TGA
Thermogravimetric Analyzer

Q Series
Getting Started Guide

NOTICE:
Click here to open the
QTGA Getting Started Guide
for instruments with a tare tube.

Revision K
Issued June 2006

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New Castle, DE 19720

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: 1993 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:

UL3101-1 Electrical Equipment for Laboratory Use; Part 1: General Requirements.
IEC 1010-2-010: 1992 Particular requirements for laboratory equipment for the heating of materials + Amendments.

Electromagnetic Compatibility Standards

For Australia and New Zealand:

AS/NZS 2064: 1997 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.

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

This Installation Category II equipment complies with the following standards for safety:

- CAN/CSA-22.2 No. 1010.1-92
- CAN/CSA-22.2 No. 1010.2.10-94
- EN 61010-1/1993
- EN 61010-2-010/1994
- UL 3101-1, Part 1
- IEC 1010-2-010: 1992

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; voltages exceeding 120 volts AC are 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.

WARNING: After transport or storage in humid conditions, this equipment could fail to meet all the safety requirements of the safety standards indicated. Refer to the CAUTION on page 37 for the method used to dry out the equipment before use.

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 or the TGA EGA 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: The TGA furnace assembly contains a layer of refractory ceramic fiber (RCF) insulation. This insulation is completely encapsulated within the ceramic subassembly, which is not meant to be disassembled. If the subassembly should break in such a way as to expose the RCF insulation, we recommend that you dispose of it as you would any refractory material.

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.

WARNING: The TGA EGA furnace assembly also contains refractory ceramic fiber (RCF) insulation. This insulation is enclosed within the furnace housing. The furnace housing should only be disassembled for replacement of EGA furnace sample tube or furnace assemblies. Refer to instructions provided with the sample tube or furnace replacement kits for procedures for handling RCF insulation.

Thermal Safety

After running an experiment, allow the open furnace and thermocouple to cool down before you touch them.

WARNING: During a sample run, the furnace base can be hot enough to burn skin. Avoid contact with the furnace base during experiments.

Mechanical Safety

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

Overview

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

TGA Q500 with Autosampler

TGA Q50
with Standard Furnace

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 instruments
- Enables you to set up experiments and enter constants
- Stores experimental data
- Runs data analysis programs.

Components

The TGA has six major components:

- The balance, which provides precise measurement of sample weight. The balance is the key to the TGA system.
- The sample platform, which loads and unloads the sample to and from the balance.
- The furnace, which controls the sample atmosphere and temperature. Both the Q50 and Q500 are equipped with a standard furnace. An optional Evolved Gas Analyzer (EGA) furnace is available for upgrade of either TGA instrument.

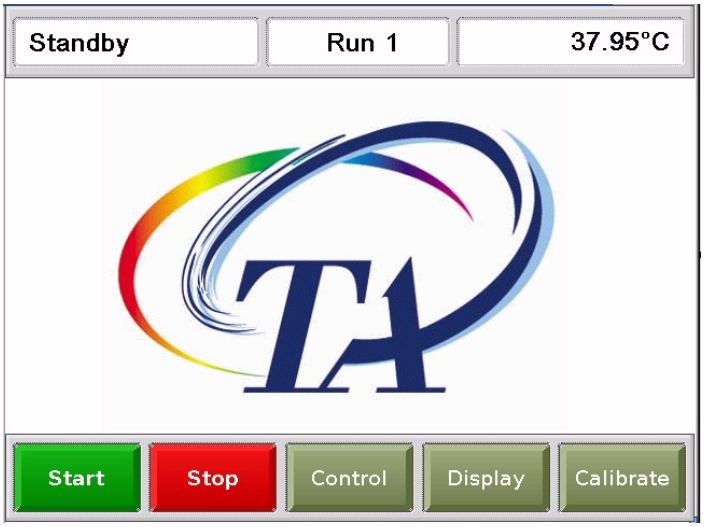
- The cabinet, where the system electronics and mechanics are housed.
- The heat exchanger, which dissipates heat from the furnace.
- The TGA Q500 has two mass flow controllers, which control the purge gas to the balance and furnace.

There are several options that are available for use with the TA Instruments TGA Q500 only. For more information on each option see page 26 and consult the online documentation associated with the instrument control software.

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.

The QTGA Touch Screen with QNX/Platinum™

The TGA Q500 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 when your instrument has QNX and Platinum capabilities installed.



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.

QNX/Platinum™ 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.

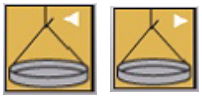
Display	Accesses the display screen, which displays the signals from the instrument such as signal display, real-time plot, instrument information, etc.
Calibrate	Displays the calibration functions available for this instrument. Functions such as Autosampler and touch screen calibration can be accessed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

QNX/Platinum™ 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.
RESET SAVED PARAMETERS	Resets the saved instrument parameters and resets the instrument.
SHUTDOWN 	Shuts down and resets the instrument.

QNX/Platinum™ 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 	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.

QNX/Platinum™ 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.

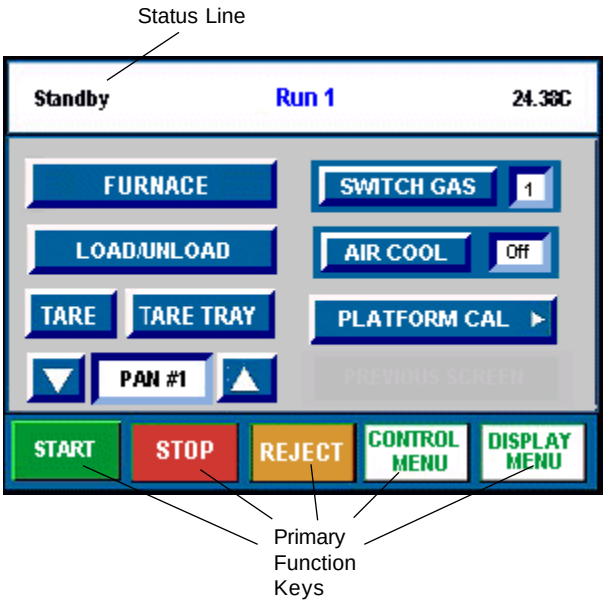
Key Name	Description
TOUCH SCREEN 	Allows you to calibrate the touch screen display.
AUTOSAMPLER 	Accesses the Autosampler Calibration functions.

The TGA Q500 Touch Screen (Original)

The TGA Q500 instrument has a built-in integrated display and keypad in the form of a touch screen for local operator control. The functions shown on the screen change depending upon the menu you are using. This section briefly describes the functions of the keys shown on the touch screen displays.

The *status line* along the top of the display (see the figure to the right) shows the current instrument status, temperature, and current run number.

At the bottom of the screen is a set of five keys that are used for the primary instrument functions. These keys are available to you regardless of the menu selected. See the next section for an explanation of the *primary function keys*.



TGA Autosampler Touch Screen

NOTE: Experiment information and instrument constants are entered from the controller keyboard, not the instrument touch screen.

Primary Function Keys

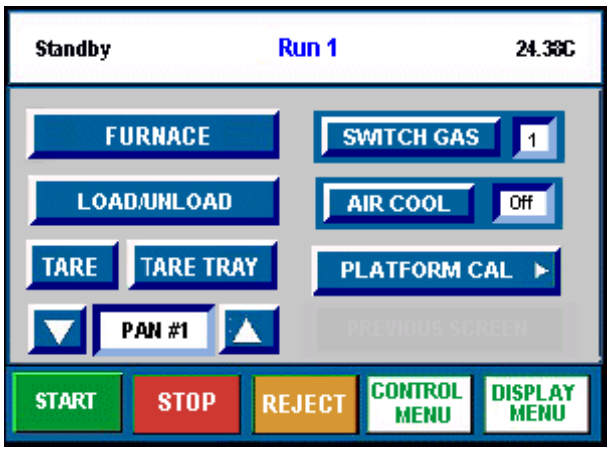
This set of keys, found at the bottom of the touch screen, are used to perform the basic functions of the instrument and to access the two main screens. See the table below for details.

Key Name	Description
START	Begins the experiment. This is the same function as Start on the instrument control software. *Forced Start* can be done by pressing the Start key while the status line displays "Set Up." Forced start begins collecting data during instrument setup.
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.*). *(tabke continued)*

Key Name	Description
	If an experiment is running, REJECT ends the method. The method-end conditions go into effect just as if the method had run to completion. However, the data that has been generated is *discarded*. This is the same function as Reject on the instrument control software.
	Displays the Control Menu touch screen keys. These are used to control the instrument actions.
	Accesses the Display Menu screen, which is used to select the desired display option.

Control Menu Keys

The Control Menu is accessed by touching the Control Menu 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.



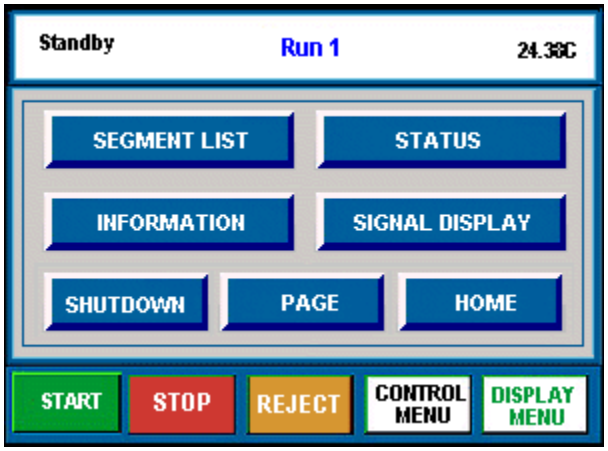
TGA Autosampler Touch Screen

Key Name	Description
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.
SWITCH GAS 1	Toggles between purge Gas #1 and Gas #2. See page 34 for information on gases to be used with the TGA.
LOAD/UNLOAD	Loads or unloads a sample pan from the sample platform onto the balance.
AIR COOL Off	Toggles the air cool function on or off. This is the same function as Air Cool on the instrument control software.
PAN #1	*Auto TGA Only:* Allows you to select the active pan. Touch the directional arrow to cycle through the pan number positions on the AutoTGA sample tray.
PLATFORM CAL	Touch this key to display the Platform Calibration screen. See the next section for details.
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 TRAY	*AutoTGA Only:* Electronically zeros the displayed weight of an entire tray of empty pans.

