

**(D) Base Support**

Provide a base support that is hot rolled rail steel or new billet steel meeting Article 1088-5, the physical requirements of ASTM A499 and the chemical requirements of ASTM A1.

Use a base support that is a uniform flanged U-channel post with a nominal weight of 3 lb./ft. before holes are punched. Use base support posts that are 18 inches in length and have sufficient number of 3/8 inch diameter holes on 1 inch centers to facilitate attachment of the flexible post.

**(E) Anchoring**

Design a delineator post for a permanent installation to resist overturning, twisting and displacement from wind and impact forces.

**(F) Temperature**

Design flexible delineators that do not bend, warp or distort and remain straight, when stored or installed at temperatures up to + 120°F. Design all components of the flexible delineator, post and reflective sheeting to remain stable and remain fully functional within a temperature range of - 20°F to + 120°F.

**(G) Impact Resistance, Wind Resistance**

Design flexible delineators that meet the impact and wind resistance of the current evaluation criteria of the NTPEP.

**(H) Product Identification**

Provide flexible delineator post that are permanently identified, on the rear side, with the manufacturer's name and the month and year of fabrication in order to provide a tracking method for ongoing outdoor evaluation, and specification quality control. The letters shall be at least 1/4 inch in height and permanently affixed to the rear of the marker.

**(I) Material Certification**

Furnish a Type 2 and Type 3 material certification in accordance with Article 106-3 for all flexible delineators before use.

**(J) Approval**

All materials are subject to the approval of the Engineer.

## SECTION 1089 TRAFFIC CONTROL

**1089-1 WORK ZONE SIGNS****(A) General**

Use Grade B fluorescent orange retroreflective sheeting on rigid work zone sign substrates. All sheeting shall conform to Article 1092-2. Cover the entire sign face of the sign substrate with Department approved sheeting. No bubbles or wrinkles will be permitted in the material.

**(1) Work Zones Signs (Stationary)**

Use approved composite or aluminum substrate for sign backing. Signs and sign supports shall meet NCHRP 350 crash requirements for breakaway devices.

**(2) Work Zones Signs (Barricade Mounted)**

Use approved composite or roll-up signs for barricade mounted sign substrates. No other type of sign substrate is allowed on barricades. Approved composite barricade

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1 mounted warning signs (black on orange) shall be Grade B retroreflective sheeting  
2 that meets the requirements of Article 1092-2. Sign and barricade assembly shall  
3 meet NCHRP 350 crash requirements for Work Zone Category II devices.

### 4 (3) Work Zones Signs (Portable)

5 Use approved composite or roll-up sign substrates on portable sign stands. No other  
6 type of sign substrate is allowed on portable sign stands.

#### 7 (a) Composite

8 Use Grade B fluorescent orange retroreflective sheeting that meets the  
9 requirements of Article 1092-2. Signs and sign supports shall meet NCHRP 350  
10 crash requirements for breakaway devices.

#### 11 (b) Roll-up Signs

12 Use Grade B fluorescent orange retroreflective sheeting for roll-up signs that  
13 meet the requirements of Article 1092-2.

14 Use roll up signs that have a minimum 3/16 inch x 1 1/4 inches horizontal rib  
15 and 3/8 inch x 1 1/4 inches vertical rib. Signs shall meet NCHRP 350 crash  
16 requirements and be Traffic Control qualified by the Work Zone Traffic Control  
17 Unit.

### 18 (B) Material Certification

19 Furnish a Type 3 material certification in accordance with Article 106-3 for all new  
20 reflective sheeting used on work zone signs meeting the retroreflective requirements of  
21 Article 1092-2. Furnish a Type 7 material certification for all used signs meeting the  
22 minimum retroreflective requirements of Article 1092-2.

### 23 (C) Approval

24 All materials are subject to the approval of the Engineer.

### 25 (D) Warranty

26 Refer to Subarticle 1092-2(B) for warranty requirements of rigid sign retroreflective  
27 sheeting.

28 Roll-up fluorescent orange retroreflective signs will maintain 80% of its retroreflectivity as  
29 described in Article 1092-2 for years 1 and 2 and 50% for year 3.

