



# LIST OF EQUIPMENTS DBR

## **VOL – VIII**

*CONSTRUCTION OF “PROPOSED CENTRE OF  
EXCELLENCE OF FIRE TESTING TRAINING AND  
RESEARCH LABORATORY AT IIT, PATNA”.*

### **LIST OF EQUIPMENT**

| <b>S. No.</b> | <b>Item</b>  | <b>Quantity</b>                       |
|---------------|--|---------------------------------------|
| 1             | Gas fired Vertical furnace of size: 4m x 3m x 2m   | 1                                     |
| 2             | 250kN Servo Hydraulic Fatigue Testing Machine with High Temperature upto 1000 degree and DIC package   | 1                                     |
| 3             | Electric Radiant Heaters & Controllers   | 1                                     |
| 4             | Heating Module & accessories   | 1                                     |
| 5             | PXI Based Data Acquisition System with 112 channels for strain, displacement, acceleration and temperature   | 1                                     |
| 6             | High Temperature Furnance - 1400°C 1000 mm x 1000 mm x 1000 mm   | 1                                     |
| 7             | High Temperature Monitoring/Surveillance Camera  | 3                                     |
| 8             | Thermal Imaging Camera with Cooling Jacket   | 1                                     |
| 9             | Heat Flux Sensor low temperature upto 200 degree with 80 W/cm2   | 4                                     |
| 10            | Heat Flux Sensor high temperature upto 600 degree with 80 W/cm2  | 3                                     |
| 11            | Thermal Conductivity Apparatus - Heat Flow meter   | 1                                     |
| 12            | Simultaneous Thermogravimetry and Differential Scanning Calorimetry  | 1                                     |
| 13            | Thermal Drone  | 1                                     |
| 14            | Workstation High end for Simulation  | 1                                     |
| 15            | Desktop Computers for Research Scholar and Project Staff   | 5                                     |
| 16            | High temperature Inductive displacement transducer   | 4                                     |
| 17            | Non-Contact Displacement Transducers (NCDTs)   | 2                                     |
| 18            | High Temperature Strain Gauges with adhesive (>1000 deg C)   | 20                                    |
| 19            | Plate Thermocouple   | 10                                    |
| 20            | Roving Thermocouple  | 10                                    |
| 21            | Copper Disc Thermocouple with 10 meter wire.   | 10                                    |
| 22            | Fire Safety Equipment  |                                       |
|               | <ul style="list-style-type: none"> <li>• Fire Suit</li> <li>• Heat proof Gloves</li> <li>• Safety Helmet</li> <li>• Safety Shoes</li> <li>• Safety Siren</li> <li>• Safety Goggles</li> <li>• Fire Blanket (per m2)</li> </ul> | 5<br>10<br>10<br>10<br>10<br>10<br>10 |

## **TECHNICAL SPECIFICATION OF EQUIPMENT**

### **1. GAS FIRED VERTICAL FURNACE**

A vertical fire resistance furnace is a specialized testing apparatus used to evaluate the fire resistance of construction materials and assemblies, such as walls, doors, and floors. This type of furnace simulates real-world fire conditions in a vertical orientation, which is particularly relevant for materials used in building facades and partitions. Commonly used to test materials like gypsum boards, wall panels, doors, steel frames, and fire-resistant coatings.

The vertical setup allows for more accurate testing of how materials behave under fire conditions in their intended applications. The furnace can maintain specific temperature profiles that mimic the conditions of a real fire, often following standardized testing protocols like those from ASTM or ISO.

**Make:** Global Scientific (India) Pvt. Ltd., CMTS Sdn. Bhd., and Sistem Teknik, Turkey

### **DETAILED TECHNICAL SPECIFICATIONS**

- 1. Specifications** should be as per ISO 834, BS 476 Parts 20, EN 1363.
- 2. Features:**
  - a. Testing chamber dimensions: 4000mm (Width) x 3000mm (Height) x 2000mm (Depth).
  - b. A furnace Combustion Control Panel. This is designed to operate on both fully automatic and manual control modes. Automatic ignition fires up the burners based on a preset heating curve, as described in ISO 834, BS 476 Parts 20-24 and EN 1363. Individual burner control enables individual burners to be ignited at will.
  - c. 16 sets of Special Flame Burners. Each burner has a flame supervision unit to ensure fail safe operation at all times.
  - d. Lifting Frame and Restraint Frames for Test Specimens - A complete set of Frame is supplied for mounting vertical specimens.
  - e. Connecting Duct and Exhaust Stack - The Chimney/Stack is constructed as per site plan.
  - f. Combustion Air Blower to Furnace Burners - The combustion air system is pre-piped and tested.
  - g. Temperature Sensor and Pressure Gauge - The system is supplied with 9 Type K thermocouples and plate thermometers, a pressure gauge and an ambient thermocouple assembly.
- 3. Software:**

The System is comprised of a compatible Data logger. The fire resistance data management software is custom written to accept and save data collected during the tests and is configured to meet the heating requirements of ISO 834, BS 476 Parts 20- 22 and EN 1363. Other standard Time-Temperature curves can also be pre-programmed into the system. The controller incorporates a built-in operator interface, contains the required recording and programming capabilities and includes all necessary motor starters for all motors in the system. The system is programmed to provide real time heating curves and display all furnace control information on the computer screen.

### **4. Applications:**

The test furnace refers to BS 476 part 20 and 22 (vertical), ISO 834-1, EN 1363-1 standard, is to assess the behavior of a specimen of an element of building construction when subjected to defined heating and pressure conditions. The method provides a means of quantifying the

ability of an element to withstand exposure to high temperatures, by setting criteria by which the loadbearing capacity, the fire containment (integrity) and the thermal transmittance (insulation) functions can be adjudged. A representative sample of the elements is exposed to a laboratory test for the determination of fire resistance of elements of construction.

#### **5. Test Function:**

The sample exposed to high temperature and pressure conditions, the test samples within the specified time bearing weight, integrity and insulation.

#### **6. Protection System:**

Monitor the pressure difference value of the measurement device and the ambient atmospheric pressure values. The equipment has the function of electric safety protection alarm, over-temperature protection and alarm function, and the protective cover with the impact of the test explosion.

#### **7. Technical Parameters:**

- a. Test Furnace
  - I. Test Furnace Size – 4m (Width) × 3m (Height) × 2m (Depth).
  - II. The Test Furnace is made of a steel structure and fireproof insulation material.
- b. Voltage Supply – AC 380V ± 10%, 50Hz.
- c. Burner System:
  - I. Gas Flow: 0-250 m<sup>3</sup>/h
  - II. Gas Max. Pressure: 5 bar.
  - III. Air Flow: 5000 m<sup>3</sup>/h
  - IV. Air max pressure: 8 bar.
- d. Test Temperature Control:
  - I. Furnace temperature control meets the requirements of standards.
  - II. Testing device Accuracy: Furnace temperature: ±15°C Sample inside temperature: ±10°C Sample backfire temperature: ±10°C.
  - III. Timing Range: 0-300 minutes, accuracy: <±1s.
  - IV. Furnace Pressure meets the standard pressure requirements.

#### **8. Fire Analysis System (Software):**

The test control system consists of a pressure sampling system, a temperature sampling control system, a signal acquisition system, a computer system, and a reasonable test and sampling circuit design.

- a. When the system detects the signal of the safety problem, the system can be feedback in real time to take the emergency safety shut down automatically
- b. Thermocouple electrical signals generated by the temperature transmitter or directly to the recorder or computer, the test process, the average temperature, single-point temperature.

Easy to operate, the system enables full control of the test process and parameter settings. Data from various sensors are transmitted to the computer for monitoring and analysis. The software provides automatic control according to the programmed temperature curve and records key parameters such as furnace temperature, furnace pressure, and test conditions, which can be exported as required.