Automatic Keypad Functions

Some of the TGA instrument touch screen keys automatically perform additional functions under certain conditions:

- START automatically loads the sample pan and closes the furnace, if necessary, before beginning the experiment.
- TARE, LOAD, and UNLOAD automatically open the furnace if necessary.
- START can be pressed while a sample LOAD is in progress.



Display Menu Keys

The Display Menu is accessed by touching the DISPLAY MENU key at the bottom of the touch screen. The menu shown in the figure here will be displayed. A brief description of the function of each key is provided in the table below.

Key Name	Description
SEGMENT LIST	Accesses the experimental procedure that is currently being used for this experiment and highlights the active segment.
STATUS	Displays the three main signals indicating the current status of the experiment.
INFORMATION	Displays instrument information such as the software version, options, and the IP (Internet Protocol) address.
SIGNAL DISPLAY	Displays the realtime signal data that comes directly from the instrument. The signals displayed here are customized through the instrument control software.
SHUTDOWN	Ensures proper shutdown of the instrument before turning off the power.
PAGE	Beeps the controller that is connected to the instrument.
HOME	Returns to the opening window.

TGA Q50 Keypad

The TGA Q50 instrument keypad, shown above, contains keys that control local operations at the instrument (experiment starting and stopping, automatic balance taring, sample loading/unloading, and furnace opening/closing). Experiment information and instrument parameters are entered using the instrument control software.

The table below explains the functions of the instrument keys:

Key	Description
	**Start Key:** Begins the experiment. This is the same function as Start on the instrument control software.
	**Stop Key:** If an experiment is running, this key ends the method normally, as though it had run to completion; *i.e.*, the post test 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.*).
	**Tare Key:** Zeros the 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. This is the same function as Tare on the instrument control software.
	**Sample Key:** Toggles between loading a sample pan from the sample platform onto the balance and unloading the sample onto the sample platform. This is the same function as Sample/Load/Unload on the instrument control software.
	**Furnace Key:** Toggles between the furnace closed and furnace open functions depending on where the furnace is when you press this key. This is the sample function as Furnace/Open or Furnace/Closed on the instrument control software.

Options and Accessories

Several accessories are available for use with the TGA Q Series instruments. There are several options that are available for use with the TA Instruments TGA Q500 only—AutoTGA (a multi-sample accessory), Hi-Res™ TGA (a high resolution option), and MTGA (Modulated TGA). The optional EGA (Evolved Gas Analyzer) furnace can be installed on either TGA instrument. This section provides a brief introduction to these options. For more detailed information refer to the online help.

Hi-Res™ TGA

The TA Instruments Hi-Res technique, dynamic rate TGA (DRTGA), 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 maximize weight change resolution. This Q500 technique allows the use of very high maximum heating rates during Hi-Res ramp segments while avoiding transition temperature overshoot. 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 option that is used with the Thermogravimetric Analyzer, TGA Q500. This option is used to study the same decomposition or volatilization properties as conventional TGA. However, MTGA 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 single kinetic mechanism
- verification of first-order kinetic model.

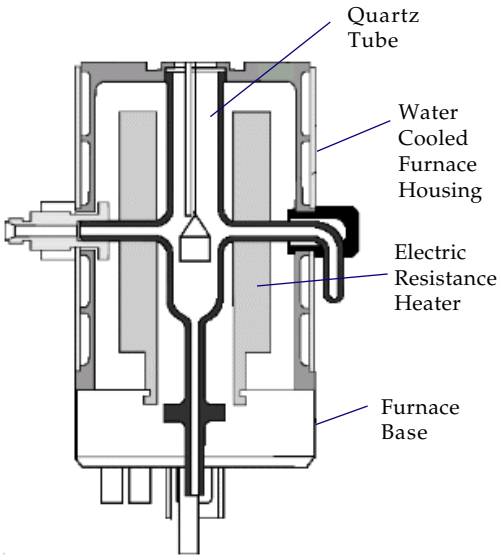
MTGA is an enhancement of TGA that provides the same information as traditional TGA, plus new information that permits unique insights into the behavior of the weight loss reaction.

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.

EGA Furnace



The Evolved Gas Analysis (EGA) furnace (shown here) is an optional accessory for the Q500 or the Q50 that allows you to connect a spectrometer to the instrument so that the gases evolved by sample decomposition can be analyzed. The EGA furnace and the standard TGA furnace can be exchanged as directed in Chapter 3.

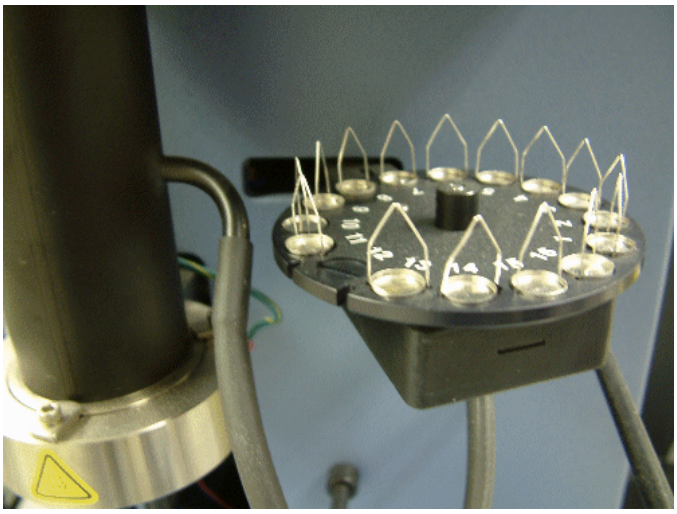
The EGA furnace consists of a quartz glass sample tube surrounded by an electric resistance heater, both of which are contained within a water-cooled furnace housing. The housing is mounted to a furnace base that raises and lowers the furnace for sample loading and unloading.

The *sample tube* has a purge gas inlet that passes through the right side of the furnace housing. A fitting on the left side of the housing allows connection of a transfer line to carry exhaust gas to a spectrometer such as a mass spectrometer. Because the heater is external to the sample tube, evolved gases from sample decomposition within the sample tube do not come in contact with the resistance elements or the furnace ceramic refractory.

Cooling air enters through the furnace base and passes upward between the outside of the sample tube and the inside of the furnace, completely separating the cooling air from the sample and the sample zone. The *furnace* is a resistance heater wound on alumina ceramic, which allows sample zone temperatures as high as 1000°C with heating rates up to 50°C/min. A Platinel II® *thermocouple* is positioned in the furnace, just above the sample pan, where it monitors the sample environment temperature.

The *furnace base* moves the furnace assembly up around the sample pan to the closed position, or down away from the sample pan to the open position.

Using the TGA Autosampler



The TGA Autosampler, known as the Auto TGA, is an accessory to the TA Instruments TGA Q500 (see the figure here). It allows you to place up to 16 samples at one time on the TGA instrument to measure the amount and rate of weight change in a material. Experiments are performed as they normally would be using the TGA—but now you can run samples on a continual basis and keep a log of the results using the Autosampler screens. The six (6) standard TGA pans listed below are used with the Auto TGA:

- 100 μL aluminum
- 50 and 100 μL platinum pans and
- 100, 250, and 500 μL alumina ceramic pans.

The Auto TGA, as an accessory to the TGA, does not alter the procedures used to start up and shut down the TGA instrument and the controller; refer to the procedures found in Chapter 3 of this manual when starting your instrument.

To calibrate the sample tray, in addition to any other information not found in this manual, refer to the online documentation found in the instrument control software.

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. Consult the appropriate local instrument manufacturer for further information.

Instrument Specifications

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

TGA Instrument Characteristics

Dimensions	Depth 55.9 cm (22 in.) Width 47 cm (18.5 in.) Height 52.1 cm (20.5 in.)
Weight Weight of transformer	30.9 kg (68 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	1.5 kVA
Insulation Rating	All electrical insulation between hazardous components have been designed to meet the requirements of reinforced insulation. Low voltage circuits are grounded.
Room Operating Temperature	15°C to 35°C (non-condensing)
Temperature control range	ambient +5°C to 1000°C
Thermocouple	Platinel II*
Heating rate with standard furnace Heating rate with EGA furnace	0.1 to 100°C/min 0.1 to 50°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 Pans	
Types	Platinum, Alumina (Al_2O_3), Aluminum
Volume capacity	Platinum: 50 µL, 100 µL Alumina: 100 µL, 250 µL, 500 µL Aluminum: 100 µL
Balance Mechanism	
Weighing capacity (sample)[1]	1.0 g
Balance measurement[2]	
Resolution	0.1 µg
Accuracy	≤ ± 0.1%
Ranges	200 mg range: 0.1 µg – 200 mg 1000 mg range: 1 µg – 1000 mg
Mass Flow Controller (MFC) Furnace Atmosphere for Q500	
Purge gases	Helium, nitrogen, oxygen, air, argon
MFC Purge rate	Up to 200 mL/min

[1] CAUTION: The total mechanical capacity of the balance is 5 g. In order to avoid damaging the balance assembly, never allow the total weight of the sample, tare weight, hang-down wires, and pans to exceed 5 g.

[2] The TGA balance mechanism is sensitive to changes in the surrounding room temperature. For optimum accuracy, you must regulate the ambient temperature.

WARNING: Do not use hydrogen or any other explosive gas in the TGA standard furnace or EGA 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	
Ambient temperature range	15 – 35 °C
Altitude	Less than 2 km

Chapter 2
Installing the TGA

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 plywood, 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.

Installing the Instrument

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 TA Instruments controller
- Connecting the heat exchanger cable and water lines, purge gas lines, accessories, and power cable
- Unpacking the balance
- Installing the hang-down wires
- Leveling the instrument and aligning the hang-down wires
- Adjusting the sample platform (see online documentation)
- Installing the optional EGA furnace .

It is recommended that you have your TGA 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 sensitivity of TGA experiments, it is important to choose a location for the instrument using the following guidelines. The TGA should be:

In ... a temperature-controlled area.
... a clean, vibration-free environment.
... an area with ample working and ventilation space.

On ... a stable work surface.

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 flowmeters, if required.

