Division 800 Material Details

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SECTION 813 GRADING REQUIREMENTSMINIMUM AND MAXIMUM PERCENTAGES PASSING

Del. No.	Sieve Size (square openings), millimeters except where noted													
	100	90	75	63	50	37.5	25	19	12.5	9.5	4.75	2.36	1.18	150 mm
1	100	90 - 100		25 - 60		0 - 15		0 - 5						
2			100	90 - 100	35 - 70	0 - 15		0 - 5						
3				100	90 - 100	35 - 70	0 - 15		0 - 5					
57						100	95 - 100		25 - 60		0 - 10	0 - 5		
67							100	90 - 100		20 - 55	0 - 10	0 - 5		
8									100	85 - 100	10 - 30	0 - 10	0 - 5	
10										100	85 - 100			10 - 30

	Sieve Size (square openings), millimeters except where noted				
	9.5	4.75	2.00	425 mm	75 mm
"RICE"	100	70 - 100	0 - 20	0 - 10	0 - 5

SECTION 814 TIMBER PRESERVATIVES

Timber preservatives shall conform to the requirements of AASHTO M 133 and the following:

(a) Oil-Borne Preservative. Oil-borne preservatives shall be creosote oil-tar conforming to the requirements of the AWPA preservative standards specified therein. The treatment shall consist of 190 kg/m^3 of creosoting oil retained for other than marine environments. For marine environments, 320 kg/m^3 of creosoting oil shall be retained. The treating shall be done according to the requirements of AWPA Standard C1, the empty-cell process.

(b) Waterborne Preservative. Waterborne preservatives shall be CCA Type A, Type B, or Type C solutions conforming to the requirements of AWPA Standard P5. The treatment shall consist of applying CCA solution at a retention rate of 13 kg/m^3 of timber for other than marine environments. For marine environments, CCA solution shall be applied at a retention rate of 40 kg/m^3. The treating shall be done according to the requirements of AWPA Standard C1, the full-cell process.

(c) Pentachlorophenol (Penta). The heavy oil type of Penta, otherwise known as Penta Type A, is the synthetic pesticide that shall be used on glulam timber for the Department's bridges. Glulam timber shall be treated with 5% Penta Type A applied at a retention rate of 9.6 kg/m^3 of wood. The process involved for preservation treatment shall conform to the applicable requirements of the AWPA. Douglas fir shall be mechanically incised in accordance with the lumber industry accepted practice before preservative treatment. Once treated, the surface of the member shall not be painted nor shall it come in contact with human or animal skin.

SECTION 815 BITUMINOUS COLD-MIX (COLD-PATCH)

815.01 Description. This material consists of a uniform mixture of compatible mineral aggregate and bituminous material.

815.02 Material Requirements. Coarse aggregate shall conform to the requirements of Section 805. Fine aggregate shall be crushed stone screenings and up to 15% washed concrete sand conforming to the requirements of Section 804. The 15% limit is based on the total dry weight of the sand compared to the total dry aggregate weight in the mixture.

Bituminous material shall conform to the requirements of Section 817. The antistripping additive shall conform to the requirements of Section 829.

The sources of all materials shall be submitted, and representative samples of the proposed bituminous material with additive and aggregate shall be provided to the Department's Materials and Research Section.

Material shall not be produced for the Contract, nor any mixture accepted, until the proposed job mix formula has been approved by the Department's Materials and Research Section. The producer shall submit a written proposal indicating the single definite percentage of each sieve fraction of aggregate and percentage of asphalt residue. Expected temperature ranges for component materials and the completed mixture shall also be provided with the job mix formula submission.

The job mix formula shall be within the following limits, however, the Department's Materials and Research Section reserves the right to make adjustments to the formula:

Sieve Size	Percent Passing	Production Tolerance (±)
9.5 mm	100	0
4.75 mm	55-90	7
2.36 mm	10-40	4
75 µm	0-3	2

Asphalt residue, including additive, shall be 4.5 to 6.5% of the total aggregate weight. When tested according to procedures described herein, the allowable production tolerance from the approved mix design is ±0.4%.

Note: There is a substantial difference between "% residue by volume" and "% residue by weight". The Department's Materials and Research Section can assist the producer in determining the proper amount of bituminous material to add to meet the job mix asphalt residue target.

815.03 Mixing Methods. The aggregate shall be heated to a temperature between 85 and 107 C, and the asphalt shall be heated to a temperature between 57 and 79 C. The completed mix shall have a temperature not to exceed 82 C.

The proposed mixing facility shall be approved by the Department's Materials and Research Section for mixing these materials. Any type mixer other than a batch type mixer will be approved for use only after careful evaluation of the mixing capabilities.

The producer shall notify the Department's Materials and Research Section of the mixing schedule at least one full working day before any mixing.

Mixing shall be continuous until all aggregates are thoroughly coated with the bituminous material.

815.04 Acceptance of Materials. Samples of the component materials and the produced mixture shall be provided to the Department's Materials and Research Section in order to test the materials' qualities. Acceptance of the materials and the produced mixture will be based on an evaluation of asphalt-aggregate compatibility using a boiling strip test and a coating test, and extraction analysis of the mixture.

815.05 Performance Requirements. The aggregate shall be uniformly coated with no stripping of the bituminous material from the aggregate. The mixture shall be capable of being stored in a stockpile for a period of at least six months without hardening or striping and shall remain workable during all expected weather conditions during this storage.

SECTION 816 POLYMER MODIFIED BITUMINOUS COLD-PATCHMATERIAL

816.01 Description. The polymer modified bituminous cold-patch material shall be a uniform mixture of compatible mineral aggregate and a polymer modified cutback asphalt. The aggregate shall be uniformly coated with no stripping of the bituminous material from the aggregate. The mixture shall be capable of being stored in a stockpile for a period of at least six months without hardening or stripping and shall remain workable during all expected weather conditions during this storage.

816.02 Submission and Approval. Written documentation of current approval by the supplier of the bituminous material of the mix design and the proposed mixing facility must be submitted to and approved by the Department's Materials and Research Section prior to production.

816.03 Material Requirements. The aggregate shall be clean, crushed limestone or stone of equal quality, free from any foreign or deleterious material.

The polymer portion of the polymer modified cutback asphalt shall be blended with a cutback asphalt. The formulation shall be at the discretion of the manufacturer. The polymer modified cutback asphalt shall be piped directly from the transporting tanker into the mixing plant without an intermediary holding tank.

816.04 Job Mix Formula. It is the responsibility of the producer to submit a written proposal indicating the single definite percentage of each sieve fraction of aggregate and percentage of asphalt residue. Expected temperature ranges for component materials and the completed mixture shall also be provided with the submission.
The polymer modified cutback asphalt shall be added at a rate of 5.25 to 6.25% by weight, with an allowable production tolerance of ±0.4% based on the total weight of the mix.

816.05 Mixing Requirements. The mixing facility must be a batch type mixer. Any type other than a batch type mixer will be approved for use only after careful evaluation of its mixing capabilities. All aggregate must be free of excess surface moisture prior to mixing. If some drying is required, heating must not exceed 66 C. Mixing shall be continuous until all aggregates are thoroughly coated with the bituminous material. After mixing, the material shall be stockpiled for a minimum of 48 hours in order to allow curing to occur. During this period of time, the stockpile will be examined for runoff and workability.

816.06 Performance Requirements. Samples of the component materials and the produced mixture will be obtained by the Department's Materials and Research Section in order to test their qualities. Acceptance of the materials and the produced mixture will be based on, but not necessarily totally on, the following described tests and considerations:

- Coating Test
- Extraction Analysis
- Boiling Strip Test

The initial approval of the material sources, mix design, plant facilities, or mixture based on the above tests shall in no way preclude further examination and testing if unsatisfactory results or performance are encountered. The acceptance at any time shall not bar future rejection. Performance will be judged at the time of materials use.

SECTION 817 CUT-BACK ASPHALTS

Cut-back asphalt's shall conform to the requirements of AASHTO M 81 for rapid curing (RC) types and AASHTO M 82 for medium curing (MC) types.

In addition, medium curing (MC) types shall conform to the following requirements:

Test	Minimum	Maximum
Kinematic Viscosity at 60 C, m^2/s	0.0004	0.0008
Flash Point, Tag Open Cup, C	66	--
Water, %	--	0.2
Distillation Test	**Minimum**	**Maximum**
Distillate, percentage by volume:		
to 225 C	0	7
to 260 C	10	45
to 315 C	55	85
Residue from Distillation to 360 C, volume percentage of sample by difference	70	--
Tests on Residue	**Minimum**	**Maximum**
Absolute Viscosity at 60 C, Pa s	30	120
Ductility 5 cm/min. at 25 C, cm	100	--
Solubility, %	99	--

SECTION 818 MORTAR SAND
Mortar sand shall conform to the requirements of AASHTO M 45 and the following grading:

Sieve Size	Percent Passing
4.75 mm	100
2.36 mm	95-100
150 µm	0-25
75 µm	0-10

Fineness Modulus: 1.6 to 2.5

The organic impurities requirement will be waived for uses other than masonry mortar.

SECTION 819 SOLID CONCRETE BLOCK

Solid concrete block shall conform to the requirements of ASTM C 139, except that absorption shall have a maximum value of 240 kg/m^3. Units less than 125 mm in thickness shall have a minimum compressive strength of 15 MPa. A concrete masonry unit may be either a concrete block or what is commonly referred to as a concrete brick.

SECTION 820 COATINGS FOR STEEL STRUCTURES

820.01 Description. This material consists of the designated systems of coatings for steel structures. If no system is designated, the material shall conform to the requirements of Subsection 820.02 (a).

820.02 Material Requirements.

(a) Inorganic Zinc-Epoxy Urethane System. Individual coats shall consist of an inorganic zinc-rich primer conforming to the requirements of AASHTO M 300, Type I or II; an epoxy-polyamide intermediate coat conforming to the requirements of SSPC-Paint 22 (pigmented to contrast with both the primer and topcoat); and an aliphatic urethane topcoat conforming to the requirements of SSPC-PS Guide 17.00, Type II. The topcoat color of the structural steel shall match color chip No. 24172 (green) of FED-STD-595B, unless otherwise indicated on the Plans.

(b) Moisture-Cured Urethane System. All paint used on any one structure shall be produced by a single manufacturer; and the coating system shall conform to the minimum requirements as noted below.

Primer:

Generic Type:	Micaceous Iron Oxide/Zinc-rich, single-component, moisture-cured polyurethane
Vehicle Type:	Moisture-cured polyurethane
Volume of Solids:	60% minimum
Pigment Type:	Micaceous Iron Oxide/Zinc dust
Coverage:	75 µm DFT minimum
VOC:	Not to exceed 0.34 kg/L
Weight:	Minimum 2.28 kg/L

Intermediate Coat

Generic Type:	Micaceous Iron Oxide, single-component, moisture-cured polyurethane
Vehicle Type:	Moisture-cured polyurethane
Volume of Solids:	60% minimum
Pigment Type:	0.48 kg/L Micaceous Iron Oxide, tinted to distinguish from primer and topcoat
Color:	Tinted to distinguish from primer and topcoat
Coverage:	75 µm DFT minimum
VOC:	Not to exceed 0.34 kg/L
Weight:	Minimum 1.92 kg/L

Finish Coat

Generic Type:	Micaceous Iron Oxide-filled, single-component, moisture-cured polyurethane
Vehicle Type:	Moisture-cured polyurethane
Volume of Solids:	60% minimum
Pigment Type:	0.42 kg/L Micaceous Iron Oxide
Finish:	Flat (low gloss)
Color:	To be specified in the Plans
Coverage:	75 µm DFT minimum
VOC:	Not to exceed 0.36 kg/L
Weight:	Minimum 1.92 kg/L

Each single coat of paint shall be a color different from the others. The color of the primer and intermediate paint shall be at the Contractor's option and shall provide contrast with the underlying substrate or previously applied paint. The color of the finish paint shall be as specified in the Plans.

Successive time interval for coating in between prime coat, intermediate coat, and finish coat shall be a minimum of four and a maximum of 14 days. If the Contractor fails to complete the painting during the established period, the surface are shall be cleaned if necessary as determined by the Engineer.

The Contractor may use one of the following approved paint systems:

(1) Wasser High-Tech Coatings, Kent, WA 98032

Primer: Wasser MC-MIO Zinc (spot) (75 µm, DFT)

Intermediate: Wasser MC-Miomastic Iron Oxide (75 µm, DFT)

Finish: Wasser Ferrox A (75 µm, DFT)

(2) Xymax Coatings, Inc., Oakland, FL 33311

Primer: Bridge Zinc 336 (spot) (75 µm, DFT)

Intermediate: Mono-Ferro (75 µm, DFT)

Finish: Bridge Finish (75 µm, DFT)

All components of the system (primer, intermediate, and finish coats) will be accepted on the basis of the manufacturer's written certification that the batch(s) produced meets their product specification.