**9. Compulsory Accessories:**

- a. Exhaust smoke filter for heavy carbon and smoke particles with water bath.
- b. Chiller for water supply with cleaner and re-circulatory.
- c. Motorized driven canopy for sample movement
- d. Heat Flux Sensor with readout.
- e. Plate Thermocouple
- f. Copper Disc Thermocouple
- g. Roving Thermocouple
- h. Gap Gauges
- i. IR Thermocouple
- j. General Ceramic Beads Thermocouple (Twisted Paired Type)
- k. Ceramic Tube

## 2. 250 kN SERVO HYDRAULIC FATIGUE TESTING MACHINE

The specification is for design, supply, installation, commissioning, and demonstration of the servo-hydraulic fatigue testing machine for evaluating tensile, compression, fatigue, and fracture properties. This equipment is proposed to be used to evaluate the aforementioned properties on various materials like aluminium alloys, steels, at ambient and high temperatures. Tests like tension, compression, and fatigue will be conducted to evaluate material properties and to assess the material behavior.

**Proof of technical competency with at least five similar equipment supplied, installed, and maintained, which are currently working elsewhere, shall be submitted along with the offer. Parties not meeting this criterion will be rejected.**

**Make:** MTS Testing Solutions India Pvt. Ltd, M/s. Walter bai Ag and INSTRON-ITW India Private Limited

### DETAILED TECHNICAL SPECIFICATIONS

#### 1. Load Frame

- Frame rated for at least  $\pm 250\text{kN}$  in tension / Compression.
- Frame stiffness  $\geq 600\text{kN/mm}$ , precision-aligned load frame with fixed lower platen and adjustable upper crosshead.
- The column clearance is  $\geq 600\text{mm}$  and the vertical daylight is  $\geq 1500\text{mm}$  between crossheads.
- The top cross head movement is hydraulically operated using declamp cylinder to position it with different grips and specimen length before starting the test.
- Touch screen operated tablet for basic operations of the machine – switching the power pack On/Off, Clamp and De-Clamp of the top cross head, moving the crosshead up and down, moving the actuator up and down to mount the specimen.
- Bottom crosshead must have provision to mount servo hydraulic actuator on it.

#### 2. Fatigue-rated actuator assembly

- 250kN Servo-Hydraulic Actuator
- $\pm 250\text{kN}$  fatigue-rated, high-performance servo-hydraulic actuator with digital encoder for position measurement Resolution of stroke measurement:  $1\text{ }\mu\text{m}$
- Accuracy of stroke measurement:  $\pm 0.5\%$  of read out value.
- Total stroke:  $\pm 75\text{mm}$  (Total  $150\text{mm}$ )
- Operating at 210 bar pressure.
- The actuator is configured with suitable servo valves to perform Tensile test as per (ASTM E8, ASTM E9), LCF test as per ASTM E606.

#### 3. Power pack

- The Hydraulic power unit should be used to meet the following dynamic performance

| Frequency (Hz) | Load (%) | Total Amplitude (mm) |
|----------------|----------|----------------------|
| 1              | 0        | 20                   |
| 30             | 0        | 0.5                  |
| 1              | 50       | 15                   |
| 20             | 50       | 0.8                  |
| 1              | 100      | 10                   |
| 10             | 100      | 1.0                  |

- b. Variable frequency drive based control hardware to achieve energy efficient flow control.
- c. Touch screen based tablet to be used for power pack operation.
- d. 10 micron return line filter with electric interlock. Pressure transducer for power pack pressure sense and temperature sensor.
- e. All the safety interlocks on the power pack to be monitored on the touch screen panel.
- f. All the accessories like hoses, oil filling pump and hydraulic oil to be included in the supply.
- g. Suitable cooling tower to be provided along with the system.

#### **4. Load Cell:**

- a.  $\pm 250\text{kN}$  Dynamic Capacity Load Cell
- b. Accuracy: ISO7500-1 Class 0.5 (0.5% of indicated load)
- c. 150% Safe over Load Capacity without mechanical damage
- d. 350 Ohm or higher resistance Strain Bridge design
- e. Non-Linearity:  $\pm 0.15\%$  of Full Scale or better
- f. Non-Repeatability:  $\pm 0.02\%$  of rated output
- g. Sensitivity: 2 to 2.5mV/v
- h. Hysteresis:  $\pm 0.02\%$  of Full Scale or better
- i. Fatigue Life:  $10^9$  or better

#### **5. Digital Servo Controller including/ensuring**

- a. 1 channel of Digital encoder channel for actuator position measurement
- b. Additionally, 8 channels of conditioned analog inputs with suitable signal conditioners must be provided
  - 5.b.1. 2-channel of load cell input
  - 5.b.2. 2-channel of strain-bridge extensometer/crack-opening displacement gage input
  - 5.b.3. 4 Spare Channels
- c. 1 channel of digital servo-control with loop update frequency of at least 6 kHz
- d. 8 digital I/O / Logic drive and sense lines.
- e. Synchronized data acquisition into host computer at 6 kHz from up to:
  - 5.e.1. 1 channels of 32-bit digital encoder readouts
  - 5.e.2. 8 channels of 24-bit analog feedback readouts
  - 5.e.3. 1 channel of Set Point
  - 5.e.4. 1 channels servo-output for monitoring purposes
- f. 8-bits of digital I/O status for time tagged device sense and control at 1kHz data acquisition rate
- g. User settable software safety limit interlocks on upper and lower limit readout on each of 2+8 feedback channels with individual option of Stop/Hold/Trip
- h. Servo control of actuator with user settable/programmable:
  - i. Mode control (Load, Stroke, Strain)
  - j. Real-time automatic adaptive servo-gain adjustment to account for system stiffness variation as a function of specimen stiffness
- k. Static ramping of Load, displacement, strain with independently settable ramp rate.

- l. Cyclic loading with ramp and sine waveform and user settable mean, amplitude and phase at frequency of up to 5 Hz and restricted as per the actuator performance curve, with better than 2% accuracy in loading through adaptive control.
- m. Provision for multi-step static and cyclic loading, with provision to switch control mode(s) as required.
- n. User settable error limit on servo-control with option of Stop/Trip
- o. Host computer with Windows 10 or higher version of operating system and suitable application software for ease of performing tests under specified conditions with provision for report generation by way of multiple worksheet XL-tables including raw data arranged suitably as columns for individual channels.
- p. One Hardwired E-Stops, located on the frame for easy access.
- q. UPS to guarantee safe shut down and unloading in the event of power failure
- r. OEM built software application for remote health monitoring must be available. For security purposes third party applications or screensharing applications are not permitted. Same software must have provision to be upgraded for remote test monitoring with camera.

## **6. Grips and Accessories for Room Temperature Applications**

- a. **Room Temperature Hydraulic Wedge Tensile Grips**
  - a. 250kN Hydraulic Wedge Grip
  - b. The grips included wedge inserts for flat and round specimens
  - c. The flat wedges have provision to accommodate specimens of 0-26 mm thickness and round specimens of diameter 3-26 mm
  - d. Variable grip pressure based on the test samples
  - e. Specimen alignment kit for aligning jaw faces to be provided
- b. **Axial Extensometer for Tensile Test Applications**
  - a. Gauge length: 12.5 mm
  - b. Measuring range minimum: +6.25/-3.1 mm
  - c. Accuracy:  $\pm 0.5\%$  of read out value as per ASTM E83
  - d. Excitation: 5 to 10 VDC
  - e. Sensitivity: 2 to 4 mv/V
  - f. Full bridge, 350 ohms strain gauged design
- c. **Axial Extensometer for Tensile Test Applications**
  - a. Gauge length: 25.0 mm
  - b. Measuring range minimum: +10.0/-10.0 mm
  - c. Accuracy:  $\pm 0.5\%$  of read out value as per ASTM E83
  - d. Excitation: 5 to 10 VDC
  - e. Sensitivity: 2 to 4 mv/V
  - f. Full bridge, 350 ohms strain gauged design
- d. **Compression Platens**
  - a. Diameter 150mm platens with spherical seat for self alignment
  - b. Rated for room temperature operation
- e. **2D DIC System**
  - a. DIC system with image acquisition camera and integrated application module
  - b. Suitable for full-field, two dimensional deformation and strain analysis
  - c. Software should have integrated modules for material testing
  - d. DIC system must be synchronized with system controller for image acquisition



- e. Imaging system must be compatible for future upgrade to real time video extensometer

## **7. Grips and Accessories for High Temperature Applications**

### **a. High Temperature LCF Hydraulic Grips**

- a. 100kN LCF Hydraulic Grip for testing in accordance with ASTM E606
- b. The grips and all the elements in the load train are assembled to ensure good alignment and backlash free operation.
- c. The LCF grip pull rods have been selected to accommodate M8, M10, M12, M16, M20 specimens.
- d. Grips rated for operation up to 900 deg. C

