

**TEMPORARY TRAFFIC CONTROL DEVICE MATERIALS – SMART WORK ZONE  
(SWZ) MANAGEMENT SYSTEM  
(REV X-YZ-22)**

Article 990-2 is deleted and replaced by the following:

**990-2 Retroreflective Sheeting for Temporary Traffic Control Devices.**

**990-2.1 Approved Product List (APL):** Sheeting for use on Temporary Traffic Control Devices shall be one of the products listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6.

**990-2.1.1 Bands for Temporary Tubular Markers, Vertical Panels, Barricades, SWZ Location Devices, and other Devices:** Bands for temporary tubular markers, vertical panels, barricades, SWZ Location Devices, and other devices shall meet the requirements of ASTM D4956 for Type III or higher retroreflective sheeting materials identified in Section 994.

**990-2.1.2 Collars for Traffic Cones and SWZ Location Devices:** Collars for traffic cones and SWZ location devices shall meet the requirements of ASTM D4956 Type III or higher retroreflective prismatic sheeting materials identified in Section 994 including supplementary requirements for reboundable sheeting. The outdoor weathering shall be for 6 months for all sheeting types.

**990-2.1.3 Drums and SWZ Location Devices:** Drums and SWZ location devices shall meet the requirements of ASTM D4956 for Type III or higher retroreflective sheeting materials identified in Section 994 including supplementary requirements for reboundable sheeting.

**990-2.1.4 Sign Panels:** Meet the requirements of 990-8.

Article 990-3 is deleted and replaced by the following:

**990-3 Portable Devices (Arrow Boards, SWZ Arrow Boards, Changeable Message Signs, SWZ Changeable Message Signs, Regulatory Signs, Radar Speed Display Units and Truck Mounted Changeable Message Signs), Automated Flagger Assistance Devices, SWZ Variable Speed Limit Sign, SWZ Variable Speed Limit Sign with Electronic Speed Feedback Sign, SWZ Vehicle Detector, SWZ Camera).**

**990-3.1 General:** ~~With the exception of the smart work zone (SWZ) Camera and SWZ Vehicle Detector,~~ all portable devices shall meet the physical display and operational requirements of the Manual on Uniform Traffic Control Devices (MUTCD). ~~Except for SWZ location devices, all SWZ devices are mounted on trailers. SWZ arrow boards, SWZ changeable messages signs, SWZ variable speed limit sign, SWZ variable speed limit sign with electronic speed feedback sign, SWZ vehicle detector, and SWZ camera shall be listed on the Department's Innovative Product List (IPL). Arrow boards, changeable message signs, regulatory signs, radar speed display units, truck mounted changeable message signs, and automated flagger assistance devices shall~~ be listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6 and include the following:

Section. 1. Certification showing that the product meets the requirements of this

2. Drawings of the device along with technical information necessary for proper application, field assembly, and installation.

Portable devices shall meet the following requirements:

3. Ensure that all assembly hardware less than 5/8 inch in diameter, including nuts, bolts, external screws and locking washers are Type 304 or 316 passivated stainless steel. Stainless steel bolts, screws and studs shall meet ASTM F593. Nuts shall meet ASTM F594. All assembly hardware greater than or equal to 5/8 inch in diameter shall be galvanized. Bolts, studs, and threaded rod shall meet ASTM A307. Structural bolts shall meet ASTM F3125, Grade A325.

4. The controllers and associated on-board circuitry shall meet the requirements of the Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise by Class A digital devices. All electronic assemblies shall meet the requirements of NEMA TS-4-2016 Section 2.

5. The controller and associated on-board circuitry shall not be affected by mobile radio, or any other radio transmissions.

6. An operator's manual shall be furnished with each unit.

7. All portable devices shall be permanently marked with, manufacturer's name or trademark, model/part number, and date of manufacture or serial number.

8. Portable devices and trailers shall be delineated on a permanent basis by affixing retroreflective sheeting in a continuous line on the face of the trailer as seen by oncoming road users.

