STATE OF NEW JERSEY
DEPARTMENT OF TRANSPORTATION
TRENTON, NEW JERSEY 08625

METRIC SPECIFICATIONS FOR A WEATHER STATION

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New Jersey Department of Transportation Specifications for a Weather Station.

The purpose of these specifications is to describe the minimum acceptable design and operating requirements for a weather station. This station accurately determines the temperature, relative humidity, wind speed and direction, presence or absence of active precipitation and presence of ice on the pavement in real-time. The sensor data is collected and processed by a remote processing unit which transmits the weather sensor data to a Central Station Processor via a standard EIA RS-232 serial port connected to a fiber optic network.

GENERAL - I

1-1 Components

Each remote weather station shall consist of one precipitation sensor, one temperature/relative humidity sensor, one wind speed sensor, one wind direction sensor, and four pavement sensors connected to a Remote Processing Unit (RPU). The weather station shall also include communications electronics, mounting equipment and cables. The Central Station Processor shall communicate to the Remote Processing Units to gather data and present it in tabular, graphical and thermal mapping displays. The Central Station Processor shall include a mechanism for supplying real-time data for all weather stations to an application program running on another computer. This data shall be updated once a minute and shall contain all measured parameters for each station.

1-2 Certification

The installation and operation of the device shall not require any special licensing, frequency assignment or permits from the FCC or other Federal agency to operate as described in this specification.

1-3 Operating Environment

All components of the weather station shall operate correctly as defined in these specifications under the following environmental conditions:

A. Ambient Temperature

The weather station equipment shall function within an ambient temperature range between -30 °C to +50 °C.

B. Relative Humidity

The weather station equipment shall function within a relative humidity range from 0% to 100%.

C. Forms of Precipitation

The weather station equipment shall function under all forms of precipitation (rain, sleet, snow, etc.)

1-4 Mounting

The weather station shall be rack-mountable.

1-5 Electrical Power

All weather station components shall operate from standard 120 volt AC electrical service. The weather station shall operate as specified over a voltage range of 105 to 125 volts AC at 60 hertz.

WEATHER STATION - II

2-1 Sensors

The weather station components shall be compatible with the RPU and supported by the same vendor.

A. Wind Speed

This sensor shall be a high-response, low-threshold, 3 cup, optoelectronic anemometer meeting the following requirements:

- Measuring Range: 0 - 161 kilometers per hour
- Accuracy: less than 1%
- Operating Temperature Range: -34 °C to +40 °C

B. Wind Direction

This sensor shall be a counter-balanced, low-threshold optoelectronic wind vane. The Wind direction sensor shall meet the following requirements:

- Measuring Range: 0°- 360°
- Resolution: 5.63°

- Damped natural wavelength: 2.5 meters
- Accuracy: less than 1%
- Sensor-transducer Type: LED/Photo transistor (code disc)
- Operating Power Supply: 11 - 15.5 volts DC, 20 milliamps typical
- Operating Temperature Range: -30 °C to +50 °C

C. Air Temperature/Relative Humidity

This sensor shall provide a relative humidity measurement range of 0% to 100% and have an operating range of -20 °C to +60 °C. The temperature measurement range shall be -20 °C to +60 °C. The sensor shall be capable of being recalibrated with one or two references.

D. Precipitation Sensor

This shall be a forward scatter type optical sensor that measures meteorological visibility and precipitation type and intensity. The precipitation type shall be determined to be one of the following classifications based on user defined limits on measured variables:

- Precipitation - non distinguished
- Rain
- Light Drizzle
- Snow

These parameters shall provide intensity indicators of None, Heavy, Light and Moderate.

E. Road Surface Sensors

This sensor shall be capable of simultaneously measuring several physical quantities at the road surface level.

- Surface Temperature
- Surface Condition

Dry	Snow & Ice
Wet	Frost
Chemically Wet	Chemical Factor

A sensor shall be provided to measure the temperature of the material below the surface of the pavement. The sensor may be included in the pavement sensor or be a separate device.

F. Radiation Shield

This shall be used to protect the temperature/humidity sensor from solar radiation and rain. The shield shall be UV-proof, well ventilated, and maintenance free.

2-2 Remote Processing Unit

Each RPU shall be microprocessor based and capable of collecting data from the following sensors:

- 1 to 4 Surface Sensors
- 1 to 4 Ground or Sub-Surface Temperature Probes
- Air Temperature/Relative Humidity Sensor
- Precipitation Classification Visibility Sensor
- Wind Speed/Direction Sensor

Powered by 110 volts AC, the RPU shall operate in a range of 100-130 volts AC at 50-60 hertz and require a maximum of 100 watts continuous power.

2-3 Maintenance

The weather station shall require minimal or no maintenance for correct operation as described in these specifications. Under normal conditions, the weather station shall require only periodic cleaning of the laser lens cover not more than four times per year to maintain effective operation.

2-4 Communications

The weather station shall transmit the specified sensor data within one second after a request by the central processor. The Supplier shall provide documentation that fully describes the weather station operation and the communications protocol required for accessing the sensor data directly from the field units or from the central monitoring station. The communications protocol description shall be complete and detailed to support development of a software interface to the sensors. The communication protocol information shall be supplied as part of the submittal information.

