

Measure  
what is measurable  
and make measurable  
that which is not.

Galileo Galilei (1564-1642)

## Reference Guide

# **MCR Evolution Series**

Modular Compact Rheometer  
MCR 102e / MCR 302e / SmartPave 102e  
MCR 502e Power / MCR 702e MultiDrive



## **Disclaimer**

This document may contain errors and omissions. If you discover any such errors or if you would like to see more information in this document, please contact us at our address below. Anton Paar assumes no liability for any errors or omissions in this document.

## **Changes, copyright, trademarks etc.**

This document and its contents may be changed or amended by Anton Paar at any time without prior notice.

All rights reserved (including translation). This document, or any part of it, may not be reproduced, changed, copied, or distributed by means of electronic systems in any form (print, photocopy, microfilm or any other process) without prior written permission by Anton Paar GmbH.

Trademarks, registered trademarks, trade names, etc. may be used in this document without being marked as such. They are the property of their respective owner.

## **Further information**

Published and printed by Anton Paar GmbH, Austria

Copyright © 2024 Anton Paar GmbH, Graz, Austria

Address of the instrument producer:

Anton Paar GmbH  
Anton-Paar-Str. 20  
A-8054 Graz / Austria – Europe

Tel: +43 (0) 316 257-0

Fax: +43 (0) 316 257-257

E-Mail: [info@anton-paar.com](mailto:info@anton-paar.com)

Web: [www.anton-paar.com](http://www.anton-paar.com)

Date: April 2024

Document number: C92IB046EN-D

---

## Reference Guide

# **MCR Evolution Series**

Modular Compact Rheometer

MCR 102e / MCR 302e / SmartPave 102e

MCR 502e Power / MCR 702e MultiDrive

# Contents

|                                                                                |           |
|--------------------------------------------------------------------------------|-----------|
| <b>1 Safety Instructions.....</b>                                              | <b>6</b>  |
| 1.1 General Safety Instructions.....                                           | 6         |
| 1.2 Special Safety Instructions.....                                           | 7         |
| 1.3 Conventions for Safety Messages .....                                      | 7         |
| 1.4 Safety Symbols on the Instrument.....                                      | 7         |
| 1.5 Remaining Risks .....                                                      | 8         |
| <b>2 MCR Evolution - An Overview .....</b>                                     | <b>10</b> |
| 2.1 Overview of the MCR Connections.....                                       | 11        |
| 2.1.1 Connections on the Right Side .....                                      | 11        |
| 2.1.2 Connections on the Left Side.....                                        | 11        |
| 2.1.3 Connections on the Left Side Panel .....                                 | 12        |
| 2.1.4 Connections on the Rear Side.....                                        | 12        |
| 2.2 Operating Panel .....                                                      | 13        |
| 2.3 Operating Modes .....                                                      | 13        |
| <b>3 Checking the Supplied Parts .....</b>                                     | <b>14</b> |
| 3.1 MCR Modular Compact Rheometer.....                                         | 14        |
| 3.2 Accessory Kit for MCR.....                                                 | 15        |
| 3.3 Optional Accessories and Parts.....                                        | 17        |
| <b>4 Installing the Instrument .....</b>                                       | <b>19</b> |
| 4.1 Installation Requirements .....                                            | 19        |
| 4.1.1 Fluid Circulator.....                                                    | 19        |
| 4.1.2 Installing Flow Indicators .....                                         | 20        |
| 4.2 Software Installation.....                                                 | 20        |
| 4.3 Connecting the MCR to the Air Supply .....                                 | 21        |
| 4.4 Connecting the MCR to Power .....                                          | 21        |
| 4.5 Removing the Transport Protection .....                                    | 21        |
| 4.6 Connecting to the PC.....                                                  | 21        |
| 4.6.1 USB .....                                                                | 22        |
| 4.6.2 Ethernet .....                                                           | 22        |
| 4.7 Leveling the Instrument.....                                               | 22        |
| 4.8 Mounting and Connecting a Temperature Device for PP / CP Measurements..... | 23        |
| 4.9 Connecting a Fluid Circulator.....                                         | 24        |
| 4.10 Installing a Hood .....                                                   | 25        |
| 4.11 Mounting a Measuring Geometry.....                                        | 26        |
| 4.12 Mounting a Flow Meter Unit (FMU).....                                     | 26        |
| 4.13 Mounting the Hose Holder .....                                            | 27        |
| 4.14 Using Inert Gas .....                                                     | 28        |
| 4.15 Mounting a Magnetic Valve.....                                            | 28        |
| <b>5 Operating the Instrument.....</b>                                         | <b>29</b> |
| 5.1 Switching on the Instrument.....                                           | 29        |
| 5.2 The MCR Display.....                                                       | 29        |
| 5.3 The MCR Operating Panel.....                                               | 30        |
| 5.4 MCR Menu.....                                                              | 32        |
| 5.5 MCR Maintenance Indicator .....                                            | 33        |
| <b>6 Performing a Measurement.....</b>                                         | <b>34</b> |
| 6.1 Start-up and Initialization .....                                          | 34        |
| 6.2 Sample Loading .....                                                       | 35        |
| 6.2.1 Concentric Cylinder Systems.....                                         | 35        |
| 6.2.2 Plate-Plate Systems .....                                                | 35        |
| 6.2.3 Cone-Plate Systems .....                                                 | 36        |
| 6.2.4 Double Gap Systems.....                                                  | 36        |
| <b>7 Upkeep and Cleaning .....</b>                                             | <b>37</b> |
| 7.1 Cleaning a Jammed Coupling.....                                            | 38        |

|                                                                              |           |
|------------------------------------------------------------------------------|-----------|
| 7.2 Wetted Parts .....                                                       | 38        |
| 7.3 Storing the Instrument.....                                              | 38        |
| 7.4 Packing the Instrument for Transport.....                                | 39        |
| <b>8 Maintenance and Repair.....</b>                                         | <b>42</b> |
| 8.1 Maintenance Performed by an Authorized Anton Paar Service Engineer ..... | 42        |
| 8.2 Repair Performed by an Authorized Anton Paar Representative .....        | 42        |
| <b>Appendix A: Technical Data .....</b>                                      | <b>43</b> |
| Appendix A.1: Pin Assignments.....                                           | 45        |

# 1 Safety Instructions

- Read this manual before using the MCR.
- Follow all tips and instructions contained in this manual to ensure the correct use and safe functioning of the MCR.
- Read and follow the safety instructions in the documentation of any accessory that is used together with the MCR.
- All personnel involved in the operation and / or maintenance of the equipment must be properly instructed in its use.
- This manual contains important information on operating and handling the instrument. You are therefore required to keep the manual with the instrument, especially when transferring the instrument to other persons.

## 1.1 General Safety Instructions

### Liability

- This manual does not claim to address all safety issues associated with the use of the instrument and samples. It is your responsibility to establish health and safety practices and determine the applicability of regulatory limitations.
- Anton Paar GmbH only warrants the proper functioning of the MCR if no adjustments have been made to the mechanics, electronics, and software.
- Only use the MCR for the purpose described in this manual. Anton Paar GmbH is not liable for damages caused by incorrect use of the MCR.

### Installation and use

- The MCR is **not** an explosion-proof instrument and therefore must not be operated in areas with risk of explosion.
- The installation procedure should only be carried out by authorized persons who are familiar with the installation instructions.
- Do not use any accessories or spare parts other than those supplied or approved by Anton Paar GmbH.
- Make sure all operators are trained to use the instrument safely and correctly before starting any applicable operations.
- In case of damage or malfunction, do not con-

tinue operating the MCR. Do not operate the instrument under conditions which could result in damage to goods and/or injuries and loss of life.

- Make sure the MCR is chemically resistant to the samples and cleaning agents you want to use.
- The MCR must not be operated in any other atmosphere than air.
- The MCR must not be operated at an air pressure considerably below usual ambient air pressure.

### Maintenance and service

- The results delivered by the MCR not only depend on the correct functioning of the instrument, but also on various other factors. We therefore recommend you have the results checked (e.g. plausibility tested) by skilled personnel before consequential actions are taken based on the results.
- Service and repair procedures may only be carried out by authorized personnel or by Anton Paar GmbH.

### Disposal

- Concerning the disposal of the MCR, observe the legal requirements in your country.

### Return shipment

- For repairs send the cleaned MCR to your Anton Paar representative. Only return the instrument together with the filled out RMA (Return Material Authorization) and the form "Safety Declaration for Instrument Repairs". Please download the Safety Declaration form from our website [www.anton-paar.com](http://www.anton-paar.com).
- Do not return instruments which are contaminated by radioactive materials, infectious agents or other harmful substances that cause health hazards.

### Precautions for highly flammable samples and cleaning agents

- Observe and adhere to your national safety regulations for handling the measured samples (e.g. use of safety goggles, gloves, respiratory protection etc.).

- Only store the minimum required amount of sample, cleaning agents and other flammable materials near the MCR.
- Do not spill sample/cleaning agents or leave their containers uncovered. Immediately remove spilled sample/cleaning agents.
- Make sure that the setup location is sufficiently ventilated. The environment of the MCR has to be kept free of flammable gases and vapors.
- Connect the MCR to the electrical power via a safety switch located at a safe distance from the instrument. In an emergency, turn off the power using this switch instead of the power switch on the MCR.
- Supply a fire extinguisher.
- During operation the MCR must be under constant qualified supervision.

## 1.2 Special Safety Instructions

- Do not use the MCR to measure fluids of the IIC group according to EN 60079-14, such as e.g. carbon disulfide or acetylene.
- Do not operate the MCR or move and touch the coupling unless you have connected a suitable compressed air supply with correct pressure.
- Parts of the instrument and its accessories, as well as the measuring geometry and the sample may become very hot or cold during operation. Touching these areas may cause severe burns. Do not touch any surface without adequate protective measures at these temperatures.
- Heated or cooled areas may take considerable time to reach room temperature. Allow these areas to cool down / warm up to room temperature and / or wear adequate protection before touching them.
- Some materials may evaporate during measurement, especially at high temperatures. Ensure adequate protection from hazardous gases. The measuring temperature should be set in such a way that no explosive substances can develop. Ensure adequate handling routines, such as protective clothing and good ventilation, when you are measuring potentially hazardous or volatile samples. Wear protective gloves and goggles when handling the MCR.

gles when handling the MCR.

- Stay clear of the MCR head when it is moving. Do not place your hands or other parts of your body between the MCR head and the plate or hood. Keep a safe distance as long as parts of the instrument are still in motion.
- Always wear adequate protective equipment (goggles, gloves) when operating the MCR.

## 1.3 Conventions for Safety Messages

The following conventions for safety messages are used in this document:



### **DANGER**

#### **Description of risk.**

Danger indicates a hazardous situation which, if not avoided, **will** result in death or serious injury.



### **WARNING**

#### **Description of risk.**

Warning indicates a hazardous situation which, if not avoided, **could** result in death or serious injury.



### **CAUTION**

#### **Description of risk.**

Caution indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

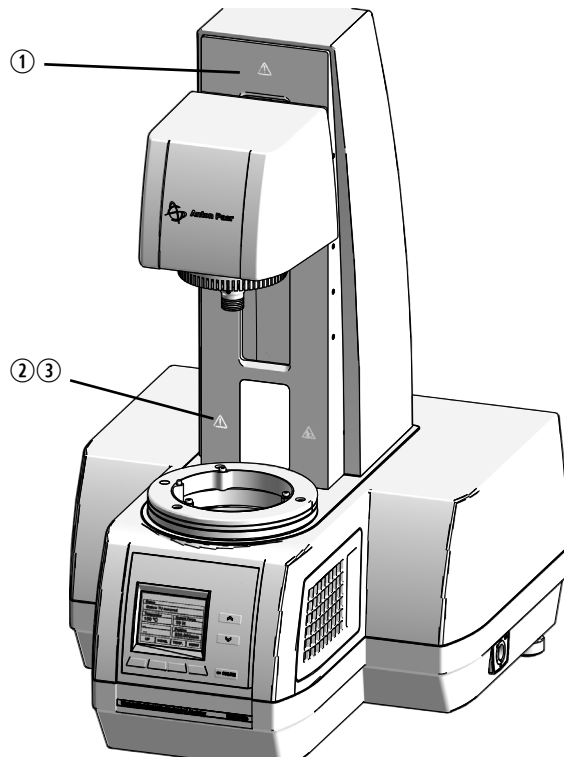
### **NOTICE**

#### **Description of risk.**

Notice indicates a situation which, if not avoided, could result in damage to property.

## 1.4 Safety Symbols on the Instrument

There are three warning symbols on the MCR. All three are on the front of the main girder, two at the bottom and one at the top.



- 1 CAUTION - General risk
- 2 CAUTION - General risk
- 3 CAUTION - Moving parts

Fig. 1: Position of warning symbols on the instrument.



### CAUTION

#### **General risk.**

There is a general risk in the area marked with this symbol. Carefully read the documentation and observe all safety notes.



### CAUTION

#### **Danger of hand injuries**

In areas marked with this sign there is the possibility of hand or finger injuries through moving parts. Keep a safe distance as long as parts of the instrument are still in motion.

### NOTICE

It is imperative that the warning symbols remain clearly legible.

## 1.5 Remaining Risks



### WARNING

#### **Sample Decomposition**

Depending on the used heating device the sample may be heated up to 1000 °C. At these temperatures the sample may emit harmful gases. Stay well below the samples decomposition temperature or supply sufficient venting.



### CAUTION

#### **Hot surface.**

Parts of the instrument may become very hot during operation.

Do not touch these parts of the instrument without adequate protective measures or let it cool down before handling.



### CAUTION

#### **Moving parts.**

Moving parts may generally expose a risk of getting injured.

Keep clear of moving parts.



### CAUTION

#### **Heavy object.**

The MCR is heavy (up to 60 kg with accessories), therefore adequate lifting by two persons is required to prevent injuries and instrument damage. Never lift the MCR by its head.

There are recessed grips at the bottom of the instrument (Fig. 2, ④), which should always be used to lift the MCR.

