

ORIGINATION FORM

THE INFORMATION BELOW IS TO BE PROVIDED BY THE ORIGINATOR

☒ Modify Specification _____ 990 _____

Subject: Modify Articles 990-5 and 990-9.

Origination date: June 1, 2005

Originator: Stefanie Maxwell/Cheryl Adams

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Problem statement: All references to “Preformed Removable Pavement Marking Film” need to be changed to “Removable Tape”. The spec needs to be updated with the current requirements for removable tape.

We currently call for RED pixels in the message display of radar speed display units, and the MUTCD states, that the pixel color should be YELLOW.

Information source: David Sadler, Construction Engineer
Stefanie Maxwell, Specialty Engineer
Cheryl Adams, Roadway Design Office

The 2003 MUTCD has added language on the color to be used, that was not in the MUTCD in 2000. (Section 2B-13 on page 2B-11)

Background data: “Preformed Removable Pavement Marking Film” is now called “Removable Tape” and the revision to the spec will reflect this change. The spec will also be modified to update some of the requirements for removable tape.

If a changeable message sign displaying approach speeds is installed, the legend YOUR SPEED XX km/h (MPH) or such similar legend should be shown. The color of the changeable message legend should be a yellow legend on a black background or the reverse of these colors.

Recommended

Usage Note: All jobs

Desired

implementation date: Beginning with the January 2006 letting.



Florida Department of Transportation

JEB BUSH
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JOSÉ ABREU
SECRETARY

MEMORANDUM

DATE: June 7, 2005

TO: Specification Review Distribution List

FROM: Duane F. Brautigam, P.E., State Specifications Engineer

SUBJECT: **Proposed Specifications Change: 9900000 – Temporary Traffic Control Devices Materials**

In accordance with Specification Development Procedures, we are sending you a copy of a proposed specification change to Section 990.

This change was proposed by Cheryl Adams of the Roadway Design Office and Stephanie Maxwell of the State Construction Office to add requirements for Removable Tape and update requirements for the Radar Speed Display Unit.

Please share this proposal with others within your responsibility. Review comments are due within four weeks and should be sent to Mail Station 75 or to my attention via e-mail at SP965DB or duane.brautigam@dot.state.fl.us. Comments received after July 5, 2005 may not be considered. Your input is encouraged.

DFB/jf

Attachment

COMMENTS:

Submitted by:

Phone #:

**TEMPORARY TRAFFIC CONTROL DEVICES MATERIALS.
(REV 6-1-05)**

SECTION 990 (Pages 925-937) is deleted and the following substituted:

**SECTION 990
TEMPORARY TRAFFIC CONTROL DEVICES MATERIALS**

990-1 General.

The work specified in this Section is the material requirements for Temporary Traffic Control Devices.

990-2 Reflective Collars for Traffic Cones.

For the retroreflective sheeting for the collars, meet the requirements of ASTM D 4956 Table 4, Type III and Table 9, Type VI; excluding 0.1 degree.

Provide three certified copies of test reports and certification from the manufacturer that the material furnished meets all requirements above. Use reflective collars for cones included on the Qualified Products List (QPL).

990-3 Portable Arrow Boards.

990-3.1 Scope: All portable arrow boards must meet the physical display and operational requirements as described in the MUTCD. Manufacturers seeking approval of their arrow board shall provide a working sample to be evaluated in accordance with these Specifications and certify that the furnished unit meets all requirements specified herein.

990-3.2 Display Panel and Housing:

(a) The display housing assembly shall be weather-tight to protect the panel from the elements.

(b) All nuts, bolts, washers and other fasteners shall be of corrosion resistant material.

(c) The display assembly shall be equipped with an automatic dimming operational mode capable of a minimum of 50% dimming and a separate manual dimmer switch

(d) The display panel background and frame for the display assembly shall be painted flat black and must meet Federal Specification TT-E-489.

(e) Display panel and housing shall be designed and constructed to allow the unit to be operated in the displayed position at speeds of 30 mph [50 k/h]. In the down position it shall be designed for speeds of 65 mph [105 k/h].

(f) The display panel, when raised in the upright position, will have a minimum height of 7 feet [2.1 m] from the bottom of the panel to the ground, in accordance with the MUTCD.

(g) The unit shall have an accessible mechanism to easily raise and lower the display assembly. A locking device shall also be provided to ensure the display panel will remain in the raised or lowered position.

