



MELT FLOW INDEXER



mi2 SERIES

The mi2 Series – flexible, compatible, systematic



HIGHLIGHTS

- Brilliant touch screen display for ease of operation, program control and display of test results
- Temperature control with two heater elements, resolution 0.01 °C
- 5 temperature calibration sets, each with their respective parameter files
- Storage of up to 500 parameter sets, each holding up to 3000 measurements in stand-alone operation
- High resolution position transducer to measure volume output, resolution 0.025 mm/impulse
- High precision timer, resolution better than 0.001 s
- Timer programmable on/off switch for heaters
- Ethernet and serial connection to communicate with the optional balance for automatic density determination
- Electric weight handling system (except mi2.1)
- Base weight 0.325 kg, test loads from 1.0 to 21.6 kg (option)



mi2.1



mi2.2



mi2.3

mi2 SERIES

The mi2 series easily performs Melt Flow Rate (MFR), as well as Melt Volume Rate (MVR) measurements. Due to the modular design of this system, it is possible to automate the measurement process step by step. The extrusion plastometer can be used either as a stand-alone instrument, or it can be run with a computer software for statistical analysis and data management.

According to standards:

- ISO 1133
- ASTM D1238
- ASTM D3364

VARIANTS

mi2.1

The mi2.1 basic unit carries out an automatic measurement after **manual weight application**. The instrument is suitable for Quality Control inspection of incoming goods, when few measurements are made with mainly smaller weights.

mi2.2

The mi2.2 has a higher operating comfort than the mi2.1 thanks to an **automated weight lifting unit**. This enables users to start the measurement automatically after the pre-melt time, to lift the weights at the push of a button and to move to the starting position after the measurement has been carried out.

mi2.3

The Melt Flow Indexer mi2.3 has a **full weight handling system**, whose magazine holds up to 8 weights. There is no need to lift or move weights manually.

OPTIONS

- Manual die plug (also heatable for polymers with high temperature)
- Manual or automated melt cutting unit (also for sticky polymers)
- Nitrogen purge for hygroscopic polymers
- Barrel and piston in corrosion resistant or abrasion resistant design
- Automated backup of all values in the event of power failure via UPS
- Battery powered cleaning device

ADD-ON

The mi2 series can be equipped with add-ons for additional functionalities in addition to numerous options.

The following add-on is available:

- + Automated determination of melt density with an integrated laboratory scale

MI-3

Semi-automated melt indexer with full set of integrated measuring weights matching highest expectations



HIGHLIGHTS

- Test-weight is chosen by moving the weight selector lever to the indicated position
- High resolution displacement measurement (0.006 mm/pulse) with automatic determination of the resolution
- Automated pre-compression of the sample
- Weight guided test piston
- Individual selection of the basic weights (standard 1.2 kg)
- Weight magazine with integrated test weights from 2.16 kg to 21.6 kg (max. 8 weights)
- Additional weights optional
- Automated weight lifting unit

MI-3

The MI-3 is equipped with a **weight magazine**, to enable the operator to choose the measuring weight manually. The instrument enables operators in quality control (QC) and incoming goods inspection to conduct single measurements, while meeting highest quality standards according to ISO 1133, as well as ASTM D1238 (Procedure A-B-C). The high resolution position sensor with an automatic selection of the resolution allows a repeatable, reliable determination of MFR and MVR. Besides the standardized measurement processes (ASTM and ISO) GÖTTFERT also provides add-ons, which are positively contributing to the total value of the instrument.

According to standards:

- ISO 1133
- ASTM D1238
- ASTM D3364

OPTIONS

- Manual die plug (also heatable for polymers with high temperature)
- Automated die plug
- Manual or automated melt cutting unit (also for sticky polymers)
- Nitrogen purge for hygroscopic polymers
- Barrel and piston in corrosion resistant or abrasion resistant design
- Automated backup of all values in the event of power failure via UPS
- Optimized test piston fixing, whereby users may choose to affix the piston to the weight, or not
- Battery powered cleaning device
- Pneumatic ejection unit (up to 50 kg/100 kg)
- Air exhaust unit at the test chamber

ADD-ON

The MI-3 can be equipped with add-ons for additional functionalities in addition to numerous options.

The following add-ons are available:

- + Die Swell measurement
- + Automated determination of melt density with an integrated laboratory scale

