

ANNEXURE TO TENDER NO.

DPS/MRPU/1/3/2178/PO1458

DESIGN, QAP, MANUFACTURING, ASSEMBLY, TESTING, INSPECTION AND SUPPLY
OF HIGH-TEMPERATURE FURNACES, PID TEMPERATURE CONTROLLERS AND
ELECTRICAL CABLES AND ACCESSORIES

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1.0 INTRODUCTION

The present tender document is for the design approval, quality assurance plan, manufacturing, testing and supply of high-temperature pit-type furnaces. These furnaces shall be installed inside glove boxes, restricted locations such as fume hoods and therefore, strict dimensional tolerances shall be maintained, and they shall be durable, have temperature stability, reproducibility and have less requirement of servicing. The furnace shall be supplied with PID temperature controllers, K-type and N-type thermocouples (push/pull type) and electrical cables required for installation of heaters and other electrical accessories in the laboratory.

2.0 SCOPE OF SUPPLY

The scope of supply includes

- a). Approval of design of high temperature pit-type furnaces based on the schematic and dimensions provided in Section 8.0 of tender document by the purchaser
- b). Submission of quality assurance plan (QAP) for the entire manufacturing process of furnaces, thermocouples and electrical cables for approval by the purchaser
- c). Procurement of raw material for the fabrication and manufacturing of furnaces, temperature controllers and electrical cables with proper documentation, standards and test reports
- d). Third party inspection at all stages of manufacturing, assembly, testing, inspection and documentation and 10% random inspection by the purchaser or representative of the purchaser
- e). Documentation report of furnaces and electrical cables consisting of all test/inspection reports, TPI report and other certificates, as applicable
- f). **The installation of 25% of the furnaces at the purchaser's site shall be in the scope of the bidder.** As per the Quality Assurance Plan (QAP) described in the tender document, testing of 100 % furnaces and PID temperature controllers is necessary. The bidder shall also be responsible for the installation of 25% of furnaces and PID temperature controllers at the purchaser's site. **The training of personnel at the purchaser's site on the operation of PID temperature controller will be in the scope of the bidder.**

3.0 PRICE-BID AND VALIDITY OF OFFER

- a). The bidder shall ensure that the price bid is submitted as per regulations stipulated by Directorate of Purchase and Stores (DPS).
- b). The technical evaluation of the offers shall be based on the submission of documents by the bidder as per Section 5.0 and 8.0 of tender document.
- c). Technical evaluation of the offer will be based on
 - i) Whether the bidder has quoted for all the items that is, the bidder shall quote for furnaces, thermocouples, temperature controllers and electrical cables as per the schedule of quantity mentioned in Section 8.5 of tender document
 - ii). Total cost of all items, and not individual cost of each item

4.0 THIRD PARTY INSPECTION

a). The bidder shall appoint a Third Part Inspection (TPI) agency for tendered work to carry out QA testing & procedures at their works, inspection of raw material supplied by the subcontractor, inspection of all works pertaining to manufacturing, fabrication, assembly and testing of the equipment at the bidder's site as per approved QAP by the purchaser. **Bidder shall appoint the TPI agency from any one among the following only:**

- i). M/s Lloyd's Register
- ii). M/s TUV Nord
- iii). M/s DNV
- iv). M/s Bureau Veritas

b). Detailed information about the TPI agency shall be provided by the bidder to the purchaser for approval. Complete contractual terms & conditions (other than commercial/financial) between contractor & TPI shall be sent to purchaser for approval pertaining to the scope of TPI for the present work. The scope of TPI shall be, but not limited to, review of Quality Assurance Plan (QAP), testing and inspection of raw materials (bought out items), in-process testing and inspection during design, manufacturing, assembly and final fit-ups for high temperature testing of furnaces, assembly and testing of PID temperature controllers and in-process inspection and final testing of electrical cables.

c). The TPI charges shall be borne by the supplier. However, it is the responsibility of the bidder to request NPCIL to be the TPI and the cost of TPI by NPCIL shall be borne by the bidder. This information shall be provided in the offer.

d). Only single TPI agency shall be appointed by the bidder for the entire work order. Multiple TPIs are not acceptable.

e). The bidder or the TPI on behalf of the bidder shall submit list of inspectors along with their credentials.

f). The curriculum vitae of the candidates of TPI agency shall be sent to the purchaser for verifying their credentials and experience in QA activities to judge the suitability for carrying out the above work. The bidder may note that candidates who have previous experience in inspection of similar nature of items for work orders by BARC, IGCAR, NPCIL, HWB, NFC shall be preferred. Approval of selected candidate/s may be cancelled by the purchaser in case of unsatisfactory performance during the period of contract.

