# Simultaneous Thermal Analyzer STA

## Thermogravimetry-Differential Scanning Calorimeter TG-DSC


High Precision × Stability × Automation
Authentic, Reliable TG-DSC

Rigaku
POWERING NEW PERSPECTIVES


## A New Generation of TG-DSC in a Different Class

# STAvesta

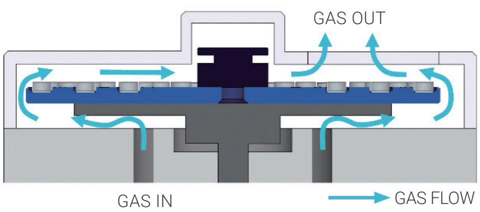
The long-awaited new STA model, STAvesta, is here—offering all the features you wanted, the precision you need, and dependable stability—all in one instrument.


All six furnace types can be swapped effortlessly without interference from attachments. Features include reduced oxygen concentration, a newly developed automatic adjustment mechanism, and thermal homogenization of the furnace body—all contributing to highly accurate and reliable quantitative measurements. Designed to support all users, from beginners to experts.

## ASC – Automatic Sample Changer Handles up to 52 samples

You can load up to 52 measurement samples (including 4 calibration samples) and 3 reference samples. With capacity for up to 1,000 consecutive runs, this greatly enhances automation and throughput. Compatible with all furnace types. The top-mounted design saves bench space.

Standard gas flow designed tray section reduces atmospheric exposure—highly effective for testing moisture-sensitive powders.




## Real-Time Sample Observation

Capture image data not available with conventional thermal analysis, such as shape and color changes. This visual insight accelerates and enhances both R&D speed and quality.

**(See P. 8 for more details)**

## Experience the Assurance of vestaeye Self-Diagnostic Functionality

STAvesta comes standard with the industry-first self-diagnostic feature "vestaeye."

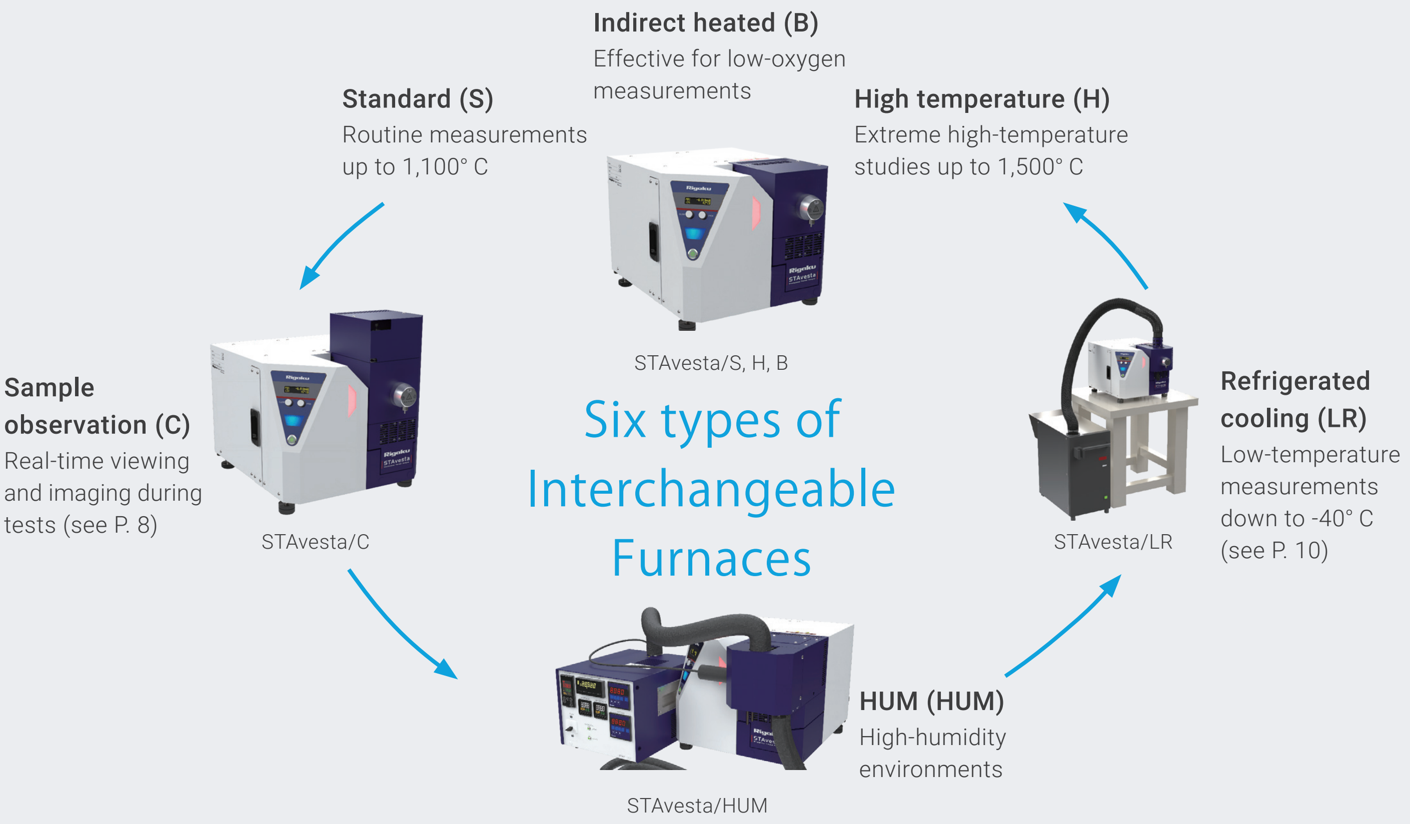
Before starting measurements, the device checks for any abnormalities, ensuring that it is operating normally. This allows you to use the device with peace of mind, knowing that any abnormalities will be detected early.


## Features of vestaeye

- Self-diagnosis begins upon device startup, ensuring peace of mind even during measurement initiation.
- Avoid sample loss due to errors during the process by detecting anomalies before starting measurements.
- Verify the device's normal operation before executing measurements after a period of inactivity or prior to nighttime operations.
- Identify specific areas of concern when abnormalities occur in the device.
- When anomalies occur in the device, generate field support reports with just one click.
- Achieve seamless service support through clear identification of device status.

