements of §714-04 shall apply except as modified herein.

Modifications.

1. Cement Type. The cement may be Type 2 or Type 6.

2. Aggregate Size. The maximum aggregate size shall be No. 2 size designation.

3. Coloring Agents. All coloring agents used in the mix shall be manufactured from minerals; and the agents shall be light-fast, durable and resistant to alkali.

4. Source of Supplies. Sources of supply of cement, aggregate and admixtures shall not be changed during the course of production of units without approval by the Regional Director or his/her representative.

The maximum allowable total chloride content in concrete shall not exceed 0.10 percent by weight of cement. Testing shall be done in accordance with written procedural directives of the Department.

Concrete Manufacturing. The concrete mix proportions shall be formulated by the precast concrete coping manufacturer. The cement content shall be a minimum of 360 kilograms per cubic meter. The following specific requirements shall apply:

<table>
<thead>
<tr>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressive Strength, MPa, 28 days</td>
<td>35</td>
</tr>
<tr>
<td>Air Content, %</td>
<td>5.0</td>
</tr>
<tr>
<td>Absorption, %</td>
<td>-</td>
</tr>
</tbody>
</table>

Fabrication. Precast concrete coping shall be fabricated to conform to the shape and size shown on the plans. The reinforcement shall be shaped as shown on the plans and any circumferential wire shall be lap welded prior to placement in the form. Precast concrete coping shall meet the requirements of permissible variation in dimension and visual inspection as set forth in ASTM C55, Grade U1 and the physical properties as set forth in this specification. The color of the precast concrete coping shall be as specified on the plans. The width of the precast concrete coping shall be that measured at the quarter points and across the top and bottom surfaces.

All surfaces exposed to view after installation except bedding surfaces shall be formed by casting a portland cement concrete mix against steel or fiber glass forms of rigid construction. All units shall be produced in such a manner that the bottom surfaces are founded on a casting bed of unyielding materials.

Castings shall be produced with a dense, smooth, uniform finished surface without rubbing or additional treatment. Consolidation of the concrete may be external or internal vibration or a combination thereof. Corners shall have a maximum radius of 3 mm and grinding will not be allowed.
The castings shall remain in the forms at least 24 hours. After 24 hours, the castings shall be removed from the forms in a manner that will prevent chipping of the edges or faces of the concrete.

Curing. Curing shall meet the requirements indicated in §706-02, Reinforced Concrete Pipe, except Controlled Atmospheric Curing shall not be allowed.

Repair. Castings with honeycomb will not be accepted regardless of the method of repair. Blow-holes on the surfaces shall be kept to a minimum. Minor blow-holes shall be repaired as follows:

The casting is to be wet and the holes shall be filled 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 with burlap until a clean, uniform appearance, with no visible coating of mortar on the concrete, is secured. The mortar repair shall be kept moist for a minimum of five days.

Sampling and Testing. Specimens for determination of strength, air content, absorption and dimension shall be 100 mm diameter cores, from each lot, obtained by the manufacturer and certified as representing a specific lot and size of precast concrete coping. A Department representative shall select the precast concrete coping units for acceptance test specimens. The minimum number of specimens shall be three cores unless otherwise directed by the Materials Bureau. The cores shall be sent to the Materials Bureau by a Department representative where they will be tested. The manufacturer will be permitted one retest to determine compliance with the absorption requirement. Test methods may be obtained from the Materials Bureau.

BASIS OF ACCEPTANCE. Precast concrete coping shall be accepted in stock lot quantities at the manufacturing location on the basis of the procedural directives of the Materials Bureau.

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. Details of materials shall comply with the requirements included in §501, Portland Cement Concrete - General, with the following modifications:

Cement. Cement shall be Type 2 or Type 6, or a combination thereof, conforming with the requirements of §701-01, Portland Cement except that shipment shall be accompanied by a Certified Shipment Notice executed by the cement manufacturer in a form and manner directed by the Materials Bureau. Shipment inspection and seal control by the Department will not be required.

Pozzolans. The manufacturer may substitute fly ash meeting the requirements of §711-10 up to a maximum of 15 percent of the minimum portland cement by weight.

Aggregates.

1. Fine Aggregate. The aggregate used shall conform to the requirements of §703-01, Fine Aggregate and shall have a gradation suitable to make a unit block meeting the requirements of ASTM C55, Grade N1. Hard durable crushed marble, the surfaces of which are not coated with any injurious materials, will be accepted.

2. Coarse Aggregate. The aggregate used shall conform to the requirements of Crushed Stone §703-0201 or Crushed Gravel, §703-0202, having a gradation suitable to make a unit block meeting the requirements of ASTM C55, Grade N1, with a maximum size of 13 mm. Hard durable crushed marble, the surfaces of which are not coated with any injurious materials, will be accepted.

Admixtures. The only admixtures permitted will be a coloring agent if required.
§ 704-12

**Coloring.** All coloring agents used in the mix shall be manufactured from minerals and, be light-fast, durable and resistant to alkali.

**Mix Proportions.** The proportion of the mix shall be that necessary to secure a unit block meeting the requirements of ASTM C55, Grade N1.

**Proportioning Equipment.** An automatic proportioning plant will not be required.

**Curing.** Curing shall meet the requirements indicated for §706-02, Reinforced Concrete Pipe, except Controlled Atmospheric Curing shall not be allowed.

**Sampling and Testing.**

1. **Sampling.** The block shall be sampled in accordance with the applicable sections of Methods of Sampling and Testing Concrete Masonry Units (ASTM C140) with the following modifications:

   a. **Selection of Test Specimens.** For the purpose of test, full size concrete block may be selected by representatives of the Department from stock lot quantities at the place of manufacture.

   b. **Number of Specimens.** For the strength, absorption and moisture content determinations, the number of specimens shall be not less than 10 units selected from each lot of 5000 units, or fractions thereof, and 20 units selected from each lot of more than 5000 and less than 50,000 units. For lots of more than 50,000 units, not less than 10 units shall be selected from each 25,000 units, or fractions thereof, contained in each lot.

2. **Testing.** The block shall be tested in accordance with the applicable sections of Methods of Sampling and Testing Concrete Masonry Units, (ASTM C140).

**Classification.** The decorative concrete blocks shall be within the range of color, quality, texture and surface finish of the standard samples on display in the office of the Deputy Chief Engineer (Structures), 1220 Washington Avenue, Albany, New York 12232.

The decorative concrete block shall meet the physical properties, permissible variation in dimension and visual inspection as set forth in ASTM C55, Grade N1. The maximum moisture content permitted will not exceed 30.0 percent.

**Splitting Procedure.** When required, the splitting of the concrete masonry block shall be made after the block has attained the required strength, but not less than seven days after curing has been completed. The splitting shall be performed on an approved mechanical self-leveling splitting machine with two steel knives, one directly above the other. The splitting shall leave relatively sharp straight parallel bearing edges, a texture and surface finish with fracture of the aggregate within the range of the standard samples on display in the office of the Deputy Chief Engineer (Structures).

**Storage.** Stock lot quantities of the block stored in the manufacturer's yard shall be neatly piled, preferably on shipping pallets, after curing is completed and protected from free moisture by a waterproof wrapping of 0.1 mm polyethylene. Such protection shall be maintained until the material is used. Sample units of full-size concrete blocks shall be individually wrapped and protected from free moisture by a waterproof wrapping of 0.1 mm polyethylene immediately after selection, prior to and during shipment to the Materials Bureau.

**Basis of Acceptance.** Block will be considered for acceptance in stock lot quantities at the manufacturer's yard or in job lots consisting of any fraction of contract quantity at the manufacturer's yard. Samples shall be secured for tests by a representative of the Department only from the lots of block they are to represent. The maximum quantity in a lot shall be as directed by the Materials Bureau. All shipments from stock lots shall be certified by a representative of the Department as directed by the Materials Bureau.
Block shall be considered ready for acceptance when a lot conforms to the specified test requirements, regardless of age, classification and measurements. The manufacturer shall be permitted one, and only one, retest to determine specification compliance.

**704-13 PRECAST CONCRETE PAVERS**

**SCOPE.** This specification covers the materials details, quality requirements and method of approval for precast concrete pavers.

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

- Cement
- Fine Aggregate Mortar Sand
- Grout Sand
- Concrete Sand
- Coarse Aggregate
- Water

No admixtures are required. Coloring agents, when required, shall be formulated such that the pavers are colorfast, durable and resistant to alkali. Other materials may be used in the manufacture as approved by the Director, Materials Bureau.

The shapes, sizes and colors shall be as specified in the contract documents.

**Pozzolans.** The manufacturer may substitute fly ash meeting the requirements of §711-10 up to a maximum of 15 percent of the minimum portland cement by weight.

**Sampling and Testing.** Samples of precast concrete pavers will be obtained by the Materials Bureau for testing and consideration of approval. The manufacturing plant, equipment and facilities shall meet the approval of the Director, Materials Bureau.

Precast concrete pavers shall meet the following requirements:

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressive Strength, MPa, Min., 28 days</td>
<td>55</td>
</tr>
<tr>
<td>24 Hour Absorption, %, Max.</td>
<td>5.0</td>
</tr>
<tr>
<td>Freeze-thaw, % Loss, Max. (25 cycles, one per day, 10% NaC1 solution)</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Satisfactory compliance with all requirements of this specification will result in the name of the manufacturer being placed on an Approved List issued by the Materials Bureau.

**BASIS OF ACCEPTANCE.** Precast concrete pavers will be accepted at the manufacturing facility in accordance with procedural directives of the Materials Bureau.

**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.
§ 705-01

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 (VACANT)

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 and 705-05 (VACANT)

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 closed cell, cross-linked foam Joint Seal and Joint Filler.

GENERAL

Type I Joint Seal. The joint material shall be a cross-linked foam material that is impermeable, weather resistant and wear resistant. The material shall be capable of maintaining a waterproof joint within the range of 50% compression and 25% tension and remain unaffected by road salts and petroleum products. The physical and chemical properties shall not alter significantly within the temperature range anticipated for road surfaces.

The joint material shall be of the thickness and width described in the contract documents within a tolerance of +10% and -2%. The joint material shall be heat welded to the proper dimensions by the manufacturer and installed using the manufacturer's recommended bonding agent.

Type II Joint Filler. The joint material shall be a closed-cell foam filler that is impermeable and weather resistant. The physical and chemical properties shall not alter significantly within the temperature range anticipated for road surfaces.

The joint material shall be of the thickness and width described in the contract documents within a tolerance of +10% and -2%. If a bonding agent is required, it shall be one which is recommended by the manufacturer and installed according to the manufacturer's recommended procedure.

MATERIAL REQUIREMENTS

Type I Joint Seal

Compression and Recovery. The load required to compress a test specimen to 50% of its original thickness shall not be less than 69 kPa, nor more than 414 kPa. Upon removal of the load, the joint material shall recover to within 5% of its original thickness within 24 hours.

Extrusion. When compressed to 50% of its original thickness with three restrained sides, no joint seal sample shall be extruded more than 6 mm on the free side.

Density. The density of the air dry material shall not be less than 42 kg/m$^3$ nor greater than 54 kg/m$^3$.

Water Absorption. No test specimen (50 mm cube, standard) shall have a weight increase of more than 3% after being submerged under 25 mm of water at room temperature for 24 hours.

Type II Joint Filler

Compression and Recovery. The load required to compress a test specimen to 50% of its original thickness shall not be less than 28 kPa. Upon removal of the load, the joint material shall recover to within 5% of its original thickness within 24 hours.

Extrusion. When compressed to 50% of its original thickness with three restrained sides, no joint seal sample shall be extruded more than 6 mm on the free side.

Density. The density of the air dry material shall not be less than 28 kg/m$^3$ nor greater than 480 kg/m$^3$.

Water Absorption. No test specimen (50 mm cube, standard) shall have a weight increase of more than 7% after being submerged under 25 mm of water at room temperature for 24 hours.

BASIS OF ACCEPTANCE. Acceptance of this material will be based on the manufacturer's certification of compliance with these specification requirements.
SCOPE. This specification covers the material requirements for preformed elastic bridge joint sealer for use in bridge joints.

GENERAL. The preformed elastic joint sealer material shall be vulcanized elastomeric compound using polymerized chloroprene as the only basic elastomer. All bridge joint sealers shall be pre-approved by the Director, Materials Bureau, prior to the submission of any individual production lot for acceptance. Such pre-approval shall be requested in writing and be accompanied by a sample of each size sealer proposed and a detailed drawing of the shape including allowed dimensional tolerances. The sample size shall be in accordance with Table 2 AASHTO M 297 Minimum Lengths of Seal Sample.

REQUIREMENTS. The requirements for Preformed Elastic Bridge Joint Sealers shall be as follows:

1. 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.

2. 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 and shall exhibit sufficient sealing pressures throughout its expected compression range to assure that no deleterious materials enter the joint.

3. Height to Width. The height of the uncompressed sealer shall be equal to or exceed the uncompressed width, excepting differences that may result from allowed dimensional tolerances. A dimensional tolerance of ± 5% of the width and height of the seal shall be applied to seals less than 102 mm in width and a dimensional tolerance of ± 6 mm shall be applied to seals 102 mm and greater.

MATERIAL REQUIREMENTS

Physical Requirements. The joint sealer material shall be tested in accordance with AASHTO M 297 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 705-01. Test specimens shall be cut and/or buffed from joint seal samples.

<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>

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.

Sampling. All preformed elastic bridge joint sealer to be used on Department projects shall be sampled from manufactured lots in accordance with procedural directives of the Materials Bureau by a representative of the Department in lengths as shown in Table 2 AASHTO M 297. Joint sealer shall be shipped in an untalcated condition.
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.

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. This material will be considered for acceptance in stock lot quantities at manufacturing locations in accordance with procedural directives of the Materials Bureau.

705-10 PREFORMED ELASTIC LONGITUDINAL JOINT SEALER

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

GENERAL. The preformed elastic joint sealer material shall be a vulcanized elastomeric compound using polymerized chloroprene as the only basic elastomer. The shape of any joint sealer, from any manufacturer, shall be approved by the Director, 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 4.5 m length of the proposed sealer. The lubricant used to install the joint sealer shall conform to §705-13, Lubricant for Preformed Elastic Joint Sealer, unless otherwise specified.

MATERIAL REQUIREMENTS

Physical Requirements. For all properties except recovery, the joint sealer material shall be in accordance with the physical requirements of AASHTO M 220. Recovery properties of the joint sealer, when tested in accordance with AASHTO M 220, shall conform to the following requirements:

<table>
<thead>
<tr>
<th>Recovery under 50% Deflection</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>After 70 hrs. @ +100EC</td>
<td>75% min.</td>
</tr>
<tr>
<td>After 22 hrs. @ -29EC</td>
<td>75% min.</td>
</tr>
</tbody>
</table>

Sampling. All preformed elastic joint sealer to be used on Department projects shall be sampled from manufactured lots by a representative of the Department.

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

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>-</td>
</tr>
<tr>
<td>Weight change, percent</td>
<td></td>
<td>-0.10 to + 0.25</td>
</tr>
<tr>
<td>Hardness, Type A durometer</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>D 792</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 durometer reading will be taken as noted above. The specimens 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. At the end of seven days the specimens 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. This material will be considered for acceptance in stock lot quantities at manufacturing locations in accordance with procedural directives of the Materials Bureau. Any unauthorized tampering or breaking of Department seals applied to this material between the time of sampling and use of the product will be cause for rejection of the material.

705-12 PREFORMED ELASTIC TRANSVERSE CONTRACTION AND EXPANSION JOINT SEALERS

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

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

The shape of any joint sealer, from any manufacturer, shall be approved by the Director, 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 sealer.

The requirements for initial consideration of a particular joint sealer geometry offered for Department evaluation, prior to shape approval, shall be as follows:
These requirements and those for normal production control, listed below, shall be satisfied before a sealer shape and manufacturer combination is approved. Once such a combination is approved, it shall continue to meet all of the above requirements for every lot produced.

**MATERIAL REQUIREMENTS**

**Physical Requirements.** For all properties except force-deflection, the joint sealer material shall be in accordance with the physical requirements of AASHTO M220.

**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 sealers shall conform to the following force-deflection requirements:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Property</th>
<th>21 mm</th>
<th>32 mm</th>
<th>41 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Transverse Contraction</td>
<td>Transverse Contraction</td>
<td>Transverse Expansion</td>
<td></td>
</tr>
<tr>
<td>Overall width of sealer, min.</td>
<td>21 mm</td>
<td>32 mm</td>
<td>41 mm</td>
<td></td>
</tr>
<tr>
<td>An operational flat area on each side of the sealer, min.</td>
<td>22 mm @ 16 mm width</td>
<td>22 mm @ 25 mm width</td>
<td>22 mm @ 32 mm width</td>
<td></td>
</tr>
<tr>
<td>Overall depth of sealer, max.</td>
<td>51 mm @ 13 mm width</td>
<td>51 mm @ 16 mm width</td>
<td>51 mm @ 22 mm width</td>
<td></td>
</tr>
</tbody>
</table>

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

**Department Approval.** Each lot of joint sealer submitted for Department approval shall demonstrate that it possesses the inherent capabilities necessary for satisfactory field installation. This property shall be judged by actual installation and 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 to the sealer’s proper installation and performance by the Department.

**Sampling.** All preformed elastic joint sealer to be used on Department projects shall be sampled from manufacturing lots by a representative of the Department.

**Test.** The sealer 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 sealer and the compression plates.

**BASIS OF ACCEPTANCE.** This material will be considered for acceptance in stock lot quantities at manufacturing locations in accordance with procedural directives of the Materials Bureau.
§ 705-13

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.

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 covers the requirements for Longitudinal Joint Ties (LJT) used in portland cement concrete pavements.

GENERAL. All Longitudinal Joint Tie systems not appearing on the standard sheets shall be tested and subject to approval before their use is allowed for Department work. Application for approval of such LJT systems shall be made to the Director, Materials Bureau. Systems found suitable shall be detailed by the Department on the appropriate standard sheet. Approved epoxy coatings, and epoxy coating applicators shall be listed on the Department’s List of Approved Products. All requirements of this specification and any directives shown on the standard sheets or List of Approved Products shall apply.

MATERIAL REQUIREMENTS

A. Longitudinal Joint Tie Material. All components of LJT systems shall be made of steel. Each component shall be capable of complying with the requirements stated in the following formula when the minimum numerical values for the steel used to manufacture the LJT in question are substituted in the formula:

\[ F \times A = 45 \text{ kN} \]

where:  
- \( F \) = Minimum yield strength of the LJT component (kPa)
- \( A \) = Minimum cross sectional area of the LJT component (mm²)

If the numerical values of the parameters fail to satisfy the requirements of the formula, the LJT system shall be rejected.

B. Epoxy Coating Material. Epoxy coatings meeting the applicable requirements of subsection 709-04 EPOXY COATED BAR REINFORCEMENT, GRADE 400 and which appear on the Department’s Approved List titled “Epoxy Coatings for Steel Reinforcing Bars” are acceptable. Epoxy coatings not tested under subsection 709-04 shall be tested in accordance with this specification, and if found suitable will be approved and placed on the Department’s Approved List titled “Epoxy Coatings for Longitudinal Joint Ties.”
C. Corrosion Inhibitive System for Threaded Ties. Approved corrosion inhibitive coatings for threaded portions of the multiple piece LJT’s shall comply with one of the following NYSDOT specifications:

1. Section 702 - BITUMINOUS MATERIALS, materials designations §702-3201, §702-3301 or §702-3401 as defined in TABLE 702-5 ASPHALT EMULSIONS, MEDIUM SETTING.

2. A Thread Sealing Compound Approved By The Materials Bureau

Corrosion inhibitive coatings shall be applied to the threads when the LJT’s are installed. The coating shall be applied in such a manner that an unbroken seal is formed to protect the ties from corrosion.

COATING APPLICATION REQUIREMENTS. All LJT systems supplied to the Department shall comply with all requirements listed below.

A. Coating Applicator. The facilities of the coating application and the method of application for the epoxy shall be subject to approval by the Director, Materials Bureau. Upon approval, the complete name and address of the coating applicator will be placed on the Department’s List of Approved Products titled “Epoxy Coatings for Longitudinal Joint Ties,” or “Epoxy Coatings for Steel Reinforcing Bars.”

B. Surface Preparation of Metal. All surfaces of the LJT or its components shall be completely blast cleaned in accordance with Steel Structures Painting Council - Surface Preparation Specification No. 10 (SSPC-SP10), Near White Blast Cleaning. After blast cleaning, the cleaned surfaces of the LJT or its components shall be defined by, and comply with SSPC-Vis1-89, Pictorial Standards A SP 10, B SP 10, or C SP 10, as applicable. The approved epoxy coating shall be applied to the cleaned surfaces as soon as possible after cleaning and before visible oxidation occurs. In no case shall more than eight (8) hours elapse between cleaning and coating.

C. Coating Application. The coating shall be applied in accordance with the recommendations of the coating manufacturer and as approved by the Director, Materials Bureau.

D. Coating Thickness. The epoxy coating shall be applied in a smooth uniform coat. After curing, the coating thickness shall be 0.25 ± 0.05 mm unless otherwise approved by the Director, Materials Bureau and published on the Department’s List of Approved Products titled “Epoxy Coatings for Longitudinal Joint Ties.” Coating thickness shall be determined and controlled by the coating applicator by taking measurements on a representative number of bars from each production run. Coating thickness measurements shall be conducted by the method outlined in ASTM G12.

E. Continuity of Coating.

1. The spray coating shall be visually checked for continuity after cure. It shall be free of holes, voids, contamination, cracks and damaged areas.

2. The coating shall not have more than two holidays (pinholes not visible to the naked eyes) in any 300 mm of coating length. A holiday detector shall be used, in accordance with the manufacturer’s instructions, to check for holidays on a representative number of bars in each production run.

3. LJT’s with uncoated areas within 50 mm from the ends of the ties due to handling during fabrication will be acceptable. The cross-sections of the ends of the fully assembled LJT systems may be uncoated.
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F. Coating Cure. Before shipment from the applicator’s facilities, the coating applicator shall check each production run to determine that the LJT systems have fully cured coatings. The LJT’s shall not be shipped until the epoxy coatings are fully cured.

G. Shop Repair of Damaged Coatings. Epoxy coated LJT’s that do not meet the requirements for Coating Thickness, Continuity of Coating, or Coating Cure shall not be repaired. Instead, LJT’s with these defects shall be replaced or, alternatively, stripped of epoxy coating, recleaned and recoated in full conformance with the requirements of this specification.

H. Field Repair of Damaged Coatings. LJT’s with coating breaks, due to handling, that exceed 6 mm in any dimension shall not be incorporated into the pavement. Uncoated areas as defined in E.3. above are not cause for rejection and do not require repair.

The Contractor shall set aside such damaged units and may effect a field repair. Coating breaks that exceed 6 mm in any dimension may be repaired with a patching material supplied by the epoxy coating manufacturer. The patching material shall be an epoxy compatible with the epoxy coating and inert in concrete. The repair material shall be applied only to the general area requiring repair. Dipping of the tie in repair material or liberal coating of undamaged areas shall not be allowed.

Testing

A. 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.

B. Laboratory Testing. Unless otherwise stated, the following laboratory tests will be performed by the Materials Bureau on all LJT systems not appearing on the standard sheets and for epoxy coating systems not appearing on the Department’s List of Approved Products.

1. Pullout Test. Each epoxy coated LJT component, as well as the fully assembled and coated LJT system shall be capable of withstanding a minimum pullout force of 45 kN without yielding. The pullout test shall be conducted in accordance with NYSDOT test method 705-E1 - LONGITUDINAL JOINT TIE TEST METHOD.

2. Corrosion Test. LJT epoxy coating systems shall be tested for corrosion resistance in accordance with the CORROSION TESTING procedure (Section VIII) of NYSDOT test method 705-E1 - LONGITUDINAL JOINT TIE TEST METHOD. The epoxy coating system shall survive a minimum of 25 freeze-thaw (FT) cycles. When viewed under 5 power magnification, the degree of corrosion observed shall be a rust grade of 10, or better, when rated in accordance with ASTM D610 EVALUATING DEGREE OF RUSTING ON PAINTED STEEL SURFACES.

For purposes of this testing, the LJT supplier shall provide the Director, Materials Bureau with three neat, clear, legible 216 x 279 mm shop drawings depicting the LJT system. Twelve (12) LJT samples with epoxy coating shall be submitted for testing. Upon receipt of the samples and corresponding shop drawings, the samples will be examined and compared for dimensional conformance with the dimensions shown on the shop drawings. Any discrepancy shall be cause for rejection of the ties and no further testing shall be conducted.

BASIS OF ACCEPTANCE. Epoxy coated longitudinal joint ties shall be accepted by the Engineer at the contract site on the basis of the following:

1. The epoxy coating manufacturer’s certification that the coating material is the same as that approved by the Materials Bureau.

2. The coating applicator’s certification that the LJT’s have been coated and tested and that they conform to the requirements of this specification.
3. Longitudinal Joint Tie manufacturer's certification that the metal used conforms to the requirements of this specification. The ASTM Designation and Grade shall be included.

4. The appearance of the LJT system on the appropriate standard sheet or as approved by the Director, Materials Bureau.

5. The appearance of the name of the coating applicator and epoxy coating material on the Department's Approved List of Products.

705-15 TRANSVERSE JOINT SUPPORTS

SCOPE. This specification covers the requirements for load transfer devices in portland cement concrete pavement transverse joints.

GENERAL. All Transverse Joint Support systems not referenced on the Department's Approved List shall be subject to testing and approval before their use is allowed for Department work. Application for approval of such Transverse Joint Support systems shall be made to the Director, Materials Bureau, at least 120 days before their intended use. Systems found suitable shall be assigned a unique reference number, which shall be listed on the Department's Approved List. All requirements of this specification, those portions of referenced specifications, and the Materials Details referenced by the Approved List, shall apply. In case of conflict between the requirements of this specification and the referenced specifications, the requirements of this specification or the instructions of the Director, Materials Bureau, shall apply.

MATERIAL REQUIREMENTS

A. General Requirements. Dowels shall be made of steel with 345 MPa minimum yield strength. Materials other than steel may be proposed, but shall be subject to the prior approval of the Director, Materials Bureau. The free ends of dowels or bar type elements shall be saw cut and free of burrs or projections that would restrict movement.

Dowel coatings shall be continuous and undamaged for the full length of the element. Elements with perforated, cracked, damaged or improperly applied coatings will be rejected. Any damage which results from welding or mechanical fixation to achieve a fixed end condition shall not extend more than 25 mm in from the weld or point of fixation. All coatings will be tested and approved by the Materials Bureau in accordance with these specifications. The dowel coating thickness and material shall be as required by the Materials Details referenced by the Approved List or as approved by the Director, Materials Bureau.

Bond breaker material (when applicable) will be subject to approval by the Materials Bureau and shall be as required by the Materials Details referenced by the Approved List. The use of field applied bond breakers will not be allowed. Bond breaker (when required) shall completely coat the dowel element to within 150 mm of the fixed end.

Premoulded resilient joint filler shall meet the requirements of §705-07 of the Standard Specifications.

B. Physical Requirements. When tested in accordance with AASHTO T253, Standard Method of testing Corrosion Resistant Coated Dowel Bars, the dowel elements shall meet the requirements of AASHTO M 254 for Load Deflection, Pull-out, Corrosion, and Abrasion.

COATING APPLICATION. Acceptable epoxy coating applicators shall be those found on the Department's List of Approved Products titled "Epoxy Coatings For Longitudinal Joint Ties (705-14)" or "Epoxy Coatings and Applicators For Steel Reinforcing Bars (709-04)." Applicators of approved coatings other than epoxy will be subject to approval by the Director, Materials Bureau.
GEOMETRIC REQUIREMENTS

A. Dowels. Joint support dowels shall be at least 460 mm and shall have a minimum bearing area of 10 300 mm². They shall have a uniform cross sectional shape for their entire length. Dowels with circular cross sections shall have a minimum diameter equal to 1/8 of the pavement design thickness exclusive of any coating(s).

B. Joint Support Assemblies. Transverse joint support assemblies shall meet the following general requirements as well as the applicable additional requirements given below for contraction, expansion, or construction joints:

1. General Requirements. Unless otherwise indicated by the plans or in the proposal, transverse joint support assemblies shall be constructed with one (1) dowel for each 300 mm of lane width. The locations of the dowels within the assemblies shall comply with the following geometry:
   a. The axis of the two end dowels shall be located such that they are spaced 150 ± 13 mm from the lane edges after concrete is placed.
   b. The axis of the intervening ten dowels shall be transversely spaced at 300 ± 13 mm centers relative to the axes of the two end dowels.
   c. The axis of each dowel shall be held at the mid-depth of the concrete pavement slab ± 6 mm.
   d. The assemblies shall be placed with each individual element’s axis aligned and held parallel to the centerline horizontally and vertically to the profile, to 1 mm per 100 mm.
   e. The dowels shall be longitudinally restrained such that the maximum longitudinal displacement of the midjoint of each dowel relative to the center of the joint is 25 mm.

2. Transverse Contraction Joints. Joint support assemblies used in contraction joints shall meet the general requirements shown in B1 above.

3. Transverse Expansion Joints. Joint support assemblies used in expansion joints shall meet the general requirements given in B1 above. In addition, a one piece premoulded resilient joint filler 19 mm thick shall be included in the assembly. The joint filler shall extend continuously across the lane width and shall extend from not less than 50 mm below the top of the pavement surface to the bottom of the pavement slab. The joint filler shall be protected on top by a metal finishing cap and supported to maintain a vertical position.

4. Transverse Construction Joints. Joint support assemblies used in construction joints shall meet the general requirements given in B1 above. In addition, a bulkhead device shown on the Materials Details referenced by the Approved List, or as approved by the DCEC, shall be used to form construction joints. The bulkhead device shall have a rigid center plate extending vertically downward from the pavement surface, through the joint support assembly, to the bottom of the pavement.

TESTS. When joint support assemblies are proposed for testing and approval, Materials Details (detailed shop drawings) for transverse contraction, construction and expansion joint assemblies, drawn by the manufacturer, shall be submitted for approval before any fabrication is started. These drawings shall be neat, clear, and legible and shall be in the manner and form required by the Director, Materials Bureau. The supplier shall also provide certification from the rolling mill as to the type and grade of steel used in the joint support elements.

The laboratory and field tests described below shall be conducted for transverse joint support elements and assemblies not referenced by the Department’s Approved List.
A. Laboratory Tests. Transverse joint support elements and assemblies being considered for approval will be subjected to the LOAD-DEFLECTION, PULL-OUT, and CORROSION-ABRASION tests defined by AASHTO T253, Coated Dowel Bars. Only joint support assemblies, exhibiting satisfactory performance in these laboratory tests, will be considered for trial installation in the field test. For purposes of laboratory testing, two complete assemblies containing joint support elements and six (6) additional loose coated junior support elements shall be submitted to the Director, Materials Bureau. One assembly shall be fabricated to meet the requirements for a transverse contraction joint; the other shall meet the requirements of a transverse expansion joint. Samples shall be submitted at least 120 days prior to their intended use.

If the proposed assembly passes the laboratory tests and is considered acceptable to the Director, Materials Bureau, approval will be given to use the system in a field test at a project site on a trial basis.

B. Field Test. Materials Bureau personnel will observe the installation of transverse joint support assemblies being considered for approval. Specific attention will be given to the alignment of joint support elements before and during paving operations. Before approval can be given for the general use of a transverse joint support assembly, it must exhibit satisfactory performance in the field test. Transverse joint support assemblies that do not exhibit satisfactory performance during the field test will be rejected. All rejected assemblies shall be replaced with acceptable assemblies at no additional cost to the Department.

For approved transverse joint support assemblies, any proposed changes in materials and/or design will require review and approval by the Director, Materials Bureau.

BASIS OF ACCEPTANCE. Transverse joint support assemblies will be accepted based on the results of testing as described under TESTS of this specification. The Department requires the submission of Materials Details as defined in §101-34.1. The supplier shall prepare and submit the appropriate material in accordance with the procedural directives of the Materials Bureau. The supplier shall also provide certification that the elements and assemblies were manufactured in accordance with this specification and the submitted Materials Details. Upon approval by the Materials Bureau, the name of the product and/or the name and address of the reference number and date of the approved Materials Details will be placed on the Approved List.

Transverse joint support assemblies will be accepted at the contract site based on their name(s) appearing on the Approved list, conformance to the approved Materials Details, and the required certifications.

For each contract supplied, the following information shall be provided to the Engineer:

A. The supplier shall provide certification that the elements and assemblies were manufactured in accordance with this specification and the approved Materials Details.

B. The supplier shall provide certification from the rolling mill as to the type and grade of steel used in the joint support elements.

C. The supplier shall provide the following information:

1. The name of the bondbreaker (when applicable) and the name and address of the manufacturer.

2. The type of corrosion protection coating and name and address of the manufacturer.

3. The name and address of the corrosion protection coating applicator.

4. The name and address of the joint support assembly manufacturer.

5. The correlation between the rolling mill's certification and the supplier's certification.
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D. Two (2) copies of the approved Materials Details, properly identified by reference number and date as shown on the Approved List.

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 M 198 Type B or ASTM C 990.

BASIS OF ACCEPTANCE. Label stating conformance to either AASHTO M 198 Type B or ASTM C 990. 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 C 443 or ASTM C 361.

BASIS OF ACCEPTANCE. Label stating conformance to either ASTM C 443 or ASTM C 361. 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 AND 705-19 (VACANT)

705-20 MORTAR FOR STONE CURBS

SCOPE. This specification covers the material requirements for cement mortar used in filling stone curb joints and bedding stone curbs.

MATERIAL REQUIREMENTS. Mortar for filling stone curb joints shall consist of one part § 701-01 Portland Cement, Type 2, with one part § 703-03 Mortar Sand or § 703-07 Concrete Sand, mixed as stiff as practicable and of such consistency that will require rodding when placed in joints.

Mortar for bedding the Types F1, G1, M, R1, R2, S and T1 curbs shall consist of one part § 701-01 Portland Cement, Type 2, and two parts § 703-03 Mortar Sand or § 703-07 Concrete Sand, by volume.

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

705-21 MORTAR FOR CONCRETE MASONRY

SCOPE. This specification covers the material requirements for mortar used in laying block for catch basins, manholes, field inlets, drop inlets and other masonry products as specified.

MATERIAL REQUIREMENTS. Ingredients for mortar shall comply with the following:

- Portland Cement, Type 2: 701-01
- Masonry Cement: 701-02
- Mortar Sand: 703-03
- Concrete Sand: 703-07
- Water: 712-01
Proportioning. Mortar shall be proportioned by volume as follows:

<table>
<thead>
<tr>
<th>Portland Cement</th>
<th>Masonry Cement</th>
<th>Sand</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>4 1/2 to 6</td>
</tr>
</tbody>
</table>

To entrain air, all cementitious materials and aggregates shall be mixed in a mechanical batch mixer for at least 3 minutes with the maximum amount of water to produce a workable consistency. Mortars that have stiffened due to evaporation may be re-tempered by adding water as needed to restore the required consistency. Mortars shall be used and placed in final position within 2 1/2 hours after mixing.

BASIS OF ACCEPTANCE. The mortar shall be accepted on the basis of 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:

- Portland Cement, Type 1 or Type 2
- Mortar Sand
- Concrete Sand
- Water

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 provisions of §706-02, Reinforced Concrete Pipe, material requirements, shall apply except that all references to reinforcing steel shall be deleted.

Test. All provisions of §706-02, Reinforced Concrete Pipe, test shall apply except as modified below.
§706-01
All references to reinforcing shall be deleted.
The strength and absorption requirements for the respective diameter pipe sizes shall be as stated in Tables 1 and 2, ASTM C14. Details of the crushing strength test and absorption test shall comply with ASTM C14 except as follows:
Specimens for the absorption test shall consist of minimum 50 mm diameter cores drilled from the pipe wall or, at the manufacturer’s option, sawed specimens 100 mm square. The number of test specimens for absorption shall be as directed by the Materials Bureau.

**BASIS OF ACCEPTANCE.** The provisions of §706-02, Reinforced Concrete Pipe, shall apply.

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

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

**GENERAL.** Reinforced concrete pipe shall be machine made or cast in accordance with working drawings approved by the Department and in full compliance with the details of this specification. Pipe shall be manufactured under the inspection procedures stipulated by the directives of the Materials Bureau.

Pipe manufactured for a specific class will be acceptable for any class having a lower design strength.

**A. Machine made units are those made by the following methods:**

1. Packerhead
2. Roller suspension
3. Centrifugal
4. Machine tampered
5. Machine vibrated
6. Other methods approved by the Materials Bureau

These methods use very low slump concrete and the methods of consolidation produce a dense product with low permeability and good resistance to freeze-thaw damage.

**B. 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.**

**MATERIAL REQUIREMENTS**

**General.** All materials used for reinforced concrete pipe shall conform to the requirements of the material specification listed below:
Portland Cement (Type 1, Type 2 or Type 3) 701-01
Coarse Aggregate 703-02
Concrete Sand 703-07
Reinforcement
Bar Reinforcement, Grade 400 709-01 5
Wire Fabric for Concrete Reinforcement 709-02
Bar Reinforcement, Grade 300 709-03
Cold Drawn Wire for Concrete Reinforcement 709-09
Stirrups
Bar Reinforcement, Grade 400 709-01 10
Bar Reinforcement, Grade 300 709-03
Cold-Drawn Wire for Concrete Reinforcement 709-09
Admixtures (Air-Entraining Agent) 711-08
Water 712-01
Concrete Pipe Joint Sealing Compound 705-16 15
Concrete Pipe Joint Elastomeric Gaskets 705-17
Concrete Repair Material 701-04

The maximum allowable total chloride content in concrete shall not exceed 0.10 percent by weight of cement. Testing shall be done in accordance with written procedural directives of the Department. Calcium chloride admixture shall not be used in concrete. Other admixtures, with the exception of air-entraining agents, shall not be used unless otherwise approved by the Materials Bureau.

Samples of reinforcement shall be taken in accordance with written instructions from the Materials Bureau. Stirrups shall be acceptable on the basis of the manufacturer's certification, unless otherwise directed by the Materials Bureau.

The provisions of Reinforced Concrete Pipe Class IV shall apply with modifications noted under Fabrication Requirements for reinforced concrete cattle pass.

Pozzolans. The manufacturer may substitute fly ash meeting the requirements of §711-10 up to a maximum of 15 percent of the minimum portland cement by weight.

Fabrication Requirements.

1. Drawings. Every manufacturer proposing to furnish pipe under this specification shall submit to the Materials Bureau for approval, detailed working drawings in the size, format and manner directed by the Materials Bureau for each size and class of reinforced concrete pipe to be manufactured. Similar pipe details may be included on a single drawing by using tables of dimensions and/or steel areas.

The working drawings shall clearly indicate the following details:

Diameter, class and wall designation.

Wall thickness and joint dimensions with working tolerances.

Position of reinforcement with working tolerances including stirrups when used.

Minimum area and maximum and minimum spacing of circular reinforcement. A note shall be included on the drawings to indicate that each cage of reinforcement shall contain sufficient longitudinal members, extending throughout the entire length of the pipe section, to maintain the reinforcement in shape and correct position.

Minimum size and maximum spacing of stirrups (when used).
§ 706-02

Cast in place lifting holes in the top of pipe when elliptical and/or quadrant mat reinforcing is used.

Location and description of method used to form lifting holes.

Gradation of coarse aggregate with necessary production tolerances.

Percent air range of concrete, dependent on coarse aggregate gradation.

Concrete mix proportions with necessary production tolerances.

Method of manufacture (cast or machine) and method of curing.

Method employed for maintaining positioning of cages during manufacture.

Details of elastomeric gasket. Dimensions to gasket-bearing surfaces shall be given by diameters with tolerances to show annular space.

Typical legend which will be imprinted on the pipe.

Pipe specifically designed for jacking shall be indicated on the drawings.

When any of these details are expected to vary for any reason, the several alternate details shall be shown on the drawings. Length of the pipe sections should not be shown.

A space should be provided on the drawings for listing possible revisions.

Concrete pipe shall not be manufactured for Department acceptance prior to full approval of the working drawings except as modified in the next section.

