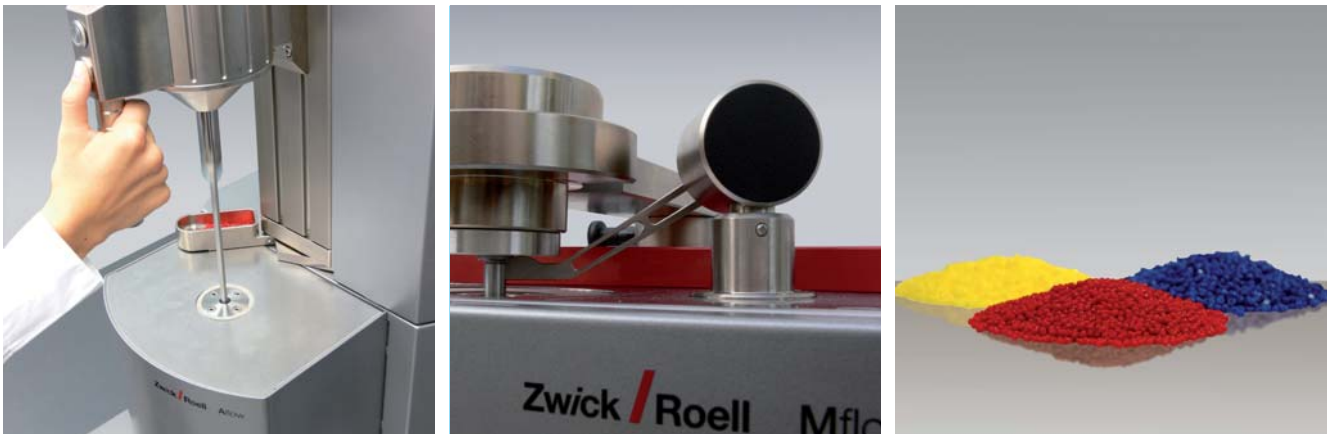


Extrusion Plastometers Aflow, Mflow and Cflow



Intelligent Testing

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1 Zwick Roell extrusion plastometers – permanent enhancement for over 40 years

For more than 40 years, Zwick has developed innovative extrusion plastometers tailored to customer requirements. The new Xflow series ranges from the manually operated Cflow for checking incoming goods, to the Mflow with weight selector and travel measurement system, to the convenient Aflow with cleaning and precompacting device and innovative load lifting for test loads of up to 50 kg.

2 The Xflow series – the ideal extrusion plastometer for every test volume

Various requirements are placed on extrusion plastometers in the plastics industry, depending on the processing stage. Zwick has the ideal extrusion plastometer for every test volume. Few tests are performed in the area of incoming goods inspection. The manually operated Cflow checks your plastics safely and quickly according to Method A.

As the test load rises, so does the need for a greater degree of automation. This is where you will find the Mflow is the ideal device: it has a modular structure and is noted for functions such as the weight selector and the automatic parameter control (APC).

Speed, user-independence and a high level of reproducibility of the measurement results matter in Research and Development, 24-hour operation and in the production check.

This is where the Aflow, with its defined precompacting of the polymer, automatic parameter control, fast ejection of remaining material with a force of up to 80 kg and cleaning at the press of a button, helps you to make the test sequence safer and faster.

For further information on the individual test methods, refer to the technical application information on plastics: Determination of melt flow rates MFR and MVR.



Fig. 1: The Aflow – Innovative load application and a powerful cleaning device

3 Features of the extrusion plastometers

3.1 Extrusion plastometer Cflow

The Cflow is a compact instrument that allows rapid inspection of the flow behavior of plastics according to Method A. It is specifically designed for the processors of plastics that are less subject to extrusion tests and which do not require a connection to a PC.



Fig. 1: The Cflow extrusion plastometer - precise MFR testing

The temperature control of the heating elements, the heating chamber and the extrusion barrel are perfectly matched to each other. The temperature is generated where it is needed. That ensures an excellent distribution of temperature across the full height of the barrel from the outset.

