TA Instruments

# THERMAL ANALYSIS

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# SDT Q600 **SPECIFICATIONS**


The Q600 provides simultaneous measurement of weight change (TGA) and true differential heat flow (DSC) on the same sample from ambient to 1,500 °C. It features a field-proven horizontal dual beam design with automatic beam growth compensation, and the ability to analyze two TGA samples simultaneously. DSC heat flow data is dynamically normalized using the instantaneous sample weight at any given temperature.

| | |
|---|---|
| System Design | Horizontal Balance & Furnace |
| Balance Design | Dual Beam (growth compensated) |
| Sample Capacity | 200 mg (350 mg including sample holder) |
| Balance Sensitivity | 0.1 µg |
| Furnace Type | Bifilar Wound |
| Temperature Range | Ambient to 1500 °C |
| Heating Rate – Ambient to 1000 °C | 0.1 to 100 °C/min |
| Heating Rate – Ambient to 1500 °C | 0.1 to 25 °C/min |
| Furnace Cooling | Forced Air (1500 to 50 °C in < 30 min, 1000 °C in 50 °C in < 20 min) |
| Thermocouples | Platinum/Platinum-Rhodium (Type R) |
| Temperature Calibration | Curie Point or Metal Standards (1 to 5 Points) |
| DTA Sensitivity | 0.001 °C |
| Calorimetric Accuracy/Precision | ± 2% (based on metal standards) |
| Mass Flow Controller with Automatic Gas Switching | Included |
| Vacuum | to 7 Pa (0.05 torr) |
| Reactive Gas Capability | Included – separate gas tube |
| Dual Sample TGA | Included |
| Auto-Stepwise TGA | Included |
| Sample Pans | Platinum: 40 µL, 110 µL<br>Alumina: 40 µL, 90 µL |

# SDT TECHNOLOGY

## Thermobalance

The Q600 features a highly reliable horizontal dual-balance mechanism that supports precise TGA and DSC measurements. It delivers superiority in weight signal measurements (sensitivity, accuracy and precision) over what is available from single beam devices, since the dual beam design virtually eliminates beam growth and buoyancy contributions to the underlying signal. It also uniquely permits independent TGA measurements on two samples simultaneously.

## Temperature Control and Measurement

A matched Platinum / Platinum-Rhodium thermocouple pair within the ceramic beams provides direct sample, reference, and differential temperature measurements from ambient to 1,500 °C. This results in the best available sensitivity in detection of thermal events. Curie Point or pure metal standards can be used for single or multi-point temperature calibration. Calibration of the DSC signal with sapphire standards results in a differential heat flow (DSC) signal that is intrinsically superior to that from single beam devices.

## Furnace

The Q600 features a rugged, reliable, horizontal furnace encased in a perforated stainless steel enclosure. The design ensures accurate and precise delivery of programmed and isothermal operation over the full temperature range from ambient to 1,500 °C. The design also provides for operator ease-of-use due to its automatic furnace opening / closing, easy sample loading, and rapid post-experiment furnace cool-down.

## Purge Gas System

A horizontal purge gas system with digital mass flow control and integral gas switching capability provides for precise metering of purge gas to the sample and reference pans. The design produces better baselines, prevents back diffusion, and efficiently removes decomposition products from the sample area. A separate Inconel® gas inlet tube efficiently delivers reactive gas to the sample. The Q600 exhaust gas port can be readily connected to a MS or FTIR for component identification purposes.

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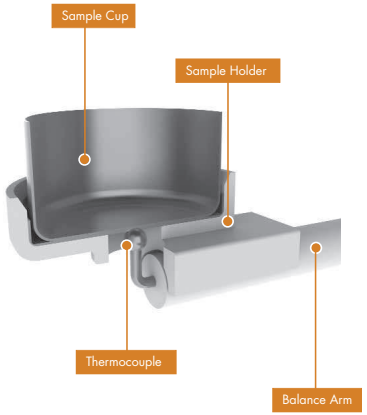
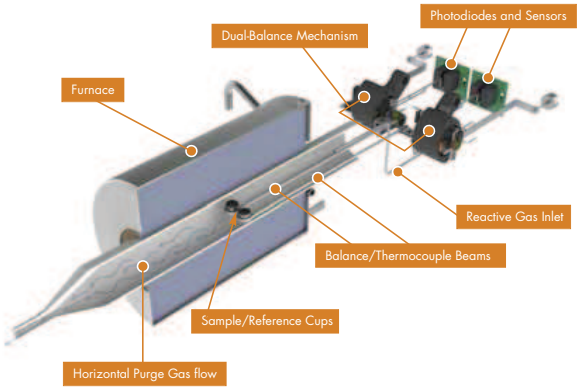



