§711-02

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

A. Tufting. The cotton thread for tufting shall be not less than 4-cord number 12’s.

B. Sewing or Stitching. The thread used for all sewing or stitching shall be at least equivalent in size and strength to standard 3-cord number 30 cotton thread.

DIMENSIONS

A. Mats. Mats shall have a filler of 1750 mm in width and shall have a flap 150 mm or more in width, consisting of an extension of two thicknesses of the covering material, extending along one longitudinal edge of the mat. The length of the mats shall be 760 mm greater than the width of pavement slab to be cured.

B. Tolerance. The length or width of the mats shall not be less than that specified by more than 2 percent.
§711-02

FABRICATION

A. Covering Material. The covering material for each surface of the mat shall consist of two widths of cloth joined by a lapped seam or by a seam formed by superimposing the two widths and uniting them by one row of stitches. If the seam of the latter type, the edges shall be on the inside of the finished mat.

B. Filling. The cotton filling materials in the form of a bat or bats shall be held in place between the coverings by sewing or tufting all around the periphery of the mat within 25 mm of each of the four edges of the filler, and by sewing or quilting longitudinally at intervals not greater than 100 mm, or by tufting at intervals both longitudinally and transversely, not greater than 75 mm. The sewing or tufting shall be sufficiently loose to permit substantially all of the surface of the mat to come in contact with a flat surface when in use, but not so loose as to permit the filling material to shift.

C. Flap and Ends. The flap shall be constructed by sewing the upper and lower covering together longitudinally within 25 mm of the outer edges of the flap. Along the edge of the mat opposite the flap, the filling materials shall be within 25 mm of the edges of the covering material, and the covering material shall be sewn together so as to enclose the filling material. The ends of the mats shall be finished by running an additional seam (i.e., a seam in addition to the seam holding the filling material in place) across the mats. This seam shall not be closer to the seam holding the filling material in place than 6 mm and not closer to the end of either covering than 12 mm, unless the ends of the mat are finished with an overlying or whip stitch, or in a manner which will not leave a raw edge.

D. Stitching. All longitudinal sewing or quilting shall average at least three stitches per 25 mm and shall have not less than five stitches in any 50 mm. All other sewing shall average six stitches per 25 mm and shall have not less than nine stitches in any 50 mm.

BASIS OF ACCEPTANCE. 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.

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:

- Manufacturer's name and/or logo
- Product name
- 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 M171 (ASTM C171) for Polyethylene Film: White Opaque. Rolls shall be wound on serviceable handling members which extend beyond the edges of the roll, forming handles to facilitate applying the covers over concrete.

BASIS OF ACCEPTANCE. Each shipment shall be accompanied by the manufacturer's certificate attesting to the fact that the shipment meets the specified standards. Upon request, the manufacturer shall supply a record of the results of the prescribed tests as made on the samples.

711-05 MEMBRANE CURING COMPOUND

SCOPE. This specification covers white-pigmented and clear membrane curing compound material and quality requirements for spray application on surfaces of newly placed Portland Cement concrete.

GENERAL. Samples of membrane curing compound shall be submitted to the Materials Bureau by the manufacturer upon application for approval. Approved material shall be delivered to the work site in clean containers. The curing compound shall be agitated mechanically to a uniform consistency throughout the container immediately before use.

MATERIAL REQUIREMENTS

A. White Pigmented. The compound shall consist of finely ground white pigment and wax-free vehicle, ready mixed for immediate use without alteration. When applied to freshly placed damp concrete at the rate of one liter per 3.5 square meters, the compound shall adhere and present a uniform white appearance and effectively obscure the original color of the concrete. The compound applied at the specified rate shall provide a curing compound displaying the following properties:

1. Drying. The compound shall produce a uniform coating at a minimum temperature of 5°C and shall dry tack-free within 4 hours.

2. Permeability. The moisture loss through the membrane shall be no more than 0.04 grams per square centimeter of surface area after three days.

3. Reflectivity. The membrane shall have a reflectance value of 60 percent, minimum based on Magnesium Oxide as a standard.

4. Durability. The membrane shall remain intact for at least seven days before becoming powdery and non-adherent due to weathering.

B. Clear. The compound shall consist of a wax-free vehicle, ready mixed for immediate use without alteration containing a fugitive dye that will fade uniformly. When applied to freshly placed, damp concrete, at the rate of 1 liter per 3.5 m², it shall provide a curing membrane displaying the following properties:

1. Drying. The compound shall produce a uniform coating at a minimum temperature of 5°C and shall dry tack-free within 4 hours.

2. Permeability. The moisture loss through the membrane shall be no more than 400 grams per square meter of surface after three days.

3. Durability. The membrane shall remain intact for at least 7 days.

4. Fugitive Dye. The membrane-forming compounds with fugitive dye shall be readily distinguishable upon the concrete surface for at least 4 hours after application, but shall become inconspicuous within 7 days after application.
§711-05

TESTS. The properties of a membrane curing compound shall be tested on laboratory specimens. Details of the tests may be obtained from the Materials Bureau.

BASIS OF ACCEPTANCE. The approval of the membrane curing compound shall be based upon tests performed by the Materials Bureau. Upon approval by the Materials Bureau, the name of the product will be placed on an Approved List. Such products shall then be accepted on the basis of the brand name labeled on the container.

711-06 BURLAP

SCOPE. This specification covers requirements for burlap for use in curing concrete.

MATERIAL REQUIREMENTS. Burlap shall conform to the requirements of AASHTO M182. The burlap shall be made from jute or kenaf and shall weigh 310 to 372 grams per meter. Burlap shall be cleaned and free from cuts, tears, uneven weaving and contaminants.

BASIS OF ACCEPTANCE. The burlap will be accepted on the basis of a visual inspection by the Engineer and weighing of a sample at the point of use.

711-07 FORM INSULATING MATERIALS FOR WINTER CONCRETING

SCOPE. This specification covers the material details, quality requirements, and method of application for approval of form insulating materials used for winter concreting operations.

MATERIAL REQUIREMENTS. Each insulating material will be judged on its ease and practicability of installation, durability and imperviousness to moisture penetration and absorption. The minimum thickness for any foam board and blanket insulation considered shall be 25 mm. The thermal conductivity (k) of any proposed insulating material shall not exceed 0.046 watt per meter kelvin (W/m K).

Application of approval of an insulating material shall be made to the Materials Bureau. Certified laboratory test results for thermal conductivity (k) and thermal resistance (R), kelvin meter²/watt (K·m²/W), measured at the nominal product thickness shall be required for evaluation. A one square meter (minimum) sample shall accompany each request for approval. The sample shall exhibit all major features of the insulating product such as covers, seams, fasteners, grommets, etc. All necessary and normal product information shall accompany the sample. If there is a specific process required to apply the insulating material, complete details of the process shall accompany the sample.

