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NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

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Replacing GB/T 26764-2011

Multifunctional high-speed highway condition monitor

多功能路况快速检测设备

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2 Normative references

The documents cited are GB 1589 (outer dimensions, axle load and mass limits of vehicles, trailers and road trains), GB/T 4208-2017 (degrees of protection provided by enclosures, IP code), GB/T 5226.1 (electrical safety of machinery, general requirements), GB/T 9969 (instructions for use of industrial products), GB/T 14267 (photoelectric distance meters), GB/T 16311 (quality requirements and test methods for road traffic markings), GB/T 18314-2009 (specifications for global positioning system surveys), GB/T 19953 (measurement of the resolution of digital cameras), GB 23254 (retro-reflective body markings for trucks and trailers) and QC/T 413 (basic technical requirements for automotive electrical equipment).

3 Terms and definitions

3.1 Multifunctional high-speed highway condition monitor: integrated intelligent inspection device able to detect automatically two or more items of road condition information among pavement distress, roughness, rut, texture depth, wearing, bumping, geometric data, the internal condition of the road structure, the coefficient of retro-reflected luminance, the forward road image and the geographical position.

3.2 Pavement distress: collective name for cracks, potholes and similar defects that reduce the technical condition or the service performance of the pavement.

3.3 Roughness: vertical deviation of the pavement surface from an ideal plane that causes a vehicle to bounce. Note: expressed by the International Roughness Index.

3.4 Rut: longitudinal band-shaped groove formed along the wheel path after the pavement has deformed, worn and subsided under repeated traffic. Note: the size of a rut is measured by the maximum groove depth of the pavement cross section.

3.5 Texture depth: depth of the open pores of the pavement surface within a specified area. Note: also called macro-texture depth; depending on the test area and the calculation model the abbreviations TD, SMTD and MPD are used.

3.6 Bumping: sudden bouncing of a vehicle caused by an abnormal bulge, subsidence or similar damage of the pavement. Note: expressed by the degree of bumping.

3.7 Wearing: state of wear of the pavement surface texture. Note: expressed by the pavement wearing rate.

3.8 Geometric data: spatial geometric shape and dimensions of the road. Note: expressed by cross slope, longitudinal slope, horizontal curve radius and vertical curve radius.

3.9 Coefficient of retro-reflected luminance: ratio of the luminance in the direction of observation to the normal illuminance on a plane perpendicular to the direction of the incident light.

4 Composition and functions

4.1 The monitor is made up of the carrier vehicle, the mileage measuring device, the functional detection systems and the data processing system. The functional detection systems are the geographical position acquisition system, the pavement distress detection system, the roughness detection system, the rut detection system, the texture depth and wearing detection system, the bumping detection system, the ground penetrating radar detection system, the geometric data detection system, the retro-reflected luminance coefficient detection system and the forward image acquisition system.

4.2 The monitor has to work with the road open to traffic. Mileage measurement supplies mileage information to the data processing system and a common drive signal to all the other systems. Geographical position acquisition uses a satellite-based geodetic positioning device and links the position to the mileage by software.

4.2 Pavement distress detection uses a planar image acquisition device or a three-dimensional pavement data acquisition device and yields, after manual or automatic recognition, statistics classified by distress type. Roughness detection uses laser distance sensors and accelerometers to record the change of longitudinal profile slope and computes roughness through a roughness model. Rut detection uses laser distance sensors to record the shape of the cross section and computes rut depth through a rut model.

4.2 Texture depth and wearing detection uses laser distance sensors to record the pavement texture and computes texture depth and pavement wearing data. Bumping detection combines laser distance sensors with an inertial reference device to record relative elevations of the longitudinal profile. Ground penetrating radar detection uses two-dimensional or three-dimensional radar to obtain echo information on the road structure and, after processing and imaging, the thickness of the structural layers and information on defects under the pavement.

4.2 Geometric data detection uses gyroscopes and angular accelerometers to record transverse and longitudinal angular change and the change of curvature of the horizontal and vertical alignment. Retro-reflected luminance coefficient detection uses a special light source with emitting and receiving devices to measure the retro-reflected luminance of road markings. Forward image acquisition records the landscape ahead of the vehicle and yields information on the road environment and the traffic safety facilities.