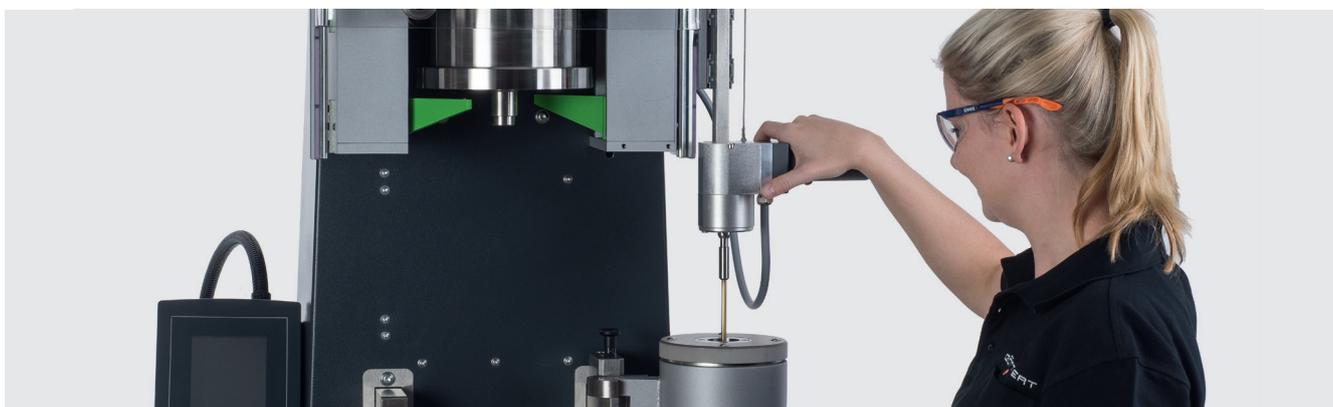
mi40

A higher accuracy, as well as a higher level of automation, are key advantages of the mi40



HIGHLIGHTS

- Force controlled pre-loading/ejection via drive and test weights
- Multi-load tests with up to 8 different weights, ascending, descending or freely selectable (ASTM procedure D)
- High precision timer with a resolution better than 0.001 s
- Temperature control algorithm, resolution 0 to 320°C: 0.01°C, 320 to 500°C: 0.1°C
- High resolution position transducer to measure volume output with automatic determination of resolution
- Automated weight selection, as well parameters are stored and called upon when running tests



mi40

The new generation of melt flow index measurements by GÖTTFERT is represented by the mi40. Operators in quality control (QC) departments have experienced the advantage of further automated melt index measurements and the exact determination of MFR (Melt Flow Rate) as well as MVR (Melt Volume Rate) according to ISO 1133 as well as ASTM D1238 (Procedure A-B-C-D). Due to force compression with up to 60 kg, the reproducibility is reaching a new standard.

An additional advantage of the mi40 is the multi-load measurement with up to 8 different weights, which are operable in a descending and ascending mode. Thus the mi40 can be used to run a shear rate curve, using each weight to measure one shear rate. Therefore, it is possible to compare the mi40 to a measurement unit which is similar to a capillary rheometer.

The cleaning process of the test chamber was simplified by a freely accessible test chamber. The cleaning of the test chamber, which is necessary after every single measurement, is further helped by an integrated, semi-automated cleaning device.

According to standards:

- ISO 1133
- ASTM D1238
- ASTM D3364

OPTIONS

- Integrated, electric operated cleaning unit
- Manual die plug (also heatable for polymers with high temperature)
- Automated die plug
- Manual or automated melt cutting unit (also for sticky polymers)
- Nitrogen purge for hygroscopic polymers
- Barrel and piston in corrosion resistant or abrasion resistant design
- Automated backup of all values in the event of power failure via UPS
- Optimized test piston fixing, whereby users may choose to affix the piston to the weight, or not
- Air exhaust unit at the test chamber

ADD-ON

The mi40 can be equipped with add-ons for additional functionalities in addition to numerous options.

The following add-ons are available:

- + Die Swell measurement
- + Automated determination of melt density with an integrated laboratory scale

mi40 visco

for extended viscosity measurements



HIGHLIGHTS

- Capillary rheometer standard ISO 11443
- Modified motor controller which control the piston speed between 0.1-40 mm/s in 0.1 mm/s steps
- Modified Test piston to meet ISO 11443 measurement standard
- Measurement force of up to 800 N (max. pressure of 110 bar)
- Viscosity die with length 10 mm and a diameter of 1 mm (L/D=10/1 mm)
- Easy to use software extension for viscosity measurements

mi40 VISCO

Melt Flow Index Testers, also called plastometers, are used to measure the melt flow rate (MFR) and the melt volume rate (MVR) of pellets, powder or fine granules. Plastometers are generally designed according to the relevant standards ISO 1133 and ASTM D1238.

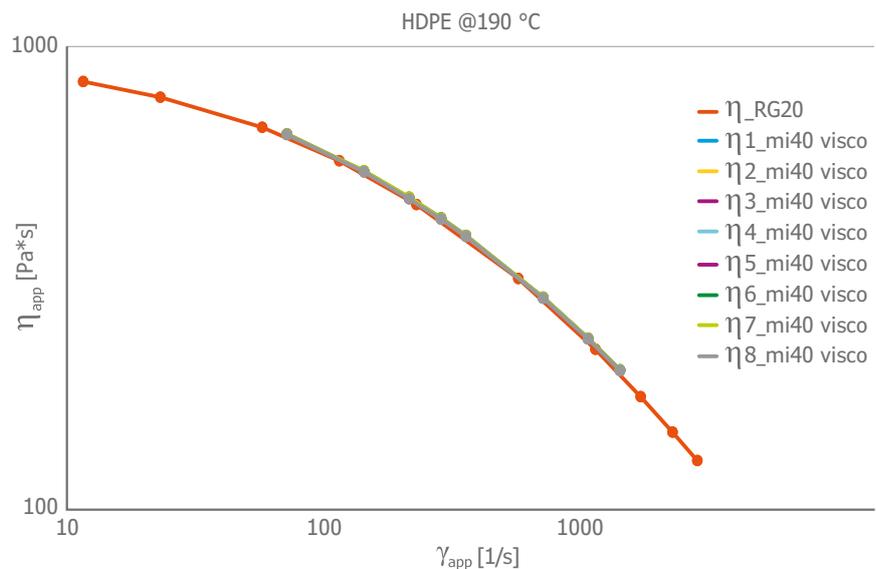
Using a capillary rheometer, the measurement is more challenging to operate and time consuming compared to a standardized MFR-test. Now using the Add-on "visco" for mi40, running these viscosity tests is as easy as standardized MFR-tests.