Rapid device control is facilitated by the test granulate contained in the scope of delivery. Addition control options are available for the temperature in the extrusion barrel, for the diameter of orifices and barrels with plug gages.

An automatic or manual extrudate cutter, a separating door and a die plug are optionally available for the Cflow.

Advantages:

- The extrusion behavior of plastics is tested safely and quickly according to Method A
- You hold the test weight in the pre-heating position with the optionally available spacer
- Extensive accessories, such as the automatic or manual extrudate cutter, are also available

3.2 Extrusion plastometer Mflow

The Mflow is a modular, expandable device with which you can determine the melt mass and melt volume flow rate. Affordable to setup and gradually expand at any time.



Fig. 2: The Mflow extrusion plastometer – modular for future expansion

You can optionally expand the Mflow with, for example, the pneumatic weight lifting unit or the weight pegging unit. The extrusion plastometers are equipped with heating elements that are specially adapted to the thermal conditions of test chambers and device covers. This achieves a very good distribution of temperature over space and time.

Operation of the Mflow via a PC offers all the advantages of *testXpert*® II: up to six devices per PC can be operated, the traceability of the results and their further processing with *testXpert*® II LIMS is possible for a statistical check and as long-term statistics.

Advantages:

- The automatic parameter control (APC) minimizes the measurement errors and optimizes the test parameters
- The weight selector allows you to change the test weights quickly and easily. The test piston is also held in any pre-heating position required
- A travel transducer is available for tests according to Method B
- *testXpert*® II works for you – whether through multi-device operation or with *testXpert*® II LIMS

Automatic parameter control can, depending on the material currently being tested, set the test parameters so that measurement errors are automatically minimized.

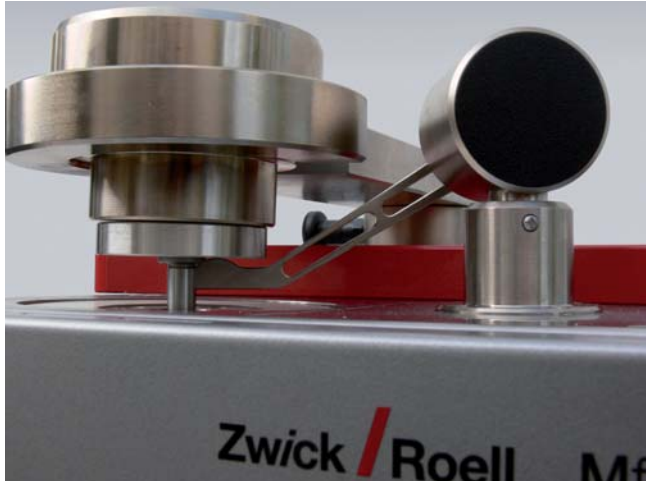


Fig. 1: The displacement transducer measures with high precision

Displacement and time measurement is required for tests according to Method B (MVR). Both measurands are recorded synchronously with the Mflow and reduce measurement errors in time and displacement.

In PC operation and for tests according to Method B, the Mflow provides a displacement-time diagram for effective control of the measuring process.

In addition to the mentioned control options, the Mflow can verify the measurement travel of the piston with control gages.



Fig. 2: Simple filling of granulate with the aid of the portioning measure and the specimen hopper

Weight selector

The pneumatic weight selector lets you change test weights easily and safely.

The instrument already contains all common test weights: 0.325 kg; 1.2 kg; 2.16 kg; 3.8 kg; 5 kg; 8.7 kg; 10 kg; 12.5 kg; 20 kg and 21.6 kg. The optional 1.05 kg or 1 kg test weights can be used instead of the 1.2 kg weight.

You also have the possibility to hold the piston at any position you choose over the orifice in the pre-heating period. This avoids the premature escape of plastics with high flow rates during the pre-heating period.



Fig. 3: Mflow with weight selector and device for holding the test piston in the pre-heating position

Definition

MFR Melt mass flow rate
MVR Melt volume flow rate

3.3 Extrusion plastometer Aflow

The Aflow is noted for having a high degree of automation: whether simple cleaning and defined pre-compacting at the press of a button, or infinitely settable test loads - the Aflow adapts to your test tasks.