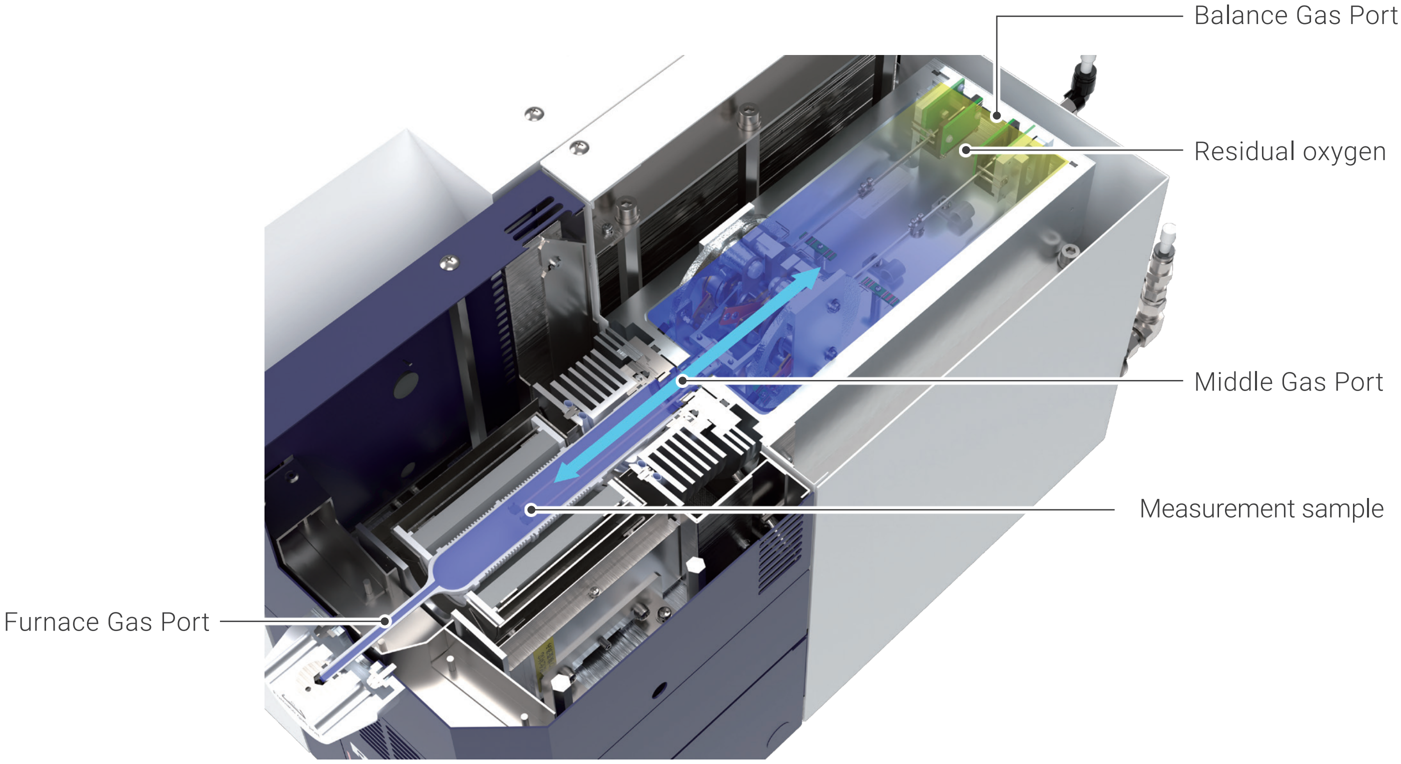
## Interchangeable Furnaces—Six Types

The STAvesta can accommodate a range of furnaces in one unit, enabling flexible operation for diverse thermal analysis needs:

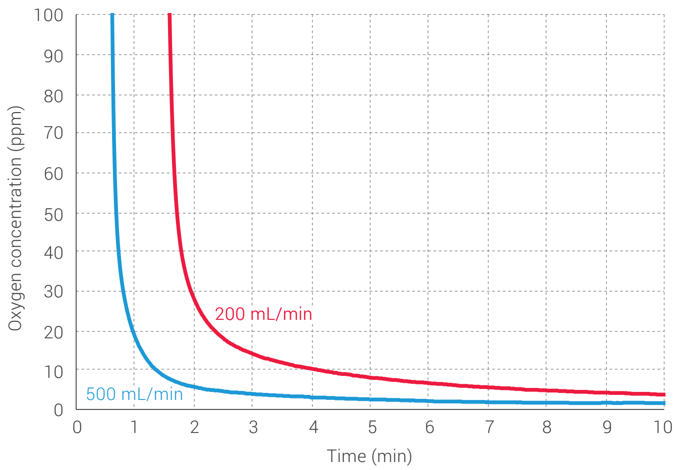


# Airtight, Optimized Furnace & Balance Chamber

Enhanced sealing and gas tubing design. Inert gas enters via the Middle Gas Port and flows both the furnace and balance chambers—preventing residual oxygen in the balance chamber from reaching the sample. Allows rapid reduction of oxygen concentration around the sample using minimal gas.

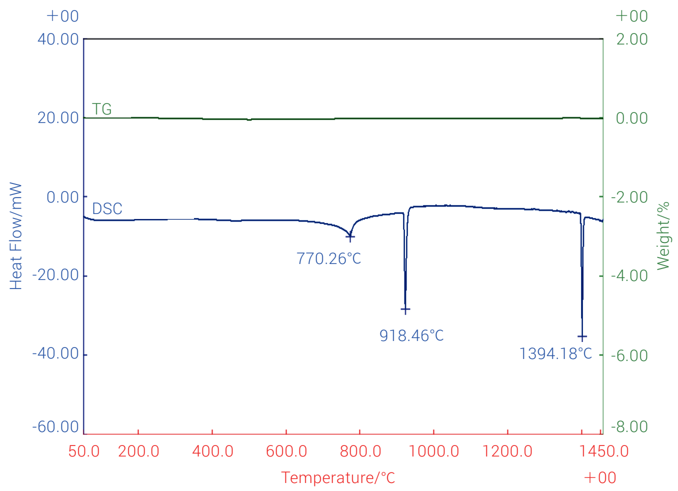



**Oxygen Concentration Change**




The start of gas flow under ambient conditions after system startup is defined as 0 min.
Instrument: STAvesta/B (with Oxygen reducing set)
Gas purity: 99.9995%
Gas tubing: From gas cylinder to Middle Gas Port: metal tubing
From Balance Gas Port to Oxygen reducing set: polyurethane tubing