If sprayed foam is the material in question, the Contractor shall also be required to send the applicator's name plus a list of jobs done by the applicator during the last 12 months. If investigation of these jobs demonstrates quality workmanship, the applicator shall be issued a temporary approval good for one contract. Based upon its subsequent performance, a decision will be made as to whether or not to place the applicator's name on the Approved List.

BASIS OF ACCEPTANCE. Insulating materials for winter concreting shall be accepted on the basis of Approved List issued by the Materials Bureau.

711-08 ADMIXTURES

SCOPE. These specifications cover the material requirements for air-entraining, water-reducing and retarding and water-reducing admixtures used in the manufacture of Portland Cement concrete. The specification also covers the requirements for water-reducing (high range) admixtures.

GENERAL. All admixtures shall be in liquid form having a consistency that flows readily. The admixtures shall not contain chemicals which, when mixed with concrete, produce a condition that is injurious to the quality and durability of the concrete or reinforcing steel. This applies specifically to compounds which, when used in manufacturing process, produce a significant amount of chloride ions in the final product. The
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:

**A. Bleeding.** The bleeding of the concrete made with the admixture under test shall not exceed that of concrete made with the reference admixture by more than 2 percentage points, the bleeding being computed as a percentage of the net amount of mixing water in each concrete. The net mixing water is the water in excess of that present as absorbed water in the aggregate.

**B. Time of Setting.** The initial time of setting of concrete containing the admixture under test shall not deviate from that of the concrete made with the reference admixture by more than ±1 hour and 15 minutes.

**C. Compressive Strength.** The compressive strength of concrete containing the admixture under test shall be not less than 90 percent of the control concrete, at the same air content, containing the reference admixture at 48 hours, 7 days and 28 days.

**D. Resistance to Freezing and Thawing.** The hardened concrete containing the admixture under test shall not exceed a weight loss of 4.0 percent in 25 cycles in a 10% NaCl solution.

**E. Length Change.** Length changes shall be based on initial measurements taken at the time of removal of the specimens from the molds and final measurements taken at the end of 14 days of air drying. The specimens shall be moist-cured for 14 days followed by 14 days of air drying. Length change shall not be greater than ± 20% of similar concrete containing the reference admixture.

**Water-Reducing and Retarding Admixtures (ASTM TYPE D).** The water-reducing and retarding admixtures shall reduce the quantity of mixing water required to produce concrete of a given consistency, and retard the setting of concrete. Concrete containing this admixture shall conform to the following requirements:

**A. Water Reduction.** The mixing water required for concrete containing the admixture under test shall be reduced at least 5.0 percent when compared to that of the reference concrete without the admixture under test.

**B. Time of Setting.** The initial set time of the concrete containing the admixture under test shall be increased by at least 50 percent when compared to that of the reference concrete without the admixture under test.

**C. Compressive Strength.** The compressive strength of the concrete containing the admixture under test, when compared to concrete without the admixture under test, shall be equal or greater at 48 hours, 7 days and 28 days.

**D. Resistance to Freezing and Thawing.** The hardened concrete containing the admixture under test shall not exceed a weight loss of 4.0 percent, in 25 cycles in a 10% NaCl solution.

**E. Length Change.** Length changes shall be based on initial measurements taken at the time of removal of the specimens from the molds and final measurements taken at the end of 14 days of air drying. The specimens shall be moist-cured for 14 days followed by 14 days of air drying. Length change shall not be greater than ± 35% of similar concrete containing the reference admixture.
§711-08

Water-Reducing Admixtures (ASTM TYPE A). The water-reducing admixtures shall reduce the quantity of mixing water required to produce concrete of a given consistency. Concrete containing this admixture shall meet the requirements of the water reducing and retarding admixtures above except that the time of setting of the concrete containing the admixture under test shall not deviate from that of similar concrete without the admixture under test used as a reference by more than ±1 hour and 15 minutes.

Water-Reducing (High Range) Admixtures (ASTM TYPE F). The water-reducing (High Range) admixture shall reduce the quantity of mixing water required to produce concrete of a given consistency. Concrete containing this admixture shall conform to the following requirements:

A. Water Reduction. The mixing water required for concrete containing the admixture under test shall be reduced at least 12.0 percent when compared to that of the reference concrete without the admixture under test.

B. Time of Setting. The initial set time of the concrete containing the admixture under test when compared to that of the reference concrete shall not be more than 1 hour earlier nor 1 hour, 30 minutes later.

C. Compressive Strength. The compressive strength of the concrete containing the admixture under test when compared to concrete without the admixture under test shall be as follows:

<table>
<thead>
<tr>
<th>Days</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 day</td>
<td>140%</td>
</tr>
<tr>
<td>3 days</td>
<td>125%</td>
</tr>
<tr>
<td>7 days</td>
<td>115%</td>
</tr>
<tr>
<td>28 days</td>
<td>110%</td>
</tr>
</tbody>
</table>

The compressive strength of the concrete containing the admixture under test at any test age shall be not less than 100% of that attained at any previous age.

D. Resistance to Freezing and Thawing. The hardened concrete containing the admixture under test shall not exceed a weight loss of 4.0 percent in 25 cycles in a 10% NaCl solution.

E. Length Change. Length changes shall be based on initial measurements taken at the time of removal of the specimens from the molds and final measurements taken at the end of 14 days of air drying. The specimens shall be moist-cured for 14 days followed by 14 days of air drying. Length change shall not be greater than ± 35% of similar concrete containing the reference admixture.

SAMPLING AND TESTING. A liter sample of admixture shall be submitted to the Materials Bureau by the manufacturer applying for approval except that for Water-Reducing (High Range) Admixtures two liters will be required. Along with the sample the manufacturer shall include data from test performed in accordance with these specifications. Data from tests performed in accordance with ASTM C260 for air-entraining agents and ASTM C494 for water-reducing and retarding admixtures and water-reducing admixtures may be substituted.

In addition to the sample and test data, information on the formulation of the product, including the raw materials from which it is compounded and a description of the manufacturing process, shall be submitted.

The Department will test the submitted admixture sample according to written Department instructions. The test procedures are available from the Materials Bureau upon request.

The Department reserves the right to monitor the performance of any previously approved admixture. Samples of admixture may be taken from actual concrete operations and retested by the Materials Bureau.

BASIS OF ACCEPTANCE. The approval of the admixture shall be based upon the submitted information and tests performed by the Materials Bureau. Upon approval by the Materials Bureau, the name of the product will be placed on the Approved List. Such products shall then be accepted on the basis of the brand name labeled plainly on the containers.

Any admixtures sampled from actual concrete operations and retested in the Materials Bureau shall give substantially the same results, at the same dosage rate, as the original tests. Any significant change will be
cause for rejection of that material and may require a resubmission of the admixture by the manufacturer for a complete retest to determine specification compliance. The admixture may be withdrawn from the Approved List during the retest period.