990-3.3 Arrow Board Matrix:

(a) The minimum legibility distance for various traffic conditions are based on the decision-sight distance concept. The minimum legibility distance is the distance at which a driver can comprehend the arrow panel message on a sunny day or a clear night. The arrow panel size that is needed to meet the legibility distance is listed as follows:

Type	Minimum Size	Minimum Number of Panel Lamps	Minimum Legibility Distance
B	30 by 60 inches [750 by 1,500 mm]	13	3/4 mile [1.0 km]
C	48 by 96 inches [1,200 by 2,500 mm]	15	1 mile [1.5 km]

For use on the state highway system, the Types “B” or “C” advance warning arrow boards may be used for low to intermediate (0 to 50 mph) [0 to 80 km/h] facilities and for maintenance or moving operations on high-speed roadways. Type “C” arrow boards shall be used on high-speed (50 mph and up) [80 km/h and up].

(b) Devices shall meet all arrow board displays identified in the MUTCD.

(c) The lamp lens should be 5 3/4 inches [145 mm] in diameter. Smaller lamp lens diameters are permissible only if they provide an equivalent or greater brightness indication and meet the legibility criteria in Section (a) of this Specification.

(d) The color of the light emitted shall be in accordance with the MUTCD.

(e) There shall be a 360-degree hood for close-up glare reduction.

(f) For solar powered arrow boards the bulbs shall provide a 350-candle power intensity for day use and an automatic reduction or dimming capacity for night use. The dimmed night operation shall provide adequate indication without excessive glare.

(g) The flashing rate of the lamps shall not be less than 25 nor more than 40 flashes per minute as required in the MUTCD.

(h) The minimum lamp “on time” shall be 50% for the flashing arrow and 25% for the sequential chevron.

990-3.4 Electrical System:

990-3.4.1 Diesel Engine: Meet the following:

(a) The power supply and electrical system shall be self-contained within the unit.

(b) The engine shall have an electrical starting system.

(c) The power source furnished shall be of sufficient size so as to provide the required maximum load energy plus 25%.

(d) The electrical system shall meet the National Electrical Code where applicable.

(e) A backup power system that shall operate the unit for a minimum of three hours automatically when the motor driven generator fails to operate.

(f) The starting batteries and back-up power supply system batteries shall be automatically charged when the generator is operating.

(g) The engine shall be supplied with an ammeter and the generator shall be supplied with a voltmeter showing voltage to the sign assembly.

For solar powered units the following shall apply:

(a) The unit shall provide automatic recharging of power supply batteries to normal operating levels.

(b) Solar array recovery time shall be accomplished in a maximum of three hours.

990-3.4.2 Battery Life Test: Meet the following:

(a) The photovoltaic unit shall be able to operate from a full battery charge without sunlight for a period of not less than 21 days.

(b) The battery shall be equipped with a controller to prevent overcharging and over-discharging. An external battery level indicator shall also be provided.

(c) The battery, controller, and power panel shall be designed to be protected from the elements and vandalism.

990-3.4.3 Controller: Meet the following:

(a) Controller and control panel shall be housed in a weather, dust, and vandal resistant lockable cabinet.

(b) The controller shall be solid-state in design and function.

990-3.4.4 Support Chassis: Meet the following:

(a) The support chassis shall be self-contained and self-supporting without the use of additional equipment or tools.

(b) Both trailer and truck-mounted units are allowed.

(1) Trailer mounted unit:

(a) The sign, power supply unit and all support systems shall be mounted on a steel, wheeled trailer with a minimum capacity of 2,600 pounds [1,180 kilograms].

(b) The trailer shall be equipped with class-A lights, using a plug adaptor.

(c) The trailer shall be equipped with adjustable outrigger leveling pads (screw-type), one on each of the four frame corners.

(d) The trailer shall be designed to be set up at the site with its own chassis and outriggers, without being hitched to a vehicle.

(e) The trailer shall be equipped with fenders over the tires and shall be made from heavy-duty metal sufficient to allow a person to stand and operate or perform maintenance on the unit.

(f) The trailer shall meet all equipment specifications set forth in Chapter 316 of the Florida Statutes, and by such rule, regulation or code that may be adopted by the Department of Highway Safety and Motor Vehicles.

(2) Truck mounted unit:

(a) The truck-mounted assembly shall be designed to fit on a 1/2 ton or greater duty truck.

