ARES-G2

Rheometer

Getting Started Guide

Revision I **Issued August 2014**

Notice

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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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
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- 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.

MISE EN GARDE: UNE MISE EN GARDE met l'accent sur une procédure susceptible d'endommager l'équipement ou de causer la perte des données si elle n'est pas correctement suivie.

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

Un AVERTISSEMENT indique une procédure qui peut être dangereuse pour l'opérateur ou l'environnement si elle n'est pas correctement suivie.

Regulatory Compliance

Safety Standards

For the European Economic Area: (In accordance with Council Directive 2006/95/EC of the European Parliament and of the Council 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.

EN 61010-2-010: 2003 Particular requirements for laboratory equipment for the heating of materials + Amendments.

Electromagnetic Compatibility Standards

For the European Economic Area: (In accordance with Council Directive 2004/108/EC 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 Class A.

Safety

Do not attempt to service this instrument, as it contains no user-serviceable components.

WARNING: The operator of this instrument 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.

AVERTISSEMENT: L'utilisateur de cet instrument est prévenu qu'en cas d'utilisation contraire aux indications du manuel, la protection offerte par l'équipement peut être altérée.

Required Equipment

While operating this instrument, you must wear eye protection that either meets or exceeds ANSI Z87.1 standards. Additionally, wear protective clothing that has been approved for protection against the materials under test and the test
temperatures.

Instrument Symbols

The following label is displayed on the ARES-G2 instrument for your protection:

Symbol	Explanation
	This symbol indicates that a hot surface may be present. Do not touch this area or allow any material that may melt or burn to come in contact with this surface. Ce symbole indique la présence possible d'une surface chaude. Prenez soin de ne pas toucher cette zone ou de laisser un matériau susceptible de fondre ou de brûler entrer en contact avec cette surface chaude.
	This symbol indicates that you must unplug the instrument *before* doing any maintenance or repair work; AC mains power voltage is present in this system. High voltages are present in this instrument. If you are not trained in electrical procedures, do not remove the cabinet covers unless specifically instructed to do so in the manual. Maintenance and repair of internal parts must be performed only by TA Instruments qualified service personnel. Ce symbole indique que vous devez débrancher l'instrument/l'accessoire avant d'effectuer des travaux de maintenance ou de réparation ; présence d'une tension de secteur CA dans ce circuit. Présence de tensions élevées dans cet instrument/accessoire. Si vous n'êtes pas formé aux procédures électriques, ne déposez pas les couvercles de l'armoire sauf indications spécifiques contenues dans le manuel. La maintenance et la réparation des pièces internes doivent être effectuées uniquement par le personnel d'entretien qualifié de TA Instruments.
	This symbol indicates that you must keep your fingers away from the sample loading area. Ce symbole indique que vous devez éloigner vos doigts de la zone de mise ne place des échantillons.

Please heed the warning labels and take the necessary precautions when dealing with these areas. The *ARES-G2 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; hazardous voltages are present in this system.

WARNING: There are no customer-replaceable fuses in the ARES-G2. High voltages are present in this instrument. If you are not trained in electrical procedures, do not remove the cabinet covers unless specifically instructed to do so in the manual. Maintenance and repair of internal parts must be performed only by TA Instruments qualified service personnel.

AVERTISSEMENT: L'ARES-G2 ne contient aucun fusible remplaçable par l'utilisateur. Présence de tensions élevées dans cet instrument. Si vous n'êtes pas formé aux procédures électriques, ne déposez pas les couvercles de l'armoire sauf indications spécifiques contenues dans le manuel. La maintenance et la réparation des pièces internes doivent être effectuées uniquement par le personnel d'entretien qualifié de TA Instruments.

Chemical Safety

Use only the gases listed in Chapter 1. Use of other gases could cause damage to the instrument or injury to the operator.

WARNING: If you are using samples that may emit harmful gases, vent the gases by placing the instrument near an exhaust.

AVERTISSEMENT: Si vous utilisez des échantillons qui émettent des gaz nocifs, ventilez les gaz en plaçant l'instrument près d'un échappement.

CAUTION: The instrument is not intended for use with combustible materials or corrosive substances without extra precautions.

MISE EN GARDE: Cet instrument n'a pas été conçu pour être utilisé avec des matières combustibles ou des substances corrosives sans précautions supplémentaires.

Thermal Safety

During an experiment the furnace, sample, clamp, and other environmental options can become very hot or very cold to the touch.

WARNING: Keep all temperature control options in both their closed and maximum open position a minimum of eight inches from any wall or object.

AVERTISSEMENT: Gardez toutes les options de commande de température en position fermée ou d'ouverture maximale à une distance minimale de huit pouces d'un mur ou d'un objet.

Mechanical Safety

This section provides safety information associated with the mechanical functions of the ARES-G2.

WARNING: Keep your hands clear of the motor while it is running. If you need to touch it, turn OFF the motor first.

AVERTISSEMENT: Éloignez vos mains du moteur lorsqu'il tourne. Si vous devez le toucher, arrêtez d'abord le moteur.

Lifting/Moving the Instrument

The ARES-G2 is a very heavy instrument. Use three people to lift and/or carry the instrument. The instrument is too heavy for one person to handle safely. In order to avoid injury, particularly to the back, please follow the procedure below.

1 Prepare the instrument for relocation as follows:

- **a** Remove all samples and geometries, as well as the lower temperature controlling device (which is mounted on the motor) such as the Sealed Bath, Peltier Plate, Peltier Concentric Cylinders, and Electrically Heated Plates.
- **b** Turn off the power and all power cords and cables to the power supply.
- **c** Lock the motor and transducer. See Chapter 2 for information.
- **d** Turn off the air/gas supply and disconnect all lines.
- **e** Close the oven (if installed) and secure it.

2 Remove the four corner plugs by pulling them straight out, as shown below. Retain the plugs for use after the instrument is moved.

3 Follow the instructions on the next page according to the method used to move the instrument, with a cart (recommended) or without a cart. If you are using a cart, you may move the instrument with two people. If you are not using a cart, three people are required to move it.

4 Install the four carrying handles by screwing them into the threaded holes on all four corners, as shown below.

Moving the ARES-G2 Using a Cart (Highly Recommended)

1 Obtain a cart that is wide enough to accommodate the instrument, and able to support at least 250 lbs (114 kg). If possible, raise the cart until the top surface is level with your lab bench.

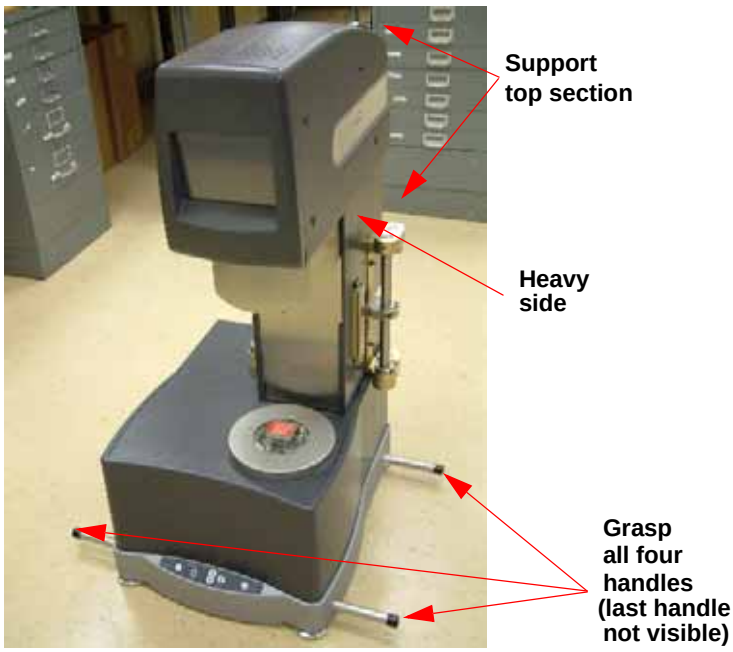
2 Position one person on the lighter side of the instrument (to the left as you face the instrument), and two people on the heavy side of the instrument (to the right as you face the instrument). Carefully slide the ARES-G2 onto the cart.

3 Wheel the cart to the desired location, slide the instrument onto the benchtop, then remove the lifting handles.

Moving the ARES-G2 Without a Cart

When moving the ARES-G2 without a cart, you must have three people to perform this procedure:

1 The handling points on the instrument are shown. Please grasp the instrument at those points.



2 Position one person on the lighter side of the instrument (to the left as you face the instrument), and two people on the heavy side of the instrument (to the right as you face the instrument).

3 Grasp the instrument as follows.

Light side: One person holds both lifting handles.

Heavy side: Each person holds one handle and puts free hand on the top section to support it.

4 Using proper lifting technique, lift and carry the instrument to the desired location.

When you have positioned the instrument at the desired location, remove the lifting handles and replace the corner plugs.

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Chapter: 1

Introducing the ARES-G2

Overview

The TA Instruments ARES-G2 is a mechanical spectrometer capable of subjecting a sample to a dynamic (sinusoidal) strain deformation, steady shear strain deformation, or a combination of dynamic and steady strain. The ARES-G2 measures the resultant torque generated by the sample in response to this shear strain. The figure below shows the ARES-G2 test station equipped with a forced convection oven. Shear strain is applied by the motor; torque is measured independently by the transducer. Test parameters are set by the operator, with the actual sample response determined by the motor and transducer.

Figure 1 ARES-G2 test station with Oven.

The ARES-G2 works in conjunction with a controller, TA Instruments TRIOS software, and environmental units to make up a rheological analysis system.

The controller is a computer that performs the following functions:

- Provides an interface between you and the instrument
- Enables you to set up experiments and enter parameters
- Runs the experiments and stores experimental data
- Allows you to calibrate the instrument
- Runs data analysis programs

The following pages provide a brief description of the components available with the system.

NOTE: For technical reference information, theory of operation, and other information associated with the ARESG2 and not found in this manual, see the TRIOS online help.

System Components

The ARES-G2 system can be set up in several different configurations depending upon your needs. The following items may be part of a system:

- ARES-G2 test station
- Modular power supply
- Geometries
- Forced Convection Oven (optional)
- LN2 Cooler (optional)
- Fluid Bath (optional)
- Peltier Plate (optional)

These components are briefly described in this chapter. For details regarding each part, please refer to the online help accessed through the TRIOS software.

ARES-G2 Test Station

An ARES-G2 test station, shown in the figure below, consists of several components. The primary components are the motor, stage, transducer, keypad, touch screen display, an environmental control option, and various geometries needed for experiments.

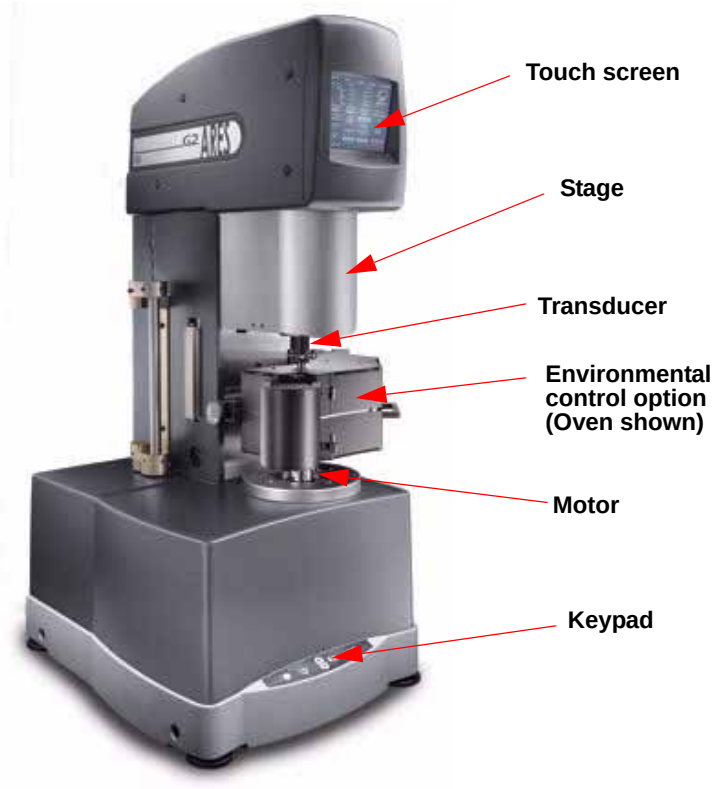


Figure 2 ARES-G2 test station.

Stage

The stage is a motorized platform that supports the transducer. The stage can be raised and lowered to facilitate sample loading using the keypad on the front of the test station, the touch screen, or through TRIOS software control. The rate at which the stage moves can be adjusted through software.

ARES-G2 Keypad

The keypad, shown in the figure below, is an external device on the front of the instrument that is used for several types of control. The indicator lights will show green when that function is on and red when it is off.

Instrument Power Status Light has five states applicable to the status light. These are:

- Blinking green displays when the instrument is powering up.
- Steady green indicates that the instrument is fully powered and ready to operate.
- Blinking red indicates that the instrument is powering down.
- Steady red displays when the instrument is in the standby state.
- Light off indicates that the power switch is off at the power supply.

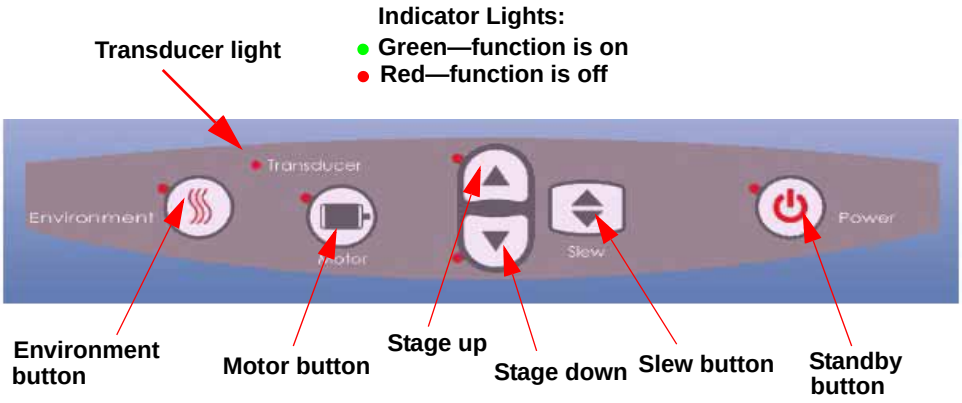


Figure 3 ARES-G2 keypad.

The functions on the keypad are described briefly below:

- ***Environment Button***: Turns the environmental control unit, such as the oven, Peltier, etc. on or off. The light beside the button indicates the state of the environmental unit.
- ***Transducer Light***: An light indicating when the transducer is either on or off.
- ***Motor Button***: Toggles between motor on and off. The light beside the button tells you the state of the motor. If the transducer and motor are both off (lights are red), pressing the motor button will also reset the transducer.
- ***Stage Up Button***: Raises the stage. The light beside the button indicates the state of the stepper motor.
- ***Stage Down Button***: Lowers the stage. The light beside the button indicates the state of the stepper motor.

- ***Slew Up/Down Button***: When the slew button is used in conjunction with the motor up or down buttons, the stage moves very quickly. To slew the stage downward, press and hold both the slew and stage down buttons. To slew the stage upward, press and hold both the slew and stage up buttons.
- ***Standby Button***: Upon pressing this button, the instrument slowly powers down after the oven comes down to the stabilization temperature of 50°C. Then the power to the instrument shuts off. The light beside the button indicates the status. To put the instrument immediately into standby mode, press and hold this button for at least 10 seconds.