### **b. Axial Extensometer for LCF Test Applications**

- a. Gauge length: 12.5 mm
- b. Measuring range: +1.0/-1.0 mm
- c. Accuracy:  $\pm 0.5\%$  of read out value as per ASTM E83
- d. Excitation: 5 to 10 VDC
- e. Sensitivity: 2 to 4 mv/V
- f. Full bridge, 350 ohms strain gauged design
- g. Rated for 1000 deg. C

### **c. Axial Extensometer for Tensile Test Applications**

- a. Gauge length: 12.5 mm
- b. Measuring range: +2.5/-2.5 mm
- c. Accuracy:  $\pm 0.5\%$  of read out value as per ASTM E83
- d. Excitation: 5 to 10 VDC
- e. Sensitivity: 2 to 4 mv/V
- f. Full bridge, 350 ohms strain gauged design
- g. Rated for 1000 deg. C

### **d. Compression Platens**

- a. Diameter 60 mm
- b. Rated for 900 deg. C

### **e. High temperature 3- zone split tube furnace:**

- a. Furnace Temperature Range: 300 to 1100 deg C
- b. Sample Temperature: upto 900 Deg C
- c. Heating Rates: Up to 10deg C/min
- d. Temperature Accuracy:  $\pm 2$ deg C
- e. Furnace be suitable for the high temperature grips and fixtures listed above
- f. Heating System: Kanthal A1
- g. "K" - type thermo couple for measurement and control of temperature.  
Minimum 6 spare thermocouples should be given.
- h. At least 3 thermocouples for sample temperature monitoring must be provide
- i. Programmable PID temperature controller for the above furnace
- j. Provision to log the temperature vs time data in the UTM software.
- k. Mounting Bracket: Should supply with suitable mounting brackets.
- l. Furnace Interface: Standalone software interface with live temperature displays, and control setup with independent logging.
- m. Suitable cooling arrangement must be provided for furnace and high temperature fixtures.

## **8. Application Software:**

### **a. Tensile and Compression Testing Software (As per ASTM E8 and ASTM E9)**

- a. Tests can be done in stroke or strain control.
- b. Online graphs of stress vs. strain and load vs. displacement.
- c. Option to save the test profiles.
- d. Auto data acquisition settings
- e. Option to view multiple test graphs in one plot.
- f. Option to run test in dual rate.
- g. Option to remove the extensometer and continue the test in stroke control.
- h. Option to stop the test after specified percentage load drop.
- i. Limit settings on stroke, strain and load channels.
- j. Offline post processing program to analyse the results in MS Excel.

**b. Basic Application Software**

- a. Performs Fatigue Test, Static or Monotonic test, Multistep programming and Time History (Custom Waveform) generation.
- b. Test can be done in Stroke, Load and COD/Extensometer control modes.
- c. Display meters for current readouts, max-min readouts, peak valley readouts, set point and cycle counters. Display of time history graph and X-Y plots.
- d. Multi-channel option available.
- e. Option to program safety interlock for load, displacement and COD/Extensometer.
- f. Data recording collects time and/or peak-valley data to binary formats. Data is then exported to MS Excel/text format where report generation and graphs are available with play back option.
- g. Data reduction options available in real time data logging and also during data exporting.

**c. Low Cycle Fatigue Testing Software (As per ASTM E606)**

- a. Tests can be done in stress control, total strain control and plastic strain control.
- b. Online display of loading modulus, unloading modulus,  $K'$ ,  $n'$  yield stress, plastic strain, max-min stress and strain.
- c. Limit settings on stroke and strain
- d. Auto data acquisition settings.
- e. Online graphs of stress vs strain and transients.
- f. Offline post processing program to analyze the results in MS Excel.
- g. Option to save the test profiles.
- h. Option to remove residual strain.
- i. Option to add strain to gage length.
- j. Option to terminate the test at specified modulus drop, stress drop and/or increase in strain.

**d. High Cycle Fatigue Testing Software for performing HCF tests must be provided**

**9. Host computer system - Test work station**

- a. Display: 24 inch LCD monitor
- b. Processor: Intel Core i5
- c. RAM: 16 GB DDR4 non-ECC Memory
- d. Storage: 3.5 inch 500 GB SSD
- e. Drive: 8x DVD+/-RW 9.5mm Optical Disk Drive
- f. Operating System: Windows 10 Pro English
- g. Wired Mouse and Keyboard
- h. 3000 VA with 30mins battery backup

**Safety Features**

- a. The system should be safely shut down in the event of Power Failure
- b. Uninterrupted Power Supply for Control console and Hardware.
- c. Manual override to stop test and return to zero load.
- d. Tripping on overload and mains failure

**General Terms and Conditions**

1. Quotation submitted by the Original Equipment Manufacturer (OEM) from India or authorized representative in India only will be accepted and will be considered for further evaluation. The authorized representative shall submit to this effect an authorization letter for OEM.
2. Quotation shall not be submitted simultaneously by an OEM as well as the Indian agent of the same OEM. In such a case, both quotations will be rejected.
3. The vendor shall be an established entity with minimum five years' experience in manufacturing and supplying Fatigue Testing Machine.
4. The equipment quoted shall be latest and standard model and should not be a customized one. Catalogues shall be submitted along with the technical bid.
5. The vendor shall have a well-trained service network available in India to cater to the service requirements of the installed Universal Testing Machine System (Capacity 250kN). The details of the same shall be submitted along with the technical bid.
6. The vendor should have either or all of ISO 9001/ NABL/ NADCAP accreditation.
7. The vendor in the last 05 years, shall have supplied & installed at least 10 no's of servo hydraulic fatigue testing machines in India.
8. The vendor has to provide the installation certificate or USER Satisfactory Report (Minimum two different users) from users to whom they have supplied such systems.
9. OEM of the quoted equipment shall certify that spare & service support for quoted equipment would be available for at least 10 years from the date of quotation.
10. If requested by the institute, the vendor shall arrange for a demonstration of the high temperature fatigue UTM system supplied by him anywhere in India.
11. The Institute shall prefer class-1 supplier with more than 50% of items manufactured in India
12. The vendor should have supplied a minimum of 05 high-temperature fatigue testing machines in India.

### **3. ELECTRIC RADIANT HEATERS AND CONTROLLERS**

**Make:** CSR Engineering Services, Global Scientific (India) Pvt. Ltd., and Tempsens Instruments (India) Limited.

#### **DETAILED TECHNICAL SPECIFICATIONS**

- a. Fifteen (15) nos. of rectangular electric radiant heaters of ceramic fiber type are to be supplied. The heated surface dimensions of each heater should be 300 ( $\pm 10$ ) mm x 450 ( $\pm 10$ ) mm.
- b. Each heater should have 4 kW ( $\pm 10\%$ ) capacity.
- c. Three independent controllers need to be provided to control these heaters. Each controller should be able to control up to 4 heaters at a time.
- d. Each controller should be able to take a target temperature value and the heater surface should be able to maintain up to 950<sup>0</sup> C constant temperature for up to five hours.
- e. The controller should take three phase power supply and provide single-phase power to each heater.
- f. A distribution panel needs to be provided along with the controller.
- g. There should be an option to by-pass the controller and switch on and switch off the heaters manually.
- h. At least 30mm thick high density (at least 128 kg/m<sup>3</sup>) blanket insulation should be provided on the heaters.
- i. The heaters and the insulation should be encased in a stainless-steel casing suitable for high temperatures, portability, and placing heaters in various orientations.
- j. The casing should have connectors/clamps to allow the heaters to be mounted on a frame.
- k. Each heater panel including the insulation and casing should not weigh more than 10 kg.
- l. Total thickness of the heater (including electrical and mechanical connectors) should not exceed 150 mm at any place.
- m. The controllers and the heaters including the ceramic and the heating elements should be of the same OEM.
- n. Each heater should come with at least 5-meter-long power cable. The 3-phase cable connecting the power source with the controller should be at least 30 meters long.

