# COMBINED DSC,DMA & TGA

The Combined **Differential Scanning Calorimeter (DSC) Dynamic Mechanical Analyzer (DMA),Thermal Gravimetric Analyzers (TGA),** shall be used for obtaining information required for routine quality control, alternate source & formulation developments and resolution of problems etc. in the area of polymeric insulating materials utilized for the manufacture of electrical machines. The details of respective instrument are given below:-

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***Control and Software for all instruments:***

- The system should be compatible with Windows XP Pentium IV based PC with CD-ROM drive.
- Software should e Multi-tasking, Multi-User with capability of handling 3 Thermal Analyzers simultaneously.
- Software should be compatible to Windows environment and should have all the parameters for Instrument Control, Method Storage, Multi Ramp capabilities, various calculations like Tm, Tg, Peak Area, Calibration Onset, OIT calculations, direct control of analyser, display of multiple curves on single screen, on-line help, various tool bars for calculations, flexibility to upgrade with Network, peak search, Delta Y and X, Multiple Y-Axis, Method Validation, user customization of various graphs etc.

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## 1. DIFFERENTIAL SCANNING CALORIMETER (DSC)

The instrument is computer control research grade based on Heat flux or power compensation principle with the following technical data:

1.1 Temperature range: -75°C to +725°C
1.2 Programmable Heating Rate: 0.01°C to 100°C/min or higher heating rate.
1.3 Cooling Rate: .up to100°C/min or higher cooling rate
1.4 Temperature Accuracy: ±0.1°C or better
1.5 Temperature precision: ±0.01°C or better
1.6 Calorimetric Precision (based on metal standards):± 0.1% or better
1.7 Calorimetric Accuracy: ±1% or better
1.8 Maximum Calorimetric Sensitivity: 0.2µ W or better
1.9 Dynamic Range +/-500 MW or better
1.10 The instrument shall be supply with the softwares used for determination of kinetic parameters from the DSC peak, degree of crystallinity, purity, partial area Analysis, height of the peak at different temperatures and time, melting of crystallization temperature, heat capacity measurement, glass transition temperature etc.
1.11 The instrument shall be supplied with sample pans required for solid and liquid materials.
1.12 The instrument shall be supplied with the standard materials certified by international accredited laboratory to be used for calibration of DSC.
1.13 The equipment shall be compatible with the electrical supply of 230 VAC ±10%, 50Hz± 1%
1.14 It should also have the provisions for the following:
1.14.1 Auto baseline optimization during the sample run.
1.14.2 Built in software for base line slope & curvature correction.
1.14.3 Preheated Purge gas before entering the sample cell
1.14.4 Multi steps programming for heating the furnace
1.14.5 Fourier transforms analysis for excellent signal to noise ratio
1.14.6 Various cooling options like intracooler, circulating liquid, Liquid Nitrogen etc.
1.14.7 Extensive networking capability.
1.14.8 Software for operation of DSC in Isothermal mode & analysis of the data.
1.14.9 Provision for least three points calibration
1.15 The instrument shall also have capability of operating in modulated mode.
1.15.1 At the time of commissioning of the instrument, the vendor has to demonstrate functioning of the DSC to the above specified data under clauses 1to 9

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**2.0 Specification of DMA:**

The instrument shall be used to characterize solid bars, elastomers, soft forms, thin film, fibers, composites, rubbers, adhesive etc.

2.1 Unit should be operatable in various deformation modes (metal probes): 3points bending, tension, single and dual cantilever bending and shear & compression modes.
2.2 Frequency range from 0 to 200 Hz or higher.
2.3 Resolution of frequency: 0.001Hz
2.4 Temperature Range from -150°C to 600°C
2.5 Modulus range : $10^3$ to $10^{12}$ Pa or higher
2.6 Tan Delta Sensitivity: 0.0001
2.7 Ten Delta range : 0.0001to 10
2.8 Ten Delta Resolution 0.00001
2.8 Displacement range: ±1000 µ
2.9 Heating rate: 0.1-20° C/min or higher
2.10 Cooling rate: 0.1 to 10 °C/min or higher

Modes of operations: Constant heating rate, Dynamic heating rate, constant reaction rate and step wise isothermal,

2.11 Force range: ± 10 N or higher
2.12 The instrument shall also have capability of operating in TMA mode.
2.13 The instrument shall be supplied with the standard materials certified by international accredited laboratory to be used for calibration of DMA.
2.14 The instrument shall have also provision for carrying out DMA studies on powder, gels samples.

