

## **DIVISION 9 SIGNING**

---

### **SECTION 900 GENERAL REQUIREMENTS FOR SIGNING**

#### **900-1 DESCRIPTION**

Furnish, fabricate and erect complete traffic sign and sign lighting systems in accordance with the requirements of the plans and the provisions of these specifications.

The provisions of this section are applicable to Division 9.

#### **900-2 APPLICABLE SPECIFICATIONS, STANDARDS, AND PUBLICATIONS**

The following specifications and reference publications referred to in Division 9 will be applicable to the work. The current edition of these as well as any other referenced ASTM, AASHTO, AWS, FHWA, FSS, UL, IES, MIL, NEC, NEMA, or ANSI specifications and publications in effect on the date of advertisement will apply.

1. The Manual on Uniform Traffic Control Devices for Streets and Highways, published by the U. S. Department of Transportation, Federal Highway Administration (hereinafter referred to as the MUTCD or Manual on Uniform Traffic Control Devices).
2. FHWA Specifications for Standard Highway Sign Colors, Color Tolerance Charts for Yellow, Red, Blue, Orange, Brown and Green, U. S. Department of Transportation, Federal Highway Administration, Washington, DC 20591.
3. Standard Alphabets for Highway Signs, U. S. Department of Transportation, Federal Highway Administration.
4. Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects, FP-92, U. S. Department of Transportation, Federal Highway Administration, Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402.
5. Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals, published by AASHTO.
6. Standard Specifications for Highway Bridges, published by AASHTO.
7. AASHTO Specification M268 "Retroreflective Sheeting for Traffic Control".
8. Munsell Book of Color--Munsell Color Company, 2441 North Calvert Street, Baltimore, Maryland 21218.
9. AWS Specification D1.1, "Structural Welding Code--Steel".
10. AWS Specification D1.2, "Structural Welding Code--Aluminum".
11. Military Specification MIL-P-17802E, "Padlocks and Padlock Sets, Low Security, Key Operated, Regular (Open) Shackle".
12. North Carolina Supplement to the Manual on Uniform Traffic Control Devices for Streets and Highways, published by the NCDOT Traffic Engineering Branch.

#### **900-3 ACCEPTANCE OF SIGNS**

Prior to final inspection of the signs, clean exposed sign and support surfaces, and repair the site as may be deemed necessary to ensure the safety, effectiveness and neat appearance of the work.

Maintain responsibility for the signs until accepted. Any damaged sign will not be accepted. Any repairs to the signs before final acceptance of the project are to be

approved.

Do not perform any repair work without written approval. Make repairs only under the supervision of the Engineer.

Handle, transport, and store all signs in accordance with the sheeting manufacturer's recommendations. Failure to comply with the manufacturer's recommendations during the handling, transportation, and storage of the signs will be cause for rejection of the signs.

The Contractor may request early Department acceptance of part or all of the highway signs, including sign panels, retroreflective sheeting, and associated hardware, before final project acceptance. To be accepted prior to final project acceptance, the signs must be required for traffic control at that phase of project construction.

If the Department accepts the signs, the Contractor will be relieved of the responsibility for any damage and/or theft that may occur to the signs, retroreflective sheeting, or associated hardware, with exception of any damage caused by the Contractor or any Subcontractor working on the project. There will be no additional compensation for the signs accepted before project completion.

**900-4 ALTERNATE DESIGN**

Standard designs for Types A, B, D, E, and F ground mounted signs are shown in the plans. In lieu of the standard design, the Contractor may submit for approval an alternate design for sign panels differing in component parts and construction details from those shown in the plans. Provide any alternate designs which are in accordance with the "Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals", published by AASHTO.

Submit complete details of the alternate sign designs to the Engineer for approval. Include the dimensions, thickness, and alloys of the component parts, and typical shop drawings of all fabrication, erection, and construction details.

Alternate design for supports and footings will not be permitted.

**900-5 COVERING OF SIGNS**

Cover signs or portions of signs which have been erected on roads to traffic, but which are not yet applicable to traffic. Keep signs or portions of signs covered until instructed to remove the covering. Provide covering for entire signs by method approved by sheeting manufacturer which will prevent the messages from being read or seen during both day and night conditions and which will cause no harm to the sheeting face. For covering portions of signs, utilize methods as shown in the plans.

**SECTION 901  
SIGN FABRICATION**

**901-1 DESCRIPTION**

Fabricate and furnish signs, including sign face, supporting frames, hardware, and package the signs for shipment.

**901-2 MATERIALS**

Refer to Division 10:

Signs and hardware .....	Article 1092-1
Button-type demountable copy .....	Article 1092-3
Retroreflective sheeting .....	Article 1092-2

**901-3 CONSTRUCTION METHODS****(A) General**

Details concerning the fabrication and erection of the signs are shown in the plans. Sign designs not shown in the plans are available from the Signing Engineer.

All items shall be fabricated to within 1/8" (3mm) of exact measurements.

Die stamp each sign, shield, arrow, overlay and/or blank on the back with the month and year of manufacture and the metal treater of the aluminum sheets.

Do not begin fabrication for Type A & B signs to be mounted on overhead sign structures until S dimensions verifications revisions for the overhead sign structures have been approved.

Provide mounting holes in the Z stringers of the signs in accordance with the details shown in the plans or approved shop drawings. Provide a space between the 'Z' bar and backing strip not greater than 1/8" (3mm).

Date the erection of all signs and sign assemblies using printed self-adhesive stickers designed for punching the appropriate day, month, and year numbers with a hole punch. Place the sticker on the back of each sign in the lower corner nearest the roadway. The Sign Fabricator will provide a sufficient quantity of the stickers for each sign. Print on the back of each sign the size of that sign [e.g. 144"(3657mm) X 48"(1219mm)] with a black permanent marker with numbers a minimum of 2 inches (50.8 mm) in height and located near the self-adhesive sticker.

**(B) Department and Contractor Furnished Signs**

The plans will show whether the signs are to be fabricated and furnished by the Contractor or whether the Department will provide them to the Contractor.

For both Department and Contractor Furnished Signs, the Contractor provides all mounting hardware consisting of, but not limited to, backing plates, mounting bolts, washers, shims, and nuts.

The sign fabricator will provide vertical Z bars required for attaching secondary signs to the primary signs.

Prior to the preconstruction conference submit to the Engineer, for approval, the estimated date the Department furnished signs will be needed. Confirm in writing, the actual date the signs will be required a minimum of 4 months in advance. The signs will be made available to the Contractor for pickup at the North Carolina Department of Correction sign fabrication facility on NC 39 near Bunn, North Carolina, unless otherwise indicated in the special provisions. Provide for all transportation.

The Engineer will inspect and approve the signs before they are packaged and crated for shipment. Any inspection by the Contractor will be done at no cost to the Department. Take delivery of all signs within 60 days of the date requested or the date they are made available, whichever occurs last, and within 96 hours of receiving the first sign. The Engineer must approve any exception to the above delivery procedure. At the time the signs are delivered to the project, provide to the Engineer one copy of the sales ticket furnished with the signs.

After taking possession of the signs, be responsible for any damage and/or theft that occurs to signs prior to final acceptance by the Engineer. Comply with the reflective sheeting manufacturer's recommendations for handling, transporting, erecting, and storage of the signs. Acceptably repair or otherwise correct any damage to the signs or refabricate them at no cost to the Department. When requested by the Contractor, the Department may have the necessary repairs made, or the signs refabricated, and deduct the associated costs thereof from monies due the Contractor.

**(C) Signs**

Construct all signs, supporting frames and assemblies in accordance with the details shown in the plans.

**TABLE 901-1  
SIGN TYPE PARAMETERS**

<b>SIGN TYPE</b>	<b>VERT. AND HORIZ. DIMENSIONS Inches (mm)</b>	<b>ALUMINUM PANELS (144" x 48") (3657mm x 1219mm)</b>	<b>HORIZONTAL Z BARS</b>	<b>ALUMINUM THICKNESS Inches (mm)</b>
A	1. Vertical or Horizontal > 144 (3657) or 2. Vertical and Horizontal > 48 (1219)	Multiple	Yes	0.125 (3.2)
B	1. Vertical and Horizontal ≤ 144 (3657), and 2. Vertical or Horizontal ≤ 48 (1219)	Single	Yes	0.125 (3.2)
D		Single	No	See Table 901-2
E		Single	No	See Table 901-2
F		Single	No	See Table 901-2

**(1) Type A Signs**

Fabricate Type A signs from multiple 0.125" (3.2mm) aluminum sheet increments, with welded studs for attachment to the supporting frame. Type A signs may be fabricated from multiple 0.080" (2mm) aluminum sheet increments, with the use of very high bond acrylic foam tape capable of obtaining 140 psi (966kPa) tensile adhesion, for attachment to the supporting frame.