NOTE: The lights next to the stage up and stage down buttons indicate the stepper motor status. A single light next to the button indicates that the mechanical limit has been reached, or that a normal force overload has disabled the motor. Both lights lit together indicates that the transducer is not functioning and, as a result, the stepper is not moving at all.

ARES-G2 Touch Screen

The ARES-G2 instrument has an integrated touch screen display for local operator control. Interactive functions such as gap zeroing, sample loading, and setting temperature can be performed on the instrument touch screen. The functions shown on the screen change depending upon the menu being used. This section briefly describes the interactive functions shown on the touch screen displays.

NOTE: For detailed information on the functions performed with the touch screen, see TRIOS online help.

The Instrument Touch Screen

The **Instrument** tab of the touch screen displays the main instrument functions and gauges. This allows you to monitor the current torque, normal force, gap, temperature, and data zones and points. Buttons on the screen are available to perform gap control, set the temperature, and stop the test.

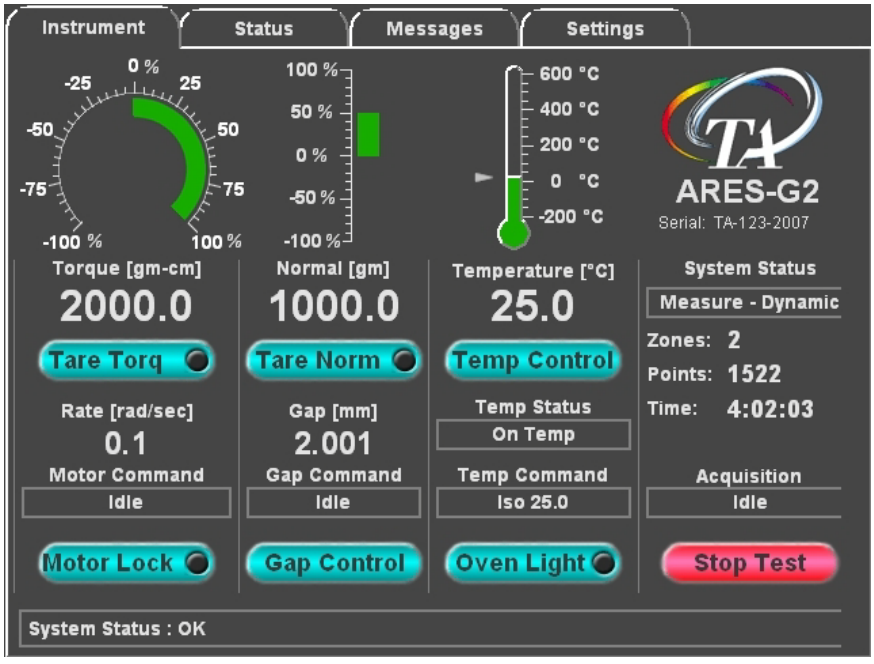


Figure 4 ARES-G2 Instrument touch screen.

The ARES-G2 Status Touch Screen

The **Status** tab (shown in the figure below) displays the instrument status regarding air pressure, temperature sensors, system status, and network communication status. It also provides easy access to system information and diagnostics that may be used to troubleshoot your instrument.

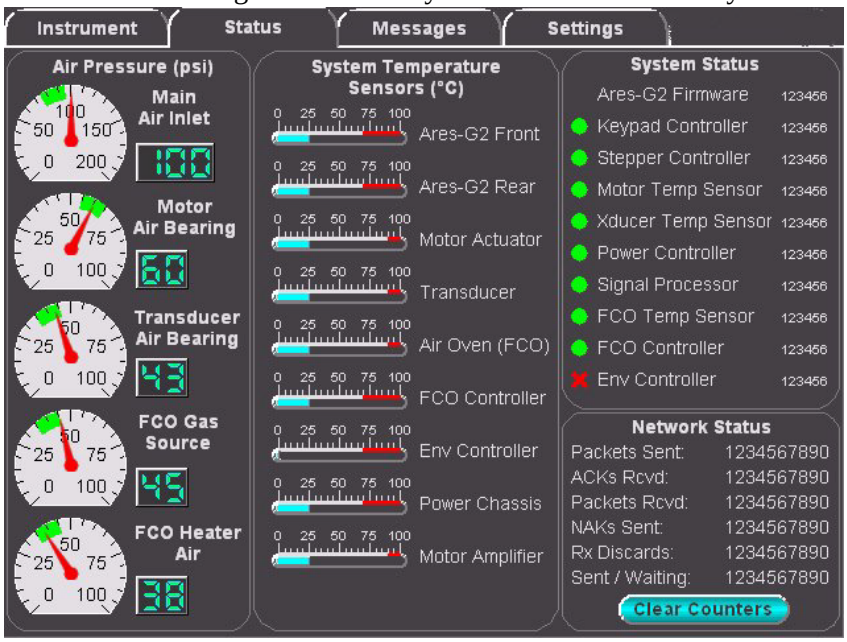


Figure 5 ARES-G2 Status touch screen.

The primary uses of this screen are to provide an overview of all the instrument components and to serve as a troubleshooting tool.

The ARES-G2 Messages Touch Screen

The **Messages** tab (shown in the figure below) displays status messages that can be used for troubleshooting.

Figure 6 ARES-G2 Messages touch screen.

The ARES-G2 Settings Touch Screen

The **Settings** tab is used to identify your ARES-G2 instrument, its location, and network (IP) address information. In addition you can perform the normal force tare function, adjust FCO camera focus and light, and calibrate the touch screen.

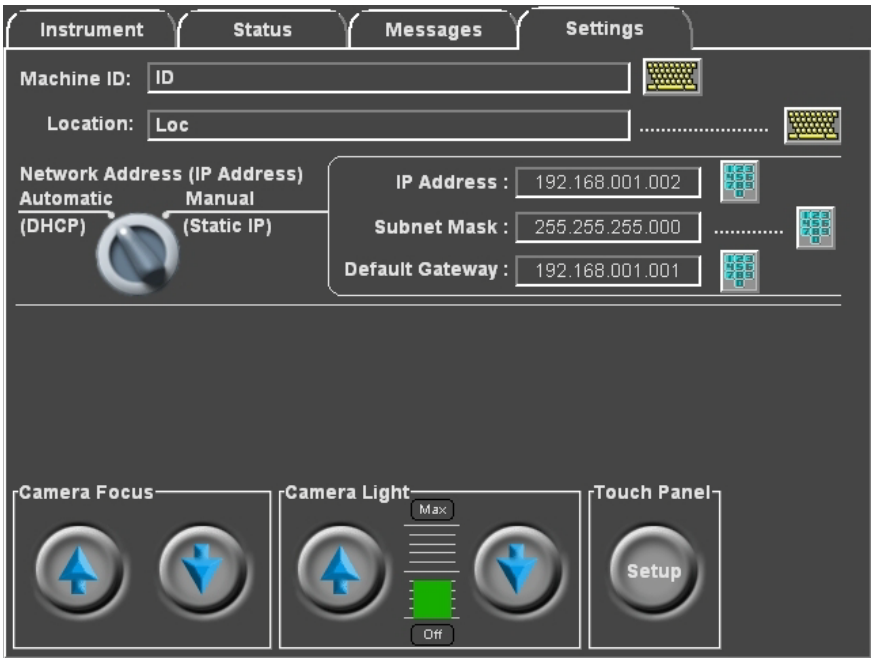


Figure 7 ARES-G2 Settings touch screen.

Transducer

The ARES-G2 utilizes a Force Rebalance Transducer (FRT), shown below, to measure torque and normal force generated by the sample.

Figure 8 ARES-G2 linear transducer.

The FRT consists of independent rotational (torque) and axial (normal force) servo control systems. Each of these systems uses position feedback to maintain the FRT shaft in a constantly null position. When a torque or normal force is applied to the FRT shaft, the servo control systems respond by driving the required current through the torque and normal force motor coils to maintain the shaft null position. The electrical currents required to maintain these null positions are proportional to the amount of torque and normal force applied to the shaft. Sense resistors sample these currents, and the resulting voltages are scaled to provide the torque and normal force signal outputs of the transducer.

Selection and control of torque range is performed using the TRIOS software.

For normal force, full-scale measurements can be made in both the upward and downward directions. The weight of the shaft and geometry does not reduce the measurement range in the downward direction.

Air Bearing Motor

The air bearing motor, also referred to as the *actuator*, deforms the sample by applying a shear strain to the sample. The motor can be operated in dynamic (sinusoidal) mode, steady (constant rotational rate) mode, or step strain and step stress mode.

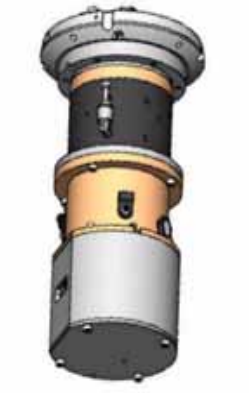


Figure 9 ARES-G2 air bearing motor.

Motor position and velocity feedback are recorded using a high resolution optical encoder. Dynamic motion can be recorded down to 0.5 µrad while transient motion can be recorded down to 30 to 40 nrad.

Modular Power Supplies

The ARES-G2 uses separate power supplies, which house the electronic instrument power supplies, motor power amplifier, the main power conductor, and a self-diagnostic display.

These stackable units are designed to sit on the floor under your lab bench, leaving more room on the top of the bench for other uses.

The larger unit on the bottom (see the figure below) is used by the ARES-G2 test station. The smaller top units are designed to be used by the optional environmental units such as the Forced Convection Oven (FCO) or the Peltier Plate system.

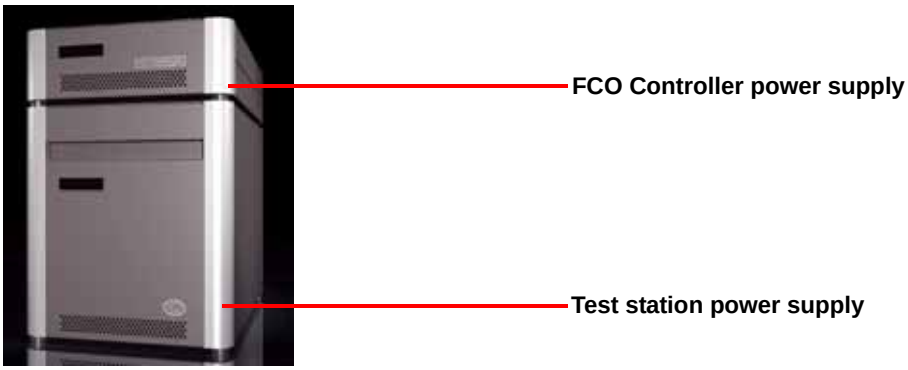


Figure 10 Stackable power supplies

Multiple environmental option power supply units can be stacked on top of the test station power supply unit for systems that have more than one environmental option.

Environmental Control Units

There are several environmental control units available for use with ARES-G2. Each system is used to control the sample temperature. The available units are described below.

NOTE: See TRIOS online help for installation information regarding all of the environmental control units

Refer to the following sections for basic information regarding each specific environmental option. For more details refer to the online help available in the TRIOS program.

Forced Convection Oven (FCO)

NOTE: For FCO installation instructions, refer to TRIOS software online Help.

WARNING: When running the oven above 450°C, make sure the special heat shield is installed on the transducer frame.

AVERTISSEMENT: Lorsque le four fonctionne à plus de 450° C, assurez-vous que l'écran thermique spécial est installé sur le châssis du transducteur.

DANGER! Do not touch the outer cover when the oven is running, as the outer covers can get very hot. Only touch the FCO handle, if necessary.

DANGER: Ne touchez pas le couvercle extérieur lorsque le four est en marche, car les couvercles extérieurs peuvent devenir très chauds. Ne touchez le manche du FCO que si c'est nécessaire.

DANGER! Do not remove the outer or inner covers of the oven, as high voltage (200 VAC) exists inside the oven when the oven is on.

DANGER: Ne déposez pas les couvercles externes ou internes du four, en raison de la présence d'une tension élevée (200 VCA) dans le four lorsqu'il est allumé.

DANGER! When opening the oven to load samples, the heaters and the gas flowing through the heaters shut off. However, the geometries remain hot, as does the air around the sample area. Therefore, show care when loading and trimming your sample.

DANGER: Lorsque vous ouvrez le four pour la mise en place des échantillons, les réchauffeurs et le gaz qui s'écoule à travers les réchauffeurs s'arrêtent. Cependant, les géométries restent chaudes de même que l'air autour de la zone de l'échantillon. Par conséquent, soyez prudent lors de la mise en place et de l'ajustage de votre échantillon.

NOTE: For optimum performance when running the oven above 250°C, make sure the lower geometry baffle is between the inner and outer covers of the oven, and that the upper geometry baffle is just above the top of the oven.

CAUTION: Make sure the purge air is flowing when the oven is on. Failure to do so could cause damage to components inside the oven. The purge line connects to the back of the ARES-G2, to the port labeled OVEN PURGE.

MISE EN GARDE: Assurez-vous que l'air de drainage circule lorsque le four est en marche. Le non respect de cette précaution pourrait provoquer des dégâts sur les composants du four. La conduite de drainage se raccorde à l'arrière de l'ARES-G2, au port étiqueté DRAINAGE DU FOUR.

The oven is a forced convection environmental chamber that encloses the sample. Mounted in the oven are two resistive heaters, which are used to control the temperature of the gas flowing through them. During testing at or above ambient temperature, either air or nitrogen gas may be input to the heaters. If test temperatures must be extended to below ambient, the input to the heaters must be evaporated liquid nitrogen (LN2) supplied by the optional cryogenic LN2 Cooler (or very cold gas supplied by the optional Chiller).

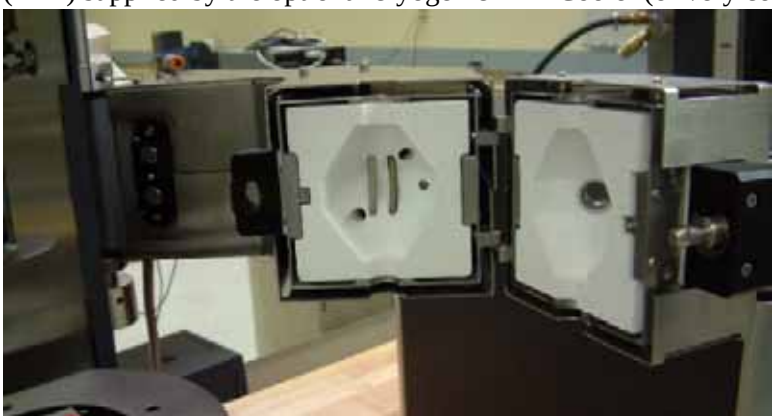


Figure 11 ARES-G2 Forced Convection Oven.