The extrusion plastometer supports all globally common standards and procedures, including ISO 1133, ASTM D 1238 according to Methods A, B, C and D.

The pneumatic precompacting feature allows the polymer to be defined and evenly precompacted at the press of a button – saving time and effort. Furthermore, *testXpert*® II determines the test results in the automatic parameter control, so that the Aflow automatically selects the correct test parameters.

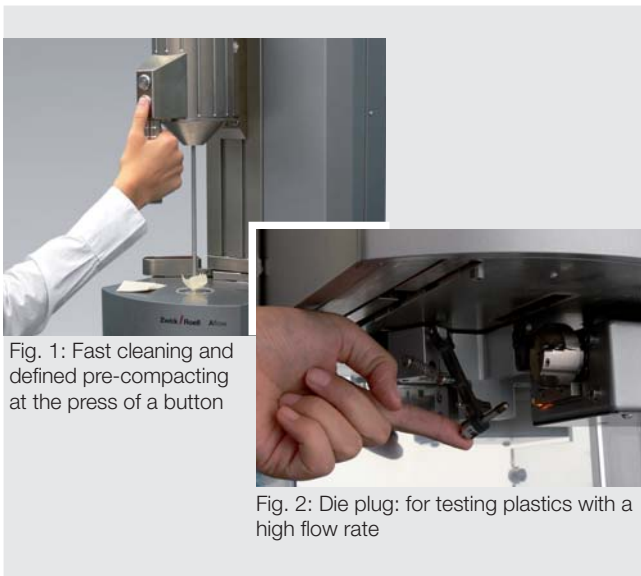


Fig. 1: Fast cleaning and defined pre-compacting at the press of a button

Fig. 2: Die plug: for testing plastics with a high flow rate

To further accelerate the test procedure after the test, you have the possibility to eject the remaining material from the extrusion barrel with a force of up to 80 kg and then to clean the extrusion barrel with a pneumatic cleaning device at the press of a button.

Space-saving, multi-device operation lets you connect up to six Aflow or Mflow extrusion plastometers to a PC. Of course, you can also use the Aflow in Stand Alone Mode without a PC.



Fig. 3: The Aflow extrusion plastometer

Advantages:

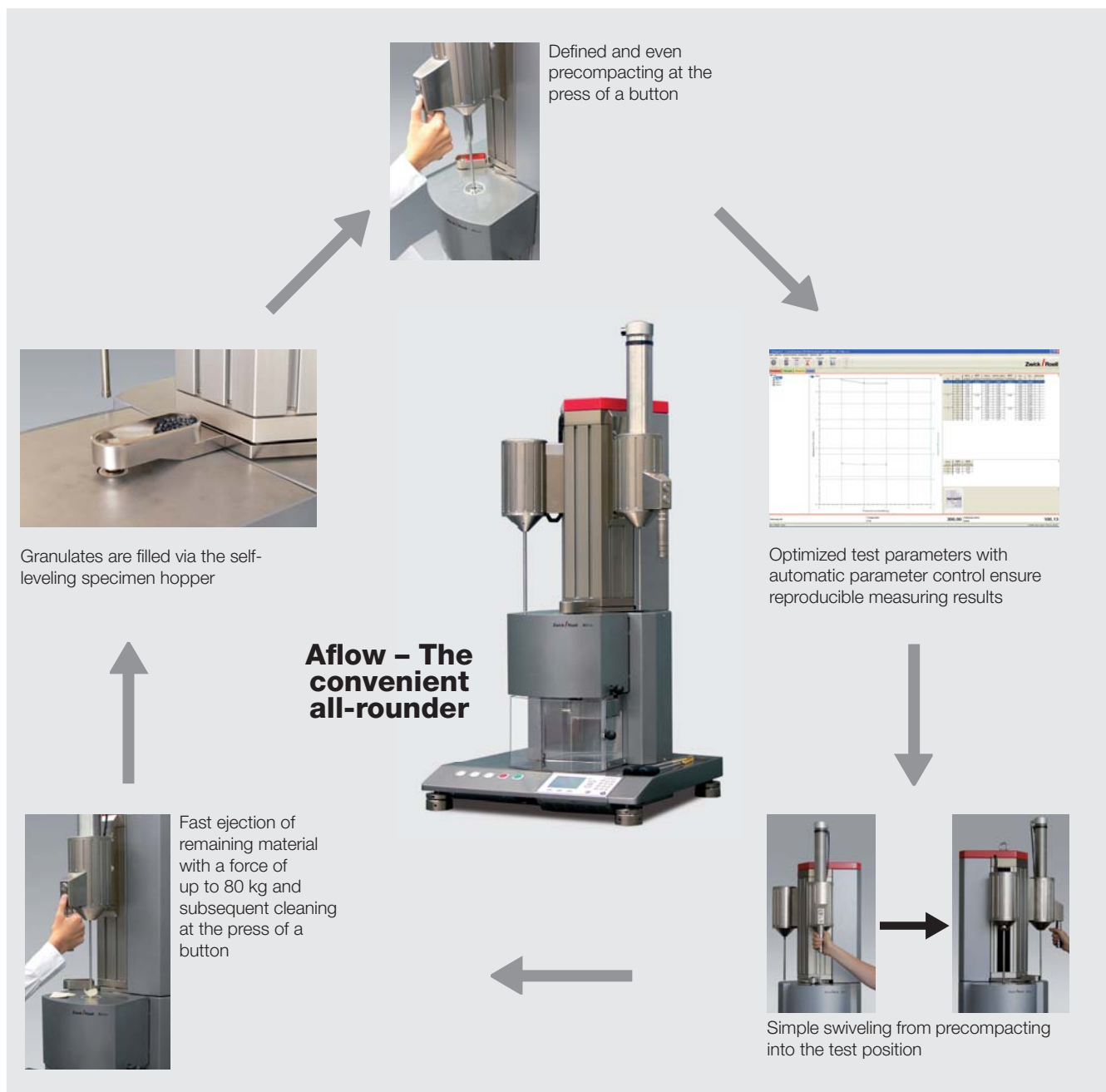
- Fast cleaning and defined pre-compacting at the press of a button
- The test loads can be infinitely set from 0.325 kg to 50 kg
- With automatic parameter control (APC), the Aflow selects the test parameters to determine the optimized test results - the result is fewer measurement errors
- The remaining material can be ejected from the extrusion barrel with a force of up to 80 kg
- Time-saving, multi-stage tests according to Method D: Several tests with different weight stages can be carried out with a single barrel filling
- The precise temperature distribution in the extrusion barrel corresponds to ISO 1133 Part 1 and Part 2
- The swiveling testing tower locks automatically in the cleaning or testing position
- Ergonomic operation: The swiveling and detachable specimen hopper is ideally suited for rapid filling of the extrusion barrel and also for quick and easy ejection of the remaining test granulate
- In Stand Alone Mode, results can be quickly and easily read without a PC

Aflow – The test sequence

The Aflow was developed for high specimen numbers and stands for a prompt test sequence as well as user-independent, quick and easy testing.

At the beginning of the test, the polymer is added to the self-leveling specimen hopper. Next, the specimen is precompacted evenly and with definition – all at the press of a button.

The automatic parameter control enables test results to be determined in such a way that produces the smallest possible measurement errors from the time and displacement measurement. Test parameters are optimized and measurement errors minimized. Further time savings are achieved after the test through the automatic ejection of remaining material with a force of up to 80 kg. Rapid cleaning then follows at the press of a button.



4 Stand Alone operation and testXpert® II

The instrument electronics offer convenient operation features in Stand Alone Mode:

- Fast switching between languages
- Input of the standard used and automatic parameter control based on that standard
- Manual input of the test parameters
- Input of the test method used (A, B)
- Automatic saving of the parameter sets used when the device is switched off
- Result output: individual values and statistical characteristic values (average, standard deviation, coefficient of variation)

Management of multiple Aflow or Mflow extrusion plastometers via a PC

In multi-device mode, up to 6 Aflow and/or Mflow extrusion plastometers can be configured and controlled via a PC with testXpert® II.