2. Dimensions and Reinforcement.

A. General. The dimensions and reinforcements for the various sizes of each class of reinforced concrete pipe shall conform to the AASHTO M 170M tables for Class II, III, IV and V pipe, walls B & C. The AASHTO tables show minimum reinforcement. The manufacturer may submit alternate reinforcement and/or wall thickness details to the Materials Bureau for consideration. Upon receipt of tentative approval, the manufacturer shall produce two lengths of pipe, both of which must meet the three-edge bearing strength test requirements to attain full approval. Any pipe produced after receipt of tentative approval and prior to full approval will be considered for lot acceptance under these specifications only if the two special test lengths satisfactorily meet all requirements.

The internal diameter of 300 mm to 3600 mm pipe shall meet the requirement of AASHTO M 170M, Table 6. The wall thickness shall not be less than that shown in the design by more than 5 percent or 5 mm whichever is greater. A wall thickness more than that required in the design will not be a cause for rejection.

Longitudinal and circumferential reinforcing shall be firmly welded at each point of intersection. Any evidence of weld failure exhibited when the mesh is placed through the forming rolls will constitute grounds for immediate rejection of that sheet or roll of fabric.

When a single line of reinforcement is called for in the specification, the circumferential member shall be placed midway between the inside and outside surfaces of the pipe within the tolerances shown on the working drawings. Double lines of reinforcement, when required, shall be placed parallel to each other with the circular reinforcement 25 mm clear from the outside and inside surfaces of the pipe. A reasonable tolerance will be permitted on the positioning of the reinforcement. The tolerance limits shall be as noted on the working drawing except that in no case shall the cover over the circular reinforcement be less than 13 mm.
Before being placed in the form, each line of reinforcement shall be assembled into a unit so designed that it may readily be placed and maintained in proper position within the form during the placing of concrete.

Use a minimum of six spacers to maintain cage position and cover. Three shall be spaced evenly around the cage within 600 mm of each end of the pipe. 760 mm is the maximum circumferential distance between spacers. Cutting and bending longitudinal wires to serve as spacers is not permitted. Other methods are subject to approval by the Director, Materials Bureau.

Circular reinforcement shall extend completely around the pipe and the ends shall be secured by one of the following methods.

(1) **Tying:** Under this method the ends shall lap to a length of not less than thirty (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.

(2) **Welding:** Each circular member shall be lapped a minimum of 50 mm and welded by one of the following methods:

   a. Electric arc welding
   b. Resistance spot welding
   c. Fusion welding
   d. Oxyacetylene torch welding

   By whichever method the lap is welded, the weld shall develop a minimum of fifty (50) percent of the specified strength of the wire.

**B. Reinforced Concrete Cattle Pass.** Sections shall have a minimum length of 1.2 mm. The two cages of wire fabric reinforcement shall consist of WWF 203x51-M W26xM W55. Variations in laying lengths of two opposite sides of a cattle pass section shall not be more than 10 mm/m of diameter, with a maximum of 16 mm in any length of cattle pass, except where beveled or curved cattle pass lengths have been specified.

**3. Concrete**

**A. Proportions.** Concrete shall be proportioned on a weight basis only. In no case shall the cement content of the concrete be less than 335 kilograms per cubic meter. Air content in cast concrete shall be within the following ranges:

- Largest size coarse aggregate in mix (table 703-5) % Air
- Size #1, passing 12.5 mm retained 6.3 mm 5.0 to 8.0
- Size #2, passing 25.0 mm retained 12.5 mm 5.0 to 8.0

**B. Placement.** The forms shall be cleaned and properly assembled before any concrete is placed therein. The transportation and placement of concrete mixture shall be accomplished by methods that will prevent the segregation of the concrete materials and the displacement of the reinforcing steel from its proper position in the form.

**C. Curing.** Pipe shall be cured by any one of the methods described in the following paragraphs. After removal of forms and before curing begins, pipe shall be sheltered from direct sunlight and drafts. The curing process shall commence no later than eight hours after the removal of the forms. Curing shall be accomplished to the satisfaction of the Materials Bureau. If at any time curing temperatures fall below the specified minimum for the chosen curing procedure, the curing period shall be increased accordingly.

(1) **Steam Curing and Controlled Atmospheric Curing**
§ 706-02

a. **Steam Curing.** Pipe may be placed in a curing chamber, free from outside drafts, and cured in a moist atmosphere maintained at a temperature between 38°C and 71°C, by the injection of steam for a period of not less than 12 hours or, when necessary, for such additional time as may be needed to enable the pipe to meet the strength requirements. Steam curing shall not commence until at least two hours have elapsed since completion of placement of concrete in the forms. When a curing chamber is not available, pipe may be placed in an enclosure of canvas and subjected to steam at the temperature and for the time specified above. The enclosure shall be so erected as to allow full circulation of steam around the entire pipe. The interior surfaces of the curing room or canvas jackets and the surfaces of the pipe shall be entirely moist at all times.

b. **Controlled Atmospheric Curing.** This method applies to machine made pipe only. The pipe shall be placed in a curing chamber or enclosure as in (a) Steam Curing, for a minimum of 12 hours at a temperature of 10°C or above. The pipe shall then be cured outdoors for a minimum of seven days. Controlled atmospheric curing shall be allowed between April 1 and November 1, unless otherwise approved by the Materials Bureau.

(2) **Water Spray Curing.** Under the conditions of enclosure described in the above paragraph on “Steam Curing,” pipe may be cured by subjecting it to 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 or such additional time as may be necessary to meet the strength requirements.

(3) **Saturated Cover Curing.** The sides and top of each pipe shall be covered with heavy burlap or other suitable material saturated with water before applying and kept saturated at a temperature of not less than 20°C for 72 hours or such additional time as may be necessary to meet the strength requirements.

(4) Other methods of curing are subject to approval by the Director, Materials Bureau.

4. **Joints.** The ends of reinforced concrete pipe sections shall be formed that, when the pipes are laid together, they will make a continuous and uniform line of pipe. The joints shall be either bell and spigot or tongue and groove design, regardless of diameter or class and shall be designed so as to permit effective jointing to reduce leakage and infiltration and to permit placement without appreciable irregularities in the flow line.

5. **Pipe Joint Materials**

A. **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.

B. **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.

C. **Sampling.** Sampling shall be as directed by the Materials Bureau.

6. **Marking.** Each pipe length shall, immediately upon completion of manufacture, be plainly and permanently marked with waterproof paint on the inside of the barrel with the following information:

- Name or trademark of manufacturer.
- Date of manufacture.
- NYSDOT Lot No. (“NYSDOT .......”)
- Diameter and Class.
- Wall Designation.
Pipe less than 450 mm diameter may be marked on the outside of the barrel.

Each pipe length with elliptical or quadrant reinforcing shall have the word “top” indelibly marked on the inside and outside of the barrel at the appropriate location.

7. **Pipe Repair.** Pipe may be repaired at the plant or in the field, if necessary, because of occasional imperfections in manufacture or accidental injury during handling. It will be acceptable if, in the opinion of the Department, the repairs are sound and properly finished and cured, and the repaired pipe conforms to the requirements of these Specifications and the Department’s written directives.

Materials used for pipe repair shall be one of the products appearing on the approved list of §701-04, Concrete Repair Material.

**Strength Requirements.** The external load to produce a 0.3 mm crack and the ultimate load as determined by the three-edge bearing method shall not be less than that specified in AASHTO M 170M, tables for Class II, III, IV and V pipe, walls B & C. The 0.3 mm crack load shall be as defined in AASHTO T280. The ultimate load is reached when the pipe will sustain no greater load. The pipe subjected to strength tests for ultimate load shall be broken to collapse and removed from the lot.

The minimum length of test specimens for the three-edge bearing test shall be 1.2 m and they may be cut from longer lengths. When specimens are so cut, the remaining section of pipe shall not be accepted for shipment. Test specimens shall be surface dry when tested and shall not have been exposed to a temperature below 5°C for the 24 hours immediately preceding the test. The manufacturer shall perform, in the presence of a representative of the Department, such number and type of three-edge bearings tests as the Materials Bureau shall deem necessary to establish the quality of pipe.

Each manufacturer furnishing pipe under these specifications shall be equipped with a testing machine of a type approved by the Materials Bureau to carry out this test. The pipe manufacturer shall employ a commercial testing agency to calibrate the testing machine to an accuracy of +2% according to ASTM E4 at a minimum of once a year. Upon request of the Materials Bureau, a record of this calibration shall be furnished.

Reinforced concrete cattle pass will not require a three-edge bearing test. However, concrete cylinders shall be cast during production and shall achieve a minimum 28-day compressive strength of 25 MPa.

**Absorption Requirements For Machine Made Pipe.** For all pipe the maximum average absorption shall not exceed 8.0% by weight for the last three specimens tested. Specimens for this test shall be cores from each lot drilled by the manufacturer in the presence of a representative of the Department. The cores will be tested by the Materials Bureau in accordance with the test method specified in ASTM C 497 except that under “absorption test” the drying period shall be 48 hours at a temperature of 110°C.

When cores are taken, the holes shall be plugged. Plugs shall be sound and properly finished and cured according to the requirements of “Pipe Repair.”

**Sampling and Testing.** The Reinforced Concrete Pipe units manufactured under the requirements of this specification shall be separated into specific and identifiable production lots. The maximum number and type of units in a lot shall be in accordance with Department procedural directives.

The type of testing required for a given lot of Reinforced Concrete Pipe or Reinforced Concrete Cattle Pass will be determined by the method of manufacture as follows:

1. For both Machine-Made and Cast Reinforced Concrete Pipe.
   
   a. Three Edge Bearing Test - The test procedure shall be as shown in procedural directives issued by the Materials Bureau.

2. For Machine-Made Reinforced Concrete Pipe Only.
§ 706-02

A. Absorption Test - This test shall be performed on machine-made reinforced concrete pipe lots in accordance with the requirements detailed above and at the frequency directed in procedural directives issued by the Materials Bureau.

3. For Cast Reinforced Concrete Pipe Only.

A. Determination of Air Content - This property of the cast concrete unit will be determined on a lot basis in accordance with either of the following methods at the option of the Department.

(1) End Product Testing: The testing of hardened concrete for air content will be performed by the Materials Bureau on 100 mm diameter cores, drilled by the manufacturer under the supervision of a Department representative.

(2) Production Testing: The testing will be performed by the manufacturer, subject to the approval of the Materials Bureau. It will consist of testing the plastic concrete for compliance to the air content required by this specification. The Department reserves the right to test the hardened concrete at any time in which case the manufacturer will drill 100 mm diameter cores at the direction of a Department representative. Sampling and test procedures for this option may be obtained from the Materials Bureau.

Shipping. No units will be considered for shipment unless the units are free from defects as noted under Pipe Repair in this specification and Department directives and all specification requirements are achieved.

Other Requirements. In addition to the above tests, the 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 Department's directives.

BASIS OF ACCEPTANCE. Pipe units will be accepted in stock lot quantities at the manufacturing location in accordance with procedural directives of the Materials Bureau.

706-03 REINFORCED CONCRETE ELLIPTICAL PIPE

CLASSES HE-II, HE-III, HE-IV

CLASSES VE-IV, VE-V, 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 general provisions of §706-02, Reinforced Concrete Pipe, shall apply.

MATERIAL REQUIREMENTS. The following sections of §706-02 shall apply except as modified below: Materials, Drawings, Fabrication, Curing, Repairs, Strength Requirements, Absorption Requirements, and Basis of Acceptance.

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.

Use concrete pipe joint sealing compound, meeting the specification requirements of §705-16 in the pipe joint.

Each pipe length shall, immediately upon completion of manufacture, be plainly and permanently marked with waterproof paint on the inside of the barrel with the following information:

7-62
Name or trademark of manufacturer.
Date of manufacture.
“NYS Lot No.”
Class and Equivalent round pipe diameter.

All reference to Classes II, III, IV and V under the §706-02, enumerated above, shall be deemed to include all classes of elliptical pipe.
Whenever reference is made under §706-02 to AASHTO M 170M and AASHTO M 207M shall apply for reinforced Elliptical Concrete Pipe.

**BASIS OF ACCEPTANCE.** Pipe will be accepted in stock lot quantities at the manufacturing location in accordance with procedural directives of the Materials Bureau.

### 706-04 PRECAST CONCRETE DRAINAGE UNITS

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

**GENERAL.** Precast concrete drainage units shall be machine made or cast at a manufacturers yard in conformance with these specifications and to the size, shape and requirements shown on the standard sheets or plans. Drainage units shall be manufactured under inspection procedures stipulated by the directives of the Materials Bureau.

A. Machine-made units are those made by the following methods:

1. Packerhead
2. Roller suspension
3. Centrifugal
4. Machine tamped
5. Machine vibrated
6. Other methods as defined by the Materials Bureau

These methods use very low slump concrete and the methods of consolidation produce a dense product with low permeability and good resistance to freeze-thaw damage.

B. 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.

**MATERIAL REQUIREMENTS**

**General.** All materials used in the manufacture of precast concrete drainage units shall conform to the requirements of the specifications following list:

<table>
<thead>
<tr>
<th>Material Requirement</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frames and Grates</td>
<td>655</td>
</tr>
<tr>
<td>Portland Cement (Types 1, 2, or 3)</td>
<td>701-01</td>
</tr>
<tr>
<td>Concrete Repair Material</td>
<td>701-04</td>
</tr>
<tr>
<td>Concrete Grouting Material</td>
<td>701-05</td>
</tr>
<tr>
<td>Coarse Aggregates</td>
<td>703-02</td>
</tr>
<tr>
<td>Concrete Sand</td>
<td>703-07</td>
</tr>
<tr>
<td>Concrete Pipe Joint Sealing Compound</td>
<td>705-16</td>
</tr>
<tr>
<td>Concrete Pipe Joint Elastomeric Gaskets</td>
<td>705-17</td>
</tr>
<tr>
<td>Mortar for Concrete Masonry</td>
<td>705-21</td>
</tr>
<tr>
<td>Reinforcement</td>
<td></td>
</tr>
</tbody>
</table>
Bar reinforcement for transverse drainage interceptors shall meet the requirements of §709-04 Epoxy Coated Bar Reinforcement, Grade 400.

The ends of chairs or spacers, used to support or locate reinforcing steel, that may come in contact with the faces of the form shall be made or coated with non-corrosive material.

The manufacturer shall maintain at the manufacturing site a record of materials used and their sources, and a copy of the concrete mix design for a minimum of 3 years following the final payment of the project.

**FABRICATION REQUIREMENTS**

1. **Drawings.** When working drawings are necessary for the manufacture of precast drainage units, five prints of each drawing shall be submitted to the Engineer for review and approval. Unless otherwise shown on the plans, the tolerances of all dimensions, including the reinforcing shall be ± 15 mm.

2. **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 C478.

   The C478 requirements for splices, laps and welds shall not apply. All bar reinforcement steel shall be tied as specified under (a) Tying below. Tack welding or any other welding of specified bar 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.

   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 thirty (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 by one of the following methods:

   a. Electric arc welding
   b. Resistance spot welding
   c. Fusion welding
   d. Oxyacetylene torch welding

   By whichever method the lap is welded, the weld shall develop a minimum of fifty (50) percent of the specified strength of the wire.

3. **Rectangular Units.** Precast bases, floors, risers, grade rings and flat slab tops shall be fabricated to the dimension and reinforcement details shown on the plans and standard sheets or in accordance with approved drawings when they are required. Splices for all required reinforcement steel shall be as specified under 2. Round Units.
4. **Concrete**

**A. Mix Requirements.** The manufacturer shall formulate and utilize concrete mixes, for the various drainage units, which meet the following requirements:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cement Content, kg/m³</strong></td>
<td>340 (minimum)</td>
</tr>
<tr>
<td><strong>Compressive Strength:</strong></td>
<td></td>
</tr>
<tr>
<td>Rectangular Units, M Pa, 28 days</td>
<td>25 (minimum)</td>
</tr>
<tr>
<td>Round Units, M Pa, 28 days</td>
<td>30 (minimum)</td>
</tr>
<tr>
<td><strong>Absorption, % (Machine Made Units Only)</strong></td>
<td>8.0 (maximum)</td>
</tr>
<tr>
<td><strong>Air Content:</strong></td>
<td></td>
</tr>
<tr>
<td>Cast Units only, %</td>
<td>5.0 - 8.0</td>
</tr>
<tr>
<td><strong>Coarse Aggregate Gradation:</strong></td>
<td></td>
</tr>
<tr>
<td>Cast Round Units</td>
<td>ASTM C33, #7 or Type CA1 of Table 501-2</td>
</tr>
<tr>
<td>Cast Rectangular Units</td>
<td>Type CA1 or CA2 of Table 501-2</td>
</tr>
<tr>
<td>Machine Made Units</td>
<td>Not specified</td>
</tr>
</tbody>
</table>

The manufacturer may substitute fly ash meeting the requirements of §711-10 up to a maximum of 15 percent of the minimum portland cement by weight.

**B. Placement.** The forms shall be cleaned and properly assembled before any concrete is placed therein. The transportation and placement of concrete mixture shall be accomplished by methods that will prevent the segregation of the concrete materials and the displacement of the reinforcing steel from its proper position in the form. For cast units the manufacturer shall properly consolidate the concrete by external or internal vibrators or a combination of both.

**C. Curing.** Drainage units shall be cured by any one of the methods described in the following paragraphs. After removal of forms and before curing begins, units shall be sheltered from direct sunlight and drafts. The curing process shall commence no later than eight hours after the removal of the forms. Curing shall be accomplished to the satisfaction of the Materials Bureau. If at any time curing temperatures fall below the specified minimum for the chosen curing procedure, the curing period shall be increased accordingly. Precast concrete drainage units shall not be subjected to freezing temperatures until the required 28 day compressive strength is achieved, unless otherwise specified or approved by the Director, Materials Bureau.

**(1) Steam Curing and Controlled Atmospheric Curing**

a. **Steam Curing.** Units may be placed in a curing chamber, free from outside drafts, and cured in a moist atmosphere maintained at a temperature between 40E and 75EC, by the injection of steam for a period of not less than 12 hours or, when necessary, for such additional time as may be needed to enable the units to meet the strength requirements. The temperature inside the enclosure shall not be increased or decreased at a rate greater than 20EC per hour. Steam curing shall not commence until at least two hours have elapsed since completion of placement of concrete in the forms. When a curing chamber is not available, units may be placed in an enclosure of canvas and subjected to steam at the temperature and for the time specified above. The enclosure shall be so erected as to allow full circulation of steam around the entire unit. The interior surfaces of the curing room or canvas jackets and the surfaces of the unit shall be entirely moist at all times. The manufacturer shall provide automatic temperature recorders to continuously record the curing temperatures. Steam cured units shall not be exposed to temperatures below freezing until at least 3 days after casting unless otherwise approved by the Director, Materials Bureau.
b. Controlled Atmosphere Curing. This method applies to machine made units only. The units shall be placed in a curing chamber or enclosure as in (a.) Steam Curing, for a minimum of 12 hours at a temperature of 10°C or above. The units shall then be cured outdoors for a minimum of seven days. Controlled atmospheric curing will be allowed between April 1 and November 1, unless otherwise approved by the Materials Bureau.

(2) Water Spray Curing. Under the conditions of enclosure described in the above paragraph on “Steam Curing”, units may be cured by subjecting them to 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 or such additional time as may be necessary to meet the strength requirements.

(3) Saturated Cover Curing. The sides and top of each unit shall be covered with heavy burlap or other suitable material saturated with water before applying and kept saturated and at a temperature of not less than 20°C for 72 hours or such additional time as may be necessary to meet the strength requirements.

(4) 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 membrane curing compound shall be applied to the concrete surface within 15 minutes following the finishing operation or form removal, whichever is applicable. The compound shall be applied as per manufacturer’s instructions at a minimum coverage rate of 1 L/3.5 m². This method of curing may not be used on any concrete surface which is to have plastic concrete bonded to it. A nother approved method of curing must be used when this condition exists. The application of curing compound is not required on any formed surface if the form is left on until the required 28 day strength is achieved.

(5) Other Methods. Other methods of curing are subject to approval by the Director, Materials Bureau.

5. 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.

6. 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 they shall conform to the shape, size and placement shall be recommended by the precast manufacturer.

7. 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 distance of 410 mm. Steps shall be embedded into the walls of the section a minimum of 75 mm. If the steps are grouted, the grouting material shall conform to §701-04 Concrete Repair Material or §701-05 Concrete Grouting Material. If plastic inserts are used for installing steps, they shall be approved by the Materials Bureau.

The rung shall project a minimum clear distance of 100 mm from the walls of the section measured from the point of embedment.

8. 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.

9. Repair. Drainage units that contain minor defects caused by manufacture or mishandling may be repaired. Minor defects shall be considered as those that are small, less than 200 mm diameter holes or
spalls that do not penetrate deeper than the steel reinforcement. Repairs shall be made using a concrete repair material conforming to §701-04. The repair shall be finished to the proper shape and cured. It shall withstand a moderate blow with a 450 gram hammer.

Drainage units that have cracks completely through the wall of the unit, honeycombing greater than 150 mm diameter or greater than 15 mm deep, or large spalls are not acceptable and shall not be repaired.

10. Marking. The manufacture shall plainly mark each individual piece with permanent waterproof paint on the inside surface. The following information shall be included:
   (a) Name or trademark of manufacturer.
   (b) Date of manufacture.
   (c) NY SDOT Lot No. (“NY SDOT . . .”). (Place on End Product Testing Units Only)
   (d) “NY SDOT 706-04”
   (e) Maximum Placement Depth in Meters. (“M PD . . .m”) Placed on rectangular drainage units only. Based on reinforcement and allowable placement depths indicated on the Standard Sheets or plans. Includes base slabs, bases and risers.
   (f) 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.

SAMPLING AND TESTING. The sampling and testing for cast units to assure that the concrete is in conformance with the specification requirements may be performed by one of the two following methods as determined by the Department. Machine made units shall be sampled and tested as noted in End Product Testing.

1. Production Testing. This testing will be performed by the manufacturer subject to the approval of the Materials Bureau and will consist of testing the plastic concrete for compliance to the air content required by the specifications and casting of concrete cylinders for compressive strength requirements. Test cylinders used to determine the required compressive strength shall be cured with the units they represent.

   The sampling procedures and test methods may be obtained from the Materials Bureau. Testing frequency will be determined by the Materials Bureau. Testing equipment and facilities shall meet the approval of the Materials Bureau. The Department reserves the right to test the plastic or hardened concrete at any time. If hardened concrete is tested, 100 mm diameter cores shall be drilled by the manufacturer under the supervision of a Department representative. Core holes shall be plugged and repaired in accordance with the requirements of “Repair.”

2. End Product Testing. The testing of hardened concrete will be performed by the Materials Bureau on 100 mm diameter cores drilled by the manufacturer under the supervision of a Department representative. Compliance with the specification of stock lots represented by the cores will be determined by the following testing:
   (a) Machine Made Units. Absorption and compressive strength.
   (b) Cast Units. Air content and compressive strength.

   Sampling and testing frequency will be determined by the Materials Bureau. Methods of test for air content and compressive strength may be obtained from the Materials Bureau. A absorption testing will be done in accordance with the test method specified in ASTM C497 except that under “A bsorption Test” the drying period shall be 48 hours at a temperature of 110E. The average absorption shall be determined from three specimens and shall not exceed the maximum absorption specified.

   Core holes shall be plugged and repaired in accordance with the requirements of “Repair.”
§ 706-04

SHIPPING. No units will be considered for shipment unless the units are free from defects as noted under “Repairs” of this specification and all specification requirements including the compressive strength requirements are achieved.

BASIS OF ACCEPTANCE. Precast concrete drainage units will be accepted in either stock lot quantities or by certification as determined by the Department. The details of the acceptance procedures shall be in accordance with Department directives.

When quality assurance testing is performed by the manufacturer under the provisions of “Production Testing” and the manufacturer’s name appears on the Department’s Approved List, the precast drainage units may be shipped when the compressive strength requirement is attained. A certification that the unit(s) shipped conform to specification shall include documentation that the reinforcing steel, when required, meets specification requirements, that the reinforcing steel conforms to the size and positioning shown in the contract documents and that the concrete conforms to specifications.

When the precast concrete drainage units are sampled and tested in accordance with End Product Testing, the units will be accepted in stock lot quantities at the manufacturing location. In addition the manufacturer shall supply the Department’s representative a certification that the reinforcing steel conforms to the size and positioning shown in the contract documents or required by the specifications.

706-05 POROUS CONCRETE PIPE UNDERDRAIN

SCOPE. This specification covers the material and quality requirements for porous concrete pipe and extra strength concrete porous 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 1/2 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 M 176. 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:

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

2. **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.

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

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

5. **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 must be retested by the Department before it can be used.

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**706-06 (Vacant)**

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**706-07 REINFORCED CONCRETE PIPE END SECTIONS**

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

**GENERAL.** The general requirements of §706-02, Reinforced Concrete Pipe shall apply.

**MATERIAL REQUIREMENTS**

**General.** The material requirements of §706-02 shall apply except for the modifications indicated in the requirements below:

1. Coarse aggregate gradation shall conform to the No. 1 Size Designation in §703-02, Coarse Aggregates, Table 703-04.

2. (Vacant)
§ 706-07

3. The barrel portion of the end sections shall conform to the applicable provisions for Reinforced Concrete Pipe, Class III, Wall Designation B. However, the three-edge bearing test will not be required. In addition, neither the absorption test nor the compressive strength test will be included as part of the acceptance procedure.

Concrete Manufacturing. The manufacturer shall formulate a concrete mix design, with a minimum cement content of 360 kilograms per cubic meter, such that the properties of the concrete meet the following requirements:

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Content, %</td>
<td>5.0-8.0</td>
</tr>
<tr>
<td>Compressive Strength, MPa, M in., 28 days</td>
<td>25</td>
</tr>
</tbody>
</table>

Fabrication Requirements. The requirements specified for reinforced concrete cattle pass and concrete proportions do not apply.

Sampling and Testing. Reinforced concrete pipe end sections manufactured under the requirements of this specification shall be separated into specific and identifiable stock lots. The maximum number of sections in a lot shall be in accordance with the Department directives. The air content of the concrete will be determined with either of the methods in § 706-02 Sampling and Testing, 3. For Cast Reinforced Concrete Pipe, at the Department’s option.

BASIS OF ACCEPTANCE. Reinforced concrete pipe end sections will be accepted in stock lot quantities at the manufacturing location in accordance with the Department directives and based on:

1. Compliance with air content requirements as determined by Department procedures, and
2. Manufacturer's certification of compliance with the manufacturing and strength requirements may be based on the results of compressive tests performed on cast cylinders representing the concrete mix design shown on the drawing.

706-08 VITRIFIED CLAY PIPE - STORM DRAIN

SCOPE. This specification covers the material and quality requirements for vitrified clay pipe used for storm drains.

MATERIAL REQUIREMENTS. Vitrified clay pipe shall conform to all the requirements of ASTM C 700 except that when tested for absorption the initial drying period of the specimens shall be 48 hours at temperature of 110E. Pipe under 300 mm in diameter shall meet the strength requirements in Table for Standard Strength Clay Pipe found in ASTM C 700. Pipe 300 mm and over in diameter shall meet the strength requirements in Table 1 for Extra Strength Clay Pipe found in ASTM C 700.

BASIS OF ACCEPTANCE. Acceptance of this material will be based on the manufacturer’s certification of compliance with these specification requirements. The Department reserves the right to sample and test delivered material.

706-09 VITRIFIED CLAY PIPE UNDERDRAIN

SCOPE. This specification cover the material and quality requirements for vitrified clay pipe used for underdrains.

MATERIAL REQUIREMENTS. Pipe used for underdrains shall meet the requirements for § 706-08, Vitrified Clay Pipe - Storm Drains, with additional construction of self-centering lugs. A minimum of three wedge-shaped lugs shall be constructed as integral parts of the bell section of the pipe. The lugs shall be equally spaced around the inside circumference of the bell and shall be of such dimensions as to
center the spigot in the bell and to allow a 10 mm opening between the end of the spigot and the inside of the bell when the pipes are snugly fitted together.

**BASIS OF ACCEPTANCE.** The requirements of §706-08 shall apply.

### 706-10 AND 706-11 (VACANT)

#### 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.** For smooth interior corrugated polyethylene pipe the Department requires the submission of Materials Details as defined in §101-34.1. The manufacturer 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 and product along with the reference number and date assigned to the approved Materials Details will be placed on the Approved List. Such products shall then be accepted in stock lot quantities in accordance with the procedural directives of the Materials Bureau.

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. S. H. T. O. M252 except the pipe stiffness requirement shall be 310 kPa at 5% deflection.

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based on the manufacturer's name appearing on the Department's Approved List and the manufacturer's certification of compliance with these requirements.

### 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 appearing on the Department's Approved List and the manufacturer's certification of compliance with these requirements.
§706-14

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 I.

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

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

<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>
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<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>

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:

7-72
<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 and with the following clearances on the installed protective cover:

**Nominal Pipe Size, Millimeters**

| Outside Diameter of Nominal Pipe and Inside Diameter of Protective Cover, Millimeters |
|-----------------------------------------|-----------------|
| 3 to 38 incl.                           | .397            |
| 50 to 100, incl.                        | .794            |
| 125 to 280, incl.                       | 1.984           |
| 300 and over                            | 2.381           |

**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. Additional material listed below shall meet the requirements of the following subsection:

- Mechanical Connectors for Reinforcing Bar Splices (Epoxy Coated) 709-10

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

1. **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, submitted by the contractor, shall meet the requirements of the NYSDOT Reinforced Concrete Box Culvert Design Guidelines.
§ 706-17

All box culvert designs shall be submitted by the contractor, to the Department, for approval. The processing, approval and transmittal of box culvert designs will be in accordance with procedural directives of the Materials Bureau. Designs shall be submitted at least 45 days prior to the start of fabrication and shall include a complete set of working drawings and a complete set of design calculations. The drawings and design calculations shall be stamped by a Professional Engineer licensed, and registered, to practice in New York State. When the contract plans contain a complete design for the culvert, working drawings are still required. However, they do not have to be stamped by a Professional Engineer and design calculations are not required.

2. Drawings. Working drawings shall include complete and accurate details for connecting headwalls, cut-off walls, wingwalls, apron slabs and when required, bridge railing to the box culvert. Working drawings, and when required design calculations, shall be submitted to the Department for approval at least 45 days prior to the start of fabrication. The processing, approval and transmittal of working drawings will be in accordance with procedural directives of the Materials Bureau.

3. General. Unless noted otherwise in the contract plans or approved working drawings the concrete cover over reinforcing steel shall be 25 mm minimum on the walls, floor slab and roof slab. 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. Fill heights shall be measured from the top of pavement to the top of the culvert roof slab. Details for connecting headwalls, cut-off walls, wingwalls, apron slabs and when required, bridge railing to the box culvert shall be as shown in the contract plans or approved working drawings. 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 100 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 shop 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.

4. Dimensional Tolerances. The dimensional tolerances contained in § 704-03 shall apply except as noted herein.
   a. Internal and external unit dimensions shall not vary by more than 10 mm from the design dimensions.
   b. Slab and wall thickness shall not vary from the design dimension by more than 5 mm for thicknesses less than 250 mm or 10 mm for thicknesses of 250 mm or greater.
   c. The length of section shall not vary more than 10 mm from the design dimension.
   d. Variations in laying lengths of two opposite surfaces of the box section shall not be more than 10 mm.

Curing. The Curing requirements contained in § 704-03 shall apply.

Repair. The Repair requirements contained in § 704-03 shall apply except surface voids or "bug holes" that are less than 50 mm in diameter and less than 10 mm deep, need not be repaired.

Sampling and Testing. The Sampling and Testing 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.
706-18 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

707-01 (VACANT)

707-02 CORRUGATED STEEL PIPE

SCOPE. This specification covers corrugated steel pipe with metallic, bituminous, and/or polymer coating intended for use in the construction of culverts and drainage systems.

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

1. 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.
2. 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.
3. Type IR. This pipe shall have a full circular cross-section, with a single thickness of smooth sheet, fabricated with helical ribs projecting outwardly.
4. Type II. This pipe shall be a Type I pipe which has been reformed into a pipe-arch, having an approximately flat bottom.
5. 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. Metallic coated corrugated steel pipe shall conform to the requirements of AASHTO M 36 Types I, IA, IR, II, and III except as modified herein. Bituminous coated corrugated steel pipe shall conform to AASHTO M 190 except as modified herein. Polymer coated corrugated steel pipe shall conform to AASHTO M 245 Types I, II, and III except as modified herein. When Type IR corrugated steel pipe (spiral rib) is specified, the nominal dimension of the ribs shall be 19 mm by 19 mm at 190 mm pitch.

Coatings. Pipe coatings shall consist of one of the following:

1. Metallic. The steel sheet shall have a protective coating of zinc (galvanizing), aluminum, or aluminum - zinc alloy. The type of coating used is the option of the contractor. Each pipe section within an individual culvert shall have the same type of metallic coating to avoid connections of dissimilar metals.
2. Fully bituminous coated and paved invert (AASHTO M 190 Type C). In addition to one of the metallic coatings, the pipe shall be fully bituminous coated and have a bituminous paved invert.
3. Fully bituminous coated and 100 percent paved (AASHTO M 190 Type D). In addition to one of the metallic coatings, the pipe shall be fully bituminous coated and have a fully paved, smooth bituminous interior.
§ 707-02

4. Polymer coated. The steel sheet shall have a protective coating of zinc (galvanizing). In addition, the pipe shall 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 shall have a minimum thickness of 0.08 mm. If no exterior polymer coating is applied, the exterior shall have the zinc coating only.

5. Polymer coated with a bituminous paved invert. In addition to the zinc and polymer coatings, the pipe shall have a bituminous paved invert.

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

- Penetration at 25°C, 110 g, 5 seconds, AASHTO T49 25-50
- Penetration Ratio (4°C/25°C x 100), AASHTO T49 80-90
- Softening Point EC (Ball & Ring), AASHTO T53 88-110

The polymer material shall conform to AASHTO M 246 and shall appear on the Department's Approved List.

**Gauge.** The nominal metal thickness corresponding to any gauge shall be as shown in Table 707-1.

<table>
<thead>
<tr>
<th>Manufacturer's Standard Gage Number</th>
<th>Thickness Equivalent(*)</th>
<th>Millimeters</th>
<th>Manufacturer's Standard Gage Number</th>
<th>Thickness Equivalent(*)</th>
<th>Millimeters</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>6.07</td>
<td>16</td>
<td>1.52</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>5.70</td>
<td>17</td>
<td>1.37</td>
<td></td>
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<tr>
<td>5</td>
<td>5.31</td>
<td>18</td>
<td>1.21</td>
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</tr>
<tr>
<td>6</td>
<td>4.94</td>
<td>19</td>
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</tr>
<tr>
<td>7</td>
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</tr>
<tr>
<td>8</td>
<td>4.18</td>
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<tr>
<td>9</td>
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<td>22</td>
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<tr>
<td>10</td>
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<tr>
<td>15</td>
<td>1.71</td>
<td>28</td>
<td>0.38</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*NOTE: Minimum thickness shall conform to the appropriate AASHTO specifications.

**End Finish.** To facilitate field joining, the ends of all helical corrugated steel 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 pipe are rerolled, there shall be only two such corrugations.

**Coupling Bands.** All round pipe sections (Types I, IA, IR, and III) 300 mm or greater in diameter shall be field joined with annular corrugated coupling bands. The band corrugations shall have the same dimensions as the pipe ends. The band shall mesh with at least one full corrugation and shall lap equally on each pipe end. The band width shall be a minimum of 180 mm for pipe diameters up to and including
750 mm. The band width shall be a minimum of 265 mm for pipe diameters greater than 750 mm. The band shall not be more than 2 nominal sheet thicknesses thinner than the pipe and in no case thinner than 1.32 mm.

Pipe arches (Type II) 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 1.63 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 (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. 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:

1. Galvanized steel angles, 50 mm x 50 mm x 5 mm.
2. Lug connectors.
3. Bar and strap connectors.

These connectors shall be riveted, bolted, or welded to the coupling bands. Any 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, a corrugated angle which conforms to an approved Material Detail may be used.

The steel sheet used for coupling bands shall be coated with one of the metallic coatings. If metallic coated corrugated steel pipe is being joined, the bands shall have the same metallic coating as the pipe.

**Coating Repair.** Damaged metallic, bituminous, and/or polymer coating shall be repaired when directed by the Engineer at no cost to the State.

Metallic coating field repairs will be allowed only when the total damaged area on each piece is less than 0.2 m² of coated surface, excluding aluminum coated rerolled ends. A piece having damaged areas totalling more than 0.2 m², excluding aluminum coated rerolled ends, will be rejected. The Contractor shall replace it at no cost to the State.

Metallic coatings shall be repaired as follows:

1. Power disk sand or mechanically wire brush areas of damaged coating to bright metal.
2. Remove oil, grease, and corrosion products from repair areas.
3. Spray or brush a zinc-rich paint on clean, dry repair areas. The paint brand shall appear on the Department's Approved List, Item 719-01, Materials for Use in Repairing Galvanized Surfaces. The dry film paint thickness shall be at least 0.13 mm. Paint shall not be applied below 4EC.

Aluminum coatings damaged during rerolling shall be repaired at the manufacturing location. The rerolled ends may be either spot repaired or completely painted to repair small areas of damaged coating. Repairs to the rerolled ends of aluminum coated pipe shall be made as referenced above. These rerolled end repairs, when properly completed, shall not count toward the 0.2 m² of allowable damaged coating described above.

Damaged interior bituminous coatings shall be repaired 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 shall require repair to the metallic coating only.

Damaged interior polymer coatings shall be repaired 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 shall require repair to the metallic coating only.
§ 707-02

Marking. Each length of corrugated steel pipe shall be marked over the coating or tagged as approved by the Department to properly cross-reference the supplier's certification.

Additional Defects. In addition to coating damage and other criteria established in Materials Bureau procedural directives, the following defects other than those listed in AASHTO will be cause for rejecting the pipe when inspected at the project:

1. Variation from a straight centerline of more than 19 mm in 6 m.
2. Any dents greater than 75 mm in diameter.
3. Any punctures.
4. Loosely formed or cracked lock seams.
5. Cracks through the metal.
6. 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. 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.

Metal and coating thicknesses shall be measured at the project by project inspectors. If the metal and/or coating thickness is less than required or certified, the pipe shall be rejected. Equipment required to measure metal and coating thicknesses 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.

Polymer coatings, coating applicator facilities, and application methods are subject to Materials Bureau approval. Requests for approval shall be submitted to the Materials Bureau Director. 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 shall include the brand and applicator of polymer coating, which must appear on the Department's Approved List.

Corrugated connecting angles will be accepted provided they are an approved Materials Detail on the Department's Approved List.

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.

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

707-05 THROUGH 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 M 167 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 707-1.

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 M 218. The units shall conform to the shape, dimensions, and thickness shown on the applicable standard sheet and/or contract plans. 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.
§ 707-10

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.

707-11 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. A aluminum end sections shall be manufactured from material meeting the requirements of AASHTO M 197. The units shall conform to the shape, dimensions, and thickness shown on the applicable standard sheet and/or contract plans. 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 §603-3.02G, 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.

707-12 (VACANT)

707-13 CORRUGATED ALUMINUM PIPE

SCOPE. This specification covers corrugated aluminum pipe intended for use in the construction of culverts and drainage systems.

CLASSIFICATION. The corrugated aluminum pipe covered by this specification is classified as follows:

1. 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.
2. 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 and lock seams.
3. Type IR. This pipe shall have a full circular cross-section with a single thickness of smooth sheet, fabricated with helical ribs projecting outwardly.
4. Type II. This pipe shall be a Type I pipe which has been reformed into a pipe-arch, having an approximately flat bottom.
5. 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 M 196 Types I, IA, IR, II, and III except as modified herein. When Type IR corrugated aluminum pipe (spiral rib) is specified, the nominal dimension of the ribs shall be 19 mm by 19 mm at .

Gauge. The nominal metal thickness corresponding to any gauge shall be as shown in Table 707-1.

End Finish. To facilitate field joining, the ends of 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 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 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 750 mm. The band widths shall be a minimum of 265 mm for pipe diameters greater than 750 mm.