711-09 EMULSIFIED CARBON BLACK

SCOPE. This specification covers the material requirements for Emulsified Carbon Black, which is used as a coloring agent in mortar or concrete.

GENERAL. The method of test shall conform to the requirements of 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 shall not be changed by more than 10% by addition of 2%, by weight of cement, of the dispersed carbon black. The ash content shall not exceed 3% by weight of the finished product. At least 25% of the commercial product shall be carbon black.

The Emulsified Carbon Black shall be stable and shall have the same effect on the air entrainment, after standing for a period of 28 days, as specified above.

The color produced on the broken surface after the seven day test shall be equal to that produced by a previously established standard of color.

The Emulsified Carbon Black shall show uniform dispersion in mortars or concrete when used in concentrations necessary to produce the desired pigmentation.

TEST. Test specimens shall be prepared as follows: Portland Cement Type 2 containing 2% by weight of Emulsified Carbon Black shall be used with standard Ottawa Sand to prepare 1:2.75 compressive cubes. The compressive strength of these cubes at the age of seven days and thereafter shall be not less than 85% of the strength of similar cubes with no pigment added.

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

711-10 FLY ASH

SCOPE. This specification covers the material requirements for fly ash when used as a partial replacement for Portland Cement in Portland Cement concrete.

MATERIAL REQUIREMENTS. Fly ash shall conform to the chemical and physical requirements for Mineral Admixture, Class F listed in ASTM C618 including Table 2 (except for Footnote A). Loss of Ignition shall not exceed 4.0%.

A. Storage. The fly ash shall be stored at its source of supply in weather-tight silos approved by the Director, Materials Bureau. All silos shall be completely empty and clean before fly ash is deposited therein unless the silo contains fly ash of the same type.

Fly ash remaining in bulk storage at the source of distribution terminal for a period greater than one year after completion of tests will be resampled and retested by the Materials Bureau before shipment or use. However, fly ash which has been in bulk storage at sources or distribution terminals more than two years from the time of original manufacture shall not be used.

B. Shipment. All shipments of fly ash shall be made in accordance with procedural directives issued by the Materials Bureau. Conveyances for bulk fly ash shipment shall be of a type approved by the Director, Materials Bureau. The compartments of all such conveyances shall be completely empty and clean before any fly ash is deposited therein.
§711-10

C. Inspection and Testing. Inspection and testing shall be in accordance with procedural directives by the Materials Bureau. Tests for chemical and physical properties shall be in accordance with test methods stipulated by 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.

711-11 MICRO SILICA

Scope. This specification covers the material requirements for microsilica admixture for use in portland cement concrete and other mixes.

General. Supply microsilica admixture as a dry powder or slurry. When necessary for testing purposes, microsilica slurries will be dried to obtain a representative sample of dry powder.

Material Requirements. The microsilica powder shall conform to the requirements of AASHTO M 307* (including optional chemical and optional physical requirements) and the following:

Uniformity of Silicon Dioxide Content. Maximum ±7.0% from the acceptance value.

Chloride Content. Maximum 0.20% as determined by AASHTO T 260, Procedure B.

Fineness. Maximum 5.0% retained on a 45-μm sieve (wet method).

Uniformity of Percent Solids (Slurry). Maximum ±5.0% from the acceptance value.

* For Materials other than Silica fume as defined by AASHTO M307, the requirement for SiO2 may be reduced if the combined quantity of reactive SiO2+Al2O3+Fe2O3 is at least 85%, and all other chemical and physical requirements are met as determined by the Materials Bureau.

Sampling and Testing. Submit two - 1 liter samples of microsilica to the Materials Bureau for approval, with the following:

Supplier and Manufacturer's Names and Addresses. If the material will be manufactured at several locations, identify each location and submit a separate sample representing each location.

Product Label, Product Information Sheets and Material Safety Data Sheets. Include the date of manufacture and shelf life of the supplied sample.

Test Results. Submit laboratory test results indicating the product meets all specification requirements. The testing laboratory must be acceptable to the Director, Materials Bureau. The Department will test the submitted microsilica sample in accordance with the specification and Department instructions. Test procedures are available from the Materials Bureau upon request. Upon approval by the Materials Bureau, the name of the product will be placed on the Approved List. The Department reserves the right to monitor the performance of any approved microsilica. Samples of microsilica may be taken from actual concrete operations and tested by the Materials Bureau. If these test results indicate that the sampled microsilica does not meet this specification, concrete incorporating the microsilica represented by the sample may be rejected.
BASIS OF ACCEPTANCE. Each shipment of microsilica will be considered for acceptance where it will be incorporated into the concrete. Acceptance will be based on the product name appearing on the Approved List and Manufacturer’s certification of conformance to this specification.

711-12 GROUND GRANULATED BLAST-FURNACE SLAG

SCOPE. This specification covers the material requirements for ground granulated blast-furnace slag when used as a partial replacement for portland cement in portland cement concrete.

MATERIAL REQUIREMENTS. Ground granulated blast-furnace slag (GGBFS) shall conform to the chemical and physical requirements for Grade 100 slag as described in ASTM C 989.

Storage. The ground granulated blast-furnace slag shall be stored at its source of supply in approved weather-tight silos. Facilities shall be provided for maintaining such silos under Department seal control when and as directed by the Materials Bureau. All silos shall be completely empty and clean before GGBFS is deposited therein unless the silo contains Department specification GGBFS of the same type.

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

SHIPPING. All shipments of ground granulated blast-furnace slag shall be made in accordance with procedural directives issued by the Materials Bureau. Conveyances for bulk shipment shall be of a type approved by the Department. The compartments of all such conveyances shall be completely empty and clean before any GGBFS is loaded therein.

INSPECTION AND TESTING. All inspection and testing shall be in accordance with procedural directives issued by the Materials Bureau. When required by the Materials Bureau, GGBFS shall be sampled by means of an automatic sampling device constructed so as to obtain continuous samples across the full stream of GGBFS and deliver such samples into a sealed container approved by the Materials Bureau.

Tests for chemical and physical properties shall be in accordance with test methods stipulated by ASTM C 989.

BASIS OF ACCEPTANCE. Ground granulated blast-furnace slag will be considered for acceptance at mill or terminal locations in accordance with procedural directives issued by the Materials Bureau.

