

## LIMITED TENDER

### To acquire A High Temperature Thermal analysis system capable of carrying out high precision TG/DSC/DTA Analysis simultaneously till 1600° C under corrosive atmosphere.

The Department of Materials Engineering, the Indian Institute of Science desires to acquire a thermal analysis system for their ongoing programme on new high temperature alloy development. The system to be acquired should be able to provide high quality data on environmental degradation under exposure to highly corrosive gases containing sulphur, oxygen, hydrogen and other gases including steam and hydrocarbons at temperatures better than 1600C. The primary measurements that we like to conduct are simultaneous thermogravimetric and thermal analysis measurement (high temperature DSC/DTA) that also include accurate measurement of heat capacity. The system should be capable of undertaking measurement both under isochronal and isothermal conditions with high stability for long term measurements. Same system platform should also enable carrying out thermo-mechanical measurements including measurement of CTE at high temperatures. The detailed specifications are given below.

#### Specifications of Thermal Analyzer:

#### TG – DSC / DTA/TMA/Dilatometry

System	<p>i) Thermal analysis system capable of simultaneous measurements of DSC-TGA and DTA-TGA as well as standalone TGA up to a temperature 1600°C or better.</p> <p>*ii) Thermo-mechanical measurement attachment, in particular having capability of measuring accurately coefficient of thermal expansion and mechanical properties under condition of thermal cycling. The attachment should be part of the same platform and same furnace system for accurate mapping of TMA results with TGA/DTA/DSC measurements.</p> <p>*iii) The system should be capable of measurements at high temperatures under the flowing environment of corrosive gases containing sulphur (SO<sub>2</sub>/H<sub>2</sub>S), ammonia/N<sub>2</sub>, hydrogen as well as environments containing oxygen with different partial pressure and steam. Simultaneous <b>TGA/DSC/DTA measurement under humid gas, 100 % pure corrosive gases (SO<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub> gases etc.) or mixture of corrosive gases with integrated MFCs for accurate gas flow is essential requirement.</b> Please mention the minimum ratio of inert carrier gas to corrosive gas the system can handle for long term measurement. A minimum of 10:90 ratio is required. The experiments demand measurements be carried out under both isothermal conditions as well as condition of thermal cycling (500°C to 1400° C) for extended period of time for evaluating superalloys and other high temperature alloys. Quick switching over of gaseous atmosphere in the furnace chamber is required. Gas flow rate range should be 10 to 200 ml/min or more for each purge gas in sample chamber, controlled by mass flow meter.</p>
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\*iv) The actual measurement system should be isolated and protected from the corrosive gas environment through a flow of inert gas. **For the same reason, the furnace heating elements should be nonmetallic and as far as possible chemically inert (non-corrosive heating elements). The same furnace should handle both low temperature (~500°C) and high temperature (1600°C) for continuous measurement.** Optional availability of high temperature furnace up to ~2000°C for future upgrade will be preferred and should be mentioned.

vi) Capability of controlled variable heating rate of 0.1°C to 50 °C/min for entire range. The furnace also should have controlled cooling rate at high temperatures (please mention the rate).

vii) Range of sensors to suit different temperature range for DSC/DTA measurements. Sensors should be shielded to protect from the exposure of the corrosive gases

viii) For TG analysis, the balance should be capable of handling sample weighing equal or greater than 10gm.

The resolution of the balance should be ~0.2µg or better. Mentioning of the balance drift is essential.

**ix) DSC features**

Nature of DSC:	Hear flux type
DSC reproducibility	1mW or better
DSC enthalpy accuracy	+/- 5 % (across the full range)
Temperature resolution	+/- 0.5 °C (across the full range)
Temperature accuracy/ Reproducibility	better than 0.5°C
Crucible volume	100 µl (min.)

Cp measurement up to 1400 C, or better, with +/-2 % accuracy, to be supplied with Cp calibration standard and software.

**x) TMA/Dilatometry**

Temperature Range	RT to 1500° C
Temperature precision	1° C
Sample length	till 20 mm (mention the minimum sample length needed for measurement)
Sample diameter	max. 14 mm (mention the min.)
Measuring range	+/- 2 mm
Resolution over the entire measuring range	10 nm or better
Standard sample	Alumina

	<p><b>Note: TMA should be under same software and hardware platform and not a separate standalone system</b></p> <p>xi) Please mention in details the control and display systems available in the platform.</p> <p>xii) All the essential analytical tools and software should part of the system</p> <p>xiii) all the essential systems and items like cooling system, vacuum system should be explicitly stated.</p> <p>xiv) Accessories like crucibles (Alumina/Platinum/Graphite), Sapphire standard samples, Kalrez O-rings for the corrosive gases, temperature calibration kit, Pt basket for TGA should be mentioned and quoted for at least two years of operation.</p> <p>xvi) All possibility of expansion including advanced software, steam generator and necessary adopters for future expansion should be given as optional item.</p>
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- **Critical requirement**

**Please note that the system should be guaranteed to withstand long term experiments particularly for simultaneous TG/DSC/DTA experiments. For isothermal experiments, the experimental time for a sample will be more than 100hours at 1400°C and for thermal cycle experiments better that 1000 cycle under the gaseous environments mentioned in the specification. A specific statement for the consideration of the expert committee on this count is necessary. As the requirement of the experiments is stringent, the expert committee is also empowered to make judgment on suitability and can relax or strengthen the specification beyond the existing one with justification to arrive at the final decision. The vendor needs to give specific compliance statement for all the sixteen items mentioned in the quote for being eligible for the consideration by the committee.**

Other conditions

1. A two part sealed quotations covering technical details and financial bid need to be submitted.
2. In the technical bid, individual compliance statement for all the items mentioned in the specifications (1-16) must be provided. In case compliance is not there please mention clearly.
3. Vendor can provide reasons and justification for not compliance for the technical committee to consider. However, final decision of the technical committee will be final.
4. Once technical committee short list the tenders on technical ground, the financial bids only of the shortlisted ones will be opened by the purchase committee.
5. The last date for receiving the bid is **15<sup>th</sup> February 2017**.