sisco

Automatic Melt Flow Index Tester User Manual

sisco

Table of Contents

I. Purpose:

The Melt Flow Rate (MFR) Tester is an instrument designed to measure the flow properties of thermoplastics at high temperatures according to the test method specified in GB3682-2000. It is used for determining the melt flow rate of polymers such as polyethylene, polypropylene, polyacetal, ABS resin, polycarbonate, and nylon plastics at elevated temperatures. This instrument is suitable for use in production and research within industrial enterprises and scientific research institutions.

II. Main Features:

1. Extrusion Die Assembly:
- Die Outlet Diameter: Φ2.095 ± 0.005 mm
- Die Outlet Length: 8.000 ± 0.025 mm
- Barrel Diameter: Φ9.550 ± 0.025 mm
- Barrel Length: 152 ± 0.1 mm
- Piston Tip Diameter: 9.475 ± 0.015 mm
- Piston Tip Length: 6.350 ± 0.100 mm
2. Relative Error of Weight Mass: ≤ 0.5%
3. Temperature Range: 50–350°C
4. Temperature Stability: ±0.5°C
5. Power Supply: 220V ±10%, 50Hz
6. Operating Environmental Conditions:
- Ambient Temperature: 10°C–40°C
- Relative Humidity: 30%–80%
- Free from corrosive media and strong air currents
- Free from vibration and significant electromagnetic interference

III. Structure and Working Principle:

The Melt Flow Rate Tester is a type of extrusion plastometer. It operates by heating the sample to a molten state under controlled temperature conditions using a high-temperature heating furnace. The molten sample is then subjected to a standardized load (weight) and extruded through a die of specified diameter to perform the flow test. In plastic manufacturing and research applications, the “melt (mass) flow rate” is commonly used to indicate the flowability and viscosity of polymer materials in the molten state.

The Melt Flow Rate (MFR) Tester is a type of extrusion plastometer. Under specified temperature conditions, a high-temperature heating furnace is used to bring the test sample to a molten state. This molten sample is then subjected to extrusion testing by passing it through a die of specific diameter under the gravitational load of a specified weight. In plastic production within industrial enterprises and in research conducted by scientific institutions, the term "Melt (Mass) Flow Rate" is commonly used to indicate the flowability, viscosity, and other physical properties of polymer materials in the molten state. The so-called Melt Index refers to the average weight of the extruded material over a measured segment, normalized to a 10-minute extrusion volume.
The Melt (Mass) Flow Rate is denoted by MFR, with the unit being grams per 10 minutes (g/10 min).

Formula: $$MFR(\theta, m_{nom}) = \frac{tref \cdot m}{t}$$

Where:

- θ— Test Temperature (°C)
- m_{nom}— Nominal Load (kg)
- m— Average mass of cut extrudate (g)
- t_{ref}— Reference time (10 min), (s) (600s)
- t— Time interval of cutting (s)

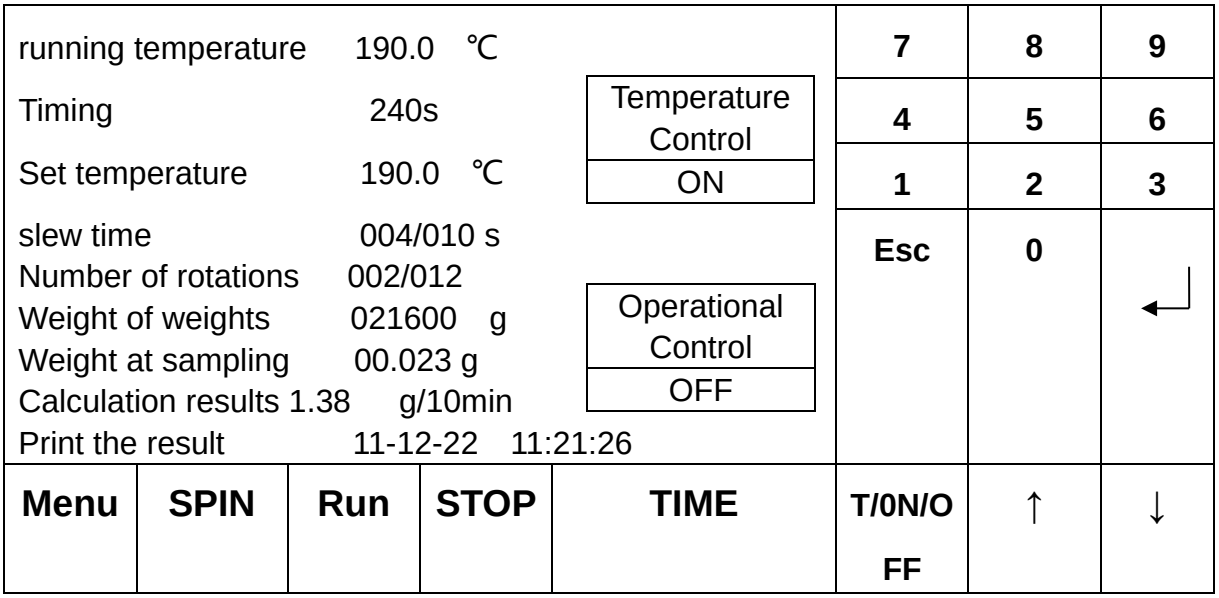
Example: A set of plastic samples was cut every 30 seconds. The measured masses were: 0.0816 g, 0.0862 g, 0.0815 g, 0.0895 g, and 0.0825 g.
Average mass m=(0.0816+0.0862+0.0815+0.0895+0.0825)÷5=0.0843(g)
Substitute into the formula: MFR=600×0.0843/30=1.686(g/10 min)

