GB

NATIONAL STANDARD OF THE

PEOPLE'S REPUBLIC OF CHINA

ICS 71.120; 83.200

G 95

GB/T 25156-2020

Replacing GB/T 25156-2010, GB/T 25157-2010

General specifications and inspection methods of rubber and plastics injection moulding machines

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Issued on: March 31, 2020 **Implemented on: February 01, 2021**

Issued by: State Administration for Market Regulation;
Standardization Administration of PRC.

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General specifications and inspection methods of rubber and plastics injection moulding machines

1 Scope

This standard specifies the model and basic parameters, requirements, testing methods, inspection rules and signs, packaging, transportation, storage of rubber and plastic injection molding machines.

This standard applies to single-screw plunger, single-station, vertical/horizontal rubber injection molding machines AND single-screw, single-station, horizontal plastic injection molding machines (hereinafter referred to as injection molding machines).

2 Normative references

The following documents are essential for the application of this document. For dated references, only the dated version applies to this document. For undated references, the latest edition (including all amendments) applies to this document.

GB/T 191 Packaging - Pictorial marking for handling of goods

GB/T 321-2005 Preferred numbers - Series of preferred numbers

GB/T 3682.1 Plastics - Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics - Part 1: Standard method

GB/T 3785.1-2010 Electroacoustics - Sound level meters - Part 1: Specifications

GB/T 6388 Transport package shipping mark

GB/T 13306 Plates

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

GB 22530 Safety requirements of injection moulding machines for rubber and plastics

GB/T 36587 Rubber and plastics machinery - Terminology

HG/T 3120 The general technological requirements for the appearance of the rubber and plastic machinery

HG/T 3228-2001 General specifications of painting for rubber and plastics

machinery

3 Terms and definitions

The terms and definitions, which are defined in GB/T 36587, as well as the following terms and definitions, apply to this document. For ease of use, some terms and definitions of GB/T 36587 are repeated below.

3.1

Repeatability of mold opening position

After the mold opening action under the same conditions, the consistency of the actual position of the moving platen, when the mold opening is terminated.

3.2

Repeatability of injection position

The consistency of the actual position of the screw or plunger, at the end of the injection, after the injection action under the same conditions.

3.3

Dry cycle time

Dry cycle

Without injection and pre-molding action, the time required for the clamping mechanism to run for one cycle, which includes mold closing time, mold opening time, conversion time.

[GB/T 36587-2018, definition 3.5.52]

4 Models and basic parameters

4.1 Model

See Appendix A for the model of the injection molding machine.

4.2 Basic parameters

See Appendix B for the basic parameters of the injection molding machine.

working surface of the hot plate shall meet the following requirements:

a) For electric heating (the size of the hot plate is not more than 1000 mm x 1000 mm), steam heating, oil heating, the temperature difference shall be controlled within 6 °C;

b) For electric heating (the size of the hot plate is larger than 1000 mm x 1000 mm), the temperature difference shall be controlled within 10 °C.

5.4 Safety requirements

Safety requirements shall comply with the provisions of GB 22530.

6 Testing methods

6.1 General testing methods

6.1.1 Testing of operation control mode

Check whether the manual operation control mode, semi-automatic operation control mode, automatic operation control mode are available and effective.

6.1.2 Motion detection of moving parts

Set the oil pressure of the system to 25% of its rated value. Perform each of mold opening and closing, hydraulic ejection and retraction, injection nozzle advance and retraction, for three times, to check whether the moving parts are crawling, jamming, or having obvious shock.

6.1.3 Detection of the coaxiality between the center of the injection nozzle hole and the positioning hole of the template mold

Move the injection nozzle head to the measurable position of the positioning hole of the fixed platen mold. Use a vernier caliper, to measure the values of the four positions (A, B, C, D) in Figure 1. Take the difference, between the maximum value and the minimum value, as the coaxiality tolerance.

Then carry out empty injection. After the material is cooled, use the standard weighing instrument to weigh out its mass $W_{plasticizing}$ (g). Then calculates the plasticizing capacity G (g/s), $G = W_{plasticizing}/2T_{plasticizing}$. This testing is carried out as such for three times. Finally, take the arithmetic mean of the three calculation results, as the plasticizing ability value.

6.1.11 Testing of injection rate

6.1.11.1 Testing conditions

The testing conditions of injection rate shall be as specified in a) ~ f) of 6.1.10.1.

6.1.11.2 Testing method

Carry out the empty injection. Use a stopwatch or other more accurate timing device, to record the injection time $t_{injection}$ (s). After the material is cooled, use a standard weighing instrument, to weigh its mass $W_{injection}$ (g). Then calculate the injection rate q (g/ s), $q = W_{injection}/t_{injection}$. This testing is performed as such for three times. Take the arithmetic mean of the three calculation results, as the injection rate value.

6.1.12 Testing of actual injection volume

6.1.12.1 Testing conditions

The testing conditions for actual injection volume are as specified in a) ~ f) of 6.1.10.1.