Table 1: FCO Specifications

Temperature Range **with LN2 Cooler** **with Chiller** **with ACS-3 Chiller**	Ambient to 600°C without LN2 Cooler option –150°C to 600°C –50°C to 600°C –100°C to 600°C
Heating Rate	up to 60°C/min
Precision	±0.05°C
Stability	±0.1°C
Geometry Compatibility	Plates up to 50 mm diameter and torsion clamps for solid bars, EVF, SER2
Optional Accessories	LN2 Cooler, Chiller, Camera

The forced convection oven has two forced gas gun heaters with counter-rotating air flow for a wide temperature range (ambient to 600°C*) and maximum temperature stability. If you plan to sustain temperatures above 450°C, the use of the heat shield is required. If you will be running at temperatures below ambient, either the optional LN2 cooler (operation to –150°C) or the ACS-3 chiller (operation to –100°C) can be used to extend the operational range of the oven. The forced convection oven is recommended for polymer melts and solids, and can accommodate Cone and Plate, Parallel Plate, Torsion Rectangular and Torsion Cylindrical geometries, as well as EVF and SER2.

NOTE: The 600°C temperature testing is limited to two hours. The transducer may shut down if it is run for a longer time period.

Oven Temperature Control

Oven temperature is maintained by a control loop that is closed around several Platinum Resistance Thermometer (PRT) sensors located in the oven. The Oven may use up to five (5) PRT sensors in order to control the temperature. These are:

- Upper Geometry PRT (Used with Parallel Plate or Cone geometries.)
- Lower Geometry PRT (Used with Parallel Plate or Cone geometries)
- Mid-Oven Air PRT (Used with solid-sample geometries, EVF, SER2)
- Upper Air PRT (Used for fast-response temperature control.)
- Lower Air PRT (Used for fast-response temperature control.)

Using the default system settings, the ARES-G2 will report and control the measured temperatures that are in closest proximity to the geometry or sample. If Upper and/or Lower Geometry PRTs are connected to the system, combinations of these measurements will be used to control and measure the Oven temperature. If Geometry PRTs are not installed, the Oven will automatically use the Mid-Oven Air PRT temperature.

Measured Oven temperatures from all PRTs are compared to the set point temperature in the FCO Controller, and heater power is changed to minimize the difference between the set point and measured temperatures. The Oven will use faster responding Air temperature measurements to stabilize rapid temperature changes in the oven, and will use the geometry or Mid-Oven Air temperature measurements to precisely adjust the final oven temperature.

LN2 Cooler

CAUTION: The bulk tank must be a low pressure (22 psi/1.5 bars) source, as a high pressure tank will damage the LN2 Controller.

MISE EN GARDE: Le réservoir en vrac doit être une source de basse pression (22 psi / 1,5 bar), vu qu'un réservoir haute pression endommagerait le régulateur LN2.

NOTE: For LN2 Cooler installation instructions, refer to TRIOS software online Help.

The LN2 cooler uses liquid nitrogen to extend the lower range of the FCO to –150°C. The LN2 cooler is connected between an external liquid nitrogen source and the ARES-G2 test station. Controlled by the oven supply enclosure through the software, the LN2 cooler consists of a Dewar flask, a solenoid valve to control liquid nitrogen flow into the Dewar, and hardware to control the boiling of the liquid nitrogen to produce cold nitrogen gas within the flask. A second solenoid valve controls the flow of the nitrogen gas out of the Dewar flask for use by the test station, and a third solenoid valve allows air to escape while the flask is filling.

Figure 12 LN2 Cooler

Table 2: LN2 Cooler Specifications

Dimensions	28 cm (11 in) W x 24.1 cm (9.5 in) D x 55.9 cm (22 in) H
Weight	17.3 kg (38 lbs)
Temperature Range	Extends lower range of oven to –150°C

Dewar Flask

A Dewar flask is a container specifically designed to efficiently store liquid nitrogen. Dewar flasks help prevent evaporation due to their double-wall construction. Within the Dewar flask, a heater immersed in the LN2 provides controlled boiling. The Dewar is equipped with two pressure relief valves to allow excess nitrogen gas to vent when the LN2 Controller is turned off.

Additional details on the installation and operation of the LN2 cooler can be found in TRIOS online help.

ACS-3 and Chiller Panel

NOTE: For installation instructions, refer to the ACS-3 Getting Started Guide.

The ACS-3 is a unique three-stage air chiller system for subambient temperature control and general cooling of select instrumentation from TA. Supported instruments and environmental systems include the DMA Q800 with standard furnace (-100°C), Discovery Hybrid Rheometer models with Environmental Test Chamber (-85°C), and ARES-G2/ RSA-G2 with Forced Convection Oven (-100°C). The ACS-3 features low-noise durable compressors (approx. 55 dB), small footprint, uninterrupted operation, CFC-free, and for specified temperature ranges, eliminates the recurring cost and safety concerns associated with handling and use of liquid nitrogen. The ACS-3 requires an air supply at pressure of 7 bar (100 psi), flow rate of 200 l/min, and dew point of -40°C (-40°F), and appropriate instrument-specific Chiller Panel.

Figure 13 ACS-3.

The Chiller Panel is mounted to the side of the ACS-3. The Chiller Panel assembly contains all of the pneumatic and electronic components needed to filter, regulate, and control the compressed gas (air or nitrogen) that is supplied to the FCO.

Figure 14 FCO Chiller Panel assembly before being mounted on Air Chiller.

Table 3: ACS-3 and Chiller Panel Specifications

Dimensions of Air Chiller (H x W x D): Without Chiller Panel With Chiller Panel	 112 cm (44 in) x 37 cm (14.5 in) x 56 cm (22 in) 112 cm (44 in) x 52 cm (20.5 in) x 56 cm (22 in)
Weight of Air Chiller Without Chiller Panel With Chiller Panel	 118 kg (260 lbs) 134 kg (295 lbs)
Dimensions of Chiller Panel	Height: 86.4 cm (34 in) Width: 48.3 cm (19 in) Depth:38.1 cm (15 in)
Weight of Chiller Panel	18.2 kg (40 lbs)
Lowest Temperature	ARES-G2/ RSA-G2 FCO: -100°C

Lower Peltier Plate

NOTE: For Peltier Plate installation instructions, refer to TRIOS software online Help.

WARNING: At all times while operating the Peltier system, ensure that the circulator is connected to the Peltier Assembly, and the circulator pump is ON.

AVERTISSEMENT: À chaque utilisation du système Peltier, assurez-vous que le circulateur est connecté à l'ensemble Peltier et que la pompe de circulation est en marche.

WARNING: The sample test surface can reach temperatures that cause personal injury. Allow the Peltier System to return to ambient temperature BEFORE you touch the sample test surface or the sample.

AVERTISSEMENT: La surface d'essai de l'échantillon peut atteindre des températures qui provoquent des blessures corporelles. Laissez le système Peltier revenir à la température ambiante AVANT de toucher la surface d'essai de l'échantillon ou l'échantillon.

CAUTION: Do not tamper with the four screws in the top cover of the Peltier assembly, as this will result in damage to the Peltier Plate.

MISE EN GARDE: Ne touchez pas aux quatre vis du couvercle supérieur de l'ensemble Peltier, car cela risque d'endommager la plaque Peltier.

The Lower Peltier Plate environmental control unit utilizes a solid-state thermoelectric heat pump to control the temperature of the lower geometry, which is an integral part of the assembly. In general, the solid-state heat pump consists of multiple semiconductor devices in series, alternating P-type and N-type. Changes in current direction control the heating or cooling of the Peltier element and hence the lower geometry plate. The devices are placed between the lower geometry and a heat sink. A source of water is needed for the Peltier to remove the heat generated by the Peltier elements.

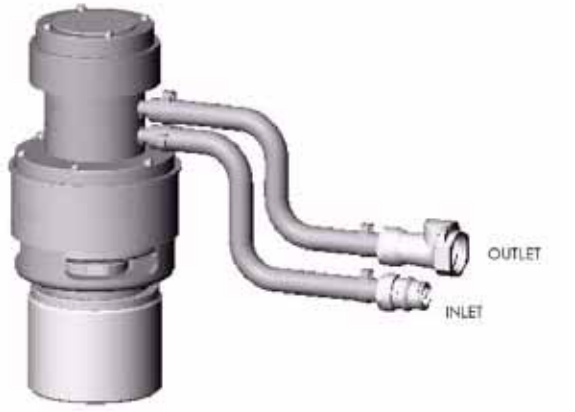


Figure 15 Lower Peltier Plate.

Table 4: Peltier Plate Specifications

Temperature Range	–40°C to 180°C, depending on circulator fluid temperature.
Heating Rate	up to 30°C/min
Precision	±0.05°C
Stability	±0.1°C
Geometry Compatibility	All ARES-G2 upper Cone and Plate geometries (up to 50 mm diameter)
Optional Accessory	Solvent Trap

Table 5: Peltier Plate Cooling Options

Option	Temperature Range
ARES Computer-Controlled Circulator	–40°C to 180°C
Peltier Circulator Model 612	–40°C to 160°C
AR Cooled Circulator Model 340	–20°C to 150°C
ARES Peltier Circulator*	–30°C to 140°C

*Operating the Peltier Plate at temperatures that are –20 °C or colder depends on maintaining cool water in the circulator reservoir. Using room temperature water in the reservoir, the Peltier Plate Accessory can hold at –30°C for about 30 minutes, but the Peltier Plate temperature will drift upwards as the water in the reservoir becomes warmer.

The Peltier Plate may lose temperature control when the coolant reservoir temperature is more than 45°C to 50°C warmer than the commanded plate temperature.

Sealed Fluid Bath

NOTE: For Sealed Fluid Bath installation instructions, refer to TRIOS software online Help.

CAUTION: Never place any lower geometry into the bath if its temperature is cooler than that of the bath. Placing a geometry into a warmer bath will result in expansion of the geometry during use. After expansion, the geometry may not be removable without damaging the bath. We suggest that you partially insert the geometry by placing a phenolic spacer between the upper lip of the lower geometry, and the surface of the bath. Allow the lower geometry temperature to match that of the bath, then remove the spacer and fully insert the lower geometry.

MISE EN GARDE: Ne placez jamais une géométrie inférieure dans le bain si sa température est plus froide que celle du bain. Placer une géométrie dans un bain plus chaud entraîne la dilatation de la géométrie pendant son utilisation. Après la dilatation, il n'est plus possible de retirer la géométrie sans endommager le bain. Nous suggérons d'insérer partiellement la géométrie en plaçant une entretoise phénolique entre la lèvre supérieure de la géométrie inférieure et la surface du bain. Laissez la température de la géométrie inférieure correspondre à celle du bain, puis retirez l'entretoise et insérez complètement la géométrie inférieure.

The Sealed Fluid Bath offers precise control of sample temperature using a closed fluid recirculating system. The operational range of the Sealed Fluid Bath is –10°C to 105°C. Thermally controlled fluid, supplied by a circulator, flows through the bath and is used to regulate the temperature. The lower geometry mounts within the bath well and attains thermal equilibrium with the surrounding bath. The temperature of the lower geometry is measured by the bath PRT, which mounts through the bath well into the motor.

The circulator (as supplied by TA Instruments) is connected to, and is under the control of, the test station and software. The circulator also has its own fluid temperature regulation, which can be used as the temperature control loop for the bath.

Figure 16 Sealed Fluid Bath.

NOTE: The temperature range of the Sealed Fluid Bath depends on the fluid in the circulator. TA Instruments recommends a fluid that is a 50/50 mixture of water and laboratory grade Ethylene Glycol. This will give an effective range of –5 to 105°C.

Table 6: Sealed Fluid Bath Specifications

Temperature Range	–10°C to 105°C
Stability	±0.1°C
Geometry Compatibility	Couette, Double Wall, Parallel Plate, Cone and Plate

ARES-G2 Accessories

The accessories currently available for use with ARES-G2 include the Camera (for use with the FCO only) and the Solvent Trap (for use with the Peltier Plate and Sealed Fluid Bath).

Camera Accessory

NOTE: For Camera Accessory installation instructions, refer to TRIOS software online Help.

CAUTION: To avoid potential damage to the camera, be sure that the air inlet tube and all electrical connections are properly connected.

MISE EN GARDE: Pour éviter des dégâts potentiels à la camera, assurez-vous que le tuyau d'arrivée d'air et tous les raccordements électriques sont correctement effectués.

The FCO can be optionally equipped with a camera viewer with remote illumination and focusing. Used in conjunction with streaming video and image capture software, the camera displays real-time images in the software; an image is stored with each data point for viewing during or after a test. The FCO camera viewer is an ideal tool for data validation.

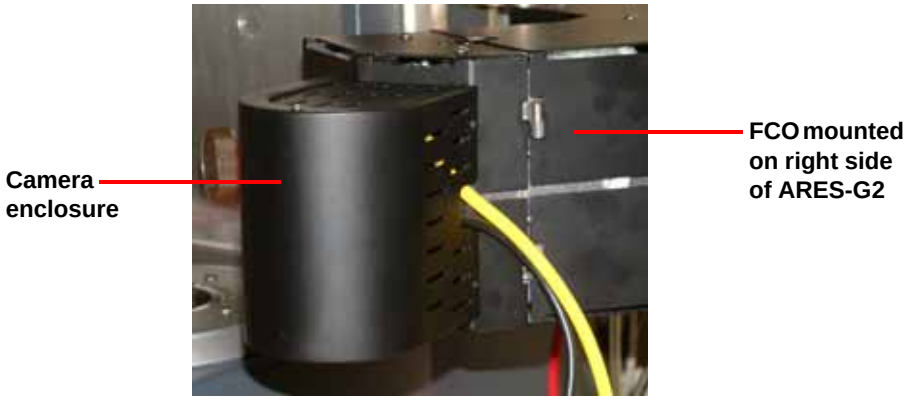


Figure 17 Camera accessory installed on FCO.

Solvent Trap Accessory

NOTE: For Solvent Trap Accessory installation instructions, refer to TRIOS software online Help.

CAUTION: Lowering the carrier assembly too quickly could cause solvent in the geometry well to splash onto the sample, thereby changing the sample's physical properties.

MISE EN GARDE: L'abaissement trop rapide de l'ensemble du support peut provoquer l'éclaboussement du solvant contenu dans le tube sur l'échantillon, modifiant ainsi les propriétés physiques de l'échantillon.

The Solvent Trap is used to trap vapor in the sample environment and therefore minimize drying of the sample. The bottom of the solvent trap splits and clamps onto the fixed portion of the Peltier Plate. After adding solvent to the well of the geometry, a glass carrier shield drops downward and simultaneously makes a seal with the split clamp and the fluid in the well. This is a non-contact seal, as the seal is made with the solvent in the geometry's well.

Figure 18 Solvent Trap accessory with carrier lowered.

For Peltier Plate, the temperature range is –40°C to 180°C with cooling device. Refer to the table below for solvent trap geometry compatibility.

Table 7: Available Geometries for Solvent Trap

Recommended Geometry	Part Number
25 mm Parallel Plate	402270.901
40 mm Parallel Plate	402271.901
25 mm.02 rad Cone	402272.901
25 mm.04 rad Cone	402273.901
25 mm.10 rad Cone	402274.901
40 mm.02 rad Cone	402275.901
40 mm.04 rad Cone	402276.901
40 mm.10 rad Cone	402277.901
25 mm Cross Hatched	402278.901
40 mm Cross Hatched	402279.901

ARES-G2 Geometries

The test geometries are an important part of the sample testing procedure. This section provides you with some background information that can be used when deciding which geometry to use.

Although the physical properties of the sample generally dictate appropriate test geometry, it is sometimes possible to test a given sample using more than one geometry. Ideally, the test results should be identical in the different geometries. However, there exist experimental limitations that may make testing in one geometry preferable to testing in another. Additionally, factors such as anisotropy and differences in strain dependence may yield inconsistent results for different geometries.

