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Field Test Methods of Subgrade and Pavement for Highway Engineering

公路路基路面现场测试规程

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1 General Provisions

1.0.1 This standard is formulated in order to adapt the demand of highway construction and management in China, guarantee the construction and maintenance quality of highway subgrade and pavement engineering, and regulate field testing instrument and equipment, test method and operating requirement.

1.0.2 This standard is applicable to field investigation, engineering quality testing and technology condition testing of highway subgrade and pavement.

1.0.3 When the test methods specified in this standard are applied in the quality evaluation or acceptance of road sections, the road section selection and sampling method shall comply the corresponding technical specifications of construction and maintenance, or the requirements of "Quality inspection and Evaluation Standards for Highway Engineering - Section 1: Civil Engineering" (JTG F80/1).

1.0.4 The instruments and equipments for testing in this standard shall meet the requirements of the corresponding standards and pass the inspection required,

1.0.5 The national legal system of units of measurement is adopted in this standard.

1.0.6 The field test of highway subgrade and pavement shall meet the requirements of the current national and professional standards or codes, besides complying with the requirements of this standard.

2 Terms and Symbols

2.1 Terms

2.1.1 Subgrade width

Sum of driveway and shoulder widths, counted in meter (m). Intermediate zone, speed change lane, climbing lane, emergency stop zone, if available, shall be included in this width.

2.1.2 Pavement width

The total width of driveway, side trip, speed change lane, climbing lane, hardened verge and emergency stop zone, counted in meter (m).

2.1.3 Subgrade cross slope

A ratio between the height difference of trench center line and trench edge points to the horizon distance hereof, expressed in a percentage (%).

2.1.4 Pavement cross slope

As for road with median strip, it is referred to the slope of the straight portion of road camber surface; as for road with median strip, it is referred to the ratio of the height difference (pavement - median strip juncture and edge of pavement to verge juncture points) to the horizon distance hereof, expressed in a percentage (%).

2.1.5 Deviation of pavement center-line

Deviation distance of the actual center line of the pavement from the design center line, counted in mm.

2.1.6 Degree of compaction

Ratio of the dry density and the standard maximum dry density of the road material after compacting, expressed in a percentage.

2.1.7 Roughness

Vertical deviation of the pavement surface relative to the ideal plane.

2.1.8 Elastic modulus

Ratio of stress and strain of material within limit of elasticity.

2.1.9 Strength of cement concrete

Compressive strength of cement concrete standard specimen after being cured under the required condition.

2.1.10 Deflection

Total vertical deformation (total deflection) or perpendicular rebound deformation (rebound deflection) of subgrade or pavement surface under the specified load action, expressed in 0.01mm;

2.1.11 Texture depth

Mean depth of opening cavity in road surface, namely, the macro-texture depth (TD), counted in mm.

2.1.12 British pendulum number (BPN)

Representative value of the friction coefficient of the pavement under the dampness condition, tested with pendulum type friction coefficient gauge; it is 100 times of the friction coefficient.

2.1.13 Sideway force coefficient

Ratio of test axle direction frictional resistance and vertical load, between the special tyre and the damp pavement when the test wheel runs at a certain velocity at the inclination of 20°from the direction of travel; it is named SFC for short, and also called zero dimension.

2.1.14 Water permeability coefficient

Volume of water penetrating into pavement of the required area within in unit time, under the specified initial head pressure, counted in mL/min.

2.1.15 Faulted joint slabs

Elevation revulsion between different structures or adjacent cement concrete slabs, counted in mm.

2.1.16 Rut

Longitudinal zonary rut groove left on the wheel path of roadway, after flow distortion, abrasion and sinkage caused by repeated running of motor vehicles; the depth of rut is counted in mm.

2.1.17 Field CBR of soil subgrade

Ratio of the load pressure and the normal pressure of the required penetration amount, expressed in a percentage. The required penetration amount is read from the load pressure - penetration curve, gained by the penetration test conducted as required under the field conditions of highway soil subgrade.