**Application** Measurement of iron under an inert atmosphere

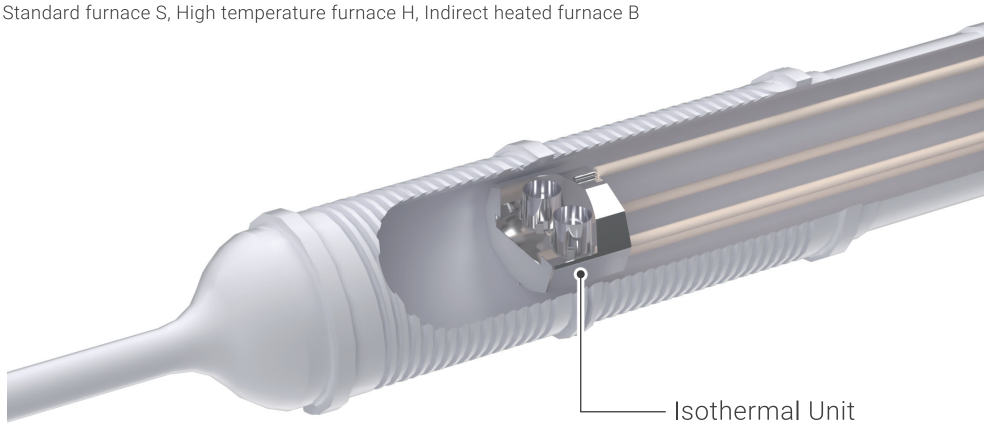



Sample: Fe, 30 mg
This result shows the measurement of high-purity iron (99.99%) under $N_2$ atmosphere.
In the DSC signal, a Curie point is observed near 770° C, and phase transitions involving crystal structure changes are seen around 918° C and 1,394° C. The TG signal shows no mass change (i.e., no oxidation), indicating that the STAvesta provides a low-oxygen measurement environment thanks to its highly airtight design.

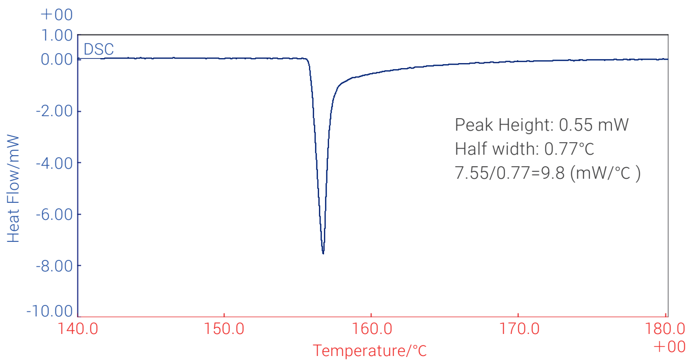
# Isothermal Unit That Greatly Improves Baseline Stability

By incorporating an isothermal unit inside the protection tube of the electric furnace*, the heat distribution around the sample is made more uniform. This effectively suppresses heat transfer by radiation and the influence of convection. As a result, baseline stability is significantly improved, enabling more accurate and reliable quantitative measurements.

*Compatible furnace types: Standard furnace S, High temperature furnace H, Indirect heated furnace B




**Temperature resolution evaluation**



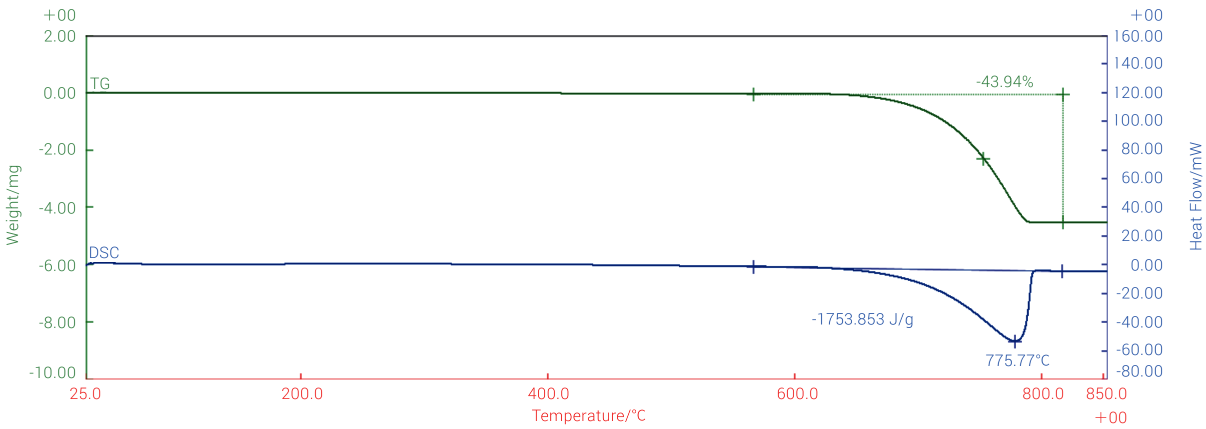

Sample: Indium, 1 mg (Al, 5 mmh open pan)
Heat. rate: 20° C/min

**Energy accuracy (σ/ave)**

| Energy (J/g) | |
|---|---|
| Meas.1 | 28.594 |
| Meas.2 | 28.48 |
| Meas.3 | 28.361 |
| Meas.4 | 28.585 |
| Meas.5 | 28.641 |
| Meas.6 | 28.448 |
| Meas.7 | 28.467 |
| Meas.8 | 28.349 |
| Meas.9 | 28.444 |
| Meas.10 | 28.402 |
| AVE | 28.504 |
| MAX | 28.769 |
| σ | 0.129 |
| σ/AVE | 0.454% |

Sample: Indium, 10 mg (crimped pan)
Reference: empty (crimped pan)
Instrument: STAvesta/H
(with Isothermal unit)

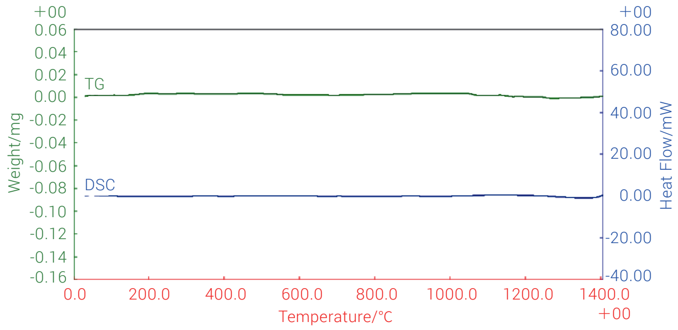
**Application** **Decarbonation Reaction of Calcium Carbonate ($CaCO_3$)**




Sample: $CaCO_3$, 10 mg
This example shows the mass loss and endothermic reaction caused by $CO_2$ release from calcium carbonate. The stable baseline enables accurate measurement of both mass change and heat flow.