Only paint arriving at the work site in new, unopened containers shall be used.

Containers of paint shall be labeled with the manufacturer's name, product name, component part, batch number, date of manufacturer, and shelf life date. Paint in containers having expired shelf life dates shall be immediately removed from the work site.

(c) Moisture-Cured Aluminum System. The moisture-cured aluminum paint must follow the following requirements:

One-Coat System

Generic Type:	Aluminum filled aromatic moisture-cured urethane
Vehicle Type:	Moisture-cured aromatic polyurethane
Pigment Type:	Minimum 0.24 kg/L non-leafing aluminum
Coverage:	50 µm DFT minimum
VOC:	Not to exceed 0.42 kg/L
Weight:	1.1 kg/L
Volume of Solids:	52.0 ± 1.0%
Shelf Life:	Six months from date of shipment, in unopened original containers stored at temperatures below 30 C.

SECTION 821 GRADED AGGREGATES

821.01 Description. This material consists of coarse crushed stone, crushed slag fragments or Portland cement concrete fragments blended with crushed particles of the same origin.

821.02 Applicable Testing Methods.

- AASHTO T 2
- AASHTO T 27
- AASHTO T 96

821.03 Material Details.

(a) Submissions. Samples from the source of the material shall be supplied as directed by the Engineer.

(b) Material Properties. The graded aggregate blend shall be uniform in quality and free of silt, clay, decomposed fragments, overburden material, soil, reinforcement, and other deleterious debris.

(c) Gradation. Graded aggregate material shall conform to the following gradation requirements for the appropriate type:

Weight Percentage Passing

Sieve Size	Type A (CR-1)	Type B (Crusher Run)
63 mm	100	--
37.5 mm	--	100
25.0 mm	50-80	--
19.0 mm	--	50-95
4.75 mm	20-50	20-50
2.00 mm	--	15-40
850 µm	10-30	--
150 µm	2-20	2-20

The percentage of wear as determined by the Los Angeles machine shall not exceed 45%.

SECTION 822 FLY ASH

822.01 Description. This material consists of fly ash, which is a by-product of coal combustion. Fly ash may be used as a mineral additive in concrete and as a partial replacement for Portland cement within Section 812 and other Sections of these Specifications.

822.02 Materials Requirements. Fly ash shall conform to the requirements of AASHTO M 295, Class C or F as modified herein. The requirements of Table 1 "Chemical Requirements" shall be modified to establish the maximum "Loss on Ignition" at 4.0%. Table 2 "Supplementary Optional Chemical Requirement" and Table 4 "Supplementary Optional Physical Requirements" shall apply. In Table 3 "Strength Activity Index" the minimum activity index at seven days shall be 85% of the control and the minimum at 28 days shall be 100% of the control. Traces of ammonia and oil shall be absent from the fly ash.

Transport containers for fly ash shall be of a design that provides for proper and complete unloading. Dedicated and reserved storage bins of fly ash shall be sampled and tested by the Engineer. All tests shall be completed and shall show that the material conforms with all requirements prior to any use.
Upon approval of the Engineer, the preceding requirement for dedicated and reserved storage bins of fly ash may be waived if the fly ash supplier is qualified for inclusion in a certification program. The Program of Certification involves acceptable supplier quality control procedures.

For an acceptable Program of Certification, the supplier must establish a history of satisfactory quality control of fly ash produced as evidenced by the results of tests performed by the Department and the supplier’s testing laboratory. The supplier shall conduct sufficient tests to ensure that adequate quality is maintained in regard to the material specifications. The supplier must maintain a record of all tests for review by the Engineer. The Engineer reserves the right to modify the program as considered necessary to maintain quality. Samples for tests by the Department may be taken at any time as determined by the Engineer. In addition, the handling and storage facilities must be approved by the Engineer.

SECTION 823 HOT-MIX, HOT-LAID BITUMINOUS CONCRETE

823.01 Description. This material consists of hot-mix, hot-laid bituminous concrete bases and surface courses.

MATERIALS.

823.02 Asphalt Cement. The asphalt cement shall be AC 20 with a viscosity grade conforming to the requirements of Section 810. Tank trucks used to deliver asphalt cement shall be equipped with an approved sampling device. The delivery temperature of the material shall not exceed the maximum mixing temperature.

823.03 Fine Aggregate. Fine aggregate is defined as all material passing the 2.36 mm sieve and shall consist of clean, hard, durable crushed stone.

In Job Mix Formula Types B, C, and D, which are defined in Subsections 823.19, 823.20, and 823.21, up to 15% of the fine aggregate may be washed concrete sand, conforming to the requirements of Section 804. If the stability, as determined by the Laboratory Marshall Method in accordance with AASHTO T 245, is less than 5.3 kN, the fine aggregate sand percentage shall be reduced or excluded. All carbonate and serpentine aggregate shall be prohibited in the final roadway wearing surface course on any roadway having a minimum average daily traffic volume (ADT) of 8000 vehicles and a posted speed of 60 km/h or greater.

823.04 Coarse Aggregate. Coarse aggregate shall be all material retained on the 2.36 mm sieve and shall conform to the requirements of Section 805. All carbonate and serpentine aggregate shall be prohibited in the final roadway wearing surface course on any roadway having a minimum average daily traffic volume (ADT) of 8000 vehicles and a posted speed of 60 km/h or greater.

823.05 Antistripping Additive. When specified for use by the Engineer, or when the Tensile Strength Ratio (TSR) is less than 80 as determined in accordance with AASHTO T 283, a heat-stable, antistripping chemical additive conforming to the requirements of Section 829 shall be blended with the asphalt cement in accordance with Subsection 823.16.

823.06 Laboratory. At all batch and dryer drum mixing plants, the Contractor shall provide a building suitable for a field laboratory in which to house and use the equipment necessary to carry on the various tests required, including bituminous extractions and gradations.

The building shall be for the use of the Engineer and inspectors for testing and recording purposes and shall be so located that activities at the plant are plainly visible from one window of the building.

The building shall have a minimum of 55 m^2 of floor space and be of acceptable dimensions. It shall be weatherproof and have at least two windows and a door, all equipped with acceptable latches and locks. The building shall be maintained to the satisfaction of the Engineer. Satisfactory lighting, heating, and air conditioning shall be supplied. The air conditioning equipment shall be capable of maintaining the room temperature throughout the laboratory at 25 C at all times.

The Contractor shall furnish all water, including drinking water, fuel, telephone, heat, and power to conduct all necessary tests. Tables, desks, chairs, and work tables shall be provided and maintained as required. Approved sanitary facilities shall be furnished and maintained.

If approved, the laboratory may be a part of another building, in which case it shall be completely partitioned off from the remainder of the building.

823.07 Testing Equipment. All production plants shall be equipped with all the necessary equipment from the equipment list supplied by the Department's Materials and Research Section. The Contractor shall ensure that the laboratory contains equipment of approved make and design and shall maintain the equipment to the satisfaction of the Engineer.

Approval of the plant will be contingent upon meeting the requirements of Subsection 823.06 and this Subsection.

823.08 Inspection of Mixing Plant Operations. The Engineer or the Engineer's representative shall have access at all times to all parts of the mixing plant for checking the adequacy of the equipment in use, inspecting the conditions and operation of the plant, verifying the weights or proportions and character of materials, and determining and checking the temperatures being maintained in the preparation of the mixtures.

MIXING PLANTS.

The two types of mixing plants are Batch Type and Continuous Mixing Type.

823.09 Batch Type. Bituminous concrete plants will not be approved unless they are automated. The automatic batch plant shall be controlled by means of an approved automatic batch selector. The batch selector shall control and deliver, accurately and in proper sequence, the designated weight or volume of bituminous material and aggregates required for the bituminous concrete mixture and shall automatically time the mixing operation. The batch selector controls shall be locked or sealed during the operation, and no changes in selector control or setting shall be made except in the presence of the Engineer's representative.

(a) Interlocks. The plant shall be equipped with interlocking cut-off circuits to interrupt and stop the automatic cycling of the operation at all times when errors in weighing or proportioning occur, or when there is a malfunction of any portion of the control system.

(b) Equipment Failure. If the automatic proportioning devices become inoperative, the plant may be permitted to batch and mix bituminous materials for a period of not more than 48 hours from the time of the breakdown, if approved by the Engineer. Written permission of the Engineer shall be required for a period of operation longer than 48 hours without automatic proportioning.

823.10 Plant and Machinery. The mixing plant used by the Contractor in preparation of the bituminous concrete shall be capable of producing a minimum of 68 metric tons per operating hour and shall comply with the following requirements:

(a) Cold Feed. The plant shall be provided with a separate cold bin or tunnel opening for each size and type of mineral aggregate used in the mix. In addition, each cold bin or tunnel opening shall be equipped with a calibrated gate and mechanical feed to provide a uniform and concurrent flow of aggregates prior to their introduction into the drier.

(b) Drier. The drier shall be a rotating cylinder type suitably designed to heat and dry the aggregates, and shall continually agitate the aggregates during heating. The drier shall be capable of preparing aggregate to the full rated capacity of the paving plant.

(c) Burner. The burner shall be of an approved design and shall be automatically controlled.

(d) Sieves. All plant sieves shall be designed, constructed, and operated so that all aggregates are sieved to their specified sizes and proportions, and shall have a capacity, when operated at normal speed, slightly in excess of the maximum capacity of the mixer.

(e) Bins. The plant shall include storage bins of sufficient capacity to supply the mixer when it is operating at full capacity. Bins shall be arranged to ensure separate and adequate storage of appropriate fractions of the mineral aggregates, and the plant shall be equipped to feed such material into the mixer within ±0.5% of the total batch weight. Separate dry storage shall be provided for filler or hydrated lime when used, and the plant shall be equipped to feed such material into the mixer within ±0.5% of the total batch weight. Each bin shall be provided with overflow pipes, sized and located to prevent material backing up into other compartments or bins. Each compartment shall be provided with an individual outlet gate that prevents leakage when closed. The gates shall cut the flow off quickly and completely. Bins shall be constructed so that samples can be readily obtained. Bins for continuous mix plants shall be equipped with adequate telltale devices to indicate the position of the aggregates in the bins at the lower quarter points. Each compartment shall be designed to prevent the overflow of material into other bins.

(f) Weigh Box or Hopper. The plants shall have a weigh box of sufficient capacity to hold the maximum amount of the aggregate material for one batch. The weigh box or hopper shall be supported on fulcrums and knife edges, and constructed such that it can not be easily thrown out of alignment or adjustment. Weighing hoppers must be free from contact with all edges, ends, sides, supporting rods or columns, or with other equipment that will in

any way affect their proper functioning. In addition, there must be sufficient clearance between the hopper and supporting devices so that foreign materials will not accumulate. The discharge gate of the weigh box must be positioned to prevent aggregate separation when dumping in the mixer. If necessary, baffles shall be inserted or other means provided to discharge the materials in a blended condition.

(g) Aggregate Scales. Scales for the weighing of aggregates shall be of standard make and design and shall be accurate to 0.5% throughout their range. The scale shall consist of a digital readout connected to a load cell. All digital readouts shall be so located that they will be in plain view of the operator and the Engineer or the Engineer's agent. No weighing of aggregates shall be permitted where vibration from the plant mechanisms or any other source prevents accurate reading of the scale. The value of the gradations of scales weighing over 2250 kg shall not be greater than 0.1% of the rated capacity of the scale.

(h) Bitumen Scales. The digital scale shall have a capacity of at least 15% in excess of the quantity of bituminous material used in a batch. The controls shall be constructed so that they may be locked at any setting and automatically reset to the reading after the addition of bituminous material to each batch. The readout shall be in full view of the mixer operator and the Engineer and the Engineer's agent and shall be graduated in increments not greater than 0.45 kg. The flow of bituminous material shall be automatically controlled. All of the bituminous material required for one batch shall be discharged in not more than 20 seconds after the flow has started. The size and spacing of the spray bar openings shall provide a uniform application of bituminous material the full length of the mixer. The section of the bituminous line between the charging valve and spray bar shall be provided with a valve and outlet for checking the meter when a metering device is substituted for a bituminous material bucket.

The equipment used to measure the bituminous material shall be accurate to ±0.5%. The bituminous material bucket shall be a non-tilting type with a loose sheet metal cover. The length of the discharge opening or spray bar shall be adequately heated. The capacity of the bituminous material bucket shall be at lease 15% in excess of the weight of bituminous material required in any batch. The plant shall have an adequately heated, quick acting, non-drip, charging valve located directly over the bituminous material bucket.