The bands shall not be more than 2 nominal sheet thicknesses thinner than the pipe and in no case thinner than 1.22 mm.

Pipe arches (Type II) 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 1.52 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:

1. A aluminum angles, 50 mm x 50 mm x 5 mm.
2. A aluminum lug connectors.
3. A aluminum bar and strap connectors.

These connectors shall be riveted, bolted, or welded to the coupling bands. Any 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:

1. Variation from a straight centerline of more than 19 mm in 6 m.
2. Any dents greater than 75 mm in diameter.
3. Any punctures.
4. Loosely formed or cracked lock seams.
5. Cracks through the metal.
6. Differences in diameters of abutting pipe ends greater than 13 mm, whether rerolled or not.

**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.
§ 707-13
Metal thickness shall be measured at the project by project inspectors. If the metal thickness is less than required or certified, the pipe shall be rejected. Equipment required to measure 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.

Corrugated connecting angles will be accepted provided they are an approved Materials Detail on the Department’s Approved List.

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 M 219 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 707-1.

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 M 219.

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 THROUGH 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 A 307. Grip shall be 140 mm threaded over at least first 63 mm. The bolts shall be fitted with two nuts, ASTM A 563 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 A 153 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 A 36.

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 PAINTS - GENERAL

SCOPE. These specifications cover the materials, packaging, delivery and general specifications common to paints used on New York State highway structures.

Failure to comply with any of these requirements shall be cause for rejection.

The primary usage of each individual paint is given under its respective materials specifications number. Methods of applying paint and using painting materials are included in §740 of these specifications.

GENERAL. Unless otherwise specified, the materials used in the composition of the paints shall conform to the requirements of ASTM or Federal Specifications as applicable and covering such materials. Test methods specified by ASTM or Federal Government for identifying raw materials and paints are applicable except where noted.

The composition requirements and properties of raw material constituents used in the paints and not otherwise covered by ASTM or Federal Specifications are as follows:


2. Siliceous Red Iron Oxide (85% Fe₂O₃).

   The pigment shall be a natural siliceous red iron oxide which, when used with other constituents of paint specified in materials specification §708-02, will impart a color to match the established reference standard.

<table>
<thead>
<tr>
<th>Properties</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total iron oxide, (Fe₂O₃)</td>
<td>70.00%</td>
<td>97.00%</td>
</tr>
<tr>
<td>Coarse particles (total residue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>retained on 45 Fm sieve)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CaO</td>
<td></td>
<td>1.00%</td>
</tr>
<tr>
<td>Moisture and other volatile matter</td>
<td></td>
<td>2.00%</td>
</tr>
<tr>
<td>Water soluble matter</td>
<td></td>
<td>1.50%</td>
</tr>
<tr>
<td>Oil Absorption</td>
<td>16</td>
<td>--</td>
</tr>
<tr>
<td>Siliceous matter</td>
<td>Balance</td>
<td>--</td>
</tr>
<tr>
<td>Organic colors</td>
<td></td>
<td>nil</td>
</tr>
</tbody>
</table>

   The percentages noted relate to mixture by weight.

3. Basic Silicate White Lead 48% (PbO Type).

<table>
<thead>
<tr>
<th>Properties</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead Monoxide (PbO)</td>
<td>46.80%</td>
<td>49.00%</td>
</tr>
<tr>
<td>Silicon Dioxide (SiO₂)</td>
<td>46.80%</td>
<td>48.60%</td>
</tr>
<tr>
<td>Sulfur Trioxide (SO₃)</td>
<td>4.00%</td>
<td>4.40%</td>
</tr>
<tr>
<td>Moisture (loss at 105EC)</td>
<td>--</td>
<td>0.20%</td>
</tr>
<tr>
<td>Coarse Particles</td>
<td>--</td>
<td>0.10%</td>
</tr>
<tr>
<td>Oil Absorption</td>
<td>14.0</td>
<td>18.0</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>3.9</td>
<td>4.10</td>
</tr>
</tbody>
</table>

   The percentages noted relate to mixture by weight.
4. **Zirconium Drier Catalyst.**

The Zirconium drier catalyst shall be a clear solution of a Zirconium organic complex containing 6% Zirconium metal. It shall be soluble in and compatible with the vehicle of which it is a component part.

<table>
<thead>
<tr>
<th>Properties</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zirconium</td>
<td>5.9%</td>
<td>6.1%</td>
</tr>
<tr>
<td>Color (Gardner)</td>
<td>--</td>
<td>4</td>
</tr>
<tr>
<td>Viscosity at 25EC (Gardner-Holdt)</td>
<td>Less than A</td>
<td>--</td>
</tr>
<tr>
<td>Specific Gravity at 20EC</td>
<td>0.855</td>
<td>0.875</td>
</tr>
</tbody>
</table>

The percentages noted relate to mixture by weight.

5. **Solvents.** All solvents shall conform to 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.

**MATERIAL REQUIREMENTS.** The paints, consisting of ingredients meeting all specified requirements, shall be well ground, shall not settle badly or cake in the container, and shall be readily broken up with a paddle into a smooth, uniform product of good brushing consistency.

The uniformity of any one batch or lot of paint, with the exception of material specification §708-21, Textured Concrete Finish Paint, shall be determined by the following tests:

1. **Weight per Liter.** Variations exceeding 36 grams per liter between samples representing the same lot shall be cause for rejection.

2. **Fineness of Grind.** Variations exceeding 1.0 unit between samples representing the same lot shall be cause for rejection.

3. **Viscosity.** Variations exceeding 3.0 Krebs Units between samples representing the same lot shall be cause for rejection.

When applied as specified, the paint shall hide the under surface completely, and dry within the specified time without running, streaking, sagging, wrinkling, or exhibiting other film defects. The primer and undercoat shall dry with a dull gloss; the finish coat with a full gloss. For aesthetic purposes, the finish coat on certain exposed portions of individual structures shall be painted from a single batch of accepted paint, as indicated on the plans or directed by the Engineer-in-Charge. Should a bridge fascia beam or other exposed surface be of such length that it cannot be painted from a single batch, one or more additional batches may be used, providing the colors are matched as closely as possible to the established standard as determined by the Engineer-in-Charge. The hiding power shall be sufficient to obtain complete hiding when applied at normal spreading rates.

**Containers.** The furnished paint shall be shipped in strong substantial containers sealed in a manner approved by the Department. The containers shall be equipped with a bolt or lever type ring seal, designed to keep the top of the container securely closed, in accordance with Department directives unless specific exception has been made by the Materials Bureau. Each container shall be plainly marked with the following:

1. Paint Name
2. Item Number
3. Name and Address of Manufacturer
4. Weight of Paint (grams per liter)
5. Volatile Organic Compound (VOC) Content (Expressed in grams per liter)
All furnished paint shall be sampled in accordance with directives issued by the Materials Bureau.

Test. Paint samples will be tested in the Materials Bureau for conformance to physical properties, chemical formulation, and volatile organic compounds (VOC). Laboratory test methods for individual paints may be obtained from the Materials Bureau.

BASIS OF ACCEPTANCE. Individual manufacturer’s batches of paint will be considered for acceptance in stock lot quantities at manufacturing locations, in accordance with procedural directive of Materials Bureau unless otherwise directed by the Department.

All acceptances shall, unless otherwise specified, expire eighteen (18) months after the date of manufacture.

Tamper-proof tags for installation on the ring seal shall be affixed by representatives of the Department in accordance with directives of the Materials Bureau. Any unauthorized tampering or breaking of tags on the container seals between the time of sealing and the time of application of the paint, shall be cause for rejection of the paint.

708-02 MAROON PRIMER

BASIS OF ACCEPTANCE. Whenever this material is specified, the primer paint supplied shall be one of the products on the Department's Approved List entitled “Paints for Structural Steel, A. Primer Paint and Thinners.” Acceptance shall be based on the appearance of the primer paint on the Approved List.

708-03 DULL ORANGE PRIMER

BASIS OF ACCEPTANCE. Whenever this material is specified, the primer paint supplied shall be one of the products on the Department's Approved List entitled “Paints for Structural Steel, A. Primer Paint and Thinners.” Acceptance shall be based on the appearance of the primer paint on the Approved List.

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.

GENERAL. The requirements of material specification §708-01, Paints - General, and Federal Specification TT-P-645, or later addenda, shall apply.

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,</td>
<td>Chalk Resistant</td>
<td>90</td>
</tr>
<tr>
<td>Zinc Oxide</td>
<td>(ASTM D79)</td>
<td>114</td>
</tr>
<tr>
<td>American Process Type</td>
<td></td>
<td></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>
</tbody>
</table>
The quantitative requirements of zinc chromate primer shall be as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
<th>Grams Per Liter</th>
</tr>
</thead>
<tbody>
<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 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 THRU 708-07 (VACANT)

708-08 READY MIXED ALUMINUM PAINT

**SCOPE.** The primary use of this paint is to preserve the original silver color of existing bridges. Also, it may be used as a prime coat for wood treated with creosote oil or oil borne wood preservative as specified in plans or proposals.

**GENERAL.** The requirements of material specification §708-01, Paints - General, shall apply.

**Type I - First Field Coat.** The first field coat of aluminum paint shall consist of 240 g of leaf-free aluminum paste of standard fineness per liter of long oil varnish suitable for making a ready-mixed aluminum paint. This paint shall be characterized by its ability to show distinct contrast with the Second Field Coat to ensure adequate coverage, but it shall not contain any added coloring materials for this purpose.

**Type II - Second Field Coat.** The second or final field coat of aluminum paint shall consist of 240 g of leafing aluminum paste of standard fineness per liter of long oil varnish suitable for making a ready-mixed aluminum paint.

The aluminum paints shall be manufactured as closely as possible to the application period, but in no case shall the lapse between manufacture and usage exceed six months.
The two types shall be distinguished as follows:

1. **Type I.** Standard Leaf-Free Aluminum Paste meeting the following requirements, as evaluated according to ASTM D480.

<table>
<thead>
<tr>
<th></th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matter not volatile at 105E-110EC (Essentially aluminum flakes)</td>
<td>65.0%</td>
<td>--</td>
</tr>
<tr>
<td>Fatty or oil matter</td>
<td>--</td>
<td>1.50%</td>
</tr>
<tr>
<td>Total impurities (other than fatty matter)</td>
<td>--</td>
<td>0.80%</td>
</tr>
<tr>
<td>Mica, fillers and other adulterants</td>
<td>--</td>
<td>None</td>
</tr>
<tr>
<td>Coarse particles retained on 45 Fm sieve</td>
<td>--</td>
<td>1.50%</td>
</tr>
</tbody>
</table>

2. **Type II.** This pigment shall consist entirely of finely divided, polished aluminum flakes in paste form, and shall meet the minimum requirements of Federal Specification TT-P-320C, Type II, Class B, or latest revision thereof, or ASTM D962, Type II, Class B.

**Liquid.** The liquid for both Type I and II shall be a long oil varnish suitable for making a ready-mixed aluminum paint, volatile solvent and driers, and shall meet the following requirements:

<table>
<thead>
<tr>
<th></th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-volatile matter</td>
<td>50.0%</td>
<td>--</td>
</tr>
<tr>
<td>Volatile thinner and drier</td>
<td>--</td>
<td>50.0%</td>
</tr>
</tbody>
</table>

The varnish shall conform to the type described in Federal Specification TT-V-81F, Type II, Class 2 dated February 10, 1949 or latest revision thereof, with certain modifications as given below. The varnish shall be clear and shall contain no limed resin.

<table>
<thead>
<tr>
<th></th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity (Pa s at 25EC)</td>
<td>0.085</td>
<td>0.125</td>
</tr>
<tr>
<td>Acid Number (Of non-volatile)</td>
<td>--</td>
<td>7</td>
</tr>
<tr>
<td>Non-volatile</td>
<td>50.0%</td>
<td>--</td>
</tr>
<tr>
<td>Kauri Reduction</td>
<td>75.0%</td>
<td>--</td>
</tr>
</tbody>
</table>

**MATERIAL REQUIREMENTS**

**Pigment.** The pigments shall be aluminum pastes of two types. They shall consist of commercially pure aluminum in the form of fine flakes compounded with a volatile paint thinner and a suitable fatty lubricant to form a paste suitable for use as a paint pigment. The paste shall show no skinning or caking in the containers. There shall be no appreciable settling out of the metallic portion of the paste in the container, i.e., no free liquid shall be present.

**Paint.** The paint, as received, shall show no more than slight settling, shall be readily mixed to a smooth, uniform appearance, free from skins or coarse particles and shall be suitable for application by brush or spray.

The paint shall be carefully mixed in such a manner as to avoid excessive agitation, entrapped air, and absorption of moisture. It should not be stored under excessively high temperature. Type I and II paints shall have the following compositions:
§ 708-08

**Composition**

<table>
<thead>
<tr>
<th>Composition</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigment</td>
<td>14.0%</td>
<td>--</td>
</tr>
<tr>
<td>Total impurities (mica, filler or</td>
<td>---</td>
<td>0.0%</td>
</tr>
<tr>
<td>other adulterants)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coarse particles (Retained on 45 Fm</td>
<td>---</td>
<td>0.1%</td>
</tr>
<tr>
<td>sieve. Calculated on paint basis)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicle</td>
<td>--</td>
<td>86.0%</td>
</tr>
</tbody>
</table>

**Composition**

<table>
<thead>
<tr>
<th>Composition</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-volatile in vehicle</td>
<td>45.6%</td>
<td>--</td>
</tr>
<tr>
<td>Moisture content (calculated on paint basis)</td>
<td>--</td>
<td>0.1%</td>
</tr>
<tr>
<td>Weight (kg/L)</td>
<td>0.96</td>
<td>--</td>
</tr>
</tbody>
</table>

**Physical Properties**

<table>
<thead>
<tr>
<th>Physical Properties</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drying Time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set to touch (hrs.)</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Dry hard (hrs.)</td>
<td>--</td>
<td>24</td>
</tr>
<tr>
<td>Viscosity, seconds using No. 4</td>
<td>25</td>
<td>65</td>
</tr>
<tr>
<td>Ford Cup at 25EC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paint flexibility (based on vehicles solids - not paint solids), Kauri Reduction</td>
<td>60.0%</td>
<td>--</td>
</tr>
</tbody>
</table>

The percentages noted relate to mixture by weight.

**Test.** The Type II paint when flowed on a clean glass panel, supported at an angle of 45E, and then allowed to dry, protected from all drafts, for 24 hours at room temperature (20-30E), shall produce a film comparable in smoothness, color, luster, and capacity to that of a similar film applied at the same time and in the same manner, using a standard comparison paint. The comparison standard shall be prepared by freshly mixing 118 Ml of aluminum paste meeting ASTM D962, Type II, Class B, with 473 Ml of spar varnish meeting Federal Specification TT-V-81F, Type II, Class 2.

The test paints, set aside in a full, tightly closed container for 30 days, at room temperature, shall show no gas pressure when opened. The Type II paint, after this aging period, shall also pass the leafing test.

**SPECIAL METHOD OF TEST**

**Pigment Content.** Pigment content shall be determined as follows: Transfer about 3 grams of sample into a weighed 100 Ml beaker and reweigh as rapidly as possible. Add 50 Ml of benzol, stir, and filter through a weighted, medium porosity sintered glass crucible. Wash the beaker with acetone and police to insure transferal of all insoluble. Wash the insoluble 6 to 8 times with acetone, dry at 105E, cool and weigh.

\[
\text{Pigment Percent} = \frac{\text{Weight Insoluble}}{\text{Weight sample}} \times 100\%
\]

**Vehicle Non-Volatile.** To determine vehicle non-volatile, first determine the total solids in the paint by the method described under Non-Volatile Matter: ASTM D154 or Federal Test Method Standard No 141a, Method 4053. The vehicle non-volatile can then be calculated as follows:

\[
\text{Non-Volatile Vehicle, Percent} = \frac{\left(\% \text{ total solids} - \% \text{ pigment}\right)}{\left(100\% - \% \text{ pigment}\right)}
\]
**Total Impurities.** Using the pigment in the pigment content test, determine total impurities by the methods described in ASTM D480, paragraph 3.

1. **Coarse Particles.** Determine the coarse particles in the mixed paint (using a 35 gram sample of paint) by the method described in ASTM D185, §6, or Federal Test Method Standard No. 141a, Method 4091. Coarse particles in the pigment can then be calculated as follows:

   \[
   \text{Coarse Particles in pigment, Percent} = \frac{\text{Weight of residue}}{35 \times \% \text{ pigment}} \times 100\%
   \]

2. **Toughness of Flexibility.** Determine the ability of the mixed paint (not the clear vehicle) to withstand a 60 percent Kauri Reduction test using the method described in ASTM D154 or Federal Test Method Standard No. 141a, Method 4151. As the pigment in the paint tends to obscure the cracks, it will be necessary to examine the bent panel with a 10X glass (or higher magnification) to positively identify them.

3. **Moisture Content.** Determine the amount of moisture in paint using the method described in ASTM D95 or Federal Test Method Standard No. 141a, Method 4082.1 modified as follows: When distillation is complete, a special policeman consisting of rubber disc attached to a heavy wire of sufficient length to permit policing the entire bore of the condenser should be employed. The diameter of the disc should be about 2/3 that of the bore of the condenser. With the policeman and a stream of dry mineral spirits from a wash bottle, carefully police all moisture from the condenser tube into the trap. Disconnect the trap and with a small policeman police all moisture to the bottom. These operations must be done with great care and attention to detail as the entire success of the test depends on them.

   Any required tests with the exception of those detailed above should be run according to applicable ASTM or Federal Specification methods.

**BASIS OF ACCEPTANCE.** Individual Manufacturer’s batches of paint will be considered for acceptance in stock lot quantities at manufacturing locations, in accordance with procedural directives of the Materials Bureau, unless otherwise directed by the Department. All acceptances shall, unless otherwise specified, expire six (6) months after the date of manufacture. Tamper-proof tags for installation on the ring seal shall be affixed by Department representatives in accordance with directives of the Materials Bureau. Any unauthorized tampering or breaking of tags on the container seals between the time of sealing and the time of application of the paint will be cause for rejection of the paint.

**708-09 BLASTED SURFACE PRIMER**

**BASIS OF ACCEPTANCE.** Whenever this material is specified, the primer paint supplied shall be one of the products on the Department’s Approved List entitled “Paints for Structural Steel, A. Primer Paint and Thinners.” Acceptance shall be based on the appearance of the primer paint on the Approved List.

**708-10 GRAY PAINT**

**BASIS OF ACCEPTANCE.** Whenever this material is specified, the intermediate paint supplied shall be one of the products on the Department’s Approved List entitled “Paints for Structural Steel, B. Intermediate Paint and Thinners.” Acceptance shall be based on the appearance of the finish paint on the Approved List.
§ 708-11

708-11 SAGE GREEN PAINT

BASIS OF ACCEPTANCE. Whenever this material is specified, the finish paint supplied shall be one of the products on the Department's Approved List entitled “Paints for Structural Steel, C. Finish Paint and Thinners.” Acceptance shall be based on the appearance of the finish paint on the Approved List.

708-12 LIGHT GRAY PAINT

BASIS OF ACCEPTANCE. Whenever this material is specified, the finish paint supplied shall be one of the products on the Department's Approved List entitled “Paints for Structural Steel, C. Finish Paint and Thinners.” Acceptance shall be based on the appearance of the finish paint on the Approved List.

708-13 (VACANT)

708-14 BLACK PAINT

BASIS OF ACCEPTANCE. Whenever this material is specified, the finish paint supplied shall be one of the products on the Department's Approved List entitled “Paints for Structural Steel, C. Finish Paint and Thinners.” Acceptance shall be based on the appearance of the finish paint on the Approved List.

708-15 BLUE PAINT

BASIS OF ACCEPTANCE. Whenever this material is specified, the finish paint supplied shall be one of the products on the Department's Approved List entitled “Paints for Structural Steel, C. Finish Paint and Thinners.” Acceptance shall be based on the appearance of the finish paint on the Approved List.

708-16 BROWN PAINT

BASIS OF ACCEPTANCE. Whenever this material is specified, the finish paint supplied shall be one of the products on the Department's Approved List entitled “Paints for Structural Steel, C. Finish Paint and Thinners.” Acceptance shall be based on the appearance of the finish paint on the Approved List.

708-17 BROWN-GRAY PAINT

BASIS OF ACCEPTANCE. Whenever this material is specified, the finish paint supplied shall be one of the products on the Department's Approved List entitled “Paints for Structural Steel, C. Finish Paint and Thinners.” Acceptance shall be based on the appearance of the finish paint on the Approved List.

708-18 DARK GRAY PAINT

BASIS OF ACCEPTANCE. Whenever this material is specified, the finish paint supplied shall be one of the products on the Department's Approved List entitled “Paints for Structural Steel, C. Finish Paint and Thinners.” Acceptance shall be based on the appearance of the finish paint on the Approved List.

708-19 DARK BLUE PAINT

BASIS OF ACCEPTANCE. Whenever this material is specified, the finish paint supplied shall be one of the products on the Department's Approved List entitled “Paints for Structural Steel, C. Finish Paint and Thinners.” Acceptance shall be based on the appearance of the finish paint on the Approved List.
708-20 STAIN RESISTANT WHITE PAINT

**BASIS OF ACCEPTANCE.** Whenever this paint is specified, the Contractor shall supply an acrylic water-borne paint specifically intended for exterior use and for use on wood surfaces. The paint shall be approved by the Engineer prior to use.

708-21 (VACANT)

708-22 WHITE CURB PAINT

**BASIS OF ACCEPTANCE.** Whenever this paint is specified, the material shall conform to the requirements of Section 640.

708-23 WHITE GUIDE RAIL PAINT

**BASIS OF ACCEPTANCE.** Whenever this material is specified, the finish paint supplied shall be one of the products on the Department's Approved List entitled “Paints for Structural Steel, C. Finish Paint and Thinners.” Acceptance shall be based on the appearance of the finish paint on the Approved List.

708-24 WEATHERED BROWN GUIDE RAIL PAINT

**BASIS OF ACCEPTANCE.** Whenever this material is specified, the finish paint supplied shall be one of the products on the Department's Approved List entitled “Paints for Structural Steel, C. Finish Paint and Thinners.” Acceptance shall be based on the appearance of the finish paint on the Approved List.

708-25 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>P1 Land &amp; Fresh Water</td>
</tr>
<tr>
<td></td>
<td>P13 Marine (Coastal Water)</td>
</tr>
<tr>
<td>Creosote-Coal Tar Solution</td>
<td>P2 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 - WATER BORNE

**SCOPE.** These specifications cover water-borne wood preservatives used in the treatment of piles, timber and lumber.
**708-31**

**MATERIAL REQUIREMENTS.** Water-borne wood preservatives shall be Ammoniacal Copper Arsenite or Chromated Copper Arsenate conforming to the requirements of American Wood-Preservers’ Association Standard P5.

Water-borne 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.

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**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.

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**SECTION 709 - REINFORCING STEEL**

**709-01 BAR REINFORCEMENT, GRADE 400**

**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**

1. **Deformed Bar Reinforcement.** Steel reinforcing bars shall be deformed billet steel bars meeting the requirements of ASTM A615M, Grade 400, or deformed rail steel bars meeting the requirements of ASTM A616M, Grade 400 including Supplementary Requirement S1.

2. **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 A615M, Grade 400. When specified the spirals shall be epoxy coated in accordance with the applicable requirements of §709-04 or §709-08.

3. **Samples and Tests.** Sampling and testing will be conducted as directed by the Materials Bureau.

**BASIS OF ACCEPTANCE.** Reinforcing bars and spirals will be considered for acceptance on the basis of the manufacturer’s name appearing on the Approved List, and certification, in accordance with the procedural directives of the Materials Bureau.

Alternatively, reinforcing bars and spirals from a manufacturer not appearing on the Approved List may be considered for acceptance in mill bonded, stock lot quantities at the fabricators or the epoxy coating applicators, based on sampling and testing in accordance with the procedural directives of the Materials Bureau.
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.** Wire fabric reinforcement 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.

Alternately, wire fabric 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.

709-03 BAR REINFORCEMENT, GRADE 300

**SCOPE.** This specification covers the material requirements for deformed billet steel reinforcing bars used in portland cement concrete.

**MATERIAL REQUIREMENTS.** Reinforcing bars shall conform to the requirements of ASTM A615M, Grade 300.

**Samples and Tests.** Sampling and testing shall be conducted as directed by the Materials Bureau.

**BASIS OF ACCEPTANCE.** Reinforcing bars will be considered for acceptance in stock lot quantities at the manufacturing supply locations in accordance with the procedural directives of the Materials Bureau.

709-04 EPOXY-COATED BAR REINFORCEMENT, GRADE 400

**SCOPE.** This specification covers bar reinforcement with protective epoxy coatings applied by the electrostatic spray method.

**MATERIAL REQUIREMENTS**

1. **Bar Reinforcement.** Steel reinforcing bars shall conform to the requirements of Section 709-01, Bar Reinforcement, Grade 400.

2. **Epoxy Coating Material.**
   a. 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.
   b. 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.

3. **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.
§ 709-04
Coating Application

1. **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.”

2. **Surface Preparation.**
   a. 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-V is 1-89, Pictorial Standards A SP 10, B SP 10, or C SP 10, as applicable.
   b. 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.
   c. The powdered epoxy resin coating shall be applied to the cleaned surface as soon as possible after cleaning and before visible oxidation occurs. No case shall more than 8 hours elapse between cleaning and coating.

3. **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.

4. **Coating Thickness.**
   a. The epoxy coating shall be applied as a uniform, smooth coat. After curing, the coating thickness shall be 0.25 ± 0.05 mm.
   b. 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.
   c. 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.
   d. 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.

5. **Continuity of Coating.**
   a. The coating shall be checked visually after cure for continuity. It shall be free from holes, voids, contamination, cracks and damaged areas.
   b. 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.
6. 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.

7. Adhesion of Coating.
   a. 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 709-1. 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 20EC and 30EC at the time of testing.
   b. 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.
   c. 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 shall be rejected.

**TABLE 709-1 BEND TEST REQUIREMENTS**

<table>
<thead>
<tr>
<th>Bar No.</th>
<th>Mandrel Diameter (mm)</th>
<th>Bar No.</th>
<th>Mandrel Diameter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>100</td>
<td>30</td>
<td>230</td>
</tr>
<tr>
<td>15</td>
<td>125</td>
<td>35</td>
<td>280</td>
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<tr>
<td>20</td>
<td>150</td>
<td>45</td>
<td>430</td>
</tr>
<tr>
<td>25</td>
<td>200</td>
<td>55</td>
<td>580</td>
</tr>
</tbody>
</table>

Testing and Sampling.

1. 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:
   a. A lot shall not exceed a single order.
   b. 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.

2. 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.

3. Plant Inspection.
   a. 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.
   b. 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.
§ 709-04
Repair of Coated Bars

1. Repairs at the Coating Applicator's Facility
   a. 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.
   b. 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.
   c. The coating applicator shall be responsible for repair to the coating due to damage at the coating applicator’s facility.

2. Repair at the Fabrication Facility
   a. The fabricator shall be responsible for repair to the coating due to damage during fabrication and handling at the fabricator’s facility.
   b. 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.
   c. 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.
   d. Visible cracks, including hairline cracks without bond loss that occur due to fabrication of the bars, shall be repaired with patching material.
   e. 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.
   f. 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 400 will be considered for acceptance in stock lot quantities at the coating applicator’s facility in accordance with the procedural directives of the Department, issued by the Materials Bureau.

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 A 108, 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 PRESTRESSING STEEL

SCOPE. This specification covers the material requirements for prestressing steel used in the fabrication of prestressed concrete units.

MATERIAL REQUIREMENTS. Prestressing steel shall conform to the requirements of ASTM A 416*.

* No stabilized (low-relaxation) strand shall be used without written approval of the Deputy Chief Engineer (Structures).

Test. Three (3), 1.5 m samples shall be taken, from each reel of prestressing steel, by the Department’s representative and tested. The steel shall be tested for compliance with the requirements of ASTM A 416. Testing shall be conducted by the Department at a place designated by the Department.

BASIS OF ACCEPTANCE. Acceptance of prestressing steel will be based on Departmental sampling, testing, and procedural directives.

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 F, G, M, R, S, and T, curbs shall meet the requirements of ASTM A 615M, Grade 300 or Grade 400 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, Grade 400; 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.

1. Wire Fabric Reinforcement. Wire fabric reinforcement shall conform to the requirements of §709-02.
§ 709-08

2. **Epoxy Coating Material.**
   a. 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.

   b. 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.

3. **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**

1. **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."

2. **Surface Preparation.**
   a. 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.

   b. 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.

3. **Coating Application.** The powdered epoxy resin coating shall be electrostatically applied in accordance with the recommendations of the coating manufacturer.

4. **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.

5. **Continuity of Coating.**
   a. The coating shall be checked visually after cure for continuity. It shall be free from holes, voids, contamination, cracks and damaged areas.

   b. 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.

6. **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.

7. **Flexibility of Coating.**
   a. The flexibility of the coating shall be evaluated on two representative sections of wire fabric from each production lot or two #15, Grade 400 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.

b. 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

1. **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:

   a. A lot shall not exceed a single order, or delivered load of 1500 sheets, whichever is smaller.
   
   b. 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.
   
   c. A lot shall consist of the number of sheets of mesh coated with the same batch or lot of epoxy.

2. **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.

3. **Plant Inspection.**

   a. 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.
   
   b. 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.

SHOP REPAIR OF COATED WIRE FABRIC. 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 removed 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 reinforcement will be considered for acceptance in stock lot quantities at manufacturing supply locations in accordance with procedural directives of the Materials Bureau.

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.
§709-09

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.

Alternately, 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, Grade 400. 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.

MATERIAL REQUIREMENTS. Mechanical connectors will be tested for the following three parameters:

1. 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.
2. The maximum slip, at 90% of the yield strength of the reinforcing bar, shall be 0.457 mm.
3. 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.”

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 M 181, Chain Link Fence, Type III, except as modified herein.

1. Wire. The aluminum alloy wire shall be 6061-T94 conforming to the applicable chemical composition limits of ASTM B211M.
2. 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.
3. **Shipping.** Fabric shall be furnished in a clean condition free of all foreign material, including oil, dust, film, etc.

**BASIS OF ACCEPTANCE.** Acceptance will be based on sampling and testing conducted by the Materials Bureau in accordance with procedural directives of the Department.

### 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.

1. **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.

2. **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.

3. **Shipping.** Fabric shall be furnished in a clean condition free of all foreign material, including oil, dust, film, etc.

**BASIS OF ACCEPTANCE.** Acceptance will be based on sampling and testing conducted by the Materials Bureau in accordance with procedural directives of the Department.

### 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.

1. **Mesh Size.** The size of the mesh shall be 50 mm unless otherwise specified in the contract documents.

2. **Wire Diameter.** The wire diameter shall be as follows unless specified otherwise in the contract documents:
   - Class A-Extruded Polyvinyl Chloride (PVC)-Coated Steel shall have a 9-gage (3.759 mm) metallic coated core wire.
   - Class B-Bonded Polyvinyl Chloride (PVC)-Coated Steel shall have an 11-gage (3.048 mm) metallic coated core wire.

3. **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.

4. **Shipping.** Fabric shall be furnished in a clean condition, free of all foreign material, including oil, dust, film, etc.

**BASIS OF ACCEPTANCE.** Acceptance will be based on sampling and testing conducted by the Materials Bureau in accordance with procedural directives of the Department.
§710-3

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.

1. **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.

2. **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. Acceptance will be based on sampling and testing conducted by the Materials Bureau in accordance with procedural directives of the Department.

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.

1. **Mesh Size Coated Wire Diameter.** The size of the mesh and the coated wire diameter shall be 51 mm and 9 gage (3.759 mm) respectively unless otherwise specified in the contract documents.

2. **Coating.** The coating shall meet the requirements of ASTM F 1345 Class 2 (305 g/m²).

3. **Shipping.** Fabric shall be furnished in a clean condition, free of all foreign material including oil, dust, film, etc.

BASIS OF ACCEPTANCE. Acceptance will be based on sampling and testing conducted by the Materials Bureau in accordance with procedural directives of the Department.

710-06 THRU 710-09 (VACANT)

710-10 & 710-10.03 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:

1. **Class A, Schedule 40 Pipe.** Posts, rails and braces shall be standard weight Schedule 40 Pipe, manufactured in accordance with ASTM F 1083, except that the protective coating system shall be as specified herein.
2. **Class B, Steel Tubing.** Posts, rails and braces shall be manufactured by one of the following methods with the steel conforming to ASTM A569M or ASTM A607 with a minimum yield strength of 345 MPa:
   A. Furnace butt welded, continuous welded
   B. Cold rolled and electric resistance welded
   C. 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>1¼ NPS</td>
<td>42.16</td>
<td>2.819</td>
<td>2.732</td>
</tr>
<tr>
<td>1½ 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>2½ NPS</td>
<td>73.02</td>
<td>4.064</td>
<td>6.904</td>
</tr>
</tbody>
</table>

3. **Class C, Rolled-Formed Shapes.** Posts, rails and braces shall be roll formed shapes which meet the requirements of ASTM F669.

4. **H. Posts.** H Posts shall be fabricated from hot-rolled steel sections which meet the requirements of ASTM F669.

5. **Fittings.** Fittings shall be manufactured of weldable steel, malleable iron, cast steel, cast iron, or aluminum alloy.

   A. **Weldable Steel.** Weldable steel shall be commercial quality or better, produced by one of the following processes: Open-Hearth, Electric Furnace, or Basic Oxygen.

   B. **Malleable Iron.** Malleable Iron shall conform to the requirements of §715-09.

   C. **Cast Iron.** Cast iron shall conform to the requirements of §715-05.

   D. **Cast Steel.** Cast steel shall conform to the requirements of §715-02.

   E. **Aluminum Alloy.** Aluminum alloy shall meet the material requirements of §710-11.

Fittings other than aluminum fittings in contact with galvanized surfaces shall be galvanized in accordance with §719-01, Type II. Fittings in contact with aluminum surfaces shall be made of aluminum alloy or be aluminum coated in accordance with §719-03.

6. **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.

7. **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; and Class B Steel Tubing.**

      1. **Galvanized Coatings.** Galvanized both inside and out in accordance with ASTM F1083.

      2. **Combined Coatings.**

         a. External surface shall be coated with the following combined coating system:
§710-10

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 have either a zinc rich coating, a cross linked polyester coating containing a corrosion inhibitor, or a hot-dip galvanized 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. 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.

Galvanized Coatings. 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, and 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 1234 Protective Coatings on Steel Framework for Fences Type C, except the coating weight shall be 305 g/m².

BASIS OF ACCEPTANCE. Acceptance will be based on the manufacturer’s certification, together with supplemental inspection at the project site in accordance with the procedural directives of the Materials Bureau.

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:
<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 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 Tumbuckles</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 Posts</td>
<td>715-04</td>
<td>6063-T6</td>
<td>Sched. 40 pipe NPS 2 1/2</td>
</tr>
<tr>
<td>Post Tops</td>
<td>715-03</td>
<td>356.0-F, 360.0, D712.0, or ZG 61A-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 1/2, 42.9 mm Inside Diameter, 1.98 mm Minimum Wall Thickness, 152.4 mm long.

**Basis of Acceptance.** Acceptance will be based on manufacturer's certification, with supplementary sampling and testing at the discretion of the Materials Bureau.

### 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 §710-10.03, 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.
§710-12
Each length of pipe shall be sealed with two snug-fitting polyethylene plug-type seals to prevent condensation and eliminate internal corrosion.

BASIS OF ACCEPTANCE. Acceptance will be based on manufacturer's certification with supplementary sampling and testing at the discretion of the Materials Bureau.

710-13 WOOD POSTS

SCOPE. This specification covers wood posts for use as guide posts and/or witness posts.

MATERIAL REQUIREMENTS. 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 on four sides and the dimensions shall be nominal 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 be used but shall be pressure treated in accordance with §708-31, Wood Preservative-Water Borne. Bituminous preservative treatments will not be permitted. Before using, the Contractor shall submit to the Regional Director, for approval, information as to the species of timber to be used and method of preservative treatment to be employed.

BASIS OF ACCEPTANCE. Acceptance will be based on the manufacturer's certification with supplementary sampling and testing at the discretion of the Materials Bureau.

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. Acceptance shall be based on the manufacturer's certification and in accordance with the Department's directives.

710-15 THRU 710-19 (VACANT)
710-20 CORRUGATED BEAM GUIDE RAILING AND MEDIAN BARRIER

**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 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.

Post connection bolts and the grippable splice bolts shall be as detailed on the Standard Sheets.

**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 materials specification §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 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.

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 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.

**Fasteners.** Fasteners shall be galvanized and conform 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.

**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:

- **Posts, Soil Plates** §710-14 Galvanized Steel Barrier Posts
- **Reflectors** §730-01 Aluminum Sign Panels
- **Reflective Sheeting** §730-05 Reflective Sheeting
- **Cable** AASHTO M 30 or ASTM A 741 Type I Construction, Class A Coating
- **Anchor Angle** ASTM A 36M
- **Bolts** ASTM F568 Class 4.6
- **Nuts** ASTM A 563M Grade A
- **Washers** ASTM F 844

**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 AND CULVERT RAILING

**SCOPE.** This specification covers the material requirements for Steel Bridge and Culvert Railing and its component parts.

**MATERIAL REQUIREMENTS.** Steel Bridge and Culvert Railing materials shall conform to the following requirements:
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<table>
<thead>
<tr>
<th>Piece</th>
<th>ASTM Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail Tubes</td>
<td>A 500 Grade B (1)</td>
</tr>
<tr>
<td>Rail Clamps</td>
<td>A 500 Grade B, A 36M, A 588M, or A 572M Grade 345</td>
</tr>
<tr>
<td>Clamp Bolts and Nuts</td>
<td>A 325 Type I, or Type III</td>
</tr>
<tr>
<td>Rail End Caps</td>
<td>A 36M or A 588M</td>
</tr>
<tr>
<td>19 mm Post Plates (3)</td>
<td>A 588M or A 572M Grade 345</td>
</tr>
<tr>
<td>25 mm Post Plates (3)</td>
<td>A 36M, A 588M or A 572M Grade 345 (2)</td>
</tr>
<tr>
<td>Post Connection Plates (3)</td>
<td>A 36M or A 588M</td>
</tr>
<tr>
<td>Base Plates (3)</td>
<td>A 588M or A 572M Grade 345</td>
</tr>
<tr>
<td>Anchor Studs</td>
<td>F 568 Class 8.8</td>
</tr>
<tr>
<td>Splice Bolts, Nuts and Washers</td>
<td>A 325M, Type 3</td>
</tr>
<tr>
<td>Carriage Bolts, Nuts and Washers</td>
<td>F 568 Class 4.6</td>
</tr>
<tr>
<td>Nuts and Washers for Anchor Studs</td>
<td>A 325M Type 1, or Type 3</td>
</tr>
<tr>
<td>Anchor Plates</td>
<td>A 36M</td>
</tr>
<tr>
<td>Post Web Plates (If Required) (3)</td>
<td>Same as Post Plate Material</td>
</tr>
<tr>
<td>Plate Shims</td>
<td>A 36M or A 588M</td>
</tr>
<tr>
<td>Rectangular Tube Rail Splices</td>
<td>A 519 Grade 1018, 1020 or 1026 Hot Finished</td>
</tr>
<tr>
<td>Solid Rail Splices</td>
<td>A 36M, A 588M, or A 572M Grade 345</td>
</tr>
<tr>
<td>Channel Rail Splices</td>
<td>A 36M, A 588M, or A 572M Grade 345</td>
</tr>
<tr>
<td>Splice Plates</td>
<td>A 36M, A 588M, or A 572M Grade 345</td>
</tr>
<tr>
<td>WF Railing Post (3)</td>
<td>A 36M, A 588M, or A 572M Grade 345</td>
</tr>
</tbody>
</table>

(1) Where unpainted A 588M steel is used for the post, the tube shall be unpainted A 500 Grade B with the chemical properties of either A 588M or A 606, Type 4. Railing tube meeting the foregoing requirements will be acceptable if its elongation is a minimum of 21% in 50 mm.

(2) Where noted on the plans, only A 588 or A 572 Grade 345 will be allowed.

(3) 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.

