# Georgia Department of Transportation
# Transportation Products
# Qualified Products List (QPL)

By signing this form, the applicant declares that he/she has read and understood the provisions of Section 694 of the GDOT Minimum Specifications for Wireless Communication Equipment and all implemented modifications. The requirements listed on this matrix are derived from Section 926, which in all cases will be the basis for determining a product's compliance and its acceptability for use on Georgia's roads.

Date: _____

Applicant's Name (print): _____

Manufacturer: _____

Signature: _____

Item, Model No: _____

**GDOT Weather Monitoring and Reporting System Specification Compliance Matrix**

| Requirement | Item Comply? (Yes/No) | Comments | Evaluation Method[1] |
|---|---|---|---|
| **General** | | | |
| 1. Comply with ISO 9001 or Sigma Six quality manufacturing requirements. | - | | - |
| 2. Provide only equipment and materials that are new and of like kind and function provided by one manufacturer, using the same model, part number, revision, and firmware for each type of sensor as shown and specified in the Contract documents. | - | | - |
| 3. Provide weather monitoring and reporting system components that are capable of interoperability and connectivity with the existing statewide ESS system and GDOT Central Software. | - | | - |
| **ESS Sensor** | | | |
| 1. Provide ESS sensors that collect, store, and transmit the following atmospheric, pavement condition, and subsurface data: | | | |
| a. Atmospheric sensors installed along the roadway or on bridges (mounted on existing or new structure or pole and/or installed on the surface): | | | |
| ☐ Air Temp. ☐ Relative Humidity ☐ Ultrasonic Wind ☐ Barometric Pressure ☐ Precipitation ☐ Visibility | - | | - |
| b. Pavement sensors (located in, above, or under the pavement): | | | |
| ☐ Pavement Condition ☐ Surface Condition | - | | - |
| c. Subsurface (subsoil) sensor (located in the first travel lane or paved shoulder as approved by the Department). | - | | - |

| Requirement | Item Comply? (Yes/No) | Comments | Evaluation Method[1] |
|---|---|---|---|
| 2. Provide ESS sensors that send their respective data as specified herein to the RPU. | - | | - |
| 3. Provide ESS sensors and other field equipment that are made of UV, heat, and corrosion-resistant materials. | - | | - |
| 4. Provide shielded, outdoor-rated cabling with UV stable jacket from the RPU to each sensor in compliance with the ESS manufacturer requirements. | - | | - |
| 5. It is acceptable to provide sensors that can support multiple measurements of different types. | - | | - |
| 6. Provide ultrasonic anemometers and other ESS sensors having no moving parts, unless otherwise specified in the Contract documents. | - | | - |
| 7. Provide ancillary equipment, including aspirated radiation shields, needed for sensors to meet performance requirements defined in this section. | - | | - |
| 8. Provide weathertight molded cables capable of operating at extended cabling lengths up to 1,000 ft from the sensor to the RPU. | - | | - |
| 9. Provide atmospheric sensors that meet the minimum performance requirements identified below and in Table 1 (694 p4). | - | | - |
| a. Air Temperature and Humidity Sensor. Provide a sensor that measures: | | | |
| ☐ air temperature using a resistive sensor ☐ relative humidity using a capacitive sensor | - | | - |
| b. Ultrasonic Wind Sensor | | | |
| i. Provide a sensor that continuously measures wind speed and wind direction | - | | - |
| ii. Provide a sensor that sends wind data to the RPU, including average wind speed, average wind direction, and peak gust and gust wind direction, determined over a 10 to 60-minute time interval as defined by the user, unless otherwise specified in the Contract documents. | - | | - |
| c. Barometric Pressure Sensor. Provide a sensor that: | | | |
| ☐ Obtains absolute atmospheric pressure. ☐ Can be calibrated for different altitudes. | - | | - |
| d. Precipitation Sensor | | | |
| i. Provide a sensor that measures the accumulation and rate or intensity of precipitation. | - | | - |
| ii. Provide a sensor that detects visible precipitation in liquid and frozen form. | - | | - |
| iii. Provide a sensor that provides a yes/no indicator until a classification has been determined. | - | | - |
| iv. Provide a sensor that adds a classification for the following types of precipitation: | | | |

