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Metering pump

计量泵

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Metering pump

1 Scope

This Standard specifies the information confirmation, requirements, tests and inspections, delivery preparation, marking, packaging and storage of metering pump.

This Standard applies to plunger metering pumps and diaphragm metering pumps (hereinafter referred to as “pumps”) for conveying liquids with a temperature of $-30\text{ }^{\circ}\text{C}$ $\sim 150\text{ }^{\circ}\text{C}$ and a viscosity of $0.3\text{ mm}^2/\text{s} \sim 2\text{ }000\text{ mm}^2/\text{s}$.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 197, General purpose metric screw threads - Tolerances

GB 2536, Fluids for electrotechnical applications - Unused mineral insulating oils for transformers and switchgear

GB/T 6003.1-2012, Test sieves - Technical requirements and testing - Part 1: Test sieves of metal wire cloth

GB/T 7784, Test methods for power reciprocating pump

GB/T 7785, Classification and vocabulary for reciprocating pump

GB/T 9069, Determination of sound power level for noise emitted by reciprocating pump - Engineering method

GB/T 9877, Hydraulic fluid power - Guide specifications for designing rotary shaft lip type seals

GB/T 11118.1, Hydraulic fluids of L-HL, L-HM, L-HV, L-HS and L-HG type

GB/T 13306, Plate

GB/T 13364, Measurement of mechanical vibration for reciprocating pump

GB/T 13384, General specifications for packing of mechanical and electrical product

JB/T 6913, Cleanliness of pump products

SH/T 0094, Worm gear oil

3 Terms and definitions

For the purpose of this document, the following terms and definitions, as well as those given in GB/T 7785, apply.

3.1

hydraulic chamber

The working chamber, in the diaphragm metering pump, that is connected to the plunger (or piston). The hydraulic medium in this cavity can convert the stroke volume of the plunger (or piston) into the deflection volume of the diaphragm.

4 Information confirmation

4.1 Buyer information

When the Buyer purchases a pump from the Seller, the Buyer shall provide the Seller with the necessary information for the Seller to select a model. The Buyer may refer to the data sheet provided in Appendix A to facilitate this work. All relevant information – including use requirements, environmental requirements, operational requirements, etc. – shall be considered. The Seller shall ask the Buyer to provide this information, as it may affect the use and life of the pump.

4.2 Alternative items

The Buyer may make special requirements beyond the scope of this Standard. The specific content can be found in the agreement or order, or in Appendix A.

4.3 Seller information

The Seller shall provide at least the following information:

- overall dimensions;
- installation dimensions;
- shaft size;
- inlet connection size;
- outlet connection size.

The Seller may also provide a data sheet including flow, pressure, pump speed and other parameters, which shall include the Buyer's requirements.

5 Requirements

5.1 General requirements

5.1.1 The pump shall comply with the provisions of this Standard and be manufactured according to the drawings and technical documents approved through the prescribed procedures. For the types and basic parameters of commonly used pumps, refer to Appendix B.

5.1.2 The area of the connecting rod large and small head plain bearings in contact with specks shall not be less than 60%.

5.1.3 The tolerance of the thread pitch diameter shall comply with the requirements of GB/T 197.

5.1.4 The technical requirements for pump seals should comply with the provisions of GB/T 9877.

5.1.5 The lubricating oil used for transmission parts should comply with the requirements of SH/T 0094.

5.1.6 The zero position (or 100%) of the dial gauge or control hand wheel and the zero point of the plunger (piston) stroke shall be adjusted to zero (or 100%). Requirements for error of plunger (piston) stroke zero point:

- When the maximum stroke length does not exceed 50 mm, it shall be less than 0.5%;
- When the maximum stroke length exceeds 50 mm, it shall be less than 0.3%.

5.1.7 The stroke adjustment error of the dial gauge shall be within $\pm 0.1\%$; the repeatability error shall be within $\pm 0.2\%$; when the minimum angle of the enclosure movement does not exceed $3^{\circ}36'$, the long needle shall rotate. The accuracy of the control hand wheel scale shall not be less than $\pm 0.1\%$ of the indication accuracy.

5.1.8 The oil used in the three-valve valve group and hydraulic cavity of the diaphragm metering pump should be the hydraulic fluid specified in GB/T 11118.1 or the transformer oil specified in GB 2536. The oil shall contain defoaming, anti-rust and antiseptics.

Note: Three-valve valve group refers to a device or combination of devices that includes three functions such as compensation, venting, and safety protection, which is matched with the hydraulic chamber of the diaphragm metering pump. In this Standard, compensation valve, vent valve and hydraulic chamber safety valve are used respectively to represent these three functional devices.

6.1.8 The uncertainty of measurement shall be calculated in accordance with the provisions of GB/T 7784.

6.2 Test items

6.2.1 No-load test

6.2.1.1 The no-load test includes the zero-flow test and the flow adjustment test.

6.2.1.2 Before operation, the inlet and outlet pipe valves shall be fully opened; the adjustment meter (or the adjustment hand wheel scale) shall be aligned to zero; the zero flow operation test shall be carried out for no less than 0.5 h; the adjustment meter (or the adjustment hand wheel scale) shall be checked to be at zero.

6.2.1.3 The adjustment test shall be carried out when the inlet and outlet pipeline valves are fully open; the stroke length shall be gradually increased until it is adjusted to 100% of the relative stroke length, then the operation shall be not less than 0.5 h. There shall be no abnormal sound and vibration during the test. The stroke adjustment shall be smooth and the adjustment handwheel shall be firm.