(b) The unit shall be self-contained with its own power supply, controls, raising and lowering device and shall be capable of being operated by one person.

(c) The unit shall be secured in the vehicle for normal operation.

990-3.4.5 Other Requirements: Meet the following:

(a) The portable arrow board assembly shall be designed to function in dry, wet, hot or cold weather (ambient temperature ranges from -30 to 165°F [-35 to 78°C]). Other environmental requirements shall be as specified in Section 615.

(b) The controller shall not be affected by mobile radio, or any other radio transmissions.

(c) An operator's manual shall be furnished with each unit.

(d) The manufacturer's name and FDOT approval number shall be affixed on the equipment.

(e) The arrow board shall be listed on the QPL.

990-4 Portable Changeable (Variable) Message Signs.

990-4.1 Scope. All Portable Changeable Message Signs (PCMS's) must meet the physical display and operational requirements as described in the MUTCD.

Manufacturers seeking approval for their PCMS shall provide a working sample to be evaluated in accordance with these Specifications and certify that the unit meets all requirements specified herein.

Permanent installations can be used but will be evaluated for each specific project or installation. These standards shall include but not be limited to the following:

990-4.2 Display Panel and Housing:

(a) The display housing assembly shall be weather-tight to protect the panel from the elements.

(b) All nuts, bolts, washers and other fasteners shall be of a corrosive resistant material.

(c) The message matrix panel background and frame for the changeable message assembly shall be painted flat black (must meet Federal Specification TT-E-489).

(d) Servicing of all message matrix panel components shall be accomplished from the front of the message matrix panel.

(e) Each message matrix panel shall provide a glare screen for each message line to aid against sun glare for non-reflecting type signs.

(f) The display panel, when raised in the upright position, will have a minimum height of 7 feet [2.1 m] from the bottom of the panel to the ground.

(g) The unit shall have an accessible mechanism to easily raise and lower the display assembly. A locking device shall also be provided to ensure the display panel will remain in the raised or lowered position.

990-4.3 Message Matrix:

(a) The overall dimensions of the 7 foot by 10 foot [2.1 by 3 m] PCMS message matrix panel shall be a maximum height of 7 feet [2.1 m] by a maximum width of 10 feet [3.0 m]. The overall dimensions of the 5 feet by 8 feet [1.5 by 2.4 m] PCMS message matrix panel shall have a maximum height of 5 foot by a maximum width of 8 foot [1.5 by 2.4 m].

(b) The message matrix panel shall contain three separate lines. Each line shall consist of eight characters, equally spaced a minimum of 3 inches [75 mm]. Each character shall contain 35 pixels in a five by seven horizontal to vertical grid arrangement.

(c) Each message line of the 7 foot by 10 foot [2.1 by 3 m] PCMS shall provide for characters 13 inches [330 mm] in width by 18 inches [457 mm] in height and variable graphic and symbol sizes to a minimum of 18 inches [457 mm] in height. The 5 foot by 8 foot [1.5 by 2.4 m] PCMS shall provide for characters 9 inches [229 mm] in width by 12 inches [305 mm] in height and variable graphic and symbol sizes to a minimum of 12 inches [305 mm] in height.

(d) For flip disk matrix signs, the disk elements shall be coated on the display side with a highly reflective florescent yellow Mylar material, and on the back with a flat black to blend in with the flat black background.

(e) Similar components shall be interchangeable.

990-4.4 Electrical System:**990-4.4.1 Diesel Engine:** Meet the following:

- (a) The power supply and electrical system shall be self-contained within the unit.
- (b) The power source furnished shall be of sufficient size so as to provide the required maximum load energy plus 25%.
- (c) The electrical system shall meet the National Electrical Code where applicable.
- (d) A lightning protection device shall be provided for stationary equipment.
- (e) The engine shall have an electrical starting system.
- (f) A backup power system shall be provided that will operate the unit for a minimum of three hours automatically when the motor driven generator fails to operate.
- (g) An automatic charging system to recharge the starting and backup power supply batteries, when the generator is operating.
- (h) The engine shall be supplied with an ammeter and the generator shall be supplied with a voltmeter showing voltage to the sign assembly.