| Requirement | | | | Item Comply? (Yes/No) | Comments | Evaluation Method[1] |
|---|---|---|---|---|---|---|
| ☐ Rain (light, moderate, and heavy) | ☐ Freezing rain (light, moderate, and heavy) | ☐ Snow (light, moderate, and heavy) | ☐ Precipitation, not categorized (light, moderate, and heavy) | - | | - |
| e. Visibility Sensor | | | | | | |
| i. Provide a sensor that detects fog, smoke, or a combination thereof. | | | | - | | - |
| ii. Provide a sensor with transmitter hood and the capability to minimize dew build-up on the window of the sensor. | | | | - | | - |
| iii. Provide a sensor that minimizes the amount and effects of dirt contamination and ice formation on the sensor window. | | | | - | | - |
| iv. Provide a sensor that uses the forward scatter principle for the determination of optical visibility in the range designated in Table 1. | | | | - | | - |

**Table 1 – Atmospheric Sensor Performance Requirements**

| Sensor | Sensor Measurement | Requirement | | | | |
|---|---|---|---|---|---|---|
| | | Accuracy Range | Operating Range | | | |
| Air Temperature and Humidity | Air Temperature | ±0.5°F (±0.3°C) | -40°F to 140°F (-40°C to 60°C) | - | | - |
| | Relative Humidity (RH) | ±3% (0% to 90% RH) ±5% (90% to 100% RH) | 0 to 100% | - | | - |
| Ultrasonic Wind | Wind Speed | ±3% from 0 to 77 mph (0 to 124 kph) ±5% from 78 to 120 mph (125 to 193 kph) | 0 to 120 mph (0 to 193 kph) Resolution: 0.03 mph | - | | - |
| | Wind Direction | ±3 degrees at speed >0.45 mph (>0.72 kph) | 0 to 360 degrees Resolution: 0.1 degrees | - | | - |
| Barometric Pressure | Barometric Pressure | ±1.0 millibar (±0.03 inch of mercury [inHg]) | 800 to 1,080 millibars (23.6 to 31.9 inHg) | - | | - |

| Requirement | | | | Item Comply? (Yes/No) | Comments | Evaluation Method[1] |
|---|---|---|---|---|---|---|
| Precipitation | Precipitation Type | Yes/No (90% reproducibility), light rain, rain, and ice | N/A | - | | - |
| | Precipitation Rate | ±0.02 in/hour (±0.5 mm/hour) | 0 to 8 in/hour (0 to 20 cm/hour) | - | | - |
| Visibility | Precipitation Accumulation | ±0.02 in (±0.5 mm) | 0 to 8 in (0 to 20 cm) | - | | - |
| | Visibility | ±10% at 100 ft (30 m) to 1 mile (1.6 km) range<br>±15% at 1 mile (1.6 km) to 10 miles (16 km) range | 100 ft to 52,800 ft (30 to 16,000 m) | - | | - |
| 10. Provide a non-invasive (no physical impact to the pavement) pavement or surface sensor that meets the minimum performance requirements identified below and in Table 2. | | | | | | |
| a. Provide a sensor that measures the temperature using IR technology. | | | | - | | - |
| b. Provide a sensor that takes a surface or pavement temperature reading at no more than three minute intervals. | | | | - | | - |
| c. Provide a sensor that determines pavement or surface status as follows: | | | | | | |
| ☐ Dry – Absence of moisture on the surface sensor. | ☐ Damp – Trace pavement moisture above freezing (no precipitation). | ☐ Wet – Precipitation has occurred and there is a continuous layer of water or moisture on the pavement. | | - | | - |
| ☐ Ice – Detection of ice layer formation on the pavement. | ☐ Snow – Detection of snow accumulation on the pavement. | | | | | |
| 11. Provide an in-pavement sensor that meets the minimum performance requirements identified below and in Table 2. | | | | | | |
| a. Provide a sensor that measures surface temperature. | | | | - | | - |
| b. Provide a sensor that measures pavement friction or a grip level (critical to dry). | | | | - | | - |
| **Table 2 – Pavement Condition Sensor Performance Requirements** | | | | | | |
| **Sensor** | **Sensor Measurement** | **Requirement** | | | | |
| | | **Accuracy Range** | **Operating Range** | | | |
| Surface Temperature | Surface Temperature | ±0.5°F (±0.3°C) | −40°F to 140°F (−40°C to 60°C) | - | | 4 |