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.
§712-01

**TABLE 712-1 WATER**

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Content of Mortar, ASTM C185, percent by volume</td>
<td>12.0 Max.</td>
</tr>
<tr>
<td>Soundness, ASTM C151 Autoclave Expansion, percent</td>
<td>0.50 Max.</td>
</tr>
<tr>
<td>Compressive Strength, ASTM C109 7 day, 28 day (optional) percent of compressive strength of mortar cubes made with standard water</td>
<td>90 Min.</td>
</tr>
<tr>
<td>Time of Setting, Vicat Test, ASTM C191</td>
<td></td>
</tr>
<tr>
<td>Initial Set, minutes</td>
<td>45 Min.</td>
</tr>
<tr>
<td>Final Set, hours</td>
<td>8 Max.</td>
</tr>
</tbody>
</table>

**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.

**712-02 CALCIUM CHLORIDE**

**SCOPE.** This specification covers the material requirements for calcium chloride for use in dust control, stabilization, ice control and for other highway construction related purposes.

Calcium chloride material shall be either Type A - Solid Flake Calcium Chloride or Type B - Liquid Calcium Chloride Solution.

**MATERIAL REQUIREMENTS**

*Type A - Solid Flake Calcium Chloride.* Solid Flake Calcium Chloride shall meet the requirements of ASTM D98 and upon analysis shall show not less than 77.0% CaCl₂. The calcium chloride shall be supplied in the form of dry, loose flakes, pellets or granules and shall be fine enough to feed through the common types of spreaders used in roadwork. The Engineer reserves the right to reject any material that has become caked or otherwise damaged.

*Type B - Liquid Calcium Chloride Solution.* Liquid Calcium Chloride shall be supplied as a mixed solution which upon analysis shall show not less than 30.0% of CaCl₂.

**Equivalent Spreading Rates.** For purposes of these specifications 0.6 kg/m² of Type A, Solid Flake CaCl₂ is equivalent to 1.0 L/m² of Type B, Liquid CaCl₂ Solution. These factors shall be used as the basis for determining other rates of application.

**PACKAGING, MARKING & SHIPPING**

*Type A - Solid Flake Calcium Chloride.* Solid Calcium chloride shall be packaged in moistureproof bags containing not more than 45 kg each, or in airtight drums weighing not more than 205 kg each, or it may be delivered in bulk in tank cars, covered hopper cars, or covered trucks. All bulk shipments that are to be stored and stockpiled on the job site shall be protected with waterproof covers. The location and protection of stockpiled material shall be approved by the Engineer prior to shipment.

The name of the manufacturer, name of the product, net weight, and the percentage of calcium chloride (CaCl₂) guaranteed by the manufacturer shall be legibly marked on each container, except in the case of bulk shipments where the invoice shall be accepted as evidence of compliance with these requirements.

*Type B - Liquid Calcium Chloride Solution.* Liquid calcium chloride shall be delivered in bulk shipments on a supplied-and-applied basis. The delivery equipment shall be capable of applying the liquid solution at the specified rate(s). The delivery equipment shall be subject to approval by the
Engineer and shall be equipped with suitable calibration devices to insure the correct rate of application. Each bulk shipment shall be accompanied with the manufacturer's invoice.

**BASIS OF ACCEPTANCE.** Calcium chloride will be accepted based on its use as follows:

**A. For dust control, ice control and other highway construction related purposes.** Type A and Type B calcium chloride will be accepted based on the Engineer's approval.

**B. For soil stabilization.** Type A and Type B calcium chloride will be accepted on the basis of the manufacturer's certification that the product conforms to the above specifications. The certification shall reference the number of containers shipped, or in the case of bulk deliveries, the invoice numbers associated with each delivery.

**712-03 - SODIUM CHLORIDE**

**SCOPE.** This specification covers the material requirements for sodium chloride to be used as a soil admixture or deicing agent for maintenance.

**MATERIAL REQUIREMENTS.** Sodium chloride shall meet the requirements of ASTM D632, Sodium Chloride - Type 1, Grade 1.

Sodium chloride shall be packaged in moistureproof bags containing not more than 45 kg each, or in airtight drums weighing not more than 205 kg each, or it may be delivered in bulk in tank cars, covered hopper cars, or covered trucks. All bulk shipments that are to be stored and stockpiled on the job site shall be protected with waterproof covers. The location and protection of stockpiled material shall be approved, by the Engineer, prior to shipment.

**BASIS OF ACCEPTANCE.** Sodium chloride will be accepted based upon the Engineer's approval.

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

**712-04 - HYDRATED LIME**

**SCOPE.** This specification contains the material requirements pertaining to Hydrated Lime.

**MATERIAL REQUIREMENTS.** Hydrated Lime shall meet the requirements of ASTM C207, Hydrated Lime for Masonry Purposes - Type NA or SA.

**BASIS OF ACCEPTANCE.** The manufacturer's certification shall constitute sufficient documentation for acceptance of this material at the site of the work. The Department reserves the right to sample this material to test for conformance to these specifications.

**712-05 - PRECAST CONCRETE RIGHT-OF-WAY MARKERS**

**SCOPE.** This specification covers the material and fabrication requirements for precast concrete right-of-way markers.

**MATERIAL REQUIREMENTS.** The material Requirements of §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.

**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

712-06 MOBILE CONSTRUCTION ZONE IMPACT ATTENUATORS

SCOPE. This specification covers the material and testing requirements for crash cushions or impact attenuators mounted on the rear of designated work vehicles. These devices are commonly called truck mounted attenuators or TMAs.

MATERIALS REQUIREMENTS. Truck Mounted Attenuators having initial purchase dates on or before October 1, 1998 shall have been satisfactorily tested in accordance with the National Cooperative Highway Research Program (NCHRP) Report 350 or 230 or other testing protocol acceptable to the State. Those purchased new after that date shall be only those that have been satisfactorily tested in accordance with NCHRP Report 350. Testing shall consist of full-scale crash testing conducted by recognized testing agencies. TMAs meeting the requirements of NCHRP 350 Test Level 2 or, for devices originally purchased on or before October 1, 1998, NCHRP 230 are the standard TMA, and shall be acceptable for all circumstances except as stated in this specification or in the Contract Documents. NCHRP 350 Test Level 3 TMAs shall be required, however, whenever indicated in the Contract Documents or whenever the posted speed limit within 350 feet upstream of the TMA is sixty-five miles per hour (65 mph).

An NCHRP 350 Test Level 3 TMA may be substituted for a NCHRP 350 Test Level 2 TMA or NCHRP 230 TMA, but a NCHRP 350 Test Level 2 TMA or NCHRP 230 TMA may not be substituted when a NCHRP 350 Test Level 3 TMA is required.

BASIS OF ACCEPTANCE. The Director of the New York State Department of Transportation’s Materials Bureau maintains an Approved List, which lists TMAs which have successfully passed the above requirements. Acceptance of NCHRP 350 Test Level 2 or 3 Mobile Construction Zone Impact Attenuators shall be at the contract site based on compliance with these specifications and either the product’s appearance on the Approved List or a letter from the Department to the vendor indicating the TMA is approved.