#### **4. HEATING MODULE AND ACCESSORIES**

**Make:** PWHT Solutions Pvt Ltd., Global Scientific (India) Pvt. Ltd., and Innovative NDT Services Private Limited

##### **DETAILED TECHNICAL SPECIFICATIONS**

1. Power Source Heating Module:
  - a. 75KVA Power source to heat up to 1000°C
  - b. 6 Channel Fully Automatic
  - c. Must include all accessories for operation using provided flexible ceramic pad heater.
2. Triple Cable Set:
  - a. Triple Cable set with Plug & Socket (should be compatible with provided power source).
  - b. 25m length.
3. Splitter Cable: 4-way splitter cable (should be compatible with provided power source).
4. Flexible Ceramic Pad Heater:
  - a. Should be compatible with provided power source.
  - b. Capable to heat upto 900°C.
  - c. 10 nos. of dimensions: 500 mm x 100 mm ( $\pm 30$ mm).
  - d. 10 nos. of dimensions: 1000 mm x 100 mm ( $\pm 30$ mm).
5. Thermocouple Attachment Unit: Should be compatible for digital temperature recorder provided.
6. Thermocouple wire reel: 100 meters.
7. Digital temperature recorder
  - a. Should be compatible with thermocouple and TAU provided,
  - b. Up to 1200°C
  - c. 12 Point.

## 5. PXI BASED DATA ACQUISITION

**Make:** Keysight Technologies, Pickering Test, and National Instruments (NI)

| S. No. | Detailed Technical Specification     |   | Qty |
|--------|--------------------------------------|---|-----|
| 1      | Analog Input                         |   | 1   |
|        | Number of channels                   | 32 differential   |     |
|        | ADC resolution                       | 16 bits   |     |
|        | Sample rate                          | 500 kS/s/channel  |     |
|        | Timing resolution                    | 10 ns   |     |
|        | Timing accuracy                      | 50 ppm of sample rate   |     |
|        | Input coupling                       | DC  |     |
|        | Input range                          | ±1 V, ±2 V, ±5 V, ±10 V   |     |
|        | MRR (at 60 Hz)                       | 80 dB   |     |
|        | Input bias current                   | ±6 nA , ±90 nA maximum over full temperature range                                    |     |
|        | Input FIFO size                      | 4,095 samples shared among channels used  |     |
|        | Data transfers                       | DMA (scatter-gather), programmed I/O  |     |
|        | Overvoltage protection for AI<0..31> |   |     |
|        | Device on                            | ±30 V   |     |
|        | Device off                           | ±15 V   |     |
|        | Analog Triggers                      |   |     |
|        | Number of triggers                   | 1   |     |
|        | Functions                            | Start Trigger, Reference Trigger, Pause Trigger, Sample Clock, Sample Clock Time base |     |
|        | Input impedance                      | 10 kΩ   |     |
|        | Coupling                             | DC  |     |
|        | Analog Output                        |   |     |
|        | Number of channels                   | 2   |     |
|        | DAC resolution                       | 16 bits   |     |
|        | DNL                                  | ±1 LSB, maximum   |     |
|        | Monotonicity                         | 16 bit guaranteed   |     |
|        | Maximum update rate (simultaneous)   |   |     |
|        | 1 channel                            | 900 kS/s  |     |
|        | 2 channels                           | 840 kS/s  |     |
|        | Timing accuracy                      | 50 ppm of sample rate   |     |
|        | Timing resolution                    | 10 ns   |     |
|        | Output range                         | ±10 V   |     |
|        | Output coupling                      | DC  |     |
|        | Output impedance                     | 0.2 Ω   |     |
|        | Output current drive                 | ±5 mA   |     |
|        | Overdrive protection                 | ±15 V   |     |
|        | Overdrive current                    | 15 mA   |     |
|        | Power-on state                       | ±20 mV  |     |
|        | Phase-Locked Loop (PLL)              |   |     |
|        | Number of PLLs                       | 1   |     |

|   |                                       |  |   |
|---|---------------------------------------|--|---|
|   | <b>Bus Interface</b>                  |  |   |
|   | Form factor                           | x1 PXI Express, specification v1.0 compliant   |   |
|   | Slot compatibility                    | x1 and x4 PXI Express or PXI Express hybrid slots                                    |   |
|   | <b>General-Purpose Counters</b>       |  |   |
|   | Number of counter/timers              | 4  |   |
|   | <b>Digital I/O/PFI</b>                |  |   |
|   | Number of channels                    | 24 total   |   |
| 2 | <b>Input Characteristics</b>          | <b>Vibration Based Sensors</b>   | 1 |
|   | Simultaneously sampled input channels | 8  |   |
|   | Input configuration                   | Pseudo-differential (50 $\Omega$ between negative input and chassis ground)          |   |
|   | Input coupling                        | AC/DC, selectable per channel  |   |
|   | ADC resolution                        | 24 bits  |   |
|   | ADC type                              | Delta-sigma  |   |
|   | Sample rates ( fs)                    | 204.8 kS/s/Channel   |   |
|   | FIFO buffer size                      | 4,095 samples  |   |
|   | DSA Dynamic Range                     | 114 dB   |   |
|   | Number of Gain Settings               | 2  |   |
|   | Highpass Filter Cut-Off Frequency     | 0.5 Hz   |   |
|   | IEPE Excitation current               | 0 or 4 mA $\pm$ 10%  |   |
|   | Compliance.                           | 24 V   |   |
|   | Bus Interface                         | PXI and PXIe   |   |
|   | Front Connection Type                 | InfiniBand (IB), SMB   |   |
| 3 | <b>Input Characteristics</b>          | <b>Strain Gauge Based Sensors</b>  | 5 |
|   | Number of channels                    | 8 analog input channels  |   |
|   | ADC resolution                        | 24 bits  |   |
|   | Type of ADC                           | Delta-Sigma (with analog prefiltering)   |   |
|   | Sampling mode                         | Simultaneous   |   |
|   | Analog Input Voltage Range:           | 100 mV/V to 100 mV/V, -25 mV/V to 25 mV/V  |   |
|   | Maximum Sample Rate                   | 25.6 kS/s  |   |
|   | Bridge Configurations:                | Full Bridge, Half Bridge, Quarter Bridge   |   |
|   | Bridge Resistance:                    | 1000 Ohm, 120 Ohm, 350 Ohm   |   |
|   | CMRR (DC to 1 kHz)                    | 85 dB  |   |
|   | Excitation Values (Vex)               | 0.625 V, 1 V, 1.5 V, 2 V, 2.5 V, 2.75 V, 3.3 V, 5 V, 7.5 V, 10 V                     |   |
|   | Analog trigger                        | AI <0.7  |   |
|   | Front End connector                   | 96-Pin Female DIN to 88-Pin Female Screw Terminal, 10 V,                             |   |
| 4 | <b>Input Characteristics</b>          | <b>Temperature Sensor</b>  | 1 |
|   | Differential Analog Input Channels:   | 32 thermocouple channels, 2 autozero channels, 8 cold-junction compensation channels |   |