In this test mode, the mi40 is using the integrated motor to push the piston at constant defined speeds. The resulting pressure is measured with a force transducer in the piston holder. Compared to normal MFR-measurements, it is possible to reach higher shear rates which are more relevant for actual production processes. Therefore, viscosity tests by this GÖTTFERT Plastometer are more like a processability test compared to the standard MFR-test.

According to standards:

- ISO 11443 (Viskosität)
- ISO 1133
- ASTM D1238
- ASTM D3364

VISCOSITY MEASUREMENT



mi40 visco vs. Capillary Rheometer RG20 with HDPE,
MFR (190 °C/2,16 kg) = 9 g/10min

ADD-ON

The mi40 can be equipped with add-ons for additional functionalities in addition to numerous options.

The following add-ons are available:

- + Die Swell measurement
- + Automated determination of melt density with an integrated laboratory scale
- + D-MELT (Kombigerät aus mi40 und Dehnrheometer)

IV TESTER

Determination of the Intrinsic Viscosity



HIGHLIGHTS

- Determination of Intrinsic Viscosity without chemical solvents
- Simple and fast measurement method
- Characterization of the average molecular weight of PET/PA/P

IV TESTER

The IV Tester is to determine the intrinsic viscosity also called solvent viscosity or intrinsic viscosity.

No chemical solvents are used in the determination. This method is used in particular for quality control of polyester (PET) or polyamide (PA). The tester does not require a PC.

According to standards:

- ISO 12418-2:2012
- ISO 1133
- ASTM D1238

OPTIONS

- Manual die plug (special heated version for high temperatures available); Automatic melt cutting unit
- Nitrogen purge for hydroscopic materials
- Alternative steel grades for barrel and piston with higher corrosion or abrasion resistance
- Data protection of parameters and results via uninterruptible power supply
- Only mi2.2: Mechanism for pre-compressing and ejection with a higher weight

ADD-ON

The IV Tester can be equipped with add-ons for additional functionalities in addition to numerous options.

The following add-on is available:

- ➕ Moisture measurement instrument

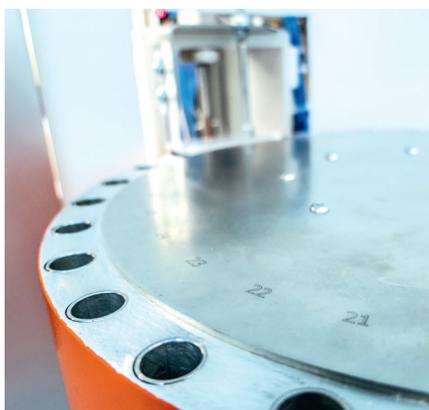
MI-ROBO 89.16

The world's only fully automated melt index instrument with automated filling, measurement and cleaning



HIGHLIGHTS

- Integrated sample magazine for 30 single tests, to fill with plastic granules, powder or similar material profiles
- Control by Panel-PC with real-time operating system and 5.7" Touch Screen Display
- MFRHost PC-Software for parameterization, online monitoring and evaluation of MFR/MVR values
- Temperature control algorithm, resolution 0 to 320°C: 0.01°C, 320 to 500°C: 0.1°C
- Precise digital position sensor to measure volume output
- High precision timer with a resolution better than 0.001 s
- Single load mode for measurements with one weight
- Multi load mode with one barrel filling, either for tests with two different weights or with one pre-load weight and one test weight



MI-ROBO

The MI-ROBO runs the melt flow rate testing process, sample loading, cleaning and die changing fully automatically and performs according to ISO 1133 and ASTM D1238 standards for granulate, as well as powder materials. This means fully automated filling of the barrel, with running the process of the measurement as well as die and barrel cleaning right after the measurement. Any number of measurements can be conducted one after each other, without any intervention of an operator. The MI-ROBO is individually configurable according to customer materials. This ensures the opportunity to measure all kinds of plastic material with a fully automated instrument.