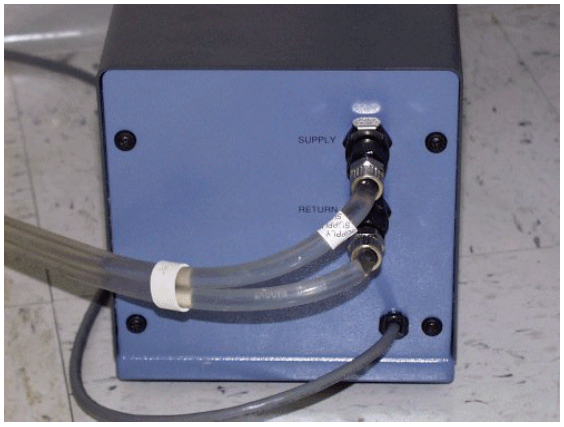
Away from ... dusty environments.
... exposure to direct sunlight.
... direct air drafts (fans, room air ducts).
... poorly ventilated areas.
... noisy or mechanical vibrations.

CAUTION: Drying out the instrument may be needed, if it has been exposed to humid conditions. It is important to be certain that the instrument ground is adequately connected to the facilities ground for safe operation.

Run the following procedure to dry out the instrument:

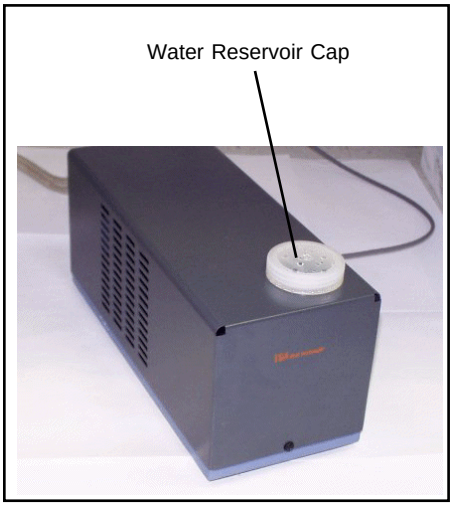
1 Ramp at 10°C/min to 400°C
2 Isothermal for 30 min.

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 31). To fill the heat exchanger, follow the directions given below.

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



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

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

CAUTION: Do not put any liquid other than distilled water 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.

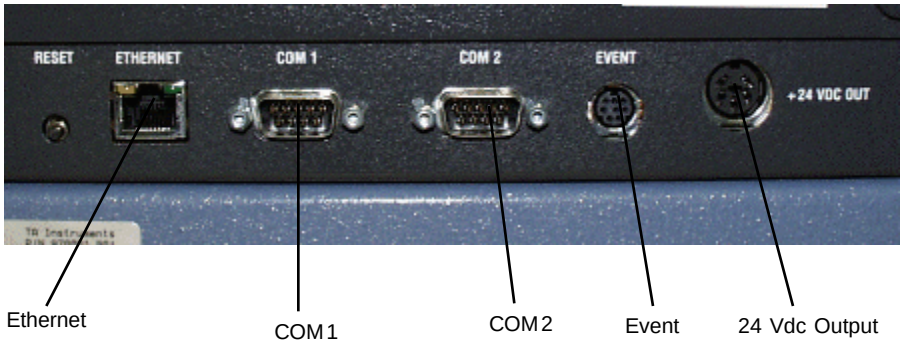
NOTE: Connect all cables before connecting the power cords to outlets. Tighten the thumb-screws on all computer cables.

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.

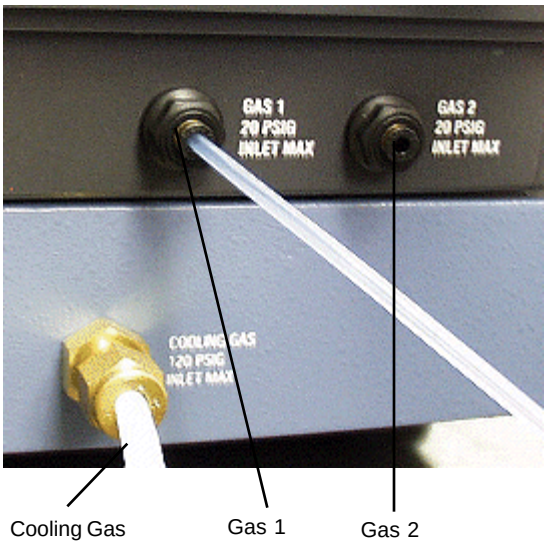
Ports

The TGA has ports that are located on the back of the instrument. The following table provides a description of 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 the following functions: general purpose relay contact closure, gas switching contact closure sync input, or general purpose input 4 – 24 Vdc for external syncing.
24 VDC output	Provides Heat Exchanger detection signals and voltage.
Base Purge	*Not used for the TGA.*
Gas 1	*TGA Q500 or TGA Q50 with MFC:* Inlet port for the Mass Flow Controller. Used for the sample and balance purge gas. 140 kPa gauge (20 psig) maximum pressure.
Gas 1	*TGA Q50:* Inlet port for sample purge gas. Requires flowmeter with 140 kPa gauge (20 psig) maximum pressure.
Gas 2	*TGA Q500 or TGA Q50 with MFC:* Inlet port for the Mass Flow Controller. Used for the sample purge gas. 140 kPa gauge (20 psig) maximum pressure. *TGA Q50:* Inlet port for sample purge gas. Requires flowmeter with 140 kPa gauge (20 psig) maximum pressure.
Cooling Gas	Provides the furnace with air for 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 30).
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 packing.
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).
7. Connect the other end of the unmarked water line to the connector labeled "RETURN" on the heat exchanger.

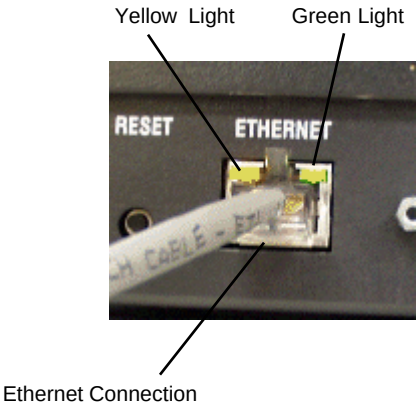
Supply & Return Lines on TGA

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. 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

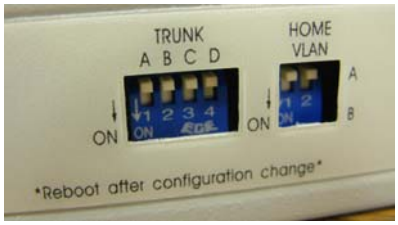


1. Locate the Ethernet port on the left rear of the instrument (shown in the figure to the right).

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



Configuration Switches

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.

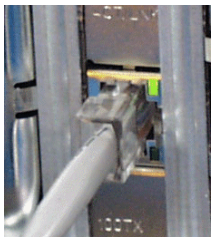
5. Check the Ethernet port on the rear of the instrument. If communication between the instrument and the switch has been properly established, a solid green light and flashing yellow light will appear at the port.

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.

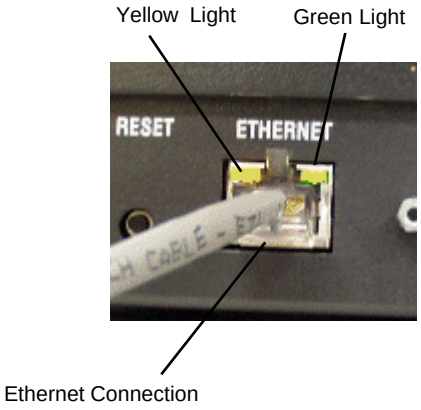
4. Check the Ethernet port on the rear of the computer. If communication between the computer and the switch has been properly established, a solid green light and flashing yellow light will appear at the port.

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

Connecting the Controller to a LAN

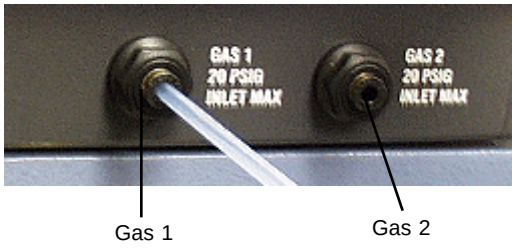
Before you can connect the controller to a LAN, you will need to have already installed a network interface card into the computer.

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.



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 Q500 is equipped with two mass flow controllers (MFC) to control the flow rates of the gases. This is an optional accessory for the TGA Q50. Up to two different gases may be connected to the instrument to facilitate gas switching. Follow these instructions to connect the air purge lines. Refer to the figure on the right to locate the purge lines.



CAUTION: Do not use any liquid in the purge lines.

Instruments with Mass Flow Controllers

Follow these instructions if your TGA is equipped with mass flow controllers, which is standard on the TGA Q500.

1. Locate the Gas 1 port. The Gas 1 port is used to purge both the sample and balance areas.
2. Locate the Gas 2 port. The Gas 2 port is only used to purge the sample area and is used when a different purge gas from Gas 1 is desired or when gas switching during an experiment is needed.
3. Connect the primary gas line to the Gas 1 port using 1/8-inch o.d. 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.

   For instruments with the mass flow controllers, the flow rates are individually controlled through settings chosen using the instrument control software.
4. Make sure that the pressure of your purge gas source is regulated between 70 to 140 kPa gauge (10 to 20 psig) maximum.
5. Specify the connected gas on the **Instrument Preferences/MFC Page** using the instrument control software.

6. Set the combined purge rate to the recommended value of 100 mL per minute or less for your experiments on the **Notes Page** of the **Experiment View**. Click **Apply** to save the changes.. The flow distribution show be as follows: (a) for the standard furnace, 40 percent to the balance chamber and 60 percent to the sample, or (b) for the EGA furnace, 10 percent to the balance and 90 percent to the sample.

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 2.

Instruments without Mass Flow Controllers

Follow these instructions if your TGA is not equipped with a mass flow controller, which is the factory configuration for a TGA Q50 (it can be upgraded with MFC installation, if desired).

1. Locate the Gas 1 port. The Gas 1 port is used to purge the sample area only. Connect the desired gas line to Gas 1 port using 1/8-inch o.d. tubing. Teflon TFE tubing is recommended and is supplied in the instrument shipping accessory kit.

2. Locate the Gas 2 port. The Gas 2 port is only used to purge the balance area. Connect the desired gas line to Gas 2 port using 1/8-inch o.d. tubing. Teflon TFE tubing is recommended and is supplied in the instrument shipping accessory kit.