(i) Test Weights. The Contractor shall provide and have readily available at least eleven standard 20 kg, one standard 5 kg, and two standard 1 kg (ten standard 50 lb.) weights, for checking the scales during operations.

The weighing equipment, in addition to complying with the above requirements, must have adjusting devices which will provide for the readjustment of any part that, being out of adjustment or balance, prevents the scale from functioning properly.

(j) Asphalt Control System. The proper amount of bituminous material in the mix, within the tolerance specified for the job mix, shall be provided by either weighing or metering.

Heating of asphalt cement shall be by steam coil, hot oil, or other approved methods. Under no circumstances shall a flame from oil or other fuel be permitted to come in direct contact with the heating tanks. The asphalt circulating system shall be sized to give proper and continual circulation of asphalt cement throughout the operating periods.

(k) Thermometric Equipment. An armored thermometer, reading within the ranges used, shall be fixed in the asphalt line at a suitable location near the weigh bucket discharge valve.

The plant shall also be equipped with an approved dial scale thermometer and an electric pyrometer or other approved thermometric instrument placed at the discharge chute of the drier to automatically register and record the temperature of the heated aggregates. This device shall also be in full view of the burner controller or the head feeder.

The Engineer reserves the right to judge the efficiency of the above instruments and direct the replacement of the instruments with some approved temperature recording apparatus. Further, the Engineer may require the Contractor to submit daily charts of the recorder's readings.

(l) Mixer Unit. The mixer shall be a heat-jacketed, insulated, batch mixer, of the standard pugmill type, or an approved heat-jacketed, insulated, rotary drum-type mixer. Rotary mixers shall be equipped with a sufficient number of paddles or blades set in position to produce properly mixed batches of any material required under these Specifications. When the clearance in the twin pugmill exceeds 25 mm, either the shortened blades or the worn liners (or both) shall be replaced to reduce the clearance to less than the allowable 25 mm maximum. The mixer shall be provided with an approved, accurate time lock that will lock the discharge gates until the specified mixing time has elapsed. In no case shall the rated capacity of the mixer specified on the manufacturer's name plate be exceeded. If sufficient mixing and coating is not obtained, the Engineer reserves the right to direct the Contractor to increase the mixing time.

Deviations in sizes of batches will be permitted to provide for mixing batches 25% below the rated capacity of the mixer. When slag coarse aggregate is used, no increase will be permitted in the size of the batch above the rated capacity of the mixer.

(m) Dust Collector. All plants shall be equipped with an approved dust collector system. Provisions shall be made to waste the collected material or to return it uniformly to the aggregate mixture as directed. All State and local air pollution control regulations and ordinances shall be followed.

(n) Safety Requirements. An adequate and safe stairway to the mixer platform and guarded ladders shall be placed at all points required for accessibility to all plant operations. All gears, pulleys, chains, sprockets, and other dangerous moving parts shall be thoroughly guarded and protected. Ample and unobstructed space shall be provided on the mixing platform. A clear and unobstructed passage shall be maintained at all times in and around the truck loading space, and this space shall be kept free of drippings from the mixing platform. A platform shall be located at the truck loading space to permit easy and safe inspection of the mixture as it is delivered into the trucks. The platform and steps shall have safety handrails. Easy and safe access shall be provided to the location above the mixer where sampling of the aggregate in the bins is to take place. Adequate overhead protection shall be provided where necessary. All other Federal, State, or local safety requirements shall be followed.

(o) Platform Truck Scales. All plants shall be equipped with platform truck scales to weigh empty and loaded trucks. Truck scales shall be of approved design and kept in good condition. Scales shall be mounted in a concrete foundation that will ensure their remaining level and plumb. Scales shall be mounted to weigh the entire truck. All platform truck scales shall be approved by the appropriate Sealer of Weights and Measures and have seals attached at the beginning of each season or at such other times, as may be deemed necessary. Manufacturer's Certified Scale Checks may be accepted. Split weighing will not be approved.

823.11 Continuous Mixing Type. The use of continuous mixing plants will be permitted for the preparation of hot-mix bituminous concrete, provided such plants conform to the requirements listed below and to the general requirements for all plants.

(a) Gradation Control Unit. The plant shall include a means for accurately proportioning each size of aggregate by either weighing or volumetric measurement. When gradation control is by volume, the plant shall include feeders mounted under the compartment bins. Each bin shall have an accurately controlled individual gate to provide an orifice for volumetrically measuring the material drawn from each bin compartment. The orifice shall be rectangular with one dimension adjustable by a positive mechanical means, and shall be provided with a lock. Indicators shall be provided in each gate to show the gate opening in millimeters.

Mineral filler, if specified, shall be proportioned separately and added to the mix to obtain uniform distribution.

(b) Weight Calibration of Bitumen and Aggregate Feed. The plant shall include a means of calibrating gate openings and meters using weight test samples. The aggregate fed out of the bins through individual orifices shall be bypassed to a suitable test box, confining the material from each compartment in a separate box. The plant shall be equipped to conveniently handle test samples weighing up to 360 kg and to weigh them on accurate scales. Means shall be provided for calibrating the flow of bitumen.

(c) Synchronization of Aggregate and Bitumen Feed. Positive interlocking control between the flow of aggregate from the bins and the flow of bitumen from the meter or other proportioning source shall be provided. This device shall include a mechanical interlock or other positive method of accurate control.

(d) Mixer Unit Continuous Method. The plant shall include a continuous mixer of an approved twin pugmill type, heat-jacketed, and capable of producing a uniform mixture within the permissible variations from the job mix specifications. The angular position of the paddles on the shafts shall be adjustable, and the paddles shall be reversible to retard the flow of the mix. The mixer shall carry a manufacturer's plate giving the net volumetric contents of the mixer at the several heights inscribed on a permanent gauge and the rate of feed of aggregate per minute at plant operating speed.

Unless otherwise required, determination of mixing time shall be by the weights method under the following formula. The weights shall be determined for the job by tests made by the Engineer.

The production capacity of the continuous mix plant shall be not less than 70 metric tons per hour (19 kg/s).

(e) Discharge Hopper. The discharge end of the pugmill shall be equipped with a hopper, or other approved device for truck loading, that will eliminate segregation of the mixed material.

PROCEDURE FOR BATCH OR CONTINUOUS TYPE PLANTS.

823.12 Preparation of Asphalt Cement. All asphalt cement shall be uniformly heated in tanks to a temperature of 120 to 175 C. Asphalt shall be maintained within these temperature limits

823.13 Preparation of Mineral Aggregates. Before entering the mixer, the aggregates shall be dried and heated to a temperature of not more than 190 C, except for recycled mixes. Flames used for drying and heating shall be properly adjusted to avoid injury to the aggregate.

Immediately after heating, the aggregates shall be screened into separate bins, ready for batching and mixing with asphalt cement.

823.14 Preparation of the Mixture. Each size of hot aggregate and the asphalt cement shall be weighed separately to accurately determine the correct portion of each constituent in the mix. The mixing temperature and tolerance will be given by the Department's Materials and Research Section for the type of material being produced.

The mixture shall consist of coarse aggregate, fine aggregate, mineral filler if required, and asphalt cement. The exact proportions within the limits specified shall be regulated to produce a satisfactory non-boiling mixture with all the particles fully coated.

After the hot fine and coarse aggregates are introduced into the twin pugmill, the asphalt cement shall be added in an even sheet the full width of the mixing chamber. After the asphalt cement is added, mixing shall be continued for 30 seconds, or until the aggregates are coated and well mixed.

The processed bituminous concrete mixture may be held in an approved storage system in accordance with Subsection 823.17.

823.15 Dryer-Drum Mixers. The plant shall be specifically designed for dryer-drum mixing and shall be capable of satisfactorily heating, drying, and mixing the bituminous mixtures. The aggregate shall enter the drum from the burner-end and shall travel parallel to the flame and the exhaust air stream. The system shall be equipped with automatic burner controls. Heating shall be controlled to prevent damage to the aggregate or the asphalt cement. The temperature of the mixture when discharged from the mixer shall be within the range specified by the Department's Materials and Research Section for the type mix being produced. The rate of flow through the drum shall be controlled to obtain a homogeneous mixture with uniformly-coated particles. In no case shall the quantity of mixture produced exceed the manufacturer's rated capacity.

Each cold feed bin shall have an adjustable gate with an indicator to reference the opening setting. A device shall be installed on each of the aggregate feeders to indicate when the flow of material from the bin is not sufficient to allow accurate proportioning through the feeder gates. These indicators shall be positive in action and shall actuate a clearly visible or audible signal to attract the plant operator's attention, and they shall stop the flow of materials to the drum when the level of material in the bin is too low for accurate proportioning. In addition, for those particular cold bins in which aggregate material tends to either bridge or lump together causing temporary interruptions in feeds, a vibrator or other suitable means shall be provided to ensure uniform flow out of bins so that aggregate material does not bridge or lump. All cold feed bins including mineral filler silos shall be accurate to 0.5% of the total weight delivered by that particular bin or silo. The order of aggregate feed onto the composite cold feed belt shall be from coarse to fine. An independently mounted scalping screen shall be installed if directed by the Engineer. Asphalt cement shall be introduced through a continuously registering, cumulative indicating meter by a pump specifically designed for dryer-drum plants. The meter shall be located in the asphalt line to continuously register the asphalt discharge to the mixer and arranged to allow diversion of the discharge through the meter to a container for measurement. The meter shall be equipped with a non-setback register and shall have an accuracy within 1% by weight of the material actually being measured in any given period of time. The temperature of the asphalt shall be monitored by a thermocouple which shall be calibrated prior to the annual asphalt feed calibration to within 2 C of a certified mercury thermometer and shall have a digital display on the control panel. The accuracy of the pump and meter shall be verified annually and whenever designated by the Engineer with the Engineer's agent present to document the calibration.

The aggregate feed and the asphalt flow systems shall be interlocked by a blending system that automatically regulates the asphalt flow and immediately corrects for variations in aggregate flow. The system shall provide positive weight measurement of the combined cold aggregate feed by use of a belt scale. The combined cold aggregate feed shall be continuously recorded on a non-setback register. Feed of material to the belt scale shall be controlled to ensure that the combined aggregate flow is between 50 and 100% of the rated capacity of the scales at normal operation. The plant shall be equipped so that the proportion of each aggregate can be individually varied. The plant shall also be equipped so that the total aggregate rate can be varied without affecting the proportions. The plant shall be equipped with a moisture compensating device in the control panel to automatically correct for the moisture in the aggregate passing over the belt scale. The plant shall be required to use the most recent moisture values obtained to ensure accurate asphalt proportioning. Moisture determinations for the combined aggregate will be made periodically during each day's operation. The plant shall also be equipped with a device in the control panel to automatically correct for the specific gravity of the asphalt.

Safe, adequate, and convenient facilities shall be provided for obtaining representative asphalt and aggregate samples. The plant shall be equipped with a sampling device capable of providing a sample of sufficient size from the full width of the combined aggregate cold feed flow. The sampling device shall be designed so that samples may be taken while the plant is operating at normal production rates. Safe, adequate, and convenient facilities shall be provided for calibrating the asphalt flow and the aggregate flow. The manufacturer's recommendations shall be followed for calibration. To calibrate the aggregate flow system, means shall be provided to permit a positive and uniform diversion of the aggregate in sufficient quantity to accurately check the weight of aggregate per period of time. To calibrate the asphalt metering system for proper proportioning, an asphalt distributor or other equipment approved by the Engineer shall be made available so that accurate tare, gross, and net weights may be obtained for the diverted asphalt discharge. The rate of flow of the total aggregate and asphalt flow shall not vary by more than 2.0% by weight from the required quantity of each.

The dryer-drum mixer shall be capable of simultaneously heating and mixing the introduced aggregate and asphalt to produce an acceptable, thoroughly coated mix meeting the required temperature and mix designs. Pyrometers or other thermometric instruments shall be located at the discharge chute of the dryer-drum mixer to automatically register the temperature of the mix.

Prior to mixing of hot-mix bituminous concrete in drum mix plants, the gradation of all stockpiled aggregate material shall be checked for grading requirements conforming to Section 813 and shall be approved prior to use. Aggregate from the approved stockpiles shall be selected based on a percentage of the stockpile sizes to meet the

appropriate job mix formula gradation according to Subsections 823.20, 823.23, and 823.24. Samples from the cold feed conveyor shall be taken to ensure that the proper gradation requirements are being met prior to the addition of asphalt for production of hot-mix.