According to standards:

- ISO 1133
- ASTM D1238
- ASTM D3364
- BS 2782
- NF51-016

SPECIFICATIONS

- A variety of cleaning tools assure optimized cleaning procedures
- Individual filling and cleaning procedures specified for each material
- Automated melt cutting unit
- Test chamber electrically heated with easily changeable test barrel
- 5 temperature calibration data sets, each with separate control parameters for optimal adaptation

OPTIONS

- Sample magazine in Standard or Inlet Design for sticky materials (option)
- Additionally fixed loads with automatic load selection, for pre-load and test load selection (option)
- Magazine heating (option)
- Nitrogen purge (option)
- Automated sampler feeding (option for sample magazine in Standard Design)
- Barrel and piston in corrosion resistant or abrasion resistant design

SOFTWARE AND OPTIONS

mi2 series, MI-3 and mi40

SOFTWARE miCONNECT

miCONNECT is a browser-based platform that can be used on mobile devices without installation. The user is able to manage and check the parameterization and control of the entire measurement process, as well as the graphical representation and evaluation of the measurement results in a single interface.

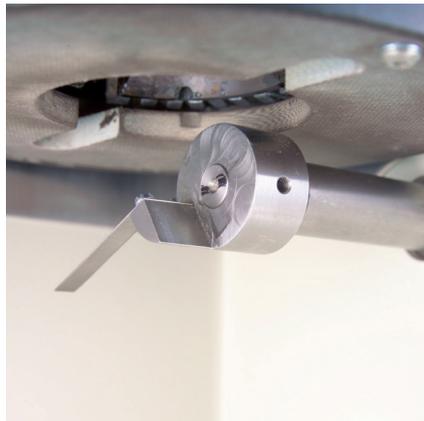
Device independent functions:

- Data transmission and data acquisition between PC and the Melt Flow Index Instrument
- Location independent set up of parameter sets
- Numerical and graphical representation of the measured values with statistical evaluation (in real-time)
- Numerical and graphical representation of the measured die swell with statistical evaluation



OPTIONS

- Manual or automated melt cutting unit (also for sticky polymers) (Img. 1)
- Time saving: Pneumatic compression and press through device for high viscous materials (MI-3) or via the drive and force control (mi40)
- Nitrogen purge for hygroscopic polymers
- Barrel and piston in corrosion resistant or abrasion resistant design
- Die plug (Img. 2)



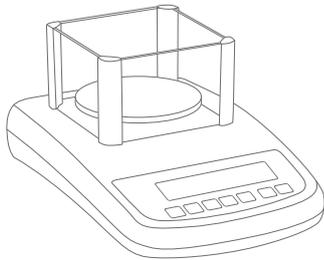
Img. 1



Img. 2

ADD-ON

Additional expansion of our standardized melt index testers
mi2 serie, MI-3 und mi40



+ Melt density

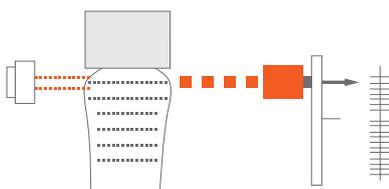
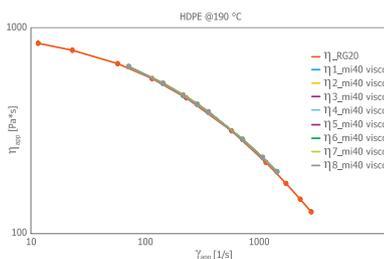
When determining the melt volume flow rate (MVR) according to method B, the extruded volume per unit of time is determined via the speed of the die in $\text{cm}^3/10 \text{ min}$. The melt density can be measured directly and used to convert between MVR and MFR.

For this add-on, a laboratory balance and the cut-off device selection option are required.

+ Viscosity

With the add-on "viscosity measurement" the mi40 is transformed into a mi40 visco. This enables the plastometer to perform viscosity measurements according to the standard for capillary rheometers ISO 11443.

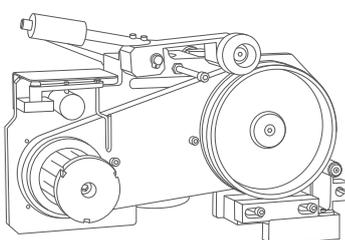
The proven ease of operation of the melt-flow indexer is combined with the increased material characterization capabilities of a capillary rheometer. This new option makes it possible to test viscosity as a QC criterion, without a huge investment in time, training or money.



+ Die Swell

The Die Swell measurement is one of many available add-ons for the series of GÖTTFERT capillary rheometers.

By means of a laser measuring head, which is adjustable in height, it is possible to measure the material-dependent swelling of the extruded polymer strand. This add-on is particularly important for process optimization and quality control of elastomer processing companies.



+ Elongation

The D-MELT consists of a GÖTTFERT melt index tester (plastometer) mi40 and an integrated HAUL-OFF system. The specially developed D-MELT measuring method offers the possibility to measure the melt flow rate (MFR) and the melt elasticity (ME) with only one filling of the channel. The HAUL-OFF system, which measures the melt elasticity, is fed by the melt index tester, also called plastometer.

APPLICATIONS

mi2 series, MI-3 and mi40

HIGHLIGHT: MI-3 & MI40

Automatic determination of the resolution!

