TGA Q5000 IR Thermogravimetric Analyzer

Q Series™ Getting Started Guide

Revision E
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Notice

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Notes, Cautions, and Warnings

This manual uses NOTES, CAUTIONS, and WARNINGS to emphasize important and critical instructions.

A NOTE highlights important information about equipment or procedures.

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

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

Regulatory Compliance

Safety Standards

For Canada:

CAN/CSA-22.2 No. 1010.1-92 Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1: General Requirements + Amendments.

CAN/CSA-22.2 No. 1010.2.010-94 Particular requirements for laboratory equipment for the heating of materials + Amendments.

For the European Economic Area: (In accordance with Council Directive 73/23/EEC of 19 February 1973 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits.)

EN61010-1: 2001 Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1: General Requirements + Amendments.

EN61010-2-010: 1994 Particular requirements for laboratory equipment for the heating of materials + Amendments.

For the United States:

UL 61010A-1: Electrical Equipment for Laboratory Use; Part 1: General Requirements.
UL 61010A-2-010 Part 2: Particular requirements for laboratory equipment for the heating of materials.

Electromagnetic Compatibility Standards

For Australia and New Zealand:

AS/NZS CISPR 11:2004 Limits and methods of measurement of electronic disturbance characteristics of industrial, scientific and medical (ISM) radiofrequency equipment.

For Canada:

ICES-001 Issue 3 March 7, 1998 Interference-Causing Equipment Standard: Industrial, Scientific, and Medical Radio Frequency Generators.

For the European Economic Area: (In accordance with Council Directive 89/336/EEC of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility.)

EN61326-1: 1997 Electrical equipment for measurement, control, and laboratory use-EMC requirements-Part 1: General Requirements + Amendments. Emissions: Meets Class A requirements (Table 3). Immunity: Meets performance criteria A for non-continuous operation (Table B.1).

For the United States:

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

Safety

Instrument Symbols

The following label is displayed on the TGA instrument for your protection:

Symbol	Explanation
	This symbol, on the front of the TGA furnace, 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.
	This symbol on the rear access panel 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 or other qualified service personnel.

Please heed the warning labels and take the necessary precautions when dealing with these areas. The *TGA Getting Started Guide* contains cautions and warnings that must be followed for your own safety.

Electrical Safety

You must unplug the instrument *before* doing any maintenance or repair work; voltages exceeding 120 Vac are present in this system.

WARNING: 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 or other qualified service personnel.

Chemical Safety

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

WARNING: Do not use hydrogen or any other explosive gas in the TGA furnace.

WARNING: Oxygen can be used as a purge gas in the TGA. However, the furnace must be kept clean so that volatile hydrocarbons, which might combust, are removed.

WARNING: If you are routinely evaluating materials in the TGA that lose a large amount of volatile hydrocarbons (*e.g.*, lubricating oils), you need to clean the furnace more frequently to prevent dangerous buildup of debris in the furnace.

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

Thermal Safety

CAUTION: After running an experiment, allow the open furnace and thermocouple to cool down before you touch them. Allow the furnace to cool down before removing the lower furnace (thermocouple) assembly.

Mechanical Safety

WARNING: Keep your fingers and all other objects out of the path of the furnace when it is moving. The seal is very tight.

Lifting the Instrument

The TGA is a fairly heavy instrument. In order to avoid injury, particularly to the back, please follow this advice:

WARNING: Use two people to lift and/or carry the instrument. The instrument is too heavy for one person to handle safely.

Chapter 1
Introducing the Q5000 IR

Overview

Your TA Instruments Thermogravimetric Analyzer (TGA) is a thermal weight-change analysis instrument, used in conjunction with a controller computer and associated software to make up a thermal analysis system.

TGA Q5000 IR

The Thermogravimetric Analyzer measures the amount and rate of weight change in a material, either as a function of increasing temperature, or isothermally as a function of time, in a controlled atmosphere. It can be used to characterize any material that exhibits a weight change and to detect phase changes due to decomposition, oxidation, or dehydration. This information helps the scientist or engineer identify the percent weight change and correlate chemical structure, processing, and end-use performance.

Your controller is a computer that performs the following functions:

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

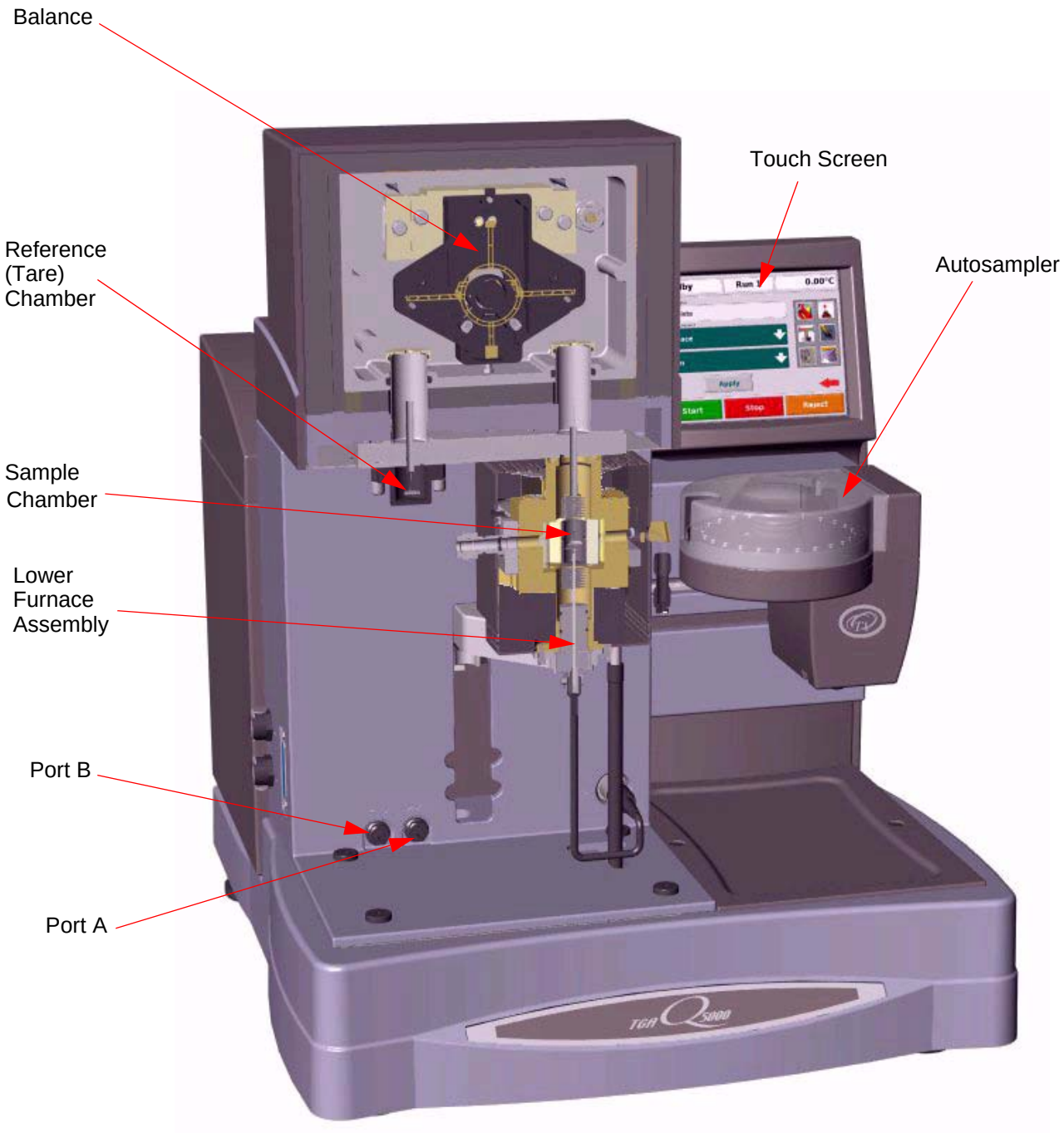
Components

The TGA Q5000 IR has the following major hardware components (see the figure on the next page for reference):

- The *balance*, which provides precise measurement of sample weight. The balance is the key to the TGA system.
- The heating system (or *Infrared (IR) furnace*), which controls the sample temperature.
- The *Autosampler*, which loads and unloads the sample to and from the balance. The Autosampler platform has a built-in pan punching mechanism that is used in conjunction with the optional sealed aluminum pans.
- The *cabinet*, where the system electronics and mechanics are housed.
- The *heat exchanger*, which dissipates heat from the furnace.
- The *Mass Flow Controllers* (or MFC), which control the purge gas to the balance and furnace.
- The *touch screen*, which is used to communicate commands to the instrument and provides real time display.

The next few pages briefly describe the components available with the TGA. Consult the online documentation associated with the instrument control software for detailed information.

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



TGA Q5000 IR Components

Balance Assembly

The TGA balance assembly is a null balance system, consisting of the balance meter movement, the balance arm, the balance position sensor, the hang-down wire assemblies, the sample pan, and the tare pan.

The *balance meter movement* is a taut-band meter movement to which the balance arm is attached.

The *balance arm* is an assembly constructed of beryllium copper alloy attached to the meter movement.

The *balance position sensor* is comprised of an LED source and an LED detector on printed circuit boards that detect the null position of the meter movement. The balance beam sensor is mounted above the balance arm. It is used in conjunction with the analog circuitry to maintain a null position.

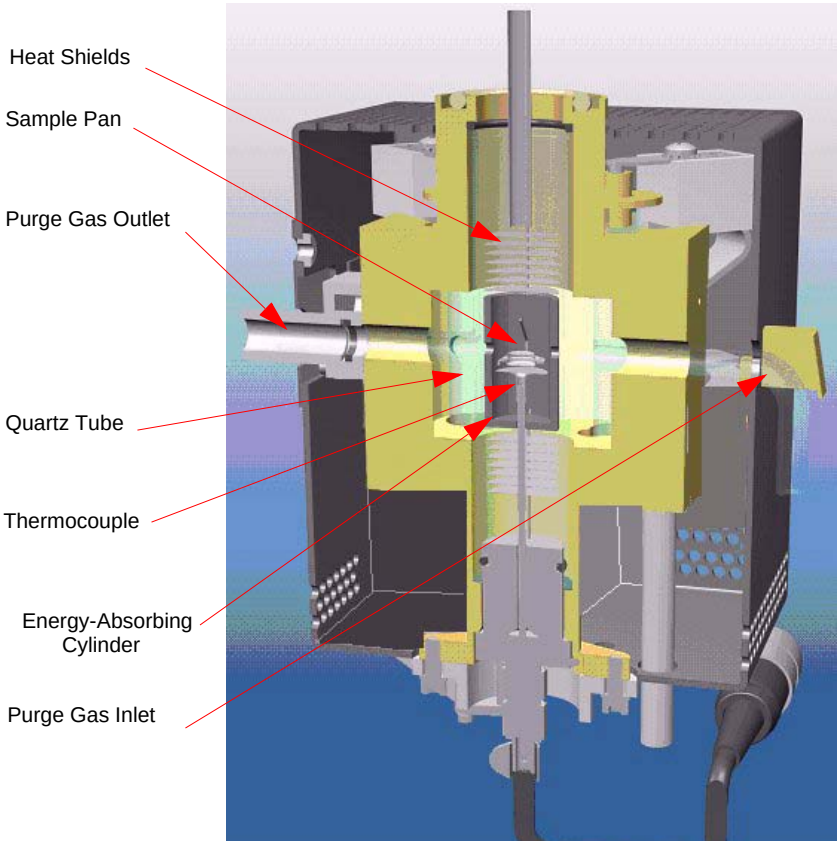
The TGA has two *hang-down wire assemblies*: one for the tare pan and one for the sample pan. Each assembly consists of a hang-down wire and beryllium copper decoupler loop. The hang-down wire has hooks at each end and connects the pan to the loop. The loop is used to connect the hang-down wire to the balance arm. The longer hang-down wire is for the sample side.

The tare hang-down wire, tare pan and any counterbalance weight mechanically balances the weight of the sample pan and sample hang-down wire.

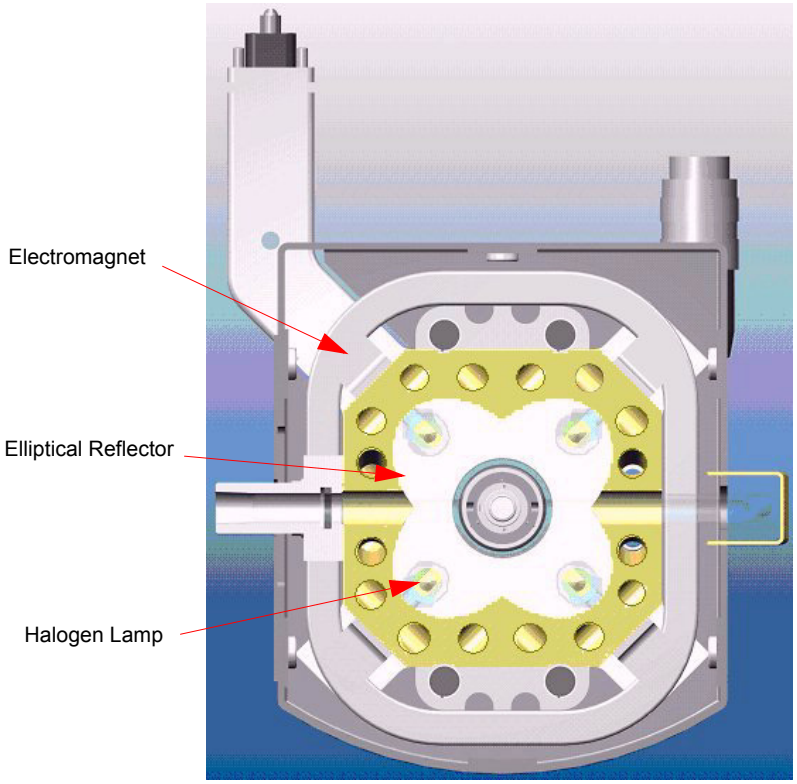
Infrared (IR) Furnace

The Infrared (IR) furnace (shown in the figure here) uses *quartz halogen lamps* as the heat source. Four lamps are arranged in a circular pattern surrounding the *quartz tube* that encloses the sample area. Infrared energy from the lamps is directed toward the *sample area* by a water-cooled, gold-plated reflector consisting of four elliptical surfaces.