823.16 Antistripping Additive Blending - All Plants. Blending of the additive and asphalt cement shall be accomplished at the bituminous concrete production plant during the production of bituminous material, through the use of an approved in-line metering and blending system. The holding tank shall be thermostatically controlled for heat and shall have a recirculating line for uniform heat control. The additive temperature shall be maintained at a uniform mix temperature at least 24 hours prior to production to ensure uniform additive viscosity. There shall be a diverter valve in the recirculating line from the pump for calibration purposes, which shall deliver a full stream from the additive pump at a height equivalent to the addition input to the main asphalt line. Additive pumps shall be calibrated on a daily basis or whenever deemed necessary by the Engineer. The calibration shall be done by plant personnel and witnessed by a representative of the Department's Materials and Research Section.

823.17 Storage Systems - All Plants. The system shall be capable of conveying the hot-mixture from the plant to the storage bins and storing the hot-mixture without a reduction in temperature and with no segregation of the mix or oxidation of the asphalt. The mixture, as delivered for the work, shall comply with all specified quality requirements.

The conveyor system may be either a continuous or skip bucket type. The continuous type shall be enclosed and heated to effectively control the mix temperature. The skip bucket type must be large enough to transport and mass dump an entire batch into the bins.

The storage bins shall be designed to prevent segregation of the mix during discharge from the conveyor into the bins. The bin discharge gates shall be designed to prevent segregation of the hot-mixture while loading into trucks. Approval for the use of storage bins may be withdrawn when excessive heat gain or loss, uneven heating, segregation of the aggregate, or migration or oxidation of the asphalt occurs due to the operation or use of storage bins. Mixtures may be retained in heated storage bins for 12 hours, provided that material and mixture qualities are maintained.

MIXTURE REQUIREMENTS.

823.18 Applicable Testing Methods. The following standards shall be used to test the qualities of the mixture.

AASHTO T 164 Method A, Quantitative Extraction of Bitumen from Bituminous Paving Mixtures

AASHTO T 166 Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens

AASHTO T 209 Maximum Specific Gravity of Bituminous Paving Mixtures

AASHTO T 245 Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus

AASHTO T 269 Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures

AASHTO T 283 Resistance of Compacted Bituminous Mixture to Moisture Induced Damage

AASHTO T 287 Asphalt Cement Content of Asphalt Concrete Mixtures by the Nuclear Method

Samples of the actual mixture in use will be taken as many times daily as determined by the Engineer. The mixture must be maintained uniform throughout the Project within the above tolerances. Should the mix produced not meet the above requirements or the Contract performance needs, changes in the mix design or mixing procedure shall be made immediately in a manner approved by the Engineer.
If an additional source of supply for materials is submitted and approved, the job mix formula shall be readjusted as necessary by the Contractor and submitted to the Engineer. All job mix formulas submitted and found unacceptable shall be readjusted to the satisfaction of the Engineer.

823.19 Job Mix Formula Types A, B, C, D, and E. The general composition limits prescribed in this Section are master ranges of tolerance to govern mixtures made from all raw materials conforming to the requirements of Sections 804 and 805. The composition limits are maximum and minimum in all cases. Closer control may be required for job materials used for specific projects according to the job mix formula. No work shall be started on the Contract, and no mixture will be accepted for the work, until the proposed job mix formula has been approved. The Contractor shall submit a written proposal indicating the single definite percentage for each sieve fraction of

aggregate and for the asphalt that the Contractor chooses as the fixed percentage for each component in the mix. The proposal shall also indicate the temperature at which the Contractor shall furnish the mixture at the plant. The approval of the job mix formula shall bind the Contractor to furnish paving mixtures that not only meet the master ranges, but also meet the exact formula set for the Project, within the allowable tolerances.

823.20 Gradation for Job Mix Formula Types A, B, C, D, and E.

Sieve Size	Type A (%)	Type B (%)	Type C (%)	Types D & E (%)	Job Mix Tolerance (%)
63 mm	100	---	---	---	±7
50 mm	90 - 100	---	---	---	±7
37.5 mm	60 - 90	---	---	---	±7
31.5 mm	---	100	---	---	±7
25.0 mm	40 - 75	95 - 100	---	---	±7
19.0 mm	---	75 - 95	---	---	±7
12.5 mm	30 - 65	50 - 80	100	---	±7
9.5 mm	---	45 - 70	85 - 100	100	±7
4.75 mm	20 - 45	30 - 50	50 - 75	80 - 100	±7
2.36 mm	---	22 - 38	33 - 59	70 - 90	±4
600 µm	---	9 - 23	14 - 32	30 - 55	±4
300 µm	---	6 - 18	7 - 26	15 - 40	±4
75 µm	2 - 10	3 - 10	3 - 10	5 - 15	±2
A.C., %	2.0 - 4.0	3.5 - 5.5	4.5 - 6.5	6.0 - 8.5	±0.4
Temp, C	107 - 135	135 - 163	135 - 163	135 - 163	±11

The percentages for aggregates are based on the total weight of aggregate. The percentages for asphalt cement are based on the total weight of the mix.

Washed gradations of final products shall be used to determine the amount of 75 µm material. The washed dust to effective asphalt ratio shall be between 0.6 and 1.2 for the final mixture.

823.21 Marshall Properties for Job Mix Formula Types A, B, C, D, and E.

Specification Requirements	Mix Type			
	A	B	C	D & E
Air Voids, % (Compacted Specimen)	---	3.0 - 5.0	3.0 - 5.0	3.0 - 5.0
Stability, kN (Minimum)	3.4	5.3	5.3	5.3
Flow, 0.25 mm	8.0 - 20.0	8.0 - 20.0	8.0 - 20.0	8.0 - 20.0
Voids in Mineral Aggregate (VMA)*, % (Minimum)	11.5	13.0	16.0	18.0
* The VMA shall be calculated from the combined bulk specific gravities of the aggregate and the actual asphalt cement content determined by the laboratory testing.				

823.22 General Uses for Job Mix Formula Types A, B, C, D, and E.

Type A - Open plant mix base course

Type B - Dense graded base and binder course

Type C - Dense graded surface course

Type D - Fine, dense graded surface course

Type E - Curb mix

823.23 Bituminous Concrete Base Course Mixture. Mix and gradation requirements for the base course mixture shall be as follows:

(a) Mix Requirements:

- Asphalt Content 3.0 - 4.5% of total mixture weight
- Air Voids 3.0 - 6.0
- Stability 4.5 kN, minimum
- Flow 8.0 - 18.0 (0.25 mm)

(b) Gradation Requirements:

Sieve Size	Percent Passing
37.5 mm	100
19.0 mm	75-100
9.5 mm	48-80

2.36 mm	20-48
600 µm	10-30
300 µm	7-25
75 µm	3-10

During production of the base course mixture, the gradation of the aggregates may vary between the specified limits, but such variations shall be gradual. Sudden variation from coarse to fine and fine to coarse on any sieve will not be tolerated.

823.24 Plant Mix Open-Graded Wearing Surface Mixture. The open-graded wearing surface shall be composed of a mixture of approved aggregate and asphalt cement. Gradation shall be as follows:

Sieve Size	Master Range Percent Passing	Tolerance from Job Mix (±)
12.5 mm	100	0
9.5 mm	88-98	3
4.75 mm	25-42	5
2.36 mm	5-15	3
75 µm	2-5	1.5

Asphalt cement shall be from 6.0 to 8.0% of the total mixture weight (to be determined by Laboratory Tests). The temperature of the asphalt cement shall not be greater than 154 ± 6 C when introduced into the mixer.
A heat-stable, antistripping additive conforming to the requirements of Subsection 823.05 shall be added to all asphalt cement used for open-graded surface course. The amount of the additive used shall be between 0.25 and 1.0% by weight of the asphalt cement as recommended by the additive manufacturer and approved by the Department's Materials and Research Section.

The additive shall be thoroughly and uniformly blended with the asphalt cement at the hot-mix production plant in accordance with Subsection 823.16.

The target temperature (±6 C) of the mix leaving the mixer shall be established by the Department on the basis of laboratory tests. A target temperature of 116 ± 6 C is typical.
Aggregate shall conform to the requirements of Section 805, except slag will not be permitted. The use of limestone or serpentine aggregate or natural sand, washed or unwashed, is prohibited. The use of washed concrete sand is also prohibited.

823.25 Reclaimed Asphalt Pavement (RAP). This material consists of existing asphalt cement concrete pavement material removed by cold milling, or removed and processed such that 100% passes the 25 mm sieve. If the Contractor has a supply of RAP meeting the approval of the Engineer, a percentage of this material, meeting the requirements of Subsection 823.26 may be substituted for the new materials required to produce bituminous base, binder, or dense surface courses.

The stockpile of RAP shall be free of topsoil, debris, foreign matter, and other contaminants.

823.26 Recycled Asphalt Concrete Mixture. The recycled mixture shall be a blend of RAP, new aggregate, and asphalt cement conforming to the mixture requirements of this Section for the type mix specified. The new aggregate shall conform to the requirements of Subsections 823.03 and 823.04. The new asphalt shall conform to the requirements of Subsection 823.02. The percentage of new aggregate is not fixed by this Subsection; however, limitations are placed on the RAP percentage permitted in the recycled mix. A job mix formula must be submitted to the Engineer per Subsection 823.19 and approved prior to initiation of work and for any subsequent changes in the blend of the mixture. The approved ratio of RAP to new aggregate and the percentage of new asphalt cement to be incorporated into the recycled asphalt concrete mixture will be determined by laboratory tests performed on representative samples of stockpiled RAP and new aggregate.

The physical properties of the RAP asphalt cement will be determined by extraction, recovery, and testing. The testing of the physical properties will govern the percentage of RAP permitted in the recycled mix. In all mixture types, the contribution of the RAP asphalt cement shall not exceed 50% of the design asphalt content for the recycled mix.

In addition, the following plant limitations shall apply to all recycled mixtures:

Table 823-A Maximum Percentage of RAP			
Plant Type	Mixtures		
	Deep Lift	Type B	Type C
Dryer-Drum	20	10	10
Batch Plant	20	10	10

Results of single extractions and sieve tests shall not be used as the sole basis for acceptance or rejection of the mixture. Any variation from the job mix formula in the gradation of the aggregate or in the asphalt content that exceeds the tolerances noted below shall be investigated, and the conditions causing the variation shall be corrected.
The following tolerances for the job mix formula will be allowed per single test:

Sieve Size	Percent Passing
12.5 mm and larger	±8
4.75 mm and 9.5 mm	±7
150 µm to 2.36 mm (inclusive)	±5
75 µm	±3
Asphalt content, weight percent of total mixture	±0.4

823.27 Recycled Mix Production. Recycled mixtures may be produced in batch or dryer-drum type plants. Batch plants shall use the heat transfer method, by introducing the RAP into the plant weigh box at the ambient temperature of the stockpile. With this method, the uncoated, virgin aggregate, shall be superheated in the dryer and transfer its heat to the cold RAP in the plant mixer. A conveying system shall be used to introduce the proper amount of RAP per batch into the weigh box in sequence with the superheated aggregates from the plant hot bins. The mixing cycle shall include a minimum 15-second dry mix cycle prior to introduction of the hot asphalt cement. The mixture produced shall be of uniform, specified temperature, evenly coated, unsegregated, and shall have all the characteristics typical of a virgin aggregate-asphalt mixture for the type mix produced.

Dryer-drum plants used in the production of recycled mixtures shall be specifically designed and equipped by the manufacturer to provide for entrance of the RAP material into the drum with subsequent heating, and for mixing the RAP with the new aggregate and asphalt without direct flame contact, excessive asphalt hardening, or violation of air quality standards. The mixture produced shall be uniform, at the specified temperature, evenly coated, unsegregated, and have all the characteristics typical of a virgin aggregate-asphalt mixture for the type mix produced.

823.28 Use of Recycled Mixtures. Unless prohibited by the Contract, the use of recycled mixtures for the mix types specified by the Contract shall be at the option of the Contractor. All provisions of Sections 401 and 823, except as modified in Subsections 823.25, 823.26, and 823.27, shall govern materials, production, storage, transportation, spreading, finishing, and compaction of recycled materials for the appropriate mix type provided.

SECTION 824 EMBEDDED REINFORCEMENT AND HARDWARE

824.01 Description. This material consists of bar reinforcement, wire mesh reinforcement, tie bars, dowel bars, hook bolts, W-bolts, and load transfer assemblies.