The displacement transducer in the device has a resolution of 0.006 mm per impulse. For optimal test results (grabbing single test points) it can be selected in 3 levels (high, regular, low), depending on the MVR value.

For the ideal determination of the resolution of the test piston displacement (mm/measuring point) this value can also be detected automatically. This is a big advantage in the case of unknown materials.

COMPRESSION

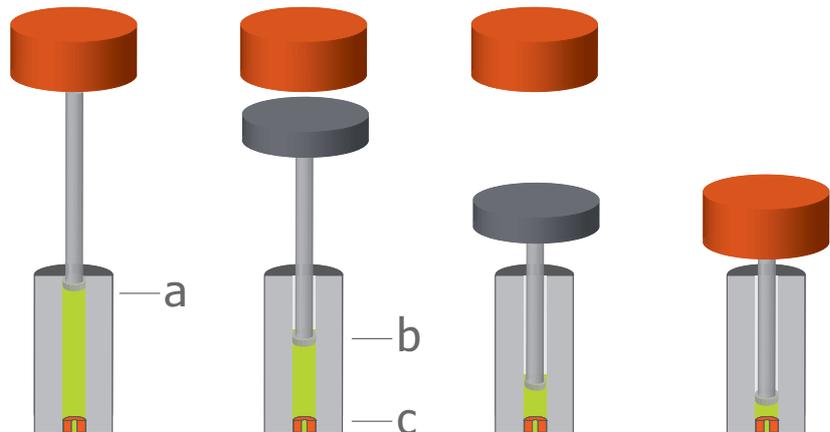
Many polymers are very sensitive when it comes to packing and pre-loading, where handling differences directly impact measurement accuracy and repeatability. Our test devices offer different ways to pack and how to apply a pre-load to the test material. This control covers the complete pre-heat/melt time. Either the time spent on each is controlled, or the position of the piston /material at a specific point in the barrel. The loads used are chosen manually with the mi2.3 and MI-3, whereas with the mi40 this can be defined in the software settings, a big advantage when it comes to data integrity.

First, compression of the material with a preselected weight. Position controlled (see Pos. a) or time controlled and with force.

Re-compression with a preselected weight to a user defined position (see Pos. b), or to 55 mm above the die (see Pos. c), 5 mm above the ISO 1133 piston travel.

Automated measurement and test weight selection. Additional possibility to run Multi-Load measurements with up to 8 weights, selectable in any sequence (see below).

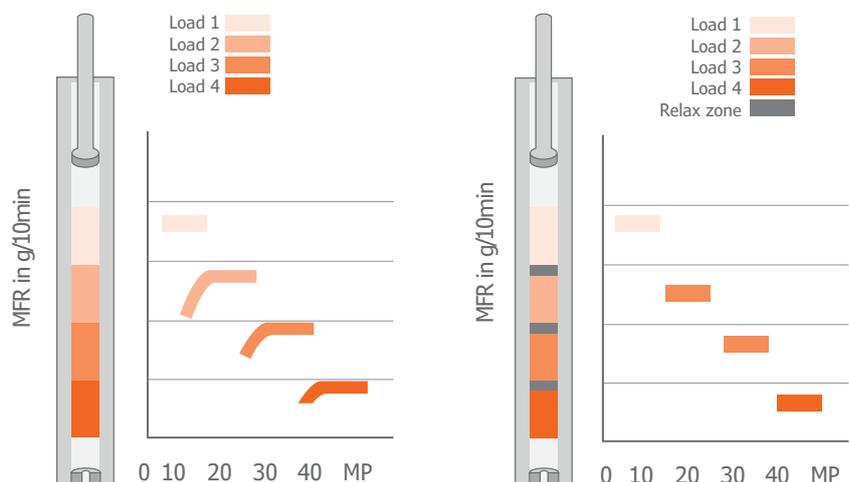
Automated purge of material with a pre-programmed and freely selectable test weight.

