

plug-in mounted to a base. Solid state switching devices shall be protected from transient voltages and lightning by components especially designed for use with solid state devices.

Circuit breakers shall be approved and listed by the UL. The operating mechanism shall be enclosed and shall be trip-free from operating handle under load and shall be trip-indicating. All circuit breakers shall be quick-make, quick-break on either automatic or manual operation. Contacts shall be silver alloy enclosed in an arc quenching chamber. Overload tripping of breakers shall not be influenced by an ambient temperature range of from -18°C to +70°C [0 to +158°F].

718.12 Conductors The number and size of conductors required in each cable is indicated on the plans. All conductors shall be stranded copper conductors. Multiconductor cables shall conform to the latest revisions of IMSA Specification Number 19-1 or 20-1. The service ground rod shall be 2400 mm by 16 mm [8 ft by • in] copperclad rod.

The service wiring shall be single conductor number 6 AWG THW stranded copper black insulated and number 6 AWG THW stranded copper white insulated rated 600 volts.

All circuits for the timer and each auxiliary control unit shall terminate in a multiple contact connector. Conductors shall be attached to all pins of the connector and cabled. Conductors of the cable, except spares, shall be fitted with terminal ends compatible with the terminal block and shall have identifying bands. The ends of all spare conductors shall be taped.

SECTION 719 - SIGNING MATERIAL

719.01 Reflective Sheeting The reflective sheeting shall consist of a retro-reflective lens system having a smooth outer surface. The sheeting shall have a precoated adhesive on the back side, protected by an easily removable liner.

The reflective sheeting and its components shall conform to all the requirements of FHWA "Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects", FP-92, Section 718.01. Engineering grade reflective sheeting shall meet the reflective intensity requirements for Type II sheeting as shown in Table 718-1, Section 718.01 - Vehicular Signal Indications, FP-92. High intensity reflective sheeting

shall meet the reflective requirements for Type III sheeting as shown in Table 718-3, Section 718.01 - Vehicular Signal Indications, FP-92.

Reflective sheeting, used in sign construction, shall have been manufactured within the six months immediately prior to fabrication of each sign. Upon delivery at the job site of each shipment of signs, a letter of certification shall be provided by the Contractor that the reflective sheeting conforms to the requirements contained herein.

For Type I Guide Signs, all reflective sheeting shall be color matched on each sign unit.

719.02 Demountable High Intensity Reflectorized Letters, Numerals, Symbols and Borders Demountable reflectorized letters, numerals, symbols and borders shall consist of cut out high intensity sheeting, conforming to FHWA, "Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects", 1992, FP-92, Section 718.01(d).

719.03 Aluminum Extrusions The extruded aluminum planks shall be bolted type with dimensions, holes, lengths, and cross sections as detailed on the plans. The extruded aluminum molding for edging of the extruded aluminum sign panels shall be of the cross section as detailed on the plans. Extruded aluminum planks shall conform to ASTM B221M/B221, 6063-T6, 6005-T5, or 6061-T6. The extruded aluminum planks and molding shall be free from all corrosion and dirt and the face and edges shall be true, smooth, and free from burrs and breaks.

a. Degreasing Required on aluminum plank by either of the following methods:

1. Vapor Degreasing shall be by total immersion of the plank in a saturated vapor of trichloroethylene or perchloroethylene. Trademark printing shall be removed with lacquer thinner or controlled alkaline cleaning system.

2. Alkaline Degreasing - Planks shall be immersed in a tank containing alkaline solutions, controlled and titrated to the solution manufacturer's specification. Immersion time shall depend upon the amount of soil present and the gauge of the metal.

b. Etching

1. Alkaline Etch The pre-cleaned aluminum surface shall be well etched in an alkaline etching material that is controlled by titration, use time, temperature and concentration specified by the solution manufacturer and rinsed thoroughly. Smut shall be removed with an acidic, chromium compound type solution as specified by the solution manufacturer and then thoroughly rinsed.

2. Alodine 500 or 1,200 is acceptable.

c. Drying Material may be air-dried or oven dried. Metal shall not be handled between all cleaning and etching operations and the application of Reflective Sheeting, except by device or clean gloves. There shall be no opportunity for metal to be exposed to grease, oils, or other contaminants before application of Reflective Sheeting.

d. Fabrication All fabrication shall be completed before metal degreasing.

719.04 Aluminum Sheets All blanks shall be made of 5052-H38 or 6061-T6 aluminum. The Contractor shall guarantee the material to be free of buckles, warp, dents, cockles, burrs and defects resulting from fabrication.

a. Degreasing Required on sheet aluminum by either of the following methods:

1. Vapor Degreasing Sign blanks shall be totally immersed in a saturated vapor of trichloroethylene or perchloroethylene. Trademark printing shall be removed with lacquer thinner or controlled alkaline cleaning system.

