

Discovery TGATM

Thermogravimetric Analyzer



Getting Started Guide



Notice

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

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Introduction

Important: TA Instruments Manual Supplement

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

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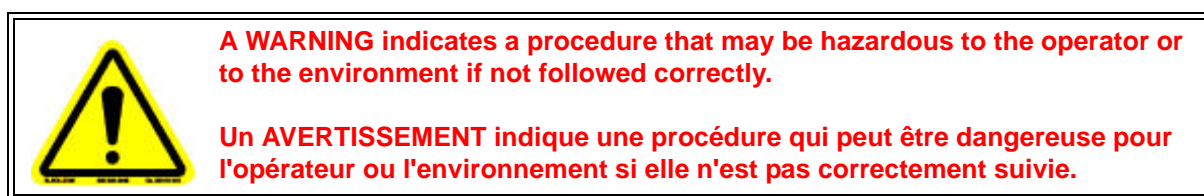
Notes, Cautions, and Warnings

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

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

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

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



Regulatory Compliance

Safety Standards

For Canada

CAN/CSA-22.2 No. 61010.1-04 Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1: General Requirements.

CAN/CSA-22.2 No.61010.2.010-04 Particular requirements for laboratory equipment for the heating of materials.

CAN/CSA-22.2 No.61010.2.081-04 Particular requirements for automatic and semi-automatic laboratory equipment for analysis and other purposes.

For European Economic Area

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

EN61010-2-010: 2003 Particular requirements for laboratory equipment for the heating of materials.

EN 61010-2-081: 2002/+A1: 2003 Particular requirements for automatic and semi-automatic laboratory equipment for analysis and other purposes.

For United States

UL61010-1 2004 Electrical Equipment for Laboratory Use; Part 1: General Requirements.

Electromagnetic Compatibility Standards

For Australia and New Zealand

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

For Canada

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

For the European Economic Area

EN61326-1: 2006 Electrical equipment for measurement, control, and laboratory use - EMC requirements - Part 1: General requirements, Table 3 - Immunity test requirements for equipment used in controlled EM environments, Emission requirements for Group 1, Class A equipment.

For the United States

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

Safety



WARNING: The operator of this instrument is advised that if the equipment is used in a manner not specified in this manual, the protection provided by the equipment may be impaired.

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

Instrument Symbols

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

Symbol	Explanation
	<p>This symbol indicates that you should read this Getting Started Guide for important safety information. This guide contains important warnings and cautions related to the installation, operation, and safety of the Discovery TGA system.</p> <p>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.</p> <p>Ce symbole indique que vous devez lire entièrement ce guide de démarrage pour obtenir d'importantes informations relatives à sécurité. Ce guide contient d'importants avertissements et mises en garde relatifs à l'installation, à l'utilisation et à la sécurité du système Discovery TGA.</p> <p>Si vous n'êtes pas formé aux procédures électriques, ne déposez pas les couvercles de l'armoire sauf indications spécifiques contenues dans le manuel. La maintenance et la réparation des pièces internes doivent être effectuées uniquement par TA Instruments ou tout autre personnel d'entretien qualifié.</p>
	<p>This symbol indicates that a hot surface may be present. Take care not to touch this area or allow any material that may melt or burn come in contact with this hot surface.</p> <p>Ce symbole indique la présence possible d'une surface chaude. Prenez soin de ne pas toucher cette zone ou de laisser un matériau susceptible de fondre ou de brûler entrer en contact avec cette surface chaude.</p>

Please heed the warning labels and take the necessary precautions when dealing with those parts of the instrument. The *Discovery 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 as high as 120/240 VAC are present in the Common Cabinet.



WARNING: High voltages are present in the Common Cabinet. 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.

AVERTISSEMENT: Présence de tensions élevées dans l'armoire commune. Si vous n'êtes pas formé aux procédures électriques, ne déposez pas les couvercles de l'armoire sauf indications spécifiques contenues dans le manuel. La maintenance et la réparation des pièces internes doivent être effectuées uniquement par TA Instruments ou tout autre personnel d'entretien qualifié.

Chemical Safety



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

AVERTISSEMENT: N'utilisez pas d'hydrogène ou tout autre gaz explosif dans le four TGA.



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

AVERTISSEMENT: L'oxygène peut être utilisé comme gaz de drainage dans le TGA. Toutefois le four doit rester propre pour que les hydrocarbures volatils, qui peuvent brûler, soient éliminés.



WARNING: If you are using samples that may emit harmful gases, attach a compatible tube to the purge gas exit to transfer the gas to an exhaust or other suitable protective device.

AVERTISSEMENT: Si vous utilisez des échantillons qui émettent des gaz nocifs, fixez un tuyau compatible à la sortie du gaz de drainage pour transférer le gaz vers un échappement ou vers tout autre dispositif de protection approprié.

Thermal Safety



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

AVERTISSEMENT: Après une expérience, laissez le four ouvert et le thermocouple refroidir avant de les toucher. Laissez le four refroidir avant de déposer l'ensemble du four inférieur (thermocouple).

Mechanical Safety



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

AVERTISSEMENT: Écartez vos doigts et tous les autres objets du chemin du four lorsqu'il est en mouvement. L'étanchéité est très hermétique.

Lifting the Instrument

The Discovery TGA is a 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.

AVERTISSEMENT: Demandez à deux personnes de soulever et/ou de porter l'instrument. L'instrument est trop lourd pour qu'une seule personne le manipule en toute sécurité.

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Chapter 1:

Introducing the Discovery TGA

Overview

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

The Discovery TGA 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. The TGA can be used to characterize any material that exhibits a weight change and to detect phase changes due to decomposition, oxidation, or dehydration. This information helps the scientist or engineer identify the percent weight change and correlate chemical structure, processing, and end-use performance.

Your controller is a computer that performs the following functions:

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

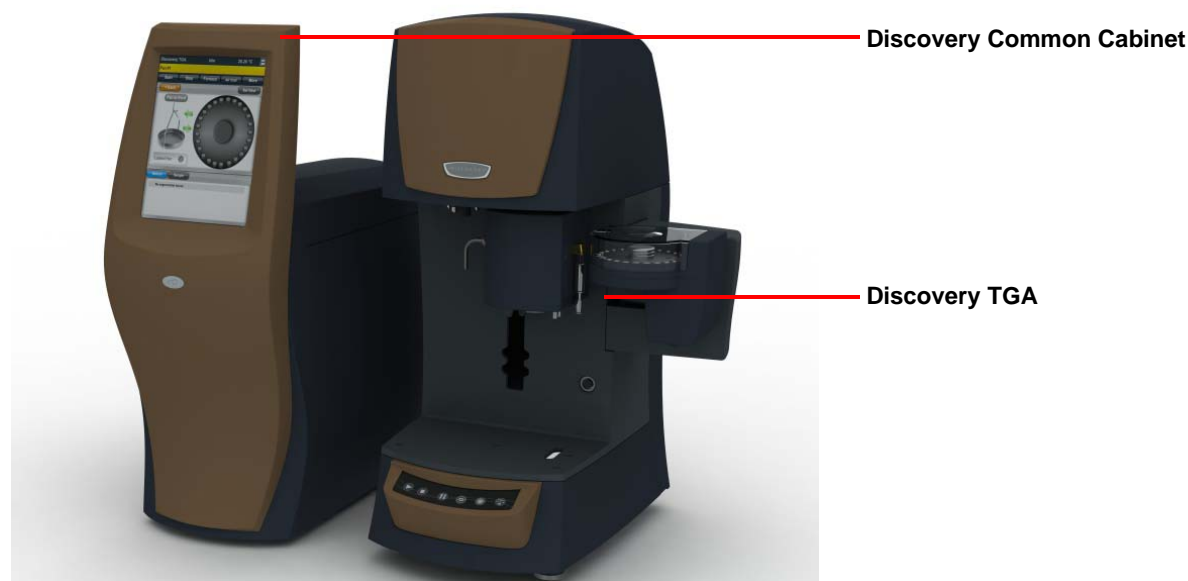


Figure 1 Discovery TGA system.

NOTE: For technical reference information, theory of operation, and other information associated with the TGA not found in this manual, see TRIOS software Online Help.

TGA System Components

A functional Discovery TGA system has two major components: the Discovery Common Cabinet, which contains the system electronics, and the Discovery TGA instrument, which includes a furnace and balance.

Discovery Common Cabinet

The Discovery Common Cabinet is the main interface to the Discovery TGA. It contains the user interface, universal power supplies, computer, and other associated electronics required to operate the Discovery TGA.



Figure 2 The Discovery Common Cabinet.

Discovery TGA

The Discovery TGA is comprised of the following major hardware components:

- The balance, which provides precise measurement of sample weight. The balance is the key to the TGA system.
- The heating system, or infrared (IR) furnace, which controls the sample temperature.
- The Autosampler, which loads and unloads the sample to and from the balance. The Autosampler platform has a built-in pan punching mechanism that is used in conjunction with the optional sealed aluminum pans.
- The heat exchanger, which dissipates heat from the furnace.
- The gas delivery module (GDM), which controls the purge gas to the balance and furnace.

The next few pages briefly describe the components of the TGA.

Balance Assembly

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

- The balance meter movement is a taut-band meter movement to which the balance arm is attached.
- The balance arm is an assembly constructed of beryllium copper alloy attached to the meter movement.
- The balance position sensor is comprised of an LED source and a pair of photodiodes on printed circuit boards that detect the null position of the meter movement.

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

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

Infrared (IR) Furnace

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

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

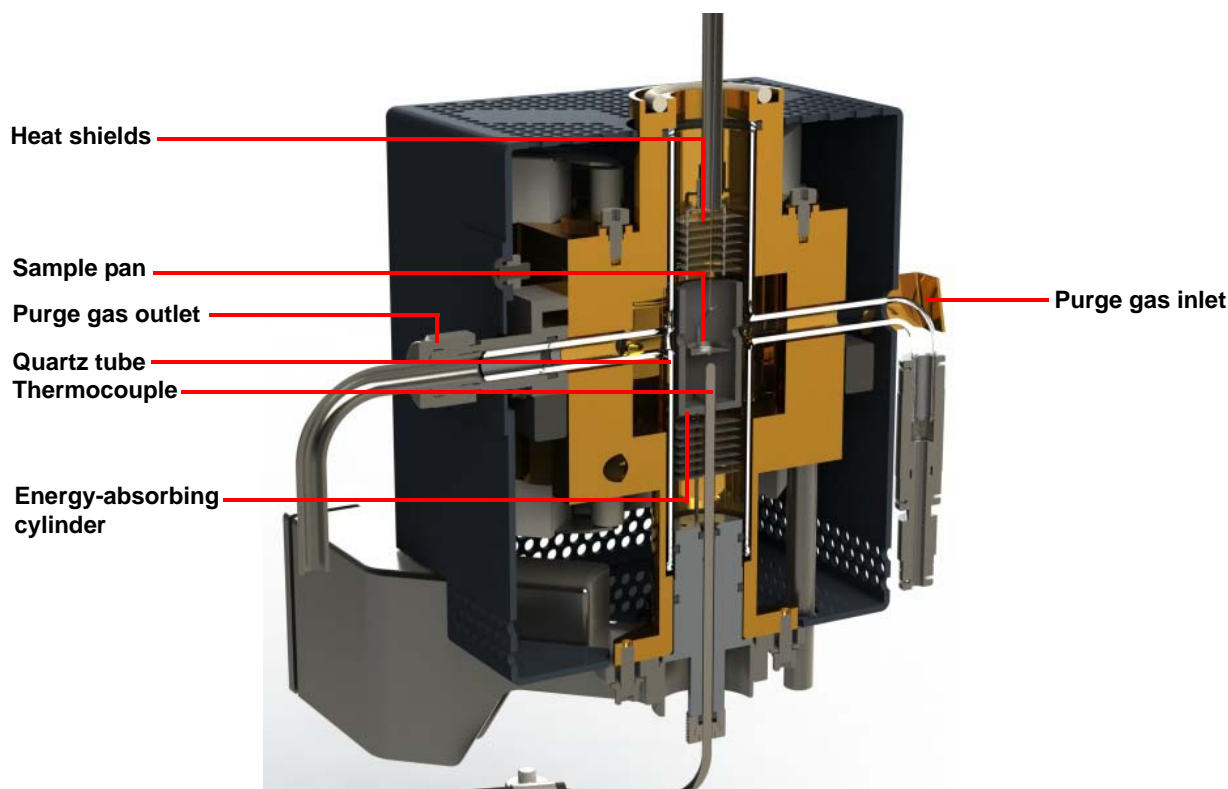


Figure 3 Discovery TGA furnace cut-away diagram.

Temperature is measured and controlled by a thermocouple assembly under the sample pan. The thermocouple assembly includes a second independent thermocouple to protect the furnace from excessive temperature.

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

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

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

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

Discovery TGA Autosampler

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

See [“Discovery TGA Sampling System” on page 22](#) for the pans that can be used with the Discovery TGA Autosampler:



Figure 4 Discovery TGA Autosampler.

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

To calibrate the sample tray and punching mechanism, refer to [“Calibrating the Discovery TGA” on page 58](#) of this manual and TRIOS Online Help.

Hi-Res™ TGA

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

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

- Improved transition resolution
- Faster scans

- Enhanced signature analysis capability
- Transition temperatures closer to isothermal values
- Increased method programming versatility

Other Discovery TGA Accessories

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

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

Consult the appropriate local instrument manufacturer for further information.

The Discovery TGA User Interface

The Discovery TGA includes a keypad and an integrated user interface display for local operator control. The functions of the user interface change depending upon the view displayed. This section briefly describes the basic layout of these functions.



