



SECTION 1042

HIGHWAY SIGN MATERIAL

1042.1 Scope. This specification covers the material used in signs and fastening devices, and the fabrication of signs.

1042.2 Material. Material shall be of new stock and shall be in accordance with the following, unless otherwise shown on the plans.

1042.2.1 Signs.

Item	Specification
Aluminum Flat Sheets	ASTM B 209, 6061-T6 or 5052-H38
Aluminum Extruded Sign Panels	ASTM B221, 6063-T6

1042.2.2 Sign Appurtenances.

Item	Specification
Aluminum Post Clip	ASTM B 108, 356-T6
Aluminum Bolts	ASTM B 211, 2024-T4 or 6061-T6
Aluminum Nuts	ASTM B 211, 2024-T4, 6061-T6, 6262-T9 or 2017-T4
Aluminum Flat Washers	ASTM B 209, or Alclad 2024-T4 or 2024-T4
Aluminum Lock Washers	ASTM B 211, 7075-T6
Aluminum Lock Nuts (Nylon Insert)	ASTM B 211, 2017-T4
Aluminum Edge Molding	ASTM B 221, 6063-T6
Stainless Steel Bolts, Nuts, Screws and Washers	ASTM A 320 or SAE J405D, Austenitic Steel, Min. Yield 30,000 psi (206 MPa)

1042.2.3 Certification. A manufacturer or supplier's Certification of Metal used for signing material listed above shall be furnished to the engineer at the fabrication plant at the time of material inspection. The contractor shall furnish to the engineer the fabricator's certification in accordance with [Sec 903.3.5.2](#).

1042.2.4 Structural Signs. Structural signs shall be fabricated of 0.081-inch (2.1 mm) minimum extruded aluminum panels and mounted as shown on the plans. The maximum allowable deviation from flatness shall not exceed 0.010 inch per inch (0.25 mm/25 mm) width of the panel. Shop drawings for approval from the engineer will be required for any variation in the assembly or mounting details.

1042.2.5 Sheet Signs. Flat sheet signs shall be fabricated as shown on the plans from sheet aluminum of the specified thickness. Flat sheet signs shall not have holes except those drilled or punched for proper mounting.

1042.2.6 Washers. Nylon washers recommended by the sign sheeting manufacturer shall be used between the bolt heads and sign faces on flat sheet aluminum signs. The washers shall be

for use with 3/8-inch (9.5 mm) bolts and shall have a minimum outside diameter of 3/4 inch (19 mm), and a nominal thickness of 1/16 inch (1.5 mm).

1042.2.7 Retroreflective Sheeting. Daytime luminance values (Y%) for all MoDOT types of reflective sheeting shall be in accordance with ASTM D 4956. Retroreflective sheeting shall be in accordance with ASTM D 4956, except as noted herein. Retroreflective sheeting shall have sufficient strength and flexibility such that the sheeting can be handled, processed and applied according to the manufacturer's recommendations without appreciable stretching, tearing, cracking or other damage. The sheeting surface shall be readily screen processed and compatible with recommended transparent and opaque screen process colors. The retroreflective sheeting manufacturer shall furnish information as to the type of solvent or solvents that may be used to clean the surface of the sheeting without detrimental loss of brightness and durability. The sheeting shall be properly orientated on the sign face to meet retroreflection requirements as specified herein. All signs fabricated with yellow sheeting shall be MoDOT Fluorescent Yellow sheeting in accordance with [Sec 1042.2.8](#)

1042.2.7.1 Type 1. Type 1 retroreflective sheeting shall be in accordance with ASTM D 4956, Type I, Class 1 or 2, except as noted herein. Type 1 retroreflective sheeting shall be enclosed lens glass-bead sheeting.

1042.2.7.2 Type 3. Type 3 retroreflective sheeting shall be in accordance with ASTM D 4956, Type IV, Class 1 or 2, except as noted herein. Type 3 retroreflective sheeting shall be high intensity prismatic classification.

1042.2.7.3 Type 7.

1042.2.7.3.1 Type 7 retroreflective sheeting shall be in accordance with ASTM D 4956, Type IV, Class 1 or 2, except as noted herein.

1042.2.7.3.2 Type 7 retroreflective sheeting shall meet or exceed the minimum coefficient of retroreflection requirements shown below, expressed as candelas per footcandle per square foot (candelas/lux/m²).

Type 7 Retroreflective Sheeting Minimum Coefficient of Retroreflection								
Observ. Angle, Degrees	Entrance Angle, Degrees	White	Yellow	Red	Green	Blue	Orange	Brown
0.2	-4	430	350	110	45	20	250	24
0.2	+30	235	190	48	24	11	110	10
0.5	-4	200	160	45	20	9.8	100	8
0.5	+30	135	85	26	10	5	50	3

1042.2.7.4 Screen Print and Overlay. For screen printed transparent colored areas or transparent colored overlay films on white sheeting, the coefficient of retroreflection (R_A) shall be no less than 70 percent of the original values for the corresponding color.