2. Alkaline Degreasing Sign blanks shall be totally immersed in a tank containing alkaline solutions, controlled and titrated to the solution manufacturer's specifications. Immersion time shall depend upon the amount of soil present and the gauge of the metal.

b. Etching

1. Alkaline Etch The pre-cleaned aluminum surface shall be well etched in an alkaline etching material that is controlled by titration, use time, temperature and concentration specified by the solution manufacturer, and rinsed thoroughly. Smut shall be removed with an acidic, chromium compound type solution as specified by the solution manufacturer and then thoroughly rinsed.

2. Alodine 500 or 1,200 is acceptable.

c. Drying Material may be air-dried or oven dried. Metal shall not be handled between all cleaning and etching operation and packaging, except by device or clean gloves. There shall be no opportunity for metal to come in contact with grease, oils, or other contaminants prior to application of to packaging and shipping.

d. Fabrication All fabrication, including shearing, cutting, and punching of holes, shall be completed before metal degreasing. Fabrication of all metal parts shall be accomplished in a uniform and skillful manner. The surface of all sign panels shall be flat.

The minimum sheet thickness shall be 2.00 mm [0.08 in] for signs of an area of 1.1 m² [12 ft²] or less and shall be 3.18 mm [0.125 in] for signs over 1.0 m² [12 ft²] unless otherwise specified.

e. Chromate Treatment Treatment shall be in accordance with ASTM B449 Class I.

719.05 Plywood The plywood shall conform to the following requirements:

a. Face stock Face veneers shall be Grade A.

b. Core and Cross Veneers Core and crossband veneers shall be Grade B or better and shall be solid jointed.

c. Glue The entire area of each contacting veneer surface shall be bonded with a waterproof adhesive that meets the test requirements for exterior type.

d. Overlay The overlay shall be of the high-density type. It shall be a minimum of 0.29 kg/m² [60 lb/1,000 ft²] surface, shall be at least 0.229 mm [0.009 in] thick, and have a minimum resin content of 40% based on the dry weight of the impregnated fiber. It shall consist of at least 2 sheets of resin-impregnated fiber of sufficient resin content to bond itself to the plywood. Manufacturing precautions shall be taken to prevent overlay surfaces from coming into contact with any substance that would inhibit adhesion of paint or reflective sheeting. The overlay shall be natural color.

e. Thickness The thickness of plywood shall be 16 mm [\bullet in].

f. Testing The plastic overlay shall not delaminate from the plywood after being subjected to the exterior boiling test for glue line durability.

719.06 Demountable Reflectorized Delineators Delineators shall be diamond reflectors approximately 75 mm [3 in] square or shall be rectangular, adhesive coated reflective sheeting permanently adhered to a sheet aluminum backing. All delineators on a project shall be the same type. Single delineators shall be clear or silver-white; double and triple delineators shall be amber.

a. Single delineators shall have one 6 mm [$\frac{1}{4}$ in] square hole for center mounting. Double and triple delineators shall have two 6 mm [$\frac{1}{4}$ in] square mounting holes on the vertical centerline.

Single delineators shall be 75 mm by 75 mm [3 in by 3 in] diamonds with 19 mm [$\frac{3}{4}$ in] radius corners and two 6 mm [$\frac{1}{4}$ in] square mounting holes, 75 mm [3 in] on center.

Double delineators shall be 75 mm by 150 mm [3 in by 6 in] rectangles with 19 mm [$\frac{3}{4}$ in] radius corners and two 6 mm [$\frac{1}{4}$ in] square mounting holes 125 mm [5 in] on center.

The aluminum shall be 6061-T6, ASTM B209 or 6063-T6 or 6005-T5 1.60 mm [0.063 in] thick sheet properly degreased and etched or treated with a light, tight amorphous chromate type coating.

The reflective sheeting shall be applied to properly treated base panels with mechanical equipment in a manner specified by the sheeting manufacturer.

b. General Requirements and Packaging. The finished delineators shall show careful workmanship, be free of burrs, scratches or damaged reflective surface.

Delineators shall be packaged in such a manner as to insure their arrival at destination in undamaged condition. Delineators shall not become wet in storage or shipment.

719.07 Assembly and Mounting Hardware - General The attachment of signs shall be in accordance with the contract documents and the appropriate hardware prescribed in this Section. Requests for substitution for all specified material shall be submitted in writing

with full documentation, including but not limited to specifications and mill certification reports, enabling the Department to evaluate the proposal promptly.

