INDIAN INSTITUTE OF TECHNOLOGY MADRAS
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V. Sathyanarayanan
Senior Manager (Project Purchase)

Ref: MET/KRAV/042/2017
Date: 20.12.2017

Open Tender No: MET/KRAV/042/2017

Due Date: 12.01.2018, at 2.00 pm

Pre-Bid meeting: - Not Required

Technical Bid opening meeting on 12.01.2018 at 3.30 p.m.

Dear Sir/Madam,

On behalf of the Indian Institute of Technology Madras, offers are invited for the supply of

1. **"100 KN High Temperature Creep Testing Machine to conduct Tensile Creep Testing (up to 1150° C)"**
2. **"100 KN High Temperature Creep Testing Machine to conduct Tensile (up to 1150° C) and Compression Creep Testing (up to 1500° C)"**

conforming to the specifications given in Annexure.

A vendor who can supply the above two items and integrate the equipment alone need to respond to the tender please.

Instructions to the Bidder

(i) **Preparation of Bids:** - The tenders should be submitted under two-bid system (i.e.) Technical bid and Financial bid.

(ii) **Delivery of the tender:** - The tender shall be sent to the below-mentioned addresses either by post or by courier so as to reach our office before the due date and time specified in our Schedule. The offer/bid can also be dropped in the tender box on or before the due date and time specified in the schedule. The tender box is kept in the office of the

Senior Manager,
Project Purchase
IC & SR Building 2nd floor,
I.I.T. Madras, Chennai – 600 036.

(iii) **Pre-Bid meeting: - Not required**.

(iv) **Opening of the tender:** - The offer/Bids will be opened by a committee duly constituted for this purpose. The technical bids will be opened first and it will be examined by a technical committee which will decide the suitability of the bid as per our specifications and requirements. The bidders will be invited for opening of Technical bids. In respect of opening of financial bid, those bidders who are technically qualified only will be called for.

(v) **Prices:** - The price should be quoted in nett per unit (after breakup) and must include all packing and delivery charges to various Departments/Centres/Institutions. The offer/bid should be exclusive of taxes and duties, which will be paid by the purchaser as applicable. However the percentage of tax & duties should be clearly indicated.

The price should be quoted without custom duty and excise duty, since I.I.T. Madras is exempt from payment of excise duty, and the custom duty will be paid at concessional rate against duty exemption certificate. In case of import supply, the price should be quoted on EX-WORKS and CIP basis indicating the mode of shipment.

(vi) **Agency Commission**: - Agency commission, if any, will be paid to the Indian agents in Rupees on receipt of the equipment and after satisfactory installation. Agency Commission will not be paid in foreign currency under any circumstances. The details should be explicitly shown in Tender even in the case of 'Nil' commission. The tenderer should indicate the percentage of agency commission to be paid to the Indian agent. The foreign Principal should indicate about the percentage of payment and it should be included in the originally quoted basic price, if any.

(vii) **Terms of Delivery**: - The item should be supplied to the Departments Metallurgical and Material Engineering as per Purchase Order. In case of import supply, the item should be delivered at the cost of the supplier to our Institution. The Installation/Commissioning should be completed as specified in our important conditions.

(viii) **Technical Bid Opening**: The technical bid will be opened on 12.01.2018 at 3.30 p.m at the Conference room, NCCRD Building, IIT Madras and the financial bids of those tenders who are technically qualified will be opened at a later date under intimation to them.

(ix) IIT Madras reserves the full right to accept / reject any tender at stage without assigning any reason.

Yours sincerely,

V. Sathyanarayanan
Senior Manager (Project Purchase)
IC&SR Building, I.I.T. Madras,
Chennai – 600 036

SCHEDULE

Important Conditions of the tender

1. The due date for the submission of the tender is **12.01.2018, 2.00 pm.**

The offers / bids should be submitted in two bids systems (i.e.) Technical bid and Financial bid. The Technical bid should consist of all technical details / specifications only. The Financial bid should indicate item-wise price for each item and it should contain all Commercial Terms and Conditions including Taxes, transportation, packing & forwarding, installation, guarantee, payment terms, pricing terms etc. The Technical bid and Financial bid should be put in separate covers and sealed. Both the sealed covers should be put in a bigger cover. The Open Tender for supply of

1. **"100 KN High Temperature Creep Testing Machine to conduct Tensile Creep Testing (up to 1150° C)"**
2. **"100 KN High Temperature Creep Testing Machine to conduct Tensile (up to 1150° C) and Compression Creep Testing (up to 1500° C)"**

should be written on the left side of the Outer bigger cover and sealed.