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 shall be tested in accordance with ASTM E 436 - “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 50 mm x 230 mm specimens supported to achieve a 180 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 1.2 m.

The requirements of these paragraphs shall not apply to 50 mm x 50 mm or 75 mm x 75 mm rail tube.

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Round rail tubes and pipes shall not be drop-weight tear tested, but shall be furnished to the following minimum Charpy V-Notch toughness requirement:

Pipe, or tube, subject to design tensile stress...27 N·m @ 4EC. The sample shall be taken after galvanizing.

**Fabrication.** Bridge and Culvert Railing shall be fabricated to the dimensions shown in the contract plans and in compliance with the specifications.

1. **Shop Drawings.** Shop drawings 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.

2. **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.

3. **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 Post Plates, Post Base Plates and Post Spacer Plates so that all sharp edges are removed.

4. **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 650EC.

5. **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 for assembly prior to galvanizing.

All galvanized bolts and galvanized anchor studs shall have a Class 6H 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 by the stick method using an approved stick galvanizing alloy and torch. A list of approved products is maintained by the Materials Bureau, Department of Transportation. Any stick galvanizing alloy not included on the Department list must be approved by the Materials Bureau prior to use.

Galvanizing repair shall be made by the following procedure:

The area to be galvanized shall be cleaned to expose a bright metal surface. The surface shall then be heated with a torch to a temperature sufficient to melt all metallics in the galvanizing alloy which is being applied in stick form.

Care shall be taken not to damage adjacent galvanized surfaces by overheating. Residues of fluxes and surface smudges shall be wiped off with waste or washed off with water.

The following areas will not require galvanizing repair:

A. One 3 mm maximum dimension spot of tight flux remaining in the fusion line of any 180 mm length of weld after blast cleaning pickling and galvanizing.

B. A total of 625 mm of uncoated area on bottom surface of the base plate.

6. **Painting Rustic Railing.** 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 the following:

a. The color of the finished coat shall conform to Federal Color Standard No. 595a, Color 20059 (Weathered Brown).
§710-23

b. Paint shall be one of the products on the Department's Approved List titled “Paints for Structural Steel, C. Finished Paint and Thinners.” Acceptance shall be based on the appearance of the paint on the Approved List.

c. All galvanized surfaces shall be cleaned in the manner required by SSPC-SP1, Solvent Cleaning.

d. A brade all galvanized surfaces by brush blast methods, or other mechanical means approved by the Engineer/Inspector. The purpose of abrading is to roughen the surface, not to remove material.

f. Apply the paint in accordance with the Manufacturer's instructions to a minimum dry film thickness of 75 µm in a single coat. Manufacturer's instructions for mixing and paint application shall be supplied to the Engineer/Inspector at least one week prior to the beginning of any painting work.

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 (VACANT)

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.

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. Other Components. Other components of high strength, low alloy steel guide rail system shall conform to the following requirements:
1. **Soil Plates** - Soil plates 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.

2. **Miscellaneous Hardware** - The base metal of all accessory hardware 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).

   a. All bolts less than 13 mm diameter and their associated washers and nuts.
   b. 44 mm x 44 mm square washers; 76 mm x 44 mm washers.
   c. 20 mm diameter anchor rods, nuts and washers associated with concrete anchors.
   d. 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.

E. **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 DM C-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.

F. **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 poles 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.

**EPOXY COATING APPLICATION REQUIREMENTS**

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
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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.

1. 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.

2. 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. .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

A. 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.

B. All epoxy coated posts shall be accepted by the Engineer at the contract site on the basis of the following:

1. The epoxy coating manufacturer’s certification that the coating material is identical to that approved by the Materials Bureau.

2. The coating applicator’s certification that the posts have been coated and that they conform to the requirements of this specification.

3. The appearance of the name of the coating applicator and epoxy coating material on the Department’s Approved List of Products.
C. 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 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 subsection 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:

- **Bolts**: ASTM F568 Class 4.6 or A307
- **Nuts**: ASTM A563M or A568, Grade A or better
- **Washers**: ASTM F844

The fasteners shall be galvanized in accordance with the requirements of §719-01 Type II.

RIGHT-OF-WAY FENCE GATES

A. Gates. Gates shall be constructed of Class A Schedule 40 Pipe conforming to §710-10.03 welded at all corners or assembled with corner fittings. The size of the pipe used to fabricate the gate
§710-30
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.

B. Hinges. Hinges shall be weldable steel, cast steel, or malleable iron 180E 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.

C. 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.

D. 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 §710-10.03.
Wood gate posts shall be made from wood conforming to the requirements for wood posts and braces as specified in the subsection titled “Fence Posts and Braces” of this specification.

BASIS OF ACCEPTANCE. Fabric acceptance will be based on sampling and testing conducted by the Materials Bureau, in accordance with procedural directives of the Department. The acceptance of all other materials specified in this specification for use in the construction of Right-of-Way Fencing will be based on the Manufacturer’s certification with supplementary sampling and testing at the direction of the Materials Bureau.

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**

1. **Tufting.** The cotton thread for tufting shall be not less than 4-cord number 12's.

2. **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.**

1. **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.

2. **Tolerance.** The length or width of the mats shall not be less than that specified by more than 2 percent.

**Construction**

1. **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. 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. The flap shall be constructed by sewing the upper and lower covering together longitudinally within 25 mm of the outer edges of the flap. A long 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. All longitudinal sewing orquilting 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.** This material will be accepted on the basis of the certification by the manufacturer. Each shipment shall be accompanied by a certification of compliance attesting that the quilted covers meet these specified standards.

**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.
§711-03

MATERIAL REQUIREMENTS. The blankets shall conform to the test requirements of A.S.T.M. C171, TABLE 1, 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.

1. Manufacturer’s name and/or logo
2. Product name
3. Meet ASTM C171, Table 1, 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 M 171 (ASTM C 171) 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

1. 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.

2. **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 m$^2$, 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 M 182. 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/m·K).

A 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 meter$^2$/watt (K·m$^2$/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 must 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 of all admixtures shall be greater than 8. (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:

1. 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.

2. 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.

3. 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.

4. 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.

5. 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:
1. **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.

2. **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.

3. **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.

4. **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.

5. **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:

1. **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.

2. **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.

3. **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:

   | Compressive Strength, minimum percent of control: |
   |---|---|---|---|
   | 1 day | 140% | 7 days | 115% |
   | 3 days | 125% | 28 days | 110% |

   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.

4. **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.

5. **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.
§ 711-08

**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 tests 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.

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**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 ASTM C109, 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 must 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 ASTM C618 including Table 1A (except for Footnote A). Loss of ignition shall not exceed 4.0%.

1. 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.

2. 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.

3. 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 ASTM C618 as modified in test methods prescribed by the Materials Bureau.

SPECIAL NOTE. The Department will consider requests to evaluate alternate cement and/or fly ash combinations such as ASTM C618 Type C fly ash and ASTM C595 Type 1P cement. 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.

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.

   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.
§712-01

TABLE 712-1 - WATER

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Content of mortar prepared and tested</td>
<td>12.0 M ax.</td>
</tr>
<tr>
<td>with ASTM C185 percent by volume</td>
<td>0.50 M ax.</td>
</tr>
<tr>
<td>Soundness, ASTM C151 Autoclave expansion,</td>
<td>90 M in.</td>
</tr>
<tr>
<td>percent</td>
<td></td>
</tr>
<tr>
<td>Compressive Strength, ASTM C109</td>
<td></td>
</tr>
<tr>
<td>7 day, 28 day (optional) (percent of</td>
<td></td>
</tr>
<tr>
<td>compressive strength of mortar cubes</td>
<td></td>
</tr>
<tr>
<td>made with standard water</td>
<td></td>
</tr>
<tr>
<td>Time of Setting, Vicat Test, ASTM C191</td>
<td>45 M in.</td>
</tr>
<tr>
<td>Initial Set, minutes</td>
<td>8 M ax.</td>
</tr>
<tr>
<td>Final Set, hours</td>
<td></td>
</tr>
<tr>
<td>Presence of oil</td>
<td>None</td>
</tr>
<tr>
<td>Ph, AASHTO T26</td>
<td>5.0 - 8.5</td>
</tr>
<tr>
<td>Organic solids, AASHTO T26, ppm</td>
<td>200 M ax.</td>
</tr>
<tr>
<td>Total inorganic solids, AASHTO T26, ppm</td>
<td>2000 M ax.</td>
</tr>
<tr>
<td>Chloride ion content, ppm</td>
<td>500 M ax.</td>
</tr>
<tr>
<td>Sulphates, ion content, ppm</td>
<td>1000 M ax.</td>
</tr>
</tbody>
</table>

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.

GENERAL. 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.

NOTE: 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 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.

7-124
**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:

1. 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.
2. 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 N.

**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 of subsection 714-04, Precast Concrete Curb shall apply except that the markers shall be fabricated to the size, shape and details shown on the appropriate standard sheet or as indicated in Contract Documents.
§ 712-05

BASIS OF ACCEPTANCE. Precast concrete right-of-way markers will be accepted based on the manufacturer’s certification of compliance with this specification.

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 backs of designated work vehicles, including trailers.

MATERIAL REQUIREMENTS. Mobile Construction Zone Impact Attenuators shall have been tested in accordance with the National Cooperative Highway Research Program Report 350 by a recognized testing agency. The tests shall consist of full scale crash testing. Truck weights, impacting vehicle weights, speeds and impact trajectories shall be as indicated in Table 1 below:

<table>
<thead>
<tr>
<th>Test No.</th>
<th>Impact Vehicle Mass</th>
<th>Impact Speed</th>
<th>Impacting Angle Degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>51</td>
<td>2000 kg</td>
<td>100 km/h</td>
<td>0</td>
</tr>
<tr>
<td>50</td>
<td>820 kg</td>
<td>100 km/h</td>
<td>0</td>
</tr>
<tr>
<td>53</td>
<td>2000 kg</td>
<td>100 km/h</td>
<td>10</td>
</tr>
</tbody>
</table>

The test vehicle weight shall be between 8200 and 9100 kilograms. Trucks shall be in second gear, and brakes set.

To be satisfactory, attenuators shall satisfy the following performance criteria:

1. Acceptable attenuator performance shall be controlled stopping of the impacting vehicle.

2. Detached elements, fragments or other debris from the impact attenuator shall not penetrate or show potential for penetrating the passenger compartment or present undue hazard to other traffic or to nearby pedestrians or workers.

3. The impacting vehicle shall remain upright during and after collision although moderate roll, pitching and yawing are acceptable. Integrity of the passenger compartment shall be maintained with essentially no deformation or intrusion.

4. The impact velocity of a hypothetical front seat passenger against the vehicle interior, when calculated from vehicle acceleration and 0.61 m forward and 0.30 m lateral displacements, shall be less than 12 and 6 m/s respectively. Also, the impacting vehicle’s highest 10 millisecond average accelerations subsequent to the instant of hypothetical passenger impact (Occupant Ridedown Acceleration) shall be less than 20 g’s.

5. After collision, the impacting vehicle trajectory shall be such that its final stopping position would intrude a minimum distance into adjacent traffic lanes assuming the truck equipped with the attenuator was centered in its driving lane.

BASIS OF ACCEPTANCE. The Director of the New York State Department of Transportation’s Materials Bureau maintains a list of products which have successfully passed the above listed requirements. Approval of Mobile Construction Zone Impact Attenuators at the contract site shall be on the basis of the product’s appearance on that list of products and the manufacturer’s certification that it complies with these specifications.

712-07 INERTIAL BARRIER MODULES

7-126
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 must 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 must 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 as defined in §101-34.1. 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
§ 712-13
Timber and Lumber, unless otherwise specified or noted upon the plans or in the itemized proposal, 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 must 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 poly-vinyl chloride (P.V.C.) gabions.

GENERAL. The materials used in fabricating and filling of gabions shall comply to specifications and tests set forth below.

MATERIAL REQUIREMENTS

A. Galvanized Gabions. The wire mesh shall be made of galvanized steel wire having a minimum size of U.S. Steel Wire Gage No. 11. Tolerance on the wire including the galvanizing shall be ± 0.1 mm. The tensile strength of the wire shall be in the range of 410 to 590 Mpa. The minimum zinc coating of the wire shall be 244 g/m² of uncoated wire surface as determined by tests conducted in accordance with ASTM A90. The maximum linear dimension of the mesh opening shall not exceed 115 mm and the areas of the mesh opening shall not exceed 5800 mm².

B. P.V.C. Coated Galvanized Gabions. The wire mesh used for P.V.C. Gabions shall be a minimum size of U.S. Steel Wire Gage No. 12 and the tensile strength shall be in the range of 350 to 520 Mpa. The wire shall be zinc coated with a minimum of 76 g/m² when the galvanized wire is additionally coated with a minimum thickness of 0.38 mm of extruded P.V.C.; or the wire shall be zinc coated with a minimum of 61 g/m² when the galvanized wire is additionally coated with a minimum thickness of 0.25 mm of bonded P.V.C. The minimum P.V.C. finished wire diameters shall be 3.55 mm for extruded P.V.C. mesh wire and 3.30 mm for bonded P.V.C mesh wire. Tolerance on the wire including the galvanizing and P.V.C. coatings shall be ± 0.1 mm. The maximum linear dimension of the mesh opening shall not exceed 115 mm and the area of the mesh opening shall not exceed 5800 mm².
The physical properties of the P.V.C. coating shall conform to the following requirements:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific Gravity</td>
<td>ASTM D792</td>
<td>1.25</td>
<td>1.40</td>
</tr>
<tr>
<td>Tensile Strength (Mpa)</td>
<td>ASTM D638M</td>
<td>1800</td>
<td>--</td>
</tr>
<tr>
<td>Elongation (%)</td>
<td>ASTM D638M</td>
<td>180</td>
<td>280</td>
</tr>
<tr>
<td>Hardness, Shore D</td>
<td>ASTM D2240</td>
<td>35</td>
<td>45</td>
</tr>
<tr>
<td>Water Absorption, 48 hours (%)</td>
<td>ASTM D570</td>
<td>--</td>
<td>0.5</td>
</tr>
<tr>
<td>Accelerated Aging 2000 Hrs. at 63±5EC</td>
<td>ASTM D1499</td>
<td>Coating shall not fade, crack, blister or split.</td>
<td></td>
</tr>
<tr>
<td>Bend Test</td>
<td>10X O.D. of wire at -20EC</td>
<td>Coating shall withstand a mandrel bent test without cracking.</td>
<td></td>
</tr>
</tbody>
</table>

**Tiewire and Baskets.**

Tiewire or connecting wire shall be supplied in sufficient quantity for securely fastening all edges of the gabion and diaphragms and to provide for eight internal connecting wires in each cell of one meter high gabion and four internal connecting wires in each cell of a one-half meter high gabion. The tiewire is to meet the same specifications as the wire used in the mesh except that it may be not more than two gages smaller.

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 data 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 criteria under Tests, Stone Fill.

**Tests.**

1. **Wire Mesh.**

   **A. Elongation.** The wire mesh shall have sufficient elasticity to permit elongation of the mesh equivalent to a minimum of 10% of the length of the section of the mesh under test without reducing the gage or tensile strength of individual wires to values less than those for similar wire one gage smaller in diameter.

   **B. Elasticity.** A section of the mesh 2 meter long and not less than 1 meter wide, after first being subjected to the elongation test described above, shall withstand a load test of 26.7 Kn applied to an area of 0.10 m² approximately in the center of the section under test. The details of this test are as follows:
§ 712-15

An uncut section of mesh 2 meter long, not less than 1 meter wide and including all selvedge binding shall have the ends securely clamped for 1 meter along the width of the sample. When the width of the sample under test exceeds 1 meter, the clamps will be placed in the middle portion of the width and the excess width will be allowed to fall free on each side of the clamped section. The sample shall then be subjected to sufficient tension to cause 10% elongation of the sample section between the clamps. After elongation and while clamped as described above (and otherwise unsupported), the section shall be subjected to a load applied to an area of 0.10 m² located approximately in the center of the sample section between the clamps, and in a direction perpendicular to the direction of the tension force. The sample shall withstand, without rupture of any wire, or opening of any mesh fastening, an actual load, so applied, equaling or exceeding 26.7 Kn. The ram head used in the test shall be circular with its edges beveled or rounded to prevent cutting of the wires.

C. Single Strand Cut. The wire mesh shall be fabricated in such a manner as to be non-raveling. This is defined as the ability to resist pulling apart at any of the twists or connection forming the mesh when a single wire in a section of mesh is cut and the section of mesh then subjected to the load test described in the elasticity test above.

D. Zinc Coating. The test shall be conducted in accordance with details described in ASTM A90.

E. Tensile Strength. The test shall be conducted in accordance with details described in ASTM A392, except that strength shall be as listed under Material Requirements above.

2. Stone Fill.

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 ±3% of manufacturer’s stated sizes.

Gabions shall be fabricated in such a manner that the 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, and sides 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.

1. Species. The following kinds of wood suitable for cross ties will be accepted.
   - Ash
   - Beech
   - Birch
   - Black Gum
   - Catalpa
   - Cherry
   - Elm
   - Hackberry
   - Locust
   - Maple
   - Mulberry
   - Oak
   - Sassafras
   - Sycamore
   - Walnut

2. 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:
   a. 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.
   b. 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.

3. 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.
§ 712-17

Standard size thickness and width dimensions are shown in Table 712-2, and apply to the rail bearing areas. The dimensions of the tie shall not be averaged. All ties shall be 2600 mm long, or as required for turnouts.

**TABLE 712-2**

<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>

4. **Tolerances.** Individual unseasoned ties shall have the following tolerances applied to the thickness and width dimensions shown in Table 712-2.

Length: plus 51 mm, minus 25 mm
Thicknss: plus 510 mm, minus 6.4 mm
Width: plus 25 mm, minus 6.4 mm

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 must conform to the dimensions shown in Table 712-2 without the application of the minus tolerances:

5. **Defects.** The occurrence of any of the following defects in an individual tie shall be the cause for rejection.

a. **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.

b. **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.

c. **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.

d. **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.

e. **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.

f. **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.

g. **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 712-1 apply.
h. **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.

i. **Twist.** The deviation from a flat plane of all four faces by a spiraling or torsional action. A rotation of more than 3.5E from end face to end face shall not be allowed.

6. **Anti-Splitting Devices.** Anti-Splitting devices are to be installed prior to preservative treatment.

I. **Dowelling.** Dowels are anti-splitting devices driven or pushed into pre-bored holes. 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 must be equal to the length of the dowel, except that holes drilled from the face opposite the face where the dowel enters must 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 must 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.

II. **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.

III. **Nail Plates.** A anti-splitting nail plates shall be applied to the ends of the ties.
§ 712-17

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.

7. Conditioning. Ties must 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.

a. Air Seasoning. Ties shall be stacked for air seasoning in accordance with the American Wood Preserver's 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>Ash</td>
<td>Hackberry</td>
</tr>
<tr>
<td>Black Walnut</td>
<td>Beech</td>
<td>Hard Maples</td>
</tr>
<tr>
<td>Honey Locust</td>
<td>Birches</td>
<td>Mulberries</td>
</tr>
<tr>
<td>Red Oaks</td>
<td>Catalpa</td>
<td>Sassafras</td>
</tr>
<tr>
<td>White Oaks</td>
<td>Cherries</td>
<td>Sycamores</td>
</tr>
<tr>
<td></td>
<td>Elms</td>
<td>White Walnut</td>
</tr>
</tbody>
</table>

b. 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.


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 M 3, 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 M 2, 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 must 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 DELIVERY. 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.

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 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:

1. The Ph of the material shall be between 5.5 and 7.6.
2. The organic content shall be not less than 2% or more than 20%.
3. 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 Fm</td>
<td>20 to 80</td>
</tr>
</tbody>
</table>

The maximum size of objects other than stones shall be 50.0 mm.
§ 713-01

4. 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 may be, or may include, approved recycled or composted materials that are either commercially or municipally produced. Amendments shall not contain any material that is deleterious to soil structure, plant growth or seed germination. If composted sewage sludge is used to amend topsoil, it must meet all applicable New York State Department of Environmental Conservation (DEC) requirements.

STOCKPLING. 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 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, 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 from topsoil that has been amended or manufactured with approved composted sewer 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 who feel that an error was made in sampling the topsoil shall, within one work day, indicate the alleged error in writing to the Engineer in Charge.

TESTING. All material tests required by this section, except for the testing of composted sewer sludge, will be done by the Department in conformance with the procedures contained in the appropriate Departmental publications or test methods current on the date of advertisement for bids.

Composted sewer sludge used to amend or manufacture topsoil shall require a certificate, from a laboratory approved by the DEC, verifying compliance with all applicable law, 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 sewer sludge, soil containing composted sewer 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.

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. Acceptance of topsoil prior to correcting organic content 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.

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.
**Bulk 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, available 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 be commercial steamed bonemeal, finely ground with a minimum of 1.0% nitrogen and a minimum of 20% phosphoric acid.
- **Type No. 9.** Superphosphate shall be an approximate 0-20-0 formulation with an acceptable minimum of eighteen percent (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.

**Bulk 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

1. 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 must 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.

2. 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 must 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.

**TYPE A:** 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.

**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 names of plants shall be in conformity with the approved names by S.P.N. (Standard Plant Names) or its successor as the American Association of Nurserymen's recognized authority 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,” a code of standards sponsored by the American Association of Nurserymen, or as further specified in the contract documents. All plants shall have a normal habit of growth and be typically characteristic of their respective kinds. When a minimum and maximum size is specified, an average size is required. Plants shall not be pruned 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.

The container shall be sufficiently rigid to hold the ball shape and protect the root ball during handling and shipping. Container grown plants shall have been grown in the container long enough for the new fibrous roots to have developed so that the root ball is firm and will retain its shape and hold...
§ 713-06

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. No cold storage plants will be accepted unless approved. Plants stored temporarily shall be properly heeled in or otherwise protected from injury. Digging shall avoid all possible injury to, or loss of, roots, but roots cut shall be cleanly cut.

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. Doors on closed trucks shall be kept closed to prevent draughts. Shipments made in boxcars or closed trucks shall be adequately ventilated to prevent “drafts.” 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.

Trees. Nursery grown trees shall have no cuts of limbs 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 (B.R) 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 (B&B) 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 (B&P) 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 structural 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 specimen plants are specified on the plans.

Shrubs. Shrubs shall have good fibrous root systems. The quality of balled and burlapped and balled and platformed shrubs shall be as specified for B&B and B&P 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 (F.G.) unless otherwise specified. Pot grown plants (P.G.) 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 quantity, size, kind or quality of plants as specified will be accepted except upon written approval.

**Labeling.** Labeling shall be in accordance with normal large scale nursery labeling practice except that the Contractor may be required at any time to supply positive identification of any plant.

**BASIS OF ACCEPTANCE.** The Contractor shall furnish the vendor with a copy of the specifications for the plants. The Contractor shall be responsible for all certificates of inspection of plant materials which may be required by Federal, State or other authority to accompany shipments of plants. All plants shall be subject to inspection at any place and at any time. Inspections desired by the Contractor, if approved, shall be at the expense of the Contractor. The Contractor shall be represented at all inspections. The Engineer 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 final 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.

**713-07 JUTE MESH OR OTHER APPROVED EROSION CONTROL MATERIALS**

**SCOPE.** This specification covers the material requirements for Jute Mesh or Other Approved Erosion Control Materials.

**MATERIAL REQUIREMENTS**

**Jute Mesh.** Jute Mesh shall be of a uniform open plain weave of undyed and unbleached single jute yarn. The jute mesh shall be furnished in the manufacturer’s standard size rolls.

Jute mesh shall be woven as follows:
- Approximately 55 warp ends per meter of width.
- Approximately 37 weft ends per linear meter.
- Mass of jute mesh shall average 0.5 kg/m² (plus or minus 5%)

**Other Erosion Control Materials.** The erosion control materials shall be approved, commercially available products that are specifically manufactured for the purpose of controlling soil erosion.

**BASIS OF ACCEPTANCE.** The basis of acceptance shall be the manufacturer’s product label or product literature which indicates compliance with the material requirements.

**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.**

1. **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.
§ 713-08
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.

2. 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

SCOPE. This specification covers the material requirements for wood fiber for use a mulch in conjunction with turf establishment or erosion control.

MATERIAL REQUIREMENTS. Wood fiber shall be an approved first generation wood derivative and shall be processed so that the fibers will remain in uniform suspension in water under agitation and will blend with grass seed, fertilizer and other additives to form a homogenous 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 grass seed in intimate contact with the soil. Wood fiber shall contain no growth or germination inhibiting factors, and shall be dyed green. Wood fibers shall be supplied in the manufacturer’s standard containers weighing not over 45 kg each, 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. Manufacturer’s label indicating compliance with these specifications.
713-12 MULCH ANCHORAGE

SCOPE. This specification covers the material requirements for mulch anchorage.

MATERIAL REQUIREMENTS. Mulch anchorage shall be approved non-staining, commercially available products that are specifically formulated for the purpose of anchoring or tacking hay or straw mulches.

The materials shall be mixed and applied in accordance with the manufacturer's instructions.

Packaging. The materials shall be furnished in the manufacturer's standard containers with the name of the material, the manufacturer's name, and the instructions for mixing and application appearing on each container.

The Engineer shall reject any materials that have become wet, caked or otherwise unfit for use.

BASIS OF ACCEPTANCE. The basis of acceptance shall be the manufacturer's product label or product literature that indicates compliance with this specification.

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

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.

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 must 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.** A cceptance shall be based on inspection by the Engineer for compliance with the material requirements.

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### §713-15 ORGANIC MATERIAL

**SCOPE:** This specification covers the material requirements for organic material used in conjunction with amending topsoil.

**MATERIAL REQUIREMENTS**

1. **HUMUS OR PEAT.** The material shall be natural humus or peat from freshwater sources and can 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 the methods of testing of A.O.A.C. in effect on the letting date, 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.

2. **PEAT MOSS.** Peat moss 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 the methods of testing of A.O.A.C. in effect on the date of the invitation of bids. Its water absorbing ability shall be a minimum of 1100% by weight on an oven-dry basis.

3. **RECYCLED AND/OR COMPOSTED ORGANICS.** Recycled and/or composted organic materials may be commercially or municipally produced and may be derived from organic wastes such as food, agricultural and other vegetative residue, rotten animal manure, or sewage sludge. Non-hazardous vegetable waste and animal manure shall not contain any material that may be deleterious to the soil structure, plant growth or seed germination. Manure shall be well decayed, reasonably free from firefang, free from sticks, stones and foreign substances injurious to plant growth. Composted sewage sludge is regulated by the New York State Department of Environmental Conservation (DEC) and must meet all applicable regulatory requirements.

4. **TESTING.** Composted sewage sludge shall require an approved laboratory's certificate of acceptability provided by the source of the compost. The certificate shall verify compliance with all applicable laws, rules and regulation. Only facilities permitted to compost sewage sludge under 6 NYCRR Part 360, SOLID WASTE MANAGEMENT FACILITIES, shall be allowed to furnish finished compost for use in topsoil.

The certification shall be provided prior to delivery of any composted sewage sludge, soil containing composted sewage sludge or other such DEC regulated material to the contract site. The sludge shall be tested and approved prior to its use.

**BASIS OF ACCEPTANCE**

A cceptance of humus, peat and peat moss shall be the Manufacturer's label or certificate of analysis by an approved laboratory indicating compliance with the material requirements.
A cceptance of recycled and/or composted organics (except sewage sludge) shall be based on an upon delivery inspection by the Engineer to assure compliance with the material requirements. Acceptance of recycled and/or composted sewage sludge shall be based on certification by an 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 not be based on inspection by the Engineer for compliance with the material requirements.

713-20 and 713-21 (VACANT)

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.

Dimensional Requirements

1. General. Curb shall be cut to conform to the shape and size shown on the standard sheets and contract plans.

2. 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.
3. 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.

4. Transition Curb for Bridge to Roadway Curbs. 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.

5. 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, T₁, and Economy</td>
<td>100 mm minimum for 2/3 of length</td>
</tr>
<tr>
<td>F₁, G₁, M, and T₂</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

1. General. Curb surfaces shall be finished as indicated on the plans or standard sheets.

2. 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.

3. 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.

4. 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.

5. Front Exposed Faces. Front exposed faces of straight types A₁, 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.
6. 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.

7. Drill Holes. Drill holes will not be permitted in exposed curb surfaces.

Exceptions to Finish Requirements

1. 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.

2. 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. Materials shall meet the requirements of the following subsections:

- Portland Cement: 701-01
- Coarse Aggregates: 703-02
- Concrete Sand: 703-07
- Epoxy Coated Bar Reinforcement, Grade 400: 709-04
- Epoxy Coated Wire Fabric Reinforcement: 709-08
- Admixtures: 711-08
- Water: 712-01

The maximum allowable total chloride content in concrete shall not exceed 0.10 percent by weight of cement. Testing shall be done in accordance with written procedural directives of the Department. Cement shall be Type 1 or Type 2. Coarse aggregate gradation shall conform to the No. 1 Size Designation in subsection 703-02 Coarse Aggregate, Table 703-4.
§ 714-04

Pozzolans. The manufacturer may substitute fly ash meeting the requirements of §711-10 up to a maximum of 15 percent of the minimum Portland Cement by weight.

Concrete Manufacturing. The manufacturer shall formulate a concrete mix design, with a minimum cement content of 360 kilograms per cubic meter, such that the properties of the concrete meet the following requirements:

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Content, %</td>
<td>5.0-8.0</td>
</tr>
<tr>
<td>Compressive Strength Mpa, min., 28 days</td>
<td>25</td>
</tr>
</tbody>
</table>

The manufacturer shall formulate a concrete mix design, with a minimum cement content of 360 kilograms per cubic meter, such that the concrete properties meet the following requirements:

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Content, %</td>
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</tr>
<tr>
<td>Compressive Strength Mpa, min., 28 days</td>
<td>25</td>
</tr>
</tbody>
</table>

The manufacturer shall maintain at the manufacturing site a record of material used and their sources, and a copy of the concrete mix design.

Fabrication. Precast curb shall be fabricated to conform to the size and shape shown on the standard sheet unless otherwise shown on the plans. Reinforcement is optional. However, if the manufacturer reinforces the curb for handling the manufacturer shall use either epoxy coated bars conforming to the requirements of §709-04 or epoxy coated wire fabric reinforcement conforming to the requirements of §709-08. Minimum lengths shall be 1.75 meters except for radial curb and closures. Maximum lengths shall be 3.05 meters.

Concrete to be set on radius of 30 meters or less shall be cast to the curve required and ends shall be formed or sawed on radial lines. Concrete on a radius of 31 meters to 60 meters shall be cast or cut in 1 or 1.25 meter, straight lengths if so directed by the Engineer. Economy and Sloped types shall be furnished in straight pieces only except when on a radius of 3.05 meters or less, they shall be cast or cut with radial joints.

The manufacturer shall produce curb sections that are uniform in appearance. The concrete mix shall be cast in steel forms unless another type of form is approved by the Regional Director or his/her representative. The concrete shall be thoroughly consolidated by external or internal vibrators or a combination of both.

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 mid-point is located at the weld.

Curing. Curing shall be accomplished in accordance with the methods set forth under §706-02, Reinforced Concrete Pipe except Controlled Atmospheric Curing shall not be allowed.

Repair. Curb sections that contain minor defects caused by manufacture or mishandling may be repaired. Minor defects are defined as those that are small holes or spalls that do not penetrate deeper than the steel reinforcement. Repairs shall be made using a concrete repair material conforming to the requirements of Subsection 701-04 and having a color similar to that of the curb section. The repair shall be finished to the proper shape and cured. It shall withstand a moderate blow with a 450 gram hammer.

Curb sections having honeycombing, cracks, or large spalls are not acceptable and shall not be repaired.

Sampling and Testing. Precast concrete curb sections manufactured under the requirements of this specification shall be separated into specific and identifiable “production” lots. The maximum number of units in a lot shall be in accordance with Department directives.

The properties of the concrete will be determined on a production lot basis, by the Department, in accordance with either of the following methods at the option of the Department:

1. Production Testing. Testing shall be performed by the manufacturer, subject to the approval and inspection of the Materials Bureau. It shall consist of testing the plastic concrete for compliance to the air content required by this specification and the casting and testing of concrete cylinders for
compressive strength determination. Test cylinders used to determine the required compressive strength shall be cured with units they represent. The Department reserves the right to test the hardened concrete at any time, in which case the manufacturer shall drill 100 mm diameter cores at the direction of a Department representative.

2. End Product Testing. The testing of hardened concrete for both air content and compressive strength will be performed by the Materials Bureau on 100 mm diameter cores drilled by the manufacturer under the supervision of a Department representative.

BASIS OF ACCEPTANCE. Precast concrete curb shall be accepted in stock lot quantities at the manufacturing location according to the procedural directives of the Materials Bureau.

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 §401, Plant Mix Pavements - General, shall apply with the following modifications:

1. Automatic batching and recording equipment will not be required.
2. 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, Range</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>

3. The asphalt cement used in the mix shall comply with either material specification §702-0400, §702-0500, or §702-0600.
4. 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.
§714-06

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. Materials shall meet the requirements of the following subsections:

Portland Cement 701-01
Coarse Aggregates 703-02
Concrete Sand 703-07
Bar Reinforcement, Grade 400 709-01
Wire Fabric for Concrete Reinforcement 709-02
Admixtures 711-08
Water 712-01

The maximum allowable total chloride content in concrete shall not exceed 0.10 percent by weight of cement. Testing shall be done in accordance with written procedural directives of the Department. Cement shall be Type 1 or Type 2. Coarse aggregates shall meet one of the following optional gradations:

Option A. The coarse aggregate gradation shall conform to the No. 1 Size Designation in §703-02, Coarse Aggregates, Table 703-4.
Option B. The coarse aggregate gradation shall conform to the following limits:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>% Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>37.5 mm</td>
<td>100</td>
</tr>
<tr>
<td>25.0 mm</td>
<td>93-100</td>
</tr>
<tr>
<td>12.5 mm</td>
<td>27-58</td>
</tr>
<tr>
<td>6.30 mm</td>
<td>0-8</td>
</tr>
</tbody>
</table>

Pozzolans. The manufacturer may substitute fly ash meeting the requirements of §711-10 up to a maximum of 15 percent of the minimum Portland Cement by weight.

Concrete Manufacturing. The manufacturer shall formulate a concrete mix design meeting the requirements stated below:

1. Option A Coarse Aggregate Gradation

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement Content, kg/m³, M in.</td>
<td>360</td>
</tr>
<tr>
<td>Air Content, %</td>
<td>5.0-8.0</td>
</tr>
<tr>
<td>Compressive Strength, MPa, M in., 28 days</td>
<td>25</td>
</tr>
</tbody>
</table>

2. Option B Coarse Aggregate Gradation

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement Content, kg/m³, M in.</td>
<td>340</td>
</tr>
<tr>
<td>Air Content, %</td>
<td>5.0-8.0</td>
</tr>
<tr>
<td>Compressive Strength, MPa, M in., 28 days</td>
<td>25</td>
</tr>
</tbody>
</table>

The manufacturer shall maintain at the manufacturing site a record of materials used and their sources and a copy of the concrete mix design.
Fabrication. Precast concrete gutter shall be fabricated to conform to the size and shape shown on the standard sheet unless otherwise shown on the plans. Wire mesh reinforcement shall consist of Size No. W4 at 101 mm centers longitudinally and transversely, and shall be 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. Size and spacing of the reinforcing bars shall be approved by the Regional Director or his/her representative. 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.

The manufacturer shall produce gutter sections that are uniform in appearance. The concrete mix shall be cast in steel forms unless another type of form is approved by the Regional Director or his/her representative. The concrete shall be thoroughly consolidated by external or internal vibrators or a combination of both.

Curing. Curing shall be accomplished in accordance with the methods set forth under §706-02, Reinforced Concrete Pipe except controlled atmospheric curing shall not be allowed.

Repair. The requirements of §714-04, Precast Concrete Curb shall apply.

Sampling and Testing. The requirements of §714-04, Precast Concrete Curb, shall apply except that when cores are taken, the holes shall be plugged. The material used as the plug shall be fully consolidated, finished and properly cured according to the requirements of “Repair.”

BASIS OF ACCEPTANCE. Precast concrete gutter shall be accepted in production lot quantities at the manufacturing location according to the procedural directives of the Materials Bureau.

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:

1. Tension flanges and webs of stringers and girders, splice plates, and lateral gusset plates welded to the members in areas subject to tensile stress.

2. 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.
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3. All truss web and chord members and attached gusset and splice plates.

4. Truss lateral bracing.

5. Portions of Arches, Bents, Towers and Rigid Frames, plus attached gusset and splice plates, designated on the plans as being subject to tensile stress.

6. Plates and shapes of specified thickness subject to design tensile stress used in sign structures. Refer to subsection 644-2.02.

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 following table:

<table>
<thead>
<tr>
<th>TYPE OF STEEL</th>
<th>CVN REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A36M, A242M</td>
<td>20 joules @ 5E C</td>
</tr>
<tr>
<td>A572 M Grade 345</td>
<td></td>
</tr>
<tr>
<td>A588M (up to 100 mm mechanically fastened)</td>
<td>*20 joules @ 5E C</td>
</tr>
<tr>
<td>A588M (up to 50 mm welded)</td>
<td>*20 joules @ 5E C</td>
</tr>
<tr>
<td>A588M (up to 50 mm to 100 mm welded)</td>
<td>*27 joules @ 5E C</td>
</tr>
<tr>
<td>Sign Structure steel plates and shapes greater than 12 mm thick.</td>
<td>**27 joules @ 5E C</td>
</tr>
</tbody>
</table>

* If the yield strength of the material exceeds 448 M pa, the temperature for the Charpy V-Notch tests for acceptability shall be reduced by 8E C for each increment of 69 M pa above 448 M pa.

** Samples shall be taken after galvanizing.

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.
If the plate thickness requires that subsize specimens be used, the following table shall be used to find the equivalent absorbed energy for the full size specimen:

<table>
<thead>
<tr>
<th>EQUIVALENT ABSORBED ENERGY</th>
<th>Full Size 10 x 10 mm (joules)</th>
<th>3/4 Size 10 x 7.5 mm (joules)</th>
<th>1/2 Size 10 x 5 mm (joules)</th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td>22</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>16</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>14</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>14</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>11</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>8</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

Impact tests for fracture-critical members shall be as described in section 9 of the SCM.

**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.

**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.
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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></td>
<td>Permanent M old Castings</td>
</tr>
<tr>
<td>B443.0-F</td>
<td>S5A-F</td>
<td>B26M</td>
<td></td>
<td>Sand Castings</td>
</tr>
<tr>
<td>A356.0(modified)*</td>
<td>SG 70-B(modified)*</td>
<td>B108</td>
<td></td>
<td>Permanent M old Castings</td>
</tr>
<tr>
<td>356.0-T6</td>
<td>SG 70A-T6</td>
<td>B26M</td>
<td></td>
<td>Sand Castings</td>
</tr>
<tr>
<td>356.0-F</td>
<td>SG 70A-F</td>
<td>B26M</td>
<td></td>
<td>Sand Castings</td>
</tr>
<tr>
<td>360.0</td>
<td>SG 100-B</td>
<td>B85</td>
<td></td>
<td>Die Castings</td>
</tr>
<tr>
<td>A712.0</td>
<td>ZG 61-B</td>
<td>B26M</td>
<td></td>
<td>Sand Castings</td>
</tr>
</tbody>
</table>

* Where this material is required, castings shall be solution treated and aged to produce the following mechanical properties:

- Ultimate Tensile Strength ................................... 172 Mpa min.
- Yield Strength ........................................ 124 Mpa min. (a)
- Elongation ........................................... 6 percent min. (b)

(a) Yield strength shall be 0.2 percent offset and need not be determined unless ordered by the Deputy Chief Engineer (Technical Services).

(b) Gage length for measurement of elongation shall be four times the diameter of the specimen.

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

**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 the table and as modified herein and by the plans and specifications.

