

MELT INDEXER
MI-4



011.01.6

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Introduction

This unique melt indexer with automatic weight selection can carry out tests according to ISO 1133 and ASTM D 1238, procedures B, as well as ISO 1133 and ASTM D 1238 procedure C for the "Half Height / Half Diameter" standard and procedure D for the FRR test (Flow Rate Ratio) and ASTM D 3364. Also the manual procedure A is possible to perform. Tests can be made either with one test load (single load mode) or with several test loads per barrel filling (multiple test load mode).

The technical highlights

- Multi-Load tests with up to 8 different weights, ascending, descending or freely selectable
- 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
- Automatic computation of resolution

Additional features of the MI-4:

- Brilliant 14,48 cm (5,7") Color-VGA Touch screen display for the operation, program control and display of the measurement results
- Single load mode for tests with one load
- Storage of up to 500 parameter sets with 3000 measurements for each parameter set
- Electric weight handling system
- Capillary quick-release and locking mechanism
- Guided test piston
- Base weight 1.200 kg, (0.325 kg, 1.000 kg and 1.050 kg option)
- Test weights from 2.160 kg to 21.600 kg integrated into the machine and automatically selected
- Pre-compressing with automatically chosen feeding weight to a free definable position or feeding time
- Electrically heated test chamber with easily exchangeable test barrel and die quick closure
- 5 Calibration settings for set temperatures with dedicated parameter files
- Built-in USB-connection (Data Stick) for data back-up
- Serial connection to communicate with the optional scale
- Ethernet-connection (LAN)
- Integrated Web-Server
- Manual and timer-programmable on/off override switch for the heaters
- Wide range of optional accessories

Application

The data are being displayed on a colour VGA touch-screen and onto a paper printer. By the combination of PC and the user friendly Software "MFRHost" a test device with a very favourable price / performance ratio, suitable for industrial applications, waits for its intended use. A precise high resolution displacement transducer is used to determinate the volume throughput.

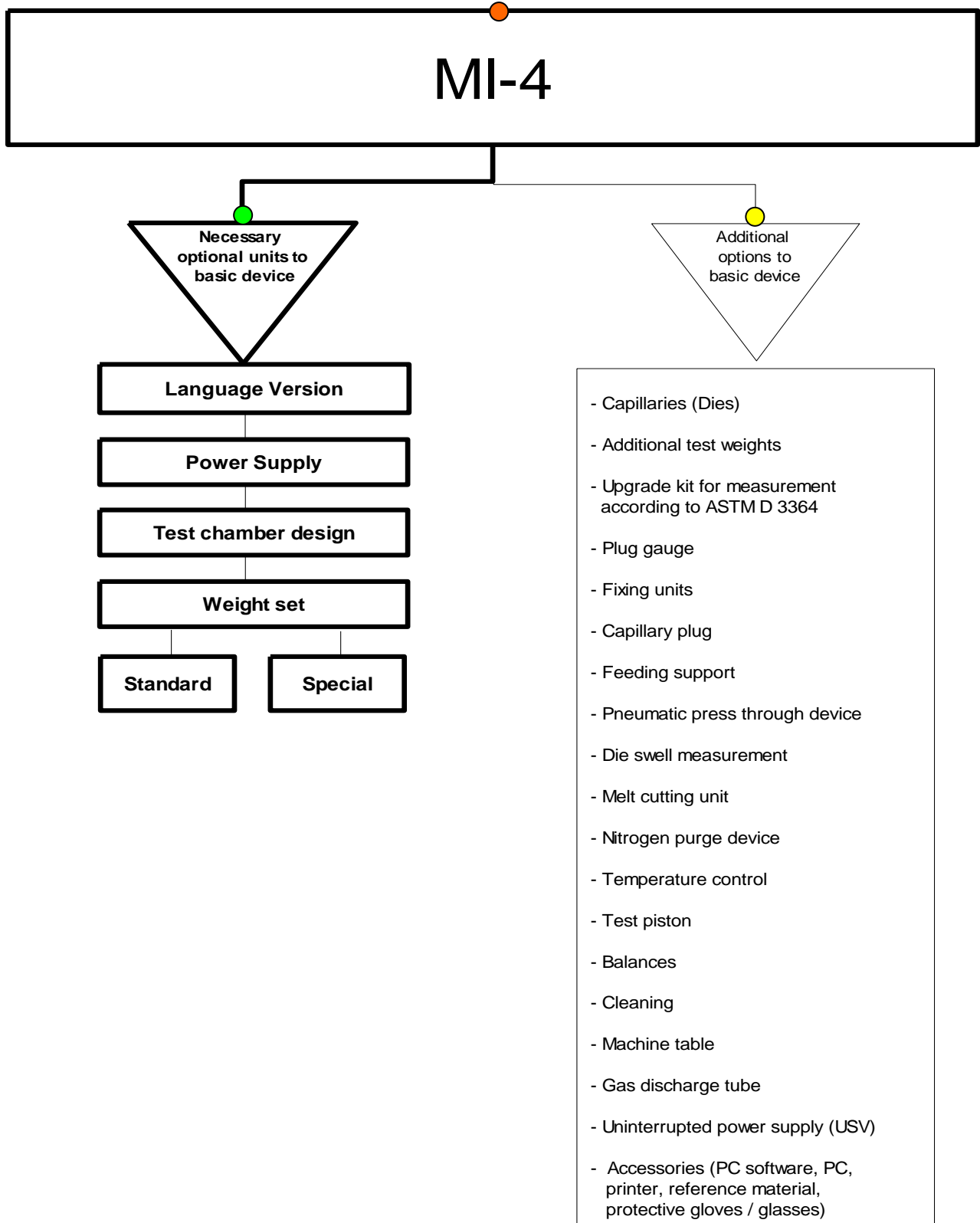
During the measurement the melt index MFR in g/10min and/or the volume flow index MVR in cm³/10min of pellets, powder or fine granules are being determined (volume output).