2. **EMD: - EMD should be Rs.6 lakhs.** No interest will be paid for the EMD and the EMD (Bid Security) will be refunded to the successful bidder on receipt of Performance Security.

3. **Performance Security:-** The successful bidder should submit Performance Security for an amount of 5% of the value of the contract/supply. The Performance Security may be furnished in the form of an Account Payee DD, FD Receipt from the commercial bank, Bank Guarantee from any nationalized bank of India will be an acceptable.

   Only after submission of Performance Security, Letter of credit will be established / payment will be released.

   Performance Security in the form of Bank Guarantee:- Incase the successful bidder wishes to submit Performance Security in the form of Bank Guarantee, the Bank Guarantee should be routed through the Beneficiary Bank to the end user bank. Otherwise, the Indian Agent of the foreign vendor has to submit a Bank Guarantee from a Nationalized Bank of India.

   The Bank Guarantee should remain valid for a period of sixty days beyond the date of completion of all contractual obligations of the supplier including the warranty obligations.

4. If an Indian agent is involved, the following documents must be enclosed:
   Foreign principal's proforma invoice indicating the commission payable to the Indian Agent and nature of after-sales service to be rendered by the Indian Agent.
   - ✓ Copy of the agency agreement with the foreign principal and the precise relationship between them and their mutual interest in the business.
   - ✓ The enlistment of the Indian agent with Director General of Supplies & Disposals under the Compulsory Registration Scheme of Ministry of Finance.

5. The offer/bids should be sent only for a machine that is available in the market and supplied to a number of customers. A list of customers in India and abroad with details must accompany the quotations. Quotations for a prototype machine will not be accepted.

6. Original catalogue (not any photocopy) of the quoted model duly signed by the principals must accompany the quotation in the Technical bid. No prices should ever be included in the Technical bid.

7. Documentary proof for the claimed position and repetition accuracies must be obtained from the principals and submitted along with the relevant pages of the standards.

8. Compliance or Confirmation report with reference to the specifications and other terms & conditions should also be obtained from the principal.

9. **Validity:** Validity of Quotation not less than 90 days from the due date of tender.

10. **Delivery Schedule**:- The tenderer should indicate clearly the time required for delivery of the item. In case there is any deviation in the delivery schedule, liquidated damages clause will be enforced or penalty for the delayed supply period will be levied.

11. **Risk Purchase Clause**:- In the event of failure of supply of the item/equipment within the stipulated delivery schedule, the purchaser has all the right to purchase the item/equipment from other sources on the total risk of the supplier under risk purchase clause.

12. **Payment**:- No Advance payment will be made for Indigenous purchase. However 90% Payment against Delivery and 10% after installation are agreed to wherever the installation is involved. In case of import supplies the payment will be made only through 100% Letter of Credit i.e. (90% payment will be released against shipping documents and 10% after successful installation wherever the installation is being done).

13. **Advance Payment:-** No advance payment is generally admissible. In case of specific percentage of advance payment is required, the Foreign Vendor has to submit a Bank Guarantee equal to the amount of advance payment and it should be routed through the Beneficiary Bank to the end user Bank. Otherwise, the Indian Agent of the foreign vendor has to submit a Bank Guarantee through a Nationalized Bank of India.

14. **On-site Installation**: - The equipment or machinery has to be installed or commissioned by the successful bidder within 15 to 20 days from the date of receipt of the item at site of IIT Madras.

15. **Warranty/Guarantee**: - The offer should clearly specify the warranty or guarantee period for the machinery/equipment. Any extended warranty offered for the same has to be mentioned separately. (for more details please refer our Technical Specifications).

16. **Late offer**: - The offers received after the due date and time will not be considered. The Institute shall not be responsible for the late receipt of Tender on account of Postal, Courier or any other delay.

17. **Acceptance and Rejection**: - I.I.T. Madras has the right to accept the whole or any part of the Tender or portion of the quantity offered or reject it in full without assigning any reason.