Some of the accessories and measuring geometries may represent an additional risk; e.g.:

- The SCF (solid cylindrical fixture) and SRF (solid rectangle fixture) measuring geometries allow mounting sharp objects.
- The BIC (bicone) measuring geometries have a very sharp edge that additionally may be rotating at a high speed (up to 3000 rpm).
- The CC (concentric cylinder) or DG (double gap) measuring geometries may expose a shearing hazard between the cylinder and the cup when the cylinder is immersed into the cup.

- The surroundings and objects near the heating devices may also become hot.

***Wear protective gloves***

Wear protective gloves when handling the MCR.

***Wear safety goggles***

Wear safety goggles when handling the MCR.

**NOTICE**

Observe the safety information in the documentation of the accessories and measuring geometries.

## 2 MCR Evolution - An Overview

The **Modular Compact Rheometer Evolution** series incorporates an EC-motor with air bearings and is designed for a wide range of measurement tasks. Temperature control and sample-specific accessories adapt the instrument to the desired application. The rheometer software together with Toolmaster (the automatic recognition and configuration system) provide a user-friendly interface.

All mechanical and electrical control components are incorporated into one unit. The movable measuring head ensures sufficient space for sample loading and trimming.

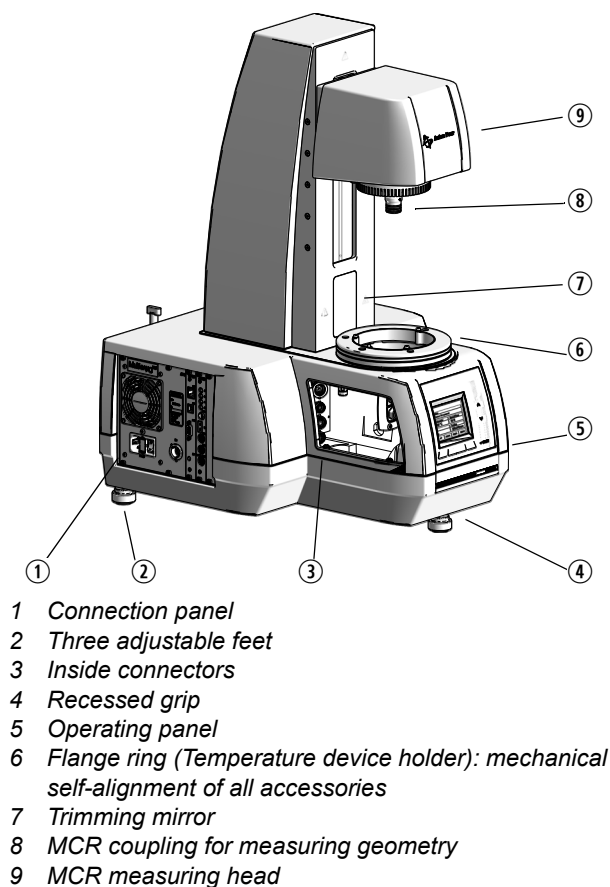
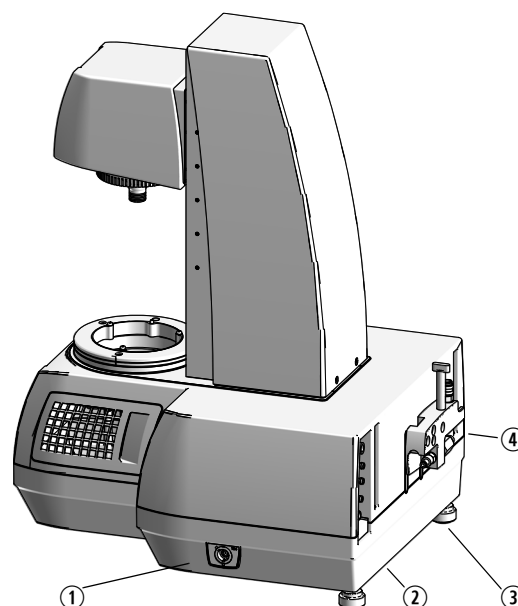


Fig. 2: Overview of MCR (left and front) with side covers removed



- 1 TD4 connector
- 2 Recessed grip
- 3 Three adjustable feet
- 4 Compressed air distributor

Fig. 3: Overview of MCR (right and rear)

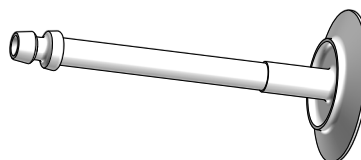


Fig. 4: PP50 measuring geometry

Anton Paar's MCR **measuring geometries** can be used with all suitable temperature devices and are interchangeable within their category of accessories. For example, a PP 25 parallel-plate measuring geometry can be used with all plate accessories, like the LTD (Liquid Temperature Device), PTD (Peltier Temperature Device), ETD (Electric Temperature Device) or CTD (Convection Temperature Device) systems. All geometry dimensions, safety limitations and calibration constants are saved in the **Toolmaster** chip located in the shaft of every measuring geometry. Made from various materials and featuring different surfaces and dimensions, all measuring geometries are optimized regarding compliance, thermal expansion and thermal conductivity.

**Information:** The measuring geometries are not part of the MCR delivery and need to be ordered separately.

**TruGap™** measures the gap and precisely adjusts to the required position, compensating for temperature and thermal expansion. The TruGap™ function requires dedicated accessories marked with TG in the abbreviation.

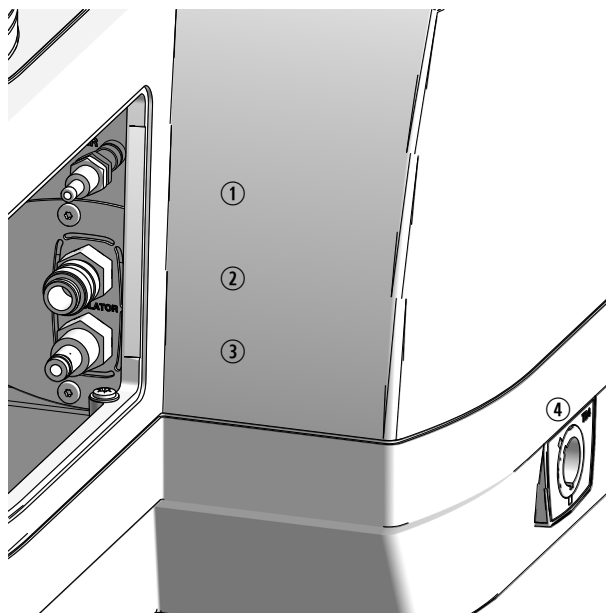
The **T-Ready™** feature employs the TruGap™ functionality to determine precisely when the required sample temperature is reached. TruGap™ accessories and measuring geometries are required.

The **SmartPave** is a dynamic shear rheometer for the measurement of the rheological properties of bitumen and asphalt. The instrument fully complies to international bitumen standards such as AASHTO, ASTM, DIN and others. It is possible to equip SmartPave with a temperature cell with a lower Peltier plate and a Peltier hood. This combination minimizes temperature gradients in the sample and guarantees reliable measurements with extreme accuracy.

## 2.1 Overview of the MCR Connections

You will find all necessary parts to connect the MCR (and to connect all accessories to it) in the accessory kit.

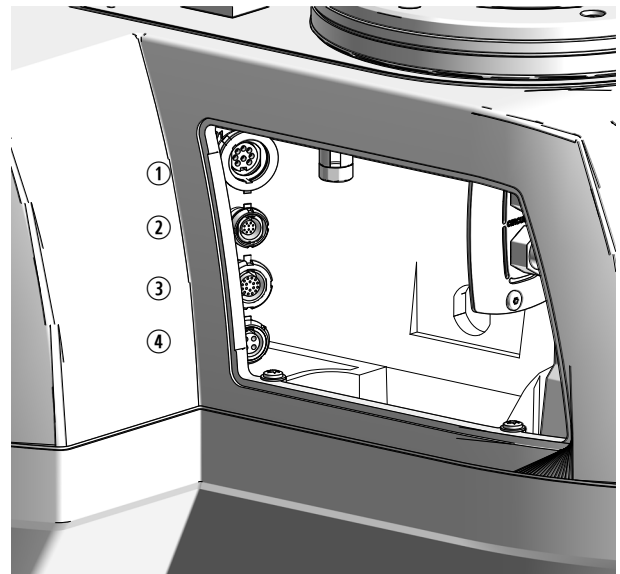
### 2.1.1 Connections on the Right Side



- 1 Air for second measuring drive (only with MCR 702e MultiDrive)
- 2 fluid circulator IN
- 3 fluid circulator OUT
- 4 TD4: temperature device connection (this is a parallel connection to TD1; do not use both at the same time)

Fig. 5: Circulator connections under the right side cover

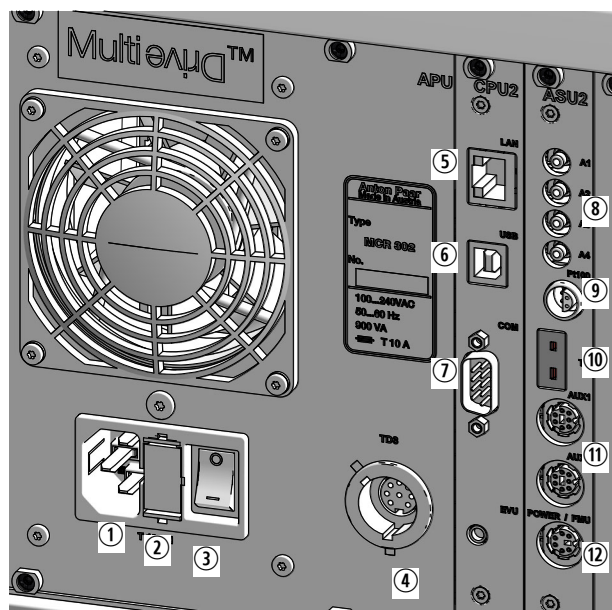
### 2.1.2 Connections on the Left Side



- 1 TD1: temperature device connection (this is a parallel connection to TD4; do not use both at the same time)
- 2 TD2: connector for TruGap and lower shafts
- 3 MOT1: data connection for the lower measuring drive (only with MCR 702e MultiDrive)
- 4 MOT2: power connection for the lower measuring drive (only with MCR 702e MultiDrive)

Fig. 6: Connections under the left side cover

### 2.1.3 Connections on the Left Side Panel



#### APU:

- 1 Power supply
- 2 Main fuse (T 10 AH)
- 3 Power switch
- 4 TD3 connector (temperature device)

#### CPU:

- 5 LAN connector
- 6 USB connector
- 7 Serial connector

#### ASU:

- 8 A1 to A4 connectors
- 9 Pt100 connector
- 10 TC connector
- 11 AUX1 and AUX2 connector
- 12 FMU connector

Fig. 7: Connection panel on the left side

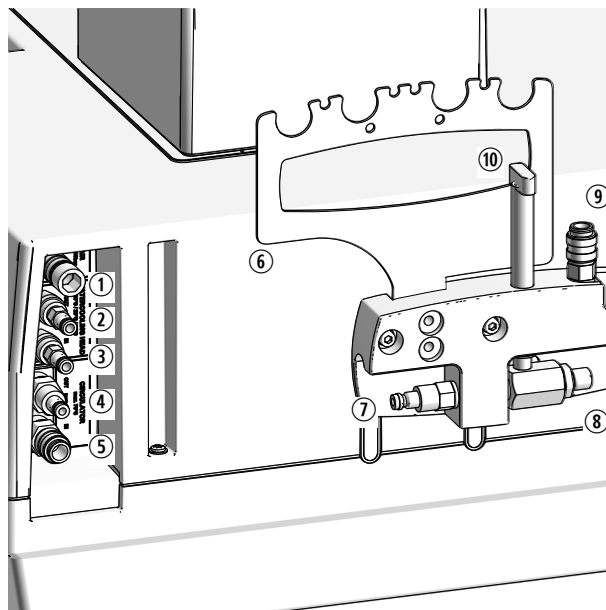


#### WARNING

##### **Electric shock hazard.**

Parts behind the MCR side panel carry hazardous voltage. Do not open the instrument, as there are no user-serviceable parts inside. Do not operate the instrument when electronic units or covers are missing. All screws must be tight.

### 2.1.4 Connections on the Rear Side



- 1 AIR: connect the air supply with 5 to 10 bar for the air bearing
- 2 Water cooling head OUT (not with MCR 102e and SmartPave 102e)
- 3 Water cooling head IN (not with MCR 102e and SmartPave 102e)
- 4 Fluid circulator OUT
- 5 Fluid circulator IN
- 6 Hose holder
- 7 Air distributor OUT: connect the magnetic valve
- 8 Air distributor IN: connect the air supply (max. 6 bar)
- 9 Air distributor OUT: connect the flow meters (FMU)
- 10 Stopcock for switching the air on and off

Fig. 8: Connection panel on the rear side

#### NOTICE

The water cooling of the measuring drive to stabilize the temperature of the measuring head has to be connected to a fluid circulator, which is also available from Anton Paar GmbH. The recommended temperatures are 20 °C, 23 °C or 25 °C and should be as near to room temperature as possible. The room temperature must be constant and must not exceed the range between 15 °C and 35 °C at a maximum pressure of 1 bar.

**NOTICE**

A fluid circulator is used to control the temperature of liquid temperature control systems (LTD), for counter-cooling of Peltier systems (PTD), to cool down electrically heated systems (ETD), or for cooling the shells of convection heated systems (CTD).

The temperature control system requires a separate fluid circulator in addition to the motor cooling fluid circulator. Water bath settings of the different temperature devices can be found in the corresponding manual. The temperature must not exceed a maximum of 70 °C, and the pressure must not exceed 1 bar.