NOTE: For more details on geometries and their usage, please refer to TRIOS software online Help.

Available Geometries

The following is a list of the geometries that can be used with the ARES-G2. General installation of a geometry is covered in Chapter 2. Details can be found in TRIOS online help.

- Parallel Plate
- Cone and Plate
- Concentric Cylinder
- Double Wall Concentric Cylinder
- Torsion Rectangular
- Torsion Cylindrical
- Extensional Viscosity Fixture (EVF)
- Helical Ribbon Fixture
- Additional special fixtures. See TRIOS online help for details.

Selecting a Geometry

Recommendations for selection of a geometry based upon sample type are as follows:

Sample Type	Geometry
Low viscosity fluids, suspensions and emulsions	Large Diameter Parallel Plate or Cone Plate, Concentric Cylinder or Double Wall Concentric Cylinder
Higher viscosity fluids, and thicker suspensions and emulsions	Parallel Plates or Cone and Plate
Solids	Torsion Rectangular/Cylindrical
Polymer Melts and Soft Solids	Parallel Plates or Cone and Plate
Thermosetting Resins and other Curing Studies	Parallel Plate. Disposable plates are available for curing studies or other reactive materials.

Instrument Specifications

The table found below contains the technical specifications for the ARES-G2.

Item/Area	Specifications
Test Station	Depth 56 cm (22 in.) Width 46 cm (18 in) Height 104 cm (39.37 in)
Power Supply Enclosure	Depth 48 cm (19 in) Width 32 cm (12.5 in) Height 34 cm (13.5 in)
Oven Supply Enclosure	Depth 48 cm (19 in) Width 32 cm (12.5 in) Height 11 cm (4.5 in)
Environmental Supply Enclosure	Depth 48 cm (19 in) Width 32 cm (12.5 in) Height 11 cm (4.5 in)
Weight: Test Station Power Supply Enclosure Oven Supply Enclosure Environmental Supply Enclosure	 104.5 kg (< 230 lbs) 18 kg (40 lbs) 6.8 kg (15 lbs) 9.1 kg (20 lbs)
Power: Test Station Power Supply Enclosure Oven Supply Enclosure Environmental Control Supply Enclosure	 from power supply: 90–264 VAC, 16 amps max 180–264 VAC, 47–63 Hz, 13 amp max 90–264 VAC, 47–63 Hz, 13 amp max
Operating Environmental Conditions	Temperature: 15–30°C Relative Humidity: 5–80% (non-condensing) Installation Category II Pollution Degree 2 Maximum Altitude: 2000 m (6560 ft) Minimum clearances of six inches from top and all sides, and eight inches from temperature control options.
TEST STATION	
Transducer	Force/Torque Rebalance
Minimum Torque in Oscillation	0.05 µN.m
Minimum Torque in Steady Shear	0.1 µN.m
Maximum Torque	200 mN.m
Torque Resolution	1 nM.n
Normal/Axial Force Range	0.001 to 20 N

Item/Area	Specifications
Motor	Brushless DC
Motor Bearings	Jeweled Air
Strain Resolution	0.04 µrad
Min Angular Displacement in Oscillation	1 µrad
Max Angular Displacement in Steady Shear	Unlimited
Angular Velocity Range	1 x 10^{-6} rad/s to 300 rad/s
Angular Frequency Range	1 x 10^{-7} to 628 rad/s
Step Change in Velocity	5 ms
Step Change in Strain	10 ms
TEMPERATURE SYSTEMS	
Smart Swap	Standard
Force Convection Oven, FCO	–150 to 600°C
FCO Camera Viewer	Optional
Peltier Plate	–40 to 180°C
Sealed Bath	–10 to 150°C

Chapter: 2

Installing the ARES-G2

Unpacking/Repacking the ARES-G2

Instructions for unpacking and repacking the instrument are found as separate unpacking instructions in the shipping box and in the instrument control software online documentation. You may wish to retain all of the shipping hardware, the pallet, and boxes from the instrument in the event you wish to repack and ship your instrument.

WARNING: Have an assistant help you unpack this unit. Do not attempt to do this alone.

AVERTISSEMENT: Faites-vous aider par une personne pour dépoter cet appareil. N'essayez pas de le faire tout seul.

Preparing the System

Before shipment, the ARES-G2 instrument is inspected both electrically and mechanically so that it is ready for operation upon proper installation. Only limited instructions are given in this manual; consult TRIOS online documentation for additional information. Installation involves the following procedures:

- Inspecting the system for shipping damage and missing parts.
- Choosing a suitable location.
- Connecting the ARES-G2 to a suitable air supply.
- Connecting all cables and lines.
- Connecting the ARES-G2 to the power supply.
- Connecting the ARES-G2 to the controller computer and network.

It is recommended that you have your ARES-G2 unpacked and installed by a TA Instruments Service Representative. Call for an installation appointment upon receiving your instrument.

CAUTION: To avoid mistakes, read this entire chapter before you begin installation.

MISE EN GARDE: Pour éviter de commettre des erreurs, lisez tout le chapitre avant de commencer l'installation.

Inspecting the System

When you receive your ARES-G2, look over the instrument and shipping container carefully for signs of shipping damage, and check the parts received against the enclosed shipping list.

- If the instrument is damaged, notify the carrier and TA Instruments immediately.
- If the instrument is intact but parts are missing, contact TA Instruments.

Choosing a Location

It is important to choose a location for the instrument using the following guidelines. The ARES-G2 should be:

In

- A temperature- and humidity-controlled area. Temperatures should be in range of 20°C to 30°C.
- A clean, vibration-free environment, preferably on the ground floor in the building. It should be located away from pumps, motors, or other devices which produce vibrations.
- An area with ample working and ventilation space.
- An area that allows at least six inches of clearance on all sides of the equipment, and that allows a minimum of eight inches from the open and closed positions of all heated environment control systems.
- An area that does not restrict airflow to cooling fans on the rear of the power control box, or the option controllers.

On

- A stable work surface. A marble table is recommended. Isolation mounts on a standard lab bench are not recommended.

Near

- A power outlet. An ARES-G2 without an oven, requires from 90 to 264 VAC/ 50 or 60Hz with a 15 amp outlet. Any unit with an oven requires 180 to 264 VAC / 50 or 60Hz with a 20 amp outlet.
- Your TA Instruments TRIOS controller.
- Compressed lab air and purge gas supplies with suitable regulators and filters.

Away from

- Dusty environments.
- Exposure to direct sunlight.
- Direct air drafts (fans, room air ducts).
- Poorly ventilated areas.
- Noisy or mechanical vibrations.
- High traffic areas, where constant movements from passing personnel could create air currents or mechanical disturbances.

Installing the ARES-G2

TA Instruments recommends that you schedule a service technician to unpack and install your instrument. The instructions given here are provided for reference, if needed.

CAUTION: Read the installation, operating, and maintenance instructions that were supplied with your air dryer. Failure to properly operate and maintain your air dryer will result in extensive damage to this instrument. Excessive moisture in the air supply may damage the test station.

MISE EN GARDE: Lisez les instructions d'installation, d'utilisation et de maintenance fournies avec votre déshydrateur d'air. L'utilisation et la maintenance inappropriées du déshydrateur d'air entraînent d'immenses dégâts sur l'instrument. L'excès de moisissure dans l'alimentation en air peut endommager la station d'essai.

Connecting the Air Dryer

The dew point of the supplied air should be 10°C or lower. It is highly recommended that the optional air dryer/filter be installed between the test station and the air supply. If the air supply has excessive moisture levels that result in the immediate condensation into water, a pre-air dryer system will be required. An oil-less compressor system is recommended as well.

The air source going into the dryer should have a minimum pressure of 100 psi (0.68 MPa). Follow the instructions below to install the air dryer.

1 Mount the air dryer to a wall in close proximity to the ARES-G2 to allow the lines to reach the back of the instrument. See the figure below.

Figure 19 Air dryer.

CAUTION: Make sure there is no power going to the power supply unit while making the connections described here. Turn the power switch to the off position.

MISE EN GARDE: Assurez-vous que le bloc d'alimentation électrique n'est pas alimenté en courant pendant le réglage des connexions décrites ici. Placez l'interrupteur d'alimentation sur la position d'arrêt.

2 Connect the line from the filter to your air source.

3 Connect the outlet line from the regulator to the test station at the “Air Inlet” port (see the figure on the next page for its location). This is an input line to the test station that is used to supply air to the oven, motor, transducer air bearings, and throughout the test station.

4 Set the Purge Rate Adjuster knob to the setting number 2.

Figure 20 Purge rate adjuster knob.

5 Turn on the air supply and use the pressure regulator knob to set the supply pressure to 80 to 90 psi (0.55 to 0.6 MPa).

Figure 21 Pressure regulator.

CAUTION: Read the installation, operating, and maintenance instructions that were supplied with your air dryer. Failure to properly operate and maintain your air dryer will result in extensive damage to this instrument. Excessive moisture in the air supply may damage the test station.

MISE EN GARDE: Lisez les instructions d'installation, d'utilisation et de maintenance fournies avec votre déshydrateur d'air. L'utilisation et la maintenance inappropriées du déshydrateur d'air entraînent d'immenses dégâts sur l'instrument. L'excès de moisissure dans l'alimentation en air peut endommager la station d'essai.

Connecting the Test Station Ports

The ports and connections on the rear of the ARES-G2 are used to connect various components of the system to the instrument. This section describes these ports. All instructions are based on viewing the instrument from the rear. Refer to the figure below as you make the connections.

CAUTION: Make sure there is no power going to the power supply unit while making the connections described here. Turn the power switch to the off position.

MISE EN GARDE: Assurez-vous que le bloc d'alimentation électrique n'est pas alimenté en courant pendant le réglage des connexions décrites ici. Placez l'interrupteur d'alimentation sur la position d'arrêt.

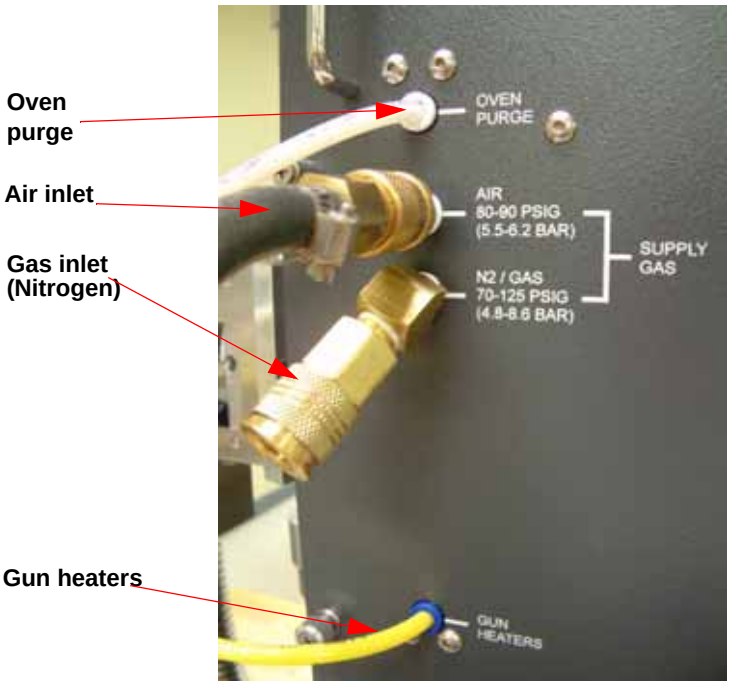


Figure 22 Gas ports on rear of ARES-G2

- ***Oven Purge***: Provides dry gas input to the oven. The gas is circulated throughout the oven in order to maintain positive pressure and minimize frost when using the LN2 cooler.
- ***Air Inlet***: Connects to the (external) air dryer. This port is used to supply dry air to the oven, motor, transducer air bearings, and throughout the test station. The air supply pressure should be 80 to 90 psi (0.55 to 0.6 MPa).
- ***Gas Inlet***: Connects to an external nitrogen (or other) inert gas supply. This port supplies nitrogen or another inert gas to the oven, thus allowing the gas to be used as the heating medium. Inert gas is used to keep a polymer sample from oxidizing and degrading. The gas supply pressure should be 70 to 125 psi (0.48 to 0.86 MPa).
- ***Gun Heaters***: Connects to the oven to provide pneumatic output from the test station to the oven. This port supplies the oven with air or N2 gas.

Gas Pressure Specifications

Pressure to the various components can be viewed on the Status tab of the instrument touch screen.

- Transducer: 40 psi
- Motor: 60 psi
- FCO Heater Air: 30 psi with oven on.

Air Quality

It is critical that high-quality, clean, dry air be supplied to the test station at all times. Any particles present in the air must be smaller than 5 microns. Since the motor and transducer use air bearings, larger particles in the air can easily damage the delicate high precision bearing surfaces of these components. Damage to the bearing surfaces may result in faulty measurements, and if significant enough, the damage may require the replacement of the entire motor or transducer.

The dew point of the supplied air should be 10°C or lower. We highly recommend installing the optional air dryer/filter between the test station and the air supply. If your air supply has excessive moisture levels, which result in the immediate condensation into water, a pre-air dryer system will be required. With air dryer installed the dew point drops to below –10°C.

Because of the critical nature of the air supplied to the instrument, and the potential for expensive damage through mishandling, we highly recommend that you inform your laboratory manager, or compressor maintenance personnel, of your instrument requirements in detail. You should also ask to be informed before any air supply interruption, or compressor maintenance, so that you can properly shut down and protect the test station. Typically after any compressor maintenance, there will be some residual particulates and moisture present in the supply lines. You should disconnect the air from the test station input (or air dryer) and purge the lines, before re-powering your instrument.

To quickly determine if there is an interruption in the air supply, we have found that it is helpful to install a pressure gauge before the air dryer. An oil-less compressor system is recommended as well.

Making the Test Station Purge Connections

CAUTION: Make sure there is no power going to the power supply unit while making the connections described here. Turn the power switch to the off position.

MISE EN GARDE: Assurez-vous que le bloc d'alimentation électrique n'est pas alimenté en courant pendant le réglage des connexions décrites ici. Placez l'interrupteur d'alimentation sur la position d'arrêt.

Follow these instructions to connect the oven and the ARES-G2 test station

1 Locate the purge line going to the oven. Push this fitting into the port labeled “Oven Purge.” This is an output line from the test station that provides purge air to the oven.

2 Locate the line going to the oven’s gun heaters. Connect this to the port labeled “Gun Heaters.” This is an outlet line from the test station to supply the oven with air or N2 gas.

3 Connect your laboratory air dryer to the test station at the “Air Inlet” port. This is an input line to the test station that is used to supply air to the oven, motor, transducer air bearings, and throughout the test station. Make sure the supply pressure is set at 80 to 90 psi (0.55 to 0.6 MPa). :

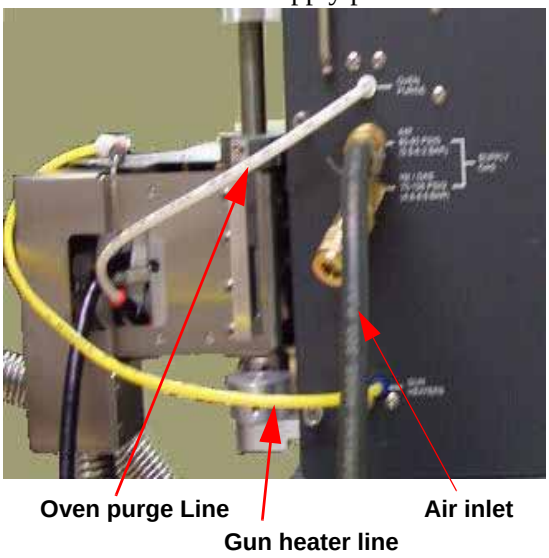


Figure 23 Test station purge connections.