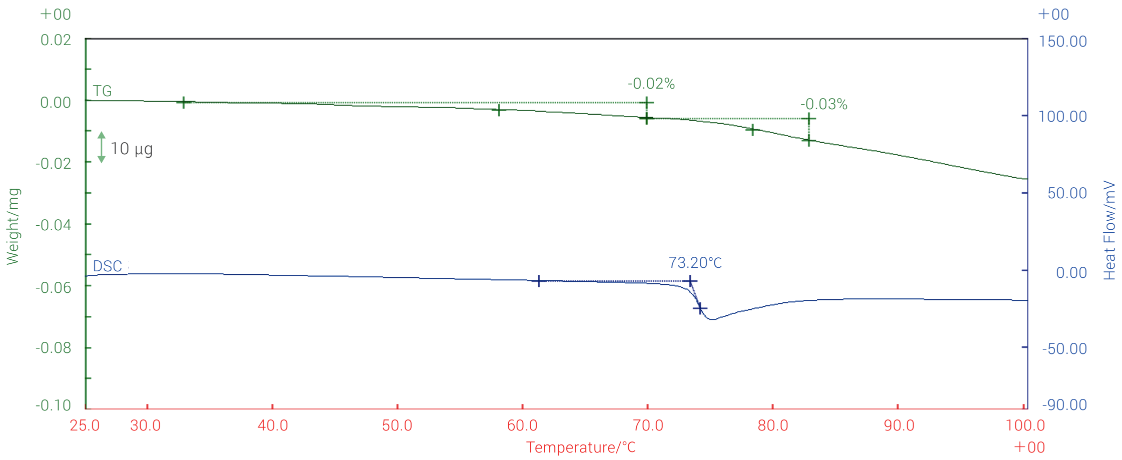
## Smart Baseline Drift Correction Balancing Reliability and Efficiency

STAvesta adopts a horizontal differential balance configuration with TG baseline reproducibility of less than 10 µg. In addition, the innovative FlatBlank function automates baseline adjustment. It corrects data intelligently to achieve a “flat baseline” without manual intervention. Even during continuous measurements using the ASC, no individual blank measurements are required. Corrections are automatically applied before measurement begins, allowing seamless transition into continuous operation—eliminating the time-consuming manual adjustments of the past.




Instrument: STAvesta/H(with isothermal unit), FlatBlank function executed
Sample pan: $Al_2O_3$, 2.5 mmh empty pan
Temp. range: Room temperature to 1,400° C
Heat. rate: 20° C/min

**Application** **Detecting minute mass changes in PET**

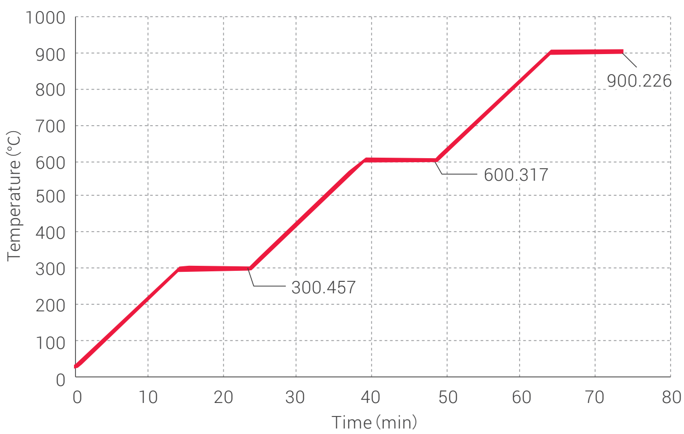



Sample: PET pellet, 25 mg
This example shows measurement results of polyethylene terephthalate (PET) under an air atmosphere. About 10 µg of total mass loss was detected, attributed to two events: volatilization of components between 30° C to 70° C, and minor gas release associated with the glass transition between 70° C to 85° C.

## Exceptional Temperature Control Performance Rapid Control + Advanced Control

The newly developed, patented Rapid Control feature enables precise tracking of the programmed reference temperature, dramatically improving the sample temperature’s responsiveness.

When combined with the newly introduced Advanced Control (Mode 2), the temperature profile more closely follows the ideal heating curve.

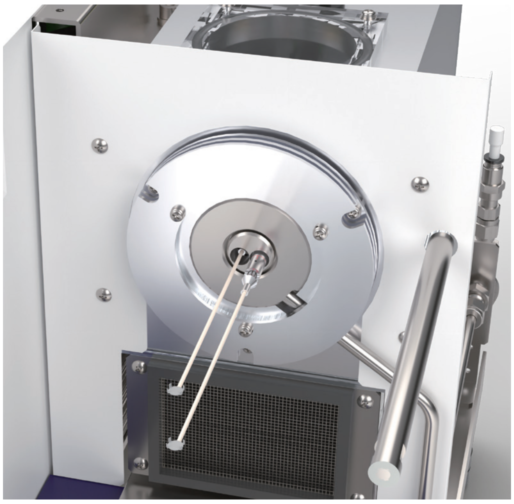



**Hold examples at 300°C, 600°C, and 900°C**
Instrument: STAvesta/H, Advanced Control (Mode 2) executed
Heat. rate: 20° C/min, 10 min hold

## Easy Sample Holder Replacement

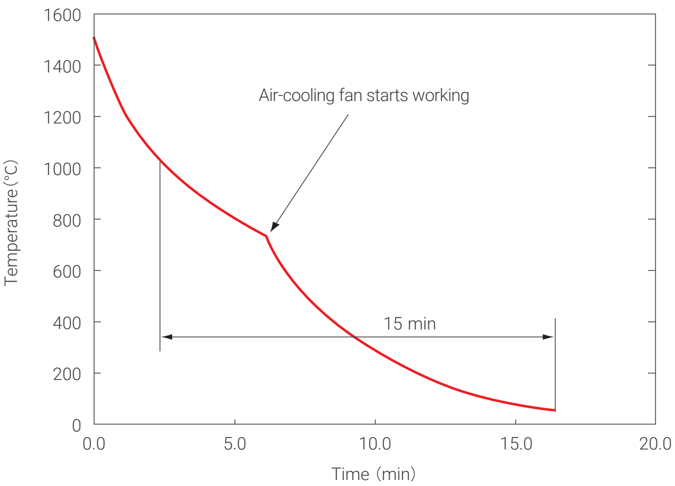
The plugin-type sample holder simplifies replacement. Maintenance is easy, even in the event of sample overflow. The holder's position can also be visually confirmed through the upper window above the balance for added safety and convenience.

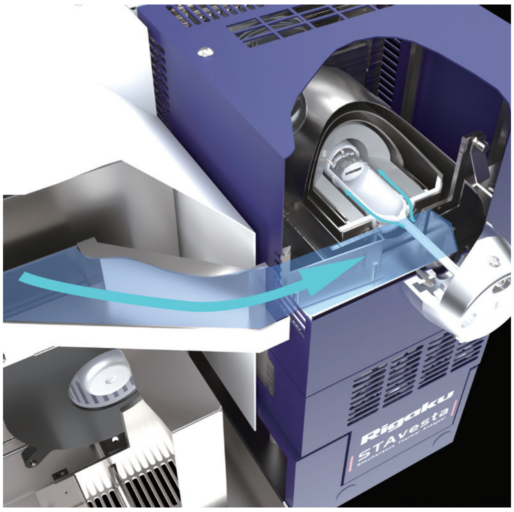
After replacement, FlatBlank automatically adjusts the baseline, allowing immediate and accurate measurements without additional steps.