Use aluminum sheets with increments of 4 feet (1.2m) in width; except, for sign widths, which are not multiples of 4 feet (4.2m), a maximum of one (1) panel may be cut to less than 4 feet (4.2m). Mount aluminum sheet increments vertically, and provide with backing strips at the vertical joints, held firmly in place, to keep the abutting sheets in proper alignment. Leave a minimum space of .020" (0.5mm) to a maximum space of .032" (0.8mm) between each panel.

Fabricate signs with a height of 12 feet (3.7m) or less, without horizontal joints. One horizontal joint will be permitted for signs, which are more than 12 feet (3.7m) in height. Locate the joint near the mid-height of the sign. Construct this joint according to the details as shown in the plans.

**(2) Type B Signs**

Fabricate Type B signs from single 0.125" (3.2m) aluminum sheets, with welded studs for attachment to the supporting frame. Type B signs may be fabricated from single 0.080" (2mm) aluminum sheets, with the use of very high bond acrylic foam tape capable of obtaining 140 psi (966kPa) use tensile adhesion, for attachment to the supporting frame

**(3) Type D, E, F Signs and Milemarkers**

Fabricate Types D, E, F signs and milemarkers from single sheets, with holes for bolting to the supports. Construct Type D, E, F signs and milemarkers of the thickness shown in Table 901-2.

Construct Type E and F signs to FHWA standard designs or those of the NC Supplement to the MUTCD. Full-scale drawings of Types E and F signs are available from the Department's Traffic Engineering Branch.

For Type E and F sign assemblies, apply the retroreflective sheeting to the separate signs in all Types E and F sign assemblies consecutively to provide correct color matching on each completed assembly. Adequately identify each individual sign to the correct assembly. Following the erection of Types E and F sign assemblies, leave the identification markings on the individual signs until Department personnel have verified compliance with these requirements.

**(4) Overlays for Existing Signs**

Manufacture all overlays for existing signs from 0.063" (1.6mm) aluminum sheeting, unless otherwise required by the plans. Do not make holes for rivets in the overlays during fabrication, but instead field-drill them during the erection process.

**(D) Aluminum****(1) Thickness Requirements**

**TABLE 901-2  
ALUMINUM THICKNESS REQUIREMENTS FOR SIGNS**

VERTICAL OR HORIZONTAL DIMENSION Inches (mm)	THICKNESS Inches (mm)
0-11.9 (0 – 302.3)	0.032 (0.8)
12-35.9 (304.8 – 911.9)	0.063 (1.6)
36-47.9 (914.4 – 1216.7)	0.080 (2)
48 and larger (1219.2 and larger)	0.125 (3.2)
Milemarkers	0.080 (2)
Overlays	0.063 (1.6)

**(2) Preparation of Aluminum Sign Surfaces:**

Complete all fabricating, including cutting, welding, riveting, and punching of holes, other than mounting holes, for demountable letters, numerals, symbols, and borders, prior to surface preparation. However, it will be acceptable to weld studs to the aluminum sheet after application of retroreflective sheeting.

Do not handle any metal, except by appropriate handling devices or by workmen wearing clean gloves, between the beginning of the cleaning operations and the completion of the application of the paint or retroreflective sheeting. Retreat aluminum sign surfaces, which come into contact with grease, oils, or other contaminants prior to the application of retroreflective sheeting.

Before applying retroreflective sheeting to the aluminum, treat the aluminum sign surfaces in strict accordance with one of the processes described below. Prepare all signs for the entire project by the same process.

**(a) Cleaning and Etching**Preliminary Cleaning

Completely immerse in an 8 percent solution of inhibited alkaline cleaner at 160 degrees to 180 degrees Fahrenheit (71-82 degrees Celsius) for 6 minutes, followed by a cold water rinse.

Etching

Give the metal either an acid etch or an alkaline etch. Provide, with the etching, a clean, matte, non-shine or non-glare finish on both sides, suitable for the application of retroreflective sheeting.

For acid etch, clean the metal, give a surface etch by complete immersion for a period of not less than 16 minutes in an 18 to 20 percent diluted phosphoric acid solution, follow by spraying with a cold water rinse, and then immerse for one minute in circulating hot water at not less than 180 degrees Fahrenheit (82 degrees Celsius).

For alkaline etch, clean the metal, and give a surface etch by immersion in an alkaline etching material that is controlled by titration. Follow the immersion period, temperature, and concentration of the etching solution as recommended by the solution manufacturer. After immersion, thoroughly rinse the metal then remove all smut with an acidic chromium compound type solution, as recommended by the manufacturer of the etching solution, and then give a second thorough rinse.

**(b) Chromate Conversion Coating:**

In lieu of cleaning and etching, the aluminum sheet may be treated with a chromate conversion coating so that the metal will be suitable for the direct application of retroreflective sheeting.

Sand smooth all burrs and scratches on aluminum before applying reflective sheeting, however sheet all sanded aluminum within the same day to prevent the formation of corrosion on the metal. Do not sand or use abrasive materials on sheeted faces.

**(c) Random Test:**

Randomly test aluminum products used for chemical, mechanical, coating weight analysis and compliance.

**(E) Supporting Frames**

Use supporting frames for Types A and B signs consisting of 2 or more horizontal aluminum Z-section stringers with vertical aluminum bar stiffeners in accordance with the details and dimensions shown in the plans. Use a nylon washer to attach all thru bolts with a minimum play of 3/16" (4.8mm). Provide stringers with necessary holes and slots for bolting stiffeners, attaching aluminum sheet increments, and mounting to supports. Do not field drill holes in any part of the structural assembly, except the field drilling of horizontal Z-bars for attaching new signs to existing supports when necessary.

**(F) Welding**

Use AWS certified welders to perform all welding in the fabrication of the signs. Furnish a copy of AWS certification for each welding operator used for fabrication. Produce welds that are free of cracks, blow holes, slag, and other irregularities and that are wire brushed, sand blasted, or otherwise cleaned. Do not field weld.

Weld aluminum components, including structural details, shielding gases, preparation, weld quality, inspect and correct welds, and qualify welding procedures and welders in accordance with the current edition of AWS Specification D1.2, "Structural Welding

Code--Aluminum", and as described in the Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals, AASHTO.

Weld studs to aluminum sheets by the capacitor discharge method. Use an inert gas shielding atmosphere around the stud at the time of weld, if the manufacturer of the stud welding equipment, or studs to be used, recommends its use. If the studs are welded after the retroreflective sheeting has been applied, take care to insure that burn-through does not damage the retroreflective sheeting.

The welding of steel components, including structural details, filler metal, workmanship and technique, qualification and inspection in accordance with the applicable provisions of the current edition of AWS Specification D1.1, "Structural Welding Code--Steel", and as described in the Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals, AASHTO.

Shoot a test stud on each Type A and B sign in the lower left corner of the most left panel as facing the back of the sign.

**(G) Retroreflective Sheeting:**

Apply retroreflective sheeting to the aluminum sign panels in accordance with the retroreflective sheeting manufacturer's recommendations. Use the types and colors of the retroreflective sheeting as shown in the plans. For each multi-panel increment sign, sheet the entire sign from the same roll.

If a sign panel needs to be replaced after sign fabrication, the replacement panel may be sheeted with retroreflective materials from a different lot or drum number than the remainder of the sign; however, use material that visually color matches and meets the requirements of Article 1092-2 of the NCDOT Standard Specifications.

Take retroreflectometer readings in all four corners of each panel and document on the sign design drawings.

Overlap all splices, of any encapsulated or enclosed lens sheeting, to allow water to run off without running into the splice.

Apply all Type III material with a calrod-heating unit, if recommended by the Sheeting Manufacturer.

Remove all foreign materials on the sheeted face with compressed air.

Keep a sample of each roll of sheeting and test for retroreflective compliance.

Patch wrinkles in the sheeting around through bolts by removing the sheeting affected to the metal. Then patch this area with a circular patch encompassing an area 1/4" (6.4mm) outside the affected area. This patch cannot exceed the standard patching specifications.

Ensure that all patches on the sign have a 1" (25.4mm) minimum width or as recommended by the sheeting manufacturer.

Maintain documentation of the lot, drum, inspector, roll size, date received, date sheeted and metal treater on all signs, slip sheeting, copy, borders, shields, overlays, arrows and panels, and retroreflectometer readings.

Use the retroreflective sheeting as shown in the plans. The retroreflective sheeting must be prequalified and "Approved for Use". Obtain and assign to the Department in writing warranties for sign sheeting used in the fabrication of all permanent signs supplied by the Contractor from the Sheeting Manufacturer. Warranty the signs against defective reflective sheeting per the requirements outlined in the current signing contract held by NCDOT. NOTE: Permanent signs include types A, B, D, E, and F signs, overlays for all sign types, and milemarkers, and excludes any signs used only for traffic control while the project is under construction.