18. **Do not quote the optional items or additional items unless otherwise mentioned in the Tender documents / Specifications.**

19. Disputes and Jurisdiction: -

a. **Settlement of Disputes:** Any dispute, controversy or claim arising out of or in connection with this PO including any question regarding its existence, validity, breach or termination, shall in the first instance be attempted to be resolved amicably by both the Parties. If attempts for such amicable resolution fails or no decision is reached within 30 days whichever is earlier, then such disputes shall be settled by arbitration in accordance with the Arbitration and Conciliation Act, 1996. Unless the Parties agree on a sole arbitrator, within 30 days from the receipt of a written request by one Party from the other Party to so agree, the arbitral panel shall comprise of three arbitrators. In that event, the supplier will nominate one arbitrator and the Project Coordinator of IITM shall nominate on arbitrator. The Dean IC&SR will nominate the Presiding Arbitrator of the arbitral tribunal. The arbitration proceeding shall be carried out in English language. The cost of arbitration and fees of the arbitrator(s) shall be shared equally by the Parties. The seat of arbitration shall be at IC&SR IIT Madras, Chennai.

b. **The Applicable Law:** This Purchase Order shall be construed, Interpreted and governed by the Laws of India, Court at Chennai shall have exclusive jurisdiction subject to the arbitration clause.

20. All Amendments, time extension, clarifications etc., will be uploaded on the website only http://tenders.iitm.ac.in and will not be published in newspapers/CPP portal. Bidders should regularly visit the above website to keep themselves updated. No extension in the bid due date/ time shall be considered on account of delay in receipt of any document by mail.

Acknowledgement:- It is hereby acknowledged that the tenderer has gone through all the conditions mentioned above and agrees to abide by them.

SIGNATURE OF TENDERER
ALONG WITH SEAL OF THE
COMPANY WITH DATE

Specification

Technical Specifications for 100 kN High Temperature Creep Testing Machine to Conduct Tensile Creep Testing under Constant Stress, Constant Strain, Constant Load, Constant Strain Rate conditions and Stress Rupture Testing up to 1150 °C [redacted] (Machine-1)

Load Frame requirement

- The load frame should be stand-alone floor machine and should not need any special base or foundation. There should be vibration dampeners provided at the base of the load frame.
- The frame should have high stiffness (frame axial stiffness >450 kN/mm), precision and durability, having a four-column electromechanical loading frame and a central single screw.
- The load frame should have a servo drive, inclusive (low-inertia) servomotor in maintenance-free AC-technology with digital position-feedback. The stroke encoder should have a resolution of 0.5 nanometer with backlash free drive
- The methods of uniaxial loading possible using the machine should be: (1). constant rate of pull-rod traverse acting via single backlash-free precision ball-screw, and (2). digital closed loop load control mode. The mode of loading can be chosen by the user. i.e. user should be able to conduct constant stress, constant stress, constant strain (stress relaxation), constant strain rate, constant load and stress rupture testing.
- Test speed range between 0.00002 mm/min to 100 mm/min with an accuracy of ± 0.1%
- Minimum displacement (stroke) range of 250 mm and vertical test space: >1250 mm without grips
- Load cell: load cell should operate in both tension and compression, and should have a capacity of 50/100 kN, with a load resolution of approximately 0.3 N. The load cell should be calibrated and the certificate of the load cell initial calibration should be provided.
- Load Measurement Accuracy: High precision auto-ranging load cell with very low nominal deformation of less than 0.5 mm and accuracy ±1% of reading down to 1/500 of load cell capacity complying with ISO 7500-1.
- Must fulfill all 5 criteria according to ISO 7500-1
- The precision of axial alignment (self-aligning load string) for uniaxial loading should conform to the requirements of ASTM standard E292 and ASTM E1012.
- Dimensions: The test area width between the drive screws should be approximately 700 mm and test area height should be approximately 1250 mm. The total height of the frame should be within 2-2.5 meter. The maximum stroke length should be approximately 250 mm.
- The lateral support of moving cross-head should have sliding bearing of four hard chromium-plated columns.
- The speed of pull rod movement should be within a range of 0.001 mm/h to 100 mm/min during uniaxial testing (user defined), and should have a return speed of

100 mm/min. The crosshead speed accuracy should vary within ± 0.1% of the set value.

- It should operate on 230 V AC power (1kVA). There should be a digital controller operating at 230 VAC (1 kVA power) for driving the machine.
- Automatic recognition of capacity, calibration & safety limits.
- Industry standard Ethernet interface to the computer for fast, reliable communication with laptop or desktop. Integrated digital closed-loop control and data acquisition electronics including load measurement, crosshead extension and strain measurement channels.
- Master software program to collect data and to conducts tests as per ASTM E139, ASTM D2990 and ASTM F519 and ASTM F1624
- 24-bit resolution card with data acquisition rate of minimum 2 kHz simultaneously on load, extension, and strain channels. The controller should have data sampling rate of 400 kHz or better.