30 Rigid and rollup fluorescent orange signs shall maintain a fluorescence luminance factor  
31 of 13% for 3 years and conform to Article 1092-2.

32 Rigid and roll up fluorescent orange signs shall maintain a total luminance factor of 25  
33 for 3 years and conform to Article 1092-2.

## 34 1089-2 WORK ZONE SIGNS SUPPORTS

### 35 (A) General

#### 36 (1) Work Zone Signs (Stationary)

37 Provide work zone sign supports for work zone signs (stationary) that are sturdy,  
38 durable and crashworthy. Work zone signs (stationary) and their supports shall meet  
39 NCHRP 350 crash requirements for Category II work zone devices.

40 Use 3 lb U-channel steel posts, 4 inches x 4 inches wood posts or perforated square  
41 steel tubing posts for all work zone signs with surface areas greater than 16 sf. Dual  
42 mount signs with surface areas greater than 10 sf on either 3 lb U-channel steel posts,  
43 4 inches x 4 inches wood posts or perforated square steel tubing posts having the  
44 equivalent or greater strength of 3 lb U-Channel Steel posts. Perforated square steel  
45 tubing breakaway posts certified by the manufacturer for single mounting purposes

1 may be used for the single mounting of stationary work zone signs for signs greater  
2 than 10 sf.

3 3 lb. steel U-channel posts shall comply with Subarticle 1094-1(B) and may be  
4 galvanized steel or painted green by the post manufacturer.

5 (2) Work Zone Signs (Portable)

6 Use work zone signs and portable work zone sign stands that are sturdy, durable and  
7 crashworthy.

8 **(B) Material Certification**

9 Provide portable work zone signs and stands that are listed on the NCDOT Approved  
10 Product List. Furnish a Type 3 material certification in accordance with Article 106-3 for  
11 all new work zone sign (stationary) posts and a Type 7 material certification for all used  
12 work zone sign (stationary) posts before use.

13 Furnish a Type 3 material certification in accordance with Article 106-3 for all new  
14 portable work zone sign stand assemblies and a Type 7 material certification for all used  
15 portable work zone sign stand assemblies before use.

16 **(C) Approval**

17 All materials are subject to the approval of the Engineer.

18 **1089-3 BARRICADES**

19 **(A) General**

20 Construct barricades out of perforated square steel tubing, angle iron or other Department  
21 approved materials that meet or exceed NCHRP 350 crash requirements for Category II  
22 work zone devices.

23 Use barricade rails constructed of approved composite, hollow/corrugated extruded rigid  
24 polyolefin, HDPE or other Department approved material that have a smooth face and  
25 alternating orange and white retroreflective stripes that slope at an angle of 45°.   
26 Barricade rails shall meet or exceed NCHRP 350 crash requirements for Category II  
27 work zone devices.

28 **(B) Supports**

29 Support barricade rails in a manner that shall be visible to the motorist and provide  
30 a stable support not easily blown over by wind or traffic.

31 **(C) Retroreflective Sheeting**

32 Use Grade B retroreflective sheeting that meets Article 1092-2. Flame treat rails before  
33 applying the sheeting if required by the sign sheeting manufacturer. Apply the reflective  
34 sheeting with a pressure sensitive adhesive to both sides of the rails.

35 Use the same color sheeting on each rail of any individual barricade.

36 **(D) Material Certification**

37 Furnish a Type 3 material certification in accordance with Article 106-3 for all new  
38 barricades and a Type 7 material certification for all used barricades before use.

39 **(E) Approval**

40 All materials are subject to the approval of the Engineer.

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### 1 1089-4 CONES

#### 2 (A) General

3 Use cones made of ultraviolet stabilized plastic impact resistant material meeting  
4 MUTCD and this article. Orange will be the predominant color on cones.