g). All QA activities by TPI shall be informed to the purchaser by the bidder from time to time, preferably on a daily basis. In case of any controversy/conflict in QA activities, the purchaser's decision will be final.

h). The entire manufacturing work and its reviewing shall be under the subject of testing and inspection of the TPI starting from raw material inspection, in-process inspection, assembly and final inspection. The TPI shall also review test reports from time to time and shall record their observations in the form of a document. The document shall be made available to the purchaser during the final inspection, which shall be carried out jointly by the TPI and the purchaser or representative of the purchaser.

h). In addition, 10% of in-process inspection shall be carried out by the purchaser or representative of the purchaser. This shall be suitably incorporated and finalized in the QAP by the bidder at the time of obtaining approval from the purchaser. The final inspection of the product shall be carried out by the purchaser or representative of the purchaser as well as the TPI. It shall be the responsibility of the bidder to ensure time frame and the delivery schedule and inform accordingly the purchaser and the TPI in advance about the final inspection.

- i). The bidder shall note that design, dimensions, tolerances of high temperature furnaces shall be approved by the purchaser, and they shall change/modify or correct the drawings, if so desired by the purchaser. This shall be considered as within the scope of work. The final approved drawings shall be reviewed by the TPI. Tentative information on the different types of tests and inspection activities to be carried out by the bidder is provided in the QAP and accordingly, the bidder shall prepare the final QAP for obtaining approval from the purchaser. The purchaser, if so desires may suggest suitable changes in the QAP, and the bidder shall accordingly submit revised QAP for approval.
- j). Final documentation will be 100% inspected by both TPI and purchaser or representative of the purchaser. Wherever 100% TPI is indicated in the QAP, the bidder shall ensure that all details are sent to the purchaser once that particular stage is inspected. All relevant documents shall be sent to the purchaser by email on a regular basis. The purchaser or representative of the purchaser shall also randomly inspect 10% of the total work (inspection of raw material test reports, in-process inspection and final inspection) inspected by the TPI. This 10% inspection shall include random checking of test reports, calibration reports, checking of applicable standards, and final testing report.
- k). In case the results of few tests do not meet the requirements of the technical specifications or what is mentioned in the applicable standards, it shall be immediately reported on by the purchaser along with the TPI report.
- l). The bidder shall give intimation in advance for inspection by the purchaser and maintain the delivery schedule. In case at any stage, the inspection has to be done by purchaser or representative of the purchaser and TPI, then the bidder shall be responsible for providing information well in advance.
- m). It shall be the responsibility of the bidder to provide regular information to the purchaser on preparation of drawings, preparation of qualification and testing procedures, testing and inspection reports and final documentation.

5.0 BIDDER ELIGIBILITY CRITERIA

- a). The bidder shall be an original manufacturer of high-temperature furnaces, muffle furnaces, tubular furnaces, split-type furnaces, sintering furnaces, electrical cables and accessories, heaters, thermocouple and thermocouple compensating cables, temperature sensors and controllers and electrical cables (single-core, multi-core) for the last 12 years or more. Offers from traders and suppliers will not be technically acceptable. Offers from firms who are registered dealers of original manufacturers also will be considered subject to their submitting the valid certificate of registration and subsequent verification by the purchaser or representative of the purchaser. It may be noted here that expired/out dated registration certificate will not be considered as valid document.
- b). The bidder shall have valid and approved quality management system such as ISO 9001:2015 accreditation from agencies such as Bureau Veritas, India or any other certified institutions. The firm shall submit all relevant documents in this regard during bidding. The bidder shall also be certified by government statutory body for operating a manufacturing unit for electrical equipment and appliances, industrial furnaces, electrical cables and other temperature monitoring and control accessories. The bidder shall have its own testing, inspection and calibration facility and it shall be accredited as per ISO/IEC 17025:2005 by NABL, Board of Quality Council of India.

c). If the bidder is registered with any other government agency as original manufacturer and supplier of industrial furnaces, cables and electrical accessories, it shall provide that information with documentary proof. Any additional certifications, if the bidder has on their quality management system, QA policy and activities, testing and laboratory facilities, they shall submit the same along with the offer.

d). The bidder shall quote for all the items as per the schedule of quantity for further technical evaluation of the offer. All tests required as per tender document shall be carried at the testing and calibration facility of the bidder. No tests shall be outsourced to any third party, but if so, the bidder shall inform accordingly to the purchaser and provide details in the compliance sheet.

e) Recommendation shall be made on overall lowest offer basis .

f). **EXPERIENCE OF FIRM**

A1). The bidder shall fill in the table below to provide details on purchase orders placed on them by government agencies for the supply of similar nature of items. Similar nature of items means **“Quality assurance plan, design, manufacturing, assembly, testing, inspection and installation of high temperature pit-type/sintering/industrial/cubical/split-type furnaces with all essential/mandatory accessories and electrical cables”**.