This test unit is designed for only be used to determine the MVR and MFR (or "melt index") of polymers (intended use).

Here the plastic granulate or powder is being melted in the test cylinder and after a melting time the test sample is being pressed through a die by using a test piston and a weight load.

With the option "melt cutting" a manual determination of the melt density is possible. By adding option laboratory balance the determination of the melt density can be done automatically.

Device configuration



Legend:

- Basic system
- Necessary options: These units are necessary
- Optional units: Choice of measurement enhancing additional sub systems

Optional units

The basic test device is no functioning instrument without the following optional units:

- Power Supply
- English version or German version
- Test chamber design
- Weight set (standard or special)

Options

The GÖTTFERT Melt Flow Indexers are already equipped with large basic functions. Our extensive option program provides a more detailed characterization of the test materials as well as supplementing accessories to the completion of the basic equipment.

Please take the following order information from this product description „MI-4“

- Additional test weights
- Upgrade kit for measurement according to ASTM D 3364

Please take the following order information from the separate product description "Options for Melt index measurement".

- Capillaries (Dies)
- Plug gauge
- Fixing units
- Capillary plug
- Feeding support
- Pneumatic press through device
- Die swell measurement
- Melt cutting unit
- Nitrogen purge device
- Temperature control
- Test piston
- Balances
- Cleaning
- Machine table
- Gas discharge tube
- Uninterrupted power supply (USV)
- Accessories (PC software, PC, printer, reference material, protective gloves/glasses)