The sample area is enclosed by a cylinder inside of the quartz tube. This *energy-absorbing cyliner* absorbs radiation from the lamps and heats the sample, pan, and thermocouple.



Temperature is measured and controlled by a *thermocouple assembly* under the sample pan. The sample thermocouple is attached to a platinum disk to improve heat exchange and aid in suppressing gas flow due to convection. The thermocouple assembly includes a second independent thermocouple to protect the furnace from excessive temperature.



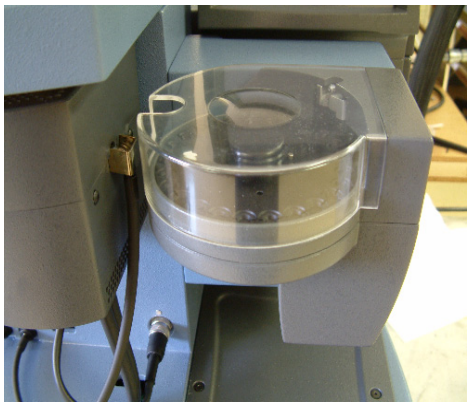
Heat shield assemblies above and below the energy-absorbing tube reduce heat losses from the ends of the furnace.

Purge gas enters the sample area through a tube within the quartz tube, passes through a hole in the wall of the absorber across the top of the sample pan, through another hole in the wall of the absorber and exits via a second tube in the quartz tube.

A *magnetic coil* surrounding the furnace generates a field that acts on magnetic samples in the sample pan. This facilitates automated temperature calibration using Curie point standards and Curie point studies.

Rapid cooling of the furnace at the end of an experiment is facilitated by air that enters the furnace chamber through the bottom of the furnace.

TGA Autosampler



The TGA Q5000 Autosampler (see the figure here) allows you to place multiple samples on the platform for automatic loading and run sequencing. Using the standard pan tray up to 25 samples can be accommodated . Experiments are performed as normal—but samples can be run on a continual basis.

The pans listed below are used with the TGA Autosampler:

Standard Pan Tray (25 pans):

- 100 and 250 µL Ceramic (use up to 1200°C)
- 50 and 100 µL Platinum (use up to 700°C)
- 50 and 100 µL Platinum-HT (to 1000°C)
- 20 µL Sealed Aluminum* (use up to 600°C)
- 80 µL Aluminum (Bottom of sealed pan) (use up to 600°C)

An optional tray is available for use with the 180 µL hemispherical quartz pans. Up to ten pans can be accommodated with this platform.

* Sealed pan is punched prior to loading and evaluation.

The sample can be sealed in a special aluminum pan and opened (exposed to the environment) immediately before being loaded into the balance via the Autosampler's built-in punching mechanism. The punching mechanism ensures that only punched pans are loaded onto the balance. (*i.e.*, If the mechanism determines that a sealed pan has not been punched, a second attempt to punch the pan will occur. If that second punching is not successful, the pan will not be loaded.)

To calibrate the sample tray and punching mechanism, refer to Chapter 3 of this manual and the online documentation found in the instrument control software.

Hi-Res™ TGA

The TA Instruments Hi-Res technique, dynamic rate TGA, differs from previous control techniques in that the heating rate of the sample material is dynamically and continuously modified in response to changes in the rate of decomposition of the sample so as to optimize both weight change resolution and time of analysis. This TGA technique (supplied with the Q5000 IR) allows the use of very high heating rates during ramp segments where no weight changes are occurring, but automatically slows the heating rate during weight changes. Once the weight change(s) are complete, the system returns to the selected ramp heating rate. Typical Hi-Res ramps often take the same or less time to complete than a comparable constant heating rate experiment run at a lower heating rate, while providing improved resolution.

Some of the benefits provided by the Hi-Res option are:

- Improved Transition Resolution
- Faster Survey Scans
- Enhanced Signature Analysis Capability
- Transition Temperatures Closer to Isothermal Values
- Increased Method Programming Versatility

Modulated TGA (MTGA™)

TA Instruments Modulated TGA (MTGA) is an innovative technique used to study the same decomposition or volatilization properties as conventional TGA. However, MTGA (supplied with the Q5000 IR) provides unique capabilities that increase the amount of information obtained from a single TGA experiment, thereby improving the quality of interpretation.

These unique capabilities include:

- continuous determination of activation energy
- verification of a single kinetic mechanism
- verification of first-order kinetic model.

MTGA is an enhancement of TGA that provides the same information as traditional TGA, plus new information that permits unique insights into the behavior of the weight loss reaction. Specifically, MTGA provides an alternative way to obtain kinetic information about one or more weight losses, in a shorter period of time than the multiple heating rate approach.

In addition, MTGA provides continuous determined values for activation energy throughout the weight loss reaction, not just at specific reaction levels. The ability to obtain activation energy continuously allows you to follow changes in the activation energy during the reaction, as a function of temperature or conversion. The calculation of activation energy is "model free"—no knowledge about the form of the kinetic equation is required. The assumption of a first-order kinetic model (a reasonable assumption for many decomposition reactions),

permits the calculation of natural logarithm of the pre-exponential factor in the same manner as the continuous determination of activation energy.

MTGA should be used where a rapid, single experiment determination of kinetic parameters is desired, or where information concerning these parameters is needed as a function of temperature or conversion.

Other Accessories

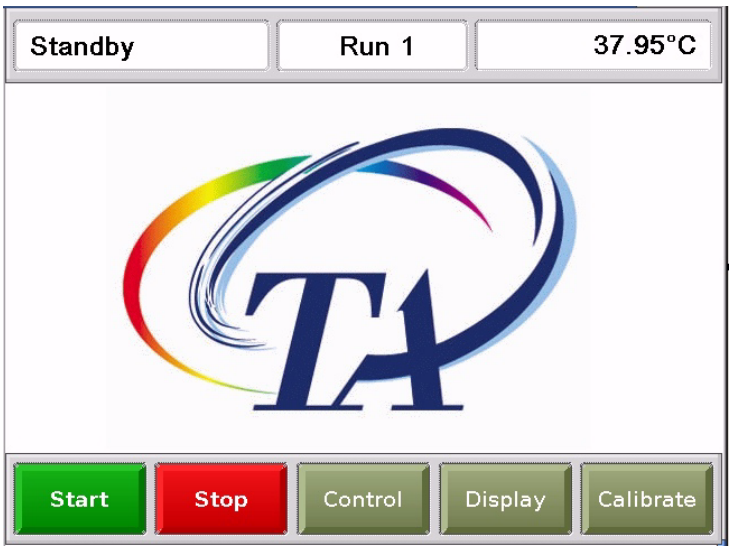
The TGA can be used with many standard analytical accessories offered by various manufacturers: FTIR, mass spectrometers, gas chromatographs, and evolved gas analyzers. To assist in the performance of mass spectrometer analysis and to prevent condensation between the furnace and the transfer line to the other coupled instrument, the standard connector at the outlet can be replaced by an optional heated connector. Purge gas, exiting the balance chamber above the furnace, exits by the same route.

If desired, a vacuum pump can be connected to the standard 1/4-inch Swagelok connector at the furnace gas outlet.

Consult the appropriate local instrument manufacturer for further information.

The TGA Q5000 Touch Screen

The TGA Q5000 instrument has a built-in integrated display and keypad in the form of a touch screen for local operator control. The functions on the screen change depending upon the menu you are using. This section briefly describes the basic layout of these functions.



The *status line* along the top of the display shows the current instrument status, run selection, and temperature.

At the bottom of the screen is a set of keys that are used for the primary instrument functions. See the table below for a description of each key.

The functions in the middle of the touch screen will vary depending on the screen displayed.

Primary Function Keys

Use the following keys for the main functions of the instrument.

Key Name	Description
Start	Begins the experiment. This is the same function as **Start** on the instrument control software. **Start** automatically loads the sample pan and closes the furnace, if necessary, before beginning the experiment.
Stop	If an experiment is running, this key ends the method normally, as though it had run to completion; i.e., the method-end conditions go into effect and the data that has been generated is saved. This is the same function as **Stop** on the instrument control software. If an experiment is not running (the instrument is in a standby or method-end state), the **Stop** key will halt any activity (air cool, all mechanical motion, etc.). If an Autosampler sequence is in progress, **Stop** will halt the sequence.
Control *(table continued)*	Displays a list of the control command functions. These are used to control the instrument actions such as furnace movement, sample loading/unloading, taring, etc. Items can be selected from the icons or from the drop-down menu. Select **Apply** to initiate the command. See the next page for more details on this screen.

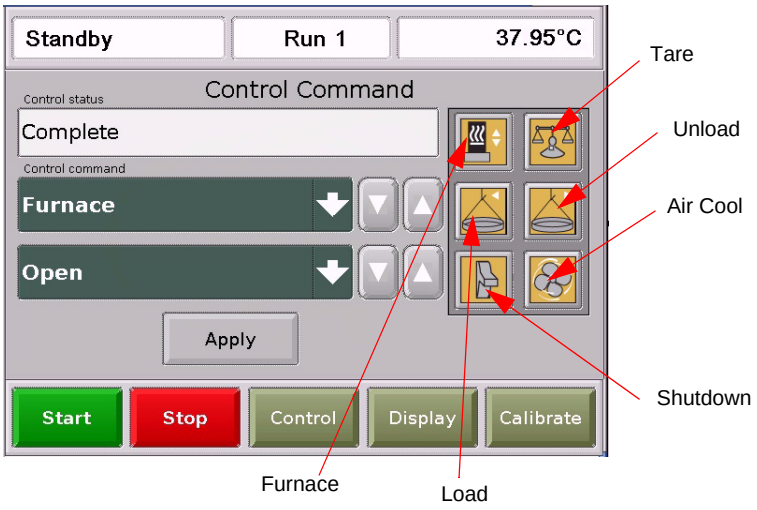
Display	Accesses the display screen, which displays the signals from the instrument such as signal display, real-time plot, instrument information, etc.
Calibrate	Displays the calibration functions available for this instrument. Functions such as autosampler and touch screen calibration can be accessed using this key.

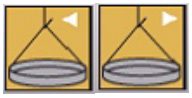
Control Menu

The Control Menu (see the figure to the right) is accessed by touching the **Control** key at the bottom of the touch screen. A brief description of each control command is provided in the table below.

NOTE: Most of the commands shown are not available during an active experiment.

Select the desired function either from the drop-down list of Control Commands or by pressing the icon. Then press **Apply** to initiate the action.



Control Command	Description
LOAD/UNLOAD 	Loads or unloads a sample pan from the sample platform onto the balance. This function will automatically close and open the furnace, if necessary.
TARE 	Zeros the displayed weight of an empty sample pan—automatically loads the pan from the sample platform, raises the furnace to protect the pan from air currents, weighs the pan, stores the weight as an offset, and then unloads the pan.
TARE ALL	Electronically zeros the displayed weight of an entire tray of empty pans.
FURNACE 	Toggles between the furnace closed (up) and furnace open (down) functions, depending on where the furnace is when you press the key. This key can be pressed while the furnace is moving, to reverse the direction of movement.

(table continued)

SWITCH GAS	Toggles between purge Gas #1 and Gas #2.
AIR COOL 	Toggles the air cool function on or off. This is the same function as Air Cool on the instrument control software.
HEAT EXCHANGER	Toggles the heat exchanger on or off.
RESET AUTO	Resets the autosampler.
PARK AUTOSAMPLER	Sends the autosampler tray to the park position, which is set off to the right and below the home position.
PAN TO FRONT	Use the pull-down menu to select the desired pan number position on the Autosampler tray. The selected pan number shown on this window will be brought to the front.
PUNCH PAN	Use the pull-down menu to select the desired pan number position on the Autosampler tray. The selected pan number shown on this window will be punched.
RESET SAVED PARAMETERS	Resets the saved instrument parameters and resets the instrument.
SHUTDOWN 	Shuts down and resets the instrument.

Display Touch Screen Options

The Display Options are accessed by touching the Display key at the bottom of the touch screen. The keys shown in the figure to the right are displayed.

A brief description of the function of each key is provided in the table below.

Key Name	Description
SEGMENTS 	Accesses the experimental method that is currently being used for this experiment.
INFORMATION  *(table continued)*	Displays instrument information such as the software version, options, and the IP address.

STATUS 	Displays the three main signals indicating the current status of the experiment.
SIGNALS 	Displays the real-time signal data that comes directly from the instrument. The signals displayed here are customized through the instrument control software by accessing Tools/Instrument Preferences.
PLOT 	Displays a time-based plot of data as it is received from the instrument during experiments.
SCREEN SAVER 	Allows you to choose a screen saver for the touch screen.
HOME 	Returns to the opening window.

Calibration Options

The Calibration Options are accessed by touching the Calibrate key at the bottom of the touch screen. The keys shown in the figure below are displayed. A brief description of the function of each key is provided in the table below.

Key Name	Description
TOUCH SCREEN 	Allows you to calibrate the touch screen display.
AUTOSAMPLER 	Accesses the Autosampler Calibration functions.

Instrument Specifications

The tables found on the following pages contain the technical specifications for the TGA.

TGA Q5000 IR Instrument Characteristics

Dimensions	Depth 55.9 cm (22 in.) Width 47 cm (18.5 in.) Height 61 cm (24 in.)
Weight of Instrument Weight of Transformer (for 230V operation)	37.27 kg (82 lbs) 8.18 kg (18 lbs)
Power	120 Vac, 50/60 Hz, standard 230 Vac, 50/60 Hz, if configured with a step-down transformer
Energy Consumption	1.44 kVA maximum, includes accessory power outlets
Insulation Rating	All electrical insulation between hazardous and low voltage components have been designed to meet the requirements of reinforced insulation. Low voltage circuits are grounded.
Temperature Range	Ambient +5°C to 1200°C
Thermocouple	Platinel II*
Heating Rate	0.1 to 500°C/min (Ballistic heating > 1000°C/min)

*Platinel II is a registered trademark of Engelhard Industries.

TGA Sampling System

The following table contains the specifications associated with the TGA sample pans, balance mechanism and furnace.