For solar powered units the following shall apply:

- (a) The photovoltaic unit of the 7 foot by 10 foot [2.1 by 3 m] PCMS shall be designed to provide 21 days of continuous operation without sunlight with a minimum of on site maintenance. The photovoltaic unit of the 5 foot by 8 foot [1.5 by 2.4 m] PCMS shall be designed to provide 12 days of continuous operation without sunlight with a minimum of on site maintenance.
- (b) Automatic recharging of power supply batteries shall be provided.

990-4.5 Battery Life Test:

- (a) The battery shall be equipped with a battery controller to prevent overcharging and over-discharging. An external battery level indicator shall be provided.
- (b) The battery, controller, and power panel shall be designed to be protected from the elements and vandalism.

990-4.6 Controller:

- (a) Controller and control panel shall be housed in a weather, dust, and vandal proof lockable cabinet.
- (b) The keyboard shall be equipped with a security lockout feature to prevent unauthorized use of the controller.
- (c) The controller shall be solid state in design and function.
- (d) The control panel shall display a representative message that will be displayed on the sign panel.
- (e) The flash rate shall be adjustable in the sign controller from one to ten seconds.

990-4.7 Operation and Performance:

- (a) The message shall be displayed in upper case except when lower case is project specific and is allowed by the MUTCD.
- (b) The message matrix panel shall be visible from 1/2 mile [0.8 km] and legible from a distance of 650 feet [200 m] under both day and night conditions. Under variable light level conditions the sign shall automatically adjust its light source so as to meet the 650 feet

[200 m] visibility requirement. The message panel shall have adjustable display rates, so that the entire message can be read at least twice at the posted speed.

(c) The control panel shall have the capability to store a minimum 50 pre-programmed messages.

(d) The controller in the control panel shall be able to remember messages during non-powered conditions.

(e) The controller shall allow the operator to generate additional messages on site via the keyboard.

(f) For a PCMS using Flip-Disk technology, the controller shall have the capability to provide a stipulated default message upon loss of controller function.

(g) All messages shall be flashed or sequenced. In the sequence mode, the controller shall have the capability to sequence three line messages during one cycle.

990-5 Preformed Removable Pavement Marking Film (Tape).

~~990-5.1 Composition: Use a mixture consisting of polymeric materials, pigments, glass beads, and a retro-reflective layer of glass beads firmly bonded to the top surface. Ensure this material meets the requirements of 971-1.8.~~

~~990-5.2 Adhesive: Precoat removable preformed plastic pavement marking film with a pressure sensitive adhesive capable of being affixed to asphalt concrete and portland cement concrete pavement surfaces without the use of heat, solvents, and other additional adhesives or activators. Use an adhesive that exhibits excellent sheer characteristics and minimal tensile characteristics. Ensure that the adhesive does not require a protective liner when the preformed plastic pavement marking film is in rolled form for shipment. Ensure that the adhesive is capable of temporarily bonding to the roadway pavement at temperatures of 50°F [10°C] and the above without pick-up distortion by vehicular traffic.~~

~~990-5.3 Pigmentation: Thoroughly blend color pigments to provide a plastic marking film that maintains uniform color under daylight and night lighting conditions throughout the expected life of the film. White pavement marking film shall meet Federal Standard Color No. 595-17886. Yellow pavement marking film shall be similar to Federal Standard Color No. 595-13538.~~

~~990-5.4 Glass Beads: Use colorless glass beads with a minimum refraction index of 1.50 when tested using the liquid oil immersion method. Use size and quantity of beads that will maintain the retro-reflectivity of the preformed plastic film as the film wears through the surface course. Firmly adhere approximately 2% by weight of glass beads to the top of the preformed plastic film.~~

990-5 Removable Tape.

990-5.1 Composition: The pavement stripes and markings shall consist of high quality plastic materials, pigments, and glass spheres or other retroreflective materials uniformly distributed throughout their cross-sectional area, with a reflective layer of spheres or other retroreflective material embedded in the top surface.

990-5.2 Skid Resistance: The surface of the stripes and markings shall provide a minimum skid resistance value of 35 BPN (British Pendulum Number) when tested according to ASTM E 303. Bike lane symbols and pedestrian crosswalks shall provide a minimum skid resistance value of 60 BPN.

990-5.3 Thickness: The Qualified Products List will list the specified thickness of each approved product.

