

# Q Series™ MCA70

## Mechanical Cooling Accessory



## Getting Started Guide



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The material contained in this manual, and in the online help for the software used to support this instrument, is believed adequate for the intended use of the instrument. If the instrument or procedures are used for purposes other than those specified herein, confirmation of their suitability must be obtained from TA Instruments. Otherwise, TA Instruments does not guarantee any results and assumes no obligation or liability. TA Instruments also reserves the right to revise this document and to make changes without notice.

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159 Lukens Drive  
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# Introduction

## Important: TA Instruments Manual Supplement

Please click the [TA Manual Supplement](#) link to access the following important information supplemental to this Getting Started Guide:

- TA Instruments Trademarks
- TA Instruments Patents
- Other Trademarks
- TA Instruments End-User License Agreement
- TA Instruments Offices

## Notes, Cautions, and Warnings

This manual uses NOTES, CAUTIONS, and WARNINGS to emphasize important and critical instructions. In the body of the manual these may be found in the shaded box on the outside of the page.

**NOTE:** A NOTE highlights important information about equipment or procedures.

**CAUTION:** A CAUTION emphasizes a procedure that may damage equipment or cause loss of data if not followed correctly.

**A WARNING indicates a procedure that may be hazardous to the operator or to the environment if not followed correctly.**



## Regulatory Compliance

### *Safety Standards*

#### **For Canada**

CAN/CSA-C22.2 No. 1010.1-92 Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1: General Requirements + Amendments.

#### **For European Economic Area**

(In accordance with Council Directive 2006/95/EC of 12 December 2006 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits.)

EN 61010-1:2001 Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1: General Requirements + Amendments.

#### **For United States**

UL61010A-1:2004 Electrical Equipment for Laboratory Use; Part 1: General Requirements.

# **Electromagnetic Compatibility Standards**

## **For Australia and New Zealand**

AS/NZS CISPR11:2004 Limits and methods of measurement of electronic disturbance characteristics of industrial, scientific and medical (ISM) radio frequency equipment.

## **For Canada**

ICES-001 Issue 4 June 2006 Interference-Causing Equipment Standard: Industrial, Scientific, and Medical Radio Frequency Generators.

## **For the European Economic Area**

(In accordance with Council Directive 2004/108/EC of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility.)

EN61326-1:2006 Electrical equipment for measurement, control, and laboratory use-EMC requirements-Part 1: General Requirements. Emissions: Meets Class A requirements per CISPR 11. Immunity: Per Table 3 Protected EM environment.

## **For the United States**

CFR Title 47 Telecommunication Chapter I Federal Communications Commission, Part 15 Radio frequency devices (FCC regulation pertaining to radio frequency emissions).

## Safety

**WARNING:** The operator of this accessory is advised that if the equipment is used in a manner not specified in this manual, the protection provided by the equipment may be impaired. Operation of this accessory is intended for the QNX-based TMA Q400 with instrument software version 22.4 or higher only.



**WARNING:** The MCA70 contains hazardous materials (i.e., flammable refrigerants). Contact TA Instruments prior to packaging for shipment.



**WARNING:** The manufacturer's documentation shall state which potentially poisonous or injurious gases can be liberated, and the quantities. These gases are as follows:


1st Stage R1270, (Propylene), approximately 14 g

2nd Stage (Blend) R1150 (Ethylene) & R290 (Propane), approximately 22 g



## Instrument Symbols

The following labels are displayed on the MCA70 system for your protection:

| Symbol  | Explanation   |
|---|---|
|  | This symbol indicates that you should read this Getting Started Guide for important safety information. This guide contains important warnings and cautions related to the installation, operation, and safety of the MCA70 system. |

Please heed the warning labels and take the necessary precautions when dealing with those parts of the accessory. The *MCA Q Series Getting Started Guide* contains cautions and warnings that must be followed for your own safety.

## *Electrical Safety*

You must unplug the instrument before doing any maintenance or repair work; voltages as high as 120/240 volts AC are present in this system.



**WARNING:** High voltages are present in this instrument. Maintenance and repair of internal parts must be performed only by TA Instruments or other qualified service personnel.

## *Water Condensation*



**WARNING:** Some of the TMA and MCA surfaces get cold during use of the MCA. The cold surfaces can cause condensation and, in some cases, frost to build up. This condensation may drip to the floor. Provisions to keep the floor dry should be made. A slipping hazard may result if the condensation is not cleaned up.



