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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

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**Forestry and grassland internet of things - Sensor technology
requirement**

林草物联网 传感器通用技术要求

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1 Scope

The document lays down the basic parameters and the general technical requirements of the sensors commonly used in the forestry and grassland internet of things.

It applies to the design and the development of forestry and grassland internet of things sensors.

2 Normative references

The content of the following document constitutes, through normative reference in the text, indispensable provisions of this document. For dated references, only the edition corresponding to that date applies; for undated references, the latest edition, including all amendments, applies.

GB/T 13283-2008 Accuracy classes of measuring instruments and display instruments for industrial process measurement and control.

3 Terms and definitions

The following terms and definitions apply to the document.

3.1 forestry and grassland internet of things: a system that carries out information exchange

and communication between things through sensing devices and according to agreed protocols, in forest, grassland, wetland, desertified and sandified environments, so as to achieve functions such as intelligent identification, positioning, tracking, monitoring and management. Source: LY/T 2413.2-2015, 3.1.1.

3.2 sensitivity: the degree of change of the response quantity produced by a given method for a unit concentration or a unit amount of the substance to be measured.

3.3 repeatability: the agreement between the results of several consecutive measurements of the same measurand carried out under the same measurement conditions.

3.4 drift: the unwanted variation in the output of a sensor, unrelated to the measurand, occurring within a given time interval.

3.5 temperature drift: the unwanted variation in the output of a sensor, unrelated to the measurand, occurring within a given time interval and caused by a change of temperature.

3.6 zero drift: the change in value of the zero position of a sensor produced with the passing of time.

3.7 sensitivity drift: the change in the sensitivity of a sensor produced by a change of external conditions.

3.8 thermal sensitivity drift: the change in the sensitivity of a sensor produced by a change of temperature.

3.9 measuring range: the interval formed by the maximum and the minimum values a sensor is able to measure.

3.10 output impedance: the impedance measured at the output end of a sensor when the input end is short-circuited.

3.11 zero output: the output when the applied measurand is zero under indoor conditions.

3.12 response: the characteristic of the output when the measurand changes.

3.13 responsive time: the time needed for the output quantity of a sensor to change as a result of a change of the measurand.

4 Classification

4.1 Physical quantities. 4.1.1 Mechanical quantities: pressure sensors, torque sensors, accelerometers, flow sensors, flow velocity sensors, displacement sensors, inclination angle sensors, gyroscopes and the like. 4.1.2 Thermal quantities: temperature sensors, infrared temperature sensors, thermal radiation sensors and the like. 4.1.3 Humidity quantities: humidity sensors and the like. 4.1.4 Optical quantities: visible light sensors, illuminance sensors and the like. 4.1.5 Acoustic quantities: ultrasonic sensors, acoustic sensors and the like. 4.1.6 Electrical quantities: current sensors, voltage sensors, electric

field sensors and the like. 4.1.7 Magnetic quantities: magnetic azimuth sensors and the like.

4.2 Chemical quantities. 4.2.1 Gas quantities: carbon monoxide concentration sensors, carbon dioxide concentration sensors, oxygen concentration sensors, nitrogen oxide concentration sensors, negative oxygen ion sensors, smoke sensors, PM2.5 sensors and the like. 4.2.2 Ion quantities: pH sensors, sodium ion concentration sensors, potassium ion concentration sensors, chloride ion concentration sensors and calcium ion concentration sensors.

4.3 Physiological quantities: heart rate sensors, blood oxygen concentration sensors, plant stem flow sensors, plant stem water content sensors and the like.

5 Technical requirements

5.1 General requirements. The general technical requirements are the following. a) Atmospheric pressure: 76 kPa to 106 kPa. b) Storage and transport temperature: minus 30 °C to 60 °C. c) Transmission mode: the sensor uses a wired or a wireless transmission mode. d) Sensor interface: RS232 serial interfaces and RS485 serial interfaces and the like are supported. e) Measurement accuracy: not lower than class 1.5 as specified in GB/T 13283-2008. f) Storage capacity: for a sensor provided with a storage function, the storage capacity is not less than 10 kB. g) Working stability: the sensor undergoes a working stability test with a power-on time of not less than 15 d. The other technical requirements for sensors in different environments are given in Table 1.