990-5.4 Durability and Wear Resistance: *When properly applied, the material shall provide neat, durable stripes and markings. The materials shall provide a cushioned resilient substrate that reduces sphere crushing and loss. The film shall be weather resistant and, through normal wear, shall show no significant tearing, rollback or other signs of poor adhesion. Durability is the measured percent of pavement marking material completely removed from the pavement. The pavement marking material line loss must not exceed 5.0% of surface area.*

990-5.5 Conformability and Resealing: *The stripes and markings shall be capable of conforming to pavement contours, breaks and faults under traffic at pavement temperatures recommended by the manufacturer. The film shall be capable of use for patching worn areas of the same types of film in accordance with the manufacturer's recommendations.*

990-5.6 Tensile Strength: *The stripes and markings shall have a minimum tensile strength of 40 psi [275 kPa] when tested according to ASTM D 638. A rectangular test specimen 6 by 1 by 0.05 [150 by 25 by 1.5 mm] minimum thickness shall be tested at a temperature range of 40 to 80°F [21 to 27°C] using a jaw speed of 0.25 inch/min [6 mm/min].*

990-5.7 Elongation: *The stripes and markings shall have a minimum elongation of 25% when tested in accordance with ASTM D 638.*

990-5.8 Plastic Pull test: *The stripes and markings shall support a dead weight of 4 lb [1.8 kg] for not less than five minutes at a temperature range of 70 to 80°F [21 to 27°C]. Rectangular test specimen size shall be 6 by 1 by 0.05 inch [150 by 25 by 1.5 mm] minimum thickness.*

990-5.9 Adhesive: *Precoat removable tape with a pressure sensitive adhesive capable of being affixed to asphalt concrete and portland cement concrete pavement surfaces without the use of heat, solvents, and other additional adhesives or activators. Use an adhesive that exhibits excellent shear characteristics and minimal tensile characteristics. Ensure that the adhesive does not require a protective liner when the removable tape is in rolled form for shipment. Ensure that the adhesive is capable of temporarily bonding to the roadway pavement at temperatures of 50°F [10°C] and the above without pick-up distortion by vehicular traffic.*

990-5.10 Color: *Meet the requirements of 971-1.7.*

990-6 Work Zone Raised Pavement Markers.

Ensure that Work Zone Raised Pavement Markers (WZRPM's) meet the requirement of 970-1.2.1 and are certified as meeting the following except for Class E markers as noted below:

(1) Composition: Use markers made of plastic, ceramic or other durable materials. Markers with studs or mechanical attachments will not be allowed.

(2) Dimensions: Marker minimum and maximum surface dimensions is based on an x and y axis where the y dimension is the axis parallel to the centerline and the x axis is 90 degrees to y. Class E markers shall be 4 inch [100 mm] (W) by 2 inch [50 mm] (H) by 1 inch [25 mm] (D).

The x and y dimension of Class D markers shall be a maximum of 5 inches [125 mm]. The x dimension shall be a minimum of 4 inches [100 mm] and the minimum y dimension will be 2.25 inches [57 mm].

Ensure that the maximum installed height of Class D markers is 1 inch [25 mm]. Ensure that the maximum installed height of Class E markers is 2 inches [50 mm]. Use Class D markers having a minimum reflective face surface of 0.35 in² [225 mm²]. Use Class E markers having a minimum reflective surface area of 1 in² [645 mm²].

Ensure that after installation, the marker's reflective face is completely visible and above the pavement surface measured from a line even with the pavement perpendicular to the face of the marker.

(3) Optical Performance: Ensure that the specific intensity of each white reflecting surface at 0.2 degrees observation angle is at least the following when the incident light is parallel to the base of the marker:

Horizontal Entrance Angle	Specific Intensity
0 degrees	3
20 degrees	1.2

For yellow reflectors, the specific intensity shall be 60% of the value for white.

For red reflectors, the specific intensity shall be 25% of the value for white. Reflectivity of all (WZRPM's) shall not be less than 0.2 Specific Intensity (SI) any time after installation.

(4) Strength requirements: Markers shall support a load of 5,000 pounds [20 kN]. Three markers per lot or shipment will be randomly selected for a test.

Position the marker base down between the flat parallel platens of a compression testing machine. Place on top of the marker a flat piece of 65 durometer rubber 6 by 6 by 0.375 inch [150 by 150 by 9.5 mm] centered on the marker. Apply the compressive load through the rubber to the top of the marker at a rate of 0.2 in/s [0.085 mm/s].

Either cracking or significant deformation of the marker at any load less than 5,000 pounds [20 kN] will constitute failure.