Sample Pan Options for 25-Pan Tray

Types	Platinum, Ceramic (Al_20_3), Aluminum
Volume Capacity and Temperature Range	20 µL Sealed Aluminum (to 600°C) 50 µL Platinum (to 700°C) 50 µL Platinum-HT (to 1000°C) 80 µL Aluminum (Bottom of sealed pan) (to 600°C) 100 µL Platinum (to 700°C) 100 µL Platinum-HT (to 1000°C) 100 µL Ceramic (to 1200°C) 250 µL Ceramic (to 1200°C)
Number of Pans per Tray	25 pans

Sample Pan Options for 10-Pan Tray (Optional with the Q5000 IR)

Types	Hemispherical Quartz
Volume Capacity and Temperature Range	180 µL Hemispherical Quartz (to 1000°C)
Number of Pans per Tray	10 quartz pans

Balance Mechanism

Weighing capacity (sample)[1]	Maximum sample mass 900 mg with an 800 mg tare mass
Weighing range	100 mg
Balance measurement	Tare weight required
Resolution	0.01 µg
Accuracy	≤ ± 0.1% of value or 10 µg, whichever is greater

[1] CAUTION: The total mechanical capacity of the balance suspension is 5 g. In order to avoid damaging the balance assembly, never allow the total weight of the sample, tare weight, balance beam, hang-down wires, and pans to exceed 5 g. The total mass of the balance system, excluding the sample pan, reference pan, sample and tare mass is 3.23 g. If the autosampler is used, the maximum sample and pan mass will be 600 mg with a 500 mg reference pan and tare mass. If manual loading is performed, the maximum sample and pan mass is 930 mg with 830 mg on the reference side.

Atmosphere Control

Purge Gases	Helium, nitrogen, oxygen, air, argon
MFC Purge Rate:	Up to 200 mL/min (Recommended rate is 25 mL/min for sample, 10 mL/min for balance.)

WARNING: Do not use hydrogen or any other explosive gas in the TGA furnace.

WARNING: Oxygen can be used as a purge gas in the TGA. However, the furnace must be kept clean so that volatile hydrocarbons, which might combust, are removed.

CAUTION: Corrosive gases cannot be used with this instrument. If you use oxygen as a purge gas, you must make sure the furnace is cleaned of hydrocarbons that could combust.

Operating Environment

Room Operating Temperature	15°C to 35°C (non-condensing)
Altitude	Less than 2 km maximum

Chapter 2

Installing the TGA Q5000 IR

Unpacking/Repacking the TGA

The instructions needed to unpack and repack the instrument are found as separate unpacking instructions in the shipping box and in the online documentation associated with the instrument control software. You may wish to retain all of the shipping hardware, the plastic 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.

Preparing the System

Before shipment, the TGA 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 the online documentation for additional information. Installation involves the following procedures:

- Inspecting the system for shipping damage and missing parts
- Filling the heat exchanger
- Connecting the TGA to the controller computer
- Connecting the heat exchanger cable and water lines, purge gas lines, accessories, and power cable
- Installing the voltage configuration unit, if you use 230 Vac rather than 120 Vac
- Unpacking the balance, including removing the furnace shipping bracket as directed.
- Installing the hang-down wires
- Leveling the instrument and aligning the hang-down wires
- Installing the lower furnace assembly and air cool line.
- Adjusting the sample platform (see online documentation)

It is recommended that you have your TGA unpacked and installed by a TA Instruments Service Representative, call for an installation appointment when you receive your instrument.

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

Inspecting the System

When you receive your TGA, 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

Because of the sub-microgram sensitivity of TGA experiments with the Q5000, it is important to choose a location for the instrument using the following guidelines. The TGA should be:

In ... a temperature-controlled area. Temperatures should be in range 20-35C.
... 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.

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

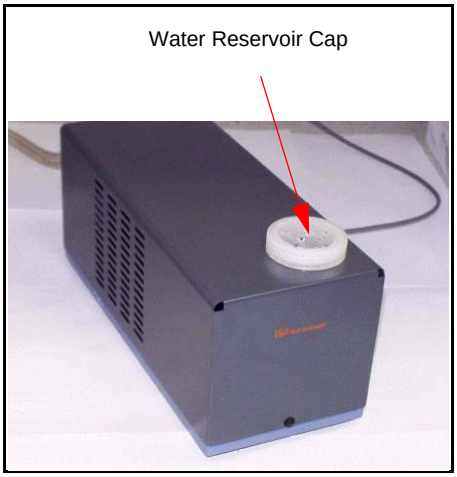
Near ... a power outlet (120 Vac, 50 or 60 Hz, 15 amps or 230 Vac, 50 or 60 Hz, 10 amps if configured with a step down transformer).
...your TA Instruments thermal analysis controller.
...compressed lab air and purge gas supplies with suitable regulators and filters, if required.

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.

Filling the Heat Exchanger

The heat exchanger contains a liquid reservoir that supplies the instrument with coolant to dissipate heat from the furnace. The coolant exits the heat exchanger through the supply line, circulates to the furnace, and comes back to the reservoir via the return line as seen in the figure here (for instructions on how to connect the water lines, turn to page 29). To fill the heat exchanger, follow the directions given below.

1. Unscrew the water reservoir cap on the heat exchanger (see the figure below).



2. Add TA Instruments TGA Conditioner (PN 952377.901) into the water reservoir. Refer to the instructions on the conditioner bottle for the amount of conditioner to add to the reservoir. Then fill the reservoir to the inner rim with distilled water.

   NOTE: After the system has been started, recheck the level of water in the reservoir and refill to the inner rim if necessary.

CAUTION: Do not put any liquid other than distilled water and TA Instruments' TGA Conditioner in the heat exchanger reservoir.

3. Replace and tighten the water reservoir cap.

Connecting Cables and Lines

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

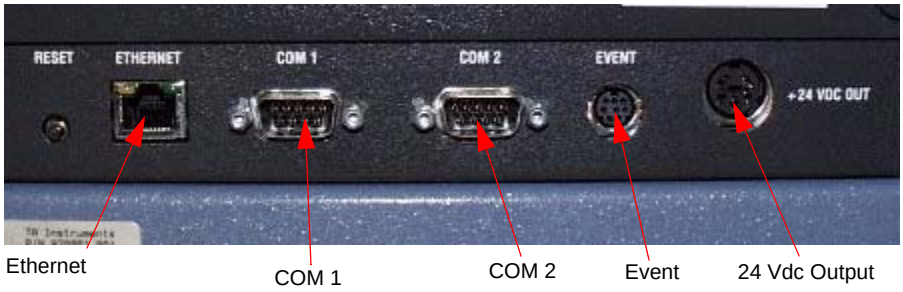
CAUTION: Connect all cables before connecting the power cords to outlets. Tighten the thumbscrews on all computer cables.

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

WARNING: Protect power and communications cable paths. Do not create tripping hazards by laying the cables across accessways.

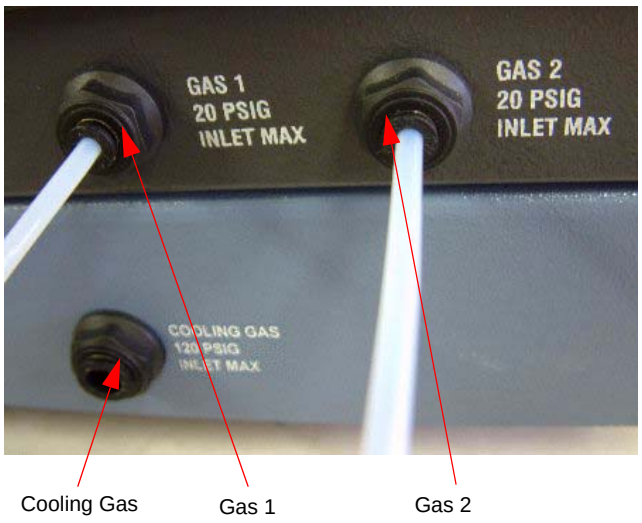
Ports

The TGA has ports that are located on the back of the instrument. The following table provides a description of the function of each port. Refer to this list when connecting cables and lines.



Five Ports on Left Rear of TGA

Port	Function
Ethernet	Provides network communication capabilities
Com 1	*Not used for the TGA.*
Com 2	*Not used for the TGA.*
Event	Capable of providing a general purpose relay contact closure.
24 VDC output	Provides Heat Exchanger detection signals and voltage.
Base Purge	*Not used for the TGA.*
Gas 1	Inlet port for the Mass Flow Controller. Used for the sample and balance purge gas. 140 kPa gauge (20 psig) maximum pressure.
Gas 2	Inlet port for the Mass Flow Controller. Used for the secondary sample purge gas. 140 kPa gauge (20 psig) maximum pressure.
Cooling Gas	Provides the furnace with air or nitrogen for post run cooling. 830 kPa gauge (120 psig) maximum pressure.



Three Usable Ports on the Right Rear of the TGA

Heat Exchanger Cable and Water Lines

Follow these instructions to connect the heat exchanger cable and water lines:

1. Locate the 24 Vdc output connector on the left rear of the instrument cabinet (see figure on page 28).
2. Connect the heat exchanger cable to the connector. The heat exchanger cable is the only cable that fits into this connector.
3. Remove the water lines from the packaging.
4. Connect one end of the water line marked "SUPPLY" to the connector labeled "SUPPLY" on the right side of the instrument cabinet (shown here).
5. Connect the other end of the water line marked "SUPPLY" to the connector labeled "SUPPLY" on the heat exchanger.
6. Connect one end of the unmarked water line to the connector labeled "RETURN" on the right side of the instrument cabinet (shown above).

Supply & Return Lines on TGA

7. Connect the other end of the unmarked water line to the connector labeled "RETURN" on the heat exchanger.

NOTE: Air trapped in the heat exchanger system must be purged before starting the first run. After installation of the TGA is complete, turn on the instrument. Then start the heat exchanger pump by selecting **Control/Prime Exchanger** from the instrument control program or scroll through the **Control command** functions on the touch screen until you come to "Heat Exchanger" and press **Apply**. Refill the coolant reservoir as needed. Repeat this process until all the air has been purged from the system and the instrument stops reporting an error.

Ethernet Switch Setup

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

Connecting the Instrument to the Switch

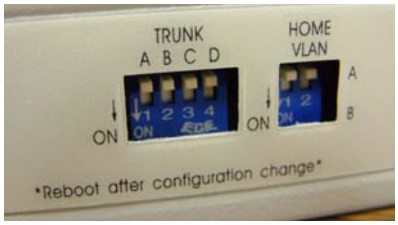
1. Locate the Ethernet port on the left rear of the instrument (shown in the figure to the right).

2. Connect one end of the Ethernet cable into the instrument's Ethernet port.

3. Connect the other end of the Ethernet cable to one of the network ports on the Ethernet switch (shown in the figure below).

Ethernet Switch

4. Check the configuration switches, located on the back panel. They must be set to off, or the up position, for the controller to communicate to the instruments.



Configuration Switches

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

6. Follow the directions in the next section to connect the controller to the Ethernet switch.

Connecting the Controller to the Switch

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

2. Plug one end of the Ethernet cable into the computer's Ethernet port (shown in the figure to the right).

Computer Ethernet Port

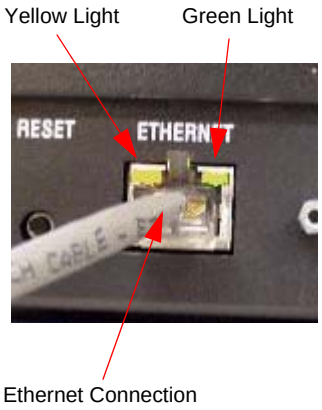
3. Connect the other end of the cable to one of the network ports on the switch.

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 to a LAN for networking capabilities.

Connecting the Controller to a LAN

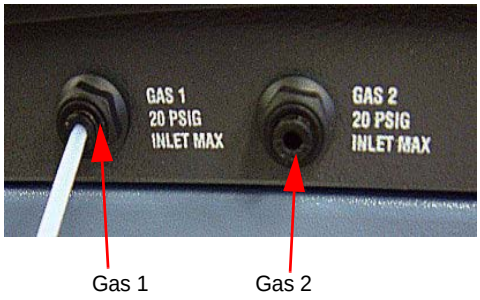
Before you can connect the controller to a LAN, you will need to have already installed a network interface card into the computer.



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.

Connecting Sample and Balance Purge Lines

You can control the sample atmosphere during TGA experiments by connecting purge gases to the system. Purge gas is distributed separately to two parts of the TGA—the furnace (sample) and the balance chamber. The TGA Q5000 IR is equipped with mass flow controllers (MFC) to control the flow rates of the gases. Up to two different gases may be connected to the instrument to facilitate gas switching. Nitrogen is typically used for Gas 1. Follow these instructions to connect the purge lines. Refer to the figure on the right to locate the purge lines.

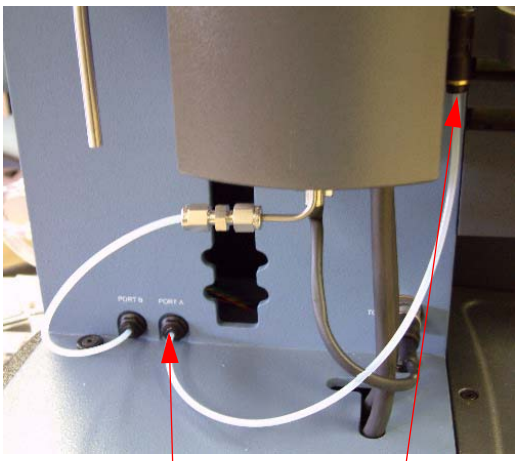


CAUTION: Do not use any liquid in the purge lines. Make sure that you use a dry gas.

Follow these instructions to connect the purge lines:

1. Locate the Gas 1 port. The Gas 1 port is used to purge both the sample and balance areas. Nitrogen is the typical gas used for Gas 1.
2. Locate the Gas 2 port. The Gas 2 port is used when a different purge gas from Gas 1 is desired to purge the sample or when gas switching during an experiment is needed.
3. Connect the primary gas line to the Gas 1 port using 1/8-inch tubing. Teflon TFE tubing is recommended and is supplied in the instrument shipping accessory kit. If desired, connect a secondary gas to the Gas 2 port.