|          |                              |   |          |
|----------|------------------------------|---|----------|
|          | Input type                   | Thermocouple  |          |
|          | ADC resolution               | 24 bits   |          |
|          | Type of ADC                  | Delta-Sigma   |          |
|          | Sampling mode                | Scanned   |          |
|          | Maximum sample rate          | 90 S/s  |          |
|          | Voltage measurement range    | ±80 mV  |          |
|          | thermocouple types           | J, K, T, E, N, B, R, S  |          |
|          | 50/60 Hz noise rejection     | 70 dB   |          |
|          | Differential input impedance | 20 MΩ   |          |
|          | Front End connector          | 96-Pin Female DIN to 67-Pin Female Screw Terminal, 10 V           |          |
|          |                              |   |          |
| 5        | <b>PXI Chassis Type</b>      | <b>PXI Express</b>  | <b>1</b> |
|          | Chassis Power Supply Type    | AC  |          |
|          | Number of Hybrid Slots       | 17  |          |
|          | Number of PXI Express Slots  | 0   |          |
|          | Redundant HW Option          | No  |          |
|          | Maximum System Bandwidth     | 4 GB/s  |          |
|          | Slot Count                   | 18  |          |
|          | Number of PXI Slots          | 0   |          |
|          | System Timing Slot           | No  |          |
|          | Slot Cooling Capacity        | 58 W  |          |
|          | Onboard Clock Type           | VCXO  |          |
|          | Input rating                 | 100 to 240 VAC, 50/60 Hz, 10 to 5 A, 100 to 120 VAC, 400 Hz, 10 A |          |
|          | Operating voltage range      | 90 to 264 VAC   |          |
|          | Nominal input frequency      | 50 Hz/60 Hz/400 Hz  |          |
|          | Operating frequency range    | 47 to 440 Hz  |          |
|          | Efficiency                   | 85% typical   |          |
|          | Safety                       |   |          |
|          |                              | IEC 61010-1, EN 61010-1   |          |
|          |                              | UL 61010-1, CSA 61010-1   |          |
|          | Controller                   | x16 Gen 3 MXI-Express for PXI Express,1 Port                      | <b>1</b> |
|          | Controller                   | x16 Gen 3 MXI-Express for PCIe Express,1 Port                     | <b>1</b> |
|          |                              |   |          |
| <b>6</b> | <b>Accessories</b>           |   |          |
|          | Front End connector          | 96-Pin Female DIN to 67-Pin Female Screw Terminal, 10 V           | <b>1</b> |
|          | Front End connector          | 96-Pin Female DIN to 88-Pin Female Screw Terminal, 10 V,          | <b>5</b> |
|          | MXI-Express Cable            | MXI-Express Cable   | <b>1</b> |
|          | Connector                    | BNC-2110 Noise Rejecting  | <b>1</b> |
|          | Connector                    | BNC-2115 Noise Rejecting,   | <b>1</b> |
|          | Power Cord                   | 250V, 10A, India  | <b>1</b> |
|          | Cable                        | 68-D-Type to 68 VHDCI Offset,                                     | <b>1</b> |
|          | Cable                        | Twisted Pair Cable with Basic Shielding,                          | <b>1</b> |



## **6. HIGH TEMPERATURE ELECTRICAL FURNACE**

**Make:** Tempsens Instruments (India) Limited, Linn High Temp GmbH and Shivang Furnaces and Ovens Industries Private Limited

### **DETAILED TECHNICAL SPECIFICATIONS:**

1. Quantity- 1
2. Dimensions:
  - a. Useful working chamber: 1000 mm × 1000 mm × 1000 mm (W × D × H)
  - b. Volume: Approximately 1000 LTR.
3. Insulation:
  - a. Special grade brick lining. There will be some cracks in the boards which is normal condition.
  - b. Double layer SS structure with air gap forming to keep outer body temperature below 65 °C.
4. Maximum Temperature: 1400 °C
5. Working Temperature: 1350 °C
6. Accuracy: ±1 °C.
7. Temperature Controller: EURO THERM PID
8. Design: Front door with side way opening.
9. Outer Chamber: Mild steel powder coated
10. Design: Front opening type
11. No. of Zones: 1
12. Temperature Controller: EURO THERM make PID programmable temperature controller.
13. Safety: Over temperature protection mechanism.
14. Heating elements: Super grade SIC U-shaped high temperature heating elements with good heat dissipation to ensure rapid heating and better uniformity in each and every corner of the chamber.
15. Power Control: Thyristorized power control.
16. Door: Vertical lifting door.
17. Thermocouple: R type duplex with high purity alumina tube.
18. Controls:
  - a. PID type digital temperature indicating controller- 1 No.
  - b. One R type thermocouple for controlling and safety. The thermocouple will be placed either in top center or diagonally center in back. 1 No.
  - c. AIR Brake magnetic contactors for heaters- 1 No.
  - d. Phase angle fired thyristors for heaters- 1 No.
  - e. Push buttons and indicators.
  - f. Mains on switch/MCCB- 1 No.
  - g. Multi-function meter- 1 No.
  - h. RYB indicator- 3 No.
19. Safety interlocks: the furnace will switch off if case of:
  - a. Over temperature
  - b. Over current
  - c. Emergency door opening (Door Limit)
20. Power supply: Rated for 3 phase 415VAC, 50 Hz, 72 KW.
21. Clarifications- The furnace controlling sensor will be NABL certified.
22. Warranty: One year from the date of installation for any manufacturing defect
23. Installation: installation and commissioning will be free at your site.

## 7. HIGH TEMPERATURE MONITORING/SURVEILLANCE CAMERA

**Make:** Tempsens Instruments (India) Limited, Linn High Temp GmbH and Shivang Furnaces and Ovens Industries Private Limited

### DETAILED TECHNICAL SPECIFICATIONS

| S.No. |   |   |
|-------|---|---|
| 1.    | <b>Technical</b>                            |   |
|       | Environment                                 | Up to 1200 °C                               |
|       | Cooling system                              | Vortex AIR & Water cooling                  |
|       | Power                                       | AC 220V/110V                                |
|       | Hole Diameter                               | 100 mm                                      |
|       |   |   |
| 2.    | <b>Requirement of Compressed Air</b>        |   |
|       | Pressure                                    | 7~10 kg/cm <sup>2</sup>                     |
|       | Volume Flow                                 | 50 m <sup>3</sup> /h                        |
|       | Temperature                                 | <35 °C                                      |
|       | Quality                                     | Dust, Oil & Moisture free clean air         |
|       |   |   |
| 3.    | <b>Requirement of Cooling water</b>         |   |
|       | Inlet Pressure                              | 2~5 kg/cm <sup>2</sup>                      |
|       | Volume Flow                                 | 0.2-1 m <sup>3</sup> /h                     |
|       | Quality                                     | DM Water                                    |
|       |   |   |
| 4.    | <b>High Resolution Camera Specification</b> |   |
|       | Image Sensor                                | 1/2.7" progressive scan CMOS                |
|       | Resolution                                  | 5 Megapixel                                 |
|       | Pixels                                      | 2592 (H) × 1994 (V)                         |
|       | Minimum Illumination                        | 0.005 Lux@F1.4                              |
|       | Lens  | C/CS Mount                                  |
|       | Shutter Speed                               | Auto/Manual, 1/3 s–1/100000 s               |
|       | Streaming Capability                        | Three streams                               |
|       | WDR   | 120db                                       |
|       | Gain Control (AGC)                          | Auto/Manual                                 |
|       | Video Compression                           | H.265+/H.265/H.264+/H.264/MJPEG             |
|       | Video Out                                   | Ethernet RJ-45 (10/100Base-T)               |
|       | Power                                       | DC 12V (±25%), AC 24V (±25%), PoE (802.3af) |
|       | Power Consumption                           | <9.2W                                       |
|       | Casing                                      | Metal                                       |
|       |   |   |
| 5.    | <b>Varifocal lens</b>                       |   |
|       | Focal Length                                | Varifocal Lens: 2.8 mm- 12 mm               |
|       | Image Sensor                                | 1/3"  |
|       | Focus and IRIS                              | Manual                                      |
|       | Mount                                       | CS Mount                                    |

## 8. THERMAL IMAGING CAMERA WITH COOLING JACKET

**Make:** Tempsens Instruments (India) Limited, Linn High Temp GmbH and Shivang Furnaces and Ovens Industries Private Limited