**WARNING:** Do not allow condensed moisture/water to accumulate in the container that surrounds the TMA furnace. This can create an unsafe condition. Lift the MCA70 cooling head and verify that the drain hole is clear and no water has accumulated before operating the TMA.

## *Thermal Safety*

During an experiment, the cooling head can become very cold to the touch.

**CAUTION:** Some surfaces of the MCA and TMA system may get extremely cold during the use of the MCA70 for cooling experiments, especially the MCA70 cooling head. This presents a danger to exposed skin coming in contact with and adhering to the cold surfaces. Use extreme caution.

## *Temperature Range*



**WARNING:** Do NOT allow the TMA furnace to exceed 60 °C with the MCA70 cooling head installed and the MCA70 power (or cooling) off, or if the communication cable is unplugged. Serious damage and/or injury could occur.

**CAUTION:** Remove the MCA70 cooling head from the TMA and disconnect the communications cable when running isothermal experiments above 400°C. Damage to the unit can occur if used at high temperatures for extended periods.

### *Lifting the Instrument:*

**WARNING:** Due to the size and weight of the cooling accessory, the MCA70 should always be lifted by two people to prevent injury or rolled from place to place.





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# Chapter 1:

## Introducing the Mechanical Cooling Accessory

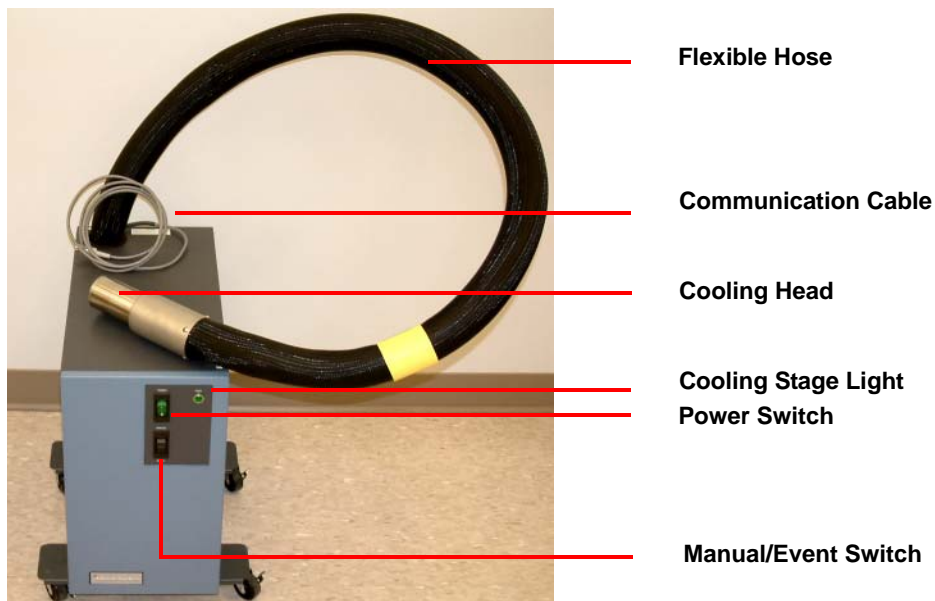
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### Overview

The Mechanical Cooling Accessory (MCA70) is designed to provide you with a source of continuous cooling for the TMA, while eliminating the need for liquid nitrogen or dry ice. It is a portable refrigeration system that can be placed on the floor under a lab bench to conserve counter space.

**CAUTION: The MCA coolers are not compatible with the accessory outlets on the back of the instrument due to power requirements.**

The MCA70 consists of a two-stage, cascade, vapor compression refrigeration system with an attached cooling head. The MCA70 can be used for experiments requiring cooling within an operating range of -70 to 400°C. The maximum rate of cooling depends on the temperature range of your experiment.



**Figure 1** MCA70

The MCA70 components are described below:

**Power Switch:** Controls power to the compressors and other internal controls in conjunction with the MANUAL/EVENT switch. The power switch on the MCA70 contains an integral breaker. Overload causes the breaker to trip. Moving the switch to the OFF position to reset the breaker will allow the unit to be turned on again if the cause of the overload has been eliminated.

