



Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

October 23, 2023

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: 997
Proposed Specification: **9970000 Traffic Monitoring Site Materials
Associated with Specification Revision 6950000**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Victor Johnson to update the language to meet Division III requirements.

Please review and transmit your comments, if any, within two weeks (10 business days). Comments should be sent via email daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on File

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh

Attachment

cc: Florida Transportation Builders' Assoc.
State Construction Engineer

Note: This revision has numerous instances of original language moved to various Articles.

TRAFFIC MONITORING SITE MATERIALS.

(REV 10-16-23)

SECTION 997 is deleted and the following substituted:

997-1 Description.

This Section governs the requirements for all traffic monitoring site (TMS) material as shown in the Plans and Standard Plans.

Provide products compatible with all other TMS APL equipment. Any electronics unit or software submitted for approval must be compatible with or convert the data into a format compatible with the Department's polling and processing software. Any substitute software modules submitted must be tested and approved by the Department.

Provide products constructed of corrosion-resistant materials, such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal. All fasteners exposed to the elements shall be Type 304 or 316 passivated stainless steel.

Provide warranties that are fully transferrable to the Department. Terms and conditions of warranties must be documented when submitting a request to the Department for certification. Include terms for a specified service performance with provisions for repair parts and labor, or for replacement.

Ensure the terms and conditions define the equipment installation date as the date for such warranty to be in effect. The installation date for construction projects is the day the site is accepted by the Engineer. For warehouse purchases, the installation date is the date of visual inspection approval, not to exceed ten days after delivery date.

Furnish replacements within 10 calendar days of notification for any part or equipment found to be defective during the warranty period at no cost to the Department.

997-1.1 Approved Product List Submittal Requirements: All products shall be listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their product for inclusion on the APL shall submit an application in accordance with Section 6 including documentation identified in Table 997-1 and this section. Documentation must demonstrate that the product meets the requirements of this Section.

Table 997-1	
Documentation	Requirements
Technical Data Sheets	<u>Provide information as required in this Section. This document will be used to verify physical and performance properties.</u>
Product Label <u>Photo</u>	Provide equipment permanently marked with manufacturer name or trademark, part number, and date of manufacture or serial number.
Product Sample	When requested, submit a product sample.
Installation <u>Instructions Manual</u>	<u>Required Instructions describing mounting, cabling, and configuration.</u>
Product Photo	Display significant features of the products.

Note: This revision has numerous instances of original language moved to various Articles.

997-2 TMS Vehicle Sensors (Non-Weight).

997-2.1 General: Non-weight vehicle sensors include inductive loops, Class II piezoelectric axle sensors, microwave radar, and ~~non-motorized sensors~~ video data collection technologies.

997-2.2 Wire for Inductive Loops: Materials used in the creation of the inductive loops must meet the material specification of No. 14 AWG International Municipal Signal Association (IMSA) 51-7 wire.

997-2.2-3 Class II Piezoelectric Axle Sensor and Non-Motorized Sensor: In-Roadway Class II piezoelectric axle sensors shall meet the physical characteristics in Table 997-2.

Table 997-2 Physical Characteristics, <u>Class II Piezoelectric</u> Axle Sensor		
Property	<u>Documentation</u>	Requirements
Sensor Element Dimensions	<u>Technical Data Sheet</u>	Approximately 6 ft. to 10 ft. in length, 3/16 in. to 3/8 in. in diameter (varies by manufacturer)
Sensor Element Material	<u>Technical Data Sheet</u>	Pressure sensing piezoelectric
Pavement Operating Temperature Range	<u>Technical Data Sheet</u>	Minimum 0°F to +150°F
Output Signal	<u>Technical Data Sheet</u>	Minimum +200mV or produce a charge signal for <u>passenger car/pickup truck axle @ 70°F with less than 10% negative signal for non-WIM axle sensors</u> <u>a FHWA Class 2 Vehicle.</u>
Environmental Requirements	<u>Technical Data Sheet</u>	NEMA TS-2- 2016 , Section <u>32</u> .

997-2.4 Microwave Radar Sensor: Sensors shall meet the physical characteristics in Table 997-3.

Table 997-3 Physical Characteristics, Microwave Radar Sensor	
<u>Property</u>	<u>Requirement</u>
<u>Detection Range</u>	<u>A minimum of 8 distinguishable lanes within a minimum 200 feet of detection zone.</u>
<u>Direction</u>	<u>Bidirectional</u>
<u>Operating Temperature Range</u>	<u>Ambient temperature of 0°F to 140°F</u>

Note: This revision has numerous instances of original language moved to various Articles.

<u>Table 997-3</u> <u>Physical Characteristics, Microwave Radar Sensor</u>	
<u>Enclosure Dimensions</u>	<u>Weatherproof aluminum, stainless steel, or polycarbonate housing. Typically, up to 15" X 12" X 6"</u> <u>Weight typically <10 lbs.</u>
<u>Operating Frequency</u>	<u>Wireless transmission in Federal Communications Commission (FCC) approved band or unlicensed RF range.</u>
<u>Communications</u>	<u>RS-232/RS-485 ports, supports minimum 19,200 baud rate.</u>
<u>Data Interface Compatibility</u>	<u>Compatible with the vehicle speed/classification unit and the Department's traffic polling system.</u>

997-2.5 Video Sensor: Sensors shall meet the physical characteristics in Table 997-4. Cameras shall be compliant with the Code of Federal Regulations Section 200.216 Prohibition on certain telecommunications and video surveillance services or equipment.

<u>Table 997-4</u> <u>Performance Characteristics, Video Sensor</u>	
<u>Property</u>	<u>Requirements</u>
<u>Configuration</u>	<u>Displays detection zones, activations, overlaid on live video inputs.</u>
<u>Configuration</u>	<u>Editable detection zone size, placement, and sensitivity. Parameters stored in and retrieved from nonvolatile memory.</u>
<u>Processor</u>	<u>Video analysis, presence detection, data collection, storage and reporting of detection data.</u>
<u>Communications</u>	<u>TIA-232, 10/100 Base TX, FCC certified secure wireless, or cellular compatible with Agency's carrier. Department must approve carrier.</u>
<u>Communications</u>	<u>CDMA compatible</u>
<u>Solid State Detection Output</u>	<u>NEMA TS2, 6.5.2.26</u>
<u>Environmental Requirements</u>	<u>NEMA TS-2, Section 2.</u>

997-3 ~~Weight Sensors (In Roadway)~~ TMS Non-Motorized Sensors.

997-3.1 General: ~~Weight sensors include bending plates, Class I piezoelectric sensors, and quartz piezoelectric sensors~~ Non-Motorized sensors include inductive loops, axle sensors, infrared, and video data collection technologies. Non-intrusive non-motorized sensors detect non-motorized vehicles and pedestrians using passive detection.

Note: This revision has numerous instances of original language moved to various Articles.

997-3.2 ~~Bending Plate~~ Wire for Inductive Loops for Non-Motorized Data Collection:

~~Provide bending Plate Weigh In Motion systems that utilize plates with strain gauges bonded to the underside. The weigh pads shall meet the physical characteristics in Table 997-4. Materials used in the creation of the inductive loops must meet the material specification of No. 14 AWG International Municipal Signal Association (IMSA) 51-7 wire.~~

Table 997-4 Physical Characteristics, Bending Plate, Weigh Pad		
Property	Documentation	Requirements
Sensor Size	Technical Data Sheet	20-in. wide x 70-in. or 50-in. long
Operating Temperature Range	Technical Data Sheet	-50°F to 176°F
Scale Capacity	Technical Data Sheet	45000 pounds per axle and overload protected to 80000 pounds per axle
Environmental Requirements	Technical Data Sheet	NEMA TS-2-2016, Section 3.

997-3.3 ~~Piezoelectric Axle Sensor (Class I)~~ Axle Sensor for Non-Motorized Data

Collection: ~~Class I sensors collect Weigh In Motion data. The vehicle sensor shall meet the physical characteristics in Table 997-5. Non-motorized Class I or II axle sensors shall meet the physical characteristics in Table 997-5. In Sidewalk and Shared Use Path non-motorized sensors shall meet the physical characteristics in Table 997-3.~~

Table 997- 5 <u>5</u> Physical Characteristics, Non-Motorized <u>Axle</u> Sensor		
Property	Documentation	Requirements
Sensor Element Dimensions	Technical Data Sheet	Approximately 3 ft. in length, 3/16 in. to 3/8 in. in diameter (varies by manufacturer)
Sensor Element Material	Technical Data Sheet	Pressure sensing piezoelectric
Pavement Operating Temperature Range	Technical Data Sheet	Minimum 0°F to +150°F
Output Signal Range	Technical Data Sheet	Minimum +34 mV (front axle) and +65mV (rear axle), 220 lbs. Passenger bicycle, at 7.3 MPH
Environmental Requirements	Technical Data Sheet	NEMA TS-2-2016, Section 3.

997-3.4 ~~Quartz Piezoelectric Sensor~~ Infrared for Non-Motorized Sensor Data

Collection: ~~The quartz piezoelectric sensors collect Weigh In Motion data. The quartz Non-motorized infrared sensors shall meet the physical characteristics in Table 997-6.~~

Note: This revision has numerous instances of original language moved to various Articles.

<u>Table 997-6</u> <u>Physical Characteristics, Quartz Piezoelectric Sensor</u>		
<u>Property</u>	<u>Documentation</u>	<u>Requirements</u>
Measuring Range wheel load (At a referenced tire contact area)	Technical Data Sheet	0 to 34000 pounds (8 in. by 12.6 in.)
Overload (twin wheel)	Technical Data Sheet	55000 pounds
Sensitivity—Nominal	Technical Data Sheet	7.6 ± 12% pC/lbf
Sensitivity shift over sensor length	Technical Data Sheet	≤ ± 3%
Threshold	Technical Data Sheet	< 0.1 lbf
Linearity	Technical Data Sheet	≤ ± 2% Full Scale Output
Hysteresis	Technical Data Sheet	≤ 2% Full Scale Output
Natural Frequency	Technical Data Sheet	> 5 kHz
Operating Temperature range	Technical Data Sheet	-40°F to 176°F
Temperature coefficient of sensitivity	Technical Data Sheet	-0.04%/°F
Operating Speed	Technical Data Sheet	5 MPH to 100 MPH
Insulation resistance	Technical Data Sheet	> 100 giga ohms
Capacitance with 130 ft. cable	Technical Data Sheet	8 to 12 nano farad
Environmental Requirements	Technical Data Sheet	NEMA TS-2 2016, Section 3.

<u>Table 997-6</u> <u>Physical Characteristics, Non-Motorized Infrared Sensor</u>	
<u>Property</u>	<u>Requirement</u>
<u>Temperature Sensitivity</u>	2°F from ambient temp.
<u>Detection Range</u>	3 ft. to 18 ft.
<u>Direction</u>	<u>Bidirectional</u>
<u>Operating Temperature Range</u>	-13°F to 120°F

997-3.5. Video Sensor: Sensors shall meet the physical characteristics in Table 997-7. Cameras shall be compliant with the Code of Federal Regulations Section 200.216 Prohibition on certain telecommunications and video surveillance services or equipment.

<u>Table 997-7</u> <u>Performance Characteristics, Video Sensor</u>	
<u>Property</u>	<u>Requirements</u>
<u>Configuration</u>	<u>Displays detection zones, activations, overlaid on live video inputs.</u>
<u>Configuration</u>	<u>Editable detection zone size, placement, and sensitivity. Parameters stored in and retrieved from nonvolatile memory.</u>
<u>Processor</u>	<u>Video analysis, presence detection, data collection, storage and reporting of detection data.</u>

Note: This revision has numerous instances of original language moved to various Articles.

<u>Table 997-7</u> <u>Performance Characteristics, Video Sensor</u>	
<u>Communications</u>	<u>TIA-232, 10/100 Base TX, FCC certified secure wireless, or cellular compatible with Agency's carrier. Department must approve carrier.</u>
<u>Solid State Detection Output</u>	<u>NEMA TS2-2021, 6.5.2.26</u>
<u>Environmental Requirements</u>	<u>NEMA TS-2, Section 2.</u>

997-3.4 TMS Weight Vehicle Sensors (In-Roadway Weight for Motorized Vehicle Data Collection).

997-3.4.1 General: Weight sensor arrays include bending plates, Class I piezoelectric inductive loops with strain gauge sensors, and or quartz piezoelectric sensors.

997-4.2 Wire for Inductive Loop: Materials used in the creation of the inductive loops must meet the material specification of No. 14 AWG International Municipal Signal Association (IMSA) 51-7 wire.

