

**INDIAN INSTITUTE OF TECHNOLOGY KANPUR**  
**Department of Earth Sciences**

**\*REVISED**

**Enquiry No: ES/PROJECT/SM/2017-18/03**

**Date: 13.12.17**

**Subject: Quotation for Manufacturing of High Pressure High Temperature (HPHT) gas medium, internally heated deformation apparatus equipped with internal load cell, axial and torsion actuators as mentioned below.**

With reference to the subject mentioned above, you are invited to submit the quotation in a sealed cover in order to reach us by **December 18th, 2017** in the form of a hard copy to the address mentioned below. If you have any question please call Dr. Santanu Misra at 0512-2596812, email: [smisra@iitk.ac.in](mailto:smisra@iitk.ac.in).

**The prospective suppliers are required to send quotation in two parts in sealed envelopes, as "Technical Bid" and "Financial Bid".** The Technical Bid should contain detailed technical specification of the product being offered and should not mention any prices. The Financial Bid should include the detailed price quotation clearly including the cost of the equipment, taxes, service charges if any, shipping and handling charges. **The two separate and sealed envelopes should be clearly marked appropriately as "Technical Bid" and "Financial Bid".**

**Specifications:-**

**A. DESIGN FEATURES**

1. Safety and convenience in use involving multiple precautions for safe operation while at the same time minimizing the risk of high pressure work.
2. Suitable high pressure safety valves at variable working pressures and sensitive alarms for anomalous temperature.
3. Gas pressure medium to ensure an inert and strictly hydrostatic environment in the vessel.
4. Oil-filled bubblers for easy leak detections.
5. Internal multi-heating-zone furnace to ensure minimal heating of the pressure vessel while permitting relatively rapid heating and cooling as well as easy control of the temperature distribution.
6. Internal high quality transducers to permit sensitive measurement of axial load, torque and displacement without correction for piston friction effects being required.
7. User friendly state-of-the-art data acquisition and real-time data visualization with open source software.
8. Deformation experiments at constant displacement (axial/torsion) or load (axial/torque) over a long period of time with stable pressure and temperature.

**B. TECHNICAL LITERATURE**

Please contact the undersigned for technical literature and other resources.

## C. BASIC TECHNICAL SPECIFICATIONS

### General

Pressure vessel:	Composed of inner and outer force fitted steel cylinders, with axis vertical and equipped with cooling coils [ <u>should be certified by burst/failure-test</u> ].
Confining pressure:	500 MPa maximum, in argon.
Free volume:	0.2 liters with specimen, furnace and internal load cell fitted
Available energy:	120 kJ in adiabatic expansion from 500 MPa with specimen, furnace and internal load cell fitted
Temperature:	1200°C maximum
Sample:	Cylindrical geometry (dia: 10, 12 and 15mm; length: 2mm to 30mm)
Assembly	Alumina and PSZ pistons with top and bottom anvils for torsional and axial deformation

### Axial Deformation Module

Axial force:	Maximum $\pm 100$ kN
Force resolution:	10N [may vary with different load cells]
Axial displacement:	Maximum 30mm on cross-head (total range 50 mm for servicing)
Displacement resolution:	1 $\mu\text{m}$ [may vary with different load cells]
Axial strain rate:	$10^{-2}$ to $10^{-7}$ $\text{s}^{-1}$ [max 500 $\mu\text{m s}^{-1}$ ; min 0.005 $\mu\text{m s}^{-1}$ with 100:1 reducer]

### Torsion Module

Torque:	Maximum $\pm 1000$ Nm
Torque resolution:	0.1 Nm [may vary with different load cells]
Torsional displacement:	no actuator limit – rotational (linear range of transducer 6.28 radians)
Displace resolution:	0.001 rad
Shear strain rate:	$10^{-2}$ to $10^{-7}$ $\text{s}^{-1}$ [max $5 \cdot 10^{-3} \text{rads}^{-1}$ ; min $5 \cdot 10^{-8} \text{rads}^{-1}$ with 100:1 reducer]

### Pore Fluid Module

Pore fluid pressure:	max 500 MPa
Volumometer displacement:	50 mm piston, equivalent to 1900mm <sup>3</sup> volume
Fluid displacement rate:	maximum 60mm <sup>3</sup> s <sup>-1</sup> ; min 0.1mm <sup>3</sup> s <sup>-1</sup>

