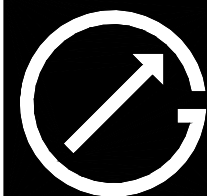




## Melt Indexer Series MI

Automated Extrusion Plastometers / Melt Indexers built to meet ISO 1133 and ASTM D 1238 specifications



# GÖTTFERT®

certified according to DIN EN ISO 9001:2000

GFT 011-9-07

From the basic melt indexer to our fully automated system with many available options, all are based on the same high-quality structure, offering the right configuration for every need.



## MI-1

This basic melt indexer can carry out a single weight test according to ISO 1133 and ASTM D 1238, procedure A, as well as ISO 1133 und ASTM D 1238 procedure C for the “Half Height / Half Diameter” standard.

- 2 heater elements / zones, resolution 0.1°C
- Electrically heated test chamber
- Capillary/die quick-release and locking mechanism
- Base weight 0.325 kg, test weights selectable from 1.000 to 21.600 kg (**Option**)
- Manual melt cutting unit
- Die plug (**Option**)
- Nitrogen purge (**Option**)



Basic device

## MI-2

The modular design allows our automated systems to run procedure B/C and incorporates up-to-date measurement electronics.

- Brilliant 5.7" Color-QVGA touchscreen display for the operation, program control and display of the test results
- 2 heater elements / zones, resolution 0.01°C
- 5 calibration settings for set temperature with dedicated parameter files
- High-resolution position transducer to measure volume output, resolution: 0.025 mm/impulse
- High-precision timer with a resolution better than 0.001 s
- Built-in USB-connection (Data Stick) for data back-up
- Built-in USB-connection for printer
- Serial connection to communicate with the MFR Host software or the optional scale
- Ethernet-connection (LAN, WEB-Server)
- Integrated WEB-Server
- Capillary/die quick-release and locking mechanism
- Base weight 0.325 kg, test weights from 1.000 to 21.600 kg (**Option**)
- Electric weight handling system (**Option**)
- Manual or automated melt cutting unit (**Option**)
- Die plug (**Option**)
- Nitrogen purge (**Option**)



With electric weight handling system



### MI-3

A fully automated melt indexer fulfilling the highest expectations and using the same touch screen technology as used for the MI-2 (see related information in this brochure).

g f t		
< G1 = 2.16 / 0 / 40 >		DIN / ISO
07 : 32	212.0 mm	190.06 ° C
		190.10 ° C
<b>MFR x =</b>		<b>7.470</b>
s = 0.022	V = 0.296	n = 20
GAMMAap = 17.7838		
TAUap = 19396.8		NO
ETAap = 1090.7		
Home	Single val.	Test/Back

Results as shown on the integrated touch screen monitor



Cleaning is made easy through the swing-out barrel design



Weight selection made easy: manually (MI-3) or automatically (MI-4)

**Every component has been optimized and integrated into a new platform for superior performance and maximum user-friendliness. Furthermore, the MI-3 offers the following additional features:**

- All test weights from 1.2 to 21.6 kg are internally installed; manual and therefore dangerous weight handling is eliminated.
- Users may simply select test weights using a small lever that activates the electrical weight handling system.
- A specially designed guidance system for the test weights ensures that measurements are not influenced by weights being slightly slanted, skew, or off center, which would lead to errors.
- To ensure a convenient access to the test chamber, it swings open 45°. The use of a special cable system ensures many years of service and is especially designed to withstand years of swinging the barrel open and shut, without breaking the connections.
- The volume and displacement sensor has more than 4 times the accuracy than the MI-2.
- Optimized displacement sensor technology allows material packing with a reproducibility never achieved before (see related information in this brochure under MI-3 and MI-4 / packing).

## MI-4

Glancing at the MI-4, one would never notice a difference to the MI-3. However, the big difference is in the inside, where all the special functionality is hidden.