   The flow rates for the balance and furnace are individually controlled through settings chosen using the instrument control software.
4. Connect the 1/8-inch Teflon TFE tubing from Port A on the front of the instrument to the Purge Gas Inlet as shown in the figure to the right. (The figure also shows the air cool line connected. This will be done when installing the lower furnace assembly. See page 45.)



5. Make sure that the pressure of your purge gas source is regulated between 70 to 140 kPa gauge (10 to 20 psig) maximum.

6. Specify the connected gas on the **Instrument Preferences/MFC Page** using the instrument control software.

7. Set the purge rate needed for your experiments on the **Notes Page** of the **Experiment View**. Click **Apply** to save the changes.

NOTE: If you are using laboratory purge, rather than bottled purge, it is highly recommended that you install an external drier and a five-micron filter.

CAUTION: Corrosive gases cannot be used with this instrument.

WARNING: Use of an explosive gas as a purge gas is dangerous and is not recommended for this instrument. For a list of the purge gases that can be used with the TGA instrument, see Chapter 1.

Installing the Cooling Gas Line

Use the following steps to install the cooling gas line.

1. Locate the Cooling Gas fitting, a 1/4-inch compression (Legris) fitting on the rear of the TGA cabinet, marked with a 120 psig (830 kPa gauge) maximum warning label.

2. Make sure your compressed lab air source is regulated to between 170 and 830 kPa gauge (25 and 120 psig) and is free of oil and water vapors.

3. Connect a compressed lab air line to the Cooling Gas fitting.

NOTE: The cooling gas flows up through the furnace cavity. If you are analyzing oxygen-sensitive materials, it is recommended that you use nitrogen as your cooling gas.

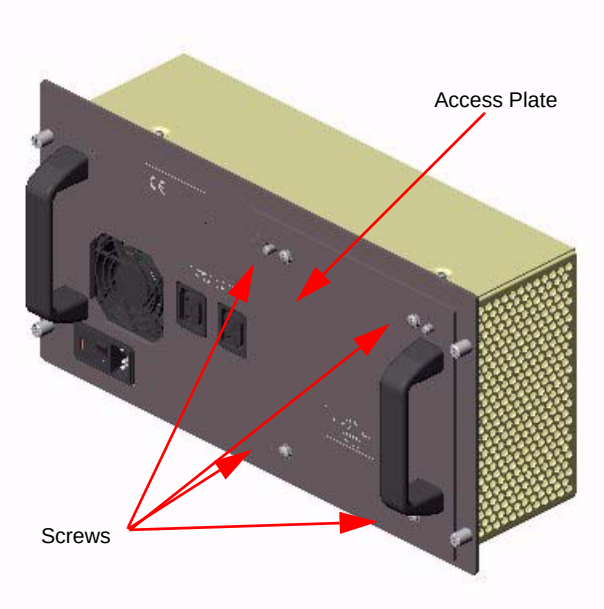
Voltage Configuration Unit

A voltage configuration unit is required, if you use 230 Vac rather than 120 Vac. Follow these steps to install the unit on the Power Control Unit (PCU):

WARNING: High voltages are present in this instrument. Be sure to unplug the instrument before performing these instructions. See the WARNING on page 9.

1. Remove the contents from the shipping box and verify that all of the components are present.

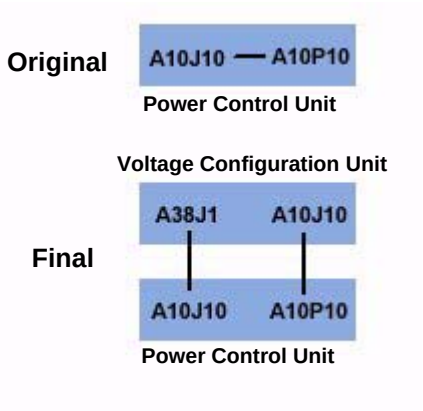
2. Remove the access plate located on the rear of the instrument by removing the four (4) screws that secure it in place. See the figure below.

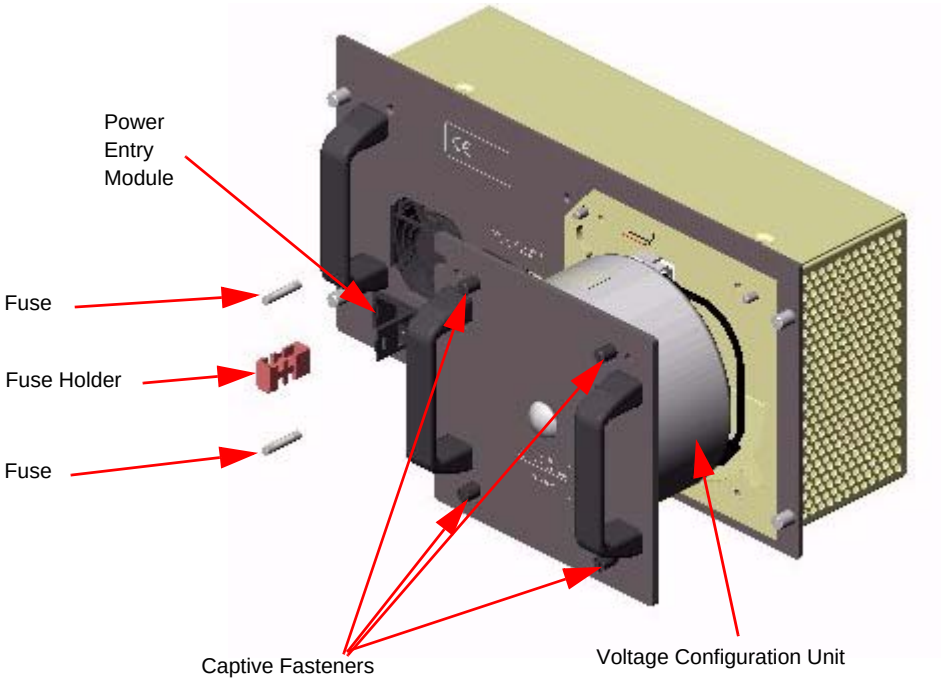


3. Disconnect the A10J10 connector from A10P10 located inside the PCU. Now connect the A10J10 connector on the voltage configuration unit to A10P10 located inside the PCU. Then connect A10J10 located inside the PCU to A38J1 on the anti-surge subassembly. See the diagram to the right for clarification.

4. Install the subassembly into the PCU and tighten the four (4) captive fasteners to secure it.

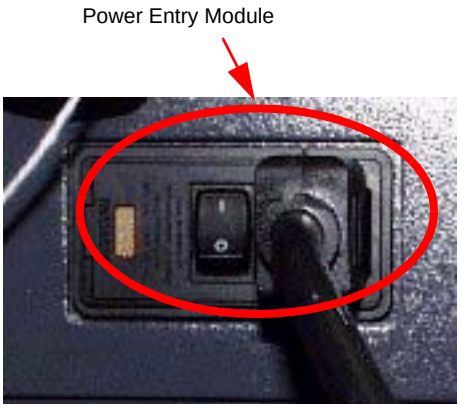
5. Remove the fuse holder from the power entry module and replace the 10 amp fuses with 6.3 amp fuses, which are supplied in the kit. Discard the 10 amp fuses. See the figure on the next page.





Power Switch

The power switch is located at the rear of the instrument. It is part of the assembly called the *power entry module*, which also contains the power cable connection. The power switch is used to turn the instrument on and off. If a transformer is required, it must be installed before turning on the power.



Power Cable

NOTE: A <HAR>-marked (harmonized) power cable meeting the standards of the country of installation is required for the European Economic Area.

Install the power cable as follows:

1. Make sure the Power switch is in the Off (0) position.
2. Plug the power cable into the TGA power entry module.

CAUTION: Before plugging the TGA 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.

3. Plug the power cable into the wall outlet.

Installing the TGA

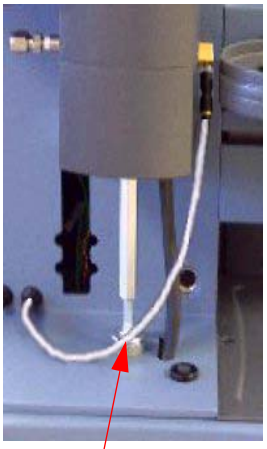
TA Instruments recommends that you complete the installation instructions stated previously in this chapter, before you unpack the TGA balance mechanism. After the instrument has been removed from the box and placed on the bench, following the instruction sheet found in the packing box, use these steps to install your instrument:

- Remove the furnace shipping bracket
- Unpack the balance
- Install the Autosampler tray
- Start the instrument
- Install the tare hang-down wire
- Install the sample hang-down tube and wire
- Align the balance
- Install the lower furnace assembly

Removing the Shipping Bracket

This step is also covered in the unpacking instruction sheet shipped with the instrument. It is repeated here for your convenience in the event the step was not completed previously.

Loosen the foot of the furnace shipping bracket shown in the figure to the right. Raise the foot of the bracket and remove the entire bracket. Retain this bracket in case the instrument needs to be shipped in the future.

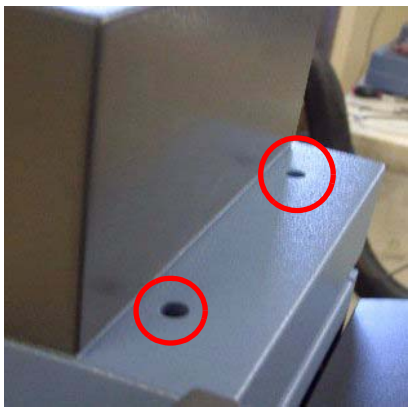


CAUTION: When unpacking the balance in the next section, be careful not to damage the balance arm or hang-down loops.

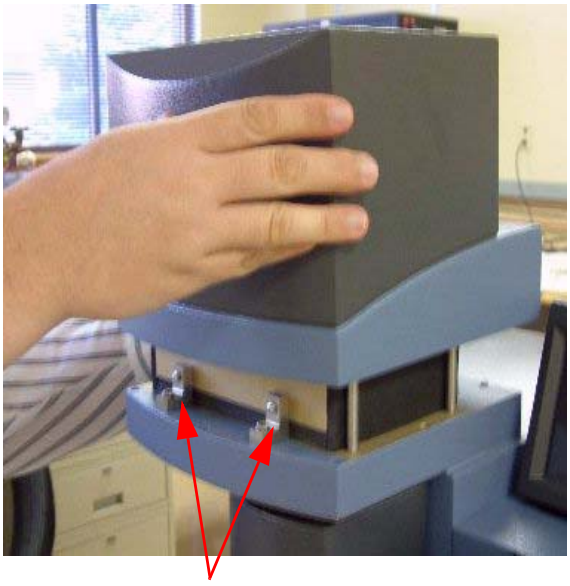
Unpacking the Balance

After removing the bracket, you can proceed to unpack the balance. This is a very important procedure to be done before you can use the instrument.

1. Remove the balance housing cover by removing the two screws in the back with a screwdriver. (See the figure below.) Retain the screws. Lift the cover off.

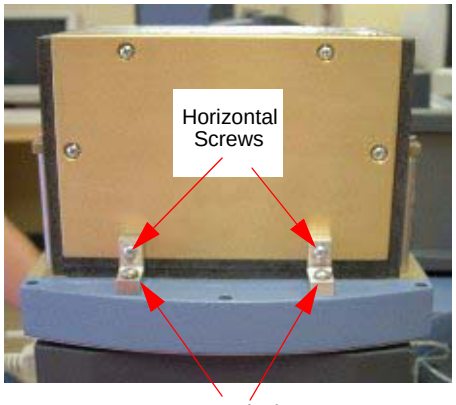


2. Remove the four balance shipping L-brackets from the housing using the Phillips screw-driver. Remove the horizontal screws first, then remove the vertical screws. See the figures above and below. Retain the brackets and screws in case you need to repack the instrument for shipping in the future.

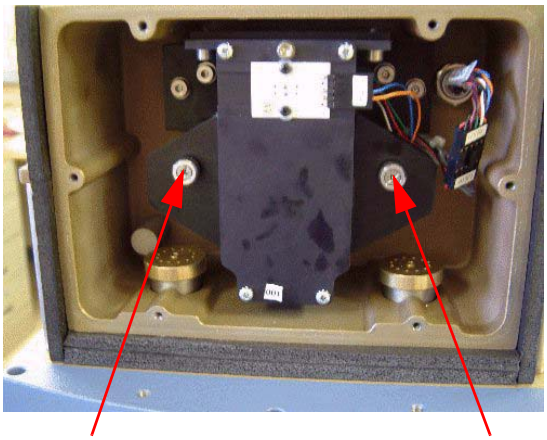


L-Brackets

3. Remove the remaining four screws on the inner balance faceplate (see the figure to the right) and remove the plate. Make sure the small o-rings inside the faceplate are not lost. They must be in place when the faceplate is reinstalled.



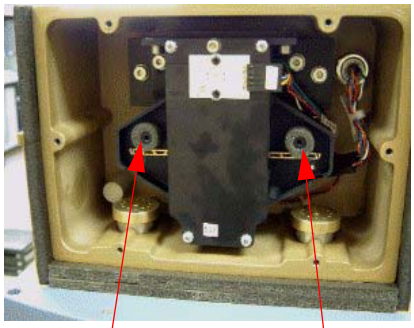
4. Loosen thumbscrews and remove the left and right balance covers shown in the figure below.



Tare Side Cover

Sample Side Cover

5. Using tweezers, compress the foam and rotate it 90 degrees to eliminate contact with the beam. Gently remove the foam inserts from the sample and tare sides (see figure directly to the right for the location), being careful not to touch the balance.



Foam in Tare Side

Foam in Sample Side

6. Replace the tare and sample side covers on the left and right side of the balance. Tighten the thumbscrews until they are finger tight.

7. Locate the four screws that are taped on the outside of the faceplate, which was removed in step 1. Two of these screws will be used for the faceplace and two for installing the balance housing.

> NOTE: If the hang-down wires need to be installed, skip steps 9, 10 and 11. The inner balance faceplate and balance housing cover will need to remain off until after the hang-down wires are installed.

9. Replace the inner balance faceplate using two of the screws from step 7 and the four screws removed in step 3. Make sure the small o-rings are in position on the inside of the faceplate so that it seats correctly.

10. Install the foam insulation from the accessory kit inside the balance assembly cover leaving the bottom open.

11. Lower the cover with the foam carefully over the balance housing. Place two of screws from step 7 in the back of the balance housing.