Set-up

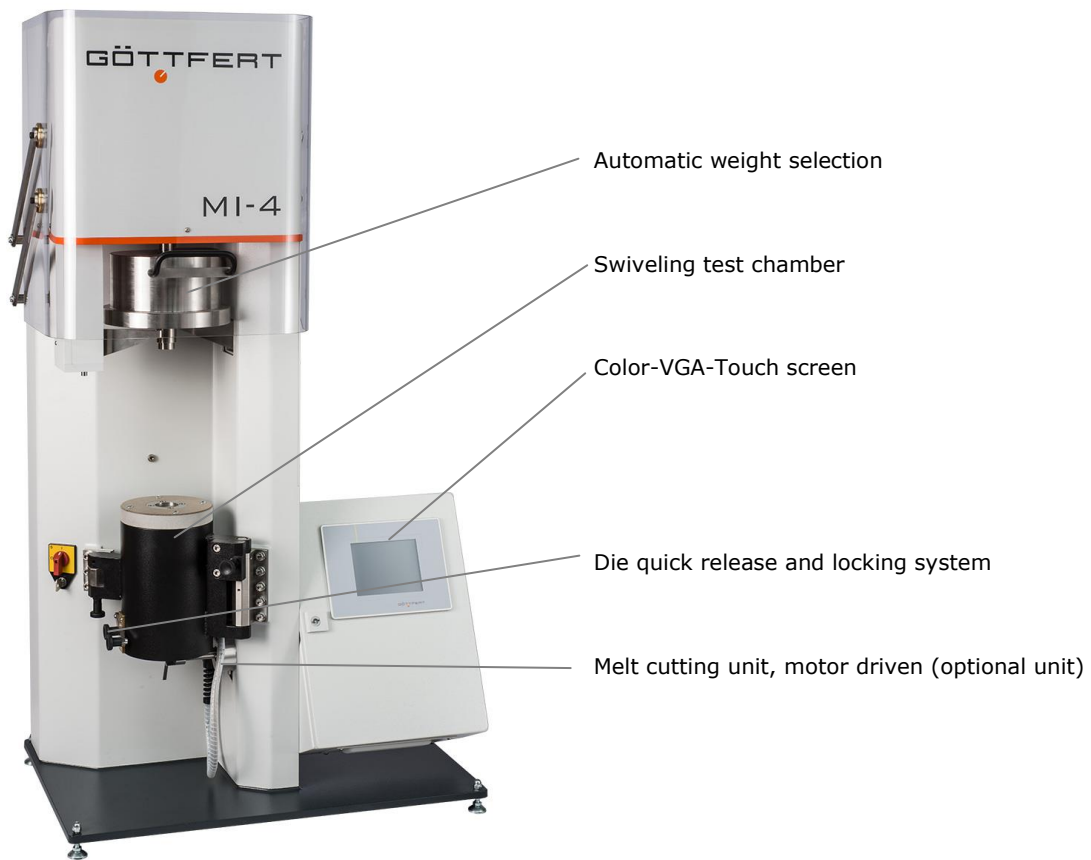


Photo: Overall view MI-4

Basic device

The Melt Indexer consists of the following components and operating software:

Components:

Housing

Sturdy frame on 4 feet. The feet are adjustable in height, which facilitates leveling of the equipment.

Test chamber

The insulated test chamber is heated with two heating circuits and is easily accessible from top and below for cleaning, especially since it can be swiveling out to aid the process.

Test barrel

easy to replace, with serial number.

Test piston

with serial number.

Capillary

Capillary, 2.095 mm diameter, 8 mm length, constructed from tungsten carbide and serial number engraved. The capillaries are not resistant against acid. It should be used only a solvent-based cleaner. The maximum allowed cleaning temperature of 550 °C must not be exceeded!

Die quick release and locking mechanism

The capillary is held and released by the quick-locking mechanism, which works simply and fast. Thus the test barrel can be cleaned user friendly.

Test weights

The MI-4 features a base weight of 1.200 kg (0.325, 1.000 or 1.050 kg see options) and permanently installed weights of 2.160 / 3.800 / 5.00 / 10.000 / (12.500 / 15.000 see options) and 21.600 kg. The selection of weights is program controlled. No mechanical settings are necessary.

Digital position transducer

High-resolution digital encoder to measure volume output.

Color-VGA-Touch screen

For the input of parameters, for program control and for the display of results.

Compact I/O-Module

For control and to receive input signals.

Temperature Controller

The test chamber temperature is controlled by a special temperature control algorithm. The temperature set points are entered via the touch screen display. During the test, the temperatures are displayed on the screen with a 0.01 °C resolution.

USB Connections

to communicate with a PC or to connect to a data stick for data back-up in ASCII-Format.

Ethernet-connection

LAN connection and communication with MFRHost software or with a networkable printer. Also for use as FTP or Web-Server.

Serial Connection

Connection to a balance.

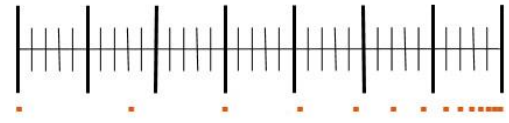
Intelligent Service Monitoring

The service data are stored and monitored in the test device. The test device will register itself automatically if a new service is necessary. In addition, information's about the device configuration can be requested.

Automatic computation of resolution

The distance 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 test piston displacement (mm / measuring point) resolution this value can also be detected automatically. This is a big advantage in case of materials with unknown melt index. Even for the first generation of the MI-3 and MI-4 this option can be retrofitted.



Menu navigation at the touchscreen

The following languages are available in the menu on the touchscreen of MI-2, MI-3 and MI-4:

German, english, chinese, french, spanish, hungarian, polish, czech, russian, korean, farsi and japanese.

The switching-over can be performed directly and without a restart of the system



MFRHost PC-Operating Software

The measurement and Visualization program for Melt Index test devices is used to configure and control the whole measurement process, the graphical presentation, the evaluation and to generate reports. For more details please see the separate product description "MFRHost".