**Manual/Event Switch:** The MANUAL mode provides power to the compressors when the main power switch is on. The EVENT mode provides power to the compressors when the Event signal is toggled ON

via the controller (the main power switch must also be on). This feature permits the operator to turn the MCA70 on and off via the controller.



**WARNING: TA recommends the MCA70 be turned on at the beginning of testing and remain on until all testing is completed at the end of the day. Do not turn the MCA70 on and off for each test via use of the Event signal in any manner, as this can cause an unsafe condition.**

**Cooling Stage Light:** Comes on 2 to 3 minutes after the first stage compressor is activated and indicates that the second stage compressor is now working. The probe head will begin to get cold very quickly.

**Flexible Hose:** Conveys refrigerant from the second stage condenser to the probe head for cooling and then back to the compressor.

**Cooling Head:** Boiling refrigerant in the cooling head removes heat from the TMA down to  $-70^{\circ}\text{C}$ .

**Communication Cable:** This cable must be connected to the rear of the TMA when using with the MCA70. The communication cable has two important functions:

- It interfaces with the TMA software to acknowledge that an MCA70 is being used to cool the TMA (as opposed to liquid nitrogen or no active cooling).
- It connects the MCA70 over-temperature safety switch (located inside the MCA70 probe head assembly) to the TMA. This safety switch prevents overheating of the MCA70 cooling head by the TMA furnace. The switch will not activate as long as the MCA70 is providing cooling to the TMA. If the MCA70 is turned off (manually or via the Event Off signal), the over-temperature switch will activate when the cooling head exceeds  $70^{\circ}\text{C}$ . Switch activation terminates the TMA method and shuts off TMA furnace power, thus protecting the MCA70 cooling head from becoming overheated. The switch must cool to approximately  $60^{\circ}\text{C}$  before it resets and makes the TMA operational again.

## Instrument Specifications

The specifications in Tables 1 and 2 apply to the Mechanical Cooling System.

**Table 1: Technical Specifications**

| Item/Area                        | Specifications  |
|----------------------------------|---|
| Instrument Compatibility         | TMA Q400/Q400EM (QNX-based instruments with instrument software version 22.4 or higher)   |
| Size<br>Height<br>Width<br>Depth | 46 cm (18 in.)<br>26 cm (10 in.)<br>51 cm (20 in.)  |
| Power Requirements               | 120 Vac/12 A/60 Hz<br>220 Vac/6 A/50 Hz   |
| Weight                           | 47.7 kg (105 lbs)   |
| Cooling Capacity                 | –70°C   |
| Feed Hose                        | 2 m (6 ft) insulated<br>from MCA70 to cooling head  |
| Refrigerants                     | 1st Stage R1270, (Propylene),<br>approximately 14 g.<br>2nd Stage (Blend) R1150<br>(Ethylene) & R290 (Propane),<br>approximately 22 g.  |
| Clearance                        | Additional clearance 45 to 60 cm (18 to 24 inches) is recommended above the MCA to allow routing of the cooling line to the instrument without putting undue stress on the line. Additional clearance 15 to 30 cm (6 to 12 inches) is also recommended at the back and on the two sides to allow adequate dissipation of heat from the RCS condenser. |
| Operating Environment Conditions | Temperature: 15–30 °C<br>Conditions Relative Humidity: 5–80% (non-condensing)<br>Installation Category II<br>Pollution Degree 2<br>Maximum Altitude: 2000 m (6560 ft)   |

Table 2, on the next page, shows the performance specifications for MCA70/TMA cooling.

**Table 2: MCA70/TMA Performance Specifications**

| Item/Area                          | MCA70 Specifications  |
|------------------------------------|---|
| Temperature Range                  | –70 to 400 °C   |
| Weight                             | With one universal power supply: 18 kg (40 lbs)   |
| Power                              | 90 to 264 VAC, 47 to 63 Hz, 12 amps maximum   |
| Power outlet                       | One or two 24 VDC, 6 amps maximum (transducer power)<br>One or two $\pm 54$ V (transducer heater power) |
| Operating environmental conditions | Temperature: 15 to 35°C<br>Relative humidity: 5 to 80% (non-condensing)<br>Maximum altitude: 2000 m     |

**CAUTION: Remove the MCA70 cooling head from the TMA and disconnect the communications cable when running isothermal experiments above 400°C. Damage to the unit can occur if used at high temperatures for extended periods.**

# Chapter 2:

## Installing the MCA70

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Installation of the MCA70 includes connecting the hose to the drain cup, installing the drain cup, and placing the cooling head assembly on the TMA. Each of these steps is described in the following sections.