Follow the steps in the next section to power up and start the instrument. If you need to install the hang-down wires, continue with the instructions on the next several pages.

Installing the Autosampler Tray

Follow the steps below to install the autosampler tray:

1. Install the Autosampler sample tray (found in the accessory kit). There is a guide pin that will help you orient the tray correctly.

2. Select Autosampler Reset from the touch screen or from the instrument control program.

Starting the Instrument

1. Check all connections between the TGA and the controller. Make sure each component is plugged into the correct connector.

2. Set the instrument power switch to the ON (1) position.

After the proper power up sequence, the TA Instruments logo will be displayed on the touch screen, the furnace will move down, and the Autosampler will move to the home position. This indicates that the instrument is ready for use.

NOTE: Allow the TGA to warm up for at least 60 minutes and condition the balance before performing an experiment. See page 46 or the instrument control online help for further details.

Installing the Hang-Down Wires

After you have finished unpacking the instrument and removing the foam you will need to install the hang-down wires.

NOTE: If the balance faceplate is already off, start with "Installing the Tare Hang-Down Wire" step 1. (Steps 1 through 4 below have already been completed.)

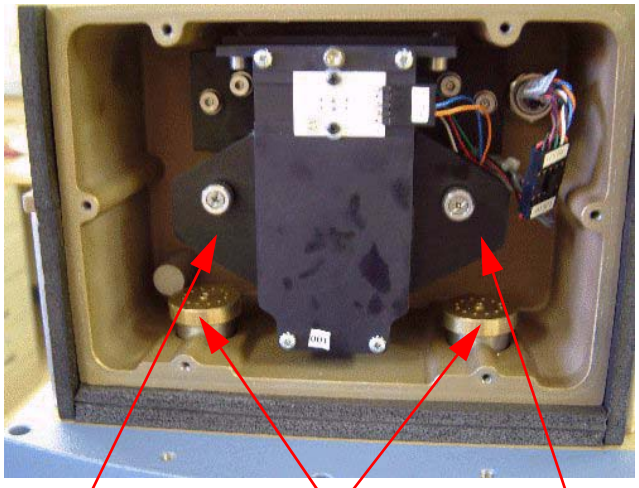
CAUTION: During installation, take care not to bend the hang-down wires or damage the hang-down loops.

1. Turn on the instrument as directed above.

2. Lower the furnace using the touch screen or instrument control program.

3. Remove the screws securing the inner balance chamber faceplate to the instrument and remove the faceplate. Make sure the small o-rings inside the faceplate are not lost. They must be in place when the faceplate is reinstalled.

4. Loosen the thumbscrew holding the balance cover on the tare (left) side of the balance mechanism and take off the cover. See the figure to the right. Continue with the next section.



Installing the Tare Hang-Down Wire

Install the tare hang-down wire as follows:

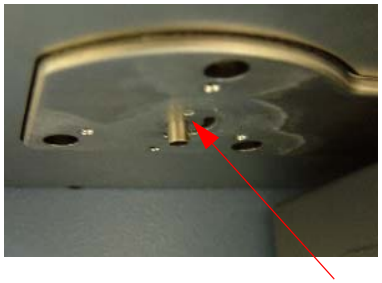
1. Locate the tare hang-down wire and tare hang-down installation tool in your TGA Accessory Kit. (The tare hang-down is the shorter of the two wires.)

2. Remove the purge control cap on the tare side, shown in the figure above. Retain the cap for installation later.

3. Loosen the three thumbscrews on the tare cap, which is located on the underside of the balance chamber. Remove the cap and put it aside to reinstall later. See the figure to the right.


Tare Cap

4. Grasp the tare tube shown in the figure below and carefully pull it straight down to remove it. Retain this tube for reinstallation.



5. Hold the hang-down wire with brass tweezers, being careful not to bend it. Position the hang-down wire so that the double bend hook is at the top.

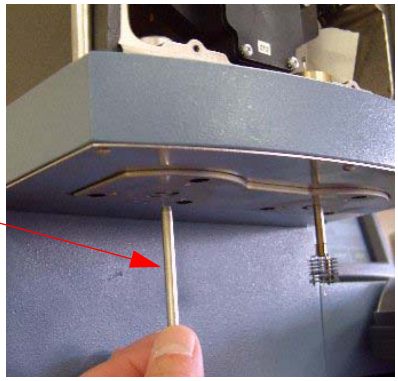
6. Lower the hang-down wire into the opening in the tare hang-down installation tool.

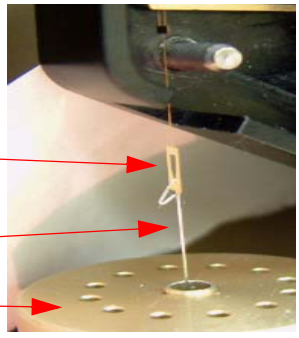
7. Insert the wire and tool vertically up inside the tare tube opening, being careful not to bend the wire. See the figure below. Continue to raise it slowly until the top of the wire protrudes from the opening in the cooling plate. Then you can release the fixture. The o-ring will hold it in place.

8. Replace the purge control cap, lowering it carefully over the hang-down wire.

9. *Optional:* At this point you may wish to place a small piece of white paper carefully behind the hang-down loop in order to see it better. See the figure below.

10. Using tweezers, gently hang the double-bend hook (pointing to the left) on the hang-down loop. Maneuver the hook until it is fully inserted through the loop. Be very careful to avoid bending the hang-down loop.





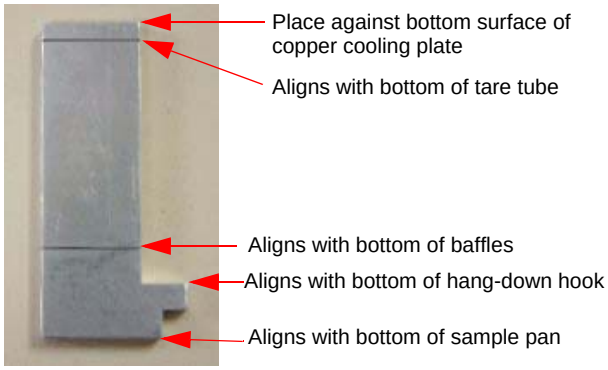
11. Remove the tare hang-down installation tool and the paper (if used).

12. Carefully insert the tare tube over the wire, pushing it up inside the cooling plate to reinstall it.

13. Check the length that the tare tube extends below the cooling plate using the alignment gauge shown below. The tube should extend 0.150-inch below the cooling plate. Push it up or pull it down to adjust the length.

14. Hang the desired sample pan on the hook. Choose the same type of pan that will be used for your experiments.

15. Replace the black tare cap over the tare side pan. Finger tighten the three thumbscrews holding the tare cap on.



Installing the Sample Hang-Down Tube

Before you can install the sample hang-down wire, you must install the tube assembly that surrounds the wire. Follow these steps:

1. Locate the sample hang-down tube in the accessory kit.
2. Open the furnace.
3. Cover the furnace opening with a flat object (such as a business card) to prevent anything from falling inside.
4. Holding the tube portion with tweezers, install the sample hang-down tube by inserting it straight up inside the sample side hole in the cooling plate. Be careful not to bend the baffles. See the figure to the right.
5. Remove the flat object covering the furnace opening.


Sample Hang-Down Tube

With the sample hang-down tube in place, you can proceed to install the sample hang-down wire. Please note that you will not need to adjust the length of the sample tube until the sample hang-down wire has been fully installed as directed in the next section.

Installing the Sample Hang-Down Wire

Install the sample hang-down wire as follows:

CAUTION: During installation, take care not to bend the hang-down wires or damage the hang-down loops.

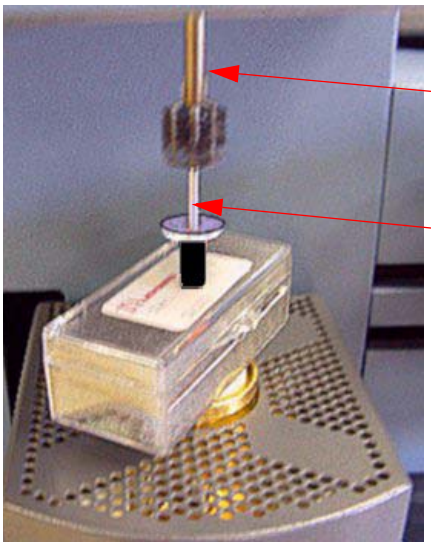

Tool

1. Placing a finger under the sample hang-down tube, push the tube up slowly until it stops moving, being careful not to bend the baffles.
2. Locate the sample hang-down wire and the sample hang-down installation tool (shown to the left), found in the accessory kit.
3. *Optional:* At this point you may wish to place a small piece of white paper carefully behind the hang-down loop in order to see it better later in this procedure.
4. Hold the hang-down wire with brass tweezers, being careful not to bend it. Position the hang-down wire so that the double bend hook is at the top.
5. Lower the hang-down wire into the opening in the sample hang-down installation tool.
6. Lower the furnace to its fully open position.
7. Carefully angling the sample hang-down installation tool as shown in the figure to the right, lower the bottom into the furnace opening until you have enough clearance to hold the tool and wire vertically **without bending the wire** (very important).

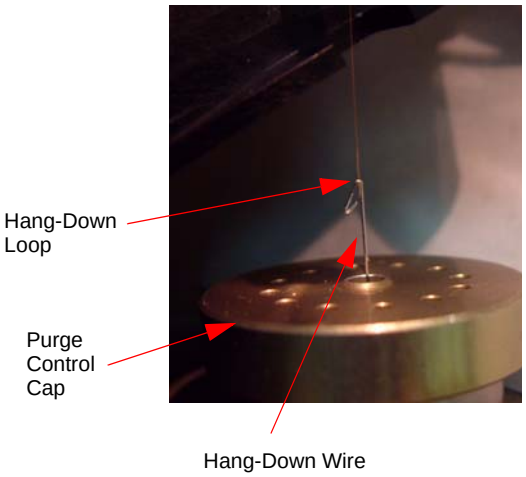
8. Insert the wire and sample hang-down installation tool vertically up inside the sample tube, being careful **not to bend the wire**. See the figure below. Continue to raise it slowly, feeding it through the purge control cap until the top of the wire protrudes from the opening in the cap.

9. Cover the furnace opening with a flat object that will completely block the opening.

10. Still holding the tool, use the touch screen **Calibrate/ Autosampler/Motor Test/Furnace Up** function to raise the furnace slowly until the bottom of the tool can rest on the flat object covering the opening. See the figure below. The top of the wire should still protrude from the top of the purge control cap.



11. Position the sample hang-down wire so that the double bend hook is pointed to the left. See the figure below. Grasp the hang-down wire with brass tweezers, being careful not to bend it.



12. Using tweezers, gently hang the double-bend hook (pointing to the left) on the hang-down loop. Maneuver the hook until it is fully inserted through the loop.

13. Lower the furnace to its fully open position, allowing the fixture to drop down with the furnace. The hang-down wire, if properly inserted through the loop will remain in position.

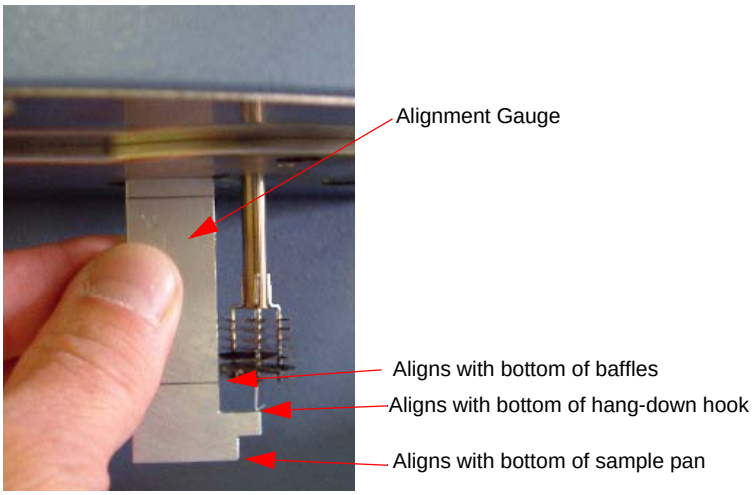
14. Remove the paper (if used) and the object covering the furnace opening.

15. Fully remove the fixture from the hang-down wire, being careful not to bend the wire.

16. Adjust the length of the sample tube by pulling it down. The length from the bottom of the baffle to the cooling plate should be 1.6 in (4.1 cm), which can be determined using the supplied gauge. See the figure to the right.

17. Hang the desired sample pan from the hook. Choose the same type of pan that will be used for your experiments.

The balance has been aligned at TA Instruments. If needed, you can align the balance as directed in the next section.



Aligning the TGA Balance

To avoid weight signal noise, the TGA instrument must be level so that the sample pan and hang-down wire hang inside the furnace without touching the sides. The angle at which the pan hangs is very sensitive to slight irregularities in benchtop surfaces, so it is required that the instrument is installed on a marble bench.

Once you have your TGA in a satisfactory location, you will need to adjust the top and bottom of the sample hang-down wire and level the instrument using the following procedures. These procedures are performed with pans loaded on the hang-down wires.

Aligning the Sample Hang-Down Wire

1. Load a pan on the sample hang-down wire.

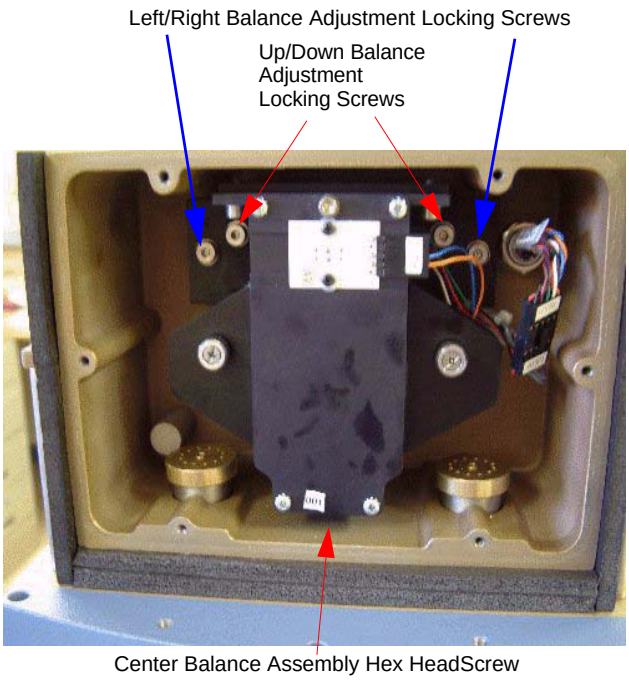
2. Adjust the position of the hang-down wire and pan until the bottom of the pan is 2.2 in. (5.6 cm) from the cooling plate as follows:

   a. Turn the center balance assembly hex head screw until it touches the floor of the chamber. (This is done to prevent the balance assembly from dropping in step b.) See the figure to the right for the location of the screw.