Central operation and the saving of results from a single workplace is rational and affords a quick overview of all tests currently in progress. For a clear overview of operations, we recommend using two monitors.

Automatic bubble detection with testXpert® II

The automatic bubble detection function enables air inclusions in the plastic melted mass to be detected during the test. You can choose whether you would like to reject or remove the section and therefore avoid measurement errors caused by air inclusions.

Live presentation of the melt volume flow rate

testXpert® II lets you choose from the beginning of the test whether you want to view the test piston speed graphically or numerically in cm³ per 10 min or by specifying the melt density in g per 10 min, and follow the progress of melting and the behavior during the measurement.

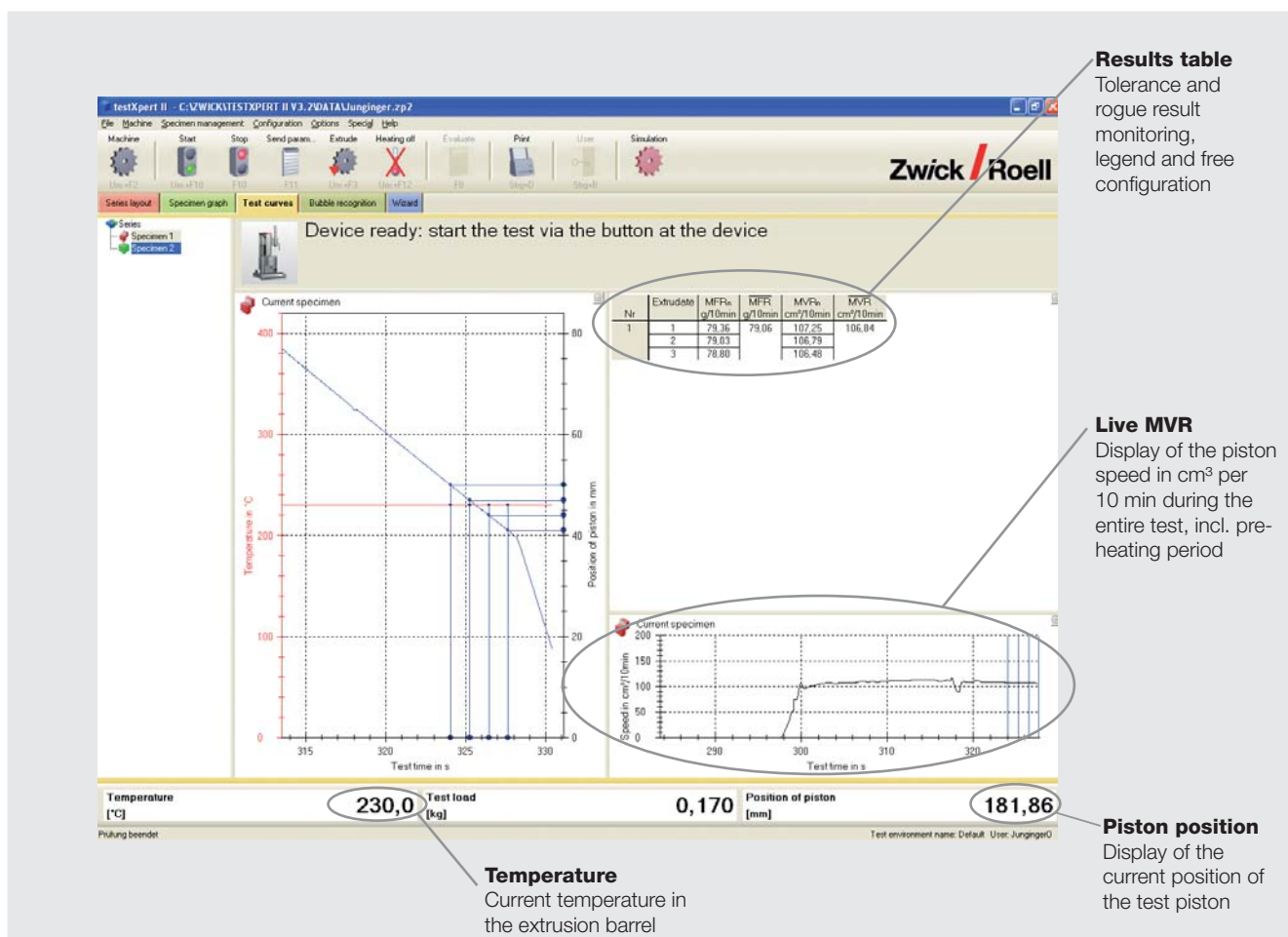


Fig. 1 : Live presentation of the melt volume flow rate (MVR)

Automatic parameter control (APC)

The automatic parameter control can be used to determine both the MVR (Method B) and the MFR (Method A).

The prerequisite for using automatic parameter control is the use of a travel measurement system. During operation without a PC, several standards-based parameter tables are available to you. When using *testXpert*® II, you can additionally create your own parameter tables. Select the appropriate parameter table before commencing the test. A pre-programmed parameter table contains optimized test parameters for the MFR/MVR value range from zero to infinity.