2.2 Symbol

δ_m——Roughness (maximum clearance);

Δ_{CL}——Deviation of pavement center-line;

R_L——Depth of pavement rut;

TD——Texture depth;

BPN——British pendulum number;

SFC——Sideway force coefficient;

C_w——Water permeability coefficient;

E_0——Resilience modulus of soil subgrade;

E_1——Resilience modulus of pavement material;

CBR——California bearing ratio (CBR) of soil subgrade;

μ——Poisson ratio of pavement material;

VBI——Accumulated displacement of bump-integrator;

IRI——International roughness index;

OWP——Driveway outside wheelmarks position;

IWP——Driveway inside wheelmarks position.

3 Field Sampling

T 0901—2008 Sampling Method

1 Objective and application scope

1.1 This method is applicable to pavement core drilling rig or cutter drilling or cutting representative samples of pavement.

1.2 This method is applicable to sampling cement concrete surface layer, asphalt mixture surface layer or inorganic material-binding stabilized bases (cement, lime and pulverized fuel ash), for testing basal density or other physical mechanic properties.

1.3 The diameter of the core sample drilled in this method should not be less than 3 times of the maximal aggregate particle size.

2 Technical requirements on equipments and materials

The following instruments / equipments and materials are required in this method:

(1) Pavement core drilling rig: pull type (manual type) or vehicular type; driven by engine or electric power; the bit diameter may beφ100mm or φ 150mm, and determined as required; equipped with trickling cooling device.

(2) Pavement cutter: hand-push type or pull type; driven by engine or electric power motor, or motor vehicle powered hydraulic pump; equipped with diamond saw blade and trickling cooling device.

(3) Platform balance.

(4) Sample container (bag) or iron pan.

(5) Dry ice (solid CO_2).

(6) Specimen label

(7) Other: pickaxe, spade, measuring rule (rope), brush, hard paper, cotton yarn, etc.

3 Method and procedure

3.1 Preparation

(1) Road section determining: select a worked section, a road section finished a day, or an inspection road section with required length selected in accordance with the requirements of the related standard.

(2) Determining the position of sampling through the method specified in Annex A.

(3) Clearing the sampling location.

3.2 Sampling procedure

(1) Drawing out a standard or approximate area (on sampling pavement) for drilling location with chalk; the cut area of the pavement shall be determined according to the objective and demand.

(2) Perpendicularly aligning the drill at the pavement, lowering the bit, and mounting the drill stably to keep the drill from moving in the running procedure.

(1) Length measuring instrument: steel tape.

(2) Theodolite, precision level, tower ruler or total-station meter.

(3) Other: chalk, etc.

3 Method and Procedure

3.1 Preparation

(1) Accurately restore the stake number on subgrade or pavement.

(2) In accordance with the relevant construction specifications or the requirements of "Quality inspection and Evaluation Standards for Highway Engineering - Section 1: Civil Engineering" (JTG F80/1), select the position of tested cross section and the mileage stake number on a testing road section and make marks in the tested cross section by the method specified in Annex A. Generally, select same cross section position for testing pavement width, cross slope, elevation and center-line plane deviation, and the position should be on the stake with integral number.

(3) Determine the boundary position of the design width of the parts of subgrade and pavement according to the requirements of road construction; make marks on the testing position with chalk.

(4) Determine the position of the vertical section for testing design elevation according to the requirements of road construction; make marks on the testing position with chalk.

(5) In accordance with the requirements of the road construction, on the cross section perpendicular to the center-line, determine the actual center line position of the pavement after forming.

(6) According to the road camber shape specified in the road design, determine the junction position of the curve and the straight portion, and the juncture of pavement and verge (hardened verge), as references for the cross slope test; if the curbstone or median strip is available, take the edge of the curbstone on both sides as the reference point for cross slope testing, and make a mark with chalk.

3.2 Test procedure for width and overall width of the parts of subgrade and pavement

With a steel rule, horizontally measure the widths of the parts of subgrade and pavement along the vertical direction of the center line, express the result in meter (m), accurate to 0.005m for expressway and Class I highway; accurate to 0.01m for other highways. the steel rule shall be kept horizontal in the test, and it must not hang to the pavement for testing. the flexible rule must not be adopted.

