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Loader for Underground Mining - Testing Method

地下矿用装岩机和装载机 试验方法

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Loader for Underground Mining - Testing Method

1 Scope

This document specifies the test content and test method of rock loader and loader for underground mining, including the performance parameter test of complete machine, load test and industrial test, etc.

This document is applicable to the exit-factory test, type test and industrial test of the following rock loaders and loaders for underground mining (collectively referred to as “the loaders”):

- rail wheel bucket rock loader;
- wheeled bucket rock loader;
- crawler bucket rock loader;
- underground loader-digger;
- shovel loader;
- vertical claw loader;
- crawler double-arm (crab claw) loader.

This document is not applicable to scraper loader, loader conveyor and carry-scraper for underground mining.

2 Normative References

Through the normative references in this text, the contents of the following documents constitute indispensable clauses of this document. In terms of references with a specified date, only versions with a specified date are applicable to this document. In terms of references without a specified date, the latest version (including all the modifications) is applicable to this document.

GB/T 6375 Earth-moving Machinery - Method of Test for the Measurement of Drawbar Pull

GB/T 8419 Earth-moving Machinery - Laboratory Evaluation of Operator Seat Vibration

GB/T 8499 Earth-moving Machinery Method for Locating the Center of Gravity

GB/T 8591 Earth-moving Machinery - Seat Index Point

GB/T 10913 Steel Roller Chains, Types S and C, Attachments and Sprockets

GB 16710 Earth-moving Machinery - Noise Limits

GB/T 21935 Earth-moving Machinery - Zones of Comfort and Reach for Controls

3 Terms and Definitions

The following terms and definitions are applicable to this document.

3.1 Stationary State

In the stationary state, the loader has not actuated the power source, the bucket mechanism or working mechanism (for example, shovel plate) is placed in the original state, the tail of the transporter is placed at the lowest position, and its center line is on the same vertical plane as the center line of the loader.

3.2 Operating State

Under the operating state, the power source is actuated, and the loader is operated under the control of the operator.

4 Test Conditions and Preparation before Test

4.1 Requirements for Technical Preparation

In preparation before the test, the tester shall:

- check the completeness and correctness of technical documents and instruments, tools, accessories, and spare parts;
- conduct visual inspection on the test prototype;
- check the power source to ensure that the test is performed under the rated voltage or atmospheric pressure;
- check the no-load working capability of the test prototype;
- check the preparation of the test site, materials, and test instruments; and make predictions.

4.2 Requirements for Preparation of Technical Documents

The test loader shall be accompanied by the following technical documents:

- design specification;
- operation instruction;

items, and the measurement accuracy shall comply with the following requirements:

- for dimensions: 1 mm;
- for mass: 1% of the test object;
- for time: 0.1 s;
- for operating force: 1 N;
- for traction force: 2% of the test object;
- for angle: 1°.

4.6 Requirements for Test Safety

The test shall comply with the corresponding technical requirements of safety, and necessary technical maintenance shall be carried out in accordance with the stipulations of the relevant technical documents.

5 Performance Parameter Test of Complete Machine

5.1 Bucket Volume

The bucket volume shall be measured through the method of filling the bucket with dry sand. During measurement, place the bucket at an inclination angle of 60° from the bottom of the bucket to the horizontal plane; the dry sand shall be piled up in sharp peaks with a natural angle of repose at each edge of the bucket mouth.

5.2 Overall Dimensions of Loader

5.2.1 The overall dimensions of the loader shall be respectively checked under the stationary state and operating state.

5.2.2 The length and width shall be respectively measured from the most protruding point (excluding the footrests) on the longitudinal and transverse planes of the loader.

5.2.3 The height shall be measured in accordance with the following methods:

- for the height in the stationary state, measure the distance from the highest point of the loader body to the rail surface (for the rail wheel type) or the ground plane (for the crawler type and wheeled type);
- for the height under the operating state, measure the distance from the highest point of the loader body to the rail surface or the ground plane when the loader is operating.

5.3 Unloading Height

forearm and the gripper to the extreme position; the conveying trough is at the position of the central axis of the walking, then, measure the distance between the two points of the left and right claw tips at the maximum edge.

5.5.2 Determination of the claw height: stretch and retract the piston rod of the hydraulic cylinder of the boom and the gripper to the limit to the highest position reached by the working mechanism; measure the vertical distance between the claw tip and the walking support surface.

5.5.3 Determination of the claw depth: the loader is placed on a step with a height difference of 2 m in the test site; the mechanism of the conveying trough is placed at the lowest position; the clawing mechanism is placed at the lowest position under the step; measure the vertical distance from the claw tip to the walking reference plane on the step.

5.6 Specific Parameters of Underground Loader-digger

5.6.1 Determination of digging distance: stretch and retract the piston rod of the hydraulic cylinder of the boom, the forearm, and the bucket to the longest position, where the boom, the forearm and the bucket are deployed together. When the bucket falls to the walking ground, measure the horizontal distance from the bucket tip to the conveying trough.

5.6.2 Determination of digging width: under the circumstance of 5.6.1, stretch and retract the piston rod of the rotary hydraulic cylinder to the extreme position of the left and right deflection of the bucket; the conveying trough is at the position of the central axis of the walking, then, measure the distance between the outer sides of the bucket when it is at the extreme left position and extreme right position.