1042.2.8 Fluorescent Retroreflective Sheeting. Fluorescent retroreflective sheeting shall be in accordance with [Sec 1042.2.7](#) and ASTM D 4956, Type IV, Class 1, except as noted herein.

1042.2.8.1 Coefficient of Retroreflection. Fluorescent retroreflective sheeting shall meet or exceed the minimum coefficient of retroreflection requirements shown below, expressed as candelas per footcandle per square foot (candelas/lux/m²). The R_A values will be the mean of test rests obtained from readings taken with orientation angles of 0 degrees and 90 degrees.

Fluorescent Retroreflective Sheeting Minimum Coefficient of Retroreflection, R _A				
Observation Angle, Degrees	Entrance Angle, Degrees	Orange	Yellow Green	Yellow
0.2	-4	200	325	240
0.2	+30	85	205	150
0.5	-4	80	235	165
0.5	+30	50	110	75

1042.2.8.2 Color Specification Limits and Luminance Factor. Fluorescent retroreflective sheeting shall meet the color specification limits (daytime) and luminance factor (daytime) requirements shown below.

Fluorescent Retroreflective Sheeting Color Specification Limits (Daytime) - Luminance Factor, Y%										
	1		2		3		4		Luminance Factor (Y%)	
	x	y	x	y	x	y	x	y	Min	Max
Orange	.583	.416	.523	.397	.560	.360	.631	.369	28	---
Weathered Orange	.583	.416	.523	.397	.560	.360	.631	.369	20	45
Yellow Green	.387	.610	.460	.540	.421	.486	.368	.539	60	---
Weathered Yellow Green	.387	.610	.460	.540	.421	.486	.368	.539	50	---
Yellow	.498	.412	.557	.442	.479	.520	.438	.472	40	---

Note: The four pairs of chromaticity coordinates will determine the acceptable color in terms of the CIE 1931 Standard Colorimetric System measured with CIE Standard Illuminant D65.

1042.2.8.3 Specular Gloss. Fluorescent retroreflective sheeting shall have a specular gloss of no less than 50.

1042.2.9 Outdoor Exposure. Retroreflective sheeting, except for work zone signs, shall be submitted by the manufacturer to NTPEP for two years of 45-degree south-facing outdoor exposure. Retroreflective sheeting for work zone signs shall be submitted by the manufacturer to NTPEP for an exposure time of one year. Results shall be published by NTPEP and available for MoDOT review. For all NTPEP test decks, retroreflective sheeting shall have a coefficient of retroreflection at least 50 percent of the original reading for Type 1 or 80 percent of the original reading for Type 3 and Type 7.

1042.2.10 Manufacturer and Brand Name Approval. Prior to approval and use of material, the manufacturer shall submit NTPEP test results from all test decks, and certification to Construction and Materials, showing specific test results and that the material is in accordance with this specification. In addition, the submittal shall include samples representing the retroreflective sheeting tested by NTPEP, and the inks. These samples shall be accompanied by a product data sheet, an MSDS, technical bulletins on sign fabrication and any special fabrication instructions relative to the retroreflective sheeting submitted. Samples of retroreflective sheeting shall be a minimum of 13 x 13 inches (330 x 330 mm).

1042.2.10.1 Preliminary approval will be based on satisfactory NTPEP test results for retroreflective sheeting and additional verification testing for retroreflectance and chromaticity as required.

1042.2.10.2 Continued approval will be based on satisfactory field performance.

1042.2.11 Type of Characters. Letters, numerals, arrows, symbols, borders and other features of the sign message shall be of the type, size and series shown on the plans or as specified by the engineer. Completed letters, numerals and other units shall be formed to provide a continuous stroke width with smooth edges, and shall yield a flat surface free of air bubbles, wrinkles or other blemishes as determined by the engineer. Units of the sign message shown on the plans shall meet the requirements for the specified type. Type L-1 and L-3 characters shall not be intermixed on a single sign face, unless otherwise shown on the plans or as approved by the engineer.

1042.2.11.1 Type L-1 Characters.

1042.2.11.1.1 The letters, numerals, arrows, symbols and borders shall be applied to the background of the sign by the direct or reverse screen process. Messages and borders of a color darker than the sign field shall be applied to the retroreflective sheeting by the direct process. Messages and borders of a color lighter than the sign field shall be produced by the reverse screen process. Inks used in the silkscreen process shall be of the type to produce the desired color and durability when applied on retroreflective sheeting. Silkscreen inks shall be used in accordance with the manufacturer's recommendations. The ink shall produce the desired color when applied on retroreflective sheeting background and shall dry to a good film without running, streaking or sagging. The screening shall be done in a manner that results in a uniform color and tone, with sharply defined edges of legend and border without blemishes on the sign field that will affect the intended use. Signs after screening shall be dried in accordance with the manufacturer's recommendations to provide a smooth hard finish. Any signs on which blisters appear during the drying process will be rejected.