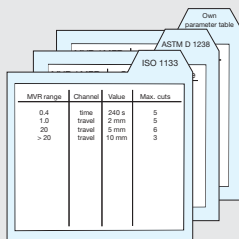
The piston speed is determined by the MFR/MVR of the polymer. The instrument automatically selects the optimal test parameters from the parameter table and uses them to perform the test.

The test results are determined so that they produce the smallest possible measurement errors from the time and displacement measurement. This gives the following advantages:

- An unknown plastic can be tested without problem; no pre-tests are required to determine the test parameters.
- If constantly changing types of plastic are tested, it is also possible to determine the test parameters without a database.
- Problem-free testing by several operators is possible, as the correct test parameters are automatically applied.

Selecting the parameter table

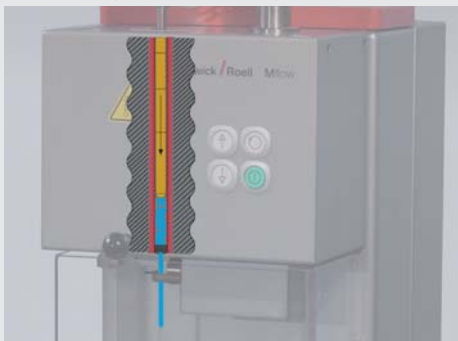
The predefined parameter table (ISO 1133) is selected in *testXpert*® II or directly at the instrument



MVR range	Channel	Value	Max. cuts
0.4	time	240 s	5
1.0	travel	2 mm	5
20	travel	5 mm	6
>20	travel	10 mm	3

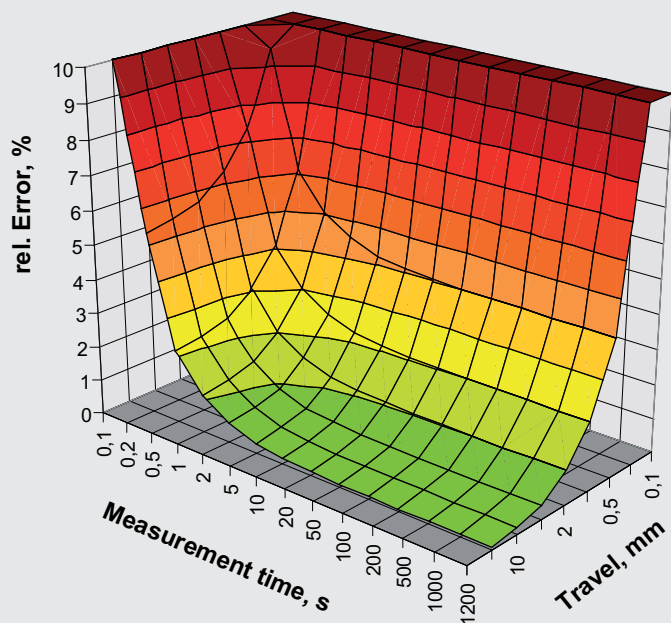
Determining the MVR

Just before the measurement begins, the extrusion plastometer determines the MVR and automatically selects the test parameters.