### DETAILED TECHNICAL SPECIFICATIONS

| Performance Specifications                |  |
|---|--|
| Temperature Range                         | -20°C to 120°C   100°C to 1000°C Switchable via Software |
| Optical Resolution                        | 384 x 288 pixels   |
| Detector                                  | Uncooled FPA Detector                                    |
| Spectral Range                            | 8 to 14 µm   |
| Pixel Pitch                               | 17 µm  |
| Frequency                                 | Upto 30Hz  |
| Sensitivity / NETD                        | <50mK@f1.0, 30Hz 300 K                                   |
| Accuracy                                  | ±2°C or ±2% of reading in °C or °K                       |
| Emissivity                                | 0.01 - 1.0 adjustable                                    |
| Interface Specifications                  |  |
| Video                                     | 100MBit/s Ethernet                                       |
| Connection                                | Power Connector, RJ-45 Ethernet Connector                |
| Output                                    | 1 Analog (4 - 20mA)   1 TTL output                       |
| Video Format for Saving                   | MPEG-4   |
| Image Format for Saving                   | BMP/JPEG   |
| Optics                                    |  |
| Lens Type                                 | Fixed / Motorized  |
| Electrical Specifications                 |  |
| Power Supply                              | 12 to 24 V DC  |
| Power Consumption                         | <4 Watt  |
| Environmental / Mechanical Specifications |  |
| Ambient Temperature                       | 0°C - 60°C   |
| Storage Temperature                       | -40°C - 70°C   |
| Relative Humidity                         | ≤95% non-condensing                                      |
| Shock Resilience                          | 25G  |
| Vibration Resilience                      | 2G   |
| Weight                                    | ~400 gms   |
| Protection Class                          | IP65   |
| EMC                                       | CE   |
| Size                                      | 60 x 70 x 80 mm  |
| Mounting                                  | UNC 1/4"-20 , UNC 3/8"-16 Standard Mount                 |
| I/O Module Specifications                 |  |
| Analog output                             | 4 Channel Analog Current Output (4 - 20mA)               |
| Digital Input                             | 2 Isolated Inputs  |
| Digital Output                            | 2 Relay Outputs  |
| Power Supply                              | 5 V DC   |
| Cooling Jacket Specifications             |  |
| Inlet/Outlet (cooling)                    | ½" BSP Thread  |
| Inlet for Air Purging                     | PU Pipe suitable for 8 mm nozzle                         |

|                  |                         |
|------------------|-------------------------|
| Water flow rate  | 6-8 L/min               |
| Air Pressure     | Min. 3 bar (Moist free) |
| Mounting         | 5× M5 Thread            |
| Protection Class | IP 67                   |

## 9. HEAT FLUX SENSOR (LOW TEMPERATURE)

**Make:** Tempsens Instruments (India) Limited, Linn High Temp GmbH and Shivang Furnaces and Ovens Industries Private Limited

### DETAILED TECHNICAL SPECIFICATIONS

1. Heat Flux (Maximum): 100 W/cm<sup>2</sup>.
2. Sensor Output Linear Output: 10 MV nominal at full range,
3. Over range: ±25% of rated heat flux,
4. Accuracy: ±5% or better,
5. Measurement duration: 60s for full range,
6. Sensor: Differential thermocouple,
7. Dimension: Diameter 25mm, Length: 25mm,
8. Mounting: Flange
9. Cable length: 2 meter or specified.

## 10. HEAT FLUX SENSOR (HIGH TEMPERATURE)

**Make:** Hukseflux Thermal Sensors, Tempsens Instruments (India) Limited, and Linn High Temp GmbH

### DETAILED TECHNICAL SPECIFICATIONS

|  |   |
|--|---|
| Measure and measurement goal               | Heat flux   |
| SI units                                   | heat flux density/irradiance in W/m <sup>2</sup>    |
| Measurand                                  | temperature   |
| Heat flux sensor                           | Thermopile  |
| Temperature sensor                         | thermocouple type K                                 |
| Sensitivity (nominal)                      | 9 x 10 <sup>-9</sup> V/(W/m <sup>2</sup> )          |
| Calibration traceability                   | To SI units   |
| Measurement range                          | (0 to 800) x 10 <sup>3</sup> W/m <sup>2</sup>       |
| <b>Rated operating temperature ranges:</b> |   |
| sensor and black coating                   | -30 to +650 °C                                      |
| high-temperature cable                     | -30 to +900 °C                                      |
| low-temperature extension cable            | -30 to +240 °C                                      |
| IP protection class                        | IP67  |
| <b>Standard cable lengths:</b>             |   |
| high-temperature cable                     | 1 m   |
| low-temperature extension cable            | 3 m   |
| Rated cooling water temperature range      | 10 to 30 °C   |
| Rated cooling water flow                   | > 30 l/h (0.01 l/s), preferably 100 l/h (0.03 l/s)  |
| Output signal                              | DC voltage  |
| Output signal range                        | 10 x 10 <sup>-3</sup> V at rated measurement range. |
| Spectral range                             | 0 to 50 x 10 <sup>-6</sup> m                        |
| Full field of view angle                   | 180 °   |
| Black coating emissivity                   | 0.92  |

## 11. THERMAL CONDUCTIVITY APPARATUS - HEAT FLOW METER

Thermal conductivity defines the ability of a material to transfer heat. Accurate measurement of this property is critical for improving energy efficiency and predicting the thermal performance of materials across diverse industries such as construction, electronics, aerospace, automotive, and many more.

**Make:** Global Scientific (India) Pvt Ltd, NETZSCH Technologies India Pvt. Ltd., and Thermtest Inc.

### DETAILED TECHNICAL SPECIFICATIONS

#### 1. Heat Flow Meter (as per ASTM E1530): Temp. Range – (+)50 °C to (+) 250 °C.

The Heat Flow Meter Method, specifically developed for evaluating insulating materials, is standardized internationally under ASTM C518, ISO 8301, and DIN EN 12667. This widely adopted method is valued across industries for its cost-effectiveness, simplicity, speed, and accuracy.

In this method, a test specimen is placed between two temperature-controlled plates that establish a defined temperature difference ( $\Delta T$ ) across the sample. The sample thickness ( $L$ ) is either adjusted to the desired target thickness for compressible samples or set to the actual physical dimension. Accurate thickness measurement is essential for reliable results. During testing, the steady-state heat flux ( $Q/A$ ) through the specimen is measured by a thin-film heat flux transducer, which cover a large surface. Unlike conventional systems, this advanced design guarantees exceptional sensitivity and accuracy in heat flow measurement.

The resulting average heat flux is then used to calculate thermal conductivity ( $\lambda$ )

Feature:

- Solid-state heating and cooling system for precise temperature control.
- High sensitivity and accuracy heat flux transducers providing highly representative and reliable heat flow measurements.
- Connected software offering powerful analysis tools and enhanced testing functionality.
- Fully compliant with international standards: Thermal Conductivity: ASTM C518, ISO 8301, DIN EN 12667

#### 2. Advanced Heat Flux Measurement:

The heat flux transducer is engineered to provide a true and undistorted measurement of total heat flux, ensuring long-term durability and reliable performance throughout its operating life.

This advanced design delivers:

- The most representative measurements of both sample temperature and heat flow
- Improved testing accuracy for heterogeneous materials.

#### 3. Precision Temperature Control:

The Heat Flow Meter employ dual arrays of solid-state elements to deliver precise and responsive heating and cooling to each plate. Thanks to their low-mass, high-output design, these elements enable rapid attainment of temperature set points, significantly enhancing productivity.

Temperature regulation is ensured by fast-response thermocouples positioned in close proximity to the sample, while an advanced control algorithm continuously maintains stable plate temperatures and quickly brings the system to full thermal equilibrium. A distinctive advantage of the systems is their ability to independently heat or cool the top and bottom plates, enabling measurements with heat flow directed either upward or downward.

For optimal performance, the instruments incorporate a recirculating chiller system as a heat exchanger, ensuring the heating elements operate at the required power output.

## 12. **SIMULTANEOUS THERMOGRAVIMETRY AND DIFFERENTIAL SCANNING CALORIMETRY**

**Make:** Hitachi High-Tech, NETZSCH Technologies India Pvt. Ltd., and TA Instruments.

### **DETAILED TECHNICAL SPECIFICATIONS**

Temperature range: 25°C to 1600°C (SiC: HEATING ELEMENT)

Heating and cooling rates: 5 K/min to 50 K/min

Weighing range: 200 mg

Resolution     TGA: up to 0.002 mg and DSC < 1  $\mu$ W

Atmosphere    inert, oxidizing, reducing, static, dynamic

### **Other Features**

TG features:

Automatic evaluation of mass-change steps, Calculation of mass/temperature values and residual mass, Automatic baseline

DSC/DTA features:

Determination of onset, peak, inflection and end temperatures, Automatic peak search, Comprehensive analysis of glass transitions