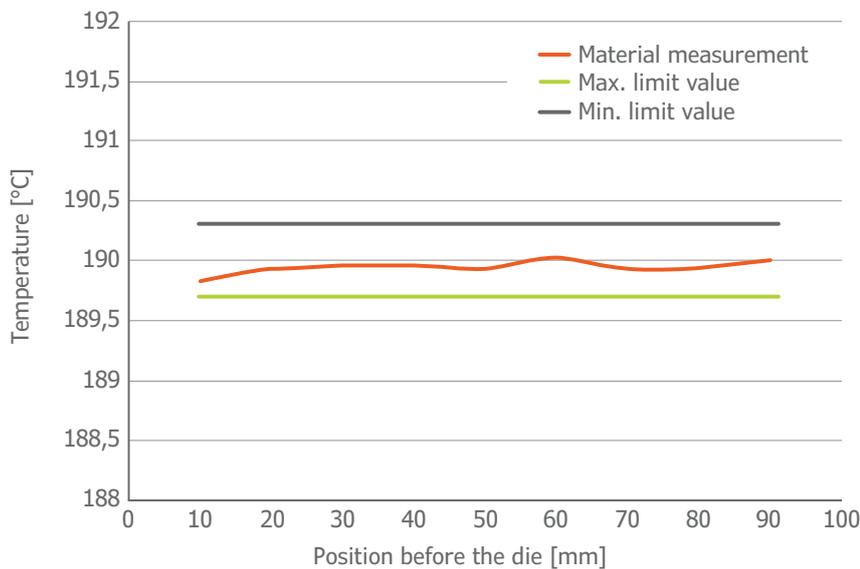


MULTI-WEIGHT-TEST

Conventional multiple load tests do not provide any relaxation phase while load changing: this results in higher dispersed test values compared to single test load measurements (figure at left). With our new multiple load function (up to 8 weights), being integrated in the mi40, the material is given enough relaxation time between load changes to minimize any pre-shearing influences.

The result is that both, single load tests and multiple load tests are now in high conformity (figure at right).





BETTER THAN WHAT THE NORM DEMANDS

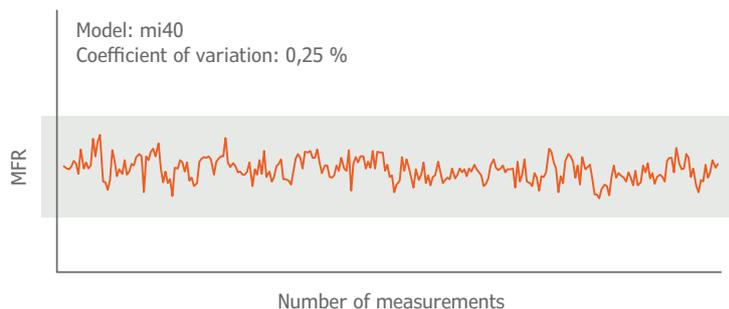
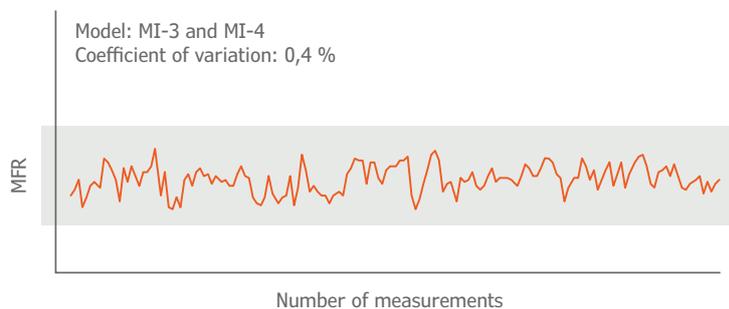
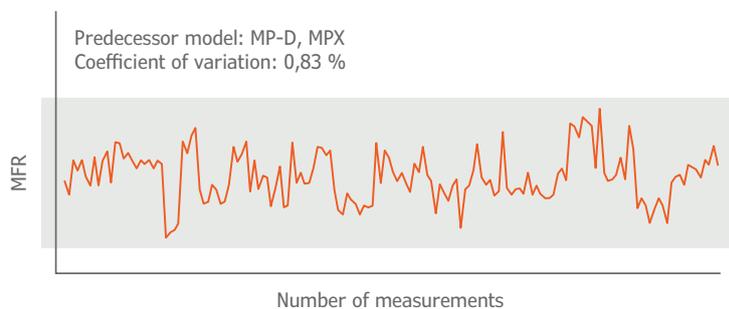
The temperature process: stability and accuracy is much better than what ISO 1133 requests. The standard concept of the ISO 1133:2011, part 2 demands for the temperature profile $\pm 0.3^\circ\text{C}$ at a distance up to 70 mm above the die.

This high accuracy requirement is exceeded with our devices as shown in both diagrams. This also holds true, even when measured by part 1.

IMPROVED ACCURACY

Variance reduced by half, accuracy doubled. Easier said than done. The combination of our goal oriented development process, uncompromising engineering and long term manufacturing experience resulted in our new MI Series having 100 % improved accuracy and machine conformity (see graphics).

The results are based on internal quality tests that each machine has to pass before shipment. Test records of at least 40 machines are evaluated and standardized. Tests with a PE material performed having an MFR value of 7.5. Whereas the predecessor models MP and MPX already achieved good minimum dispersion values of 0.83%, the new generation of the mi2 series and MI-3 now reduces the difference to 0.4% and the mi40 to only 0,25%. Variance reduced by half, accuracy doubled: that is a great advantage.