997-3.4.2.3 Bending Plate Strain Gauge Sensor: Provide bending Plate Weigh-In-Motion (WIM) systems that utilize plates with strain gauges bonded to the underside or one-piece gauge strip scale. The weigh pad strain gauge sensors shall meet the physical characteristics in Table 997-48.

<u>Table 997-48</u> <u>Physical Characteristics, Bending Plate, Weigh Pad Strain Gauge Sensor</u>		
<u>Property</u>	<u>Documentation</u>	<u>Requirements</u>
<u>Sensor Size</u>	<u>Technical Data Sheet</u>	<u>.5 in. to 20 in. wide x 70 in. or 50 in. to 80 in. long</u>
<u>Operating Temperature Range</u>	<u>Technical Data Sheet</u>	<u>-50°F to 176°F</u>
<u>Scale Capacity</u>	<u>Technical Data Sheet</u>	<u>45,000 pounds per axle and overload protected to 80000 pounds per axle</u>
<u>Environmental Requirements</u>	<u>Technical Data Sheet</u>	<u>NEMA TS-2-2016, Section 23.</u>

997-3.3 Piezoelectric Axle Sensor (Class I): Class I sensors collect Weigh In Motion data. The vehicle sensor shall meet the physical characteristics in Table 997-5.

<u>Table 997-5</u> <u>Physical Characteristics, Piezoelectric Axle Sensor, Class I</u>		
<u>Property</u>	<u>Documentation</u>	<u>Requirements</u>
<u>Sensor Size</u>	<u>Technical Data Sheet</u>	<u>6 ft. to 8 ft. Flat Element 0.26 in. wide x 0.063 in. thick</u>
<u>Operating Temperature Range</u>	<u>Technical Data Sheet</u>	<u>-40°F to 160°F</u>
<u>Temperature sensitivity</u>	<u>Technical Data Sheet</u>	<u>0.2%/°F</u>
<u>Output Uniformity</u>	<u>Technical Data Sheet</u>	<u>5% to 7%</u>
<u>Output Signal</u>	<u>Technical Data Sheet</u>	<u>250 mV for 400 pound wheel load at 70 F° and 55 mph</u>

Note: This revision has numerous instances of original language moved to various Articles.

		[250 mV for 181 kg wheel load at 21 C° and 88 kph] Minimum
Insulation Resistance	Technical Data Sheet	> 500 MΩ
Passive Signal Cable	Technical Data Sheet	RG 58 C/U with High Density Polyethylene Outer Jacket 0.187" [4.75 mm] OD
Center Core	Technical Data Sheet	16-gauge, flat braided, silver plated copper wire
Piezoelectric Material	Technical Data Sheet	Spiral Wrapped PVDF piezoelectric film
Cable Capacitance	Technical Data Sheet	27 pF/ft [89 pF/m]
Piezoelectric Coefficient	Technical Data Sheet	34 pC/N—nominal
Life	Technical Data Sheet	40 Million ESAL's [Minimum]
Environmental Requirements	Technical Data Sheet	NEMA TS-2-2016, Section 3.

997-34.4 Quartz Piezoelectric Sensor: The ~~q~~Quartz piezoelectric sensors use one piece quartz crystal sensors to collect Weigh-In-Motion data. The quartz sensor shall meet the physical characteristics in Table 997-~~69~~.

Property	Documentation	Requirements
Measuring Range wheel load (At a referenced tire contact area)	Technical Data Sheet	0 to 34000 pounds (8 in. by 12.6 in.)
Overload (twin wheel)	Technical Data Sheet	55000 pounds
Sensitivity – Nominal	Technical Data Sheet	7.6 ± 12% pC/lbf
Sensitivity shift over sensor length	Technical Data Sheet	<± 3%
Threshold	Technical Data Sheet	<0.1 lbf
Linearity	Technical Data Sheet	<± 2% Full Scale Output
Hysteresis	Technical Data Sheet	≤ 2% Full Scale Output
Natural Frequency	Technical Data Sheet	> 5 kHz
Operating Temperature range	Technical Data Sheet	-40°F to 176°F
Temperature coefficient of sensitivity	Technical Data Sheet	-0.04%/°F
Operating Speed	Technical Data Sheet	5 MPH to 100 MPH
Insulation resistance	Technical Data Sheet	> 100 giga-ohms GΩ
Capacitance with 130 ft. cable	Technical Data Sheet	8 to 12 nano-farad nF
Environmental Requirements	Technical Data Sheet	NEMA TS-2- 2016 , Section 3 2

997-45 TMS Solar Power Unit for Motorized Data Collection.

997-45.1 General: ~~Provide s~~Solar power unit ~~consisting~~ consists of the following components: solar panel(s) and mounting hardware; 12 V storage battery; and voltage regulator with wiring and associated mounting hardware.

Note: This revision has numerous instances of original language moved to various Articles.

997-4.5.2 Solar Panel Configured for Nominal 12 V_{DC}: Solar panels cannot have internal voltage regulators and must be capable of multiple arrays and series or parallel wiring configurations. Meet the physical characteristics in Table 997-710:

Table 997-710 Physical Characteristics, Solar Panel		
Property	Documentation	Requirements
Peak power range	Technical Data Sheet	80-85 to 130-300 watts
Voltage	Technical Data Sheet	Maximum power voltage greater than 16.5 V at 77°F
Current	Technical Data Sheet	Maximum power current greater than 2.85 A at 77°F
Photovoltaic modules construction	Technical Data Sheet	Mono or poly-crystalline cells
Efficiency Rating		Minimum 20%
App Frame construction	Technical Data Sheet	Anodized aluminum
Mounting hardware construction	Technical Data Sheet	Anodized, galvanized or stainless-steel

997-4.5.3 Battery 12 V: Meet the physical characteristics in Table 997-811:

Table 997-811 Physical Characteristics, Battery 12 V		
Property	Documentation	Requirements
		Rechargeable for photovoltaic application.
Battery Chemistry		Rechargeable valve regulated lead-calcium gelled electrolyte or absorbed glass mat for photovoltaic applications
Case Construction	Technical Data Sheet	ABS Plastic or Polypropylene
Current discharge rate	Technical Data Sheet	Minimum of 100 hours at 0.9 amperes
Dimensions	Technical Data Sheet	Approximately Maximum of 12 inches by 7-8 inches by 9-10 inches

997-4.5.4 Voltage Regulator Configured for Nominal 12 V_{DC}: Meet the physical characteristics in Table 997-912:

Table 997-912 Physical Characteristics, Voltage Regulator		
Property	Documentation	Requirements
Voltage for battery charging.	Technical Data Sheet	Minimum of 13.5 V _{DC}

Note: This revision has numerous instances of original language moved to various Articles.

<u>Begin Charging-Battery Voltage</u>		Begin charging when battery voltage is 13.3 V or less
<u>End Charging-Battery Voltage</u>		Discontinue charging when battery voltage is <u>Maximum of</u> 14.5 V
Quiescent current	<u>Technical Data Sheet</u>	Maximum 15 mA
<u>Charge rating</u>		<u>Minimum of 20 A.</u>
Operating Temperature range	<u>Technical Data Sheet</u>	<u>Range: 0 to 122°F</u>
Dimensions	<u>Technical Data Sheet</u>	Approximately 2 inches by 5 inches by 1 inch.

997-6 TMS Solar Power Unit for Non-Motorized Data Collection.

997-6.1 General: Solar power unit consists of the following components: solar panel(s) and mounting hardware; 12 V storage battery; and voltage regulator with wiring and associated mounting hardware.

997-6.2 Solar Panel Configured for Nominal 12 V_{DC}: Solar panels cannot have internal voltage regulators and must be capable of multiple arrays and series or parallel wiring configurations. Meet the physical characteristics in Table 997-13.

<u>Table 997-13</u> <u>Physical Characteristics, Solar Panel</u>	
<u>Property</u>	<u>Requirements</u>
<u>Peak power range</u>	<u>65 to 300 watts</u>
<u>Voltage</u>	<u>Maximum power voltage greater than 16.5 V at 77°F</u>
<u>Current</u>	<u>Maximum power current greater than 2.85 A at 77°F</u>
<u>Photovoltaic modules construction</u>	<u>Mono or poly-crystalline cells</u>
<u>Efficiency Rating</u>	<u>Minimum 20%</u>
<u>Frame construction</u>	<u>Anodized aluminum</u>
<u>Mounting hardware construction</u>	<u>Anodized, galvanized, or stainless steel</u>

997-6.3 Battery 12 V: Meet the physical characteristics in Table 997-14.

<u>Table 997-14</u> <u>Physical Characteristics, Battery 12 V</u>	
<u>Property</u>	<u>Requirements</u>
<u>Battery Chemistry</u>	<u>Rechargeable valve regulated lead-calcium gelled electrolyte or absorbed glass mat for photovoltaic applications</u>
<u>Case Construction</u>	<u>ABS Plastic or Polypropylene.</u>

Note: This revision has numerous instances of original language moved to various Articles.

<u>Table 997-14</u> <u>Physical Characteristics, Battery 12 V</u>	
<u>Property</u>	<u>Requirements</u>
<u>Current discharge rate</u>	<u>Minimum of 21 to 100 hours</u> <u>at 0.9 amperes</u>
<u>Dimensions</u>	<u>Maximum of 12 inches by</u> <u>8 inches by 10 inches</u>

997-6.4 Voltage Regulator Configured for Nominal 12 VDC: Meet the physical characteristics in Table 997-15.

<u>Table 997-15</u> <u>Physical Characteristics, Voltage Regulator</u>	
<u>Property</u>	<u>Requirements</u>
<u>Charging Voltage</u>	<u>Minimum of 13.5 V_{DC}</u>
<u>Begin Charging- Battery Voltage</u>	<u>13.3 V or less</u>
<u>End Charging- Battery Voltage</u>	<u>Maximum of 14.5 V</u>
<u>Quiescent current</u>	<u>Maximum 15 mA</u>
<u>Charge rating</u>	<u>Minimum of 20 amps</u>
<u>Operating Temperature range</u>	<u>Range: 0 to 122°F</u>
<u>Dimensions</u>	<u>2 inches by 5 inches by 1 inch</u>

997-5.7 Site-TMS System Communications Modem: Meet the physical characteristics in Table 997-~~1016~~. Modems shall be compliant with the Code of Federal Regulations Section 200.216 Prohibition on certain telecommunications and video surveillance services or equipment.

<u>Table 997-1016</u> <u>Physical Characteristics, <u>Site-TMS</u> Modem</u>		
<u>Property</u>	<u>Documentation</u>	<u>Requirements</u>
Configuration	<u>Technical Data Sheet</u>	1.The device shall be field configurable to be powered from 12 VDC. 2.The device shall have the ability and be configured to utilize a network service that shall be at a minimum 4G LTE with fallback to 3G EV-DO.

Note: This revision has numerous instances of original language moved to various Articles.

Table 997- 10 16 Physical Characteristics, Site TMS Modem		
Property	Documentation	Requirements
Protocols: The device shall have the ability to utilize, at a minimum, the following protocols:	Technical Data Sheet	<ol style="list-style-type: none"> 1. Network: TCP/IP, UDP/IP, Domain Name System (DNS) 2. Routing: Network Address Translation (NAT), Host Port Routing, DHCP, Point-to-Point Protocol over Ethernet (PPPoE), VLAN, Virtual Router Redundancy Protocol (VRRP), Reliable Static Route. 3. Application: Short Message Service (SMS), Telnet/SSH, Reverse Telnet, Simple Mail Transfer Protocol (SMTP), SNMP, SNTP, Reliable Static Route 4. Serial: TCP/UDP Packet Assembly Disassembly (PAD) Mode, Modbus (ASCII, RTU, Variable), Point-to-Point Protocol (PPP)
<u>Communication Transmission</u>		<u>Code Division Multiple Access (CDMA) capable.</u>
Event Reporting: The device shall have the capability to record and report, at a minimum, the following events in plain text:	Technical Data Sheet	<ol style="list-style-type: none"> 1. Network parameters 2. Data usage 3. Power 4. Device temperature 5. Digital input 6. Global Positioning 7. System/Automatic 8. Vehicle Locator (GPS/AVL) 9. Timer
Security: The device shall have the following security provisions:	Technical Data Sheet	<ol style="list-style-type: none"> 1. Ability to establish VPN tunnels. 2. IPsec, Secure Sockets Layer (SSL), and Generic Routing Encapsulation (GRE) VPN client 3. Port forwarding and Demilitarized Zone (DMZ) 4. Port filtering 5. Trusted IP 6. MAC address filtering
Operating Temperature range	Technical Data Sheet	Minimum 0 to 158°F
<u>FCC Certification</u>		<u>FCC identification number displayed on an external label on the equipment</u>
<u>Number of SIM slots</u>		<u>Minimum of two SIM slots. SIM cards provided by the Department</u>
<u>Minimum Ethernet Port Speed</u>		<u>10/100 Base-TX</u>

Note: This revision has numerous instances of original language moved to various Articles.