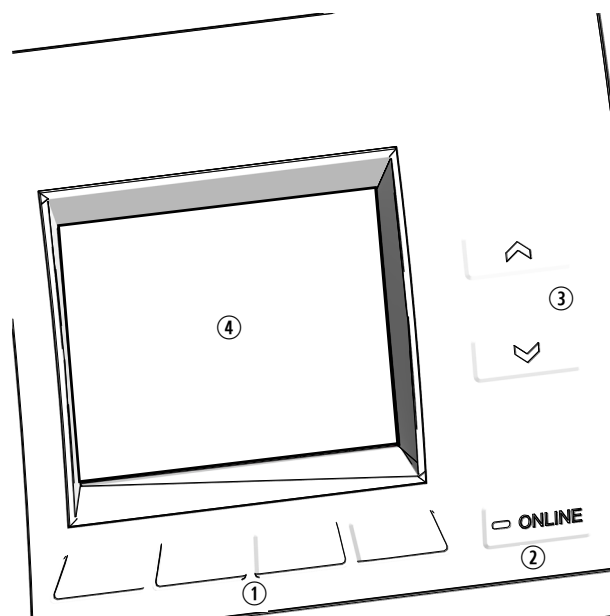
## 2.3 Operating Modes

The MCR can be operated in two different modes:

- **Offline mode:**  
The LED (Fig. 9; ②) on the operating panel is off. The MCR can be operated with the buttons of the operating panel (see section 5).
- **Online mode:**  
The LED (Fig. 9; ②) on the operating panel is on. The MCR is remotely controlled by the rheometer software.

In this operating mode you can stop the movement of the measuring head by pressing the button ONLINE on the operating panel.

## 2.2 Operating Panel



- 1 4 Softkeys
- 2 Online button with LED
- 3 Up and down buttons
- 4 Color display

Fig. 9: Operating Panel

## 3 Checking the Supplied Parts

The MCR was tested and packed carefully before shipment. However, damage may occur during transport.

1. Keep the packing material (box, foam pieces, transport protection) for possible returns and further questions from the transport and insurance company.
2. Check the delivery for completeness by comparing the supplied parts to those noted in the tables below.
3. If a part is missing, contact your Anton Paar representative.
4. If a part is damaged, contact the transport company and your Anton Paar representative.

The following tables list all supplied parts contained in your order. Every instrument is delivered as a unit

and the delivery contains all parts according to your order.

### 3.1 MCR Modular Compact Rheometer



#### CAUTION

##### **Heavy object.**

The MCR is heavy (up to 60 kg with accessories), therefore adequate lifting by two persons is required to prevent injuries and instrument damage. Never lift the MCR by its head.

There are recessed grips at the bottom of the instrument (Fig. 2, ④), which should always be used to lift the MCR.

**Table 1: Supplied Parts**

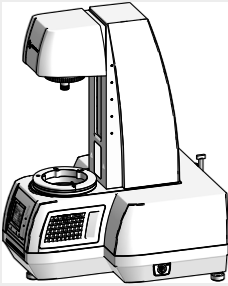
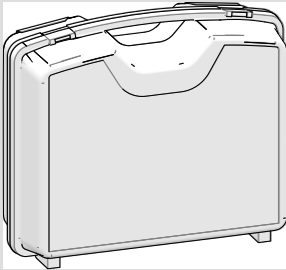
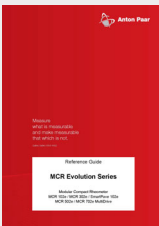
| Symbol                                                                              | Pcs. | Article Description                                                                                                                                         | P/N    |
|-------------------------------------------------------------------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
|  | 1    | <b>MCR 102e</b><br>Modular Compact Rheometer                                                                                                                | 241352 |
|                                                                                     | or 1 | <b>MCR 302e</b><br>Modular Compact Rheometer                                                                                                                | 241353 |
|                                                                                     | or 1 | <b>SmartPave 102e</b><br>Modular Compact Rheometer for asphalt rheology                                                                                     | 241355 |
|                                                                                     | or 1 | <b>MCR 502e Power (300 mNm, 70 N)</b><br>Modular Compact Rheometer                                                                                          | 241358 |
|                                                                                     | or 1 | <b>MCR 702e MultiDrive</b>                                                                                                                                  | 241354 |
|  | 1    | <b>Accessory kit small</b><br><b>for MCR 102e, SmartPave 102e</b><br>complete with all necessary parts and tools for the MCR, consists of 2 boxes           | 91612  |
|                                                                                     | or 1 | <b>Accessory kit large</b><br><b>for MCR 302e, MCR 502e Power, MCR 702e</b><br>complete with all necessary parts and tools for the MCR, consists of 2 boxes |        |
|                                                                                     | 1    | <b>USB Storage Device</b><br>with further information about the instrument                                                                                  |        |

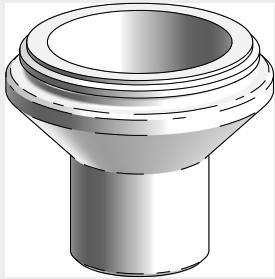
Table 1: Supplied Parts

| Symbol                                                                            | Pcs. | Article Description | P/N |
|-----------------------------------------------------------------------------------|------|---------------------|-----|
|  | 1    | Documentation       |     |

## 3.2 Accessory Kit for MCR

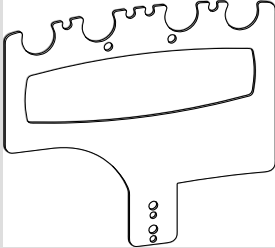
The **accessory kit** contains all parts and tools necessary for installing the MCR. The content depends on the type of MCR. It consists of a tool box and a box with hoses and cables.

Table 2: Content of the Accessory Kit Small

| Symbol                                                                              | Pcs.  | Article Description                                                                                                                                                | P/N                                                          |
|-------------------------------------------------------------------------------------|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
|                                                                                     | 1x2 m | Ethernet cable for network connection<br>RJ45G SFTP CAT5e                                                                                                          | 18470                                                        |
|                                                                                     | 1x2 m | USB connection cable<br>A/Plug - B/Plug                                                                                                                            | 168165                                                       |
|                                                                                     | 2.5 m | Power cable (3x1.0 mm <sup>2</sup> , 10 A), suitable for destination country<br>- CEE<br>- UK<br>- USA<br>- China<br>- CH<br>- Thailand<br>- Brazil                | 52112<br>61865<br>52656<br>27011<br>93408<br>79730<br>130117 |
|  | 2x3 m | Air hose connection to the air filter unit including:<br>Air hose 4x6 polyurethane Chainflex black,<br>2x fitting NW7.2-6x4<br>1x self-locking fitting NW5-6x4 red | 26936<br>26933<br>26935                                      |
|  | 1     | Protection tube MCR                                                                                                                                                | 2834                                                         |

### 3 Checking the Supplied Parts

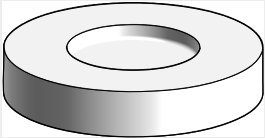
**Table 2: Content of the Accessory Kit Small**

| Symbol                                                                            | Pcs. | Article Description | P/N   |
|-----------------------------------------------------------------------------------|------|---------------------|-------|
|  | 1    | Hose holder         | 91322 |

**Table 3: Additional Content Accessory Kit Large**

| Symbol                                                                              | Pcs.  | Article Description                                                                                                                                                                | P/N                     |
|-------------------------------------------------------------------------------------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
|    | 2x2 m | Measuring drive - circulator including:<br>Thermostat hose 7.9x15.9mm, NBR/CR black,<br>2x self-locking coupling NW5-9mm, blue<br>3x hose clamps<br>2x marking "Watercooling Head" | 94166<br>14385<br>94168 |
|  | 1     | Flow indicator 6-11mm                                                                                                                                                              | 93035                   |

**Table 4: Additional Content for SmartPave 102e Only**

| Symbol                                                                              | Pcs. | Article Description                    | P/N   |
|-------------------------------------------------------------------------------------|------|----------------------------------------|-------|
|  | 2    | Silicon mold for asphalt binder, 18 mm | 26300 |
|                                                                                     | 2    | Silicon mold for asphalt binder, 8 mm  | 26301 |

**Table 5: Content of the Tool Box**

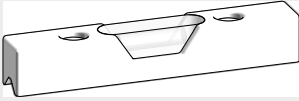
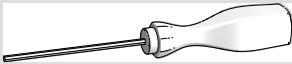
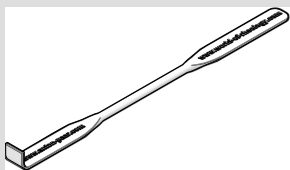
| Symbol                                                                              | Pcs. | Article Description                          | P/N              |
|-------------------------------------------------------------------------------------|------|----------------------------------------------|------------------|
|  | 1    | Aluminum water level L=150, 0.6 mm/m         | 17205            |
|  | 4    | Allen wrench 2.0 mm<br>Allen wrench 4x100 mm | 222422<br>300494 |
|  | 1    | Standard viscoelastic,<br>PSTD1000VE, 50 ml  | 9696             |

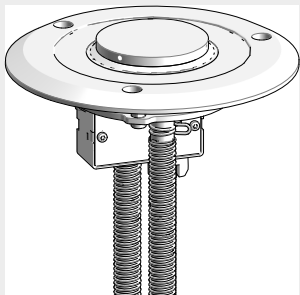
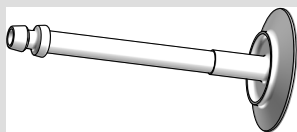
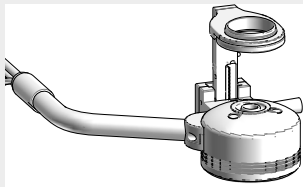
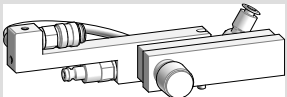
Table 5: Content of the Tool Box

| Symbol                                                                            | Pcs. | Article Description                                                     | P/N    |
|-----------------------------------------------------------------------------------|------|-------------------------------------------------------------------------|--------|
|  | 1    | Double spatula 18/10 steel, 150x9 mm                                    | 131594 |
|                                                                                   | 3    | Knurled screw M3x6, MCR                                                 | 99678  |
|                                                                                   |      | Mounting material for the hose holder<br>2x M5x20 screw<br>2x M5 washer |        |

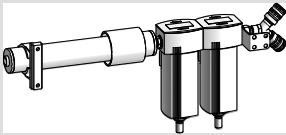
### 3.3 Optional Accessories and Parts

Anton Paar GmbH offers a wide variety of application-specific accessories to match your specific measurement needs. For details about the relevant accessory refer to the respective accessory manual.

Table 6: Examples of Accessories

| Symbol                                                                              | Article Description          | P/N |
|-------------------------------------------------------------------------------------|------------------------------|-----|
|  | Measuring plate - example    |     |
|  | Measuring geometry - example |     |
|  | Hood - example               |     |
|  | Flow meter - example         |     |

**Table 6: Examples of Accessories**

| Symbol                                                                            | Article Description                                     | P/N |
|-----------------------------------------------------------------------------------|---------------------------------------------------------|-----|
|  | Fluid circulator - example                              |     |
|  | Air filter and dryer - see specifications in Appendix A |     |

# 4 Installing the Instrument

## 4.1 Installation Requirements

The setup location and surroundings should meet the requirements of a typical laboratory (see below and Appendix A).

Allow the equipment to reach ambient temperature before installation. This is very important, if the equipment has been stored or transported at lower temperatures.



### CAUTION

#### **Moving parts.**

There is a risk of body parts being jammed between the upwards moving measuring head and other objects above the MCR. Maintain a clearance of at least 50 cm above the MCR.



### CAUTION

#### **Heavy object.**

The MCR is heavy (up to 60 kg with accessories), therefore adequate lifting by two persons is required to prevent injuries and instrument damage. Never lift the MCR by its head. There are recessed grips at the bottom of the instrument (Fig. 2, ④), which should always be used to lift the MCR.

Place the instrument on a stable, flat lab bench which is free of vibrations:

- leave at least 0.5 m space above the MCR
- leave enough space to the left of the instrument, so that the power switch can easily be accessed

To ensure temperature stability and trouble-free measurement, never locate the MCR:

- next to a heating facility
- near an air conditioning, ventilation system or an open window
- in direct sunlight
- Keep the instrument away from vibrations (e.g. caused by other instruments on the same lab bench).
- Keep the instrument away from magnetic fields.
- For best results we recommend to operate the

MCR in an air-conditioned room at a constant temperature.

- Read the Safety Instructions in section 1.
- Find all Technical Data in Appendix A.

### NOTICE

Do not remove the transport protection before you have connected a suitable air supply with air quality according to ISO 8573-1, class 1.3.1.

### NOTICE

Always mount the MCR protection tube to protect the coupling of the measuring drive and the measuring drive when the MCR is not in use.

### 4.1.1 Fluid Circulator

#### **Choice of Cooling Fluid:**

There are various different use-cases for cooling fluids and the correct choice of the cooling fluid depends on them:

- Temperature control of **Measuring Drive**: Mixture of water and antifreeze as defined in this manual.
- Cooling, counter-cooling or temperature control of **Temperature Devices** and other **Accessories**: Mixture of water and antifreeze as defined in this manual or other relevant manuals.
- High temperature requirements: H20S fluid as defined in the relevant manuals.
- Low temperature requirements: H5 fluid as defined in the relevant manuals.

#### **Recommended antifreeze:**

Recommended antifreeze with corrosion protection are BASF G30, G40 and G48 or equivalent products of other suppliers.

See Appendix A for information about the choice of cooling liquid.



### CAUTION

#### **Highly inflammable**

Never use ethanol or any other low-viscosity solvent as coolant. The rheometer's quick couplings are not sufficiently solvent-proof.

## 4 Installing the Instrument

For circulators offered by Anton Paar (except for the Julabo AWC100):

- Use a mixture of 60 % distilled, deionized water and 40 % concentrate of engine coolant anti-freeze with corrosion protection suitable for aluminum.
- In case of evaporation of the coolant, refilling must always be carried out with the correct mixing ratio of 60:40.
- Verify the pH-value of the coolant in intervals of two months in order to ensure a stable, neutral quality between pH = 7 and 9.

If the pH value drops below pH = 7, the coolant mixture must be changed immediately. The addition of pH-increasing agents is not permitted.

- Dispose of the coolant according to the instructions on the manufacturer's safety data sheet.
- In the case of a blockage in the cooling circuit, contact an AP service technician immediately.

For the Julabo AWC100 circulator:

- Use a mixture of 90 % distilled, deionized water and 10 % concentrate of engine coolant anti-freeze with corrosion protection suitable for aluminum.
- In case of evaporation of the coolant, refilling must always be carried out with the correct mixing ratio of 90:10.
- Verify the pH-value of the coolant in intervals of two months in order to ensure a stable, neutral quality between pH = 7 and 9.

If the pH value drops below pH = 7, the coolant mixture must be changed immediately. The addition of pH-increasing agents is not permitted.