## Rapid Post-Measurement Cooling

After measurement, an integrated cooling fan automatically brings the system back to room temperature. Cooling from 1,000°C to 50°C takes less than 15 minutes, supporting high-throughput operation.




## Flexible Gas and Environment Control

By connecting the 2ch-FLOW COMPO Jr., flow control of up to six different gases synchronized with the temperature program becomes possible. Additional units can also be installed after purchase to accommodate future application needs.

## Sample Observation STA

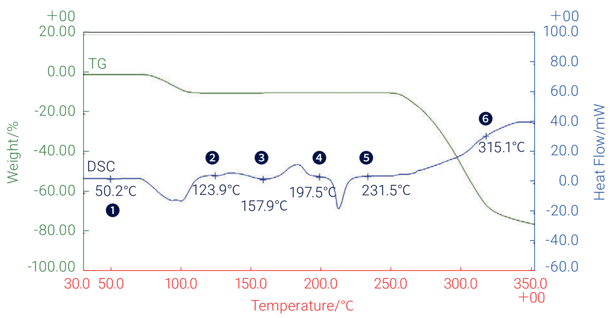
# STAvesta/C

Real-time observation of sample change


Any sample changes during measurement can be observed as they happen. The analysis results and sample images can be studied together, leading to new insights.

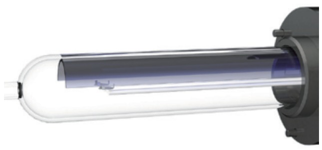
- Records the sample images clearly during measurement up to 1,000°C
- Ensures visibility with the devitrification protection unit
- Real-time observation of changes in sample shape during heating
- Corresponds with ASC's continuous measurement

**Application** Thermal behavior of disaccharide hydrate

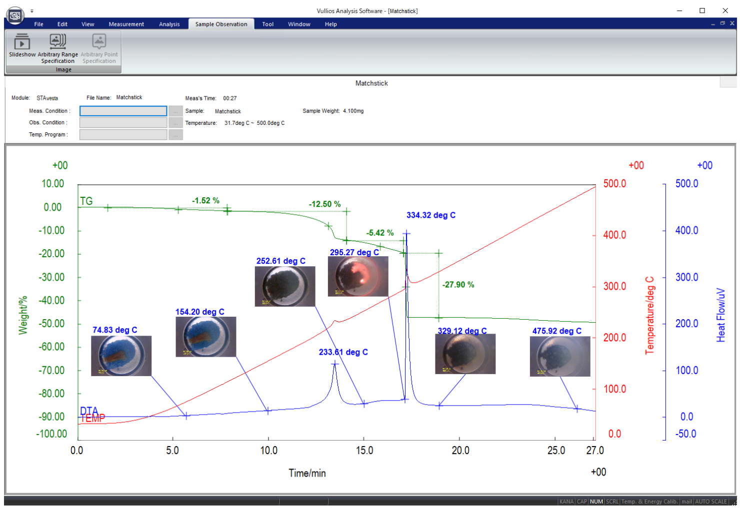



❶ Initial state | ❷ Dehydration (volumetric shrinkage) | ❸ Amorphization (liquefaction) | ❹ Crystallization (whitening) | ❺ Fusion (transparent) | ❻ Combustion (blackening, foaming)

## Devitrification Prevention Unit for Protection Tube



Gases released during sample decomposition can cause devitrification or contamination of the quartz glass protection tube, resulting in blurred observation images. By installing the devitrification prevention unit, only the replaceable devitrification prevention plate—mounted inside the protection tube—is exposed to the gas, allowing the quartz protection tube to remain in use. This helps simplify maintenance and reduce overall measurement costs.



## Compatible with Various Options

The unit can be installed alongside other options such as the ASC and evolved gas introduction interface, without interference.

## Easy Installation

Easily mountable onto the standard configuration of the STAvesta system.

You can watch example videos of measurements with the sample observation unit here

https://rigaku.com/products/thermal-analysis/sta/stavesta-sample-observation

## Humidity-Controlled STA

# STAvesta/HUM-I

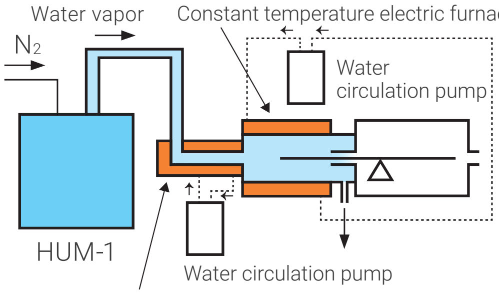

### Easy TG-DSC Measurements in Water Vapor Atmosphere

STAvesta/HUM-1 combines a simultaneous thermal analyzer with a steam generator, enabling TG-DSC measurements under water vapor atmosphere.

It employs a polymer-type relative humidity sensor and a high-precision temperature sensor to provide fast response and long-term stability in steam concentration control.

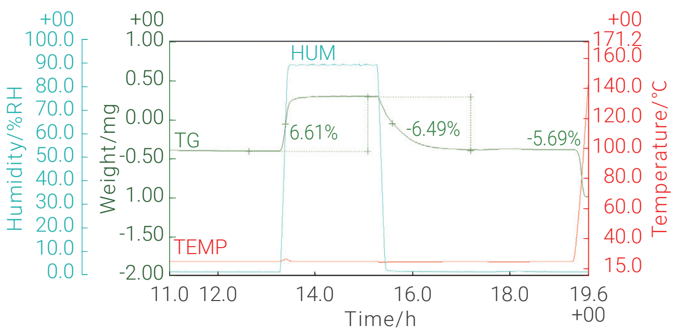
Compatible with ASC.

**STAvesta/HUM-1 system c onfiguration diagram**




**Application**

**Mass changes in α-cyclodextrin associated with change in controlled humidity**




When the relative humidity changed from 25° C dry to 25° C 90% RH, a 6.6% mass increase is observed. 6.5% mass loss is observed when RH is returned to dry conditions. When the sample was re-heated in dry conditions, 5.7% mass loss is observed.

### Refrigerated Cooling STA

# STAvesta/LR

Enables low-temperature measurements from -40° C and controlled cooling beyond conventional limits

In gas adsorption studies using $CO_2$ and similar gases, lower temperatures generally increase the amount of gas adsorbed. Therefore, measurements below room temperature are often required. STAvesta/LR meets this need by enabling evaluation from as low as -40°C, making it possible to analyze gases that are difficult to adsorb at room temperatures and to more accurately assess the performance of adsorbent materials.