Connecting the Signal Panel

CAUTION: Make sure there is no power going to the power supply unit while making the connections described here. Turn the power switch to the off position.

MISE EN GARDE: Assurez-vous que le bloc d'alimentation électrique n'est pas alimenté en courant pendant le réglage des connexions décrites ici. Placez l'interrupteur d'alimentation sur la position d'arrêt.

The Signal Panel is the input/output interface for electrical signals entering and leaving the ARES-G2 test station.

Upper Set of Signal Connections

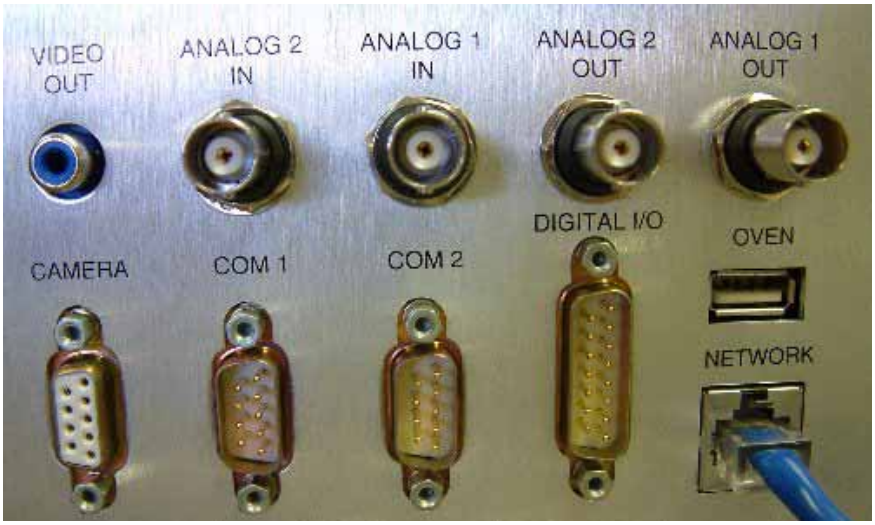


Figure 24 ARES-G2 upper signal panel.

The table below contains information regarding the upper set of signal panel connectors.

Connector	Purpose
VIDEO OUT	Outputs the video signal from the ARES-G2 camera option to the controller computer for display.
ANALOG 1 IN	Accepts a ±10 VDC signal that can be sampled and stored in the experiment data file. This input is defined through the TRIOS program.
ANALOG 2 IN	Accepts a ±10 VDC signal that can be sampled and stored in the experiment data file. This input signal is defined using the TRIOS program.
ANALOG 1 OUT	A ±10 VDC signal that is defined using the TRIOS program.
ANALOG 2 OUT	A ±10 VDC signal that is defined using the TRIOS program.
CAMERA	Connection for the cable between the ARES-G2 test station and the camera located inside the Forced Convection Oven. (This includes power, camera control signals, and camera output.)
COM 1	A serial port output from the system CPU. This port will be used for communication to an external circulator.
COM 2	A serial port output from the CPU. (For future use.)
OVEN	CAN bus connection to the Forced Convection Oven option.
DIGITAL I/O	TTL-compatible input and output signals and relay contact closures. They are defined using the TRIOS software.
NETWORK	Connection for communication between the ARES-G2 and the system network. (See "Connecting the Computer to the Switch" on page 54.)

Lower Panel Signal Connections

The figure below identifies the upper set of connections on the signal panel

Figure 25 ARES-G2 lower signal panel.

The table below contains information regarding the lower set of signal panel connectors.

Connector	Purpose
TORQUE IN	An external user input that can be connected to the internal torque measurement channel instead of the transducer torque signal. (User selectable.)
TORQUE OUT	Outputs a DC voltage that is proportional to transducer torque. Scaling is ± 5.0 VDC = ± Full Scale Torque
NORMAL IN	An external user input that can be connected to the internal normal force measurement channel instead of the transducer normal force signal. (User selectable.)
NORMAL OUT	Outputs a DC voltage that is proportional to the transducer normal force. Scaling is ± 5.0 VDC = ± Full Scale Normal
COMMAND STRAIN	Outputs a DC voltage that is proportional to the actual motor defection.
HIGH V ENABLE	A relay contact closure that is used to enable the High Voltage amplifier of the ER option.
FREQ RESPONSE	An input signal, defined using the TRIOS software, that can be sampled simultaneously with the Transducer Torque and Normal Force signals during an experiment. Input scaling is ± 5 VDC.
DSP DAC	A general purpose ± 10-volt analog output for future use that is derived from a digital-to-analog converter on the DSP board.

OSP Panel Signal Connections

The figure below identifies the connections on the OSP/GPIB signal panel.

Figure 26 ARES-G2 lower signal panel

The table below contains information regarding the set of connectors at the OSP/GPIB signal panel..

Connector	Purpose
ORTHOGONAL IN	CMD displacement signal for axial displacement, defined using TRIOS software in Orthogonal Superposition mode (OSP). Scaling is ± 5.0 VDC = ± 50 micron displacement.
ORTHOGONAL OUT	Outputs a DC voltage proportional to the axial transducer displacement in Orthogonal Superposition mode (OSP). Scaling is ± 5.0 VDC = ± 50 micron displacement.

Connecting Cables and Lines

To connect the cables and gas lines, you will need access to the ARES-G2 instrument's rear panel. All directional descriptions are written on the assumption that you are facing the back of the instrument.

CAUTION: Connect all cables before connecting the power cords to the outlets. Tighten the thumb-screws on all computer cables.

MISE EN GARDE: Raccordez tous les câbles avant de connecter les cordons d'alimentation aux prises. Serrez les vis à serrage à main sur tous les câbles d'ordinateur.

CAUTION: Whenever plugging or unplugging power cords, handle them by the plugs, not by the cords.

MISE EN GARDE: Chaque fois que vous branchez ou débranchez les cordons d'alimentation, tenez-les par les fiches et non par les cordons.

WARNING: Protect power and communication cable paths. Do not create tripping hazards by laying the cables across access ways.

AVERTISSEMENT: Protégez les chemins de câble électriques et de câbles de télécommunication. Ne créez pas de risques de déclenchement en posant des câbles sur les voies d'accès.

Connecting the Signal Cables on the Signal Panel for OSP Operation

NOTE: Orthogonal superposition (OSP) is only available on instruments with the serial number 4010-0383 and higher or instruments with a lower serial number that have upgraded to OSP.

To connect the signal cables for OSP, plug in the supplied short BNC connector cables at the signal panels at the rear of the test station. Make the following connections:

1 Connect **Orthogonal IN** at the OSP signal panel to **DSP DAC** at the lower signal panel.

2 Connect **Orthogonal OUT** at the OSP panel to **Freq. Resp./Spare** at the lower signal panel.

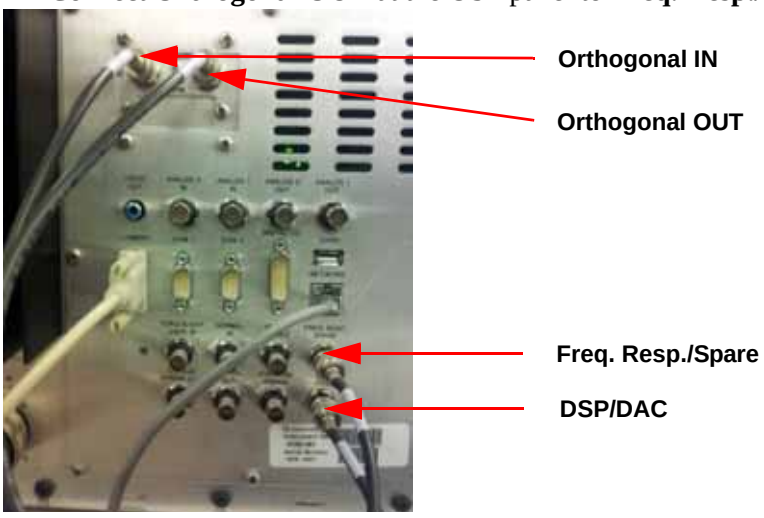


Figure 27 ARES-G2 signal panels and connectors for OSP at the rear of the test station.

Connecting the Modular Power Supplies

Stackable power supplies are used with the ARES-G2 to house various printed circuit boards and electrical components. They provide power and communication with the instrument. Follow these instructions to connect the power supplies to the instrument and accessories.

CAUTION: Make sure there is no power going to the power supply unit while making the connections described here. Turn the power switch to the off position.

MISE EN GARDE: Assurez-vous que le bloc d'alimentation électrique n'est pas alimenté en courant pendant le réglage des connexions décrites ici. Placez l'interrupteur d'alimentation sur la position d'arrêt.

Test Station (Lower) Power Supply

To connect the power supply, follow these steps:

1 Using the grip holds to move the test station power supply, place it on the floor close to the ARES-G2. Make sure you have access to the rear of the power supply and the ARES-G2. See the figure below. (The connections are already made in the figure.)

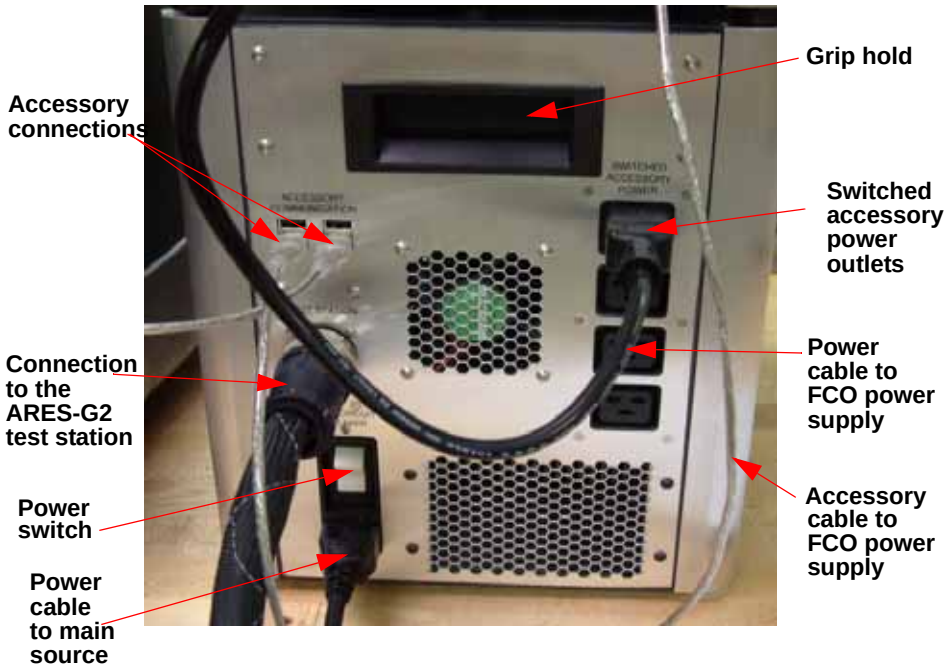


Figure 28 Test station power supply.

2 Obtain the accessory cable(s) from the accessory kit(s). Connect each cable to any of the four accessory connections. These will be connected to the upper power supplies (from one to four upper power supplies can be connected).

3 Connect one end of the large multi-pin cable to the test station connector. The other end will be connected to the ARES-G2 later.

4 Plug in up to four accessory power cables to any of the switched accessory power outlets. These will be connected to the upper power supplies (from one to four upper power supplies can be connected).

5 Connect a power cable to the connector below the power switch, but do not connect this to the main power supply at this point.

6 Install any optional upper power supply units, such as the forced convection oven or environmental control power supplies.

Forced Convection Oven Controller Power Supply (used in conjunction with an FCO).

CAUTION: Make sure there is no power going to the power supply unit while making the connections described here. Turn the power switch to the off position.

MISE EN GARDE: Assurez-vous que le bloc d'alimentation électrique n'est pas alimenté en courant pendant le réglage des connexions décrites ici. Placez l'interrupteur d'alimentation sur la position d'arrêt.

To connect the FCO power supply, follow these steps:

1 Place the FCO controller power supply on top of the test station (lower) power supply or on top of a previously-installed environmental control power supply within the limit of the cable length. Make sure you have access to the rear of the power supply and the ARES-G2. See the figure below.

2 Obtain the loose end of one of the accessory cables that have already been connected to the lower power supply (see step 2 on the previous page), and insert it into the accessory port on the FCO power supply.

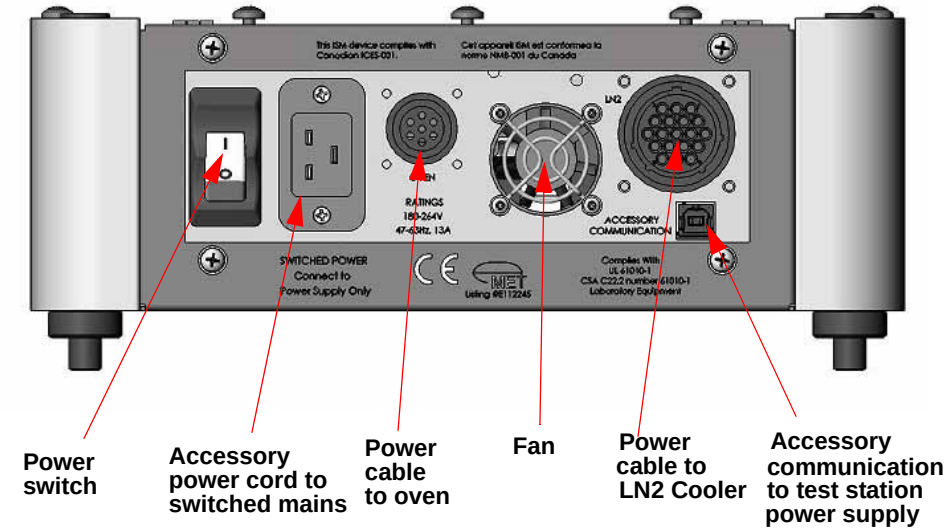


Figure 29 FCO Controller power supply.

3 *Oven*: Connect the power cable from the oven to the connector to the left of the fan.

4 Obtain the loose end of one of the power cables that are already connected to a switched accessory power outlet on the lower power supply (step 4 in the previous section). Connect this to the power inlet next to the power switch on the FCO power supply.