1042.2.11.1.2 Transparent overlay films may be used as a replacement for the reverse screen process, as recommended by the sheeting manufacturer.

1042.2.11.2 Type L-3, Direct Applied Characters. The letters, numerals, symbols, borders and other features of the sign message shall be cut from the color and type of sheeting shown on the plans, and applied to the sign field in accordance with the sheeting manufacturer's recommendations.

1042.2.11.3 Allowable Variations. The design height of rounded letters or numerals shall be 1/64 inch (0.4 mm/25 mm) of height greater than normal height, both on top and bottom of letter or numeral, where rounded. The loop portion of letters such as f, g and y, shall conform to the dimensions shown on the plans with the allowable tolerance. The following variations in dimensions of letters and numerals, regardless of character type, will be acceptable with all measurements made to the nearest 1/8 inch (3 mm).

Allowable Variation		
Nominal Height, inches (mm)	Variation in Height, inches (mm)	Variation in Width, inches (mm)
4 thru 12 (100 thru 300)	-1/8 to +3/8 (-3 to +9.5)	-1/4 to +1/4 (-6 to +6)
Over 12 (Over 300)	-1/8 to +3/8 (-3 to +9.5)	-3/8 to +3/8 (-9.5 to +9.5)

1042.3 Sign Fabrication. A sign shall consist of aluminum flat sheets or extruded panels retroreflectORIZED on the face side with all letters, numerals, symbols, borders, corners and route shields mounted on the face, and shall include all necessary mounting devices shown on

the plans. Signs with an area of 30 square feet (3 m²) or more will be considered structural (ST) and shall be fabricated with extruded panels. Signs with an area of less than 30 square feet (3 m²) will be considered sheet (SH) signs and shall be fabricated with flat sheet.

1042.3.1 The signs shall be retroreflectorized as follows.

1042.3.1.1 All aluminum substrate shall be given a chromate conversion coating in accordance with ASTM B 449, Class 2, and shall be prepared by one of the Treatment Sequence Options described in ASTM B 449, Appendix X2. The chemicals and solvents shall be applied in strict accordance with the manufacturer's recommendations. Sufficient laboratory facilities to test and control the concentration of the solutions used shall be maintained at the treating plant. A log of the concentration of treating solutions shall be maintained. Treated panels shall be handled in such a manner as to prevent contamination. Panels shall be stored in a dry, clean area free from dust, acid fumes or vapors. When aluminum is shipped to a secondary location for retroreflectorizing, adequate precautions shall be taken to ensure that the material arrives at the destination uncontaminated.

1042.3.1.2 Retroreflective sheeting used for background, letters, numerals, arrows, symbols, borders and other features of the sign message shall be from a single manufacturer.

1042.3.1.3 Retroreflective sheeting splices on structural signs shall be kept to a minimum. Rolled overlap splices in accordance with the sheeting manufacturer's recommendations may be used, with no more than one allowed per panel. Retroreflective sheeting shall be placed on the individual extruded panels in accordance with the manufacturer's recommendations. The sign panels may be clear coated or edge sealed after application of the retroreflective sheeting, if recommended by the sheeting manufacturer. If edge sealer is used, the sealer shall be applied to all splices and edges. The completed sign shall have good color matching of retroreflective sheeting and shall be free from air bubbles, wrinkles or other blemishes.

1042.3.1.4 Retroreflective sheeting applied to standard flat sheet signs shall not have splices on signs where the smallest dimension is less than 4 feet (1200 mm). One vertical overlap splice approximately 1/4 inch (6 mm) wide will be allowed on standard flat sheet signs where the smallest dimension is greater than 4 feet (1200 mm). Any special flat sheet signs requiring splicing other than noted for the standard flat sheet signs shall be as approved by the engineer. The sign panels may be clear coated or edge sealed after application of the retroreflective sheeting if recommended by the sheeting manufacturer. If clear finish is used, the finish shall be applied after screening of messages and borders. If edge sealer is used, the sealer shall be applied to all splices and edges. The completed sign face shall be free from air bubbles, wrinkles or other blemishes.

1042.3.2 Nuts on panel bolts shall be torqued to 220 - 230 inch-pounds (25 - 26 N-m).

1042.3.3 Periodic shop inspection of sign fabrication will ordinarily be made at the fabricating shop, but in some cases may be waived, and complete inspection made when the fabricated signs are delivered to the site of the work. The engineer shall be notified well in advance of the beginning of shop work so adequate arrangements can be made for inspection. Whether or not shop inspection is made, workmanship and material that are not in accordance with the specifications and recognized as good practice may be rejected at any time prior to acceptance of the work.

1042.3.3.1 The contractor will be charged with the transportation costs of sign inspectors for trips made from Jefferson City, Missouri to points to which the inspectors must travel for shop inspection work. Routine shop inspection work will include inspection and sampling of material, inspection of treatment and fabrication processes, and of any signs completed at time

of inspection. Transportation costs will be deducted by the Commission from monies due the contractor.