719.071 Aluminum Planking The bolt assembly required to fasten the extruded aluminum planks together shall conform to the designs used in standard commercial processes for the selected type of extruded aluminum panels. Guidance for bolt hole punching and typical plank-to-plank attachment is provided in the contract documents.

719.072 Overhead Signing Sign panels mounted to independent sign support structures and support structure components mounted to bridges passing over the highway are considered to be overhead signing. Overhead signing shall be mounted on W150 by 14 [W6 by 9] steel beams conforming to the requirements of ASTM A992/A992M, galvanized in accordance with AASHTO M111 (ASTM A123), or the same size aluminum beams conforming to ASTM B221M, alloys and tempers of 6061-T6, 6063-T6 or 6005-T5. These components shall be horizontally spaced a maximum of 1.6 m [5¼ ft] on center, extending from the bottom of sign panel to the top. If supplemental signs are included in the contract, these beams will extend from the bottom of the main sign panel to the top of the supplemental sign panel. The maximum distance from the edge of the sign to the center of the W150 by 14 [W6 by 9] shall not exceed approximately 1 meter [3¼ ft].

On independent sign support structures, these W150 by 14 [W6 by 9] beam components shall be fastened to chords with a pair of appropriately sized U-bolts on each side of the web at each fastening location. A similar pair of U-bolt assemblies shall be used in attaching each chord of an overhead component to upright supports. U-bolts for steel support structures shall conform to ASTM A449, Type 1 or 2. The U-bolt hardware, which includes nuts, flat washers and helical lock washers, shall be galvanized in accordance to AASHTO 232 (ASTM A153 or B695, Class 50, Type 1). Washers shall conform to the requirements of ASTM F436. The U-bolt material for aluminum support structures, or a combination of steel and aluminum structural components, shall be stainless steel conforming to the requirements of ASTM F593, alloy group 1, with a minimum yield strength of 310 Mpa [45 ksi]. Steel support structures may also utilize stainless steel hardware assemblies as an alternative to galvanized steel. Nuts shall be of the locking type with nylon inserts. Washers shall conform to the requirements of ASTM A276, Type 302. Flat washers, without helical lock washers, will be acceptable in this stainless steel assembly.

On bridge mounted structures, the fastener configurations shall be depicted in the contract

documents.

719.073 Post Clip Hardware For Overhead Signing Signs mounted steel or aluminum W shape beam components shall be attached using post clip hardware as described in this Section as well as the contract documents. Overhead signing shall have post clip assemblies fastened in pairs, one on each side of the web of the W shape beam, at all locations on the backside of the extruded plank panels that provide a groove accommodating a post clip bolt and assembly. Post clips shall be 356-T6 aluminum conforming to the requirements of ASTM B108. The post clip bolt material for overhead signing shall be stainless steel conforming to the requirements of ASTM A193/A193M, AISI Type 304, Grade B8. The post clip bolt nut shall be stainless steel material conforming to the requirements of ASTM A194/194M, AISI, Type 303, Grade 8F and of the locknut type with nylon inserts. Flat washers of these assemblies shall be stainless steel material conforming to the requirements of ASTM A276, Type 302.

719.074 Post Clip Hardware For Roadside Signing Signs mounted on other than overhead locations may be mounted using aluminum hardware. The aluminum post clips shall be 356T-6 aluminum conforming to the requirements of ASTM B108. The post clip bolts, washers and nuts shall conform to the requirements of aluminum alloy 2024-T-4 (bolts and washers) and alloy 6061-T6 or 6262-T9 (lock nuts).

719.073 Roadside Signing Aluminum signs mounted on U-channel posts shall be fastened with M8 by 38 mm [$\frac{5}{16}$ in by 1½ in] stainless steel bolts, washers, and self-locking type nuts. The bolts shall conform to the requirements of ASTM F593. A washer, either a white nylon or neoprene or stainless steel ASTM F593 shall be used between the head of the bolt and the face of the sign.

Plywood signs mounted on U-channel posts shall be fastened with M8 by 60 mm [$\frac{5}{16}$ in by 2½ in] stainless steel cap screws and hex nuts conforming to ASTM F593, and a washer either white nylon or neoprene or stainless steel ASTM F593 shall be used between the head of the bolt and the face of the sign.

Delineator assembly hardware shall consist of M6 by 60 mm [$\frac{1}{4}$ in by 2¼ in] stainless steel bolts, washers, and self-locking type nuts. The bolt assembly shall conform to the requirements of ASTM F593.