6.2.2 Load test

6.2.2.1 The load test shall be carried out at rated pump speed and the maximum stroke length, with the discharge pressure gradually increased from normal pressure to rated discharge pressure. Depending on the rated discharge pressure, there are several pressure-increasing situations:

- For pumps with rated discharge pressure exceeding 5 MPa, the pressure shall be divided into four grades: 25%, 50%, 75%, and 100% and gradually increased. Operate under each pressure condition for no less than 15 minutes, and operate at full load for no less than 2 hours;
- For pumps with rated discharge pressure range of 1 MPa ~ 5 MPa, after operating at 1 MPa for at least 0.5 h, the pressure can be increased to the rated discharge pressure for operation for at least 2 h;
- For pumps with rated discharge pressure lower than 1 MPa, after operating at normal pressure for not less than 0.5 h, the pressure can be directly increased to the rated discharge pressure for operation for not less than 2 h.

6.2.2.2 The diaphragm metering pump shall be debugged for the three-valve valve group at the rated discharge pressure, and the performance test can only be carried out after the safety valve, compensation valve, etc. are operated as qualified.

6.2.3 Continuous operation test

Follow the provisions in GB/T 7784.

6.2.4 Diaphragm pump safety valve opening test

When the diaphragm pump is operating under rated conditions, adjust the outlet pipeline valve to increase the discharge pressure. The safety valve shall operate correctly under the opening pressure specified in 5.2.4. After opening, adjust the outlet pipeline valve and observe the sensitivity of its reseating action. The test shall be carried out at least 3 times.

6.2.5 Performance test

The performance test shall be carried out in accordance with GB/T 7784.

6.2.6 Performance test at rated operating point

Measure the flow and leakage of the pump under rated conditions and the maximum stroke length. The leakage is limited to the measurement of plunger metering pumps.

6.2.7 Flow calibration and measurement accuracy test

6.2.7.1 The flow stability accuracy test shall be carried out under rated conditions. Measure five sets of flow data in sequence at the relative stroke lengths of 100%, 75%, 50%, 30% and 10%. The number of single flow measurement values taken at each relative stroke length shall not be less than 3.

6.2.7.2 For the reproducibility accuracy test, the flow rate values shall also be measured discontinuously at the following stroke lengths:

- At 100% of the stroke length, measure no less than 3 flow values;
- At 75% and 50% of the stroke length, measure no less than 2 flow values;
- At 30% and 10% of the stroke length, measure at least one flow value.

6.2.7.3 Flow calibration and linearity are obtained by mathematical statistics and calculation of all data measured in the stability accuracy test and reproducibility accuracy test.

6.2.7.4 When the pump has no flow or abnormal flow at a small relative stroke length, several sets of flow data shall be measured in sequence starting from the relative stroke length where normal flow begins.

6.2.7.5 The adjustment range is determined based on the above test in accordance with 6.4.9.4.

6.2.8 Cavitation performance test

6.2.8.1 The cavitation performance test shall be carried out under rated conditions and at the maximum stroke length.

6.6 Test result documents

6.6.1 Type inspection shall include the following documents:

- Information on the assembly of the pump before the test and the inspection of relevant key parts and components;
- Inspection results of the pump after the test and inspection records of major parts;
- Pump working conclusion;
- Test medium materials;
- System diagram of the test device;
- Test records;
- Performance curve, flow calibration and metering accuracy curve as well as adjustment range area diagram, suction performance curve;
- Calibration records of test instruments and meters.

6.6.2 Ex-factory inspection shall include the following documents:

- Test records;
- Flow calibration and metering accuracy as well as adjustment range area diagram;
- Pump test conclusion.

6.6.3 Test record (see Appendix D) shall include the following contents:

- Pump model, specification, factory serial number, and main performance parameters;
- Test equipment and test conditions;
- All measurements and calculations, test dates and names of testers.
- All test result documents shall be signed by the test leader.

6.7 Inspection rules

6.7.1 Each pump must pass the inspection and be accompanied by a product certificate before leaving the factory.

6.7.2 All types of inspections on the pump shall be carried out in accordance with the items specified in Table 9.

7.4 Installation and operating instructions

Unless the Buyer has special requirements, the Seller shall package the installation and operating instructions and other documents required by the Buyer together with the pump unit.

8 Marking, packaging and storage

8.1 Marking

8.1.1 The pump nameplate shall be fixed in a conspicuous position on the pump; the technical requirements for the nameplate size shall comply with the provisions of GB/T 13306; the materials of the nameplate and its fasteners shall be selected according to the working environment of the pump. The nameplate shall include the following:

- Name of production unit;
- Pump model and name;
- Main technical specifications: rated flow, L/h; rated discharge pressure, MPa; pump speed, min^{-1} ; equipped power, kW; mass, kg;
- Factory serial number;
- Year and month of manufacture.

8.1.2 Important purchased supporting equipment of the pump shall also have nameplates.

8.1.3 The pump shall have a clear mark on the motor rotation direction, and other important unidirectional rotating equipment shall also have rotation direction indication.

8.2 Packaging

8.2.1 The packaging of the pump shall comply with the requirements of GB/T 13384.

8.2.2 Pump accessories, special tools and auxiliary equipment, if placed inside the box, shall be secured, to prevent mechanical damage during transportation and storage.

8.2.3 The accompanying documents and packing list shall be packed in moisture-proof bags, sealed and placed in the mainframe box.

8.3 Storage

The pump shall be stored in a dry and ventilated environment and shall be protected from rust within 6 months.

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