This instrument consists of a heating furnace and a temperature control system, mounted on a machine body (column) base. The temperature control section uses a microcontroller-based power regulation method, featuring strong anti-interference capability, high temperature control accuracy, and stable control. The heating element inside the furnace is wound around the heating rod in a specific pattern to minimize the temperature gradient and meet standard requirements.

IV. Keyboard Operation

1. Keyboard Construction and Functions
The instrument includes 10 numeric keys ("0-9"), function keys, and symbol function keys (↑↓), etc. Users use these keys to input numerical values.

2. Function Key Operation



Keyboard Instructions:

- Numeric Keys 0-9: For entering numerical values.
- Esc: Cancel key. Cancels incorrectly entered values.
- ← (Arrow): Confirm key. Confirms the entered content or selected option.
- Menu: Menu key. In this operating system, it is used to select functions. To select a function, you must first execute the menu selection and then use the direction keys to choose.
- SPIN: Manual cutting trigger. On the main display screen, pressing this key will cause the cutter to rotate automatically once.
- Run: Run key. Pressing this key starts the program according to the set parameters.
- Time: Countdown timer. After loading the sample, it counts down based on the set time and measures the heating test time.
- Stop: Stop key. Stops the countdown or the running program process at any time.
- T/on/off: Temperature control key. Pressing this key turns the temperature control ON or OFF. When ON, it heats up and maintains temperature; when OFF, it stops heating and maintaining.
- Main Display Screen Explanation:

- Running Temperature: Displays the current actual temperature. During the test, this temperature is required to be within ±0.5°C of the set temperature.
- Timer: When TIME is pressed, this area starts a 240s countdown.
- Set Temperature: Sets the required temperature.
- Rotation Time: 004/010 s indicates that during program operation, the current count time is 4 seconds. The cutter rotates automatically every 10 seconds.
- Rotation Count: 002/012 times indicates that during program operation, the cutter has already cut 2 times. A total of 12 cuts are required.
- Weight of Load: Enter the weight of the added load so that the data can be stored and printed.
- Sample Weight: Enter the average weight of each small segment after cutting.
- Calculation Result: Automatically calculates the current melt flow rate result.
- Print Result: Move the cursor to this location, press confirm, and the current test conditions and results can be printed.
- Temperature Control: Has OFF/ON states, displaying the current temperature control status (off/on).
- Running Control: Has OFF/ON states, displaying the current program running status (off/on).

V. Instrument Installation and Operation

1. Instrument Adjustment:

After unpacking the instrument, check the name and quantity listed on the packing list and attached drawings. Inspect whether the instrument is intact and whether the technical documents and accessories are complete. After confirming there is no damage, wipe the instrument clean and place it on a stable workbench. Then, push the push rod of the connecting port mold baffle into the furnace body from the upper port of the barrel. Looking down into the barrel from the upper port, you should see the port mold baffle blocking about one-third of the inner diameter of the barrel.

Then, insert the spirit level into the barrel from the upper port, placing it flat inside and bringing its bottom surface into contact with the port mold baffle. Using the spirit level bubble as a guide, adjust the four adjustment screws at the bottom of the barrel until the barrel reaches a horizontal state. (Note: This is to avoid excessive friction caused by the piston or bending under heavy loads.) Subsequently, tighten the lock nuts of the adjustment screws and remove the spirit level and its support bracket.

2. Instrument Operation:

(1) Install the Port Mold: Install the port mold from the upper port of the barrel and use the loading rod to press it until it touches the port mold baffle.