824.02 Material Requirements.

a. Bar Reinforcement. Bar reinforcement shall conform to the requirements of AASHTO M 31M, Grade 300 or Grade 400, as specified on the Plans.
b. Epoxy Coated Bar Reinforcement. Epoxy coated bar reinforcement shall conform to the requirements of AASHTO M 284/M 284M.
c. Wire Mesh Reinforcement. Wire mesh reinforcement shall conform to the requirements of AASHTO M 55. Alkali resistant fiber reinforcement shall conform to the requirements of ASTM C 1116, Type III with a minimum fiber length of 12 mm and a maximum length of 38 mm.
d. Tie Bars. Tie bars shall conform to the requirements of AASHTO M 31M.
e. Hook Bolts. Hook bolts used in lieu of deformed tie bars shall conform to the Plans and the Standard Construction Details.
f. W-Bolts. W-bolts shall conform to the Plans and the Standard Construction Details.
g. Coated Dowel Bars. Coated dowel bars shall be round, steel bars of the diameter and length shown on the Plans, with a corrosion-resistant coating over a plain steel bar core, conforming to ASTM A 675/A 675 M, Grade 450. The coating shall conform to AASHTO M 254 and be either Type A, 635 ± 130 µm, multi-layer, low-bond plastic coating, or Type B, 180 ± 50 µm, fusion-bonded epoxy coating, requiring graphite application.
h. Load Transfer Assemblies. The load transfer device shall be fabricated from corrosion-resistant, coated dowel bars conforming to AASHTO M 254, Type A or Type B coating described in (g) above.
i. Splice Couplers. Splice couplers shall conform to the requirements specified on the Plans and shall be submitted to the Engineer for approval.

SECTION 825 FENCE

825.01 Description. This material consists of right-of-way fence and chain-link fence.

825.02 Right-of-Way Fence. Right-of-way fence material shall conform to the following requirements:

(a) Metal Posts. Tubular steel posts and braces shall conform to the requirements of AASHTO M 281 and shall be galvanized in accordance with AASHTO M 111.

Steel posts of tee, channel, wide flange, or U-bar shapes, shall be formed structural steel, hot-rolled carbon steel, or hot-rolled rail steel, having a minimum yield strength of 280 MPa and a minimum ultimate strength of 480 MPa. Steel posts shall be either galvanized in accordance with AASHTO M 111, painted with weather resistant paint that is specifically designed for steel, or painted with enamel that has been shop or factory baked.

(b) Barbed Wire. Barbed wire shall be galvanized steel conforming to the requirements of AASHTO M 280 and shall consist of two-strand 2.51 mm (12 ½ gage) wire with tightly wrapped, sharp, four-point barbs formed of 2.03 mm (14 gage) wire spaced evenly at not more than 130 mm intervals. Galvanizing shall be Class 3.

(c) Woven Wire Fencing. Woven wire fencing or woven wire fabric shall be 3.77 mm galvanized wire conforming to the requirements of AASHTO M 279, Class 3 coating or 3.77 mm aluminum coated steel wire conforming to the requirements of ASTM A 584 with a minimum coating weight of 120 g/m^2.

825.03 Chain-Link Fence. Chain-link fence shall be either galvanized steel fabric fence, aluminum-coated steel fabric fence, or aluminum alloy fabric fence, conforming to the appropriate requirements of AASHTO M 181.

SECTION 826 STRUCTURAL STEEL

826.01 Description. This material consists of structural steel, fasteners, bearings, and related materials fabricated, painted, and inspected in a shop environment. Related field activities such as erection and field painting are specified in Section 605. Requirements for working drawings are specified in Subsection 105.04.

MATERIAL REQUIREMENTS.

826.02 Structural Steel. Materials shall be stored in accordance with Subsection 605.03.
Structural steel for bolted and welded steel structures shall be furnished according to the following specifications unless otherwise specified:

(a) Structural carbon steel for bolted or welded construction conforming to AASHTO M 183/M 183M shall be furnished.

(b) Steel for eyebars shall be of weldable grade. These grades include:

(1) Structural steel conforming to AASHTO M 183/M 183M,

(2) Structural steel conforming to AASHTO M 222/M 222M,

(3) High-strength low-alloy structural manganese vanadium steel conforming to AASHTO M 223/M 223M, and

(4) High-strength low-alloy structural steel conforming to AASHTO M 270/M 270M.

(c) High-strength low-alloy structural steel shall conform to:

(1) AASHTO M 222/M 222M, or

(2) AASHTO M 223/M 223M, or

(3) AASHTO M 244/M 244M.

(d) High-strength low-alloy structural steel for welding shall conform to:

(1) AASHTO M 223/M 223M, Grades 290 and 345. Structural shapes shall be limited to Groups 1, 2, and 3 of AASHTO M 160/M 160M. Plates and bars of Grade 290 shall be limited to thicknesses through 100 mm. Plates and bars of Grade 345 shall be limited to thicknesses through 38 mm.

(2) AASHTO M 222/M 222M. The following supplemental requirements for impact properties shall be met:

a. Impact Tests. The Contractor shall provide the heat qualification results for one impact test from the thickest material and one impact test for the thinnest material for each heat and product furnished. The impact test shall be the longitudinal Charpy V-Notch (CVN) test conforming to the requirements of AASHTO T 244. Products are defined as plates, shapes, and bars. If less than 45 metric tons of a product are supplied using a given heat, only one impact test for the thickest material is required for that heat.

For a heat to qualify, the average energy absorbed at 4 C on the test specimens shall not be less than 20 J, except when sub-size specimens are required. The minimum average energy absorption for sub-size test specimens shall be as follows:

Size	Energy Absorbtion
10 by 7.5 mm	16 J
10 by 5 mm	11 J

One impact test consists of the average value of three adjacent specimens. The results for a single specimen may be below the above specified minimum values, but in no case below two-thirds of the value. If more than one value is below the specified minimum, or if one specimen is below two-thirds of the specified minimum, a retest of three additional specimens shall be made. Each retest must equal or exceed the specified minimum. If the thickest or thinnest material tested fails to qualify, the thickness or those thicknesses shall be rejected. However, the next thinner or thicker material to be furnished may be tested. If the retest results meet the requirements, the heat will be considered qualified for those thicknesses represented by the retest.

The governing thickness for beams, tees, and channels shall be the average flange thickness. The governing thickness for angles shall be the specified leg thickness. Test specimens for these sections shall be taken at a point one-third the distance from the outer edge of the flange or leg to the web or heel of the section.

b. Requirements for Notch Toughness. Requirements are provided herein for notch toughness of the steel. These are mandatory for material designated as main load carrying member components subject to tensile stress.

The material supplied shall meet the longitudinal CVN tests specified in Table 826-A. Sampling and testing procedures shall be in accordance with AASHTO T 243/T 243M.

Table 826-A

Charpy V-Notch Test Requirements

Steel Designation	Thickness	Equivalent Absorbed Energy	Frequency of Testing
AASHTO M 183/M 183M	Up to 100 mm	20 J @ 4 C	H**
AASHTO M 222/M 222M	Up to 50 mm, welded	20 J @ 4 C	H
	51 to 100 mm, welded	27 J @ 4 C	
	Up to 100 mm,	20 J @ 4 C	

	mechanically fastened		
AASHTO M 223/M 223M*	Up to 50 mm, welded	20 J @ 4 C	H
	Up to 100 mm, mechanically fastened	20 J @ 4 C	
AASHTO M 244/M 244M	Up to 64 mm, welded	34 J @ -18 C	P***
	65 to 100 mm, welded	47 J @ -18 C	
	Up to 100 mm, mechanically fastened	34 J @ -18 C	
* If the yield point of the material exceeds 450 MPa, the temperature for the CVN value for acceptability shall be reduced by 8 C for each increment of 70 MPa above 450 MPa. ** "H" (Heat Testing) *** "P" (Piece Testing)			

The materials subject to the notch toughness requirements are the main load carrying components under tensile stress. The main load carrying member components are the flanges, webs, and splice plates of the steel girders.

(e) High-strength structural steel for bolted construction shall conform to:

(1) AASHTO M 222/M 222M, or

(2) AASHTO M 223/M 223M, or

(3) AASHTO M 244/M 244M.

826.03 Fasteners. The Contractor shall provide a supplier's certification for all bolts, nuts, and washers. This certification shall include origin of all materials, result of the rotational-capacity tests, date and location of tests, and zinc thickness on galvanized fasteners. Lot numbers of fasteners shall be listed on the certificate and the shipping papers.

Bolts, nuts, and circular washers shall conform to the requirements of AASHTO M 164M, Type 1 including suitable nuts and plain hardened washers. Bolts manufactured to AASHTO M 164M are marked on the top of the head with three radial lines and the symbol **A 325M**. Nuts are marked on one face with three similar circumferential markings, 120 degrees apart, or alternatively, with **C**, **2**, **D**, **2H**, or **DH**. Bolt and nut dimensions shall conform to Table 826-B for heavy hexagon structural bolts and for heavy semi-finished nuts, except as allowed in the following paragraph.

Bolts	Nuts
A 325M	ASTM A 563M
A 490M	

When specified on the Plans, or at the option of the Contractor, bolts, nuts, and circular washers conforming to the requirements of AASHTO M 253M, Type 1, quenched and tempered shall be used. Alloy steel bolts for structural steel joints shall be furnished.

Subject to the approval of the Engineer, other fasteners which meet the chemical composition requirements of AASHTO M 164M and which meet the mechanical requirements of the same specifications in full-size tests, and which have body diameter and bearing areas under the head and nut, or their equivalent, not less than those provided by a bolt and nut of these same nominal dimensions referenced in Table 826-B, may be used. Such alternate fasteners may differ in other dimensions from those specified for AASHTO M 164M bolts and nuts.

Table 826-B

Bolt and Nut Dimensions

Nominal Bolt Size (D)	Heavy Hexagon Structural Bolt Dimensions (mm)			Nut Dimensions (mm)	
	Width Across Flats (F)	Height (H)	Thread Length (T)	Width Across Flats (W)	Height (H)
13	22	8	25	22	12
16	27	10	32	27	15
19	32	12	35	32	19
22	36	14	38	36	22
25	41	15	44	41	25
28	46	17	50	46	28
32	50	20	50	50	31
35	55	21	57	55	34
38	60	24	57	60	37

Circular washers shall be flat and smooth and their nominal dimensions shall conform to dimensions referenced in Table 826-C.

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 826-C.

Where necessary, washers may be clipped on one side to a point not closer than seven-eighths of the bolt diameter from the center of the washer.

Table 826-C

Washer Dimensions [a]

Circular Washers					Square or Rectangular Beveled Washers for American Standard Beams		
Nominal Bolt Size (D)	Nominal Outside Diameter [b]	Nominal Diameter of Hole	Thickness		Minimum Side Dimension	Mean Thickness	Slope of Tape
			Min	Max			
13	27	13	3	5	44	8	1:6
16	33	17	3	5	44	8	1:6
19	37	21	3	5	44	8	1:6
22	44	24	4	5	44	8	1:6
25	50	27	4	5	44	8	1:6
28	57	32	4	5	57	8	1:6
32	63	35	4	5	57	8	1:6
35	69	38	4	5	57	8	1:6
38	75	41	4	5	57	8	1:6
44	85	47	5 [c]	7 [c]	---	---	---
50	94	53	5	7	---	---	---
51 to 100	2D-13	D-3	6 [d]	9 [d]	---	---	---

[a] millimeters

[b] May be exceeded by 6 mm

[c] 5 mm nominal

[d] 6 mm nominal

Unless otherwise specified on the Plans, all high-strength bolts, nuts, and washers shall be mechanically galvanized in accordance with AASHTO M 298. Coating thickness, adherence, and quality requirements, however, shall conform to Class C of AASHTO M 232. Type 3, A 325M and A 490M, bolts, nuts, and washers specified for use with unpainted, ASTM A 588/A 588M connections shall not be galvanized. Ungalvanized A 490M bolts and hardware will not be used for hot-dipped galvanized connections. In addition, hot-dip galvanizing of Type 3, A 325M or A 490M, bolts will not be permitted.

826.04 Shear Connectors. Shear connector studs shall conform to the requirements of AASHTO M 169 for cold-finish carbon steel bars and shafting, and cold-drawn bars, Grades 1015, 1018, or 1020, either semi-kilned or fully-kilned. If flux-retaining caps are used, the steel for the caps shall be of a low-carbon grade suitable for welding and shall comply with ASTM A 109M for cold-rolled, carbon-steel strip.
Tensile properties as determined by tests of bar stock after drawing or of finished studs shall conform to the following requirements:

Tensile strength (minimum) - 415 MPa

Yield strength * (minimum) - 345 MPa

Elongation (minimum) - 50 mm

Reduction in area (minimum) - 50%

* As determined by a 0.2% offset method

Tensile properties shall be determined according to the applicable sections of AASHTO T 244 for mechanical testing of steel products. Tensile tests of finished studs shall be made on studs similar to those shown in Table 826-D.