Note: Separate table shall be added by the bidder to describe details of each reference order.

S. No.	Description	Response by bidder
1.	Name and address of the client (Contact person, email address etc.)	
2.	Purchase order number and date	
3.	Purchase order value	
4.	Item description	
5.	Scope of work	
6.	Brief details of design + manufacturing procedure	
7.	Details of work outsourced or subcontracted, if any	
8.	Completion period as per purchase order	
9.	Actual completion period	
10.	Technical acceptance of client received/not received	
11.	Copy of approved QAP	
12.	Details of testing carried out as per technical specifications	
13.	Details of third party inspection	
14.	Details of test reports submitted, certificate of compliance from the purchaser	

A2). The bidder shall also provide details of purchase orders, if any from IGCAR, BHAVINI, BARCF, FRFCF placed on them in the last five years and their present status. Details shall include date of release of purchase order, description of work, date of completion of purchase order or current status (extension of delivery period, work completion certificate/performance certificate/technical acceptance certificate).

A3). Capability of the bidder shall be established by list of machinery, equipment, infrastructure facilities, testing and calibration facility, QA personnel on rolls currently possessed by the bidder

in order to complete the contract on time. **The qualification and list of personnel available shall be provided in the table below.**

S. No.	Position and company rolls	Total number of staff	Qualification			Experience (years)
			Graduate	Diploma	Certificate	
Design						
Procurement and testing of raw material						
Manufacturing /Fabrication + certified personnel						
Quality Assurance including qualification pertaining to electrical safety						
Planning, Production and Management engineering team						

6.0 COMPLIANCE SHEET (TO BE SUBMITTED BY THE BIDDER ALONG WITH OFFER)

The bidder shall fill in the details in the compliance sheet below and separately submit it along with the offer. If the compliance sheet is not filled in, the offer by the bidder shall not be considered further for technical evaluation and will be rejected.

S.No.	Description	Remarks/Response by firm
1.	Official website, complete address and documentary proof of manufacturing facility unit of the bidder and all in-house testing facilities? Documentary proof of sales office, actual geographical location of manufacturing unit, testing and calibration facility and email addresses of personnel in-charge/production engineers/testing and inspection, QA personnel.	
2.	Are you the original manufacturer of high-	

	temperature furnaces, temperature controllers, K-type and N-type thermocouples and electrical cables? Provide details with documentary proof	
4.	Does the bidder have a valid quality management system certificate (preferably ISO 9001:2015 or later and other QMS certificates) specifically stating that your firm is an original manufacturer of electrical equipments and accessories? Submit details along with documentary proof	
5.	Has the bidder supplied similar nature items to BARC, IGCAR, HWB, NPCIL, DRDO, ISRO, ONGC, HP? Please submit all details such as purchase orders, approved QAPs, technical acceptance reports, test certificates etc. Here, similar nature of items means “Manufacturing, fabrication and supply of high temperature pit-type, muffle, tubular, split-type furnaces, sintering furnaces, temperature controller and supply of electrical cables (single-core, multi-core)”	
6.	Does the bidder have their own in-house testing and inspection facility? Provide details with documentary proof and list of all testing equipment, machinery for the inspection of cables, heaters, thermocouples etc. Is your testing and inspection facility approved by NABL? Provide details with documentary proof.	
8.	Does the bidder confirm that they would accordingly modify the QAP (furnace, thermocouples, cables, temperature controller) provided in the tender document and submit it for approval by the purchaser? Deviations, if any shall be recorded here.	
8.	Has the bidder quoted for all the items as per the schedule of quantity mentioned in the tender document? Any deviations may be recorded here.	
9.	Has the bidder included the prices for third party inspection as per the technical requirements of the purchaser mentioned in Section 4.0 of tender document? The bidder may note here that 10% random inspection will be carried out by the purchaser or representative of the purchaser.	
10.	Does the bidder confirm that they would submit a final documentation report consisting of raw material inspection report, in-process inspection	

	reports, TPI reports and comments and final testing report (hard bound, 2 copies)?	
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7.0 DOCUMENTS TO BE SUBMITTED ALONG WITH PRICE BID

The following documents shall be submitted by the bidder for the technical evaluation of the offer along with the price bid. Failure to submit the certificates as per the list below shall render the offer technically non-acceptable.