**Section 901**

The reflective sheeting may be patched to repair incidental damage to the sheeting that might occur during manufacture, in transit, or after installation; however, the patches cannot exceed the limits given in the following table:

**Sign Patching Limits**

SIGN AREA SQ. FT. (SQ. Meter)	During Fabrication		Additional Patches After Field Erection	
	Max. No. Patches per sign	Max. Patch Size per Patch Sq. In. (SQ. Meter)	Max. No. Patches per sign	Max. Patch Size per Patch Sq. In. (SQ. Meter)
0 to 15.0 (0 to 1.4)	0	0	0	0
15.1 to 50.0 (1.41 to 4.65) (Single Panel)	1	1 (645)	1	1 (645)
30.0 to 80.0 (2.79 to 7.43) (Increment Panel)	2	2 (1290)	1	2 (1290)
80.1 (7.44) and Greater	*	3 (1935)	*	3 (1935)

\* Average not to exceed 1 Patch per Panel per Sign. Maximum of 3 patches per panel allowed during fabrication with one additional patch per panel allowed after field erection.

**(H) Reflectorized Letters, Numerals, Symbols, Border and Shields:**

**(1) General**

Use direct-applied retroreflective sheeting, demountable button-type, or demountable retroreflective sheeting letters, numerals, borders, shields and arrows as indicated on the sign designs.

Use designs of letters and numerals which conform to the requirements of "Standard Alphabets for Highway Signs", 1977 edition, prepared by the Federal Highway Administration. Use border widths, and design of route shields and arrows, which conform to the requirements of the MUTCD.

Route shields used on Type A or B signs or overlays are to be demountable.

Space and size of all legends and borders as shown in the plans or in approved shop drawings. Any loose, deformed or misplaced legends and borders will be cause for rejection of the entire sign.

**(2) Direct Applied**

Provide direct-applied reflectorized letters, numerals, arrows, and borders, which are of the type and color of retroreflective sheeting shown in the plans for each sign. All direct applied copy or border not permanently affixed may be removed and replaced on signs if necessary during manufacture.

**(3) Demountable**

Attach demountable letters, numerals, borders, shields, arrows, and alphabet accessories directly to sign faces with rivets, and use those which are of the type and color shown in the plans.

**(a) Button-Type**

Use reflectorized demountable button-type letters, numerals, arrows, and borders, which consist of embossed aluminum frames, in which prismatic reflectors are securely affixed to prevent their displacement in handling or service. Do not use letters in which button reflectors are assembled by means of tape.

**(b) Demountable Retroreflective Sheeting Type**

Use letters, numerals, arrows, borders and shields made of adhesive-coated retroreflective sheeting, permanently adhered to a flat aluminum backing, of the sheeting type and colors shown in the plans.

Use aluminum backing made of a minimum of .032"(0.8mm) thick aluminum sheet of 3004-H38, 5052-H38 or 6061-T6 alloy. Properly degrease the aluminum and etch, or treat with a light, tight, amorphous chromate-type coating in accordance with the recommendations of the retroreflective sheeting manufacturer. Apply the retroreflective sheeting to the properly prepared aluminum using the method and equipment prescribed by the sheeting manufacturer.

Supply each letter, numeral, arrow, border, and shield with mounting holes, and secure to the sign surface with non-twist corrosion resistant aluminum rivets. Use letters, numerals, arrows, and borders which have rivets on all sides and ends spaced not more than 6" (152.4mm) on centers, measured along the edges. Make sure that each legend piece has at least 1 rivet in each corner and at least 2 rivets in each end. Attach route shields as part of Type A or B signs with aluminum rivets spaced a maximum of 9" (228.6mm) apart, measured along the edges of the shield(s).

Use a 1/4" (6.4mm) diameter nylon washer under the head of all pull through type rivets for all demountable copy and shields.

**(I) Silk Screening:**

Apply all legends and borders on Types E & F signs by silk-screening or reverse silk-screening after the sheeting is attached to the panels. Perform all screening as recommended by the manufacturer of the retroreflective sheeting. Use the color of all legends, borders, and backgrounds, and their placement on the sign, as shown in the plans or full-scale drawings available from the Department's Traffic Engineering Branch.

Use opaque black paint or ink, for nonreflectorized message application, as manufactured or recommended by the manufacturer of the retroreflective sheeting.

Use transparent paint or ink, and thinner, for application on signs reflectorized with white retroreflective sheeting, as manufactured or recommended by the manufacturer of the retroreflective sheeting. Use colors, which conform to the FHWA Color Tolerance Charts and AASHTO Designation M268 when thoroughly dry.

Test all lots of transparent ink for compliance with the minimum coefficient of retroreflection equal to seventy percent of the specified minimum retroreflection of the corresponding sheeting color and documented.

The area supervisor will inspect the first five signs of each screening and then every fifth sign.

Only three nonwets per square foot, no larger than 1/16" (1.6mm) in diameter, covering no more than one third of the total area of the sign are allowable. This includes nonwets from either the sheeting or the screen printing.

Only one tadpole per six square feet, no longer than 1 1/2" (38.1mm) and not readily visible under lighted inspection is allowable.

**(J) Mounting Hardware**

Provide all mounting hardware consisting of, but not limited to, backing plates, mounting bolts, washers, shims, and nuts. Provide mounting holes in the Z stringers of the ground mounted signs in accordance with the details shown in the plans.

**(K) Packaging, Shipping and Storage:**

Protect all signs during shipment and storage. Before shipping, make sure that all signs are free of moisture and that all paints and inks are thoroughly dry. Do not apply adhesive tapes to any sign surface. Keep all packaged signs entirely dry.

Use assembled or partially assembled signs other than flat sheet signs, which have sufficient braces securely attached to prevent buckling or warping at all times.

Affix a label outlining the retroreflective sheeting manufacturer's recommendations for handling, transporting, and storing all types of signs to each shipping carton or crate. Provide full details of such recommendations with each shipment of signs.

Label each crate or package of signs or panels as to the contents (arrows, shields, etc.), Project Number, and sequence of packages if more than one package is for a single sign.

Maintain documentation of the lot, drum, inspector, roll size, date received, date sheeted, metal treater on all signs, slipsheeting, copy, borders, shields, overlays, arrows and panels, and retroreflectometer readings.

Individually rack or separate by foam or slip sheeting on A-frame racks all sheeted panels. Do not use spliced, overlapped, ripped or torn slipsheeting or foam.

Pack all signs standing at a seventy-five to ninety degree angle.

Turn all panels and sign faces to the inside of the crates, whenever possible.

When crating a one panel sign, provide the face side with an extra piece of foam and cardboard taped to the outside of the face side of the package.

Pack panels of 102" (2590.8mm) in length or longer in only two per package.

Ensure all signs are debris free on the back side, with no misplaced writing, tape or extraneous sheeting.

Crate to allow a 2" (50.8mm) space on the inside dimensions larger than the size of the largest package.

Store completed Type A and B signs back to back with minimum of 12" (304.8mm) between faces.

When crating two panels of different sizes, place the smaller panel with its face to the back of the larger panel and package with an extra piece of foam and cardboard taped to the outside of the larger panel, with its face to the outside of the crate. Provide extra packaging on both outsides of the package for double-faced signs.

Crate packaged panels to allow the passage of a 1/8" (3.2mm) spacer on the inside of each side of the crate, so that the panels are not overly tight or binding in crate.

The Sign Manufacturer will inspect all signs and packaging before shipping to assure compliance with the plans and specifications. The North Carolina Department of Transportation retains the right to inspect the signs and packaging before shipping.

**901-4 INSPECTION PROCEDURE****(A) General**

This procedure establishes guidelines of inspection for a consistent method of inspecting the daytime appearance and nighttime reflective performance of sign sheeting. The primary function of a highway sign is to be seen by the traveling public and therefore

the sign sheeting must present a neat and balanced appearance free from visible defects.

Sheeting may be inspected before application to sign blanks, after installation to sign blanks, after completion of the sign in the sign fabricator's facility and after installation. Clean all installed signs prior to final field inspection.

**(B) Daylight Visual Inspection**

Under day light conditions, inspect the sign sheeting to detect color match problems, non-uniform color, streaks, spots, abrasions or other defects in the sheeting. Inspect signs from twenty-five (25) feet (7.6m). Judge slight imperfections that may be visible at an extremely close distance and would not be visible at 25 feet (7.6m) in daytime viewing, under the nighttime inspection.

**(C) Nighttime Visual Inspection**

Inspect the sheeting with an inspection light while holding the inspection light at eye level and looking directly over the top of the light. Inspect to detect color match problems, non-uniform color, streaks, spots, abrasions, blistering or other defects in the sheeting. Inspect signs from fifty (50) feet (15.2m).

**(D) Inspection Lights**

Use lights to inspect signs during fabrication that are 120 watt, 120 volt reflector flood lamp with a average rating of 1600 lumens. Use a light for field inspection that is a 50 watt, 12 volt spot lamp with a maximum output of 100,000 candlepower. In either case, use an inspection light will be bright enough to cause the sheeting to reflect, but not so bright as to cause the sheeting to be brilliantly illuminated.

**(E) Close up Inspection**

The DOT reserves the right to inspect sheeting for defects.