If fracture occurs outside the middle half of the gage lengths, the test shall be repeated.
Finished studs shall be of uniform quality and condition, free from injurious laps, fins, seams, cracks, twists, bends, or other injurious defects. Finishing shall be as produced by cold-drawing, cold-rolling, or machining.
The studs shall conform to the dimensions given in the following table:

Table 826-D

Shear Connector Studs standard dimensions and tolerances in millimeters

Shank		Head	
Diameter (c)	Length* (L)	Diameter (H)	Thickness (T)
19 +0.000 -0.5	100 +1.6 -3.2	32 +0.5	9.5 minimum
22 +0.000 -0.5	100 +1.6 -3.2	44 +0.5	9.5 minimum

* Length includes thickness of head. Standard length is 100 mm but other lengths may be obtained by special order.

The Contractor shall furnish the manufacturer's certification that the studs as delivered are in accordance with the material requirements of this Section. Certified copies of in-plant quality control test reports shall be furnished to the Engineer upon request.

It shall be the Contractor's responsibility to comply with all requests of the inspector to correct improper workmanship and to remove and replace, or correct as instructed, all welds found defective or deficient. The Department will inspect all welds using visual inspection or nondestructive testing.

826.05 Forgings and Castings.

(a) Carbon Steel Forgings. Steel forgings shall conform to AASHTO M 102, Class C, unless otherwise specified.

(b) Cold Finished Carbon Steel Shafting. Cold finished carbon steel shafting shall conform to AASHTO M 169, Grade Designation 1016-1030, inclusive, unless otherwise specified.

(c) Alloy Steel Forgings. Alloy steel forgings shall conform to AASHTO M 102, Class G, unless otherwise specified.

(d) Steel Castings for Highway Bridges. Steel castings for use in highway bridge components shall conform to AASHTO M 192/M 192M, Class 485, Grade 485-250 steel, or AASHTO M 103/M 103M.

(e) Chromium Alloy-Steel Castings. Chromium alloy-steel castings shall conform to AASHTO M 163/M 163M, Grade CA-15, unless otherwise specified.

(f) Iron Casting. Iron casting shall be gray-iron castings conforming to AASHTO M 105, Class No. 30, unless otherwise specified.

(g) Ductile Iron Castings. Ductile iron castings shall conform to ASTM A 536, Grade 60-40-18, unless otherwise specified.

(h) Malleable Castings. Malleable castings shall conform to ASTM A 47M, Grade No. 22010, unless otherwise specified.

(i) Workmanship, Finish, and Cleaning for Iron Castings, Ductile Iron Castings, and Malleable Castings. Castings shall be true to pattern in form and dimensions, and free from pouring faults, sponginess, cracks, blow holes, or other defects in positions affecting their strength and value for the service intended.

The castings shall be boldly filleted at angles. The arises shall be sharp and perfect.

All castings must be sandblasted or otherwise effectively cleaned of scale and sand to present a smooth, clean, and uniform surface.

(j) Bronze Castings. Bronze castings shall conform to AASHTO M 107, Alloy UNS No. C91300 or C90500 modified with up to 2.5% lead maximum.

826.06 Bearing Materials.

(a) Elastomeric Bearing Pads. The elastomeric bearing pads shall be cast in a single, integral layer. Multiple-layer pads, separated by non-elastic sheets to resist deformations in thick pads, may be permitted. The variation in thickness in the longitudinal direction (taper) shall not exceed 5% of the length of the pads. The least horizontal dimension of the pads shall not be less than five times the thickness (shape factor l.25 minimum).

(b) Copper-Alloy Plates. Copper-alloy plates shall conform to AASHTO M 108, Copper Alloy UNS No. C51000 or C65500.

(c) Polytetraflourethylene - Stainless Steel Structural Bearings. The polytetrafluorethylene (TFE) self-lubricating bearing element shall be composed of 100% virgin (unfilled) TFE polymer, bonded to a rigid confining substrate. The substrate shall limit the flow (elongation) of the confined TFE to not more than 225 µm under a load of 14 MPa for 15 minutes at 26 C for a 50 by 75 mm test sample. The virgin (unfilled) TFE shall have a thickness of not less than 1 mm. The properties of the TFE shall conform to the requirements of following table:

Table 826-E TFE Properties		
Requirements	Test Method	Value
Hardness at 26 C	ASTM D 2240	50-65 Durometer D
Tensile Strength, MPa	ASTM D 1457	20 (min. avg.)
Elongation, %	ASTM D 1457	200 (min. avg.)
Deformation under load, % at 26 C, 14 MPa (13 x 13 x 1 mm)	ASTM D 621	4 (max.)
Specific Gravity	ASTM D 792	2.14 to 2.21

The preformed fabric bearing pad shall consist of multiple layers of 227 g duck impregnated with high quality rubber, capable of withstanding loads of 70 MPa perpendicular to the plane of lamination without detrimental reduction in thickness and without extrusion. Actual dimensions are determined by the design criteria noted on the structural drawings. The bearing pad shall meet the environmental requirements of MIL-STD-810E(2).

The stainless steel shall be no less than 1.5 mm meeting the AISI Type 304 (ASTM A 240) requirements and have a mirror finish of less than 0.25 µm on the side in contact with the TFE. The stainless steel shall be 3 mm smaller than the sole plate all around. The stainless steel shall be mechanically bonded to the sole plate.

The coefficient of friction between the self lubricating bearing element (TFE) and the stainless steel shall not be more than 0.06 at 5.6 MPa compressive loading.

The sole plate and base plate shall be the same type of structural steel specified for the steel structure. The dimensions shall comply with the details as shown on the structural drawings. All exposed surfaces shall be given the coating specified for the steel structure. Unless otherwise specified, a base plate shall be used for each bearing.

The bearing pad shall have a shore "A" hardness of 90 ± 5. The expansion bearing total thickness will be ±10%. The TFE thickness shall be -0, +0.4 mm.

(d) Steel - Bronze Bearings and Rocker Bearings. The steel used for bearings shall be the same type of steel designated for the steel structure unless otherwise specified. All exposed surfaces, except sliding surfaces, shall receive the same coating used for the structural steel.

Steel surfaces of the sole plate, rocker plate, and web and bearing plates in contact with other surfaces, shall be machine finished to at least 6.4 µm. Surfaces of the sole plate and masonry plate in contact with the bronze plate shall have a machine finish of at least 3.2 µm. The sliding surfaces shall be coated with a multipurpose grease before shipment. Prior to erection, the coating shall be removed using a solvent.

The bearing shall be shop assembled and match-marked to ensure proper fit.

Bevel the sole plate to match the grade if the grade exceeds 1%. For low profile fixed bearings, bevel the sole plate if grade exceeds 3%.

Self-lubricating bronze bearing plates shall conform to the requirements of AASHTO M 107, Alloy C91100 unless otherwise specified. The sliding surfaces of the plates shall be polished and provided with annular grooves or cylindrical recesses, or a combination thereof, filled with a lubricating compound. The compound shall be free of any material that could cause abrasive or corrosive action upon the metal surfaces and also shall be able to withstand extremely high pressures and the atmospheric elements over long periods of time. The lubricating compound shall be compressed into the recesses under sufficient pressure to form a non-plastic, lubricating inset. The lubricating inset shall comprise not less than 25% of the total area of the plate. The frictional coefficient shall not exceed 0.10 during the first 1000 cycles at the design dead load.

(e) Elastomeric Bearings. Elastomeric bearings shall conform to the AASHTO Standard Specifications for Highway Bridges, Section 18, Division II. The elastomer having a durometer hardness of 70 shall not be used in laminated bearings.

To prevent any relative movement between the bearing pad and the sole plate or the masonry, the Contractor shall perform one of the following:

(1) Use epoxy and grit on the bottom surface of the sole plate and roughen the bridge seat, or

(2) Use bonding compound approved by the Engineer to bond the contact surfaces. The beam and bearing pad shall be set in place before the bonding compound hardens.

The relative motion may be prevented using other methods recommended by the Contractor or the manufacturer, subject to the Engineer's approval.

826.07 Galvanizing. When galvanizing is shown on the Plans or specified in the Special Provisions, most ferrous metal products shall be galvanized in accordance with AASHTO M 111. High-strength bolts and other small, highly-stressed parts shall be mechanically galvanized as specified in Subsection 826.03

826.08 Sheet Zinc. Sheet zinc shall conform to ASTM B 69, Type II.

SHOP FABRICATION.

826.09 Quality of Workmanship. Fabrication of primary load carrying members will require AISC Category I or III shop certification.

826.10 Connections Using High Strength Bolts. Connections using high-strength bolts shall conform to the requirements of Subsection 605.15.

826.11 Plate Cut Edges. Plate cut edges shall conform to the requirements of Subsection 605.16.

826.12 Welding and Oxygen Cutting. Temporary or permanent welds not shown on the Plans or permitted by this Section or Subsection 605.17 shall not be made without specific written authorization by the Engineer.
All welding and oxygen cutting shall conform to AWS D1.1 and ANSI/AASHTO/AWS D1.5.

Welding of steel structures and nondestructive testing of welds shall conform to ANSI/AASHTO/AWS D1.5. All nondestructive testing required shall be done by the Contractor in the presence of the Department's inspector.

(a) Welding Processes. Manual shielded metal arc and submerged arc welding procedures covered in ANSI/AASHTO/AWS D1.5 are approved for use without procedure qualification tests.

Vertical submerged arc, electrogas arc, and electroslag welding processes shall not be used unless called for in the Plans or Special Provisions. The Contractor may request permission to use these processes from the Engineer by written notification. The Engineer will make the final decision as to the suitability of such processes.

The Engineer will not authorize the use of gas shielded, metal arc welding processes for welding of primary stress members (main girders, transverse beams, sign bridges, bridge bearings, etc.) or for any welded connections on either primary or secondary stress members. Consideration and authorization to use other welding processes may be given for welding of secondary stress members such as diagonal bracing to gusset plates, gusset plates to stiffeners, bridge railing posts, railing splices, grates, grate frames, and drain pipes.

Processes outlined in ANSI/AASHTO/AWS D1.5 and authorized for use in fabrication shall conform to the applicable provisions of the Contract.

(b) Inspection of Welding. The Contractor shall notify the Engineer at least 30 calendar days in advance of the beginning of work at the steel fabrication shop. The Engineer or the Engineer's authorized representative will be under no obligation to accept any shop work performed before the 30th day after such notice.

Nondestructive inspection includes radiographic, magnetic particle, dye penetrant, and ultrasonic methods, as well as any other type of inspection the Contractor proposes to use with the Engineer's approval.

Edges of flange butt welds in tension areas shall be magnetic particle (yoke method) or dye penetrant tested.

Ultrasonic testing may be used, when approved, in lieu of radiographic testing and shall be in accordance with AWS/AASHTO specifications.

Nondestructive testing in addition to visual inspection shall be performed by the Contractor and shall be in compliance with the requirements of AWS D1.1 and as modified by ANSI/AASHTO/AWS D1.5.

All inspections shall be performed by a firm or agent employing qualified welding inspection personnel and using equipment approved by the Department. The Contractor shall inform the Department's inspector (or the Department's inspection agency) of the name of its inspecting firm and the identity of the equipment to be used. No fabricated steel shall be inspected or accepted until the firm and its equipment have been approved.

All radiographing, magnetic particle, ultrasonic and other nondestructive testing inspection shall be performed in the presence of the Department's representative. All radiographing, magnetic particle, ultrasonic, and other nondestructive testing inspection performed without the Department's representative present will not be accepted and shall be repeated with the Department's representative present. The Contractor's inspector and the Department's representative shall jointly ascertain that each radiograph is photographically marked with a suitable identification indicating exactly where the image was taken on the beam or girder.

(c) Prequalification of Welding Operators. All fabrication shop welders, welding operators, and tackers shall be qualified in accordance with AWS D1.1, as modified by ANSI/AASHTO/AWS D1.5. The Contractor shall ensure that the fabricator retains certified copies of the qualification test records (AWS D1.1, Appendix E) and requalification tests, if appropriate, for use by the Department's authorized representative upon demand. In addition, records shall be maintained by the Contractor to ensure compliance with

AASHTO and AWS requirements for the period of effectiveness as indicated in AWS D1.1, Section 5.30.