Protection of specimen and fixtures:

- Machine should have the capability of automatically adjusting the crosshead without damaging the specimen while gripping before the test commences.
- Preventive limit controls to avoid overloading of specimens, fixtures, and load cells during crosshead adjustment

High temperature pull rods and Specimen adapters:

- The adapters should be aligned optimally for uniaxial loading according to the ASTM standard E-1012 and ASTM E292.
- Upper pull rod should be spherically seated.
- Lower pull rod should be pivotable around longitudinal axis, having a rigid seating by means of clamping lever.
- Self-aligning and adjustable seating adapter for various pull rod configurations
- The pull rods should be made of material compatible for use at high temperatures (at maximum temperatures as specified for high temperature furnace) and also at room temperature, at a maximum load of 50/100 kN.
- Pull rods capacity: 100 kN at room temperature
- The material of construction for the pull rods should be corrosion resistant nickel base super alloy having strength and dimensions amenable for use at temperatures ranging from room temperature to 1200 °C.
- The pull rods should be connected to the adapters and the connection should have adequate strength to withstand loads during slow strain rate testing.
- The specimen adapter for specimens should be joined to the pull rod by a compatible joint.
- The material of construction for the specimen adapters should be corrosion resistant nickel base super alloy having strength and dimensions amenable for use at temperatures ranging from room temperature to 1200 °C.
- High temperature adapter for button head specimens with diameter 6 mm & 8 mm

High-temperature furnace and temperature controller:

3-zone high temperature furnace for conducting creep testing and stress rupture testing, besides determination of elastic behaviour, tensile strength and yield strength of materials at elevated temperature in air.

- Min. temperature: 100°C and Max. temperature: 1150°C
- Heating rate: 20 °C/min
- Nominal power: 3.3 kW, and Nominal voltage: 3 x 400 V
- Heating zones: 3
- Temp Constancy: < ± 2K, and Temperature Constancy zone: 100 mm
- Inner diameter: ≈90 mm
- Heated length/zone: 300 mm
- Temperature tolerance at the specimen at a length of 100 mm shall be ± 2K
- Temperature constancy at the specimen shall be ± 2K (according ASTM 139)
- 3 channel PID controller with connection for 6 thermocouples (3 thermocouples for the Heating zones of the furnace and 3 thermocouples for the specimen)
- Ability for digital display of temperature from all 6 thermocouples on monitor.
- Interface for connection to the software
- The temperature controller should automatically set the control parameters for even temperature distribution along specimen and preventing temperature overshoots. Therefore, there should not be any need for setting the PID factors by empirically established means for various temperatures.
- The shell of the furnace should be made of split stainless steel having heavy duty hinge assembly. The furnace should be cylindrical with openings at both ends to allow the pull rods to go inside the furnace.
- The dimensions of the furnace should be such that it is easily accommodated within the load frame of the machine.
- There should be three thermocouples to measure and control the temperature along the length of the furnace.
- Furnace should be equipped with thermocouples and mounting arrangements for the thermocouples along with mounting brackets.
- The furnace should have three hot zones with temperature control of each zone. The furnace should have proper insulation to minimize heat loss during heating and during slow strain rate test.
- There shouldbe adequate provision in the furnace for integrating side entry extensometer.
- The temperature controller shall be capable of maintaining the temperature of the furnace and the test specimen within a range of:
  200°C up to 350°C: ±2K
  350°C up to 1150°C: ±1K
- The temperature controller shall be capable of maintaining a uniform temperature distribution within the hot zone of the furnace and shall prevent temperature overshoot. The controller shall be of adaptive and automatic type. No PID settings necessary to be set by the user.

- The temperature controller should be interfaced with a computer and the temperature should be recorded on the computer. There should be a digital display of the temperature of the furnace.
- The furnace positioning unit shall be able to position the furnace vertically within the test area of the load frame at a location determined by the user.
- The center of the furnace and the center of the specimen should be automatically aligned by the positioning unit.
- There should be a swiveling unit so that the furnace can be removed from the test area for the room temperature tests.
- The positioning unit should be capable of maintaining the vertical position of the furnace for the entire duration of the test.

Strain Gauge or Extensometer & Strain Card for Tensile Creep Measurement: Temperature Range of 100°C -1150°C.