Figure 5 Discovery TGA Common Cabinet user interface display.

The instrument user interface has four basic sections:

- The status line along the top of the display indicates the current instrument status, run selection, and sample temperature.
- The primary function keys allow for easy access of common functions.
- Two customizable view panels allow for real-time instrument status and associated actions.

Primary Function Keys

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

Table 1: Primary Function Keys on the User Interface

Key Name	Description
Start	Initiates the currently-programmed experiment. This is the same function as Start in the instrument control software. Start automatically loads the selected 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 in 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.
Furnace Open/Close	Toggles between opening and closing the TGA furnace.
Air Cool	Toggles between enabling and disabling air cool.
More...	Displays a menu of other instrument control options such as user interface calibration, shut down, restart instrument, and the About panel.

View Panels

The user interface allows for the display of two simultaneous view panels, each providing real-time instrument status. These panels are selected through the **Set View** button. These panels also include additional functionality pertinent to the selected view. In cases where user input is required, the view will switch to full-screen mode until the input is satisfied.

A list of available views is described below.

Table 2: View Panel Functions on the User Interface

Key Name	Description
Run Details	Provides a summary of the sample and method information for the current run. When the instrument is idle, access to the Quick Run setup is available through this panel.
Signals	Displays the real-time signal data generated directly from the instrument. Up to six signals can be displayed. These are specified by selecting the desired signal from a drop-down list.
Autosampler	Displays a graphical representation of the Autosampler tray, indicating the status of the active sequence (e.g., which pan positions have been configured in the active sequence and which runs are active or pending). In addition, this panel provides access to other Autosampler operations such as pan load/unload, reset Autosampler, and calibration functions.
Notifications	Displays a log of the instrument messages.
Information	Displays instrument information such as the software version, options, and network configuration.
Auto Weight Calibration	Provides easy access to the autoweight calibration procedure, which uses two calibration fixtures.

Discovery TGA Keypad

The Discovery TGA includes a keypad designed for local control of common instrument functions.

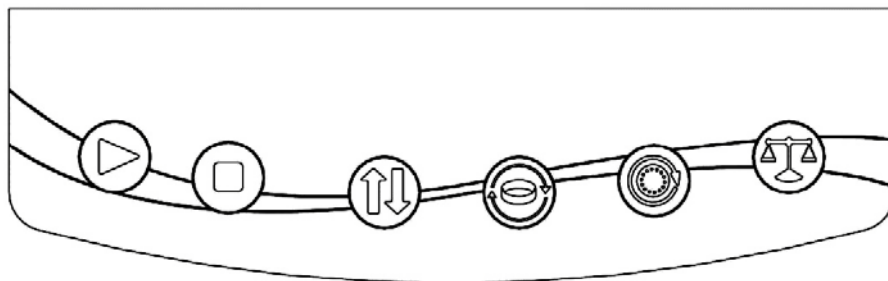








Figure 6 Discovery TGA keypad.

Experiment information and instrument parameters are entered using TRIOS software or the user interface, as described in the previous section.

Table 3: Discovery TGA Keypad Functions

Key Name	Description
Start 	This key begins the experiment. This is the same function as Start on the instrument control software. This button is <i>white</i> when the system is in standby mode, <i>yellow</i> when a method is loaded (at least one run in the TRIOS Running Queue), and <i>green</i> when the system is running.
Stop 	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. Press this key twice to stop temperature control. This button is always <i>red</i> .
Furnace Up/Down 	Toggles between the raising and lowering of the Discovery TGA furnace. This button is always <i>white</i> .
Load/Unload 	Depending on the state of the instrument, either removes the loaded pan from the balance and returns it to its original tray location or loads the pan from tray position #1 to the balance position. This button turns <i>red</i> when the pan is being loaded.
Autosampler Reset 	Resets the tray platform to its home position.
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.

Instrument Specifications

The tables found below contain the technical specifications for the Discovery TGA, Common Cabinet, and sampling system.

Discovery TGA Instrument Characteristics

Table 4: Discovery TGA Technical Specifications

Item/Area	Specifications
Dimensions	Depth: 45 cm (17.8 in) Width: 42.5 cm (16.74) Height: 67 cm (26.4 in)
Weight of instrument	26 kg (57 lbs)
Power	Furnace: ± 54 V (from Common Cabinet) System: 24 VDC
Operating environmental conditions	Temperature: 15 to 35°C Relative humidity: 5 to 80% (non-condensing) Installation Category II Pollution Degree 2 Maximum altitude: 2000 m The degree of protection for this instrument according to IEC 529 is IP20.
Temperature range	Ambient +5°C to 1200°C
Purge gases	Helium, nitrogen, oxygen, air, argon
Purge flow rate	Up to 200 mL/min (recommended rate is 25 mL/min for sample, 10 mL/min for balance.)
Thermocouple	Platinel II*
Heating rate	Linear heating rates from 0.1 to 500°C/min (Ballistic heating > 1000°C/min)

**Platinel II is a registered trademark of Engelhard Industries.



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

AVERTISSEMENT: N'utilisez pas de gaz corrosifs, d'hydrogène ou tout autre gaz explosif dans le four TGA.



WARNING: Oxygen can be used as a purge gas in the TGA. However, if you use oxygen as a purge gas, you must make sure the furnace is cleaned of hydrocarbons that could combust.

AVERTISSEMENT: L'oxygène peut être utilisé comme gaz de drainage dans le TGA. Toutefois le four doit rester propre pour que les hydrocarbures volatils, qui peuvent brûler, soient éliminés.

Table 5: Common Cabinet Technical Specifications

Item/Area	Specifications
Dimensions	Depth 46 cm (18 in) Width 28 cm (11 in) Height 69 cm (27 in)
Weight	With one universal power supply: 18 kg (40 lbs)
Power	90 to 264 VAC, 47 to 63 Hz, 12 amps maximum
Power outlet	One or two 24 VDC, 6 amps maximum (transducer power) One or two ± 54 V (transducer heater power)
Operating environmental conditions	Temperature: 15 to 35°C Relative humidity: 5 to 80% (non-condensing) Maximum altitude: 2000 m

Discovery TGA Sampling System

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

Table 6: Sample Pan Options for 25-Pan Tray

Item/Area	Specifications
Types of pans available	Platinum, ceramic (Al_2O_3), aluminum
Volume capacity and temperature range	20 μL Sealed aluminum (to 600°C) 50 μL Platinum (to 700°C) 50 μL Platinum-HT (to 1000°C) 80 μL Aluminum (bottom of sealed pan, to 600°C) 100 μL Platinum (to 700°C) 100 μL Platinum-HT (to 1000°C) 100 μL Ceramic (to 1200°C) 250 μL Ceramic (to 1200°C)
Number of pans per tray	25 Pans

Table 7: Balance Mechanism

Item/Area	Specifications
Weighing capacity (sample) ¹	Maximum sample mass 900 mg with an 800 mg tare mass
Dynamic weighing range	100 mg
Resolution	0.01 µg
Accuracy	≤ ± 0.1% of value or 10 µg, whichever is greater

¹ **CAUTION:** If the autosampler is used, the maximum sample and pan mass will be 600 mg with a 500 mg tare pan and tare mass. If manual loading is performed, the maximum sample and pan mass is 930 mg with 830 mg on the tare side.

¹ **MISE EN GARDE:** Si vous utilisez l'échantillonneur automatique, le poids maximum de l'échantillon et du bac est de 600 mg dont 500 mg pour la tare du bac et le poids à vide. Si vous effectuez la mise en place manuelle, le poids maximum de l'échantillon et du bac est de 930 mg dont 830 mg pour la tare.

Chapter 2:

Installing the Discovery TGA System

Unpacking/Repacking the TGA

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.

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

Installing the Discovery TGA System

Before shipment, the TGA is inspected both electrically and mechanically so that it is ready for operation upon proper installation. Installation involves the following procedures:

- 1 Inspecting the system for shipping damage and missing parts
- 2 Choosing a location for instrument installation
- 3 Preparing the Discovery TGA for installation, which includes removing the shipping bracket and unpacking the balance
- 4 Connecting the Discovery TGA transducer module to the Discovery Common Cabinet
- 5 Setting up system communication between the Discovery Common Cabinet and computer (controller)
- 6 Connecting purge gas lines to the GDM
- 7 Connecting the heat exchanger cable and water lines
- 8 Connecting the TGA power cable
- 9 Installing the Autosampler tray
- 10 Installing the hang-down wires
- 11 Leveling the instrument and aligning the hang-down wires
- 12 Installing the lower furnace assembly
- 13 Closing up the balance and conditioning the balance
- 14 Filling the heat exchanger reservoir and purging the heat exchanger system of air

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.

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

Inspecting the System

When you receive your Discovery TGA system, 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 ultra-high sensitivity of the Discovery TGA microbalance, it is important to choose a suitable location for the instrument using the following guidelines. The Discovery TGA system should be:

In

- A temperature-controlled area. Temperatures should be in range 20 to 35°C.
- A clean, vibration-free environment, preferably on the ground floor in the building. It should be located away from pumps, motors, or other devices which produce vibrations.
- An area with ample working and ventilation space.

On

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

Near

- A power outlet (120 Vac, 50 or 60 Hz, 15 amps; or 230 Vac, 50 or 60 Hz, 10 amps).
- Your TA Instruments controller.
- Compressed lab air and purge gas supplies with suitable regulators and filters, if required.

Away from

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

NOTE: Allow free air to circulate around both enclosures. Do not place equipment against walls or cabinets that might impede air flow. Leave at least 7.5 cm (3 in) clearance around the Common Cabinet and the Discovery TGA.



WARNING: For safety, position the equipment in a manner that allows access to the power cord for emergency disconnection.

AVERTISSEMENT: Par mesure de sécurité, placez l'équipement de sorte qu'il permette d'accéder facilement au cordon d'alimentation en cas de débranchement d'urgence.

Preparing the Discovery TGA for Installation

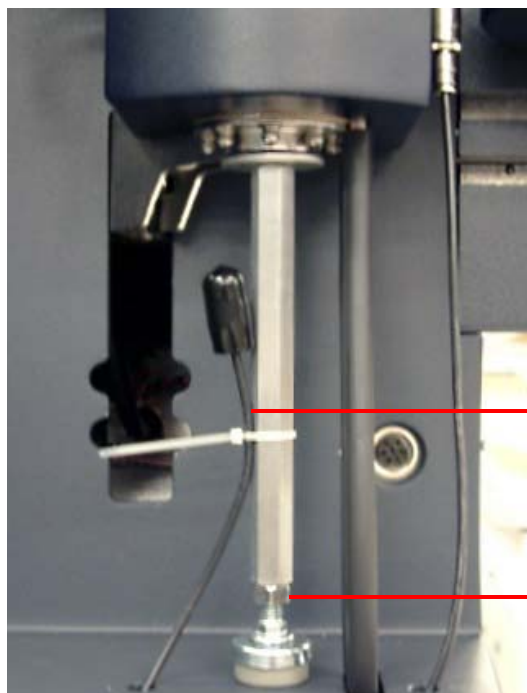
After the TGA instrument has been removed from the box and placed on the bench following the instruction sheet found in the packing box, use these steps to prepare your instrument for installation:

Removing the Shipping Bracket

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

To remove the shipping bracket:

- 1 Cut the wire-tie securing the air cool line to the shipping bracket, then loosen the foot of the furnace shipping bracket. See the figure below.



Air cool line secured to shipping bracket

Loosen shipping bracket here

Figure 7 Shipping bracket on Discovery TGA.

- 2 Raise the foot of the bracket and remove the entire bracket.
- 3 Retain this bracket in case the instrument needs to be shipped in the future.

Unpacking the Balance

After removing the bracket, you can proceed to unpack the balance. **This very important procedure must be completed before you can use the Discovery TGA.**

- 1 Remove the balance housing cover by removing the two recessed screws in the back with a T-handle hex key and lifting the cover off. Be sure to retain the screws.

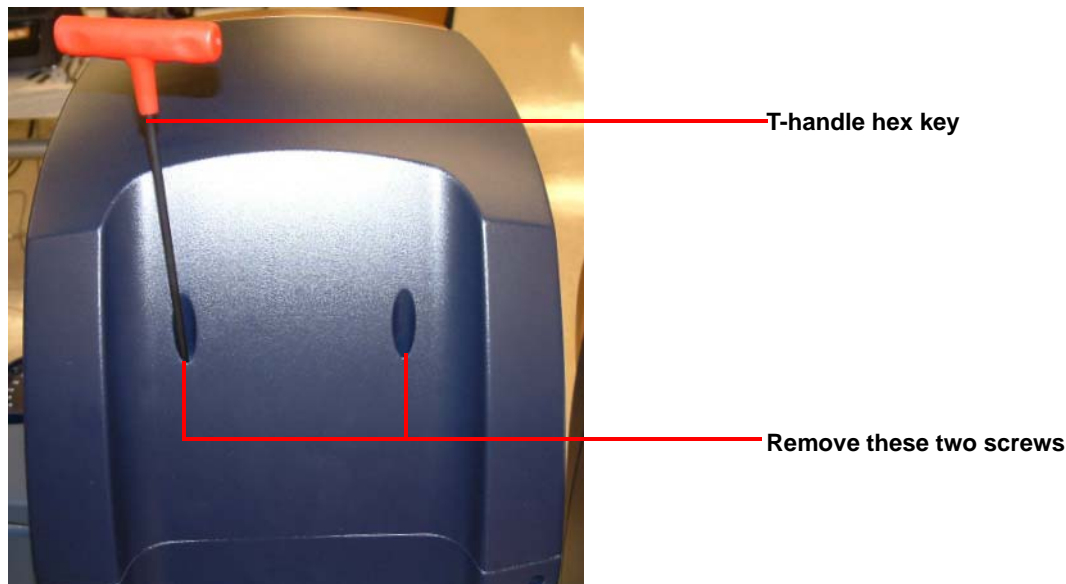


Figure 8 Removing the balance housing cover.

