

SECTION 90

ROADWAY SIGNS AND DELINEATORS

90.1 DESCRIPTION

- A. General:** This work consists of furnishing materials, making and preparing signs and delineators, erection and installation of signs and delineators, and performing incidental work. The specific combination of Contractor furnished and installed material or City furnished and Contractor installed material will be as called for in the Bidder's Proposal or as directed by the Engineer.

All traffic control remaining on the site following project acceptance shall become the property of the City. All existing traffic control devices shall remain the property of the City. All signs, signals, or delineators removed by the Contractor shall be delivered in the condition prior to removal to the City of Rapid City, Traffic Operations, unless directed otherwise by the Engineer. All returned traffic control devices shall be delivered disassembled. A delivery list shall accompany all returned traffic control devices.

B. Related Work:

Section 91	Pavement Marking
Section 92	Temporary Traffic Control
Section 93	Traffic Signals and Roadway Lighting
Section 203	Submittals

90.2 MATERIALS

General: If requested by the Engineer, a Certificate of Compliance shall be furnished for each material item and shall state that the item conforms to the required specification, with reference being made to the appropriate specification number.

- A. Shop Drawings:** Prior to fabrication of project or location specific signs (example: street name signs), the Contractor shall submit shop drawings showing the sign layout with correct spelling and suffixes to the City for review and approval. Submittals shall be made in accordance with Section 203 Submittals. The Contractor shall not begin fabrication prior to the City's review and final approval of shop drawings. The Contractor shall not begin fabrication or construction of the work contained in the shop drawings until the City has completed the review. Contractor shall not deviate from materials reviewed without additional review and approval.

- B. Anchor Bolts, High Strength Bolts and Anchor Rods:** SDDOT Section 972.

C. Signs:

1. **Sheet Aluminum:** Shall meet the requirements of ASTM B209 for alloy 5052-H38 or alloy 6061-T6. The aluminum shall be properly degreased and etched or treated with a light, tight, amorphous chromate coating. All signs shall be fabricated using an aluminum backing and have a thickness of 0.080 inches for signs with a horizontal dimension of 30 inches or less and a thickness of 0.100 inches for signs with a horizontal dimension greater than 30 inches.
2. **Bolts, Nuts, and Washers:** Shall be galvanized in accordance with ASTM F2329 or zinc plated per ASTM F1941.

D. Perforated Tube Posts: Post material shall meet impact performance (change in momentum) requirements for small sign supports contained in the current AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic signals."

Perforated tube posts shall conform to ASTM A1011 Grade 50 structural steel.

Posts shall be a 2 inch square tube formed of 12 gauge steel, 0.105 inch thick, rolled to size. The tubing shall be molded so the weld or flash does not interfere with telescoping. The posts shall be hot dipped galvanized with a 1.25 ounce per square foot coating conforming to ASTM A123. As an alternate, the post shall be given a triple coated protection by application of hot dip galvanized zinc conforming to ASTM A53, followed by a chromate conversion coating and a polyurethane exterior coating, with inside surfaces given corrosion protection by in-line application of zinc base organic coating after fabrication.

The posts shall be punched, bored, or have knockouts with 7/16 inch diameter holes on 1 inch centers of all four sides for the entire length of the posts. The post sections shall be straight, with a smooth uniform finish and a minimum amount of play between telescoping sections. Holes and cutoff ends shall be free of burrs and ragged edges.

Wind anchors as specified and shown on the plans shall be installed as part of the perforated sign posts.

Bolts, nuts, and washers shall conform to ASTM A307, ASTM A563, and ASTM F436, respectively, and shall be galvanized in accordance with ASTM B695.

E. Slip Base Assemblies:

1. **Base Plates and Friction Fuse Plates:** Shall conform to ASTM A36. The plates shall be galvanized in accordance with ASTM A123. Welding, punching, and boring of the plates shall be done before galvanizing.
2. **Bolts, Nuts and Washers:** Bolts, hex nuts, and washers used in conjunction with base plates or friction fuse plates shall conform to ASTM A325, except 1/2 inch

and 5/8 inch bolts conforming to ASTM A449 are permissible instead of ASTM A325. Bolts, hex nuts, and washers shall be covered with zinc coating (hot dip galvanized) per ASTM F2329.

3. **Shims:** Shims used in conjunction with base plates or friction fuse plates shall be covered with a zinc plating (electro-deposited zinc) as per ASTM B633.