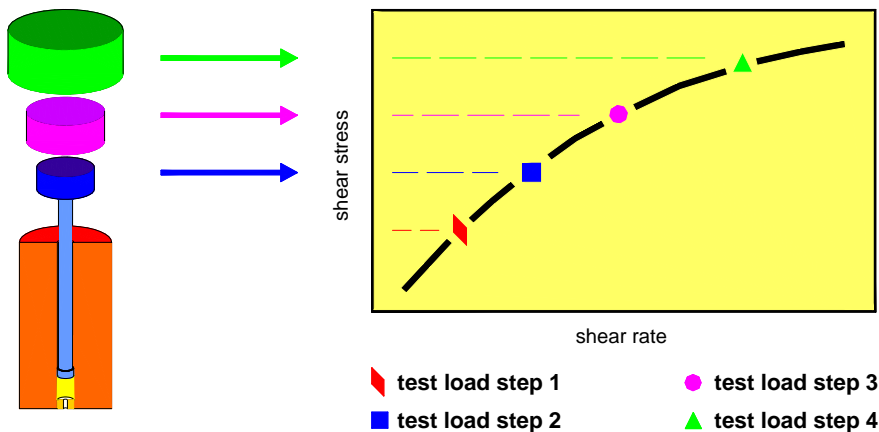
Like with the MI-3, all test weights are internally installed. The selection of the test weight(s) is performed fully automatically based on pre-programmed test procedures selected via the user friendly touch screen.

This function enables the MI-4 to perform similar to a rheometer running different with loads.



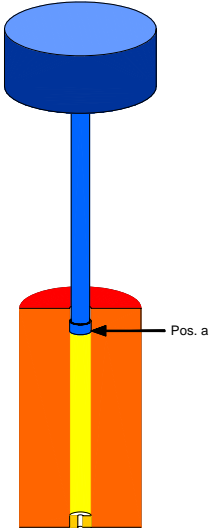
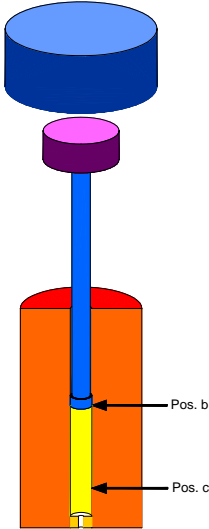
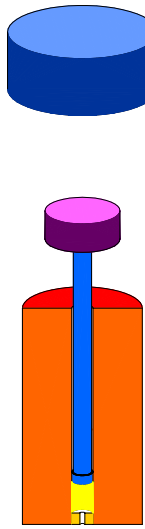
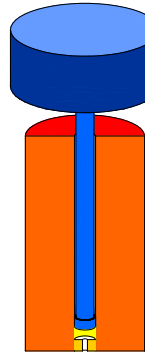
Melt strand cutting device (optional), either automated or manual

- The selection of the concentric, internally installed weights – ranging from 1.2 kg to 21.6 kg – is available for different automated functions such as charging, packing, pre-loading, measurement and purging.
- The Multi-Weight functionality of the **MI-4** makes it behave similar to a rheometer, where up to four different loads can be used to expose the testing material to different stresses within one test run to measure and calculate MVR and MFR.
- The configuration of how the **Multi-Weight test** shall be run is freely user configurable and not restrictive, as with most other systems that offer a similar option. Many materials can be measured with better repeatability, running either with decreasing, or increasing weights, both methods are available for use in the MI-4.



## Loading functionality for the MI-3 and MI-4

Many polymers are very sensitive when it comes to packing and applying pre-loads to them and show different measurement results if done differently. At a minimum, the reproducibility is effected. The **MI-3 and MI-4** offer different ways to pack and how to apply a pre-load to the test material. These options manipulate the material before the actual melting time and or afterwards. Either the time spent on each is controlled, or the position of the piston /material at a specific point in the barrel. The weights hereby used are chosen manually with the **MI-3** and automatically in the **MI-4**.