Table 997- 10 16		
Physical Characteristics, <u>Site TMS</u> Modem		
Property	Documentation	Requirements
Antenna: Use an antenna that meets the following requirements:	Technical Data Sheet	1. Dual diversity 2. Minimum NEMA rating of NEMA 3 3. Frequencies: F₁ = 824 to 896 MHz, F₂ = 1850 to 1990 MHz, F₃ = 1850 to 1955 MHz, F₄ = 1710 to 1770 MHz, F₅ = 2110 to 2170 MHz 4. Voltage Standing Wave Ratio (VSWR) of 1.5:1 or less at resonant point 5. 50 Ω nominal impedance 6. Gain of 3.0 dB to 5.15 dB 7. Omni-directional radiation pattern 8. Vertical polarization 9. Glass-filled polypropylene radome 10. Adhesive mounting or Bolt mount 11. SMA male plug connectors 10 ft. (minimum) coaxial length

997-8 TMS Modem Antenna.

Meet the physical characteristics in Table 997-17.

Table 997-17	
Physical Characteristics, TMS Modem Antenna	
<u>Property</u>	<u>Requirements</u>
<u>Antenna Requirements</u>	<u>1. Dual diversity</u> <u>2. Minimum NEMA rating of NEMA 3</u> <u>3. Frequencies: F₁ = 824 to 896 MHz, F₂ = 1850 to 1990 MHz, F₃ = 1850 to 1955 MHz, F₄ = 1710 to 1770 MHz, F₅ = 2110 to 2170 MHz</u> <u>4. Voltage Standing Wave Ratio (VSWR) of 1.5:1 or less at resonant point</u> <u>5. 50 Ω nominal impedance</u> <u>6. Gain of 3.0 dB to 5.15 dB</u> <u>7. Omni-directional radiation pattern</u> <u>8. Vertical polarization</u> <u>9. Glass-filled polypropylene radome</u> <u>10. Adhesive mounting or Bolt mount</u> <u>11. SMA male plug connectors 10 ft. (maximum) coaxial length</u> <u>12. Antenna shall be compatible with the site modem</u>

997-9 TMS Vehicle Speed/Classification Unit.

Vehicle speed/classification units must meet the physical characteristics in Tables 997-18 and 997-19. Unit must be compatible with the Department's polling software as listed in Table 997-20.

Note: This revision has numerous instances of original language moved to various Articles.

<u>Table 997-18</u> <u>Performance Characteristics, Vehicle Speed/Classification Unit</u>	
<u>Property</u>	<u>Requirements</u>
<u>Operations</u>	<u>Operates in an unattended mode, accumulating and locally storing real-time data allowing for later retrieval by downloading via the polling computer system. Capable of downloading through direct connection, serial or Ethernet, with a PC, without deleting or marking the files.</u>
<u>Compatibility with software</u>	<u>Outputs data compatible with the Department's polling computer system. If non-compatible, then furnish a software module that converts the data into a format compatible with the Department's polling computer system.</u>
<u>Compatibility with sensors</u>	<u>Compatible with the weigh-in-motion sensors, embedded inductive loops, axle sensors, magnetometers and non-intrusive vehicle sensors in place at the Traffic Monitoring Site.</u>
<u>Count and Classification</u>	<u>Capable of determining the count and classification by type and speed of all vehicles for both directions of traffic on the roadway.</u>
<u>Functional Requirements</u>	<u>Capable of receiving input from two 6-foot by 6-foot embedded inductive loops, spaced 12 to 24 feet apart, leading edge to leading edge, with a single axle sensor located between the loops, in each lane of a six lane (minimum) roadway.</u>
<u>Functional Requirements</u>	<u>Capable of collecting data from each of the lanes of traffic in any combination of counts, classification, speed, or direction.</u>
<u>Electrical Components</u>	<u>Electrical components are designed to be solid-state so that they will not be damaged by jolts and vibrations encountered during shipping and everyday use.</u>
<u>Plug-In Modules</u>	<u>The vehicle speed/classification unit may be constructed utilizing plug in modules; however, when plug in modules are used, each vehicle speed/classification unit must be identical except for the number and type of modules used. Ensure that modules of the same type are identical and interchangeable.</u>
<u>Multiple Vehicle Speed/Classification Units in One Cabinet</u>	<u>Ensure that each vehicle speed/classification unit has a unique, individual unit number. The unit number must reside in non-volatile memory, so that it is not changed when a "cold or warm boot" is performed or by a power interruption.</u>
<u>Data Collection Requirement</u>	<u>Capable of obtaining and providing volume, speed, classification, and classification by speed data simultaneously.</u>
<u>Data Collection Requirement</u>	<u>Capable of obtaining and providing volume data by lane.</u>
<u>Data Collection Requirement</u>	<u>Capable of obtaining and providing speed data by lane in a minimum of 15 bins, programmable in 5 mph increments.</u>

Note: This revision has numerous instances of original language moved to various Articles.

<u>Data Collection Requirement</u>	<u>Capable of obtaining and providing Classification by lane in vehicle type by axle class in 15 bins (minimum) in accordance with FHWA Classification Scheme “F” in Florida’s Traffic Forecasting Handbook, Chapter 2, Figure 2.2 which can be accessed on the Department’s website at the following URL address: https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/planning/systems/systems-management/document-repository/traffic-analysis/2019-project-traffic-forecasting-handbook.pdf?sfvrsn=e105e71d_2.</u>
<u>Data Collection Requirement</u>	<u>Capable of obtaining and providing a minimum of 95% accuracy of vehicle class, speed and volume.</u>
<u>Data Collection Requirement</u>	<u>Capable of providing real-time monitoring of volume data by lane or direction in user selected intervals of as little as 15 minutes, when required, without disrupting the above selected programs</u>
<u>Communications</u>	<u>Capable of communicating directly with a PC or through a modem at a minimum rate of 19,200 bps.</u>
<u>Configuration</u>	<u>At a minimum, the following parameters are programmable by direct connection to the vehicle speed/classification unit by Ethernet or via modem:</u> <ol style="list-style-type: none"> <u>1. Six-digit site number.</u> <u>2. Number of lanes and directions.</u> <u>3. Date and time.</u> <u>4. Data operating and transmission parameters.</u> <u>5. Sensor spacing.</u> <u>6. Recording interval.</u> <u>7. Vehicle parameter table with axle spacing ranges for each type of vehicle.</u> <u>8. Number and range of speed categories, axle and length classifications, and headway.</u>
<u>Sensor Failure</u>	<u>The vehicle speed/classification unit must continue to provide the speed and/or volume from the remaining functioning sensors.</u>
<u>Sensitivity</u>	<u>The sensitivity level for each axle sensor must be individually adjustable using software, by direct PC connection and remotely via</u>
<u>Loop Detector</u>	<u>Loop detectors must be internal and self-tuning. The sensitivity level and any additional parameters necessary to prevent “loop crosstalk” for each embedded inductive loop must be individually adjustable using software, both by direct PC connection and remotely via telemetry.</u>
<u>Time Delay</u>	<u>A time delay, or “de-bounce” value for ignoring spurious axle signals (ghost axles) in the vehicle speed/classification unit software must be provided.</u>

Note: This revision has numerous instances of original language moved to various Articles.

<u>Power</u>	<u>Provide a vehicle speed/classification unit that is field configurable to be powered 12 VDC and does not consume more than a total of 12 watts. If an internal battery is required, it must be capable of being recharged and shall be furnished and included with the vehicle speed/classification unit at no extra cost.</u>
<u>Mechanical</u>	<u>Provide a modular electronics unit which is completely enclosed in a durable housing of sheet metal or cast aluminum with a durable finish. When configured for operation the vehicle speed/classification unit including all cables must fit into a Type III cabinet.</u>
<u>Environmental</u> <u>(Ambient Temperature Range)</u>	<u>Provide an electronics unit which operates as specified when the ambient temperature and humidity inside the controller cabinet are within the following limits:</u> <u>The operating ambient temperature range must be between minus 0 to 140°F.</u> <u>The rate of change in ambient temperature must not exceed 63°F per hour, during which the relative humidity must not exceed 90%.</u>
<u>Environmental</u> <u>(Relative Humidity)</u>	<u>Provide an electronics unit which operates as specified when the ambient temperature and humidity inside the controller cabinet are within the following limits:</u> <u>The relative humidity must not exceed 90% over the temperature range of 40 to 109°F. Above 109°F, constant absolute humidity must be maintained as seen in Table 997-19. The relative humidity range shown in Table 997-19 is for dynamic testing.</u>

<u>Table 997-19</u>		
<u>At 14.6 psi Barometric Pressure</u>		
<u>Dry Bulb °F</u>	<u>Relative Humidity (%)</u>	<u>Wet Bulb °F</u>
<u>40</u>	<u>75</u>	<u>37</u>
<u>50</u>	<u>80</u>	<u>46</u>
<u>60</u>	<u>83</u>	<u>57</u>
<u>70</u>	<u>86</u>	<u>66</u>
<u>80</u>	<u>87</u>	<u>77</u>
<u>90</u>	<u>89</u>	<u>88</u>
<u>100</u>	<u>89</u>	<u>97</u>
<u>109</u>	<u>90</u>	<u>108</u>
<u>120</u>	<u>70</u>	<u>109</u>
<u>130</u>	<u>50</u>	<u>109</u>
<u>140</u>	<u>38</u>	<u>109</u>
<u>150</u>	<u>28</u>	<u>109</u>
<u>160</u>	<u>21</u>	<u>109</u>
<u>165</u>	<u>18</u>	<u>109</u>

Note: This revision has numerous instances of original language moved to various Articles.

<u>Table 997-20</u> <u>Performance Characteristics, Vehicle Speed/Classification Unit Polling Software</u>	
<u>Property</u>	<u>Requirements</u>
<u>Operations</u>	<u>Real time polling software operates on a PC using the Department's recommended operating system.</u>
<u>Communications</u>	<u>Communicates with the traffic counter/classifier and downloads data via cellular modem and produces reports of 15 minute, hourly, weekly, monthly and annual volume and classification data.</u>
<u>Configuration</u>	<u>Displays and enters operating parameters into the vehicle class/counter and allowing the display of real-time traffic volumes in addition to routine data collection activities.</u>
<u>Data Storage</u>	<u>Processes and stores all vehicle data retrieved in routine mode, regardless of the selected parameters.</u>

997-10 TMS Vehicle Weigh in Motion Unit.

Weigh in Motion Unit must meet the physical characteristics in Tables 997-21 and 997-22. Polling software must meet the requirements in Table 997-23.

<u>Table 997-21</u> <u>Performance Characteristics, Vehicle Weigh in Motion Unit</u>	
<u>Property</u>	<u>Requirements</u>
<u>Operations</u>	<u>Operates in an unattended mode, accumulating data and locally storing real-time data allowing for later retrieval by downloading via the polling computer system. Capable of downloading through direct connection with a PC, without deleting or marking the files.</u>
<u>Compatibility with software</u>	<u>Outputs data compatible with the Department's polling computer system. If non-compatible, then furnish a software module that converts the data into a format compatible with the Department's polling computer system.</u>
<u>Compatibility with sensors</u>	<u>Compatible with the weigh-in-motion sensors, embedded inductive loops, axle sensors, and non-intrusive vehicle sensors in place at the Traffic Monitoring Site.</u>
<u>Count and Classification</u>	<u>Capable of determining the count and classification by type and speed of all vehicles for both directions of traffic on the roadway.</u>
<u>Functional Requirements</u>	<u>Capable of receiving input from a 6-foot by 6-foot (or 6-foot by 8-foot) embedded inductive loop, with four single WIM axle sensors located outside the loop, in each WIM lane of a six lane (minimum) roadway.</u>
<u>Functional Requirements</u>	<u>Capable of collecting data from each of the lanes of traffic in any combination of Weight, counts, classification, speed, or direction.</u>
<u>Electrical Components</u>	<u>Electrical components are designed to be solid-state so that they will not be damaged by jolts and vibrations encountered during shipping and everyday use.</u>

Note: This revision has numerous instances of original language moved to various Articles.