- Dispose of the coolant according to the instructions on the manufacturer's safety data sheet.
- In the case of a blockage in the cooling circuit, contact an AP service technician immediately.

### NOTICE

#### ***Damage caused by unsuitable cooling water quality.***

- Hard water is not suitable for temperature control because it leads to calcification.
- Ferrous water will cause formation of rust even in instruments made of stainless steel.
- Water must not contain chlorine or added minerals. Chlorinated water will cause pitting corrosion.
- Due to their corrosive characteristics, pure distilled water and deionized water are unsuitable as open circuit cooling fluids.
- Avoid microbiological proliferation in the bath water as organic particles can clog the instruments.

### 4.1.2 Installing Flow Indicators

To check if the fluid circulator is working properly and the fluid's quality is appropriate, we recommend installing flow indicators (p/n 93035, delivered with circulators purchased from Anton Paar).

Make sure the circulator is turned off. Cut the outlet hose of the circulator at a point where the flow indicator will be clearly visible at all times. Mount the flow indicator between the two hose ends with the supplied hose clamps.

### NOTICE

#### ***Risk of damage***

Handle with care. Don't overstrain the flow indicators. Check for leak-tightness after mounting.

The coolant flowing through the flow indicator should be clear and devoid of visible particles at all times.

## 4.2 Software Installation

You will find a USB-storage device in the box of the MCR. This USB-storage device contains all required software and some additional information.

Install the RheoCompass software on the PC that will be connected to the MCR according to the instructions that were delivered with the software.

To install RheoCompass on the PC, insert the installation USB storage device and follow the instructions you will find on the USB device.

### 4.3 Connecting the MCR to the Air Supply

In order to avoid damaging the air bearings, connect the air supply with the supplied hose to the MCR air connector (Fig. 8, ①). Make sure that the air supply meets all requirements given in Appendix A.

#### NOTICE

Never operate the MCR or move the coupling unless you have connected a suitable compressed air supply with correct pressure. It is good practice to connect the air supply first, before doing anything else with the instrument.

### 4.4 Connecting the MCR to Power

Connect the mains cable of the MCR to a voltage supply that meets the specifications of the MCR (see Appendix A). Only use an outlet with protective earth to avoid the risk of an electric shock and use the cables supplied by Anton Paar GmbH.

### 4.5 Removing the Transport Protection

#### NOTICE

Do not continue if an error message is displayed. Especially if "NO AIR PRESSURE!" is displayed, check the air supply.

#### NOTICE

The air bearing is especially sensitive to side loads, even with connected air pressure. Never press the coupling or a connected measuring geometry sideways.

1. Switch on the instrument. The main switch is on the panel on the left side of the instrument.
2. Wait for the instrument to boot. The boot sequence is finished when the status line of the display shows "Status: O.K."

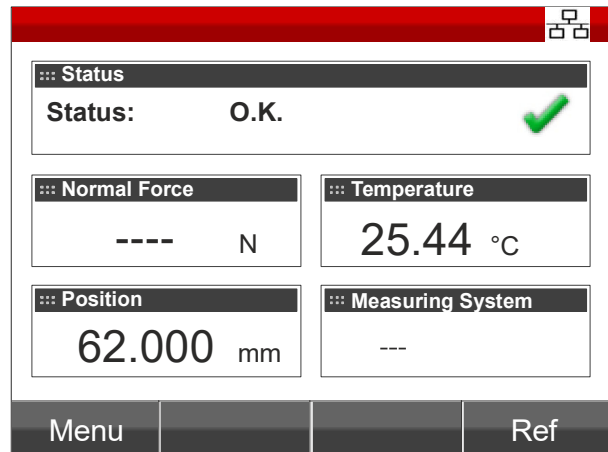


Fig. 10: Display ready

#### NOTICE

Always mount the MCR protection tube to protect the coupling of the measuring drive and the measuring drive when the MCR is not in use.

3. Press the button marked "ONLINE" once to switch off the white LED (-> offline).



#### CAUTION

##### Moving parts.

There is a risk of body parts being pinched by the moving measuring head. Keep clear of the measuring head while it is moving.

4. Press "Ref". The measuring head will move to the highest position.
5. Remove the transport protection. Please keep the transport protection in case the instrument needs to be moved or shipped later on.
6. Press "ONLINE" again to switch on the white LED (-> online).

### 4.6 Connecting to the PC

You have two possibilities to connect the MCR to a network or PC. Find the suitable cables in the accessory kit:

- MCR USB - PC directly:  
using the USB cable
- MCR LAN - network:  
using the Ethernet cable

## 4 Installing the Instrument

The instrument has to be set to one of these options from the instrument menu. The default setting is USB.

See section 5.4 for details about changing the various settings.

### To change the communication setting from USB:

1. Switch on the MCR and wait for the boot procedure to finish (see section 4.5).
2. Press the "ONLINE" button once to go to offline mode (white LED is off), then press "Menu" and "Edit" to access the "Select Connection" menu. The active option is displayed with dark background. To change the setting use the up- and down-buttons on the operating panel. Press "Select" for the desired option.
3. After you have made your selection, press "Save" and wait for the instrument to finish storing the new settings.
4. Press "ONLINE" to return to online mode.
5. Switch off the instrument before connecting any cables.

### 4.6.1 USB

Connect the USB cable to the connector marked "USB" (Fig. 7, ⑥) on the connection panel of the instrument and to a free USB port on the computer on which RheoCompass will be installed.

The required USB drivers are installed together with RheoCompass.

### 4.6.2 Ethernet

Each instrument is equipped with an Ethernet interface. The MAC address of this interface is given on the instrument. The TCP/IP protocol is used for the communication between RheoCompass and the instrument.

To connect the instrument to the network, use a patch panel connector or an Ethernet switch. The included standard patch cable can be used for the di-

rect connection and for most modern switches.

Connect the patch cable to the connector marked "LAN" on the connection panel (Fig. 7, ⑤) of the instrument and to the network.

**Information:** *Disable any WLAN connection in the control panel of your PC (it is not sufficient to turn off the WLAN with a switch on the PC). An active WLAN connection might have negative effects on the LAN connection to the MCR.*

## 4.7 Leveling the Instrument

For correct measurements the MCR has to be leveled with the adjustable feet:

- To do this, place the supplied water level on the flange ring, align it parallel to the back of the MCR and check if it is leveled. Level the MCR with the rear adjustable feet.

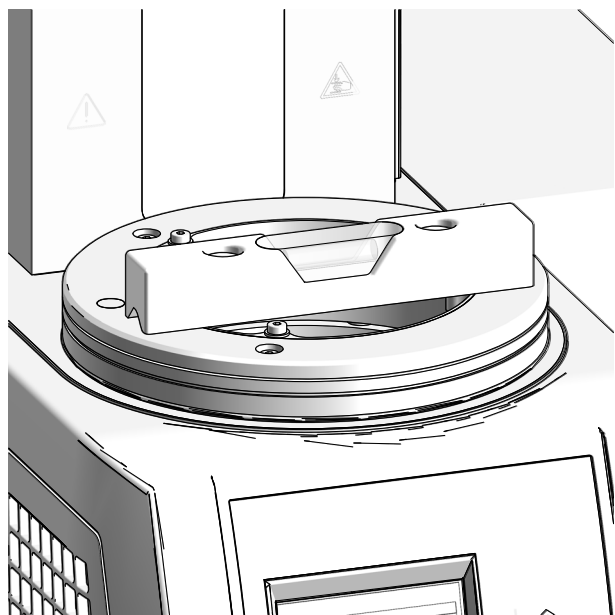


Fig. 11: Water balance parallel to back of instrument

- Turn the water level by 90° so that it lies on the flange ring perpendicular to the back of the MCR and check again if it is leveled. Level it with the front adjustable foot.

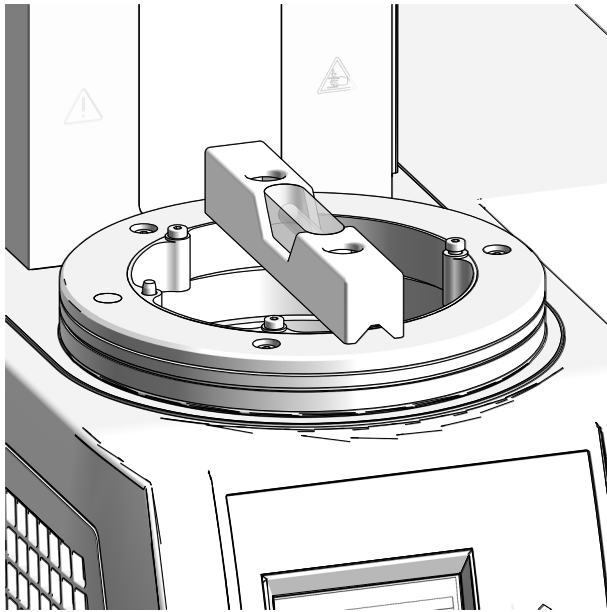


Fig. 12: Water balance perpendicular to back of instrument

### NOTICE

The leveling of the MCR may influence measurements at small torque values. Therefore, check and repeat the leveling regularly. Especially repeat the leveling after moving the instrument.

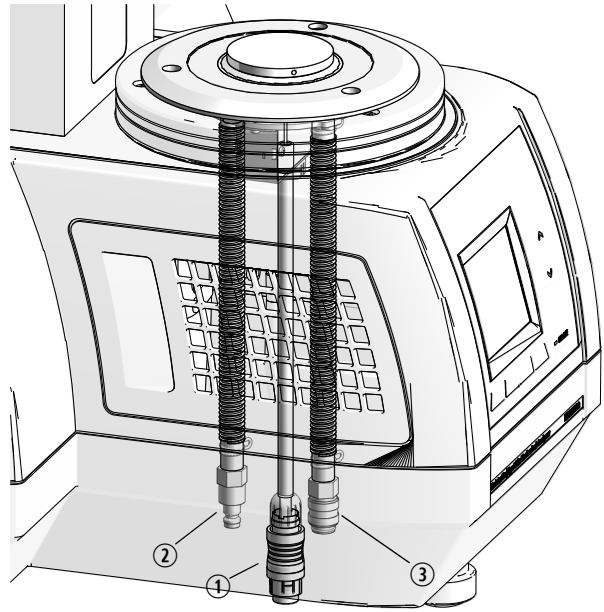
## 4.8 Mounting and Connecting a Temperature Device for PP / CP Measurements



### CAUTION

#### General Risks.

Read and observe the safety instruction you will find in the documentation of the accessories used together with the MCR.



- 1 Control cable
- 2 Temperature control hose OUT
- 3 Temperature control hose IN

Fig. 13: Temperature device installed on the MCR (shown transparent)

Anton Paar GmbH offers different types of heating devices mounted in several different ways.

Always refer to the respective manual for details.

1. Before installing the plate remove both MCR side covers.
2. Guide the control cable and the temperature control hoses through the MCR flange ring.
3. Place the plate on the flange ring and align it with the guide pin.
4. First tighten the screw opposite the pin, then fasten the two others so that they are hand-tight.

**Information:** There are two types of screws available. The knurled screws can be opened and fixed without using a tool, but they can not be used in combination with all accessories.

5. Connect the red control cable to the TD1 connector on the MCR.
6. Connect the temperature control hoses to the connectors behind the right side cover of the MCR (circulator IN and OUT).

### 4.9 Connecting a Fluid Circulator



#### CAUTION

##### **General Risks.**

Read and observe the safety instruction you will find in the documentation of the accessories used together with the MCR.



#### CAUTION

##### **Highly Inflammable**

Do not use ethanol as coolant. The quick couplings are not sufficiently proof for ethanol.

#### NOTICE

##### **Risk of damaging the instrument**

Only use coolants as defined in Appendix A. Do not use pure tap water. Do not use silicone oil when silicone hoses are used (e.g. T-PTD 200)

You need a fluid circulator for the temperature control of a temperature device or for the cooling of a temperature device, especially for a Peltier Temperature Device (PTD). Find the required specifications in the respective manual.

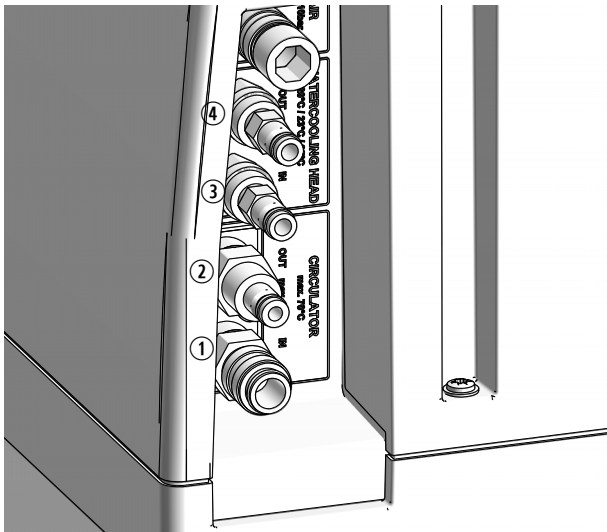


Fig. 14: Hose connections on rear panel to fluid circulator

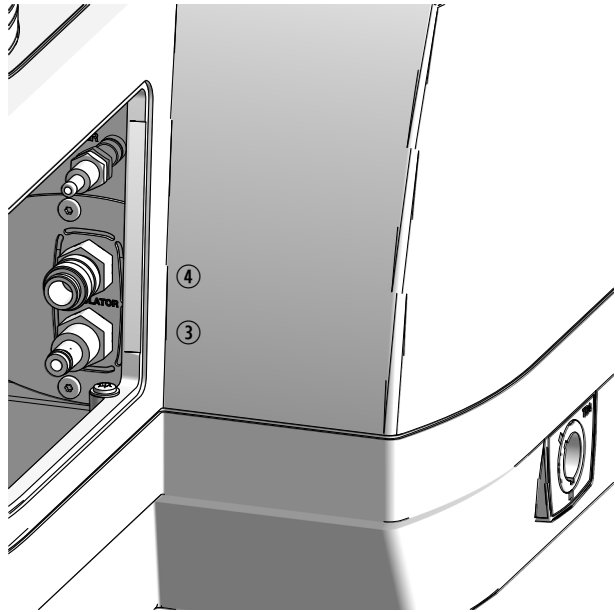


Fig. 15: Hose connections inside the instrument for the temperature device

To check if the fluid circulator is working properly and the fluid is circulating, we recommend installing the supplied flow indicator. Therefore, before you connect the hoses, cut the hose coming from "Circulator IN" on the MCR at a point where the flow indicator will be clearly visible at all times. Mount the flow indicator between the two hose ends with the supplied hose clamps.