Acceptance of NCHRP 230 qualified devices shall be on the basis of compliance with these specifications, appearance of the TMA on the Approved List, or letter from the Department indicating approval of the TMA, plus the provision of certification satisfactory to the Engineer. This certification shall indicate that the NCHRP 230 qualified TMA was sold new to a user on or prior to October 1, 1998. The current owner and the original purchaser need not be the same.

Manufacturers or Vendors wishing to have products considered for inclusion on the Approved List shall provide copies of drawings, specifications, test reports, and Federal Acceptance Letters to the Director of the Materials Bureau. The review process requires thirty (30) days minimum.

712-07 INERTIAL BARRIER MODULES

SCOPE. This specification covers the material and performance requirements for sand-filled inertial barrier systems used for site hazard protection.

GENERAL. Modules composing the array shall be free-draining with respect to residual moisture in the fill sand. Their lids shall be such that they divert precipitation and stop moisture from seeping into the shell. Lids shall be fastened with a minimum of six equally spaced pop rivets or secured by other approved fasteners so as to provide a reasonably vandal resistant, closed barrel.

MATERIAL REQUIREMENTS. The modules shall be federal yellow or as shown on the plans. They shall be durable, waterproof, resistant to deterioration from ultra-violet rays, deformation from dynamic loadings due to vibration in the placement area and long-term stresses induced by thermal expansion and contraction and fill settlement.

The fill sand shall conform to the requirements of either §703-06, Cushion Sand, or §703-07, Concrete Sand. Sodium chloride, as dry rock salt, equal to 3-5 percent by weight of the sand, shall be thoroughly mixed into the sand. Sodium chloride shall meet the requirements of §712-03, Sodium Chloride.
TESTS. To determine the crash worthiness of inertial barrier modules not on the NYSDOT's Approved List, an array containing each size module shall be subjected to crash tests to verify that the barrier system can safely decelerate an impacting vehicle. These tests shall be done in accordance with the National Cooperative Highway Research Program Report 350, test numbers, 3-40, 3-41, 3-42, 3-43 and 3-44. Evaluation criteria shall conform to the safety evaluation guidelines found in Table 5.1, as specified in Table 3.2.

Crash cushion arrays shall be designed to conform to the occupant risk values found in NCHRP Report 350, Table 5.1, Criteria D, H and I.

Any values deviating from these shall be justified by site and/or shape limitations, or cost, and approved by the Director, Materials Bureau.

BASIS OF ACCEPTANCE. The Department requires the submission of Materials Details as defined in §101-02. 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 THROUGH 712-11 (VACANT)

712-12 ASPHALT ROOFING FELT

SCOPE. These specifications contain the material requirements pertaining to Asphalt Roofing Felt.

MATERIAL REQUIREMENTS. Roofing shall conform to the requirements of the standard specifications for Asphalt-Saturated Roofing Felt for use in Waterproofing and in Constructing Built-Up Roofs, ASTM D226.

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

712-13 TIMBER AND LUMBER

GENERAL. Unless otherwise specified or noted upon the plans or in the itemized proposal, timber and lumber shall be of any kind acceptable to the Engineer. The material shall be sound, square-edged, free from shakes, loose knots or decay.

712-14 STRESS GRADED TIMBER AND LUMBER

GENERAL. Stress graded timber and lumber shall be graded for the stress grade selected, in accordance with grading rules for the indicated stress grade, developed from ASTM D245.

Commercial stress grades of timber and lumber, with grade descriptions providing material which will meet the indicated stress requirements under rules conforming to ASTM D245, will be acceptable.

MATERIAL REQUIREMENTS. The manufacturer shall inspect and grade the timber and lumber. Each piece shall be clearly branded with the stress grade mark of the manufacturer's inspector. Stress graded timber and lumber will be subject to inspection by representatives of the Department, to whom the manufacturer shall supply three copies of its certification of inspection and piece tally.

The Contractor shall furnish all facilities for the inspection of this material by the Department's representatives and shall allow them free access to all premises where inspections can be made.
§712-14

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 area 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±5°C</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 -20°C</td>
<td>Coating shall withstand a mandrel bent test without cracking.</td>
<td></td>
</tr>
</tbody>
</table>

C. 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.
D. Stone Fill. The baskets shall be filled with approved stone of the following sizes:

<table>
<thead>
<tr>
<th>Basket Depth or Height</th>
<th>Minimum Stone Size</th>
<th>Maximum Stone Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 mm</td>
<td>100 mm</td>
<td>200 mm</td>
</tr>
<tr>
<td>Greater than 300 mm</td>
<td>100 mm</td>
<td>300 mm</td>
</tr>
</tbody>
</table>

The soundness of all stone used for gabions shall be approved on the basis of a geologic evaluation in accordance with the control procedure in effect on the 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

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:

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.

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.
§712-15

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

A. Species. The following kinds of wood suitable for cross ties will be accepted.

<table>
<thead>
<tr>
<th>Ash</th>
<th>Elm</th>
<th>Sassafras</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beech</td>
<td>Hackberry</td>
<td>Sycamore</td>
</tr>
<tr>
<td>Birch</td>
<td>Locust</td>
<td>Walnut</td>
</tr>
<tr>
<td>Black Gum</td>
<td>Maple</td>
<td></td>
</tr>
<tr>
<td>Catalpa</td>
<td>Mulberry</td>
<td></td>
</tr>
<tr>
<td>Cherry</td>
<td>Oak</td>
<td></td>
</tr>
</tbody>
</table>

B. Manufacture. Cross ties shall be well sawed in top, bottom and sides. A cross tie shall be considered well sawed as long as score marks are not more than 6.4 mm deep and the surfaces are even.

Cross ties shall be straight, cut square at the ends, have bottom and top parallel, and have all bark
entirely removed. A cross tie shall be considered straight only if it meets both of the following requirements:

1. A straight line drawn along the top of the tie from the middle of one end to the middle of the other end of the tie, falls entirely within the width of the tie.

2. A straight line drawn along a side of the tie from the middle of one end to the middle of the other end of the tie, is everywhere more than 51 mm from the top and 51 mm from the bottom of the tie.

The top and bottom of a tie will be considered parallel if any difference in the thickness at the sides or ends does not exceed 13 mm.

C. Dimensions. All thicknesses and widths apply to areas of the tie defined as the 'rail bearing area(s)'. The rail bearing areas are those areas which lie between 508 mm and 1016 mm on both sides of the mid-point of the tie length. The rail bearing area for switch ties is the area between 305 mm from each end of the switch tie.

All determinations of width shall be made on the top of the tie. The top is defined as the narrower of the horizontal surfaces, or the surface with the least or no heartwood if both surfaces are the same width.

Standard size thickness and width dimensions are shown in Table 712-17, and apply to the rail bearing areas. The dimensions of the tie shall not be averaged.

All ties shall be 2591 mm long, or as required.