9. SWZ portable devices shall be equipped with wireless Global Positioning System (GPS) location and remote communication devices.

**990-3.1.1 Electrical Systems:**

**990-3.1.1.1 Solar Powered Unit:** The solar powered unit shall meet the following:

1. The unit shall provide automatic recharging of power supply batteries to normal operating levels with meters showing charge.

2. Solar array recovery time for arrow boards and regulatory signs shall be accomplished in a maximum of three hours.

3. Arrow boards and changeable message signs shall be designed to provide 180 days of continuous operation with minimum onsite maintenance.

**990-3.1.1.2 Battery Life Test:** Meet the following:

1. The photovoltaic unit shall be designed to provide 21 days of continuous operation without sunlight with a minimum of onsite maintenance for arrow boards, SWZ arrow boards, SWZ CCTV, SWZ changeable message signs, SWZ vehicle detector, SWZ variable speed limit sign, SWZ variable speed limit sign with electronic speed feedback sign, and changeable message signs, or 10 days of continuous operation without sunlight with a minimum of onsite maintenance for regulatory signs, and radar speed display units, or 2 days of continuous operation without sunlight with a minimum of onsite maintenance for Automated Flagger Assistance Devices.

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

3. The battery, controller, and power panel shall be designed to be protected from the elements and vandalism.
4. Automatic recharging of power supply batteries shall be provided with charge indicator meter.
5. An AC/DC battery charger unit shall be provided.

**990-3.1.2 Display Panel and Housing:** With the exception of SWZ Camera and SWZ Vehicle Detector, all portable devices shall meet the following requirements:

1. The display housing assembly shall be weather-tight.
2. Except for Automated Flagger Assistance Devices, 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
3. The display panel background and frame for the display assembly shall be painted flat black and shall meet Federal Specification TT-E-489.
4. The display panel for arrow boards and changeable message signs, when raised in the upright position, shall have a minimum height of 7 feet from the bottom of the panel to the ground, in accordance with the MUTCD. The display panel for radar speed display units, when raised in the upright position, will have a minimum height of 5 feet from the bottom of the panel to the ground.
5. The regulatory speed sign panel for regulatory signs, variable speed limit signs, variable speed limit signs with electronic speed feedback signs, and radar speed display units, when raised in the upright position, shall have a minimum height of 7 feet from the bottom of the regulatory sign panel to the ground.
6. 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.
7. The display panel for changeable message signs shall have a safety system to protect against the panel falling from the trailer to the roadway should the panel separate from the lift system.

**990-3.1.3 Controller:** The Controller shall meet the following:

1. Controller and control panel shall be housed in a weather, dust, and vandal resistant lockable cabinet.
2. Controller and associated on-board circuitry shall meet the requirements of the FCC Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise by Class A digital devices.
3. For changeable message signs and arrow boards ensure that the sign control software provides an on-site graphical representation that visibly depicts the message displayed on the sign face.
4. For changeable message signs, if remote communication is included, ensure that the sign controller is addressable through the Ethernet communications network using software that complies with the National Transportation Communications for ITS Protocol (NTCIP) 1101 base standard, including all amendments as published at the time of contract letting, the NTCIP Simple Transportation Management Framework, and conforms to Compliance Level 1. Ensure that the software implements all mandatory objects in the supplemental requirement SR-700-4.1.1-01, FDOT Dynamic Message Sign NTCIP Requirements, as published on the FDOT State Traffic Engineering and Operations Office web

site at the time of contract letting. Ensure that the sign complies with the NTCIP 1102v01.15, 2101 v01.19, 2103v02.07, 2201v01.15, 2202 v01.05, and 2301v02.19 standards. Ensure that the sign complies with NTCIP 1103v02.17, section 3. Ensure that additional objects implemented by the software do not interfere with the standard operation of mandatory objects.