1. Connect the hose with the flow indicator between the fluid circulator outlet and the connector "Circulator IN" on the rear panel of the MCR (Fig. 14, ①).
2. Connect the second hose between the fluid circulator inlet and the connector "Circulator OUT" on the rear panel of the MCR (Fig. 14, ②).
3. Connect both hoses of the temperature device to the two connectors inside the instrument (Fig. 15, ③ and ④).

#### **Not for MCR 102e and SmartPave 102e:**

Connect a suitable separate circulator to control the temperature of the measuring head using the delivered hoses from the accessory kit.

When using the water cooling for the measuring head, take following into account:

- the temperature of the circulator should be near room temperature.
- Should only be used for long-time measurements above 150 mNm.

- Only to increase the temperature stability of the normal force when measuring aqueous samples in the lower torque range.
4. Connect the hose from the circulator outlet to the connector "Watercooling head IN" on the rear panel of the MCR (Fig. 14, ③).
  5. Connect the hose from the circulator inlet to the connector "Watercooling head OUT" on the rear panel of the MCR (Fig. 14, ④).

## 4.10 Installing a Hood



### CAUTION

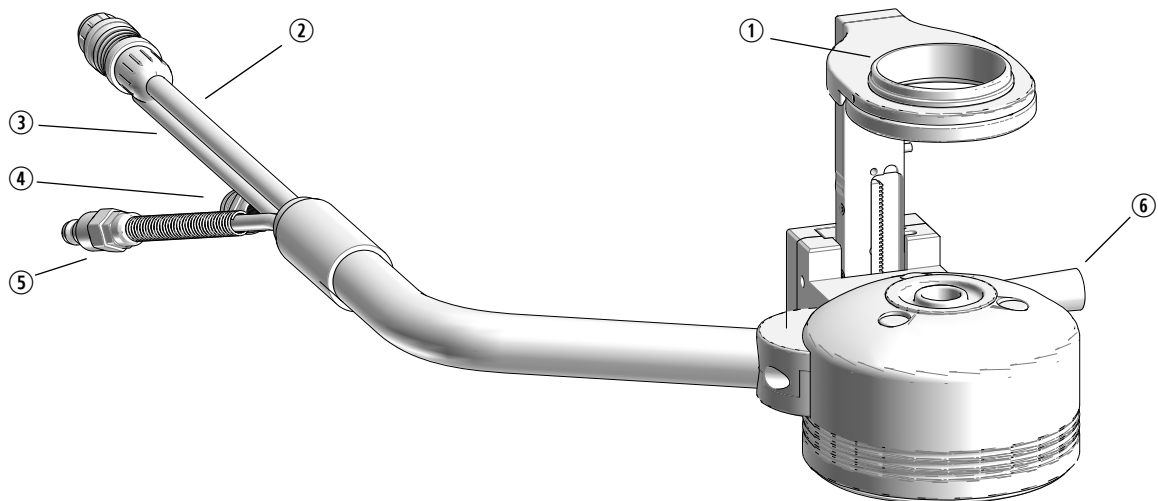
#### General Risks.

Read and observe the safety instruction you will find in the documentation of the accessories used together with the MCR.

Anton Paar GmbH offers different types of hoods mounted in several different ways.

Always refer to the respective manual for details.

1. Place the hood in such a way that the guiding rail is placed at a right angle to the measurement area and fit the fixing nut (Fig. 16, ①) to the flange on the MCR head.
2. Tighten the screw hand-tight. Be careful to align the hood before tightening the fixing nut to avoid damaging the thread.
3. Connect the control cable to the connector marked "TD3".
4. Connect the outlet of the fluid circulator to the temperature control hose "IN" of the hood (Fig. 16, ⑤).
5. Connect the temperature control hose "OUT" of the hood (Fig. 16, ④) to "IN" on the rear panel of the MCR (Fig. 14, ①).
6. Connect "OUT" on the rear panel of the MCR (Fig. 14, ②) to the inlet of the fluid circulator.



- 1 Fixing nut for mounting on the MCR
- 2 Control cable to MCR (Pt100 / heating)
- 3 Hose for air/gas supply to FMU

- 4 Temperature control hose OUT
- 5 Temperature control hose IN
- 6 Knob for raising and lowering the hood

Fig. 16: Example of a hood

### 4.11 Mounting a Measuring Geometry



#### CAUTION

##### **General Risks.**

Read and observe the safety instruction you will find in the documentation of the accessories used together with the MCR.



#### CAUTION

##### **Hot Surface.**

Parts of the instrument may become very hot during operation.  
Do not touch these parts of the instrument without adequate protective measures or let it cool down before handling.

Anton Paar GmbH offers a wide range of different measuring geometries. Please contact our local distributor for details.

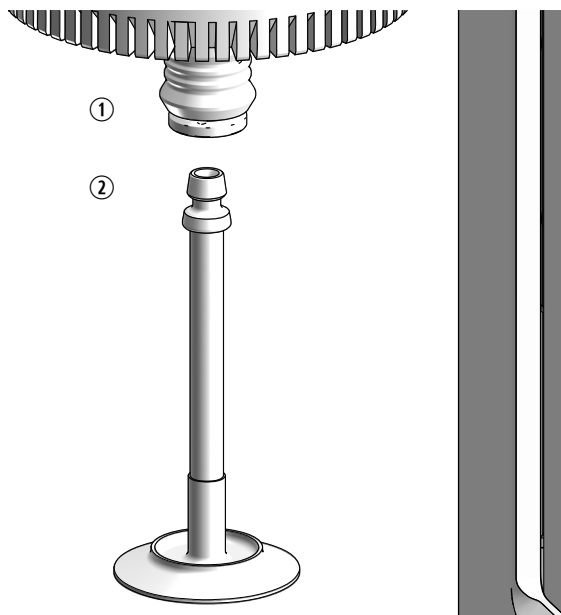


Fig. 17: Mounting a measuring geometry

#### NOTICE

Make sure that you have connected and switched on a suitable compressed air supply (according to ISO 8573-1, class 1.3.1) with correct pressure before you touch and move the coupling.

#### NOTICE

The air bearing is especially sensitive to side loads, even with connected air pressure. Do not press the coupling or a connected measuring geometry sideways.

1. Move the sleeve of the MCR coupling (Fig. 17, ①) upwards.
2. Turn the coupling until the marker on it matches the marker on the measuring geometry.
3. Insert the measuring geometry (Fig. 17, ②) into the coupling of the MCR.
4. Pull down the sleeve of the MCR coupling to fix the measuring geometry.

To remove the measuring geometry, hold it with one hand and then push the sleeve of the MCR coupling upwards. Then carefully take out the measuring geometry.

#### NOTICE

Always handle the measuring geometry with care, since minor damage may cause serious measurement errors.

### 4.12 Mounting a Flow Meter Unit (FMU)

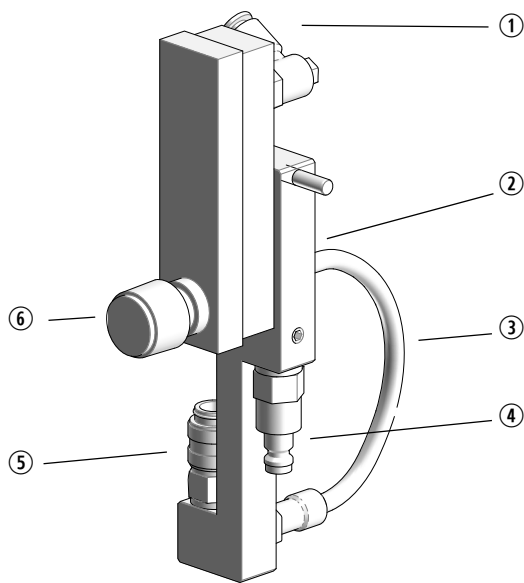


#### CAUTION

##### **General Risks.**

Read and observe the safety instruction you will find in the documentation of the accessories used together with the MCR.

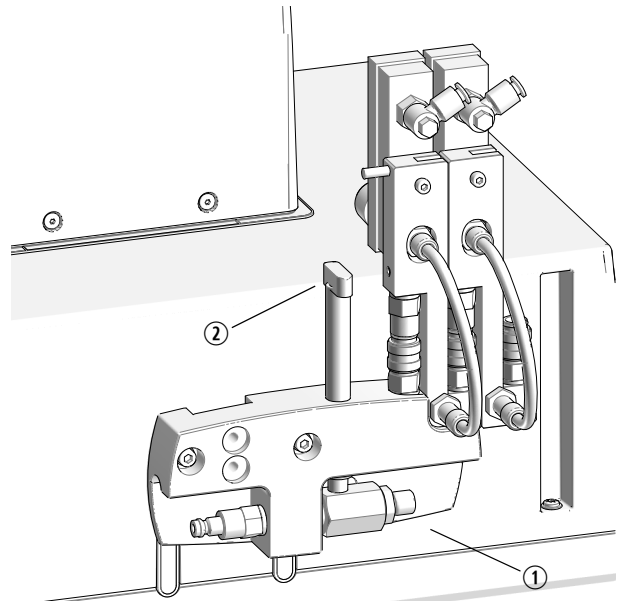
Depending on the accessory you use with the MCR, it might be necessary to use a flow meter unit (FMU) to control the flow of the air or of other gases for optimal temperature distribution in the sample.



- 1 Connector to accessory
- 2 Connector to flow regulator
- 3 Air hose
- 4 Connector to compressed air distributor (or previous FMU)
- 5 Connector for next FMU
- 6 Knob for flow adjustment

Fig. 18: Flow meter unit

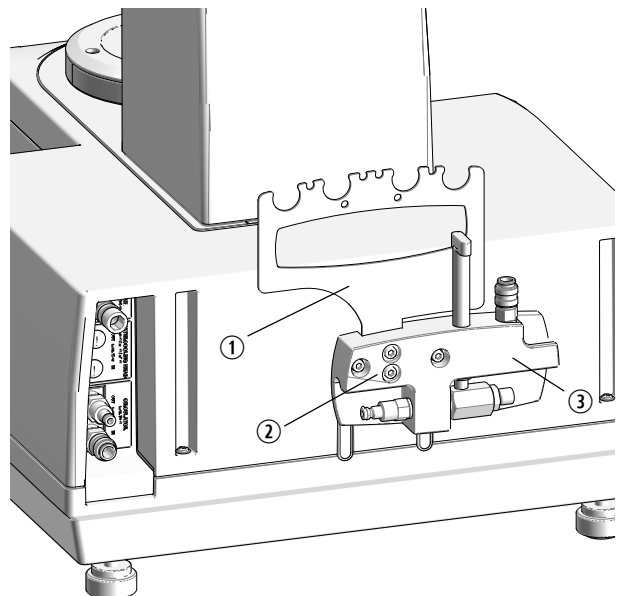
1. Mount the FMU by pushing its connector (Fig. 18, ④) onto the quick connector on the compressed air distributor on the rear of the MCR (Fig. 8, ⑨). Make sure it fits properly. The first FMU is mounted directly to the compressed air distributor. All subsequent FMUs are mounted to the previous FMU.
2. Connect the accessory with the supplied hose to the outlet of the flow meter unit (Fig. 18, ①).
3. Connect the second output of the air supply to the compressed air distributor:
  - Connect the long hose from the in connector (Fig. 19, ①) of the compressed air distributor to the air supply.
  - Switch the air flow on and off by turning the stopcock on the compressed air distributor (Fig. 19, ② shows a closed stopcock).



- 1 Air in connector
- 2 Stopcock

Fig. 19: Air connection of FMU

### 4.13 Mounting the Hose Holder



- 1 Hose holder
- 2 Two screws
- 3 Air distributor

Fig. 20: Mounting the hose holder

1. Slide in the hose holder (Fig. 20, ①) from above behind the compressed air distributor (Fig. 20, ③) on the back of the MCR.
2. Tighten the two screws (Fig. 20, ②) to fix it.

### 4.14 Using Inert Gas



#### CAUTION

##### **General Risks.**

Read and observe the safety instruction you will find in the documentation of the accessories used together with the MCR.

When you use separate air/gas supplies for heating and shaft cooling, proceed as follows. It is assumed that the air supply unit has been installed correctly.

1. Close the stop cock on the compressed air distributor.
2. Disconnect the short air hose (Fig. 18, ③) from the two lower connectors on the flow meter marked "Heating". To disconnect the hose, push back the sleeve of the connector and pull out the hose. The connectors are self-locking.
3. Connect the gas supply to the inlet for additional gas supply (middle connector of the FMU, Fig. 18, ②). The input pressure of the FMU needs to be constant, the recommended input pressure is 3 to 5 bar. The diameter of the connector is 6 mm, suitable for a 4/6 mm hose (inner/outer diameter).
4. Open the gas supply and adjust the flow rate.

### 4.15 Mounting a Magnetic Valve



#### CAUTION

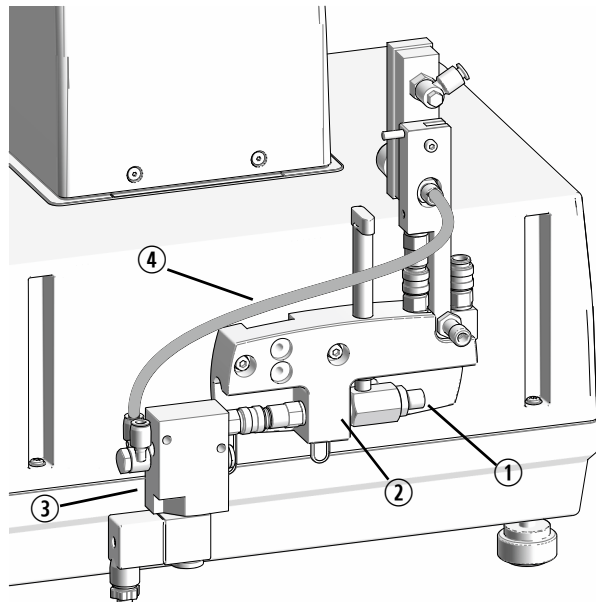
##### **General Risks.**

Read and observe the safety instruction you will find in the documentation of the accessories used together with the MCR.