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

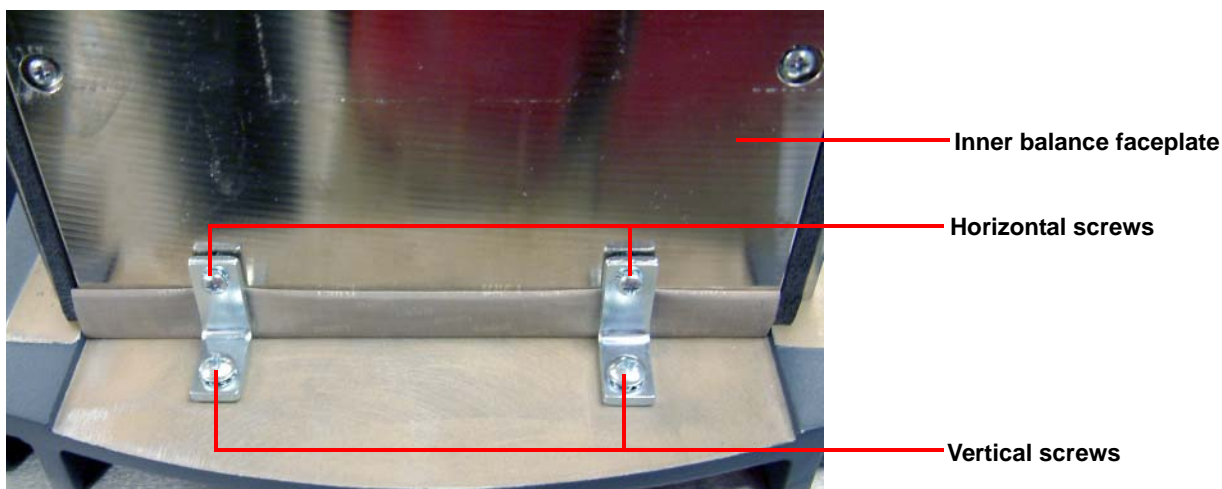


Figure 9 L-brackets on inner balance faceplate (other two brackets on reverse side not shown).

- 3 Remove the remaining four screws on the inner balance faceplate (shown below) and remove the plate. Make sure the small o-rings inside the faceplate are not lost; they must be in place when the faceplate is reinstalled.

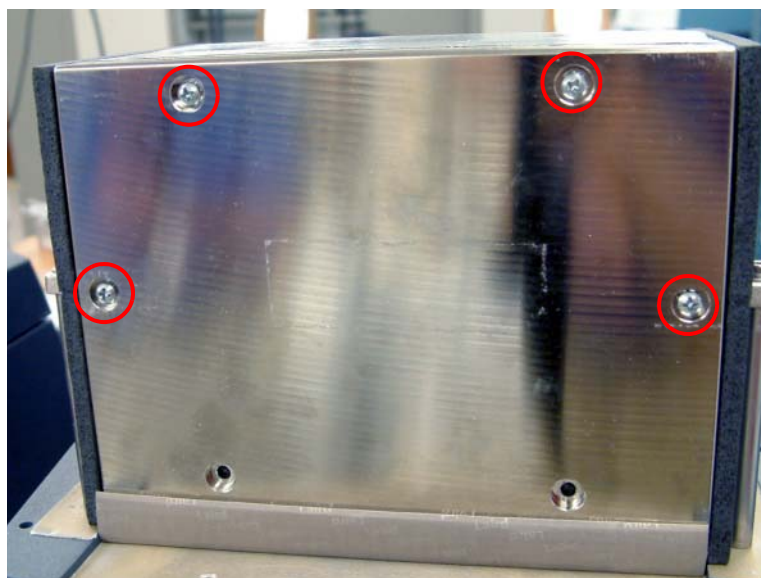


Figure 10

- 4 Loosen the thumbscrews and remove the left (tare) and right (sample) balance covers shown in the figure below.

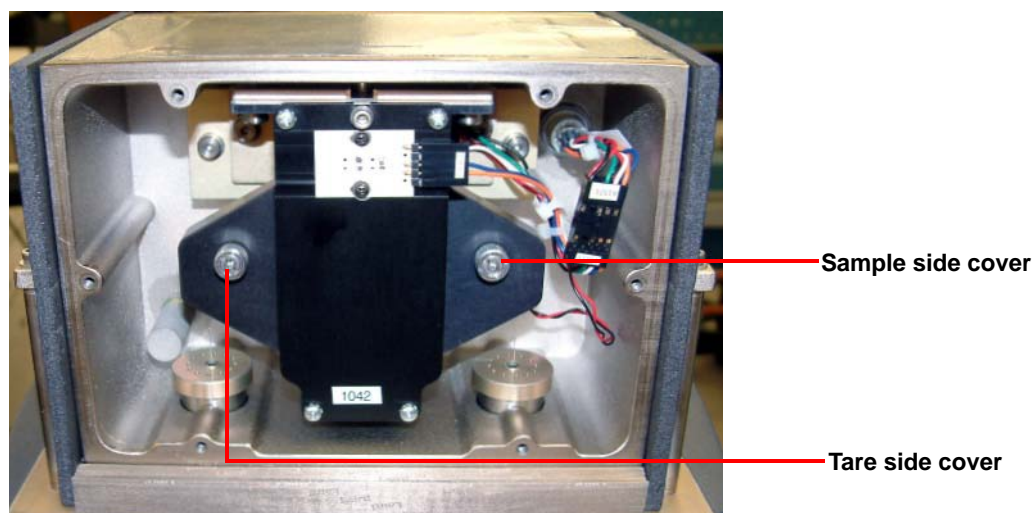


Figure 11 Thumbscrews on left and right balance covers.

- 5 Using tweezers, compress the foam and rotate it 90 degrees to eliminate contact with the beam. Gently remove the foam inserts from the sample and tare sides, being careful not to touch the balance. Refer to the figure below.

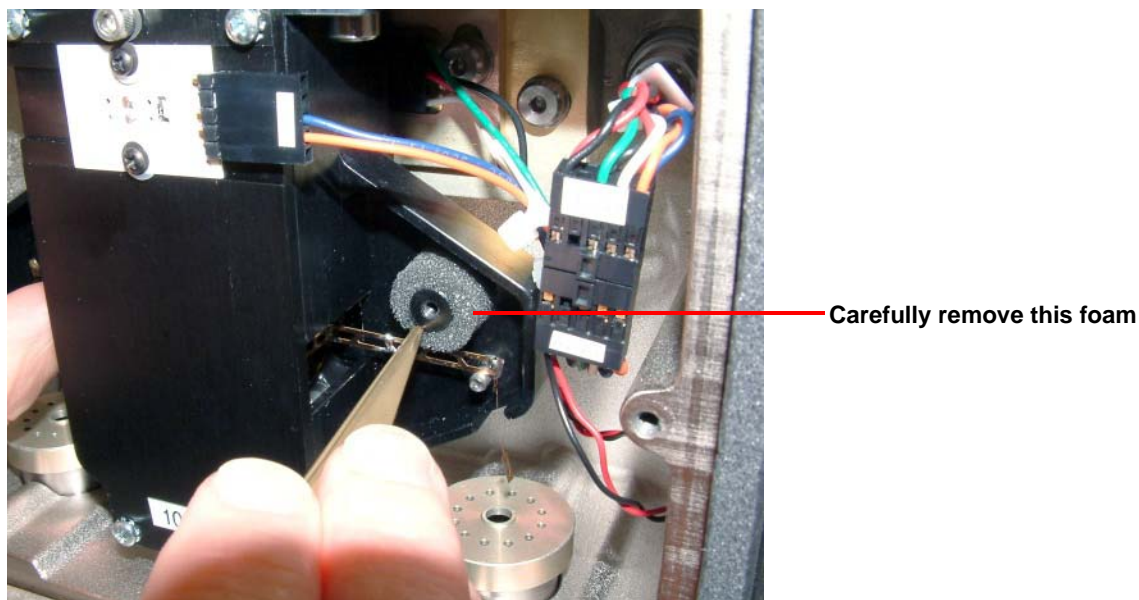


Figure 12 Removing the foam inserts.

- 6 Replace the tare and sample side covers on the left and right side of the balance. Tighten the thumbscrews until they are finger tight.
- 7 Locate the four screws that are taped on the outside of the faceplate, which was removed in [step 1](#). Two of these screws will be used for the faceplate and two for installing the balance housing.

Set these screws aside for later use; the inner balance faceplate and balance housing cover will need to remain off for the installation of the hang-down wires. The faceplate and balance housing cover are re-installed at the end of this installation.

Connecting the Discovery TGA to the Common Cabinet

To connect the TGA system, you will need access to the Discovery TGA instrument's back panel and the Common Cabinet's back panel.

NOTE: Connect all cables before connecting the power cord to an outlet. Tighten the screws on the 24 V/CAN/interlock cable.

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

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



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

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


The Discovery TGA back panel has nine ports; the table below provides a description of the function of each port.

Table 8: Discovery TGA Back Panel

Port	Function
AIR COOL	Provides the furnace with air for post-run cooling. Maximum pressure is 172 kPa gauge (25 psig).
GAS 1 BALANCE PURGE	Gas inlet port controlled by the gas delivery module. Used for the sample and balance purge gas. Maximum pressure is 140 kPa gauge (20 psig).
GAS 2	Gas inlet port controlled by the gas delivery module. Used for the secondary sample purge gas. Maximum pressure is 140 kPa gauge (20 psig).
GAS 2 Vent O ₂	Pressure relief valve for Gas 2 line
FURNACE POWER IN	Provides power (± 54 V) to the instrument heating element.
USB "B" Port	Provides communication between Common Cabinet and TGA instrument.
24 VDC OUT	Enables control of heat exchanger.
EVENT	Capable of providing a general purpose relay contact closure.
USB "A" Port	Auxiliary port.

Table 8: Discovery TGA Back Panel

Port	Function
CONTROL IN	CAN BUS communication, 24 V power, and heater power control interlock connection.



WARNING: If connecting oxygen, it should ONLY be connected to the Gas 2 port.

AVERTISSEMENT: Tout raccordement de l'oxygène doit s'effectuer UNIQUEMENT sur l'orifice à gaz 2.

The Discovery Common Cabinet back panel is explained in [Table 9](#).

Table 9: Discovery Common Cabinet Back Panel

Port	Function
Ethernet	Provides communication between the Common Cabinet and the controller.
USB ports (four)	Communication to Discovery Series instrument and connection to accessories.
USB 1 USB 2 USB 3 USB 4 DC Power	A green LED above the USB labels indicates that a USB-compatible device is connected. A green LED above the DC Power label indicates that the system is receiving power.
Reset button	Resets instrument.
FURNACE POWER OUT	Provides programmable power (± 54 V range) to the instrument heating element.
CONTROL OUT	CAN BUS communication, 24 V power, and heater power control interlock connection.
Power switch	Powers the Common Cabinet off (O)/on (I).

To connect the Discovery TGA to the Common Cabinet, follow the instructions below:

- 1 Connect the low voltage cable from the **CONTROL OUT 1** port on the back panel of the Common Cabinet to the **CONTROL IN** port on the back panel of the Discovery TGA. Refer to [Figure 13](#) and [Figure 14](#) for connection ports.
- 2 Connect the furnace power cable from the **FURNACE POWER OUT 1** port on the back panel of the Common Cabinet to the **FURNACE POWER IN** port on the back panel of the Discovery TGA. Refer to [Figure 13](#) and [Figure 14](#) for connection ports.
- 3 Connect the USB cable from the USB “A” port on the back panel of the Common Cabinet to the USB “B” port on the back panel of the Discovery TGA. Refer to [Figure 13](#) and [Figure 14](#) for connection ports.

NOTE: The low voltage port and the furnace power cable port are arranged in pairs on the back panel of the Common Cabinet. These two cables **must** be connected to the same Discovery instrument in order for the system to function properly.