826.13 Assembly.

(a) Shop Assembly. The field connections of main members of trusses, arches, continuous beam spans, bents, towers (each face), plate girders, and rigid frames shall be assembled in the shop with milled ends of compression members in full bearing. While the connections are assembled the subsize holes shall be reamed to the specified size. Assembly shall be Full Truss or Girder Assembly unless Progressive Truss or Girder Assembly, Full Chord Assembly, Progressive Chord Assembly, or Special Complete Structure Assembly is specified in the Special Provisions or on the Plans.

A camber diagram shall be furnished to the Engineer by the Contractor showing the camber at each panel point of each truss, arch rib, continuous beam line, plate girder, or rigid frame. When the shop assembly is Full Truss or Girder Assembly or Special Complete Structure Assembly, the camber diagram shall show the camber measured during assembly. With any of the other methods of shop assembly, the camber diagram shall show the calculated camber.

Each assembly, including camber, alignment, accuracy of holes, and fit of milled joints, shall be approved by the Engineer before reaming is commenced.

(b) Full Truss or Girder Assembly. This shall consist of assembling all members of each truss, arch rib, bent, tower face, continuous beam line, plate girder, or rigid frame at one time.

(c) Progressive Truss or Girder Assembly. This shall consist of initially assembling for each truss, arch rib bent, tower face, continuous beam line, plate girder, or rigid frame at least three contiguous panels but not less than the number of panels associated with three contiguous chord lengths (i.e., length between field splices) and not less than 45 m in the case of structures longer than 45 m. At least one shop section or panel or as many panels as are associated with a chord length shall be added at the advancing end of the assembly before any member is removed from the rearward end so that the assembled portion of the structure is never less than that specified above.

(d) Full Chord Assembly. This shall consist of assembling, with geometric angles at the joints, the full length of each chord of each truss or open spandrel arch, or each leg of each bent or tower and then the reaming the field connection holes while the members are assembled and reaming the web member connections to steel templates set at the geometric (not cambered) angular relation to the chord lines.

Field connection holes in web members shall be reamed using steel templates. At least one end of each web member shall be milled or shall be scribed normal to the longitudinal axis of the member. The templates at both ends of the member shall be accurately located from one of the milled ends or scribed lines.

(e) Progressive Chord Assembly. This shall consist of assembling contiguous chord members in the manner specified for Full Chord Assembly and in the number and length specified for Progressive Truss or Girder Assembly.

(f) Special Complete Structure Assembly. This shall consist of assembling the entire structure including the floor system. This assembly is ordinarily needed only for complicated structures such as those having curved girders or extreme skews in combination with severe grades or cambers.

826.14 Match-Marking. Connecting members assembled in the shop for the purpose of reaming holes in field connections shall be match-marked. A diagram showing such marks shall be furnished to the Engineer.

826.15 Facing of Bearing Surfaces. The surface finish of bearing and base plates and other bearing surfaces that are to come in contact with each other or with concrete shall conform to the surface roughness requirements as defined in ANSI/ASME B46.1, Part 1, as follows:

Steel slabs - 50 µm

Heavy plates in contact in shoes to be welded - 25 µm

Milled ends of compression members, stiffeners, and fillers - 12.5 µm

Bridge rollers and rockers - 6.3 µm

Pins and pin holes - 3.2 µm

Sliding bearings - 3.2 µm

826.16 Fabrication of Members. Unless otherwise shown on the Plans, steel plates for main members and splice plates for flanges and main tension members shall be cut and fabricated so that the primary direction of rolling is parallel to the direction of the main tensile compressive stress.

826.17 Annealing and Stress Relieving. Structural members who are indicated in the Contract to be annealed or normalized shall have finish machining, boring, and straightening done subsequent to heat treatment. Normalizing and annealing (full annealing) shall be as specified in ASTM E 44. The temperatures during the heating and cooling process shall be maintained uniformly throughout the furnace so that the temperature at any two points on the member will not differ by more than 56 C at any one time.

A record of each furnace charge identifying the pieces in the charge and showing the temperatures and schedule actually used shall be provided. Proper instruments, including recording pyrometers, shall be provided for determining the temperatures of members in the furnace at all times. The records of the treatment operation shall be available to and meet the approval of the Engineer.

Members such as bridge shoes, pedestals, or other parts that are built up by welding sections of plate together shall be stress relieved, when required by the Plans, this Section, or Special Provisions governing the Contract, in accordance with procedures established by ANSI/AASHTO/AWS D1.5.

826.18 Pins and Rollers. Pins and rollers shall be accurately turned to the dimensions shown on the drawings and shall be straight, smooth, and free from flaws.

Pins and rollers more than 230 mm in diameter shall be forged and annealed.

Pins and rollers 230 mm or less in diameter may be either forged and annealed, or fabricated from cold-finished, carbon-steel shafting.

In pins larger than 230 mm in diameter, a hole not less than 50 mm in diameter shall be forged full length along the axis after the forging has been allowed to cool to a temperature below the critical range under suitable conditions, to prevent injury by too rapid cooling, and before being annealed.

826.19 Boring Pin Holes. Pin holes shall be bored true to the specified diameter, smooth and straight, at right angles to the axis of the member and parallel with each other unless otherwise required. The final surface shall be produced by a finishing cut.

The distance outside to outside of end holes in tension members and inside to inside of end holes in compression members shall not vary from that specified more than 1 mm.

826.20 Pin Clearances. The diameter of the pin hole shall not exceed that of the pin by more than 0.5 mm for pins 125 mm or less in diameter, or 1 mm for larger pins.

826.21 Threads for Bolts and Pins. Threads for all bolts for structural steel construction shall conform to ANSI/ASME B1.13M, Class 6H. Class 6G threads for pin ends having a diameter of 35 mm or more shall be threaded.

826.22 Pilot and Driving Nuts. Two pilot nuts and two driving nuts for each size of pin shall be furnished, unless otherwise specified.

826.23 Notice of Beginning of Work. The Contractor shall give the Engineer 30 days notice prior to the beginning of work at the mill or in the shop so that inspection may be provided. The term "mill" means any rolling mill or foundry where material for the work is to be manufactured. No material shall be manufactured or work done in the shop before the Engineer has been so notified.

826.24 Facilities for Inspection. The Contractor shall furnish equipment, material, and work space for the inspection of material and workmanship in the mill and shop. The inspectors shall be allowed free access to the necessary areas of the mill and shop.

826.25 Identification of Steels During Fabrication. The Engineer shall be furnished with complete certified mill test reports showing chemical analysis and physical tests for each heat of steel for all members, unless excepted by the Engineer. Each piece of steel to be fabricated shall be properly identified for the Engineer.
Shop drawings shall specifically identify each piece that is made of steel. Pieces made of different grades of steel shall not be given the same assembling or erecting mark even though they are of identical dimensions and detail. The Contractor's system of assembly marking individual pieces made of steel other than AASHTO M 183/M 183M steel and the issuance of cutting instructions to the shop (generally by cross-referencing the assembly marks shown on the shop drawings with the corresponding item covered on the mill purchase order) shall maintain the identity of the mill test report number.

The Contractor may furnish from stock any acceptable material that it can identify by heat number and mill test report.

During fabrication, up to the point of assembling members, each piece of steel other than AASHTO M 183/M 183M steel shall show clearly and legibly its specification identification color code shown in Table 826-F.
Individually marked pieces of steel that are used in the furnished size, or reduced from the furnished size only by end or edge trimming, in a manner that does not disturb the heat number or color, or leave any usable piece, may be used without further color coding provided that the heat number or color code remains legible.
Pieces of steel, other than AASHTO M 183/M 183M steel, that are to be cut to smaller size pieces shall, before cutting, be legibly marked with the AASHTO M 160/M 160M specification identification color code.
Individual pieces of steel, other than AASHTO M 183/M 183M steel, that are furnished in tagged lifts or bundles shall be marked with the AASHTO M 160/M 160 M specification identification color code immediately upon being removed from the bundle or lift.

Pieces of steel, other than AASHTO M 183/M 183M steel, that prior to assembling into members, will be subjected to fabricating operations such as blast cleaning, galvanizing, heating for forming, or painting, which might obliterate paint color marking, shall be marked for grade by low stress, steel die stamping, or by a substantial tag firmly attached.

The identification colors indicated in Table 826-F shall be used to mark materials meeting the individual specifications listed in Table 826-F.

Table 826-F

Identification Color Codes

AASHTO	ASTM	Color
M 244/M 244M	A 514/A 514M	Red
	A 517/A 517M	Red and Blue
M 223/M 223M	A 572/A 572M	Grade 345 Green and Yellow
M 222/M 222M	A 588/A 588M	Blue and Yellow

Other steels, except AASHTO M 183/M 183M steel, that are not covered in Table 826-F and are not included in the AASHTO M 160/M 160M specification shall have an individual color code established and recorded for the Engineer.

Upon request, the Contractor shall furnish an affidavit certifying that throughout the fabrication operation it has maintained the identification of steel in accordance with this Subsection.

826.26 Tests for Structural Members.

(a) Full Size Tests. When full size tests of fabricated structural members or eyebars are required by the Contract, the Contract will state the number and nature of the tests, the results to be attained, and the measurements of strength, deformation, or other parameters that are to be performed and recorded. The Contractor shall provide suitable facilities, material, supervision, and labor necessary for performing and recording the tests.

(b) Non-Destructive Testing. When non-destructive tests of fabricated structural members are required by the Contract, they shall be done in accordance with Subsection 826.12 (b).

826.27 Erection Marking and Shipping. Each member shall be painted or marked with an erection mark for identification. An erection diagram shall be furnished with erection marks shown thereon.
The Contractor shall furnish the Engineer with three copies of material orders, shipping statements, and erection diagrams as the Engineer may direct. The weights of the individual members shall be shown on the statements. Members weighing more than 2.75 metric tons shall have the weights marked thereon. Structural members shall be loaded on carriers, transported, and unloaded at their destination, without being excessively stressed, deformed, or otherwise damaged.

Bolts of one length and diameter, and loose nuts or washers of each size, shall be packed separately. Pins, small parts, and packages of bolts, washers, and nuts shall be shipped in boxed, crates, kegs, or barrels. The gross weight of any package shall not exceed 135 kg. A list and description of the material enclosed shall be plainly marked on the outside of each shipping container.

SHOP PAINTING.

826.28 Urethane Paint System. The Contractor shall select a complete coating system from one manufacturer conforming to the requirements of Subsection 820.02 (a). This selected coating system must be submitted to the Department’s Materials and Research Section for approval prior to coating.

The topcoat color of the structural steel shall match color chip No. 24172 (green) of FED-STD-595B, unless otherwise indicated on the Plans. The Contractor shall supply the Engineer with the product data sheets before any painting is done. The product data sheets shall indicate the mixing and thinning directions, the recommended spray nozzles and pressures and all other coating related information.

826.29 General Requirements. Shop painting of metal structures shall consist of shop cleaning, and shop application of the coating system on new structural steel and fasteners with the provision for field application of the topcoat at the option of the Contractor. Included is the cleaning and repair of surfaces damaged in shipping, handling, and erecting the structural steel in accordance with this Specification and as directed by the Engineer. The coating system shall consist of a coat of inorganic zinc-rich primer, a coat of high-build epoxy, and a urethane topcoat. Terminology used herein is in accordance with the definitions used in Volume 2, Systems and Specifications of the SSPC Steel Structures Painting Manual.

With the exception of abutting joints and base plates, machine finished surfaces shall be painted as soon as practicable after being accepted, and before removal from the shop, with a layer of material meeting the requirements of MIL-C-16173E, automotive grease, or other approved corrosion preventing material.

All structural steel painting will be performed in the shop, except the final coat (topcoat) may be applied in the field after erection. There will be no separate payment for any additional costs of any kind associated with field painting.

826.30 Provisions for Inspection. During fabrication and shop coating, scaffolding shall be furnished and erected, meeting the approval of the Engineer to permit inspection of the steel prior to and after coating.
Rubber rollers, or other protective devices meeting the approval of the Engineer shall be used on scaffold fastenings. Metal rollers or clamps and other types of fastenings that will mar or damage freshly coated surfaces shall not be used.

826.31 Preparation for Shop Coating. All areas shall be blast cleaned to a near-white finish as defined in SSPC-SP 10 for which reference should be made to SSPC Visual Standards. Areas of oil and grease on surfaces to be

coated shall be cleaned with clean petroleum solvents prior to blast cleaning. Prior to blast cleaning a beam, the top of the bottom flange shall be scraped to remove any accumulated dirt.

All fins, tears, slivers, and burred or sharp edges that are present on any steel member, or that appear during the blasting operations, shall be removed by grinding and the area reblasted to give a 25 to 63 µm surface profile. Scaling hammers may be used to remove heavy scale, but heavier type chipping hammers that would excessively scar the metal shall not be used.