<table>
<thead>
<tr>
<th>TABLE 712-17</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Size</strong></td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>3A</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>1</td>
</tr>
</tbody>
</table>

D. Tolerances. Individual untreated ties shall have the following tolerances applied to the thickness and width dimensions shown in Table 712-17.

- **Length:** plus 51 mm, minus 25 mm
- **Thickness:** plus 51 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 shall conform to the dimensions shown in Table 712-17 without the application of the minus tolerances.

E. Defects. The occurrence of any of the following defects in an individual tie shall be the cause for rejection.

1. **Shakes.** A separation along the grain, occurring between the annual growth rings. A shake length more than one-third the nominal width of the tie shall not be allowed.

2. **Slant or Slope of Grain.** Except in the case of woods with interlocking grain, a slant or slope of grain in excess of 1 in 15 shall not be allowed.

3. **Holes.** Large holes shall not be allowed. A large hole is more than 12.7 mm in diameter and 76.2 mm deep within the rail bearing areas, or more than one-fourth the width of the surface on
which it appears and 76.2 mm deep outside the rail bearing area. Numerous holes shall not be allowed. Numerous holes are any number equalling a large hole in size.

4. **Knots.** Large knots shall not be allowed. A large knot is one whose average diameter exceeds one-fourth the width of the face on which it appears. Numerous knots shall not be allowed. Numerous knots are any number equalling a large knot in size.

5. **Checks.** A separation along the grain of the wood occurring across the annual rings. Fully seasoned and treated ties with check depths greater than one-fourth the thickness and longer than one-half the length of the tie shall not be allowed.

6. **Decay.** Ties shall contain no decay. Although blue stain is not considered decay and is not a defect, ties shall be inspected with extra care for presence of decay in heavily stained areas.

7. **Wane.** The lack of wood on the edge or corner of the tie due to the natural curvature of the log from which the tie is cut. Wane which reduces the face dimension greater than 76 mm outside the rail bearing area shall not be allowed. In the rail bearing area, dimensions given in Table 712-17 apply.

8. **Splits.** A split is a separation of the wood extending from one surface to an opposite or adjacent surface. In unseasoned ties, a split more than 3.2 mm wide or longer than 127 mm shall not be allowed.

   After treatment, a split in either end of the tie greater than 3.2 mm wide or longer than 127.0 mm is not acceptable without an anti-splitting device. A split tie which has had an anti-splitting device applied but which re-opens after treatment to exceed 12.7 mm in width is not acceptable.

9. **Twist.** The deviation from a flat plane of all four faces by a spiraling or torsional action. A rotation of more than 3.5° from end face to end face shall not be allowed.

**F. Anti-Splitting Devices.** Anti-Splitting devices are to be installed prior to preservative treatment.

1. **Dowelling.** Dowels are anti-splitting devices driven or pushed into pre-bored holes. The length of dowel embedded shall not be less than half the width or thickness through which it is placed. Use of lubricants to facilitate driving of dowels is prohibited.

   a. **Equipment.** These specifications are based on dowelling by mechanical dowel machines. Alternate methods may be used if the results are equal to those obtained by mechanical devices that press the tie together, drill and dowel in one or two operation. Dowelling by mechanical means is considered satisfactory as long as sufficient pressure is applied to completely close the split.

   Substitution of hand drills and pneumatic hammers for drilling dowels in switch ties is satisfactory as long as splits are held closed during dowelling by the use of clamps or other devices.

   b. **Pre-Drilled Holes.** The maximum diameter of the pre-drilled holes is 3.2 mm less than the diameter of dowel. The minimum length of the hole shall be equal to the length of the dowel, except that holes drilled from the face opposite the face where the dowel enters shall be completely through the tie.

   c. **Location of Dowels.** Dowels shall be driven perpendicular to the face most parallel to the split. Two dowels shall be used to close each split. They shall be located a minimum of 100 mm and a maximum of 152 mm from the end of the tie. Where the tie is split parallel to the narrow faces, the 197 mm long dowels shall be located 38.1 mm plus or minus 6.4 mm from each wide face. Where the tie is split parallel to the wide faces, 146 mm long dowels are driven 51 mm plus or minus 6.4 mm from each narrow face.
d. Protruding Dowels. Dowels not completely driven by dowelling machines shall be driven flush with the wood with a hammer. Dowels which protrude more than 6.4 mm after driving should be burned off with an oxyacetylene torch. However, dowels bent over flush with the surface of the wood will be accepted, provided this is done without splitting the wood.

2. Irons. Anti-splitting irons are driven into the ends of ties and shall be placed to cross at right angles and the greatest possible number of radial lines of the wood. Irons shall be placed far enough from the wide faces to prevent splitting of the tie.

a. Design. Anti-splitting irons shall be made from a strip of steel formed to an “S” iron or “C” iron design. They will be of adequate size to prevent splitting of the tie.

b. Material. Irons shall conform to specifications for anti-splitting irons given in the AREA Manual, Chapter 3, Section 1.9.2.1.

3. Nail Plates. Anti-splitting nail plates shall be applied to the ends of the ties.

a. Design. Anti-splitting nail plates shall be rectangular and perforated to form multiple nails.

b. Material. Nail plates shall be stamped from 1.214 mm galvanized sheet steel.

c. Size. The area of anti-splitting nail plates shall not be less than 60% of the nominal end area of the tie.

G. Conditioning. Ties shall be dried before preservative treatment until the amount of moisture in the wood will not prevent adequate penetration and retention of preservative. The producer may use any of the following methods as long as satisfactory results are obtained.

1. Air Seasoning. Ties shall be stacked for air seasoning in accordance with the American Wood Preservers Association (AWPA) Standard C6, Cross Ties and Switch Ties - Preservative Treatment by Pressure Process. Stacking dates during the period of stacking shall be painted on the front of the stack. A maximum of 60 days age spread shall be allowed between the dates of the first ties stacked and the last ties stacked.

Ties shall be stacked as grouped below:

<table>
<thead>
<tr>
<th>Group Ta</th>
<th>Group Tc</th>
<th>Group Td</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Locust</td>
<td>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>

2. Accelerated Seasoning. Ties may be conditioned by the Boulton drying process, kiln drying, vapor drying or controlled air seasoning in accordance with AWPA Standard C6, Cross ties and Switch Ties - Preservative Treatment by Pressure Process.

H. Preservative Treatment. Plants used for the treatment of wood shall conform to AWPA Standard 3, Standard Quality Control Procedures for Wood Preserving Plants.

All cross ties shall be treated with creosote-coal tar solution conforming to AWPA Standard P2, Standard for Creosote and Creosote Solutions, Grade C. Grades A or B may be substituted for Grade C.

Preservative treatment shall be carried out in accordance with AWPA Standard C1, All Timber Products - Preservative Treatment by Pressure Processing or C6, Cross Ties and Switch Ties - Preservative Treatment by Pressure Processes. The method used shall be the empty cell process by use of initial air to control retention.