- a). All relevant documents pertaining to Section 5, clause (f) of tender document
- b). Quality assurance plan prepared by the bidder for earlier work orders and documentary proof (copy of earlier QAPs may be attached)
- c). Quality Management System certificate of the bidder and other certificates as applicable
- d). Filled in compliance sheet in Section 6.0 of tender document
- e). Certificate of confirmation that the bidder shall fulfil the documentation report as per Section 10.0 of tender document
- f). Certificate of confirmation that the bidder shall fulfil the QAP as per Section 9.0 of tender document. Any deviations shall be recorded here.
- g). Price break-up sheet for all items as listed in the tender document (as per Section 8.5)
- g). Any other documents that the bidder wishes to submit to confirm their eligibility criteria as per Section 5.0 of tender document.

8.0 DETAILED TECHNICAL SPECIFICATIONS AND SCHEDULE OF QUANTITY

8.1 GENERAL DESCRIPTION OF HIGH-TEMPERATURE PIT-TYPE FURNACE

The high temperature pit-type furnace consists of recrystallized alumina cylindrical muffle surrounded by high density high temperature ceramic insulation and packed tightly in a cylindrical manner either by stainless steel sheet or shell. The alumina muffle shall be wound by high purity KanthalAPM grade wire covering a specific height for achieving a uniform temperature zone. The end-terminals of the furnace shall be M/F connector for heavy duty iron box connector that will be connected to 3-core cable from the PID temperature controller. It shall be compatible to 230 V, 50 Hz, single phase. Maximum power rating of the furnace shall be calculated by assuming that maximum temperature of the furnace shall be 1000 °C, maximum temperature for continuous operation for 24 h is 700 °C and maximum temperature for continuous operation for 100 h is 600 °C. The rating shall be more than 2 kW but not more than 3 kW. Maximum body temperature of the furnaces shall be less than 40 °C for 550 °C continuous operating temperature, and accordingly the thickness and density of thermal insulation shall be arrived at. The furnace should have an isothermal hot zone of sufficient height. The high-temperature furnace shall be controlled by a PID temperature controller that should not be in-built but independent of the furnace. It shall be connected to the furnace by heavy duty 15 A, iron box connector. Details are shown in the schematic (refer annexure). The temperature of the furnace shall be controlled by K-type thermocouple connected through the PID controller and placed into the muffle. The power supply to the temperature controller shall be compatible to 230 V, 50 Hz, single phase and connected to it through 3-core insulated cable with 15 A plug. The heavy-duty iron box connector attached to the furnace through M/F connector shall be provided

with about 3 m long 3-core cable. It shall be the responsibility of the bidder to ensure complete electrical safety of the entire assembly during high-temperature operation. There shall be no sparking at any of the electrical connections during operations at full power. The dimensions of the furnace, alumina muffle, outward projections and length of the male connector attached to the furnace are described by the variables x_1 to x_9 . Description of the furnaces is provided in the table below.

Table: Dimensions of furnace models based on the variables x_1 to x_9 . (Refer the schematic in the annexure). Dimensional tolerance is ± 1 mm in all cases.

Type of furnace	Dimensions (in mm)									
	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	Maximum isothermal hot zone
	Inner diameter of the alumina muffle	Outer diameter of the alumina muffle	Overall height of alumina muffle	Height of thermal insulation packing from bottom of muffle to the bottom of furnace	Overall diameter of furnace	Dimension of annular gap of thermal insulation packing around the alumina muffle	Overall height of furnace	Maximum length of electrical connector attached to the furnace (male)	Maximum projection height of alumina muffle from top of furnace	
Furnace, Type-1	92	100	360	100	300	100	410	30	50	150
Furnace, Type-2	70	78	360	100	278	100	410	30	50	150
Furnace, Type-3	102	110	290	80	240	65	345	30	25	120

General technical specifications

A). Heating element: Kanthal APM grade wire

a). Power rating: More than 2 kW but less than 3 kW.