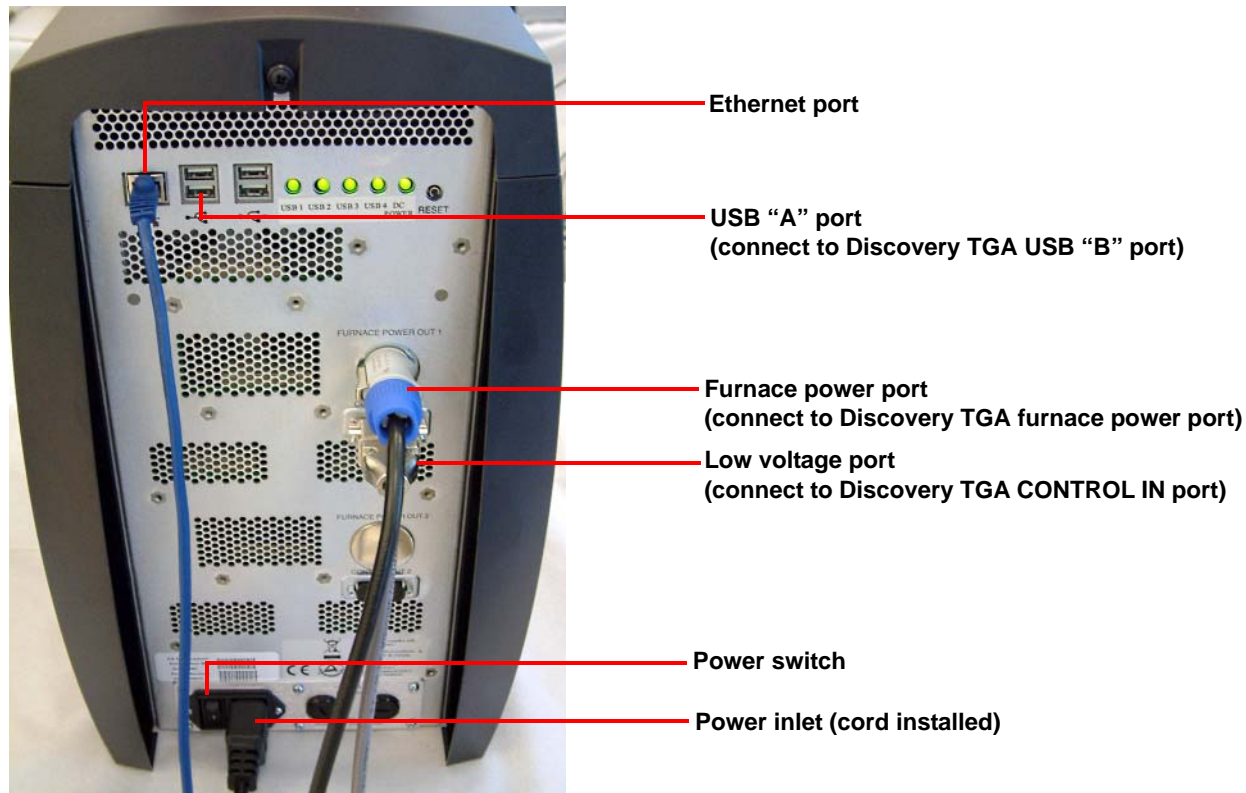


Figure 13 Common Cabinet rear panel connections.

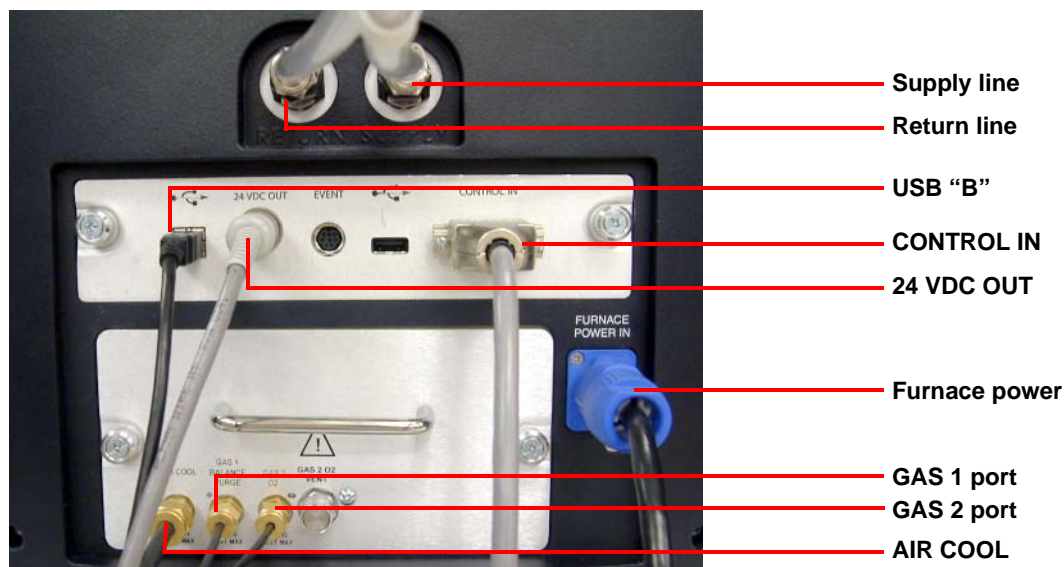


Figure 14 Discovery TGA rear panel connections.

Setting Up System Communication

In order to connect the instrument to a network, you will need to connect the Common Cabinet and controller computer to a router, then connect the computer to a LAN.

Refer to [TRIOS Software Installation Instructions](#) for more details.

Connecting Lines to the Gas Delivery Module



DANGER: The gas delivery module (GDM) o-rings (on the interior of the GDM) are sealed using Krytox[®] vacuum grease. This grease may be harmful or fatal if ingested. Avoid contact with eyes and skin. For additional important safety information, refer to the Krytox MSDS.

DANGER: Les joints toriques (à l'intérieur du GDM) du module d'alimentation en gaz (GDM) sont scellés à l'aide de la graisse à vide Krytox[®]. En cas d'ingestion, cette graisse peut être nocive ou fatale. Évitez tout contact avec la peau et les yeux. Pour obtenir des renseignements supplémentaires sur la sécurité, reportez-vous à la fiche technique santé-sécurité du Krytox.

It is important to accurately control the sample atmosphere during Discovery TGA experiments. This is achieved 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 Discovery TGA is equipped with mass flow controllers (MFC) to control the flow rates of the gases. Up to four different gases may be connected to the instrument to facilitate gas switching. Nitrogen is typically used for **Gas 1**. Follow these instructions to connect the purge lines. Refer to [Figure 14](#) for gas port locations.

CAUTION: Corrosive gases cannot be used with this instrument.

MISE EN GARDE: Des gaz corrosifs peuvent être utilisés avec cet instrument.

Connecting Purge Gas Lines

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

MISE EN GARDE: N'utilisez aucun liquide dans les conduites de gaz de drainage.



WARNING: Use of flammable or explosive gas as a purge gas is dangerous and is not recommended for this instrument.


AVERTISSEMENT: L'utilisation d'un gaz inflammable ou explosif comme gaz de drainage est dangereuse et n'est pas recommandée pour cet instrument.

NOTE: If you are using a “house” laboratory supply rather than bottled gas, it is highly recommended that you install an external drier and a 5- μ m filter.

- 1 Locate the **Gas 1** port on the back of the Discovery TGA. The **Gas 1** port is used to purge both the sample and balance areas. As such, an inert gas such as nitrogen should be used in this port.
- 2 Locate the **Gas 2** port. The **Gas 2** port is also used to purge the sample area and is used when a purge gas other than **Gas 1** is desired or when gas switching during an experiment is needed.

Krytox[®] is a registered trademark of E.I. du Pont de Nemours and Company

- 3 Connect the primary gas line to the **Gas 1** port. If desired, connect a secondary gas to the **Gas 2** port. Refer to [Figure 15](#) for reference.



WARNING: If connecting oxygen, it should **ONLY** be connected to the **Gas 2** port.

AVERTISSEMENT: Tout raccordement de l'oxygène doit s'effectuer **UNIQUEMENT** sur l'orifice à gaz 2.

NOTE: The flow rate is controlled through settings chosen using the instrument control software.

- 4 Connect the 1/8-inch Teflon TFE tubing from the instrument to the purge gas inlet, as shown below.



Figure 15 Gas connections on rear of Discovery TGA.

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

CAUTION: The Gas 1 and Gas 2 lines feeds into a pressure relief valves that are set to 170 kPa gauge (25 psig). The source pressure setting should not go above this value.

MISE EN GARDE: Les conduites de gaz 1 et 2 alimentent une soupape de détente de pression réglée à 170 kPa (pression manométrique) (25 psig). Le réglage de la pression à la source ne doit pas dépasser cette valeur.

- 6 Specify the connected gas on the **Discovery TGA > General** page of the **TRIOS Options**.
- 7 Set the sample flow rate to the recommended value of 25 cc/min for your experiments through the Control Panel options within TRIOS Instrument Control Software.

Connecting the Air Cool Line

Use the following steps to install the Air Cool line:

- 1 Locate the **AIR COOL** fitting on the back panel of the Discovery TGA, marked with a 172 kPa gauge (25 psig) warning label.
- 2 Make sure your compressed air is regulated between 138 to 172 kPa gauge (20 to 25 psig) and is free of water and vapors.

CAUTION: The AIR COOL line feeds into a pressure relief valve that is set to 170 kPa gauge (25 psig). The source pressure setting should not go above this value.

MISE EN GARDE: La conduite de refroidissement de l'air alimente une soupape de détente de pression réglée à 170 kPa (pression manométrique) (25 psig). Le réglage de la pression à la source ne doit pas dépasser cette valeur.

3 Connect the 1/4-inch O.D. tubing from the compressed air source to the **AIR COOL** fitting.

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

Connecting the Heat Exchanger Cable and Water Hoses

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

- 1 Locate the **24 VDC** output connector on the rear of the TGA instrument and connect the heat exchanger cable to the connector. The heat exchanger cable is the only cable that fits into this connector.
- 2 Remove the water hoses from the packaging.
- 3 Obtain the water hose marked **SUPPLY**. Connect one end of this hose to the connector labeled **SUPPLY** on the rear of the instrument.
- 4 Connect the other end of the water hose marked **SUPPLY** to the connector labeled **SUPPLY** on the heat exchanger.
- 5 Connect one end of the unmarked water hose to the connector labeled **RETURN** on the rear of the instrument.
- 6 Connect the other end of the unmarked water hose to the connector labeled **RETURN** on the heat exchanger.



Figure 16

NOTE: Air trapped in the heat exchanger system must be purged before starting the first run. See [“Purging Air from the Heat Exchanger System” on page 52](#) after completing installation of the Discovery TGA.

Connecting the Power Cable

NOTE: A <HAR>-marked (harmonized) power cable with an IEC 60320 C19 style connector meeting the standards of the country of installation is required for the European Economic Area.

Install the power cable as follows:

- 1 Make sure the power switch is in the Off (0) position, as shown in [Figure 17](#).
- 2 Plug the power cable into the Common Cabinet power entry module (shown below).



Figure 17 Power cable in power entry module on back panel of Common Cabinet.

- 3 Plug the power cable into the wall outlet.

Installing the Autosampler Tray

Follow the steps below to install the Autosampler tray:

- 1 Install the Autosampler sample tray (found in the accessory kit). Use the guide pin to orient the tray correctly.
- 2 Select **Autosampler Reset** from the user interface or from the instrument control software.
- 3 If necessary, calibrate the Autosampler as described in [“Autosampler Calibration” on page 58](#).

Installing the Hang-Down Wires

The procedures below describe how to install the tare and sample hang-down wires. The following procedures assume that the instructions found in [“Preparing the Discovery TGA for Installation” on page 26](#) have been completed.

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

MISE EN GARDE: Pendant l'installation, prenez soin de ne plier les fils suspendus et de ne pas endommager les boucles suspendues.

Installing the Tare Hang-Down Wire

Install the tare hang-down wire as follows:

- 1 Verify that the instructions found in [“Preparing the Discovery TGA for Installation” on page 26](#) have been completed. The balance housing cover should already be removed at this point in the installation.
- 2 Loosen the three thumbscrews (circled below) on the tare cap, which is located on the underside of the balance chamber. Remove the cap and put it aside to reinstall later.

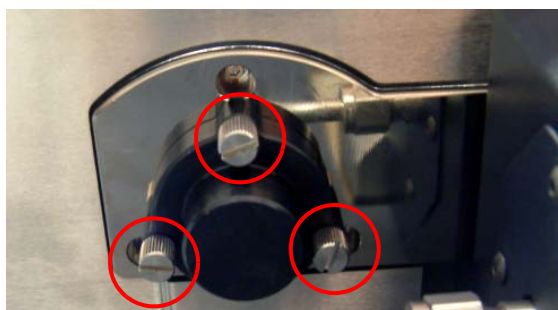


Figure 18 Removing the tare cap.

- 3 Locate the tare hang-down wire and tare hang-down installation tool in your TGA Accessory Kit. The tare hang-down wire is the shorter of the two wires. For now, leave the tare hang-down wire in its case.
- 4 Position the hang-down wire case so that the wire's double bend hook is at the top.
- 5 With the tare hang-down wire still in its case, insert the bottom of the wire into the tare hang-down installation tool, as shown below. Then remove the installation tool and wire from the case.

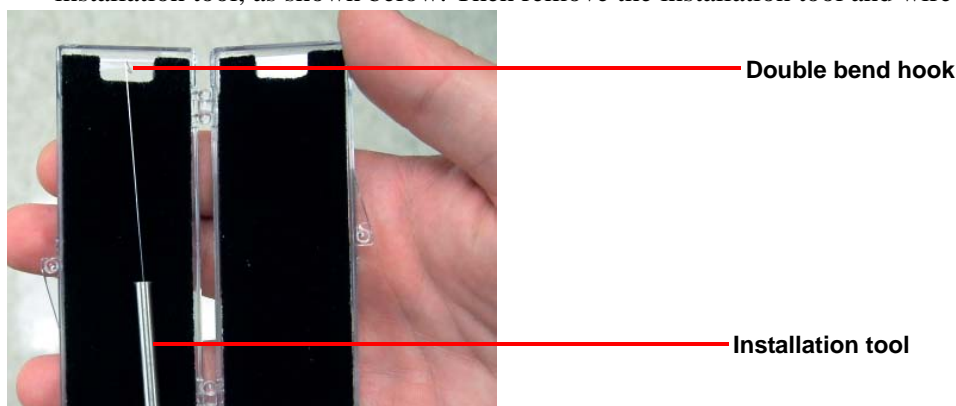


Figure 19 Inserting tare hang-down wire into installation tool.

- 6** Insert the wire and installation tool vertically into the tare tube, being careful not to bend the wire.