Retention of preservative shall be 112.1 kg/m³ of preservative of wood. Retention shall be
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determined by gauge in accordance with paragraph 3.1 of AWPA Standard C1.

When specified, pentachlorophenol in heavy AWPA Standard P9A solvent may be used as a preservative. Minimum retention shall be 6.4 kilograms of preservative per cubic meter of wood.

INSPECTION AND TESTING. The Contractor shall give the Materials Bureau thirty days written notice prior to the start of preservative treatment. This notice shall include at the minimum, the name of the tie treater, the location of the treating plant and that date of the initial treatment.

The treating company is responsible for performing quality control in accordance with AWPA M3, Standard Quality Control Procedures for Wood Preserving Plants. All records required to be maintained in accordance with the quality control procedure shall be made available to the Department upon request.

A Department representative may be assigned, at the option of the Materials Bureau, to perform sampling and inspection in accordance with Materials Bureau directives and AWPA M2, Standard For Inspection of Treated Timber Products. The producer shall furnish all facilities and equipment for the inspection and testing of the materials and workmanship.

In the event plant inspection is waived, written notice will be provided to the tie treater by the Materials Bureau. The tie treater shall then supply the Materials Bureau with all preservative charge reports, which describe the treatment process and preservative retention, and written certification that the treatment and ties conform to these specifications.

All treated ties shipped to the project site shall bear in legible form, the inspector's stamp of approval; however, in the event plant inspection has been waived, ties shall be shipped only if they are accompanied by a copy of the Materials Bureau notification waiving plant inspection.

Treated ties shall be subject to final inspection and approval by the Engineer after arrival at the project site.

SHIPMENT AND STORAGE. Ties delivered at the job site shall be stacked not less than 3048 mm from the nearest rail of any track at suitable and convenient places. They shall not be stacked at public crossing or where they will interfere with the view of trainmen or of people approaching the railroad. Where room for spaced stacking is not available, ties may be piled together provided the lowest layer is at least 150 mm above the ground.

BASIS OF ACCEPTANCE. The wood cross ties will be considered for acceptance in stock lot quantities at the treatment facility in accordance with procedural directives of the Materials Bureau.

712-18 IMPACT ATTENUATOR, HDPE CYLINDER AND CABLE TYPE

SCOPE. Impact Attenuators, HDPE Cylinder and Cable Type are manufactured, NCHRP 350 crash tested products intended for the protection of narrow objects having width of 610 mm or less. These impact attenuators are four, six, or nine cylinders in length. They are suitable in situations where frequent frontal impacts are expected.

MATERIALS REQUIREMENTS. Impact Attenuator, HDPE Cylinder and Cable Type components shall meet the following requirements:

Cylinders. Cylinders shall be black, high molecular weight polyethylene conforming to ASTM D3350 cell class 345434C. Dimensions and wall thicknesses of all cylinders shall be as given on the manufacturer's drawings.

Cables. Cables shall be approved 6 X 25 FW plow steel conforming to API STD-9A, galvanized, prestretched and nominally 260 kN minimum breaking strength of the size and lengths indicated on the manufacturer's drawings. Cables shall be fitted both ends with galvanized fittings of the type indicated on the approved manufacture's drawings.
Other Steel Parts. Anchor plates and structural angles shall be ASTM A36M steel, galvanized after fabrication. Structural tube used to construct the back up structure, used in the rear section of the rail unit of the six (6) and nine (9) cylinder units and in the railing for the four (4) cylinder units shall be ASTM A 500, Grade B. Chain shall be high strength steel linked chain of the indicated sizes, galvanized and fitted each end with screw pin anchor shackles. Fasteners, anchor bolts and anchor pins and other parts not specified herein shall be as given on the manufacturer’s drawings or in the fabricator’s instructions.

All metal parts shall be galvanized after fabrication in accordance with §719-01 Galvanized Coatings and Repair Methods, Type I. Welding shall be in accordance with the Steel Construction Manual.

Reactorization. Reactorization, consisting of Class B (High Intensity) sheeting conforming to §730-05 directly applied to aluminum sheeting, shall be affixed to the front cylinder of the impact attenuator in a manner satisfactory to the Engineer. Aluminum sheeting shall be 6061T6, 0.81mm thick. The pattern and color of the reactorization shall be as indicated on the plans.

If no pattern is provided, the pattern shall be approximately square, 450 mm on a side. Whenever approaching traffic is allowed to pass on both sides of the unit, the pattern shall be upward pointing chevrons formed with alternating 100 mm reactorized stripes and black opaque non-reactorized stripes. When traffic will be permitted on only one side, the pattern shall be diagonal 100 mm stripes, downward sloping to the side traffic is to be permitted, formed as indicated above. If no color is given, color shall be yellow.

Basis of Acceptance. Impact Attenuator, HDPE Cylinder and Cable Type will be accepted at the project site on the basis of the manufacturer’s name appearing on the Approved List, conformance of the delivered article with the manufacturer’s drawings, and the manufacturer’s certification that the product delivered is in conformance with these specifications.

712-19 IMPACT ATTENUATOR, QUAD BEAM TYPE WITH EXPENDABLE MODULES

Scope. Impact Attenuator, Quad Beam Type With Expendable Modules are manufactured, NCHRP 350 crash tested products intended for the protection of objects having widths of 610 mm to 2290 mm. These attenuators are three, four, five, six, and nine bays in length, and may transition to concrete barriers, vertical walls, corrugated barrier and thin beam corrugated barrier.

Materials Requirements. Each Impact Attenuator, Quad Beam Type With Expendable Modules shall contain all external and internal parts necessary to give satisfactory service at the indicated site. Components shall meet the following requirements:

Cartridges. The cartridge boxes shall be Type I and Type II cartridge boxes and shall be of the number and arrangement indicated by the manufacturer for the intended application. Cartridge boxes shall be manufactured from a weather resistant plastic material. Type I cartridges shall contain paper honeycomb material. Type II cartridges shall contain steel honeycomb material which shall be coated to minimize the effects of corrosion.

Cartridge Brackets. Each bay shall be equipped with cartridge brackets.

Diaphragms. Diaphragms shall be made from 10 gage ASTM A 36 M steel quadruple corrugated beam. The length of each diaphragm shall be as required for each application. Two support legs shall be welded to a channel which, in turn, shall be welded to the quadruple corrugated beam. Ski shaped plates shall be welded to the bottom of the support legs. The diaphragms shall be designed to lock onto, and be guided by, an anchored and mounted center monorail support structure.