(5) Adhesion: Use bituminous adhesive materials recommended by the marker manufacturer for bonding the markers to the pavement. The adhesive used shall be one of the products included on the QPL.

(6) Removability: Ensure that the pavement marker is removable from asphalt pavement and portland cement concrete pavement intact or in substantially large pieces, either manually or by mechanical devices at temperatures above 40°F [4°C], and without the use of heat, grinding or blasting.

(7) Replacement Requirements: Replace markers any time after installation when more than two markers in a skip, or more than three consecutive markers on an edgeline are missing at no expense to the Department. Replace all failed markers in a timely manner as directed by the Engineer.

990-7 Temporary Glare Screen.

990-7.1 Design and Installation: Meet the following requirements:

(a) Glare screen units shall be manufactured in lengths such that when installed the joint between any one modular unit will not span barrier sections. Color shall be green, similar to Federal Color Standard 595-34227.

(b) Blades, rails and/or posts shall be manufactured from polyethylene, fiberglass, plastic, polyester or polystyrene, and be ultraviolet stabilized and inert to all normal atmospheric conditions and temperature ranges found in Florida.

(c) For paddle type designs, the blade width shall not be more than 9 inches [225 mm]. Blades or screen for individual or modular systems shall be 24 to 30 inches [600 to

750 mm] high and capable of being locked down at an angle and spacing to provide a cut-off angle not less than 20 degrees.

(d) For glare screen mounted on temporary barrier wall, a strip (6 by 12 inches) [(150 by 300 mm)] of reflective sheeting as specified in 994-2 shall be placed on a panel, centered in each barrier section (at a spacing not to exceed 15 feet [4.5 m]) and positioned in such a manner as to permit total right angle observation by parallel traffic. When glare screen is utilized on temporary concrete barriers, warning lights will not be required.

(e) Prior to approval an impact test shall be performed by the manufacturer to verify the safety performance of the proposed system. The minimum impact strength of the posts, blades, rail and the barrier attachment design shall be sufficient to prevent the unit from separating from the barrier when impacted by a 3 inch [88.9 mm] outside diameter steel pipe traveling at 30 mph [48 km/h] and impacting mid-height on the glare screen assembly.

(f) All hardware shall be galvanized in accordance with ASTM A 123 or stainless steel in accordance with AISI 302/305.

Alternative designs for temporary glare screen may be submitted as a Value Engineering Change Proposal (VECP) in accordance with 4-3.5.

990-7.2 Certification: Furnish certified test reports including all applicable test methods stating that the materials comply with the requirements of this specification.

990-7.3 Qualified Products List: Manufactured glare screen systems may be modular or individual units listed on the QPL.

990-8 Portable Regulatory Signs.

990-8.1 Sign Panel Assembly: The sign panel assembly shall consist of two regulatory signs as shown in the Design Standards, Index No. 600, intended to notify oncoming traffic that workers are present. The sign panel assembly shall meet the following minimum physical requirements:

(1) all nuts, bolts, washers, and other fasteners shall be of corrosion resistant material.

(2) the sign panel shall fold down and be pinned in place for towing. Maximum travel height shall be 80 inches [2 m].

(3) construct the sign panel and light housing to allow the unit to be operated in the displayed position at speeds of 30 mph [48 km/h]. Design the sign panel assembly to withstand transport speeds of 65 mph [105 km/h]. Transport the assembly in the down position.

(4) construct the sign panel such that, when in the raised position, the sign panel will have a height of seven feet [2.1 m] from the bottom of the lowest panel to the ground, in accordance with the MUTCD.

(5) provide the unit with a mechanism to raise and lower the sign panel. Provide the unit with a device to lock the sign panel in the raised and lowered position.

990-8.2 Flashing Lights: Provide a pair of hooded PAR 46 L.E.D. advance warning flashing lamps on each side of the top of the sign panel. These lamps shall be visible day or night at a distance of one mile [1.6 km] with a flash rate of approximately 55 flashes per minute.

The lamp lens should be at least 5 3/4 inches [145 mm] in diameter. Smaller diameter lens are permissible if they provide an equivalent or greater brightness indication and meet the legibility criteria above.

The color of the light emitted shall be in accordance with the MUTCD. For solar powered units, the bulbs shall provide a 350 candlepower intensity for day use and an automatic

reduction or dimming capacity for night use. The dimmed night operation shall provide adequate indication without excessive glare.

