

Specification Requirements for High Pressure Thermogravimetric Analysis (HP-TGA) System

CLIN 0001

High Pressure Thermogravimetric Analysis (HP-TGA) System

1. Temperature control for the entire system must be within $\pm 0.1^{\circ}\text{C}$ up to 80°C and within $\pm 0.5^{\circ}\text{C}$ above 80°C .
2. The operational pressure range must be at least from 150 bars (up to 750°C) down to at least 1×10^{-6} mbar for vacuum studies and sample evacuation.
3. The instrument must include a RMS1 Rubotherm balance Magnetic Suspension Balance including metal balance housing and complete control system for contactless weight change measurements which must have 8gm. max sample weight and 1 microgram sensitivity.
4. The sample cell of the instrument must be made of a single block of Rene 41 and incorporate a liquid N_2 (LN2) cooled furnace with a standard temperature range for sorption testing of at least -150°C to 750°C (1000°C for sample pre-treatment).
5. The LN2 Cooling System must provide programmable temperature control for the entire HP-TGA system from -150°C to 600°C and include a liquid nitrogen Dewar, automatic level control of liquid nitrogen in this Dewar, and a 230L LN2 bulk tank (with wheels and handle) for LN2 supply to the automatic level control Dewar.
6. A sample transfer system that provides sample handling for air sensitive samples also must be included. The transfer system must consist of two components: (1) gas tight container for sample holder and sample that can be taken into and out of an inert atmosphere glovebox under vacuum and (2) mini-glove chamber surrounding high pressure sample chamber that would allow inert atmosphere loading of the air-sensitive sample into the test chamber of the HP-TGA system.
7. The HP-TGA system must also include a thermally-controlled flow-dosing manifold made of SS 316 which consists of two mass flow controllers (0-200 cc, STP/min), and SS 316 vaporizers with platinum resistance thermometers for measuring the temperature of the organic (or water) liquid plus a back pressure regulator and by-passing tubes for evaporators. The flow-dosing manifold must be capable of operating across the pressure range of the instrument. All joints in the manifold must be welded or have VCR or VCO high vacuum/pressure connectors. Two pressure transducers must be provided: one with a range of 155 bars with an accuracy of 0.04% of range and a capacitance-type transducer with an accuracy of 0.15% of reading and a range of 1.3 bars. The low-pressure transducer must be isolated from high-pressure by an automated high-pressure

- valve. All valves must be high vacuum bellows type. It must be possible to use a large variety of adsorbates (such as ethanol, methanol, benzene, hexane, water, etc) to dew points up to 50°C in this system.
8. The system must also be equipped with a pressure amplifier (i.e. intensifier) for adsorbate gas pressurization, which will enable lower supply gas to be pressurized up to 150 bar .
 9. The HP-TGA system also must include a computer/controller with control and analysis software. The computer system must provide full controls for the instrument, collect all the necessary sorption data, store it, and must have a complete suite for the analysis of sorption data. This package must include the following programs:
 - Isotherm fitting by BET, Langmuir and GAB equations.
 - Surface area calculations using BET and Langmuir methods for both water and organic adsorbates.
 - Enthalpy of adsorption using Clausius-Clapeyron Equation.
 - Kinetic analysis of sorption data using linear driving force (LDF) mass transfer model.
 - Diffusion coefficients using the $t^{0.5}$ and moments method.
 - Calculation of vapor transmission rates using a permeability cell.

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10. 1 Year Standard Commercial Warranty with full parts and labor guarantee