5. The SWZ variable speed limit sign and the SWZ variable speed limit sign with Electronic Speed Feedback Sign shall support the NTCIP protocol. The variable speed limit display shall have the capability of being remotely changed. The sign location, speed value, and battery voltage shall be remotely accessible. The activity log report shall be available for download.

**990-3.1.4 Support Chassis:** The support chassis shall meet the following:

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

2. Both trailer and truck-mounted units are allowed for arrow boards and changeable message signs. Trailer mounted units are required for regulatory signs, ~~and~~ radar speed display units, SWZ Arrow Boards, SWZ Camera, SWZ Changeable Message Signs, SWZ Variable Speed Limit Sign, SWZ Variable Speed Limit Sign with Electronic Speed Feedback Sign, and SWZ Vehicle Detector. Automated Flagger Assistance Devices may be trailer or non-trailer units.

a. Trailer mounted unit:

1. The sign, power supply unit and all support systems shall be mounted on a wheeled trailer.

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, one on each of the four frame corners.

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

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

6. 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.

990-3.1.5 Cellular Modem: For SWZ devices, cellular modems shall be capable of providing 4G LTE and backward compatible with 3G communications. Cellular modems shall provide cellular communications via a removable subscriber identity module (SIM) card.

Cellular modems shall be capable of providing positional information with accuracy of 3 meters—including latitude and longitude—in real-time time to Traffic Management Center.

990-3.1.5.1 Network Interface: The cellular modem shall include a minimum of two Ethernet ports, which must provide 10/100 Base connections. All copper-based network interface ports utilized shall be registered jack (RJ)-45 connectors. The cellular modem unit shall adhere, at a minimum, to the following network requirements:

1. FirstNet broadband communications network

2. Multi-carrier support (AT&T, Verizon, and Sprint) by software configuration

3. 4G LTE cellular network support

4. License-free enterprise software supporting advance routing protocols, VPN, logging and authentication, and stateful firewall

**990-3.1.5.2 Protocols:** The unit shall have the ability to utilize, at a minimum, the following protocols:

1. Network: TCP/IP, UDP/IP
2. Routing: Network Address Translation (NAT), Port Address Translation (PAT), Dynamic Host Configuration Protocol, and Static Routing.
3. Application: SSH, SNMP, Radius Server Capable

**990-3.1.5.3 Event Reporting:** The unit shall have the capability to record and report, at a minimum, the following events in plain text:

1. Event Log
2. Email Notification of Link Status Changes
3. Bandwidth Status
4. Remote Syslog Host Capable

**990-3.1.5.4 Security:** The device shall have the following security provisions:

1. Ability to establish VPN tunnels
2. IPsec and SSL
3. Port forwarding

**990-3.1.5.5 Mechanical Specifications:** The cellular modem shall be permanently marked with manufacturer name or trademark, product or part number, date of manufacture, and serial number. All parts shall be made of corrosion-resistant materials, such as plastic, stainless steel, anodized aluminum brass, or gold-plated metal.

**990-3.1.5.6 Environmental Specifications:** The cellular modem shall perform all required functions under the following environmental conditions: -20 to 70 °C, 10 – 95%, non-condensing.

**990-3.1.5.7 Electrical Specifications:** Cellular modem must operate on a nominal voltage of 120 V alternating current ( $V_{AC}$ ). Supply an appropriate voltage converter for units that require operating voltages of less than 120  $V_{AC}$ .

**990-3.1.5.8 Antenna:** The antenna shall be fully compatible with the proposed cellular modem.

**990-3.2 Portable Arrow Board and SWZ Portable Arrow Board:**

**990-3.2.1 Arrow Board Matrix:**

1. 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 board message on a sunny day or a clear night. The arrow board size that is needed to meet the legibility distance is listed as follows:

Type	Minimum Size	Minimum Number of Elements	Minimum Legibility Distance
B	30 by 60 inches	13	3/4 mile
C	48 by 96 inches	15	1 mile

Type B arrow boards may be used on low to intermediate speed (0 mph to 50 mph) facilities or for maintenance or moving operations on any speed facility. Type C arrow boards shall be used for all other operations on high-speed (50 mph and greater) facilities and may be substituted for Type B arrow boards on any speed facility.