A magnetic valve controls the flow of separate

air/gas supplies automatically.

1. Connect the magnetic valve (see Fig. 21, ③) to the out connector of the compressed air distributor (see Fig. 21, ②).
2. If not done before, connect the air/gas supply to the air in connector of the compressed air distributor (Fig. 21, ①).
3. Connect the cable to the connector "FMU" of the ASU board (Fig. 7, ⑫) on the left side of the instrument.
4. Disconnect the short air hose (Fig. 18, ③) on the rear side of the FMU and keep it for later use.
5. Connect the hose (Fig. 21, ④) between the valve and the middle rear connector (Fig. 18, ②) on the FMU.
6. Open the air/gas supply and adjust the flow rate.



- 1 Air in connector
- 2 Air distributor
- 3 Magnetic valve
- 4 Hose

Fig. 21: Magnetic valve

## 5 Operating the Instrument

### 5.1 Switching on the Instrument

When you have finished connecting all cables and hoses, switch on the MCR with the main power switch on its left side (Fig. 7, ③).

While the instrument is booting, a progress indicator is shown on the display.

After the MCR has finished the boot procedure and is ready, the following screen is displayed:

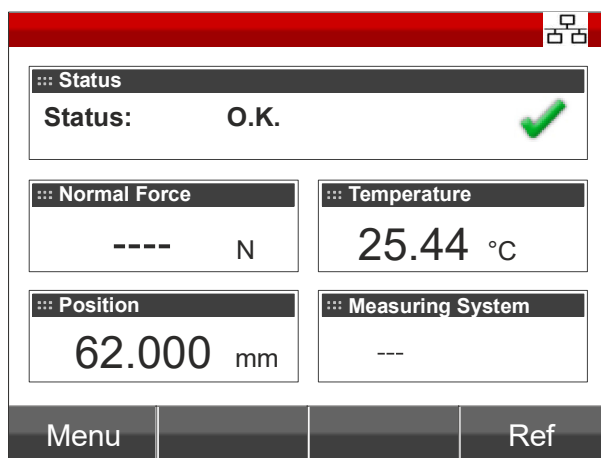


Fig. 22: MCR ready

#### NOTICE

Do not continue if an error message is displayed. Especially if "NO AIR PRESSURE!" is displayed, check the air supply.

Physical properties such as normal force, temperature and gap are displayed on the screen.

The bottom line of the screen displays the functions that can be carried out with the respective softkey below.

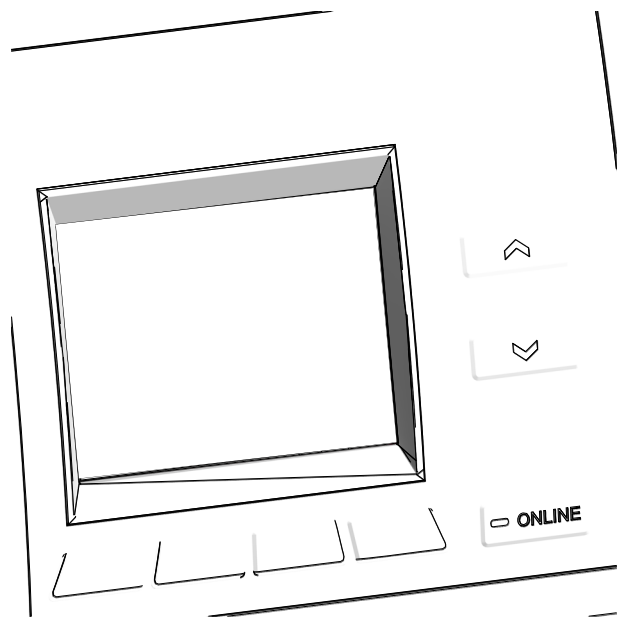


Fig. 23: Front view

### 5.2 The MCR Display

Table 7: MCR Display (see Fig. 22)

|                                                                                                                                                                         |                                                                                                                                                                                                                               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | The top line of the display shows the current connection which can either be Ethernet or USB.                                                                                                                                 |
| <b>Status</b>                                                                                                                                                           | This field displays the current status of the MCR. When selected in the menu (see section 5.4), it also displays the active pressure for the air bearing.                                                                     |
| <b>Normal Force</b>                                                                                                                                                     | This field displays the normal force acting on the air bearing. When the normal force limit is exceeded, the background of this field turns red. The limit depends on the active moving profile, which is set in RheoCompass. |
| <b>Temperature</b>                                                                                                                                                      | This field displays the current temperature of the temperature device. The background of this field turns red when the temperature device has reached its limits.                                                             |

**Table 7: MCR Display (see Fig. 22)**

|                         |                                                                                                                                                                                                                                                                                                 |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Position</b>         | This field displays the current measuring gap. The value is calculated from the position of the measuring head and depends on the mounted measuring geometry and the temperature device. The background of this field turns red when the position of the measuring head has reached its limits. |
| <b>Measuring System</b> | This field displays the name of the currently mounted measuring geometry.                                                                                                                                                                                                                       |

### 5.3 The MCR Operating Panel

The operating panel on the front of the instrument consists of the display, the four softkeys, the up and down button and the ONLINE button.

The function of the four softkeys may change depending on the current operating state. The relevant function is always displayed in the bottom line of the display.



#### CAUTION

##### ***Moving parts.***

There is a risk of body parts being pinched by the moving measuring head.  
Keep clear of the measuring head while it is moving.

**Table 8: Button Functions**

| Button                                                                              | Description                                                                                                                                                                                                                                                               |
|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | With this button you can move the measuring head upwards when the MCR is in offline mode.<br>This button is also used to navigate within the MCR menu.                                                                                                                    |
|  | With this button you can move the measuring head downwards when the MCR is in offline mode.<br>This button is also used to navigate within the MCR menu.                                                                                                                  |
|  | With this button you can switch between online and offline mode. When the white LED is on, the MCR is in online mode.<br>In case of an emergency, it can also be used to interrupt any movements of the measuring head, when the MCR is being controlled by the software. |
|  | With this softkey you open the MCR menu.                                                                                                                                                                                                                                  |
|  | With this softkey you can move the measuring head to its reference position.                                                                                                                                                                                              |
|  | With this softkey you can leave the MCR menu without saving any changes.                                                                                                                                                                                                  |
|  | This softkey becomes visible when the MCR menu is active. When you press this button the selected setting is opened for editing.                                                                                                                                          |
|  | This softkey becomes visible when the measuring head of the MCR is at the lowest position. With this softkey you can move the measuring head further down to its parking position (see section 7.3).                                                                      |

**Table 8: Button Functions**

| Button                                                                            | Description                                                                                     |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
|  | After changing settings in the MCR menu, you use this softkey to save and activate the changes. |
|  | With this softkey you can select the value of a setting from a list of available values.        |
|  | When a test is running, you can interrupt it with this softkey.                                 |

**TIP:** When the MCR is online and remotely controlled by the PC software, the softkey STOP and the button ONLINE can be used to interrupt the remote control and stop any movement of the measuring head in case of an emergency.

When the MCR is controlled by the RheoCompass Software, the following additional functions are available on the operating panel:

**Table 9: Additional Softkey Buttons with RheoCompass**

| Button                                                                              | Description                                                                                     |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
|  | This softkey starts the initialization of the instrument.                                       |
|  | This softkey starts the determination of the zero gap position.                                 |
|  | This softkey starts the motor adjustment.                                                       |
|  | If there are more than 4 softkeys available, you can switch to the next page with this softkey. |
|  | With this softkey you can switch back to the previous page.                                     |
|  | With this softkey you can move the measuring head to the active load position.                  |
|  | With this softkey you can move the measuring head to the active waiting position.               |
|  | With this softkey you can move the measuring head to the active measuring position.             |

**Table 9: Additional Softkey Buttons with RheoCompass**

| Button                                                                            | Description                                                                                                                               |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
|  | After pressing the softkey Adjust, you can start the motor adjustment with this softkey.                                                  |
|  | This softkey is used to stop certain actions. Whenever this softkey is available, you can interrupt the current action with this softkey. |
|  | With this softkey you can start a test that is prepared by the RheoCompass software.                                                      |
|  | This softkey is used to confirm certain actions or questions.                                                                             |

## 5.4 MCR Menu

In the MCR menu you will find various setting that you may change as required. Table 10 shows all available settings.

**To change a setting proceed as follows:**

1. Press the softkey .
2. Use the  and  buttons to select the setting you want to change.
3. Press the softkey .
4. Use the  and  buttons to change the value of the setting and press the softkey  to set the value (the changed values do not become active yet).
5. Return to step 2 for any other setting you want to change.
6. When finished amending the settings, press the softkey  to save the new values (now the changes become active) or press  to discard the changes.

**Table 10: MCR Menu**

| Setting            | Possible Values | Description                                                                                                                       |
|--------------------|-----------------|-----------------------------------------------------------------------------------------------------------------------------------|
| Connection         | Ethernet        | The connection to the PC running the software is established via Ethernet network                                                 |
|                    | USB             | The connection to the PC running the software is established via USB.                                                             |
|                    | RS 232          | This connection method is reserved for service purposes. Do not use it.                                                           |
| Status Information | OFF             | The MCR doesn't show any status information.                                                                                      |
|                    | ON              | The MCR shows various status information.                                                                                         |
|                    | Air Pressure    | The MCR shows the air pressure of the air bearings.                                                                               |
| Motion Warning     | ON<br>OFF       | Here you can turn the motion warning on and off. The motion warning sounds an acoustic signal while the measuring head is moving. |

Table 10: MCR Menu

| Setting          | Possible Values | Description                                                                                                                                                                                              |
|------------------|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Show Temperature | OFF<br>ON       | With this setting you can turn the display of the measured temperature on and off. This might be desired when using a value correction in the software and the uncorrected value shall not be displayed. |
| Error Warning    | OFF<br>ON       | When this setting is turned OFF, error warnings coming from the software RheoCompass are suppressed.                                                                                                     |

## 5.5 MCR Maintenance Indicator

The MCR should be maintained and calibrated by qualified service technicians in regular intervals. To remind you of this service, the MCR has a built-in maintenance countdown.

From 30 days before the planned maintenance date the MCR will display the number of remaining days in the title line of the MCR display. After the planned

date the maintenance countdown will continue with negative numbers.

The MCR Maintenance Indicator does not affect the performance of the MCR in any way.

The maintenance countdown will be reset by the service technician when the requested maintenance is performed. If you want this service to be performed, please contact your local Anton Paar representative.



Fig. 24: MCR maintenance indicator

## 6 Performing a Measurement

Measurements can only be performed together with a PC and the rheometer software.

You will find further information in the RheoCompass manual.

**Tip:** *You will also find video guided measuring templates in the RheoCompass software.*

To operate the MCR, it is required that the installation has been carried out as described in section 4. The accessories and the rheometer software also have to be installed. Information on the accessories is found in the respective manual, information on the installation and operation of the software is found in the software manuals on the provided USB storage device.

### 6.1 Start-up and Initialization

#### NOTICE

Make sure that the air supply and filter system are connected and working at the correct pressure.

1. To start up the instrument, switch it on. Then wait for the instrument to boot; this takes approx. one minute. The instrument is ready when the display shows "Status: O.K." in the first line.
2. Start your computer and the operating system, then start the rheometer software.
3. Switch on the accessory / accessories, for example an external temperature controller or water bath (if applicable).
4. Initialize the instrument from the software to establish communication.

During initialization, the measuring head will move to the top position to check the gap sensor. The rotor will perform several revolutions at high speed to check the position sensor.

**TIP:** *If this is the first start-up of the instrument you should carry out the motor adjustment and, if necessary, the determination of the moment of inertia for the measuring geometry you are going to use.*

5. If this is not the first start-up, you can proceed with the measurement.



#### CAUTION

##### **Extreme temperature.**

The measuring geometry, the sample and parts of the accessory may reach temperatures far below or above room temperature. Allow the equipment to reach room temperature or make sure you are protected adequately before touching any of these parts.

6. Send the required temperature to the accessory and mount the measuring geometry. For cylinder systems go to the measuring position and wait for thermal equilibrium. For measuring geometries where a zero gap is required start the zero gap procedure and move to the measuring position after the procedure has been finished. Wait for thermal equilibrium and repeat the zero gap.
7. Set up the measurement parameters as described in the software manual.
8. Move up the instrument head and load the sample.
9. Move to measuring position.  
For cone-plate and parallel-plate systems the movement stops at trimming position. Trim the sample and then move to the measuring position.
10. Wait for thermal equilibrium and start the measurement.

#### NOTICE

Avoid scratching or otherwise damaging the measuring geometry and / or accessory.

11. After the measurement, disconnect the measuring geometry and move up the instrument head.
12. Remove the sample and clean both upper and lower measuring geometries.
13. Re-mount the measuring geometry for the next measurement.

The setting of the measurement parameters and the evaluation of the rheological data are very dependent on the sample and the selected measurement type. It would far exceed the scope of this manual to describe the rheological background. For further reading the "Rheology Handbook" (ISBN 978-3-

86630-864-0) or the "Applied Rheology" book (part of delivery) by Thomas Mezger are recommended.

## 6.2 Sample Loading

The sample amount and the handling of the sample during loading are two of the most important factors for the correctness and reproducibility of rheological measurement results.

As most materials are sensitive to external forces, it is essential that all samples are treated as similarly as possible before the measurement. They should be applied carefully to the measuring geometry to avoid influencing the results.

**TIP:** You can find the required sample volume for every measuring geometry in the RheoCompass software.

### 6.2.1 Concentric Cylinder Systems

The sample volume required for concentric cylinder systems is indicated by a marker inside the measuring cup.

Fill the cup with sample up to this mark. After lowering the measuring head to measuring position, the measuring bob should be completely immersed in the sample.