Device-Operating Software

Measurement and Visualization Program for Melt Indexer is used to configure and control the whole measurement process, the graphical presentation, the evaluation and the report generation.

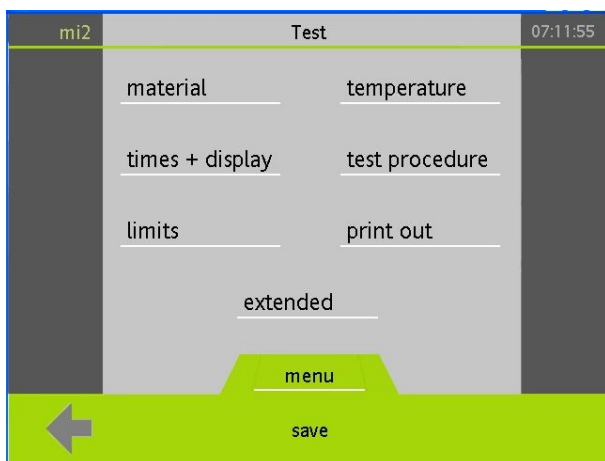
Features

In addition to the basic functions the operating software provides numerous features such as:

- Structured, self explaining menu navigation
- Intelligent Service Monitoring
- Menu navigation available in several languages
- RemoteNet

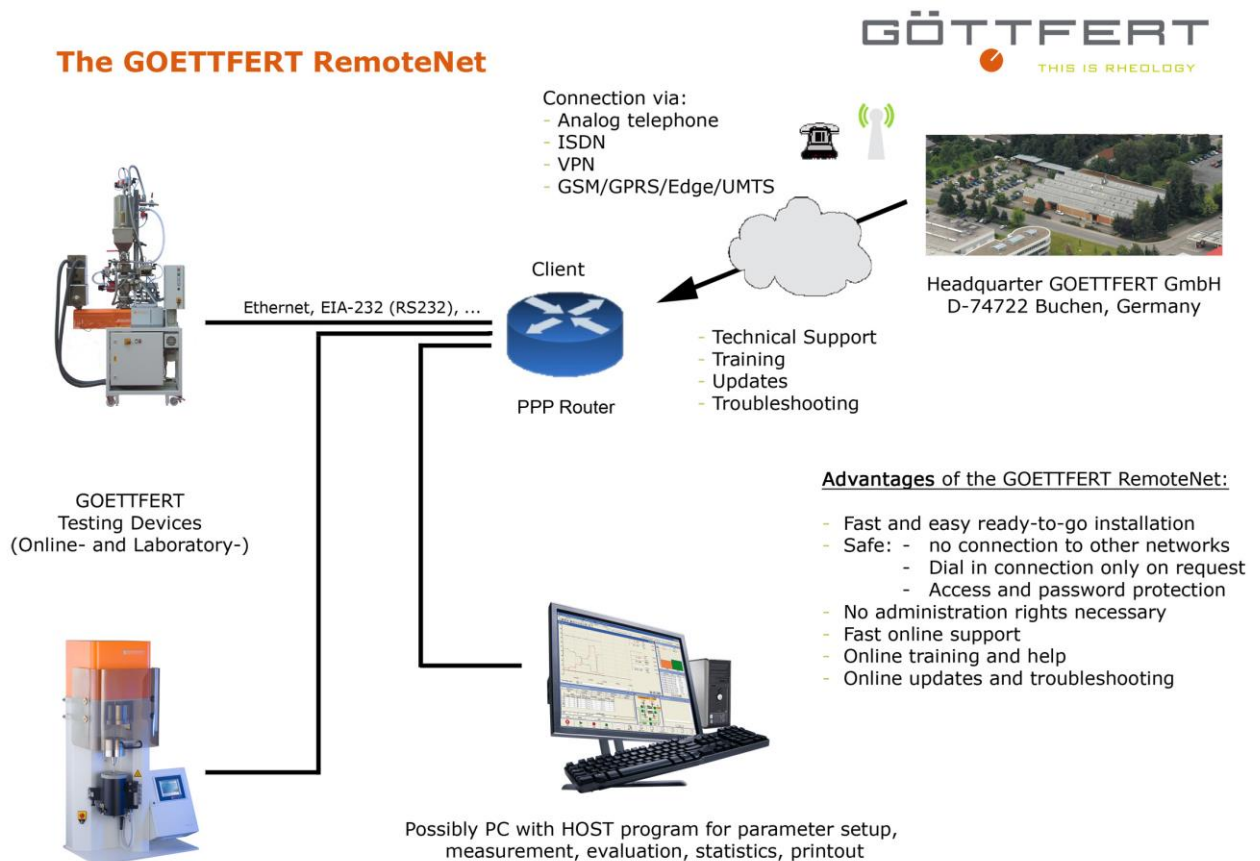
Structured, self explaining menu navigation

The self explaining menu navigation at the touch screen has been improved by a structured set up. Based on an algorithm, that leads thematically through the menu and shows only the relevant information at each step.