2. Devices shall meet all arrow board displays identified in the MUTCD.
3. The element lens should be 5-3/4 inches in diameter. Smaller element lens diameters are permissible only if they provide an equivalent or greater brightness indication and meet the legibility criteria in 990-3.2.1(a).
4. The color of the light emitted shall be in accordance with the MUTCD.
5. There shall be a 360 degree hood for close-up glare reduction.
6. 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.
7. The flashing rate of the element shall not be less than 25 flashes or more than 40 flashes per minute as required in the MUTCD.
8. The minimum element "on time" shall be 50% for the flashing arrow and 25% for the sequential chevron.

9. The SWZ portable arrow board shall use a wireless Global Positioning System (GPS) location and a remote communication device.

**990-3.3 Portable Changeable Message Sign and SWZ Portable Changeable Message Sign:**

**990-3.3.1 Message Matrix:**

1. Message matrix panel shall be a maximum height of 7 feet by a maximum width of 146 inches.
2. The matrix must be capable of displaying three lines of 8 characters using an 18 inch or 12 inch font. PCMS with a minimum font size of 18 inches shall be used on any speed facility. PCMS with a minimum font size of 12 inches may be used on facilities with speed limits of 45 mph or less.
3. The matrix must display characters that meet or exceed the numeral and letter sizes prescribed in the MUTCD and SHS (Standard Highway Signs) companion document. Fonts and graphics must mimic the characteristics of fonts and graphics defined in NEMA TS4, the MUTCD, and SHS.
4. Similar components shall be interchangeable.

**990-3.3.2 Operation and Performance:**

1. The message shall be displayed in upper case except when lower case is project specific and is allowed by the MUTCD.
2. The message matrix panel shall be visible from one-half mile.
3. The 18 inch letter height message shall be legible from 650 feet for nighttime conditions and 800 feet for normal daylight conditions.
4. The 12 inch letter height message shall be legible from 650 feet for nighttime conditions and 650 feet for normal daylight conditions.
5. Under variable light level conditions the sign shall automatically adjust its light source to maintain legibility.
6. The message panel shall have adjustable display rates, so that the entire message can be read at least twice at the posted speed.

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

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

9. The controller shall allow the operator to generate additional messages on site via the keyboard.

10. 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.

11. The SWZ PCMS shall use a wireless Global Positioning System (GPS) location and a remote communication device.

#### **990-3.4 Portable Regulatory Signs:**

**990-3.4.1 Sign Panel Assembly:** The sign panel assembly shall consist of a 24 inches by 30 inches "SPEED LIMIT XX" sign panel and a "WHEN FLASHING" sign panel, intended to notify oncoming traffic the speed limit where workers are present. The sign panel assembly shall meet the following minimum physical requirements:

1. The sign panel shall fold down and be pinned in place for towing. Maximum travel height shall be 80 inches.

2. Construct the sign panel and light housing to allow the unit to be operated in the displayed position at speeds of 30 mph. Design the sign panel assembly to withstand transport speeds of 65 mph.

3. Construct the sign panel such that, when in the raised position, the sign panel will have a height of 7 feet from the bottom of the lowest panel to the ground, in accordance with the MUTCD.

4. 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.

**990-3.4.2 Flashing Lights:** Provide a pair of hooded PAR 46 LED 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 with a flash rate of approximately 55 flashes per minute.

The lamp lens should be at least 5-3/4 inches 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.

#### **990-3.5 Portable Radar Speed Display Unit:**

**990-3.5.1 Display Unit Panel and Housing:** Meet the requirements of 990-3.1.2 and the following physical requirements as a minimum:

1. Provide capability to mount a 24 inches by 30 inches regulatory sign with interchangeable numbers showing the posted speed limit above the message display.