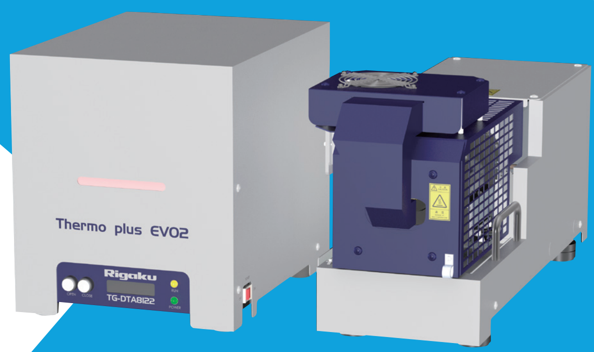
The unit also allows heating up to 700°C, making it suitable for pretreatment processes such as gas desorption from materials. By utilizing programmable heating and cooling sequences, both pretreatment and adsorption/desorption analysis can be performed in a single continuous run.

In addition, the optional automatic sample changer allows for automated, continuous measurement of multiple samples.

### Separated-Type TG-DTA

# TG-DTA8122 with Separate Controller

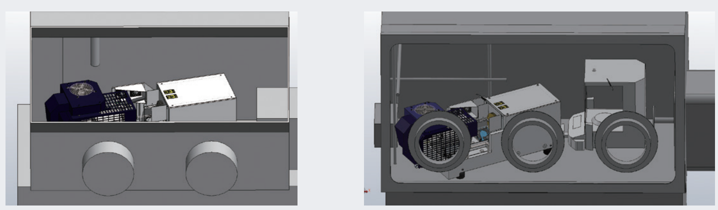
Flexible installation with separate balance and controller units




The separated design allows the balance and control unit to be installed independently, offering greater installation flexibility—including use inside a glove box.

Compatible with automatic sample changer and sample observation furnace configurations.

**Image of Installation in a glove box**



## Temperature Modulation Measurement

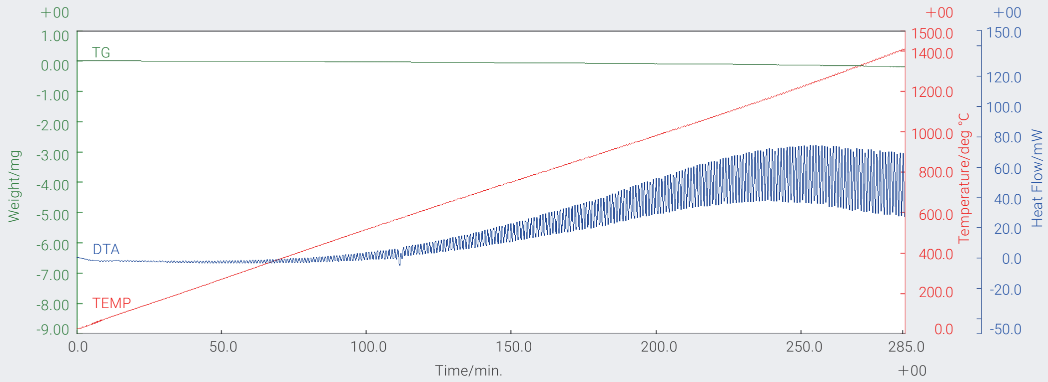
# Dynamic STA

This technique applies sinusoidal modulation to the conventional constant-rate heating program, enabling new modes of thermal analysis. With this function, specific heat capacity (Cp) measurements can be performed up to a maximum of 1500°C.*1

### Dynamic DSC with TG-DSC

Sample: Silica ($SiO_2$) powder, Heating rate: 5° C/min, Modulation period: 60 seconds, Amplitude: 2° C

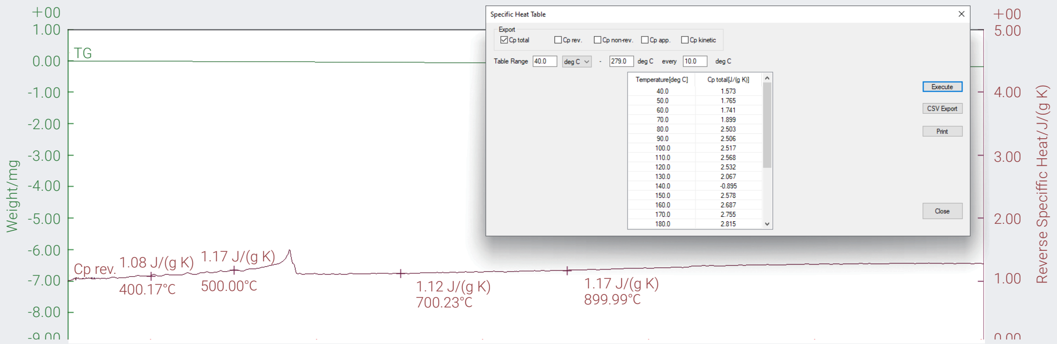
Dynamic DSC measurement result




Analysis

Quartz is known to undergo a phase transition from α-quartz to β-quartz at elevated temperatures under ambient pressure:
α-quartz → 573° C → β-quartz
The Dynamic DSC function in TG-DTA/DSC systems enables Cp measurement over a wide temperature range that is difficult to achieve using conventional DSC methods.

Dynamic DSC analysis result

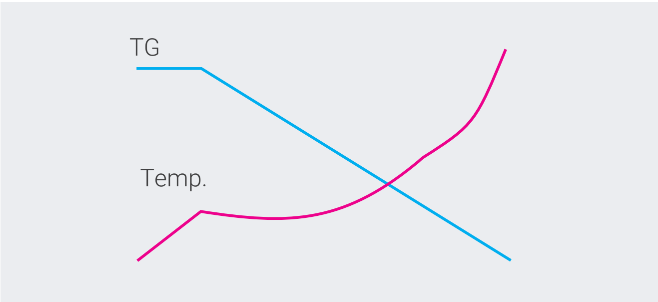



| | |
|---|---|
| Maximum heating/cooling rate | 20° C/min |
| Temperature amplitude | 0.02° C to 5° C (setting resolution: 0.01° C) |
| Modulation period | 40 s*2 to 200 s (setting resolution: 1 s) |
| Temperature range | According to furnace specifications |

*1 Maximum temperature depends on the furnace specifications
*2 Minimum modulation period setting is 5 seconds

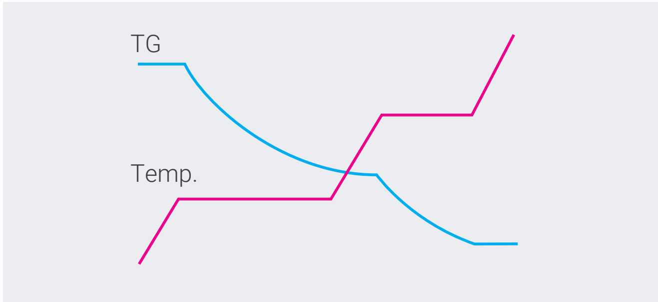
# Dynamic TG: sample-controlled thermogravimetric analysis (SCTG)

The sample's rate of mass change is used as a parameter for controlling temperature. Two measurement modes with different control methods can be selected, namely Constant Reaction Control (CRC) and Stepwise Isothermal Analysis (SIA).