3. For instruments without the MFC, it is important to maintain the proper flow rates by using a flowmeter that is connected to each of the purge fittings (Gas 1 and Gas 2) on the back of the TGA Q50.

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

5. Specify the connected gas on the I**nstrument Preferences/MFC Page** using the instrument control software.

6. Set the combined purge rate to the recommended value of 100 mL per minute or less for your experiments on the **Notes Page** of the **Experiment View**. Click **Apply** to save the changes.. The flow distribution show be as follows: (a) for the standard furnace, 40 percent to the balance chamber and 60 percent to the sample, or (b) for the EGA furnace, 10 percent to the balance and 90 percent to the sample.

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 2.

Cooling Gas Line

Use the following steps to install the cooling gas line.

1. Locate the Cooling Gas fitting, a 1/4-inch compression fitting or 1/4-inch Legris fitting on the rear of the TGA cabinet, marked with a 830 kPa gauge (120 psig) 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: Nitrogen may also be used as a cooling gas.

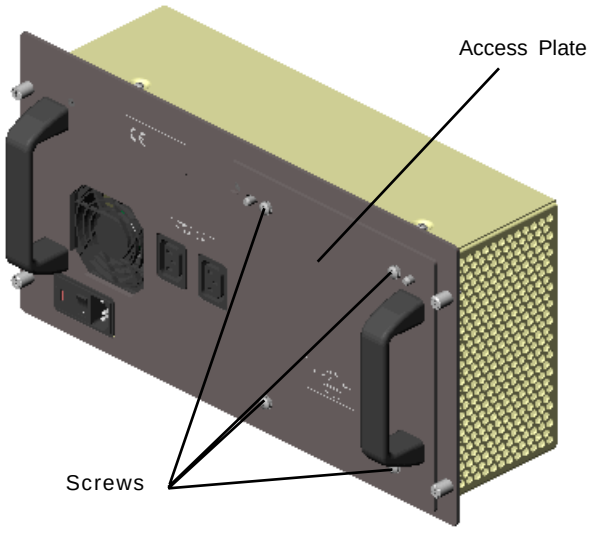
Voltage Configuration Unit

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):

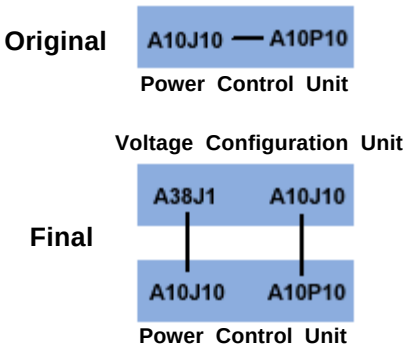
WARNING: High voltages are present in this instrument as indicated by the label. Be sure to unplug the instrument before performing these instructions. See the WARNING on page 9.

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.

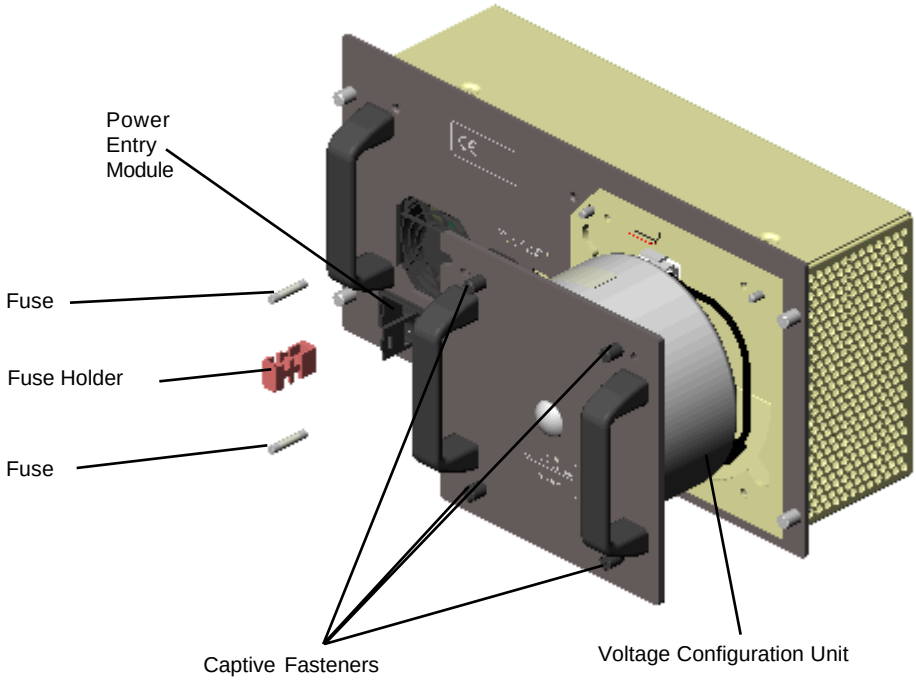


3. Disconnect the A10J10 connector from A10P10 located inside the PCU. Now connect the A10J10 connector on the voltage configuration unit to A10P10 located inside the PCU. Then connect A10J10 located inside the PCU to A38J1 on the anti-surge subassembly. See the diagram to the right for clarification.



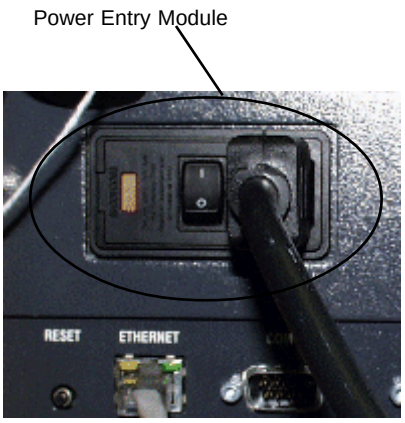
4. Install the subassembly into the PCU and tighten the four (4) captive fasteners to secure it.

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 below.



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 TGA POWER switch is in the Off (0) position.
2. Plug the power cable into the TGA power entry module.

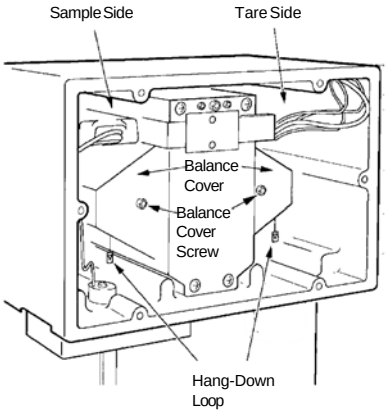
CAUTION: Before plugging the TGA power cable into the wall outlet, make sure the instrument is compatible with the line voltage. Check the label on the back of the unit to verify the voltage.

3. Plug the power cable into the wall outlet.

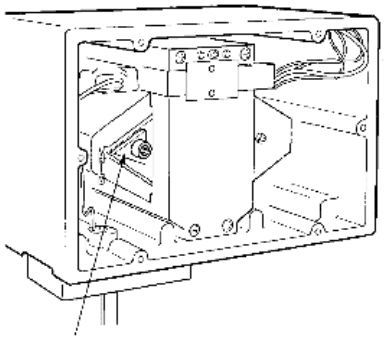
Unpacking the Balance

TA Instruments recommends that you complete the installation instructions stated previously in this chapter, before you unpack the TGA balance mechanism.

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



1. Using the1/16-inch ball driver supplied in your TGA accessory kit, loosen the six captive screws securing the balance chamber faceplate to the instrument.
2. Take off the faceplate.
3. Loosen and remove the thumbscrew holding the balance cover on the sample (left) side of the balance mechanism (shown here), and take off the cover.
4. Using tweezers, remove the foam insert from around the screw hole (see figure below):



   a. Gently compress the foam with the tweezers, being careful not to touch the balance.

   b. Remove the foam insert from the balance chamber.

5. Replace the sample side cover and screw.
6. Repeat the procedure to remove the foam insert in the tare (right) side of the balance.

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 for the Q500 and, for the Q50, the green light on the keypad will be lit. This indicates that the instrument is ready for use.

NOTE: Allow the TGA to warm up for at least 30 minutes before performing an experiment.

Installing the Hang-Down Wires

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

1. Turn on the instrument.

2. Press the **FURNACE** key to lower the furnace.

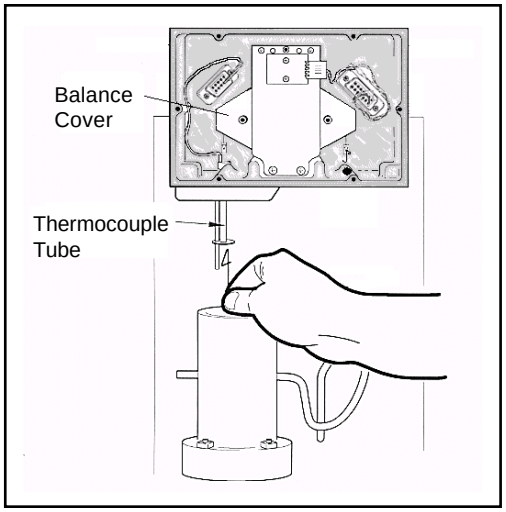
3. Using the ball driver supplied in your TGA accessory kit, loosen the six captive screws securing the balance chamber faceplate to the instrument and remove the faceplate.

4. Loosen and remove the thumbscrew holding the balance cover on the sample (left) side of the balance mechanism and take off the cover.

5. Locate the sample hang-down wire in your TGA Accessory Kit.

6. Hold the wire in your hand so that the doubly bent top hook is pointing to the left and the bottom hook is pointing to the right. See the figure to the right.

7. Carefully insert the bottom of the hang-down wire into the top of the furnace far enough so that you can insert the top of the wire into the thermocouple tube without bending the wire.



8. Thread the hang-down wire up through the thermocouple tube into the balance chamber, and hook the top of the wire over the top of the tube.

NOTE: To make the hang-down loops easier to see, we suggest sliding a piece of white paper into the balance chamber behind each loop before you hook the hang-down wire into it. (Do not forget to remove the paper when finished.)

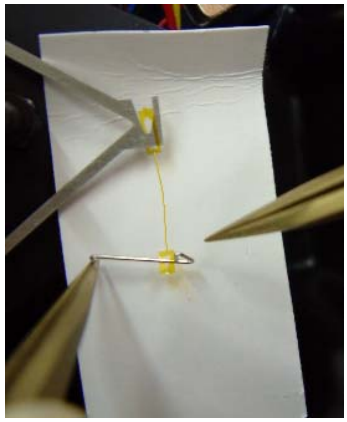
9. Grasp the top hook of the hang-down wire with brass tweezers. Being careful to keep the top hook pointing to the left, pass the double bend through the hang-down loop so the wire is hanging from the loop.