6.1.12.2 Testing method

Carry out the empty injection. After the material is cooled, use a standard weighing instrument, to weigh its mass. Carry out testing for three times. Finally take the arithmetic mean of the three test results, as the actual injection volume value.

6.1.13 Testing of injection pressure

6.1.13.1 Testing method 1

Set the injection molding machine to the semi-automatic operation mode, without material. Run the injection to the end. Determine the system's working pressure p_0, according to the pressure gauge. Then calculate the injection pressure p, according to formula (5).

$$p = \frac{A_0 p_0}{A_S} n \qquad \cdots\cdots\cdots\cdots\cdots\cdots (5)$$

Where:

p - The injection pressure, in megapascals (MPa);

A_0 - The effective cross-sectional area of the injection piston, in square centimeters (cm^2);

p_0 - The working pressure of the system, in megapascals (MPa);

A_S - The cross-sectional area of the screw or barrel plunger, in square centimeters (cm^2);

n - The number of injection cylinders.

6.1.13.2 Testing method 2

The test raw material is recommended to use polystyrene (PS); the heating temperature is 216 °C ± 6 °C. Install a pressure detection device, which has an accuracy of 0.01 MPa, at the nozzle. After the machine enters a stable state, set the injection speed to be less than 20% of the maximum injection speed. Perform cyclically 10 injection pressure tests. Read the maximum injection pressure value. Calculate the injection pressure value, which is measured 10 times according to the arithmetic mean, as the injection pressure of the machine.

6.1.14 Testing of clamping force

6.1.14.1 Testing conditions

During the test, the tie rod to be tested and test block shall not have temperature changes, which are caused by human factors; the hydraulic system shall be under the rated working pressure.

6.1.14.2 Testing method 1

The testing method is carried out, according to the following steps:

a) The method of measuring the maximum strain of the tie rod by a strain gauge (it is also allowed to use a clamping force tester, which has comparable accuracy, for testing).

b) Install the test block at the center of the fixed platen (see Figure 4). The material and size of the test block are in accordance with Table 10; the form of the test block shall be one selected from two. When the inner spacing of tie rods is inconsistent in horizontal and vertical directions, take the size of the test block which is corresponding to the smaller value.

c) On each tie rod, paste sensitive strain gauges, as shown in Figure 4. The distance, between the sensitive strain gages and the fixed template, is less than 1.5 times the diameter of the tie rod. Paste two or more (even number) stain gauges.

d) Measure the strain ε_i of the tie rod (under the clamping state of the clamping mechanism).

Where:

$F_{Clamping}$ - Clamping force, in kilonewton (kN);

p_0 - The reading value of the pressure gauge, in megapascal (MPa);

A - The area of the hydraulic pressure acting on the plunger, in square centimeters (cm^2);

n - The number of hydraulic cylinders.

6.1.15 Testing of product quality repeatability accuracy

6.1.15.1 Testing conditions

Test conditions include the following:

a) The material of plastic injection molding machine adopts the unmodified uncolored polystyrene (GPPS), which has a melt flow rate MFR of 200/5 = 7 g/10 min ~ 9 g/10 min (see GB/T 3682.1), OR the unmodified uncolored high-density polyethylene (HDPE), which has a melt flow rate MFR of 190/2.16 = 3 g/10 min ~ 4 g/10 min (see GB/T 3682.1). Rubber injection machine material adopts nitrile rubber (NBR) film.

b) The test mold is provided by the manufacturer or the user.

c) The quality of the test product shall be 60% ~ 80% of the actual injection volume of the injection molding machine.

d) The injection molding machine shall be in normal working state (including the mold), after debugging; its injection molding process parameters shall be set reasonably.

6.1.15.2 Testing method

The number of test products, which are continuously injected by the injection molding machine, shall be not less than 50. After the material is naturally cooled, weigh the mass of each product. Take the average value, as the test result of the product quality. Calculate the repeatability of the product mass, according to formula (8).

$$\delta_w = \frac{\sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(w_i - \overline{w})^2}}{\overline{w}} \times 100\% \qquad \cdots\cdots(8)$$

Where:

δ_w - The repeatability accuracy of product quality;

w_i - The mass of the i^{th} product, in grams (g);

$\overline{w}$ - The average mass of the product, in grams (g);

n - The number of test products.

6.1.16 Testing of dry cycle time

6.1.16.1 Testing conditions

Testing conditions include the following:

a) The injection molding machine is set to a fully automatic cycle mode, which has only mold opening-closing action.

b) Install the test block at the center of the fixed platen. The material and size of the test block are in accordance with Table 10. The form of the test block is selected from two. Load a force, which is equivalent to 70% of the rated clamping force.

c) The measuring stroke is 70% of the inner spacing of the larger tie rod. If this requirement is not met, it shall make special instructions. The end position of mold opening can be set accurately to 10 mm.

d) In addition to cooling, vulcanization or recirculation time, the switching time, between the other actions, shall be included in the dry cycle time.

6.1.16.2 Testing method

Carry out 10 automatic cycles continuously. Use a stopwatch or other more accurate timing device, to record the total time of 10 cycles, including mold opening time, mold closing time, conversion time. Take the average time of 10 cycles, as the dry cycle time.