SERVICE

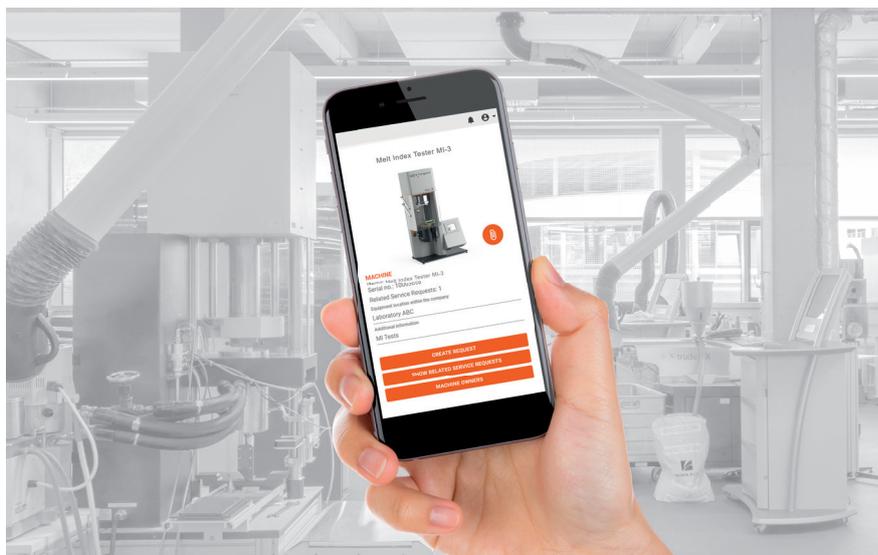
miCONNECT – a new generation of application Software for Melt Flow Indexers

HIGHLIGHTS

miCONNECT is a browser-based platform that can be used on mobile devices without installation. The user is able to manage and check the parameterization and control of the entire measurement process, as well as the graphical representation and evaluation of the measurement results in a single interface.

Device independent functions:

- Data transmission and data acquisition between PC and the Melt Flow Index Instrument
- Location independent set up of parameter sets
- Numerical and graphical representation of the measured values with statistical evaluation (in real-time)
- Numerical and graphical representation of the measured die swell with statistical evaluation



MAINTENANCE AND CALIBRATION

Our instruments experience a long lifetime with minimal failure rate. In order to ensure sustainable reproducible and reliable test results, periodic maintenance of these reliable test instruments is indispensable. The globally active and well-trained team of service technicians, ensure consistently reliable and accurate rheological test results.

Regular maintenance ensures long-term reliability. We offer you a service contract tailored to your needs in order to keep the equipment at the highest quality level. Our professionally trained service team and our certified quality management system (according to international standard DIN EN ISO 9001) guarantee fast and worldwide reliable service.

Our service technicians are able to carry out the following maintenance in accordance with ISO/IEC 17025:

SERVICE BASIC*

Maintenance and calibration of the instrument with traceable measuring devices.

After successful completion a maintenance check list (inspection protocol) will be provided.

* SERVICE BASIC is no longer provided for manually operated melt flow indexers of the current model series.

SERVICE BASIC PLUS

Maintenance with factory calibration protocol: Maintenance and calibration of the instrument with traceable measuring devices, including statistical measurement uncertainty, which has been determined by an evaluation of the statistical measurands on several different instruments.

After successful completion a factory calibration protocol (inspection protocol) will be provided.

SERVICE ISO 17025

Maintenance and calibration of the instrument with traceable measuring devices, including an indication of the lowest measurement uncertainty, which has been determined directly at the test device on site.

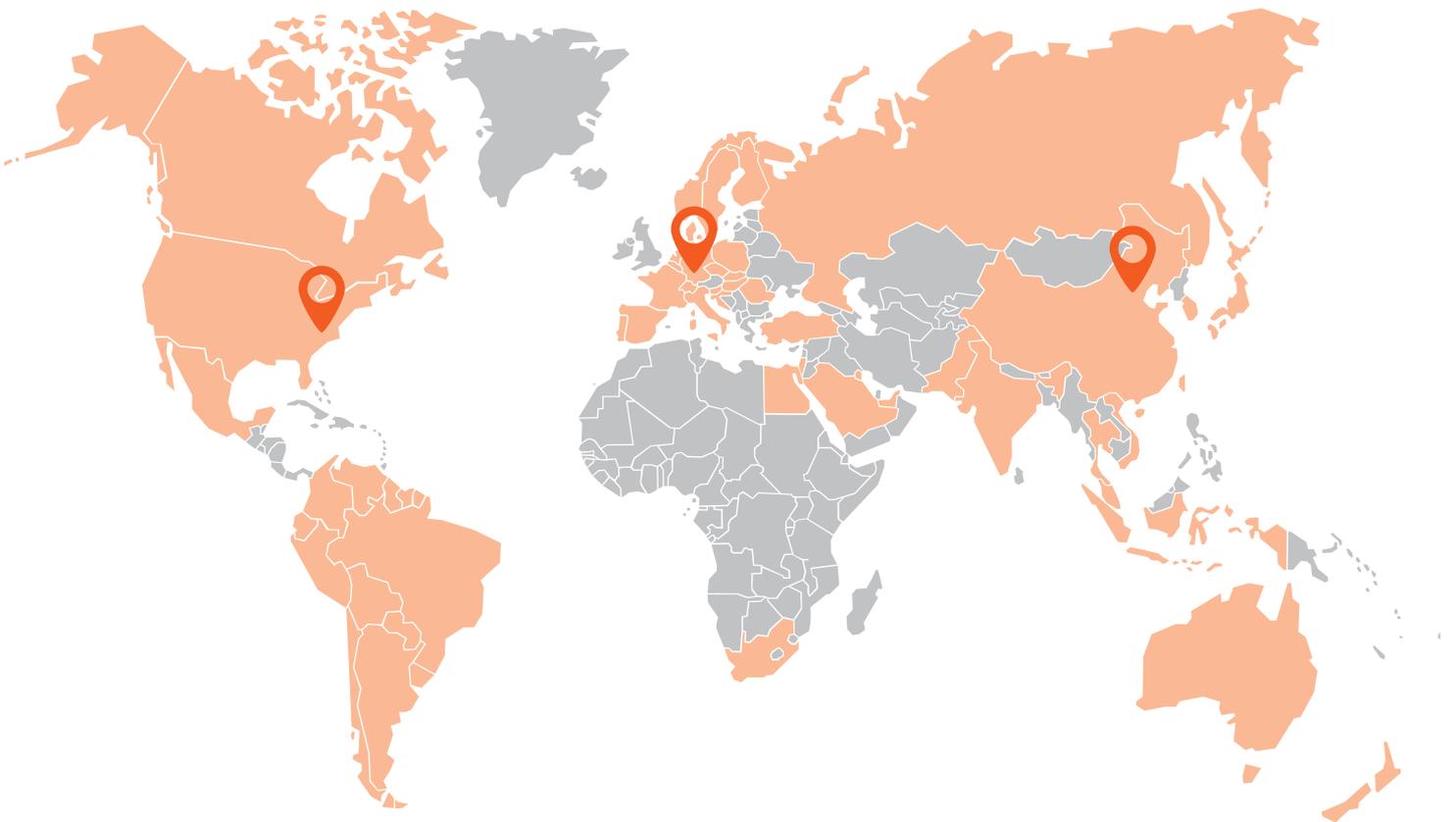
After successful completion a verification report will be provided in accordance with the requirements of ISO 17025.