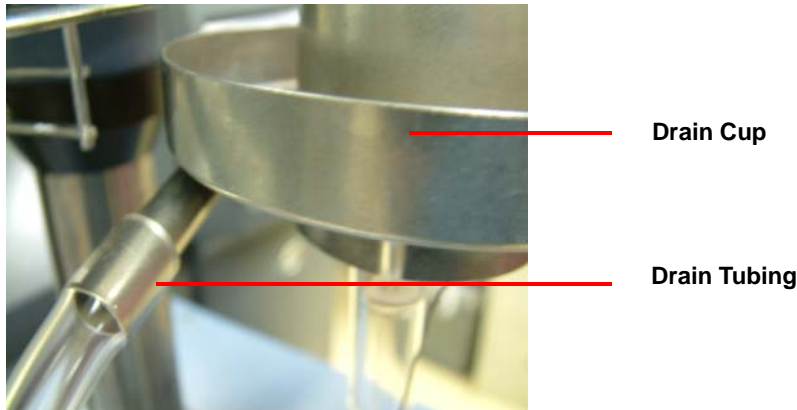
**CAUTION: Due to the size and weight of the cooling accessory, the MCA70 should always be lifted by two people to prevent injury or rolled into position.**

### *Installing the MCA70*

The MCA70 unit connects to the TMA via a cooling head. This cooling head is made up of an internal heat exchanger, and various other components. The following steps describe the procedure for making the connection between the TMA and the MCA70 unit.

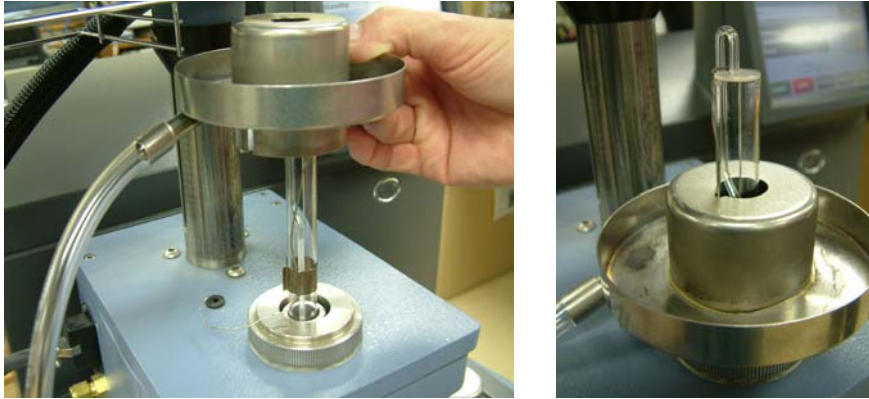
When using the Mechanical Cooling Accessory with the TMA, follow these steps:

- 1 Remove the existing stage shield from the TMA, taking care not to bend or pull off the thermocouple or break the probe.
- 2 Obtain the drain cup and tubing from the accessory kit. Push one end of the tubing onto the drain outlet. It will need to run from the drain cup to a catch container such as a beaker or other type of container to catch condensation.



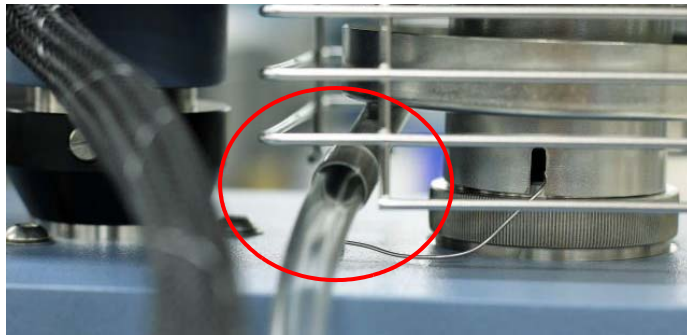
**Figure 2** Drain tubing and cup.

- 3 Carefully lower the drain cup over the TMA probe and thermocouple.