6.1.17 Testing of diameter of positioning holes on the template

The diameter of the positioning hole is tested, by the use of an inner micrometer.

6.1.18 Testing of other parameters of injection molding machine

6.1.18.1 Testing of inner spacing (horizontal, vertical) of tie rods or length of hot plate

Use a length ruler, which has an accuracy of more than 1 mm, to measure the inner distance of the tie rod, in the horizontal and vertical directions, OR the length and width of the hot plate.

6.1.18.2 Testing of mold opening stroke, maximum mold thickness, minimum mold thickness (three items are tested together)

shown in Figure 6. When the hot plate is completely closed, hold the pressure for 1 min. Take out the flattened fuse. Use a micrometer, to measure the thickness of the middle of each fuse. Take the difference, between the maximum thickness and the minimum thickness, as the parallelism measurement result of the two adjacent hot plates.

6.3.2 Pressure drop testing of mold closing system

Put the test block, in between the adjacent hot plates. Pressurize with the rated pressure. After the mold is completely clamped, start timekeeping. Record the reading of the pressure gauge, after 1 minute. Record the reading at the interval of 1 minute after that. When the time reaches 10 minutes, that is, after taking 10 records, calculate the difference, between the maximum reading and the minimum reading, as the pressure drop of the clamping system.

6.3.3 Testing of the maximum temperature of hot plate

For the steam-heated rubber injection molding machine, heat it by saturated steam at a pressure of 0.8 MPa. For the oil-heated and electric-heated rubber injection molding machine, connect the hot oil source and power supply, to heat the hot plate to a stable state; then use a spot thermometer of the corresponding range, to make measurement at two points nearby the center line. Take the average value, as the maximum working temperature of the hot plate.

6.3.4 Temperature uniformity testing on the working surface of the hot plate

Heat the hot plate to 150 °C. After the temperature reaches a steady state, use a spot thermometer, to make measurement:

a) When the length L of the hot plate is ≤ 1000 mm, make measurement according to the arrangement as shown in Figure 7;

b) When the length of the hot plate is 1000 mm < L ≤ 6000 mm, make measurement according to the arrangement as shown in Figure 8;

c) When the length of the hot plate is L > 6000 mm, make measurement according to the arrangement as shown in Figure 9.

Calculate the temperature difference, in accordance with formula (12).

$$\Delta T = T_{max} - T_{min} \qquad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (12)$$

Where:

ΔT - Temperature difference, in degrees Celsius (°C);

T_{max} - The maximum reading of the spot thermometer, in degrees Celsius (°C);

items in 5.1.2 ~ 5.1.3, 5.1.6, 5.3, during the running test. If a failure occurs during the test, the test time or number shall be recalculated, after the failure is eliminated.

7.3 Type test

7.3.1 Type test shall be carried out, for all the requirements in Chapter 5 and the basic parameters of Appendix B, which are specified in this standard.

7.3.2 The type test shall be carried out in one of the following situations:

a) Trial type identification of new products OR old products after trans-plant production;

b) After formal production, where there are major changes in structure, material, process, which may affect the performance of the product;

c) After the production is restored, after long-term suspension;

d) When there is a big difference between the exit-factory inspection results and the last type test;

e) When the national market supervision department puts forward a request for type test.

8 Marking, packaging, transportation, storage

8.1 Marking

Each product shall have a product label, which is fixed in an obvious position. The label shall comply with the provisions of GB/T 13306 and include the following contents:

a) Manufacturer's name and trademark;

b) Product name, model, implemented standard number;

c) Product number and date of exit-factory;

d) Main technical parameters, including at least clamping force and injection capacity.

8.2 Packaging

The product packaging shall comply with the provisions of GB/T 13384. The following technical documents shall be packed, in the product packaging box (in a waterproof bag):

a) Product certificate;

Appendix B

(Normative)

Basic parameters

B.1 Parameters that shall be provided in the sales contract (agreement) or product instruction manual:

a) Clamping force (kN) is recommended to select the specification parameter value, from the priority number R10 or R20 series, in GB/T 321-2005;

b) Theoretical injection volume;

c) Plasticizing ability;

d) Injection rate;

e) Injection pressure;

f) Actual injection volume.

When expressing plasticizing capacity, injection rate, actual injection volume in technical documents, it shall state the material to be used, which is generally expressed in the following format, such as: plasticizing capacity (GPPS): 100 g/s.

B.2 Parameters that the manufacturer shall provide to the user:

a) Spacing (horizontal, vertical) within the tie rod or the length of the hot plate;

b) Diameter of mould positioning hole;

c) Mould-opening stroke;

d) The maximum die thickness (or the maximum opening distance of the formwork);

e) Minimum mould thickness;

f) Minimum mould size.

B.3 The installation parameters that the manufacturer shall provide to the user:

a) Motor power, heating power;

b) The weight of the whole machine AND the overall dimensions of the machine.

B.4 Parameters that the manufacturer can provide to the user:

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