5.6.3 Determination of loading width: under the circumstance of 5.6.1, stretch and retract the piston rod of the rotary hydraulic cylinder to the extreme position of the left and right deflection of the bucket; the conveying trough is turned left and right to the position of the maximum turning angle, then, measure the distance between the outer sides of the bucket when it is at the extreme left position and extreme right position.

5.6.4 Determination of digging height: stretch and retract the piston rod of the hydraulic cylinder of the boom, the forearm and the bucket to the highest position lifted by the working mechanism; measure the vertical distance from the bucket tip to the walking support surface.

5.6.5 Determination of digging depth: the loader is placed on a step with a height difference of 2 m in the test site; the mechanism of the conveying trough is placed at the lowest position; the bucket is placed at the lowest position under the step; measure the vertical distance from the bucket tip to the walking reference plane on the step.

5.7 Movement Speed of Transport Mechanism Scraper Chain (or belt)

Put a mark on the scraper chain (or belt); measure the time it takes for the scraper chain (or belt) to circulate for one round under the no-load condition and calculate its movement speed.

5.8 Mass of Complete Machine

For the loader with its own light source, use an illuminometer to respectively measure the illuminance at the loading area, the unloading area, and the operating position.

5.21 Climbing Capability

On a thoroughly compacted, hard, and dry pavement, the gradient of the pavement is 3° greater than the allowable gradient of the loader; the length of the pavement exceeds 3 times the length of the equipment. The working mechanism and transshipment and transport mechanism of the crawler loader or the wheeled loader are all under the transport state. Under the two working conditions of no-load and rated load, in the forward and backward modes, uphill and downhill, carry out the test back and forth respectively for three times.

6 Load Test

6.1 The loader shall be subjected to the load test on the test bench or test field of the manufacturer.

6.2 For the materials to be loaded by the test prototype, the hardness (Protodyakonov coefficient f), lumpiness and bulk density shall be similar to the properties of the loaded rock as specified by the loader. During the test, the material stacking shall follow the example of an actual operation site; the material stacking width shall not be less than the loading width of the test prototype; the stacking height shall be 1.5 m ~ 2 m.

6.3 For the prototype that is subjected to the load test under the specified conditions of use, the total amount of ore rock continuously loaded each time:

---for the bucket rock loader, it shall not be less than 15 m³;

---for the shovel loader, it shall not be less than 60 m³;

---for the double-arm loader, vertical claw loader and loader-digger, it shall not be less than 200 m³.

6.4 Determination of technical productivity: on the horizontal rail (for the rail wheel type) or the ground (for the crawler type and wheeled type), when the working mechanism and conveyor of the loader are arranged along the center line of the machine, continuously load loose ore rock; measure the total amount of the ore rock loaded per unit time for conversion and determination.

7 Industrial Test

7.1 Test Contents

The test contents include the service reliability, the productivity and energy consumption, the performance stability of the main components, the operating comfort of the driver, the convenience of technical maintenance and the sensitivity of the working mechanism of the loader, and whether the disassembly, transportation and assembly of the complete machine are

suitable for the requirements of the operating environment of the mine shaft, etc.

7.2 Test Requirements

7.2.1 In the exit-factory test and load test, the weak links shall be thoroughly exposed and eliminated. After further assessment of various performances of the loader, the industrial underground loading test can be carried out.

7.2.2 The underground loading test shall be carried out on site. The hardness (Protodyakonov coefficient f), lumpiness and bulk density of the loaded ore rock shall not be lower than the design requirements of the loader.

7.2.3 When a fault occurs during the test and the test is suspended, the fault shall be eliminated, the cause shall be found out and measures shall be taken. Afterwards, the test shall continue, until all the specified test contents are completed.

7.2.4 The conformity of the prototype to safety regulations, industrial hygiene and labor protection, the suitability of light and sound signaling devices, the reliability of locking devices, the safety of protective covers for the rotating, movable and conductive parts, as well as the grounding devices shall all be tested through the operation of individual assembled parts and the complete machine.

7.3 Amount of Loaded Rock of the Test

The total amount of loaded rock Q_H completed in the industrial test shall comply with the estimated value of Formula (2), in which, the amount of underground loaded rock shall not be lower than 80% of the total amount. During the test, except for normal wear, repair, maintenance and adjustment, the main components of the loader shall not be replaced, otherwise, the test shall be re-calculated.

$$Q_H \geq K_i \times A_T \times 10^4 \quad \dots\dots\dots (2)$$

Where,

Q_H ---the specified value of the total amount of loaded ore rock, expressed in (m³);

K_i ---the working condition coefficient. For the loader under periodic work, $K_i = 0.3$; for the loader under continuous mining work, $K_i = 1.2$; for the loader under continuous excavation work, $K_i = 0.7$;

A_T ---the technical productivity of the loader, expressed in (m³/min).

7.4 Evaluation of Technical and Economic Indicators and Complete-machine Performance

7.4.1 In order to determine the technical state after the test, the loader shall be disassembled and inspected within the scope specified in the test program. The causes for fractures and

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