F. Reflective Sheeting:

1. **Grade:** Reflective Sheeting shall be Type IV or higher for all signs except street name signs, which shall be Type IX or higher. All reflective sheeting shall be prismatic.
2. **General Characteristics:** The reflective sheeting shall be free from ragged edges, cracks, and extraneous materials. There shall be no more than four splices per 50 yard length. Splices shall be made by overlapping the sheeting a minimum of 3/16 inch.
3. **Fabrication:** The background for signs shall be sheet reflective material applied to aluminum backing. The preparation of the aluminum surface and the sheeting application shall be in complete compliance with the recommendations of the manufacturer.

All legend and border utilizing the color black shall be vinyl or screen printed black, non-reflectorized material. All other legend and border shall be of the same type of sheeting as the background of the same sign.

4. **Application:** Reflective sheeting shall be applied to properly prepared aluminum (degreased and etched or treated with a light, tight, amorphous chromate coating) with mechanical equipment in a manner prescribed by the sheeting manufacturer.

Sign faces comprising two or more pieces or panels of reflective sheeting must be carefully matched for color during sign fabrication to provide uniform appearance and brilliance, day and night. Alternate, successive width sections of either sheeting or panels must be reversed and consecutive to insure that corresponding edges of reflective sheeting lie adjacent on the finished sign.

Reflective sheeting for sheet aluminum signs shall be of the pressure sensitive or heat activated type. Splicing of the sheeting will not be allowed except those splices permitted by the sheeting manufacturer. Splices will not be permitted on signs which are screen processed with transparent color.

5. **Legend:** Message and borders shall be type, reflective material, and color specified.
 - a) **Screen Process:** Message and borders shall be processed on reflective sheeting using mechanical equipment, materials, and operational methods

and procedures as prescribed by the sheeting manufacturer. Processing shall be accomplished by the direct or reverse screen method using opaque or transparent processing material as required. Screening may be accomplished either before or after application of the sheeting to the base panels, conditional upon the method recommended by the sheeting manufacturer. Freehand painting will not be permitted on any part of the finished sign face.

- b) Direct Applied:** Cut-out message and borders shall be reflective sheeting or opaque lettering film applied directly to clean, dust free, reflective sheeting background. Message and borders shall be applied in accordance with the operational methods and procedure prescribed by the sheeting manufacturer. The finished letters, numerals, symbols, and borders shall be cut with smooth regular outline, free from ragged or torn edges.

Mounting holes will not be drilled or punched in any part of the nonremovable copy.

- 6. Color:** The reflective sheeting shall meet the color specification limits and luminance factors listed in Tables 1-4 when tested in accordance with ASTM E1347 or ASTM E1349. Fluorescent retroreflective materials shall be tested in accordance with ASTM E991. The reflective sheeting shall maintain the colors and luminance factors provided in the appropriate tables throughout its service life. Warning signs, except those for bicycle and shared use path facilities, shall be fluorescent yellow. Warning signs for bicycle and shared use path facilities shall be fluorescent yellow-green. All pedestrian and school signs shall be fluorescent yellow-green.

Table 1

Color	Chromaticity Coordinates (corner points)							
	1		2		3		4	
	X	Y	X	Y	X	Y	X	Y
White	0.303	0.300	0.368	0.366	0.340	0.393	0.274	0.329
Red	0.648	0.351	0.735	0.265	0.629	0.281	0.565	0.346
Orange	0.558	0.352	0.636	0.364	0.570	0.429	0.506	0.404
Brown	0.430	0.340	0.430	0.390	0.518	0.434	0.570	0.382
Yellow	0.498	0.412	0.557	0.442	0.479	0.520	0.438	0.472
Green	0.026	0.399	0.166	0.364	0.286	0.446	0.207	0.771
Blue	0.078	0.171	0.150	0.220	0.210	0.160	0.137	0.038

Table 1: Daytime Color Specification Limits for Retroreflective Material with CIE 2° Standard Observer and 45/0 (0/45) Geometry and CIE Standard Illuminant D65.