SPECIFICATIONS



Model	mi2.1	mi2.2	mi2.3	MI-3	mi40
Test procedure	Automated measurement with single load		Automated measurement with single load and manual weight selection		Automated measurement and software controlled weight selection, Multi load measurement
Test chamber	Two heater circuits, electrically heated, temperature sensor PT100 1/3 DIN Temperature difference over time: $< \pm 0.1^{\circ}\text{C}$ Temperature difference over distance (0 - 70 mm before the die) $< \pm 0.2^{\circ}\text{C}$ of set temperature (temperature range 60°C to 400°C) $< \pm 0.3^{\circ}\text{C}$ of set temperature (option: temperature range 400°C to 500°C)				
Load steps	0.325 - 21.6 kg				
Weight guidance	Piston guidance according to ISO/ASTM			Piston guidance according to ISO/ASTM and internally installed test weights	
Weight handling system	-	Yes	Yes	Yes	Yes
Pre-load and material purge function	-	Manually with weights (option)	Semi automated with manual weight selection	Automated with manual weight selection	Fully automated with weights or force controlled
Multi-Load function	-				8 weight steps, selectable in any sequence
Actual temperature display	0 - 500°C on touch screen monitor				
Temperature acquisition	Via 16-bit converter, resolution 0 - 320°C: 0,01°C; resolution 320 - 500°C: 0,1°C				
Test barrel	9.555 (-0.01) mm diameter				
Touchscreen display	14.48 cm (5.7") Color VGA touch screen monitor				
Test value acquisition	Electronically, resolution: 0.025 mm/impulse			Electronically, resolution: 0.006 mm/impulse	
Test data display	Numerical				
Die	2.095 (± 0.003) mm diameter, 8 (± 0.025) mm length 1.048 (± 0.005) mm diameter, 4 (± 0.025) mm length (option)				
Advanced evaluation 1	IV calculation to characterize polyester and polyamide based plastics				
Advanced evaluation 2: Add-On die swell measurement	-			Flow Rate Ratio (FRR) calculation for multi load tests	
Melt cutting unit	Option				
Die locking mechanism	Option				
Nitrogen purge	Option				
Corrosion resistant version	Option				
Abrasion resistant version	Option				
Pre-load function	-	Manual pre-loading (option)		Semi-automatic	Fully-automated
Data input	Touch screen monitor				
Interfaces	Ethernet, serial, 1 or 2 x USB (printer, memory)				
Power supply	115 V or 230 V				
Ambient temperature	+10 bis +40°C				
Ambient humidity	max. 90 % not condensing				
Dimensions Width/Depth/Height (* with cleaning module)	W: 510 mm D: 380 mm H: 625 mm	W: 510 mm D: 430 mm H: 1,025 mm	W: 510 mm D: 430 mm H: 1,120 mm	W: 700 mm D: 450 mm H: 1,290 mm	W: 820 mm* D: 605 mm* H: 1,325 mm*
Weight	Approx. 45 kg	Approx. 75 kg	Approx. 105 kg	Approx. 170 kg	Approx. 200 kg

THIS IS RHEOLOGY



GOETTERT
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