10. Loosen and remove the thumbscrew holding the balance cover on the tare (right) side of the balance mechanism and take off the cover.

11. Locate the tare hang-down wire in your accessory kit.

12. Hold the wire in your hand so that the tip of the bottom hook (the single bend hook) can be inserted through the kapton loop hole from the right side as shown in the figure to the right. Insert the bottom hook through the hole. For the tare hang-down wire alignment is not critical; therefore, the bottom (double bend) hook can be facing in either direction.

Step 12
Inserting Bottom Hook Through Loop



Step 13
Rotating the Hook Upside Down

13. Using two sets of brass tweezers, as shown in the figure to the left, carefully rotate the hook to turn it upside down.

14. Lower the hook until the double bend hook just reaches the kapton loop hole. Release the hook.

15. Gently raise and lower the wire until the double bend hook rests on the bottom of the kapton hole.

16. Select a sample pan of the same size and type that you will use in your experiments and hang it from the tare hang-down wire.

You are now ready to align the sample hang-down wire as directed in the next section. The tare hang-down wire does not require alignment.

Step 15
Final Position of Double Bend Hook

Aligning the Sample Hang-Down Wire

To avoid weight signal noise, the TGA instrument must be level so that the sample pan and hang-down wire hang inside the furnace and thermocouple tube without touching them. The angle at which the pan hangs is very sensitive to slight irregularities in benchtop surfaces, so it is important that you select a sturdy table or bench for your TGA.

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.

Aligning the top of the sample hang-down wire:

1. Place an empty sample pan on the sample platform.

2. Touch the **LOAD** key on the instrument touch screen. The TGA will automatically lower the furnace (if necessary), move the sample platform over to the furnace, and load the pan onto the balance.

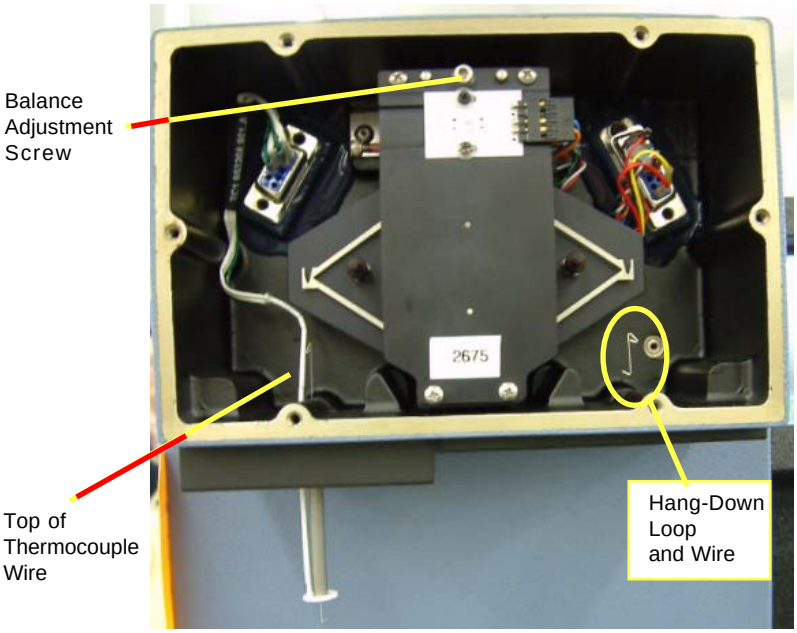
   If the pan will not automatically load, place it manually (using brass tweezers) on the sample hang-down wire and continue with the procedure. Use the Sample Platform Adjust procedure (see the software online help for information) to correct loading after completing sample hang-down wire alignment.

3. Check to see whether the top end of the sample hang-down wire is hanging freely and is roughly centered

within the thermocouple tube inside the balance chamber.

4. If the wire is not roughly centered inside the thermocouple tube, turn the balance adjustment screw (see the figure to the right) with the 7/64-inch ball driver until the wire is centered.

   Turning the balance adjustment screw clockwise will move the wire backwards; turning the screw counterclockwise will move the wire to the front.



Aligning the bottom of the hang-down wire:

1. Touch the **FURNACE** key on the Control menu touch screen to raise the furnace just to the bottom of the sample pan, and touch **STOP**.

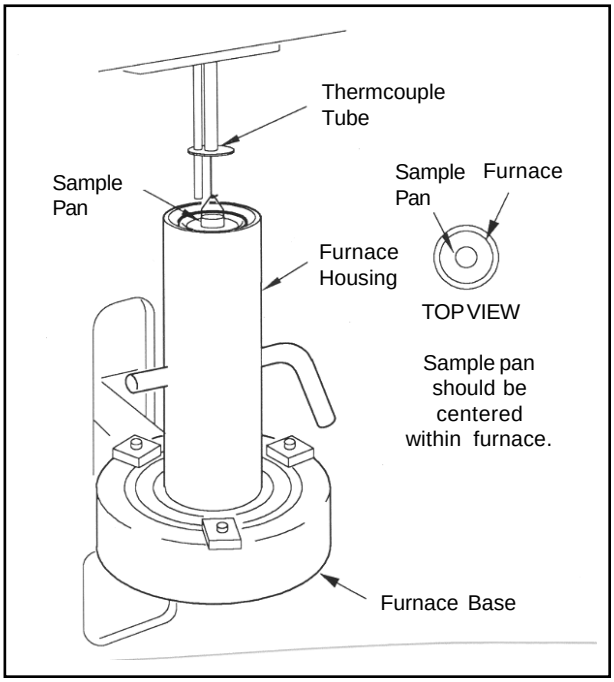
2. Check the alignment of the sample pan within the furnace. It should hang freely, roughly centered, and should not be touching the sides of the furnace or the thermocouple tube (shown in the figure here).

3. If the sample pan is not centered and hanging freely within the furnace, level the TGA instrument by adjusting the feet on the bottom. Turn the feet clockwise to lengthen or counterclockwise to shorten the legs. Continue adjusting until the pan hangs correctly.

4. Touch the **FURNACE** key to lower the furnace.

5. Touch the **UNLOAD** key to remove the sample pan from the furnace.

6. Replace the balance chamber faceplate and its 6 screws.



If you had to load the sample pan manually in order to align it in the furnace, you should now adjust the sample platform using the instrument control software (see the online help for information).

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.

To ensure proper shutdown of the instrument, it is recommended that you select **Control/Shutdown Instrument** from the Instrument Control menu or touch the **SHUTDOWN** key on the Display Menu touch screen. A confirmation message will be displayed. Select OK (touchscreen) or Shutdown (Instrument Control) to proceed. All communication to the instrument will be halted while the instrument saves data to the flash screen. 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 to the OFF (0) position.

Chapter 3
Use, Maintenance, & Diagnostics

Using the TGA

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 type and material
- 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
- Setting the purge gas flow rate
- 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
- Connected heat exchanger water lines
- Connected all gas lines
- Powered on each unit
- Installed all appropriate options
- Connected the instrument with the controller
- 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.

Two types of calibration are needed for the TGA: temperature and weight calibration. Both calibration procedures are performed through the instrument control software. For detailed information on all calibrations, refere to the online help in instrument control.

Temperature Calibration

Temperature calibration is useful for TGA experiments in which precise transition temperatures are essential. To temperature calibrate the TGA, you need to analyze a high-purity magnetic standard for its curie temperature, and then enter the observed and correct values in the temperature calibration table (see the online help and documentation for further information). The observed and correct temperatures correspond to the experimental and theoretical transition temperatures (*e.g.*, curie temperature) of the calibrant. From one to five temperature calibration points (pairs of observed and correct temperature points) can be entered in the calibration table. A multiple-point calibration is more accurate than a one-point calibration. See the online help for further information.

Weight Calibration

Weight calibration should be performed on the TGA at least once a month. The weight calibration procedure calibrates both the 200 mg and 1 g weight ranges. The calibration parameters are stored internally in the instrument.

You must be sure to determine the exact weight of the calibration weights before they are used to calibrate the instrument.

The instrument control weight calibration functions guide you through the calibration procedure step-by-step, 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.

- Selecting the pan type 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.
- Attaching and setting up external accessories as required such as the purge gas.
- Starting the experiment.

Taring the Sample Pan

Taring must be done before the sample is loaded to ensure that the balance gives you an accurate reading.

Place an empty sample pan on the platform and select **TARE** from the TGA Control Menu touch screen or keypad, or select **Control/Tare** from the instrument control software. 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

After taring the sample pan, load the sample into the TGA furnace as follows:

1. Place the sample in the sample pan, and position the pan on the sample platform.

   The wire on the bottom of the sample pan should align with the groove in the pan hole, 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.

2. Touch the **LOAD** key on the Control menu touch screen or keypad. The TGA will automatically load the sample pan onto the balance.

3. Position the thermocouple at the edge of the sample pan, rather than in the middle, for best results.

   NOTE: The position of the thermocouple should be about two millimeters from the sample.

4. Touch the **FURNACE** key on the Control menu touch screen or keypad to close the furnace by moving it up around the sample.

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 keypad, 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.

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 Control menu touch screen or keypad, or by selecting Stop through the instrument control software. 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.

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 Furnace Housing

Follow the instructions in this section that apply to the type of TGA furnace found on your instrument. The TGA Q 50 and Q500 are shipped with the standard furnace, however, an EGA furnace may installed as an option.

Cleaning the TGA Standard Furnace Only

To ensure long furnace life, we recommend that you clean the furnace housing at least once a month to remove condensation materials. Follow the instructions below.

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 standard furnace more frequently to prevent dangerous buildup of debris in the furnace.

1. Press the **FURNACE** key to open the furnace completely.
2. Unload any pans, if necessary.
3. Set the power switch to the off position (0) and unplug the power cord from the instrument.
4. Disconnect the purge tube from the furnace housing purge connection.
5. Loosen and remove the nut and lockwashers holding the ground wire to the rear of the furnace housing, and disconnect the wire from the housing.

CAUTION: Take care not to drop the nut or lockwashers into the TGA cabinet.