4.2 The data processing system covers acquisition and processing. The acquisition software drives all systems from the same source, stores the data and unifies the position of the multi-source data; its main interface controls and monitors the whole system and allows the detection route, start chainage, direction, lane, sampling interval, storage location and display mode to be set, with real-time calibration and checking of the chainage during detection. The processing software computes each indicator separately and produces single-indicator or multi-indicator statistics and assessments.

5 Technical requirements

5.1.1 The vehicle has to be clean and complete, with all parts sound and firmly connected. External attachments carry retro-reflective marks, and the rear of the carrier vehicle carries a permanent warning legend such as road inspection, or a variable-message electronic screen, together with warning lamps; the legend must be legible and unobstructed and its total outline area not smaller than 60 % of the projected rear area of the carrier vehicle. The outline dimensions of the carrier vehicle in working condition comply with GB 1589, the vehicle appears in the national vehicle production catalogue, and the ground penetrating radar is connected to the carrier vehicle as an integrated structure.

5.1.1 Inside the carrier vehicle an antistatic insulating floor is laid and an antistatic device is fitted outside. A stable power supply system with safety protection is provided, together with an interface for an external supply, and the on-board supply sustains continuous work with adequate power quality. Other electrical equipment complies with GB/T 5226.1 and QC/T 413. External attached devices have a degree of protection not lower than IP55 of GB/T 4208-2017.

5.1.2 and 5.1.3 Mileage is measured by an incremental photoelectric encoder or a similar device that also supplies the common drive signal. Geographical position is acquired by a satellite positioning system such as BeiDou, linked automatically to the chainage, and recorded and stored at 5 m intervals.

5.1.4 Pavement distress detection may use area-array imaging, line-scan imaging, laser digital imaging or three-dimensional data imaging, with auxiliary lighting as needed. It has to cover both asphalt and cement concrete pavements, work continuously in the longitudinal direction, and deliver orthogonal images with accurate position information, clear texture and even brightness suitable for automatic recognition. The software displays and stores images or three-dimensional data in real time, allows manual assistance, review and correction when automatic recognition is used, stores the annotated result, and provides statistics over 10 m, 100 m and 1 000 m intervals; the 10 m damage ratio is the sum of the damaged areas multiplied by their weights or conversion factors divided by the inspected pavement area, and the 100 m and 1 000 m ratios are the arithmetic means of the 10 m ratios they contain.

5.1.5 Roughness detection uses laser profile measurement referred to an inertial reference system, covers asphalt and cement concrete pavements, measures on the centre line of one or both wheel paths, and uses accelerometers with a nominal range of at least +/- 2 g. The software computes and stores the IRI of 10 m intervals according to Annex A, flags invalid data when conditions are abnormal, and aggregates to 100 m and 1 000 m as arithmetic means.

5.1.6 Rut detection uses multi-point laser on a common beam or line structured light, with a transverse sampling interval not greater than 300 mm and a longitudinal sampling interval not greater than 200 mm; for the multi-point laser beam type the nominal measuring range of the laser distance sensor is at least 200 mm. The software computes the left, right and section rut depth of every cross section according to Annex B, the section value being the greater of the two sides, flags incomplete or abnormal sections, and aggregates over 10 m, 100 m and 1 000 m as arithmetic means.

5.1.7 Texture depth and wearing detection uses laser profile measurement with a longitudinal sampling interval not greater than 2 mm; in two-line detection the sensors sit on the centre lines of the left and right wheel paths, in three-line detection on the wheel paths and the lane centre line. The software computes the texture depth of 10 m intervals according to Annex C, aggregates to 100 m and 1 000 m, and derives the pavement wearing rate from the 10 m texture depth through the wearing rate model.

5.1.8 Bumping detection uses a single laser or a laser group measuring the longitudinal profile, covers asphalt and cement concrete pavements and measures on the centre lines of the left and right wheel paths with a sampling interval not greater than 100 mm. Its software removes bridge expansion joints and other abnormal data and the influence of the longitudinal alignment before computing the number and degree of bumps per 10 m