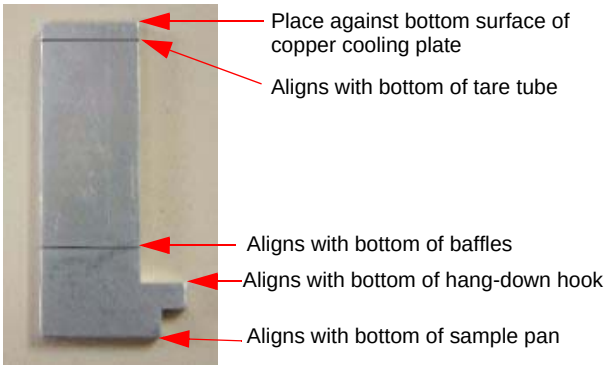
   b. Loosen the two inner up/down balance adjustment locking screws located inside the balance as shown in the figure to the right.

   c. Turn the center balance assembly hex head screw until the pan height is at the correct distance. The figure below shows the correct distance for each item. Make your adjustments using the alignment gauge as a guide.

   d. Tighten the up/down screws to lock them in position.



   e. Turn the center balance assembly hex head screw all the way up until it is tight against the balance assembly.



3. Adjust the side-to-side position of the sample hang-down wire as follows:

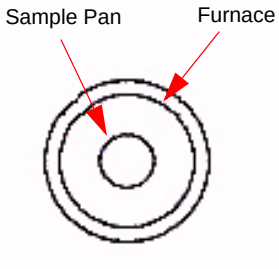
   a. Loosen the two outer left/right balance adjustment locking screws shown in the figure above.

   b. Manually position the balance assembly left or right until the hang-down wire is centered in the purge cap at the top and in the sample tube at the bottom.

   c. Tighten the screws to lock them in position.

Aligning the Bottom of the Sample Hang-Down Wire

The purpose of this procedure is to center the sample pan within the furnace so that its movement is not hindered as the furnace is opened and closed. See the figure to the right.



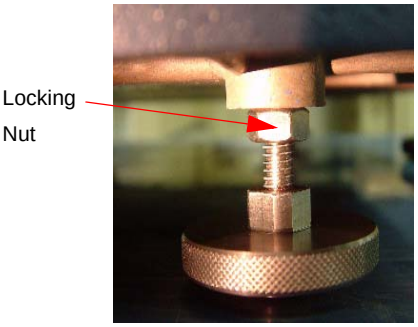
Sample pan should be centered within the furnace opening when viewed from above.

1. Use the touch screen **Calibrate/Autosampler/Motor Test/Furnace Up/ Down** functions to slowly raise the furnace just to the bottom of the sample pan, and touch **STOP**.

2. Check the alignment of the sample pan within the furnace. It should hang freely, centered, and should not be touching the sides of the furnace (shown in the figure here).

3. If the sample pan is not centered and hanging freely within the furnace, level the instrument by adjusting the two front feet on the bottom. Turn the feet clockwise to lengthen or counterclockwise to shorten the legs, making sure the front feet and the rear stabilizer bar contact the table securely. Continue adjusting until the pan hangs correctly.

4. Use a 7/16-inch wrench to tighten the locking nuts up against the bottom of the cabinet when the instrument is level to fix the position of the mounting feet in place. See the figure to the right.



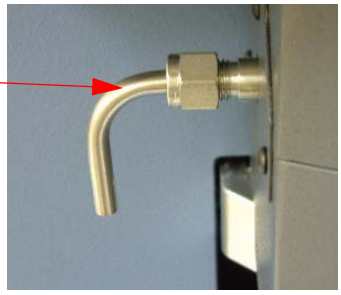
5. Raise the furnace slowly again to make sure the sample tube baffles clear the furnace. If they do not, call TA Instruments for service.

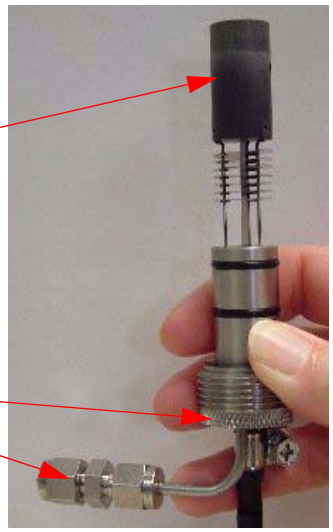
6. Lower the furnace then manually remove the pan and place it back on the tray.

Installing the Lower Furnace Assembly

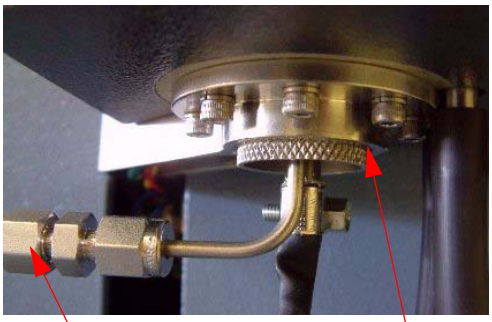
After the hang-down wires have been properly aligned, follow these steps to install the lower furnace assembly.

1. Close the furnace completely.
2. Locate the lower furnace assembly in the accessory kit.
3. Carefully remove the lower furnace assembly from the plastic shipping tube.
4. Orient the lower furnace assembly so that the air cool inlet points to the left as you slide it up into the bottom of the furnace. See the figure to the right for the parts of the lower furnace assembly. Raise the lower furnace assembly until it goes all the way inside and until only the thumbscrew shows on the outside. The O-ring will hold it in place.
5. Turn the thumbscrew to hold the assembly in place.
6. Loosen the outer nut and remove the furnace exhaust tube from the left-hand side of the furnace. See the figure to the right.





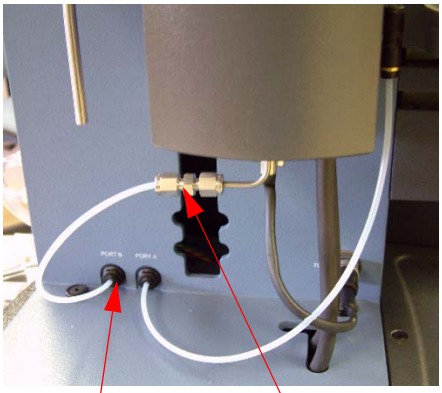
Lower Furnace Assembly



7. Look into the furnace outlet port on the side of the instrument. The holes in the heat-absorbing tube should align with the inlet and outlet ports on the furnace housing allowing light to pass through. Rotate the lower furnace assembly until the proper alignment has been achieved.
8. Fully tighten the thumbscrew.
9. Replace the furnace exhaust tube.
10. Insert the lower furnace assembly cable connector into the connector below and to the right front of the furnace as shown in the lower left-hand figure. Tighten the knurled nut.

Lower Furnace Assembly Cable Connection

11. Connect the 1/8-inch Teflon TFE tubing from Port B on the front of the instrument to the Air Cool Inlet as shown in the figure to the right. (The figure also shows the sample purge line connected. See "Connecting Sample and Balance Purge Lines" on page 31 for details.).



Closing the Balance Assembly

After you have finished the procedures on the previous pages, follow these instructions to complete the installation of the TGA Q5000:

NOTE: If you have already replaced the balance faceplate, skip to step 2.

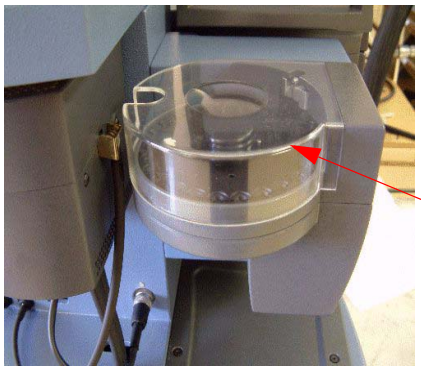
1. Replace the inner balance faceplate and secure with six screws. (Four screws were removed during step 3 on page 36 and two were shipped separately in a plastic bag.) Make sure the small o-rings are in position on the inside of the faceplate so that it seats correctly.

2. Obtain the balance housing foam insert from the accessory kit.

3. Install the foam insulation from the accessory kit inside the balance assembly cover leaving the bottom open. See the figure to the right.

4. Lower the cover with the foam carefully over the balance assembly. Replace the two screws on the rear of the cover as shown on page 36.

5. Place the Autosampler cover over the tray. The installation procedure is now complete.



Balance Conditioning

Balance conditioning is required for the TGA Q5000 in order to achieve optimum performance from your instrument and keep your balance housing dry. Balance conditioning is needed when the instrument is first installed and whenever the balance housing is opened.

The recommended balance housing temperature is 40°C. Allow the temperature of the balance housing to stabilize for one hour during installation or after the balance housing was opened. You will need to dry the balance with nitrogen at 200 mL/min for a minimum of 12 hours. See the online help for more details.

To maintain a dry balance after conditioning, use a balance purge rate of 10 mL/min.

Shutting Down the Instrument

Before you decide to power down your instrument, consider the following:

- All of the components of your thermal analysis system are designed to be powered on for long periods.
- The electronics of the TGA and the controller perform more reliably if power fluctuations caused by turning units on and off are minimized.

For these reasons, turning the system and its components on and off frequently is discouraged. Therefore, when you finish running an experiment on your instrument and wish to use the thermal analysis system for some other task, it is recommended that you leave the instrument on with the furnace in the up (closed) position, and with a 10 mL/min balance purge and a 25 mL/min sample purge.

To ensure proper shutdown of the instrument, it is recommended that you select **Control/Shutdown Instrument** from the Instrument Control menu or select **Shutdown** from the touch screen Control options. A confirmation message will be displayed. Select OK (touch screen) or Shutdown (Instrument Control) to proceed. All communication to the instrument will be halted while the instrument saves data to the flash memory. Once this procedure is complete, the instrument will post a message indicating that it is safe to turn off the power to the instrument or reset the instrument.

To power down your instrument set the power switch on the rear of the instrument to the OFF (0) position.

Chapter 3
Use, Maintenance, & Diagnostics

Using the TGA Q5000 IR

All of your TGA experiments will have the following general outline. 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 the pan size and material
- Selecting the purge gas and setting flow rates
- Creating or choosing the test procedure and entering experiment information through the TA instrument control software
- Selecting and taring the sample pan
- Loading the sample
- Starting the experiment
- Unloading the sample at the end of the experiment.

To obtain accurate results, follow procedures carefully and check calibration periodically (once a month).

Before You Begin

Before you set up an experiment, ensure that the TGA and the controller have been installed properly. Make sure you have:

- Made all necessary cable connections between the TGA and the controller (ethernet connections)
- Connected heat exchanger power and water lines
- Connected all gas lines
- Powered on each unit
- Installed all appropriate options
- Become familiar with controller operations
- Calibrated the TGA, if necessary.

Calibrating the TGA

To obtain accurate experimental results you should calibrate the instrument when you first install it. For the best results, however, you should recalibrate periodically.

Several types of calibration are needed for the TGA: Autosampler, weight, and temperature calibration. A brief description is provided below. Autosampler calibration is performed from the instrument's touch screen. Weight and temperature calibration are performed through the instrument control software.

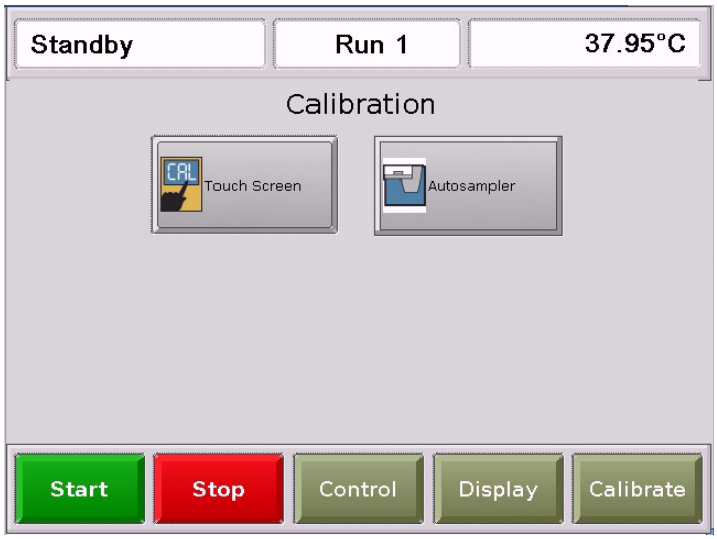
Touch screen calibration is also available through the calibration screen shown in the figure below. See the online help for more details on touch screen calibration.

Autosampler Calibration

If the Autosampler fails to pick up a sample pan correctly during an automatic loading procedure, the Autosampler may need to be calibrated. The calibration procedure is performed at installation and should be done periodically thereafter, as needed.

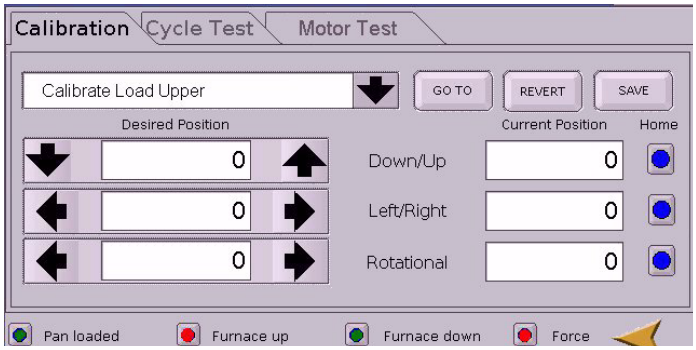
Other possible causes for improper pan pickup include:

- The instrument is not level. See "Aligning the TGA Balance" for instructions to solve this problem.
- The hang-down wire is not straight. Replace the hang-down wire. See "Installing the Hang-Down Wires" for instructions.
- The bails on the sample pan are bent. If possible, straighten them or use new pans.