| Requirement | | | | Item Comply? (Yes/No) | Comments | Evaluation Method[1] |
|---|---|---|---|---|---|---|
| Surface Status | Dry | N/A | Resolution: 0.1°F (0.06°C) | - | | - |
| | Damp | | | | | |
| | Wet | | | | | |
| | Ice | | | | | |
| | Snow | | | | | |
| Surface Condition | Ice Layer | ±0.004 in (±0.1 mm) | 0 to 0.06 in (0 to 2 mm) | - | | - |
| | Water Layer | ±0.004 in (±0.1 mm) | 0 to 0.06 in (0 to 2 mm) | - | | - |
| | Grip Level | N/A | 0.01 o 1 | - | | - |
| 12. Provide a subsurface sensor that meets the minimum performance requirements identified below and in Table 3. | | | | | | |
| d. Provide a sensor that measures subsurface temperature. | | | | - | | - |
| e. Provide a sensor that measures the temperature at depths up to 18 in below the pavement layer, unless otherwise indicated in the Contract documents. | | | | - | | - |
| **Table 3 – Subsurface Sensor Performance Requirements** | | | | | | |
| **Sensor** | **Sensor Measurement** | **Requirement** | | | | |
| | | **Accuracy Range** | **Operating Range** | - | | - |
| Subsurface Temperature | Subsurface Temperature | ±0.4°F (±0.22°C) | -40°F to 140°F (-40°C to 60°C)<br>Resolution: 0.1°F (0.06°C) | | | |
| **RPU** | | | | | | |
| 1. Provide RPU that can collect, store, and process sensor data to describe current weather conditions. | | | | - | | - |
| 2. Provide RPU that accepts a minimum of 10 sensors concurrently and can be expanded to accept up to five additional sensors. | | | | - | | - |
| 3. Provide RPU that allows for interoperability and connectivity to multiple vendors' sensor products. | | | | - | | - |
| 4. Support local digital RS-232 and RS-485, analog, and Ethernet communications to sensors. | | | | - | | - |

| Requirement | Item Comply? (Yes/No) | Comments | Evaluation Method[1] |
|---|---|---|---|
| 5. Provide RPU that uses "watch-dog" circuitry and monitors its' own operation and resets itself if the RPU software enters an indeterminate state by itself or by a user administrator. | - | | - |
| 6. Provide RPU that can be reset from a centralized control location. | - | | - |
| 7. Provide RPU circuitry, including voltage inputs, sensor inputs, and communications ports, with transient and surge protection. | - | | - |
| 8. Provide RPU that uses SNMP traps to alert a system operator of alarm conditions. | - | | - |
| a. Provide RPU that issues an alert if its power supply is low or if there has been a complete power loss. | - | | - |
| b. Provide RPU that sends a message to the system operator when the unit returns to normal operation. | - | | - |
| 9. Provide RPU that connects a dry contact solid state relay to open or closed based on any weather condition parameter sensed by the ESS sensor. | - | | - |
| 10. Provide RPU that uses sensor data to calculate the precipitation (any type) start and end time, time since last precipitation, forecasted snow or rain accumulation (equal to previous time interval), and probability of precipitation. | - | | - |
| 11. Provide RPU that uses non-invasive sensor data to calculate or determine the depth of precipitation including water and ice, percent of ice, snow/ice warning, snow/ice watch, wet below freezing, and frost condition. | - | | - |
| 12. Provide RPU that uses in-pavement sensor data to calculate or determine the average surface temperature and average grip level. | - | | - |
| 13. Provide RPU that uses subsurface sensor data to calculate or determine the average subsurface temperature to display temperature data incrementally by depth of reading. | - | | - |
| 14. Provide RPU with the capability to record and archive automated ESS sensor observations for a minimum period of three calendar days and provides user-selectable interval of archived observations between 1 and 20 minutes. | - | | - |
| 15. Provide RPU with software that has a user interface on the RPU (either through web or an external display) for troubleshooting, sensor configuration, and routine maintenance. | - | | - |
| 16. Provide RPU that supports remote firmware upgrades and sensor calibrations without the need for personnel to be on-site. | - | | - |
| **Mobile ESS (Type 3 Only)** | | | |
| 1. Provide mobile ESS sensors that meet the minimum performance requirements identified below and in Table 4. | - | | - |
| 2. Provide mobile ESS with new, corrosion-resistant sensors. | - | | - |
| 3. Provide mobile ESS that operates with different surface materials (asphalt, concrete) without special calibration. | - | | - |