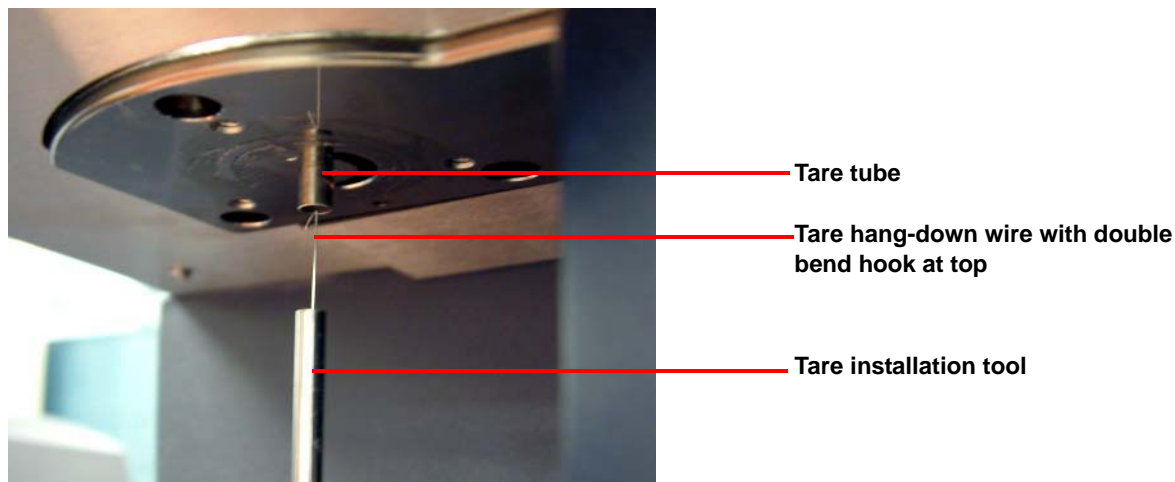


Figure 20 Inserting hang-down wire into tare tube.

- 7** Continue to raise it slowly until the top of the wire protrudes from the opening in the purge control cap. Be sure to hold the installation tool in place, as it will fall out of the tare tube opening if released.

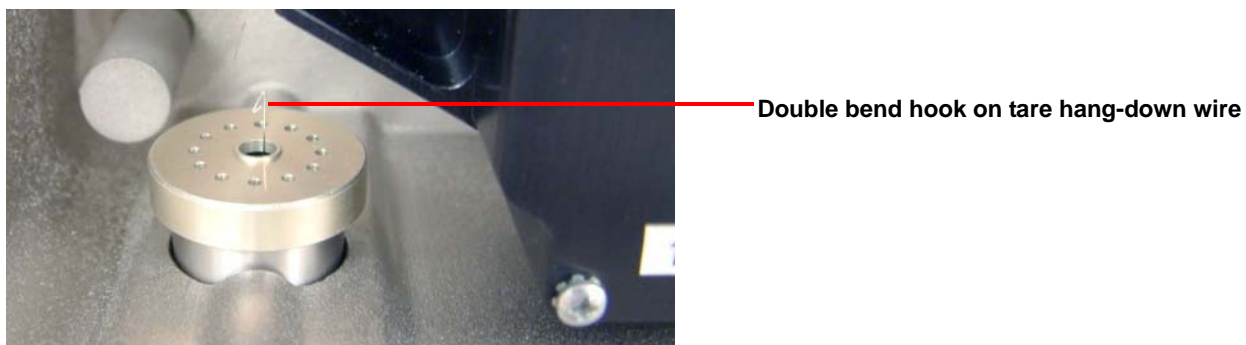


Figure 21

- 8** Using tweezers, gently hang the double-bend hook (pointing to the left) on the hang-down loop. Maneuver the hook until it is fully inserted through the loop. Be very careful to avoid bending the hang-down loop.
- 9** Remove the tare hang-down installation tool.
- 10** Carefully insert the tare tube over the wire, pushing it up inside the cooling plate to reinstall it.

- 11 Use the alignment gauge (shown below) to ensure that the length of the tare tube extends 0.150-inch below the cooling plate. Push it up or pull it down to adjust the length.

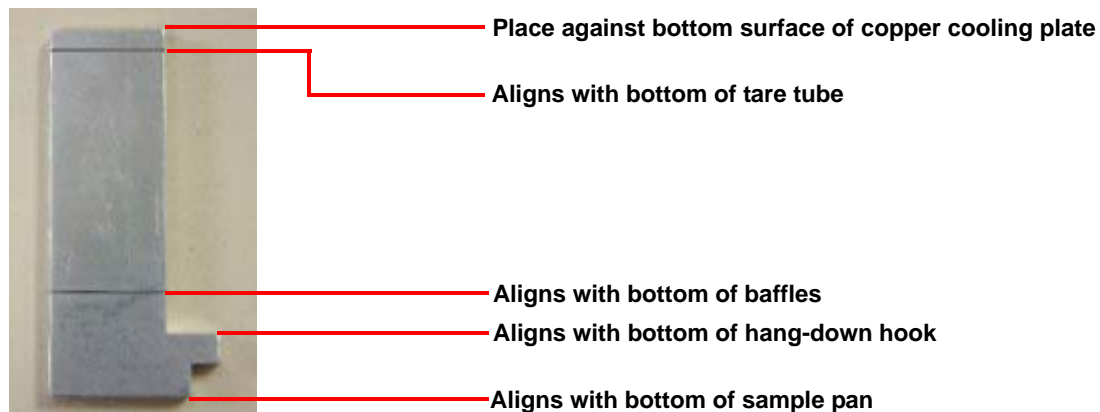


Figure 22 Alignment gauge.

- 12 Hang the desired sample pan on the hook. Choose the same type of pan that will be used for your experiments.
- 13 Replace the black tare cap over the tare side pan. Finger tighten the three thumbscrews holding the tare cap on.

Installing the Upper Furnace Assembly and Sample Hang-Down Wire

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

- 1 Locate the upper furnace assembly in the accessory kit.
- 2 Lower the furnace to its fully open position.
- 3 Cover the furnace opening with a flat object (such as a business card) to prevent anything from falling inside.
- 4 Holding the assembly by the tube section, install the upper furnace assembly by inserting it straight up inside the sample side hole in the cooling plate, being sure not to bend the baffles. See the figure below.

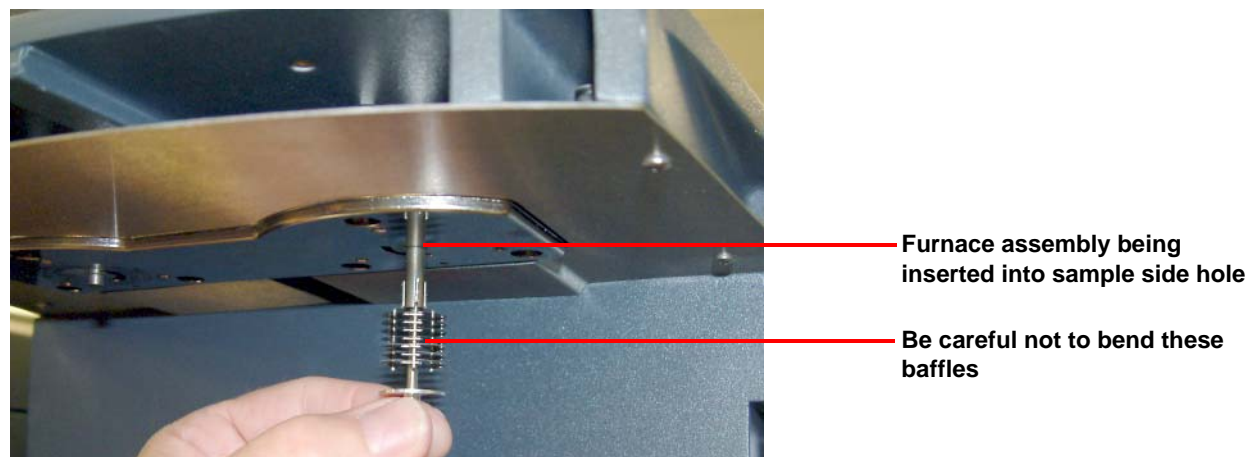


Figure 23 Installing the upper furnace assembly.

- 5 With the upper furnace assembly in place, you can proceed to install the sample hang-down wire. Please note that you will not need to adjust the length of the upper furnace assembly tube until the sample hang-down wire has been fully installed.

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

MISE EN GARDE: Pendant l'installation, prenez soin de ne plier les fils suspendus et de ne pas endommager les boucles suspendues.

- 6 Placing a finger under the upper furnace assembly, push the tube up slowly until it stops moving; be careful not to bend the baffles.
- 7 Locate the sample hang-down wire and the sample hang-down installation tool (shown below), which are found in the accessory kit. For now, leave the sample hang-down wire in its case.



Figure 24 Installation tool.

- 8 Position the hang-down wire case so that the wire's double bend hook is at the top.
- 9 With the sample hang-down wire still in its case, insert the bottom of the wire into the sample hang-down installation tool, as shown below. Then remove the installation tool and wire from the case.

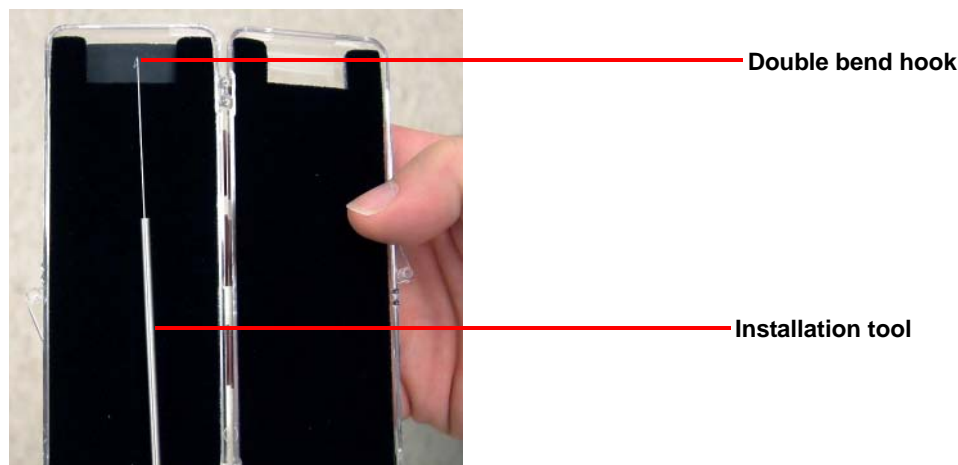


Figure 25 Inserting sample hang-down wire into installation tool.

- 10 Remove the flat object covering the furnace opening and lower the furnace to its fully open position.

- 11 Carefully angling the sample hang-down installation tool (as shown below), lower the bottom into the furnace opening until you have enough clearance to hold the tool and wire vertically **without bending the wire** (very important).

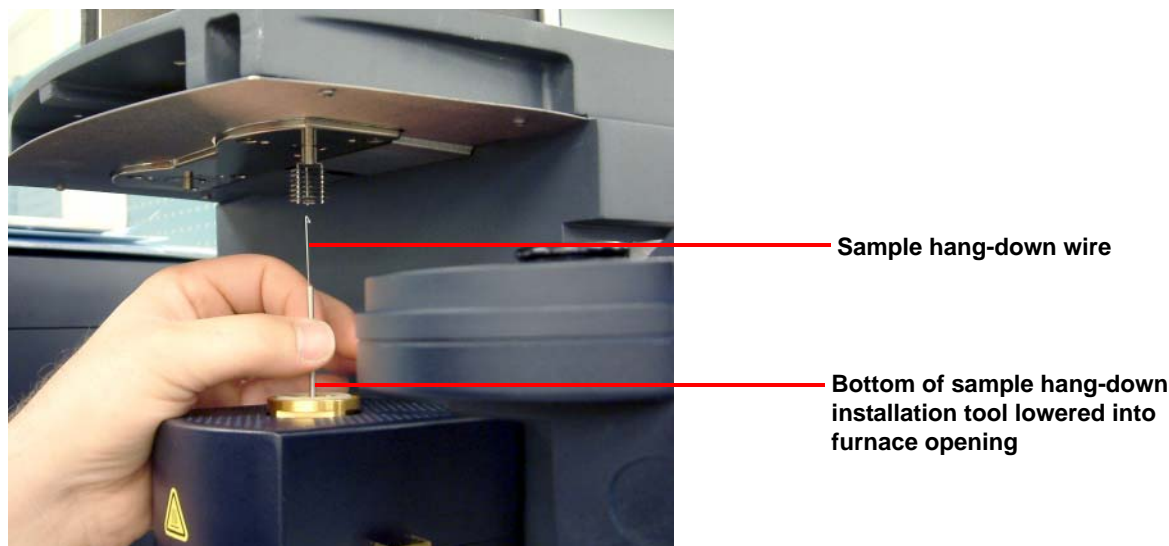


Figure 26 Positioning the sample hang-down installation tool.

- 12 Insert the wire and sample hang-down installation tool vertically into the sample tube, being careful not to bend the wire. Continue to raise it slowly, feeding it through the purge control cap until the top of the wire protrudes from the opening in the cap.
- 13 Cover the furnace opening with a flat object that will completely block the opening.
- 14 Position the sample hang-down wire so that the double-bend hook is pointed to the left. Grasp the hang-down wire with brass tweezers, being careful not to bend the wire.
- 15 Using tweezers, gently hang the double-bend hook (pointing to the left) on the hang-down loop. Maneuver the hook until it is fully inserted through the loop.