Optimized test parameters

Optimized test parameters produce small measurement errors: Relative measurement error of the MVR in %, calculated with the following accuracy:
 travel ± 0.02 mm, time ± 0.01 s
 (ISO 1133, § 5.2.3.1)



5 Technical data of the extrusion plastometers

The basic version of the **Aflow** is designed for MFR and MVR tests according to Method A, B, C and D. They can be achieved with an automatic extrudate cutter and scale. Tests to the following standards are possible: ISO 1133, ASTM D 1238, ASTM D 3364, JIS K 7210.

The basic version of the **Mflow** is designed for MFR tests according to Method A and can be expanded for MVR tests according to Method B. Tests to the following standards are possible: Methods A and B according to ISO 1133, ASTM D 1238, ASTM D 3364, JIS K 7210.

The **Cflow** is designed for MFR tests according to Method A. Tests to the following standards are possible: Method A according to ISO 1133, ASTM D 1238, ASTM D 3364, JIS K 7210.

The Extrusion Plastometers at a glance:

	Aflow	Mflow	Cflow
Power consumption	600 W	500 W	500 W
Compressed air, oiled, dry	6 - 10 bar	6 - 10 bar With option for weight lifting unit	-
Weight (Full equipment included)	130 kg	70.6 kg	46.6 kg
Dimensions (Height x Width x Depth)	1200 x 580 x 600 mm Full equipment with cleaning	930 x 360 x 520 mm Full equipment with test weights	850 x 270 x 400 mm Full equipment with test weights
Interfaces	USB	USB	-
Test loads	0.325 kg up to 50 kg (stepped or infinite)	0.325 kg up to 21.6 kg	0.325 kg up to 21.6 kg
Temperature range	+50 up to +450 °C	+50 up to +450 °C	+120 up to +400 °C
Scope of supply	Cleaning accessories for extrusion barrel and orifice, test granulate, swiveling filling channel, USB cable	Test weights 0.325 kg and 2.16 kg, funnel, cleaning accessories, test granulate, filling channel for granulate, USB cable	Test weights 0.325 kg and 2.16 kg, funnel, cleaning accessories, test granulate, filling channel for granulate

6 Accessories for the extrusion plastometers

The extensive accessories for all extrusion plastometers of the Xflow series include **extrusion barrels, test pistons and orifice pairs.**

An **extrusion barrel** must be chosen to suit the materials to be tested. Cleaning pads and a cleaning piston are supplied to clean the extrusion barrel. You can choose between extrusion barrels for specimens with and without fluoride.



You can choose between different **pistons** that correspond to the materials you intend to test. Pistons are available for plastic without fluoride as well as for plastic with fluoride. The matching **orifice pairs** are made from sintered material.

Items such as plug gages, cleanings tools for orifices, scales, thermometers, cleaning brushes as well as test granulate for verifying devices are available for all extrusion plastometers.

We also have the required test programs available for your tests, such as the basic *testXpert*[®] II Test Program for instruments or the *testXpert*[®] II Master Test Program for determining the melt flow rate.

The **automatic extrudate cutter and the spacer** make it easier for you to work with the Mflow and Cflow.

The **automatic extrudate cutter** is recommended for short cutting intervals in order to obtain precisely timed cuts. The die plug prevents premature flow of the material when testing plastics with high flow rates (> 10 cm³ per 10 min at a load of 0.375 kg).



Fig. 4: The die plug prevents premature flow of the granulate

Depending on the plastic use, the Mflow and Cflow extrusion plastometers can be fitted with different **test weights.**

The **spacer** for the Cflow holds the test weight in the pre-heating position. Individual specimen cuts are collected with the separating door.

