

**Technical specifications for
High Temperature Thermal Diffusivity and High
Temperature DSC and Cp measurement**

(The Bidder Should Quote for both items together)

**Required mandatory specifications
(all the conditions should be met)**

Note: High Temperature Thermal Diffusivity and High Temperature DSC and Cp measurement setup should be quoted together by the same company.

High Temperature Thermal Diffusivity setup technical specifications

S.No.	Parameter	Description
1	Temperature range	RT – 1600 °C provision for adding high temperature furnace beyond 1600 °C is mandatory
2	Furnace Type	Vertical, Motorized double hoist
3	Temperature Accuracy	± 1 °C
4	Isothermal Stability	0.02 °C/min or better
5	Heating rate	1. to 50 °C/ min Heating rate lower or higher than the aforementioned value can be quoted if there is a possibility
6	Measuring System	Single Pyrometer to measure the entire range
7	Thermal Diffusivity range	0.01 mm ² /s to 1000 mm ² /s
8	Thermal Conductivity range	0.1 W/(m.K) to 2000 W/(m.K)
9	Accuracy	Thermal diffusivity: ± 3% or better (over the entire temperature range)
10	Sample Dimensions	Ø: varying from 5 mm to 25 mm 1. mm to 6 mm thickness (minimum and maximum permissible diameter and thickness of the samples should be quoted)
11	Sample Holder	Sample holder details must be clearly provided
12	Atmosphere	Inert, Oxidizing – details may be provided
13	Detector	System should work with a highly sensitive IR-detector for measuring the temperature rise on the back surface. IR detector system shall be used over the entire temperature

		range. No Mirror shall be used on the detector side.
14	Laser System	Variable energy up to 25 J/pulse or better and pulse width between 0.1 ms and 1.5 ms A glass fiber optics must be implemented for an improved homogenization of the laser beam.
15	Pulse width	The laser pulse width must be approximately 0.1 ms to 1.5 ms in steps of 0.01 ms. The width should be nearly uniform over the entire pulse (from bottom to half width) so that a sharp and defined peak with negligible tailing results.
16	Pulse mapping	The system must be equipped with a pulse mapping device to measure the actual pulse shape for each individual laser pulse
17	Laser class	Should conform to laser class 1
18	Additional specifications	The instrument should be vacuum-tight by design. The detectors (and the furnaces) of the system shall be user-exchangeable to accommodate any future application.
19	Software	<ul style="list-style-type: none"> • Software should be freely able to communicate with PC/workstation with MS-windows 10 or higher operating system. • A free license for the system software should be provided with the equipment. • License for both machine control and processing software should be included with the system. • The software shall operate the instrument in the fully automatic or manual mode • The software should allow a data export in different export formats including pdf, emf, tif, jpg or bmp. • The software should include at least four (4) baseline corrections (including shifted baseline). It should be possible to modify and change the baseline correction in subsequent analysis. • The software should have a model for correction of radiation heat transfer simultaneously to finite pulse and heat loss corrections

		<ul style="list-style-type: none"> • The software should have a heating function which allows for rapid heating of the furnace outside the scope of a measurement, e.g., for thermal pre-treatment of samples or for cleaning purposes • The software should allow specific heat determination on the basis of a comparative method. For C_p calculation the pulse has to be integrated over the time period to measure the energy input. This means the real pulse energy is considered. • The software must have the capability of correcting the experimental data for the finite pulse width of the laser and radial and facial heat loss simultaneously (based on a non-linear regression routine and an improved heat diffusion model (Cape-Lehman)) • Least square fits • Pulse Correction: Exponential, Numerical, Center of gravity • Baseline Correction: Linear, Horizontal, Vertical shifted • Detection area (0 to 100%) • Illumination area (0 to 100%) • Software models: Parker, Cowan5, Cowan 10, Azumi, Clark-Taylor, Cowan • Simultaneous correction of finite pulse width and radial and facial heat loss(improved Cape-Lehman method)
20	<p>Documentation requirement The following documentations should be provided (one set of each in English)</p>	<ul style="list-style-type: none"> • Operation manual • Software instruction manual • Maintenance, troubleshooting and safety guidelines manuals • Manuals to handle accessories and guidelines • Occupational Health and Safety (OHS) guidelines and warnings
21	Warranty	<ul style="list-style-type: none"> • Minimum warranty for 1 year • Possibility of extending the warranty beyond the mandatory period should be clearly mentioned with