5 Use cones conical in shape with a minimum height of 28 inches or 36 inches. The  
6 28 inch cones shall have a minimum base dimension of 13.75 inches, and the 36 inch  
7 cones shall have a minimum base dimension of 14.5 inches as shown in the *Roadway*  
8 *Standard Drawings*. The 28 inch and 36 inch cones (excluding ballast) shall have a  
9 minimum weight of 7 lbs. and 10 lbs. respectively. When in an upright position, have the  
10 cones display the same dimensions regardless of their orientation to oncoming traffic.

#### 11 (B) Ballast

12 Provide wind resistant cones that do not blow over under normal roadway conditions,  
13 including high speed truck traffic in close proximity to the cones when properly ballasted.  
14 Provide cones that do not permanently distort to a degree that would prevent reuse when  
15 struck.

16 Achieve ballasting of the cones by using any of the following methods:

- 17 (1) Cones with bases that may be filled with ballast,
- 18 (2) Doubling the cones or using heavier weighted cones, or
- 19 (3) Cones with special weighted bases or weights such as rubber rings that can be  
20 dropped over the cones and onto the base to provide increased stability.

21 Provide cones with 70% of the weight of the cone in the base. These added weights shall  
22 not present a hazard if the devices are inadvertently struck.

#### 23 (C) Retroreflective Sheeting

24 Where retroreflective cones are required, provide a cone with flexible, prismatic cone  
25 sheeting having impact resistance and attached with precoated pressure sensitive  
26 adhesive. The retroreflective sheeting shall meet or exceed the retroreflectivity  
27 requirements of Grade B sheeting in Section 1092. Use two retroreflective bands, the top  
28 one is 6 inches wide and the bottom one is 4 inches wide; see *Roadway Standard*  
29 *Drawings*.

#### 30 (D) Material Certification

31 Furnish a Type 3 material certification in accordance with Article 106-3 for all new cones  
32 with or without retroreflective sheeting and a Type 7 material certification for all used  
33 cones with or without retroreflective sheeting before use.

#### 34 (E) Approval

35 All materials are subject to the approval of the Engineer.

### 36 1089-5 CHANNELIZING DEVICES

#### 37 (A) Drums

##### 38 (1) General

39 Provide drums composed of a body, alternating orange and white 4-band pattern of  
40 Type III-High Intensity or higher prismatic retroreflective sheeting and ballasts  
41 evaluated by NTPEP.

##### 42 (2) Body

43 Provide a drum made of orange, impact resistant, ultraviolet plastic material capable  
44 of maintaining its integrity upon impact throughout a temperature range of -20°F to

1 125°F. When struck, the drum shall not permanently distort to a degree that would  
2 prevent reuse, nor roll excessively after impact. Design the drum to prevent water  
3 from accumulating and freezing in the top or bottom.

4 Provide a drum that is cylindrical in shape with the following dimensions;  
5 a minimum height of 36 inches, a minimum top outer diameter of 18 inches, a  
6 bottom outer diameter of 21 inches to 24 inches, and a minimum weight of 7 lbs.  
7 The top outer diameter shall not exceed the bottom outside diameter. Provide closed  
8 tops on drums to prevent accumulation of debris.

9 (3) Retroreflective Stripes

10 Provide at least four retroreflective bands with two orange and two white alternating  
11 horizontal circumferential bands. The top band shall always be orange. Use a 6 inch  
12 to 8 inch wide band Type III–High Intensity or higher prismatic retroreflective  
13 sheeting meeting the requirements of Article 1092-2 for each band. Do not exceed  
14 2 inches for any non-retroreflective spaces between orange and white stripes. Do not  
15 splice the retroreflective sheeting to create the 6 inch band. Apply the retroreflective  
16 sheeting directly to the drum surface. Do not apply the retroreflective sheeting over  
17 a pre-existing layer of retroreflective sheeting. Do not place bands over any  
18 protruding corrugations areas. No damage to the retroreflective sheeting should  
19 result from stacking and unstacking the drums, or vehicle impact.