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**3.0 SPECIFICATION OF TGA:**

3.1 Temperature Range: ambient to 1000°C
3.2 Isothermal Temperature accuracy: ±1°C
3.3 Isothermal Temperature Precision: ±0.1°C
3.4 Heating Rate range: 0.1 to 100°C/min or better
0.1 to 50°C/min in 0.01°C/min increments (EGA furnace)
3.5 Furnace cooling: Forced air 1000°C to 50°C in <15min.
3.6 Weighing capacity: 1.0 grams or more
3.7 Weighing sensitivity: 0.1micro gram
3.8 Weighing precision: better than .01%
3.9 TGA must include touch screen for easily controller access and monitoring.
3.10 TGA must communicate with computer/controller through Ethernet BUS.
3.11 Data file contain measured sample temperature, not calculated temperature. This allows the user to know what temperature the sample is actually at during different heating rate experiments and make for accurate and precise transition temperatures.
3.12 TGA must enjoy single thermocouple design with continuous use of the measured sample temperature to control the furnace so as to minimize thermal lag.
3.13 TGA must demonstrate ability to have up to five points for temperature calibration to provide greater temperature accuracy over wide temperature ranges.
3.14 System should have the necessary data analysis and instrument control softwares based on windows operating system.
3.15 Both platinum and ceramic samples should be supplied along with the system with necessary calibration standards.
3.16 The TGA should have capability to upgrade with FTIR /Mass Spectrograph combination for EGA ( Gas Evolved Analysis)
3.17 It should have built- in sleeve chamber for low convection effects.
3.18 The should be able to be evacuated up to 10-3 pressure & should have capability to use various types inert & active gases.
3.19 The instrument shall be supplied with software to be used for determination of kinetic parameters of a TGA Curve.

**4.0 Qualifying Conditions:**

4.1 Only those vendors should quote, who have supplied and commissioned all three instruments similar to offered model in India in last three years and are presently working satisfactorily since their commissioning.
4.2 The vendor should have service centre in India with back up of trained service engineers & necessary spares required for servicing the instruments.
4.3 Vendor should quote for all three equipments.

**5.0 COMMISIONING:** The equipments shall be installed and commissioned by the supplier at BHEL laboratory. The performance of all the equipments in respect of their specified respective parameters is to be demonstrated by the supplier at user end.

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**6.0 TRAINING:** The vendor shall provide free of charge training in respect of operation of each equipment & corresponding its software's & minor trouble shooting to two BHEL engineers either at BHEL or their training centre.

**7.0 SAFETY PROVISIONS**

All necessary safety provisions shall be made in all the equipments to prevent overloading or any unintended damage to the parts of the equipment

**8.0 GUARANTEE:**
The supplier shall guarantee for satisfactory performance, reliability of all the instruments for a period of 12 months from the date of commissioning. Any spare required during guarantee period shall have to be arranged by the vendor free of cost (up to BHEL Haridwar stores) and duty levied has to be borne by the vendor.

**9.0 GENERAL INFORMATION**:

**The supplier shall furnish following additional information:**

9.1 The supplier shall provide detailed circuit diagrams, three copies of operation and maintenance manuals for all the instruments at the time of delivery.
9.2 Specific ambient conditions, foundation / load requirements, if any, for successful commission / operation of the equipments shall be furnished by the vendor.
9.3 The supplier should specifically indicate where the specified technical requirement is not being met.
9.4 Where the standard technical literature of the supplier does not cover the details as required in this specification, such details shall be separately furnished.
9.5 Detailed break up of each & every item under offered prices of each instrument shall be furnished in the offer to enable proper choice & estimation of total price at the user end. The details of the softwares if included in the offer shall be clearly indicated.
9.6 The vendor should have experience not less than 5 years in the field of manufacture of thermal analysis equipments of advanced proven technology along with world wide service support including India. The vendor should submit the detailed address viz. Phone No., Fax No., e-mail address, postal address etc. of their customers preferably in India who are utilizing the offered model successfully for not less than 2 years.

**10.0 PACKING:**

The supplier shall provide light but sturdy packing to suit transport by Air and subsequently by road and ensure protection against damage an account of handling, storage, transit in tropical climate etc.

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