Before Melt Time	During Melt Time	Measurement	After Measurement
			
<p><b>MI-3</b></p> <p>Pre-load with <b>manually</b> chosen weight. Position controlled (see a.) and or time controlled (time x)</p> <p><b>MI-4</b></p> <p>Pre-load with <b>automatically</b> controlled and chosen weight. Position controlled (see a.) and or time controlled (time x)</p>	<p><b>MI-3</b></p> <p>Pre-load with <b>manually</b> chosen weight. Position controlled (see b.), or <b>manual chosen</b> test weight brings piston head to 55 mm above the die (see c.), 5 mm above DIN 1133 measurement range</p> <p><b>MI-4</b></p> <p>Pre-load with <b>automatically</b> controlled and chosen weight. Position controlled (see b.), or <b>automatically</b> controlled and chosen weight brings piston head to 55 mm above the die (see c.), 5 mm above DIN 1133 measurement range</p>	<p><b>MI-3</b></p> <p>Automated measurement with single weight and <b>manual selection</b> of such</p> <p><b>MI-4</b></p> <p>Automated measurement and test weight selection, additionally possibility to run Multi-Weight measurements with up to <b>4 weights</b> either in increasing, or decreasing fashion</p>	<p><b>MI-3</b></p> <p>Purging of material after the measurement with a <b>manually selectable</b> test weight</p> <p><b>MI-4</b></p> <p><b>Automated purging</b> of material with a pre-programmed and freely selectable test weight.</p>

**Original printouts from MI-2, MI-3 (below) and MI-4 (right)**

The high resolution displacement sensor / volume measurement makes it possible to track up to 40 single measurement points within the testing range. With the simple "push of a button", outliers can easily be deselected and the measurement be corrected.

Not only MVR and MFR are displayed, but rheological data for shear stress, shear rate and viscosity are shown as well.

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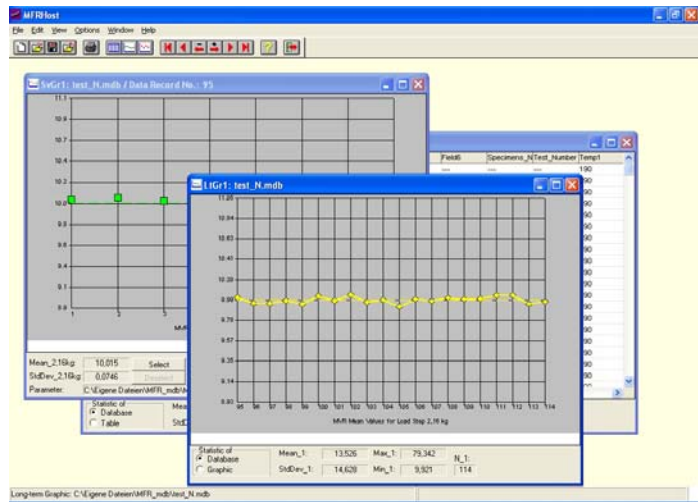
=====
MI-3 Version 1.
=====
Pruefplan/test plan      : standard
Datei/File               : TEST.006
Datum-Uhrzeit/Date-Time  : 18/11/2004 12:1
Material/material        : S5 mit MI-3 G
Probennr./sample no     : H
Charge/charge            :
Lot/lot                  : ---
Gerat/Pr. Device/Op.    : MI-3
Temperatur/temperature   : 190 Grad C/Degree
Aufschmelzzeit/melting time : 04:00
Vorlaufzeit/pre running time: 00:00
Messzeit/test time       : 08:15
Messstrecke/test range   : DIN/ISO
                        : von/from: 50 mm bis/to: 20 mm (B)
-----
-----
Gewicht/load 2.16 kg (0.77 g/ccm)  Aufl./res.: Normal 1x selekt./selected
( 7.314) ( 7.336) 7.371 7.406 7.406 ( 7.356) ( 7.343) ( 7.343)
( 7.364) 7.371 7.371 7.379 7.377 7.385 7.392 7.393
7.412 7.424 7.424 7.418 7.405 7.404 7.404 7.405
7.412 7.405 7.404 7.404 7.405 7.412 7.412 7.432
( 7.445) ( 7.451) ( 7.451) ( 7.458) ( 7.452) ( 7.467) ( *7.460) ( 7.473)
-----
MFRx: 7.40176 g/10min (NO) s: 0.0168084 g/10min V: 0.227087 % n: 26
GAMMAap: 17.621 1/s TAUap: 19396.8 Pa ETAap: 1100.78 Pa s
=====

```