990-8.3 Electrical System: The unit shall provide automatic recharging of power supply batteries to normal operating levels. Solar array recovery time shall be accomplished in a maximum of three hours.

990-8.4 Battery Life: The photovoltaic unit shall be able to operate from a full battery charge without sunlight for a period of not less than ten days. The battery shall be equipped with a controller to prevent overcharging and over-discharging. An external battery level indicator shall be provided. The battery, controller and power panel shall be designed for protection from the elements and vandalism.

990-8.5 Controller: The controller and control panel shall be housed in a weather, dust and vandal resistant lockable cabinet. The controller shall be solid-state in design and function.

990-8.6 Trailer Mounted Unit: The trailer shall be equipped with Class-A lights, using a plug adapter. The trailer shall be equipped with adjustable outrigger leveling pads (screw type), one on each of the four frame corners. The trailer shall be designed to be set up at the site with its own chassis and outriggers, without being hitched to a vehicle. The trailer shall be equipped with fenders over the tires and shall be made from heavy-duty metal sufficient to allow a person to stand and operate or perform maintenance on the unit. The trailer shall meet all equipment specifications set forth in Chapter 316 of the Florida Statutes, and by such rule, regulation or code adopted by the Florida Department of Highway Safety and Motor Vehicles. The trailer shall be painted Omaha orange, Federal Standard 595-B, Number 12243.

990-9 Radar Speed Display Unit.

990-9.1 Display Unit Panel and Housing: The Display Unit Panel and Housing shall meet the following physical requirements as a minimum:

- (1) Use Corrosion resistant nuts, bolts, washers, and other fasteners for assembly.
- (2) Paint the panel background and frame with a flat black paint meeting Federal Specification TT-E-489.
- (3) Cover the panel with a polycarbonate, non-glare face having a ultra-violet inhibitor to protect from fading and yellowing.
- (4) Construct the Display Unit panel support structure such that it may be raised and lowered, and when raised to the upright position, the maximum height to the top of the panel from the ground is 8 feet [2.4 m].

(5) Provide capability to mount a 24 by 30 inch [610 by 760 mm] regulatory sign with interchangeable numbers showing the posted speed limit above the message display.

(6) Provide legend "YOUR SPEED" either above or below the message display.

990-9.2 Message Display: The message Display shall meet the following physical requirements as a minimum:

- (1) Provide a bright LED, ~~18 inch [450 mm]~~, two digit speed display with ~~red/yellow~~, pixels, ~~or a two (2) line display~~.
- (2) *Each digit shall contain 35 pixels in a seven by five vertical to horizontal grid arrangement. Each digit shall measure minimum 18 inches 457[mm] in height by maximum 13 inches [330 mm] in width. The message display area shall be a maximum 66 inches [1.7 mm] wide by 24 inches [.6 m] high. The message matrix panel shall contain two separate lines. Each line shall consist of at least seven characters, equally spaced a minimum of the equivalent to a*

~~single column of inactive matrix elements. Each message shall provide for a minimum 10 inch [254 mm] character height.~~

(3) Speed display shall be visible from a distance of at least 1/2 mile [805 m] and legible from a distance of at least 650 feet [198 m] under both day and night conditions.

(4) Display shall adjust for day and night operation automatically with a photocell.

990-9.3 Electrical System: Provide solar powered units meeting the following criteria:

(1) The battery shall be equipped with a battery controller to prevent over-charging and over-discharging, and an external battery level indicator.

(2) The unit shall provide for automatic recharging of power supply.

(3) The unit shall provide ten days of continuous operation without sunlight.

(4) The battery, controller, and power panel shall be designed to be protected from the elements and vandalism.

990-9.4 Radar: The radar unit shall not be affected by normal radio transmissions and meet the following physical requirements as a minimum:

(1) Approach-Only sensor.

(2) Equipped with a low power K-Band transmitter.

(3) Part 90 FCC acceptance, 3 amps, 10.8 to 16.6 vdc. Fuse and reverse polarity protected.

(4) Range of 1,000 feet [305 m] for mid-size vehicle, capable of accurately sensing speeds of 10 to 99 mph [16 to 159 km] with over speed function that operates when a vehicle approaches over the posted speed limit.

990-9.5 Trailer Mounted Unit: Ensure the trailer meets the following:

(1) The trailer shall be painted Omaha orange, Federal Standard 595-B, Number 12243.

