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NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 23561.8-2024

Replacing GB/T 23561.8-2009

Methods for determining the physical and mechanical properties of coal and rock - Part 8: Methods for determining the deformation parameters of coal and rock

煤和岩石物理力学性质测定方法 第8部分:煤和岩石变形参数测定方法

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2 Normative references

The following document contains provisions which, through normative reference in this text, constitute 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 23561.7-2009 Methods for determining the physical and mechanical properties of coal and rock - Part 7: Method for determining the uniaxial compressive strength and counting softening coefficient.

3 Terms and definitions

3.1 modulus of secant - the slope of the line joining the origin to the stress point at 50 % of the compressive strength on the axial stress-strain curve of the specimen during loading.

3.2 modulus of elasticity - the ratio of the normal stress to the normal elastic strain in the elastic stage when the specimen is under uniaxial load.

3.3 Poisson's ratio - the absolute value of the ratio of the strain along the direction of the load to the strain perpendicular to the direction of the load when the specimen is under uniaxial load.

4 Main instruments, equipment and materials

4.1 Machining equipment: core drilling machine, rock saw, rock grinder or surface grinder.

4.2 Inspection tools for the test sample: vernier caliper with a smallest division of 0.02 mm; universal bevel protractor, dial gauge stand and dial gauge; levelling table.

4.3 Testing machine, one of the following two types. Material testing machine: the accuracy shall not be lower than grade 0.5. Electro-hydraulic servo testing machine: the accuracy shall not be lower than grade 0.5 and it shall be able to load at a rate of 0.5 MPa/s to 1.0 MPa/s.

4.4 The measuring system comprises the following. The range of the load cell shall satisfy Formula (1), in which the expected maximum failure load of the specimen is expressed in kilonewtons (kN) and the maximum value of the loading range of the material testing machine is expressed in kilonewtons (kN); the relation given is that the maximum of the range lies between 1.25 times and 5 times the expected maximum failure load. A static or dynamic resistance strain gauge indicator. A displacement transducer with a range not greater than 50 mm. An extensometer, preferably a longitudinal double-bridge extensometer, with a range preferably not smaller than 5 mm and a measuring accuracy of +/- 0.25 % of full scale. A computer data acquisition and processing system. Other equipment and instruments may be used, but their accuracy grade shall not be lower than that specified in this document. The results may be obtained by manual reading and recording of the gauges, by electrical digital recording, by automatic detection with the computer data acquisition and processing system, or by automatic detection with the internal measuring system of the electro-hydraulic servo testing machine.

4.5 Materials required for the test. Resistance strain gauges, commonly with a gauge size of 3 mm x 15 mm to 3 mm x 20 mm, a sensitivity coefficient of 0.2 as printed in the source, and a resistance of 120 ohm +/- 0.2 ohm. Adhesives: cyanoacrylate 502 glue, epoxy resin adhesive or another adhesive of similar performance. Moisture proof cement: epoxy compound, polyvinyl chloride adhesive or polyvinyl acetal adhesive. Cleaning agents: acetone, analytical grade ethanol, absorbent cotton or gauze.

5 Specimen specification

The specification of the specimens, the machining accuracy, the number of specimens and their moisture state shall meet the requirements of Clause 5 of GB/T 23561.7-2009.

6 Preparations before the test

6.1 Checking the strain gauges. Before bonding, the strain gauges shall be checked: the resistance wire shall be straight and evenly spaced, the wire shall be firmly bonded to the backing, and the length of the grid shall be more than ten times the largest grain of the rock and smaller than the radius of the specimen. The working gauges and the temperature compensating gauges of one set of specimens shall be of the same specification and sensitivity coefficient, and the permissible deviation of the resistance of the temperature compensating gauge is +/- 0.2 ohm.