RemoteNet

If needed a worldwide direct connection with the device PC can be realized via the Internet or where required via telephone line. Even the connection into the test device is possible and fulfills the support completely. A special Software, which has to be installed on a PPP Router (test device PC) allows us to control, to check settings, to run updates or to handle problems of the PC after the release of the user – in a safe way! The display of the device status, the adjustment of calibration values or even updates of the test device firmware are easy to perform. Of course this system can also be taken for training purposes. The Software can be sent to you together with a detailed instruction on request, the files can also be downloaded under www.goettfert.com.



Technical Data

| | |
|----------------------------|--|
| Standards | ISO 1133 ASTM D 1238 ASTM D 3364 |
| Barrel | |
| Diameter | 9.555 - 0.01mm (0.376 inches) |
| Length | 160 mm (6.2992 inches) |
| Capillaries | |
| Diameter / Length | 2.095 ± 0.003 mm (0.0825 inches) / 8 ± 0.025 mm (0.315 inches) 1.05 ± 0.005 mm (0.0413 inches) / 4 ± 0.025 mm (0.1575 inches) |
| Diameter / Length (Option) | 2,096 ± 0.005 mm / 4 + 0.05 mm with inlet angle 120° for ASTM D 3364 |
| Material | Tungsten carbide |
| Cleaning temperature | Max. 550°C |
| Test Piston | |
| Diameter | 9.48 - 0.01 mm (0.3732 inches) |
| Length | 220 ± 0.2 mm (8.6614 inches) 202,6 ± 0.2 mm for ASTM D 3364 |
| Weights | |
| Base weights | 1.200 kg (0.325 kg, 1.000 kg, 1.050 kg as option) 20 kg for ASTM D 3364 |
| Additional weights | 2.16 kg, 3.8 kg, 5.0 kg, 10.0 kg, 21.6 kg (12.5 kg, 15.000 kg as option) |
| Tolerance | ± 0.5 % |
| Control | |
| Local | 14.48 cm (5.7") Colour-VGA-Touch screen IPC |
| PC (Option) | MFRHost Program, connection via LAN |
| Heater | |
| Temperature range | 5°C above room temperature up to 400°C (752°F), optional up to 500°C (932°F) |
| Temperature acquisition | via 16-Bit converter |
| Sensors | PT100 1/3DIN |
| Heater circuits | 2 |
| Controller | special algorithm |
| Resolution | 0 up to 320°C: 0.01°C 320 up to 500°C: 0.1°C |

| | |
|--|---|
| Variation over time in usable range | Less $\pm 0.1^{\circ}\text{C}$ |
| Spatial distribution in usable range (0-70 mm before the die) | 60 up to 400 $^{\circ}\text{C}$: < 0.2 $^{\circ}\text{C}$ 400 up to 500 $^{\circ}\text{C}$: < 0.3 $^{\circ}\text{C}$ |
| Drive | |
| Motor | Capacity motor, 150 Watt with brake |
| Overload protection | Electrical for torque limitation |
| Measurement | |
| Resolution digital position transducer | 0.006 mm |
| Resolution time measurement | 1 millisecond, time basis 48 MHz quartz, precision 50 ppm |
| Power supply | |
| Voltage | 1 x 230V AC (400 $^{\circ}\text{C}$ or 500 $^{\circ}\text{C}$) 1 x 115V AC (400 $^{\circ}\text{C}$ or 500 $^{\circ}\text{C}$) Other on request |
| Tolerance | $\pm 10\%$ |
| Frequency | 50 Hz - 60 Hz |
| Protective Earthing | Earth resistance less than 5 Ohm |
| Short-time breaks | Less than 10 msec |
| Power consumption: | approx. 870 W / 1 kW |
| Standby power | Heated at an ambient temperature of 25 $^{\circ}\text{C}$ 190 $^{\circ}\text{C}$ < 130 W 230 $^{\circ}\text{C}$ < 140 W 300 $^{\circ}\text{C}$ < 220 W |
| Ambient conditions | |
| Ambient temperature | + 10 $^{\circ}\text{C}$ up to + 40 $^{\circ}\text{C}$ |
| Air humidity | max. 90 % not-condensing |
| Sound pressure level | < 70 dB (A) |
| Dimensions | |
| Width | 700 mm (27.5591 inches) |
| Depth | 450 mm (17.7165 inches) |
| Height | 1290 mm (50.79 inches) |
| Weight | approx. 170 kg (375 pounds) net, approx. 200 kg (441 pounds) gross |
| Finish | |
| Hood, front and cover plates | Light grey RAL 7035 |
| Hood framing | Pure orange RAL 2004 |
| Ground plate | Anthrazite grey RAL 7016 |
| Protection | Protective hood with double contacts |