The abrasive used for blast cleaning shall be in accordance with Subsection 605.45, and shall have a gradation such that the abrasive will produce a uniform profile of 25 to 63 µm, as measured with Testex Replica Tape.
All abrasive and paint residue shall be removed from steel surfaces with a good commercial grade vacuum cleaner equipped with a brush-type cleaning tool, or by double blowing. If the double blowing method is used, the exposed top surfaces of all structural steel, including flanges, longitudinal stiffeners, splice plates, hangers, etc., shall be vacuumed after the double blowing operations are completed. The air line used for blowing the steel clean shall have an in-line water trap and the air shall be free of oil and water as it leaves the air line. The steel shall then be kept dust free, and primed within eight hours after blast cleaning.

Care shall be taken to protect freshly coated surfaces from subsequent blast cleaning operations. Blast damaged primed surfaces shall be thoroughly wire brushed or, if visible rust occurs, reblasted to a near-white condition. The wire brushed or blast cleaned surfaces shall be vacuumed and reprimed.

All areas where field welding is required, shall be masked prior to applying the primer. Areas where shear stud connectors will be welded to the top flange shall be masked after the primer coat has been applied, but before the epoxy coat is applied.

826.32 Painting Conference. Before fabrication of the structural steel begins the appropriate parties involved shall attend a "Post-Award Painting Conference".

Present at the conference shall be the following:

a. Contractor.
b. Steel fabricator and its coating specialist.
c. Paint and coating material supplier including local technical and sales representative plus any other experienced personnel.
d. Engineer.

The purpose of the conference is to discuss the specifications in detail and ensure that the painting work conforms to the manufacturer’s product data sheets and application instructions as well as the requirements of this Section. The discussions shall include:

a. Equipment use and servicing.
b. Material storage.
c. Application techniques (including thickness tolerances).
d. Definition of the degree of cleaning, i.e., SSPC Pictorial Standards.
e. Surface preparation of shop-primed surfaces by shotblasting or sandblasting, describing abrasive to be used, necessary air pressure at the blast nozzle, etc.
f. Inspection requirements including surface preparation, wet and dry film thickness checking, techniques, and equipment to be used.
g. Inspection Reports.
h. Safety precautions stated in the manufacturer’s printed instructions.
i. Availability of the work for inspection by the Engineer.

826.33 Painting.

(a) Mixing the Paint. The paint shall be mixed with a high shear mixer such as Jiffy Mixer, in accordance with the manufacturer’s directions, to a smooth, lump-free consistency. Paddle mixers or paint shakers are not allowed. Mixing shall be done thoroughly, in the original containers, and shall be continued until all the metallic powder or pigment are in suspension.

Care shall be taken to ensure that all of the paint solids that may have settled to the bottom of the container are thoroughly dispersed. The paint shall then be strained through a screen having openings no larger than those specified for a 300 µm sieve in ASTM E 11. After straining, the mixed paint shall be kept under continuous agitation up to and during the time of application.

(b) Thinning the Paint. In general the paints are supplied for normal use without thinning. If it is necessary to thin the paint for proper application in cool weather, or to obtain better coverage of the urethane topcoat, the thinning shall be done in accordance with the manufacturer's recommendations and shall be subject to the Department's approval.

(c) Conditions for Painting. Paint shall be applied only when the following conditions have been met:

(1) Temperature. The temperature of the air and the steel shall be above 10 C for paint other than the topcoat. This 10 C minimum temperature shall be maintained throughout the minimum time between coats as listed in the Qualified Products List. For the urethane topcoat, the temperature of the air and steel shall be above 4 C. Coatings shall not be applied if the temperature is high enough to cause blistering. The surface temperature of the steel shall be at least 3 C higher than the dew point.

(2) Humidity. The paint shall not be applied when the relative humidity is greater than 90%, nor when a combination of temperature and humidity conditions are such that moisture condenses on the surface being painted.

(d) Applying the Paint. After the surface to be coated has been cleaned and approved by the Engineer, the primer shall be applied so as to produce a uniform even coating bonded with the metal. Succeeding coats shall be applied when approved by the Engineer. The minimum curing time between coats shall be according to the manufacturer's specifications. Depending on site conditions, additional time may be required for proper curing before applying succeeding coats. Cure time for proper application of succeeding coats shall not be less than the minimum nor exceed the maximum as recommended by the paint manufacturer. The Contractor shall provide the Engineer written documentation of manufacturer recommended cure times and any pre-treatments of existing coats prior to application of succeeding coats. It is the applicator's responsibility to determine the condition of each coat prior to application of succeeding coats. Any oxidation products, chalking, salts, residue or other surface condition that form on existing paint surfaces and interfere with proper adhesion shall be completely removed in accordance with manufacturer recommendations or as directed by the Engineer. Removal shall be accomplished through water blasting, solvent wiping, brush-off blasting or other means as necessary to properly prepare the surface for coating.

The coatings shall be applied with the spray nozzles and pressures recommended by the producer of the coating system, so as to attain the film thicknesses specified. All surfaces, including faying (contact) surfaces, and flange tops, shall be shop primed by spray in accordance with SSPC-PA 1. The intermediate coat shall also be applied in the shop in accordance with SSPC-PA 1. The topcoat shall be shop applied or field applied after steel erection at the Contractor's option. Faying surfaces and surfaces to be in contact with Portland cement concrete shall not receive the intermediate and topcoats.

Flange tops shall receive a fog coat of between 12 and 19 µm of inorganic zinc primer. The dry film thickness of the primer coat on the bolted friction splices on the main members shall not be less than 25 µm or greater than 63 µm. The faying surfaces of bolted field splices, bolted shop splices, or any other bolted faying surfaces, shall be masked during subsequent coating operations. In the areas of field bolted connections (including the

outside surface of splice plates), the outside surfaces shall be primed a minimum of 100 µm. On all other areas, the minimum dry film thickness for the primer coat shall also be 100 µm, for the epoxy coat it shall be 88 µm, and for the urethane protective coat it shall be sufficient to provide a uniform color and appearance but in no case shall be less than 25 µm.

The dry film thickness will be determined by the use of a magnetic dry film thickness gage. The gage shall be calibrated on the blasted steel with plastic shims approximately the same thickness as the minimum dry film thickness. A Tooke film thickness gage may be used to verify the coating thickness when requested by the Engineer. If the Tooke gage shows the primer coat to be less than the specified minimum thickness, the total coating system will be rejected even if the total dry film thickness exceeds the total of the minimum for each coat of the three-coat system.

All bolted shop connections and shop bolted cross frames or diaphragms shall be removed and disassembled prior to the blasting and coating of the girders or beams. The parts shall be blasted separately, primed, then reassembled and the bolts fully tightened in accordance with the applicable specifications.

All galvanized components in bolted shop connections, including mechanically galvanized nuts, bolts, and washers, shall be solvent cleaned, given a tie coat, if recommended by the paint manufacturer, and then coated with both the epoxy coat and the urethane protective coat.

If the application of the coating at the required thickness in one coat produces runs, bubbles, or sags, the coating shall be removed and reapplied in multiple passes of the spray gun, the passes separated by several minutes. Where excessive coating thickness produces "mud-cracking", such coating shall be scraped back to soundly bonded coating and the area recoated to the required thickness.

In areas of deficient primer thickness, the areas shall be thoroughly cleaned with power washing equipment, as necessary, to remove all dirt; the areas shall then be wire brushed, vacuumed, and recoated.

All coating shall be done in a neat and workmanlike manner as described in SSPC-PA 1, producing a uniform, even coating which is bonded to the underlying surface.

Erection marks, for the field identification of members, and weight marks shall be transferred or preserved.

All metal coated with impure, unsatisfactory, or unauthorized coating material, or coated in an unworkmanlike or objectionable manner, shall be thoroughly cleaned and recoated or otherwise corrected as directed by the Engineer.

All dry spray shall be removed, by sanding if necessary, prior to the application of the succeeding coat.

Material shall not be loaded for shipment until the shop coating has been adequately cured and inspected. The components will be stamped "Recommended for Use" only after the loading has been completed and approved.

826.34 Stenciling Requirement. At the completion of the painting work, the completion date (month and year) and the bridge number, shall be stenciled on the structure in 75 mm numbers. The paint used for this marking shall be the same as the topcoat except the color shall be black. The numbers shall be stenciled on the outside of each fascia beam at the approaching traffic end of the structure, on a location designated by the Engineer.

826.35 Handling Steel. Extreme care shall be exercised in handling the steel in the shop, during shipping, during erection, and during subsequent construction of the bridge. The steel shall be insulated from the binding chains by softeners approved by the Engineer. Hooks and slings used to hoist steel shall be padded. Diaphragms and similar pieces shall be spaced in such a way that no rubbing will occur during shipment that may damage the coatings.

The steel shall be stored on pallets at the job site, or by other means approved by the Engineer, so that it does not rest on the dirt or so that components do not fall or rest on each other. All shipping and job site storage details shall be presented to the Engineer at the "Post-Award Painting Conference" and they must be approved prior to shipping the steel.

826.36 Field Repair and Field Coating. The Contractor shall furnish and erect scaffolding meeting the approval of the Engineer and shall provide a time mutually agreed upon for inspecting the structural steel prior to and after coating.

Rubber rollers, or other protective devices meeting the approval of the Engineer, shall be used on scaffold fastenings. Metal rollers or clamps and other types of fastenings that will mar or damage freshly coated surfaces shall not be used.

All field repairs shall be made in strict accordance with the coating supplier's recommendations and shall be approved by the Engineer. All coatings applied to repair areas shall be applied using recommended spray equipment only. The coating supplier's recommendations are to be supplied to the field personnel by the fabricator of the steel. Such field repairs shall include the application of the following coating system; e.g., on rusted areas: the zinc-rich primer, the epoxy intermediate coat, and the urethane protective coat; on non-rusted areas (where the primer is at least equal to the minimum required dry film thickness): the epoxy intermediate coat and the urethane protective coat; and on galvanized components: the tie coat, the epoxy intermediate coat, and the urethane protective coat.

Surfaces that will be inaccessible for coating after erection shall be repaired and/or recoated prior to erection. When the erection work has been completed, including all connections and the straightening of any bent metal, the steel shall be prepared for repairs. All adhering scale, dirt, grease, form oil, or other foreign matter shall be removed by appropriate means and any rusted or uncoated areas blast cleaned to a near-white finish in accordance with SSPC-SP 10. All abrasive and paint residue shall be removed from steel surfaces by vacuuming or by double blowing, except that if the double blowing method is used, the top surfaces of all structural steel, including top and bottom flange, splice plates, hangers, etc., shall be vacuumed after the double blowing operations are completed. The coating surrounding the blasted area shall be thoroughly wire brushed, vacuumed, and the area recoated with the same coating system used in the shop. When spraying a blasted area or an area of insufficient primer thickness, the surrounding area will be coated with primer. Prior to the application of the intermediate coat, the area around the area where the primer has been repaired shall be adequately rubbed to remove the primer from the surrounding epoxy or urethane. The requirements specified herein for provisions for inspection, mixing the coating, thinning the coating, temperature, and humidity requirements for coating, and applying the coatings, shall govern application of the topcoat and application of the coating to the repaired areas. The requirements for the dry film thickness of the topcoat and the repair coats are the same as for the shop coats. Proper curing conditions will be required prior to application of the topcoat and between applications of the repair coats as previously specified herein.

Mechanically galvanized nuts, bolts, and washers shall be coated in accordance with the recommendations of the manufacturer of the coating system. This procedure shall include the removal of any lubricant or residuals on the surface and the application of a tie coat prior to application of the field coats. This tie coat shall be brushed or sprayed as specified by the manufacturer. The epoxy and urethane shall then be applied to the bolts and the surrounding connection surfaces.

Any temporary attachments or supports for scaffolding or forms shall not damage the coating system. (In particular, on the fascias where bracing is used, sufficient size support pads must be used.) Any damage that occurs from such devices shall be repaired by the same procedure as for a field repair.

If the stenciling which was applied at the completion of the shop coating is marred or damaged, the marking shall be repaired as directed by the Engineer. The paint used for this marking repair shall be the same as the urethane protective coat used in the field repairs except the color shall be black.

826.37 Protection of the Work. Pedestrian, vehicular, and other traffic upon or underneath the structure shall be protected in accordance with Section 107. All portions of the structures (superstructure, substructure, slope protection and highway appurtenances) shall be protected against splatter, overspray splashes, and smirches of coating or coating material by means of protective covering suitable for the purpose. The Contractor shall be responsible for any damage caused by his operations to vehicles, persons or property.
Whenever the intended purposes of the protective devices are not being accomplished, work shall be suspended until corrections are made.