To perform Autosampler calibration follow the instructions below.

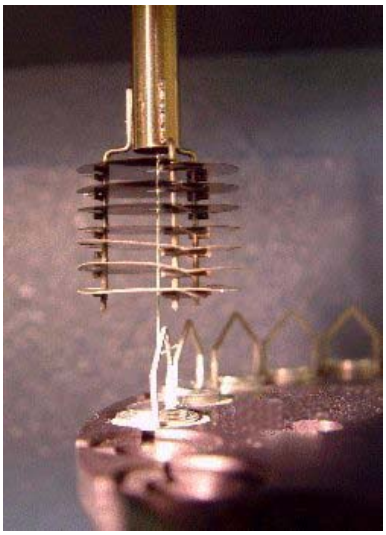
1. Touch the **Calibrate** button at the bottom of the touch screen. The screen shown in the figure to the right will be displayed.
2. Press the **Autosampler** button.
3. Touch the **Calibration** tab, if it is not already selected. The screen shown in the figure to the right is displayed.
4. Follow the instructions on the next page to adjust the two Autosampler pan positions "Calibrate Load Upper" or "Calibrate Load Lower."
5. If you are using sealed aluminum pans, you will also need to calibrate the "Punch Lower, Upper, and Limit" positions. Select these from the list at the top of the page using the arrow buttons. See the online help for more instructions on these functions.



In addition to calibration, two other functions are available: *TGA Autosampler Cycle Test*, which allows you to test load/unload and punch functions, and *TGA Autosampler Motor Test*, which allows you to test the individual motors. See the online help for information.

Calibrate Load Upper Position

This calibration is used to adjust the position of the sample tray as it slides across to load a sample pan.



1. Place a pan in the number 1 position of the sample tray.
2. Select "Calibrate Load Upper" from the **Calibration** page on the touch screen.
3. Select the **GO TO** button. The pan will be moved to the load position.
4. Observe the position of the bail and the hang-down wire hook when the pan stops. The hook should be in the center of the bail's angled handle and should not touch the bail so that the hook will not pull off the pan when the tray moves. See the figure to the right.
5. Touch the directional arrows, followed by the **GO TO** button, to move the desired position for the tray up/down, left/right, or clockwise/counter-clockwise until the tray is correctly positioned.
6. Select **SAVE** when the tray has moved to the desired load (upper) position.

Calibrate Load Lower Position

This calibration is used to adjust the position of the sample tray so that the tray can move out of the way without interfering with the pan when the pan hangs from the hang-down wire hook.

1. Load the pan from the number 1 position of the sample tray.
2. Select "Calibrate Load Lower" from the **Calibration** page on the touch screen.
3. Select the **GO TO** button.
4. Observe the motion of the tray. The tray should move down and clear the bottom of the pan without touching it.
5. Touch the directional arrows, followed by the **GO TO** button, to move the tray up/down, left/right, or clockwise/counterclockwise until the tray is correctly positioned.
6. Select **SAVE** when the tray has been moved to the desired unload (lower load) position.

NOTE: The left/right and rotational positions will be saved to both the **Calibrate Load Lower** and **Calibrate Load Upper** windows. Therefore, you will automatically save the values to both places during the calibration procedure.

Weight Calibration

Weight calibration is required when you first install the system. After initial calibration, weight calibration should then be done periodically (once a month is recommended). This calibration can be performed manually (using an empty pan and a calibration weight) or automatically (using the two weight calibration pans).

- *Manual weight calibration* is performed using a known calibration weight, typically 100 mg. This procedure involves weighing a pan with and without the calibration weight to calibrate the 0 to 100 mg weight range. This procedure is conducted through the controller software using the **Calibrate/Weight** menu.

- *Automatic weight calibration* is also accessed through the instrument control program by selecting **Calibrate/ Autoweight**. In this case the pan differential is used to calibrate the weight. The weight calibration pans may only be used when a platinum reference pan is installed.

See the online help for more information on weight calibration of either type.

Temperature Calibration

Temperature calibration is required for TGA experiments in which precise transition temperatures are essential. There are two techniques for TGA temperature calibration recognized by the American Society for Testing and Materials. These techniques are described in ASTM Standards E914-83 and E1582-93. The latter, which is based on the Curie Point of paramagnetic metals, is recommended for the TA Instruments TGA's.

In this technique, a Curie standard is heated in a sample pan in a magnetic field. The Q5000 IR furnace is equipped with an electromagnet to facilitate this operation. As the standard goes through its Curie Point, its attraction to the magnet changes, appearing as a weight change. The extrapolated endpoint of this weight change is adjusted to agree with the material's known Curie Point Temperature. Up to five calibration points can be entered into the temperature calibration table. A multi-point calibration is more accurate than a one-point calibration. See the online help for further information.

Running a TGA Experiment

Experimental Procedure

All of your TGA experiments will have the following general outline. In some cases, not all of these steps will be performed. See the instrument control software online help for anything not covered in this manual.

- Attaching and setting up external accessories as required such as the purge gas.
- Selecting the pan size and material.
- Taring the empty sample pan.
- Loading the sample into the pan.
- Entering experiment information through the TA controller, this includes both sample and instrument information.
- Creating or selecting the experimental procedure using the instrument control software.
- Starting the experiment.

Selecting the Pan Size and Material

The TGA has the following pans available. Choose a pan based on the desired temperature range and application. The pan size and material are specified through the instrument control program on the **Summary Page**. Proper selection is important to ensure proper pan bouyance correction is applied, optimum performance is achieved, and pan punching is initiated (only when a sealed pan is selected).

- 100 and 250 µL Ceramic (use up to 1200°C)
- 50 and 100 µL Platinum (use up to 700°C)
- 100 µL Platinum-HT (to 1000°C)
- 20 µL Sealed Aluminum (use up to 600°C)
- 80 µL Aluminum (Bottom of sealed pan) (use up to 600°C)
- 180 µL Hemispherical quartz pans (use up to 1000°C) are also available, but require the optional ten-pan quartz sample tray.

Taring the Sample Pan(s)

Taring of all sample pans on the tray must be done before the sample is loaded to ensure that the balance gives you an accurate reading.

> NOTE: A sample pan of the same size and type that will be used for your experiments is required on the tare side for proper operation.

1. Place clean, empty pan(s) on the platform. (If you are using sealed aluminum pans, then you must tare the lid along with the empty pan. See the online help for more information.)

2. Specify the pan type through the instrument control program. Only pans of the same type may be run in the same sequence.

3. Select the **Control** button on the touch screen then select **Tare or Tare All**. Alternatively, you can select **Calibrate/Tare** from the instrument control program.

4. Select **Apply** to initiate the tare procedure. The pan will automatically be loaded and the furnace raised to make the measurement. When the tare procedure is complete, the furnace will automatically lower and unload the pan.

Loading the Sample Pans

Loading Open Pans

After taring the sample pan, load the sample as follows:

NOTE: This procedure does not apply to sealed aluminum pans. If you are using sealed pan, a different procedure applies. See below.

1. Make sure the punch mechanism is fully retracted before using any non-sealed pans. Use a Phillips screwdriver to loosen the screw on top of the punching mechanism. Slide the mechanism out of the way.

2. Place the sample in the sample pan and position the pan on the sample tray in its original position. (This may be done with the tray on or off the instrument.) The wire on the bottom of the sample pan, if present, should align with the groove in the pan recess, so that the sample pan can be picked up by the sample hang-down wire.

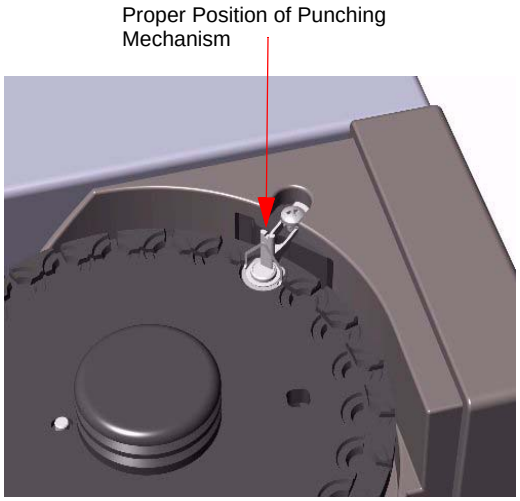
   NOTE: Always use brass tweezers to handle the sample pans.

3. Replace the sample tray on the Autosampler, if needed, and place the plastic cover over the samples, if desired.

You can preweigh the samples prior to the start of the experiment, if desired, in order to obtain a record of the weight. A preweight is valuable for highly volatile materials. This function is performed before you start an experiment. This weight is stored within the data file record.

Loading Sealed Pans

Consult the online help for information on punch calibration and alignment for sealed aluminum pans. After taring the sample pan and lids, load the sample as follows:



1. Make sure the punch mechanism is correctly positioned and calibrated. This is important for consistently successful punching of sealed pans. See the figure to the right.

2. Follow the procedure to load the sample and seal the sample pans using the sample encapsulating press. See the online help for detailed instructions.

   NOTE: Always use brass tweezers to handle the sample pans.

3. Reposition the bail/pan on the sample tray in its original pan position. (This may be done with the tray on or off the instrument.) The tab on the bail should align with the groove in the tray, so that the sample pan can be picked up by the sample hang-down wire. Check that the bail wire is at a right angle (90°) to the bail base. This will avoid failure to connect with the hang-down wire hook or interference with the punch during the pan punching process.

4. Replace the sample tray on the Autosampler, if needed, and place the plastic cover over the samples, if desired.

Starting an Experiment

Before you start the experiment, ensure that the TGA is online with the controller and you have entered all necessary information through the instrument control software.

> NOTE: Once the experiment is started, operations are best performed at the computer keyboard. The TGA is very sensitive to motion and might pick up the vibration caused by touching a key on the instrument touch screen or keypad.

Start the experiment by touching the **START** key on the instrument touch screen or by selecting **Start** on the instrument control software. When you start the instrument, the system automatically loads the sample pan and closes the furnace if necessary, and then runs the experiment to completion.

If multiple runs are in the sequence, the procedure is repeated for the next run until the run sequence is complete.

Stopping an Experiment

If for some reason you need to discontinue the experiment, you can stop it at any point by touching the **STOP** key on the bottom of the touch screen or by selecting **Stop** through the instrument control software. If an autosampler sequence is in progress, selecting **Stop** from the instrument will stop both the run and the sequence.

Another function that stops the experiment is **Reject**. However, the **Reject** function discards all of the data from the experiment; the **Stop** function saves any data collected up to the point at which the experiment was stopped.

> NOTE: See Chapter 2 for information on shutting down the instrument.

Maintaining the Instrument

The primary maintenance procedures described in this section are the customer's responsibility. Any further maintenance should be performed by a representative of TA Instruments or other qualified service personnel. Consult the online documentation installed with the instrument control software for further information.

WARNING: Because of the high voltages in this instrument, untrained personnel must not attempt to test or repair any electrical circuits.

Cleaning the Instrument

You can clean the TGA 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.

CAUTION: 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.

Cleaning the IR Furnace

WARNING: Do not touch the furnace sample tube with your bare fingers. Skin oils may cause devitrification of the quartz glass, resulting in severely reduced sample tube life. Do not insert metallic instruments inside the sample tube to scrape or chip contaminants from the sample tube as breakage may result.

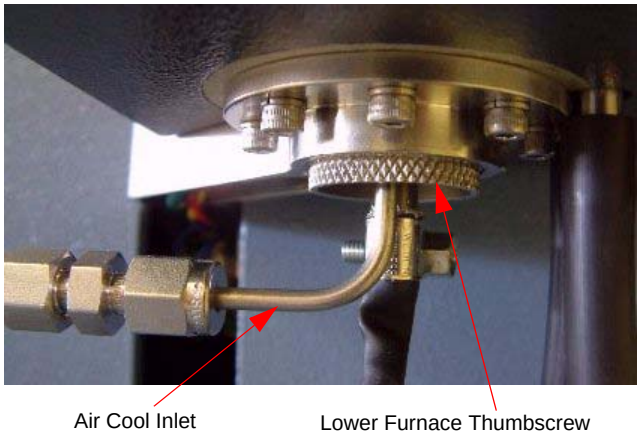
CAUTION: When cleaning the furnace DO NOT disturb the hang-down wires, the baffles on the sample tube located directly above the furnace as damage may result.

1. Press the **FURNACE** key to lower the furnace completely.
2. Load an empty platinum or ceramic pan, depending on the corresponding tare side pan. (Aluminum pans CANNOT be used due to the high temperatures.)
3. Raise the furnace completely.
4. Heat the TGA to 1000°C in air purge and allow to cool.

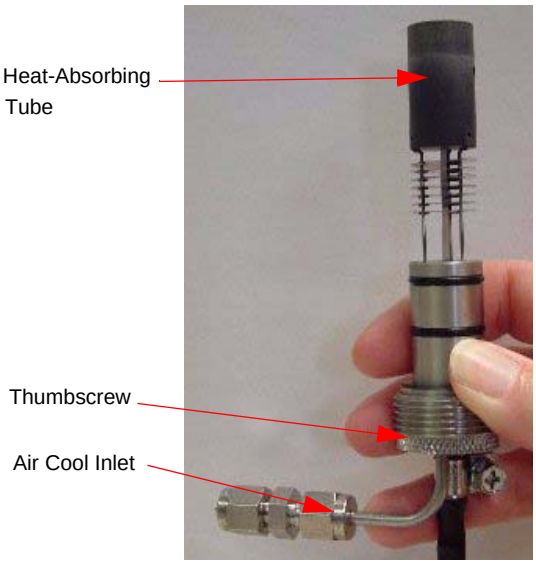
CAUTION: Allow the furnace to cool completely before continuing with the next step.

5. Unload the sample pans.

6. Remove the lower furnace assembly by unscrewing the thumbscrew as shown in the figure to the right.



7. Remove the lower furnace assembly from the furnace by pulling it straight down until the entire assembly is clear of the instrument. DO NOT TWIST THE LOWER FURNACE.