Steel grades

This table shows the possibility to select different steel grades according to the application. If no information was given to us during the order procedure we will select **steel grade No. 5S** automatically. Here it is the part number with the addition "Standard".

Applicable steel grade types, comparison table:

| Steel grade | Hardness | Abrasion resistance | Acid resistance | Temperature range / Test material |
|------------------------------|----------|---------------------|-----------------|---|
| Steel grade 1S | ★ | ★ | ★★★★★★ | Up to 500°C, e.g. ETFE or PVDF (up to 250°C) |
| Steel grade 2 | ★★ | ★★ | ★★★★★★ | Up to 500°C, e.g. PVDF (up to 250°C) |
| Steel grade 3 | ★★★ | ★★★★ | ★★★★ | Up to 500°C, e.g. PVDF (up to 250°C), PVC, PLA, Bio polymers |
| Steel grade 4 | ★★★★★★ | ★★★★★★ | ★★★ | Up to 500°C, e.g. PEEK |
| Steel grade 5S (Standard) | ★★★★★★ | ★★★★ | ★ | Up to 500°C |

Note:

Dies have a nickel share, so they are corrosion resistant

★ = less suitable

★★★★★★ = very good suitable

Please contact us for more details.

Supplied accessories

MI-4

- 1 User information*
- 1 Reamer for die cleaning
- 1 Alignment support
- 1 Brass brush
- 1 Standard die
- 1 Mirror for watching the die
- 1 Plug gauge according to ISO 1133
- 1 Cleaning cloth
- 1 Filler neck
- 1 Touch Screen Stick
- 1 Wrench for removing piston nuts
- 1 Material filler
- 1 Die scraper
- 1 Material compressor
- 1 Steel brush with handle
- 1 Cleaning piston with handle
- 1 Set of micro fuse
- 1 Mains cable
- 1 Pair of tweezers

Order information

Melt Flow Indexer MI-4

Basic device

Order number 5.70.507

● Necessary optional units to basic device:

Language version and user information

English Version

Marking and user information* (on CD) in English, operating manual on paper format.

Order number 5.70.509

German Version

Marking and user information* (on CD) in German, operating manual on paper format.

Order number 5.70.508

* Scope of supply user information:

- Operating manual
- Order related operating manuals
- Program documentation (Software)
- Calculation basis
- Technical documentation (overview drawings and wiring diagrams)
- Additional contract-related documents according to agreements

Additional user information* English, on paper format

Complete printed English user information* in single A4 ring binder.

One user information* on CD belongs to standard scope of the basic instrument.

Order number 5.70.527

Additional user information* German, on paper format

Complete printed German user information* in single A4 ring binder.

One user information* on CD belongs to standard scope of the basic instrument.

Order number 5.70.528

* The user information contains:

Operating manual, technical documentation and calculation basis.

Power supply

Following power supplies are available:

400°C**Power supply 230V~; 50-60 Hz and test temperature up to 400°C**

Voltage: 1 x 230V AC; (1L+N+PE)

Permissible voltage fluctuations: +/- 10% (permissible range: 207V...253V)

Frequency: 50 - 60 Hz

Power consumption: approx. 870 W

Order number 5.70.510

Power supply 115V~; 50-60 Hz and test temperature up to 400°C

Voltage: 1 x 115V AC; (1L+N+PE)

Permissible voltage fluctuations: +/- 10% (permissible range: 103,5V...126,5V)

Frequency: 50 - 60 Hz

Power consumption: approx. 870 W

Order number 5.70.511

Note:

Please note that for test temperatures **above 400°C** a special test chamber with ceramic heaters is required. At temperatures from 400°C to 500°C the spatial temperature deviation is $\leq \pm 0.3^\circ\text{C}$.