```

=====
MI-4 Version 1.1.7
=====
Pruefplan/test plan      : stufen
Datei/File               : TBST.006
Datum-Uhrzeit/Date-Time  : 6/12/2004 11:15
Material/material        : Vestolen
Probennr./sample no     : A 6016
Charge/charge            : H
Lot/lot                  : ---
Gerat/Pr. Device/Op.    : GFT
Temperatur/temperature   : 190 Grad C/Degree C
Aufschmelzzeit/melting time : 04:00
Vorlaufzeit/pre running time: 00:00
Messzeit/test time       : 07:22
Messstrecke/test range   : User
                        : von/from: 100 mm bis/to: 0 mm (B)
-----
-----
FRR (3.8/2.16)=2.03083 FRR (5/2.16)=2.89792 FRR (10/2.16)=7.51964
-----
Gewicht/load 10 kg (0.77 g/ccm)  Aufl./res.: Niedrig/low 1x selekt./selected
( 56.392) ( 56.432) 56.526 56.634 56.687 56.741 56.768 56.929
( 57.037) ( 57.145)
-----
MFRx: 56.7148 g/10min (NO) s: 0.13552 g/10min V: 0.238949 % n: 6
GAMMAap: 135.018 1/s TAUap: 89800 Pa ETAap: 665.097 Pa s
-----
Gewicht/load 5 kg (0.77 g/ccm)  Aufl./res.: Normal 1x selekt./selected
( 21.943) 21.879 21.857 ( 21.814) 21.836 21.857 21.857 21.857
21.857
-----
MFRx: 21.8577 g/10min (NO) s: 0.0142772 g/10min V: 0.065319 % n: 7
GAMMAap: 52.0355 1/s TAUap: 44900 Pa ETAap: 862.873 Pa s
-----
Gewicht/load 3.8 kg (0.77 g/ccm)  Aufl./res.: Normal 1x selekt./selected
( 15.269) 15.291 15.299 15.313 15.313 15.328 15.343 ( 15.372)
( 15.357)
-----
MFRx: 15.3149 g/10min (NO) s: 0.0188041 g/10min V: 0.122783 % n: 6
GAMMAap: 36.4593 1/s TAUap: 34124 Pa ETAap: 935.947 Pa s
-----
Gewicht/load 2.16 kg (0.77 g/ccm)  Aufl./res.: Normal 1x selekt./selected
( 7.524) 7.535 7.532 7.532 7.539 7.546 7.554 7.554
( 7.554 ( 7.568)
-----
MFRx: 7.5436 g/10min (NO) s: 0.00993256 g/10min V: 0.131669 % n: 8
GAMMAap: 17.9587 1/s TAUap: 19396.8 Pa ETAap: 1080.08 Pa s
=====

```



**Long-term statistical analysis with MFRHost**

MFRHost is a database program based on ACCESS Microsoft®. On-line, all current GOETTERT melt indexers (except for the all manual MI-1) can be connected to it. Several measurement databases can be displayed simultaneously, which allows to run several instruments at the same time. Numerical data in table form and a graphical display of single test points is possible, as is the display of the average of many testing points.

## Overview of specifications of all instruments:

Model characteristics	MI-1	MI-2	MI-3	MI-4
Test procedure:	Manually measurement with single load	Automatic measurement with single load	Automatic measurement with single load with manually weight selection	Automatic measurement and weight selection additional: measurement with multi-weights
Test chamber:	Two heater circuits, electrically heated, temperature sensor PT 100 1/3 DIN Temperature difference over time: $< \pm 0.1 \text{ }^{\circ}\text{C}$ Temperature difference over distance (0-70 mm before the die): $\leq \pm 0.2 \text{ }^{\circ}\text{C}$ of set temperature (temperature range $60^{\circ}\text{C}$ to $400^{\circ}\text{C}$ ) $\leq \pm 0.3 \text{ }^{\circ}\text{C}$ of set temperature (temperature range $400^{\circ}\text{C}$ to $500^{\circ}\text{C}$ )			
Load steps in kg:	0.325 – 21.6	0.325 – 21.6	0.325 – 21.6	0.325 – 21.6
Weight guidance:	Pistons according to ISO/ASTM	Pistons according to ISO/ASTM	Pistons according to ISO/ASTM: additionally, internally installed test weights	Pistons according to ISO/ASTM: additionally, internally installed test weights