5 Using the grip handles, position the power supplies as desired. (They may be placed on the floor or on the table top.)

6 Proceed to the next sections to connect the LN2 accessory and/or another power supply box, if applicable. **DO NOT switch on the power supply at this point.**

LN2 Cooler Connection (optional)

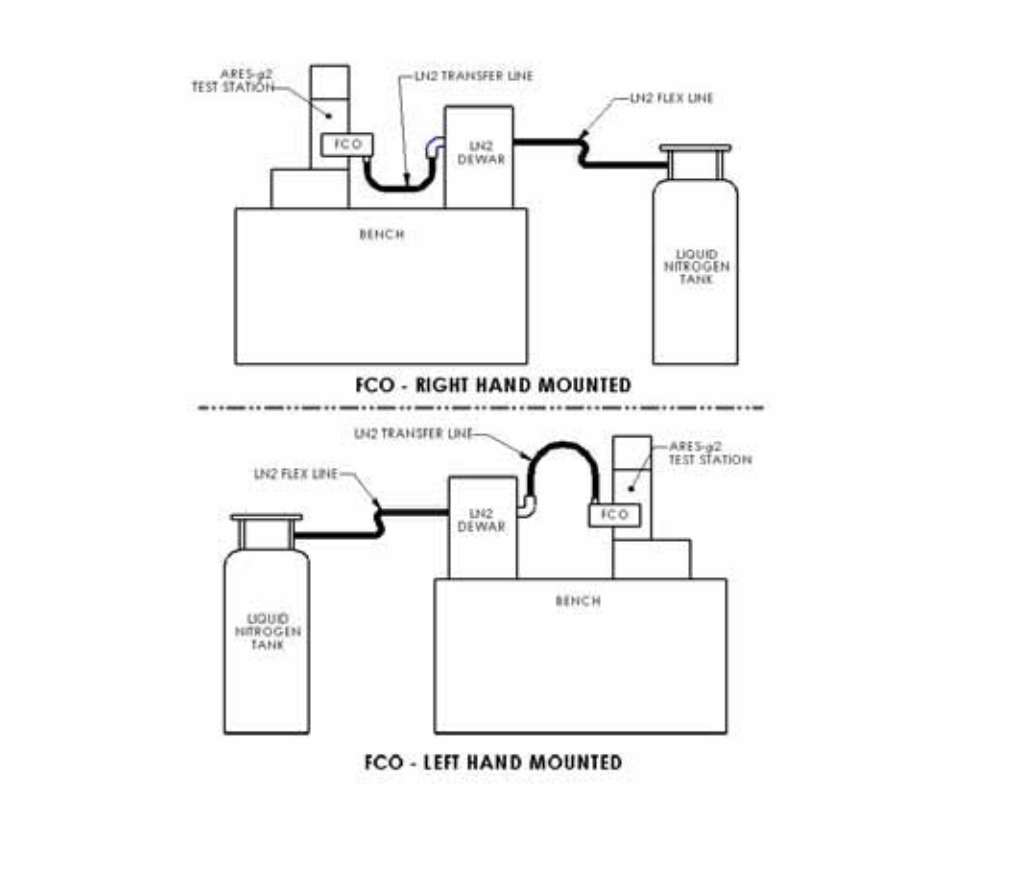
1 Obtain the LN2 flex line from the LN2 accessory kit and connect between the LN2 Cooler and a liquid nitrogen supply source (bulk tank). Bulk tank needs to be a low pressure (22 psi) source.

2 Obtain the LN2 transfer line.

3 Connect the elbowed end of the transfer line to the LN2 Cooler.

4 Connect the opposite end to the FCO LN2 supply connection.

5 Connect the power cable from the LN2 cooler to the connector on the right side, above the communications port.



Environmental Control Power Supply

CAUTION: Make sure there is no power going to the power supply unit while making the connections described here. Turn the power switch to the off position.

MISE EN GARDE: Assurez-vous que le bloc d'alimentation électrique n'est pas alimenté en courant pendant le réglage des connexions décrites ici. Placez l'interrupteur d'alimentation sur la position d'arrêt.

To connect the environmental control power supply, follow these steps:

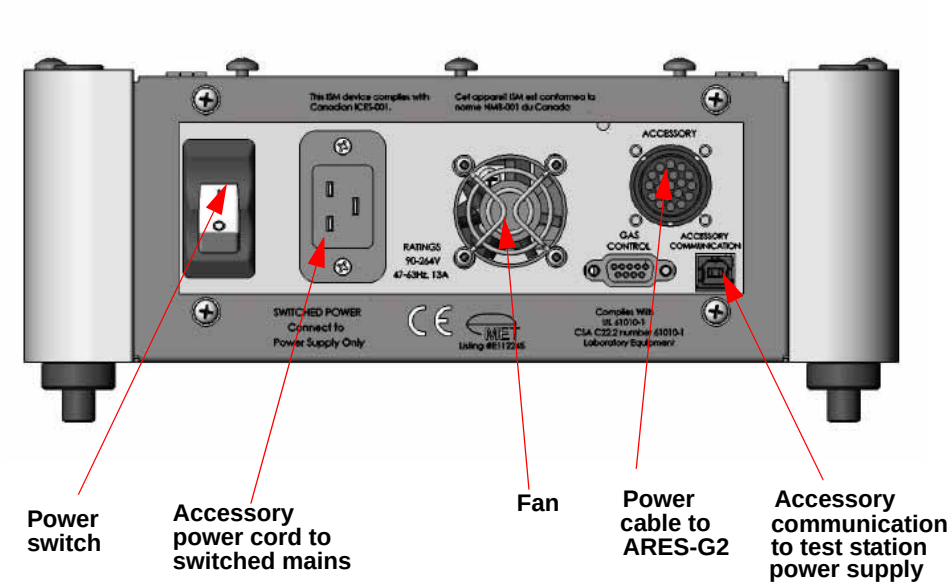


Figure 30 Environmental Control power supply.

1. Place the environmental control power supply on top of the test station (lower) power supply or on top of a previously installed FCO power supply, within the limit of the cable length. Make sure you have access to the rear of the power supply and the ARES-G2.
2. Obtain the loose end of one of the accessory cables that have already been connected to the lower power supply (see step 2 on page 49), and insert it into the accessory port on the environmental control power supply.
3. Connect the power cable from the Accessory Control connector on the rear of the ARES-G2 to the connector located on the upper right side of the fan.
4. Obtain the loose end of one of the power cables that are already connected to a switched accessory power outlet on the lower power supply (step 4 on page 49). Connect this to the power inlet next to the power switch on the environmental control power supply.
5. Using the grip handles, position the power supplies as desired. (They may be placed on the floor or on the table top.)
6. Proceed to the next section to connect the ARES-G2 test station to your network. DO NOT switch on the power supply at this point.

Router Setup

In order to connect the instrument, you will need to make the necessary cable connections as described below. The instrument and controller computer will be connected to a router. In addition, there are instructions for connecting the computer to a LAN.

CAUTION: Make sure there is no power going to the power supply unit while making the connections described here. Turn the power switch to the off position.

MISE EN GARDE: Assurez-vous que le bloc d'alimentation électrique n'est pas alimenté en courant pendant le réglage des connexions décrites ici. Placez l'interrupteur d'alimentation sur la position d'arrêt.

Figure 31 Router.

Connecting the Instrument to the Router

1. On the ARES-G2 display, press the **Display Settings** tab and ensure the software knob is set for DHCP.
2. Using Keyboard icons, enter **Machine ID** and **Location**.
3. Power down the ARES-G2.
4. Make sure **Host Computer LAN** is set for **DHCP**.
5. Make sure TRIOS software has been installed.
6. Connect two Ethernet cables to two of the Router ports.
7. Connect one Ethernet cable to the ARES-G2 Network port.

Figure 32 Ethernet connection

8 Connect the other Ethernet cable to the Host Computer Network port.

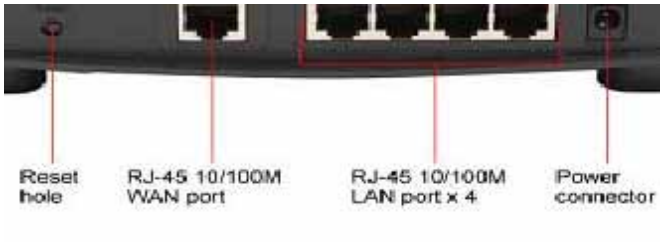


Figure 33 Router ports.

9 Connect the 12 volt output from the Router transformer into the Router power port.

10 Connect the input from the Router transformer into an AC outlet (100 to 240 VAC 50/60Hz).

11 Power up the ARES-G2.

12 The Power and two of the Ethernet LEDs will light up on the Router.

13 Click on the TA Explorer icon.

14 The ARES-G2 will be recognized based on the Instrument ID.

15 Click on the Instrument Icon and communication between TRIOS and the ARES-G2 will be established.

Connecting the Computer to the Switch

1 Locate the Ethernet port on the back of the computer.

Figure 34 Computer ethernet port

2 Plug one end of the Ethernet cable into the computer's Ethernet port.

3 Connect the other end of the cable to one of the network ports on the switch.

4 Check the Ethernet port on the rear of the computer. If communication between the computer and the switch has been properly established, a solid green light and flashing yellow light will appear at the port.

5 Follow the directions in the next section to connect the controller computer to a LAN for networking capabilities.

Connecting the Computer to a LAN

Before you can connect the controller computer to a LAN, you will need to have already installed a network interface card into the computer.

1 Locate the second Ethernet port on the back of the computer.

2 Plug one end of the Ethernet cable into the computer's Ethernet port.

3 Plug the other end into the LAN.

4 Check the Ethernet port on the rear of the computer. If communication between the computer and the LAN has been properly established, a solid green light and flashing yellow light will appear at the port.

For more information regarding network connections and setting the IP addresses, refer to the TRIOS online help.

Locking/Unlocking the Motor

When you first receive your ARES-G2, the motor will be locked with a motor cover. See the figure below. Unlock the motor as directed below BEFORE powering up the instrument.

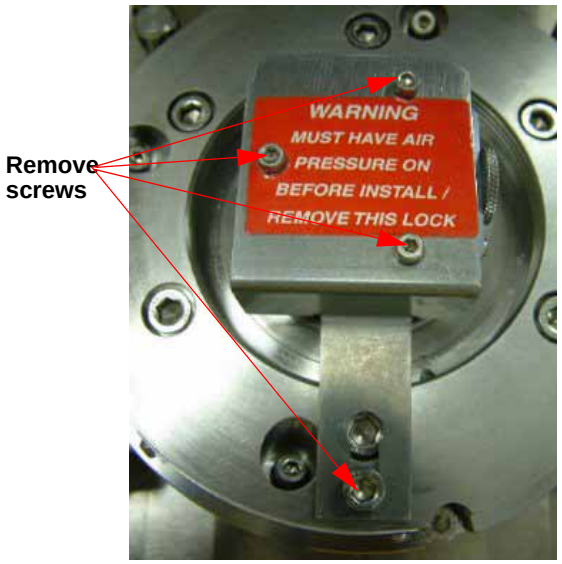


Figure 35 Motor cover installed.

Unlocking the Motor

To unlock the motor, follow these instructions:

1. Ensure that instrument power is **off** and **air is being supplied** to the motor. See the warning on the red label.
2. Loosen and remove the three machine screws and the hex head screw.
3. Remove the motor cover. Retain the cover and screws in the event they are needed. The motor should turn freely in either direction.

Locking the Motor

Once the motor has been unlocked, you will not need to lock it again unless you shut off the air supply to the instrument or the instrument must be moved.

To lock the motor:

1. Ensure that instrument power is **off** and **air is being supplied** to the motor.
2. Lock the transducer as directed on the next page.
3. Place the lock on the motor, aligning the four screw holes.
4. Insert the three machine screws and the hex head screw.
5. Tighten all four screws. Now you can turn off the air supply or move the instrument.

Locking/Unlocking the Transducer

In addition to unlocking the motor BEFORE powering up the instrument, you will need to unlock the transducer. After unlocking it as directed below, it will not need to be locked again unless you shut off the air flow or move the instrument.

Please observe the following precautions to ensure the integrity of your instrument:

- Do not apply power to the instrument when the bearing is locked.
- Do not unlock the bearing unless air is applied to the transducer.
- If the air supply must be intentionally interrupted, turn off instrument power and lock the bearing prior to removing air.
- If the air supply is interrupted while the bearing is unlocked, do not touch the anvil until air flow is restored.
- Maintain air flow to the transducer at all times to prevent contamination of the air bearing.
- Failure to observe these precautions will result in damage to the transducer.

CAUTION: Force Rebalance Transducers contain a precision air bearing that is equipped with a bearing lock, which prevents movement of the air bearing when no air is applied. To avoid damaging your transducer, familiarize yourself with the operation of the bearing lock, and read the instructions carefully.

MISE EN GARDE: Les transducteurs de rééquilibrage de force contiennent un palier à air de précision équipé d'un verrou de palier qui empêchent le mouvement du palier à air lorsque l'air n'est pas appliqué. Pour éviter d'endommager le transducteur, familiarisez-vous avec l'utilisation du verrou de palier et lisez attentivement les instructions.

Unlocking the Transducer

Follow these steps to unlock the transducer:

1 Ensure that instrument power is **off** and **air is being supplied** to the motor.

2 Turn the locking handle toward the back of the instrument as shown in the figure below.

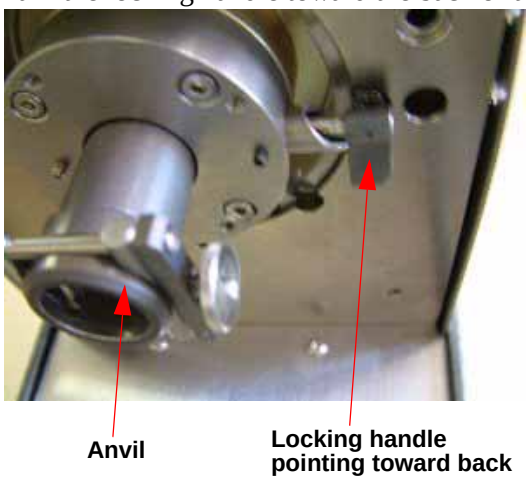


Figure 36 Transducer unlocked.

Locking the Transducer

Once the transducer has been unlocked, you will not need to lock it again unless you shut off the air supply to the instrument or the instrument must be moved.

To lock the transducer:

1 Ensure that instrument power is **off** and **air is being supplied** to the motor.

2 Turn the locking handle toward the front of the instrument as shown in the figure to the right. Now you can turn off the air supply or move the instrument.

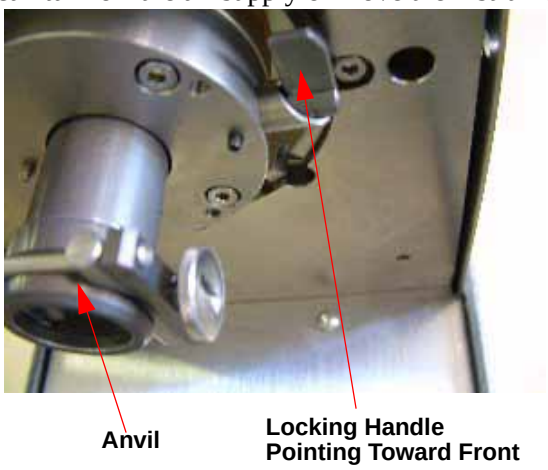


Figure 37 Transducer locked.

Connecting Accessories

Follow the instructions in the associated manual or online help for instructions on connecting any accessories to the ARES-G2.

To install the various geometries, see Chapter 3 for basic instructions. See the online help for geometry-specific information.

Connecting the Test Station Power Cable

Once all cables and lines have been connected to the modular power supplies and the ARES-G2 test station, connect the power cable.

Install the power cable as follows:

1 Make sure the power switch on the lower power supply module is in the Off (O) position.

2 Plug the large, multi-pin cable from the lower power supply to the appropriate connection on the rear of the ARES-G2 test station, as shown in the figure below.