<u>Plug-In Modules</u>	<u>The vehicle Weigh in Motion unit may be constructed utilizing plug-in modules; however, when plug in modules are used, each vehicle Weigh in Motion unit must be identical except for the number and type of modules used. Ensure that modules of the same type are identical and interchangeable.</u>
<u>Multiple Vehicle Speed/Classification Units in One Cabinet</u>	<u>Ensure that each vehicle Weigh in Motion unit has a unique, individual unit number. The unit number must reside in non-volatile memory, so that it is not changed when a “cold or warm boot” is performed or by a power interruption.</u>
<u>Data Collection Requirement</u>	<u>Capable of obtaining and providing Weight, volume, speed, classification, and classification by speed data simultaneously.</u>
<u>Data Collection Requirement</u>	<u>Capable of obtaining and providing volume data by lane.</u>
<u>Data Collection Requirement</u>	<u>Capable of obtaining and providing speed data by lane in a minimum of 15 bins, programmable in 5 mph increments.</u>
<u>Data Collection Requirement</u>	<u>Capable of obtaining and providing Classification by lane in vehicle type by axle class in 15 bins (minimum) in accordance with FHWA Classification Scheme “F” in Florida’s Traffic Forecasting Handbook, Chapter 2, Figure 2.2 which can be accessed on the Department’s website at the following URL address: https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/planning/systems/systems-management/document-repository/traffic-analysis/2019-project-traffic-forecasting-handbook.pdf?sfvrsn=e105e71d_2.</u>
<u>Data Collection Requirement</u>	<u>Capable of obtaining and providing a minimum of 95% accuracy of vehicle weight, class, speed, and volume.</u>
<u>Data Collection Requirement</u>	<u>Capable of providing real-time monitoring of volume data by lane or direction in user selected intervals of as little as 15 minutes, when required, without disrupting the above selected programs</u>
<u>Communications</u>	<u>Capable of communicating directly with a PC or through a modem at a minimum rate of 19,200 bps.</u>

Note: This revision has numerous instances of original language moved to various Articles.

<u>Configuration</u>	<p><u>At a minimum, the following parameters are programmable by direct connection to the Weigh in Motion unit by Ethernet or via modem:</u></p> <ol style="list-style-type: none"> <u>1. Six-digit site number.</u> <u>2. Number of lanes and directions.</u> <u>3. Date and time.</u> <u>4. Data operating and transmission parameters.</u> <u>5. Sensor spacing.</u> <u>6. Recording interval.</u> <u>7. Vehicle parameter table with axle spacing ranges for each type of vehicle.</u> <u>8. Number and range of speed categories, axle and length classifications, and headway.</u>
<u>Sensor Failure</u>	<p><u>The Weigh in Motion unit must continue to provide the speed and/or volume from the remaining functioning sensors.</u></p>
<u>Sensitivity</u>	<p><u>The sensitivity level for each axle sensor must be individually adjustable using software, by direct PC connection and remotely via telemetry.</u></p>
<u>Loop Detector</u>	<p><u>Loop detectors must be internal and self-tuning. The sensitivity level and any additional parameters necessary to prevent “loop crosstalk” for each embedded inductive loop must be individually adjustable using software, both by direct PC connection and remotely via telemetry.</u></p>
<u>Time Delay</u>	<p><u>A time delay, or “de-bounce” value for ignoring spurious axle signals (ghost axles) in the vehicle speed/classification unit software must be provided.</u></p>
<u>Power</u>	<p><u>Provide a vehicle Weigh in Motion unit that is field configurable to be powered 12 VDC and does not consume more than a total of 12 watts. If an internal battery is required, it must be capable of being recharged and shall be furnished and included with the vehicle Weigh in Motion unit at no extra cost.</u></p>
<u>Mechanical</u>	<p><u>Provide a modular electronics unit which is completely enclosed in a durable housing of sheet metal or cast aluminum with a durable finish. When configured for operation the Weigh in Motion unit including all cables must fit into a Type III cabinet.</u></p>
<u>Environmental (Ambient Temperature Range)</u>	<p><u>Provide a Weigh in Motion unit which operates as specified when the ambient temperature and humidity inside the controller cabinet are within the following limits:</u></p> <p><u>The operating ambient temperature range must be between minus 0 to 140°F.</u></p> <p><u>The rate of change in ambient temperature must not exceed 63°F per hour, during which the relative humidity must not exceed 90%.</u></p>

Note: This revision has numerous instances of original language moved to various Articles.

<u>Environmental (Relative Humidity)</u>	<p><u>Provide a Weigh in Motion unit which operates as specified when the ambient temperature and humidity inside the controller cabinet are within the following limits:</u></p> <p><u>The relative humidity must not exceed 90% over the temperature range of 40 to 109°F. Above 109°F, constant absolute humidity must be maintained as seen in Table 997-22. The relative humidity range shown in Table 997-22 is for dynamic testing.</u></p>
--	--

<u>Table 997-22</u>		
<u>At 14.6 psi Barometric Pressure</u>		
<u>Dry Bulb °F</u>	<u>Relative Humidity (%)</u>	<u>Wet Bulb °F</u>
<u>40</u>	<u>75</u>	<u>37</u>
<u>50</u>	<u>80</u>	<u>46</u>
<u>60</u>	<u>83</u>	<u>57</u>
<u>70</u>	<u>86</u>	<u>66</u>
<u>80</u>	<u>87</u>	<u>77</u>
<u>90</u>	<u>89</u>	<u>88</u>
<u>100</u>	<u>89</u>	<u>97</u>
<u>109</u>	<u>90</u>	<u>108</u>
<u>120</u>	<u>70</u>	<u>109</u>
<u>130</u>	<u>50</u>	<u>109</u>
<u>140</u>	<u>38</u>	<u>109</u>
<u>150</u>	<u>28</u>	<u>109</u>
<u>160</u>	<u>21</u>	<u>109</u>
<u>165</u>	<u>18</u>	<u>109</u>

<u>Table 997-23</u>	
<u>Performance Characteristics, Department's Weigh in Motion Unit Polling Software</u>	
<u>Property</u>	<u>Requirements</u>
<u>Operations</u>	<u>Real time polling software operates on a PC using the Department's recommended operating system.</u>
<u>Communications</u>	<u>Communicates with the Weigh in Motion unit and downloading data via cellular modem and producing reports of 15 minute, hourly, weekly, monthly, and annual volume, weight, and classification data.</u>
<u>Configuration</u>	<u>Displays and enters operating parameters into the vehicle Weigh in Motion unit and allows the display of real-time traffic volumes in addition to routine data collection activities.</u>

Note: This revision has numerous instances of original language moved to various Articles.

<u>Table 997-23</u> <u>Performance Characteristics, Department's Weigh in Motion Unit Polling Software</u>	
<u>Property</u>	<u>Requirements</u>
<u>Data Storage</u>	<u>Processes and stores all vehicle data retrieved in routine mode, regardless of the selected parameters.</u>

997-11 TMS Non-Motorized Data Collection Units.

Non-Motorized data collection units must meet the physical characteristics in Tables 997-24. Polling software must meet the requirements in Table 997-25.

<u>Table 997-24</u> <u>Performance Characteristics, Classification Unit</u>	
<u>Property</u>	<u>Requirements</u>
<u>Operations</u>	<u>Operates in an unattended mode, accumulating data for later retrieval by downloading via the polling computer system. Capable of downloading through direct connection with a PC, without deleting or marking the files.</u>
<u>Operations</u>	<u>Non-motorized unit operating procedures.</u>
<u>Compatibility with software</u>	<u>Outputs data compatible with the Department's polling computer system. If non-compatible, then furnish a software module that converts the data into a format compatible with the Department's polling computer systems.</u>
<u>Compatibility with sensors</u>	<u>Compatible with the embedded inductive loops, axle sensors, and non-intrusive vehicle sensors in place at the Traffic Monitoring Site.</u>
<u>Count, Speed and Classification</u>	<u>Capable of determining the count and classification (bicycle and pedestrian) by type for all directions of traffic on the sidewalk, side path, bicycle lane, and shared use path.</u>
<u>Functional Requirements</u>	<u>Capable of receiving input from embedded inductive loops, axle sensors, and non-intrusive sensors on the sidewalk, side path, bicycle lane, and shared use path.</u>
<u>Functional Requirements</u>	<u>Capable of collecting data from each direction of bicycle and pedestrian traffic in any combination of counts, classification, or direction.</u>
<u>Electrical Components</u>	<u>Electrical components are designed to be solid-state so that they will not be damaged by jolts and vibrations encountered during shipping and everyday use.</u>
<u>Plug-In Modules</u>	<u>The non-motorized data collection unit may be constructed utilizing plug-in modules; however, when plug in modules are used, each non-motorized data collection must be identical except for the number and type of modules used. Ensure that modules of the same type are identical and interchangeable.</u>

Note: This revision has numerous instances of original language moved to various Articles.

<u>Multiple Classification Units in One Cabinet</u>	<u>Ensure that each non-motorized data collection has a unique, individual unit number. The unit number must reside in non-volatile memory, so that it is not changed when a “cold or warm boot” is performed or by a power interruption.</u>
<u>Data Collection Requirement</u>	<u>Capable of obtaining and providing volume and classification data simultaneously.</u>
<u>Data Collection Requirement</u>	<u>Capable of obtaining and providing volume data by direction.</u>
<u>Data Collection Requirement</u>	<u>Capable of obtaining and providing a minimum of 80% accuracy of non-motorized classification and volume.</u>
<u>Communications</u>	<u>Capable of communicating directly with a PC or through a modem at a minimum rate of 115,200 bps.</u>
<u>Configuration</u>	<u>At a minimum, the following parameters are programmable by direct connection to the classification unit by Ethernet or via modem:</u> <ol style="list-style-type: none"> <u>1. Six-digit alphanumeric site number.</u> <u>2. Bicycle and pedestrian direction of travel.</u> <u>3. Date and time.</u> <u>4. Data operating and transmission parameters.</u>
<u>Sensor Failure</u>	<u>The non-motorized data collection unit must continue to provide the volume from the remaining functioning sensors.</u>
<u>Piezo Sensitivity</u>	<u>The sensitivity level for each axle sensor must be individually adjustable using software, by direct PC connection and remotely via telemetry.</u>
<u>Loop Detector</u>	<u>Loop detectors must be internal and self-tuning. The sensitivity level and any additional parameters necessary to prevent “loop crosstalk” for each embedded inductive loop must be individually adjustable using software, both by direct PC connection and remotely via telemetry.</u>
<u>Time Delay</u>	<u>A time delay, or “de-bounce” value for ignoring spurious axle signals (ghost axles) in the classification unit software must be provided.</u>
<u>Power</u>	<u>Provide a non-motorized data collection unit that is field configurable to be powered by 12 VDC and does not consume more than a total of 12 watts. If an internal battery is required, it must be capable of being recharged and shall be furnished and included with the non-motorized data collection unit at no extra cost.</u>
<u>Mechanical</u>	<u>Provide a modular electronics unit which is completely enclosed in a durable housing with a durable finish. When configured for operation the classification unit including all cables must fit into a Type III cabinet or self-contained in the manufacture’s housing.</u>
<u>Environmental</u>	<u>Provide an electronics unit which operates as specified when the ambient temperature and humidity inside the controller cabinet are within the following limits:</u> <u>The operating ambient temperature range must be between minus 0 to 140°F.</u>

Note: This revision has numerous instances of original language moved to various Articles.

<u>Table 997-25</u> <u>Performance Characteristics of Non-Motorized Data Collection Polling Software</u>	
<u>Property</u>	<u>Requirements</u>
<u>Operations</u>	<u>Polling software operates on a PC using the Department's recommended operating system.</u>
<u>Operations</u>	<u>Software operating procedures.</u>
<u>Communications</u>	<u>Capable of communicating with the non-motorized data collection unit and downloading data via cellular modem and producing reports of hourly, weekly, monthly and annual volume and classification data.</u>
<u>Configuration</u>	<u>Capable of displaying and entering operating parameters into the non-motorized data collection unit and allowing the display of traffic volumes in addition to routine data collection activities.</u>
<u>Data Storage</u>	<u>Capable of processing and storing all non-motorized data retrieved in routine mode, regardless of the selected parameters.</u>

997-12 Adhesive Bonding Agent.

Meet the requirements in Table 997-26.