| Requirement | Item Comply? (Yes/No) | Comments | Evaluation Method[1] |
|---|---|---|---|
| 4. Provide mobile ESS that maintains continuous performance even with pavement damage and potholes in the road. | - | | - |
| 5. Provide mobile ESS sensor on the exterior front of the vehicle that measures surface temperature, air temperature, and humidity in real time. | - | | - |
| 6. Provide mobile ESS sensor on the exterior rear of the vehicle that measures pavement conditions (dry, moist, wet, ice), provides the thickness of any water or ice detected on the pavement, and calculates the friction of the pavement. | - | | - |
| 7. Provide mobile ESS that operates within a DC power range of 12 to 24 VDC. | - | | - |
| 8. Provide mobile ESS that integrates with automated vehicle location units. | - | | - |
| **Communications and Network** | | | |
| 1. Support direct fiber-based 10/100 Ethernet connections, Ethernet-based broadband cellular, or IEEE 802.11 wireless connectivity for transport of ESS data to the TMC as specified in the Contract documents. | - | | - |
| 2. For sites utilizing broadband cellular service for providing network connectivity to the TMC, utilize the Department's current cellular telecommunication service provider. Refer to Section 926.2.01.F for broadband cellular router requirements. | - | | - |
| 3. Comply with NTCIP 1204 v03 or later. | - | | - |
| 4. Provide NTCIP conformance documentation with PRL with the materials submittal package. | - | | - |
| 5. Provide support to the Department in making the weather monitoring and reporting system data from the ESSs available to the National Weather Service for use by the Meteorological Assimilation Data Ingest System or successor program software. The data shall be pushed at regular intervals from a central ESS server to a known site, such as a hosted FTP server. RPU communication with the hosted server shall utilize NTCIP-ESS protocol. The RPU shall allow the server to poll the RPU via Ethernet communications. The data shall be formatted in a common data format (e.g., .csv or .xml) for exporting into other system(s). | - | | - |
| **Mechanical** | | | |
| 1. Provide equipment that is permanently marked with manufacturer name or trademark, part number, and serial number. | - | | - |
| 2. Provide conductive contact surfaces or pins that are made of a noncorrosive, nonrusting, conductive metal. | - | | - |
| 3. Do not use self-tapping screws on the exterior of the assembly. | - | | - |
| 4. Provide parts that are made of corrosion and UV-resistant materials, such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal. | - | | - |
| 5. Provide assembly and mounting hardware, including nuts, bolts, external screws, and locking washers <5/8 in (15.8 mm) in diameter, that are made of Type 304 or 316, stainless steel meeting the requirements of ASTM F593 and ASTM F594. | - | | - |