20 (4) Ballast

21 Ballast drums using the sandbag ballast method, the tire sidewall ballast method or  
22 the preformed weighted base ballast method. When properly ballasted, the drums  
23 shall be wind resistant to the extent of withstanding wind created by traffic under  
24 normal roadway conditions, including high speed truck traffic in close proximity to  
25 the drums. Do not place ballast on top of the drum.

26 (a) Sandbag Ballast Method

27 Supply a sandbag with 50 lb. of sand with each drum. Place the sandbag inside  
28 the body on top of the detachable base. Upon impact the main body of the drum  
29 shall deform and become detached from the base, allowing vehicles to easily  
30 pass over the remaining base.

31 (b) Tire Sidewall Ballast Method

32 Design the base of the drums to accommodate no more than two tire sidewalls  
33 that when combined will have a weight of at least 30 lb and no more than 50 lb.  
34 Use the manufacturer's required tire sidewall ballast. Upon impact the main  
35 body of the drum shall deform and become detached from the tire sidewalls,  
36 allowing vehicles to easily pass over the tire sidewall ballasts.

37 (c) Preformed Weighted Base Ballast Method

38 Supply a preformed base specifically designed for the model drum. The weight  
39 of each drum's preformed base will be self-certified by the manufacturers. Each  
40 drum with preformed bases shall be approved by the Work Zone Traffic Control  
41 Unit. Upon impact, the main body of the drum shall deform and become  
42 detached from the base allowing vehicles to easily pass over the remaining base.

43 (5) Material Certification

44 Furnish a Type 3 material certification in accordance with Article 106-3 for all new  
45 drums and a Type 7 material certification for all used drums before use.

46 (6) Approval

47 All materials are subject to the approval of the Engineer.

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### (B) Skinny Drums

#### (1) General

Provide skinny drums composed of a body, alternating orange and white stripes of Type III-High Intensity or higher prismatic retroreflective sheeting and ballasts evaluated by NTPEP.

#### (2) Body

Provide a skinny drum made of orange, impact resistant, ultraviolet plastic material capable of maintaining its integrity upon impact throughout a temperature range of -20°F to 125°F. When struck, the skinny drum shall not permanently distort to a degree that would prevent reuse, nor roll excessively after impact. Design the skinny drum to prevent water from accumulating and freezing in the top or bottom.

Provide a skinny drum that is cylindrical in shape with the following dimensions; a minimum height of 42 inches, a minimum top outer diameter of 4 inches and a bottom outer diameter of 7.5 inches. The top outer diameter shall not exceed the bottom outside diameter. Provide closed tops on drums to prevent accumulation of debris.

#### (3) Retroreflective Stripes

Provide at least four retroreflective bands with two orange and two white alternating horizontal circumferential bands for each skinny drum. The top band shall always be orange. Use a 6 inch to 8 inch wide band Type III-High Intensity or higher prismatic retroreflective sheeting that meets Article 1092-2 for each band. Do not exceed 2 inches for any non-retroreflective spaces between orange and white stripes. Do not splice the retroreflective sheeting to create the 6 inch band. Apply the retroreflective sheeting directly to the skinny drum surface. Do not apply the retroreflective sheeting over a pre-existing layer of retroreflective sheeting. Do not place bands over any protruding corrugation areas. No damage to the reflective sheeting should result from stacking and unstacking the skinny drums, or vehicle impact.

#### (4) Ballast

Ballast skinny drums using a preformed base specifically designed for the model skinny drum. Each base shall be at least 15 lb and circular or polygonal with equal sides. When properly ballasted, the skinny drums shall be wind resistant to the extent of withstanding wind created by traffic under normal roadway conditions, including high speed truck traffic in close proximity to the skinny drums. Do not place ballast on top of the drum. Upon impact, the main body of the drum shall deform and become detached from the base allowing vehicles to easily pass over the remaining base.

#### (5) Material Certification

Furnish a Type 3 material certification in accordance with Article 106-3 for all new skinny drums and a Type 7 material certification for all used skinny drums before use.

#### (6) Approval

All materials are subject to the approval of the Engineer.