Table 2

Color	Chromaticity Coordinates (corner points)							
	1		2		3		4	
	X	Y	X	Y	X	Y	X	Y
White	0.475	0.452	0.360	0.415	0.392	0.370	0.515	0.409
Red	0.650	0.348	0.620	0.348	0.712	0.255	0.735	0.265
Orange	0.595	0.405	0.565	0.405	0.613	0.355	0.643	0.355
Brown	0.595	0.405	0.540	0.405	0.570	0.365	0.643	0.355
Yellow	0.513	0.487	0.500	0.470	0.545	0.425	0.572	0.425
Green	0.007	0.570	0.200	0.500	0.322	0.590	0.193	0.782
Blue	0.033	0.370	0.180	0.370	0.230	0.240	0.091	0.133

Table 2: Nighttime Color Specification Limits for Retroreflective Material with CIE 2° Standard Observer and Observation Angle of 0.33°, Entrance Angle of +5° and CIE Standard Illuminant A.

Table 3

Color	Chromaticity Coordinates (corner points)								Luminance Factor (Y %)	
	1		2		3		4		Min	Max
	X	Y	X	Y	X	Y	X	Y		
Fluorescent Orange	0.583	0.416	0.535	0.400	0.595	0.351	0.645	0.355	25	None
Fluorescent Yellow	0.479	0.520	0.446	0.483	0.512	0.421	0.557	0.442	45	None
Fluorescent Yellow-Green	0.387	0.610	0.369	0.546	0.428	0.496	0.460	0.540	60	None
Fluorescent Green	0.210	0.770	0.232	0.656	0.320	0.590	0.320	0.675	20	30

Table 3: Daytime Color Specification Limits and Luminance Factors for Fluorescent Retroreflective Material with CIE 2° Standard Observer and 45/0 (0/45) Geometry and CIE Standard Illuminant D65.

Table 4

Color	Chromaticity Coordinates (corner points)							
	1		2		3		4	
	X	Y	X	Y	X	Y	X	Y
Fluorescent Orange	0.625	0.375	0.589	0.376	0.636	0.330	0.669	0.331
Fluorescent Yellow	0.554	0.445	0.526	0.437	0.569	0.394	0.610	0.390
Fluorescent Yellow-Green	0.480	0.520	0.473	0.490	0.523	0.440	0.550	0.449
Fluorescent Green	0.007	0.570	0.200	0.500	0.322	0.590	0.193	0.782

Table 4: Nighttime Color Specification Limits for Fluorescent Retroreflective Material With CIE 2° Standard Observer and Observation Angle of 0.33°, Entrance Angle of +5° and CIE Standard Illuminant A.

G. Object Markers:

1. **Description:** Object markers shall be adhesive coated reflective sheeting permanently bonded to sheet aluminum backing.

Object markers shall be of the size and color specified. Type 1, 2, 3, and 4 object markers shall conform to the following requirements:

- a) Type 1 object markers shall consist of a yellow 18 inch x 18 inch reflector unit.
 - b) Type 2 object markers shall consist of a yellow 6 inch x 12 inch or size specified reflector unit.
 - c) Type 3 object markers shall consist of a yellow and black 12 inch x 36 inch reflector unit. The yellow and black stripe pattern shall be 6 inch black and 4 inch yellow.
 - d) Type 4 object markers shall consist of a red 18 inch x 18 inch reflector unit.
2. **Reflective Sheeting:** Shall be Type XI or higher conforming to ASTM D4956.

In addition to the requirements stated above, the reflective sheeting shall maintain the colors provided in the appropriate tables contained in this section throughout its service life.

3. **Fabrication:** The aluminum shall be a 0.080 inch thick sheet conforming to the requirements of ASTM B 209 for alloy 6061-T6 or 5052-H38. The aluminum shall be properly degreased and etched or treated with a light, tight, amorphous chromate coating.

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

4. **Shape and Holes:** Object markers shall be punched or sheared to size with 1½ inch radius corners. Mounting holes shall be as follow:
 - a) Type 1 object markers shall have 2 holes 1/4 inch in diameter 20 inches center to center.
 - b) Type 2 object markers shall have 2 holes 1/4 inch in diameter 8 inches center to center.
 - c) Type 3 object markers shall have 2 holes 1/4 inch in diameter 30 inches center to center.
 - d) Type 4 object markers shall have 2 holes 1/4 inch in diameter 20 inches center to center.

5. **General Requirements:** The finished object markers shall be free of burrs, scratches, and damaged reflective sheeting and shall have essentially a plane surface.
6. **Object Marker Posts:** Shall be the same as sign posts.