500°C**Power supply 230V~; 50-60 Hz and test temperature up to 500°C**

Voltage: 1 x 230V AC; (1L+N+PE)

Permissible voltage fluctuations: +/- 10% (permissible range: 207V...253V)

Frequency: 50 - 60 Hz

Power consumption: approx. 1 kW

With this option, temperatures up to 500 °C can be used.

Order number 5.70.512

Power supply 115V~; 50-60 Hz and test temperature up to 500°C

Voltage: 1 x 115V AC; (1L+N+PE)

Permissible voltage fluctuations: +/- 10% (permissible range: 103,5V...126,5V)

Frequency: 50 - 60 Hz

Power consumption: approx. 1 kW

With this option, temperatures up to 500 °C can be used.

Order number 5.70.513

Note:

The power supply connector of the test device is being supplied with an IEC socket. A power supply cable (2m) in german/european design is included in the delivery (plug type E+F (CEE 7/7), socket type according to IEC60320-C13), see also figure 1.

For the US american market the delivery contains a cable with a plug in type B (NEMA 5-15, 3-polig) and the same socket as above (according to IEC60320-C13), see also figure 2.

Due to the huge number of worldwide different connection plugs the country relevant connection cable has to be provided by the customer.

Figure 1:



Figure 2:

**Residual current rating**

The test device operates with motor controller and line filters. These electronic parts have naturally a leakage current behaviour.

The power supply must be equipped according to DIN EN 50178 due to this higher leakage current of $> 10 \text{ mA DC}$ and $> 3.5 \text{ mA AC}$ with a fixed termination and a separate protective earthing conductor (min. $10 \text{ mm}^2 \text{ Cu}$).

The use of a Residual Current protective Device (RCD) can lead to problems. In this case only AC/DC sensitive RCD (or also called RCCB (residual current circuit breaker)), type B according to IEC 60755, with a release current (residual current rating) of $> 300 \text{ mA}$ can be used.

However, false release activations can occur:

- When connecting servo amplifiers to the power line (short-termed single or two- phase operation by contact bouncing in the mains contactor)
- By higher frequented discharge currents appearing during operation with longer motor cables
- By strong asymmetries of the 3-phase-current system

It is the responsibility of the customer to ensure a connection that meets the applicable requirements for it (local directives). When a RCD with a release current of $\leq 300 \text{ mA}$ is required, GÖTTFERT offers a suitable isolating transformer solution on request.

*

The ratings indicated by the manufacturers of the protective switches (RCD) are to be seen as max. values, where the protective switch surely releases.

Usually the protective switch releases already at about 60% of the residual current rating.

Test chamber design

Test chamber design „Steel type 5S“

consisting of test barrel and test piston
(Standard design)

Order number 5.70.028

Test chamber design „Steel type 1S“

consisting of test barrel and test piston
Recommended for more acid resistance

Order number On request

Test chamber design „Steel type 2“

consisting of test barrel and test piston
Recommended for more acid resistance

Order number 5.70.516

Test chamber design „Steel type 3“

consisting of test barrel and test piston
Recommended for more wear resistance

Order number 5.70.039

Test chamber design „Steel type 4“

consisting of test barrel and test piston
Recommended for more wear resistance

Order number 5.70.030

Weight set

To complete the basic device a weight set must be selected (standard weight set / special weight set).

Additionally to this requirement further weight steps can be selected if necessary.

To add this additional test weights please refer under the section "Additional optional units of the basic device"

Note: The maximum number of selectable test weights is 8.

Standard weight set

Standard weight set

Weight steps 1,200 kg / 2,160 kg / 3,800 kg / 5,00 kg / 10,00 kg / 21,60 kg

Order number 5.70.176

or

Special weight set

The special test weight replace the standard test weight.

Special weight set I

Weight steps: 0,325 kg / 1,0 kg / 2,160 kg / 3,800 kg / 5,000 kg / 10,00 kg / 21,6 kg
instead of the standard weight set.