### 13. THERMAL DRONE

**Make:** DJI, Xboom, Ideaforge and Global Scientific (India) Pvt Ltd.

#### **DETAILED TECHNICAL SPECIFICATIONS**

| Parameters            | Required   |
|-----------------------|--|
| Flight Time           | 60 min   |
| Speed                 | 50 kmph  |
| Operating Distance    | 1-2 Km   |
| Wind Resistance       | 40 kmph  |
| Pay Load              | 5-6 Kg   |
| Camera                | <i>Thermal</i><br>Vanadium Oxide (VOX) Sensor with -4 to 932°F / -20 to 500°C<br>Measurement Range (61° FoV)<br><br><i>Wide</i><br>48 MP, 1/2"-Type CMOS Sensor with 24mm-Equivalent, f/2.8 Lens<br>(84° FoV)<br><br><i>Telephoto</i><br>12 MP, 1/2"-Type CMOS Sensor with 162mm-Equivalent, f/4.4 Lens<br>(15° FoV) |
| Obstacle Sensing      | Omnidirectional (Forward, Backward, Lateral, Upward, Downward)   |
| Operating Temperature | -10° C to 80°C or above  |



#### 14. WORKSTATION COMPUTER FOR SIMULATION

**Make:** Dell, HP and Lenovo.

##### **DETAILED TECHNICAL SPECIFICATIONS**

| Sr No | Item             | Specifications  |
|-------|------------------|---|
| 1     | Form Factor      | Tower   |
| 2     | Processor        | Intel Xeon w9-3595X   |
| 3     | Memory           | 128 GB DDR5 or more, Memory expandability up to 2048 GB   |
| 4     | Storage & ODD    | 1 GB or more NVMe SSD through M.2 Slot  |
| 5     | Graphics         | NVIDIA RTX 5000 Ada Generation (32 GB) or better  |
| 6     | Operating System | Microsoft Windows 11 Professional with OEM Recovery DVD or option of Cloud Recovery   |
| 7     | Networking       | Integrated 10/100/1000 Ethernet Controller<br>Integrated Intel WI-FI 6 with Bluetooth 5.2 and above   |
| 8     | Ports            | Video: 1 Display Port, 1 HDMI<br>Minimum 10 USB Port out of which at least 4 USB should be of 3.2 Gen 2 in front  |
| 9     | Slots            | 1 PCIe x1<br>1 PCI<br>1 PCIe 4 x16<br>2 M.2 slots for WIFI & SSD  |
| 10    | Keyboard         | USB Wired/Wireless Keyboard (Same OEM)  |
| 11    | Mouse            | USB Optical Wired/Wireless Mouse (Same OEM)   |
| 12    | Security         | Minimum TPM 2.0 (Hardware)  |
| 13    | Manageability    | Integrated utility to enables hardware level testing outside the operating system<br>Drivers should be available on OEM Website for download  |
| 14    | Certifications   | Microsoft Windows 11, Ubuntu Linux<br>FCC, CE, RoHS, UL, EPEAT Gold India, Energy Star,<br>TCO of Desktop and Monitor both,<br>ISO 20001, 27001 for OEM,<br>OEM should be in TOP 3 IDC Player IN Desktop Category as per recent Quarter.<br>Technical Compliance in OEM Letterhead<br>OS should be OEM factory pre-loaded. An undertaking from OEM should be submitted along with ATC document. |
| 15    | Display          | Minimum 30.75 inch or Higher (Same OEM as Desktop),<br>Display & HDMI Port, TCO 9.0 certified   |
| 16    | Warranty         | 3 Years or more onsite  |

## 15. DESKTOP COMPUTERS FOR RESEARCH SCHOLAR AND PROJECT STAFF

**Make:** Dell, HP and Lenovo

### DETAILED TECHNICAL SPECIFICATIONS

| Sr No | Item             | Specifications  |
|-------|------------------|---|
| 1     | Form Factor      | Tower/Micro Tower/Mini Tower  |
| 2     | Chassis          | Standard Chassis  |
| 3     | Chipset          | Intel® Q670 Chipset or better   |
| 4     | Processor        | Intel® Core™ i9-14900, 2.1 GHz base frequency, 30 MB cache, 16 cores, With Intel® vPro® Enable  |
| 5     | Memory           | 16 GB DDR5-4800 Mhz, Memory expandability up to 64 GB with 2 DIMM Slots   |
| 6     | Storage & ODD    | 512 GB NVMe SSD through M.2 Slot  |
| 7     | Graphics         | Intel® UHD Graphics 770   |
| 8     | Operating System | Microsoft Windows 11 Professional with OEM Recovery DVD or option of Cloud Recovery   |
| 9     | Networking       | Integrated 10/100/1000 Ethernet Controller<br>Integrated Intel WI-FI 6 with Bluetooth 5.2 and above   |
| 10    | Ports            | Video: 1 Display Port, 1 HDMI<br>Minimum 10 USB Port out of which at least 4 USB should be of 3.2 Gen 2 in front  |
| 11    | Slots            | 1 PCIe x1<br>1 PCI<br>1 PCIe 4 x16<br>2 M.2 slots for WIFI & SSD  |
| 12    | Keyboard         | USB Wired Keyboard (Same OEM)   |
| 13    | Mouse            | USB Optical Wired Mouse (Same OEM)  |
| 14    | Power Supply     | 260 W with 92% efficiency (The same should be mentioned in the OEM Datasheet of the specific quoted product available in the public domain)   |
| 15    | Volume           | Not More than 16 L  |
| 16    | Security         | Minimum TPM 2.0 (Hardware)  |
| 17    | Manageability    | Integrated utility to enables hardware level testing outside the operating system &<br>Drivers should be available on OEM Website for download  |
| 18    | Certifications   | Microsoft Windows 11, Ubuntu Linux<br>FCC, CE, RoHS, UL, EPEAT Gold India, Energy Star,<br>TCO of Desktop and Monitor both,<br>ISO 20001, 27001 for OEM,<br>OEM should be in TOP 3 IDC Player IN Desktop Category as per recent Quarter.<br>Technical Compliance in OEM Letterhead<br>OS should be OEM factory pre-loaded. An undertaking from OEM should be submitted along with ATC document. |
| 19    | Display          | Minimum 23.8 inch or Higher (Same OEM as Desktop), Display & HDMI Port, TCO 9.0 certified   |
| 20    | Warranty         | 3 Years onsite  |

## 16. HIGH TEMPERATURE INDUCTIVE DISPLACEMENT TRANSDUCER

**Make:** Micro Epsilon, HBM, Honeywell

### DETAILED TECHNICAL SPECIFICATIONS

| Sl. No. | LVDT SPECIFICATIONS   |   |
|---------|---|---|
| 1.      | Type  | Inductive type LVDTs  |
| 2.      | Nominal Range   | 0-100 mm  |
| 3.      | Nominal sensitivity   | Not less than 80 mV/V with output unloaded.   |
| 4.      | Zero point tolerance  | $< \pm 8$ mV/V with core in zero position.  |
| 5.      | Linearity deviation   | i.e Greatest deviation between start and end point $\leq 0.1 < \pm 0.2 < \pm 0.1\%$                       |
| 6.      | Operating temperature   | Minimum $-25^{\circ}\text{C}$ to $+200^{\circ}\text{C}$ .   |
| 7.      | I/P and O/P resistances                                       | $350\ \Omega \pm 10\%$ and $680\ \Omega \pm 10\%$ respectively.   |
| 8.      | Output  | 0 to 10V  |
| 9.      | Nominal Excitation Voltage                                    | 2.5 Vrms with operating excitation voltage range of 0.5-10 Vrms.  |
| 10.     | Carrier frequency   | $4.8 \pm 1\%$ kHz, operating range: $4.8 \pm 8\%$ KHz   |
| 11.     | Surface material  | It must be rust resistant   |
| 12.     | Vibration resistant<br>Vibration acceleration                 | Frequency range between 5 to 65 Hz<br>$150\ \text{m/s}^2$   |
| 13.     | Diameter  | $\leq 12\text{mm}$  |
| 14.     | Weight  | Not more than 170 for 200mm and 120 grams for 100 mm (Including LVDTs body and probe).                    |
| 15.     | Degree of protection  | IP67  |
| 16.     | Service Life  | Min 1,00,000 cycles   |
| 17.     | Max. permissible plunger acceleration                         | $2400\ \text{m/s}^2$  |
| 18.     | Impact resistance<br>Number of impacts<br>Impact acceleration | 1000 Nos.<br>$150\ \text{m/s}^2$  |
| 19.     | Type of connection at the transducer                          | LEMO connector & Mating connector.  |
| 20.     | Calibration certificate                                       | Each LVDT shall be supplied with valid calibration certificate not less than one year                     |
| 21.     | Warranty  | Minimum One-year warranty from the date of supply   |
| 22.     | Manual  | Each LVDT shall have one set of user manual   |
| 23.     | OEM Authorization   | Vendor shall submit a copy of authorization traceable to OEM certificate along with Technical bid itself. |