90.3 CONSTRUCTION REQUIREMENTS

Roadway signs, delineators, and object markers shall comply with the current edition of the MUTCD and Standard Highway Signs, issued by the U.S. Department of Transportation, FHWA.

A. Signs:

1. **Location and Position:** The location of each sign shall be established by a stake bearing the sign number as determined from the plans.

Posts shall be in a plumb position and the flanges of structural shape posts or other supports shall lie in the same plane. The post shall not extend above the top of the sign.

2. **Post Size:** Shall be 2 inch square, extensions for street name signs shall be 1 ¾ inch square. The Contractor shall field verify the post length prior to ordering.

- B. **Object Markers:** Object markers of the type specified shall be erected at the locations shown in the plans or as directed by the Engineer.

- C. **Perforated Tube Posts:** Shall be installed in accordance with the contract or as directed by the Engineer. Sign post locations in concrete shall be installed in a cored hole or preformed sleeved hole opening.

- D. **Slip Base Assemblies:** The use of surface mount slip base breakaway bases shall require prior approval by the Engineer. Slip base assemblies shall be assembled per manufacturer's instructions.

The top of the concrete footing/grout pad shall be placed flush with the finished grade. The mounding of soil around the footing will not be permitted.

- E. **Reflective Sheeting:** Shall be of the type specified.

- F. **Remove, Salvage, Relocate, and Reset Sign:** The Contractor shall remove signs, post, and bases for reset as shown in the plans. The Contractor shall reuse existing extruded aluminum panels, posts, footings, and hardware where specified. All existing posts, bases, and signs listed in the plans that are scheduled for removal shall be dismantled. All bolts, nuts, and washers shall be placed in containers to keep the hardware separated. Backing materials shall be separated from the signs and may be reused at the Contractor's discretion. Wooden posts shall be carefully removed to avoid damage and cleaned of excess

dirt and neatly stockpiled separate from the steel posts. The resultant holes in the ground from removal of wooded posts shall be backfilled to the satisfaction of the Engineer.

90.4 METHOD OF MEASUREMENT

- A. **Signs:** Sheet aluminum and extruded aluminum signs will be paid for at the contract unit price per each sign. Payment will be full compensation for furnishing and installing materials, including post, base assemblies, hardware, borders, legend, and edge trim.
- B. **Object Markers:** Object marker quantities will be determined by count of each type regardless of size.
- C. **Delineators:** Delineator quantities will be determined by count of each type.
- D. **Perforated Tube Posts:** Field measurement will not be made.
- E. **Fixed Base Assemblies:** Field measurement will not be made.
- F. **Slip Base Assemblies:** Field measurement will not be made.
- G. **Reflective Sheeting:** Field measurement will not be made.
- H. **Remove, Salvage, Relocate, and Reset Sign:** Measurement will be the actual count of signs on a per each assembly basis regardless of the number of signs or posts at each assembly.

90.5 BASIS OF PAYMENT

- A. **Signs:** Sheet aluminum and extruded aluminum signs will be paid for at the contract unit price per each sign, regardless of size. Payment will be full compensation for furnishing and installing materials, post, base assemblies, hardware, borders, legend, and edge trim.
- B. **Object Markers:** Object markers will be paid for at the contract unit price per each, regardless of size. Payment will be full compensation for furnishing and installing materials, including posts, reflective panels, and hardware.
- C. **Delineators:** Delineators will be paid for at the contract unit price per each, regardless of size. Payment will be full compensation for furnishing and installing materials, including posts, reflectors, and hardware.
- D. **Perforated Tube Posts:** Separate payment will not be made for tube posts. They are incidental to the sign being furnished.
- E. **Fixed Base Assemblies:** Separate payment will not be made for fixed base assemblies. The base assemblies will be considered incidental to the sign furnished.

- F. Slip Base Assemblies:** Separate payment will not be made for slip base assemblies. The slip base assemblies will be considered incidental to the sign furnished.
- G. Reflective Sheeting:** Separate payment will not be made for reflective sheeting. The reflective sheeting will be considered incidental to the sign furnished.
- H. Remove, Salvage, Relocate, and Reset Sign:** Payment shall be full compensation to remove and reset existing signs and shall include all costs for labor and equipment necessary to remove, dismantle, backfill holes, and deliver salvaged material to the City Traffic Operations shop at the contract unit price per each assembly.

END OF SECTION