**901-5 METHOD OF MEASUREMENT**

The actual number of square feet (square meters) of sign face areas of each type, including milemarkers and overlays, which have been acceptably fabricated. In measuring this quantity, the sign face areas will be calculated to the nearest 1/100 of a square foot (square meter), using the dimensions shown in the plans.

The areas of odd-shaped signs (e.g. stop signs and shield-shaped route markers) will be calculated as squares or rectangles using the dimensions shown in the plans. The areas of round, diamond, and triangular signs will be calculated for their true shapes using plan dimensions.

**901-6 BASIS OF PAYMENT**

Payment will be made for the quantities as measured in Article 901-5, for the pay items shown below:

Contractor Furnished, Type \_\_ Sign ..... Square Feet (Square Meter)  
Department Furnished, Type \_\_ Sign ..... Square Feet (Square Meter)

**SECTION 902  
FOOTINGS FOR SIGNS**

**902-1 DESCRIPTION**

Construct footings for sign supports including locating, staking, excavating, shoring, backfilling, forming, landscaping and other necessary tasks as required.

**902-2 MATERIALS**

Refer to Division 10:

Portland Cement Concrete Production and Delivery .....	Section 1000
Reinforcing Steel.....	Section 1070
Anchor bolts .....	Article 1072-6
Joint sealer .....	Article 1028-2
Structural Steel and Overhead Sign Structures .....	Section 1072 and 1096
Select Material and Borrow Material.....	Section 1016 and 1018
Organic zinc repair paint.....	Article 1080-9

**902-3 CONSTRUCTION METHODS****(A) General**

The Engineer will establish the proper offset, longitudinal location, footing elevation and S dimension of each ground mounted, barrier mounted and overhead sign support.

Provide proper level and orientation of all supports.

Thoroughly compact all backfill in 6 inch (152.4mm) layers. Remove all unneeded excavated material from the site.

**(B) Ground Mounted**

Perform all excavation necessary for footing construction to the elevations and dimensions shown in the plans. Perform the excavation so that the sides of the excavation area conform as nearly as possible to the required dimensions. Place concrete against undisturbed soil.

Construct concrete sign footings in accordance with Section 825. Shape the tops of the footings to conform with finished ground elevations such that water will not collect against the supports. No construction joints will be permitted.

Form the top 6 inches (152.4mm) of footings by approved methods. Center the supports in the footings, securely brace, and hold in proper position and alignment during placement of the concrete. Give the concrete an ordinary surface finish.

**(C) Overhead**

Design footings for the combined effects of dead and wind loads. The footings may be either spread type or pole type. Design spread footings for a maximum soil bearing of 3 ksf (145 kilopascal), unless otherwise allowed by the "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals". See Section 903-3(C) for Overhead Sign Support shop drawing requirements. If, in the judgment of the Engineer, the soil in a given footing excavation is not adequate for 3 ksf (145 kilopascal) bearing pressure, or any other bearing pressure noted on approved footing drawings, the Contractor may be required to change his footing design to meet actual soil conditions at no cost to the Department.

Construct footing excavations for overhead sign structures which conform to the applicable provisions of Section 410. Make sure that the sides of the excavation for pole-type footings conform as nearly as practicable to the required dimensions. Place concrete for pole-type footings against undisturbed soil. If, in the judgement of the Engineer, significant discontinuities in the required configuration of the excavation for pole-type footings are created by the removal of boulders, or as a result of other causes, backfill the excavation and compacted as provided for in Section 410. Re-excavate the footings to the proper dimensions. Obtain approval prior to the use of shoring, if shoring is necessary to stabilize the sides of excavation for pole-type foundations.

Construct footings for overhead sign structures in accordance with Section 825. Construct all footings of Class A concrete. Where rectangular forms are used, use forms

**Section 902**

that have a chamfer strip at all corners for at least that distance protruding above ground level. Use chamfers which measure one inch (25.4 mm) along the diagonal face. Securely brace anchor bolts positioned in the form, and hold in proper position and alignment. Provide a rubbed finish on concrete surfaces to be exposed above finished ground in accordance with Subarticle 825-6(D). Do not erect overhead sign structures on footings until the concrete has reached a minimum compressive strength of 3,000 psi (20.7 MPa). Determine concrete compressive strength by nondestructive test methods, or by compressive strength tests made in accordance with AASHTO T22 and T23. Furnish equipment used for nondestructive tests and obtain Engineer approval.

Fill the space between the top of the footing and the bottom of the base plate and neatly finish with a non-shrinking and non-metallic grout approved by the Engineer.

**902-4 METHOD OF MEASUREMENT**

The quantity of reinforced and plain concrete footings to be paid for will be the actual number of cubic yards (cubic meters) of concrete which has been incorporated into the completed and accepted footing. Computing the number of cubic yards (cubic meters) of concrete will be done from the dimensions shown in the plans or from revised dimensions authorized by the Engineer, calculated to the nearest 0.01 of a cubic yard (cubic meter).

The quantity of overhead footings to be paid for will be the actual number of footings which have been satisfactorily placed and accepted.

**902-5 BASIS OF PAYMENT**

Payment will be made for quantities as measured in Article 902-4 or per footing referenced by structure for the pay items shown below:

Reinforced Concrete Sign Footings .....	Cubic Yard (Cubic Meter)
Plain Concrete Sign Footings.....	Cubic Yard (Cubic Meter)
Overhead Footing.....	Each

**SECTION 903  
SIGN SUPPORTS**

**903-1 DESCRIPTION**

Furnish, fabricate, clear for sight distance, and install ground mounted and barrier mounted signs supports and design, fabricate, construct and erect overhead sign supports.

The types of supports covered by this section are:

1. Overhead sign supports
2. Breakaway steel beam sign supports
3. Simple steel beam sign supports
4. 3-lb. (4.5 kilogram) steel U-channel posts
5. 2-lb. (3 kilogram) steel U-channel posts
6. Barrier sign support assembly
7. Wood Supports

**903-2 MATERIALS**

Refer to Division 10:

Breakaway or simple steel sign supports (W or S shapes) .....	Subarticle 1094-1(A)
High strength bolts, nuts, and washers .....	Subarticle 1094-1(A)
Signing Materials .....	Section 1092
Ground Mounted Signs .....	Section 1094
Structural steel .....	Section 1072 and 1096
Overhead Structures .....	Section 1096

Steel U-channel posts ..... Article 1094-1  
Anchor bolts ..... Article 1072-6  
Joint sealer ..... Article 1028-2  
Organic zinc repair paint ..... Article 1080-9  
Portland Cement Concrete Production and Delivery .....Section 1000  
Reinforcing Steel .....Section 1070

**903-3 CONSTRUCTION METHODS**

**(A) Location and Field Verification**

The support lengths and dimensions for steel and wood ground mounted and overhead supports shown in the original plans are estimated for project bid purposes.

The Engineer will establish the proper offset, longitudinal location, footing elevation and S dimension of each ground mounted, barrier mounted and overhead sign support. The Engineer will furnish field-verified S dimensions to the Signing Section for a revision of the Sign Support Chart Sheet and Structure Line drawings.

Prepare shop drawings for overhead signs and order supports for ground mounted signs when the revised support lengths, dimensions and sizes have been determined and the appropriate plan revision is completed.

Provide the proper vertical plumb, level, and orientation of all signs and supports.

**(B) Clearing for Sign Sight Distance:**

Clear vegetation in front of signs where necessary to achieve proper sight distance to the sign. The sight distance area includes the triangular region of land extending from the edge of the travel lane 800 feet (243.8m) in advance of the sign to 4 feet (1.2m) beyond the furthest edge of the sign from the travel lane. The Engineer will determine where clearing is required, and the amount of clearing at the sign locations. Perform the clearing in accordance with Section 200.

**(C) Overhead Sign Supports**

**(1) Shop Drawings:**

Design the overhead sign supports, including footings prior to fabrication. Submit computations and shop drawings for the designs to the Engineer for acceptance.

Have a professional engineer registered in the State of North Carolina perform the computations and render a set of sealed, signed, and dated drawings detailing the construction of each support.

Submit for approval a complete design and fabrication details for each overhead sign support, including footings and brackets for supporting the signs, maintenance walkways, electrical control boxes, and lighting luminaires. Base such design upon the revised structure line drawings, wind load area and the wind speed shown in the plans, and in accordance with the "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals". Show on the shop drawings applicable material specifications, and any other information necessary for procuring and replacing any part of the complete overhead sign support.

Submit thirteen copies of completely detailed shop drawings and one copy of the design computations for each overhead sign support to the Engineer for approval prior to fabrication

Allow at least 40 days for shop drawing approval after the Engineer receives them. If revised drawings are required, additional time will be required for review and approval of final shop drawings.

Approval of shop drawings by the Engineer will not relieve responsibility for the

correctness of the drawings, or for the fit of all shop and field connections and anchors.

**(2) Design and Fabrication:**

Fabricate all overhead sign supports, including footings in accordance with the details shown in the approved shop drawings and with the requirements of these specifications.