2. Provide legend "YOUR SPEED" either above or below the message display.

**990-3.5.2 Message Display:** The message display shall meet the following physical requirements as a minimum:

1. Provide a bright LED, two-digit speed display on a flat black background with bright yellow LEDs.

2. Each digit shall contain either a seven-segment layout or matrix-style design. Each digit shall measure a minimum 18 inches in height.

3. Speed display shall be visible from a distance of at least one-half mile and legible from a distance of at least 650 feet under both day and night conditions.

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

**990-3.5.3 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 V<sub>DC</sub> to 16.6 V<sub>DC</sub>. Fuse and reverse polarity protected.

4. Range of 1,000 feet for mid-size vehicle, capable of accurately sensing speeds of 10 mph to 99 mph with over speed function that operates when a vehicle approaches over the posted speed limit.

**990-3.6 Truck Mounted Changeable Message Sign:**

**990-3.6.1 General:** Truck mounted changeable message signs shall meet the physical display and operational requirements of the MUTCD and be listed on the APL.

1. Sign shall be secured on the vehicle for normal operation.

2. A fault light shall be located on rear of the sign and operate whenever the sign is displaying a message. The light shall flash at the same rate as the message being displayed.

3. An operator's manual shall be furnished with each sign.

4. The manufacturer name, model or part number, and date of manufacture or serial number shall be permanently affixed to the sign housing.

**990-3.6.2 Display Panel and Housing:**

1. The housing maximum size shall not exceed a width of 96 inches.

2. The housing shall be designed to withstand exposure to the elements and include a locking device to secure the housing from unauthorized entry.

3. Provisions (by convection or fan) shall be made for heat dissipation within the unit.

4. The message matrix panel background and frame for the dynamic message assembly shall be painted flat black, Federal Specification TT-E-489.

5. The face of the display shall be easily opened from the front. Faces that open up shall be locked to stay open far enough to allow for servicing of all message panel components.

6. The face of the sign shall be covered by an impact resistant polycarbonate face that aids against glare and includes an ultraviolet inhibitor to protect from fading and yellowing.

7. The display panel support structure, when raised in the upright position, shall be designed to allow for a minimum height of 7 feet from the bottom of the panel to the ground.

8. The unit shall have a manual and automatic control mechanism to 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.

**990-3.6.3 Message Matrix:**

1. The matrix shall utilize light emitting diodes (LED).
2. LEDs used shall be amber (590 nm dominate wavelength) and shall meet the visibility requirements of this specification. LEDs shall have a viewing angle no less than 30 degrees. LED intensity shall not fall below 80 percent within three years.
3. All display modules shall be identical and interchangeable.
4. The matrix shall be capable of displaying a minimum of two lines of eight characters each, using a 10 inch font that meets the height to width ratio and character spacing requirements in the MUTCD, Section 2L.04 (paragraphs 05, 06, and 08) and Section 6F.60, paragraph 15.

5. The matrix shall provide variable letter, graphic and symbol sizes from 10 to 36 inches. The matrix must display characters that meet or exceed the numeral and letter sizes prescribed in the MUTCD and SHS companion document. Fonts and graphics must mimic the characteristics of fonts and graphics defined in NEMA TS4, the MUTCD, and SHS.

#### **990-3.6.4 Electrical System:**

1. The power supply shall be a 12 V<sub>DC</sub> system designed to operate the sign with a dedicated battery that is charged by the vehicle electrical system, but isolated so it does not drain the vehicle battery.
2. All internal sign components shall be treated with a protective, weather-resistant polyurethane or silicone conformal coating to protect against the adverse effects of humidity and moisture.

#### **990-3.6.5 Sign Controller:**

1. The sign controller shall be housed inside the sign and shall be equipped with a security lockout feature to prevent unauthorized use.
2. An external weather-resistant, hand-held control keypad shall be used to display the message on the sign.
3. The sign controller shall have the capability to provide a predetermined or blank default message upon loss of controller function.