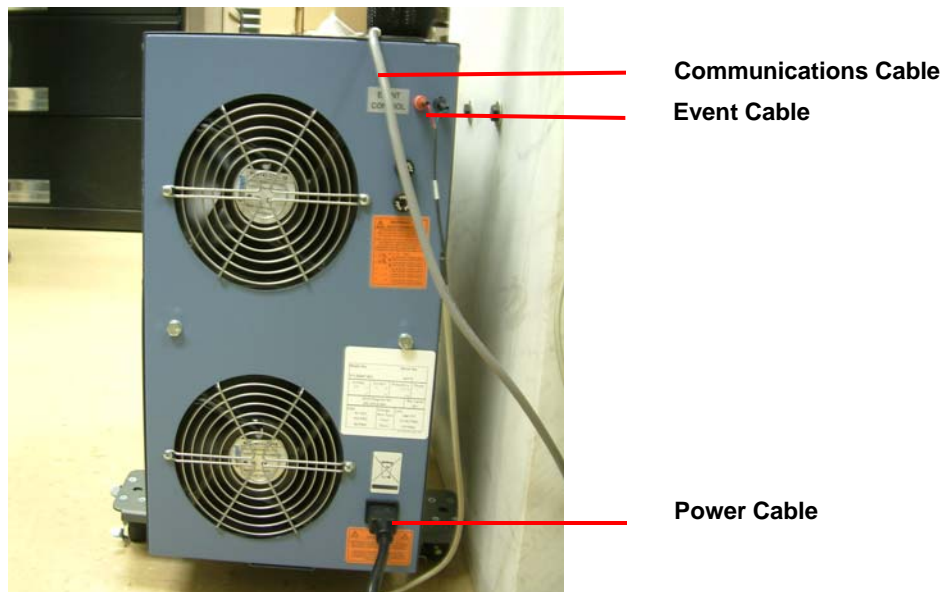
**Figure 3** Installing the drain cup.

**NOTE:** Take care to position the drain outlet and tubing in the back left corner cutout of the stage shield so that it does not interfere with normal movement of the furnace.



**Figure 4** Cutout for drain tubing.

- 4 Cut the loose end of the tubing to the desired length so that any condensate will flow freely to the collection beaker or container.
- 5 Locate the MCA70 communications cable, which emerges near the flexible feed hose on top of the MCA cabinet.





**Figure 5** Rear of MCA70.

- 6 Obtain access to the back of the MCA70 and the back of the instrument.
- 7 Plug the connector on the end of the communications cable into the +24 Vdc Out port on the back of the TMA as shown in the figure below.



**Figure 6** +24 Vdc Out port.

- 8 Connect the MCA70 Event Control port to the TMA Event Control port using the event cable. The red lead is connected to the red port on the left and the black lead is connected to the black port as shown in the figure below.

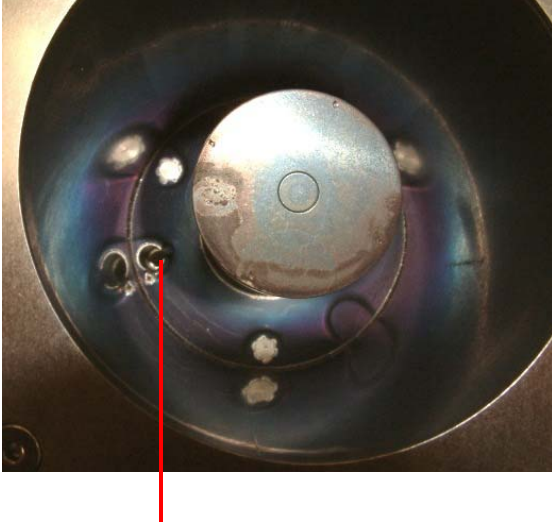


**Figure 7** Event Control connection.

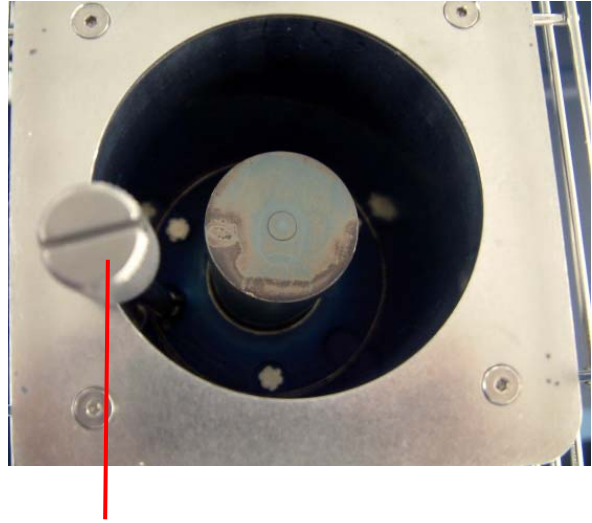
- 9 Plug the power cable into the back of the MCA70 and into a power outlet.