3.3 Test procedure of vertical section elevation

(1) Arrange the precision level on even section of the pavement, level the precision level and erect the tower ruler on the testing position of the center-line, and take the reference point elevation nearby the line. Measure and record the elevation reading of the measuring point, expressed in meter (m), accurate to 0.001m.

(2) Continuously measure all measuring points, and align them with the reference point.

3.4 Test procedure of pavement cross slope

(1) Pavement arranged with median strip: Arrange the precision level on even section of the pavement, level the precision level and erect the tower respectively on the edge (d1) of the side trip on the junction between pavement and median strip, and the junction (d2) (or edge of outside curbstone) of the pavement and the verge; the points d1 and d2 must be located on same cross section; measure the elevations of d1 and d2, and record the elevation readings,

(6) Other: enamel tray, cotton yarn, etc.

3 Method and Procedure

3.1 The thickness of base or sand-gravel pavement may be tested by the pitting method, and the thickness of cement concrete pavement slab shall be tested by drilling method.

3.2 Procedure of pitting method:

(1) Randomly sample and determine the pitting position by the method specified in Annex A in accordance with the requirements of the current standards; if old road is sampled and significant defect or seam like hole exists on the pitting position, the position aside may be sampled.

(2) On the tested position, select a 40cm×40cm even surface, and clean it with brush.

(3) Select proper implements like pickaxe, shovel and chisel according to the hardness degree of the material, excavate the material of this layer till the bottom surface. To be convenient for excavation, reduce the cut surface as smaller as possible; shape the hole a circle, and shovel the material out and placed it in a enamel tray while excavating.

(4) Clean the hole bottom with a brush, and confirm that the top surface of the lower layer is exposed.

(5) Horizontally span the steel rule on the hole, adopt another steel rule or caliper to extend to the hole bottom perpendicularly on the middle position, and measure the distance from the hole bottom to the first steel rule. The measured distance is the thickness of the tested layer, expressed in mm, accurate to 1mm.

3.3 Test procedure of drilling (coring) method:

(1) Randomly sample and determine the drilling position by the method specified in Annex A in accordance with the requirements of the current standards; if old road is sampled and significant defect or seam like hole exists on the drill position, the position aside may be sampled.

(2) Drill and core with the pavement core drilling rig by the method specified in T 0901, and the diameter of shaped core shall meet the requirements of Article 2 in this method. The drilling depth must reach the thickness of the tested layer.

(3) Take the core sample out carefully, clear away the gray soil on the bottom surface, and find out the boundary surface to the lower layer.

(4) Measure the height from the surface to the boundary surface with a steel rule or caliper on four symmetrical points (at cross direction) along the circle, and work out the mean values of four measured heights. The mean value is the thickness of the tested layer, accurate to 1mm.

3.4 During the construction of asphalt pavement, the measuring points may be selected randomly as required if the asphalt mixture has not cooled down; insert a screwdriver to the bottom surface of the asphalt layer, and measure the depth with a ruler. The measured reading is the thickness of the asphalt layer, expressed in mm, accurate to 1mm.

3.5 The pit and drill hole is filled up with the materials same to the sampling layer by the following procedures:

(1) Clean the residue in the hole and absorb out the water left in drilling.

(2) The pit and drill hole left on inorganic binding material stable layer and cement concrete pavement slab shall be filled up with fresh material with same mixing proportion to the one of the sampled material by layers, and compacted with a hammer. A little amount of

radar wave identification software, and the thickness of the layers are worked out on the base of the two-way travel times.

5 Report

The pavement depth test report shall include the mean thickness, standard deviation and thickness representative value of the tested road section.

T 0914——2008 Method for Testing Pavement Cross Slope - Geometrical Data Test System

1 Objective and Application Scope

1.1 This method is applicable to the continuous acquisition of the pavement cross slope data by the geometrical data test system under normal running condition.