3 Connect the grounding wire to the cabinet, as shown in the figure below.

4 Plug the power cord from the lower power supply module into the wall outlet.

CAUTION: Before plugging the power cable into the wall outlet, make sure the instrument is compatible with the line voltage. Check the label on the back of the unit to verify the voltage.

MISE EN GARDE: Avant de brancher le câble d'alimentation du dans la prise murale, assurez-vous que l'instrument est compatible avec la tension de la ligne. Consultez l'étiquette au dos de l'appareil pour vérifier la tension.

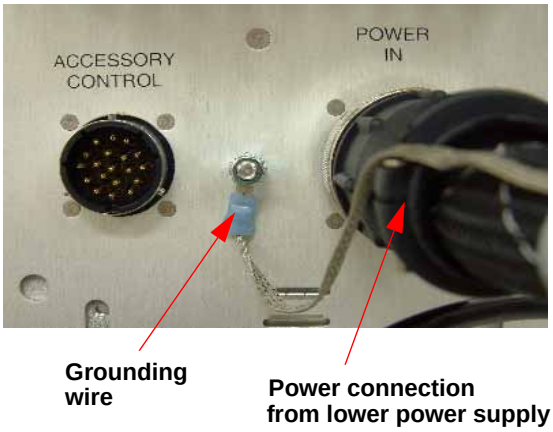


Figure 38 Power and grounding wire connections on rear of ARES-G2 test station.

Leveling the ARES-G2

The ARES-G2 is levelled using the feet, or levellers, located on each corner. Note that the right rear leveller is fixed in position; therefore, you will be adjusting the other three levellers. Follow the instructions below to perform this procedure.

Figure 39 Leveller.

1. Raise the left rear leveller by turning it clockwise until it has been raised as far as possible.
2. Make sure that the air is on and the motor is unlocked.
3. Install a lower parallel plate geometry (either the 25 or 50-mm size can be used).

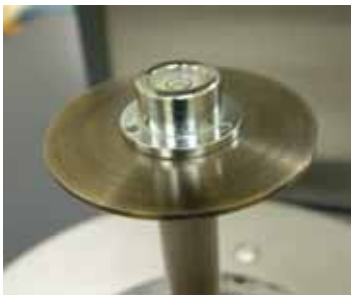


Figure 40 Parallel plate geometry.

4. Place the supplied bubble level in the center of the plate.
5. **Front-to-Back Adjustment:** Turn the right front leveller in either direction until the bubble is roughly centered front-to-back on the horizontal axis of the circle. (At this point the left-to-right position is not important.)

Figure 41 Front levellers on ARES-G2.

6 **Left-to-Right Adjustment**: Turn the left front leveller in either direction until the bubble is centered within the circle.

7 Repeat steps 5 and 6, if necessary, until the bubble is centered and the instrument is level.

8 Turn the left rear leveller counterclockwise, lowering it until it just touches the surface of the laboratory benchtop.

Starting the ARES-G2

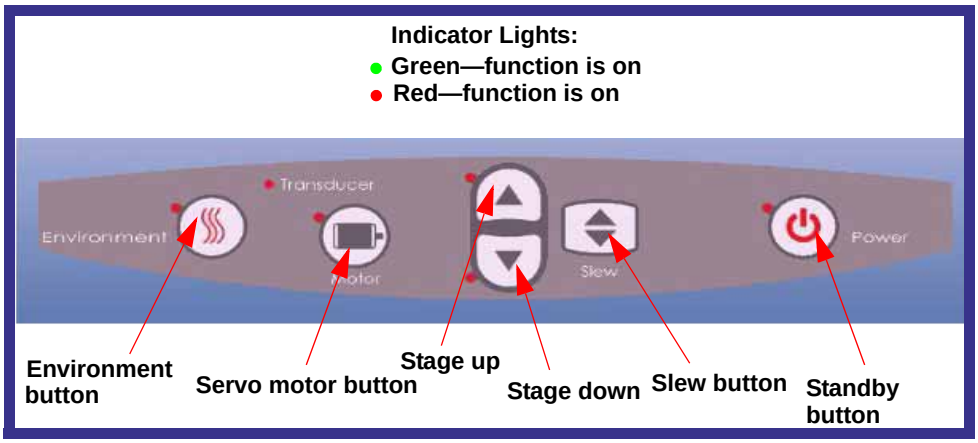
When all of the connections have been made between the test station, oven, power supplies, network, and any environmental system accessory; and the transducer and motor are unlocked, power on the system as described below.

1 Plug the power cord from the lower power supply module into the power source for the room.

2 Turn the power switch on the back of the lower power supply module to the On position (|).

3 Press the standby button on the test station front panel (shown in the figure below). The instrument power status light will blink until the instrument comes up to full power. The light will show a steady green when the instrument is ready for operation. When the instrument is powered up, the motor will become energized and automatically move to the zero position. Do not impede the motor's movement while this is happening.

See Chapter 3 for basic information on using the ARES-G2. For details, refer to the online help accessed through the TRIOS software.



Shutting Down the ARES-G2

Should you need to shut down the ARES-G2, simply press and release the standby button on the front panel. This will safely power down the instrument as soon as the oven comes down to a safe operating temperature. At that point, the power will be shut down and the power light will turn red. This means the instrument is now in the standby state. If you press and hold the standby button, the instrument will immediately go into the standby state.

Before switching the system to the standby state, remove all test sample materials from test fixtures, and move the transducer into a position where the upper test fixture is not in contact with the lower test fixture. (When power is restored, the motor will perform a calibration operation that will require free motor shaft rotation.)

If an error occurs that causes the instrument to not switch into the standby state, the press and hold the **Standby** button continuously for 10 seconds to force a shutdown to occur.

Powering Off the ARES-G2

If the instrument is expected to be disassembled for maintenance, disconnected from its compressed air source, or is being moved, then it is necessary to turn the power to the system completely off. Please follow these instructions:

- Use the rocker switch/ circuit-breaker located on the lower part of the rear panel on the Power Controller to remove all power from all components plugged into the Power Controller.
- Please make every effort to put the instrument into the “Standby” state before disconnecting power. Switching off the power while the system is operating may damage electronics or mechanical systems.
- Removing power from the system will cause some settings (specifically the Gap-Zero measurement) to be lost. It will be necessary to re-zero the test fixture after power is restored.
- Power should be turned off and the system unplugged from the main power source if there is a reasonable expectation of a large electrical disturbance on the main power source. (Severe weather, anticipated power outage, utility work, or anticipated extraordinary power-line transients.)
- Removing power from the system is not recommended as a daily practice; it is preferable to leave the system in its “Standby” state unless there is a specific reason to completely remove power.

Chapter: 3

Use, Maintenance, & Diagnostics

Using the ARES-G2

All ARES-G2 experiments follow the general outline below. In some cases, not all of these steps will be performed. The majority of these steps are performed using the instrument control software. The instructions needed to perform these actions can be found in the online help in the instrument control program; therefore, they will not all be covered in detail here.

- Calibrating the instrument.
- Selecting and preparing the sample.
- Selecting and installing the appropriate geometry for the desired test and sample.
- Creating or choosing the test procedure and entering sample and instrument information through the TRIOS instrument control software.
- Loading the prepared sample.
- Starting the experiment.
- Displaying and analyzing results.
- To obtain accurate results, follow all instructions carefully.

For detailed information, refer TRIOS software online Help.

Before You Begin

Before you set up an experiment, ensure that the ARES-G2, the environmental unit, and the TRIOS software have been installed properly. Make sure you have:

- Made all necessary cable connections from the ARES-G2 to the computer and to the modular power supplies.
- Connected all gas lines (air bearing and air cool).
- Connected your environmental units.
- Powered up the unit.
- Become familiar with the TRIOS software.

- Calibrated the ARES-G2, if necessary.

WARNING: HIGH VOLTAGE is used in this instrument. DEATH ON CONTACT may result if operating personnel fail to observe safety precautions.

Learn the areas of high voltage connections, and exercise care not to contact these areas when performing instrument calibration.

Prior to working inside the instrument, remove all jewelry, turn off the power, and ground points of high voltage. Make adjustments using an insulated electronic adjustment geometry. Do not make contact with the inside of the instrument while power is being applied.

AVERTISSEMENT: Des tensions élevées sont utilisées dans cet instrument. Si le personnel d'exploitation ne respecte pas les précautions d'utilisation, il peut en résulter la MORT AU CONTACT de cet instrument.

Familiarisez-vous avec les zones des raccordements haute tension et faites preuve de prudence pour ne pas toucher ces zones lors de l'étalonnage de cet instrument.

Avant de travailler à l'intérieur de l'instrument, débarrassez-vous de tous vos bijoux, coupez l'alimentation et mettez les points de haute tension à la terre. Effectuez des réglages à l'aide d'une géométrie de réglage électronique isolée. N'établissez pas de contact avec l'intérieur de l'instrument lorsqu'il est sous tension.

Calibrating the ARES-G2

To obtain accurate experimental results, calibrate the ARES-G2 when you first install it. For the best results, you should recalibrate periodically. The calibration procedures that you need to perform will vary. See the chart below for a general guide to types of calibration. **For details on how to perform that calibration, refer to the online documentation accessed through the TRIOS software.**

The table below lists required calibration tasks and the recommended calibration interval for each task. The table also shows when certain calibrations must be performed following repairs.

Table 8: Calibration Tasks and Recommended Intervals

Calibration Task	Calibration Interval
Torque Calibration	Suggested: Monthly. Mandatory: Following transducer replacement.
Normal Force Calibration	Suggested: Monthly. Mandatory: Following transducer replacement.
Phase Angle Check	Suggested: Phase angle is checked at the time of installation and is recommended to be rechecked once a year during a scheduled preventative maintenance visit. Mandatory: Following transducer replacement. When attempting to diagnose system problem.
PDMS Check	Suggested: Monthly Run a PDMS sample at 30°C on a 25-mm plate.

This section provides a brief description of each type of calibration. For the procedures needed to perform the calibration, refer to the online help accessed through the TRIOS software.

Torque Calibration

Torque Calibration ensures that the transducer is accurately measuring torque. The calibration involves hanging a precision weight from the calibration geometry, a 2.5-centimeter moment arm that is mounted on the transducer, over a pulley during calibration. The applied torque is therefore the product of the weight and the 2.5-cm moment. For example, hanging a 200 g weight applies a torque of (200 g)(2.5 cm) = 500 g·cm (0.049 N-m).

Normal Force Calibration

Normal Force Calibration ensures that the transducer is properly measuring normal force. The calibration involves hanging a precision weight from a hook on the calibration geometry, which is mounted on the transducer during calibration. The applied normal force is the amount of weight applied to the calibration geometry. For example, hanging a 1000-g weight applies a normal force of 1000 (9.8 N).

Phase Angle Check

The phase angle correction compensates for possible phase shifts that may be added to torque and strain due to instrument electronics. Once the correction is determined, it should remain constant for the life of the system. The phase angle correction is computed and entered at the factory before the instrument is shipped, and should not have to be adjusted under normal operating conditions.

Phase angle is checked at the time of installation and is recommended to be rechecked once a year during a scheduled preventative maintenance visit. A Torsion Rectangular Clamp Set (p/n 403220.901) is required if you wish to periodically check the phase angle, or perform a phase angle calibration outside of a scheduled preventative maintenance visit.

To check the phase angle using the ARES-G2, a Dynamic Frequency Sweep is run on a steel sample that is loaded into a torsion rectangular geometry. Recall that a purely elastic sample has a phase angle of zero degrees. The phase angle of steel is near zero. If the values obtained from this test are abnormal, please contact Technical Services for further assistance.

System Check Using PDMS

Included in the calibration kit (supplied with the instrument) is a jar of PDMS. PDMS (polydimethyl siloxane) is a rheological reference material that is used to verify the correct operation of the test station in addition to the various types of calibration. A PDMS test should be run periodically to ensure proper operation of the instrument. It should also be run as a preliminary diagnostic any time there is a question regarding instrument performance.

Selecting and Installing a Geometry

General Recommendations

Although the physical properties of the sample generally dictate appropriate sample geometry, it is sometimes possible to test a given sample using more than one geometry.

Ideally, the test results should be identical in the different geometries. However, there exist experimental limitations that may make testing in one geometry preferable to testing in another. Additionally, factors such as anisotropy and differences in strain dependence may yield inconsistent results for different geometries.

Recommendations for selection of a geometry based upon sample type are as follows:

- Fluids, Suspensions and Emulsions: Low viscosity fluids, or suspensions of limited stability can be tested using either the ***Concentric Cylinder*** or ***Double Wall Concentric Cylinder geometry***. Higher viscosity fluids, and thicker suspensions and emulsions can be tested using ***Parallel Plates***, or ***Cone and Plate geometries***.
- Solid Samples, including Thermosets, Thermoplastics, and Elastomers: These materials can be tested using the ***Torsion Rectangular geometry***. Several inserts are available to accommodate a variety of sample thicknesses.
- Polymer Melts and Soft Solids: Melts can be tested using the ***Parallel Plate*** or ***Cone and Plate geometries***. The ***Extensional Viscosity Fixture*** or EVF is an option for testing elongation viscosity of polymer melts and high viscosity viscoelastic fluids.
- Thermosetting Resins and other Curing Studies: These materials are best tested in a ***Parallel Plate geometry***. Disposable plates are available for curing studies, or other geometry reactive materials.

Testing Limits and Compliance

Instrument compliance is defined as displacement, in radians, per unit of applied torque. Stiffness is the reciprocal of compliance. Transducer compliance is the transducer shaft angular displacement divided by the torque applied to the transducer. Shaft displacement is measured by a position sensor on the transducer shaft. Sample compliance is sample displacement divided by the force applied to the sample.

Because the transducer is not an infinitely stiff device, both the transducer and sample exhibit compliance. Since the transducer can be deformed along with the sample, some of the strain that is commanded deforms the sample, and some of the strain may deform the transducer. If the transducer deformation is large, relative to the sample deformation, this may lead to errors in moduli stiffness.

The ARES-G2 utilizes an online hardware correction scheme to adjust for transducer compliance. The system determines sample deformation (strain) by taking the difference between the (measured) motor and transducer displacement signals.

Under “ideal” conditions, the sample deformation is relatively large, and as such, the transducer displacement is much smaller than the motor displacement applying the torque. The difference between the two deformations (which is used to obtain sample displacement) is therefore a large number, and the relative error associated with the measurement is small. However, this error becomes significant when very stiff samples are tested, and the transducer displacement becomes close to the motor displacement. In most cases, the automatic online hardware correction scheme mentioned above eliminates the error. However, if the measured strain value is significantly smaller than the commanded strain value; the data are likely affected by transducer compliance.

As a practical guideline, measured sample strain should be at least 10% the commanded strain.

Although measurements can be taken below these limits, you are cautioned that accuracy may be affected. Measurements that are affected by transducer compliance report modulus values that are lower than the true modulus. One method of determining if transducer compliance is affecting the data is to switch to a different geometry and compare the results to the first tests. If the data are unaffected by compliance, the results from the two geometries should be nearly identical.

Sample compliance, or stiffness, is related to both the modulus and geometry of the sample. Since the modulus is fixed, the sample dimensions are normally adjusted (to make the sample less stiff), or the geometry is changed altogether, to obtain the desired sample compliance. It is critical that the sample compliance is within the operational range of the instrument otherwise inconsistent or incorrect results will be obtained.