CENTRAL STATION - III

3-1 Communications

Communication between the central station and remote processors shall be via multi-drop or direct connect RS232 links. The central station shall include multiple RS232 ports which can be connected to a workstation. Over this channel, all weather information from any remote station shall be available and refreshed at least once a minute. The protocol for accessing this information shall be supplied as part of the submittal package.

3-2 Displays

The workstation processor or central station processor shall provide displays representing all data returned from the Remote Processing Units. This data shall be presented in the following formats:

A. Graphical Displays indicating the development and trend of the measured and calculated variables.

B. Tabular Displays showing data from several Remote Processing Units.

C. Thermal Mapping Displays indicating which are likely to freeze first.

3-3 Alarm System

Important messages shall be shown on the screen and/or printer. The threshold for these alarms shall be user definable. Important messages include changes in precipitation status, changes in pavement sensor status and significant changes in temperature.

3-4 Workstation or Central Station Equipment

One (1) personal computer based on the Intel 80486SX microprocessor shall be provided to run the Central Station Software. This system shall include the following components or features at a minimum:

- 200 megabyte hard disk.
- 4 megabyte RAM memory.
- CPU speed of 33 megahertz or greater.
- Isobar power strip or equivalent.
- All required MSDOS, Xenix, or OS/2 system software required to support the central weather station implementation.
- Epson LX810, 9 Pin Dot Matrix Printer or equivalent.
- Procomm Software or equivalent
- Hewlett Packard Paintjet Printer or equivalent.

TESTING - IV

All equipment defined in this specification shall be subject to factory testing as subsequently described. The factory test shall demonstrate or provide confirmation that all of the equipment operates over the specified environmental range for each component and meets the overall specifications. The factory test shall include at least two fully configured remote stations and one central station. The central station shall be connected to the remote stations via a multi-drop or direct null-modem RS232 connection. The procedure shall demonstrate the operation of the central station and the production of all interactive displays and reports. The factory test shall include a demonstration of the central interface port. In addition, methods shall be proposed for fully exercising all sensors for all environmental conditions encountered in New Jersey.

The supplier shall be responsible for submitting a test plan which has been designed to exercise and monitor the equipment for the purpose of determining compliance with the specifications.

TRAINING - V

Prior to the acceptance of the first unit of each type, training shall be provided for the Department's engineering, consultants, maintenance and operations staff, at a facility provided

by the Department. The training shall include all material and manuals required for each participant. The training shall be as follows:

5-1 Maintenance Training

The training shall be provided for a minimum of 40 hours for at least five (5) personnel with an electronics background. The training shall include operation instructions, theory of operation, circuit description, field adjustments, preventive maintenance procedures, troubleshooting and repair of all components.

5-2 Engineering Training

The training shall be provided for a minimum of 8 hours for at least twenty (20) engineering and operations personnel. The training shall include a complete demonstration of the operation and capabilities of the equipment. This session should include a complete review of any field adjustments or calibration of the weather equipment which may be necessary for optimum performance and should stress the ability to diagnose problems down to a faulty board or bad connector. In addition, the configuration of each board shall be discussed. This training shall be proficient to provide the engineers and operators with the ability to operate and maintain the system.

5-3 Software Training

The training shall be provided for a minimum of 8 hours for a minimum of five (5) experienced programmers. The purpose of the training is to review the software protocol necessary to communicate directly with the field sensors and the central interface port. The session shall include a "hands-on" program diagnostic session.

INSTRUCTIONS AND GUARANTEES - VI

6-1 One set of complete schematics and operations/maintenance manuals of each component shall be supplied with every field and central assembly furnished. Maintenance manuals shall include complete sub-component parts listing. Operations manuals shall include a complete description of the software protocol.

6-2 No changes or substitutions in these requirements will be acceptable unless authorized in writing. Inquiries regarding this specification shall be addressed to the Manager, Office of ITS Engineering, New Jersey Department of Transportation, P.O. Box 613, 1035 Parkway Avenue, Trenton, New Jersey 08625.

6-3 All components shall carry a two-year guarantee from the date of acceptance against any imperfections in workmanship or materials.

6-4 The manufacturer agrees to, upon the request of the Manager, Office of ITS Engineering to deliver to the Office, a sample of each assembly to be supplied in compliance with these specifications for inspection and test before acceptance. After completion of the test, the sample shall be returned.

6-5 The supplier shall furnish any and all equipment which they deem necessary for safe and reliable field and central operation of the weather equipment as part of the quoted price for the specified equipment. This equipment shall include all towers, labeling, and field sensors.

6-6 All components furnished under this specification shall be current production equipment and of recent manufacturer, identical models of which are in field operation in not less than one hundred sites worldwide. Untried or prototype units shall not be considered for acceptance.

6-7 All major components shall be identified with a metal plate containing the serial number with a bar code identification.

6-8 Any repairs made by a manufacturer or representative shall be documented and returned with units when warranty repaired. This documentation shall include an explanation of the exact repairs made and identification of parts replaced by part number and circuit number. All warranty repairs shall be completed within thirty days of delivery of the equipment to the designated repair depot.