1.2 Data acquisition, transmission, recording and data processing in this method are automatically controlled and conducted by special software.

1.3 This method is applicable to the engineering quality acceptance of new and reconstructed pavement, and the cross slope evaluation of traffic pavement free of severe hollow or rut.

1.4 In the testing process, the pavement shall be clean, and the test shall be conducted in the time period of small wind force.

2 Technical Requirements on Equipments and Materials

The geometrical data test system consists of bearing vehicle, data collecting processing system and distance measurement system.

2.1 Basic technical requirement and parameter of bearing vehicle

The body height of the bearing vehicle for the geometrical data test system should not exceed 1.7m, and the type of the vehicle shall satisfy the requirement of the equipment manufacturer.

2.2 Technical requirement and parameter of test system

(1) Distance calibrated error: ≤0.1%.

(2) Working temperature: -10~60℃.

(3) Cross slope resolution: ≤0.1°.

3 Method and Procedure

3.1 Preparation

(1) Check the tire pressure, and ensure the air pressure under normal working condition.

(2) Distance calibration: the distance calibration must be conducted when the bearing vehicle runs per 5000km or re-tyred. the distance calibration length is 1000m, within the error of 0.1%.

(3) Open the power of the control panel, and inspect control function keys, indicator lights and technical parameter selecting status.

3.2 Test Procedure

(1) Open the test system, and the preheating time shall not be shorter than the requirement specified in the equipment operating manual.

(2) The system deviation calibration must be conducted in accordance with the method specified in the equipment operating manual before staring the test each time or when the continuous test length of the system exceeds 100km.

(3) Set the required test modes in the requirements in the equipment operating manual and the field technical requirements of the tested road section.

(4) The driver expedite the test vehicle to the testing velocity (30 ~ 90km/h) at constant acceleration. The test vehicle runs into the tested road section along the normal wheel path. In the testing process, the bearing vehicle shall run at a constant speed along the traffic lane, without overtaking or changing the direction.

(5) After accessing the tested road section, the test staff must input initial point and terminal pint of the tested road section and other required special marking points into the test data record timely and accurately.

(6) When the bearing vehicle pulls out from the tested road section, the operating staff stops the data acquisition and recording, and restores the parts of the system initial state.

(7) He operating staff shall inspect the test data. The content hereof shall be normal. otherwise, the test shall be redone.

(8) Close the power supply of the test system, and complete the test.

4 Report

The report shall include the mean value, standard deviation and variation coefficient of the cross slope value.

5 Compaction Degree

T 0921—2008 Method for Testing Compaction Degree - Pitting Sand Replacement Method

1 Objective and Application Scope

1.1 This method is applicable to the density and compaction degree field test for material compacted layers of base (or sub-base), sand-gravel pavement and subgrade soil. And it is not applicable to compaction degree test for macroscopic void or macro-porous material compacted layers like rock-fill road embankment.

1.2 The density and compaction degree test with pitting and sand replacement method shall meet the following requirements:

(1) A small-sand inserting barrel (φ100mm) should be adopted when the maximum particle size of the aggregate is less than 13.2mm, and the tested thickness is not larger than 150mm.

(2) A large-sand inserting barrel (φ150mm) shall be adopted when the maximum particle size of the aggregate is equal to or greater than 13.2mm and not larger than 31.5mm and the tested thickness is not larger than 200mm.

2 Technical Requirements on Equipments and Materials

The following instruments / equipments and materials are required in this method:

(1) Sands inserting barrel: two types, large one and small one, are adopted as required. the type and main dimension hereof is detailed in Figure T 0921 and Table T0921. a sands inserting barrel which the dimension disagrees with ones in the table, and that does not affect the use, may be adopted. The upper part is a sand storage barrel, and a round pore is opened on the center of the barrel; the lower part is a resupinate cone funnel, and its upper end is opened with a pore which the diameter is same to the one of the round pore on the bottom of the sand storage barrel; the funnel welded on a steel plate, and a round hole is opened on the center of the steel plate to connected with the upper pore of the resupinate funnel. A switch (a sheet iron) is arranged between the bottom of the sand storage barrel and the steel plate. An end of the sheet iron is articulated with the steel plate, and the other end stretches outside of

(2) The factors like particle size of material, grading, evenness and composition have less effects on the test result. But some materials (like kaolin, mica, gypsum and lime) containing crystal water or organic substance may significantly affect the test. The tests for them shall be contrasted with other responsible approaches, adjusting the test results.