## High Resolution SDT

If separation of closely related weight losses is required, the Q600 offers an automated version of StepWise Isothermal (SWI), the classical technique for improved TGA resolution. The stepwise isothermal approach consists of heating at a constant rate until a weight change begins (as determined by an operator-chosen rate or amount of weight loss) and then holding isothermally until the weight change is complete. This sequence of heating and isothermal steps is repeated for each weight change encountered. The result is optimum weight loss resolution.

## Temperature Calibration and Weight Loss Verification

TA Instruments offers the widest range of ICTAC certified and NIST traceable Curie Point reference materials that provide SDT apparatus temperature calibration over the range from 150 to 1,120 °C. TA Instruments also offers certified Mass Loss Reference Materials for validation of SDT instrument performance.

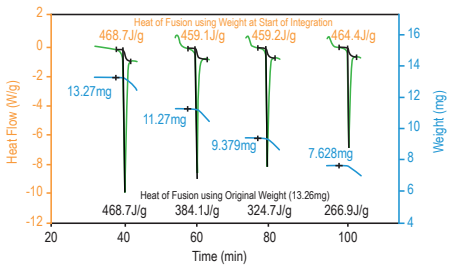
## Q600 Sample Pans

Platinum pans (40 and 110 µL) and ceramic cups (40 and 90 µL) are available for use with the Q600. The platinum cups are recommended for operation to 1000 °C, and for their general inertness and ease of cleaning. The ceramic cups are advised for operation to 1,500 °C, and for samples that react with platinum.

# APPLICATIONS

## Improved DSC Data

In SDT experiments, superior accuracy in DSC data is obtained when the instantaneous weight (rather than the initial sample weight) is used in heat flow calculations. This figure shows data for sodium chloride (which loses weight on heating) cycled through its melt four times, and the heat of fusion (J/g) determined using the instantaneous weight. The accompanying table shows a comparison of this data versus an identical experiment where the initial sample weight was used for calculating the DSC data in each cycle. The differences in reproducibility are significant.




| | Cycle 1 | Cycle 2 | Cycle 3 | Cycle 4 |
|---|---|---|---|---|
| Heat of Fusion Initial Weight (J/g) | 468.7 | 384.1 | 324.7 | 266.9 |
| Heat of Fusion Instantaneous Weight (J/g) | 468.7 | 459.1 | 459.2 | 464.4 |

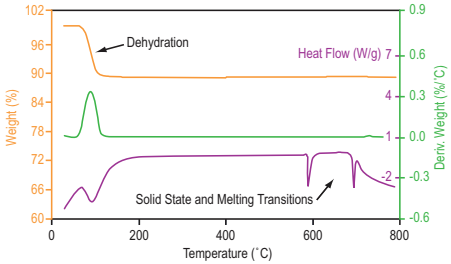


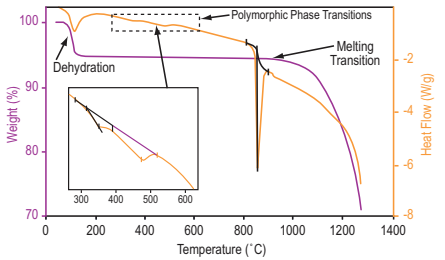
## High Sensitivity

This figure shows a high sensitivity application of the Q600 in which a small (3 mg) sample of sodium tungstate is analyzed at 10 °C/min from ambient to 800 °C. The TGA and derivative TGA (DTG) signals quantitatively record the dehydration step. The DSC trace quantitatively shows the loss of water plus higher temperature solid state phase and melting transitions respectively. The latter pair are thermal events where no weight loss occurs.

## Simultaneous DSC/TGA

This figure contains simultaneous DSC and TGA data to 1,300 °C for a soda ash sample. The TGA signal measures the dehydration and the onset of a higher temperature decomposition. The DSC signal reveals transitions associated with the dehydration, a polymorphic phase transition and the high temperature melt. The inset shows details about the phase transition. In the Q600, heat flow integrations are automatically normalized using the dynamic weight at the start of each transition.

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