## 1089-6 FLASHING ARROW BOARDS

### (A) General

Provide a trailer mounted arrow board that meets or exceeds the physical and operational requirements of the MUTCD and which has been evaluated by NTPEP. The following

1 specifications supplement those basic requirements. Provide a totally mobile complete  
2 unit capable of being located as traffic conditions demand.

3 The display housing shall meet the minimum size requirements of a Type C panel with  
4 a 15 or 25 lamp configuration.

5 The display housing shall have a hand-crank mechanism to allow raising and lowering  
6 the display with a locking device to ensure the display housing will remain secured in  
7 either position

8 The display housing will have a minimum height of 7 feet from the bottom of the sign to  
9 the ground when raised in the upright position.

10 The display housing assembly shall be of weather resistant construction.

11 The lamps shall be controlled to provide the following modes as a minimum: Flashing  
12 Right or Left Arrow, Flashing Double Arrow and Caution Mode (four outermost corner  
13 lamps).

14 **(B) Power System**

15 Provide a unit that is solar powered and supplemented with a battery backup system that  
16 includes a 110/120 VAC powered on-board charging system.

17 The unit shall also be capable of being powered by standard 110/120 VAC power source.

18 The batteries, when fully charged, shall be capable of powering the display for  
19 20 continuous days with no solar power.

20 Store the battery bank and charging system in a lockable, weather and vandal resistant  
21 box.

22 **(C) Controller**

23 Provide automatic brightness/dimming of the display and a manual override dimming  
24 switch.

25 The controller shall provide a battery-charge status indicator.

26 Mobile radio or any other radio transmissions shall not affect the controller.

27 Store the controller in a lockable, weather and vandal resistant box.

28 **(D) Trailer**

29 Finish all exterior metal surfaces with Federal orange enamel per Federal Standard 595a,  
30 color chip ID# 13538 or 12473 respectively. The trailer shall be able to support  
31 a 100 mph wind load with the display fully extended.

32 The trailer shall be equipped with leveling jacks capable of stabilizing the unit in  
33 a horizontal position when located on slopes 6:1 or flatter.

34 The trailer shall be properly equipped in compliance with North Carolina Law governing  
35 motor vehicles.

36 Provide a minimum 4 inch wide strip of fluorescent orange retroreflective sheeting to the  
37 frame of the trailer. Apply the sheeting to all sides of the trailer. The retroreflective  
38 sheeting shall be Grade C that conforms to Article 1092-2. Drums may be supplemented  
39 around the unit in place of the sheeting.

40 **(E) Reliability**

41 Provide a sign unit that all components are rated to operate at temperatures ranging from  
42 -30°F to 165°F.

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1 The sign manufacturer shall notify the Work Zone Traffic Control Unit whenever  
2 modifications are made to a prequalified sign on the NCDOT APL.

3 The Work Zone Traffic Control Unit will review changes and per its discretion either  
4 make no change to the sign's status or remove it from the list until the sign can be  
5 reevaluated.

### 6 (F) Material Certification

7 Furnish a Type 3 material certification in accordance with Article 106-3 for all new  
8 flashing arrow boards, a Type 7 material certification for all used flashing arrow boards,  
9 and wind load certifications required in Subarticle 1089-6(D) for all new and used  
10 flashing arrow boards before use.

### 11 (G) Approval

12 The sign shall be on the NCDOT APL before use on construction projects in North  
13 Carolina. A sign may be removed from the NCDOT APL due to unsatisfactory field  
14 performance and shall not return to the list until the manufacturer identifies the reason for  
15 the failure and the problem has been corrected to the satisfaction of the Department.

16 The sign manufacturer shall notify the Department whenever modifications are made to  
17 their sign that was prequalified on the NCDOT APL. The Department will review  
18 changes and per its discretion, either make no change to the sign's status on the NCDOT  
19 APL or remove the sign from the list until the sign can be reevaluated.

## 20 1089-7 PORTABLE CHANGEABLE MESSAGE SIGNS

### 21 (A) General

22 Provide trailer or truck mounted portable changeable message signs that meet MUTCD  
23 and have been evaluated by NTPEP.