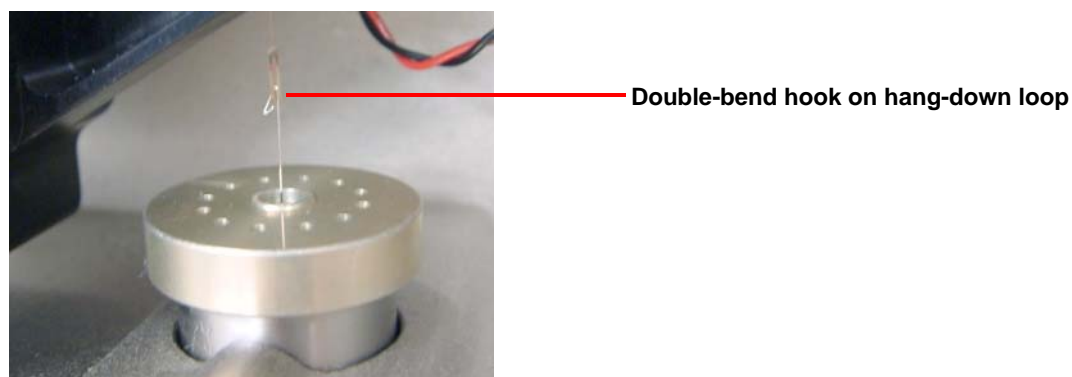


Figure 27 Hanging the sample hang-down wire.

- 16 Slide the installation tool down to remove it from the upper furnace assembly. The hang-down wire, if properly installed through the loop, will remain in position. Be careful not to bend the hang-down wire.

- 17** Adjust the length of the upper furnace assembly by pulling it down. The length from the bottom of the baffle to the cooling plate should be 1.6 in (4.1 cm), which can be determined using the supplied gauge. See the figure below.

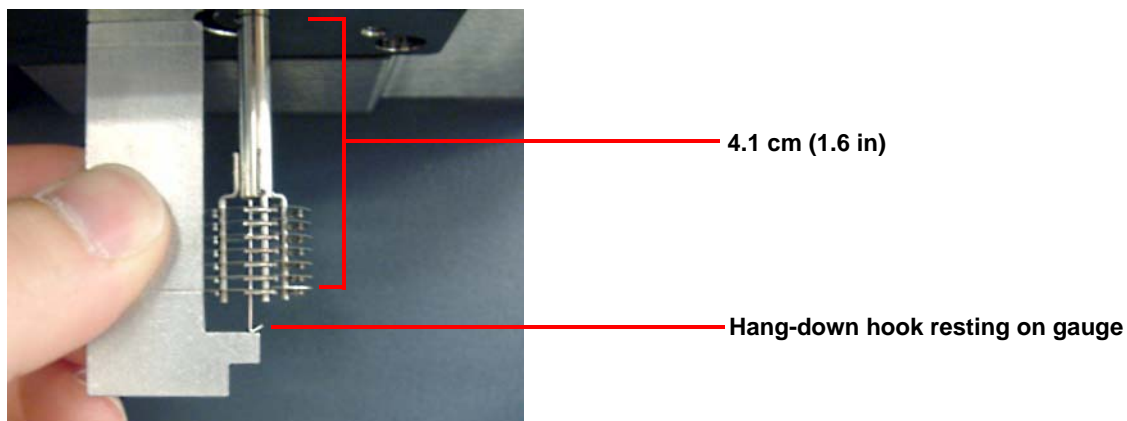


Figure 28 Proper positioning of alignment gauge and upper furnace assembly.

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

Leveling the Discovery TGA and Aligning the Balance

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

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

Aligning the Sample Hang-Down Wire

- 1 Load a pan on the sample hang-down wire.
- 2 Adjust the position of the hang-down wire and pan until the bottom of the pan is 2.2 in. (5.6 cm) from the cooling plate as follows:
 - a Turn the center balance assembly hex head screw until it touches the floor of the chamber; this is done to prevent the balance assembly from dropping in step b. See [Figure 29](#) for the location of the screw.
 - b Loosen the two inner up/down balance adjustment locking screws located inside the balance as shown below.

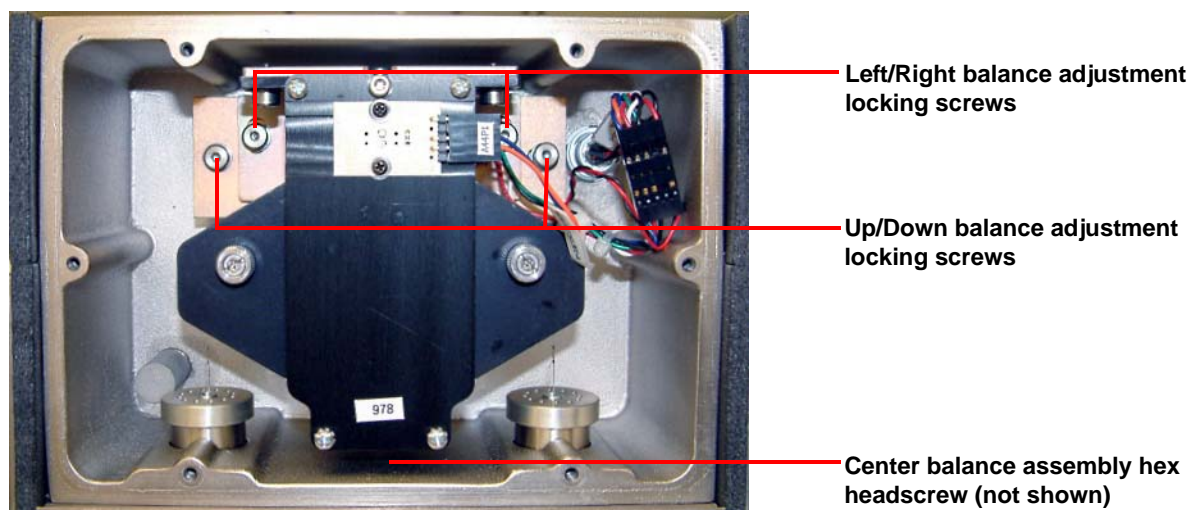


Figure 29 Balance alignment locking screws.

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

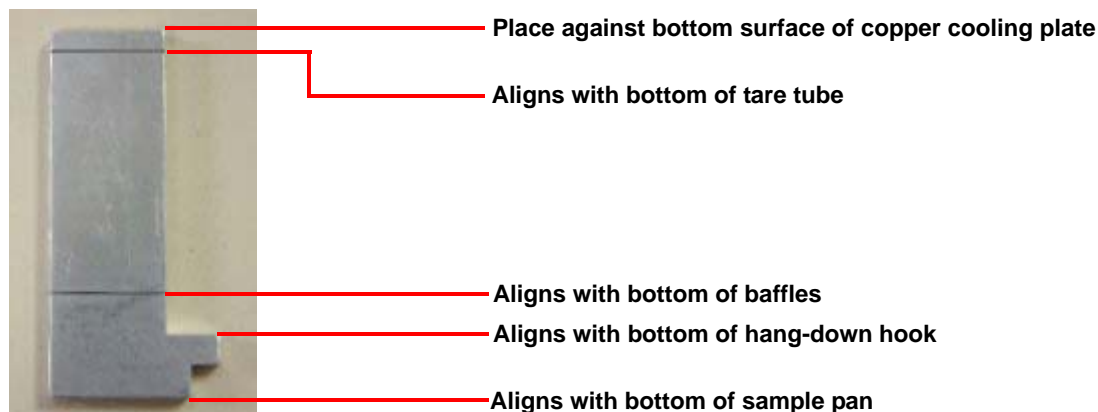


Figure 30 Alignment gauge.

- d Tighten the up/down screws to lock them in position.
 - e Turn the center balance assembly hex head screw all the way up until it is tight against the balance assembly.
- 3** Adjust the side-to-side position of the sample hang-down wire as follows:
- a Loosen the two outer left/right balance adjustment locking screws shown in the figure above.
 - b Manually position the balance assembly left or right until the hang-down wire is centered in the purge cap at the top and in the sample tube at the bottom.
 - c Tighten the screws to lock them in position.

Aligning the Bottom of the Sample Hang-Down Wire

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

- 1** Use the user interface **Calibrate > Autosampler > Motor Test > Furnace Up/Down** functions to slowly raise the furnace just to the bottom of the sample pan, and touch **STOP**.
- 2** Check the alignment of the sample pan within the furnace. It should hang freely, centered, and should not be touching the sides of the furnace (shown in the figure here).

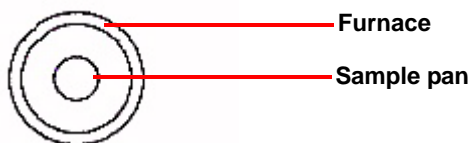


Figure 31

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

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

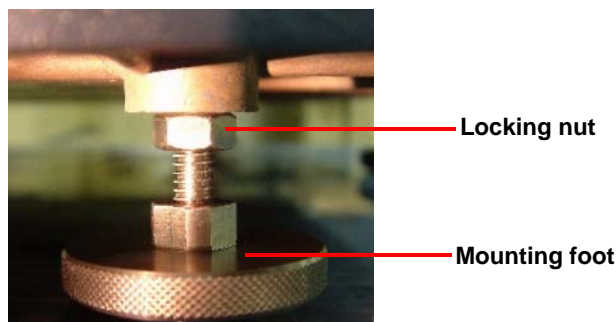


Figure 32 Locking nut position shown.

- 5 Raise the furnace slowly again to ensure the sample tube baffles clear the furnace. If the baffles come in contact with the furnace, call TA Instruments for service.
- 6 Lower the furnace, then manually remove the pan and place it back on the Autosampler tray.
At this point, the lower furnace assembly is ready to be installed. Proceed to the next section.

Installing the Lower Furnace Assembly

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

- 1 Close the furnace completely.
- 2 Locate the lower furnace assembly in the accessory kit.
- 3 Carefully remove the lower furnace assembly from the plastic shipping tube.
- 4 Orient the lower furnace assembly (shown below) so that the air cool inlet points to the left as you slide it up into the bottom of the furnace.

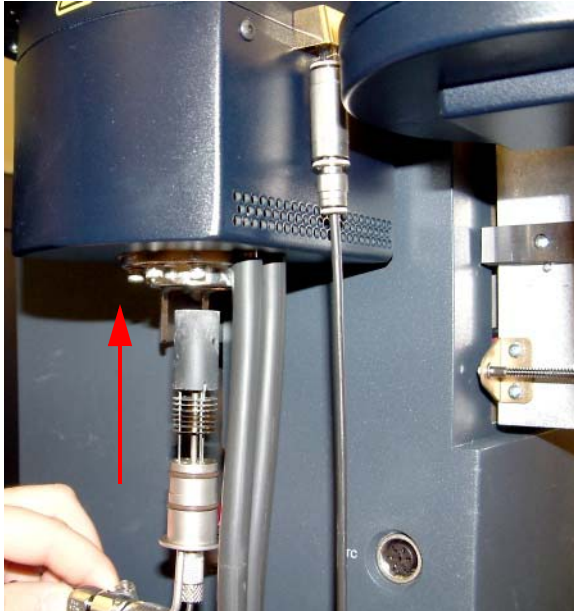


Figure 33 Lower furnace assembly parts identification.

- 5 Raise the lower furnace assembly until it goes all the way inside and until only the thumbscrew shows on the outside. The O-ring will hold the furnace assembly in place.
- 6 Turn the thumbscrew to hold the assembly in place.

- 7 Loosen the outer nut and remove the furnace exhaust tube from the left-hand side of the furnace.

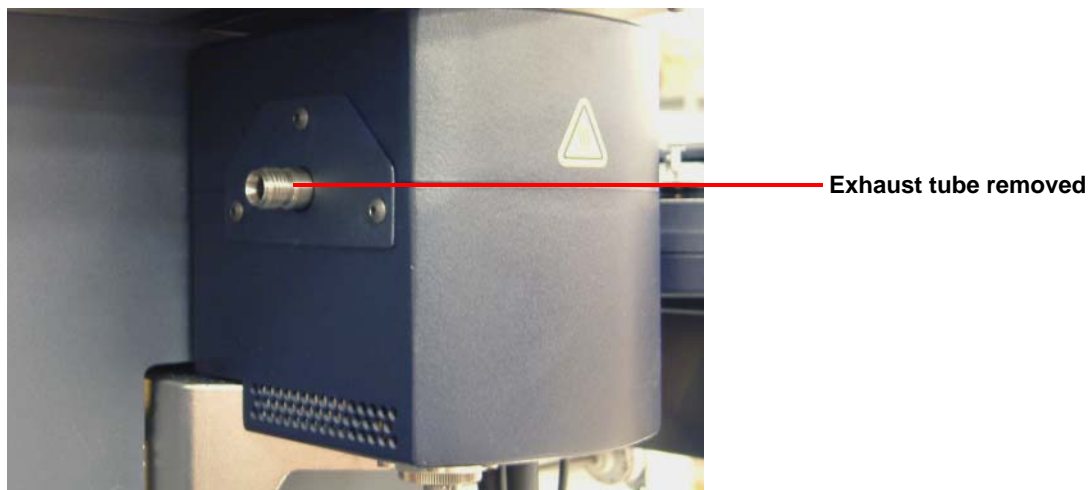


Figure 34 Furnace exhaust tube removed.

- 8 Look into the furnace outlet port. The holes in the heat-absorbing tube should align with the inlet and outlet ports on the furnace housing, allowing for light to pass through. Rotate the lower furnace assembly until achieving the proper alignment.
- 9 Fully tighten the thumbscrew once proper alignment is achieved.
- 10 Re-install the furnace exhaust tube.
- 11 Insert the lower furnace assembly cable connector into the connector shown below. Tighten the knurled nut.



Figure 35 Lower furnace accessory cable installed.

- 12** Connect the 1/8-inch Teflon TFE tubing from the base of the instrument to the LFA air cool inlet, as shown in the figure below. Note that the figure below also displays the sample purge line, which was installed in [“Connecting Lines to the Gas Delivery Module” on page 33](#).