Order number 5.07.063

Special weight set II

Weight steps: 0,325 kg / 1,2 kg / 2,160 kg / 3,800 kg / 5,000 kg / 10,00 kg / 21,6 kg
instead of the standard weight set

Order number 5.07.068

Special weight set III

Weight steps: 0,325 kg / 1,0 kg / 2,160 kg / 3,800 kg / 5,000 kg / 10,00 kg / 12,50 kg /
15,00 kg / 21,60 kg instead of the standard weight set

Order number 5.70.120

Special weight set IV

Weight steps: 0,325 kg / 1,2 kg / 2,160 kg / 3,800 kg / 5,000 kg / 10,00 kg / 12,50 kg /
15,00 kg (manual selection) / 21,60 kg

instead of the standard weight set

Order number 5.70.121

Special weight set V

Weight steps: 0,325 kg / 1,2 kg / 2,160 kg / 5,000 kg / 10,00 kg / 12,50 kg / 15,00 kg /
21,60 kg

instead of the standard weight set

Order number 5.70.147

Special weight set VI

Weight steps: 1,0 kg / 2,160 kg / 5,000 kg / 10,00 kg / 12,50 kg / 15,00 kg (manual
selection) / 21,60 kg

Order number 5.70.177

Special weight set VII

Weight steps: 1,05 kg / 2,160 kg / 5,000 kg / 10,00 kg / 12,50 kg / 15,00 kg /
21,60 kg

Order number 5.70.178

Further special sets of weight on request.

Weights for retrofitting**Base weights**

Following base weights are only required for retrofitting **of already delivered testing devices**:

Base weight 1.00 kg+ 2.16 kg

instead of 1.20 kg basis weight and the 2,16 kg standard weight

Order number 5.07.370

Base weight 1.05 kg + 2.16 kg

instead of 1.20 kg basis weight and the 2,16 kg standard weight

Order number 5.07.369

● **Additional optional units of the basic device:**

Upgrade kit for measurement according to ASTM D 3364

Upgrade kit for measurement according to ASTM D 3364

"steel grade 5"

consisting of:

- capillary L/D = 23.24/2.096 (total length 25,4 mm)
with 120 degrees inlet angle
- test piston for capillary L = 25,4 mm
- (test weight 20,0 kg / option: special weight set)

Order number 5.07.405

Upgrade kit for measurement according to ASTM D 3364

"steel grade 3" / corrosion resistant

consisting of:

- capillary L/D = 23.24/2.096 (total length 25,4 mm)
with 120 degrees inlet angle
- test piston for capillary L = 25,4 mm
- (test weight 20,0 kg / option: special weight set)

Order number 5.70.179

Upgrade kit for measurement according to ASTM D 3364

"steel grade 2"

consisting of:

- capillary L/D = 23.24/2.096 (total length 25,4 mm)
with 120 degrees inlet angle
- test piston for capillary L = 25,4 mm
- (test weight 20,0 kg / option: special weight set)

Order number 5.70.539

Additional test weights

(selectable for Standard- und additional test weights)

Additional test weights 12.500 and 15.000 kg

Are used in the base system between the test weight 10.000 and 21.600 kg.

Automatically selected as the other test weights.

Order number 5.07.359

For further optional units to the MI-4 please refer in the separate product description "Options for Melt Index Measurement".

Note

GÖTTFERT GmbH provides full warranty for the function of machines that have been supplied as complete system that means with PC and printer by GÖTTFERT. PC means generally the complete system comprising of PC, monitor, keyboard, interfaces, mouse and if applicable joysticks. Principally, we do not give a functioning guarantee for connecting externally supplied PCs and printers (non-GÖTTFERT supply).

If the customer provides the PC by himself, GÖTTFERT cannot guarantee the trouble-free functioning of PC and GÖTTFERT unit. Service work, which will be essential due to appearing problems in regard to configuration, serial interfaces, connection cables, communication etc. do not belong to the warranty obligations and will therefore be invoiced on an actual expense basis.

Some GÖTTFERT devices require the application of PC extension cards. By default they are executed in full construction height, consequently the application of a mini Tower PC is necessary. If the customer provides a PC in „Small-Form-Factor“ format by himself, then low profile extension cards have to be used.

Please refer with the order if a PC with low profiles extension slots shall be used! GÖTTFERT is checking if low profile cards are available for the requested application and will offer these extension cards. Please specify the brand and type of the used PC when placing the order!

Due to the various printer designs that are available on the market, we do not give any function guarantee for printers not supplied by GÖTTFERT. Support for possible adjustments will be charged on an actual expense basis.

All data are based on rated voltage and standard frequency as well as an surrounding temperature of +20°C (+68°F).

Subject to change due to technical developments.

Images may deviate from the original.

WE TAKE CARE OF OUR INSTRUMENTS, YOU TAKE CARE OF ITS MEASUREMENTS.
OUR REPUTATION IN EACH OTHER`S HANDS.

THIS IS RHEOLOGY

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