24 A trailer mounted portable changeable message sign shall be a totally mobile complete  
25 sign unit capable of being located as traffic conditions demand.

### 26 (B) Display Panel

27 Provide sign capable of sequentially displaying at least 2 phases of 3 lines of a  
28 programmable message with at least 8 characters per line and a character height of at  
29 least 18 inches.

30 The display characters will be composed of LED elements. The display panel may be of  
31 the following types- Full Matrix, Continuous Line Matrix, and Character Matrix.

32 Messages are to be automatically centered and proportionally spaced on each line of  
33 a Full Matrix and Continuous Line Matrix displays. Character Matrix displays shall  
34 display odd number character messages one character left of the centerline.

35 The display characters shall be protected with a polycarbonate lens that shall not decrease  
36 the daytime visibility of the sign.

37 The display panel shall have an electro-hydraulic system to allow raising and lowering  
38 the display with 360° rotation capability. The distance from the bottom of the sign to the  
39 ground shall be at least 7 feet. A locking device(s) shall be provided to ensure the display  
40 will remain secure in the raised, lowered and rotated positions. The sign shall have the  
41 capability to be raised and rotated to its operating position by one person.

42 A manual backup mechanism for the raising and lowering the display panel shall be  
43 provided in the event the electro-hydraulic system fails.

44 The display panel assembly shall be of weather resistant construction



**(C) Power System**

The unit shall be Solar powered and supplemented with a battery backup system which includes a 110/120 VAC powered on-board charging system.

The batteries, when fully charged, shall be capable of powering the display for 20 continuous days with no solar power. The unit shall be capable of being powered by standard 110/120 VAC power source.

Store the battery bank and charging system in a lockable, weather and vandal resistant box.

**(D) Controller**

The controller shall be capable of being equipped with the necessary hardware and software to allow wireless communication with other portable changeable message signs or other components of an intelligent transportation system. The controller shall also provide at a minimum; a keyboard, a display for message review and editing, a light source for nighttime operations, an event time clock and all other required controls for the operation of the display. Program each controller with password protection that will deter unauthorized programming of the controller. The password system is recommended to include at least two levels of security such that operators at one level may only change message sequences displayed using preprogrammed sequences and operators at a higher level may create and store messages or message sequences.

The controller shall include the following capabilities; manually dimming the display, storing at least 99 user generated messages, adjusting the flash rate of display and display phasing and monitoring battery-charge status.

Mobile radio or any other radio transmissions shall not affect the controller.

The controller shall be stored in a lockable, weather and vandal resistant box.

The controller shall be pre-programmed with messages shown below and stored in memory:

MAX SAFE SPEED 25 MPH	MAX SAFE SPEED 30 MPH
STOP AHEAD	YIELD AHEAD
MAX SAFE SPEED 35 MPH	MAX SAFE SPEED 40 MPH
MAX SAFE SPEED 45 MPH	MAX SAFE SPEED 50 MPH
ONE LANE BRIDGE	SURVEY CREW
MAX SAFE SPEED 55 MPH	DETOUR AHEAD
CAUTION DETOUR AHEAD	LANE CLOSED AHEAD
RIGHT LANE CLOSED	LEFT LANE CLOSED
CENTER LANE CLOSED	SINGLE LANE AHEAD
MERGE LEFT	MERGE RIGHT
KEEP LEFT	KEEP RIGHT
PASS LEFT	PASS RIGHT
USE LEFT LANE	USE RIGHT LANE
MERGE AHEAD	ROAD MACHINES AHEAD
ROAD WORK AHEAD	FLAGGER AHEAD
BUMP	DIP
STOP AHEAD	YIELD AHEAD
BE PREPARED TO STOP	SIGNAL AHEAD
SIGNAL NOT WORKING	DO NOT PASS
ONE LANE BRIDGE	SURVEY CREW
SHOULDER WORK	SOFT SHOULDER
PAVEMENT ENDS	LANE ENDS
ROAD CLOSED 1/4 MILE	ROAD CLOSED 1/2 MILE
ALL TRAFFIC EXIT LEFT	ALL TRAFFIC EXIT RIGHT
ROAD NARROWS	ROAD CLOSED AHEAD