<u>Table 997-26</u> <u>Physical Characteristics, Adhesive Bonding Agent</u>	
<u>Property</u>	<u>Requirements</u>
<u>Agent</u>	<u>Flowable mortar-based methyl methacrylate resin</u>
<u>Application</u>	<u>Per manufacturer's instruction.</u>
<u>Curing Time</u>	<u>Less than 60 minutes.</u>
<u>Gel Time</u>	<u>At 77°F, 13 to 17 minutes</u>
<u>Tensile Strength</u>	<u>Greater than 2,000 psi</u>

997-13 Loop Sealant for TMS.

Meet the requirements in Table 997-27.

<u>Table 997-27</u> <u>Physical Characteristics, Loop Sealant</u>	
<u>Property</u>	<u>Requirements</u>
<u>Agent</u>	<u>2-part unsaturated polyester resin utilizing a liquid methyl ethyl ketone peroxide (MEKP) hardener</u>
<u>Application</u>	<u>Per manufacturer's instruction. Hardener component amounts may be adjusted according to temperature and an accelerator is available for use in colder climates to further reduce drying time. Improper mixing may cause poor results.</u>
<u>Curing Time</u>	<u>Less than 60 minutes.</u>

Note: This revision has numerous instances of original language moved to various Articles.

<u>Gel Time</u>	<u>At 77°F, 10 to 25 minutes</u>
<u>Tensile Strength</u>	<u>Greater than 1,000 psi</u>

997-14 TMS Cabinets.

Meet the requirements of Tables 997-28 and 997-29.

<u>Table 997-28</u> <u>Physical Characteristics, TMS Cabinet</u>	
<u>Property</u>	<u>Requirements</u>
<u>Cabinet Shell Material</u>	<u>0.125-inch-thick sheet aluminum Type 5052-H32</u>
<u>Weld Quality</u>	<u>Exterior seams are continuously welded, smooth, free of cracks, blow holes or other irregularities and the inside and outside edges are free of burrs.</u>
<u>Cabinet Finish</u>	<u>Outside surface of the cabinet has a smooth, uniform, and natural finish and the cabinet top has a sloped surface to prevent accumulation of water.</u>
<u>Cabinet Vent</u>	<u>Vent between the top of the door and the top of the cabinet, covered by screen material with a maximum opening of 0.125 inches.</u>
<u>Cabinet Door Hinge</u>	<u>Continuously hinged door constructed of 14-gauge stainless steel or 0.125 inches aluminum that occupies 80% of the front surface area of the cabinet and is rain and dust tight; hinged on the right side of the cabinet; hinge pin is stainless steel and capped at the top and bottom to deter tampering.</u>
<u>Cabinet Door</u>	<u>Double flanged on all four sides and equip it with a restraint that will hold the door open in the 90 degree and 120-degree position.</u>
<u>Cabinet Door Lock</u>	<u>Three point latching system, consisting of the following latch points: (1) Center of the cabinet - latching handle with provisions for a padlock in the center position (2) Top of the cabinet - controlled by the door handle (3) Bottom of the cabinet - controlled by the door handle Ensure that latching points (2) and (3) remain in the locked position until the latching handle is rotated to the unlocked position.</u>
<u>Cabinet Door Vent</u>	<u>Louvered vents meeting the NEMA rod entry test for 3R enclosures. The louvers are covered by a replaceable air filter mounted inside the cabinet door with either brackets or clamps that will allow easy removal and replacement.</u>
<u>Cabinet Shelf</u>	<u>Adjustable shelf, constructed of 0.08 inches thick aluminum, that is adjustable to within 15 inches of the top of the cabinet and to within 26 inches of the bottom of the cabinet in 2 inches increments.</u>

Note: This revision has numerous instances of original language moved to various Articles.

<u>Table 997-29</u> <u>TMS Cabinet Dimensions</u>			
<u>Cabinet Dimensions in Inches</u>			
<u>Cabinet Type</u>	<u>Height</u>	<u>Width</u>	<u>Depth</u>
<u>Type III</u>	<u>38"</u>	<u>23"</u>	<u>18"</u>
<u>Type IV</u>	<u>48"</u>	<u>30"</u>	<u>16"</u>
<u>Type V</u>	<u>56"</u>	<u>38"</u>	<u>27"</u>

997-15 TMS Suppression Devices.

997-15.1 Power Suppression Devices: Meet the requirements of Table 997-30.

<u>Table 997-30</u> <u>Physical Characteristics, Power Suppression Devices</u>	
<u>Property</u>	<u>Requirements</u>
<u>Connector Type</u>	<u>Terminal Strip - plug in or screw type</u>
<u>Voltage</u>	<u>12 – 24 V_{DC}</u>

997-15.2 Sensor Suppression Devices: Meet the requirements of Table 997-31.

<u>Table 997-31</u> <u>Physical Characteristics, Sensor Suppression Devices</u>	
<u>Property</u>	<u>Requirements</u>
<u>Connector Type</u>	<u>Terminal Strip - plug in or screw type</u>
<u>Voltage</u>	<u>6 V_{DC}</u>

997-16 TMS Managed Field Ethernet Switch.

Meet the requirements of Table 997-32 and be compliant with the Code of Federal Regulations Section 200.216 Prohibition on certain telecommunications and video surveillance services or equipment.

<u>Table 997-32</u> <u>General Characteristics, Managed Field Ethernet Switch</u>	
<u>Property</u>	<u>Requirements</u>
<u>Layer 2+ Capability</u>	<u>QoS, IGMP, rate limiting, security filtering</u>
<u>Transmission</u>	<u>Full Duplex, Half Duplex Ethernet communications</u>
<u>Error-free Operation</u>	<u>99.999%</u>
<u>Mean Time Between Failures</u>	<u>10 years or 87,600 hours, using Bellcore/Telcordia SR-332 standards</u>
<u>Networking Standards</u>	<u>IEEE 802.1Q, IEEE 802.1P, IEEE 802.3, IEEE 802.3u, IEEE 802.3x,</u>

Note: This revision has numerous instances of original language moved to various Articles.

<u>Table 997-32</u> <u>General Characteristics, Managed Field Ethernet Switch</u>	
<u>Property</u>	<u>Requirements</u>
<u>Optical Ports</u>	<u>Single Mode: 1,310 or 1,550 nanometers.</u> <u>Type ST or LC.</u>
<u>Optical Ports</u>	<u>1000 Base FX, with optical budget of at least 15dB. Minimum of four ports designed for use with two pair of fibers, two strands transmit, the other two strands receive.</u>
<u>Copper Ports</u>	<u>Minimum of four copper ports, Type RJ-45, auto-negotiate (10/100 Base), full duplex. IEEE 802.3 standard pinouts.</u>
<u>Operational Indicators</u>	<u>LEDs showing link, transmit, receive, and power.</u>
<u>Management Capability</u>	<u>Port-based VLAN, VLAN tagging, IEEE 802.1Q, 4-kilobit VLAN address table.</u>
<u>Management Capability</u>	<u>Forwarding/filtering rate at a minimum 14,880 packets per second for 10 megabits per second, and 148,800 packets per second for 100 megabits per second.</u>
<u>Management Capability</u>	<u>Minimum 4 kilobit MAC address table.</u>
<u>Management Capability</u>	<u>Support of, at a minimum, Version 2 of the Internet Group Management Protocol (IGMP).</u>
<u>Management Capability</u>	<u>Support of Secure Shell (SSH) and secure Web-based GUI.</u>
<u>Management Capability</u>	<u>Support of the Simple Network Management Protocol (SNMP) version 1/2/3. Accessible using the EIA-232 management port or telecommunication network.</u>
<u>Management Capability</u>	<u>Support of Remote Authentication Dial-In User Service (RADIUS) or Terminal Access Controller Access-Control System Plus (TACACS+).</u>
<u>Management Capability</u>	<u>Support of remote monitoring (RMON) of the Ethernet agent and the ability to switch monitoring (SMON).</u>
<u>Management Capability</u>	<u>Support of Secure Copy (SCP) or Secure File Transfer Protocol (SFTP) and either Network Time Protocol (NTP) or Simple Network Time Protocol (SNTP).</u>
<u>Management Capability</u>	<u>Supports port mirroring when combined with a network analyzer.</u>
<u>Power Requirements</u>	<u>Compatible with the solar requirements in 997-5.</u>
<u>Power Requirements</u>	<u>Fiber port fail open feature.</u>
<u>Environmental Requirements</u>	<u>NEMA TS 2 2021, Sections 2.2.7, 2.2.8., and 2.2.9.</u>

Note: This revision has numerous instances of original language moved to various Articles.

<u>Table 997-32</u> <u>General Characteristics, Managed Field Ethernet Switch</u>	
<u>Property</u>	<u>Requirements</u>
<u>Data Interface Compatibility</u>	<u>Compatible with the Vehicle Speed/Classification Unit, Weigh-In-Motion Unit, and Non-motorized Data Collection Unit.</u>
<u>Data Interface Compatibility</u>	<u>Compatible with the Department's polling software (TPAS).</u>

Note: This revision has numerous instances of original language moved to various Articles.

TRAFFIC MONITORING SITE MATERIALS.

(REV 10-16-23)

SECTION 997 is deleted and the following substituted:

997-1 Description.

This Section governs the requirements for all traffic monitoring site (TMS) material as shown in the Plans and Standard Plans.

Provide products compatible with all other TMS APL equipment. Any electronics unit or software submitted for approval must be compatible with or convert the data into a format compatible with the Department's polling and processing software. Any substitute software modules submitted must be tested and approved by the Department.

Provide products constructed of corrosion-resistant materials, such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal. All fasteners exposed to the elements shall be Type 304 or 316 passivated stainless steel.

Provide warranties that are fully transferrable to the Department. Terms and conditions of warranties must be documented when submitting a request to the Department for certification. Include terms for a specified service performance with provisions for repair parts and labor, or for replacement.

Ensure the terms and conditions define the equipment installation date as the date for such warranty to be in effect. The installation date for construction projects is the day the site is accepted by the Engineer. For warehouse purchases, the installation date is the date of visual inspection approval, not to exceed ten days after delivery date.

Furnish replacements within 10 calendar days of notification for any part or equipment found to be defective during the warranty period at no cost to the Department.

997-1.1 Approved Product List Submittal Requirements: All products shall be listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their product for inclusion on the APL shall submit an application in accordance with Section 6 including documentation identified in Table 997-1 and this section. Documentation must demonstrate that the product meets the requirements of this Section.

Table 997-1	
Documentation	Requirements
Technical Data Sheets	This document will be used to verify physical and performance properties.
Product Label Photo	Provide equipment permanently marked with manufacturer name or trademark, part number, and date of manufacture or serial number.
Product Sample	When requested, submit a product sample.
Installation Manual	Instructions describing mounting, cabling, and configuration.
Product Photo	Display significant features of the products.

Note: This revision has numerous instances of original language moved to various Articles.

997-2 TMS Vehicle Sensors (Non-Weight).

997-2.1 General: Non-weight vehicle sensors include inductive loops, Class II piezoelectric axle sensors, microwave radar, and video data collection technologies.

997-2.2 Wire for Inductive Loops: Materials used in the creation of the inductive loops must meet the material specification of No. 14 AWG International Municipal Signal Association (IMSA) 51-7 wire.

997-2.3 Class II Piezoelectric Axle Sensor: In-Roadway Class II piezoelectric axle sensors shall meet the physical characteristics in Table 997-2.

Property	Requirements
Sensor Element Dimensions	Approximately 6 ft. to 10 ft. in length, 3/16 in. to 3/8 in. in diameter (varies by manufacturer)
Sensor Element Material	Pressure sensing piezoelectric
Pavement Operating Temperature Range	Minimum 0°F to +150°F
Output Signal	Minimum +200mV or produce a charge signal for a FHWA Class 2 Vehicle.
Environmental Requirements	NEMA TS-2, Section 2.

997-2.4 Microwave Radar Sensor: Sensors shall meet the physical characteristics in Table 997-3.

Property	Requirement
Detection Range	A minimum of 8 distinguishable lanes within a minimum 200 feet of detection zone.
Direction	Bidirectional
Operating Temperature Range	Ambient temperature of 0°F to 140°F
Enclosure Dimensions	Weatherproof aluminum, stainless steel, or polycarbonate housing. Typically, up to 15" X 12" X 6" Weight typically <10 lbs.
Operating Frequency	Wireless transmission in Federal Communications Commission (FCC) approved band or unlicensed RF range.

Note: This revision has numerous instances of original language moved to various Articles.