(3) In the tests for hot-mix asphalt composite pavement paved just now, the instrument cannot be placed on the pavement, and it shall be shifted from the pavement for cooling after the test, avoiding affecting the test result.

(4) In the test, there shall be no nuclear instrument and other radioactive sources within 10 m around the instrument.

3 Calibration of Instruments

(1) The nuclear wet density tester shall be calibrated a time within per 12 months; the calibration can be conducted by the instrument manufacturer or independent qualified service institution.

(2) New instruments may not be calibrated if calibrated in advance in the manufacturer. the existing instruments after being repaired may result in the structure, so the instrument must be used upon being calibrated. in the calibration verification process, the instrument must be recalibrated if it cannot satisfy the specified limits.

(3) The density (or water ratio) tested by the instrument after calibration shall meet the requirements, the calibration on each test depth of all calibration blocks shall be ±16kg/m^3.

4 Technical Requirements on Equipments and Materials

The following instruments / equipments and materials are required in this method:

(1) Nuclear wet density tester: The instrument shall meet the health protection and safety standards specified the country, the measuring range of the density shall be 1.12~2.73g/cm^3, The measurement error is not larger than ±0.03g/cm^3; The measuring range of the water ratio is 0~0.64g/cm^3, And the measurement error is not larger than±0.015g/cm^3. It includes the following components:

① Gamma ray source: double sealed isotope radioactive source, cesium—137, cobalt—60 or radium—226, etc.

② Neutron source: americium (241)—beryllium, etc.

③ Detector: gamma-ray detector, like G - M counter tube; thermal neutron detector, like helium—3 tube.

④ Reading display device: LCD display, impulse counter, rate meter, or direct reading meter.

⑤ Standard counter block: a material block with uniform and content density and hydrogen content; it is used for testing the running condition of the instrument and providing the reference standard for radiation counting.

⑥ Drill rod; drill the test hole for inserting gauge rod.

⑦ Safety protection equipments: the equipments meeting the country specified requirements.

⑧ Strike-off stick, drill rod, connection wire, etc.

(2) Fine sand: 0.15~0.3mm.

(3) Balance or platform scales.

(4) Other: brush, etc.

5 Method and Procedure

5.1 As for this method, diffuse transmission method should be adopted to test the compacted density of the asphalt mixture surface layer and the density of the hard perforated material like hardened cement concrete; direct transmission method shall be adopted to test the density and water ratio of the easily perforated materials like earth base, base material or unhardened cement concrete.

5.2 When the diffuse transmission method is used to test the surface, the maximum thickness shall be determined according to the property of the instrument, to test the layer thickness of the asphalt surface course. In the determination of the compacted density and the water ratio of earth base and base material, the direct transmission method shall be adopted to test the layer thickness not larger than 30cm after drilling hole.

5.3 Preparation

(1) Before using or in case of suspicion on the test result, the standard counting block shall be used to test the standard value of the instrument by the following procedure:

① The position for standard value test shall be at least 10m away from other radioactive source, and the ground must be compacted and leveled.

② Switch on the power source, and conduct the preheating for the instrument according to the instruction book of the instrument.

③ In the test, the property of the instrument shall be checked normal. The instrument shall be placed stable on the standard counting block. Conduct the standardized counting in accordance with the requirements of the instrument instruction book, the standardized counting value must meet the requirements. If the standardized counting value exceeds the required limit, confirm whether the method and environment of the standardized counting meet the requirements, and repeat the standardized counting; of the second standardized counting value always meet the required limit, it shall be regarded as failure and the instrument shall be inspected.