### Data acquisition & visualization

Load cells:	Two load cells for low (100 kN, resolution 10N) and high (30 kN, resolution 3N) sensitivities. Pairs of LVDTs dedicated to axial displacement, axial load and torque equipped with conditioning unit.
Pressures:	Sensitive pressure gauges for each stage of pressurization (NI)
Temperature:	R/K type thermocouples. Eurotherm/NI programmable temperature controller.
Torsion Displacement:	RVDT with variable rotational ratios.
Acquisition:	Multi-channel, programmable data-recorder (NI) for real-time displaying and storing data of i) confining and intensifier pressures, ii) sample and furnace temperatures, iii) internal and external axial loads, iv) internal

and external axial displacements, v) internal and external torque, vi) torsional displacement, vii) upstream and downstream pressure, viii) Volumometer, ix) pore pressure etc.

High frequency data acquisition (sampling rate 0.01 Hz, minimum) with options to change the frequency.

Operation: Combinations of automatic and manual with user-friendly computer interface (LabView).

#### **D. SCOPE OF THE WORK**

The manufacturing of the instrument should have 7 (seven) major steps. Each step will be evacuated after completion –

**1. Approval of the design of each component and materials as listed below**

- a) Safety housing, working space, stair-case, computer etc.
- b) Pressure vessel and its components, high pressure sealing and closure nuts, cooling system, pressure generating components (gas booster, intensifier, oil tank etc.), high pressure plumbing, leak-detecting bubblers, operational and safety valves etc.
- c) High and low resolution load cells, casing, compensating pistons and its components, tools for dismantling and assembling load cell.
- d) Sample assembly and its components, axial compression and torsion anvils, tools for inserting and extracting the assembly etc.
- e) Heating system, furnace, insulation, electrical feed through, tools for inserting and extracting the assembly etc.
- f) Axial actuator and its components, gear box, motor, external load cell, limit switch etc.
- g) Torsion actuator, motor, encoder, gear box, external torque cell etc.
- h) Calibration kits for furnace, axial load, axial displacement, torque, torsional displacement etc.
- i) Dummies for leak-detection and troubleshooting (load cell, furnace, additional spacers etc.)
- j) Data conditioning unit, separate operations units for axial and torsion deformation
- k) All electrical connections, cablings and electronic devices for safety and operation
- l) Data acquisition and related cablings
- m) All material specifications including components that need to be purchased (company, model, warranty etc.)
- n) Any other items which may arise in the course of designing the instrument
- o) 3D CAD drawing of the entire machine

**2. Manufacturing/purchasing of the components**

**3. Assembly of all components**

**4. Satisfactory testing at the manufacturer's site/workshop**

**5. Dismantling, packing and lifting**

**6. Shipment to IITK**

**7. Installation, testing and commissioning in IITK**

## **E. SUBMISSION OF THE TECHNICAL AND FINANCIAL QUOTATION**

- 1. A pre-bidding meeting may be organized to clarify the technical specifications and/or other details in IITK.**
2. The prospective manufacturers are required to send quotation in two parts in sealed envelopes, as "Technical Bid" and "Financial Bid". The Technical Bid should contain detailed technical specification of the product being offered and should not mention any prices. The Financial Bid should include the detailed price quotation clearly including the cost of the equipment, taxes, service charges if any, shipping and handling charges. The two separate and sealed envelopes should be clearly marked appropriately as "Technical Bid" and "Financial Bid".
3. The price must be quoted in Indian Rupees (INR). Please indicate the conversion rate, if applicable.
4. In instrument should be installed at IITK within 10 months from the PO date.
5. The manufacturer must have at least 15 years' of experience in heavy industry and/or design and manufacturing of complex machine and test rigs.
6. Maximum education discount, if any should be offered.
7. Validity of quotation should be at least for 60 days.
8. Prices should be on CIF and FOB separately (if imported).
9. Each item/component's price should be mentioned separately in the Financial Bid.
10. Prices should include the installation and training cost.
11. Normal payment terms for the Institute will be applicable (90% on delivery of the items and the remaining 10% after satisfactory installation/ inspection).
12. Quotation should carry proper certifications like agency certificate, proprietary certificate etc.

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