#### **990-3.6.6 Operation and Performance:**

1. The message shall be displayed in upper case.
2. The message matrix panel shall be visible from one-half mile. With a 10 inch character displayed, the sign shall be legible from a distance of 400 feet in both day and night conditions. Under variable light level conditions, the sign shall automatically adjust its light source to meet the 400 foot visibility requirement.
3. The sign shall have the capability to store a minimum of 40 common messages and graphics of which a minimum of 30 shall be user-programmable messages.
4. All messages shall be capable of being flashed or sequenced. In the sequence mode, the message shall consist of no more than two phases, with each phase consisting of no more than three lines of text. Both message dwell time and message flash rate shall be individually programmable.

#### **990-3.7 Automated Flagger Assistance Devices (AFAD):**

**990-3.7.1 General:** AFAD's shall meet the physical display and operational requirements in the MUTCD and be listed on the APL. Manufacturers seeking evaluation of their product for the APL must include detailed vendor drawings, signed and sealed by a Professional Engineer registered in the State of Florida, showing typical application of the device in accordance with Standard Plans, Index 102-603. All electronic assemblies shall meet the requirements of NEMA TS-5-2017 Section 4.

**990-3.7.2 Stop/Slow Automated Flagger Assistance Devices:** Provide a remotely operated Stop/Slow AFAD including a Stop/Slow sign that alternately displays the stop face and the slow face of a Stop/Slow paddle.

When a gate arm is used, ensure that the gate arm descends to a down position across the approach lane of traffic when the stop face is displayed and then ascends to an upright position when the slow face is displayed.

Ensure the gate arm is fully retroreflectorized on both sides, with vertical alternating red and white stripes at 16 inch intervals measured horizontally in accordance with the MUTCD. When the arm is in the down position blocking the approach lane:

1. The minimum vertical aspect of the arm and sheeting shall be 2 inches; and,
2. The end of the arm shall reach at least to the center of the lane being controlled.

**990-3.7.3 Red/Yellow Lens Automated Flagger Assistance Devices:** Provide a remotely operated Red/Yellow Lens AFAD that alternately displays a steadily illuminated circular red lens and a flashing circular yellow lens to control traffic.

Ensure that the Red/Yellow Lens AFAD includes a gate arm that descends to a down position across the approach lane of traffic when the steady circular red lens is illuminated and then ascends to an upright position when the flashing circular yellow lens is illuminated.

Ensure that the gate arm is fully retroreflectorized on both sides, with vertical alternating red and white stripes at 16 inch intervals measured horizontally in accordance with the MUTCD. When the arm is in the down position blocking the approach lane:

1. The minimum vertical aspect of the arm and sheeting shall be 2 inches; and,
2. The end of the arm shall reach at least to the center of the lane being controlled.

Do not provide a change interval between the display of the steady circular red indication and the display of the flashing circular yellow indication. Provide a steady illuminated circular yellow indication, with at least a 5 second duration, between the transition from flashing circular yellow indication and the display of the steady circular red indication. The Engineer may approve a different duration, provided it falls within the range recommended by the MUTCD.

**990-3.8 SWZ Variable Speed Limit (VSL) Sign and VSL with Electronic Speed Feedback Sign (ESFS):** The size of the VSL sign shall meet the requirements of MUTCD Section 2B.03. The VSL sign letter height shall be designed in accordance with the FHWA Standard Highway Signs 2012 Supplement. The VSL sign legend "SPEED LIMIT" shall be a black legend on a white retroreflective background. The VSL legend shall be displayed in white LEDs on an opaque black background. The VSL must be able to display speed limits from 5-70 mph in five mph increments.

The ESFS shall be mounted below the speed limit sign. The ESFS displays to the approaching drivers the speed at which they are traveling. The changeable portion of the ESFS display panel shall be approximately the same height, width, and stroke of the VSL display. The vehicle speed feedback plaque shall be mounted above the ESFS display.

The ESFS speed threshold must automatically calibrate to the new SWZ portable VSL sign value.