(2) Before the density measurement of the asphalt mixture compacted layer, the calibration shall be conducted by nuclear wet density tester and drill hole sampling specimens; for the density measurement of other materials, the calibration shall be conducted with the results of the pitting and sand replacement method. The calibration procedure is as follow:

① Select compacted pavement under the condition same to the section test; the pavement with larger texture must be filled with fine sand, the instrument is placed on the test point and rotated for several times, or strike-off stick is used on the test point, scraping for several times, meeting the test condition. The nuclear wet density tester is used to test the density by the required procedures, reading.

② On the same testing position, conduct sampling and thickness measurement by drilling method and pitting & sand replacement method, and test the density of the material by the standard method specified in the related standard.

③ Test at least 15 points for same pavement depth and material type before normal using, and gain the correlation on the measured density tested by two different methods; the correlation coefficient (R) shall not be less than 0.95.

(3) Selection of test position

① Determine the test position by the method specified in Annex A, and the minimum distance to the edge of pavement or other object must not less than 30cm. the distance from the nuclear wet density tester to other radioactive source must not be less than 10m.

3.1 Preparation

(1) Select the tested road section in accordance with the related requirements.

(2) Selection of testing point on tested road section: for the quality test of the asphalt pavement under construction, the testing point shall be located on seam crossing, and a single pole is adopted to test and evaluate; for the engineering quality acceptance or road condition evaluation of subgrade and pavement of highways except expressway, select a testing position per 200m, and test the length of 10 chi (1 chi = 33.33 cm) on each position. Except one with special requirements, a side of wheel wheelmark (0.8 ~ 1m away from the traffic lane) shall be adopted as the standard position of continuous measurement. as for the rutted pavement of old road, the middle position of the rut shall be adopted as testing position, marked on the pavement with chalks.

(3) Clean the testing position on pavement.

3.2 Test Procedure

(1) In the test under the construction, place the three-meter ruler on the road surface on the testing point according to the testing direction as required.

(2) Test the clearance between the three-meter ruler bottom surface and the road surface by sight, and determine the position of the maximum clearance.

(3) Place the clearance gage with height scale into the clearance, and measure the height (mm0 of the maximum clearance; or measure the depth from the ruler top surface to the road surface with a depth gauge on the maximum clearance position, and the height of the maximum clearance is the measured depth deducted by the height of the ruler, accurate to 0.2mm.

4 Calculation

In the roughness calculation for the pavement test with single pole, the maximum clearance between the three-meter ruler and the pavement is the test result. in the 10-chi test, check whether the measured value is qualified, and work out the qualification percentage; work out the mean value of the 10 maximum clearances.

5 Report

In the single pole test, test positions and test results shall be recorded. in the 10-chi test, the mean value, disqualified length and qualification rate shall be reported.

T0932—2008 Method for Testing Roughness - Continuous Roughometer

1 Objective and Application Scope

1.1 This method specifies the test for the unevenness standard deviation (σ) of pavement with continuous roughometer, for indicating the pavement roughness, expressed in mm.

1.2 This method is applicable to the roughness test of road surface and the evaluation of construction and service quality, and it is not applicable to the roughness test of pavements with many hollows and severe damage.

2 Technical Requirements on Equipments and Materials

The following instruments / equipments and materials are required in this method:

(1) Continuous roughometer

① Overall structure: the structure of a continuous roughometer is detailed in Figure T0932-1. except in special cases, the standard length of a continuous roughometer is 3m, and the quality hereof shall meet the requirements of the instrument standards; a frame 3m long,

2 Technical Requirements on Equipments and Materials

(1) Test system

The test system consists of bearing vehicle, distance-measuring device, bump accumulated value testing device and master control system. the master control system can control the operation of the testing device, complete the data acquisition, transmission, storage and computation process.

(2) Requirements on bearing vehicle

The bearing vehicle for the test system shall be selected according to the requirements of the equipment supplier.

(3) Basic technical requirements and parameter of test system

① Testing velocity: 30~80km/h.

② Maximal testing amplitude value: ±20cm.