**Constant Reaction Control (CRC)**

To achieve a constant DTG, the temperature is controlled automatically, and temperature decrease is also controlled. CRC is suitable for investigating reaction mechanisms, reaction-kinetic analysis and reaction simulation. This method also allows predicting the measurement duration.




**Stepwise Isothermal Analysis (SIA)**

The temperature is increased at a constant rate. When DTG exceeds the preset value, isothermal control starts automatically. When DTG is below the preset value, the temperature is increased at a constant rate.
This sequence is repeated until the reaction ends.

In the conventional constant-rate heating method, the temperature is raised according to the temperature program during reaction. Hence, if multiple reactions occur continuously, the decrease in mass appears overlapped (Fig. 2: constant-rate heating). In the dynamic TG method, the temperature is controlled according to the mass loss rate without performing forcible temperature increase and ignoring the sample’s reaction (Fig. 1).

Through this method, we can obtain data with improved separation of reactions and resolution compared to the conventional constant-heating rate method (Fig. 2).

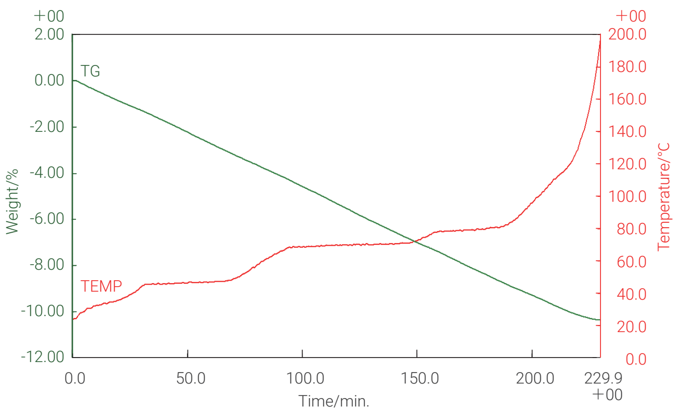



**Figure 1: Dynamic TG (CRC method) measurement results for cyclodextrin Mass decrease rate: 0.03%/min**

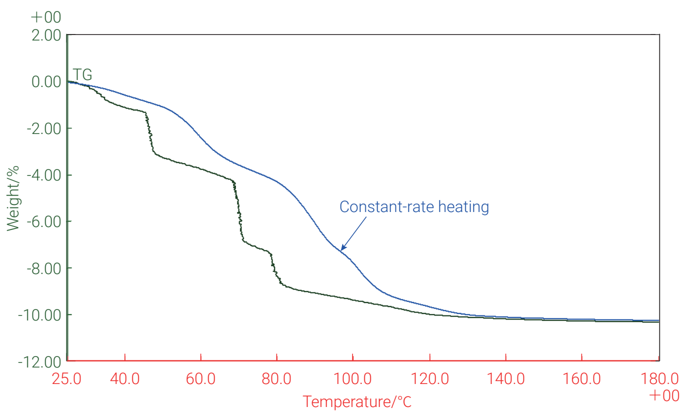



**Figure 2: Comparing cyclodextrin measurement results of constant-rate heating method and dynamic TG method (abscissa axis is temperature)**

※ Sample-controlled Thermo gravimetry

# Optional Attachment / Unit

## Evolved gas measurement

### GC-MS Interface

A powerful tool for advanced material development and quality control, allowing simultaneous acquisition of thermal and evolved gas data. This interface supports integration with mass spectrometers and GC-MS systems from various manufacturers. Gas analysis can be performed alongside thermal measurements, and sample observation furnaces are also supported.

### FTIR Interface

Thermal analysis provides temperature data, but not gas composition. By connecting an STA with an FTIR via this interface, STA-FTIR measurements enable qualitative analysis of gases evolved by decomposition or volatilization and their temperature correlation.

### SPME Attachment

Solid Phase Micro Extraction (SPME) allows for qualitative gas analysis during STA without the need for a direct interface with a GCMS system. Gases can be extracted easily using SPME fibers for simplified evolved gas analysis.
SPME requires no complex equipment and is effective for extracting samples from solids, liquids, or gases. In a temperature range where mass loss is observed, a needle is inserted into the TG exhaust port to collect gas using the SPME fiber. The fiber is then introduced into a GCMS injection port, and the collected gases are separated and analyzed via GC to identify reaction products.


# Optional Attachment / Unit

## Flow meter

The flow meter controls the flow rate of the atmospheric gas (inert gas, air, etc.) supplied in the sample chamber.

Three models with 200, 500 and 1,000 mL/min F.S. are available.

## Gas selector

The gas selector links to the measurement program and switches the internal valves to control the gas flowing into the sample chamber.

Note: Flow meter is an optional unit. Please contact us for details on the flow rate and gas type.

## 2ch-FLOW COMPO Jr.

Enables gas flow, flow rate setting and switching of gases with precision specified in the measurement program. Gas types and full scale can be selected.


## Oxygen-reducing set

This kit enables rapid reduction of residual oxygen concentration by flowing inert gas through the system. An included air pump also allows airflow when required.

## Tabletop vibration isolation table

Ideal for conducting STA measurements in places with high levels of vibration.

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## Automatic Sample Changer (ASC)

The automatic sample changer enables up to 1,000 consecutive measurements by automatically replacing sample pans. This significantly contributes to automation and high-throughput analysis.

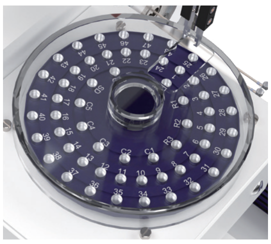
The sample tray section, where samples are placed, comes standard with a gas-flow design. During standby, gas can be flowed over the sample area to minimize contact with the atmosphere. This feature is particularly effective for moisture-sensitive powder samples, ensuring more reliable measurement results.

## ASC Safety Cover

A standard accessory, this safety cover is designed to reduce mechanical hazards associated with the operation of the automatic sample changer. An electromagnetic lock prevents the cover from being opened during ASC operation or active measurement, thereby preventing accidental contact with moving components.

## ASC Safety Full Cover

This optional full cover provides additional protection by enclosing not only the ASC but also the furnace drive mechanism. It minimizes overall system risks, including pinch-point hazards and contact with heated or moving parts.