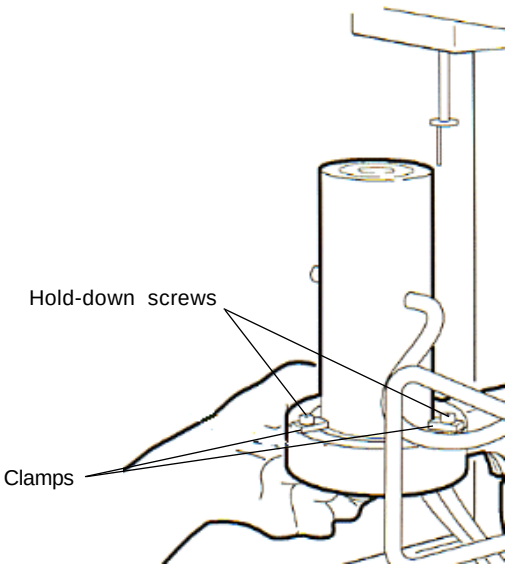
6. Loosen the three (3) hold-down screws on the clamps securing the furnace housing flange to the furnace base (see the figure to the right), and turn the clamps a quarter-turn clockwise to move them off the flange.

7. Carefully lift the furnace housing up and over the furnace to the left. (You may have to move the thermocouple in order to lift the furnace housing completely off the furnace.)

8. Lay some paper towels down, and invert the furnace housing over them.

9. Clean the inside of the housing with a solvent (such as alcohol) and cotton swabs. Make sure that you take care not to scratch or remove the gold plating.

   NOTE: Dry the housing and purge ports with air to remove any traces of solvent before replacing the housing on the furnace.



10. Replace the housing on the furnace by reversing the procedure you used to remove it—lower the housing carefully over the furnace, position the clamps over the housing flange, tighten the hold-down screws, reattach the ground wire with its nut and lockwashers, and reconnect the purge tube.

WARNING: For continued protection against electric shock, the ground wire *must* be securely connected.

NOTE: Remember to replace the thermocouple if you had to move it to lift up the furnace housing.

11. Connect the power cord to the instrument and set the power switch to the on position (I).

12. Purge the system for 1 hour with nitrogen.

13. After cleaning and replacing the furnace housing, heat the TGA to 900 °C to remove any remaining solvent.

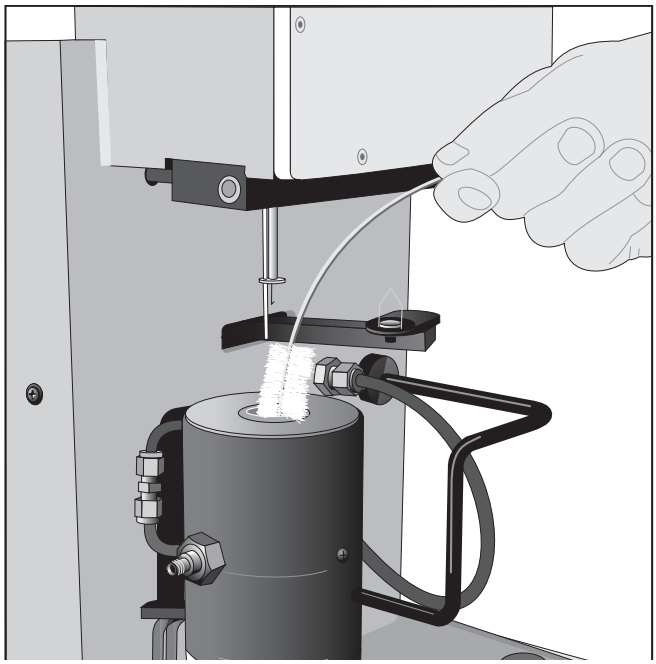
Cleaning the EGA Quartz Furnace Tube

The EGA furnace may be installed as an option on the TGA. Use these instructions to clean the quartz tube in the 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: Do not disturb the hang-down wire and furnace thermocouple located directly above the furnace when cleaning the furnace, as damage may result.

1. Press the **FURNACE** key to open the furnace completely.
2. Remove any sample pans.
3. Remove the rubber cap located on the underside of the furnace base.
4. Place a small cup under the furnace tube. 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.
5. Using a soft bristle brush (we recommend a flexible bottle brush), gently slide the brush up and down to clean out the inside of the furnace tube, allowing the handle to bend freely as shown here.
6. Rinse the furnace tube with the solvent again.
7. Replace the rubber cap on the quartz tube stem when you have completed the cleaning procedure.
8. Purge the system with nitrogen for one hour.
9. Heat the furnace to 900°C to remove any remaining solvent.



Replacing a TGA Furnace

The TGA furnace can be removed for replacement should it fail for any reason. Follow the instructions appropriate to the furnace that you have installed on your instrument.

Removing and Reinstalling the Standard Furnace

To remove or reinstall the furnace, you will have to remove the furnace arm from its connection inside the slot on the front of the instrument cabinet.

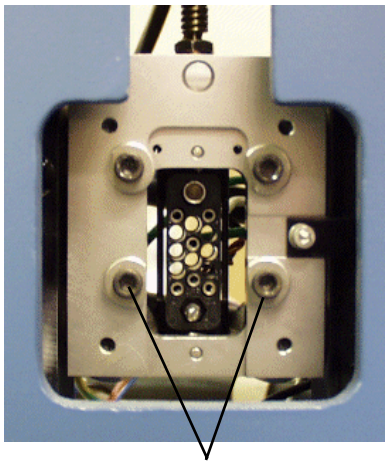
Furnace Removal

To remove the furnace use the following procedure:

1. Press the **FURNACE** key to open the furnace completely.

2. With the ball driver supplied in your TGA Accessory Kit, loosen the two screws on each side of the furnace arm connection, within the slot on the front of the instrument cabinet.

In the figure to the right the furnace arm/base has been removed to better show the location of the screws and the cleats.

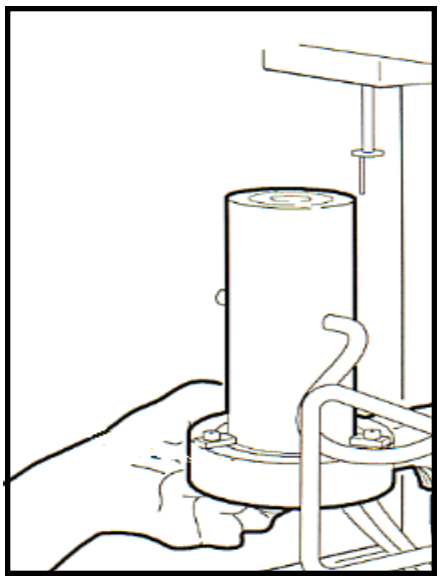


NOTE: To obtain access to the upper left screw and cleat, loosen the three hold-down screws on the furnace base. Rotate the furnace housing gently counterclockwise to move the coolant connections away from the front of the cabinet slot.

3. Rotate each screw to turn the D-shaped cleat so that the flat edge of the cleat is aligned vertically and parallel with the groove in the furnace arm.

4. While holding the furnace base in one hand, touch the **FURNACE** key to raise the furnace about 1/4 of the way up, and touch **STOP**.

5. Unplug and remove the furnace arm/base from the instrument cabinet. See the figure here.



6. Loosen the hold-down screws, if necessary, and remove the furnace housing from the furnace base, being careful not to disturb the coolant connections. Lay the furnace housing on the front ledge of the cabinet.

7. Unplug the Air Cool line from the bottom of the furnace arm/base. The furnace arm/base is now completely free of the instrument.

NOTE: When you remove the Air Cool line, do not let it slip back into the instrument cabinet.

Furnace Replacement

To replace or reinstall the furnace:

1. Plug the Air Cool line into the bottom of the furnace arm/base.

   NOTE: Before trying to reconnect the furnace arm to the plug inside the cabinet slot, it may help to back each of the four screws inside the slot out one more complete turn, again aligning the flat edge of each cleat so that it is parallel with the groove on the furnace arm. (Loosening the screws one more turn each will give you a bit more room to maneuver the arm into its connection.) In order to loosen the screws, press the FURNACE key to lower the connection so that you can reach it through the wide part of the slot. When you have aligned the cleats, press the FURNACE key again to raise the furnace about 1/4 of the way up.

2. Plug in the furnace arm.

3. Continuing to hold the furnace base, press the **FURNACE** key to lower the furnace completely.

4. Using the ball driver, tighten the two screws on either side of the furnace arm connection, making sure that the curved edges of all four cleats engage the groove on the furnace arm.

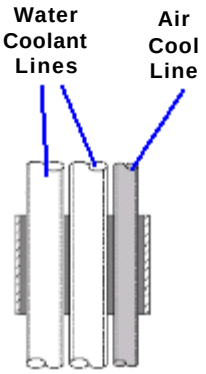
5. Elevate the furnace until the top surface of the core reaches the ceramic disk suspended from the thermo-couple tube. **Very carefully** tighten the two screws installed in the ceramic base, aligning the furnace core side-to-side with the ceramic disk. The ceramic disk should be concentric with the internal diameter of the core.

   Do not exceed 1/8 turn past fingertip tight or the furnace base may crack.

6. Lower and remove the furnace. Install the water-cooled furnace housing using the clamps from the plastic bag and the screws set aside in step 3.

7. Attach the ground wire ring lug to the furnace housing. Reinstall the furnace and housing in the TGA.

   NOTE: To obtain access to the upper left screw and cleat, rotate the furnace housing gently counterclockwise. This will move the purge and coolant connections away from the front of the cabinet slot.



8. To avoid kinking of the coolant or air cool lines, make sure the lines are oriented as shown in the figure to the right (when facing the TGA from the front).

9. Rotate the furnace housing clockwise until it is aligned correctly, and snug the three hold-down screws to ensure the furnace opening is aligned for proper sample loading. If needed, realign the sample hang-down wire as directed in Chapter 1. The TGA is now ready for operation.

Installing the EGA Furnace

The following set of instructions tells you how to install an EGA furnace for the first time on the TGA.

First-Time Installation

The first time that you install the EGA furnace involves the removal of the standard TGA furnace and replacement with the EGA furnace. Refer to "Removing and Reinstalling the EGA Furnace," for subsequent furnace exchanges.

1. Place a drip pan to the left of the instrument to catch the coolant that will leak from the hose connections when the standard furnace is removed.