- Creep tensile HT-extensometer up to 1150°C with the following specifications:
- Able to measure axial elongation of round or flat specimens (without collars) by contact gauges irrespective of specimen geometry
- Axial gauge length of 10 - 50 mm. Spacers for gage length of 10, 15, 20 and 25 mm need to be provided.
- Travel range of 10 mm (minimum)
- Strain Measurement Accuracy: ASTM E83 Class B or ISO 9513 Class 1 extensometer
- Calibrated as per ASTM E83 or ISO 9513 and resolution less than 0.1 µm and calibrated from 20 µm
- Max temperature:1150 °C
- Max. nonlinearity: Class 1 according ISO 9513, Class C according ASTM E83
    - - 2 analogue 50 mm sensors
    - - axial entry into HT-furnace
    - - appropriate inserts for the specimen

Advanced Material Testing Software:

- The software should be in English language and should be compatible for operation in Microsoft windows.
- Load and testing parameter setting and control shall be possible by the computer software. The user shall have the possibility to set load as well as temperature blocks. It should be possible to specify limits to load and displacement by the software.
- All the test parameters shall be programmable from the software.
- The software shall show the real-time plots (such as load Vs time, elongation Vs time) and also the real-time measured values of load, extension, specimen temperature on the screen, during the entire test duration.
- The specimen design details should be entered into the software and the software should use those values to calculate properties such as stress, total ductility etc.
- The software must have the safety inspection square concept, which will help in fast and secure set up by description of the set test. Operator-independent security

through the position-controlled system with the continuous backup of the current crosshead position in electronics. This means that the operator, when conversion of tools no longer has to worry about the settings.

- The software package should meet the needs of a wide variety of applications (ex: Metals including strips wires etc.).
- Should have the capability for tension, compression, flexure, tear and adhesion.
- The software should have the capability to save the test method along with the start position, limit positions etc. so that the machine automatically comes to the start position for testing when the file is opened.
- To create customized reports that can be linked with test methods and used to export test results
- To import ASCII data from NPL UK into the test software as a means of verification
- The software must have three levels of user access based on user login name and password protection.
- The software shall allow a user to configure a specific transducer (such as load cell or extensometer) and link it with a specific method such that the method will require that the specific transducer is used. If a different transducer is connected when a test is run with that method, the test will not run.
- It should be possible to export the raw data and the test data channels by a single mouse click into Excel or Word etc.
- The software must have the safety inspection square concept, which will help in fast and secure set up by description of the set test. Operator-independent security through the position-controlled system with the continuous backup of the current crosshead position in electronics. This means that the operator, when conversion of tools no longer has to worry about the settings.
- Preferably, testing software should have an "Education Module" to teach the students various testing configurations, virtually.

Computer and peripherals:

- The computer provided with the slow strain rate test machine should be of latest configuration, having at least 1 TB of hard disk capacity, with the latest version of windows along with the compatible necessary drivers and software necessary for data acquisition and control for long time measurements.
- Need RAID function which can write data simultaneously on two HDD for safety and prevention of data loss in case of failure of HDD.

Explicit Need:

- Compliance to ASTM E8 Methods A&B ASTM E139, ASTM D2990, ASTM F1624 and ISO 6892-1 Method A strain control in closed loop with extensometer.
- The machine should perform tests in accordance to the above requirements in addition to the normal standards and the strain rate should be displayed.

Installation, commissioning and training:

- Complete installation of machine to be completed by supplier. Also, actual testing on real sample should be shown after installation to ensure that all the modules of the testing facility are working properly as per the specifications.

- A two-day intensive training (hand on training) of the testing facility showing the various module in working condition should be provided to few students.

Warranty and support:

- 3-year onsite warranty should be provided after installation and commissioning of the testing facility. The replacement of defective part and other service charges will be provided at free at cost at our site, till 3-year warranty period is intact. Additional charges in any form should not be claimed from IITM.
- Technical support personnel should visit the testing facility (within a week after the complaint) to attend any break down or malfunction of the testing facility during the warranty period. Assurance in this connection should be provided by the vendor.
- Manufacturer should be in a position to supply the compatible accessories on demand for the next 15 years after the installation of the testing.
- Supplier should have good track record of having commissioned the similar creep testing frame within India. Specifically, OEM should have supplied at least 10 similar units in the Centrally Funded Technical Institutions (CFTI) or Government R&D laboratories within India in the last 10 years. The contact details of the customers within India should be provided.