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RAMP CLOSED	REDUCE SPEED
ROAD PAVING AHEAD	ALL TRAFFIC MUST STOP
SLOW MOVING TRAFFIC	NIGHT WORK AHEAD
CAUTION FLAGGER AHEAD	RUNAWAY TRUCK RAMP
MEDIAN WORK AHEAD	
LEFT LANE NARROWS	RIGHT LANE NARROWS
TEST PATTERN A <sup>A</sup>	TEST PATTERN B <sup>B</sup>

1     **A.** Test Pattern A is 1/2 of the LEDs on at a time.

2     **B.** Test Pattern B is for the remaining 1/2 of the LEDs on at a time.

### 3     **(E) Trailer**

4     Finish all exterior metal surfaces with Federal orange enamel per Federal Standard 595a;  
5     color chip ID# 13538 or 12473 respectively except for the sign face assembly that shall  
6     be flat black.

7     Provide a minimum 4 inches wide strip of fluorescent orange retroreflective sheeting to  
8     the frame of the trailer. Apply the sheeting to all sides of the trailer. The retroreflective  
9     sheeting shall be Grade C that conforms to Article 1092-2. Drums may be supplemented  
10    around the unit in place of the sheeting.

11    The trailer shall be able to support a 100 mph wind load with the display fully extended.

12    The trailer shall be equipped with leveling jacks capable of stabilizing the unit in  
13    a horizontal position when located on slopes 6:1 or flatter.

14    The trailer shall be properly equipped in compliance with North Carolina Law governing  
15    motor vehicles.

### 16    **(F) Reliability**

17    Provide a sign unit that all components are rated to operate at temperatures ranging from  
18    -30°F to 165°F.

### 19    **(G) Material Certification**

20    Furnish a Type 3 material certification in accordance with Article 106-3 for all new  
21    changeable message signs, a Type 7 material certification for all used changeable  
22    message signs and wind load certifications required in Subarticle 1089-7(E) for all new  
23    and used changeable message signs before use.

### 24    **(H) Approval**

25    The sign shall be listed on the NCDOT APL before use on construction projects in North  
26    Carolina. A sign may be removed from the NCDOT APL due to unsatisfactory field  
27    performance and shall not return to the list until the manufacturer identifies the reason for  
28    the failure and the problem has been corrected to the satisfaction of the NCDOT.

29    The sign manufacturer shall notify NCDOT whenever modifications are made to their  
30    sign that was prequalified on the NCDOT APL. The Department will review changes  
31    and per its discretion will either make no change to the sign's status on the NCDOT APL  
32    or remove the sign from the list until the sign can be reevaluated.

## 33    **1089-8 TEMPORARY CRASH CUSHIONS**

### 34    **(A) General**

35    Provide temporary crash cushions that meet NCHRP 350 for Work Zone Test Level II for  
36    work zones that have a posted speed limit of 45 mph or less. Provide temporary crash  
37    cushions that meet NCHRP 350 for Work Zone Test Level III devices for work zones  
38    that have a posted speed limit of 50 mph or greater. Provide redirective temporary crash  
39    cushions or non-directive temporary crash cushions that capture errant vehicles without  
40    complete penetration through the device.

1 The temporary crash cushion shall contain the debris resulting from impact within the  
2 structure of the temporary crash cushion.

3 Include in the temporary crash cushion package any required rear transition panels to  
4 connect the back of the temporary crash cushion to rigid or flexible barrier systems.  
5 Include any required portable base, as recommended by the manufacturer of the  
6 temporary crash cushion, to connect the bottom of the temporary crash cushion to a  
7 paved surface. Temporary crash cushion shall not be placed on an unpaved surface.

8 **(B) Retroreflective End Treatments**

9 Provide a yellow nose wrap that visually matches the color chip that corresponds to the  
10 Federal Standard No. 595a for Yellow (Color No. 13538) for all temporary crash  
11 cushions.