(2) The trailer shall be equipped with class-A lights, using a plug adaptor.

(3) The trailer shall be equipped with adjustable outrigger leveling pads (screw-type), one on each of the four frame corners, designed to be set up at the site with its own chassis and outriggers, without being hitched to a vehicle.

(4) The trailer shall be a see through design (no box designs) equipped with fenders over the tires and shall be made from heavy-duty metal sufficient to allow a person to stand and operate or perform maintenance on the unit.

(5) The trailer shall meet all equipment specifications set forth in Chapter 316 of the Florida Statutes, and by such rule, regulation or code that may be adopted by the Department of Highway Safety and Motor Vehicles.

990-9.6 Traffic Counter: The unit shall be fitted with a *non-intrusive* device, which counts the number of vehicles passing the Radar Speed Display Unit. The counter device shall be capable of:

(1) Digital readout of the number of vehicles passing the radar speed display unit.

(2) Digital readout of the number of vehicles exceeding the speed shown on the radar speed display unit.

990-10 Safety Warning Transmitter.

990-10.1 General: Manufacturers providing the device described herein shall provide a certified test report to the Engineer indicating the device meets these specification requirements.

990-10.2 Output Frequency:

- (1) 24.1 GHz.
- (2) Maximum Output Power; 25 milliwatts per square meter at 3 meters.
- (3) Output Beam; 23 inch [.584 m] maximum vertical, 25 inch [.4 m] maximum horizontal beam width at 3dBC points, vertically polarized (if transmitter is horizontally mounted).
- (4) Input Power; + 11.0 to + 16.0 volts DC. Negative ground, maximum current 0.75 amperes, except initial surge maximum of 1.5 amperes.
- (5) Data Transmission; Either of two output messages selected depending upon speed of host vehicle relative to programmed threshold speed (stationary message and moving message). Capable of transmitting multiple advanced warning messages at least 2 miles.
- (6) Threshold Speed; 10 mph [16 km].
- (7) Field Programmability; Output messages may be programmed by PC or terminal using optional accessory cable.

990-11 Temporary Traffic Control Signals.

990-11.1 General: Meet the physical display and operational requirements of conventional traffic signal described in the MUTCD for portable traffic signals. The standard includes but is not limited to the following:

- (1) Use signal heads having three 12 inch [305 mm] vehicular signal indications (Red, Yellow and Green). Ensure there are two signal heads for each direction of traffic.
- (2) The traffic signal heads on this device will be approved by the Department.
- (3) Department approved traffic signal lamps will be installed in each section with the filament opening in an upright position. Other Department approved lighting sources will be installed in each section in accordance with the manufacturer's permanent directional marking(s), that is, an "Up Arrow", the word "UP" or "TOP," for correct indexing and orientation within a signal housing.
- (4) The masts supporting the traffic signal heads will be manufactured with the lowest point of the vehicular signal head as follows:
 - (a) Eight feet [2.4 m] above finished grade at the point of their installation for "pedestal" type application or
 - (b) Seventeen to 19 feet [5.2 to 5.8 m] above pavement grade at the center of roadway for "overhead" type application.
- (5) The yellow clearance interval will be programmed three seconds or more. Under no condition can the yellow clearance interval be manually controlled. It must be timed internally by the controller as per Department specifications.
- (6) The green interval must display a minimum of five seconds before being advanced to the yellow clearance interval.
- (7) The controller will allow for a variable all red clearance interval from 0 to 999 seconds.
- (8) Portable traffic control signals will be either manually controlled or traffic actuated. Indicator lights for monitoring the signal operation of each approach will be supplied and visible from within the work zone area.
- (9) When the portable traffic control signals are radio actuated the following will apply:

(a) The transmitter will be FCC Type accepted and not exceed 1 watt output per FCC, Part 90.17. The manufacturer must comply with all “Specific limitations” noted in FCC Part 90.17.

(b) The Controller will force the traffic signal to display red toward the traffic approach in case of radio failure or interference.

(10) The trailer and supports will be painted construction/maintenance orange enamel in accordance with the MUTCD color.

(11) The device will meet NEMA environmental standard. The test report certified by an independent laboratory will be provided.

(12) Ensure the certification number is engraved or labeled permanently on equipment.

(13) Ensure the device has an external, visible, water resistant label with the following information: “Certification of this device by the Florida Department of Transportation allows for its use in Construction Zones Only.”