Other terms and conditions:

- The mandatory requirement for bidding is that a vendor should quote for both the Machine-1 and Machine-2. Bidding for a single Machine shall not be considered and will be deemed disqualified.
- Machine-1 and Machine-2 should be of the same brand. Bidding with different brands (even by the same agent) for Machine-1 and Machine-2 will be deemed unsuitable and will not be considered for evaluation.
- The total value of the two Machines together will be calculated and considered for selecting the L1 vendor.
- Technical documentation substantiating the technical specifications should be provided.

Technical Specifications for 100 kN High Temperature Creep Testing Machine to Conduct Tensile Creep Testing (up to 1150 °C) and Compression Creep Testing (up to 1500 °C) under Constant Stress, Constant strain, Constant Load, Constant Strain Rate conditions, and Stress Rupture Testing in Tension [redacted] (Machine-2)

Load Frame requirement

- The load frame should be stand-alone floor machine and should not need any special base or foundation. There should be vibration dampeners provided at the base of the load frame.
- The frame should have high stiffness (frame axial stiffness >450 kN/mm), precision and durability, having a four-column electromechanical loading frame and a central single screw.
- The load frame should have a servo drive, inclusive (low-inertia) servomotor in maintenance-free AC-technology with digital position-feedback. The stroke encoder should have a resolution of 0.5 nanometer with backlash free drive
- The methods of uniaxial loading possible using the machine should be: (1). constant rate of pull-rod traverse acting via single backlash-free precision ball-screw, and (2). digital closed loop load control mode. The mode of loading can be chosen by the user. i.e. user should be able to conduct constant strain rate, constant stress, constant strain (stress relaxation) and stress rupture testing.
- Test speed range between 0.00002 mm/min to 100 mm/min with an accuracy of ± 0.1%
- Minimum displacement (stroke) range of 250 mm and vertical test space: >1250 mm without grips
- Load cell: load cell should operate in both tension and compression, and should have a capacity of 50/100 kN, with a load resolution of approximately 0.3 N. The load cell should be calibrated and the certificate of the initial load cell calibration should be provided.
- Load Measurement Accuracy: High precision auto-ranging load cell with very low nominal deformation of less than 0.5 mm and accuracy ±1% of reading down to 1/500 of load cell capacity complying with ISO 7500-1.
- Must fulfill all 5 criteria according to ISO 7500-1
- The precision of axial alignment (self-aligning load string) for uniaxial loading should conform to the requirements of ASTM standard E292 and ASTM E1012.
- Dimensions: The test area width between the drive screws should be approximately 700 mm and test area height should be approximately 1250 mm. The total height of the frame should be within 2-2.5 meter. The maximum stroke length should be approximately 250 mm.
- The lateral support of moving cross-head should have sliding bearing of four hard chromium-plated columns.
- The speed of pull rod movement should be within a range of 0.001 mm/h to 100 mm/min during uniaxial testing (user defined), and should have a return speed of

100 mm/min. The crosshead speed accuracy should vary within ± 0.1% of the set value.

- It should operate on 230 V AC power (1kVA). There should be a digital controller operating at 230 VAC (1 kVA power) for driving the machine.
- Automatic recognition of capacity, calibration & safety limits.
- Industry standard Ethernet interface to the computer for fast, reliable communication with laptop or desktop. Integrated digital closed-loop control and data acquisition electronics including load measurement, crosshead extension and strain measurement channels.
- Master software program to collect data and to conducts tests as per ASTM E139, ASTM D2990 and ASTM F519 and ASTM F1624
- 24-bit resolution card with data acquisition rate of minimum 2 kHz simultaneously on load, extension, and strain channels. The controller should have data sampling rate of 400kHz or better.

Protection of specimen and fixtures:

- Machine should have the capability of automatically adjusting the crosshead without damaging the specimen while gripping before the test commences.
- Preventive limit controls to avoid overloading of specimens, fixtures, and load cells during crosshead adjustment

High temperature pull rods and specimen adapters:

- The adapters should be aligned optimally for uniaxial loading according to the ASTM standard E-1012 and ASTM E292.
- Upper pull rod should be spherically seated.
- Lower pull rod should be pivotable around longitudinal axis, having a rigid seating by means of clamping lever.
- Self-aligning and adjustable seating adapter for various pull rod configurations
- The pull rods should be made of material compatible for use at high temperatures (at maximum temperatures as specified for high temperature furnace) and also at room temperature, at a maximum load of 50/100 kN.
- Pull rods capacity: 100 kN at room temperature
- The material of construction for the pull rods should be corrosion resistant nickel base super alloy having strength and dimensions amenable for use at temperatures ranging from room temperature to 1200 °C.
- The pull rods should be connected to the adapters and the connection should have adequate strength to withstand loads during slow strain rate testing.
- The specimen adapter for specimens should be joined to the pull rod by a compatible joint.
- The material of construction for the specimen adapters should be corrosion resistant nickel base super alloy having strength and dimensions amenable for use at temperatures ranging from room temperature to 1200 °C.
- High temperature adapter for button head specimens with diameter 6 mm & 8 mm

- Compression setup with punch/pull rod and other accessories to carry testing up to 1500 °C
- Compression device should be allowed to carry out testing for specimens with width or diameter up to 14 mm.

High-temperature furnace and temperature controller:

3-zone high temperature furnace for conducting creep testing and stress rupture testing, besides determination of elastic behaviour, tensile strength and yield strength of materials at elevated temperature in air.

- Min. temperature: 100°C and Max. temperature: 1500°C
- Heating rate: 20 °C/min
- Nominal power: 3.6 kW, and Nominal voltage: 3 x 400 V
- Heating zones: 3
- Temp Constancy: < ± 3K, and Temperature Constancy zone: 100 mm
- Inner diameter: ≈120 mm
- Heated length/zone: 360 mm
- Temperature tolerance at the specimen at a length of 100 mm shall be ± 3K
- Temperature constancy at the specimen shall be ± 3K (according ASTM 139)
- 3 channel PID controller with connection for 6 thermocouples (3 thermocouples for the heating zones of the furnace and 3 thermocouples for the specimen)
- Ability for digital display of temperature from all 6 thermocouples on monitor.
- Furnace should be air-cooled only (no water cooling)
- The temperature controller should automatically set the control parameters for even temperature distribution along specimen and preventing temperature overshoots. Therefore, there should not be any need for setting the PID factors by empirically established means for various temperatures.
- The shell of the furnace should be made of split stainless steel having heavy duty hinge assembly. The furnace should be cylindrical with openings at both ends to allow the pull rods to go inside the furnace.
- The dimensions of the furnace should be such that it is easily accommodated within the load frame of the machine.
- There should be three thermocouples to measure and control the temperature along the length of the furnace.
- Furnace should be equipped with thermocouples and mounting arrangements for the thermocouples along with mounting brackets.
- The furnace should have three hot zones with temperature control of each zone. The furnace should have proper insulation to minimize heat loss during heating and during slow strain rate test.
- There shouldbe adequate provision in the furnace for integrating side entry extensometer.
- The temperature controller shall be capable of maintaining a uniform temperature distribution within the hot zone of the furnace and shall prevent temperature overshoot. The controller shall be of adaptive and automatic type. No PID settings necessary to be set by the user.

- The temperature controller should be interfaced with a computer and the temperature should be recorded on the computer. There should be a digital display of the temperature of the furnace.
- The furnace positioning unit shall be able to position the furnace vertically within the test area of the load frame at a location determined by the user.
- The centre of the furnace and the centre of the specimen should be automatically aligned by the positioning unit.
- There should be a swiveling unit so that the furnace can be removed from the test area for the room temperature tests.
- The positioning unit should be capable of maintaining the vertical position of the furnace for the entire duration of the test.

Strain Gauge or Extensometer & Strain Card for Tensile Creep Measurement: Temperature Range of 100°C -1150°C.

- Creep tensile HT-extensometer up to 1150°C with the following specifications:
- Able to measure axial elongation of round or flat specimens (without collars) by contact gauges irrespective of specimen geometry
- Axial gauge length of 10 - 50 mm. Spacers for specimens with gage length of 10, 15, 20 and 25 mm need to be provided.
- Travel range of 10 mm (minimum)
- Strain Measurement Accuracy: ASTM E83 Class B or ISO 9513 Class 1 extensometer
- Calibrated as per ASTM E83 or ISO 9513 and resolution less than 0.1 µm and calibrated from 20 µm
- Max. nonlinearity: Class 1 according ISO 9513, Class C according ASTM E83
    - - 2 analogue 50 mm sensors
    - - axial entry into HT-furnace
    - - appropriate inserts for the specimen

Strain Gauge or Extensometer & Strain Card for Compression Creep Measurement: Temperature Range of 100°C -1500°C.