Fabricate the span and cantilever supporting structures using tubular members of either aluminum or steel, using only one type of material throughout the project. Sign support structures that are to be attached to bridges may be fabricated using other structural shapes.

Horizontal components of the supporting structures for overhead signs may be of a truss design or a design using singular horizontal members to support the sign panels. Truss or singular member centerline must coincide with centerline of largest sign design area shown on the line drawings. Provide permanent camber in addition to dead load camber in accordance with the "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals". Indicate on the shop drawings the amount of camber provided and the method employed in the fabrication of the support to obtain the camber.

Use cantilever sign supports that meet the following design criteria:

1. Do not exceed an  $L/150$  vertical dead load deflection at the end of the arm due to distortions in the arm and vertical support, where  $L$  is the length of the arm from the center of the vertical support to the outer edge of the sign.
2. Do not exceed an  $L/40$  horizontal deflection at the end of the arm due to distortions in the arm and vertical support, as a result of design wind load.

Attach the overhead sign supports to concrete foundations by the use of galvanized anchor bolts with galvanized nuts, flat washers, and lock washers. For cantilever structure use a minimum of eight anchor bolts. Provide anchor bolts that have an anchor plate with nut at the end to be embedded in concrete.

Fabricate attachment supports for mounting signs in a manner that allows easy removal of sign panels for repair.

Provide adequate supporting frames for mounting the lighting luminaires in the positions shown in the plans or approved shop drawings for all overhead sign supports to be illuminated.

**(3) Maintenance Walkways:**

Provide maintenance walkways with an open, skid-resistant surface, and safety railings on all overhead structures unless specifically stated otherwise in the plans. Requirements for design and fabrication of the walkways are shown in the plans. Provide a walkway that is continuous and extends from 3 feet (1m) outside the edge of pavement over the shoulder to the farthest edge of any sign on the structure. If a sign is to be located such that it extends more than three feet outside the edge of pavement, extend the walkway for the full length of that sign. Provide walkways with a safety railing along the front side that can be folded, when not in use, to a horizontal position that will not obscure the signs.

To accommodate lighting luminaires, (when required by the plans), extend supports for the walkways in front of the walkway and railing. If external ballast is required, make provisions adjacent to the walkway and between the walkway and sign to accommodate ballast boxes for lighting circuits in a manner readily accessible from the walkway. Provide ballast box, brackets, and fastening devices which will withstand the loading requirements for the walkway, and mount so that the top of the box will be

flush with the top of the walkway.

The walkway sections are to be connected rigidly where sections join to avoid an uneven walking surface. Attach the walkway directly to the walkway brackets.

Install a 4-inch x 4-inch (100mm x 100mm) safety angle in back of and parallel to the walkway and extend it the entire length of the walkway, except in the area occupied by ballast boxes. Design the safety angle to withstand a loading in keeping with the walkway.

Fabricate folding safety railing in lengths not exceeding 10 feet (3m) and install for the full length of the walkway. Join each folding safety railing post to walkway supports through a hinge support of appropriate design that will rotate freely. Provide a hinge support that has a locking or latching device and holds the railing in a steady manner, free of movement while in the raised position. Maximum allowable displacement from vertical at the top of the railing will be 1 inch (25mm).

Install fixed safety railing along the sign side of the walkway from the beginning of the walkway to the edge of the first sign. Provide fixed safety rails between signs when they are greater than 12 inches (304.8m) apart. Provide one fixed safety rail below any sign having a clearance between the bottom of the sign and the walkway grating of greater than 24 inches (609.6m) and less than 42 inches (1066.8m). Provide two fixed rails when the clearance between the bottom of a sign and the walkway exceeds 42 inches (1066.8m).

Provide a walkway in which the open ends have a galvanized steel coil safety chain attached on one end near the top of the safety railing, and on the other end to the walkway hanger, or other fixed member of the structure. When the railing is folded, the chain must not hang below the walkway bracket.

Where offsets in the walkway and safety railing are necessitated by variable luminaires offsets, provide safety chains between the offset handrail sections.

#### **(4) Installation**

Drill or punch bolt holes and slots to the finished size provided the diameter of the punched holes is at least twice the thickness of the metal being punched. Do not flame cut bolt holes or slots.

Erect sign panels in accordance with the requirements for Type A or Type B signs, as indicated in the plans. Field drill two holes per connection in the Z-bars for attaching signs to overhead structures. Use two bolts at each connection.

Do not weld, cut, or drill in any manner in the field, unless approved by the Engineer or by this specification.

Use two coats of an organic zinc repair paint in touching up minor scars on galvanized materials.

See Section 902-3(C) for footing design and construction.

### **(D) Ground Mounted Supports**

#### **(1) Breakaway Steel Beam and Simple Steel Beam:**

Fabricate and install the supports as shown in the plans. Punch, cut, or weld supports prior to galvanizing. Galvanize each component part in accordance with ASTM A123 prior to support. Provide supports which are uniformly straight to within 1/8 inch (3.2mm) tolerance for pieces less than 20 feet (6.1m) in length and 1/4 inch (6.4mm) tolerance for pieces over 20 feet (6.1m) in length.

Cut the upper and middle sections of breakaway supports from the same member. Bolt the hinge joint in the breakaway supports so as to ensure true alignment of the two

sections. After bolting of hinge connections make sure that the two sections are in the same position relative to each other, as prior to being cut. Completely assemble breakaway supports prior to erection.

Provide supports that are plumb. Do not shim the supports. Take adequate care during erection of supports to prevent damage to the surface finish. Use two coats of an organic zinc repair paint in touching up damaged areas on all galvanized materials.

**(2) Steel U-Channel:**

Use 3-lb (1.36 kg) galvanized steel U-channel posts for Types D, E, and F signs. Use 2-lb (0.91 kg) galvanized steel U-channel posts for milemarkers. Use posts of sufficient length to permit the appropriate sign mounting height or splice posts if required as shown in the plans.

Drive the posts to the required depth, being sure they are plumb. Drive the posts by hand or by mechanical means. Protect the posts with an appropriate driving cap. Concrete footings are not required.

Replace any post that is bent, or otherwise damaged in driving.

Do not weld or cut supports in the field, except for the saw cutting of U-channel post material for the frames and cross-braces that may be required for Types D, E, and F signs with two or more supports.

Use two coats of an approved organic zinc repair paint in touching up the tops of U-channel posts that may have been damaged in driving, cut ends of U-channel posts, frames and cross-bracing, and damaged areas on these and all other galvanized materials.

**(E) Barrier Supports****(1) (Small):**

Attach brackets and U-channel posts to the median or shoulder barrier for the erection of Type E Signs, Type F Signs, or Mile Markers as required in the plans.

**(2) (Large):**

Attach brackets, anchorage and pipe posts to the median or shoulder barrier for the erection of Type E Signs as required in the plans.

**(F) Wood Supports**

Wood supports must conform to Sections 1082-2 and 1082-3.

**903-4 METHOD OF MEASUREMENT**

The supports outlined in this specification which have been installed and accepted will be measured for payment as follows:

- The actual number of pounds (kg) of structural steel. The computed nominal weights shown in the final revised plans will be used in determining this quantity. Measurement will not be made of the weight of nuts, bolts, and washers which are part of the sign support, as they will be considered incidental to the work
- Actual number of linear feet (linear meters) of 3-lb (4.5 kg) steel u-channel posts incorporated into the completed and accepted supports and assemblies. Measurements of length will be made to the nearest tenth of a foot ( meter).
- Actual number of 2-lb (3 kg) steel U-channel post.
- Actual number of Supports, Barrier (Small) and (Large).
- Actual number of overhead sign supports.
- Actual number of linear feet (linear meters) of wood support incorporated into the

completed and accepted supports. Measurements of length will be made to the nearest tenth of a linear foot (linear meter). The computed linear feet (linear meters) of sign supports, as indicated in the final revised plans will be used in determining this quantity.

**903-5 BASIS OF PAYMENT**

Payment will be made for the quantities as measured in Article 903-4, for the pay items shown below:

Payment will be made under:

Supports, Breakaway Steel Beam .....	Pound (Kg)
Supports, Simple Steel Beam.....	Pound (Kg)
Supports, 3-lb (4.5 kg) Steel U-Channel.....	Linear Foot (Linear Meter)
Supports, 2-lb (3 kg) Steel U-Channel.....	Each
Supports, Barrier (Small) .....	Each
Supports, Barrier (Large) .....	Each
Supports, Overhead Structure-__ .....	Lump Sum
Supports, Wood.....	Linear Foot (Linear Meter)

**SECTION 904  
SIGN ERECTION**

**904-1 DESCRIPTION**

Erect existing and proposed ground mounted and overhead signs to existing and proposed supports, and furnish mounting hardware.