<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>
</tr>
<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-T94*</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</td>
<td>5154-0</td>
<td>B221M</td>
</tr>
<tr>
<td>EXTRUDED BARS, RODS, AND SHAPES</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>
</tbody>
</table>
§ 715-04

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>ALLOY &amp; TEMPERS</th>
<th>ASTM SPEC.</th>
</tr>
</thead>
<tbody>
<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 ASTM **</td>
</tr>
<tr>
<td></td>
<td>5154-0</td>
<td>Not ASTM **</td>
</tr>
</tbody>
</table>

* See Mechanical Properties.
** Available from American Welding Society.

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.** Iron castings shall conform to the requirements of ASTM A48, Class No. 30, unless otherwise specified.

**MATERIAL REQUIREMENTS.** Iron 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.

Castings shall be boldly filleted at angles and the arrises shall be sharp and perfect.

Castings having blow holes plugged or filled with putty or cement of any kind will be rejected.

**BASIS OF ACCEPTANCE.** Acceptance of this material shall be in accordance with procedural directives of the Department.

715-06 STEEL FORGINGS

**SCOPE.** Steel forgings shall conform to the requirements of ASTM A668, Class C, or other class approved by the D.C.E.S.

**BASIS OF ACCEPTANCE.** Acceptance of this material shall be in accordance with procedural directives of the Department.

715-07 AND 715-08 (VACANT)

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715-09 MALLEABLE IRON CASTINGS

SCOPE. Malleable Iron Castings shall conform to the requirements of ASTM A47M. The Grade shall be Grade 225010 unless Grade 22018 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 arrises 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, 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)

715-11 METAL BIN TYPE RETAINING WALL

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

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

Table DCCXV - 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, 12</td>
<td>719-01 Type IV</td>
<td>Vertical Member, Front &amp; Back</td>
</tr>
<tr>
<td>Column Cap</td>
<td></td>
<td></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</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>All connections</td>
</tr>
<tr>
<td>16 mm dia. nuts</td>
<td>6 mm</td>
<td>719-01 Type II</td>
<td>All connections</td>
</tr>
<tr>
<td>16 mm dia. nuts</td>
<td></td>
<td>719-01 Type II</td>
<td>All connections</td>
</tr>
<tr>
<td>16 mm dia. Spring nuts</td>
<td></td>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>
§715-11
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.

715-12 (Vacant)

715-13 Prefabricated Adjustment Rings and Frames for Drainage Units and Manholes

Scope. This specification covers the material requirements and fabrication of adjustment rings and frames for drainage structures and manholes.

General. The adjustment rings and frames shall consist of one of the following types unless otherwise approved by the Director, Materials Bureau.

A. Rings
   Type AR1 - Single Height Segmented Unit
   Type AR2 - Single Height - One Cut Unit
   Type AR3 - Single Height - Solid Unit

B. Frames
   Type AF1 - Single Height Segmented Unit
   Type AF2 - Single Height Solid Unit

All adjustment rings and frames shall be designed to allow full bearing of the unit on the existing frame seat. All designs shall include a clamping device capable of securing the adjustment ring or frame to the existing frame. Alternate methods of securing the rings and frames to the existing frame shall be approved by the Director, Materials Bureau. All adjustment rings and frames shall be reinforced to prevent bending during construction and routine service.

Material Requirements and Fabrication. All rings and frames shall be fabricated from steel, iron castings or a combination of both.

The steel used for fabrication of rings or frames 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.

Steel rings or frames shall be galvanized in accordance with §719-01 Galvanized Coatings and Repair Methods. When steel rings or frames 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 and frames do not require any galvanizing, but may instead be coated with a bituminous based or coal tar product approved by the Director, Materials Bureau.
A. 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.

B. 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.

**BASIS OF ACCEPTANCE.** The Department requires the submission of Materials Details as defined in §101-34.1. 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 D.C.E.S.

**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 taper in thickness, and shall conform to the dimensions 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.
TABLE 715-14
WASHER DIMENSIONS (a)

<table>
<thead>
<tr>
<th>Bolt Size</th>
<th>Circular Washers</th>
<th>Square or Rectangular Beveled Washer for American Standard Beams and Channels</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nominal Outside Diameter (b)</td>
<td>Thickness Min.</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>

(a) Dimensions in mm.  (b) May be exceeded by 5 mm  (c) 5 mm nominal.  (d) 6.5 mm nominal.

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:

1. 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.

2. 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,” 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 and aluminum bridge railings.

MATERIAL REQUIREMENTS. The stainless steel connecting products shall conform to the following ASTM designations except as modified by Table 715-16:

7-160
1. Bolts designed for 517 Mpa minimum yield strength shall conform to the requirements of ASTM A 193M, Grade B6 (AISI 410).

2. Bolts designed for 206 Mpa minimum yield strength shall be either AISI 304 or 305 stainless steel conforming to the requirements of ASTM A 193M, Grade B8, Class 1 or 2.

3. Nuts for Grade B6 bolts shall conform to the requirements of ASTM A 194M, Grade 6 (AISI 416).

4. Nuts for Grade B8 bolts shall conform to the requirements of ASTM A 194M, Grade 8 (AISI 304).

5. Flat washers shall be circular, flat, smooth and shall be fabricated from material conforming to the requirements of ASTM A 167 (AISI 302 or 304).

6. Lock washers shall be fabricated in accordance with ANSI B18.21.1 from material conforming to the requirements of ASTM A 313 (AISI 302 or 305).

7. Set screws shall conform to the requirements of ASTM A 320M, Grade B8F (AISI 303).

### TABLE 715-16
CHEMICAL AND PHYSICAL REQUIREMENTS

<table>
<thead>
<tr>
<th>Piece</th>
<th>517 Mpa MIN. YIELD</th>
<th>206 Mpa MIN. YIELD (1)</th>
<th>LOCK WASHERS</th>
<th>FLAT WASHERS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BOLTS</td>
<td>NUTS</td>
<td>BOLTS</td>
<td>BOLTS</td>
</tr>
<tr>
<td>AISI</td>
<td>410</td>
<td>416</td>
<td>304 or 305 Class 1</td>
<td>304 or 305 Class 2</td>
</tr>
<tr>
<td>Tensile Strength Mpa</td>
<td>690-1035</td>
<td>450 min.</td>
<td>795 min.</td>
<td>450 - 830</td>
</tr>
<tr>
<td>Hardness</td>
<td>Rc 22-38</td>
<td>Rc 22 max.</td>
<td>Rc 34 max.</td>
<td>Rc 30 max.</td>
</tr>
<tr>
<td>Nickel(2)%</td>
<td>10.0-13.0</td>
<td>10.0-13.0</td>
<td>10.0-13.0</td>
<td>17.0-19.0</td>
</tr>
<tr>
<td>Chromium(2) %</td>
<td>17.0-19.0</td>
<td>17.0-19.0</td>
<td>17.0-19.0</td>
<td></td>
</tr>
</tbody>
</table>

(1) B8 bolts less than 9.52 mm in diameter will be accepted based on chemical properties only.
(2) Requirements for AISI 305 only.

**Cleaning.** Following heat treatment all stainless steel hardware shall be descaled and cleaned in accordance with the requirements of ASTM A 380. 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 hardware 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.
§ 715-16

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.

SECTION 716 BEARINGS AND EXPANSION PLATES

716-01 (VACANT)

716-02 PLAIN ELASTOMERIC BRIDGE BEARINGS

SCOPE. This specification covers the material requirements for plain elastomeric bridge bearings. Bearings furnished under this specification shall adequately provide for thermal expansion and contraction, rotation, camber changes, and creep and shrinkage, where applicable, of structural members.

GENERAL. Plain elastomeric bridge bearings shall be composed entirely of elastomeric material. They shall be cast in a mold under pressure and heat. A bearing which has been obtained by bonding smaller pieces of material together will not be accepted. A bearing which has been cut from a larger piece of material will be accepted provided it conforms to all criteria outlined in this specification.

External load bearing plates, when used, shall be factory bonded by vulcanization to the elastomeric element during the primary molding process.

Plain elastomeric bridge bearings with external load plates shall be fabricated with flat and parallel upper and lower steel plates.

Shape factor of the bearings is defined as the plan area divided by the area free to bulge (total peripheral area). Effective rubber thickness (ERT) is defined as the average thickness. All compressive and shear stresses are computed on the plan area.

MATERIAL REQUIREMENTS. All materials shall be new, unused material 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 physical properties of the cured elastomeric compound shall be determined by using samples taken from actual bearings. The physical properties of neoprene and natural rubber used in these bearings shall conform to the following ASTM requirements, except as modified below:

<table>
<thead>
<tr>
<th>Elastomeric Compound</th>
<th>ASTM Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neoprene</td>
<td>D–2000, Line Call Out M 2BC514A 14B34</td>
</tr>
<tr>
<td>Natural Rubber</td>
<td>D–2000, Line Call Out M 4A A 514A 13B33</td>
</tr>
</tbody>
</table>

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 100 Kpa for tensile strength, to the nearest 10% for elongation, and to the nearest 1% for change in aged tensile and aged elongation. Hardness and aged hardness shall be rounded off to the nearest point.

External Load Bearing Plates. External load bearing plates shall conform to the requirements of ASTM A36M and the requirements of the SCM (When the SCM requires DCES approval, delete the
term “DCES” and replace it with “the Regional Director.”). Except as noted, all bearing surfaces of external load bearing 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 external load 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 $\mu m$, as defined by ANSI B46.1.

Repair, when necessary, shall conform to the requirements of the SCM (When the SCM requires DCES approval, delete the term “DCES” and replace it with “the Regional Director.”). The external load bearing plates shall be protected from rust until all exposed surfaces can be field painted with three coats of paint. Any rust inhibitor utilized must be removed from all surfaces to be welded prior to welding.

Fabrication Details. The finish of the mold used to produce these bearings shall conform to good machine shop practice. Bearings cut from a larger piece of material will be accepted only if they are furnished with a smooth straight cut.

Shape Factor. Bearings with shape factors less than 5.0 or over 12.0 shall not be accepted for Department contracts.

Dimensions. Gross bearing dimensions shall have a tolerance of $-0, + 3.0$ mm. At no time shall the bearing thickness vary such that the actual shape factor falls below 5.0 or over 12.0. Any internal details shall be dimensioned to the extremities of the bearing. At no time shall these details vary by more than $\pm 1.6$ mm in relation to the extremities of the bearing or to each other. The internal details themselves, specifically holes or slots, shall have a tolerance of $-0, + 2.0$ mm.

Characteristics

Compression Strain. Compression strain of each bearing shall not exceed 5.00% of the effective rubber thickness at the compressive load of 3.45 MPa, nor 8.00% of the effective rubber thickness at the compressive load of 5.5 MPa. The bearing and ambient temperatures shall be $23\pm 5^\circ C$ at the time of testing.

Shear Strain. The bearing shall be conditioned at $-30\pm 1^\circ C$ for 96±1 hours and subjected to a compressive stress of 3.45 MPa and a shear force such that the bearing exhibits a shear strain of 25% of the effective rubber thickness. The shearing force required to produce the 25% shear shall not exceed 345 Kpa when measured 15 minutes after the ultimate shear strain is achieved.

Adhesion. For bearings with bonded top and bottom external load plates, the adhesion of the elastomeric compound to the external steel plates shall be demonstrated by subjecting the bearing to an axial compression load of 150% of the design dead plus live load of the bearing. Upon visual examination, the bearing shall be free of any resultant defects.

NOTE: For the purpose of determining conformance with these specifications, an observed or calculated value shall be rounded to the nearest 0.01% for compressive deflection and to the nearest 1 Kpa for shear stress in accordance with ASTM recommended practice E29.

Sampling and Inspection. All bearings shall be subject to inspection and sampling at the manufacturing site and testing by the Department. The Contractor shall submit detailed shop drawings, drawn by the manufacturer only, in conformance with the requirements specified in the New York State Steel Construction Manual, for approval before any fabrication is started (When the SCM requires DCES approval, delete the term “DCES” and replace it with “the Regional Director.”). The manufacturer shall note on the shop drawings, the shape factor, effective rubber thickness, compressive area, shear area, and length to height ratio (plan dimension in direction of shear divided by the effective rubber thickness). The drawings shall indicate the total quantity of each size and type bearing required for the project. The Contractor shall also provide the Materials Bureau with written notification thirty (30) days prior to the start of bearing production. This notification shall include the contract number, quantity and size bearings.
§ 716-02

being produced, the manufacturer's name, location, and representative who will coordinate production, inspection, sampling and testing with the Materials Bureau. A copy of this notification shall be sent to the Regional Director. Bearings should be made available by the manufacturer for testing by the Department at least thirty (30) days prior to their intended installation. The Department's representative will choose three (3) full size bearings per size per contract, to be tested as follows by the Materials Bureau:

Tests Required

1. Three compression strain tests.
2. One set (two bearings) for cold temperature shear.
3. One for physical properties of the elastomeric material.

The Contractor shall assume responsibility and cost of transporting the bearings to Albany. Physical properties testing will be destructive and, therefore, the bearing will not be returned for incorporation into the project. If the bearings are over 0.4 m², the Bureau will cut model bearings, with shape factors of 5.0, from the full size bearings. Test results obtained from these model bearings will determine the acceptability of the full size bearings. The plan shape of the model bearings will be similar to that of the full size bearings. If the model bearings are required none of the sampled bearings will be returned.

Requirements

Compression. Compression strain has historically proven to be a linear relationship for bearings of this type when the shape factor exceeds 5, and the stress is below 7 MPa. Compression deflection characteristics shall therefore be determined by computing the slope of the straight line portion via two point measurement, and then plotting this line through the origin. If any obvious deviations from the expected results are noted, the entire stress-strain curve will be generated, from which a determination of acceptability will be made.

Cold Temperature Shear. Cold temperature shear testing shall be performed as follows: After conditioning the bearings at -30±1°C for 96±1 hours, the bearings shall be loaded in compression to 3450 Kpa based on the plan area of the bearing. The bearings shall then be sheared to a total strain equivalent to 25% of the effective rubber thickness. Shear stresses, based on the plan area of the bearing, shall be recorded at 0 and 15 minutes after the ultimate shear strain is reached. The shear stress, measured 15 minutes after the ultimate shear strain has been met, shall not exceed 345 Kpa. The total time lapse between removal from the -30°C environment and completion of the test shall not exceed 30 minutes. Bearings shall be insulated from any heat conducting surface of the testing apparatus by a suitable material having a thermal conductivity of not more than 0.173 W/m·K. During removal and positioning for test, the bearings shall be completely covered with a minimum of 50 mm thick insulating blanket of suitable material having a thermal conductivity of not more than 0.069 W/m·K. During the test proceeding, all exposed sides of the bearings shall be enclosed with the blanket.

BASIS OF ACCEPTANCE. Bearings will be considered for acceptance in project lot quantities, or portions thereof, at the manufacturing site in accordance with procedural directives of the Materials Bureau.

716-03 (VACANT)

716-04 STEEL LAMINATED ELASTOMERIC BRIDGE BEARINGS

SCOPE. This specification covers the material requirements for steel laminated elastomeric bridge bearings. Elastomeric bearings furnished under this specification shall adequately provide for the thermal expansion and contraction, rotation, camber changes, and creep and shrinkage, where applicable, of structural members.
GENERAL. Elastomeric bearings shall be composed of multiple laminates of elastomeric material separated by steel plates. They shall be cast as a unit in a mold under pressure and heat and the steel plates separating the elastomeric layers shall be completely bonded by vulcanization to the elastomeric material on all surfaces. Any external load bearing steel plate(s) shall be factory vulcanized to the elastomeric bearings during the primary molding process.

Each laminate within a bearing has associated with it a shape factor, equal to its total load area (actual internal plate plan area) divided by the area free to bulge (actual peripheral rubber area between two adjacent plates, measured at the plate edges). If the shape factor of all bearing laminates is less than twelve, the bearing's effective rubber thickness shall be the total bearing height minus total internal plate thickness minus the laminate thickness of the layers with shape factors of twelve or greater. Bearing length to height ratios, as referred to in this specification, shall be defined as the plan dimension in the direction of shear divided by the effective rubber thickness. For circular bearings, length to height shall be defined as the plan diameter divided by twice the effective rubber thickness. All compressive stresses shall be computed on the net plan area of the internal plates. Shear stresses are computed on the net plan area of the rubber.

Steel laminated elastomeric bearings with external load bearing plates, shall be fabricated and supplied with flat and parallel upper and lower steel bearing plates.

MATERIAL REQUIREMENTS. All materials shall be new, unused material 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 physical properties of the cured elastomeric compound shall be determined by using samples taken from actual bearings. The physical properties of neoprene and natural rubber used in these bearings shall conform to the following ASTM requirements, except as modified below:

<table>
<thead>
<tr>
<th>Elastomeric Compound</th>
<th>ASTM Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neoprene</td>
<td>D-2000, Line Call Out M 2BC514A 14B34</td>
</tr>
<tr>
<td>Natural Rubber</td>
<td>D-2000, Line Call Out M 4A A 514A 13B33</td>
</tr>
</tbody>
</table>

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 for 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 100 Kpa for tensile strength, to the nearest 10% for elongation, and to the nearest 1% for change in aged tensile and aged elongation. Hardness and aged hardness shall be rounded off to the nearest point.

Steel Sheets and External Load Bearing Plates

1. Internal Steel Plates. The internal steel plates shall be rolled mild steel conforming to the following ASTM, AASHTO or AISI Designations:
   A. 4.8 mm thickness or over — AASHTO M 183 or ASTM A 283M Grade D
   B. Under 4.8 mm thickness - ASTM A 366M, ASTM A 569M, ASTM A 570M, Grade 33, 36, or 40, ASTM A 611 Grade C or D, or AISI 1015-1025 inclusive.

2. External Load Bearing Plates. External load bearing plates shall conform to the requirements of ASTM A 36M and the requirements of the SCM (When the SCM requires DCES approval, delete the term “DCES” and replace it with “the Regional Director.”). Except as noted, all bearing
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Surfaces of external load bearing 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. Oxygen cut surfaces shall not exceed a surface roughness value of 25 \( \mu \text{m} \), as defined by ANSI B46.1. When necessary, shall conform to the requirements of the SCM (With the SCM requires DCES approval, delete the term “DCES” and replace it with “the Regional Director.”). The bottom surface of lower external load plates (masonry plates) designed to rest on bearing pads shall not exceed an out-of-flatness value of 1.6 mm.

The external load bearing plates shall be protected from rust until all exposed surfaces can be field painted with three coats of paint. Any rust inhibitor utilized must be removed from all surfaces to be welded prior to welding.

FABRICATION DETAILS. The finish of the mold used to produce these bearings shall conform to good machine shop practice. Every bearing shall have the project identification number and individual bearing number applied in indelible ink to a side visible after erection. The following details shall also apply:

Elastomeric Laminae. The thickness of elastomeric laminae shall not vary more than ±20% of design thickness. At no time shall the shape factor be less than 5.0 or over 12.

Internal Steel Plates. The internal steel plates shall be checked for non-parallelism by measuring the distance from the base of the bearing to the bottom of each plate at four points around the bearing. These measurements shall be taken at intervals of 90°. The difference between the largest and the smallest of the four measurements shall be recorded for each plate. The cumulative total of these differences shall not exceed 25% of the design effective rubber thickness.

Edge Seal. There shall be a minimum of 3.0 mm edge seal, integral with the bearing, over all internal plates. No rubber cover will be required over internal details which will not be exposed to moisture after erection, specifically vertical holes covered by bearing seats or flanges.

Elastomeric Bedding Surface. There shall be a constant minimum thickness of 6 mm elastomeric bedding surface on both the top and bottom of the bearing. When an external load plate is required, there shall be an effective rubber laminate between the load plate and the internal steel sheet.

Continuous Sealing Ribs. Continuous sealing ribs on both the top and bottom of the bearing will not be required. When used, the ribs shall be 5.0 mm wide and 3.0 mm deep with a tolerance on each dimension of -0, +1.0 mm. A sealing rib shall not be present on a surface where a bonded load plate is required.

Bearing Dimensions. Gross bearing dimensions shall have a tolerance of -0, +3.0 mm. All internal plan details shall be dimensioned to the extremities of the internal plates. At no time shall the internal plan details vary by more than 1.6 mm in relation to the extremities of the internal plates or each other. The internal details themselves, specifically holes or slots, shall have a tolerance of -0, +2.0 mm.

CHARACTERISTICS

Compression Strain. Compression strain of each bearing shall not exceed 5.00% of the effective rubber thickness at a compressive load of 3.45 M Pa nor 8.00% of the effective rubber thickness at the compressive load of 5.50 M Pa. When bearings are designed for loading stresses higher than 5.50 M Pa the compression strain shall not exceed 8.00% of the effective rubber thickness at the higher stress. The bearing and ambient temperature shall be 23 ±5°C at the time of testing.

NOTE: Low length to height ratios, e.g., 3.0 or less, historically have had a substantial effect upon compression strain results.

Shear Strain. The bearing shall be conditioned at -30 ±1°C for 96 ± 1 hours, then be subjected to a compressive stress of 3.45 M Pa and a shear force such that the bearing exhibits a shear strain of 25% of 7-166
the effective rubber thickness. The shearing force required to produce the 25% shear shall not exceed 345 Kpa when measured 15 minutes after the ultimate shear strain is achieved.

**NOTE:** For the purpose of determining conformance with these specifications, an observed or calculated value shall be rounded to the nearest 0.01% for compressive deflection and to the nearest 1 Kpa for shear stress in accordance with A STM recommended practice E29.

**Adhesion.** For bearings without top and bottom steel load plates, the adhesion of the elastomeric compound to the internal and external steel plates shall not be less than 175 N per 25 mm width when peeled at an angle of 90° to the steel plate. For the purpose of determining conformance to this requirement, adhesion results shall be rounded to the nearest N per 25 mm in accordance with A STM recommended practice E29.

For bearings with top and bottom steel load plates, the adhesion of the elastomeric compound to the internal and external steel plates shall be demonstrated by subjecting the bearing to an axial compression load of 150% of the design dead plus live load of the bearing. Upon visual examination, the bearing shall be free of any resultant defects.

**Physical Properties of Elastomeric Material.** Samples of elastomeric material for physical property tests will be removed from a surface of the bearing. For bearings with top and bottom bonded load plates, the sample will be removed from the side of a bearing. If a sufficient sample cannot be obtained in this manner, one bearing per lot will be destroyed for physical property testing.

**Sampling and Inspection.** The Contractor shall submit detailed shop drawings, drawn by the manufacturer only, in conformance with the requirements specified in the New York State Steel Construction Manual, for approval before any fabrication is started (When the SCM requires DCES approval, delete the term “DCES” and replace it with “the Regional Director.”). The manufacturer shall note on the shop drawings the shape factor, effective rubber thickness, typical lamina thickness, compressive area, shear area, and length to height ratio, which are to be computed as defined in this specification. The drawings shall indicate the total quantity of each size and type bearing required for the project. The Contractor shall also provide the Materials Bureau with written notification thirty (30) days prior to the start of bearing production. This notification shall include the contract number, quantity and size bearings being produced, the manufacturer’s name, location, and representative who will coordinate production, inspection, sampling, and testing with the Materials Bureau. A copy of this notification shall be sent to the Regional Director. The Department’s representative will choose, at random, the required number of bearings at the manufacturing site to fulfill the requirements of the sampling schedule.

Bearings, with exterior bonded load plates with attached dowel pins, which are selected for testing, shall be delivered to the test site accompanied by a single unattached load plate. This plate shall be aluminum or steel with a compressive surface the same shape as the bearing itself and shall have an area equal to or slightly greater than that of the bearing: its thickness shall be greater than the height of protrusion of the dowel beyond the surface of the steel plus 15% of the effective rubber thickness with a hole (holes) in the plate to match the dowel pin (pins). This plate will be available for return to the manufacturer upon completion of testing at the manufacturer’s expense.

Bearings should be made available by the manufacturer for testing by the Department at least thirty (30) days prior to their intended installation.

**Performance Characteristics for Bearings Less than 0.4 m².** Bearings with a plan area equal to or less than 0.4 m² shall be tested for performance characteristics by the Materials Bureau, Albany, New York. The Contractor shall assume the responsibility and cost of transporting the required bearings from the place of manufacture to Albany and then to the job site.

The sampling rate shall be one per every five in each size category per project per production run, a minimum of three bearings. For bearings with bonded top and bottom load plates, one bearing per lot may be destroyed during testing, to determine the physical properties of the elastomeric material (Note
§ 716-04

1. No separate payment will be made for bearings destroyed during testing. All bearings shall be returned to the Contractor, except that bearings with bonded top and bottom steel load plates selected for destructive testing will only be returned at the Contractor's request.

The testing of the samples shall be as follows:

<table>
<thead>
<tr>
<th>Test</th>
<th>Samples Tested</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression Strain</td>
<td>All</td>
</tr>
<tr>
<td>Cold Temperature Shear</td>
<td>One set of samples every 50 bearings required for the project in each size category per production run, a minimum of one set (one set equals 2 bearings).</td>
</tr>
<tr>
<td>Physical Properties of Elastomeric Material,</td>
<td>a. One per project per size per production run. For lots of less than 10 bearings, the Department may, at its discretion, consider combining lots for evaluation of elastomeric material.</td>
</tr>
<tr>
<td>a. For bearings with bonded top and bottom steel load plates</td>
<td>b. One per project per size per production run.</td>
</tr>
<tr>
<td>b. All others</td>
<td>Three per project per production run.</td>
</tr>
<tr>
<td>Adhesion</td>
<td></td>
</tr>
</tbody>
</table>

NOTE 1. For bearings with bonded top and bottom load plates, samples of elastomeric material will be removed from the side(s) of the bearing, if possible. A sample size equivalent to twelve (12) 25.0 x 150.0 x 3.0 mm thick pieces of elastomer will be necessary for tests. If the configuration of the bearing is such that a sufficient sample cannot be obtained, one bearing per lot will be destroyed.

Performance Characteristics of Bearings Greater than 0.4 m². Bearings with a plan area greater than 0.4 m² shall be tested for performance characteristics by an outside laboratory approved by the Materials Bureau. The Department shall assume the cost of testing. Transportation scheduling and costs shall be the responsibility of the Contractor.

The sampling rate shall be one per every five in each size category per project per production run, a minimum of three bearings. For bearings with bonded top and bottom load plates, one bearing per lot may be destroyed during testing to determine the physical properties of the elastomeric material (Note 2). No separate payment will be made for bearings destroyed during testing. All bearings shall be returned to the Contractor, except that bearings with bonded top and bottom steel load plates selected for destructive testing will only be returned at the Contractor's request.

<table>
<thead>
<tr>
<th>Test</th>
<th>Samples Tested</th>
</tr>
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<tbody>
<tr>
<td>Compression Strain</td>
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<tr>
<td>Cold Temperature Shear</td>
<td>Two sets of samples every 50 bearings required for the project in each size category per production run, a minimum of two sets (one set equals 2 bearings).</td>
</tr>
<tr>
<td>Physical Properties of Elastomeric Material,</td>
<td>a. One per project per size per production run. For lots of less than 10 bearings, the Department may, at its discretion, consider combining lots for evaluation of elastomeric material. (Note 2)</td>
</tr>
<tr>
<td>a. For bearings with bonded top and bottom steel load plates</td>
<td>b. One per project per size per production run. (Note 3)</td>
</tr>
<tr>
<td>b. All others</td>
<td>Three per project per production run.</td>
</tr>
<tr>
<td>Adhesion</td>
<td></td>
</tr>
</tbody>
</table>
NOTE 2. At the time of inspection, the Department representative will, if possible, remove a sample of elastomeric material from the side of a bearing (not from a bearing which requires the compression strain or cold temperature shear test) and forward it to the Materials Bureau for testing. A sample size equivalent to twelve (12) 25.0 x 150.0 x 3.0 mm pieces of elastomer will be necessary for tests. If the configuration of a bearing with top and bottom load plates is such that a sufficient sample cannot be obtained, one bearing per lot will be destroyed. Bearings with areas removed for elastomer samples shall be repaired by a method approved by the Materials Bureau.

NOTE 3. At the time of inspection, the Department Representative shall remove from a designated surface(s) (not from a bearing which requires the compression strain or cold temperature shear test) a sample of elastomeric material equivalent to twelve (12) 25.0 x 150.0 x 3.0 mm pieces of elastomer and forward it to the Materials Bureau for testing. Bearings with areas removed for elastomer samples shall be repaired by a method approved by the Materials Bureau.

BASIS OF ACCEPTANCE. Bearings will be considered for acceptance in project lot quantities, or portions thereof, at the manufacturing site in accordance with procedural directives of the Materials Bureau.

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:

| Concave Surface | Positive tolerance = 0.25 mm |
|                | Negative tolerance = Zero |
| Convex Surface  | Positive tolerance = Zero  |
|                | Negative tolerance = 0.25 mm |
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The curved surface shall be machined to a tolerance of 15 Fm 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.

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 & 716-06.01 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.

1. Fixed Bearings. Fixed bearings shall allow rotation but no longitudinal or transverse movement in the bearing plane.

2. 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.

3. 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.

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 following requirements:
### Physical Property Requirements

<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>Min. 57 Max. 67</td>
</tr>
</tbody>
</table>
| Tensile Stress, Mpa (1)                       | D412             | At 100% elongation 14 Min. --- Max. 5  
|                                               |                  | At 300% elongation 26 Min. --- Max. 5  
| Tensile Strength, Mpa (1)                     | D412             | Min. 34.5          |
| Ultimate Elongation, % (1)                    | D412             | Min. 220 Max. ---  |
| Compression Set (1)                            | D395             | 22 Hrs. at 70EC Min. --- Max. 40 |

**NOTE (1):** A 10% deviation from specified values is permissible.

### 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 A–167, or ASTM A–240, 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 –215EC to +260EC, non-flammable, non-absorbing of water, and shall conform to the following physical requirements:

<table>
<thead>
<tr>
<th>Physical Property</th>
<th>ASTM Test Method</th>
<th>Unfilled</th>
<th>15% Glass</th>
<th>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 Details

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. Alternatively, 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.
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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 \( \mu \)m, 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.").

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 90E apart on the perimeter of the bearing.

The test results will be evaluated as follows:

1. 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.
2. Non-uniform compression deflections at a desired stress level shall be cause for rejection.
3. 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:

1. The measured sliding coefficients of friction shall not exceed 75% of the maximum design coefficient of friction.

2. 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:

1. The bearing will be visually examined both during and after the test. Any resultant visual defects shall be cause for rejection.

2. 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.

1. 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.

2. The thickness and plan area of the polyether urethane structural elements required.

3. The maximum design coefficient of friction as noted on the Contract Plans.

4. The type of PTFE sheet (filled or unfilled) and, if applicable, the type and amount (by weight) of filler.

5. The type(s) of steel(s) to be used.

6. 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.

7. The location of the fabrication plant.

8. 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.
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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:

1. A lot shall not exceed a single contract or project quantity.
2. A lot shall not exceed 25 bearings.
3. 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.
4. 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 1 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 lot (Note 1)</td>
</tr>
<tr>
<td>Coefficient of Friction</td>
<td>Manufacturer</td>
<td>One production bearing per lot (Note 1)</td>
</tr>
<tr>
<td>Compression Strain</td>
<td>Materials Bureau</td>
<td>a) For bearings with load capacities less than 2650 Kn; three production bearings per lot</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b) For bearings with load capacities greater than 2650 Kn; three production bearings per lot, tested by an outside laboratory approved by the Materials Bureau (Note 2).</td>
</tr>
<tr>
<td>Physical Properties Polyether Urethane Rotational Element (except compression set)</td>
<td>Materials Bureau</td>
<td>One 250 x 375 mm sheet of polyether urethane material (thickness of 1.5 to 3.0 mm) per lot. (Note 3)</td>
</tr>
<tr>
<td>Compression Set of Polyether Urethane Rotation Element</td>
<td>Materials Bureau</td>
<td>One 100 x 100 mm sheet of polyether urethane material, molded or cut to the thickness requirements of ASTM D395, Method B. (Note 4)</td>
</tr>
<tr>
<td>Physical Properties of PTFE Sheet</td>
<td>Materials Bureau</td>
<td>One 250 x 375 mm sheet of polyether urethane material per lot. (Note 5)</td>
</tr>
</tbody>
</table>

**NOTE 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.

**NOTE 2:** The Department shall assume the cost of this testing. The Contractor shall be responsible for transportation scheduling and costs. All bearings shall be made available for return to the Contractor.

**NOTE 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.
NOTE 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.

NOTE 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.

**Sampling and Testing Requirements.** The manufacturer shall furnish the required number of samples to perform testing in accordance with Table 1.

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.

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 form a single body, rectangular in shape and uniform in thickness.

The manufacturer shall select, at random, the required sample bearing(s) from the 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, 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.

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 & 716-07.01 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.

1. **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.

2. **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...
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or keyway systems and their mating steel surfaces shall be faced with strips of either PTFE or PTFE-stainless steel.

3. 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 the following ASTM or AASHTO requirements, with modifications as noted.

<table>
<thead>
<tr>
<th>Elastomeric Compound</th>
<th>ASTM Requirement</th>
<th>AASHTO Standard Specifications for Bridge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Rubber</td>
<td>D2000, Line Call Out M4A517A13B33</td>
<td>Section 2.25.2, Materials, 50 Durometer Hardness.</td>
</tr>
</tbody>
</table>

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 A-167, or ASTM A-240, 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.

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**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 \(-215^\circ\text{C}\) to \(+260^\circ\text{C}\), non-flammable, non-absorbing of water, and shall conform to the following physical requirements:

<table>
<thead>
<tr>
<th>Physical Property</th>
<th>ASTM Test Method</th>
<th>Unfilled</th>
<th>15% Glass</th>
<th>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 DETAILS.** The finish of the mold used to produce the elastomeric rotational elements shall conform to good machine shop practices. 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 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 0.25 mm. 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 \(\mu\text{m}\), 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:

1. The measured sliding coefficients of friction shall not exceed 75% of the maximum design coefficient of friction.

2. 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:

1. The bearing will be visually examined both during and after the test. Any resultant defects shall be cause for rejection.

2. 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” 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 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.

1. 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.

2. The thickness and plan area of the elastomeric rotational elements and the internal diameters of the steel base pots required.

3. The maximum design coefficient of friction as noted on the Contract Plans.

4. The type of PTFE sheet (filled or unfilled) and, if applicable, the type and amount (by weight) of filler.

5. The type(s) of steel(s) to be used.

6. 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.”).

7. The location of the fabrication plant.
8. 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**

**TABLE 1 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 lot (Note 1).</td>
</tr>
<tr>
<td>Coefficient of Friction</td>
<td>Manufacturer</td>
<td>One production bearing per lot (Note 1).</td>
</tr>
<tr>
<td>Physical Properties of</td>
<td>Materials Bureau</td>
<td>One production bearing per lot (Note 1).</td>
</tr>
<tr>
<td>Elastomeric Rotational Element</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical Properties of</td>
<td>Materials Bureau</td>
<td>One Elastomeric element per lot (Note 2).</td>
</tr>
<tr>
<td>PTFE sheet</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE 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.

**NOTE 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.

**NOTE 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.

**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:

1. A lot shall not exceed a single contract or project quantity.
2. A lot shall not exceed 25 bearings.
3. 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 of samples to perform testing in accordance with Table 1.

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.
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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.

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 ELASTOMERIC SLIDING BRIDGE BEARINGS

SCOPE. This specification covers the material requirements for elastomeric sliding bridge bearings. Elastomeric sliding bearings furnished under this specification shall adequately provide for the thermal expansion and contraction, rotation, camber changes, and creep and shrinkage, where applicable, of structural members.

GENERAL. Elastomeric sliding bearings shall consist of a plain or steel laminated elastomeric element bonded to a lower steel bearing plate. To allow movement, the upper surface of the element shall be faced with a steel backed, polytetrafluoroethylene (PTFE) sheet and support a sliding steel top bearing plate. The mating surface of the top steel bearing plate shall be faced with polished stainless steel.

Elastomeric sliding bridge bearings shall be supplied as guided expansion bearings or non-guided expansion bearings, as designated by the Contract Documents.

1. Guided Expansion Bearings. Guided expansion bearings shall allow rotation and longitudinal movement in the bearing plane; transverse movement shall be restricted. To restrict transverse movement, a guide bar or keyway system shall be used. If required, the guide bar or keyway system shall be faced with strips of PTFE.


MATERIAL REQUIREMENTS
All material shall be new and unused, with no reclaimed material incorporated in the finished bearing.

1. Elastomeric Element. The elastomeric element used in the construction of these bearings shall conform to the requirements of §716-02, Plain Elastomeric Bridge Bearings or §716-04, Steel Laminated Elastomeric Bridge Bearings.

2. Steel Backing Plate and External Load Bearing Plates. Steel backing plate for PTFE sheet, and external load bearing plates shall conform to the requirements of ASTM A36M; A167, Type 304; A240, Type 304; or A588M and the applicable provisions of the SCM, unless otherwise provided for in the contract plans (When the SCM requires DCES approval, delete the term “DCES” and replace it with “the Regional Director.”).

External load bearing plates fabricated from ASTM A36M steel shall be protected from rust until all exposed surfaces can be field painted. Any rust inhibitor used shall be removed from all surfaces to be welded, prior to welding.

Steel backing plate that is fabricated from ASTM A36M steel, and both backing plates and external load bearing plates that are fabricated from ASTM A167, A240 and A588M steels shall not be painted or coated with rust inhibitors.

3. Stainless Steel. Stainless steel shall conform to the requirements if ASTM A167, or A240, Type 304. Stainless steel in contact with PTFE sheet shall be polished to a No. 8, bright mirror finish. The minimum thickness the stainless steel shall be 1.25 mm.
4. Polytetrafluoroethylene (PTFE) Sheet. Polytetrafluoroethylene (PTFE) sheet 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 filler, percent by weight).

PTFE sheet shall be bonded to or recessed into its steel backing plate. 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 mating sliding 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 following minimum physical requirements:

<table>
<thead>
<tr>
<th>Physical Property</th>
<th>ASTM Test Method</th>
<th>Unfilled</th>
<th>15% Glass</th>
<th>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 DETAILS. The finish of the mold used to produce the bearing elements shall conform to good machine shop practices. 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 elastomeric element shall be fabricated in accordance with the requirements of §716-02 and §716-04. External lower steel bearing plates and steel backing plates for PTFE sheet shall be factory bonded, by vulcanization, to the elastomeric element during the primary molding process.

The PTFE sheet shall be bonded to its grit blasted steel backing plate 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 backing plate for one-half its thickness. The bearing manufacturer shall have the option of bonding recessed PTFE sheet.

Stainless steel sheet used for sliding surfaces on upper steel bearing plates fabricated from ASTM A36M or A588M steel shall be attached by a full perimeter, continuous weld.

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 external load plates (masonry plate) 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 Fm, as defined by ANSI B46.1. Repair, when necessary, shall conform to the requirements of the SCM (When the SCM requires DCES approval, delete the term “DCES” and replace it with “the Regional Director.”).

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 SCM (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

1. Compressive Strain. The compressive strain of an assembled bearing shall not exceed 5.0% of the effective rubber thickness of the elastomeric element at a compressive load of 3.45 Mpa or 8.0% of the effective rubber thickness at a compressive load of 5.50 Mpa. When bearings are designed for loading stresses higher than 5.50 Mpa, the compression strain shall not exceed 8.0% of the effective rubber thickness at the higher stress. The bearing and ambient temperature shall be 23°C ± 5°C at the time of testing.
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2. **Compressive Load.** Assembled bearings shall be tested in compression by applying a load corresponding to 150% of the design dead load plus live load capacity.

   The compressive load shall be maintained for five minutes and the test results evaluated as follows:

   a. The bearing shall be visually examined both during and after the test. Any visual defects shall be cause for rejection.

   b. Non-uniform compression deflection at 150% compressive load will be cause for rejection. Deflection will be measured by dial indicators, at 4 locations 90° apart, on the perimeter of the bearing.

3. **Sliding Coefficient of Friction.** For all guided and non-guided sliding bridge 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 testing will be evaluated as follows:

   a. The measured sliding coefficients of friction shall not exceed 75% of the maximum design coefficient of friction.

   b. 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.

**DRAWINGS.** The Contractor shall submit detailed shop drawings, drawn by the Manufacturer only, in conformance with the applicable requirements of the SCM, for approval by the Regional Director prior to the start of fabrication (When the SCM requires DCES approval, delete the term “DCES” and replace it with "the Regional Director."). In addition, the manufacturer shall note the following on the shop drawings.