| Requirement | Item Comply? (Yes/No) | Comments | Evaluation Method[1] |
|---|---|---|---|
| 6. Provide assembly hardware ≥5/8 in (15.8 mm) in diameter that are galvanized meeting the requirements of ASTM F3125. | - | | - |
| **Electrical** | | | |
| 1. Provide DC conversion for any equipment requiring DC power. | - | | - |
| 2. Supply DC-to-DC or AC-to-DC conversion as required and voltage converter for devices that require operating voltages <120 VAC. | - | | - |
| 3. When required in the Contract documents, connect to a field UPS as specified in Section 939.2.07. | - | | - |
| 4. ESS Type 1 only: Provide the capability to operate using 120 VAC (±10%) 50/60 Hz (±5%). | - | | - |
| 5. ESS Type 2 only: Provide the capability to operate using 12 VDC (±10%) power provided from a solar power system meeting the minimum solar power system requirements specified in Section 939.2.08. | - | | - |
| 6. ESS Type 3 only: Provide the capability to operate using 12 VDC (±10%) as provided from a standard vehicle DC connector outlet. | - | | - |
| **Field Cabinet** | | | |
| 1. Provide system components that are compatible with the field cabinet as shown in the Contract documents. The field cabinet is not included in the pay items defined in Section 694.5. | - | | - |
| **Mounting and Support Structure** | | | |
| 1. Mount ESS atmospheric sensors, ESS field cabinet, and other required components on a single existing or new Department support structure or pole unless otherwise specified in the Contract documents. | - | | - |
| 2. Provide new support brackets, mounting hardware, and ancillary materials to mount ESS sensors and components. | - | | - |

| Requirement | Item Comply? (Yes/No) | Comments | Evaluation Method[1] |
|---|---|---|---|

**Table 4 – Mobile ESS Sensor Performance Requirements**

| Sensor | Sensor Measurement | Requirement | | |
|---|---|---|---|---|
| | | Accuracy Range | Operating Range | Frequency of Reading |
| Air Temperature and Relative Humidity | Air Temperature | ±0.5°F (±0.3°C) | -22°F to 122°F (-30°C to 50°C) | 10 times per second |
| | Relative Humidity (RH) | ±3% (0% to 90% RH) ±5% (90% to 100% RH) | 0 to 100% | |
| Surface Temperature | Surface Temperature | ±1.1°F (±0.6°C) | | |
| Surface Status | Dry | N/A | N/A | 10 times per second |
| | Wet | | | |
| | Damp or Moist | | | |
| | Frost | | | |
| | Snow and Ice | | | |
| Surface Condition | Ice Layer | ±0.1 mm (up to 1.0 mm) ±0.004 in | 0 to 0.06 in (0 to 2 mm) | |
| | Water Layer | ±0.1 mm (up to 1.0 mm) ±0.004 in | 0 to 0.06 in (0 to 2 mm) | |
| | Grip Level | N/A | 0.01 to 1 | |

| | | | |
|---|---|---|---|
| **Environmental** | | | |
| 1. Provide ESS equipment and components capable of operating in the following minimum temperature range and humidity levels: | | | |

| Requirement | | Item Comply? (Yes/No) | Comments | Evaluation Method[1] |
|---|---|---|---|---|
| ☐ -40°F (-40°C) through 140°F (60°C) for outside the vehicle and -13°F (−25°C) through 122°F (50°C) for inside the vehicle | ☐ Up to 95% relative humidity (non-condensing) | - | | - |
| 2. Comply with NEMA 250, Type 4X corrosion requirements when installed within 5 miles (8 km) of the coast line. | | - | | - |
| 3. Comply with IEC EN 60068-2, NEMA TS-2 Sections 2.1.9 and 2.1.10, or approved equivalent vibration and shock testing requirements. | | - | | - |
| 4. Comply with IEC EN 61000-4-5 surge immunity testing requirements. | | - | | - |
| 5. Provide ESS system that can withstand wind speeds of 100 mph (161 kph) with a 20% gust factor. | | - | | - |
| 6. Comply with the following EMC emission standards: | | | | |
| ☐ FCC Part 15, Subpart B, Class B | ☐ IEC EN 61326-1 | - | | - |

**Note 1:**
**Evaluation Method**

1. **Physical Inspection** – a vision inspection of the product
2. **Compliance Matrix Review** – a review of the matrix comments column itself to see if all required statements were made
3. **Document Review** – a review of all specs, lab test reports, etc.
   a. Independent 3rd Party Facility Test results
   b. 1st Party (Manufacturer) Test results
4. **Functional Review / Inspection –** GDOT Lab and/or Field Trial testing