NOTE: If the compliance effects on the sample are too large, you need to make the sample less stiff by either increasing the sample gap or length or decreasing the sample cross section area.

Determination of Operational Range

Operating range is defined as the region bounded by the maximum and minimum complex modulus, G*, that can be measured by the transducer using a specific geometry.

For each geometry there are specific factors that will affect the operating range for that geometry. Additionally, the following instrument-specific factors affect the operating range of all geometries:

- Minimum torque that can be measured by the transducer
- Transducer compliance
- Maximum strain that can be generated by the motor

When the sample stiffness is comparable with the geometry's stiffness, the geometry compliance correction should be considered. The geometry compliance correction is done through the TRIOS software by entering the geometry’s compliance values in the geometry setup.

Note: See Configuring a New Geometry for more information.

Basic Instructions for Geometry Installation

WARNING: The operator of this instrument 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.

AVERTISSEMENT: L'utilisateur de cet instrument est prévenu qu'en cas d'utilisation contraire aux indications du manuel, la protection offerte par l'équipement peut être altérée.

The following instructions provide some general information for installing a geometry on the ARES-G2. Refer to the online help for further information.

The following general sample loading guidelines pertain to all geometries:

- Make sure the geometries are clean and free from damage.
- Install the geometries correctly, as described. In general they should be easy to install. Having to use undue force is a sign that something is wrong. Stop and ascertain the problem before continuing.

- Make sure the geometries align with each other properly and that the gap is properly zeroed.
- When using the oven, close the oven door carefully to ensure that the sample or geometry does not interfere with the door.
- While loading the sample onto the geometry, ensure that the sample is centered, as well as is possible, between the mounting surfaces. Off-center loading may cause misalignment of the transducer/motor shafts. Additionally, misalignment may also affect the accuracy of the data. If misalignment does occur, the sample should be removed and carefully reloaded.
- When testing at temperatures below ambient temperature (or the temperature at which the sample was loaded), the clamps on some geometries may loosen as they cool. This is due to difference in the thermal expansion coefficients of the sample and that of the geometry. Before initiating testing at the lowest test temperature, you may wish to open the oven door and verify that the screws securing the clamps are tight, taking care not to touch any surface of the oven or geometries, which may be at dangerous cryogenic temperatures.

Installing the Upper Geometry

NOTE: The Upper PRT should only be used if an FCO Environmental system is being used and Parallel Plate or Cone/Plate geometries are being used.

To install an upper geometry follow these steps:

1 Loosen the knob on the transducer mount.

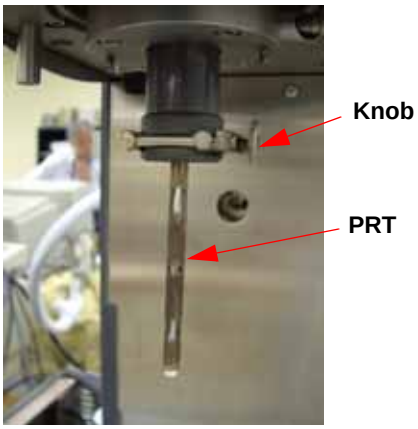


Figure 42 Upper PRT installed.

2 Insert the transducer PRT into the opening. While applying light upward force, rotate the PRT until it slips into place, indicating that the PRT has aligned with the keyway in the electrical jack. When properly installed, it will register the ambient temperature. See the figure to the right.

3 Obtain the desired geometry. Make sure there is no dirt or dust at the location surfaces for parallel and concentric alignment. Holding the geometry by the shaft, carefully slide the geometry over the PRT. The PRT temperature sensor is spring loaded and will need to be pushed upward as far as it will go then hold it in place.

4 Tighten the knob. Hand tighten the knob, but do not over-torque it. The retainers will move inward to hold the geometry in place. See the figure below.

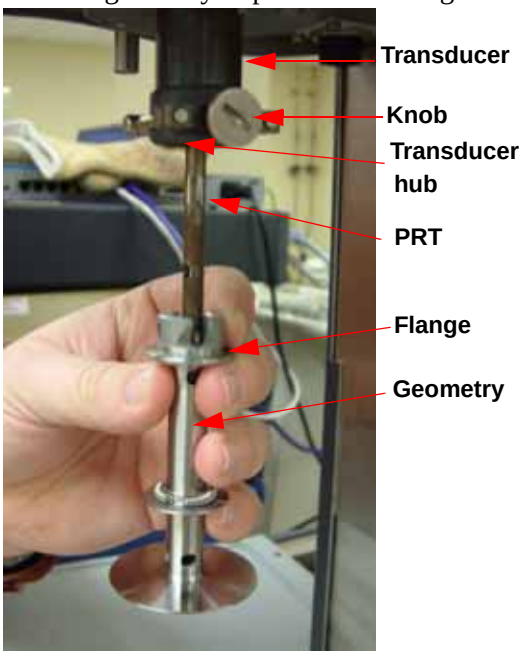


Figure 43 Installing the upper geometry.

NOTE: For more information on Platinum Resistance Thermometers (PRTs) and the different types of geometries, see TRIOS software online Help.

Installing the Lower Geometry

NOTE: The Lower PRT should only be used if an FCO Environmental system is being used and Parallel Plate or Cone/Plate geometries are being used.

Follow the directions depending on whether you have a motor mount or fluid bath mount.

Installation with a Motor Mount (Oven or Ambient)

To install a lower geometry onto the motor, refer to figures while performing the following steps:

1 Loosen the knob on the motor mount.

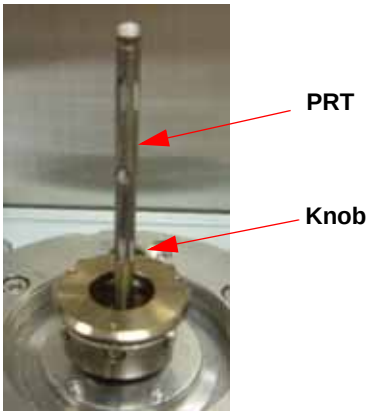


Figure 44 Lower PRT installed.

2 Insert the motor PRT into the opening. While applying light downward force, rotate the PRT until it slips into place, indicating that the PRT has aligned with the keyway in the electrical jack. When properly installed, it will register the ambient temperature. See the figure below.

3 Obtain the desired geometry. Make sure there is no dirt or dust at the location surfaces for parallel and concentric alignment. Holding the geometry by the shaft, carefully slide the geometry over the PRT. The PRT temperature sensor is spring loaded and will need to be pushed downward as far as it will go then hold it in place.

4 Tighten the knob. Hand tighten the knob, but do not over-torque it. The retainers will move inward to hold the geometry in place.

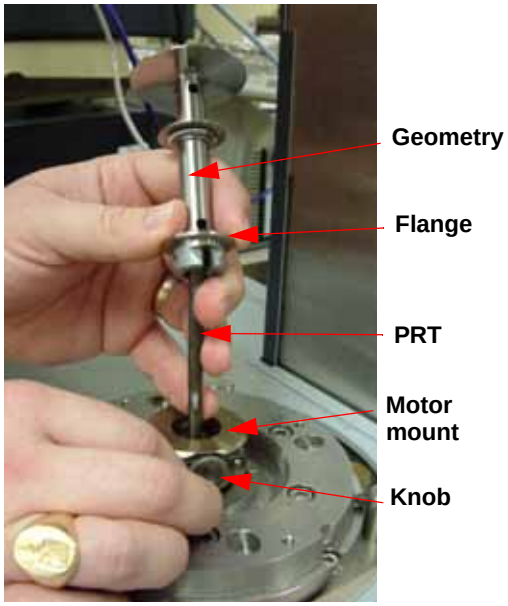


Figure 45 Installing the lower geometry.

NOTE: For more information on the different types of geometries, see TRIOS software online Help.

Creating a Procedure

The ARES-G2 is capable of performing a number of tests individually, oscillation, step (transient), and flow tests. These tests are organized under the following test types categories. (For detailed information, please consult the online help available through TRIOS.)

- **Oscillation**: In oscillation experiments, the material is subjected to a sinusoidal shear deformation. The material functions that are obtained are dependent on frequency.
- **Flow**: In flow tests, the input stress, strain, or strain rate are step or ramp functions in time. The results in flow experiments are obtained from the steady state or quasi-steady state material response.
- **Step (Transient)**: A step test increments to a target value of stress (creep), strain (stress relaxation), or strain rate, and measures the response as a function of time.
- **Other**
  - **Extensional Test**: The typical deformation applied by a rotational rheometer is the shear deformation. The special extensional fixture, EVF, transforms the rotational movement of the rheometer into a uniaxial extension deformation in the sample. Some uniaxial extension deformation can also be performed by driving the stage at the desired strain rate. The EVF winds up a sample film on both sides, this achieves large total deformation of approximately 50times the original length. The deformation is measured in Hencky strain (logarithmic measure).
  - **Axial Test**, which includes the linear/exponential motion of the stage or constant force on the sample for compressive or tensile testing on a sample.
  - **Arbitrary Waveform Test**, which allows defining the strain history used to deform the sample by supplying one or more analytical equations for strain, as a function of time.

Running an Experiment

Once you have chosen and installed a geometry and loaded the sample into the ARES-G2, you will need to set up and run your experiment. This section provides basic instructions, for details on the steps involved, see the online help accessed through the TRIOS program.

1 Select and install the appropriate geometry. If testing is to be done at temperatures other than ambient, install the geometry and then adjust the temperature to the desired initial value. Allow the geometry to reach thermal equilibrium.

2 Enter the desired sample information using the TRIOS program.

3 Configure the selected geometry and create the desired experimental procedure.

4 Zero the gap between upper and lower test geometries.

5 Open the gap and load the sample onto the geometry.

6 Lower the upper geometry onto the sample.

7 Trim the sample.

8 Bring the gap down to the final sample gap.

9 Wait for the sample to relax.

10 Start the test.

Maintaining the Instrument

This section provides some basic maintenance procedures that you may need to use for your ARES-G2 instrument.

Cleaning Geometries

After you have finished testing your sample, open the oven (if used), raise the upper geometry and brush or wipe off the sample. You can remove the geometry, if needed. Alternatively, use disposable plates and discard them after use.

Routine Maintenance

A few maintenance procedures should be done on a regular basis to keep your instrument running safely and accurately.

Cable and Hose Inspection

Damage to the AC power cords can cause a safety hazard. Periodically inspect these items as follows.

AC Power Cords Inspection

Remove AC power to the instrument and inspect as follows:

1 Turn the power switch on the lower power supply module to the Off (O) position.

2 Remove the power cable leading to lower power supply module from the wall outlet.

3 Inspect all the cords for frayed insulation or exposed bare copper wire, especially in the immediate vicinity of the plugs on either end. If any damage is found, notify TA Instruments Service.

4 Apply AC power to the instrument as follows:

5 Make sure the power switch on the lower power supply module is in the Off (O) position.

6 Plug the power cable from the lower power supply module into the wall outlet.

7 Turn the power switch on the lower power supply module to the On (|) position.

Air Hose Inspection

Remove AC power to the instrument as follows:

1 Turn the power switch on the lower power supply module to the Off (O) position.

2 Remove the power cable leading to lower power supply module from the wall outlet.

3 Lock the transducer and motor as directed in Chapter 2.

4 Remove air supply to instrument.

Inspect the air hoses for cracks and other damage that could result in leaks, especially in the vicinity of the bend radii. If any damage is found, notify TA Instruments for service.

If no leaks are found, apply AC power to the instrument as follows:

1 Establish airflow through the air dryer, but do not connect the air output to the test station. Allow the air to purge for 3 to 5 minutes.

2 Connect the air supply to the test station.

3 Unlock the transducer and motor as directed in Chapter 2.

4 Plug the power cable from the lower power supply module into the wall outlet.

5 Turn the power switch on the lower power supply module to the On (|) position.

6 Verify that the air pressure to the motor, transducer, and oven are correct.

NOTE: To verify the proper pressure setting for the FCO ("FCO Heater Air"), the FCO must be turned on. If the pressure is too low, the FCO turns off within a few seconds of being turned on and the system displays a "low pressure" error message.

Internal Filter Inspection

There are also internal filters inside the test station that should be inspected and serviced on an approximately six- month to a year basis. Only qualified service personal should perform this maintenance.

NOTE: Opening the back panel will allow you to see the internal filters. The filters should be white. Any yellow color indicates oil is getting through and they should be changed.

Air Dryer Inspection

Inspect and service the air dryer according to its manual. The two external filter cartridges mounted with the air dryer can be checked and changed. Make sure the moisture indicator is green. If it turns red, disconnect the air line, drain the filter bowls, and change the filter cartridges. Make sure the air dryer is set to "2."

Power Supply Maintenance

The only maintenance procedure that you can perform for the power supply units is to use a vacuum to remove dust and debris from the fans on the rear of the units. Call TA Instruments if any other service is required.

LN2 and Forced Convection Oven Maintenance

There are no maintenance procedures that you can perform for the LN2 cooler or the oven. To maintain LN2 Controller transfer line effectiveness the LN2 Controller should be run at least once every two months to insure optimal performance. Call TA Instruments if service is required.

Cleaning the Instrument

If the exterior plastic or metallic surfaces of the instrument require cleaning, use only a solution consisting of a non-abrasive household dish detergent and water.

Clean as follows:

1. Remove AC power to the instrument as follows:
   - **a** Turn the power switch on the lower power supply module to the Off (O) position.
   - **b** Remove the power cable leading to lower power supply module from the wall outlet.
2. Apply some cleaning solution onto a cotton cloth, then wring out the cloth to discharge excess water; the cloth must be damp, but not wet.
3. While ensuring that excess fluid from the cloth does not enter any crevice of the instrument, use the cloth to gently clean the desired external surfaces.
4. Ensure that all surfaces of the instrument are dry.
5. Apply AC power to the instrument as follows:
   - **a** Plug the power cable from the lower power supply module into the wall outlet.
   - **b** Turn the power switch on the lower power supply module to the On (|) position.

Cleaning the Touch Screen

You can clean the touch screen as often as you like. The touch screen should be cleaned with a household liquid glass cleaner and soft cloth. Wet the cloth (not the touch screen) with the glass cleaner, and then wipe off the touch screen and surrounding surfaces.

WARNING: Do not use harsh chemicals, abrasive cleansers, steel wool, or any rough materials to clean the touch screen, as you may scratch the surface and degrade its properties.

AVERTISSEMENT: N'utilisez pas de produits chimiques agressifs, de nettoyants abrasifs, de la laine d'acier ou tout autre matériau rugueux pour nettoyer écran tactile, car vous pourriez égratigner sa surface et dégrader ses propriétés.

Troubleshooting

See the online help accessed through the TRIOS software for information on solving any problems that may develop.

Other than the routine maintenance listed in the previous section, there are no other repairs or service that you, as the customer, can perform. There are no customer-replaceable fuses in the ARES-G2.

Contact TA Instruments regarding service or repairs, as well as the availability of service contracts and plans.

Replacement Parts

Replacement parts for the ARES-G2 that are available from TA Instruments. See the table below when ordering parts.

Part Number	Description
1000cP oil	700.01016
PDMS	700.01011
Replacement coalescing filter element	613.06404
Replacement particle filter element:	613.06406

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