- The resolution of the extensometer must be better than or equal to 0.15 µm
- The gauge length must be automatically set as required by operator or according to the formula according to standards. The compression measurement device has a travel of ±5mm
- The extensometer must also be able to measure compressive deflections
- Sensor Conditioner card that should provide closed loop control and data acquisition capability for transducers.

Advanced Material Testing Software:

- The software should be in English language and should be compatible for operation in Microsoft windows.
- Load and testing parameter setting and control shall be possible by the computer software. The user shall have the possibility to set load as well as temperature

blocks. It should be possible to specify limits to load and displacement by the software.

- All the test parameters shall be programmable from the software.
- The software shall show the real-time plots (such as load Vs time, elongation Vs time) and also the real-time measured values of load, extension, specimen temperature on the screen, during the entire test duration.
- The specimen design details should be entered into the software and the software should use those values to calculate properties such as stress, total ductility etc.
- The software must have the safety inspection square concept, which will help in fast and secure set up by description of the set test. Operator-independent security through the position-controlled system with the continuous backup of the current crosshead position in electronics. This means that the operator, when conversion of tools no longer has to worry about the settings!
- The software package should meet the needs of a wide variety of applications (ex: Metals including strips wires etc.).
- Should have the capability for tension, compression, flexure, tear and adhesion.
- The software should have the capability to save the test method along with the start position, limit positions etc. so that the machine automatically comes to the start position for testing when the file is opened.
- To create customized reports that can be linked with test methods and used to export test results
- To import ASCII data from NPL UK into the test software as a means of verification
- The software must have three levels of user access based on user login name and password protection.
- The software shall allow a user to configure a specific transducer (such as load cell or extensometer) and link it with a specific method such that the method will require that the specific transducer is used. If a different transducer is connected when a test is run with that method, the test will not run.
- It should be possible to export the raw data and the test data channels by a single mouse click into Excel or Word etc.
- The software must have the safety inspection square concept, which will help in fast and secure set up by description of the set test. Operator-independent security through the position-controlled system with the continuous backup of the current crosshead position in electronics. This means that the operator, when conversion of tools no longer has to worry about the settings.
- Preferably, testing software should have an "Education Module" to teach the students various testing configurations, virtually.

Computer and peripherals:

- The computer provided with the slow strain rate test machine should be of latest configuration, having at least 1 TB of hard disk capacity, with the latest version of windows along with the compatible necessary drivers and software necessary for data acquisition and control for long time measurements.
- Need RAID function which can write data simultaneously on two HDD for safety and prevention of data loss in case of failure of HDD.

Explicit Need:

- Compliance to ASTM E8 Methods A&B ASTM E139, ASTM D2990, ASTM F1624 and ISO 6892-1 Method A strain control in closed loop with extensometer.
- The machine should perform tests in accordance to the above requirements in addition to the normal standards and the strain rate should be displayed.

Installation, commissioning and training:

- Complete installation of machine to be completed by supplier. Also, actual testing on real sample should be shown after installation to ensure that all the modules of the testing facility are working properly as per the specifications.
- A two-day intensive training (hand on training) of the testing facility showing the various module in working condition should be provided to few students.

Warranty and support:

- 3-year onsite warranty should be provided after installation and commissioning of the testing facility. The replacement of defective part and other service charges will be provided at free at cost at our site, till 3-year warranty period is intact. Additional charges in any form should not be claimed from IITM.
- Technical support personnel should visit the testing facility (within a week after the complaint) to attend any break down or malfunction of the testing facility during the warranty period. Assurance in this connection should be provided by the vendor.
- Manufacturer should be in a position to supply the compatible accessories on demand for the next 15 years after the installation of the testing.
- Supplier should have good track record of having commissioned the similar creep testing frame within India. Specifically, OEM should have supplied at least 10 similar tensile units (up to 1150 °C) and at least 2 similar compression units (up to 1500 °C) in the Centrally Funded Technical Institutions (CFTI) or Government R&D laboratories within India in the last 10 years. The contact details of the customers within India should be provided.

Other terms and conditions:

- The mandatory requirement for bidding is that a vendor should quote for both the Machine-1 and Machine-2. Bidding for a single Machine shall not be considered and will be deemed disqualified.
- Machine-1 and Machine-2 should be of the same brand. Bidding with different brands (even by the same agent) for Machine-1 and Machine-2 will be deemed unsuitable and will not be considered for evaluation.
- The total value of the two Machines together will be calculated and considered for selecting the L1 vendor.
- Technical documentation substantiating the technical specifications should be provided.