   1. The total quantity of each kind of elastomeric sliding bearing required, i.e. guided or non-guided, grouped according to size and design capabilities.

   2. The shape factor, effective rubber thickness, typical laminate thickness, compressive area, and length to height ratio of the elastomeric element. Computations shall be as defined in §716-04.

   3. The maximum design coefficient of friction as noted on the Contract Plans.

   4. The type of PTFE sheet (filled or unfilled) and, if applicable, the type and amount (by weight) of filler.

   5. The type(s) of steel(s) to be used.

   6. If applicable, any welding process used in the bearing manufacture that does not conform to the approved processes of the SCM shall be clearly described and detailed.

   7. The location of the fabrication plant.

   8. The Manufacturer's name and the name of its 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 within 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 tests as required. A minimum of thirty (30) days shall be allowed for the Department's inspection, sampling and testing of 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.

Bears 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. The plate shall be made of the same material and be the same size and thickness as the tapered sole plate. Additionally, the single beveled plate shall be so constructed that when placed in contact with the tapered sole plate the two shall form a single body, rectangular in shape and uniform in thickness.

The Department's representative shall select, at random, the required sample bearing(s) from completed lots of bearings, and samples of the elastomer and PTFE materials for testing by the Materials Bureau. All samples shall be taken in accordance with the Department's written instructions.

**1. Performance Characteristics for Bearings Less Than 0.4 m².** Bearings with a plan area of less than 0.4 m² shall be tested for performance characteristics by the Materials Bureau, Albany, New York. The Contractor shall assume the responsibility and cost of transporting the required bearings from the place of manufacture to Albany and return.

The sampling rate shall be one per every five in each size category, per project per production run, a minimum of three bearings. All bearings shall be returned to the Contractor.

The testing of the samples shall be as follows:

<table>
<thead>
<tr>
<th>TEST</th>
<th>SAMPLES TESTED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressive Strain</td>
<td>All</td>
</tr>
<tr>
<td>Compressive Load</td>
<td>All (Note 1)</td>
</tr>
<tr>
<td>Sliding Coefficient of Friction</td>
<td>One set of samples per project per size, per production run. (1 set equals 2 bearings)</td>
</tr>
<tr>
<td>Physical Properties of Elastomeric Element</td>
<td>One 250 x 375 mm (10 mm min. thickness) sheet of elastomeric material per project, per production run. (Note 2)</td>
</tr>
<tr>
<td>Physical Properties of PTFE Sheet</td>
<td>One 250 x 375 mm sheet of PTFE material per project, per production run. (Note 2)</td>
</tr>
</tbody>
</table>

**2. Performance Characteristics for Bearings Greater Than 0.4 m².** 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. Transportation and scheduling costs shall be the responsibility of the Contractor.

The sampling rate shall be one per every five in each size category, per project per production run, a minimum of two bearings. All bearings shall be returned to the Contractor.

The testing of the samples shall be as follows:
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TEST
Compressive Strains
Compressive Load
Sliding Coefficient of Friction
Physical Properties of Elastomeric Elements
Physical Properties of PTFE Sheet

SAMPLES TESTED
All
All
One set of samples per project, per size, per production run. (1 set equals 2 bearings)
One 250 x 375 mm (10 mm thickness) sheet of elastomeric material per project, per production run. (Note 2)
One 250 x 375 mm sheet of PTFE material per project per production run. (Note 3)

NOTE 1: Production bearings of such size that cannot be tested by the Materials Bureau at 150% design capacity for compressive load shall be tested at their actual design capacity.

NOTE 2: Single sheets of elastomeric and PTFE material from which the bearing has been fabricated shall be submitted to the Materials Bureau for test. All submitted samples shall be certified by the Manufacturer as having been taken from the same batch of material as was used in the actual production bearings.

NOTE 3: The Materials Bureau will perform this testing. At the time of inspection, single sheets of elastomeric and PTFE sheets from which the bearing has been fabricated shall be submitted by the Department’s representative. All submitted sample sheets 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 shall 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.

SECTION 717 - CONCRETE PROTECTIVE COATINGS

717-01 EPOXY RESIN PROTECTIVE COATING

SCOPE. This specification covers the material requirements of a two component, pigmented epoxy resin protective coating system used for the environmental protection of Portland cement concrete and other materials. This material should not be applied at temperatures above 35EC or below 5EC.

GENERAL. The epoxy resin protective coating system shall be a two component, flexibilized, solvent-free, thermosetting system consisting of a modified epoxy resin, Component A, and a curing agent, Component B.

MATERIAL REQUIREMENTS

Characteristics of Component A. Component A shall be based on a high grade epoxy resin such as obtained from the condensation of Bisphenol A and Epichlorohydrin having the following characteristics:

<table>
<thead>
<tr>
<th>Property</th>
<th>Specific Value</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity, PaG @ 23± 2EC</td>
<td>Min. 9 Max. 12</td>
<td>Brookfield Model RV No. 5/20 RPM</td>
</tr>
<tr>
<td>Density @ 23± 2EC, kg/L</td>
<td>1.45 ---</td>
<td>ASTM D1475</td>
</tr>
<tr>
<td>Percent filler and pigment</td>
<td>--- Max. 40.0</td>
<td>By Ignition</td>
</tr>
</tbody>
</table>

Pigment filler shall be light-fast, durable and resistant to alkali.
Characteristics of Component B. Component B shall have the following characteristics:

<table>
<thead>
<tr>
<th>Property</th>
<th>Specific Value</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity, PaGs @ 23±2°C</td>
<td>0.05 ---</td>
<td>Brookfield Model RV No. 1/20 RPM</td>
</tr>
<tr>
<td>Density @ 23±2°C, kg/L</td>
<td>0.83 ---</td>
<td>ASTM D1475</td>
</tr>
</tbody>
</table>

Characteristics of the Mixture

The mixture of Components A & B shall have the following characteristics:

<table>
<thead>
<tr>
<th>Property</th>
<th>Specific Value</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity, PaGs @ 23±2°C</td>
<td>--- 10</td>
<td>Brookfield Model RV No. 5/20 RPM</td>
</tr>
<tr>
<td>Pot Life, minutes @ 23±2°C</td>
<td>30 ---</td>
<td>(described under Test)</td>
</tr>
<tr>
<td>Initial Cure, hrs. @ 23±2°C</td>
<td>70/1 ---</td>
<td>Tack–free to Touch</td>
</tr>
<tr>
<td>Shore D Hardness, @ 23±2°C after 7 days</td>
<td>16314 16492</td>
<td>ASTM D2240</td>
</tr>
<tr>
<td>Color—Gray</td>
<td>16314 16492</td>
<td>Federal Std. No. 595</td>
</tr>
<tr>
<td>Color Fastness</td>
<td>no appreciable change</td>
<td>Atlas Ci 35A Weatherometer</td>
</tr>
<tr>
<td>Shelf Life in Months</td>
<td>12 ---</td>
<td>---</td>
</tr>
</tbody>
</table>

Packaging. All materials 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:

2. Name of product.
3. Mixing proportions and instructions.
4. Name and address of the manufacturer.
5. Lot number and batch number.
6. Date of manufacture.
7. Quantity.
8. 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.

Test

Viscosity. The viscosity of the mixture of components A & B shall be taken 20 minutes after the components are mixed and within 15-20 seconds of the time the viscometer is started. This material shall then be used to fill the lid of a 355 mL ointment can approximately two-thirds full. This specimen shall be used to determine the tack-free time for initial cure requirement.

Initial Cure. The initial cure shall be considered that time at which a mixture of components A & B as prepared under viscosity above shall be tack-free to touch.

Pot Life. The pot life is determined as follows: Samples of each resinous cement component are conditioned at 23±2°C. When the samples have reached 23±2°C, 60± 0.4 g total of components A and
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B in the proportions recommended by the manufacturer are weighed into an unwaxed paper cup. The time is recorded and they are immediately mixed, stirring for three minutes with a wooden tongue depressor, taking care to periodically scrape the walls and bottom of the cup and the mixer. The sample is then poured into an unwaxed paper cup, set on a bench top, and probed every two minutes with a small stick, starting twenty minutes from the time of mixing. The time at which a soft ball forms in the center of the container is recorded as the pot life. This specimen shall be retained and used for the determination of the Shore D hardness.

Shore D Hardness. The hardness test shall be performed on the specimen retained from Pot Life above.

Color Fastness. The test for color fastness of the cured epoxy shall be conducted as follows: Cast two, 90 mm diameter, buttons following the manufacturer’s instructions for mixing the epoxy components. Allow each button to cure for 72±2 hours at laboratory temperature in a dark chamber away from sources of ultraviolet light. Designate one button as the color control button and retain it in the dark chamber. Subject the other button to 16 hours total exposure time (20 minute cycle) in the Atlas Ci 35A Weatherometer. Each cycle, continuously repeating, starts with 17 minutes of light followed by 3 minutes of light and water spray. Remove the test button and compare the color of the exposed area to Federal Standard 595, colors 16314 through 16492, and to the color of the control button. The color of the test button shall not differ appreciably from the color of the control button and shall fall within the color range 16314 through 16492, inclusive, defined by Federal Standard 595.

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 twelve months 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 jobsite will be cause for rejection of the material.

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:

1. 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.
2. Coarse aggregate gradation shall be No. 1 Size or ASTM D448, No. 67.
3. Concrete requirements for Classes A and C concrete shall not apply.
4. Air content shall be 7 percent ± 2 percent.
5. The use of calcium chloride, or an admixture containing calcium chloride will not be permitted.

Steel

1. Bar reinforcement shall meet the requirements of §709-01 or §709-03.
2. Wire fabric shall meet the requirements of §709-02.
3. Chairs or other devices necessary to ensure the proper placement of steel items shall meet the requirements §556-2.02.
4. Prestressing steel shall meet the requirements of §709-06.
5. Bearing plates, if required, shall meet the applicable requirements of §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**

**Types**

1. **Contract Drawings.** Drawings which accompany the contract proposal are designated as contract drawings. These drawings are not intended to be working drawings.

2. **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 D.C.E.S. 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 D.C.E.S., 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:

1. Plan layout of superstructure indicating the piece mark assigned to each prestressed unit.
2. Fabricating plant production schedule.
3. 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 D.C.E.S.
4. Proposed admixture to be added to the concrete mix.
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5. Quality control tests and procedures.

6. Method and outline of unit and cylinder curing procedure, as required by “Curing”, of this Subsection.

7. The name of the manufacturer of the prestressing steel, including any alternate source.

8. Material and manner of sealing the exposed portions of the prestressing steel.

9. Transfer of prestress procedure for all unit types to be fabricated.

10. 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.

11. Proposed method of handling and transporting prestressed concrete units to the project site.

12. Working drawings shall clearly indicate any proposed deviations from the prestressed concrete unit shown on the contract drawings.

13. 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 D.C.E.S., 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 D.C.E.S. 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 D.C.E.S., 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 D.C.E.S., the original drawings shall be forwarded to the D.C.E.S. for written approval, after which a set of approved drawings will be returned. The original drawings shall remain the property of the State.

The D.C.E.S. 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 D.C.E.S. 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 D.C.E.S. 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.

A 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 Requirements

1. 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.

2. Data Required with Working Drawings. Data required by the D.C.E.S. prior to approval of the working drawings shall be as follows:
   A. Calculations of strand elongation for each unique casting length (grip-to-grip).
   B. 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.
C. 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.

3. 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. A certificate from the prestressing steel manufacturer stating that the prestressing steel has
been manufactured in accordance with §709-06.
B. 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:
   1. The breaking strength.
   2. The elongation at rupture.
   3. The load at one percent elongation.
   4. 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. 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:
1. Commencement of work.
2. Commencement of work after a work suspension of 48 hours or more.
3. Unit shipping.
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

1. 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.

2. 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.
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Welded wire fabric, smooth or deformed, may be substituted for the required bar reinforcement provided that:

1. The required cover is maintained.
2. The design steel area of the fabric equals that of the bar reinforcement.
3. 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 D.C.E.S. 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 D.C.E.S. to incorporate a High Range Water Reducing (HRWR) admixture into the concrete mix. The D.C.E.S. will grant such permission only if deemed to be in the best interests of the State and then only under such conditions as the D.C.E.S. 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:

1. Slump.
2. Air content.
3. Temperature.
4. 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

1. General. 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 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. Acceptable methods are:

A. Accelerated Cures:
   1. Low Pressure Steam.
   2. Radiant Heat and Moisture.

B. Non-Accelerated Cure:
   1. Saturated Cover.

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.

2. Method. The full curing cycle shall consist of an Initial Curing Phase and Final Curing Phase described as follows:

A. Accelerated Cures.

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.

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
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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.

3. 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

1. Test Cylinders.

A. 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.

B. 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 D.C.E.S. 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.

2. 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:

A. 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.
B. 28 Day Strength.

(1) 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.

(2) 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:

1. Strength Requirement. Any unit represented by cylinders not meeting the required strengths, as specified in Concrete Strength Requirements, of this subsection.

2. Exposed Prestressing Steel. Any unit that has one (1) prestress strand exposed in excess of 24 diameters, or two (2) or more exposed strands.

3. 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.

4. 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 6 µm in width.

5. 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 D.C.E.S.

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.
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Structural Repair. Repair, designated as “structural” by the D.C.E.S., 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:

1. 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:
   a. Mixing shall be done as close as possible to the portion to be repaired.
   b. All necessary equipment for mixing and placing shall be present at the site, and in good working order, prior to the start of mixing.
   c. 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.
   d. Dry, fine aggregate shall be placed in the mix container first. It shall be thoroughly agitated prior to the addition of the epoxy.
   e. The two components of the epoxy system shall be thoroughly mixed together before being added to the fine aggregate.
   f. The epoxy shall be added to the fine aggregate slowly, but mixing time shall not exceed three minutes.
   g. 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.
   h. The epoxy grout shall not be retempered.

2. Placing. The epoxy grout shall be placed against a clean, primed, receiving surface, in accordance with the following:
   a. 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).
   b. The priming of the receiving surface shall be done immediately prior to the placement of the epoxy grout.
   c. The epoxy grout shall be placed quickly and continuously. It shall not be overworked.
   d. The temperature of the receiving surface shall be above 10°C at the time of grout placement.
   e. 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.
   f. 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.
   g. 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 D.C.E.S. shall be made with either of the following:

1. Epoxy grout composed of epoxy resin system (§ 721-01), or epoxy polysulfide grout (§ 721-03), and fine aggregate,
2. Epoxy repair paste (§721-05).

The Contractor has the choice of materials.

a. Mixing. Epoxy grout shall be mixed in accordance with the requirements of 1. Mixing as given under Structural Repair of this subsection.

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 2. Placing as given under Structural Repair of this subsection.

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 D.C.E.S.

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, 718-03 and 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. Materials specification 718-01, Prestressed Concrete Units (Structural) shall apply with the following modifications:

Under Reinforcement and Prestressing Steel, 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.

Under Finishing, the tops of units do not have to be magnesium float finished.

Under 2. Testing for Concrete Strength, the provisions of §718-01 shall be replaced by the following:

" 2. 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 m³ of concrete, or major fraction thereof, placed in any one day."
§ 718-05  

A. **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.  

B. **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.  

C. **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.”

Under **Rejection of Units:** The provisions of §718-01 shall be replaced by the following:  

“**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:  

1. **Strength Requirements.** Any unit represented by cylinders not meeting the required strengths, as specified in Concrete Strength Requirements, of this specification.  

2. **Exposed Prestressing Steel.** Any unit which exhibits one or more exposed prestressing strand(s) on a top or bottom surface.  

3. **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.  

4. **Cracks.** Any unit which exhibits a crack that is greater than 13 mm in depth, and 64 µm in width.”

Under **Repair:** The provisions of §718-01 shall be replaced by the following:  

“**Repair:** Repair, if allowed by the DCES, shall be made with Epoxy Repair Paste (721-05). 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 A 446, Grades A through E. Fabrication shall be in conformance with ASTM A 525, Coating Class G165.
The Contractor shall supply the Engineer with certification that the form supports meet the foregoing requirements."

Under **Tolerances.** The provisions of §718-01 shall be replaced by the following:

"**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>L ength ± 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 THRU 718-23 (VACANT)**

**718-24 PRECAST CONCRETE PANEL UNITS (Mechanically Stabilized Earth System)**

**SCOPE.** This specification covers the materials and fabrication requirements for the precast concrete panel units indicated on the Contract Drawings. These units shall be used to construct a mechanically stabilized earth system.

The work "unit(s)", wherever it appears, shall be understood to mean precast concrete panel units, whether face panel units or corner panel units.

All units shall be obtained through the designated, approved designer-supplier.

**MATERIALS**

**General.** The materials used for the fabrication of these units shall be either Manufacturer certified or Department approved prior to being incorporated in the units. Unless specifically noted as accepted by certification, the materials shall be Department approved through Department quality assurance procedures.

The Contractor is hereby notified that some of the listed materials are peculiar to specific precast panel designs. It is the Contractor's responsibility to ensure that the proper materials are included in the chosen precast panel design.

**Concrete.** Concrete shall meet the requirements of §501-1, §501-2 and §501-3, with modifications as noted:

1. Cement shall be Type 1, Type 2, or Type 3. Only one type and brand of cement shall be used for the units required for any one structure. **NOTE:** The use of Type 3 cement shall be restricted to concrete cured in accordance with Method 1 or 2, under Curing of this specification.

2. Coarse aggregate gradation shall be N.Y.S. No. 1 size or ASTM Designation D448, No. 67 size.

3. Concrete proportioning requirements for the respective classes of concrete shall not apply.

4. Air content shall be 5.5% minimum, 7.0% desired, and 9.0% maximum.

5. Automatic proportioning equipment will not be required but is allowed.

**Reinforcing Bars.** Reinforcing bars shall meet the requirements of §709-04 Epoxy Coated Bar Reinforcement; Grade 400.

**Tie Strips.** Steel tie strips shall meet the requirements of any one of the following:
§ 718-24

a. ASTM Designation A570M, Grade 250, and galvanized in accordance with the requirements of §719-01, Type I; OR
b. ASTM Designation A570M, Grade 345, and galvanized in accordance with the requirements of §719-01, Type I.

Acceptance of this material shall be based on manufacturer's certification.

Coil Embed. The coil embed shall be fabricated from cold drawn steel wire conforming to AISI C1035, and galvanized in accordance with the requirements of §719-01, Type I.

Acceptance of this material shall be based upon manufacturer's certification.

Grease. Grease used in coil embed holes shall be that approved by the D.C.E.S. and supplied by the designated designer-supplier.

Dowels. Dowels shall meet the requirements of the designated designer-supplier.

Acceptance of this material shall be based on manufacturer's certification.

Lifting Devices. The type and adequacy of lifting devices shall be in accordance with the directives of the designated designer-supplier.

FABRICATION

Inspection. Fabrication of the units shall be inspected by an Inspector designated by the State. The Contractor shall inform the State seventy-two hours prior to:

1. Commencement of work.
2. Commencement of work after a work suspension of forty-eight (48) hours or more.
3. Unit shipping.

The Contractor shall keep the Inspector accurately informed of day-to-day fabrication scheduling operations. The inspector shall have free access to the fabrication plant in order to be satisfied that the work being done is in conformance with the Contract Documents. The Inspector shall be present during all testing. Work done at any time the Inspector has been refused or prevented from access shall automatically be rejected.

Production Note Sheet. The Contractor shall submit to the D.C.E.S. the in-process production information required below. Except as noted, this information shall require the approval of the D.C.E.S., prior to the beginning of any fabrication. All information shall be noted on a sheet titled: PRODUCTION NOTE SHEET.

1. Size and Type of Sheet: The size and type requirements of Subparagraph 2A - Working Drawings, Size and Type, as given in §718-01, under Drawings, shall apply.

2. Information Required: The following information shall be given:

a. Description of the fabricating plant, including any backup concrete mixing facilities; original design mix (including name and source of all constituents) and proposed method of concrete placement. Modifications to, or deviations from, the original design mix, which occur at any time, shall be submitted in writing to the D.C.E.S.

b. Fabricating plant production schedule and size of Lot as required under CONCRETE STRENGTH VERIFICATION OF THIS SPECIFICATION.

c. Quality Control tests and procedures, including the number of cylinders to be sampled per lot.

d. Method and outline of unit and cylinder curing procedure, as required under Curing of this specification.

e. Winter concreting procedures, if need is anticipated.

f. Typical piece mark, including the lot and casting sequence number and date.

g. Precasting tolerances as required under TOLERANCES of this specification.
h. Concrete lifting strength, and twenty-eight day strength.

3. Submission for Approval: The procedures described under SUBMISSION OF WORKING DRAWINGS, of §718-01, shall apply.

A approval of the Production Note Sheet shall not constitute approval of the information required under 2.a, above. This data is for informational purposes only.

Commencement of Work. No fabrication work shall be started until the Production Note Sheet has been approved and the Department's Inspector has received official copies.

Data for Inspector Approval. No fabrication work shall be started until the Inspector has received and approved the following data:

1. A calibration certificate attesting to the fact that the concrete cylinder testing machine to be used has been calibrated within the twelve (12) month period immediately prior to the first date of actual use of the machine.

2. Certificates indicating compliance with the requirements of this specification for all material incorporated as part of the unit.

Concrete Forms. Forms shall be well constructed, carefully aligned, and sufficiently tight to prevent leakage of mortar. The forms shall be constructed in a manner to allow all exposed faces of the unit to be cast against a steel form except where an architectural finish is specified.

All form surfaces that come in contact with the concrete shall be thoroughly treated with a form coating in the manner and at the rate specified by the manufacturer. Only form coatings which appear on the Department's approved list shall be used.

Reinforcement and Appurtenances. Prior to installation in the units, the reinforcement and any other embedded material shall be free of frost, dirt, oil, or any material that may prevent bond between it and the concrete.

Concrete Mix Design and Proportioning. The Contractor shall be responsible for designing a concrete mix to produce the required minimum compressive concrete strength in the units as determined by test cylinders sampled cured, and tested in accordance with this specification. If no compressive strength is indicated on the Contract Drawings, the required minimum compressive strength shall be Mpa at 28 days.

Maximum cement content for the design mix shall be limited to 450 kg/m$^3$.

The Contractor may request permission from the D.C.E.S. to incorporate a High Range Water Reducing (HRWR) admixture into the concrete mix. The D.C.E.S. will grant such permission only if deemed to be in the best interests of the State and then only under such conditions as the D.C.E.S. may require.

Concrete Placement. No concrete shall be placed in the forms without the Inspector's approval.

Plastic concrete shall be consolidated in place by internal or external vibration methods or both. Internal vibrators shall be the “pencil” type. All vibrators shall be approved by the inspector prior to use. Vibrators shall be used only to consolidated concrete after it has been properly placed. They shall not be used to move concrete within the forms. Internal vibrators shall be slowly inserted and removed from the concrete.

Suitable means shall be used for placing concrete to prevent segregation. Concrete 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 following quality control tests shall be performed and recorded by the Contractor, in the presence of the Inspector, from the same concrete sample as that used to satisfy the CONCRETE STRENGTH VERIFICATION requirements of this specification:

1. Slump
§ 718-24

2. Air Content
3. Temperature
4. Mass/m³

If truck-mixed concrete is employed, the Contractor shall sample concrete from each truck, immediately after depositing an initial quantity of concrete in the next panel, and perform these tests prior to discharging the remaining portion of the load.

**Winter Concreting.** If the atmospheric temperature is below 7°C fabrication of the units shall only be done in accordance with the Winter Concreting Procedures noted on the PRODUCTION NOTE SHEET. If Winter Concreting Procedures have not been previously approved, the Contractor shall submit them for approval, in accordance with the Submission For Approval Subsection of this specification. The D.C.E.S. will make every effort to reply in a timely manner. However, the time taken to review the Winter Concreting Procedures shall not be a reason to request an extension of time as provided for by §108-04. No additional compensation shall be made if Winter Concreting Procedures are employed.

**Curing.** The method of curing concrete units and cylinders shall be one of the following and shall meet the requirements noted below:

- Low Pressure Steam 718-01
- Radiant Heat and Moisture 718-01
- Water Spray 706-02
- Saturated Cover 718-01

Cylinders shall be cured in the same manner as the lot of units they represent.

**Record of Curing; Time-Temperature.** The Contractor shall provide automatic temperature recorders to continuously record the curing time and temperature. The actual number of recorders required will depend upon the method of cure chosen, and the type of form set-up. The PRODUCTION NOTE SHEET shall indicate the number of recorders as part of the curing information submitted for approval.

After curing is completed, all charts shall be properly marked and given to the Inspector.

**CONCRETE STRENGTH VERIFICATION**

1. General
   a. Concrete strength shall be determined from concrete test cylinders made in conformance with the requirements of ASTM designation C31. All cylinders shall be tested in conformance with ASTM Designation C39, on a testing machine approved by the Inspector. All cylinders shall be made and tested by the Contractor, in the presence of the Inspector.
   b. Cylinders shall be made from the same batch of concrete actually placed in the units. The Inspector shall be the sole judge, as to which cylinders are defective or damaged, and are not to be included in the determination of the strength class.
   c. The Contractor shall cast a sufficient number of concrete test cylinders to fulfill the strength test requirements as stated in Testing for Concrete Strength. The Contractor may submit to the D.C.E.S., for approval, an alternate sampling procedure based on the concreting operation proposed. If the alternate sampling procedure is approved, the Contractor shall indicate it on the PRODUCTION NOTE SHEET.
   d. To verify Lifting Strength, a minimum of two cylinders per lot shall be cast.
   e. To verify 28-day strength, a minimum of four cylinders shall be cast for each lot. The lot size shall not exceed the lesser of:

   1. Thirty Units; OR
2. The number of unit forms available for set-up at the time of casting (split units excepted).

The Contractor shall indicate, on the PRODUCTION NOTE SHEET, the number of units that shall be defined as a casting lot.

f. All units within a lot shall be cast without interruption. If an interruption in casting is encountered for a period in excess of one hour, the units cast prior to the interruption shall be defined as a lot, and a new lot shall be established for those units subsequently cast.

2. Testing for Concrete Strength. The strength requirements for each lot shall be verified by the Contractor before that lot is accepted for strength. Strength determination shall be accomplished as follows:

a. Lifting Strength: Two cylinders representing each lot shall be tested in immediate succession prior to lifting any panel in that lot from its form. The average strength of the two cylinders shall be equal to or greater than the Lifting Strengths specified (by the Contractor) on the PRODUCTION NOTE SHEET.

b. 28-Day Strength: Two cylinders representing each lot shall be tested in immediate succession at twenty-eight 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 these requirements are not met, the remaining cylinders representing the lot shall also be tested at 28 days of age. Subsequently, the average strength of all cylinders representing the 28-day strength of that lot shall be equal to or greater than the required 28-day strength.

Option: The Contractor may test two cylinders representing each lot, in immediate succession, prior to the twenty-eight day age limit. The average strengths of the two 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 the Contractor chooses this option, additional cylinders shall be made so that a minimum of four cylinders are available for testing at 28 days.

FINISHING. All surfaces of concrete shall be true and even, free from rough, open, or honeycombed areas, depressions, or projections.

All uncoated steel projecting from the panel unit, shall be coated with epoxy material, supplied by the coating applicator, prior to unit placement in the storage area. Epoxy material shall be applied and cured in accordance with the coating applicator’s instructions.

REJECTION OF UNITS. Rejection of units and lots will be governed by the following:

1. Strength Requirements. A lot represented by cylinders not meeting the required 28 day strength of concrete, as specified under CONCRETE STRENGTH VERIFICATION, shall be rejected.

2. Deleterious Materials. The materials used for the manufacture of concrete shall not contain or cause concentration of, chemicals or deleterious materials that are injurious to concrete as determined by the D.C.E.T.S. A total concentration of chloride ions in excess of 0.10% by weight of cement per cubic meter of concrete will be considered injurious. Sampling and testing of concrete and materials, in order to determine specification conformance, will be in accordance with Department instructions. A lot represented by concrete samples indicating injurious chemical concentrations, or the presence of deleterious materials, shall be rejected.

3. Honeycombing. Honeycombing of the concrete to such an extent that chipping away of the honeycombed concrete results in exposed steel.

If chipping of the honeycombed portion causes a hole more than one-half the thickness of the unit the unit will be rejected.

All honeycombed areas shall be chipped until sound concrete is detected. Sound concrete is defined as that point at which chipping causes fracture of the aggregates.
§ 718-24

The Inspector shall determine whether spalled, honeycombed, or otherwise defective concrete shall be repaired or be cause for rejection. The decision to repair a unit or reject it shall require the concurrence of the D.C.E.S. Repair of Units, if allowed, shall be done in a manner satisfactory to the Inspector. Regardless of what manner of repair is used, repair to concrete surfaces which will be exposed to view after construction is completed, shall be such that the repaired area is not distinguishable from the non-repaired area.

4. Tolerances. Just prior to shipping, all units shall be checked for compliance with the tolerances listed below. All units not meeting the listed tolerances shall be rejected.

Responsibility for rejection shall rest solely with the Inspector, except that the total number of rejected units of one day's production may not exceed twenty percent without the concurrence of the D.C.E.S.

Tolerances are as follows:

a. Panel dimensions (edge-to-edge of concrete) shall be ± 5mm.
b. Panel thickness shall be ± 6mm.
c. Squareness. The length difference between two diagonals of a rectangle shall not exceed 13 mm.
d. Distance between the centerline of dowel and dowel sleeve shall be ± 6mm.
e. Face of panel to centerline of dowel and dowel sleeve, and to centerline of reinforcing steel shall be ± 3mm.
f. Location of Tie Strip shall be ± 25mm.
g. Location of Coil Embed shall be ± 3mm.
h. Warping of the exposed panel face shall not exceed 4mm in one meter.

SHIPPING. No unit shall be shipped until the required twenty-eight day strength has been attained. Each unit shall be clearly marked with its piece mark and the date of fabrication. This mark shall be indelible and shall be placed on a surface which will not be exposed to view after construction is complete. No unit shall be shipped without the Inspector's stamp of approval.

BASIS OF ACCEPTANCE. Appearance on the Approved List and the Inspector's stamp of approval shall constitute basis of acceptance for shipment to the project site.

718-25 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. Where the materials called for are to be galvanized, they 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 for base metal less than 1.6 mm thickness shall be as follows:

<table>
<thead>
<tr>
<th>Minimum Wt of Coating (g/m² of surface)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average of Specimen</td>
</tr>
<tr>
<td>460</td>
</tr>
</tbody>
</table>

**Type IV.** ASTM A525, Steel Sheet, Zinc Coated (Galvanized) by the Hot Dip Process, General Requirements — Coating Designation G. 210 unless otherwise specified.

**Type V.** Flame Sprayed Coating System. 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 30 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.

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.

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.

Material galvanized in accordance with these Specifications shall be free from wet storage stains (white rust). These corrosion deposits, if present, 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 immediately removed from the worksite. Acceptable material will be provided to replace rejected material at no additional expense to the State.

**Repair.** When directed by the Engineer, the Contractor shall repair any damaged zinc coating of Type I, II, III, IV, or V galvanizing. Field repair shall be allowed only when the total damaged area on each piece is less than 2 percent of the coated surface, or 10 000 mm², whichever is less. Any material with total damaged area greater than the amount specified above, shall be rejected and replaced by the Contractor at no cost to the State. The zinc coating is to be repaired by the following method:

Clean the damaged area by wire brushing, sand or grit blasting, or any other suitable method approved by the Engineer, to remove all loose and cracked coating. Paint the cleaned area with one brush coat or two spray coats of zinc repair material. The brand of material used shall be one which appears on the Department’s approved list.
§719-01
These repair procedures are allowed only for those field repairs directed by the Engineer. This method shall not be allowed for shop repairs. All repairs shall be made at no cost to the State.

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.

MATERIAL REQUIREMENTS. Anodic coatings for Aluminum and its alloys shall conform to the following requirements for the coating designation shown on the plans or in the proposal:

<table>
<thead>
<tr>
<th>Coating Designation</th>
<th>Sealed with</th>
<th>Minimum Coating Thickness, Fm</th>
<th>Coating Weight, Milligrams Per Square Millimeter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 202</td>
<td>Boiling water</td>
<td>7.62</td>
<td>0.0217</td>
</tr>
<tr>
<td>Type 302</td>
<td>Nickel Acetate</td>
<td>7.62</td>
<td>0.0217</td>
</tr>
<tr>
<td>Type 204</td>
<td>Boiling water</td>
<td>10.16</td>
<td>0.0326</td>
</tr>
<tr>
<td>Type 205</td>
<td>Chromate</td>
<td>5.08</td>
<td>0.0171</td>
</tr>
<tr>
<td>Type 210</td>
<td>Chromate</td>
<td>10.16</td>
<td>____</td>
</tr>
<tr>
<td>Type 215</td>
<td>Boiling water</td>
<td>20.32</td>
<td>0.0620</td>
</tr>
<tr>
<td>Type 226</td>
<td>None required</td>
<td>50.80</td>
<td>0.1333</td>
</tr>
</tbody>
</table>

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 Fm on any individual specimen and the average of the specimens tested shall not be less than 58 Fm. 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 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.

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 OF PILES. 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.
§720-02

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 (ENCON).

**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.

**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 withstand driving without excessive deformation.

**BASIS OF ACCEPTANCE.** Approval by the D.C.E.S. shall constitute acceptance.
720-06 STEEL SPLICES

SCOPE. This specification covers the material requirements for steel splices for steel piles.

GENERAL. The material requirements for §720-04, Steel Bearing Piles, shall govern.

BASIS OF ACCEPTANCE. The provisions for §720-04, Steel Bearing Piles, shall apply.

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.

Characteristics of the Mixture

<table>
<thead>
<tr>
<th></th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pot life for 0.5 liter unit measured from time of original mixing at 23± 2°C, minutes</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>Initial viscosity, Pa·s (Brookfield Model RVT Spindle No. 3 @ 20 RPM)</td>
<td>___</td>
<td>2</td>
</tr>
</tbody>
</table>

Cured Materials. Mixed with three (3) parts by volume of Ottawa silica sand conforming to ASTM C109, the resulting mortar shall have the following characteristics:

<table>
<thead>
<tr>
<th></th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressive strength of 50 mm x 50 mm cubes cured at 23± 2°C for 24 hours, Mpa</td>
<td>55</td>
<td>___</td>
</tr>
<tr>
<td>Tensile splitting strength of a 50 mm x 100 mm cylinder cured at 23± 2°C for 24 hours, Mpa</td>
<td>10</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:

1. N.Y.S.D.O.T. materials specification number.
2. Name of product.
3. Mixing proportions and instructions.
4. Name and address of the manufacturer.
§ 721-01
5. Lot number and batch number.
6. Date of manufacture.
7. Quantity.
8. 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.

Test

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 (M in. 1 3/4:1). In addition, the ratio of epoxy resin to curing agent shall be 11:1 by weight (M ax. 12:1, M in. 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>Specific Value</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color, Hellige</td>
<td>Min. 0</td>
<td>Max. 5</td>
</tr>
<tr>
<td>Epoxide equivalent</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>Min.</th>
<th>Max.</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color, Hellige</td>
<td>9</td>
<td>12</td>
<td>ASTM D1544</td>
</tr>
<tr>
<td>Sulphur Content, percent</td>
<td>36</td>
<td>40</td>
<td>ASTM D129</td>
</tr>
<tr>
<td>Shelf Life</td>
<td>1 year</td>
<td>---</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 following physical characteristics:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pot Life at 25EC, min.</td>
<td></td>
<td>30</td>
<td>---</td>
</tr>
<tr>
<td>Initial Viscosity at 25EC, PaG</td>
<td></td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>Spray application</td>
<td></td>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td>Other applications</td>
<td></td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Tack free time at 25EC, hrs.</td>
<td></td>
<td>2</td>
<td>---</td>
</tr>
<tr>
<td>Degree of temporary gelation,</td>
<td></td>
<td>3.5</td>
<td>---</td>
</tr>
<tr>
<td>depth, mm.</td>
<td>ASTM D482</td>
<td>---</td>
<td>50</td>
</tr>
<tr>
<td>Ash content, percent</td>
<td>ASTM D1259</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Volatiles, percent</td>
<td></td>
<td></td>
<td></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 following physical characteristics:

<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>2.75</td>
<td>---</td>
</tr>
<tr>
<td>Double Strength, Mpa</td>
<td>M M M – B - 350 Paragraph 4.4.3</td>
<td>2.75</td>
<td>---</td>
</tr>
<tr>
<td>Beam Break Test, Mpa</td>
<td>Described under “Test”</td>
<td>5.50</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:

1. N.Y.S.D.O.T. materials specification number.
2. Name of product.
3. Mixing proportions and instructions.
4. Name and address of the manufacturer.
5. Lot number and batch number.
6. Date of manufacture.
7. Quantity.
8. 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.
§ 721-03

Test

Pot Life. The pot life shall be determined as follows: The two components are conditioned to 25EC 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 25EC 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 25EC 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 10EC or above 40EC. It is suitable for damp, moist, and underwater applications.

7-210
MATERIAL REQUIREMENTS. 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 — shall be the curing agent for the system and shall be capable of curing the system from 5Ec 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 10Ec to 40Ec. It shall also have the following characteristics:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pot Life @ 25EC, minutes</td>
<td>See Test</td>
<td>10 min.— 60 max.</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressive Strength 50 mm cubes, @ 24 hours, M pa</td>
<td>---</td>
<td>21 min.</td>
</tr>
<tr>
<td>Bond Test Modulus of Rupture, M pa</td>
<td>See Test</td>
<td>5.50 min.</td>
</tr>
<tr>
<td>Freeze-thaw</td>
<td>See Test</td>
<td>80% Bond Strength, min.</td>
</tr>
</tbody>
</table>

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:

1. N.Y.S.D.O.T. materials specification number.
2. Name of product.
3. Mixing proportions and instructions.
4. Name and address of manufacturer.
5. Lot number and batch number.
6. Date of manufacturer.
7. Quantity.
8. Date of expiration of acceptance.

Test

Pot Life. The components will be conditioned to 25EC 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 M pa 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
§721-05

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 through 721-19 (Vacant)

721-20 Rapid Setting Polymer Concrete

Scope. This specification covers the material requirements of a two component, rapid setting, methyl methacrylate based polymer concrete repair material. The material is used with a primer to repair hardened concrete.

Materials Requirements

A. 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 manufacturer shall not be used.

B. 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>
<thead>
<tr>
<th>PROPERTY</th>
<th>REQUIREMENT</th>
<th>TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Modulus of Rupture, MPa, min.</td>
<td>10</td>
<td>ASTM C580</td>
</tr>
<tr>
<td>2. Elastic Modulus, MPa</td>
<td>3450 to 6900</td>
<td>ASTM C580</td>
</tr>
<tr>
<td>3. Thermal Expansion Coefficient, mm/mm/EC</td>
<td>(1.8 to 3.6) x 10⁻⁵</td>
<td>ASTM C531</td>
</tr>
</tbody>
</table>

C. The material shall also exhibit the following properties when tested under NYSDOT Test Method 701-13F:

1. A minimum one hour compressive strength of 17 Mpa, a 24 hour strength of 24 Mpa, and a 28 day strength of 35 Mpa.
2. Be able to withstand 50 cycles of freeze-thaw (10% NaCl solution) with a maximum loss of 4%.

D. 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 2°C and 40°C inclusive.

E. Flammability — The polymer concrete shall not support or sustain combustion within five (5) minutes after mixing.

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 - (VACANT)

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 the Light Standard Dimensions Table.