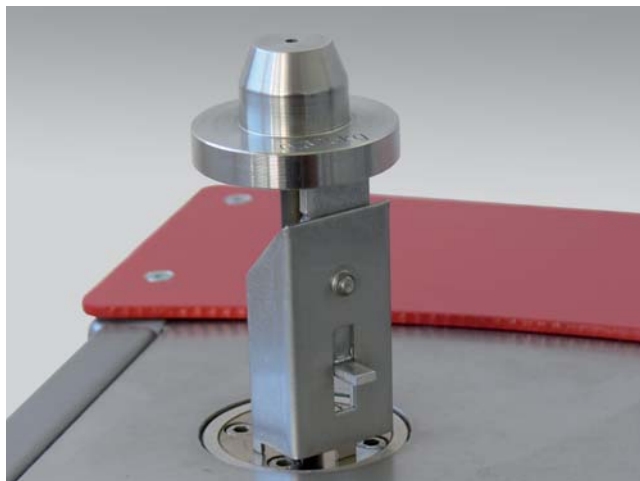


Fig. 5: Spacer at the Cflow extrusion plastometer

The weight selector and the travel transducer make it easier for you to work with the Aflow extrusion plastometer.

To simplify your work, the weights can be lifted and lowered effortlessly by the **pneumatic weight lifting unit**. The test weight can be automatically lifted by the weight lifting unit after reaching the pre-heating position. This minimizes any premature flow of the plastic granulate in the pre-heating period.

A **travel transducer** is available for measuring the displacement. It is needed for tests according to ISO 1133-Method B and ASTM D 1238 Method B. **Control gages** for 10, 30 and 50 mm are used to verify the travel transducer.

The **weight selector** contains all commonly used test weights: 0.325 kg; 1.2 kg; 2.16 kg; 3.8 kg; 5 kg; 8.7 kg; 10 kg; 12.5 kg; 20 kg and 21.6 kg. The additionally available test weights of 1 kg and 1.05 kg can be used instead of the 1.2 kg weight.

The **device for holding the piston in the pre-heating position** can be used to stop the piston at a manually set position during the pre-heating period. At the end of the pre-heating period, the test weight is automatically released.

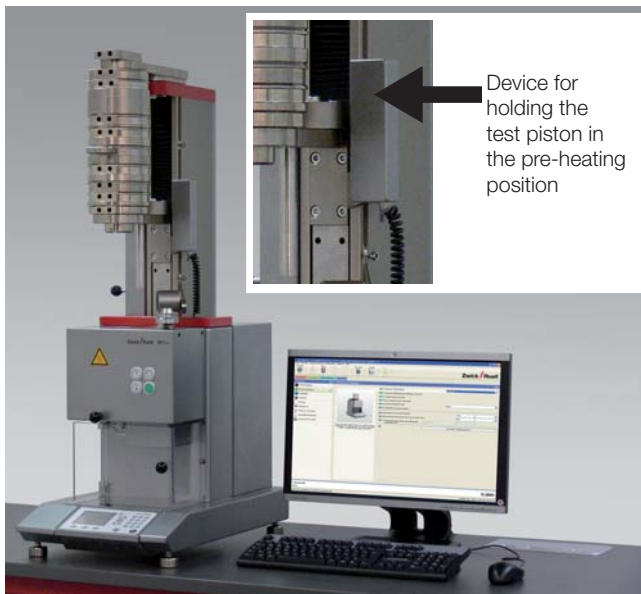


Fig. 1: Weight selector at the Mflow extrusion p lastometer

A pneumatic device is available for fast and fatigue-proof cleaning and precompacting of the Aflow.

The **pneumatic cleaning device** of the Aflow can be used to clean and precompact at a preset pressure.

The **cleaning and precompacting pressure** can be variably set via the device electronics or via *testXpert*® II with the cleaning and precompacting option. In addition, a switch on the cleaning device enables switching between the two pressure stages.

The **automatic extrudate cutter** is used for precision cutting of the extrudate. The die plug prevents premature flow of the material when testing plastics with high flow rates (> 10 cm³ per 10 min at a load of 0.325 kg).

When using the **die plug**, an extrudate cutter is required to eject the plug.



Fig. 2: Aflow: Cleaning and pre-compacting at the press of a button


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