**990-3.9 Smart Work Zone Vehicle Detector:** The SWZ vehicle detector must meet the requirements of Section 995. The SWZ vehicle detector must collect speed and volume data, 24 hours, seven days a week, in all weather conditions. The SWZ vehicle detector must be compatible with the SWZ central processor.

**990-3.10 Portable SWZ Camera:** The pan-tilt-zoom CCTV cameras must meet the requirements of Section 996, except for the environmental and SunGuide requirements.

Article 990-13 is deleted and replaced by the following:

### **990-13 Channelizing Devices.**

**990-13.1 General:** Provide channelizing devices in accordance with the MUTCD and the dimensions shown in the Standard Plans. SWZ location devices shall be provided in accordance with the Developmental Design Standards. SWZ location devices shall be equipped with wireless Global Positioning System (GPS) location and remote communication devices. The SWZ location device shall be designed to provide 10 days of continuous autonomous operation without recharging.

**990-13.2 Product Application:** Manufacturers seeking inclusion of channelizing devices on the APL shall submit the following:

1. For Cones, Drums, and Temporary Tubular Markers:
  - a. Photographs
  - b. Drawings of sufficient detail to distinguish between similar devices
  - c. Manufacturer self-certification of MASH compliant
2. For Barricades and Vertical Panels:
  - a. Installations Instructions
  - b. Photographs
  - c. Drawings (may be included in Installation Instructions) of sufficient detail to distinguish between similar devices
  - d. Any field assembly details and technical information necessary for proper application and installation
  - e. Crash testing reports demonstrating the device meets MASH TL-3
  - f. All relevant FHWA Eligibility Letters

Section 990 is expanded by the following:

**990-17 Smart Work Zone Central Processor:** The central processor shall meet the following:

1. Two-way secured wireless communication with the roadside equipment including SWZ arrow boards, SWZ Camera, SWZ portable changeable message signs (PCMS), SWZ variable speed limit (VSL) signs, SWZ VSLs with electronic speed feedback signs, SWZ vehicle detectors, and SWZ Location Devices.

2. Collect operational status of all work zone equipment. The software interface must display the current status (device location, on/off, SWZ arrow board display, SWZ PCMS message, SWZ VSL value, traffic volume and speed data, communication status, power level) in both a List and Map view.

3. The Map view must show common device icons and color-coded sensors and roadway segments based on vehicle speed data. The Map must utilize a common mapping base (Google, Waze, etc.) and be scalable.

4. Capable of acquiring traffic speed data and selecting messages automatically without operator intervention after initialization. The lag time between changes in speed threshold ranges and the posting of the appropriate SWZ message(s) must be no greater than 60 seconds.

5. The processed data is used as an input in the system logic to remotely control the messages displayed on the SWZ PCMS. The SWZ vehicle detector must provide speed data to an external system controller every minute, which must utilize the approved system logic and automatically control the associated SWZ PCMS message every minute.

6. Capable of providing warning and distance-based outputs regardless of the order the vehicle detectors are deployed. The adjustment must be automatic and must occur within ten minutes of deployment or any shifts or order change of devices.

7. Capable of storing and displaying messages created by the Department and logging this action when overriding any default automatic advisory message.

8. Capable of sending alerts via SMS, email, and SNMP.

9. Server-based, located in a secure cloud environment.

10. Incorporates an error detection and correction mechanism to ensure the integrity of all traffic conditions data and motorist information messages. Any required configuration of the communication system must be performed automatically during system initialization.

11. Stores system raw data for post-processing, reporting, and evaluation. The reports shall include the number of crashes, traffic volumes through the work zone, travel times through the work zone, time stamped work zone speed limits, time stamped PCMS messages, and work zone layout.

12. Post processed data shall comply with the AASHTO Connected and Automated Vehicle requirement: <https://cav.transportation.org/work-zones/>.

13. Capable of publishing the WZDx data feed from the system in real-time via a secured API endpoint to authenticated and authorized subscribers.