## 17. NON CONTACT DISPLACEMENT SENSORS

**Make:** Micro Epsilon, optris, sensopart, HBM

### DETAILED TECHNICAL SPECIFICATIONS

| S No. | Description                     | Parameters   |
|-------|---------------------------------|--|
| 1.    | Measuring range                 | 500 mm   |
| 2.    | Start of measuring range        | 100mm  |
| 3.    | Mid of measuring range          | 350mm  |
| 4.    | End of Measuring range          | 600mm  |
| 5.    | Linearity                       | $\leq \pm 0.08\%$ FSO  |
| 6.    | Repeatability                   | $\leq 20\text{-}40\mu\text{m}$   |
| 7.    | Spot Size (Mid-range)           | 950 x 1200 $\mu\text{m}$   |
| 8.    | Measuring rate (Programmable)   | 0.25 kHz/0.5kHz/1 kHz/2 kHz/ 4kHz/ 8kHz/10kHz  |
| 9.    | Laser source                    | Semiconductor laser <1mW, 670 nm (red)   |
| 10.   | Laser safety class              | Class 2 in accordance with DIN EN 60825-1: 2015-07 or above  |
| 11.   | Permissible ambient light       | 10,000 lx  |
| 12.   | Supply voltage                  | 11...30 VDC  |
| 13.   | Power Consumption               | < 3 W (24V)  |
| 14.   | Signal input                    | 1 x HTL multifunction input: trigger in /zero setting/mastering /teach   |
| 15.   | Digital interface               | RS422 (16 bit)/PROFINET4/ Ethernet /IP4  |
| 16.   | Analog Output                   | 4-20 mA/0-10 V with cable (12 bit, freely scalable within the measuring range)   |
| 17.   | Switching output                | 2 x switching outputs; npn, pnp, push pull   |
| 18.   | Connection                      | Integrated cable 3m, open ends, min. bending radius 30mm (fixed installation); or integrated pigtail 0.3 m with 17-pin M12 plug  |
| 19.   | Assembly                        | Screw connection via two mounting holes  |
| 20.   | Storage temperature             | -20°C - +70°C or better  |
| 21.   | Operation Temperature           | 0...+65°C or better  |
| 22.   | External cooling Jacket         | To withstand higher ambient temperature with external cooling jacket   |
| 23.   | Shock (DIN EN 60068-2-29)       | 15 g/6 ms in 3 axes, 1000 shocks each  |
| 24.   | Vibration (DIN EN 60068-2-6)    | 20g/20... 500 Hz in 3 axes, 2 directions and 10 cycles each  |
| 25.   | Protection class (DIN EN 60529) | IP67 or above  |
| 26.   | Material                        | Aluminum housing   |
| 27.   | Weight                          | Approx. 185 g (incl. pigtail), approx. 300 g (incl. cable)   |
| 28.   | Control and display elements    | Web interface for setup 6): Selectable presets, peak selection, video signal , freely selectable averaging, data reduction, setup management; 2x color LED's for power /status |
| 29.   | Calibration Report              | OEM calibration Report required  |

## 18. HIGH TEMPERATURE STRAIN GAUGES WITH ADHESIVE (>1000 DEG C)

**Make:** HBM, Micro Measurements, HPM

### DETAILED TECHNICAL SPECIFICATIONS

| S. No. | Nominal Parameters                           | Specification Value   |
|--------|--|---|
| 1.     | Sensitive grid material                      | Iron-chromium-aluminum  |
| 2.     | Possible number of sensitive elements        | 1   |
| 3.     | Base length, mm                              | 1.9-3.5   |
| 4.     | Gage width, mm                               | 1.6-2.7   |
| 5.     | Resistance, Ohm                              | 120   |
| 6.     | Resistance deviation in batch, not more than | ±1% or ±3%  |
| 7.     | Lead wire material                           | Iron-chromium-aluminum  |
| 8.     | Lead wire diameter, mm                       | 0.07-0.15   |
| 9.     | Lead wire type                               | Ribbon or round   |
| 10.    | Lead wire length, mm                         | 50-300  |
| 11.    | Temporary carrier                            | Fiberglass-reinforced PTFE or filter paper                                  |
| 12.    | Average gage factor at 20°C                  | 2.3   |
| 13.    | Fatigue life at ±650 ppm at 20°C, cycles     | 10 <sup>6</sup>   |
| 14.    | Bonding Methods                              | Ceramic Cement or Alumina flame spray                                       |
| 15.    | Max. working temperature                     | 1150°C  |
| 16.    | Type of measurements                         | Static and dynamic  |
| 17.    | Cement Glue                                  | High temperature strain gauges bonding for operating temperature upto 900°C |

## 19. PLATE THERMOCOUPLE

**Make:** Gunther, Global Scientific (India) Pvt Ltd. and Tempsens Instruments (India) Limited

### DETAILED TECHNICAL SPECIFICATIONS

1. Construction: Plate without and with insulator.
2. Thermocouple Mounting: for thermocouple diameter 1 mm to 3 mm.
3. Plate dimensions: 100 mm × 100 mm.
4. Connector to protective pipe: Standard connection, side connection, black connection.
5. Version number: Standard version (annealed plate and non-annealed plate).
6. Type of connection to the pipe: Swivel connector, Connector on the cotter pin, thread.

## 20. ROVING THERMOCOUPLE

Roving thermocouples, dedicated for instantaneous measurements are made of thermocouple wire with a diameter of 1.0mm. They have a protection tube, a cable and a thermally insulating profile handle. The contact element is a copper plate with a diameter of 12 mm and a thickness of 0.5 mm. Whole construction is made in accordance with the guidelines included in the standard EN 1363.

**Make:** Gunther, Global Scientific (India) Pvt Ltd. and Tempsens Instruments (India) Limited

### **DETAILED TECHNICAL SPECIFICATIONS**

1. Construction: Roving thermocouple
2. Handle: Profiled wooden handle
3. Lead-out of the measuring tip: Ceramic insulator,  $\phi 8\text{mm}$
4. Cable ends: Free ends, Ferrules, Standard plug, Mini plug
5. Calibration certificate
6. Version number: Standard version and Modified version
7. Cable length: specified in meter with 2 decimal places, e.g. 2.00 m
8. Immersion length (L): specified in mm
9. Cable isolation: Silicone/ Silicone ( $T_{\text{max}} +180^{\circ}\text{C}$ )

## 21. SURFACE THERMOCOUPLE WITH A COPPER DISC

Surface thermocouples with a copper disc are made of a cable with a mini, standard plug or free ends. The shape and method of connecting the measurement joint is made in accordance with the requirements of the standard.

**Make:** Gunther, Global Scientific (India) Pvt Ltd. and Tempsens Instruments (India) Limited

### **DETAILED TECHNICAL SPECIFICATIONS**

1. Construction: Surface thermocouple with copper disc
2. Wire diameter (D): 0.5 mm, 0.8 mm, and others
3. Cable ends: Free ends, Ferrules, Standard plug, Mini plug, Standard HT plug, Mini HT plug, Ceramic standard plug
4. Version of Hot-junction: Version A (twisted), Version B (through the disc)
5. Version number: Standard version and Modified version
6. Cable length (AL): Specified in meter with 2 decimal places
7. Disc diameter: 12 mm
8. Cable isolation: Fiberglass/Metal braid ( $T_{\text{max}} +400^{\circ}\text{C}$ )
9. Length of leads to the hot junction: Specified in mm, e.g. 50 mm.

## 22. FIRE SAFETY EQUIPMENT

**Make:** Sistem Teknik, Turkey, Global Scientific (India) Pvt Ltd. and Tempsens Instruments (India) Limited

### **ACCESSORIES**

1. Fire Suit
2. Heat proof Gloves
3. Safety Helmet
4. Safety Shoes
5. Safety Siren
6. Safety Goggles
7. Fire Blanket (per m2)