- 10** Verify that the drain hole is clear and that no water has accumulated.



**Drain hole clear for use with  
MCA70**

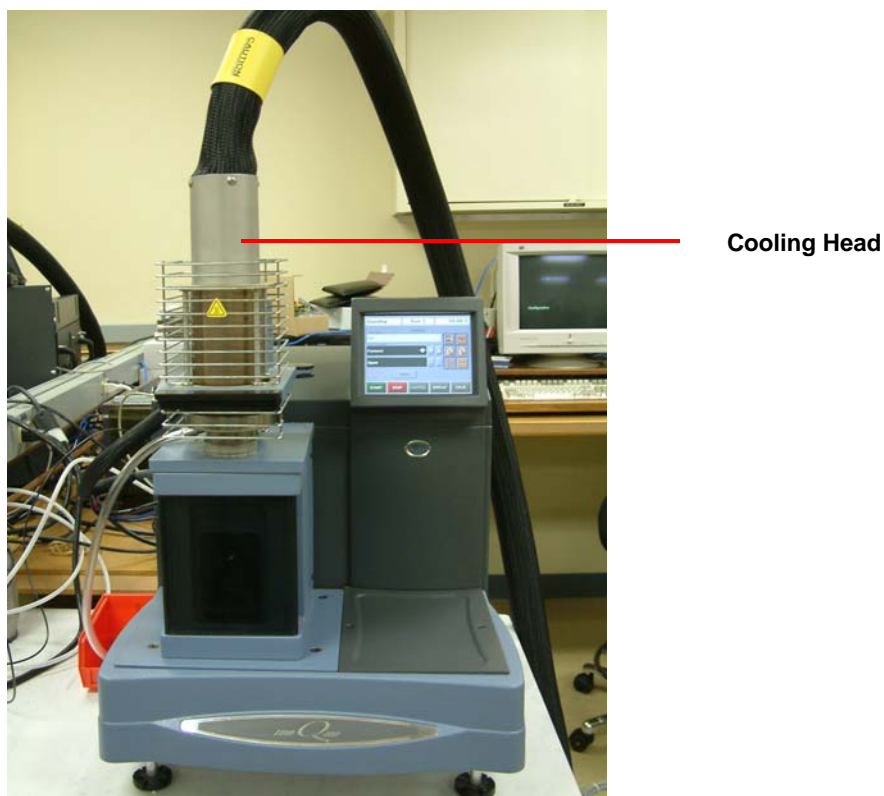


**Drain hole plug installed for  
LN2 use**

- 11** Place the cooling head carefully into the TMA furnace reservoir.

**NOTE:** Take care not to stretch or bend the hose and cooling head beyond its limits. The hose becomes very rigid when cold, be sure to position it so that the hose is as straight as possible and does not exert pressure on the furnace.

**CAUTION:** The cooling head gets very cold, to  $-100^{\circ}\text{C}$ , when the MCA70 is operating; use extreme caution and do not handle it or skin damage could occur.



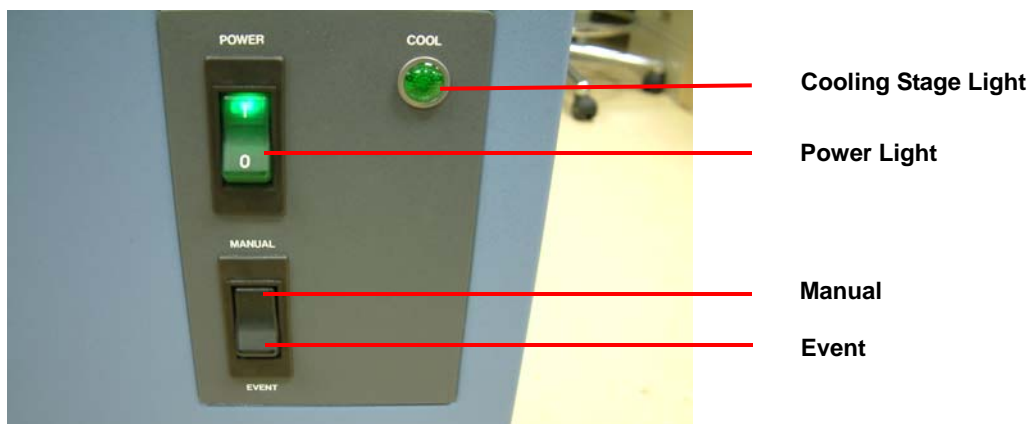
**Figure 8** MCA70 Cooling Head installed furnace down.