6.2 Method of bonding the strain gauges. The gauges shall be bonded at the middle of the specimen in the direction of its height, keeping clear of fissures, joints and pegmatitic parts. Two to three longitudinal and two to three transverse gauges are bonded on each specimen. The longitudinal and transverse gauges are arranged in a T shape lying on its side or in an inverted T shape, as shown in Figure 1. Before bonding, perpendicular lines are drawn at three equally spaced positions round the circumference and a circumferential line is drawn at half the height, so that the gauges can be centred. For specimens of uniform lithology and high machining accuracy, one longitudinal and one transverse gauge may be bonded at the middle of two opposite sides only.

6.3.1 Cleaning the surface. The area to be bonded is first rubbed with grade zero abrasive paper over an area larger than the gauge, then cleaned with gauze or absorbent cotton moistened with acetone or another volatile solvent until no dust marks remain on the gauze or cotton.

6.3.2 Applying the adhesive and bonding. Ordinary specimens may be bonded with 502 glue or epoxy resin adhesive; specimens with a high moisture content or saturated specimens require the moisture proof cement. The modulus of elasticity of the adhesive shall be smaller than that of the specimen. A thin layer of adhesive is applied first to the bonding area of the specimen and, when it is dry, a thin layer is applied to the back of the gauge, which is then bonded in the required direction and position. A small piece of plastic film is placed over the gauge and rolled with the finger to squeeze out the air bubbles and the excess adhesive between the gauge and the specimen; a few tens of seconds of pressure are enough for a firm bond.

6.3.3 Curing. The adhesive can generally cure by itself at room temperature. The curing time follows the instructions for the adhesive used; when the work is urgent it may be dried with heat according to the instructions for the type of adhesive.

6.3.4 Wiring. The lead wires at the tail of the gauge are soldered to insulated wires. The wires shall be fixed before soldering so that the gauge is not damaged if a wire is knocked. The material, the length and the diameter of every wire shall be the same, and the length should not exceed 10 m.

6.4 Moisture proofing. To protect against moisture from the base, the surface of the specimen is cleaned with acetone and coated with epoxy resin adhesive to a thickness not exceeding 0.1 mm over an area larger than the gauge, so that moisture from inside the specimen cannot reach the gauge. After the base coat has cured the gauge is bonded and the short leads are soldered out; after the gauge has been bonded and cured, the insulation resistance to earth shall meet the requirements of the test and shall be greater than 200 megohm; the gauge is then coated with moisture proof cement about 1 mm thick and the wire joints are treated in the same way. For specimens that have been water saturated the insulation resistance shall also be greater than 200 megohm.

6.5 Fitting of the dial gauges. The dial gauges are used mainly to measure the longitudinal and transverse deformation of soft and very soft coal and rock, which deform much and have low strength. The dial gauge is mounted on a magnetic stand fixed to the lower bearing plate of the testing machine; the head of the longitudinal gauge touches the edge of the upper bearing plate and the head of the transverse gauge touches the specimen directly, and the initial readings are taken. The two pairs of mutually perpendicular longitudinal and transverse gauges shall be mounted at diametrically opposite positions on the specimen.

7 Test procedure

7.1 Before the determination the name of the coal or rock and the number of the coal or rock sample are checked, and the colour, grain, bedding, jointing, fissures, degree of weathering and moisture state of the specimen, together with any problems arising during machining, are described in accordance with Annex A.

7.2 The diameter and the height of the specimen are measured and recorded in accordance with Annex A. Diameter: the diameter is measured in two mutually perpendicular directions on the sections near the upper and lower end faces and near the middle, and the arithmetic mean is taken as the diameter of the specimen. Height: two points are taken in each of two intersecting planes through the central axis, two height values are measured and their arithmetic mean is taken as the height of the specimen.

7.3 The material testing machine shall be selected in accordance with 4.3.

7.4 The testing machine is switched on and brought to the working state. The specimen is placed at the centre of the bearing plate so that the machine, the upper and lower bearing plates and the specimen have their centre lines in one straight line and the upper and lower faces of the specimen are evenly loaded. Rigid pads slightly larger in diameter than the