③ Vertical displacement definition: 1mm.

④ Distance calibrated error: <0.5%.

⑤ Work environment temperature: 0~60℃.

⑥ The system software can automatically conduct the conversion of bump accumulated values on the base of the related relation equation, and directly output the international roughness index (IRI).

3 Method and Procedure

3.1 Preparation

(1) If the test vehicle is on one of the following conditions, the correlation calibration of the measured value and IRI shall be conducted, and the correlation coefficient (R) shall not be lower than 0.99: the test vehicle runs under normal condition more than 20000km; the calibrated interval exceeds 1 year; the shock absorber and tyre are changed or repaired.

(2) Test the tire pressure of the test vehicle, reaching the required standard air pressure; the tire shall be clean free from sundries; the load, staff number and distribution in the vehicle shall be in conformity with the one at correlation calibration test.

(3) The distance measurement system, if required to installed on field, shall be installed according to the operating manual to guarantee the clamp device stable and firm.

(4) Inspect the test system: the part shall meet the test requirements and are free from obvious visible damages.

(5) Open the system power supply, initiate the control procedure, and check the working conditions of parts.

3.2 Test Procedure

(1) Before the test, run the test vehicle at the testing velocity for 5 ~ 10km and preheat the test system for the specified preheating time according to the operating manual.

(2) Settle the test vehicle on the position 300 ~ 500m before the test starting point, initiate the roughness test system procedure, and set the required test modes according to the requirements of the equipment operating manual and the field technical requirements of the tested road section.

(3) Before entering the tested road section, the driver shall keep the vehicle velocity within a specified testing velocity, and run the vehicle to enter the tested road section along the normal wheel path.

(4) After accessing the tested road section, the test staff initiates the acquisition and

recording program and input initial point and terminal pint of the tested road section and other required special marking points into the test data record timely and accurately.

(5) When the bearing vehicle pulls out from the tested road section, the operating staff stops the data acquisition and recording, and restores the parts of the system initial state.

(6) The operating staff shall inspect the data file. The file shall be complete and the content hereof shall be normal. Otherwise, the test shall be redone.

(7) Close the power supply of the test system, and complete the test.

4 Calculation

The correlation equation is gained by the correlation calibration test according to the bump accumulated value (VBI) directly outputted by the bump-integrator, and converted into IRI (expressed in m/km) at the calculation interval of 100m.

5 Correlation contrast test of bump-integrator measured value and international roughness index (IRI)

5.1 Basic requirements

Because the bump-integrator measured value may be affected by the factors like testing velocity, the testing velocity actually adopted in the test system shall be calibrated respectively, and the calibration procedure and analytic result of correlation equation shall be recorded in detail and archived.

5.2 Test conditions

(1) Select 4 road sections with different roughness which the IRI variation amplitude is not less than 1.0, and the selected road sections shall have enough speedup or slowing-down length. The calibrated road section within a certain range may be increased according to the IRI distribution of the measured road.

(2) The length of each road section is not less than 300m.

(3) The roughness within a section shall be uniform, including the 50m approach road before the road section.

(4) Select the straight road section with smaller slope change and traffic volume, be convenient for traffic dispersion.

(5) The calibration should be conducted on the normal running wheelmarks of the driveway, definite marking the wheelmark, initial point and terminal pint of the calibrate road section.

5.3 Testing procedure

(1) Distance calibration

① Select an even and straight road section with small slope change according to the length recommended by the equipment supplier, and mark the initial point, terminal pint and running track.

② Before the calibration, run the calibration vehicle at the test running velocity for 5 ~ 10km and preheat the calibration system for the specified preheating time according to the operating manual.

③ Align the front wheel at the starting line, initiate the range calibration procedure, run the vehicle along the straight road section track, avoiding abrupt acceleration or slowdown; when approaching the terminal, slowdown and stop the vehicle according to the gesticulation of the directing staff, and ensure aligning the front wheel at the finish line; complete the range calibration procedure. repeat this procedure and ensure the accuracy of the range sensor

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