The types of signs covered by this specification are:

- |                                     |                                 |
|-------------------------------------|---------------------------------|
| 1. Type A (Overhead) signs          | 8. Milemarkers                  |
| 2. Type A (Ground Mounted) signs    | 9. Overlay (Overhead) signs     |
| 3. Type B (Overhead) signs<br>signs | 10. Overlay (Ground Mounted)    |
| 4. Type B (Ground Mounted) signs    | 11. Reposition (Overhead) signs |
| 5. Type D signs                     | 12. Logo Trailblazer            |
| 6. Type E signs                     | 13. Logo to panel               |
| 7. Type F signs                     |                                 |

**904-2 MATERIALS**

Refer to Division 10:

Signing Materials .....	Section 1092
High strength bolts, nuts, and washers .....	Subarticle 1094-1(A)
Organic Zinc repair paint .....	Article 1080-9

**904-3 CONSTRUCTION METHODS**

**(A) General:**

Provide new mounting bolts, washers, hex nuts, backing plates, and all hardware for all signs, existing and proposed, to be mounted on existing or proposed supports and attached to overhead sign supports.

Do not weld, cut, or fabricate in any manner in the field, except for as allowed under Section 903, and for the drilling of holes for attaching demountable legends and borders which cannot be attached in the shop. Field drill Z bars for attaching signs to supports as required.

Use two coats of an organic zinc repair paint in touching up field-drilled holes; and damaged areas on all galvanized materials as covered under Section 903.

Make sure that the horizontal edges of signs are level, and that the faces of signs are vertical.

Refer to Sections 900 and 901 for provisions of care and handling of signs, final clean up and covering of signs.

**(B) Type A and B**

**1) General**

Attach the signs to supports as shown in the plans or in the approved shop drawings. Make sure that the face of the sign is flat. Any appreciable buckling or warping of the sign face will be cause for rejection of the entire sign.

**2) Ground Mounted**

Erect ground mounted Type A & B secondary signs by the required method of attachment shown in the plans. Affix these signs by bolting the horizontal Z stringers directly to the supports, or by bolting vertical Z bars to the horizontal Z stringers of and the primary sign.

**3) Overheads**

For new overhead supports, erect overhead secondary signs as shown in the approved shop drawings.

For existing overhead supports, design and furnish all new structural members and mounting hardware necessary to erect the new signs. Prepare and submit to the Engineer for approval complete shop drawings and design computations for the bracing and accessory hardware required to attach the sign to the existing overhead sign support, which includes lighting support brackets and maintenance walkways unless specified otherwise. See Section 905 for proposed sign shop drawing requirements. Prepare the design in accordance with the Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, as published by AASHTO, the structure line drawings and wind speed shown in the plans. Upon request, the Engineer will provide the Contractor with copies of the shop drawings for existing overhead sign supports.

Attach a new sign above a designated existing overhead sign as designated on the plans. Furnish all new structural members and mounting hardware necessary to erect the new sign.

**(C) Type D, E, F and Milemarkers:**

Attach the signs to U-channel posts as shown in the plans. Use mounting hardware as shown in the plans.

**(D) Overlay (Ground Mounted and Overhead):**

Attach overlays to designated existing ground mounted or overhead signs as required by the plans.

Remove and dispose of all conflicting demountable legends, borders, and overlays prior to attaching new overlays. Employ any method of removal necessary, provided it does not damage the existing sign or the attached overlay. Perform such minor repairs to existing signs as necessary prior to the attachment of overlays to ensure a finished sign face that is completely flat.

Field-drill 5/32 inch (4mm) holes in both the overlay and the existing sign simultaneously, according to the rivet spacing requirements shown in the plans. Attach the proposed overlays with 1/8 inch (3.2mm) diameter aluminum rivets of the "pull-through" type. Exercise sufficient care in attaching the overlays to ensure that the finished sign face is completely flat and without any ripples and/or buckles.

**(E) Reposition Overhead Signs:**

Reposition existing signs on existing overhead sign supports as required by the plans. Reposition associated lighting systems and secondary signs along with the signs.

When required, drill new holes in the existing vertical attachment members, in order to maintain a minimum clearance of 17 feet (5.2m) to the roadway surface at the new location on the structure. No other field drilling will be allowed.

Adjust and relocate conduit and junction boxes as required.

**(F) Logo Trailblazer:**

All logos will be made available for pick up at the Division Traffic Services’ sign shop. Erect logos on U-channel post in accordance with Type F Sign details shown in the plans.

**(G) Logo to Panel:**

All logos will be made available for pick up at the Division Traffic Services’ sign shop. Attach logos to the mainline signs with ten 1/8-inch (3.2mm) diameter rivets of the “pull through” type. Attach logos to the ramp signs with four 1/8-inch (3.2mm) diameter rivets of the “pull through” type. Drill 5/32-inch (4mm) holes in the background signs to match those in the logos for attaching the logos to the background signs. Place logos as shown on the plans.

**904-4 METHOD OF MEASUREMENT**

The quantity of sign erections (ground mounted and overhead) to be paid for will be the actual number of ground mounted and overhead signs erected and accepted. Each type F sign assembly will be measured as one sign. Payment for signs erected on proposed overhead sign supports will be made under Section 903 (Sign Supports).

Walkway pay item to be used only when adding or modifying an existing overhead sign structure.

**904-5 BASIS OF PAYMENT**

Payment will be made for the quantities as measured in Article 904-4, for the pay items shown below:

Payment will be made under:

Sign Erection, Type _____(Overhead) .....	Each
Sign Erection, Type _____(Ground Mounted) .....	Each
Sign Erection, Type _____.....	Each
Sign Erection, Milemarkers .....	Each
Sign Erection, Overlay (Overhead).....	Each
Sign Erection, Overlay (Ground Mounted).....	Each
Sign Erection, Reposition Overhead.....	Each
Sign Erection, Logo to Panel .....	Each
Sign Erection, Logo Trailblazer.....	Each
Sign Erection, Walkway.....	Linear Foot (Linear Meter)

**SECTION 905  
SIGN LIGHTING SYSTEMS**

**905-1 DESCRIPTION**

Furnish and install all electrical equipment and components, luminaires, service poles and related service equipment, conduit, wire, and all other hardware; design alternate luminaire systems; and test to provide complete lighting systems for overhead sign structures.

Perform all work in accordance with the National Electrical Code (NEC).

These specifications are for materials and equipment to construct and put in working order the proposed lighting system(s); however, they may not show or describe every fitting, minor detail, or feature. Perform the work according to the best practice of the trade.

Have a license of the proper classification from the North Carolina State Board of Examiners of Electrical Contractors in accordance with Article 4 of Chapter 87 of the General Statutes for those actually performing the work.

**905-2 MATERIALS**

**(A) General:**

Refer to Division 10:

Sign Lighting Systems .....	Section 1097
Organic zinc repair paint .....	Article 1080-9

**(B) Submittals:**

Submit for approval catalog cuts and/or shop drawings for materials propose for use on the project. Allow thirty days for review on each submittal. Do not use materials that have not been approved on the project. Submit eight copies of each catalog cut and/or drawing and show on each the material description, brand name, stock number, size, rating, and manufacturer's specification. Include in the submittals sufficient information to verify compliance with the specifications, and reference each material to the appropriate contract pay item. In addition to catalog cuts, include in submittals for luminaires the manufacturer's isofoot-candle charts and coefficient of utilization graphs, ballast replacement part numbers, and wiring diagrams.

**905-3 CONSTRUCTION METHODS**

**(A) Layout:**

The Engineer will establish the actual location of service poles. The plans show the approximate location of service poles based on available project data. Mark the proposed location of circuits, ducts, and all other components for approval prior to installation.

Submit a drawing showing all underground conduit and cable dimensioned from fixed objects or station marks.

**(B) Conduit Installation:**

Install conduit as shown in the plans, and in accordance with NEC requirements for an approved watertight raceway.

Attach the conduit system to and install along the structural components of the overhead sign assembly. Attach conduit to structural components with beam clamps or stainless steel strapping. Install strapping according to the strapping manufacturer's recommendations. Do not use welding or drilling to fasten conduit to structural components.

Support conduit suspended from concrete portions of a bridge by galvanized clamps

attached to the concrete with 1/4 inch (6.4mm) stud type concrete expansion anchors.

Space the conduit fasteners at no more than 4 feet (1.2m) for conduit 1 1/2 inches (38.1mm) and larger, or at no more than 6 feet (1.8 m) for conduit 1 1/4 inches (31.8mm) and smaller. Place fasteners no more than 3 feet (0.9m) from the center of bends, fittings, boxes, switches, and devices.

Locate underground conduit as shown in the plans at a minimum depth of 30 inches (762 mm) and extend a minimum of 2 feet (0.6m) past the edge of pavement or paved shoulder. Either metallic or nonmetallic underground conduit may be used.

Where conduit is required beneath pavement, bury the conduit at the required depth prior to paving, or bore and jack the conduit beneath the pavement. Do not cut pavement to install conduit or use "water jetting" as an installation method. Produce openings by boring and jacking which are not more than 1 inch (25.4mm) larger than the outside diameter of the conduit. Plug any abandoned opening for bored and jacked conduit as the Engineer directs.