Weight handling system:	--	Option	Standard	Standard
Material squeezing function:	--	--	Manual, with weights	Automatically, with weights
Multi-Weight:	--	--	--	4 weight steps selectable
Actual temperature display:	0.0 – 500.00 $^{\circ}\text{C}$ on integrated controller	000.00 – 500.00 $^{\circ}\text{C}$ on Touchscreen monitor	000.00 – 500.00 $^{\circ}\text{C}$ auf Touchscreen monitor	000.00 – 500.00 $^{\circ}\text{C}$ auf Touchscreen monitor
Temperature acquisition:	Resolution 0,1 $^{\circ}\text{C}$	via 16-Bit converter; temp. Resolution 0 up to $320^{\circ}\text{C}$ : 0,01 $^{\circ}\text{C}$ , 320 up to $500^{\circ}\text{C}$ : 0,1 $^{\circ}\text{C}$		
Test barrel:	9.555 – 0.01 mm diameter			
Touchscreen Display:	--	5.7" color-QVGA touchscreen		
Die:	2.095 $\pm$ 0.003 mm diameter, 8 $\pm$ 0.025 mm length, 1.048 $\pm$ 0.005 mm diameter, 4 $\pm$ 0.025 mm length (option) Material: Tungsten carbide			
Test value acquisition:	manually	Electronic, Resolution: 0.025 mm/impulse	Electronic, Resolution: 0.006 mm/impulse	Electronic, Resolution: 0.006 mm/impulse
Melt cutting unit:	Option	Option	Option	Option
Die locking mechanism:	Option	Option	Option	Option
Swell measurement unit:	--	--	Option	Option
Nitrogen purge:	Option	Option	Option	Option
Corrosion resistance version:	--	--	Option	Option
Loading:	--	--	Partially automated	Fully automated
Touchscreen Display:	--	5.7" Farb-QVGA Touchscreen	5.7" Farb-QVGA Touchscreen	5.7" Farb-QVGA Touchscreen
Test data display:	--	numerical	numerical	numerical
Data input:	Temperature input at controller	Touchscreen monitor	Touchscreen monitor	Touchscreen monitor
Interfaces:	--	USB, Serial (PC) USB (printer) Ethernet	USB, Serial (PC) USB (printer) Ethernet	USB, Serial (PC) USB (printer) Ethernet
Power supply:	115 V or 230V			
Ambient temperature:	+ 10 to + 40 $^{\circ}\text{C}$			
Ambient humidity:	max. 90% not condensing			
Dimensions:	Width: 400mm, Depth: 300mm, Height: 500mm	Width: 490mm, Depth: 400mm, Height: 580mm	Width: 700mm, Depth: 450mm, Height: 1220mm	Width: 700mm, Depth: 450mm, Height: 1220mm
Weight:	Approx. 30 kg	Approx. 30 kg	Approx. 60kg	Approx. 60kg

## Melt Index Testing - and what else ? - Capillary Rheometry !

Maybe we could wake your interest in more rheology ? Please find here the most important capillary rheometers for determination of the viscosity at wide shear rate range.



### RHEO-TESTER 500

This entry-level capillary rheometer is capable of generating a force of 5 kN to enable the measurement of viscosity flow curves over a wide range of shear rates for a broad range of materials.



### RHEO-TESTER 1000

This capillary rheometer is an ideal instrument for rheological quality control. Its modular design allows the optional integration of the die swell unit and RHEOTENS, a unit designed for testing the melt elongation.



### RHEO-TESTER 2000

This capillary rheometer is featuring the choice between single-barrel or dual-barrel system. Its modular design allows the optional integration of the die swell unit and elongational testing of polymer melts.



### RHEOGRAPH 6000

High pressure capillary rheometer for viscosity measurements with maximum range of shear rates (1:400.000). Many options, including single-barrel and triple barrel system and PVT analysis.



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