Table 997-3 Physical Characteristics, Microwave Radar Sensor	
Communications	RS-232/RS-485 ports, supports minimum 19,200 baud rate.
Data Interface Compatibility	Compatible with the vehicle speed/classification unit and the Department's traffic polling system.

997-2.5 Video Sensor: Sensors shall meet the physical characteristics in Table 997-4. Cameras shall be compliant with the Code of Federal Regulations Section 200.216 Prohibition on certain telecommunications and video surveillance services or equipment.

Table 997-4 Performance Characteristics, Video Sensor	
Property	Requirements
Configuration	Displays detection zones, activations, overlaid on live video inputs.
Configuration	Editable detection zone size, placement, and sensitivity. Parameters stored in and retrieved from nonvolatile memory.
Processor	Video analysis, presence detection, data collection, storage and reporting of detection data.
Communications	TIA-232, 10/100 Base TX, FCC certified secure wireless, or cellular compatible with Agency's carrier. Department must approve carrier.
Communications	CDMA compatible
Solid State Detection Output	NEMA TS2, 6.5.2.26
Environmental Requirements	NEMA TS-2, Section 2.

997-3 TMS Non-Motorized Sensors.

997-3.1 General: Non-Motorized sensors include inductive loops, axle sensors, infrared, and video data collection technologies. Non-intrusive non-motorized sensors detect non-motorized vehicles and pedestrians using passive detection.

997-3.2 Wire for Inductive Loops for Non-Motorized Data Collection: Materials used in the creation of the inductive loops must meet the material specification of No. 14 AWG International Municipal Signal Association (IMSA) 51-7 wire.

997-3.3 Axle Sensor for Non-Motorized Data Collection: Non-motorized Class I or II axle sensors shall meet the physical characteristics in Table 997-5.

Table 997-5 Physical Characteristics, Non-Motorized Axle Sensor		
Property		Requirements

Note: This revision has numerous instances of original language moved to various Articles.

Sensor Element Dimensions		3 ft. in length, 3/16 in. to 3/8 in. in diameter (varies by manufacturer)
Sensor Element Material		Pressure sensing piezoelectric
Pavement Operating Temperature Range		0°F to +150°F
Output Signal Range		Minimum +34 mV (front axle) and +65mV (rear axle), 220 lbs. Passenger bicycle, at 7.3 MPH
Environmental Requirements		NEMA TS-2-2016, Section 3.

997-3.4 Infrared for Non-Motorized Sensor Data Collection: Non-motorized infrared sensors shall meet the physical characteristics in Table 997-6.

Table 997-6 Physical Characteristics, Non-Motorized Infrared Sensor	
Property	Requirement
Temperature Sensitivity	2°F from ambient temp.
Detection Range	3 ft. to 18 ft.
Direction	Bidirectional
Operating Temperature Range	-13°F to 120°F

997-3.5. Video Sensor: Sensors shall meet the physical characteristics in Table 997-7. Cameras shall be compliant with the Code of Federal Regulations Section 200.216 Prohibition on certain telecommunications and video surveillance services or equipment.

Table 997-7 Performance Characteristics, Video Sensor	
Property	Requirements
Configuration	Displays detection zones, activations, overlaid on live video inputs.
Configuration	Editable detection zone size, placement, and sensitivity. Parameters stored in and retrieved from nonvolatile memory.
Processor	Video analysis, presence detection, data collection, storage and reporting of detection data.
Communications	TIA-232, 10/100 Base TX, FCC certified secure wireless, or cellular compatible with Agency's carrier. Department must approve carrier.
Solid State Detection Output	NEMA TS2-2021, 6.5.2.26
Environmental Requirements	NEMA TS-2, Section 2.

Note: This revision has numerous instances of original language moved to various Articles.

997-4 TMS Vehicle Sensors (Weight for Motorized Vehicle Data Collection).

997-4.1 General: Weight sensor arrays include inductive loops with strain gauge sensors or quartz piezoelectric sensors.

997-4.2 Wire for Inductive Loop: Materials used in the creation of the inductive loops must meet the material specification of No. 14 AWG International Municipal Signal Association (IMSA) 51-7 wire.

997-4.3 Strain Gauge Sensor: Weigh-In-Motion (WIM) systems utilize plates with strain gauges bonded to the underside or one-piece gauge strip scale. The strain gauge sensors shall meet the physical characteristics in Table 997-8.

Table 997-8 Physical Characteristics, Strain Gauge Sensor		
Property		Requirements
Sensor Size		.5 in. to 20 in. wide x 50 in. to 80 in. long
Operating Temperature Range		-50°F to 176°F
Scale Capacity		45,000 pounds per axle and overload protected to 80000 pounds per axle
Environmental Requirements		NEMA TS-2, Section 2.

997-4.4 Quartz Piezoelectric Sensor: Quartz piezoelectric sensors use one piece quartz crystal sensors to collect Weigh-In-Motion data. The quartz sensor shall meet the physical characteristics in Table 997-9.

Table 997-9 Physical Characteristics, Quartz Piezoelectric Sensor		
Property		Requirements
Measuring Range wheel load (At a referenced tire contact area)		0 to 34000 pounds (8 in. by 12.6 in.)
Overload (twin wheel)		55000 pounds
Sensitivity – Nominal		7.6 ± 12% pC/lbf
Sensitivity shift over sensor length		<± 3%
Threshold		<0.1 lbf
Linearity		<± 2% Full Scale Output
Hysteresis		≤ 2% Full Scale Output
Natural Frequency		> 5 kHz
Operating Temperature range		-40°F to 176°F
Temperature coefficient of sensitivity		-0.04%/°F
Operating Speed		5 MPH to 100 MPH
Insulation resistance		> 100 GΩ
Capacitance with 130 ft. cable		8 to 12 nF
Environmental Requirements		NEMA TS-2, Section 2

Note: This revision has numerous instances of original language moved to various Articles.

997-5 TMS Solar Power Unit for Motorized Data Collection.

997-5.1 General: Solar power unit consists of the following components: solar panel(s) and mounting hardware; 12 V storage battery; and voltage regulator with wiring and associated mounting hardware.

997-5.2 Solar Panel Configured for Nominal 12 V_{DC}: Solar panels cannot have internal voltage regulators and must be capable of multiple arrays and series or parallel wiring configurations. Meet the physical characteristics in Table 997-10:

Table 997-10 Physical Characteristics, Solar Panel		
Property		Requirements
Peak power range		85 to 300 watts
Voltage		Maximum power voltage greater than 16.5 V at 77°F
Current		Maximum power current greater than 2.85 A at 77°F
Photovoltaic modules construction		Mono or poly-crystalline cells
Efficiency Rating		Minimum 20%
Frame construction		Anodized aluminum
Mounting hardware construction		Anodized, galvanized or stainless-steel

997-5.3 Battery 12 V: Meet the physical characteristics in Table 997-11:

Table 997-11 Physical Characteristics, Battery 12 V		
Property		Requirements
Battery Chemistry		Rechargeable valve regulated lead-calcium gelled electrolyte or absorbed glass mat for photovoltaic applications
Case Construction		ABS Plastic or Polypropylene
Current discharge rate		Minimum of 100 hours at 0.9 amperes
Dimensions		Maximum of 12 inches by 8 inches by 10 inches

997-5.4 Voltage Regulator Configured for Nominal 12 V_{DC}: Meet the physical characteristics in Table 997-12:

Table 997-12 Physical Characteristics, Voltage Regulator		
Property		Requirements
Voltage for battery charging.		Minimum of 13.5 V _{DC}

Note: This revision has numerous instances of original language moved to various Articles.

Begin Charging-Battery Voltage		13.3 V or less
End Charging-Battery Voltage		Maximum of 14.5 V
Quiescent current		Maximum 15 mA
Charge rating		Minimum of 20 A.
Operating Temperature range		Range: 0 to 122°F
Dimensions		Approximately 2 inches by 5 inches by 1 inch.

997-6 TMS Solar Power Unit for Non-Motorized Data Collection.

997-6.1 General: Solar power unit consists of the following components: solar panel(s) and mounting hardware; 12 V storage battery; and voltage regulator with wiring and associated mounting hardware.

997-6.2 Solar Panel Configured for Nominal 12 V_{DC}: Solar panels cannot have internal voltage regulators and must be capable of multiple arrays and series or parallel wiring configurations. Meet the physical characteristics in Table 997-13.

Table 997-13 Physical Characteristics, Solar Panel	
Property	Requirements
Peak power range	65 to 300 watts
Voltage	Maximum power voltage greater than 16.5 V at 77°F
Current	Maximum power current greater than 2.85 A at 77°F
Photovoltaic modules construction	Mono or poly-crystalline cells
Efficiency Rating	Minimum 20%
Frame construction	Anodized aluminum
Mounting hardware construction	Anodized, galvanized, or stainless steel

997-6.3 Battery 12 V: Meet the physical characteristics in Table 997-14.

Table 997-14 Physical Characteristics, Battery 12 V	
Property	Requirements
Battery Chemistry	Rechargeable valve regulated lead-calcium gelled electrolyte or absorbed glass mat for photovoltaic applications
Case Construction	ABS Plastic or Polypropylene.
Current discharge rate	Minimum of 21 to 100 hours at 0.9 amperes

Note: This revision has numerous instances of original language moved to various Articles.

Table 997-14 Physical Characteristics, Battery 12 V	
Property	Requirements
Dimensions	Maximum of 12 inches by 8 inches by 10 inches

997-6.4 Voltage Regulator Configured for Nominal 12 VDC: Meet the physical characteristics in Table 997-15.

Table 997-15 Physical Characteristics, Voltage Regulator	
Property	Requirements
Charging Voltage	Minimum of 13.5 V _{DC}
Begin Charging- Battery Voltage	13.3 V or less
End Charging- Battery Voltage	Maximum of 14.5 V
Quiescent current	Maximum 15 mA
Charge rating	Minimum of 20 amps
Operating Temperature range	Range: 0 to 122°F
Dimensions	2 inches by 5 inches by 1 inch

997-7 TMS System Communications Modem. Meet the physical characteristics in Table 997-16. Modems shall be compliant with the Code of Federal Regulations Section 200.216 Prohibition on certain telecommunications and video surveillance services or equipment.

Table 997-16 Physical Characteristics, TMS Modem	
Property	Requirements
Configuration	<ol style="list-style-type: none"> 1.The device shall be field configurable to be powered from 12 VDC. 2.The device shall have the ability and be configured to utilize a network service that shall be at a minimum 4G LTE with fallback to 3G EV-DO.

Note: This revision has numerous instances of original language moved to various Articles.

Table 997-16 Physical Characteristics, TMS Modem		
Property		Requirements
Protocols: The device shall have the ability to utilize, at a minimum, the following protocols:		<ol style="list-style-type: none"> 1. Network: TCP/IP, UDP/IP, Domain Name System (DNS) 2. Routing: Network Address Translation (NAT), Host Port Routing, DHCP, Point-to-Point Protocol over Ethernet (PPPoE), VLAN, Virtual Router Redundancy Protocol (VRRP), Reliable Static Route. 3. Application: Short Message Service (SMS), Telnet/SSH, Reverse Telnet, Simple Mail Transfer Protocol (SMTP), SNMP, SNTP, Reliable Static Route 4. Serial: TCP/UDP Packet Assembly Disassembly (PAD) Mode, Modbus (ASCII, RTU, Variable), Point-to-Point Protocol (PPP)
Communication Transmission		Code Division Multiple Access (CDMA) capable.
Event Reporting: The device shall have the capability to record and report, at a minimum, the following events in plain text:		<ol style="list-style-type: none"> 1. Network parameters 2. Data usage 3. Power 4. Device temperature 5. Digital input 6. Global Positioning 7. System/Automatic 8. Vehicle Locator (GPS/AVL) 9. Timer
Security: The device shall have the following security provisions:		<ol style="list-style-type: none"> 1. Ability to establish VPN tunnels. 2. IPsec, Secure Sockets Layer (SSL), and Generic Routing Encapsulation (GRE) VPN client 3. Port forwarding and Demilitarized Zone (DMZ) 4. Port filtering 5. Trusted IP 6. MAC address filtering
Operating Temperature range		Minimum 0 to 158°F
FCC Certification		FCC identification number displayed on an external label on the equipment
Number of SIM slots		Minimum of two SIM slots. SIM cards provided by the Department
Minimum Ethernet Port Speed		10/100 Base-TX

Note: This revision has numerous instances of original language moved to various Articles.

997-8 TMS Modem Antenna.

Meet the physical characteristics in Table 997-17.