Fender Panels. Fender panels shall be fabricated from 10 gage steel quadruple corrugated beam guide rail sections. Each fender panel shall be drilled and slotted so that when assembled in the field, the front end shall be bolted to a diaphragm by means of the three horizontally placed 16 mm bolts, one of which shall be a “mushroom bolt.” The back end of each quadruple corrugated beam fender panel shall overlap and be
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connected to the fender panel of the next bay by means of mushroom bolts which shall fit through the long horizontal slot in the forward fender panel and the short vertical slot in the overlapped fender panel. (The bolt shall have a nut and square washer on the inside.) This permits movement, front to back, of one set of fender panels relative to the panels in the following bay.

Monorail Assembly. The monorail assembly shall be fabricated to the dimensions shown on the manufacturer's or working drawings.

Tension Strut Back-up. If a concrete back-up structure is not to be provided, a tension strut back-up assembly shall be provided. The details of this assembly shall be as indicated in the manufacturer's or working drawings.

Nose Cover. The nose cover shall be made from a high density polyethylene plastic material of the color indicated in the plans or directed by the Engineer.

Metal Work. All metal work, except transition panels, shall be fabricated from either M1020 Merchant Quality or ASTM A36M steel. After fabrication, all metal work shall be hot dip galvanized in accordance with §719-01 Galvanized Coatings and Repair Methods. Welding shall be in accordance with the New York State Steel Construction Manual.

Fasteners. All bolts shall be American Standard Regular Bolts, unless indicated otherwise in the Plans. Anchor bolts shall be ASTM A193 grade B7 grouted into the concrete slab with polyester grout.

Transition Panels. Transition panels shall be fabricated from steel conforming to ASTM A36 M, hot dip galvanized in accordance with ASTM A123. Five standard transition panels shall be available. These shall transition to: Jersey Barrier; W-rail Corrugated Beam; Thrie Beam; vertical surfaces; and Single Slope Concrete Barrier.

Reflectorization. Reflectorization, consisting of Class B (High Intensity) sheeting conforming to §730-05 directly applied to aluminum sheeting, shall be affixed to the nose cover of the Quad Beam Type Impact Attenuator in a manner satisfactory to the engineer. Aluminum sheeting shall be 6061T6, 0.81mm thick. The pattern and color of the reflectorization shall be as indicated on the plans.

If no pattern is provided, the pattern shall be approximately square, 450 mm on a side. Whenever approaching traffic is allowed to pass on both sides of the unit, the pattern shall be upward pointing chevrons formed with alternating 100 mm reflectorized stripes and black opaque non-reflectorized stripes. When traffic will be permitted on only one side, the pattern shall be diagonal 100 mm stripes, downward pointing to the side traffic is to be permitted, formed as indicated above. Unless otherwise noted, the color shall be yellow.

BASIS OF ACCEPTANCE. Impact Attenuator, Quad Beam Type With Expendable Modules will be accepted at the site of the work on the basis of appearance of the product on the Approved List, conformance of the delivered product with the manufacturer's or working drawings, and receipt of the manufacturer's certificate of compliance with these specifications.

712-20 IMPACT ATTENUATOR, CORRUGATED BEAM TYPE WITH METAL TEARING STRIPS

SCOPE. Impact Attenuator, Corrugated Beam Type With Metal Tearing Strips are fabricated, NCHRP 350 crash tested products intended for the protection of narrow objects 610 mm or less in width and for the protection of concrete jersey shaped median barrier barrier. These impact attenuators are available in six and nine bay lengths.

MATERIAL REQUIREMENTS. Each Impact Attenuator, Corrugated Beam Type with Metal Tearing Strips shall contain all external and internal parts necessary to give satisfactory service at the indicated site.

The major components of the Each Impact Attenuator, Corrugated Beam Type with Metal Tearing Strips...
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are - 1 sled assembly, 7 (nine bay) or 4 (six bay) intermediate frames, 1 backup frame, base assembly, cross ties and 20 (nine bay) or 12 (six bay) fender panels. One or more of the following components may also be required - metal transition panels, wood or plastic block outs, backup frame adapter and W-beam end shoes.

**Fender Panels.** Fender panels shall be fabricated from 10 gage steel, double corrugated beam guide rail sections.

**Nose Cover.** The nose cover shall be made from a high density polyethylene plastic material of the color indicated in the contract documents. If no color is given, the color of the nose cover shall be yellow, or the color directed by the Engineer.

**Metal Work.** All metal work except fasteners shall be fabricated from ASTM A36M steel. After fabrication, all metal work shall be galvanized in accordance with section §719-01, Galvanized Coatings and Repair Methods, Type I. Welding shall be in accordance with the New York State Steel Construction Manual.

**Fasteners.** All bolts shall be American Standard Regular Bolts, unless indicated otherwise in the Plans. Anchor studs shall be ASTM A193 grade B7, grouted into the concrete or asphalt.

**Grout.** Anchors requiring grouting shall be grouted with material approved under §701-05 Concrete Grouting Material or §701-07 Anchoring Materials - Chemically Curing.

**Transition Panels.** Standard transition panels between Impact Attenuator, Corrugated Beam Type with Metal Tearing Strips and Jersey Barrier shall be available. Transition panels shall be fabricated from 12 gage steel, double corrugated beam guide rail sections. They shall be terminated at the concrete barrier end with W-beam end shoes. Details of the transition shall be provided by the manufacturer.

**Plastic Block Outs.** Plastic block outs shall conform to §710-26 Plastic and Synthetic Block Outs for Heavy Post Guiderail System, except the dimensions shall be as per the approved manufacturer’s or working drawings.

**Wood Block Outs.** Wood block outs shall conform to §710-13 Wood and Timber Posts and Timber Block outs, except the dimensions shall be as per the approved manufacturer’s or working drawings. Pressure treatment shall be done after all cutting, sawing, trimming and drilling has been completed.

**Reflectorization.** Reflectorization, consisting of Class B (High Intensity) sheeting conforming to §730-05 directly applied to aluminum sheeting, shall be affixed to the front face of the sled assembly in a manner satisfactory to the engineer. Aluminum sheeting shall be 6061T6, 0.81mm thick. The pattern and color of the reflectorization shall be as indicated on the plans.

If no pattern is provided, the pattern shall be approximately square, minimum 625 mm on a side. Whenever approaching traffic is allowed to pass on both sides of the unit, the pattern shall be upward pointing chevrons formed with alternating 100 mm reflectorized stripes and black opaque non-reflectorized stripes. When approaching traffic is permitted on only one side, the pattern shall be diagonal 100 mm stripes, downward pointing to the side traffic is to be permitted, formed as indicated above. If no color is given, color shall be yellow.

**BASIS OF ACCEPTANCE.** Each Impact Attenuator, Corrugated Beam Type with Metal Tearing Strips will be accepted at the project site on the basis of the manufacturer’s name appearing on the Approved List, its conformance with the manufacturer’s drawings, and the manufacturer’s certificate of compliance with these specifications.

NEW YORK STATE DEPARTMENT OF TRANSPORTATION
STANDARD SPECIFICATIONS of January 2, 2002

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