Table 1 has two columns, class and technical requirements, and two rows. For class 1 it fixes an operating temperature of minus 40 °C to 60 °C, a relative humidity of 10 % to 100 %, a sand and dust concentration of 0.17 mg to 0.22 mg per cubic metre, a continuous operating time of not less than 1 year, and calibration and adjustment at least once every six months. For class 2 it fixes an operating temperature of minus 20 °C to 60 °C, a relative humidity of 10 % to 95 %, a sand and dust concentration of 0.04 mg to 0.11 mg per cubic metre, a continuous operating time of not less than 2 years, and calibration and adjustment at least once a year.

5.2.1.1.1 Atmospheric pressure sensors. The main technical requirements are the following. a) Measuring range: 600 hPa to 1 300 hPa. b) Measurement accuracy: 0.03 % FS. c) Zero drift: not greater than 0.02 % FS. d) Temperature drift: not greater than 0.02 % FS. e) Thermal sensitivity drift: not greater than 0.02 % per °C.

5.2.1.1.2 Liquid pressure sensors. The main technical requirements are the following. a) Measuring range: 0 MPa to 30 MPa. b) Measurement accuracy: 0.03 % FS. c) Zero drift: not greater than 0.2 % FS. d) Temperature drift: not greater than 0.02 % FS. e) The liquid pressure sensor has a corrosion-resistant outer housing and is provided with a pressure tapping hole, and its continuous working life exceeds 10 000 h.

5.2.1.2 Torque sensors. The main technical requirements are the following. a) Measuring

range: 0 r/min to 6 000 r/min, as printed on the document. b) Concentricity: the error does not exceed $\pm 0.2\%$. c) Measurement accuracy: 0.2% FS.

5.2.1.3 Accelerometers. The main technical requirements are the following. a) Measuring range: linear acceleration from minus 200 to 200 metres per second squared, angular acceleration 500 degrees per second squared. b) Output impedance: not greater than 1 kilohm. c) Temperature drift: not greater than 0.02% FS per $^{\circ}\text{C}$. d) Thermal sensitivity drift: not greater than 0.04% per $^{\circ}\text{C}$. e) Maximum sampling frequency: not lower than 1 000 Hz. f) Measurement accuracy: 0.2% FS.

5.2.1.4 Flow velocity sensors. The main technical requirements are the following. a) Measuring range: minus 20 m/s to 20 m/s. b) Output impedance: not greater than 1 kilohm. c) Zero output: 100 mV. d) Temperature drift: not greater than 0.02% FS per $^{\circ}\text{C}$. e) Thermal sensitivity drift: not greater than 0.04% per $^{\circ}\text{C}$. f) Maximum sampling frequency: not lower than 10 Hz.

5.2.1.5 Flow sensors. The main technical requirements are the following. a) Measuring range: 10 to 100 cubic metres per hour. b) Measurement accuracy: 0.5% FS.

5.2.1.6 Displacement sensors. The main technical requirements are the following. a) Measuring range: 0 mm to 100 mm. b) Measurement accuracy: 0.5% FS.

5.2.1.7 Inclination angle sensors. The main technical requirements are the following. a) Measuring range: ± 60 degrees. b) Measurement accuracy: 0.5% FS.

5.2.1.8 Gyroscopes. The main technical requirements are the following. a) Measuring range: 0 to 100 degrees per second. b) Zero bias stability: 0.001 degrees per second. c) Resolution: 0.01 degrees per second. d) Bandwidth: greater than 50 Hz.

5.2.2.1 Temperature sensors. The main technical requirements are the following. a) Measuring range: minus 55°C to 125°C . b) Basic error: not greater than $\pm 0.1\%$ FS. c) Response time at 90 % of the change: not greater than 10 s.

5.2.2.2 Infrared temperature sensors. The main technical requirements are the following. a) Measuring range: 0°C to 300°C . b) Response wavelength range: $3\text{ }\mu\text{m}$ to $14\text{ }\mu\text{m}$. c) Measurement accuracy: 0.5% FS. d) Resolution: 0.1°C . e) Response time: 300 ms. f) Detection distance: greater than 200 m.

5.2.2.3 Thermal radiation sensors. The main technical requirements are the following. a) Span: minus 55°C to 125°C . b) Measurement accuracy: 0.25% FS.

5.2.3.1 Air humidity sensors. The main technical requirements are the following. a) Error: $\pm 5\%$ between 10 % and 80 % at 20°C , $\pm 7\%$ below 10 % or above 80 % at 20°C . b) Humidity hysteresis: not greater than 3 %. c) Repeatability: not greater than 2 %. d) Response time: not greater than 30 s.

5.2.3.2 Soil humidity sensors. The main technical requirements are the following. a)