### LIGHT STANDARD DIMENSIONS TABLE

<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>
</tr>
<tr>
<td>9</td>
<td>4.6</td>
<td>4</td>
<td>200 X 150</td>
</tr>
<tr>
<td>9</td>
<td>6</td>
<td>6</td>
<td>225 X 150</td>
</tr>
<tr>
<td>11</td>
<td>4.6</td>
<td>5</td>
<td>200 X 150</td>
</tr>
<tr>
<td>11</td>
<td>6</td>
<td>6</td>
<td>250 X 150</td>
</tr>
<tr>
<td>13</td>
<td>4.6</td>
<td>4</td>
<td>250 X 150</td>
</tr>
<tr>
<td>13</td>
<td>6</td>
<td>6</td>
<td>250 X 150</td>
</tr>
<tr>
<td>14</td>
<td>4.6</td>
<td>6</td>
<td>250 X 150</td>
</tr>
<tr>
<td>16</td>
<td>4.6</td>
<td>6</td>
<td>250 X 150</td>
</tr>
<tr>
<td>8</td>
<td>4.6*</td>
<td>5</td>
<td>200 X 150</td>
</tr>
<tr>
<td>9</td>
<td>4.6*</td>
<td>6</td>
<td>200 X 150</td>
</tr>
<tr>
<td>11</td>
<td>4.6*</td>
<td>6</td>
<td>250 X 150</td>
</tr>
<tr>
<td>13</td>
<td>4.6*</td>
<td>6</td>
<td>250 X 150</td>
</tr>
<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>

* Twin-Arm.

**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.

**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:

1. Manufacturer's certification of compliance with these specification requirements.
2. 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.


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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

1. General:
   a. 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.”
   b. The design wind loading shall be chosen to be consistent with the location of the structure and the height factor. See Section 723-01.
   c. It shall be the contractor’s responsibility to obtain verification of all necessary weights and effective projected areas as required in the plans.

2. Poles:
   a. 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.
   b. 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.
   c. 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.
   d. The finished pole shall be galvanized in accordance with Section 719-01 of the N.Y.S. Standard Specification (Coating and Repair Methods, Type 1). 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.

3. Anchor Base:
   a. The anchor base shall be fabricated of steel meeting or exceeding the yield strength of ASTM-A-36M.
   b. The anchor base shall telescope the butt end of the pole and be welded on the inside bottom and outside top.

4. Anchor bolts, nuts, and washers:
   a. 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.
b. 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 Section 719-01 of the N.Y.S. Standard Specifications (Galvanized Coating and Repair Method, Type II).

c. 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.”

5. Welding: Pole sections shall have no more than one 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.

6. 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.

7. Head Frame:
   a. 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.
   b. The head frame shall be equipped with a suitable weather resistant and bird proof cover.
   c. 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.
   d. The head frame shall provide at least three point suspension for the luminaire ring assembly.
   e. 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 degrees bearing surface and be equipped with suitable guides to prevent jumping the sheaves. Sheave bearings shall be permanently lubricated on stainless steel shafts.
   f. 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).
   g. 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.
   h. 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.

8. Lowering System and Luminaire Assembly:
   a. 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...
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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.

b. 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.

c. 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.

d. 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.

**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)

723-15.01 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, 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.
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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 as defined in §101-34.1. 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 75EC 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 following requirements:

CLASS 1, Heavy Wall PVC - Federal Specification W-C-1094A, Type II (UL 651, Heavy Wall PVC Conduit).


All fittings, couplings and expansion fittings shall conform to the applicable requirements of Federal Specification W-C-1094A and UL 514. 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 Federal specification WW-C-581: CLASS 1 - Rigid Metal Steel Conduit Class 2 - Intermediate Metal Steel Conduit (UL Type I IMC and UL Type II IMC).

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 Federal Specification WW-C-581-D, ANSI C80.1.

The Hot-dipped Galvanized Rigid Steel Conduit shall be assembled with a tightly drawn-up coupling.

The plastic coating shall be bonded to the exterior surface with a minimum thickness of 0.5 mm.

The poly (vinyl chloride) compound shall conform at -12°C up to +93°C temperature to Federal Specifications LP-406b, Method 2051, Amendment of 25 September 1952 (ASTM D746).

Hardness: 82-89 Shore A. Durometer (5 Seconds)
Dielectric Strength (volts/µm for 300 µm thickness): 40
Flammability: Self extinguishing
Tensile Strength Kpa: 16 133 (ASTM D638)
Percent Elongation: 220%

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.
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**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:

- Mean lumens at 10 hours/start: 90%
- Warm-up time: 3 to 4 minutes
- Restart time: 1 minute
- Max power variance around design center: ± 5%
- Lowest ambient starting temperature: -29°C

The unit shall be supplied with an ANSI-IES medium, semi-cutoff vertical light distribution unless otherwise specified on the plans or ordered by the engineer. 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.
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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 electrochemically 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.

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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:

- % Mean lumens at 10 hours/start: 90%
- Warm-up time: 3 to 4 minutes
- Restart time: 1 minute
- Maximum power variance around design center: ± 5%
- Lowest ambient starting temperature: -29°C
- Bulb finish: Clear

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.
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723-31 MERCURY VAPOR LUMINAIREs (UNDERBRIDGE MOUNT)

SCOPE. This specification covers the material and quality requirements for Mercury Vapor Luminaire (Underbridge Mount).

GENERAL. The luminaire shall be complete for surface or pendant 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 29EC. The lamps shall be included with the luminaire.

BASIS OF ACCEPTANCE. Mercury Vapor Luminaire 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 reinforced concrete foundations and pullboxes.

MATERIAL REQUIREMENTS. The requirements for Precast Reinforced Concrete Foundations and Pullboxes shall be identical to the requirements for §706-04 Precast Concrete Drainage Units with the following exceptions:

1. Only five (5) sets of shop drawings will be required.
2. The requirements for ’Steps for Manholes, §725-02’ do not apply.

BASIS OF ACCEPTANCE. The pullbox units will be accepted on the basis of manufacturer's certification that the units were manufactured from materials conforming to these specifications and that the properties of the finished units also meet the specification requirements.

The Department reserves the right to test plastic or hardened concrete at any time. If hardened concrete is tested, 100 mm diameter cores shall be drilled by the manufacturer.

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.

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°C to +71°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
§ 723-60
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 THHN as designated by Underwriter’s Laboratory Specifications. The single conductor cable shall have heat and moisture resistant insulation for a maximum operating temperature of 75EC, 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
(a) 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. No. S-66-524 and NEMA Pub. No. WC-7 “Thermoplastic - Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.”
(b) Cable shall consist of 7 copper strands up to and including #2 AWG and shall be constructed of 19 copper strands in larger sizes.
(c) Insulation shall be chemically cross linked (vulcanized) polyethylene insulating compound.
(d) Cable shall be mechanically spliced and insulated using the highest quality poured splices available for underground 600V cables.
(e) Cable shall be factory or shop twisted in a duplex or a triplex configuration in accordance with the publications listed in (a) above and as indicated by the plans.

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.

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MATERIAL REQUIREMENTS. Ground wire shall be #6, soft-drawn bare copper wire, 7 strand single conductor for 600 volts.

BASIS OF ACCEPTANCE. Ground wire shall be accepted upon the manufacturer’s certification that it meets the requirements of this specification as well as being Underwriter’s Laboratory approved. All ground wire shall also carry the Underwriter’s Laboratory approval label.

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.

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.

GENERAL

A. Types of Poles

1. Span Wire - Span wire poles are used for supporting a steel cable or cables to which are attached traffic signals and overhead signs.
2. 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.
3. Post Top Mount - Post top mount poles are used for mounting traffic signals directly on the top of the pole.
4. Bracket Mount - Bracket mount poles are used to support traffic signals and other items bracketed from or attached to the side of the pole.
5. Traffic Signal Poles with Lighting Arms - Lighting arms may also be attached to all pole
types except post top mount.

B. Design Criteria. The poles shall be designed in accordance with the AASHTO Standard
Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, 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, with respect to these elements:

1. Any tubular segments of the structure.
2. Hand hole reinforcement and other hole reinforcement.
3. Device used to connect cable to pole.
4. Base plate.
5. Mast arm to pole connections.
6. 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 3 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.

C. (Vacant).

D. Wind Loads. Poles and attachments thereto 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

A. Steel and Aluminum Materials. The following materials, or approved alternates, as
determined by the Deputy Chief Engineer, Facilities Design, 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.

1. Steel.

a. Poles and Arms.
   1) ASTM A500, Grade B or ASTM A501.
   2) ASTM A53, Grade B pipe.
3) 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.

4) ASTM A252, Grade 2 or Grade 3.

5) 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.

6) ASTM A572M, Grades 290, 345, 415 or 450.

7) ASTM A595, Grade A.

8) ASTM A618, Grade I, II or III.

9) ASTM A588M.

10) 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.

11) ASTM A607, Grade 400 Class 2.

The finished pole shall be galvanized in accordance with section 719-01 Galvanized Coatings and Repair Methods, Type 1.

b. Bases.

1) ASTM A27M, Grade 65-35, mild to medium strength carbon steel castings.

2) ASTM A36M.

3) ASTM A588M.

4) ASTM A572M, Grade 290, 345, 415 or 450.

5) ASTM A633M (Any Grade).

The base shall be galvanized under the same specification as the pole.

c. Anchor Bolts, Nuts and Washers.

1) ASTM F568 Class 4.6 (Bolts and Nuts).

2) ASTM F568 Class 8.8 (Bolts).

3) 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.

4) ASTM A675M Grades 485 through 620 (Bolts).

5) ASTM A563M Grades A, B, C, D, or DH (Nuts).

6) ASTM A687 (Bolts).

7) 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.

8) 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 section 719-01, Galvanized Coatings and Repair Methods, Type II.

d. Welding. All welding shall be performed in accordance with the New York State Steel Construction Manual.

e. Connection Devices

1) ASTM A36M.
2) ASTM A588M.
3) ASTM A325M.

f. 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 section 719-01, Galvanized Coatings and Repair Methods, Type II.


B. Fabrication Details

1. General Requirements for All Poles

a. Bases. The base plate shall be welded to the pole by an acceptable weld in accordance with the New York State Steel Construction Manual.

b. Anchor Bolts, Nuts and Washers. 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. “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:

1) Hole diameter not more than 3 mm greater than the bolt.
2) Hole diameter not more than 6 mm greater than the bolt, for bolt diameters equal to or greater than 25 mm.
3) Hole diameter not more than 9 mm greater than the bolt, for bolt diameters equal to or greater than 50 mm.

c. Pole Shape. Poles shall be round or multi-sided shapes.
d. **Pole Construction.** Poles may be fabricated in any of the following shapes and styles:

1) **Round Continuously Tapered.** Poles shall be fabricated with not more than one longitudinal seam which shall be continuously welded and ground or rolled flush. Poles 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 11 mm, but not less than 6 mm per meter of length.

2) **Round Step Tapered Construction.** Poles 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 poles shall achieve a tapered effect equal to a maximum rate of 11 mm and a minimum of 6 mm per meter of length by use of decreasing diameter round pipe sections.

3) **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 poles will not be allowed.

4) **Round Untapered.** Poles 8 meters or less in length may be round untapered with not more than one longitudinal seam.

e. **Hand Holes and Holes for Wiring Fittings.** Poles shall be equipped with hand holes except that hand holes will not be required 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. 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.

f. **Miscellaneous Requirements.**

1) Poles and arms shall be equipped with end caps secured with stainless steel set screws.

2) Anchor bolt covers shall be furnished. These shall be affixed to the base or shaft with stainless steel cap screws.

3) Poles shall be equipped with a grounding terminal accessible through the hand hole. Grounding terminals are not necessary if there is no hand hole.

2. **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” Section 1.2.6, given in the contact 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. **Shaft and Base.** Shaft and base shall be constructed as specified in the General Requirements Section.
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c. Physical and Mechanical Properties. Span Wire poles shall conform to the following requirements.

1) Minimum Wall Thickness - 3 mm.

2) 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.

3) Maximum Pole Diameter at the Base - 58 mm per meter of pole length.

d. Poles with Lighting Arms. Poles with lighting arms shall be constructed in accordance with the configuration in the contract documents and this Specification.

If not specified, lighting arms may be of either the single member type or of the truss type. 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.

e. 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>

f. 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.


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 standard specifications for “Structural Supports for Highway Signs, Luminaires and Traffic Signals.” The wind speed, locations, dimensions, weights, and projected areas of the signals, signs, and supports shall be as specified in the contract documents.

b. Shaft and Base. Shaft and base shall be constructed as specified in the general requirements section. Shafts may be untapered.

c. Mast Arm Shapes. Arms shall be round or multi-sided shapes and have the same cross-sectional shape as the shaft.

d. Arm Construction. Mast arms of any length may be constructed by any of the methods indicated under Material Requirements paragraph, B, 1, d, Pole Construction. They may be of two piece construction with a telescoping joint secured by thru-bolt and locknut.
e. **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.

f. **Physical and Mechanical Properties.** Mast arms and shafts shall conform to the following requirements:

1) Minimum Wall Thickness - 3 mm.

2) Maximum Deflection at Design Load.
   - Shaft - 42 mm per meter of length.
   - Arm - 42 mm per meter of length.

3) Maximum Diameter at base of shaft or arm.
   - Shaft - 58 mm per meter of length.
   - Arm - 58 mm per meter of length.

g. **Poles with Lighting Arms.** Poles with lighting arms shall be constructed in accordance with the configuration in the contract documents and this specification.

If not specified, lighting arms may be of either the single member type or of the truss type. 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.

h. **Poles with Multiple Arms.** Poles with multiple arms shall be constructed in accordance with the arm configuration in the contract documents.

i. **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 (mm)</td>
<td>8</td>
</tr>
<tr>
<td>Minimum Yield Strength (MPa)</td>
<td>345</td>
</tr>
<tr>
<td>Manufacturers Name or Logo</td>
<td>-</td>
</tr>
<tr>
<td>Month and Year of Manufacture</td>
<td>1077</td>
</tr>
</tbody>
</table>

4. **Post Top 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 standard specifications for “Structural Supports for Highway Signs, Luminaires and Traffic Signals.”

The wind speed, location, weights, dimensions and projected areas shall be as given in the contract documents.

5. **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 standard specifications for “Structural Supports for Highway Signs, Luminaires and Traffic Signals.”

The wind speed, location, weights, dimensions and projected areas shall be as given in the contract documents.
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Lighting arms when specified shall be of truss-type design with upper and lower members joined near the luminaire end of the arm. The arm shall be braced with one or two vertical struts depending on the length of the arm. Arms may either be galvanized steel or aluminum.

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

1. 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.
2. Submission of the manufacturer's certificate of compliance with these specification requirements and the approved fabrication details.

Span Wire Poles

1. The acceptance requirements for All Poles and Arms, given above, shall apply.
2. Submission of mill certifications for all structural materials.
3. 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.

MATERIAL AND CONSTRUCTION REQUIREMENTS

A. Standard Signal Heads

Material. All traffic signal head housings shall be made of cast 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.

All suspension components, brackets, clamps, trunnions, arms, elbows, crosses, etc., shall be made of one of the following materials:

1. Malleable iron in accordance with ASTM A47M.
2. Steel pipe in accordance with ASTM A53.
4. Aluminum Die Castings in accordance with ASTM B85, Alloy SC 84B.
5. Aluminum pipe in accordance with ASTM B429.

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.

The following items shall be made of non-magnetic stainless steel, Type 303 or 304, in accordance with ASTM A296 (latest revision).

A. All set screws.
B. The U/J-bolts, rivet and their related nuts, washers and cotter pin in the span wire lamp.
C. The eye-bolt, rivet, tightening bolt and their related nuts, washers, and cotter pin in the balance adjuster.

Pipe arms shall be made of steel pipe in accordance with ASTM A120 (latest revision).

**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.”

**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.

Threads and threaded parts shall not be coated and shall be protected from the coating process at the time of application.

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 71EC. 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 M inimum</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
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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.

1. 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.

2. 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 slilifter 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 pipeplug 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 intermate 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 $3.5E$ 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).

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
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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.

**B. 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 components of the optical system shall comprise:

1. Lamp.
2. Lamp collar.
3. Optical limiter-diffuser.
4. Objective lens.

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. 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.

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.
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.

**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 -40EC to 74EC 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.

**C. Standard Pedestrian Signal Heads**

In addition to applicable items in Parts A 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.
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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 DONT WALK above or integral with the legend WALK.

When illuminated, the WALK indication shall be lunar white. When illuminated, the DONT WALK indication shall be portland orange. All except the letters shall be obscured by an opaque material.

When not illuminated, the WALK and DONT 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:

1. The head shall be a two section unit. Lettering shall be a minimum of 114 mm.
2. 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.
3. Signal head shall be supplied with an 18 AWG, color coded wiring harness, and a four position, barrier type terminal block.
4. Lenses shall be made of plastic.

D. Fiberoptic Pedestrian Signal Heads

In addition to applicable items in Parts A & C 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 DONT 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 DONT the word WALK in the DONT WALK message will remain dark.

Each message shall be displayed separately and never concurrently.

MATERIALS. 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 signal shall consist of:

1. Weatherproof housing, door, gaskets, and visor
2. Fiberoptic module with individual output attached
3. Color filters for desired message colors
4. Light sources
5. Transformers
6. Protective back cover for the module
7. 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 0.56 with a maximum transmission attenuation of 800 DB per kilometer. Each fiber shall have a \(0.05 \pm 0.005\) mm diameter with an included acceptance angle of 68 degrees. All fiber ends shall be ground smooth and polished to an 8 Fm 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 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:

a) Core to clad fusion  
b) Size  
c) Roundness of fiber  
d) Optical transmission  
e) 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.

E. Fiberoptic Dual Indication Arrow

In addition to applicable items in Part A, 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.

MATERIALS. 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 signal shall consist of:

1. Weatherproof housing, door, gaskets, and visor
2. Fiberoptic module with individual output attached
3. Color filters for desired message colors
4. Light sources
5. Transformers
6. Protective back cover for the module
7. Electrical system including wiring

Optical Requirements. The optics shall have a glass-on-glass fiber with a 83% core to 17% clad 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 Fm 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 aluminum 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.

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 $-37^\circ$C to $+75^\circ$C.

**F. Strobing Signal Indication.** In addition to applicable items in Part A 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 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.

**MATERIALS**

**Optical System:** This item shall consist of:

1. Weatherproof housing, door, gaskets, and visor.
2. Alzak parabolic reflector or equivalent. No plastic material will be accepted for the reflector or reflector bracket.
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3. One bar strobe bulb with a minimum 5000 hours duty life enclosed in a dustproof, shockproof and watertight enclosure.
4. 300 mm glass red lens.
5. Power supply.
6. Electrical system including wiring and control circuitry.
7. 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 aluminum 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.

BASIS OF ACCEPTANCE. Acceptance of signal heads will be based on manufacturer's certification of compliance with these specification requirements.

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 minus -46EC to +60EC. 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 360E horizontally. The fire pre-emption tell-tale light shall operate from a 115 volt 60 Hz. single phase power source.
§724-15
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 4.5E°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.

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 0E°C and 38E°C shall be a minimum of six months.
MATERIAL REQUIREMENTS

Requirements for materials with a Shore A hardness between 15 and 40:

<table>
<thead>
<tr>
<th>Property</th>
<th>Min.</th>
<th>Max.</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pot Life, minutes @ 22EC</td>
<td>15</td>
<td>-</td>
<td>DOT Test Method 724-40E</td>
</tr>
<tr>
<td>Curing Time (tack free surface) hours @ 22EC</td>
<td>2</td>
<td>2</td>
<td>DOT Test Method 724-40E</td>
</tr>
<tr>
<td>Tensile Strength, Kpa</td>
<td>345</td>
<td>-</td>
<td>ASTM D412</td>
</tr>
<tr>
<td>Elongation, percent</td>
<td>150</td>
<td>-</td>
<td>ASTM D412</td>
</tr>
<tr>
<td>Hardness, Shore A</td>
<td>15</td>
<td>40</td>
<td>ASTM D2240</td>
</tr>
<tr>
<td>Water Absorption, percent</td>
<td>-</td>
<td>1.0</td>
<td>DOT Test Method 724-40E</td>
</tr>
<tr>
<td>Adhesion to Asphalt Concrete, kg</td>
<td>91</td>
<td>-</td>
<td>DOT Test Method 724-40E</td>
</tr>
<tr>
<td>Adhesion to Concrete, kg</td>
<td>23</td>
<td>-</td>
<td>DOT Test Method 724-40E</td>
</tr>
<tr>
<td>Extension, mm</td>
<td>6.4</td>
<td>-</td>
<td>DOT Test Method 724-40E</td>
</tr>
<tr>
<td>Accelerated Weathering</td>
<td>No cracking, checking, chalking, shrinking, or breaking -180° bend at -26°C Per DOT Test Method 724-40E</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Requirements for materials with a hardness between Shore A 50 and Shore D 65:

<table>
<thead>
<tr>
<th>Property</th>
<th>Min.</th>
<th>Max.</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pot Life, minutes @ 22EC</td>
<td>15</td>
<td>-</td>
<td>DOT Test Method 724-40E</td>
</tr>
<tr>
<td>Curing Time (tack free surface) hours @ 22EC</td>
<td>2</td>
<td>2</td>
<td>DOT Test Method 724-40E</td>
</tr>
<tr>
<td>Tensile Strength, Mpa</td>
<td>2.8</td>
<td>-</td>
<td>ASTM D412</td>
</tr>
<tr>
<td>Elongation, percent</td>
<td>20</td>
<td>-</td>
<td>ASTM D412</td>
</tr>
<tr>
<td>Hardness, Shore A</td>
<td>50</td>
<td>-</td>
<td>DOT Test Method 724-40E</td>
</tr>
<tr>
<td>Shore D</td>
<td>65</td>
<td>-</td>
<td>DOT Test Method 724-40E</td>
</tr>
<tr>
<td>Water Absorption, percent</td>
<td>-</td>
<td>1.0</td>
<td>DOT Test Method 724-40E</td>
</tr>
<tr>
<td>Adhesion to Asphalt Concrete, kg</td>
<td>227</td>
<td>-</td>
<td>DOT Test Method 724-40E</td>
</tr>
<tr>
<td>Adhesion to Concrete, kg</td>
<td>136</td>
<td>-</td>
<td>DOT Test Method 724-40E</td>
</tr>
<tr>
<td>Extension, mm</td>
<td>3</td>
<td>-</td>
<td>DOT Test Method 724-40E</td>
</tr>
<tr>
<td>Accelerated Weathering</td>
<td>No cracking, checking, chalking or shrinkage Per DOT Test Method 724-40E</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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...
§724-23

resistance throughout the life of the device. The housing shall be of a design or be provided with adapters 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.

725-02.01 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:

1. Ferrous Metal. Steps shall conform to the following requirements:
   - Malleable Iron Castings — Grade 35018, subsection 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.

2. 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 Zinc Chromate Primer conforming to the requirements of subsection 708-04 or shall be coated with bituminous material approved by the Materials Bureau.

3. Reinforced Plastic. Steps shall consist of polypropylene or other plastic material meeting this specification. It may be extruded, cast, or molded into the standard size and shape manhole

7-250
steps, having a steel core center for strength and completely covered by the plastic molding for 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°C or greater.

c. **Flexibility.** It shall remain flexible over a temperature range of -30°C to +120°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 mm² 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. However, the Department reserves the right to take random samples at any time for testing for compliance with the requirements of this specification.

**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**

A. **White and Yellow ReflectORIZED Thermoplastic**

1. **Composition Requirements.** 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><strong>White</strong></td>
<td></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>
<tr>
<td><strong>Yellow</strong></td>
<td></td>
</tr>
<tr>
<td>Binder</td>
<td>17.0, min.</td>
</tr>
<tr>
<td>Titanium Dioxide</td>
<td>---</td>
</tr>
<tr>
<td>Glass Beads</td>
<td>30-40</td>
</tr>
<tr>
<td>Calcium Carbonate &amp; Inert Fillers</td>
<td>30-40</td>
</tr>
<tr>
<td>Yellow Pigments</td>
<td>*</td>
</tr>
</tbody>
</table>

* A mount 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.

2. 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 10YR 8/14 (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).

B. 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 Fm to 600 Fm 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 Fm</td>
<td>100</td>
</tr>
<tr>
<td>600 Fm</td>
<td>79-95</td>
</tr>
<tr>
<td>300 Fm</td>
<td>15-60</td>
</tr>
<tr>
<td>180 Fm</td>
<td>0-15</td>
</tr>
</tbody>
</table>

Glass spheres for drop-ons shall be treated with a moisture-proof coating.

C. Primer

1. **Type I Primer.** This primer shall be for use on bituminous concrete pavement surfaces only, and meet the following requirements:

   Type I primer shall be a thermo-setting adhesive, with a solids content of pigment reinforced synthetic rubber and synthetic plastic resin dissolved and/or dispersed in a volatile organic solvent. The solids content shall not be less than 10% by weight, and at 21°C and 60% R.H., a wet film thickness of 0.10 to 0.15 mm shall dry to a tack-free condition in less than five (5) minutes.

2. **Type II Primer.** This primer shall be for use on either bituminous concrete or Portland Cement concrete pavement.

   Type II primer shall be a two component epoxy adhesive and meet the following requirements:

<table>
<thead>
<tr>
<th>Part A</th>
<th>Part B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass per liter, min.</td>
<td>0.97 kg</td>
</tr>
<tr>
<td>Epoxide Equivalent of Solids</td>
<td>185-200</td>
</tr>
<tr>
<td>Potlife of Mixture @ 22.2EC (in closed container)</td>
<td>24 hours</td>
</tr>
</tbody>
</table>

   The reactive solids content of the mixed epoxy primer (Part A and Part B) shall be 50%, minimum, by weight. The reactive solids content shall be determined by blending one (1) part by weight of Part A with one (1) part by weight of Part B and allowing this mixture to react. A solids content of this reacted mixture shall then be determined after constant weight is reached in an oven at 105°C.

   The field mixing ratio for the application of the Type II epoxy primer shall be two (2) Parts A to one (1) Part B, by volume.

3. **Type III Primer.** Type III primers shall be of the type recommended by the manufacturer of the thermoplastic composition.

   Type III primers shall be approved, by the Materials Bureau, prior to use. Requests for approval shall be accompanied with technical data, instructions for use, and a one (1) liter sample of the primer material.

D. Packaging and Shipment. 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.
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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.

Types I, II, and III 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, Type II primer containers shall be identified as “Part A” and “Part B.” Type III primers shall be shipped to the job site accompanied with instructions for use.

BASIS OF ACCEPTANCE. Thermoplastic material shall be accepted on the basis of sampling and inspection 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. In addition, all samples shall be accompanied with the manufacturer’s certified identification of the binder formulation (e.g. “formulated as a hydrocarbon resin”). Any unauthorized tampering or breaking of the seals on the containers between the time of sampling and delivery to the job site shall be cause for rejection of the material.

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.

Type I and Type II primers may be accepted at the job site on the basis of the manufacturer's certification that they conform to the requirements of this specification, or samples may be submitted to the Materials Bureau for testing.

Upon prior approval by the Materials Bureau of Type III primers, to be used on either bituminous concrete or Portland Cement concrete pavements, as applicable, the name of the product shall be placed on an “approved list” of Primers for White and Yellow Thermoplastic Reflectorized Pavement Markings; the product may then be accepted on the basis of the brand name labeled on the container.

727-02 WHITE AND YELLOW REMOVABLE REFLECTORIZIED 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

A. 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.

B. Physical Properties

1. 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).

2. **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:
   
   a. Casing dimensions, minimum — 100 mm x 100 mm x 19 mm.
   
   b. Area of each reflective lens, minimum — 245 mm².

3. **Reflectance**
   
   a. **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 0.2E and 0.5E observation angles and 86.0E 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>Color</th>
<th>White</th>
<th>Yellow</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Observation Angle</strong></td>
<td>0.2E</td>
<td>0.5E</td>
</tr>
<tr>
<td><strong>Specific Luminance, (mcd·m⁻²) ¹x⁻¹</strong></td>
<td>1770</td>
<td>1270</td>
</tr>
</tbody>
</table>

   b. **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 0.2E and entrance angles of 0E and 20E. The photometric quantity to be measured shall be specific intensity (SI) and it shall be expressed as millicandelas per lux.

<table>
<thead>
<tr>
<th>Color</th>
<th>White</th>
<th>Yellow</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Entrance Angle</strong></td>
<td>0E</td>
<td>20E</td>
</tr>
<tr>
<td><strong>Specific Intensity (mcd/lx)</strong></td>
<td>93</td>
<td>37</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.
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4. 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.

C. 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

A. Epoxy Material

1. 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.

Part A of both white and yellow shall conform to the following requirements:
PERCENT BY WEIGHT OF PART A

WHITE  
  Pigment(1) — 18 Minimum, Titanium Dioxide (ASTM D476, Type II)  
  Epoxy Resin — 75 to 82

YELLOW  
  Pigment(1) — 23 Minimum, Medium Chrome Yellow (ASTM D211, Type III)  
  Epoxy Resin — 70 to 77

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.

The amine value of Part B shall be tested in accordance with ASTM D2074(2) to determine its total amine value. 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.

2. 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, when applied at a nominal wet film thickness of 0.38 ± 0.02 mm and allowed to cure, shall be a reasonable visual match to Munsell Book Notation N 9.5/0 (ASTM D1535).

The yellow epoxy composition, when applied at a nominal wet film thickness of 0.38 ± 0.02 mm and allowed to cure, shall be a reasonable visual match to Munsell Book Notation 10YR 8/14 (ASTM D1535).

b. Directional Reflectance.  
The white epoxy composition (without glass spheres) shall have a daylight directional reflectance of not less than 84% relative to a magnesium oxide standard when tested in accordance with ASTM E1347.

The yellow epoxy composition (without glass spheres) shall have a daylight directional reflectance of not less than 55% relative to a magnesium oxide standard when tested in accordance with ASTM E1347.

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.

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(1) The entire pigment composition shall consist of either titanium dioxide or medium chrome yellow. No extender pigments are permitted. The white pigment, upon analysis, shall contain a minimum of 16.5% TiO₂ (100% purity). The yellow pigment, upon analysis, shall contain a minimum of 20% PbCrO₄ (100% purity).

(2) The manufacturer may specify an alternate test method for determining the amine value subject to the approval of the Director, Materials Bureau.
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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 spectroscopy. 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.

**B. 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 Fm</th>
<th>600 Fm</th>
<th>300 Fm</th>
<th>180 Fm</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 glass spheres shall be treated with a moisture-proof coating. They shall show no tendency to adsorb moisture in storage and shall remain free of clusters and hard lumps. They shall flow freely from the dispensing equipment at any time when surface and atmospheric conditions are satisfactory for marking operations. The moisture-resistance of the glass spheres shall be determined on the basis of the following 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. Pour the sample slowly into 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.

**C. Packaging and Shipment.** 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:

1. Name of Product
2. Item Number
3. Lot Number
4. Batch Number
5. Test Number

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Reflective glass spheres 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.

**BASIS OF ACCEPTANCE.** Only epoxy pavement marking materials from manufacturers appearing on the Department’s Approved List shall be considered for acceptance. Details for obtaining Approved List status are available from the Materials Bureau.

Epoxy pavement marking materials will be sampled and tested in accordance with the procedural directives of the Materials Bureau. Samples will be taken at the manufacturing location and considered for acceptance in stock lot quantities.

Department red and green metal security seals will be placed on containers of pavement marking materials that meet specifications. The colored metal security seals serve as the evidence of acceptance for epoxy material delivered to the job site.

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.

**A. White and Yellow Preformed ReflectORIZED Pavement Markings**

1. **General Requirements.** 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.
2. Physical Properties.

a. 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).

b. 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.

c. 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 25EC.

d. 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.

e. 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 ± 2EC. For calculating the tensile strength of patterned type
material, the thickness measurements shall be taken in the thinnest portions of the cross-
sectional area.

f. 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.

g. 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 ±
2EC.

B. 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).

C. 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.

A 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.
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°C.

The spheres shall meet the following gradation:

<table>
<thead>
<tr>
<th>Standard Sieve</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passing 850 Fm; Retained 600 Fm</td>
<td>5%</td>
<td>20%</td>
</tr>
<tr>
<td>Passing 600 Fm; Retained 300 Fm</td>
<td>30%</td>
<td>75%</td>
</tr>
<tr>
<td>Passing 300 Fm; Retained 180 Fm</td>
<td>9%</td>
<td>32%</td>
</tr>
<tr>
<td>Passing 180 Fm</td>
<td>0%</td>
<td>10%</td>
</tr>
</tbody>
</table>

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.

Method of Testing. The properties indicated above shall be determined in accordance with the following methods of test:

1. Sphericity. Irregularly shaped particles (out-of-round) shall be tested in accordance with ASTM D1155.

2. Gradation. Tested in accordance with ASTM D1214.

3. 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.
§727-05

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 — VERTICAL LOAD TRANSMITTING DEVICES

728-01 RUBBER IMPREGNATED WOVEN COTTON FABRIC

SCOPE. This specification covers the material requirements, tests and basis of acceptance for rubber impregnated woven cotton fabric.

MATERIAL REQUIREMENTS. Rubber impregnated woven cotton fabric shall be composed of multiple layers of prestressed cotton 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.

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 under an Approved List.

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 M 2BC514A14B34. 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.

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**728–05 (VACANT)**

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**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>
<thead>
<tr>
<th>ASTM Test Method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>C642</td>
<td>6.7%</td>
</tr>
<tr>
<td>D1894</td>
<td>0.36</td>
</tr>
<tr>
<td>D1894</td>
<td>0.24</td>
</tr>
<tr>
<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.

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**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.

**GENERAL.** 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.

**MATERIAL REQUIREMENTS**

**Preparation of Panel Surface for Reflective Sheeting.** The surface preparation of panels for the application of Reflective Sheeting, materials specification §730–05, shall be performed by Method I or Method II, in strict accordance with the recommendations of the manufacturer of the reflective sheeting.

**Method I**

1. **Cleaning (Vapor or Alkaline cleaning)**
§730–01

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.  Sheetling 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 sheeting 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 recleaned until all traces of oil disappear.  Examine with extreme care, the surface near the edges, for presence of oil.

2. Etching (Use Acid or Alkaline Etch)

A. Acid Etch.  Etch in a 6% to 8% phosphoric acid solution at 38EC.  Rinse thoroughly with running cold water followed by hot water tank 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.

Method II

1. 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 82EC 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.

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GENERAL. Plywood sign panels for signs shall conform to the requirements for high density overlay as set forth in Product Standard PS 1–66—Soft Plywood, Construction and Industrial, for Douglas Fir Plywood and all amendments thereto as established through the United States Department of Commerce. The plywood panels shall be high density overlay, exterior type plywood, 5 ply and B–B grade or better. Inner plies shall be B grade veneers or better.

MATERIAL REQUIREMENTS. The thickness of the plywood sign panels and plywood battens shall be 19 mm. 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 thermo–setting 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/100m$^2$ 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 (tri–chloroethylene) 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.

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 m$^2$. 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, Classes A, B, and C, 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 adhesive or a heat and pressure activated adhesive, either of which may
§ 730–05
be applied without necessity of additional adhesive tack coats on the reflective sheeting or application surface.

Reflective sheeting shall be one of the following classes:

Class A (Materials Designation 730–05.01). 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.

Class B (Materials Designation 730–05.02). A high intensity reflective sheeting often referred to as high intensity. It is recommended for all highway signs, construction signs, other work zone devices and delineators.

Class C (Materials Designation 730–05.03). This is a highly reflective sheeting recommended for delineators, construction barricades and vertical panels. This material is not recommended for highway or construction zone sign faces.

REFLECTIVE SHEETING

730 TABLE 1
REFLECTIVE SHEETING MATERIALS

<table>
<thead>
<tr>
<th>Class</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials Designation</td>
<td>730–05.01</td>
<td>730–05.02</td>
<td>730–05.03</td>
</tr>
<tr>
<td>AASHTO Standard M 268</td>
<td>Type I</td>
<td>Type III</td>
<td>Type V</td>
</tr>
<tr>
<td>Nomenclature</td>
<td>Engineer Grade</td>
<td>High Intensity</td>
<td>Super High Intensity</td>
</tr>
<tr>
<td>Typical Uses:</td>
<td>Signs (tourist &amp;</td>
<td>Signs (regulatory,</td>
<td>Delineators,</td>
</tr>
<tr>
<td>(Intended only as</td>
<td>motorist services),</td>
<td>warning),</td>
<td>construction</td>
</tr>
<tr>
<td>general information guide)</td>
<td>work zone devices</td>
<td>work zone devices,</td>
<td>barricades,</td>
</tr>
<tr>
<td></td>
<td>delineators</td>
<td>delineators</td>
<td>vertical panels</td>
</tr>
</tbody>
</table>

MATERIAL REQUIREMENTS

1. Specific Intensity Per Unit Area (SIA). The SIA of the reflective sheeting shall conform to the minimum requirements of Table 2. Measurements shall be conducted in accordance with AASHTO Standard T257. The SIA shall be expressed in candelas per lux per square meter.

2. Color Requirements. The day color of the reflective sheeting shall conform to the requirements of Table 3, as determined in accordance with ASTM E1347. (Geometric characteristics must be confined to illumination incident within 10 degrees of, and centered about a direction of 45 degrees from a perpendicular to the test surface; viewing is within 15 degrees of, and centered about the perpendicular to the test surface. Condition of illumination and observations must not be interchanged.) The test apparatus shall be standardized in accordance with the manufacturer's recommended procedure. The reference standards for calibration of the apparatus shall be the Munsell Papers designated in Table 3.

3. Fabrication. The reflective sheeting shall be so fabricated as to allow its being easily cut 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 to all Federal, State and Local air quality regulations.

To assure uniform appearance and brilliance under both night 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.
### TABLE 2

**MINIMUM SIA (CANDELAS/LUX/m²) – CLASSES A, B* AND C SHEETING**

<table>
<thead>
<tr>
<th>Observation Angle (E)</th>
<th>Entrance Angle (E)</th>
<th>Color</th>
<th>Class A</th>
<th>Class B</th>
<th>Class C</th>
<th>Class A</th>
<th>Class B</th>
<th>Class C</th>
<th>Class A</th>
<th>Class B</th>
<th>Class C</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>-4</td>
<td>WHITE</td>
<td>70.0</td>
<td>250.0</td>
<td>700.0</td>
<td>14.5</td>
<td>45.0</td>
<td>150.0</td>
<td>25.0</td>
<td>100.0</td>
<td>230.0</td>
</tr>
<tr>
<td>0.2</td>
<td>+30</td>
<td>RED</td>
<td>30.0</td>
<td>95.0</td>
<td>400.0</td>
<td>6.0</td>
<td>13.3</td>
<td>86.0</td>
<td>7.0</td>
<td>26.0</td>
<td>131.0</td>
</tr>
<tr>
<td>0.5</td>
<td>-4</td>
<td>ORANGE</td>
<td>30.0</td>
<td>95.0</td>
<td>160.0</td>
<td>7.5</td>
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<td>34.0</td>
<td>13.5</td>
<td>30.0</td>
<td>53.0</td>
</tr>
<tr>
<td>0.5</td>
<td>+30</td>
<td>YELLOW</td>
<td>15.0</td>
<td>65.0</td>
<td>100.0</td>
<td>3.0</td>
<td>10.0</td>
<td>21.0</td>
<td>4.0</td>
<td>25.0</td>
<td>33.0</td>
</tr>
<tr>
<td>2.0</td>
<td>-4</td>
<td>GREEN</td>
<td>70.0</td>
<td>30.0</td>
<td>30.0</td>
<td>1.0</td>
<td>1.0</td>
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<td>3.0</td>
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<tr>
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<td>BLUE</td>
<td>70.0</td>
<td>30.0</td>
<td>30.0</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>1.8</td>
<td>1.8</td>
<td>1.8</td>
</tr>
<tr>
<td>2.0</td>
<td>-4</td>
<td>BROWN</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>2.0</td>
<td>+30</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

**NOTE:** *Minimum SIA value for Class B sheeting with either glass bead or prismatic retroreflective element material.

### TABLE 3

**COLOR SPECIFICATION LIMITS AND REFERENCE STANDARDS (CLASSES A, B AND C SHEETING)**

<table>
<thead>
<tr>
<th>CHROMATICITY COORDINATES&lt;sup&gt;3&lt;/sup&gt; (CORNER POINTS)</th>
<th>REFLECTIVE LIMITS (% Y)</th>
<th>REFERENCE STANDARDS&lt;sup&gt;4&lt;/sup&gt; (MUNSELL PAPER)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Color</td>
<td>X</td>
<td>Y</td>
</tr>
<tr>
<td>White&lt;sup&gt;2&lt;/sup&gt;</td>
<td>.303</td>
<td>.287</td>
</tr>
<tr>
<td>Red</td>
<td>.613</td>
<td>.297</td>
</tr>
<tr>
<td>Orange</td>
<td>.550</td>
<td>.360</td>
</tr>
<tr>
<td>Yellow&lt;sup&gt;2&lt;/sup&gt;</td>
<td>.498</td>
<td>.412</td>
</tr>
<tr>
<td>Green</td>
<td>.030</td>
<td>.380</td>
</tr>
<tr>
<td>Blue</td>
<td>.144</td>
<td>.030</td>
</tr>
</tbody>
</table>

**NOTES:**
1. Class A, B and C sheeting. The four pairs of chromaticity coordinates determine acceptable color in terms of the CIE, 1931 standard colorimetric system measured with standard illumination Source C.
2. Silver white is an acceptable color designation.
3. Available from Munsell Color Company, Baltimore, MD.
4. Values are for Yellow Class A & B sheeting only. For Yellow Class C sheeting: Corner Point 1, X = .528; Y = .382; Corner Point 2, X = .590; Y = .410; Corner Point 3, X = .479; Y = .520; Corner Point 4, X = .438; Y = .472.
§730–05
Backgrounds, characters, delineators, etc., shall be coated and/or edge sealed with the recommendations of the sheeting manufacturer. When performed, coating operations shall be done in 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 of storage. The sheeting surface shall be capable of being readily processed and be compatible with recommended transparent and opaque process inks and show no loss of the color with normal handling, cutting and application.