2. Remove the standard TGA furnace using the instructions found in Chapter 3 "Removing and Reinstalling the Furnace."

   Make sure that you do not remove the furnace from its housing.

3. Unplug the AIR COOL line from the bottom of the furnace arm/base.

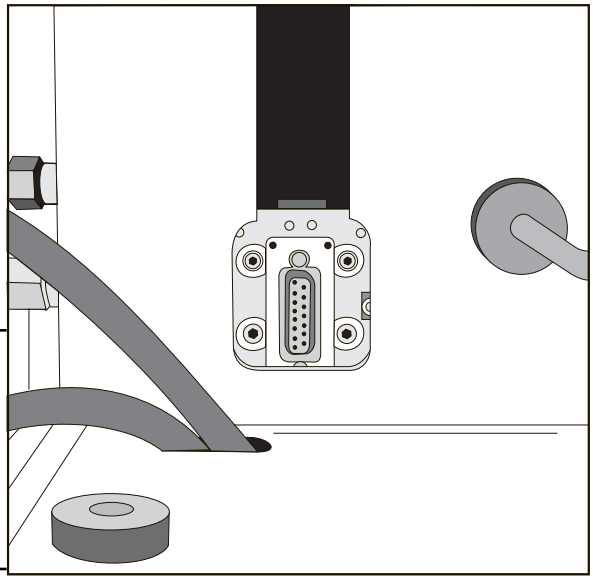
   NOTE: When you remove the AIR COOL line, do not let it slip back into the instrument cabinet.

4. Lay the furnace assembly down on the left side of the instrument so that the hose connections are positioned over the drip pan. Visually note the left (AAA) and right (CCC) orientation of the water lines so that you do not cross them later when they are reconnected. (See the figure on the next page.) Then carefully snip the wire ties and disconnect the cooling water lines from the housing. (A small amount of cooling water will drain out into the pan when the hoses are disconnected.)

5. Press the **FURNACE** key to lower the furnace carriage completely.

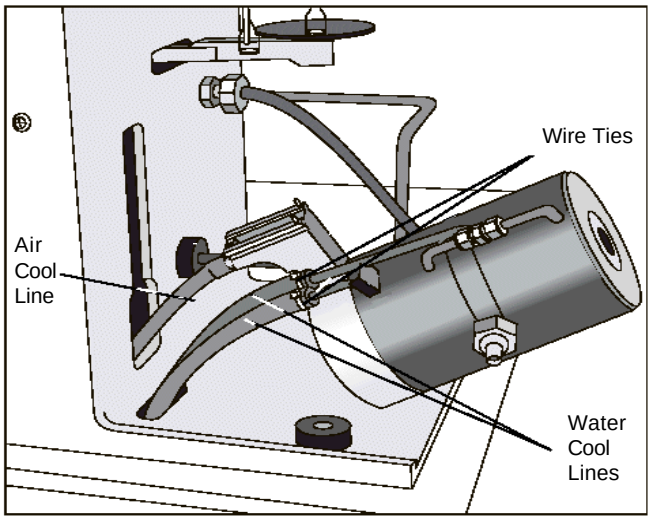
6. Loosen each of the mounting screw no more than one full turn, so that the flat sides of the cleats are aligned vertically as shown here.

   Now tighten the lower two mounting screws fully, then loosen each of them two full turns, plus a fraction of a turn, so that the flat sides of the cleats are aligned vertically as shown in the figure to the right.



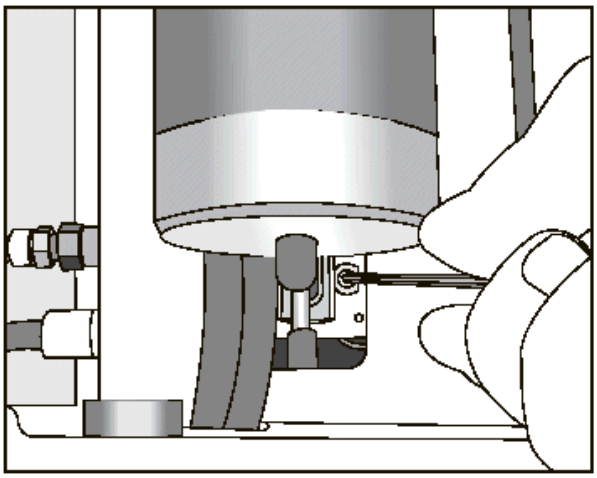
CAUTION: Loosening the upper two mounting screws any more than one full turn may cause the screws to interfere with the inside of the instrument cabinet, causing damage to the instrument.

7. Plug the AIR COOL line into the base of the EGA furnace, then connect the two water-cooling lines, making sure that the lines are not crossed. See the figure to the right for the correct placement of the lines. Be sure to install the wire ties (supplied in the kit) around the cooling lines to prevent water leakage.

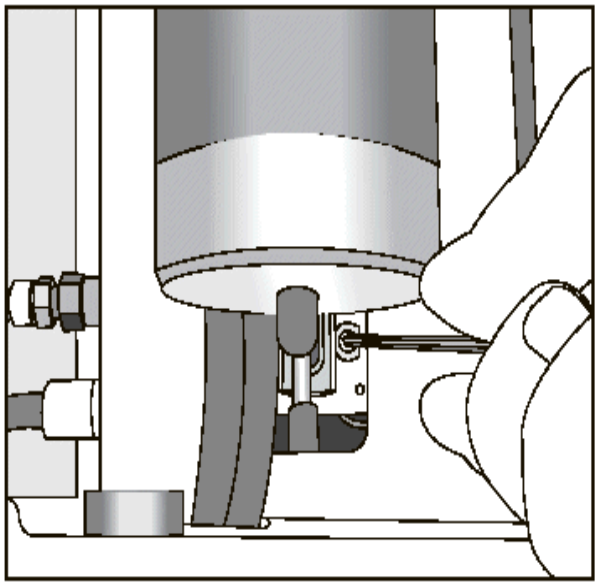


8. Press the **FURNACE** key to raise the furnace carriage until the lower mounting screws are below the top edge of the enlarged cutout in the instrument faceplate. Then press the **Stop** key.

9. Plug the EGA furnace arm into the connector on the carriage and tighten the lower two mounting screws using the ball driver supplied in your TGA Accessory Kit. See the figure directly below.



10. Press the **FURNACE** key to completely lower the furnace. Use the ball driver to tighten the upper furnace mounting screws. To reach the upper left mounting screw, insert the ball driver between the water connections on the left side of the furnace housing as shown below.



11. Connect the purge hose to the gas purge inlet on the right side of furnace.

CAUTION: Hold onto the glass purge tube with one hand while you install the purge hose to avoid breaking the glass.

12. Check the Heat Exchanger reservoir water level and add water if needed. See Chapter 2 "Filling the Heat Exchanger" for instructions.

Removing and Reinstalling the EGA Furnace

To remove or reinstall the furnace, you will have to remove the furnace arm from its connection inside the slot on the front of the instrument cabinet.

EGA Furnace Removal

To remove the EGA furnace use the following procedure.

1. Touch the **FURNACE** key on the Control menu touch screen to open the furnace completely.

2. Locate the top two mounting screws on each side of the furnace arm connection, found in the slot on the front of the instrument. Using the ball driver supplied in your TGA Accessory Kit, loosen the two screws no more than one full turn. To reach the upper left mounting screw, insert the ball driver between the water connections on the left side of the furnace housing.

3. Touch the **FURNACE** key to raise the furnace about one (1) inch and touch Stop.

4. Loosen the bottom two mounting screws using the ball driver supplied.

5. Unplug and remove the EGA furnace arm/base from the instrument cabinet.

6. Unplug the AIR COOL line from the bottom of the furnace arm/base.

   NOTE: When you remove the AIR COOL line, do not let it slip back into the instrument cabinet.

7. Place a drip pan to the left of the instrument to catch the coolant that will leak from the hose connections when the EGA furnace is removed.

8. Lay the furnace assembly down on the left side of the instrument so that the hose connections are positioned over the drip pan. Then carefully snip the wire ties and disconnect the cooling water lines from the housing. (A small amount of cooling water will drain out into the pan when the hoses are disconnected.)

   The furnace is now completely free from the instrument.

EGA Furnace Installation

To replace or reinstall the EGA furnace. Refer to the figures on previous pages, if needed.

1. Plug the AIR COOL line into the bottom of the furnace arm/base.

2. Slip the water cooling hoses over the EGA furnace water connections and secure them with the wire ties.

3. Tighten the upper two mounting screws fully, then loosen each of them no more than one full turn, so that the flat sides of the cleats are aligned vertically.

   Now tighten the lower two mounting screws fully, then loosen each of them two full turns, plus a fraction of a turn, so that the flat sides of the cleats are aligned vertically.

CAUTION: Loosening the upper two mounting screws any more than one full turn may cause the screws to interfere with the inside of the instrument cabinet, causing damage to the instrument.

4. Press the **FURNACE** key to raise the furnace carriage until the lower mounting screws are just below the top edge of the enlarged cutout in the instrument faceplate. Then press the STOP key.

5. Plug the EGA furnace arm into the connector on the carriage and tighten the lower two mounting screws using the ball driver.

6. Press the **FURNACE** key to completely lower the furnace. Use the ball driver to tighten the upper furnace mounting screws. To reach the upper left mounting screw, insert the ball driver between the water connections on the left side of the furnace housing.

7. Connect the purge hose to the gas purge inlet on the right side of furnace.

CAUTION: Hold onto the glass purge tube with one hand while you install the purge hose to avoid breaking the glass.

8. Check the Heat Exchanger reservoir water level and add water if needed. See "Filling the Heat Exchanger" in Chapter 2 for instructions. If needed, realign the sample hang-down wire as directed in Chapter 1.

Connecting the Spectrometer

The TGA EGA furnace allows you to connect a spectrometer, such as a FTIR spectrometer, to the instrument. To connect any spectrometer, you will need to use a transfer line (supplied by the spectrometer manufacturer) to transport the gas evolved from the sample on the TGA to the spectrometer.

- The transfer line should be 1/8 inch in diameter to connect with a 1/8-inch Swagelok® fitting on the exhaust gas connection.

- The transfer line should be made of heat-resistant alloy capable of resisting corrosion by the evolved gas and oxidation at temperatures up to 1000°C.