Table 997-17 Physical Characteristics, TMS Modem Antenna	
Property	Requirements
Antenna Requirements	<ol style="list-style-type: none"> 1. Dual diversity 2. Minimum NEMA rating of NEMA 3 3. Frequencies: F1 = 824 to 896 MHz, F2 = 1850 to 1990 MHz, F3 = 1850 to 1955 MHz, F4 = 1710 to 1770 MHz, F5 = 2110 to 2170 MHz 4. Voltage Standing Wave Ratio (VSWR) of 1.5:1 or less at resonant point 5. 50 Ω nominal impedance 6. Gain of 3.0 dB to 5.15 dB 7. Omni-directional radiation pattern 8. Vertical polarization 9. Glass-filled polypropylene radome 10. Adhesive mounting or Bolt mount 11. SMA male plug connectors 10 ft. (maximum) coaxial length 12. Antenna shall be compatible with the site modem

997-9 TMS Vehicle Speed/Classification Unit.

Vehicle speed/classification units must meet the physical characteristics in Tables 997-18 and 997-19. Unit must be compatible with the Department's polling software as listed in Table 997-20.

Table 997-18 Performance Characteristics, Vehicle Speed/Classification Unit	
Property	Requirements
Operations	Operates in an unattended mode, accumulating and locally storing real-time data allowing for later retrieval by downloading via the polling computer system. Capable of downloading through direct connection, serial or Ethernet, with a PC, without deleting or marking the files.
Compatibility with software	Outputs data compatible with the Department's polling computer system. If non-compatible, then furnish a software module that converts the data into a format compatible with the Department's polling computer system.
Compatibility with sensors	Compatible with the weigh-in-motion sensors, embedded inductive loops, axle sensors, magnetometers and non-intrusive vehicle sensors in place at the Traffic Monitoring Site.
Count and Classification	Capable of determining the count and classification by type and speed of all vehicles for both directions of traffic on the roadway.

Note: This revision has numerous instances of original language moved to various Articles.

Functional Requirements	Capable of receiving input from two 6-foot by 6-foot embedded inductive loops, spaced 12 to 24 feet apart, leading edge to leading edge, with a single axle sensor located between the loops, in each lane of a six lane (minimum) roadway.
Functional Requirements	Capable of collecting data from each of the lanes of traffic in any combination of counts, classification, speed, or direction.
Electrical Components	Electrical components are designed to be solid-state so that they will not be damaged by jolts and vibrations encountered during shipping and everyday use.
Plug-In Modules	The vehicle speed/classification unit may be constructed utilizing plug in modules; however, when plug in modules are used, each vehicle speed/classification unit must be identical except for the number and type of modules used. Ensure that modules of the same type are identical and interchangeable.
Multiple Vehicle Speed/Classification Units in One Cabinet	Ensure that each vehicle speed/classification unit has a unique, individual unit number. The unit number must reside in non-volatile memory, so that it is not changed when a “cold or warm boot” is performed or by a power interruption.
Data Collection Requirement	Capable of obtaining and providing volume, speed, classification, and classification by speed data simultaneously.
Data Collection Requirement	Capable of obtaining and providing volume data by lane.
Data Collection Requirement	Capable of obtaining and providing speed data by lane in a minimum of 15 bins, programmable in 5 mph increments.
Data Collection Requirement	Capable of obtaining and providing Classification by lane in vehicle type by axle class in 15 bins (minimum) in accordance with FHWA Classification Scheme “F” in Florida’s Traffic Forecasting Handbook, Chapter 2, Figure 2.2 which can be accessed on the Department’s website at the following URL address: https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/planning/systems/systems-management/document-repository/traffic-analysis/2019-project-traffic-forecasting-handbook.pdf?sfvrsn=e105e71d_2 .
Data Collection Requirement	Capable of obtaining and providing a minimum of 95% accuracy of vehicle class, speed and volume.
Data Collection Requirement	Capable of providing real-time monitoring of volume data by lane or direction in user selected intervals of as little as 15 minutes, when required, without disrupting the above selected programs
Communications	Capable of communicating directly with a PC or through a modem at a minimum rate of 19,200 bps.

Note: This revision has numerous instances of original language moved to various Articles.

Configuration	<p>At a minimum, the following parameters are programmable by direct connection to the vehicle speed/classification unit by Ethernet or via modem:</p> <ol style="list-style-type: none"> 1. Six-digit site number. 2. Number of lanes and directions. 3. Date and time. 4. Data operating and transmission parameters. 5. Sensor spacing. 6. Recording interval. 7. Vehicle parameter table with axle spacing ranges for each type of vehicle. 8. Number and range of speed categories, axle and length classifications, and headway.
Sensor Failure	The vehicle speed/classification unit must continue to provide the speed and/or volume from the remaining functioning sensors.
Sensitivity	The sensitivity level for each axle sensor must be individually adjustable using software, by direct PC connection and remotely via
Loop Detector	Loop detectors must be internal and self-tuning. The sensitivity level and any additional parameters necessary to prevent “loop crosstalk” for each embedded inductive loop must be individually adjustable using software, both by direct PC connection and remotely via telemetry.
Time Delay	A time delay, or “de-bounce” value for ignoring spurious axle signals (ghost axles) in the vehicle speed/classification unit software must be provided.
Power	Provide a vehicle speed/classification unit that is field configurable to be powered 12 VDC and does not consume more than a total of 12 watts. If an internal battery is required, it must be capable of being recharged and shall be furnished and included with the vehicle speed/classification unit at no extra cost.
Mechanical	Provide a modular electronics unit which is completely enclosed in a durable housing of sheet metal or cast aluminum with a durable finish. When configured for operation the vehicle speed/classification unit including all cables must fit into a Type III cabinet.
Environmental (Ambient Temperature Range)	<p>Provide an electronics unit which operates as specified when the ambient temperature and humidity inside the controller cabinet are within the following limits:</p> <p>The operating ambient temperature range must be between minus 0 to 140°F.</p> <p>The rate of change in ambient temperature must not exceed 63°F per hour, during which the relative humidity must not exceed 90%.</p>

Note: This revision has numerous instances of original language moved to various Articles.

Environmental (Relative Humidity)	Provide an electronics unit which operates as specified when the ambient temperature and humidity inside the controller cabinet are within the following limits: The relative humidity must not exceed 90% over the temperature range of 40 to 109°F. Above 109°F, constant absolute humidity must be maintained as seen in Table 997-19. The relative humidity range shown in Table 997-19 is for dynamic testing.
--------------------------------------	--

Table 997-19 At 14.6 psi Barometric Pressure		
Dry Bulb °F	Relative Humidity (%)	Wet Bulb °F
40	75	37
50	80	46
60	83	57
70	86	66
80	87	77
90	89	88
100	89	97
109	90	108
120	70	109
130	50	109
140	38	109
150	28	109
160	21	109
165	18	109

Table 997-20 Performance Characteristics, Vehicle Speed/Classification Unit Polling Software	
Property	Requirements
Operations	Real time polling software operates on a PC using the Department's recommended operating system.
Communications	Communicates with the traffic counter/classifier and downloads data via cellular modem and produces reports of 15 minute, hourly, weekly, monthly and annual volume and classification data.
Configuration	Displays and enters operating parameters into the vehicle class/counter and allowing the display of real-time traffic volumes in addition to routine data collection activities.
Data Storage	Processes and stores all vehicle data retrieved in routine mode, regardless of the selected parameters.

997-10 TMS Vehicle Weigh in Motion Unit.

Note: This revision has numerous instances of original language moved to various Articles.

Weigh in Motion Unit must meet the physical characteristics in Tables 997-21 and 997-22. Polling software must meet the requirements in Table 997-23.

Table 997-21 Performance Characteristics, Vehicle Weigh in Motion Unit	
Property	Requirements
Operations	Operates in an unattended mode, accumulating data and locally storing real-time data allowing for later retrieval by downloading via the polling computer system. Capable of downloading through direct connection with a PC, without deleting or marking the files.
Compatibility with software	Outputs data compatible with the Department's polling computer system. If non-compatible, then furnish a software module that converts the data into a format compatible with the Department's polling computer system.
Compatibility with sensors	Compatible with the weigh-in-motion sensors, embedded inductive loops, axle sensors, and non-intrusive vehicle sensors in place at the Traffic Monitoring Site.
Count and Classification	Capable of determining the count and classification by type and speed of all vehicles for both directions of traffic on the roadway.
Functional Requirements	Capable of receiving input from a 6-foot by 6-foot (or 6-foot by 8-foot) embedded inductive loop, with four single WIM axle sensors located outside the loop, in each WIM lane of a six lane (minimum) roadway.
Functional Requirements	Capable of collecting data from each of the lanes of traffic in any combination of Weight, counts, classification, speed, or direction.
Electrical Components	Electrical components are designed to be solid-state so that they will not be damaged by jolts and vibrations encountered during shipping and everyday use.
Plug-In Modules	The vehicle Weigh in Motion unit may be constructed utilizing plug-in modules; however, when plug in modules are used, each vehicle Weigh in Motion unit must be identical except for the number and type of modules used. Ensure that modules of the same type are identical and interchangeable.
Multiple Vehicle Speed/Classification Units in One Cabinet	Ensure that each vehicle Weigh in Motion unit has a unique, individual unit number. The unit number must reside in non-volatile memory, so that it is not changed when a "cold or warm boot" is performed or by a power interruption.
Data Collection Requirement	Capable of obtaining and providing Weight, volume, speed, classification, and classification by speed data simultaneously.
Data Collection Requirement	Capable of obtaining and providing volume data by lane.
Data Collection Requirement	Capable of obtaining and providing speed data by lane in a minimum of 15 bins, programmable in 5 mph increments.

Note: This revision has numerous instances of original language moved to various Articles.

Data Collection Requirement	Capable of obtaining and providing Classification by lane in vehicle type by axle class in 15 bins (minimum) in accordance with FHWA Classification Scheme "F" in Florida's Traffic Forecasting Handbook, Chapter 2, Figure 2.2 which can be accessed on the Department's website at the following URL address: https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/planning/systems/systems-management/document-repository/traffic-analysis/2019-project-traffic-forecasting-handbook.pdf?sfvrsn=e105e71d_2 .
Data Collection Requirement	Capable of obtaining and providing a minimum of 95% accuracy of vehicle weight, class, speed, and volume.
Data Collection Requirement	Capable of providing real-time monitoring of volume data by lane or direction in user selected intervals of as little as 15 minutes, when required, without disrupting the above selected programs
Communications	Capable of communicating directly with a PC or through a modem at a minimum rate of 19,200 bps.
Configuration	At a minimum, the following parameters are programmable by direct connection to the Weigh in Motion unit by Ethernet or via modem: <ol style="list-style-type: none"> 1. Six-digit site number. 2. Number of lanes and directions. 3. Date and time. 4. Data operating and transmission parameters. 5. Sensor spacing. 6. Recording interval. 7. Vehicle parameter table with axle spacing ranges for each type of vehicle. 8. Number and range of speed categories, axle and length classifications, and headway.
Sensor Failure	The Weigh in Motion unit must continue to provide the speed and/or volume from the remaining functioning sensors.
Sensitivity	The sensitivity level for each axle sensor must be individually adjustable using software, by direct PC connection and remotely via telemetry.
Loop Detector	Loop detectors must be internal and self-tuning. The sensitivity level and any additional parameters necessary to prevent "loop crosstalk" for each embedded inductive loop must be individually adjustable using software, both by direct PC connection and remotely via telemetry.
Time Delay	A time delay, or "de-bounce" value for ignoring spurious axle signals (ghost axles) in the vehicle speed/classification unit software must be provided.

Note: This revision has numerous instances of original language moved to various Articles.

Power	Provide a vehicle Weigh in Motion unit that is field configurable to be powered 12 VDC and does not consume more than a total of 12 watts. If an internal battery is required, it must be capable of being recharged and shall be furnished and included with the vehicle Weigh in Motion unit at no extra cost.
Mechanical	Provide a modular electronics unit which is completely enclosed in a durable housing of sheet metal or cast aluminum with a durable finish. When configured for operation the Weigh in Motion unit including all cables must fit into a Type III cabinet.
Environmental (Ambient Temperature Range)	Provide a Weigh in Motion unit which operates as specified when the ambient temperature and humidity inside the controller cabinet are within the following limits: The operating ambient temperature range must be between minus 0 to 140°F. The rate of change in ambient temperature must not exceed 63°F per hour, during which the relative humidity must not exceed 90%.
Environmental (Relative Humidity)	Provide a Weigh in Motion unit which operates as specified when the ambient temperature and humidity inside the controller cabinet are within the following limits: The relative humidity must not exceed 90% over the temperature range of 40 to 109°F. Above 109°F, constant absolute humidity must be maintained as seen in Table 997-22. The relative humidity range shown in Table 997-22 is for dynamic testing.