- 12** Switch the power on and allow the MCA70 to operate for at least 10 minutes before beginning a TMA experiment. You must allow enough time for both compressors to be fully operational in order to produce cooling action.

**NOTE:** If you turn the unit off, it must remain OFF for at least 10 minutes before you switch it back ON again.

The MCA70 compressor activity is indicated by the two lights on the front panel:

- **Power light:** Lights when the power switch is in the ON position (regardless of what the Manual/Event switch is set to).
- **Low-stage compressor light:** Comes on 2 to 3 minutes later when the second compressor is activated.



**Figure 9** MCA70 Front Panel.

**13** Set the MCA70 control switch to EVENT.

**NOTE:** The EVENT setting allows the MCA70 to be controlled by the system software. MANUAL keeps the MCA turned on continuously until it is manually shut off by the operator.

## *Starting the TMA MCA70*

Once the MCA70 has been properly installed, follow the steps below to set up the instrument parameters and condition the TMA-MCA system for optimum performance.

- 1** Access the **Tools/Instrument Preferences/Cooler** page of the TMA instrument control software. Verify that the correct cooler type (MCA70) is selected.
- 2** Verify that the MCA70 control switch on the MCA70 is set to EVENT and turn the power switch to ON (I). If the "Event On" signal is selected, the compressor will turn on and begin cooling the sample. Once the MCA70 second stage compressor has started (a few minutes later), the probe will begin cooling very quickly.

**NOTE:** The EVENT setting allows the MCA70 to be controlled by the instrument control software. MANUAL keeps the MCA70 turned on continuously until it is manually shut off. The EVENT setting allows the software to turn off the MCA70 (usually at the end of testing for the day), thereby minimizing excess moisture/frost buildup.

- 3** Verify that the post-test conditions (accessed through the **Procedure** page by clicking the **Post Test** button) are set as desired. A temperature window above ambient should be used to prevent the sample from cooling down between experiments (e.g., typical values are 35 to 50°C). Once these conditions are verified, select the **Go To Standby Temp** from the **Control** menu to invoke the standby temperature specified.

## Turning Off the MCA70

When running consecutive experiments, it is recommended that you leave the MCA70 on between experiments. However, if you don't plan on using the TMA overnight or for several days, you should turn off the MCA to prevent excessive frost buildup. The MCA70 can be turned off manually, using the event method segment, or through post-test options.

**NOTE:** If you turn the unit off, it must remain OFF for at least 10 minutes before you switch it back ON again.

**WARNING:** Do not allow the TMA furnace to exceed 60°C with the MCA70 cooling head installed and the MCA70 power (or cooling) off, or if the communication cable is unplugged. Serious damage and/or injury could occur.



## Deselecting the MCA70

If it is necessary to deselect the MCA70, the communication cable must be unplugged from rear of the TMA. Simply turning off the MCA70 power switch does not deselect the MCA70. After unplugging the cable, select **NONE** on the **Tools > Instrument Preferences > TMA** page of the TMA instrument control software.

**WARNING:** Do not allow the TMA furnace to exceed 60°C with the MCA70 cooling head installed and the MCA70 power (or cooling) off, or if the communication cable is unplugged. Serious damage and/or injury could occur.



# Chapter 3:

## Use & Maintenance

### *Guidelines for Using the MCA70*

Once the MCA70 is properly installed, the system conditioned and calibrated, the following guidelines should be maintained during standard experimental operation.