- The transfer line must pass through the exhaust gas fitting and a glass branch tube in the sample tube. It should end at a point just short of the inside diameter of the sample tube to ensure that the evolved gases do not condense before entering the transfer line.

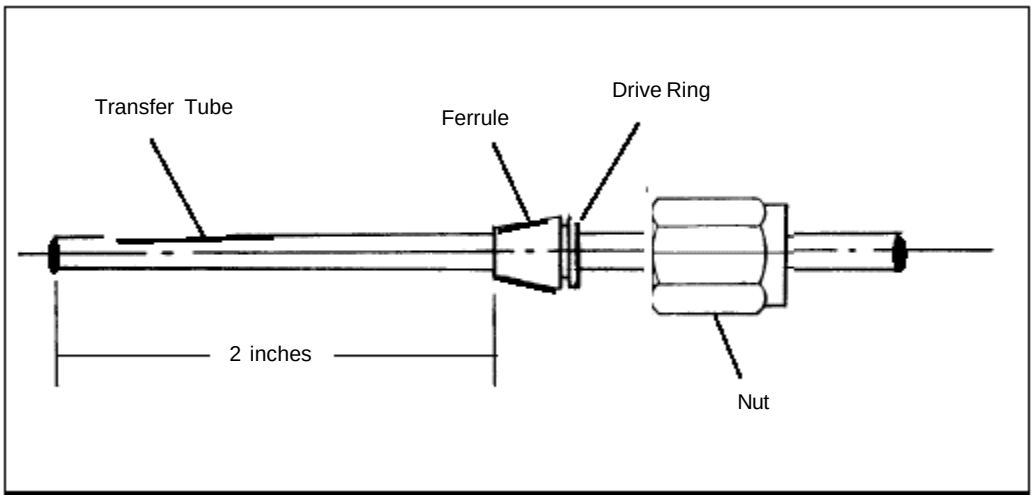
- The transfer line must be long enough to allow flexible movement. It must accommodate movement of the EGA furnace up and down 8.2 cm (3 and 5/8 inches) to open and close for sample loading and unloading. (If the transfer line is not long enough, it must be disconnected and reconnected each time the furnace is opened and closed.)

To connect your spectrometer to the EGA furnace follow these steps:

1. Install a Swagelok® nut, drive ring, and ferrule on the correct length of transfer line, leaving more than two inches of transfer line projecting beyond the ferrule.

2. Swage the ferrule, then cut the end of the transfer tube off so that two inches of the tube projects beyond the ferrule. See the figure on the next page.

NOTE: Extending the transfer line more than two inches beyond the Swagelok® fitting may cause the TGA to operate improperly.



3. Make sure that the end of the transfer line is straight and free of oxide deposits before you insert it into the exhaust gas connection.

4. Insert the transfer line and tighten the Swagelok® nut to seal the connector. When you tighten the Swagelok® nut, use a 3/8-inch wrench on the exhaust fitting flats to prevent them from turning.

WARNING: If the transfer line is not straight, or has heavy oxide deposits on it, the sample tube may be broken as the line is inserted.

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 bottle, refill it with distilled water, and add TA Instruments TGA Conditioner, as described in the next section.

Draining and Refilling the Water Reservoir

Drain and refill the heat exchanger water reservoir as follows:

1. Disconnect the heat exchanger control harness and water lines from the instrument cabinet.
2. Unscrew and remove the water reservoir cap.
3. Drain the coolant and flush out the system as follows:
   a. Lift the heat exchanger and dump out the contents of the water reservoir bottle.
   b. Fill the bottle to 2/3 full with distilled water only and replace the cap.
   c. Reconnect the heat exchanger control cable and water lines to the instrument cabinet.
   d. Turn on the pump by selecting Control/Prime Exchanger from the instrument control program and allow the water to circulate for several minutes.
   e. Turn off the pump by selecting Control/Stop, and check the clarity of the water in the reservoir bottle.
   f. If the water clarity is still unacceptable, disconnect the heat exchanger cable and water lines from the instrument cabinet, and repeat steps a through e.
   g. Continue repeating this procedure until you are satisfied with the clarity of the water in the bottle after it has circulated.
4. Dispose of the water and fill the bottle with TGA Conditioner (PN 952377.901) and fresh distilled water.
5. Turn on the pump again by selecting **Control/Prime Exchanger**, and circulate the water until the air bubbles disappear from the water lines, then stop the pump by selecting **Control/Stop**.
6. Replace and tighten the water reservoir cap.

Replacing the TGA Thermocouple

Weight changes in TGA are typically plotted versus sample temperature as measured by a thermocouple located close to the sample. This thermocouple is exposed to sample off-gases and to contamination if the sample sputters or foams during decomposition. The thermocouple will need to be replaced. Embrittlement due to cycling up to 1000°C will also require replacement.

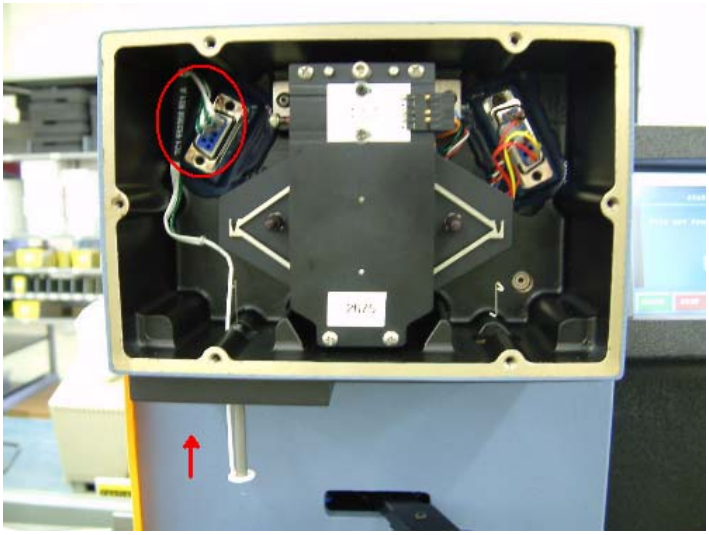
To replace the sample thermocouple:

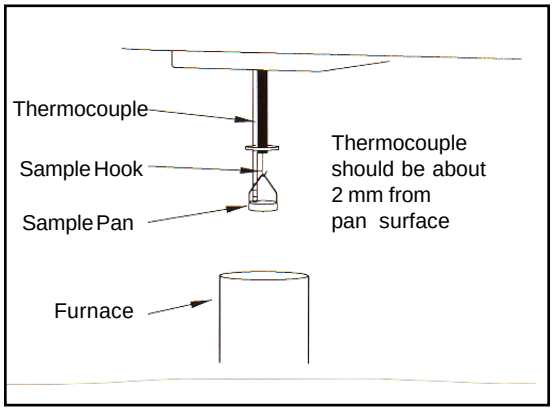
1. With the sample pan removed, the furnace open and the balance faceplate removed, push the thermocouple up from the bottom, to feed it back into the balance chamber.

2. Unplug the thermocouple from its connector and remove the thermocouple from the balance chamber.

3. Plug the new TGA thermocouple into the connector.

4. Thread the new thermocouple down through the hole next to the thermocouple tube.





5. Thread the end of the thermocouple just through the ceramic disk at the end of the thermocouple tube.

6. Position the thermocouple about 2 mm from the sample pan. Make sure that the end of the thermocouple does not touch the pan.

7. Make certain that the hang-down wire does not touch the top of the thermocouple inside the balance chamber.

8. Replace the balance chamber faceplate and secure the screws.

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

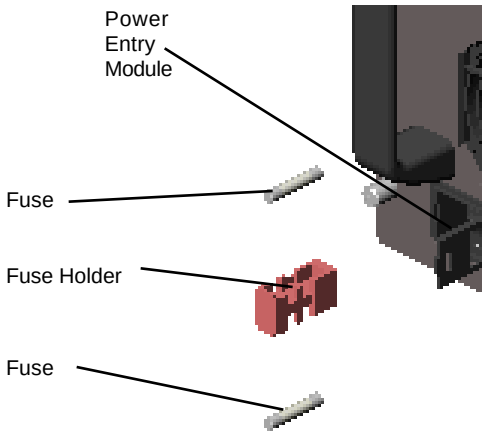
Replacing Fuses

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 TGA that are available from TA Instruments. Some parts must be replaced by a service representative. See the tables below and the list of offices on page 88 to order parts.

Fuses, Cords, and Cables

Part Number	Description
205221.001	Fuse (6.3 amp, 250 V)
205221.002	Fuse (10 amp, 250 V)
251470.025	Ethernet cable (25 foot, shielded)
253827.000	Power cord
920223.901	Event cable

TGA Accessories

Part Number	Description
920063.901	Power Control Unit
200063.029	O-ring, bottom cap plate of furnace
259508.000	Brass tweezers
259509.000	Spatula, curved, 165 mm long
265749.001	O-ring, bottom of furnace housing
269845.001	O-ring, furnace housing to balance chamber
269920.002	Balldriver, 0.050-inch
269920.026	Balldriver, 7/64-inch
280255.001	Balldriver, 1/16-inch
952014.901	Balance assembly
952040.901	Sample hang-down wire
952040.903	Tare hang-down wire (without tare tube)
952162.901	Heat exchanger tubing
953110.901	Motor drive PCB
953160.901	TGA Heat Exchanger Assembly
953208.901	Sample thermocouple assembly
953550.901	Mass Flow Controller Upgrade Kit - Includes Field Service installation
952121.001	Work surface tray
952256.901	Kapton hangdown loop

TGA Sample Pans and Accessories

Part Number	Description
952018.906	100 µL platinum sample pan kit
952018.907	100 µL ceramic sample pan kit
952018.908	50 µL platinum sample pan kit
952018.909	250 µL ceramic sample pan kit
952323.902	100 µL aluminum sample pan kit
952377.901	Conditioner Kit
952018.910	500 µL ceramic sample pan kit

TGA Calibration/Reference Materials

Part Number	Description
269930.001	Class C calibration weight kit (1 mg to 500 mg)
269931.001	Cal. wt. 100 mg
269931.002	Cal wt. 1 g
900905.901	Calcium oxalate sample
952011.906	Calibration weight kit (100 mg and 1 g)
952384.901	TGA Temperature Calibration kit
952385.901	TGA nickel reference material
952398.901	TGA alumel reference material
953032.901	Furnace assembly

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