Install buried conduit in a trench with essentially vertical walls that is no wider than necessary for easy installation of the conduit. Backfill in accordance with Article 300-7.

Clean conduit after installation by "snaking" with a mandrel of a diameter not less than 85% of the nominal diameter of the conduit. Seal the ends of underground conduit with temporary caps and, after installation of circuits; plug the ends with oakum. Coat field cut threads and other uncoated metal or damaged galvanizing with 2 coats of organic zinc repair paint. Ream the ends of rigid conduit.

### **(C) Wiring Methods:**

Bury underground circuits at the depth shown in the plans and surrounded with at least 3 inches (76.2mm) of sand or earth backfill free of rocks and debris. Compact backfill in 6 inch (152.4mm) layers. Do not splice underground circuits unless specifically noted in the plans.

Color code all conductors per the NEC (grounded neutral-WHITE; grounding-BARE or GREEN), and use BLACK and RED phase conductors. Approved marking tape, paint, or sleeves may be used in lieu of continuous colored conductors for No. 8 AWG and larger. Do not mark a white conductor in a cable assembly any other color. However, you may strip a white, red, or black conductor all accessible points and use it as a bare equipment grounding conductor.

Install joints, taps, and splices only at locations indicated in the plans.

Make joints, taps, and splices in junction boxes and enclosures by either of the following methods:

1. Cut and remove the insulation only as far as necessary to make a secure mechanical and electrical connection. Use a removable type connector (split-bolt, set screw, wire nut, etc.), and cover with self-vulcanizing rubber tape, applied in half-lap layers to give a smooth covering at least twice the thickness of the original insulation. Use a self-fusing type putty rubber tape in tape form that can be wrapped, stretched, or molded around irregular shapes for smooth insulation build-up. Apply two layers of vinyl plastic tape, half-lap, over the rubber tape. Use vinyl plastic tape that is 7-mil, (0-2200 degrees F [-17.8 – 1204 degrees C]), and ultraviolet, abrasion, moisture, alkali, acid, and corrosion resistant.
2. Install an approved manufactured mechanical or compression connector, with factory-made waterproof insulating boots, in accordance with procedures and tools specified by the manufacturer.

Make joints, taps, and splices located underground in direct buried circuits as follows: Cut and remove the insulation only as far as necessary to make a secure mechanical and

electrical connection. Use a compression type connector, installed according to procedures and tools specified by the manufacturer. Apply vinyl plastic tape over the connector and bare conductor. Encase the entire connection with a manufactured splicing kit. Use a kit with an insulating and moisture-sealing field-mixed epoxy resin compound and snap-together mold forms. Install the kit as specified by the manufacturer. Encase no more than one "leg" (phase, neutral, or equipment grounding conductor) in each epoxy resin compound mold for individual conductor circuits. For cabled conductor circuits, encase no more than one circuit in each epoxy resin compound mold.

**(D) Grounding and Bonding:**

Include an equipment grounding conductor of the type and size shown in the plans, with each set of circuit conductors.

Bond all metal conduit, enclosures, luminaires, and structures together and ground with the equipment grounding conductor to the grounding electrode.

Protect grounding electrode conductors with rigid galvanized steel conduit that is bonded to the grounding electrode conductor at each end.

**(E) Equipment Mounting:**

Mount equipment securely at locations and dimensions shown in the plans and make sure it is plumb and level. Install fasteners as recommended by the manufacturer, and space them evenly. Use all mounting holes and attachment points for attaching enclosures to structures.

Locate straps and buckles as shown in the plans and install them per the manufacturer's instructions.

Use holes for expansion anchors that are the size recommended by the manufacturer of the anchors. Drill and thoroughly clean them of all debris.

Provide one key operated, pin tumbler, dead bolt padlock, with brass or bronze shackle and case, conforming to Military Specification MIL-P-17802E (Grade I, Class 2, Size 2, Style A), for each electrical panel and switch on the project. Key all padlocks alike and provide 6 keys to the Engineer.

If a new sign is to replace an existing sign, adjust the position of the luminaires in accordance with the plans for the new sign if necessary.

**(F) Luminaires and Lamps:**

Provide lamps for all luminaires and clearly mark the installation date on the mogul base of High Intensity Discharge (HID) lamps.

**(G) Inspection:**

Comply with all local ordinances and regulations. Prior to the start of any electrical work, apply for and obtain all permits and/or licenses required by local regulation. Be responsible for having each system inspected and approved by the licensed city, county, or state electrical inspector who has jurisdiction where the systems are located.

Inspection by the local electrical inspectors will neither eliminate, nor take the place of, inspection by the Department.

Furnish written certification to the Engineer that the local electrical inspector having jurisdiction has approved the system(s). Provide this approved electrical inspection certificate prior to final acceptance of the project.

Be responsible for having the power turned on.

**(H) Electrical Service:**

Coordinate all work to ensure that electrical power of the proper voltage, phase,

frequency, and ampacity is available to complete the project. Contact the utility company, make application, pay all deposits and other costs to provide necessary electrical service. The Contractor will be reimbursed for the actual verified cost of any utility company charges.

The Engineer will provide authorization to the Contractor for electrical service to be obtained in the name of the Department and for the monthly power bills to be sent directly from the utility company to the Department. The Department will be responsible for direct payment of monthly power bills received from the utility company.

**(I) Performance Tests:**

The Engineer will not accept lighting systems for overhead sign structures until the lighting system is operational, including automatic control equipment and all other apparatus, without interruption or failure attributable to poor workmanship or defective material for a period of 2 consecutive weeks. The Engineer will inspect all lights and equipment for normal operation. Perform these tests and make all repairs and replacements needed.

**905-4 ALTERNATE LUMINAIRES**

If furnish luminaires other than those shown on the plans are proposed for use, prepare and submit for approval a complete design for the proposed lighting system for each overhead sign assembly. Base such design on high pressure sodium luminaires and conform to Illuminating Engineering Society (IES) criteria. Design the luminaries for signs sized and spaced as shown in the plans.

Submit designs for alternate luminaires for approval prior to submitting shop drawings for the overhead sign structures. Coordinate the design for the lighting system with the design of the overhead sign assembly, and show any changes necessitated by the alternate luminaire design on appropriate shop drawings.

Provide photometric data for each sign for review of the alternate luminaire design. Include in the data a point-by-point foot-candle chart showing readings along the sign face at one-foot intervals, vertically and horizontally, based on the proposed alternate luminaire design spacing. Submit an isofoot-candle diagram for the luminaire. State the mounting height on the isofoot-candle diagram. If the mounting height shown on the isofoot-candle chart differs from the horizontal distance from the bottom of the sign face to the center of the luminaire, furnish a correction multiplier.

**905-5 COMPENSATION**

The work covered by this section will be paid for at the contract lump sum price for each Sign Lighting System \_\_\_\_\_.

Payment will be made under:

Sign Lighting System \_\_\_\_\_ .....Lump Sum

**SECTION 906  
RELOCATING SIGNING COMPONENTS**

**906-1 DESCRIPTION**

Relocate signing components and provide footings when necessary.

**906-2 CONSTRUCTION METHODS**

Maintain signs in good serviceable condition throughout the duration of the project. Repair any areas or materials within the project limits disturbed or damaged in performance of the work required under this section as directed by the Engineer at no cost to the Department.

**Section 906**

Remove existing sign components from their existing locations and relocate to their new location as required in the plans. Repair or replace signs damaged in relocating at no cost to the Department. Refer to Section 907 for removal of sign components.

Erect signs and supports according to provisions of Sections 903 and 904. Immediately relocate all warning and regulatory signs and components to new locations. Relocate all other signs and components to new locations immediately or within twelve (12) hours.

**906-3 METHOD OF MEASUREMENT**

The amount of sign relocations to be paid for will be the actual number of signing components that have been acceptably relocated. Secondary signs will be considered incidental work in conjunction with the primary sign. Sign assemblies consisting of more than one sign panel will be considered one sign. Overhead sign systems include signs, supports, walkways and all electrical components. Sign systems include signs, supports and footings. Supports include footings.

**906-4 BASIS OF PAYMENT**

Payment will be made for the quantities as measured in Article 906-3, for the pay items shown below:

Payment will be made under:

Relocate Sign, Type _____ .....	Each
Relocate Support, Overhead Sign System .....	Each
Relocate Support, Steel Beam .....	Each
Relocate Lighting System .....	Each
Relocate Wood Support .....	Each

**SECTION 907  
DISPOSAL AND STOCKPILING OF  
SIGNING COMPONENTS**

**907-1 DESCRIPTION**

Dispose or stockpile signing components.

**907-2 CONSTRUCTION METHODS**

**(A) General**

Dispose or stockpile signing components as required in the plans.

Repair any areas or materials within the project limits disturbed or damaged in performance of the work required under this section as directed by the Engineer at no cost to the Department.