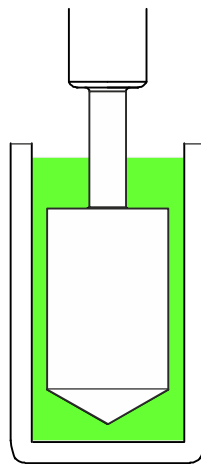


Fig. 25: Concentric cylinder system filling

#### Advantages of a Concentric Cylinder System:

- easy to prevent sample from drying-out (e.g. oil film on top of sample)
- no trimming necessary
- no gap leakage at high shear rates

#### Disadvantages of a Concentric Cylinder System:

- relatively high sample volume required
- difficult to clean
- entrapment of air bubbles in paste-like samples
- turbulences at high shear rates
- slower temperature equilibration

### 6.2.2 Plate-Plate Systems

The correct filling with sample for a plate-plate system is shown in the figure below. The sample should be just outside the rim of the measuring geometry. Ideally, all excess sample is removed at a position (trim position) just above the measuring position; then the measuring geometry is moved to the measuring position. Both too much and too little sample will lead to large errors in the measurement data.

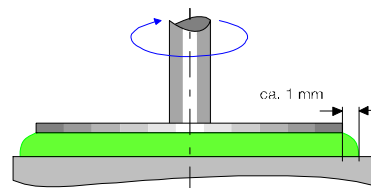


Fig. 26: Plate-Plate system filling

#### Advantages of a Plate-Plate System:

- suitable for high viscous samples
- high shear rate range
- small sample volume
- easy to fill and to clean
- quick temperature equilibration
- measurement gap is adjustable
- samples with small particles can be measured

#### Disadvantages of a Plate-Plate System:

- gap leakage of the substance at too high shear rates

### 6.2.3 Cone-Plate Systems

The correct filling with sample for a cone-plate system is shown in the figure below. The sample should be just outside the rim of the measuring geometry. Ideally, all excess sample is removed at a position (trim position) just above the measuring position; then the measuring geometry is moved to the measuring position. Both too much and too little sample will lead to large errors in the measurement data.

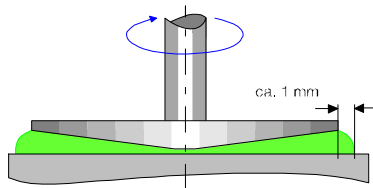


Fig. 27: Cone-Plate system filling

#### Advantages of a Cone-Plate System:

- constant shear rate within entire gap due to cone shape
- small sample volume
- easy to fill and to clean
- quick temperature equilibration

#### Disadvantages of a Cone-Plate System:

- gap leakage of the substance at too high shear rates
- particles in sample can disrupt the measurement
- sample drying effects

### 6.2.4 Double Gap Systems

Put a small amount of sample in the gap of the cup. Then lower the measuring bob to measuring position (the sample shall flow over slightly). Remove excess sample from the top of the cup's center cylinder with a syringe (arrow in Fig. 28).

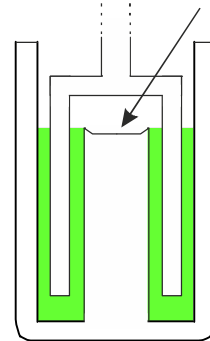


Fig. 28: Double gap system filling

#### Advantages of a Double Gap System:

- suitable for low viscous samples ( $\eta < 100$  mPas)
- accurate temperature within entire cup
- small gap

#### Disadvantages of a Double Gap System:

- sample drying effects
- slow temperature equilibration
- difficult to clean
- turbulences at high shear rates

# 7 Upkeep and Cleaning

Perform the recommended maintenance work regularly to ensure the smooth long-term operation of the instrument.

Also make sure to follow the maintenance instructions provided with any third-party products (e.g. air-compressors, dryers, filters, fluid-circulators).

- Wipe off the MCR with a dry or slightly damp, lint-free cloth. Do not scratch the surface.
- Find a list of all wetted materials below.
- Where applicable check before and during each measurement that the fluid circulator is working properly and the fluid is circulating. If the flow indicator does not work properly, check that the hose is not dirty or blocked, and check that the circulator is not broken.
- Regularly check the hose connections to the MCR. They should not be bent or blocked.
- Regularly check that the supplied air is clean, dry and oil-free, and that the compressed air supply unit meets all necessary requirements

(Appendix A). For details see the documentation of the filter system. In particular:

- Check the air filters: the replacement interval for these elements is described in the Dry-Point instruction manual. Replacement filters are available from Anton Paar.
- Check the membrane air dryer: this element should be replaced after a fixed period of operation described in the DryPoint instruction manual. Note that, in that case, Anton Paar recommends changing the whole air filter + membrane dryer unit.
- Always handle the measuring geometry with care. Even minor damage may cause serious measurement errors. Never use force when you remove the measuring geometry from the sample or when you wipe sample off the measuring geometry.
- We recommend a maintenance contract. Please contact our local representative for details.

**Table 11: Upkeep and Cleaning**

| What?                         | Interval                           | How?                                            |
|-------------------------------|------------------------------------|-------------------------------------------------|
| measuring geometries          | before and after every measurement | clean and wipe dry                              |
| fluid-circulator flow through | weekly                             | check flow indicators <sup>a</sup>              |
| cooling fluid                 | yearly                             | see manufacturer documentation                  |
| fluid-circulator              |                                    | see manufacturer documentation                  |
| air-supply compressor         |                                    | see manufacturer documentation                  |
| filters of air-dryer          | yearly                             | replace filters; see manufacturer documentation |
| maintenance indicator         | see section 5.5                    | request service if necessary                    |

*a If flow through is insufficient, please contact your local representative.*

## 7.1 Cleaning a Jammed Coupling



### CAUTION

#### **Flammable liquids.**

Do not perform the following while the temperature devices are still hot. Wait for the device to cool down to ambient temperatures.

### NOTICE

Do not perform the following with the lower measuring drive. Solvent might go inside the measuring drive and damage it.

Generally keep the MCR coupling clean. Do not oil or grease the coupling, otherwise it could start slipping.

To test the coupling, you can slowly open and close the coupling while checking the normal force display (reset normal force first). The value should not exceed 25 N in either direction before the coupling is fully opened or closed.

- Use cotton buds and Ethanol to clean the inner surface of the coupling. Take care not to damage the transponder contact in the center of the coupling.
- If the sleeve of the coupling is jammed, you can try to carefully drip a very small amount of Ethanol or Isopropanol between the sleeve and the rest of the coupling (see Fig. 29). Don't apply the solvent anywhere else. Don't use any other solvents; some models of the coupling have an NBR O-ring inside that might get damaged. Then move the sleeve up and down until it runs smoothly. Dry the coupling with a lint-free cloth.

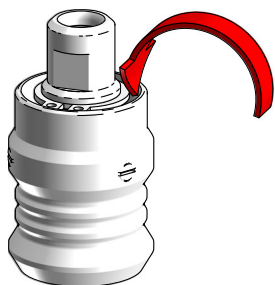


Fig. 29: Dripping solvent into the coupling

## 7.2 Wetted Parts

The following materials are wetted by the measured sample or the solvent:

**Table 12: Sample Wetted Parts**

| Material                   | Description                  |
|----------------------------|------------------------------|
| Stainless Steel (standard) | 1.4404 or 1.4418             |
| Titanium                   | Titanium Grade 5, DIN 3.7165 |
| Hastelloy®                 | Hastelloy® C276, DIN 2.4819  |
| Quartz Glass (QGL)         | Quartz glass Suprasil        |
| Glass (GL)                 | Borosilicate 3.3             |

The following materials are wetted by the cooling fluid:

**Table 13: Cooling Wetted Parts**

| Material         | Description                |
|------------------|----------------------------|
| Brass, Ni coated | Couplings and fittings     |
| Stainless steel  | 1.4310<br>1.4034<br>1.4037 |
| NBR              |                            |
| Nitrile rubber   |                            |

## 7.3 Storing the Instrument

If the MCR is taken out of operation for a longer time period or if you have to send it back for some reason or transport, the measuring head and especially the air bearing have to be secured in a special way.



### CAUTION

#### **Moving parts.**

There is a risk of body parts being pinched by the moving measuring head. Keep clear of the measuring head while it is moving.

**NOTICE**

Do not turn off the air supply before the transport protection is applied and the measuring head is in the parking position.

1. Remove the measuring geometry and (if applicable) the temperature device from your rheometer. If applicable, also remove the protection tube from the measuring head; failure to do so might result in damage to the air bearing.
2. Lay the transport protection on the center of the temperature device flange with the gray foam rubber facing upwards.
3. If the MCR is in online mode, press "ONLINE" and switch the MCR to offline mode (white LED is off).
4. Use the downward arrow to move the measuring head to its lowest position.
5. When the measuring head reaches the lowest position, the softkey "Park" becomes available.
6. Press "Park" and the measuring head will move down even further.  
  
When the position display changes to "---.--- mm", the parking position is reached.
7. Now you can turn off the instrument and disconnect the air supply.
8. Disconnect the cooling water supply and drain the pipes.

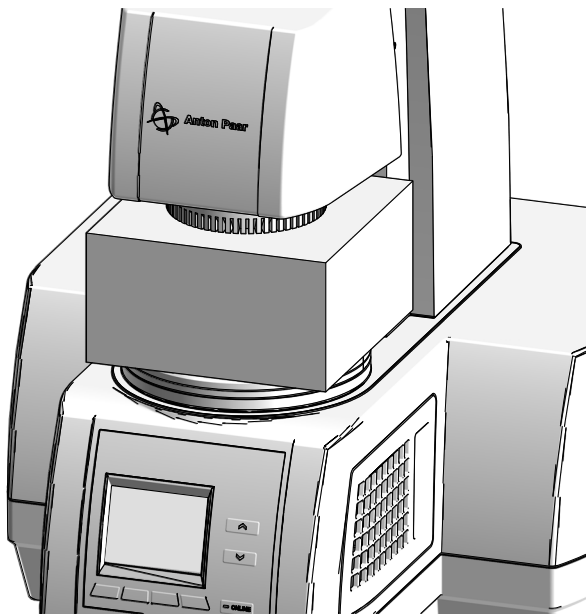


Fig. 30: MCR with transport protection

## 7.4 Packing the Instrument for Transport

This instruction shows you how to pack an MCR of the xx2e series for transport.

**NOTICE**

Please note that the instructions must be carried out carefully, as failures can result in serious damage to the MCR.

For questions or in case of uncertainty regarding the instruction for packing an MCR xx2e please contact your local distributor or Anton Paar GmbH directly.

**Supplied Accessories**

If you didn't keep the packing material the MCR originally was delivered in, you will need the following items to pack an MCR for transportation:

- p/n 102149: Transport protection for MCR measuring head
- p/n 76428: Desiccant bag DESI PAK®, 4 DIN units = 125 g
- p/n 18453: SG-Bag, transparent, 670/450x1100x0.10 mm
- p/n 98947: Two-way pallet
- p/n 98696: Cardboard box, 850x580x680 cm
- p/n 98695: Packing foam material for MCR

Additionally, you will need adhesive packing tape as well as packing clamps and/or transport straps.

**Packing for Transportation****CAUTION****Moving parts.**

There is a risk of body parts being pinched by the moving measuring head. Keep clear of the measuring head while it is moving.

**NOTICE**

Do not turn off the air supply before the transport protection is applied and the measuring head is in the parking position.

1. Prepare the instrument as described in section 7.3.

## 7 Upkeep and Cleaning

2. Fix a desiccant bag (p/n 76428) to the front of the transport protection with adhesive tape.
3. Wrap the instrument with the SG-Bag (p/n 18453). Close the bag tightly with adhesive tape.



### CAUTION

#### **Heavy object.**

The MCR is heavy (up to 60 kg with accessories), therefore adequate lifting by two persons is required to prevent injuries and instrument damage. Never lift the MCR by its head. There are recessed grips at the bottom of the instrument (Fig. 2, ④), which should always be used to lift the MCR.

### NOTICE

The MCR should never be lifted by its head. Use the recessed grips at the rear side and underneath the front of the instrument.

4. Place the bottom part of the cardboard box (p/n 98696) onto the two-way pallet (p/n 98947) and insert one half of the protection foam (p/n 98695).

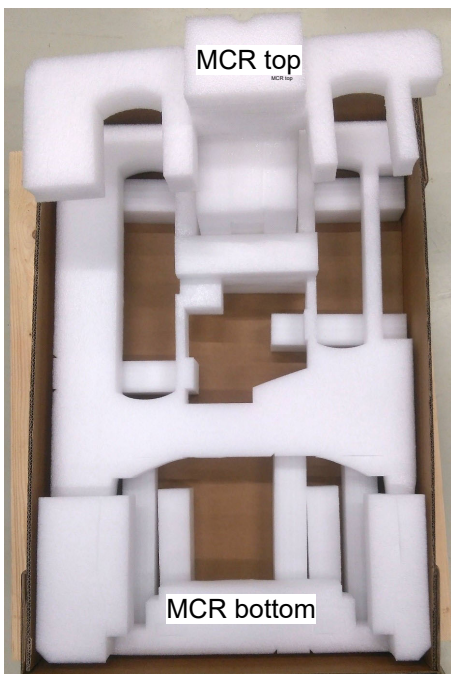


Fig. 31: Lower part of cardboard box and protection foam

5. If you are using the original packing material skip the next step and continue at step 7.
6. Break out the parts of the protection foam indi-

cated in Fig. 32 as follows:

- For MCR 102e (p/n: 241352) and SmartPave 102e (p/n: 241355) remove the yellow and orange parts.
- For MCR 302e (p/n: 241353), MCR 502e Power (p/n: 241354) and MCR 702e MultiDrive (p/n: 241358) additionally remove the red parts.