		<p>the appropriate cost.</p> <ul style="list-style-type: none"> • Bidder should have provision for a continuous Annual Maintenance Contract upon the completion of warranty period.
22	Inspection, installation, commissioning and training	<ul style="list-style-type: none"> • All the essential requirements ensuring a ready-to-use set up at IIT Madras should be supplied. • Comprehensive training for research fellows/students should be imparted upon installation
23	Spares, consumables, mandatory accessories and standard feedstocks	<ul style="list-style-type: none"> • Bidder should offer a list of essential spare parts and accessories with their part numbers • Bidder should also ensure that the spare parts and accessories should be made available to procure for a smooth operation over at least 15 years from the date of installation.
24	Additional mandatory conditions	<ul style="list-style-type: none"> • A continuous operational support to IIT Madras should be provided without any additional cost during the warranty period • There should be a minimum of two visits per year during the warranty period by the service engineer and application engineer of the equipment supplier (preferably from OEM). • The total cost of the system should be inclusive of these visits. • The bidder should have supplied at least one same model machine to IITs/NITs/other CFTIs/National laboratories/government organizations. • A global reference list as well as user list in India should be enclosed. • The operational status of all the equipment in India should be provided. • Total weight of the system • Special design/provision should be made to prevent accidents while in operation. • Safety manuals and charts should be provided. • Supplier should provide safety training at the time of installation. • A preinstallation instructions should be provided with the equipment, indicating electrical, space, gas connections and safety protocols should be provided.

25	Supplier service support	Supplier should have office, service center and application lab in India.
Additional mandatory requirements:		
<ul style="list-style-type: none"> • Proof of technical competency with at least one similar equipment supplied, installed, maintained, within ten years which are currently working elsewhere (IISc/IITs/IISER/NITs/Central Universities/DRDO/CSIR and other government Labs), shall be submitted along with the offer. • The proof that the bidder was not blacklisted previously in any of government institutions and organizations. • A detailed compliance statement, clearly indicating the compliance (or deviation) against each technical specification to above mentioned specifications should be provided along with technical and financial quotes in separate covers • Financial bids should be provided as a modular bid with a list price for each and individual item. Price should be in CIF Chennai. 		

High Temperature DSC and Cp measurement setup technical specifications

Required mandatory specifications (all the conditions should be met)

S.No.	Parameter	Description
1	Principle of operation	Heat Flux based principle. To study Specific Heat Capacity, Phase Transitions, Glass Transition Temperatures, Melting and Crystallization behavior.
2	DSC Temperature range	RT to 1500°C. Equipment should have provision in future for upgrading to high Temperature studies beyond 1500 °C either by exchanging the furnace or carrier arm to hold the second furnace.
3	Furnace	Metallic furnace like Platinum for withstanding high temperature up to 1500 °C
4	Temperature Accuracy	± 1°C or better
5	Temperature Precision	± 0.3 °C or better
6	Specific heat (Cp) Accuracy	± 3% or better
7	Cp measuring range	Up to 5 J/gK
8	Enthalpy precision	± 0.5% or better

9	Heating/Cooling rate	0.001 to 50° C/min
10	DSC sensor	DSC Sensor should be suitable for operating range with the required accuracy. It should be chemical resistant, corrosion resistant, exchangeable type sensor. DSC sensor should be supplied with S type Thermocouple The sample carrier should be easily replaceable within a minute
11	Sensitivity of DSC Sensor	> 15 μ V/mW
12	Gas Flow Control	Equipment should have magnetic gas frits for 3 gases (2 purge gas and 1 protective gas)
13	Gas Switching	The system should have the possibility to allow automatic gas changes during a running measurement.
14	Gas Atmosphere	Inert, oxidizing, reducing
15	Cooling system	Forced Air Cooling System
16	Crucibles	Alumina Crucible (10 Qty) Alumina Lid (10 Qty)
17	Calibration standards	The DSC system must be delivered with 8 traceable standards to allow calibration for temperature and enthalpy (Indium, Tin, Bismuth, Zinc, Aluminum, Silver, Gold, Nickel)
18	Evolved Gas Analysis	Instrument should have provision for Evolved gas Studies by interfacing with FTIR/GCMS in future
19	Software	<ul style="list-style-type: none"> • Software should be freely able to communicate with PC/workstation with MS-windows 10 or higher operating system. • A free license for the system software should be provided with the equipment. • License for both machine control and processing software should be included with the system. • Software should have the feature of Auto evaluation

		<p>(This feature does automatic evaluation of unknown curves)</p> <ul style="list-style-type: none"> • The software should include calibration routines and offer the possibility for automatic baseline correction of the DSC signal • Defined and free programmable calibration routines must be available • The instrument settings should be automatically detected (automatic detection of furnaces, sensors, gas switches) • Up to 256 programmable temperature segments (isothermal, dynamic up/down or standby) should be possible. • Loop programming (insertion, deletion, and annexation of temperature segments) even in already existing temperature programs should be possible. • The software should allow for a comparative analysis of up to 64 curves/temperature segments from the same or different measurements. • Connection of segments by spline interpolation: Dynamic segments with the same heating direction and isothermal segments can be analyzed as interrelated and depicted temperature-scaled
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		<p>mandatory period should be clearly mentioned with the appropriate cost.</p> <ul style="list-style-type: none"> • Bidder should have provision for a continuous Annual Maintenance Contract upon the completion of warranty period.
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