4. Test Methods and Requirements. Except as noted herein, all sheeting (Class A, Class B and Class C) shall be tested in accordance with the methods, and for the requirements as specified in AASHTO M 268. In addition, for initial Department approval samples of the sheeting material shall be subjected to continuous actual outdoor exposure for a minimum of two (2) years at three (3) locations within the State.

Exceptions to AASHTO M 269 shall include the following:

a) Specific Intensity Per Unit Area
b) Color Requirements

The specific intensity per unit area and color of Class A, B and C sheeting shall be tested in accordance with and meet the requirements of this specification (§730–05).

Basis of Acceptance. Class A, Class B and Class C reflective sheeting shall be approved by the Materials Bureau. Detailed requirements and procedures for approval are available from the Materials Bureau.

Approvals of reflective sheeting will be based on independent laboratory analysis and actual outdoor field exposure tests conducted in accordance with this specification. If the reflective sheeting passes the requirements for laboratory analysis and initial outdoor exposure tests, the product will then be placed on the Department’s “Approved List” of materials.

Project acceptance will be based on the appearance of the sheeting material on the Department’s approved list of reflective sheeting materials and the manufacturer’s certification of compliance to this specification.

730-06 THRU 730-08 (VACANT)

730-09 TUBULAR MARKERS

Scope. The specification covers the material requirements for flexible tubular markers used to define the proper travel path along a roadway, to channelize traffic in highway work zones, or to supplement or substitute for pavement markings in conformance with §290 of the Manual of Uniform Traffic Control Devices. These tubular markers are resilient when struck by errant vehicles but have sufficient stability to resist overturning due to wind and traffic turbulence.

General. Tubular markers shall be orange in color with a minimum height of 915 mm and a minimum outside diameter of 64 mm. 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 of the marker. The space between the bands 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.

MATERIAL REQUIREMENTS. When tested in accordance with the procedural directives of the Materials Bureau, tubular markers shall conform to the following requirements:

1. **Cold Bend Test.** After being conditioned at -23 ± 3°C and bent so that no part of the post is more than 300 mm above the height of the base, posts must return to their original straight configuration within an angle of ± 5° within 30 seconds and their bases must remain fixed to the concrete block.

2. **Cold Impact Test.** When conditioned at -23 ± 3°C and impacted 400 mm - 500 mm from the base with 54 J of energy imparted by means of a weight dropped a minimum of 300 mm, posts shall exhibit no cracking or splintering.

3. **Weatherometer Test.** When tested in accordance with ASTM G23, Method 2, for 300 hours, posts shall show no signs of discoloration and the reflective sheeting shall remain fixed to the post.

4. **Field Test.** After ten vehicle impacts impact at 80 km/h posts shall remain intact and securely anchored, return to their original vertical orientation within an angle of ± 15°, and retain a minimum of 50% of their reflective sheeting.

After each test, the post shall not exhibit any signs of distress (i.e., cracking, delamination, significant loss of rigidity).

**BASIS OF ACCEPTANCE.** Application for approval of tubular markers 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 tubular markers 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” (730–09).

### 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.
§730-10

Definitions and Optical Requirements

1. **Entrance Angle.** Shall mean the angle at the reflector between the direction of light incident on it and the direction of reflector axis.

2. **Observation Angle.** Shall mean the angle at the reflector between observers line of sight and direction of light incident on the reflector.

3. **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 $1 \times 10^{-6}$ 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.

**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>a</td>
<td>0</td>
<td>1.9</td>
</tr>
<tr>
<td>a</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 Sheetings, 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 Sheetings, 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

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.

730–15 THRU 730–19 (VACANT)

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 A–1 or rerolled axle steel may be used for small angle posts and ASTM A–36, A–242, A–441, A–572, Grade 345 and A–588 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.

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 materials specification §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 metal 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 Zinc Chromate Primer, §708–04, 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.

**GENERAL.** 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. Sheetng shall be applied in accordance with the sheeting manufacturer’s written instructions.
MATERIAL REQUIREMENTS. When tested in accordance with the procedural directives of the Materials Bureau, flexible delineator posts shall conform to the following requirements:

1. **Hot and Cold Bend Tests.** After being bent 90° around a 50 mm mandrel at 38°C and -23°C posts must return to their original straight configuration within an angle of ±10° within five minutes.

2. **Weatherometer Test.** When tested in accordance with ASTM G23, Method 2, for 500 hours, posts shall show no signs of discoloration and the reflective sheeting shall remain fixed to the post.

3. **Deflection Tests.** When cantilevered 1.2 m and loaded 13 mm from the end, posts shall develop an equivalent stress before collapse of 164 Pa for round posts and 254 Pa for flat or elliptical posts. After conditioning by cyclic loading, post shall develop at least 80% of the previously determined equivalent stress.

4. **Crash Tests.** After two vehicle impacts at 90 km/h and eight vehicle impacts at 70 km/h posts shall remain intact and securely anchored, return to their original vertical orientation within an angle of ±10°, and retain a minimum of 50% of their reflective sheeting.

5. **Field Test.** A one year field installation may be required to determine field performance at the discretion of the Director, Materials Bureau. After each test, the post shall not exhibit any signs of distress (i.e., cracking, delamination, significant loss of rigidity).

BASIS OF ACCEPTANCE. Flexible delineator posts shall be approved by the Director, Materials Bureau. Detailed requirements and procedure for approval are available from the Materials Bureau. Product acceptance will be based on the manufacturer's name and type of flexible delineator post appearing on the Department's Approved List.

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 specified on the plans or standard sheets and 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.

**BASIS OF ACCEPTANCE.** Acceptance will be based on the manufacturer's certification that its product conforms to these specifications.

**TABLE 730-22-1 STEEL FASTENERS**

<table>
<thead>
<tr>
<th>BOLT(1)</th>
<th>BOLT SIZE</th>
<th>ALLOWABLE NUTS(2,3)</th>
<th>BOLT, NUTS &amp; WASHER COATING SYSTEMS(4)</th>
<th>PLAIN WASHER</th>
<th>PREVAILING TORQUE HEX NUTS AND HEX FLANGE NUTS(6)</th>
<th>LOCK WASHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS 4.6</td>
<td>M 5 TO M 36 M 42 TO M 100</td>
<td>5 - H1 5 - HH</td>
<td>P OR Z P OR Z</td>
<td>CLASS 5,9 or 10</td>
<td>SEE NOTE 5</td>
<td>SEE NOTE 7</td>
</tr>
<tr>
<td>CLASS 8.8</td>
<td>M 16 TO M 36 M 42 TO M 100</td>
<td>9 - H2 12 - H2 9 - HH 12 - HH</td>
<td>P Z P Z</td>
<td>CLASS 5,9 or 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 10.9</td>
<td>M 5 TO M 36 M 42 TO M 100</td>
<td>10 - H1 12 - HH</td>
<td>P P OR Z</td>
<td>CLASS 9 or 10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**

1. ASTM F568
2. ASTM A563M
3. 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
4. P > M 9.5, use: ASTM B695, class 50, type 1
   - P # M 9.5, use: ASTM B695, class 40, type 1, cadmium coating
   - ASTM B696, class 8, type 2
   - ASTM B766, class 12, type 2, cadmium/tin coating
   - ASTM B635, class 8, type 2
   - Z > M 9.5, use: ASTM A153, class C
   - Z # M 9.5, use: ASTM A153, class D

5. $ M 12, use: ASTM F436M IFI 542 or ANSI B18.22M, hard only
   - M 12, use: ANSI B18.22M, soft
6. ANSI B18.16.1M
7. General Motors Standard Metric Helical Spring General Specification F100

**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 following physical requirements:

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>ASTM TEST METHOD</th>
<th>MIN.</th>
<th>MAX.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength</td>
<td>D638</td>
<td>69 MPa</td>
<td>5</td>
</tr>
<tr>
<td>Tensile Modulus</td>
<td>D638</td>
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<tr>
<td>Impact Resistance</td>
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**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/EC 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."

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**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 approved Type A Sign Supports shall 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.
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.

EQUIPMENT REQUIREMENTS. 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, 2½ or 4 NPS 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 SamplerS

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
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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 compo-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 Subsection 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.

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°C ± 3°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°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°C to +38°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 A446, Grades A thru E. Fabrication shall be in conformance with ASTM A525, coating Class G165. Prior to fabrication of forms the Contractors shall submit to the Engineer certification for conformity of steel and galvanizing to ASTM A446.

**DESIGN REQUIREMENTS.** The following shall govern the design of permanent corrugated metal stay-in place (S. I. P.) forms:

1. **Design Span** shall be the clear span of form plus 50 mm measured parallel to the form flutes.

2. **Design Load** shall be the sum of the weights of form, bar reinforcement, plastic concrete and 2500 newtons per square meter for construction loads.

3. **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.

4. **Dead Load Deflection** shall not exceed 1/180 of the form span or 13 mm, whichever is less.

5. **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.** The Contractor shall submit to the Engineer for acceptance, the form manufacture's certification, 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 A446 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 THROUGH 739 (VACANT)**
SECTION 740 - PAINTING PROCEDURES

740-01 PAINTING METAL STRUCTURES

SCOPE. This specification covers painting procedures required for the shop, field and maintenance painting of metal surfaces.

Definitions

A. **Painting** shall include the surface preparation and application of paint or paint coats to metal surfaces in the shop or field.

B. **Paint** unless otherwise specified in the contract documents, shall mean the Department’s standard structural paints, materials specification section 708.

C. **Surface Preparation** shall mean the cleaning, pretreating or repairing of surfaces to be painted as specified in the contract documents.

D. **Shop Painting** the painting of metal surfaces at the place of fabrication prior to shipment.

E. **Field Painting** the painting of new prime coated metal surfaces at the construction site.

F. **Maintenance Painting** the painting of existing installations or structures in service.

G. **Steel Structures Painting Council (SSPC)** SSPC specifications referred to herein, may be obtained through the Council at: Mellon Institute, 4400 Fifth Avenue, Pittsburgh, Penn. 15213.

Material

A. **General.** All paint, unless otherwise specified in the contract documents, shall meet the requirements of section 708-01, Paints - General, of these specifications.

B. **Prime Coat.** The primer for steel surfaces cleaned in accordance with paragraph “Commercial Blast Cleaning” shall conform to the requirements of material specification §708-09, Blasted Surface Primer or material specification §708-03, Dull Orange Primer.

C. **Intermediate Coat.** The intermediate coat or second coat, unless otherwise noted in the contract documents shall conform to the requirements of material specification §708-10, Gray Paint. the intermediate coat may be applied in the shop or the field.

D. **Finish Coat.** The finish or third coat, unless otherwise noted in the contract documents shall conform to the requirements of material specification §708-11, Sage Green Paint or §708-12, Light Gray Paint. The contract documents will designate those areas upon which each finish coat is to be applied. If the contract documents do not designate a finish coat, Sage Green Paint, section 708-11, shall be used. The finish coat may be applied in the shop or field.

Atmospheric Conditions. No paint shall be applied, either in the field or shop, when the ambient temperature is below 4.5°C or the relative humidity is greater than 85%. No paint shall be applied when the receiving surface temperature is less than 4.5°C nor more than 38°C, or when determined, by the Engineer or Inspector, atmospheric conditions are such as to produce unsatisfactory results.

Storage of Paint. All containers shall be stored so as to be protected against freezing and excessive heat. In cold weather paint shall be stored in warm surroundings of not less than 0°C. In hot
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weather conditions the paint shall be stored in such a manner that material temperatures do not exceed 38°C.

Surface Preparation

A. General. All metal surfaces and welds to be painted shall be thoroughly cleaned of rust, mill scale, slag, dirt, oil or grease and other foreign substances to the degree specified. All cleaned steel surfaces shall be inspected by and approved by the Engineer or Inspector prior to the application of paint. Surfaces which do not meet these specification requirements shall be cleaned again at the Contractor’s expense.

The following methods of surface preparation or cleaning shall be used unless otherwise noted in the contract documents.

B. Solvent Cleaning. For the removal of dirt, oil, grease, drawing and cutting compounds, and detrimental weld fume deposits by the use of solvents and other materials.

Solvent cleaning shall be performed in accordance with the requirements of SSPC-SP1, No. 1, Solvent Cleaning.

All solvents and other materials used in cleaning operations shall conform to Federal, State, and local air pollution regulations.

C. Hand Tool Cleaning. For the removal of loose rust, loose mill scale and loose paint by the use of hand sanding, brushing, chipping, other hand impact tools or a combination of these methods.

Hand tool cleaning shall be performed in accordance with the requirements of SSPC-SP2, No. 2, Hand Tool Cleaning.

The surface, after cleaning, shall be defined by SSPC-Vis 1, Pictorial Standards BSt2, CSt2, or DSt2 as applicable.

D. Power Tool Cleaning. For the removal of loose rust, loose mill scale, loose paint and slag with power sanders, power impact tools, power wire brushes, power grinders, other power tools or a combination of these methods.

Power tool cleaning shall be performed in accordance with the requirements of SSPC-SP3, No. 3, Power Tool Cleaning.

The surface, after cleaning, shall be defined by SSPC-Vis 1, Pictorial Standards BSt3, CSt3, or DSt3 as applicable.

E. Brush-Off Blast Cleaning. For rapid removal of oil, grease, dirt, loose rust, loose mill scale, loose paint and slag. Tight rust, mill scale, and paint is sufficiently abraded to provide adhesion of the paint.

Brush-off cleaning shall be performed in accordance with SSPC-SP7, No. 7 Brush-Off Blast Cleaning.

SSPC-Vis 1-89 or other visual pictorial standards of surface preparation will not be specified to supplement the SSPC-SP7 written definition of surface cleanness.

After blasting operations are completed, all surfaces shall be cleaned of blasting products and other residue by the use of clean soft brushes, or blown off with compressed air, or vacuumed, or water rinsed.

F. Commercial Blast Cleaning. For the removal of all dirt, grease, rust scale, foreign material and mill scale, rust, old paint and slag to the extent that staining is limited to light shadows, slight steaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied paint.

Commercial blast cleaning shall be performed in accordance with SSPC - SP6, No. 6, Commercial Blast Cleaning. After blasting operations are completed, all surfaces shall be cleaned of blasting products and other residue by the use of compressed air or vacuumed.
The surface, after cleaning, shall be accepted by visual comparison to a project prepared standard. The contractor shall prepare the project standard by blast cleaning a representative area on the structure that is being prepared for painting. The prepared standard shall generally conform to SSPC-Vis 1-89, “Visual Standard for Abrasive Blast Cleaned Steel”, Pictorial Standard B SP 6, C SP 6, and D SP 6, as applicable, and shall be approved by the Engineer before the start of general cleaning work.

At least one standard shall be prepared for each structure that is being specified for cleaning. More than one standard may be necessary if the cleaned steel differs significantly from the photographic standards due to surface conditions, abrasive being used, etc. Each standard shall be at least 0.5 m x 0.5 m in size, and shall be located on an area of the structure that is accessible to, and approved by the Engineer.

The contractor shall protect the project standard from corrosion and contamination throughout the duration of work. Protection shall be provided by applying a clear coat of polyurethane, or other means. At the completion of cleaning work the project standard shall be recleaned and painted according to the contract documents. If in the opinion of the Engineer the project standard becomes deteriorated, or otherwise ineffective, it shall be re-established in accordance with this specification, at no additional cost.

G. Final Preparation. Unless otherwise noted in the contract documents, the final surface preparation, prior to painting, shall be done by Commercial Blast Cleaning methods.

In the case of rolled or fabricated steel being prepared for installation on Department contracts, only surfaces which generally conform to pictorial standards B SP 6 and C SP 6 will be acceptable.

Mixing Paint. All paint shall be thoroughly mixed prior to application. Preferably mechanical mixers should be used to thoroughly disperse many settled pigment or solids. When hand mixing is performed, the liquid portion of the paint shall be poured into a clean container, leaving any settlement in the original container. The liquid shall then be slowly poured back into the original container while at the same time dispersing any settled material by stirring with a clean paddle or other suitable instrument. When all settlement has been dispersed, the paint shall be poured several times from one container to the other to insure proper mixing.

Solvent Restrictions. No thinning of paint, by the use of solvents or other material shall be allowed, and painters shall not carry or in any other way have access to containers of solvent when painting.

The quantity of solvent permitted on the job site shall be only the reasonable amount necessary for cleaning equipment, wiping dirt and grease from surfaces to be painted and cleaning of paint and spatters.

All solvents used for cleaning operations shall conform to the Federal, State and local air pollution regulations.

Unauthorized use of solvents shall result in the repainting of the surface in conformance with the specifications and to the satisfaction of the Engineer, at the Contractor's expense.

Consistency of Paint. Paints specified are formulated ready for application when delivered to the job site. If during cool weather it is desirable to reduce the consistency so that the paint will flow more freely, the paint may be heated. Heating may be accomplished by placing the container of paint in hot water, wrapping the container with heating coils, using paint heaters or heat exchangers or by other methods approved by the Engineer. Heating by open flame shall not be allowed. In no instance shall paint be heated to a temperature in excess of 38EC.

Number of Coats. With the exception of those specific areas excluded herein or as otherwise specified in the contract documents, all new structural steel shall be painted at least three coats of paint in the following order: prime coat, intermediate coat, and finish coat.
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Painting Schedule. With the exception of those areas to be “striped” in advance of general painting and structural steel which has been primed with material specification §708-09, Blasted Surface Primer, at least 48 hours shall elapse between the application of any two coats of paint. Structural steel primed with material specification §708-09, may be painted the intermediate coat not sooner than 16 hours after application of the primer. In no case shall a succeeding coat be applied until the previous coat has dried throughout the full thickness of the paint film.

On new structural steel members subjected to outdoor storage, the intermediate coat shall be applied no later than 120 days after application of the prime coat. The counting of days shall commence on the first day of outdoor storage. Steel stored outdoors and not painted the intermediate coat within 120 days shall be reclined and repainted another prime coat at the Contractor’s expense.

The finish coat may be applied at any time, but in no case sooner than 48 hours after the application of the intermediate coat.

No changes to the painting schedule will be permitted without the express written consent of the Director, Materials Bureau.

Paint Application Methods

A. General. All paint shall be applied in a neat and workmanlike manner. Paint shall be applied uniformly at the specified wet film thickness and coatings shall be free of runs, sags, drips, ridges or other defects. Paint may be applied by brushes, or rollers, or air-less spray, or a combination of these methods provided the method does not cause damage to public or private property.

B. Hand Brushing. The paint, shall be applied with brushes, shall be so manipulated by the brush as to produce a uniform even coating. When applying a coating to a previously painted surface, strokes should be made perpendicular to those of the receiving surface to insure adequate anchorage. Brushes shall be of good quality and the length of the exposed bristle shall be equal to or greater than the width of the brush.

On those areas which are inaccessible to brushes, the paint shall be applied by the use of rollers, or air-less spray equipment, or daubers, or sheepskins.

C. Rolling. Rollers for the application of paint shall be of such a quality to produce a smooth uniform coating. Roller covers shall be “all-mohair” made from Angora Goat wool; “mohair” made from blends of mohair, wool and/or rayon or as approved by the Engineer.

The roller cover shall be uniformly loaded with paint by rolling on the slanted surface of a tray, framed screen wire or other suitable device. Roller application shall be done at such a pace that no spinning of the roller or throwing off of paint occurs when the roller is lifted from the surface. The paint shall be applied by rolling from a dry to a wet area while varying the direction of the stroke. The paint shall be feathered out by using light pressure at the end of the stroke to promote uniformity.

On those areas which are inaccessible to roller application, the paint shall be applied by the use of brushes, or air-less equipment, or daubers, or sheepskins.

D. Air-less Spraying. Air-less spray equipment shall be capable of applying paint in a fine, even spray so as to produce a uniform coating. Air-less spray equipment shall consist of a hydraulic pump (air or electric power) mounted over a paint tank, high pressure hoses, spray gun, valves, gages, regulators, screens, traps and other equipment necessary to satisfactorily complete the work.

Spray painting shall be done by experienced and qualified painters. Painters shall determine the best distance between the spray gun and receiving surface so as to promote uniform coverage and prevent and discontinuity of the applied paint film. The spray gun shall be moved uniformly across and perpendicular to the receiving surface. To insure a uniform coating each spray pass
should lap the other by 50%. Any sags, drips, air holes or other film defects shall be immediately corrected by hand brushing.

On those areas that are inaccessible to air-less spray application, the paint shall be applied by brushes, or rollers, or daubers or sheepskins.

E. Electrostatic Spray. Electrostatic spray application will be permitted only upon approval of the Deputy Chief Engineer (Structures).

The Contractor shall give proof of the following:

That it is familiar with electrostatic spray painting and has successfully used the process.

That painters applying the paint are experienced in the operation of the electrostatic spray equipment.

That additives, if any, to the paints in section 708 of these specifications, to make said paints compatible with the electrostatic spray process shall not be detrimental to the normal life expectancy of said coatings.

The spraying operation shall be conducted in strict accordance with the recommendations of the manufacturer of the electrostatic equipment. The Contractor shall make available at the site of the work, for not less than a total of 5 working days, a technical advisor employed by the equipment manufacturer to instruct the Engineer in proper application techniques and inspection methods.

Termination of Spraying or Rolling Operations. The Engineer is empowered to terminate spraying or rolling operations, temporarily or permanently, if he determines that any of the following conditions exist:

a. Satisfactory results are not being obtained.

b. The required wet film thicknesses are not being obtained.

c. Areas not specifically designated to be painted are likely to be or are being affected by the application method.

d. The application method is causing damage to public or private property.

If the Engineer permanently terminates spraying or rolling operations, he may do so by verbal order by he shall notify the Contractor, in writing, of his reasons for termination, within one week or termination. The Engineer may temporarily terminate painting operations by verbal orders. Spraying or rolling operations which are terminated due to damage to public or private property shall not be resumed unless the Contractor takes appropriate measures to protect such property and demonstrates to the Engineer's satisfaction that such property damage will not recur. If spraying or rolling operations are permanently terminated, the Contractor may apply paint in accordance with another approved method. No extra compensation will be paid for the substitution of another method of application.

Painting

A. General. The painting of metal surfaces shall include, but not limited to the following:

- The proper penetration of surfaces.

- The application, protection and drying of the paint coatings.

- The protection, from paint spatter or spillage, of pedestrian, vehicular, marine or other traffic upon, beneath or adjacent to the painted surfaces.

- The protection against disfigurement of all portions of bridge and other structures as well as highway appurtenances. Disfigurement may be caused by abrading, scoring, spattering, over-spraying, splashing and smirching of paint or cleaning materials.
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- The prevention of spillage of paint or any other pollutants into any waterway or body of water.
- The supplying of all equipment, tools, tackle, scaffolding, labor and materials necessary to complete the entire work.

Equipment. Prior to the start of and throughout the duration of work the Contractor shall be required to supply the Engineer with the following:

- Air Thermometer, pocket type, -10°C to +100°C (2)
- Surface Thermometer, -10°C to +100°C (2)
- Wet Film Thickness Gage, prong type (1)
- Dry Film Thickness Gage, magnetic type (1)

Number in parentheses designate minimum quantity required.

Unless otherwise specified herein, all new structural steel shall be painted the prime coat in the shop or plant. The intermediate coat or both the intermediate and finish coats may be applied either in the shop or field, at the Contractor's option.

No painting shall begin until cleaned surfaces have been inspected and approved by the Engineer or Inspector.

All receiving surfaces shall be clean and dry. Steel surfaces that have been cleaned by wet blasting or water rinsed shall not be painted sooner than 24 hours after the cleaning operation has been completed.

All containers of paint used shall be approved and sealed by the Department in accordance with Materials Method 6 and 6.11 prior to use. The seals shall not be broken nor containers ressealed during the progress of the work without authorization of the Engineer or Inspector.

Metal surfaces coated with unauthorized paint and those surfaces not coated in accordance with paragraph, “Painting Schedule” shall be cleaned and repainted in accordance with these specifications and to the satisfaction of the Engineer.

Painting requirements for structural steel members embedded in, partially embedded in, or in contact with: cast-in-place, or pneumatically projected concrete are as follows:

1. Fully embedded steel, defined as a steel member completely surrounded by concrete, shall not be painted.

2. Partially embedded steel, defined as steel member with a portion fully surrounded by concrete, shall have its exposed surfaces painted. Such painting shall extend at least 0.3 m along the embedded portion. If the steel is weathering steel and is not to be painted, the embedded portions shall not be painted.

3. A steel member, or portion of a steel member, neither fully, nor partially embedded, but still in contact with concrete shall have all its surfaces painted unless otherwise required by the contract documents. The sole exception to this requirement is top flanges of steel girders, beams and stringers against which concrete is to be placed. These shall not be painted.

Whenever painting is required, the prime, intermediate, and finish coats shall be applied in accordance with the requirements of this subsection.

Metal to metal contact surfaces shall not be painted. Contact surfaces shall be given a coat of clear lacquer or other protective coating as approved by the Engineer or Inspector if exposure is to exceed three months prior to erection. This coating shall be removed at the time of erection.

Machine finished surfaces shall be protectively treated in accordance with subsection 207.4, Protective Coating for Machined Surfaces, of the New York State Steel Construction Manual.
Structural steel which is to be welded, except for preblasted material which has been treated with an approved washcoat, *shall not be painted until all welding is complete. If welding is to be done in the shop only, the welds shall be cleaned, "Striped" and painted in the shop with one extra coat of primer. Steel which is to field welded shall be left unpainted for a minimum of 100 mm from the weld area.

* An approved washcoat shall be one approved by the D. C. E. S.

To secure a maximum thickness of paint film all welded areas, rivet heads, bolt heads, nuts and edges of plates, angles or other shapes shall be “striped” with one coat of shop primer in advance of general painting and shortly thereafter shall be given a second coat when the general coat is applied. Preferably, welds to be "striped" in advance of general painting operations should be coated immediately after the steel has been cleaned and accepted. The paint shall be worked into all joints and open spaces.

Surfaces of iron and steel castings milled for the purpose of removing scale, scabs, fins, blisters or other surface deformation shall be painted one coat of primer in the shop.

**B. Shop Painting.** All structural steel surfaces shall be cleaned in accordance with the requirements of “Surface Preparation,” subdivision F. Commercial Blast Cleaning, and subdivision G. Final Preparation.

Surfaces may be primed with either material specification §708-03, Dull Orange primer, or materials specification §708-09, Blasted Surface Primer.

Surfaces cleaned in accordance with paragraph, “Commercial Blast Cleaning” may be preblasted and treated with an approved washcoat prior to fabrication.

On welded work, special care shall be taken to insure the removal of all weld spatter, flux, slag and fume deposits which could cause paint failure. Detrimental weld residue shall be removed in accordance with an approved method as listed in “Surface Preparation.”

Final cleaning of welded work shall directly precede "striping" operations. Striping shall be performed in accordance with one of the methods in "Paint & Application Methods."

All structural steel specified to be painted shall receive at least the prime coat of paint in the shop after fabrication work is completed and accepted. Unless otherwise specified, the intermediate coat and finish may also be applied.

Cleaned structural steel, except for that material which has been preblasted and treated with approved washcoat shall be painted one coat of primer within 24 hours after cleaning operations have been completed.

The application of additional coats of paint shall be done in conformance with “Painting Schedule.” Prior to the application of the intermediate or finish coats, the previously painted steel shall be cleaned of all grease, dirt, oil, or other foreign material in accordance with “Solvent Cleaning.” If detrimental rusting has occurred, these areas shall be cleaned by one of the methods in “Surface Preparation” and “touched-up” or repainted the previous coat to the satisfaction of the Engineer, to Inspector. After drying, each paint coat shall be examined for damage and "touched-up" prior to recoating or shipment.

Unless otherwise specified, the inside surfaces of boxed members and other surfaces that will be sealed from the atmosphere after assembly shall not be painted.

The manufacturer of fabricator shall not paint his name upon any structural member. Shipping pieces shall not be loaded until thoroughly dry. Erection marks for the field identification of members shall be painted on the prime intermediate coats. Markers or attached tags shall be used to identify those members which have been painted the finish coat in the shop. All marking shall be done in accordance with the requirements of subsection 206.11, Marking and Shipping, of the New York State Steel Construction Manual.

For recoating purposes, after the prime coat has thoroughly dried, the date (month/day/year) of application of the paint shall be painted upon the previously painted surface.
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C. Field Painting. Structural steel not previously painted with the intermediate and finish coats in the shop shall be painted in the field.

The intermediate coat shall be Gray Paint as specified in “Intermediate Coat.” The finish coat shall be as specified in the contract documents and in accordance with “Finish Coat.”

The application of the intermediate coat shall be completed within the time limits of “Painting Schedule.”

Painting operations may be performed either prior to or after erection. Preferably the finish coat should be applied after erection and when all concrete work is completed.

Prior to general field painting, previously painted steel shall be thoroughly cleaned of oil, grease, dirt, concrete spatter and other detrimental material in accordance with “Solvent Cleaning.” Particular care shall be taken in cleaning field rivets and bolts and in cleaning field welds.

The Contractor shall take all necessary precautions to protect cleaned surfaces and wet paint from dust and other foreign material at the construction site.

After erection, all areas where paint has become damaged or deteriorated shall be thoroughly cleaned and “touched-up” or repainted the appropriate number of coats as directed by and to the satisfaction of the Engineer. When the finish coat is applied prior to erection, any portions of the structure that have been damaged, marked (including touch-up work) or otherwise abraded, to the extent that the aesthetic continuity of the structure is interrupted, shall be repainted another finish coat, as directed by the Engineer, at the Contractor’s expense.

D. Maintenance Painting. Maintenance painting shall be performed in accordance with the requirements of this Section (740) as modified by Section 570, "Cleaning and Painting" and the following:

1. Surface Preparation.

A. Abrasives for Blast Cleaning. Abrasive materials for blast cleaning operations may be selected by the Contractor, except that they shall be approved by the Engineer before the start of the work.

All abrasives shall be free of corrosion producing contaminants and also free of oil, grease or other deleterious contaminants.

The size of the abrasive selected for use in cleaning Category I steel surfaces to bare metal shall be such as to produce a cleaned surface that is suitable for the application of the specified paint.

B. Solvents and Cleaning Agents. Solvents and other cleaning materials for use in surface preparation work may be selected by the Contractor except that they shall be approved by the Engineer and must conform to all applicable Local, State or Federal law, regulation or code.

C. Brush-off (SSPC-SP7) and Commercial Blast Cleaning (SSPC-SP6). Before any blast cleaning work begins all visible deposits of oil, grease, dirt, salt or similar contaminants shall be removed by any of the methods specified in SSPC-SP1, Solvent Cleaning.

On surfaces cleaned to bare metal (Category I) the perimeter(s) or edges(s) of adjoining intact paint shall be feathered back and the adjoining paint must be tightly adhered. Ragged edges on adjoining paint will not be allowed. Adherence will only be considered satisfactory if the adjoining remaining paint is smoothly feathered and cannot be removed by lifting with a dull putty knife.

On surfaces cleaned to bare metal (Category I), small pieces of intact paint that measure twenty-five (25) square centimeters or less in area, and that remain within the cleaned surface
area, shall be completely removed. Small pieces of intact paint that are greater than twenty-five
(25) square centimeters will be allowed to remain only if their perimeter(s) can be satisfactorily
feathered back in accordance with this specification.

After blast cleaning work is complete, any remaining visible deposits of oil, grease, dirt, salt
or similar contaminants shall be removed in accordance with SSPC-SP1. All blasting residues
shall be removed. All surfaces cleaned to bare metal shall be inspected for cleanliness by
comparison with the pictorial standards.

2. Paint Film Thickness. All paint shall be applied at the specified wet film thickness so as to
produce a minimum dry film thickness as specified in the contract documents.

3. Painting. No work shall begin until the Contractor has supplied the Engineer with the
inspection equipment specified in §740-01.

Stripe painting with primer will be required on the following surfaces cleaned to bare metal
(Category I). All welds, rivets, bolts, nuts, and edges of plates, angles, lattice pieces or other
shapes, and corners and crevices shall be "striped" with primer before the general touch-up prime
coat is applied. The stripe coat shall be allowed to set to touch, before the general touch-up primer
coat is applied. All strip painting will be performed using a brush only. No other method of paint
application will be allowed for stripe painting.

On surfaces painted with primer, the intermediate coat shall be applied no later than 120 days
after application of the primer coat. Steel surfaces not painted the intermediate coat within 120
days shall be recleaned and repainted another prime coat at the Contractor’s expense.

On surfaces cleaned to bare metal (Category I) the dry film thickness for each coat of paint
(primer, intermediate and finish) shall be determined in accordance with SSPC-PA2, Paint
Application Specification No. 2, Measurement of Dry Paint Thickness with Magnetic Gages.
Wet film thicknesses shall be recorded on previously painted surfaces (Category II).

On any painted surface (Category I and Category II) the total dry film thickness as determined
by SSPC-PA2, shall not be less than the total thickness for all coats specified in the contract
documents. Should the dry film thickness measure less than specified on any completed surface,
the Contractor shall repaint the surface to obtain the specified film thickness. All recoating work
done for this purpose shall be performed as directed by the Engineer, and at no additional cost to
the State.

740-02 PAINTING TIMBER AND LUMBER

SCOPE. This specification covers the procedures for the shop and field painting of timber and lumber
surfaces. The requirements of section 740-01, Painting Metal Structures shall apply as applicable.
Paint material shall comply to the requirements of section 708, Paints.

Painting. Prior to application of paint, all wood surfaces shall be clean and dry. Cracks, splits,
gouges or other surface defects shall be repaired with a high quality wood putty or caulking compound.
Cleaning shall be accomplished by wiping, sanding or wire brushing.

Unless otherwise permitted by the Engineer, paint shall be applied by brushes.

New timber and lumber surfaces shall be primed with a mixture of materials specification §708-
20, Stain Resistant White Paint and pure linseed oil. The composition used for priming new surfaces
shall be mixed in the following proportions:

1 liter white paint
1 liter pure linseed oil

Previously painted timber and lumber surfaces shall be primed with the finish paint as specified in
the contract documents.
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When painting wood surfaces which have been treated with Creosote Oil, Oil Borne wood preservative is specified or noted upon the plans or in the proposal, the clean, dry, cured surface shall be given a prime coat of material specification §708-08, Ready-Mixed Aluminum Paint prior to application of the specified finish paints.

740-03 PAINTING GALVANIZED SURFACES

SCOPE. This specification covers the procedures required for painting galvanized surfaces. The requirements of section 740-01, Painting Metal Surfaces, shall apply as applicable.

Painting. Prior to painting, galvanized surfaces shall be treated as follows:
First, the galvanized surface shall be cleaned of all dirt, oil, grease and other foreign material in accordance with the requirements of section 740-01, “Solvent Cleaning.”
Second, the cleaned galvanized surface shall be pre-treated with a “wash-coat” of a type conforming to the requirements of Military Specification MIL-P-15328b or c or an approved equal. The pretreatment may be applied by any method, as approved by the Engineer.
After application and drying of the pretreatment, paint shall be applied as specified in the contract documents.

740-04 PAINTING ALUMINUM SURFACES

SCOPE. This specification covers the procedures required for painting aluminum surfaces. The requirements of section 740-01, Painting Metal Structures, shall apply as applicable.

Painting. Those portions of aluminum or aluminum alloy surfaces that will be in contact with cast or pneumatically projected concrete shall be painted one coat of a good quality zinc chromate primer or another type of paint material specifically formulated to reduce alkali attack.
Aluminum surfaces not in contract, but which are required to be painted, shall be coated the appropriate number of coats of paint as specified in the contract documents. Unless otherwise specified, pretreatment of the aluminum surface, prior to the coating application, shall not be necessary.

SECTION 741 - PAINT REMOVAL AND CONTAINMENT

741-01 LOCALIZED PAINT REMOVAL FROM STRUCTURAL STEEL BY VACUUM CONTAINED METHODS

SCOPE. This specification covers removing paint, corrosion products, dirt, salt, and other materials required by the contract documents from structural steel. All removals will be performed by means of solvents and vacuum containing paint removal equipment.

EQUIPMENT REQUIREMENTS. Equipment used for this work may be shrouded power tools with vacuum attachments; a vacuum blaster; a combination of the two; or any other vacuum containing method which:
1. Is capable of removing all existing paint from the surface.
2. Will collect and contain the removed material, and all abrasive employed.
3. Does not permit the release of visible quantities of dust or debris into the atmosphere.
4. Will not vaporize existing paint into the atmosphere.

The contractor is hereby notified that some types of vacuum containing removal equipment are patented. The possibility of royalty payments exists.
All equipment will be approved by the Engineer prior to the beginning of any work. Equipment will be approved on the basis of a paint removal demonstration. For each type of equipment the Engineer will choose a demonstration site which is part of the work. Each demonstration site shall be at least 1 m² in area unless otherwise permitted by the Engineer. Each demonstration site shall be reflective of the different configurations to be encountered and exhibit all material in need of removal. If this is not possible, the Engineer shall choose separate demonstration sites which meet the foregoing requirements. Each type of equipment will be required to remove all materials as noted in the contract documents, and conform to the requirements of this specification.

If the equipment uses abrasives, the contractor may supply any recyclable abrasive which contains less than one percent free silica. The supplied abrasive shall be compatible with the requirements of the equipment.

The Engineer is empowered to rescind approval of any piece of equipment which, in his/her opinion, is not performing as required. All such equipment shall be immediately removed from the work site.

**CONSTRUCTION DETAILS.** Unless otherwise provided by the contract documents, all existing paint shall be removed for a minimum distance of 100 mm on each side of the centerline of cut, bolt row, rivet row, or weld, as applicable. If the steel is to be heated prior to straightening, or other similar operation, the minimum removal limits shall be 100 mm beyond the direct heat application area or as shown on the plans.

Unless otherwise noted by the contract documents, the contractor shall assume that all paint removed is lead-based; therefore, all waste resulting from the removals shall be treated, handled and disposed of as hazardous waste in accordance with all applicable Federal, State, and Local rules and regulations. The contractor’s attention is directed to subsection 107-05; SAFETY AND HEALTH REQUIREMENTS.

All material not contained by the paint removal equipment shall be collected by vacuum methods only. No shoveling, dry sweeping, wet sweeping, or air-blowing will be permitted. All vacuums shall be equipped with high efficiency particulate (HEPA) filters.

After the paint has been removed by vacuum containing methods, the location shall be inspected for cleanliness. No existing paint will be permitted to remain. If the contractor is able to effectively demonstrate that vacuum containing methods are incapable of removing remaining paint, the Engineer may permit paint removal by a supplemental method such as hand tools or chemical stripping.

Rust, mill scale, and other similar materials that are not paint, demonstrably not removable by vacuum containing methods, may be permitted to remain, or may be required to be removed by one, or more, of the foregoing methods. Removal will be ordered by the Engineer.

All removed material generated by power tool or hand cleaning methods shall be collected by vacuums equipped with HEPA filters. No other method will be permitted.