SECTION 1092
SIGNING MATERIALS

1092-1 SIGNS AND HARDWARE

Fabricate signs from aluminum alloy sheets. Use supporting frames and accessories made of aluminum. Use galvanized steel backing plates and mounting bolts. Use materials that conform to Tables 1092-1 and 1092-2.

Filler metal shall conform to Section 10(3) of the *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*.

Aluminum sign studs, welded to the sign panels in accordance with Article 901-3, shall be capable of withstanding a direct pull-out load of 400 lb. Furnish a Type 3 material certification in accordance with Article 106-3 demonstrating conformance to this requirement. The Materials and Tests Unit will take samples of the studs and make random field tests of the welded studs to verify the statement of certification. Failure of more than 10% of the studs tested on any one sign will be sufficient evidence for rejection of stud welding on the entire sign. When tested in tension, the studs shall not fail in the weld area, but fail in the threaded portion of the stud.

Drill bolt holes and slots to finished size or they may be punched to finished size, provided the diameter of the punched holes is at least twice the thickness of the metal being punched. Flame cutting of bolt holes and slots will not be permitted. No galvanizing of any steel part will be allowed until all welding, cutting, milling, punching, and drilling of the part has been completed.

TABLE 1092-1
ALUMINUM SIGN MATERIALS

Aluminum Materials	Alloy Specification	Test Method
Extruded Bars	6061-T6	ASTM B221
Sheets and Plates	6061-T6,5052-H38 or 3004-H38	ASTM B209
Structural Shapes	6061-T6	ASTM B308
Standard Weight Pipe	6061-T6	ASTM B241
Castings	356-T7	ASTM B26
Bolts	6061-T6, 2024-T4[A]	ASTM B211
Nuts (1/4" Tap and under)	2024-T4[A], 6061-T6 or 6262-T9	ASTM B211
Nuts (5/16" Tap and over)	2024-T4[A], 6061-T6 or 6262-T9	ASTM B211
Nuts (3/8" Self-locking)	2017-T4, 6061-T6	ASTM B211
Washers (std. flat) Alclad	2024-T4[A] or 6061-T6	ASTM B209
Washers (std. lock)	7075-T6	ASTM B211
Welded Studs (1/4")	5356-H12 or 5356-H32	ASTM B211

A. The alloy shall have anodic coating of 0.0002 inch minimum thickness with dichromate or boiling water seal

TABLE 1092-2
STEEL SIGN MATERIALS

Galvanized Steel Materials	Test Method for Base Metal	Test Method for Galvanizing
Structural Shapes and Plates	ASTM A36	ASTM A123
Standard Weight Black Pipe	ASTM A53	ASTM A123
Bolts and Nuts	ASTM A307	ASTM F2329
Washers (std. flat and lock)	ASTM A307	ASTM F2329
High Strength Bolts, Nuts and Washers	ASTM A325	ASTM B695 Class 55

1092-2 RETROREFLECTIVE SHEETING

Reflectorize all signs. Use colors and sheeting grades of the sign backgrounds and messages as shown in the contract. After preparation of the sign panels, in accordance with Subarticle 901-3(D), apply retroreflective sheeting as required herein. The retroreflective sheeting shall consist of white or colored sheeting having a smooth outer surface and the property of a retroreflector over its entire surface.

Retroreflective sheeting shall meet ASTM D4956 and are listed on the NCDOT APL.

The reflective material specified herein is intended for use on surfaces of various traffic control devices, including drums, barricades, traffic cones and highway signs, to assure their adequate visibility at all times upon exposure to a light source when totally dry or wet. Provide reflectorization that produces a wide-angle retroreflectivity, enhancing nighttime visibility. This retroreflective sheeting shall consist of encapsulated, enclosed lens or prismatic with a transparent plastic having a smooth, flat outer surface. Provide material that is flexible, of good appearance, free from ragged edges, cracks and extraneous materials, and exhibits good quality workmanship.

(A) Performance and Test Requirements

TABLE 1092-3
MINIMUM COEFFICIENT OF RETROREFLECTION FOR NC GRADE A
(Candelas Per Lux Per Square Meter)

Observation Angle, degrees	Entrance Angle, degrees	White	Yellow	Green	Red	Blue	Fluorescent Yellow Green	Fluorescent Yellow
0.2	-4.0	525	395	52	95	30	420	315
0.2	30.0	215	162	22	43	10	170	130
0.5	-4.0	310	230	31	56	18	245	185
0.5	30.0	135	100	14	27	6	110	81
1.0	-4.0	80	60	8	16	3.6	64	48
1.0	30.0	45	34	4.5	9	2	36	27

TABLE 1092-4
MINIMUM COEFFICIENT OF RETROREFLECTION FOR NC GRADE B
(Candelas Per Lux Per Square Meter)

Observation Angle, degrees	Entrance Angle, degrees	White	Yellow	Green	Red	Blue	Fluorescent Yellow Green	Fluorescent Yellow	Fluorescent Orange
0.2	-4.0	380	285	38	76	17	300	230	115
0.2	30.0	215	162	22	43	10	170	130	65
0.5	-4.0	240	180	24	48	11	190	145	60
0.5	30.0	135	100	14	27	6	110	81	30
1.0	-4.0	80	60	8	16	3.6	64	48	7.5
1.0	30.0	45	34	4.5	9	2	36	27	5.6

TABLE 1092-5
MINIMUM COEFFICIENT OF RETROREFLECTION FOR NC GRADE C
(Candelas Per Lux Per Square Meter)

Observation Angle, degrees	Entrance Angle, degrees	White	Yellow	Green	Red	Blue	Brown
0.2	-4.0	250	170	45	45	20	12
0.2	30.0	150	100	25	25	11	8.5
0.5	-4.0	95	62	15	15	7.5	5
0.5	30.0	65	45	10	10	5	3.5

For areas printed with transparent colors, the coefficient of retroreflection shall not be less than 70% of the values for the corresponding color.