12 The retroreflective end treatment shall meet the requirement for retroreflectivity in  
13 Article 1088-1 and *Roadway Standard Drawings*.

14 **(C) Material Certification**

15 Furnish a Type 3 material certification in accordance with Article 106-3 for all new  
16 temporary crash cushions and a Type 7 material certification for all used temporary crash  
17 cushions before use.

18 **(D) Approval**

19 Use temporary crash cushions listed on the NCDOT APL.

20 **1089-9 ATTENUATORS**

21 **(A) General**

22 Provide truck mounted attenuators that meet NCHRP 350 Test Level II for work zones  
23 that have a posted speed limit of 45 mph or less. Provide truck mounted attenuators that  
24 meet NCHRP 350 Test Level III for work zones that have a posted speed limit of 50 mph  
25 or greater.

26 Use trucks with gross vehicle tare weight as described in the NCHRP 350 crash test for  
27 the impact attenuator provided. Provide truck in accordance with the manufacturer's  
28 specifications. Ballasting methods are not permitted.

29 Use the attenuator in accordance with the manufacturer's specifications. Provide truck  
30 mounted attenuators with standard trailer lighting systems, including brake lights, tail  
31 lights and turn signals.

32 **(B) Retroreflective End Treatment**

33 The retroreflective end treatment shall meet Article 1088-1 and *Roadway Standard*  
34 *Drawings*.

35 **(C) Material Certification**

36 Furnish a Type 3 material certification in accordance with Article 106-3 for all new truck  
37 mounted attenuators and a Type 7 material certification for all used truck mounted  
38 attenuators before use.

39 **(D) Approval**

40 Use only truck mounted attenuators listed on the NCDOT APL.

**Section 1090**

1 **1089-10 FLAGGER**

2 **(A) 24 Inch Stop and Slow Paddle**

3 (1) Retroreflective Sheeting

4 Use retroreflective sheeting with a smooth, sealed outer surface that will display the  
5 same color both day and night. Cover the entire sign face with Grade B  
6 retroreflective sheeting. Retroreflective sheeting shall meet Article 1092-2. The  
7 distance from the bottom of the sign to the ground shall be at least 6 feet.

8 (2) Material Certification

9 Furnish a Type 3 material certification in accordance with Sections 106-3 for all new  
10 reflective sheeting used on flagger paddles and a Type 7 material certification for all  
11 used sheeting before use.

12 (3) Approval

13 All materials are subject to the approval of the Engineer.

14 **(B) Vest**

15 (1) Apparel Materials

16 Use highly-visibility safety apparel that meets the Performance Class 2 or higher  
17 requirements of the ANSI/ISEA 107-2010 or the equivalent revision. For nighttime  
18 flagging operations, Performance Class 3 safety apparel is required.

19 (2) Apparel Verification

20 (3) All safety apparel shall have the original tag or label indicating that it meets the  
21 requirements of the ANSI/ISEA 107-2010 or the equivalent revision. Approval

22 All safety apparel is subject to the approval of the Engineer.

23 **SECTION 1090**

24 **PORTABLE CONCRETE BARRIER**

25 **1090-1 PORTABLE CONCRETE BARRIER**

26 **(A) General**

27 Use portable concrete barrier that meets Section 854, Section 1077 and the plans. The  
28 requirement for approved galvanized connectors will be waived if the barrier remains the  
29 property of the Contractor.

30 **(B) Used Portable Concrete Barrier**

31 Used barrier will be acceptable provided the following conditions have been met:

32 (1) The Contractor has furnished a Type 7 material certification in accordance with  
33 Article 106-3.

34 (2) The strength of the concrete in each barrier unit is at least 4,500 psi as evidenced by  
35 nondestructive tests made in place by a rebound hammer in accordance with  
36 ASTM C805.

37 **(C) Anchor Bolts**

38 Use anchor bolts that meet ASTM A325.

39 **(D) Approval**

40 All materials are subject to the approval of the Engineer.