# Specifications and Utilities

## Specification

| Model name | Thermo plus EVO3 | | | | | | Thermo plus EVO2 |
|---|---|---|---|---|---|---|---|
| | STAvesta | | | | | | TG-DTA8122 |
| | Sample observation | Standard | High temperature | Indirect heated | Refrigerated cooling | High concentrate water vapor | TG-DTA with Separate controller |
| | C | S | H | B | LR | HUM | |
| Measurement temperature | Room temperature to 1,100° C*1 | Room temperature to 1,100° C | Room temperature to 1,500° C | Room temperature to 1,500° C | -40° C to 700° C | Room temperature to 1,400° C | Room temperature to 1,500° C |
| range | 100°C/min | | | 50°C/min | 20°C/min | 20°C/min | 100°C/min |
| Balance system | Horizontal differential triple coil balance system | | | | | | |
| Sample amount (max) | 1 g (90 µL) | | | | | | |
| TG range | ±500 mg | | | | | | ±250 mg |
| DSC range | ±600 mW (100°C) , ±1,400 mW (1,000°C) , ±3,000 mW (1,500°C) | | | | | | — |
| DTA range | ±1,000 µV | | | | | | |
| TG sensitivity / noise level (RMS) *2 | 0.18 µg/0.09 µg | | | | | | — |
| DSC sensitivity / noise level (RMS) *2 | 10 µW/5 µW | | | | | | — |
| Temperature accuracy*2 | ±0.2°C | | | | — | — | — |
| Energy precision (σ/ave.) *2 | ±1% | | | | — | — | — |
| Temperature precision (σ) *2 | ±0.05°C | | | | — | — | — |
| Specific heat precision *2 | — | ±3% | | — | — | — | — |
| TG baseline drift volume *2 | <10 µg (up to 1,000° C), <20 µg (up to1,400° C) | | | | — | — | — |
| Measurement atmosphere | Air, inert gas, vacuum*3 | | | | Dry gas (Simulated air, inert gas $N_2$, Ar, He) | Inert gas ($N_2$), humid atmosphere | Air, inert gas, vacuum*3 |
| Isothermal unit | Not compatible | Option | | | Not compatible | Not compatible | Not compatible |
| Self-diagnostic function | Yes | | | | | | No |
| Blank auto-adjustment function | Yes | | | | | | No |
| ASC*4 | Automatic sample changer (Sample: 52, reference: 3, calibration sample: 5) | | | | | | |
| ASC safety cover | Standard accessory | | | | | | — |

*1 For sample observation measurement: up to 1,000° C *2 Under Rigaku's condition *3 Not compatible with ASC measurement *4 Option

| Model | HUM-1 |
|---|---|
| Humidity generation method | Bubbling bath/dry gas combination method |
| Humidity range | Room temperature to 80° C, dry to 90% RH |
| Gas | Dry $N_2$ |
| Humidity sensor | Polymer type relative humidity sensor |
| Temperature measurement element | Pt resistance temperature sensor |
| Duration for continuous humidity | 100 hours at 60° C, 90% RH, 40 hours at 80° C, 90% RH |

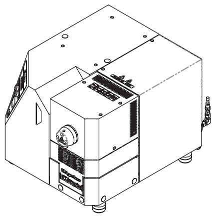
## Utility

| | |
|---|---|
| **STAvesta** | Single phase 100-240 VAC, 50/60 Hz, 15 A, grounded 1-socket outlet |
| Refrigerated cooling unit | Single phase 100 VAC, 50/60 Hz, 15 A, grounded 1-socket outlet |
| HUM unit | Single phase 100 VAC, 50/60 Hz, 5 A, grounded 1-socket outlet |
| **TG-DTA with Separate controller** | Single phase 100-240 VAC, 50/60 Hz, 15 A, grounded 1-socket outlet |

Current value is the maximum current rating when connected to the 100 V power source.

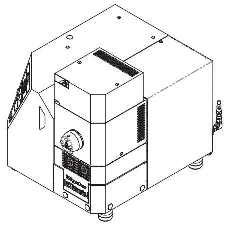
# Dimensions

## STAvesta
Mass : 45 kg



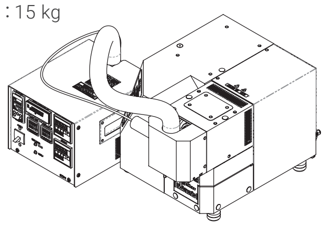
W412×D561×H355 mm

## STAvesta/C (Sample observation)
Mass : 47 kg



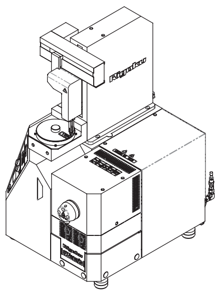
W412×D561×H456 mm

## STAvesta/HUM
Mass : 50 kg
(HUM-1)
Mass : 15 kg



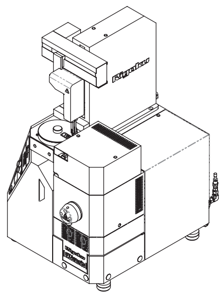
W412×D621×H355 mm
(HUM-1) W290×D350×H260 mm

## STAvesta+ASC
Mass : 55 kg



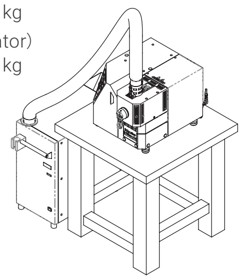
W412×D561×H705 mm

## STAvesta/C+ASC
Mass : 57 kg



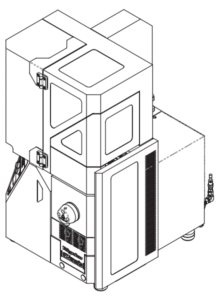
W412×D561×H705 mm

## STAvesta/LR
Mass : 50 kg
(Refrigerator)
Mass : 61 kg



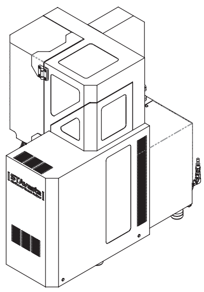
W412×D601×H422 mm
(Refrigerator) W295×D500×H570 mm

## STAvesta+ ASC safety cover
Mass : 61 kg



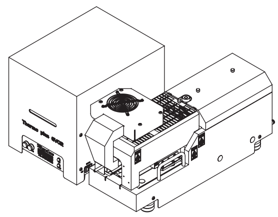
W435×D561×H727 mm

## STAvesta+ ASC safety full cover
Mass : 65 kg



W434×D720×H727 mm

## TG-DTA with Separate controller
Mass : 31 kg (Main unit 18 kg, Control unit 13 kg)



Main unit W208×D625×H299 mm
Control unit W275×D355×H318 mm

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