(1) Adhesive

Meet ASTM D4956.

(2) Field Performance

The fabricating agency will date all signs (month, year) at the completion of fabrication. That date constitutes the start of the field performance obligation period.

(B) Manufacturer's Warranty and Obligations

(1) Warranty

The sheeting manufacturer warrants to the Department that all materials furnished under this Specification will be new, of good components and workmanship and agrees to the following conditions.

Retroreflective sheeting processed and applied to sign blank materials in accordance with the manufacturer's manuals shall be warranted by the manufacturer to perform effectively as stated in this section. The manufacturer's manuals shall contain a complete descriptive explanation of all the requirements necessary of the sign fabricator.

(2) Obligation Grades A, B and C

(a) Years 1 through 7 (Years 1 Through 2 for Fluorescent Orange)

Cover the cost of restoring the sign face in its field location to its original effectiveness at no cost to the Department for materials, labor and equipment. In addition to the reflective requirements for Grade B fluorescent orange, the sheeting shall at least maintain a total Luminance Factor (Y) of 25 (ASTM D4956) and a Fluorescence Luminance Factor (YF) of 13% (ASTM E2301) for 3 years. Maintain at least 80% of fluorescent orange sheeting reflectivity for years 1 and 2.

(b) Years 8 through 10 (Year 3 for Fluorescent Orange)

Replace the sheeting required to restore the sign face to its original effectiveness. Maintain 50% of fluorescent orange sheeting reflectivity for year 3.

(c) Years 11 through 12

Replace 50% of the sheeting required to restore the sign face to its original effectiveness.

1092-3 CERTIFICATION

Provide a Type 6 material certification in accordance with Article 106-3 for all retroreflective sheeting used in the manufacture of signs certifying that the sheeting meets Section 1092.

SECTION 1094
GROUND MOUNTED SIGNS

1094-1 GROUND-MOUNTED SIGN SUPPORTS

(A) Breakaway or Simple Steel Beam Sign Supports

Fabricators of breakaway or simple steel beam sign supports shall be AISC Category I certified.

Steel supports for Type A and B ground mounted signs shall be galvanized rolled steel sections, either breakaway or simple design, as required by the contract. Fabricate supports from plates, W shapes, and S shapes, as required by the contract, and they shall conform to ASTM A36. Splices in the supports will not be permitted. Perform galvanizing before assembly that conforms to ASTM A123. Cutting steel supports to length after they have been galvanized will not be permitted in new construction. The support(s) shall be uniformly straight to within 1/8 inch tolerance for pieces less than 20 feet in length, and 1/4 inch tolerance for pieces over 20 feet in length.

Fabricate high strength bolts, nuts and washers required for breakaway supports from steel in accordance with ASTM A325 and galvanize in accordance with ASTM B695, Class 55.

(B) 3 lb Steel U-Channel Posts

Make 3 lb steel U-channel posts out of rerolled rail steel or new billet steel, conforming to the mechanical requirements of ASTM A499, Grade 60, and the chemical requirements of ASTM A1, for rails having nominal weights of 91 lbs. per yard or greater. Proportion the cross section so a moment of 1,450 ft-lb, applied to the cross section normal to the flanges, will produce an extreme fiber stress no greater than 39,500 psi. Use posts that weight 3 lbs/lf. Punch or drill all posts with 3/8 inch diameter holes on the centerline, spaced 1 inch on centers, starting 1 inch from the top and extending to the bottom of the posts. Galvanize these posts after fabrication for the full length and total area in accordance with ASTM A123. The zinc coating inside of the 3/8 inch diameter holes shall not exceed Specification requirements enough to prevent a 5/16 inch diameter bolt from freely passing through.

Use U-channel post sections of the same general configuration as that shown in the contract, however minor variations may be considered acceptable by the Engineer provided all other requirements are met.

(C) 2 lb Steel U-Channel Posts

Use 2 lb steel U-channel posts that are variable length galvanized steel, U-shaped channel posts.

Fabricate the U-channel posts from steel meeting ASTM A1008 or ASTM A499, or an approved alternate. The posts shall weigh 2 lbs/lf, and be of the length necessary to meet the erection requirements of the contract. Before galvanizing, punch or drill 3/8 inch diameter holes on 1 inch centers, beginning 1 inch from the top of the post, for a minimum distance equal to the vertical dimension of the respective sign or mile marker. Galvanize these posts after fabrication in accordance with ASTM A123. The zinc coating inside of the 3/8 inch diameter holes shall not exceed Specification requirements enough to prevent a 5/16 inch diameter bolt from freely passing through.