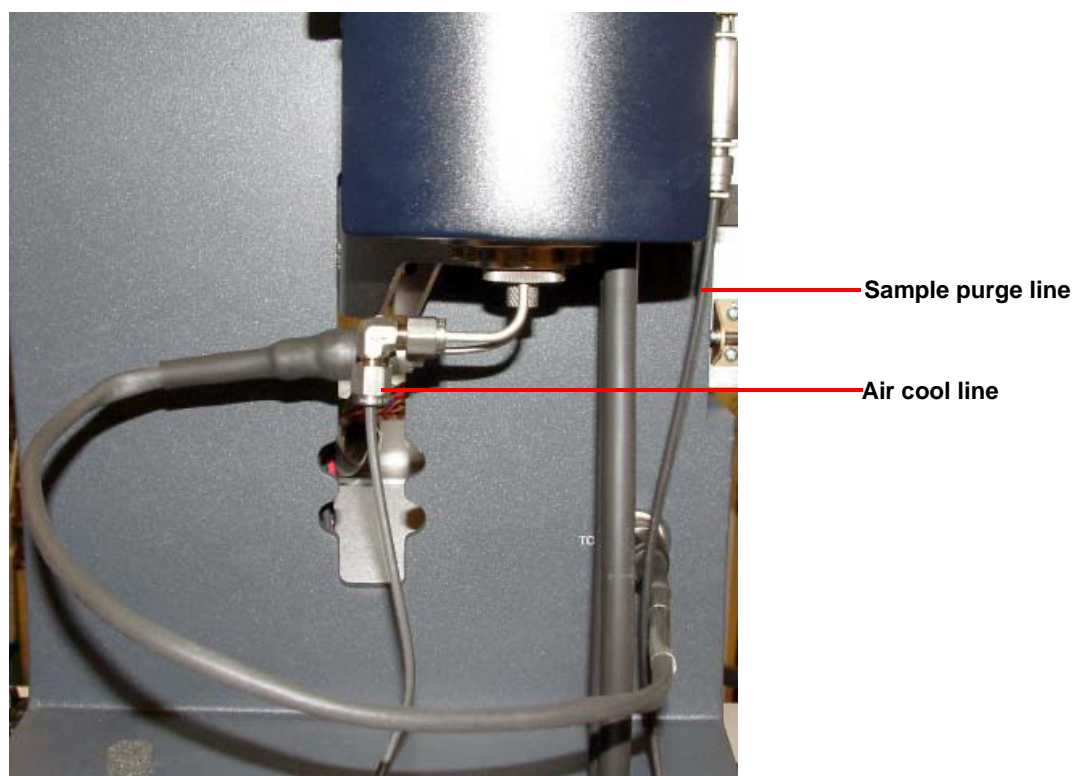


Figure 36 Lower furnace assembly fully installed.

- 13** Proceed to the next section to complete installation of the Discovery TGA.

Closing the Balance Assembly

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

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

- 1 Replace the inner balance faceplate and secure with six screws. (Four screws were removed during [step 3](#) of [“Unpacking the Balance” on page 27](#), and two were shipped separately in a plastic bag.) Make sure the small o-rings are in position on the inside of the faceplate so that it seals correctly.
- 2 Obtain the balance housing foam block insert from the accessory kit.
- 3 Place the foam insulation block inside the balance assembly cover, as shown below.



Figure 37 Foam insulation block over balance assembly cover.

- 4 Lower the balance cover carefully over the foam insulation block and balance assembly. Replace the two screws on the rear of the cover as shown on [“Unpacking the Balance” on page 27](#).
- 5 Place the Autosampler cover over the tray.

The installation procedure is now complete. However, since the balance housing has been opened during this installation, balance conditioning is required.

Balance Conditioning

Balance conditioning is required for the Discovery TGA in order to achieve optimum performance from your instrument and keep the balance housing dry. Perform a balance conditioning when:

- The instrument is first installed
- Whenever the balance housing is opened
- Whenever the instrument is powered off for an extended period of time.

For more information related to conditioning the balance, see [“Conditioning the Balance” on page 63](#) for detailed instructions.

Filling the Heat Exchanger Reservoir

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 returns to the reservoir via the return line. To fill the heat exchanger, follow the directions given below.

For instructions on how to connect the water lines, see [“Connecting the Heat Exchanger Cable and Water Hoses” on page 36](#).

- 1 Disconnect the heat exchanger control harness and water lines from the instrument cabinet.
- 2 Unscrew and remove the water reservoir cap.



Figure 38 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.
 - b Fill the reservoir 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 clicking **Prime Exchanger** from the **General** Control panel, and allow the water to circulate for several minutes.
 - e Turn off the pump by clicking **Stop** from the **General** Control panel, 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 reservoir after it has circulated.
- 4 Dispose of the water. Add TA Instruments TGA Conditioner (P/N 952377.901) into the water reservoir. Refer to the instructions on the conditioner bottle for the amount of conditioner to add to the reservoir, then fill the reservoir to the inner rim with distilled water.

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

MISE EN GARDE: Ne versez aucun liquide autre que de l'eau distillée et l'agent de conditionnement TGA de TA Instruments dans le réservoir de l'échangeur thermique.

- 5 Turn on the pump again by clicking **Prime Exchanger** from the **General** Control panel, and circulate the water until the air bubbles disappear from the water lines, then stop the pump by clicking **Stop** from the **General** Control panel. You may see **Err 119** on the instrument display until all the air has been removed.

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

- 6 Replace and tighten the water reservoir cap.

Purging Air from the Heat Exchanger System

Air trapped in the heat exchanger system must be purged before starting the first run. After the initial installation of the Discovery TGA is complete, perform the following procedure:

- 1 Turn on the instrument. See [“Starting the Discovery TGA System” on page 55](#) if necessary.
- 2 Start the heat exchanger pump by either:
 - Clicking the **Prime Heat Exchanger** icon from the TRIOS software **General** Control panel, or
 - Selecting **Prime Heat Exchanger** from the instrument user interface **More** menu options
- 3 Refill the coolant reservoir as needed. Repeat this process until all of the air has been purged from the system and the instrument stops reporting an error.

Installing the Autosampler Tray

When you receive your TGA, the Autosampler tray is shipped in the accessory box, separate from the instrument. After unpacking the instrument and installing the instrument completely (see instructions in this chapter), you will be ready to run samples using the Autosampler.

- 1 Locate the open slot on the Autosampler tray.

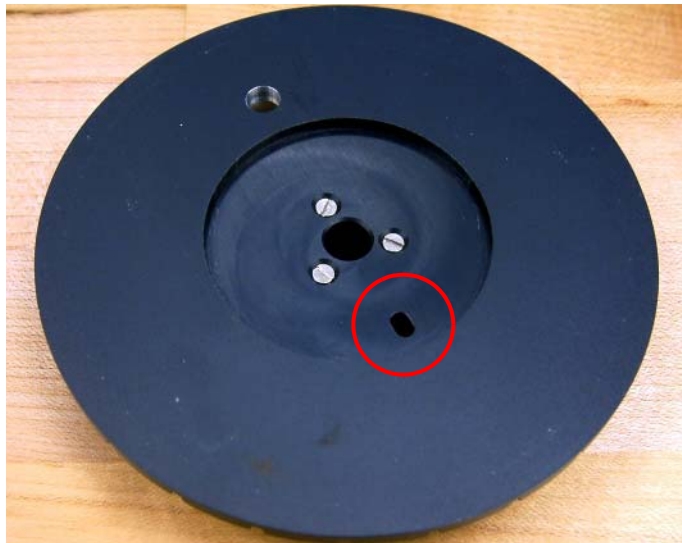


Figure 39 Slot on Autosampler tray.

- 2 Locate the guide pin on the instrument Autosampler.

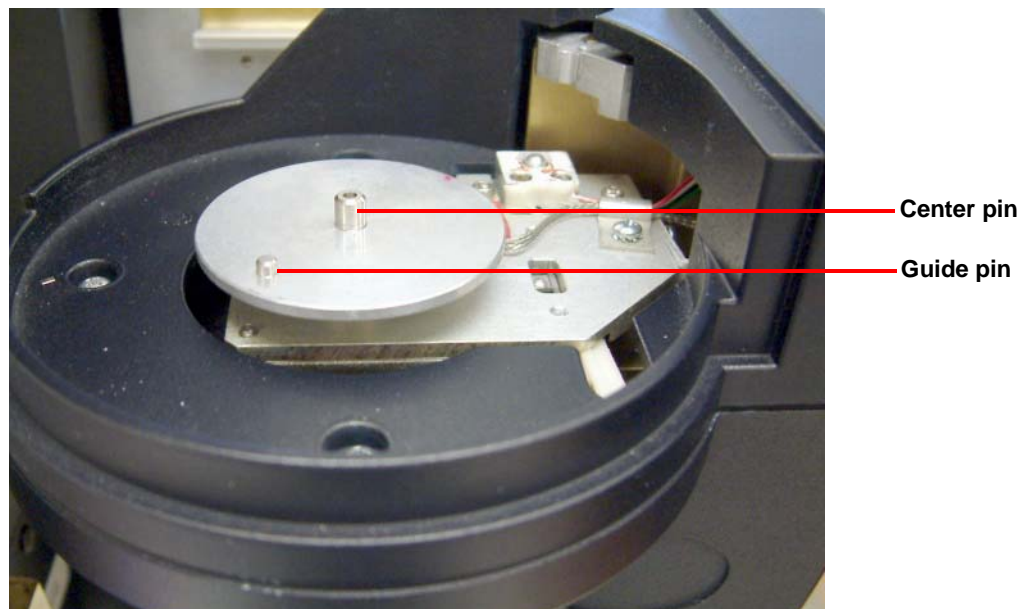
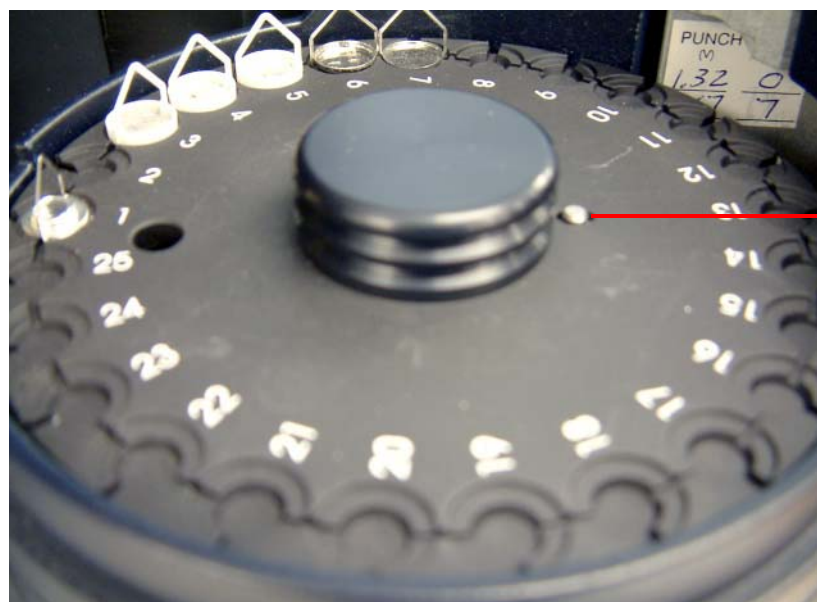


Figure 40 Guide pin on instrument Autosampler.

- 3 Grasp the tray by the center knob and lower it onto the instrument Autosampler, aligning the open slot on the tray with the guide pin on the Autosampler.



Guide pin in Autosampler
tray open slot

Figure 41 Autosampler tray installed on instrument.

Starting the Discovery TGA System

The power switch is located at the back panel of the Common Cabinet. It is part of the assembly called the power entry module, which also contains the power cable connection and fuses. The power switch is used to turn the TGA system on and off.

To power on the system:

- 1** Check all connections between the TGA, the Common Cabinet, and the controller. Make sure each component is plugged into the correct connection port.
- 2** Set the Common Cabinet power switch to the ON (**I**) position.
- 3** The lighted logo on the front panel indicates that power is turned on. After the proper power up sequence, the instrument user interface appears and the keypad buttons are lit; this indicates that the instrument is ready for use.

NOTE: Allow the Discovery TGA to warm up for at least 60 minutes before performing an experiment.

Shutting Down the Discovery TGA

Before you decide to power down your system, 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 execute a shutdown from the user interface or TRIOS software before turning off the power to the instrument. To shut down, perform one of the following options:

- Select **Shutdown** from the instrument user interface **More** menu.
- Select **Shutdown** from the **Instrument** menu within the TRIOS software.

A confirmation message displays. Select **Yes** to continue. All communication to the instrument halts while the instrument saves any unsaved data. Once this procedure is complete, the instrument user interface screen goes blank (black), indicating that it is safe to turn off the power to the instrument.

To power down your system, set the power switch to the OFF (0) position.

Chapter 3:

Use, Maintenance, & Diagnostics

Using the Discovery 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 size and material
- Selecting the purge gas and setting flow rates
- Creating or choosing the test procedure and entering experiment information in TRIOS software
- Selecting and taring the sample pan
- Loading the sample
- Starting the experiment
- Unloading the sample at the end of the experiment

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

Before You Begin

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

- Made all necessary cable connections from the Discovery Common Cabinet to the Discovery TGA
- Connected the instrument with the controller
- Connected all gas lines
- Connected heat exchanger power and water lines
- Installed any desired options
- Powered up the Discovery TGA and heat exchanger
- Become familiar with controller operations
- Calibrated the Discovery TGA, if necessary

Calibrating the Discovery TGA

To obtain accurate experimental results, you should calibrate the instrument upon initial installation. For the best results, however, you should recalibrate periodically.