Lower Furnace Assembly

8. Unscrew the knurled nut at the other end of the lower furnace assembly (shown in the figure to the right) to release it from the instrument cabinet.

9. Disconnect the tubing from the air cool inlet.

10. Check for any residue inside the heat-absorbing tube. Remove any residue by turning the assembly upside down or gently blowing the residue out. Place the assembly aside for reinstallation later.

CAUTION: When using any solvent, as directed in the next step, it is recommended that you wear protective rubber gloves.

11. Place a small cup under the furnace. Rinse the furnace tube using a solvent (such as alcohol) to remove debris. The solvent will drain out of the bottom of the tube into the cup.

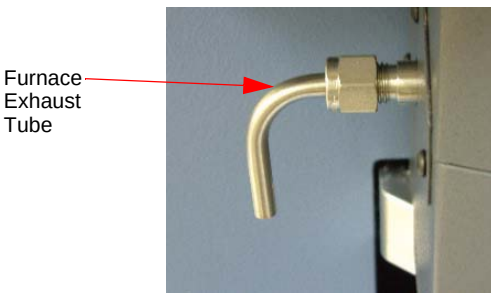
12. Using a soft bristle brush (we recommend a flexible bottle brush), insert the brush up the furnace from the underside. Gently slide the brush up and down to clean out the inside of the furnace tube, allowing the handle to bend freely.

13. Rinse the furnace tube with the solvent again, catching the debris and solvent in a cup once again.

14. Replace the lower furnace assembly as follows: Orient the lower furnace so that the air cool inlet points to the left you slide it up. See the figure above left for the parts of the lower furnace assembly. Raise the lower furnace until it goes all the way inside until only the nut shows on the outside. The O-ring will hold it in place.

15. Turn the thumbscrew enough to hold the assembly in place.

16. Loosen the outer nut and remove the furnace exhaust tube from the left-hand side of the furnace. See the figure to the right.



17. Look into the furnace outlet port on the side of the instrument. The holes in the heat-absorbing tube should align with the inlet and outlet ports on the furnace housing allowing light to pass through. Rotate the lower furnace assembly until the proper alignment has been achieved.

18. Fully tighten the thumbscrew.

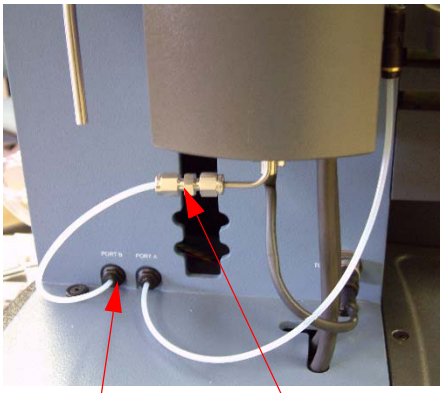
19. Replace the furnace exhaust tube.

20. Insert the lower furnace cable connector at the opposite end to the panel-mounted connector. Tighten the knurled nut.

21. Connect the 1/8-inch Teflon TFE tubing from Port B on the front of the instrument to the Air Cool Inlet as shown in the figure to the right.

22. Purge the system with nitrogen for one hour.

23. Heat the furnace to 900°C to remove any remaining solvent.



Cleaning the Pans

The TGA platinum and ceramic sample pans are designed to be reusable. However, they must be thoroughly cleaned between experiments. This is typically accomplished by "burn-off" of residue with a propane torch. In some cases, soaking the pans in an appropriate solvent provides another alternative. Care must be taken not to deform the pan and bail wire during cleaning or the TGA automatic pan pick-up process will not work.

CAUTION: The aluminum and quartz pans can not be cleaned with a propane torch. The aluminum pans are disposable, they are not meant to be reused. Refer to the online help for special cleaning instructions for the quartz pans.

CAUTION: Do not use an acid wash to clean the platinum-HT pans as this may damage the pans.

Maintaining the Heat Exchanger

The heat exchanger does not require any maintenance other than to maintain the level and quality of the liquid coolant. If the level drops too low, or the coolant becomes contaminated, this could result in problems with your instrument.

CAUTION: Do not put any liquid other than distilled water and TA Conditioner in the heat exchanger reservoir.

You should check the level and condition of the heat exchanger coolant periodically. We recommend routine checks every three to six months, depending on use of the instrument.

Add distilled water to the reservoir, if necessary, to keep the reservoir at least 2/3 full. If algae growth is visible, drain the reservoir, refill it with distilled water, and add TA Instruments TGA Conditioner, as described in the TGA online help.

Replacing the TGA Lower Furnace Assembly

Weight changes in TGA are typically plotted versus sample temperature as measured by a thermocouple located close to the sample inside the lower furnace assembly. This lower furnace assembly is exposed to sample off-gases and to contamination if the sample sputters or foams during decomposition. The lower furnace assembly will need to be replaced, if it becomes contaminated and cannot be cleaned. Embrittlement due to long term cycling up to 1200°C will also require replacement.

To replace the lower furnace assembly:

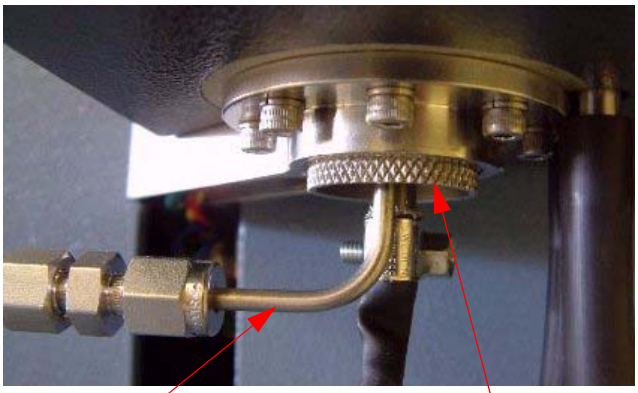
1. Close the furnace completely.

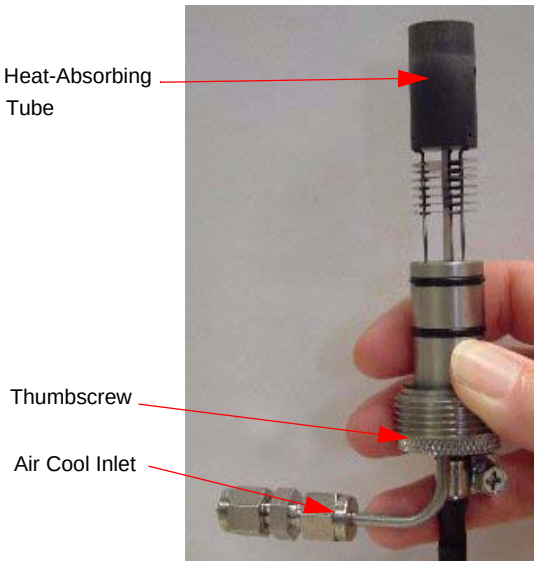
2. Unscrew the knurled nut at the other end of the lower furnace assembly (shown in the figure below) to release it from the instrument cabinet.

3. Disconnect the tubing from the air cool inlet.

4. Remove the lower furnace assembly by unscrewing the thumbscrew as shown in the figure to the right.

5. Remove the lower furnace assembly from the furnace by pulling it straight down until the entire assembly is clear of the instrument. DO NOT TWIST THE LOWER FURNACE.





Lower Furnace Assembly

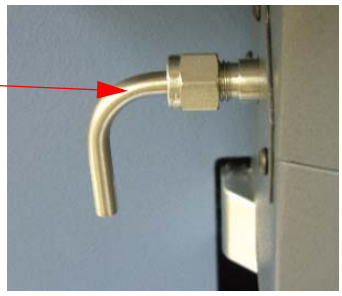
6. Locate the lower furnace assembly in the accessory kit.

7. Carefully remove the lower furnace assembly from the plastic shipping tube.

8. Orient the lower furnace so that the air cool inlet points to the left you slide it up. See the figure to the left for the parts of the lower furnace assembly. Raise the lower furnace until it goes all the way inside until only the nut shows on the outside. The O-ring will hold it in place.

9. Turn the thumbscrew to hold the assembly in place.

10. Loosen the outer nut and remove the furnace exhaust tube from the left-hand side of the furnace. See the figure to the right.



11. Look into the furnace outlet port on the side of the instrument. The holes in the heat-absorbing tube should align with the inlet and outlet ports on the furnace housing allowing light to pass through. Rotate the lower furnace assembly until the proper alignment has been achieved.

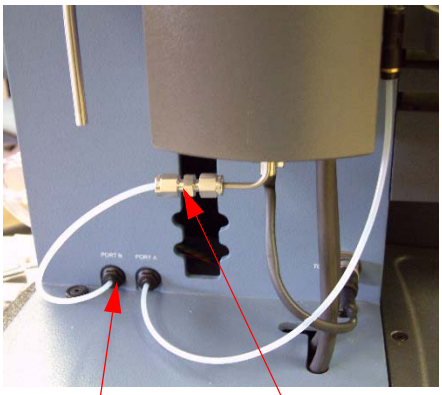
12. Fully tighten the thumbscrew.

13. Replace the furnace exhaust tube.

14. Insert the lower furnace cable connector at the opposite end to the panel-mounted connector. Tighten the knurled nut.

15. Connect the 1/8-inch Teflon TFE tubing from Port B on the front of the instrument to the Air Cool Inlet as shown in the figure to the right.

NOTE: To replace the tare and sample hang-down wires, refer to Chapter 2 "Installing the Hang-Down Wires."



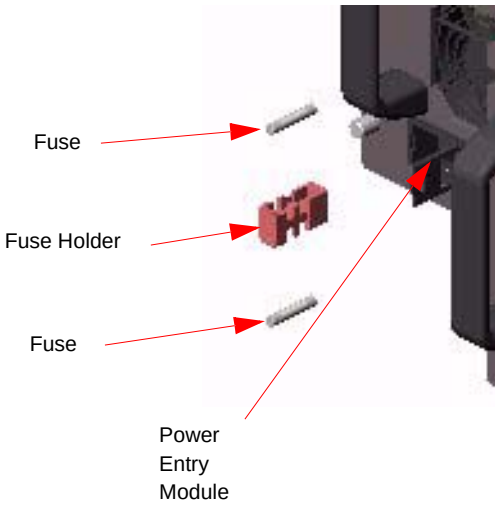
Replacing Fuses

WARNING: Always unplug the instrument before you examine or replace the fuses.

The TGA contains internal fuses that are not user serviceable. If any of the internal fuses blows, a hazard may exist. Call your TA Instruments service representative.

The only fuses that you can replace yourself are the fuses located in the power entry module located at the rear of the instrument. To check or change these fuses:

1. Turn the instrument off and remove the power cord.
2. Insert a small screwdriver at the edge of the power entry module door and pry it open.
3. Insert the screwdriver on the edge of the fuse holder to pull it out of the instrument.
4. Remove old fuses and replace the fuses only with the type and rating indicated on the instrument's rear panel.
5. Place fuse holder back into opening and push the door shut.



Replacement Parts

This section lists the replacement parts for the Q5000 IR that are available from TA Instruments. Some parts must be replaced by a service representative. See the tables below to order parts.

Fuses, Cords, and Cables

Part Number	Description
205221.001	Fuse (6.3 amp, 250 V) for 230 Vac operation with the Voltage Configuration unit
205221.002	Fuse (10 amp, 250 V) for 120 Vac operation
251470.025	Ethernet cable (25 foot, unshielded)
253827.000	Power cord
920223.901	Event cable

TGA Q5000 IR Accessories

Part Number	Description
920163.901	Power Control Unit
259508.000	Brass tweezers
259509.000	Spatula, curved, 165 mm long
271621.001	O-ring, furnace housing to balance chamber
269920.004	Balldriver, 5/64-inch
269920.026	Balldriver, 7/64-inch
269920.005	Balldriver, 3/32-inch
952162.901	Heat Exchanger tubing
952377.901	Heat Exchanger conditioner kit
953160.901	TGA Heat Exchanger assembly
957331.901	Hang-down loop
957082.901	Sample hang-down wire
952040.901	Tare hang-down wire
957399.901	Lower furnace assembly
957291.901	Upper internal furnace assembly
200391.001	Wrench, double angle, 1/4-inch
200392.001	Mirror, adjustable, 7/8-inch diameter
957357.001	Gauge, position, furnace/hook/pan
957367.901	IR Furnace Bulb Replacement Kit (4 bulbs)

TGA Q5000 IR Sample Pans and Accessory Kits

Part Number	Description
957099.901	25-pan Tray, Autosampler (standard with Q5000 IR)
957216.901	10-pan Tray, Autosampler (optional)
957207.903	50 µL platinum sample pans (package of 3)
957207.904	100 µL platinum sample pans (package of 3)
957387.901	50 µL platinum-HT sample pans (package of 3)
957387.902	100 µL platinum-HT sample pans (package of 3)
957329.903	100 µL ceramic sample pans (package of 3)
957329.904	250 µL ceramic sample pans (package of 3)
957363.901	80 µL aluminum sample pans (package of 100)[1,2,3]
957362.901	Aluminum sample lids (package of 100)
957364.901	Stainless steel bails (package of 15)
957352.901	Sealed aluminum pan kit, which contains: 957362.901 Aluminum sample lids (package of 100) 957363.901 80 µL aluminum sample pans (package of 100)[1,2,3] 957364.901 Stainless steel bails (package of 15) 957358.001 Sealed pan punch alignment tool 957201.001 Sealed pan crimping tool

1 Requires 25-pan tray, PN 957099.901.

2 Requires several additional parts found in Sealed Aluminum Pan Kit, PN 957352,901.

3 Requires TA Instruments blue sample press, PN 900878.902, or Tzero sample press, PN 901900.901, with purple die set, PN 957450.901.

TGA Q5000 IR Calibration/Reference Materials and Kits

Part Number	Description
957349.901	Mass Spectrometer Interface Kit
200413.002	Calibration weight 100 mg - Class 1
200413.001	Calibration weight 50 mg - Class 1
900905.901	Calcium oxalate monohydrate sample
952385.901	TGA nickel reference material
952398.901	TGA ALUMEL® reference material
957341.901	Autocal weight kit
952541.902	Q5000 ICTAC Curie Point reference materials kit

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