Florida Department of Transportation

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KEVIN J. THIBAULT, P.E.
SECRETARY

August 3, 2021

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.**

Dear Mr. Nguyen:

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

The changes are proposed by Eric Griffin from the Transportation Data and Analytics to implement a new Section in Division III for Traffic Monitoring Site Materials. The proposed specification is associated with Section 695.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to 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/ra
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

TRAFFIC MONITORING SITE MATERIALS
(REV 6-23-21)

The following new Section is added after Section 996.

SECTION 997
TRAFFIC MONITORING SITE MATERIALS

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.

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.

997-1.1 Approved Product List Submittal Requirements: 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	Provide information as required in this Section.
Product Label	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 Instructions	Required.
Product Photo	Display significant features of the products.

997-2 Vehicle Sensors (Non-Weight).

997-2.1 General: Non-weight vehicle sensors include microwave vehicle detection system (MVDS), axle sensors, and non-motorized sensors.

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

Table 997-2
Physical Characteristics, Axle Sensor

Property	Documentation	Requirements

Sensor Element Dimensions	Technical Data Sheet	Approximately 6 ft. to 10 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	Technical Data Sheet	Minimum +200mV or produce a charge signal for passenger car/pickup truck axle @ 70°F with less than 10% negative signal for non-WIM axle sensors
Environmental Requirements	Technical Data Sheet	NEMA TS-2-2016, Section 3.

In-Sidewalk and Shared Use Path non-motorized sensors shall meet the physical characteristics in Table 997-3.

Table 997-3
Physical Characteristics, Non-Motorized 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 lb. Passenger bicycle, at 7.3 MPH
Environmental Requirements	Technical Data Sheet	NEMA TS-2-2016, Section 3.

997-3 Weight Sensors (In-Roadway).

997-3.1 General: Weight sensors include bending plates, Class I piezoelectric sensors, and quartz piezoelectric sensors.

997-3.2 Bending Plate: 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.

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

Table 997-5
Physical Characteristics, Piezoelectric Axle Sensor, Class I

Property	Documentation	Requirements
Sensor Size	Technical Data Sheet	6 ft. to 8 ft. Flat Element 0.26 in. wide x 0.063 in. thick
Operating Temperature Range	Technical Data Sheet	-40°F to 160°F
Temperature sensitivity	Technical Data Sheet	0.2%/°F
Output Uniformity	Technical Data Sheet	5% to 7%
Output Signal	Technical Data Sheet	250 mV for 400-pound wheel load at 70 F° and 55 mph [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.

997-3.4 Quartz Piezoelectric Sensor: The quartz piezoelectric sensors collect Weigh-In-Motion data. The quartz sensor shall meet the physical characteristics in Table 997-6.

Table 997-6
Physical Characteristics, Quartz Piezoelectric Sensor

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
Capacitance with 130 ft. cable	Technical Data Sheet	8 to 12 nano farad
Environmental Requirements	Technical Data Sheet	NEMA TS-2-2016, Section 3.

997-4 Solar Power Unit.

997-4.1 General: Provide solar power unit consisting of the following components: solar panel(s) and mounting hardware; 12 V storage battery; and voltage regulator with wiring and associated mounting hardware.

997-4.2 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 997-7:

Table 997-7
Physical Characteristics, Solar Panel

Property	Documentation	Requirements
Peak power range	Technical Data Sheet	80 to 130 watts.
Voltage	Technical Data Sheet	Maximum power greater than 16.5 V at 77°F
Current	Technical Data Sheet	Maximum power greater than 2.85 A at 77°F.
Photovoltaic modules construction	Technical Data Sheet	Mono or poly-crystalline cells.
AppFrame construction	Technical Data Sheet	Anodized aluminum.
Mounting hardware construction	Technical Data Sheet	Anodized, galvanized or stainless-steel.

997-4.3 Battery 12 V: Meet the physical characteristics in Table 997-8:

Table 997-8
Physical Characteristics, Battery 12 V

Property	Documentation	Requirements
		Rechargeable for photovoltaic application.
		Valve regulated lead-calcium gelled electrolyte or absorbed

		glass mat.
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 12 inches by 7 inches by 9 inches.

997-4.4 Voltage Regulator Configured for Nominal 12 V_{DC}: Meet the physical characteristics in Table 997-9:

Table 997-9
Physical Characteristics, Voltage Regulator

Property	Documentation	Requirements
Voltage for battery charging.	Technical Data Sheet	Minimum of 13.5 V_{DC} .
		Begin charging when battery voltage is 13.3 V or less.
		Discontinue charging when battery voltage is 14.5 V.
Quiescent current	Technical Data Sheet	Maximum 15 mA.
Operating Temperature range	Technical Data Sheet	0 to 122°F.
Dimensions	Technical Data Sheet	Approximately 2 inches by 5 inches by 1 inch.

997-5 Site Modem: Meet the physical characteristics in Table 997-10**:**

Table 997-10
Physical Characteristics, Site Modem

Property	Documentation	Requirements
Configuration	Technical Data Sheet	1.The device shall be field configurable to be powered from 12 V_{DC}. 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.

Protocols: The device shall have the ability to utilize, at a minimum, the following protocols:	Technical Data Sheet	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)
Event Reporting: The device shall have the capability to record and report, at a minimum, the following events in plain text:	Technical Data Sheet	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	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.

Antenna: Use an antenna that meets the following requirements:	Technical Data Sheet	1. Dual diversity 2. Minimum NEMA rating of NEMA 3 3. Frequencies: F_1 = 824 to 896 MHz, F_2 = 1850 to 1990 MHz, F_3 = 1850 to 1955 MHz, F_4 = 1710 to 1770 MHz, F_5 = 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

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Output Signal	Technical Data Sheet	Minimum +200mV or produce a charge signal for passenger car/pickup truck axle @ 70°F with less than 10% negative signal for non-WIM axle sensors
Environmental Requirements	Technical Data Sheet	NEMA TS-2-2016, Section 3.

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Sensor Size	Technical Data Sheet	20 in. wide x 70 in. or 50 in. long

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Scale Capacity	Technical Data Sheet	45000 pounds per axle and overload protected to 80000 pounds per axle
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