**(B) Removal**

Do not remove existing signing components until required replacements have been erected and are available for use by traffic or are available for immediate replacement.

Remove signing components by methods, which will not damage other portions of the project or facility. Repair any damage by methods satisfactory to the Engineer.

Cut and remove electrical conduit to at least 18" (457.2mm) below finished ground elevation. Plug or seal the ends of the cut conduit by methods approved by the Engineer.

Remove footings, including any reinforced steel or anchor bolts, to a minimum depth of two feet (0.6 m) below the finished ground elevation unless otherwise indicated by the plans.

Promptly backfill and compact areas disturbed by removal of footings with suitable

materials and match the finished ground elevation. Seed disturbed areas in accordance with Section 1661.

**(C) Disposal**

All materials to be removed and disposed of will become the property of the Contractor. Promptly transport the materials from the project after they have been removed unless otherwise permitted by the Engineer.

Promptly dispose of the concrete, reinforcing steel, and anchor bolts from the project.

**(D) Stockpile**

The Department maintains ownership of all materials to be stockpiled. Transport and stockpile designated items to location(s) as approved by the Engineer. Sort and stockpile all materials neatly in stacks or storage bins.

Repair or replace materials damaged in removal or while in storage at no cost to the Department.

Prior to stockpiling, remove signs from posts.

**907-3 METHOD OF MEASUREMENT**

The amount of disposal or stockpiling to be paid for will be the actual number of signing components that have been acceptably removed, stockpiled or disposed. Removal is incidental to stockpiling and disposal. Removal will be paid when an existing signing component is to be reused. Secondary signs will be considered incidental work in conjunction with the primary sign. Sign assemblies consisting of more than one sign panel will be considered one sign. Overhead sign systems include signs, supports, walkways and all electrical components. Sign systems include signs, supports and footings. Supports include any footings.

**907-4 BASIS OF PAYMENT**

Payment will be made for the quantities as measured in Article 907-3, for the pay items shown below:

Payment will be made under:

Disposal of Sign System, Overhead .....	Each
Disposal of Sign System, Steel Beam .....	Each
Disposal of Sign System, U-Channel .....	Each
Disposal of Sign System, Wood .....	Each
Disposal of Sign, A or B, (Ground Mounted) .....	Each
Disposal of Sign, A or B, (Overhead) .....	Each
Disposal of Sign, D, E, or F .....	Each
Disposal of Sign, Milemarker .....	Each
Disposal of Sign, Overlay (Overhead).....	Each
Disposal of Sign, Overlay (Ground Mounted) .....	Each
Disposal of Support, Overhead Structure .....	Each
Disposal of Support, Steel Beam .....	Each
Disposal of Support, U-Channel .....	Each
Disposal of Support, Wood .....	Each
Disposal of Lighting System .....	Each
Disposal of Lighting Fixtures.....	Each
Disposal of Walkway .....	Each
Stockpile Sign System, Overhead .....	Each
Stockpile Sign System, Steel Beam .....	Each
Stockpile Sign System, U-Channel .....	Each
Stockpile Sign System, Wood .....	Each
Stockpile Sign, A or B, (Overhead) .....	Each

**Section 907**

Stockpile Sign, A or B, (Ground Mounted) .....	Each
Stockpile Sign, D, E, or F .....	Each
Stockpile Sign, Milemarker .....	Each
Stockpile Support, Overhead Structure .....	Each
Stockpile Support, Steel Beam .....	Each
Stockpile Support, U-Channel .....	Each
Stockpile Support, Wood .....	Each
Stockpile Lighting System .....	Each
Stockpile Lighting Fixtures.....	Each
Stockpile Walkway .....	Each

**SECTION 908  
TEMPORARY SIGNS AND SUPPORTS**

**908-1 DESCRIPTION**

Fabricate, furnish, install, erect, relocate, remove, and cover all temporary signs and supports, other than black on orange “Work Zone” signs. Temporary signs are defined as all temporary signs for Work Zones or any other signs not accounted for in Division 11.

**908-2 MATERIALS**

Refer to Division 10:

Breakaway or simple steel sign supports (W or S shapes) .....	Subarticle 1094-1(A)
High strength bolts, nuts, and washers .....	Subarticle 1094-1(A)
Signing Materials .....	Section 1092
Ground Mounted Signs .....	Section 1094
Overhead Structures .....	Section 1096
Portland Cement Concrete Production and Delivery .....	Section 1000
Reinforcing Steel.....	Section 1070
Steel U-channel posts.....	Article 1094-1
Anchor bolts .....	Article 1072-6
Joint sealer.....	Article 1028-2
Select Material and Borrow Material.....	Section 1016 and 1018
Organic zinc repair paint.....	Article 1080-9
Structural timber and lumber .....	Section 1082

**908-3 CONSTRUCTION METHODS**

**(A) General**

Details concerning the fabrication or use of existing signs and location of signs are shown in the TCP plans. Temporary signs are the possession of the Contractor unless otherwise specified in the plans. The scheduling of work and the location to which the signs are to be moved will be shown in the traffic control plans or as directed.

Immediately relocate and/or re-erect all warning, regulatory signs and guide signs to new or existing locations or as directed. Relocate and/or re-erect all other signs to new or existing within twelve (12) hours.

**(B) Fabrication**

Fabricate signs according to Section 901 with the following exceptions:

- Fabricate temporary signs from Type I, II, or III sheeting. Apply the sheeting using manufacturer’s recommendations
- Recycled or reused materials may be used to fabricate sign.
- Sections 901-3(D2) and 901-3(G) will not be required to fabricate signs.

## Section 908

- Re-sheeting of signs will be allowed if proposed message is not distorted when viewed by a motorist. Remove all demountable copy and shields prior the re-sheeting a sign.
- Erection date on signs is not required as specified in Section 901-3(A).
- Allow the use of plywood to fabricate Type D, E, and F signs. For signs  $\leq 9$  sq. ft. ( $0.8 \text{ m}^2$ ) use a minimum 1/4" (6.4 mm) plywood. For signs  $\geq 9$  sq. ft. ( $0.8 \text{ m}^2$ ) use a minimum 3/8" (9.5 mm) plywood.
- Section 901-4 will not be required to fabricate signs provided the signs meet the requirements of Section 901-3(E).

### (C) Supports

Design ground mounted supports and skids in accordance to the Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals, published by AASHTO. Ground mounted support designs are available from the Signing Section upon request. Provide the following information when requesting the Signing Section design supports: size of signs and s-dimension based on Standard 901.70 of the Roadway Standard Drawings.

Erect type D, E, and F signs on either 3lb (4.5 kilogram) U-channel or 4" x 4" (102mm x 102mm) wood supports as shown in the Roadway Standard Drawings. Mount all ground mounted signs on breakaway supports unless protected by guardrail or portable barrier.

### (D) Covers

Use exterior plywood to cover a temporary sign. Secure the temporary sign covers to existing signs with 1/4" (6.35mm) diameter bolts, nuts, and washers and space by the use of a sleeve or bushing such that the back of the temporary sign covers be located a minimum of 0.125" (3.18mm) from the copy material of the sign. For signs that will be used later during construction phase without covers, use nylon washers or other spacing devices to keep the covers from direct contact with the sign panel and install covering material in a manner that the sign panel will not be defaced.

Use 0.080" (2mm) aluminum for temporarily overlaying portions of signs, such as word messages. Use reflective sheeting that is of the same type and color as the background of the sign to be covered

Cover all permanent signs in accordance to the requirements in Section 900-5.

### (E) Maintenance

Throughout the duration of the project, ensure all signs, supports, and covers are maintained in good serviceable condition, perform their intended function, and meet the requirements of Article 1105-4. Repair or replace signs and supports which in the judgement of the Engineer are damaged, stolen, displaced by traffic or other means, or deteriorated beyond effectiveness at no cost to the Department. Failure to maintain all guide signs and supports may be cause for suspension of construction operations until proper traffic control is re-established.

## 908-4 METHOD OF MEASUREMENT

The amount of temporary signs to be paid for will be the actual number of square feet (square meters) of sign face areas of each type which have been acceptably fabricated.

See Section 903-5 for Method of Measurement for supports.

The amount of temporary sign relocations to be paid for will be the actual number of ground mounted and overhead signs and supports that have been acceptably relocated. The removal of existing signs, supports, overhead sign structures, and footings are covered in Section 907 and will be included in pay items in the signing plans.

**Section 908**

The amount of temporary sign covers to be paid for will be the actual number of temporary ground mounted and overhead sign covers that have been installed and accepted.

**908-5 BASIS OF PAYMENT**

Payment will be made for the quantities as measured in Article 908-3, for the pay items shown below:

Payment will be made under:

Temporary Sign, Type ____ .....	Square Foot (Square Meter)
Temporary Relocate Sign, Type ____ .....	Each
Temporary Relocate Support, Steel Beam .....	Each
Temporary Relocate Support, Wood .....	Each
Temporary Sign Covers .....	Each

## NOTES