Table 997-22 At 14.6 psi Barometric Pressure		
Dry Bulb °F	Relative Humidity (%)	Wet Bulb °F
40	75	37
50	80	46
60	83	57
70	86	66
80	87	77
90	89	88
100	89	97
109	90	108
120	70	109
130	50	109
140	38	109
150	28	109
160	21	109

Note: This revision has numerous instances of original language moved to various Articles.

165	18	109
-----	----	-----

Table 997-23 Performance Characteristics, Department's Weigh in Motion Unit Polling Software	
Property	Requirements
Operations	Real time polling software operates on a PC using the Department's recommended operating system.
Communications	Communicates with the Weigh in Motion unit and downloading data via cellular modem and producing reports of 15 minute, hourly, weekly, monthly, and annual volume, weight, and classification data.
Configuration	Displays and enters operating parameters into the vehicle Weigh in Motion unit and allows the display of real-time traffic volumes in addition to routine data collection activities.
Data Storage	Processes and stores all vehicle data retrieved in routine mode, regardless of the selected parameters.

997-11 TMS Non-Motorized Data Collection Units.

Non-Motorized data collection units must meet the physical characteristics in Tables 997-24. Polling software must meet the requirements in Table 997-25.

Table 997-24 Performance Characteristics, Classification Unit	
Property	Requirements
Operations	Operates in an unattended mode, accumulating data for later retrieval by downloading via the polling computer system. Capable of downloading through direct connection with a PC, without deleting or marking the files.
Operations	Non-motorized unit operating procedures.
Compatibility with software	Outputs data compatible with the Department's polling computer system. If non-compatible, then furnish a software module that converts the data into a format compatible with the Department's polling computer system.
Compatibility with sensors	Compatible with the embedded inductive loops, axle sensors, and non-intrusive vehicle sensors in place at the Traffic Monitoring Site.
Count, Speed and Classification	Capable of determining the count and classification (bicycle and pedestrian) by type for all directions of traffic on the sidewalk, side path, bicycle lane, and shared use path.
Functional Requirements	Capable of receiving input from embedded inductive loops, axle sensors, and non-intrusive sensors on the sidewalk, side path, bicycle lane, and shared use path.

Note: This revision has numerous instances of original language moved to various Articles.

Functional Requirements	Capable of collecting data from each direction of bicycle and pedestrian traffic in any combination of counts, classification, or direction.
Electrical Components	Electrical components are designed to be solid-state so that they will not be damaged by jolts and vibrations encountered during shipping and everyday use.
Plug-In Modules	The non-motorized data collection unit may be constructed utilizing plug-in modules; however, when plug in modules are used, each non-motorized data collection must be identical except for the number and type of modules used. Ensure that modules of the same type are identical and interchangeable.
Multiple Classification Units in One Cabinet	Ensure that each non-motorized data collection has a unique, individual unit number. The unit number must reside in non-volatile memory, so that it is not changed when a “cold or warm boot” is performed or by a power interruption.
Data Collection Requirement	Capable of obtaining and providing volume and classification data simultaneously.
Data Collection Requirement	Capable of obtaining and providing volume data by direction.
Data Collection Requirement	Capable of obtaining and providing a minimum of 80% accuracy of non-motorized classification and volume.
Communications	Capable of communicating directly with a PC or through a modem at a minimum rate of 115,200 bps.
Configuration	At a minimum, the following parameters are programmable by direct connection to the classification unit by Ethernet or via modem: <ol style="list-style-type: none"> 1. Six-digit alphanumeric site number. 2. Bicycle and pedestrian direction of travel. 3. Date and time. 4. Data operating and transmission parameters.
Sensor Failure	The non-motorized data collection unit must continue to provide the volume from the remaining functioning sensors.
Piezo Sensitivity	The sensitivity level for each axle sensor must be individually adjustable using software, by direct PC connection and remotely via telemetry.
Loop Detector	Loop detectors must be internal and self-tuning. The sensitivity level and any additional parameters necessary to prevent “loop crosstalk” for each embedded inductive loop must be individually adjustable using software, both by direct PC connection and remotely via telemetry.
Time Delay	A time delay, or “de-bounce” value for ignoring spurious axle signals (ghost axles) in the classification unit software must be provided.

Note: This revision has numerous instances of original language moved to various Articles.

Power	Provide a non-motorized data collection unit that is field configurable to be powered by 12 VDC and does not consume more than a total of 12 watts. If an internal battery is required, it must be capable of being recharged and shall be furnished and included with the non-motorized data collection unit at no extra cost.
Mechanical	Provide a modular electronics unit which is completely enclosed in a durable housing with a durable finish. When configured for operation the classification unit including all cables must fit into a Type III cabinet or self-contained in the manufacture's housing.
Environmental	Provide an electronics unit which operates as specified when the ambient temperature and humidity inside the controller cabinet are within the following limits: The operating ambient temperature range must be between minus 0 to 140°F.

Table 997-25 Performance Characteristics of Non-Motorized Data Collection Polling Software	
Property	Requirements
Operations	Polling software operates on a PC using the Department's recommended operating system.
Operations	Software operating procedures.
Communications	Capable of communicating with the non-motorized data collection unit and downloading data via cellular modem and producing reports of hourly, weekly, monthly and annual volume and classification data.
Configuration	Capable of displaying and entering operating parameters into the non-motorized data collection unit and allowing the display of traffic volumes in addition to routine data collection activities.
Data Storage	Capable of processing and storing all non-motorized data retrieved in routine mode, regardless of the selected parameters.

997-12 Adhesive Bonding Agent.

Meet the requirements in Table 997-26.

Table 997-26 Physical Characteristics, Adhesive Bonding Agent	
Property	Requirements
Agent	Flowable mortar-based methyl methacrylate resin
Application	Per manufacturer's instruction.
Curing Time	Less than 60 minutes.
Gel Time	At 77°F, 13 to 17 minutes
Tensile Strength	Greater than 2,000 psi

Note: This revision has numerous instances of original language moved to various Articles.

997-13 Loop Sealant for TMS.

Meet the requirements in Table 997-27.

Table 997-27 Physical Characteristics, Loop Sealant	
Property	Requirements
Agent	2-part unsaturated polyester resin utilizing a liquid methyl ethyl ketone peroxide (MEKP) hardener
Application	Per manufacturer's instruction. Hardener component amounts may be adjusted according to temperature and an accelerator is available for use in colder climates to further reduce drying time. Improper mixing may cause poor results.
Curing Time	Less than 60 minutes.
Gel Time	At 77°F, 10 to 25 minutes
Tensile Strength	Greater than 1,000 psi

997-14 TMS Cabinets.

Meet the requirements of Tables 997-28 and 997-29.

Table 997-28 Physical Characteristics, TMS Cabinet	
Property	Requirements
Cabinet Shell Material	0.125-inch-thick sheet aluminum Type 5052-H32
Weld Quality	Exterior seams are continuously welded, smooth, free of cracks, blow holes or other irregularities and the inside and outside edges are free of burrs.
Cabinet Finish	Outside surface of the cabinet has a smooth, uniform, and natural finish and the cabinet top has a sloped surface to prevent accumulation of water.
Cabinet Vent	Vent between the top of the door and the top of the cabinet, covered by screen material with a maximum opening of 0.125 inches.
Cabinet Door Hinge	Continuously hinged door constructed of 14-gauge stainless steel or 0.125 inches aluminum that occupies 80% of the front surface area of the cabinet and is rain and dust tight; hinged on the right side of the cabinet; hinge pin is stainless steel and capped at the top and bottom to deter tampering.
Cabinet Door	Double flanged on all four sides and equip it with a restraint that will hold the door open in the 90 degree and 120-degree position.

Note: This revision has numerous instances of original language moved to various Articles.

Cabinet Door Lock	Three point latching system, consisting of the following latch points: (1) Center of the cabinet - latching handle with provisions for a padlock in the center position (2) Top of the cabinet - controlled by the door handle (3) Bottom of the cabinet - controlled by the door handle Ensure that latching points (2) and (3) remain in the locked position until the latching handle is rotated to the unlocked position.
Cabinet Door Vent	Louvered vents meeting the NEMA rod entry test for 3R enclosures. The louvers are covered by a replaceable air filter mounted inside the cabinet door with either brackets or clamps that will allow easy removal and replacement.
Cabinet Shelf	Adjustable shelf, constructed of 0.08 inches thick aluminum, that is adjustable to within 15 inches of the top of the cabinet and to within 26 inches of the bottom of the cabinet in 2 inches increments.

Table 997-29 TMS Cabinet Dimensions			
Cabinet Dimensions in Inches			
Cabinet Type	Height	Width	Depth
Type III	38"	23"	18"
Type IV	48"	30"	16"
Type V	56"	38"	27"

997-15 TMS Suppression Devices.

997-15.1 Power Suppression Devices: Meet the requirements of Table 997-30.

Table 997-30 Physical Characteristics, Power Suppression Devices	
Property	Requirements
Connector Type	Terminal Strip - plug in or screw type
Voltage	12 – 24 V _{DC}

997-15.2 Sensor Suppression Devices: Meet the requirements of Table 997-31.

Table 997-31 Physical Characteristics, Sensor Suppression Devices	
Property	Requirements
Connector Type	Terminal Strip - plug in or screw type
Voltage	6 V _{DC}

Note: This revision has numerous instances of original language moved to various Articles.

997-16 TMS Managed Field Ethernet Switch.

Meet the requirements of Table 997-32 and be compliant with the Code of Federal Regulations Section 200.216 Prohibition on certain telecommunications and video surveillance services or equipment.

Table 997-32 General Characteristics, Managed Field Ethernet Switch	
Property	Requirements
Layer 2+ Capability	QoS, IGMP, rate limiting, security filtering
Transmission	Full Duplex, Half Duplex Ethernet communications
Error-free Operation	99.999%
Mean Time Between Failures	10 years or 87,600 hours, using Bellcore/Telcordia SR-332 standards
Networking Standards	IEEE 802.1Q, IEEE 802.1P, IEEE 802.3, IEEE 802.3u, IEEE 802.3x,
Optical Ports	Single Mode: 1,310 or 1,550 nanometers. Type ST or LC.
Optical Ports	1000 Base FX, with optical budget of at least 15dB. Minimum of four ports designed for use with two pair of fibers, two strands transmit, the other two strands receive.
Copper Ports	Minimum of four copper ports, Type RJ-45, auto-negotiate (10/100 Base), full duplex. IEEE 802.3 standard pinouts.
Operational Indicators	LEDs showing link, transmit, receive, and power.
Management Capability	Port-based VLAN, VLAN tagging, IEEE 802.1Q, 4-kilobit VLAN address table.
Management Capability	Forwarding/filtering rate at a minimum 14,880 packets per second for 10 megabits per second, and 148,800 packets per second for 100 megabits per second.
Management Capability	Minimum 4 kilobit MAC address table.
Management Capability	Support of, at a minimum, Version 2 of the Internet Group Management Protocol (IGMP).
Management Capability	Support of Secure Shell (SSH) and secure Web-based GUI.
Management Capability	Support of the Simple Network Management Protocol (SNMP) version 1/2/3. Accessible using the EIA-232 management port or telecommunication network.
Management Capability	Support of Remote Authentication Dial-In User Service (RADIUS) or Terminal Access Controller Access-Control System Plus (TACACS+).
Management Capability	Support of remote monitoring (RMON) of the Ethernet agent and the ability to switch monitoring (SMON).

Note: This revision has numerous instances of original language moved to various Articles.

Table 997-32 General Characteristics, Managed Field Ethernet Switch	
Property	Requirements
Management Capability	Support of Secure Copy (SCP) or Secure File Transfer Protocol (SFTP) and either Network Time Protocol (NTP) or Simple Network Time Protocol (SNTP).
Management Capability	Supports port mirroring when combined with a network analyzer.
Power Requirements	Compatible with the solar requirements in 997-5.
Power Requirements	Fiber port fail open feature.
Environmental Requirements	NEMA TS 2 2021, Sections 2.2.7, 2.2.8., and 2.2.9.
Data Interface Compatibility	Compatible with the Vehicle Speed/Classification Unit, Weigh-In-Motion Unit, and Non-motorized Data Collection Unit.
Data Interface Compatibility	Compatible with the Department's polling software (TPAS).