Several types of calibration are required for the TGA: Autosampler, weight, and temperature calibration. A brief description is provided below. Autosampler calibration is performed via the instrument user interface. Weight and temperature calibration are performed through TRIOS software. In addition, user interface calibration is available.

NOTE: Please make sure that you run your experiments with the same gas that you used to calibrate the system. For example, if you calibrate using nitrogen, make your runs with nitrogen.

Calibration consists of several different types of procedures that are described briefly below. For more details on performing each type of calibration, refer to the instructions in TRIOS software Online Help.

Autosampler Calibration

Perform Autosampler calibration after initial installation of the system, and calibrate periodically thereafter as needed. If the Autosampler fails to pick up a sample pan correctly during an automatic loading procedure, the Autosampler may need to be calibrated.

Other possible causes for improper pan pickup include:

- The instrument is not level. See [“Leveling the Discovery TGA and Aligning the Balance” on page 44](#) for instructions to solve this problem.
- The hang-down wire is not straight. Replace the hang-down wire; see [“Installing the Hang-Down Wires” on page 38](#) for instructions.
- The bails on the sample pan are bent. If possible, straighten them or use new pans.

To perform Autosampler calibration, access the Autosampler panel on the user interface. Refer to TRIOS software Online Help for detailed instructions.

Weight Calibration

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

- *Manual weight calibration* is performed using a known calibration weight, typically 100 mg. This procedure involves weighing a pan with and without the calibration weight to calibrate the 0 to 100 mg weight range. This procedure is conducted through TRIOS software using the **Calibrate > Weight** function.
- *Automatic weight calibration* is accessed through the instrument’s User Interface, or through TRIOS software by selecting **Calibrate > Autoweight**. In this case the pan differential is used to calibrate the weight. The weight calibration pans may only be used when a platinum tare pan is installed.

See TRIOS software Online Help for more information on weight calibration of either type.

Temperature Calibration

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

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

User Interface Calibration

The Discovery TGA user interface may occasionally need calibration to adjust the pressure spots on the screen for proper alignment. This calibration is executed from instrument user interface **More** menu. Refer to TRIOS software Online Help for more information.

Running a Discovery TGA Experiment

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

- 1 Attaching and setting up external accessories and/or environmental conditions as required, such as the purge gas
- 2 Selecting the pan size and material
- 3 Taring the empty sample pan
- 4 Loading the sample into the pan
- 5 Entering experiment information in TRIOS software; this includes both sample and instrument information.
- 6 Creating or selecting the experimental procedure using TRIOS software.
- 7 Starting the experiment

Selecting the Pan Size and Material

Choose a pan based on the desired temperature range and application. See [“Discovery TGA Sampling System” on page 22](#) for the pans that can be used with the Discovery TGA Autosampler.

Taring the Sample Pan(s)

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

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

- 1 Place clean, empty pan(s) on the platform. If you are using sealed aluminum pans, then you must tare the lid along with the empty pan. See TRIOS software Online Help for more information.
- 2 Specify the pan type in TRIOS software. Only pans of the same type may be run in the same sequence.
- 3 Select the **Tare** button on the Autosampler panel of the user interface. Alternatively, select **Calibrate > Tare** from within TRIOS software.
- 4 Select the desired pans, then select **Tare** (from the user interface) or **Start** (from TRIOS) to initiate the tare procedure. The pan will automatically be loaded and the furnace raised to make the measurement. When the tare procedure is complete, the furnace automatically lowers and unloads the pan.

Loading the Sample Pans

Loading Open Pans

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

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

- 1 Make sure the punch mechanism is fully retracted before using any non-sealed pans. Use a Phillips screwdriver to loosen the screw on top of the punching mechanism. Slide the mechanism out of the way.
- 2 Place the sample in the sample pan and position the pan on the sample tray in its original position; this may be done with the tray on or off the instrument. The wire on the bottom of the sample pan, if present, should align with the groove in the pan recess so that the sample pan can be picked up by the sample hang-down wire.

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

- 3 Replace the sample tray on the Autosampler, if removed.

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

Loading Sealed Pans

Consult TRIOS software Online Help for information on punch calibration and alignment for sealed aluminum pans. After taring the sample pan and lids, load the sample as follows:

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

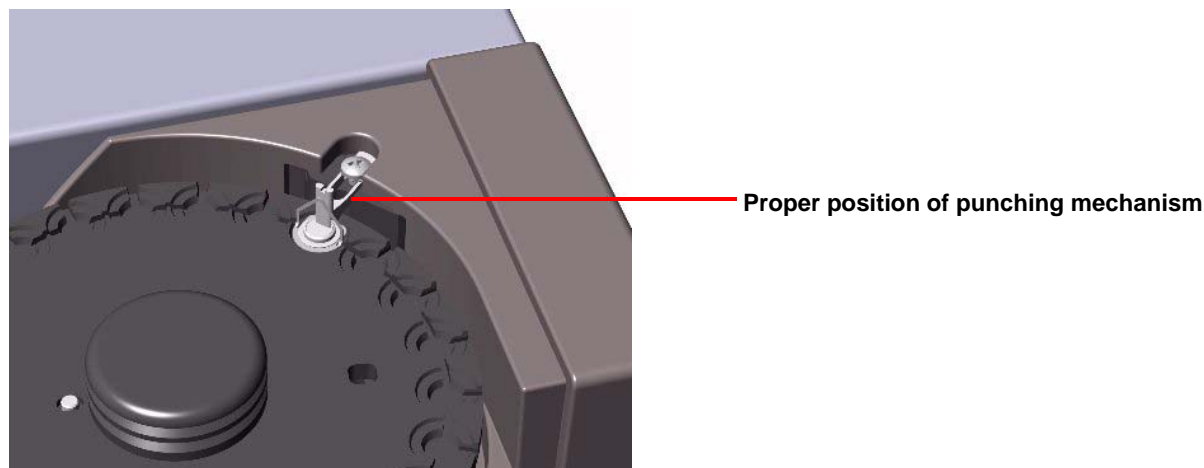


Figure 42 Autosampler tray and punching mechanism position.

- 2 Follow the procedure to load the sample and seal the sample pans using the sample encapsulating press. See TRIOS software Online Help for detailed information.

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

- 3 Reposition the bail/pan on the sample tray in its original pan position; this may be done with the tray on or off the instrument. The tab on the bail should align with the groove in the tray so that the sample pan can be picked up by the sample hang-down wire. Check that the bail wire is perpendicular (90°) to the bail base. This avoids failing to connect with the hang-down wire hook or interference with the punch during the pan punching process.
- 4 Replace the sample tray on the Autosampler, if removed.

Starting an Experiment

Before you start the experiment, ensure that the Discovery TGA is online with the controller and you have entered all necessary information in TRIOS software.

NOTE: Once the experiment is started, to avoid unintentional disturbance to the measurement, operations are best performed at the instrument user interface or the computer keyboard.

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

If multiple runs are in the sequence, the procedure repeats for the next run until the run sequence completes.

Stopping an Experiment

If you need to terminate the experiment, you can do this at any point by touching the **STOP** key on the bottom of the user interface or by selecting **Stop** from within TRIOS software. If an autosampler sequence is in progress, selecting **Stop** from the instrument keypad stops both the run and the sequence.

NOTE: See [“Shutting Down the Discovery TGA” on page 56](#) for information on shutting down the instrument.

Maintaining the Instrument

The primary maintenance procedures described in this section are the customer's responsibility. Any further maintenance should be performed by a representative of TA Instruments or other qualified service personnel. Consult TRIOS software Online Help for further information.



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

DANGER: À cause de la présence de circuits électriques de grande puissance dans cet instrument, le personnel non formé ne doit pas essayer de tester ou de réparer les circuits électriques.

CAUTION: Before using any cleaning or decontamination method except those recommended by TA Instruments, check with TA Instruments that the proposed method will not damage the instrument.

MISE EN GARDE: Avant d'utiliser une méthode de nettoyage ou de décontamination autre que celle recommandée par TA Instruments, vérifiez auprès de TA Instruments que la méthode proposée n'endommagera pas l'instrument.

Conditioning the Balance

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

The recommended balance housing temperature is 40°C. Allow the temperature of the balance housing to stabilize for one hour during installation or after the balance housing was opened.

NOTE: The balance housing should be dried with nitrogen at 200 mL/min for a minimum of 12 hours. See TRIOS Online Help for more details.

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

Cleaning the Furnace

After extended use, the inside of the furnace may become coated with sample and therefore require cleaning. Periodic cleaning is recommended for optimum operation and performance.

See TRIOS software Online Help for furnace cleaning instructions.

Cleaning the Pans

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

CAUTION: The aluminum pans can not be cleaned with a propane torch. The aluminum pans are disposable; they are not meant to be reused.

MISE EN GARDE: Les bacs en aluminium peuvent être nettoyés à l'aide d'un chalumeau au propane. Les bacs en aluminium sont jetables et ne sont pas conçus pour être réutilisés.

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

MISE EN GARDE: N'utilisez pas de lavage à l'eau acidulée pour nettoyer les bacs en platine-HT, car cela risque d'endommager les bacs.

Cleaning the User Interface Screen

The user interface screen should be cleaned with a household liquid glass cleaner and soft cloth. Moisten the cloth, not the user interface screen with the glass cleaner, and then wipe off the screen and surrounding surfaces.



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

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

Replacing Fuses



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

AVERTISSEMENT: Débranchez toujours l'instrument avant d'examiner ou de remplacer les fusibles.

The Discovery 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 customer-replaceable fuses are located in the fuse holder located on the back panel of the Common Cabinet. To check or change these fuses:

- 1 Turn the Common Cabinet off and remove the power cord.
- 2 The Common Cabinet has two standard fuse holders on the rear panel. Use a flat-blade screwdriver to remove the fuse carriers.
- 3 Remove old fuses and replace the fuses only with the type and rating indicated on the Common Cabinet's rear panel.
- 4 Place the fuse carrier back into the fuse holder and lock in place with the screwdriver.

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.

MISE EN GARDE: Ne versez aucun liquide autre que de l'eau distillée et l'agent de conditionnement TGA de TA Instruments dans le réservoir de l'échangeur thermique.

- Check the level and condition of the heat exchanger coolant periodically. TA Instruments recommends routine checks every three to six months, depending on use of the instrument.
- Add distilled water to the reservoir, when necessary, to keep the reservoir at least 2/3 full. If algae growth is visible, drain the reservoir, refill it with distilled water, and add TA Instruments TGA Conditioner (PN 952377.901), as described in the **Maintaining the Heat Exchanger** TRIOS software Help topic.

Replacement Parts

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

Table 10: Fuses, Cords, and Cables*

Part Number	Description
200721.002	Power cord, 240 V, Discovery TGA Common Cabinet
201242.001	Fuse 12-amp time delay, 250 V (T12 A H 250 V)
251470.010	Ethernet cable (10 foot, shielded)
573046.001	Power cord, 120 V, Discovery TGA Common Cabinet
920223.901	Event cable
201258.001	USB, 6ft black
922224.901	24V/CAN hi/lo cable

*Contact your local TA Instruments representative for information on non-US style power cords.

Table 11: Discovery TGA Tools and Parts

Part Number	Description
259508.000	Brass tweezers
259509.000	Spatula, curved, 165 mm long
271621.001	O-ring, furnace housing to balance chamber
269920.004	Balldriver, 5/64-inch
269920.026	Balldriver, 7/64-inch
269920.005	Balldriver, 3/32-inch
952162.901	Heat exchanger tubing
952377.901	Heat exchanger conditioner kit
953260.901	TGA heat exchanger assembly
957331.901	Hang-down loop
957082.901	Sample hang-down wire
952040.901	Tare hang-down wire
957399.901	Lower furnace assembly
922225.901	Harness furnace power cable

Table 11: Discovery TGA Tools and Parts (Continued)

Part Number	Description
954290.902	Lower interior furnace assembly
957291.901	Upper internal furnace assembly
200391.001	Wrench, double angle, 1/4-inch
200392.001	Mirror, adjustable, 7/8-inch diameter
957357.001	Gauge, position, furnace/hook/pan
957367.901	IR Furnace Bulb Replacement Kit (4 bulbs)

Table 12: Standard Series Pans and Lids

Part Number	Description
957099.901 957216.901	25-pan tray, Autosampler (standard with Q5000 IR) 10-pan tray, Autosampler (optional)
957207.903 957207.904	50- μ L platinum sample pans (package of 3) 100- μ L platinum sample pans (package of 3)
957387.901 957387.902	50- μ L platinum-HT sample pans (package of 3) 100- μ L platinum-HT sample pans (package of 3)
957329.903 957329.904	100- μ L ceramic sample pans (package of 3) 250- μ L ceramic sample pans (package of 3)
957363.901 957362.901 957364.901	80- μ L aluminum sample pans (package of 100) ^{1, 2, 3} Aluminum sample lids (package of 100) Stainless steel bails (package of 15)
957352.901	Sealed aluminum pan kit, which contains: <ul style="list-style-type: none"> 957362.901 Aluminum sample lids (package of 100) 957363.901 80-μL aluminum sample pans (package of 100)^{1,2,3} 957364.901 Stainless steel bails (package of 15) 957358.001 Sealed pan punch alignment tool 957201.001 Sealed pan crimping tool

¹ Requires 25-pan tray, P/N 957099.901.

² Requires several additional parts found in Sealed Aluminum Pan Kit, P/N 957352.901.

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

Table 13: Calibration/Reference Materials

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

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