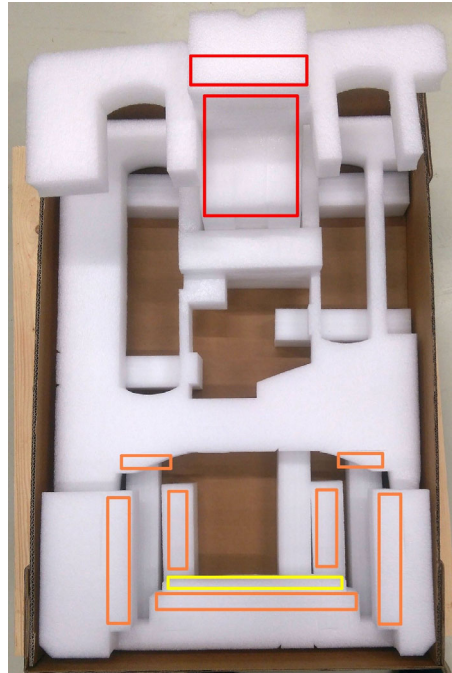


Fig. 32: Lower packing foam break outs

7. Carefully place the MCR onto the packing foam.



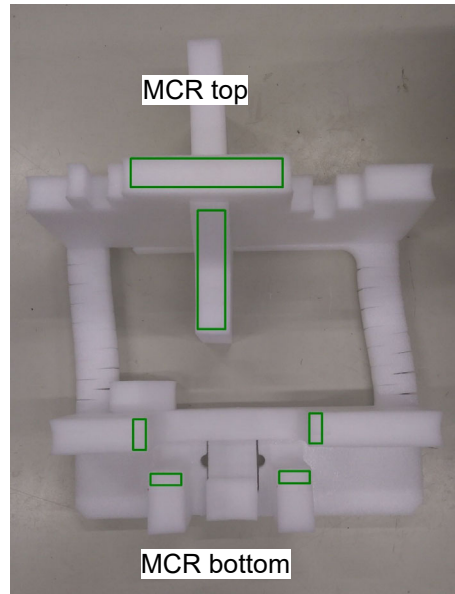
Fig. 33: MCR on lower packing material

- Put the accessory kits and the documentation folder in their place (see Fig. 34).



*Fig. 34: Accessory kits and documentation folder in place*

- If you are using the original packing material skip the next step and continue at step 11.
- Remove the parts of the upper packing foam indicated in green in Fig. 35.



*Fig. 35: Upper packing foam break outs*

- Turn the upper packing foam over and put it onto the MCR.



*Fig. 36: Upper packing foam in place*

- Close the box with adhesive tape and packing clamps. Fasten the box to the two-way pallet with transport straps.

The MCR is now ready for transportation.

## 8 Maintenance and Repair

### 8.1 Maintenance Performed by an Authorized Anton Paar Service Engineer

The MCR xx2e requires periodic maintenance which shall be performed by an authorized Anton Paar Service Engineer. <sup>1</sup>

A missing maintenance may mean that under certain conditions your warranty is no longer valid. <sup>2</sup>

#### Maintenance Interval:

- Maintenance for the MCR xx2e shall be performed once a year.
- Depending on your MCRs configuration, various maintenance kits are available, which are selected by the service technician.

#### Parts excluded from warranty (wear parts):

- Parts of the maintenance kits
- Filters
- O-rings
- Parts made of glass
- Rolling bearings

### 8.2 Repair Performed by an Authorized Anton Paar Representative

In case your instrument needs repair, contact your local Anton Paar representative, who will take care of the necessary steps. If your instrument needs to be returned, request an RMA (Return Material Authorization Number). It must not be sent without the RMA and the filled "Safety Declaration for Instrument Repairs". Please make sure it is cleaned before return.

**TIP:** Find the contact data of your local Anton Paar representative on the Anton Paar website (<http://www.anton-paar.com>) under "Contact".

---

<sup>1</sup> Please contact your Anton Paar representative to get an offer.

<sup>2</sup> For detailed information please see the general terms of delivery (GTD) on the Anton Paar website (<http://www.anton-paar.com>).

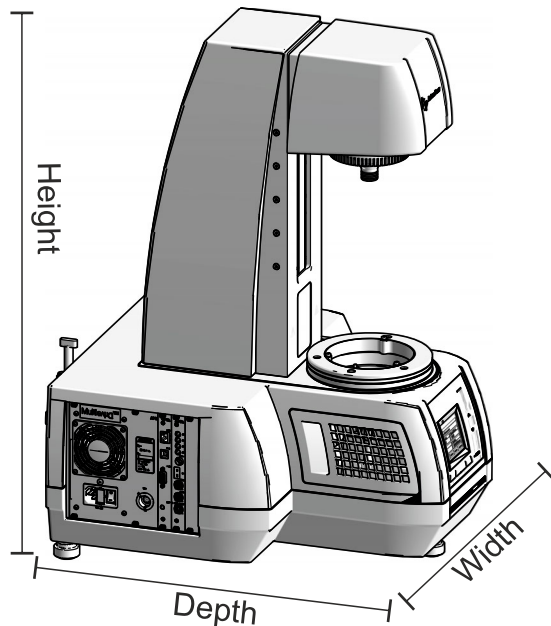
# Appendix A: Technical Data

Table 14: Technical Data

| Environmental Conditions (EN61010): |                                                                                                               |          |          |          |
|-------------------------------------|---------------------------------------------------------------------------------------------------------------|----------|----------|----------|
| Temperature:                        | +15 °C to +35 °C, recommended 23 °C to ±3 °C                                                                  |          |          |          |
| Humidity:                           | 10 to 80 % relative humidity, non-condensing                                                                  |          |          |          |
| Altitude:                           | max. 3000 m                                                                                                   |          |          |          |
|                                     | for indoor use only                                                                                           |          |          |          |
| Overvoltage category:               | II                                                                                                            |          |          |          |
| Degree of pollution:                | 2                                                                                                             |          |          |          |
| Radiated emissions:                 | Class A. This equipment can generate radiated disturbances in residential environment.                        |          |          |          |
| Airborne noise emission:            | < 70 dB (A)                                                                                                   |          |          |          |
| Power supply:                       | Grounded 16 A power socket is mandatory. Protection class I (IEC 61140)                                       |          |          |          |
| Voltage:                            | AC 100 V to 230 V; max. ±10% fluctuation                                                                      |          |          |          |
| Frequency:                          | 50 to 60 Hz                                                                                                   |          |          |          |
|                                     | MCR 102e                                                                                                      | MCR 302e | MCR 502e | MCR 702e |
| Power consumption:                  | 900 W                                                                                                         |          |          |          |
| Fuse:                               | T10 AH                                                                                                        |          |          |          |
| Weight:                             | 42 kg                                                                                                         | 47 kg    |          |          |
| Size:                               |                                                                                                               |          |          |          |
| Width                               | 444 mm                                                                                                        | 444 mm   | 444 mm   |          |
| Height                              | 678 mm                                                                                                        | 731 mm   | 753 mm   |          |
| Depth                               | 586 mm                                                                                                        | 586 mm   | 586 mm   |          |
| Air/Gas Supply:                     |                                                                                                               |          |          |          |
| Quality:                            | Clean, dry and oil-free (ISO 8573.1, class 1.3.1)                                                             |          |          |          |
| Air pressure:                       | 6 bar recommended (min. 5 bar, max. 10 bar)                                                                   |          |          |          |
| Air consumption average:            | 1.8 m³ <sub>N</sub> /h (MCR without any accessories)<br>4.7 m³ <sub>N</sub> /h (complete system in operation) |          |          |          |
| Circulator:                         |                                                                                                               |          |          |          |
| Temperature:                        | -20 °C to +70 °C                                                                                              |          |          |          |
| Flow rate:                          | 0.4 L/min to 0.7 L/min                                                                                        |          |          |          |
| Maximum pressure:                   | 1 bar                                                                                                         |          |          |          |

**Table 14: Technical Data**

|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Coolant: | <p>Mixture of 60 % distilled water and 40 % concentrate of engine coolant antifreeze with corrosion protection suitable for aluminum.</p> <p>Water must not contain chlorine or added minerals. The use of pure distilled or deionized water is not permitted.</p> <p>The pH-value of the mixture must be between pH = 7 and pH = 9 (minimum pH = 8 at time of installation).</p> <p>Recommended coolants with corrosion protection are BASF G30, G40 and G48 or equivalent products of other suppliers.</p> |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|


**Fig. 37: Dimensions**
**NOTICE**

Only use coolants as defined by the manufacturer of the circulator. Do not use pure tap water. Do not use silicone oil when silicone hoses are used (e.g. T-PTD 200).


**CAUTION**
**Highly Inflammable**

Do not use ethanol as coolant. The quick couplings are not sufficiently proof for ethanol.

**Table 15: Technical Data and Specifications**

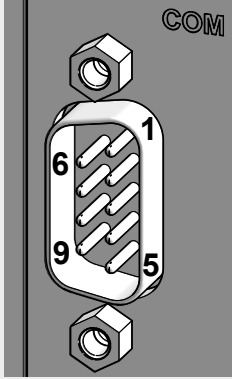
|                         |                                                                                                    | MCR 102e         | MCR 302e         | MCR 502e         | MCR 702e         |
|-------------------------|----------------------------------------------------------------------------------------------------|------------------|------------------|------------------|------------------|
| Bearing                 |                                                                                                    | Air              | Air              | Air              | Air              |
| Min. torque rotation    | nNm                                                                                                | 5                | 1                | 100              | 1                |
| Min. torque oscillation | nNm                                                                                                | 5 <sup>a</sup>   | 0.5              | 50               | 0.5              |
| Max. torque             | mNm                                                                                                | 200              | 230              | 300              | 230              |
| Deflection angle        | μrad                                                                                               | 0.5 to ∞         | 0.05 to ∞        | 0.1 to ∞         | 0.05 to ∞        |
| Max. speed              | rad/s                                                                                              | 314              | 314              | 220              | 314              |
| Min. frequency          | rad/s                                                                                              | 10 <sup>-7</sup> | 10 <sup>-7</sup> | 10 <sup>-7</sup> | 10 <sup>-7</sup> |
| Max. frequency          | rad/s                                                                                              | 628              | 628              | 628              | 628              |
| Normal force range      | N                                                                                                  | 0.01 to 50       | 0.005 to 50      | 0.01 to 70       | 0.005 to 50      |
| <b>Computer:</b>        | See the information you will find on the USB storage device you received together with RheoCompass |                  |                  |                  |                  |

<sup>a</sup> 2 nNm with activated TruStrain option.

## Appendix A.1: Pin Assignments

All images of connectors show the view from outside the MCR.

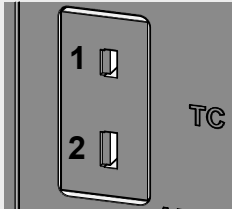
**Table 16: Serial Interface COM**

|  | Pin | Name | Description   |
|-----------------------------------------------------------------------------------|-----|------|---------------|
|                                                                                   | 1   | N.C. | not connected |
|                                                                                   | 2   | RXD  |               |
|                                                                                   | 3   | TXD  |               |
|                                                                                   | 4   | N.C. | not connected |
|                                                                                   | 5   | W-   |               |
|                                                                                   | 6   | N.C. | not connected |
|                                                                                   | 7   | RTS  |               |
|                                                                                   | 8   | CTS  |               |
|                                                                                   | 9   | W+   |               |

**Table 17: Pt100**

|  | Pin | Pt100      | Description |
|-------------------------------------------------------------------------------------|-----|------------|-------------|
|                                                                                     | 1   | Pt100+     |             |
|                                                                                     | 2   | Pt100_Sig+ |             |
|                                                                                     | 3   | Pt100_Sig- |             |
|                                                                                     | 4   | Pt100-     |             |

**Table 18: Thermo Couple**

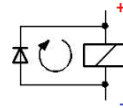
|  | Pin | TC       | Description |
|-------------------------------------------------------------------------------------|-----|----------|-------------|
|                                                                                     | 1   | TC_Sig + |             |
|                                                                                     | 2   | TC_Sig - |             |

**Table 19: Analog outputs A1 to A4**

|  | Pin                           | Name          | Description                                                          |
|-----------------------------------------------------------------------------------|-------------------------------|---------------|----------------------------------------------------------------------|
|                                                                                   | inner                         | analog signal | Analog representation of a value as voltage between -10 V and +10 V. |
|                                                                                   | outer                         | GND           | Signal ground                                                        |
|                                                                                   | <b>Specifications:</b>        |               |                                                                      |
|                                                                                   | Output type                   |               | ground referred                                                      |
|                                                                                   | Output voltage                |               | $\pm 10$ V                                                           |
|                                                                                   | Max. output current           |               | $\pm 10$ mA                                                          |
|                                                                                   | Max. capacitive load          |               | 820 pF                                                               |
|                                                                                   | Resolution                    |               | 0.305 mV                                                             |
|                                                                                   | Accuracy                      |               | $\pm 10$ mV (theoretically < 2.5 mV)                                 |
|                                                                                   | Output short circuit duration |               | indefinite                                                           |

**NOTICE**

All devices connected to the AUX or POWER/FMU connector must be equipped with flyback diodes.

**Table 20: AUX1 and AUX2**

|  | Pin                            | Name | Description                                         |
|--|--------------------------------|------|-----------------------------------------------------|
|  | 1                              | RGND | Remote GND                                          |
|  | 2                              | RSW2 | Relay switch 1                                      |
|  | 3                              | R+   | Remote +                                            |
|  | 4                              | RSW1 | Relay switch 2                                      |
|  | 5                              | AIN- | Analog IN-                                          |
|  | 6                              | AIN+ | Analog IN+                                          |
|  | 7                              | N.C. | not connected                                       |
|  | <b>Specifications:</b>         |      |                                                     |
|  | Input type                     |      | differential                                        |
|  | Differential input voltage     |      | $\pm 10$ V                                          |
|  | Absolute maximum input voltage |      | $\pm 30$ V (any pin to GND, no damage)              |
|  | Differential input resistance  |      | $10\text{ M}\Omega \parallel 10\text{ pF}$          |
|  | Common mode input resistance   |      | $100\text{ K}\Omega$                                |
|  | Common mode input voltage      |      | $\pm 7$ V                                           |
|  | Resolution                     |      | $0.305\text{ mV}$                                   |
|  | Accuracy                       |      | $\pm 10\text{ mV}$ (theoretical $< 2.5\text{ mV}$ ) |
|  | Max. current relay contact     |      | $2\text{ A DC / AC}$ (ohmic load)                   |
|  | Max. voltage relay contact     |      | $38\text{ V DC}, 30\text{ V AC}$ (ohmic load)       |
|  | Voltage supply                 |      | $25\text{ V DC} \pm 5\%$                            |
|  | Max current long term          |      | $300\text{ mA}$                                     |
|  | Output short circuit duration  |      | indefinite                                          |