(2) Insert the Piston (Assembly): Insert the piston assembly from the upper port of the barrel into the barrel.

(3) Plug in the power plug and turn on the power switch on the control panel; the power indicator light will illuminate. In the test parameter setting interface, set the constant temperature point, sampling time interval, number of samples, and applied load. After entering the test main interface, press the "Start" key, and the instrument will begin to heat up. When the temperature stabilizes at the set value, maintain the constant temperature for at least 15 minutes.

(4) After maintaining a constant temperature for 15 minutes, wearing prepared gloves (to prevent burns), remove the piston rod. Use the hopper and loading rod to sequentially fill and compact the prepared sample into the barrel, completing the entire process within 1 minute. Then, reinsert the piston into the barrel. After 4 minutes, apply the standard-specified test load to the piston.

The estimated flow rate, feed mass, and cut-off time interval are shown in Appendix 1.

The corresponding test temperature and load for the test materials are shown in Appendix 2.

(5) Cutting of the Sample

The setting is detailed in the previous sections on the selection of automatic or manual mode.

- A. Automatic Cutting: Place the sampling tray under the discharge outlet. When the piston descends to the level where its lower ring mark aligns with the upper surface of the adapter, press the "RUN" key. The cutter will automatically cut according to the set number of cuts and sampling time interval.
- B. Manual Cutting: Place the sampling tray under the discharge outlet. Set the sampling method to manual. When the piston descends to the level where its lower ring mark aligns with the upper surface of the adapter, press the "SPIN" key to rotate the manual knob cutter.
- C. Canceling Manual Cutting: (Cutting should be performed between the upper and lower ring marks on the piston rod.)

(6) Result Calculation

Select 3-5 bubble-free strands, allow them to cool, and place them on the balance. Weigh each one (balance accuracy: 0.01g), calculate the average value, input this average value on the test homepage, and press the "←" key. The instrument will automatically calculate the melt flow rate value and display it on the main interface. Select to print the result and generate the test report. At this point, the test is completed.

(7) Post-Test Cleaning Procedure

The following steps should be performed after the test:

- A. After all the material in the barrel has been extruded, wear the prepared gloves (to prevent burns), remove the weight and piston rod, and clean the piston rod.
- B. Remove the connecting rod of the die plate adapter and pull the sampling rod outwards. Use the loading rod to push out the die, clean the test material from the die hole with a die cleaning wire, and then wipe it repeatedly with a gauze strip in the small hole until it is completely clean. Also, clean the sampling rod thoroughly.
- C. Wrap clean white gauze around the barrel cleaning rod and wipe the barrel while it is still hot until it is clean.

(8) Turn off the instrument power and unplug the power cord.

VI. Precautions:

- The single-phase power socket must have a ground wire hole and must be reliably grounded.
- If the LCD display shows abnormal readings, turn off the machine first. After restarting, reset the test temperature and resume operation.
- During normal operation, if the barrel temperature exceeds 450°C, the software protection will activate, interrupting heating and emitting an alarm.
- 4 If any abnormal ph.enomena occur, such as failure to control temperature or display issues, turn off the machine and perform maintenance/inspection.
- When cleaning the piston rod, do not use hard objects to scrape it.

sisco

Appendix 1

Melt Flow Rate (g/10min)	Mass of Sample in Barrel (g)	Extrusiontting Cu Time Interval (s)
0.1 - 0.5	3 - 5	240
>0.5 - 1	4 - 6	120
>1 - 3.5	4 - 6	60
>3.5 - 10	6 - 8	30
>10	6 - 8	5 -15

1. If the value ob tained in this test is less than 0.1g/10min or greater than 100g/10min, it is recommended not to measure the melt flow rate.
2. When the material density is greater than 1.0g/10min, it may be necessary to increase the sample amount.
3. When measuring materials with an MFR greater than 25g/10min, to obtain sufficient reproducibility, it may be necessary to automatically control and measure cutting time intervals less than 0.1s, or to use Method B.

Appendix 2

Material	Test Temperature θ, ° C	Nominal Load (mnom), kg
PS	200	5.00
PE	190	2.16
PE	190	0.325
PE	190	5.00
PP	230	2.16
ABS	230	10.00
PS-1	200	5.00
E/VAC	150	2.16
E/VAC	190	2.16
E/VAC	125	0325
SAN	220	10..00
ASA, ACS, ABC	220	10.00
PC	300	1.2
PMMA	230	3.8
PB	190	2.16
PB	190	10.00

Material	Test Temperature θ, ° C	Nominal Load (mnom), kg
POM	190	2.16
MABS	220	10.00