- Verify that the MCA 70 switch is set to EVENT on the MCA unit. To turn on the MCA70, select Event/On from the Control menu.
- A dry, moisture-free gas source is required as the standard purge gas. Helium is recommended for this purge. This gas must remain on continuously. If not, atmospheric moisture will enter and condense on the system.
- Access the **Tools/Instrument Preferences/Cooler** page of the TMA instrument control software. Verify that the correct cooler type (MCA70) is selected. (NOTE: The MCA70 is compatible with the QNX-based TMA Q400 with instrument software version 22.4 or above only.)
- Select **Tools/Instrument Preferences/TMA** page of the TMA instrument control software and verify the desired "Standby Temperature."
- When setting up experiments, be sure to verify the post-test conditions. The temperature window should be enabled and a temperature range above ambient should be used to prevent the cell from cooling down to subambient temperatures between experiments. If desired, you can turn off the MCA70 at the end of the test. If you are running consecutive tests, leave the MCA70 on at the end of the test until the last experiment has been run.



**WARNING:** Do not exceed 60°C with the MCA70 cooling head installed and the MCA70 power (or cooling) off, or if the communication cable is unplugged. Serious damage and/or injury could occur.



**WARNING:** Do not allow condensed moisture/water to accumulate in the container that surrounds the TMA furnace where the MCA70 cooling head is installed. This can create an unsafe condition. Lift the MCA70 cooling head and verify that the drain hole is clear and no water has accumulated before operating the TMA.

**CAUTION:** Remove the MCA70 cooling head from the TMA and disconnect the communications cable when running isothermal experiments above 400°C. Damage to the unit can occur if used at high temperatures for extended periods.

# Maintaining the MCA70

There is very little maintenance involved with the Mechanical Cooling Accessory. This section discusses general cleaning and fuse replacement, if there are problems with the MCA70 that this manual does not address, contact TA Instruments for service.

## Cleaning the MCA70

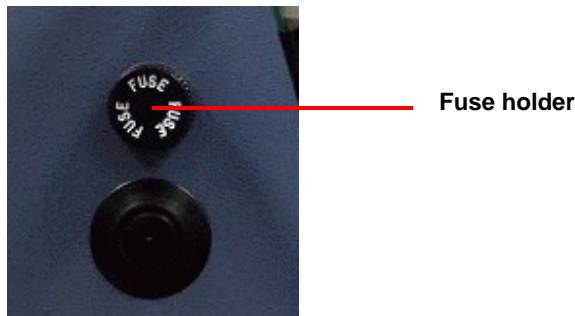
The only cleaning needed is on the outside of the unit. Wipe the surface of the unit with a damp cloth to remove any dust buildup. Make sure that the rear and side vents of the MCA70 unit stay free of dust and debris to allow the proper ventilation of the unit. If necessary, vacuum the vents to remove any dirt or debris and allow the fans to operate freely.

## Replacing the MCA70 Fuses

**NOTE:** If you feel that a fuse needs to be replaced, try the following first. Turn the power switch to the OFF position, wait five to ten minutes for the internal refrigerant pressures to equalize, then turn it back ON. The power switch on the MCA70 has an integral breaker. Overload will cause the breaker to trip. Moving the switch to the OFF position to reset the breaker will allow the unit to be turned on again if the cause of the overload has been eliminated. Operating the MCA70 at high temperatures is one thing that may cause an overload resulting in the breaker trip. If this does not solve the problem, proceed to replace the fuses as follows.

The Mechanical Cooling System (MCA70) may contain one or two fuses, depending upon whether you have the 120 V/60 Hz model (USA) or the 230 V/50 Hz model.

Both fuses can be replaced by turning the fuse holder (shown to the right) counterclockwise to remove the holder. The fuse slips out easily. Insert a new fuse into the holder. Replace fuse with same type and rating only. Place the fuse holder back into the cabinet by turning it clockwise until it locks in place.



**Figure 10** MCA70 fuse holder.

## *Replacement Parts*

Replacement parts for the MCA70 are listed below. Refer to the tables below when ordering parts.

**Table 3: Replacement Parts**

| <b>Part Number</b> | <b>Description</b>   |
|--------------------|--|
| 205224.039         | Fuse GLA for 120 V/60 Hz MCA70<br>(1.00 amp 250 V Slo Blo)           |
| 253827.000         | Power Cord for 120 V/60 Hz MCA70                                     |
| 205224.035         | Fuse GLA for 230 V/50 Hz MCA70<br>(0.75 amp 250 V Slo Blo)           |
| 270469.001         | Power Cord without Plug for 230 V/50 Hz MCA70<br>(10 amp/220V 50 Hz) |
| 945602.001         | Drain Cup  |
| 920223.902         | Event Cable  |
| 945068.001         | Drain Hole Plug  |