b). Power supply: Shall be compatible to 230 V, 50 Hz, single phase

c). Maximum temperature of operation: 1000 °C

d). Maximum time and temperature for continuous operation

i). 700 °C for 24 h

ii). 600 °C for 100 h

e). Body temperature at 550 °C continuous operation: Shall be less than 40 °C

f). Temperature at the bottom of the furnace: Shall not increase beyond 40 °C at 700 °C continuous operation

8.2 GENERAL DESCRIPTION OF PID TEMPERATURE CONTROLLER

- a). The temperature controller panel shall be a standalone type having integral thyristor power controlled by a single-channel PID system. The PID module shall be of reputed make. It shall have a single thermocouple input and deliver power to the furnace as described above. It shall be compatible to 230 V, 50 Hz, single phase.
- b). The single-channel shall have control toggle switches for (i). heater on/off, (ii). auto/manual mode selection, and (iii). power on/off. Maximum current to heater shall be controlled with power limit adjustment and control functionalities. The channel shall be provided with a temperature over protection if process temperature value exceeds the safety level set temperature value (user selectable), and then the output to heater shall be cut off.
- c). All necessary connectors and cable(s) shall be supplied along with the temperature controller.
- d). The front panel of the controller shall have the display unit of the PID module and analog/digital display of input voltage and output power (adjustable and user selectable using power adjusting knob).

S. No.	Description	Technical requirement
GENERAL SPECIFICATIONS		
1.	Size of temperature controller enclosure	Shall be less than 300 (width) x 300 (depth) x 300 (height) mm
2.	Auxiliary supply	230 V, 50 Hz, single phase
3.	Input	User selectable thermocouple type
4.	Output	0-10 V DC or 4-20 mA to drive thyristor power regulator.
5.	Sampling time	1 second for four inputs
6.	PV display	4 digit 7 segment red LED
7.	Set value	4 digit 7 segment green LED
8.	Communication	RS 485
9.	Output display	Green LED
10.	Accuracy	±0.3% of display +1digit.
11.	Parameter setting	Using front panel buttons
12.	Parameter locking	Shall be user selectable
13.	Program selection	Shall be linked for 64 steps or more
14.	Auto tuning	Multiple temperature zone (3 or more)
15.	Control	Shall be user selectable, ramping/soaking time shall be selected by user
16.	Repeat cycle	User selectable, shall be 10 cycles or more
17.	Isolation	Shall be provided for input, output and power
GENERAL SPECIFICATIONS OF THYRISTOR POWER REGULATOR		
1.	Power supply	230 V, 50 Hz, single phase
2.	Input	4-20mA or 0-10V suitable for PID output
3.	Output	0-215V AC
4.	Capacity	Shall be compatible for heater with power rating of 3 kW, single phase
5.	Protection	Semiconductor fuse

6.	Soft start	1-20 s, adjustable
7.	Soft end	1-20 s, adjustable
8.	Control method	Phase angle control or cycle control or zero cross-User selectable.
9.	Cooling	Cooling fan
10.	Heater connection	3-core cable, 3 m long, with heavy duty iron box connector
OPERATING CONDITIONS		
1.	Temperature storage	0-55 °C for operation and 10 to 65 °C for storage
2.	Humidity	35 to 85 % RH Non-condensing

8.3 GENERAL DESCRIPTION OF ELECTRICAL CABLES

Electrical cables conforming to IS:8130:84 for fiber glass insulated single-core cable and IS:5831, IS:1554, BS:5308 for 3-core and 10-core PVC shielded cables shall be supplied along with furnaces (as per Section 8.1) and PID temperature controller (as per Section 8.2) of tender document as per the description below.

S. No.	Type	Description of item
1.	Electrical cable type-1	Fiber glass insulation single core cable, 2.5 sq. mm, multistrand, annealed bare copper conductor
2.	Electrical cable type-2	3-core cable, 2.5 sq. mm, multistrand, annealed bare copper conductor
3.	Electrical cable type-3	3-core cable, 1.5 sq. mm, multistrand, annealed bare copper conductor
4.	Electrical cable type-4	3-core cable, 4.0 sq. mm, multistrand, annealed bare copper conductor
5.	Electrical cable type-5	Shielded cable, 10 cores, 0.5 sq. mm, multistrand, annealed bare copper conductor.

8.4 GENERAL DESCRIPTION OF K-TYPE AND N-TYPE THERMOCOUPLES

For controlling and monitoring the temperature of the high-temperature furnaces, K-type and N-type thermocouples shall be supplied. General technical specifications are provided in Section 12.0 of tender document.

8.5 SCHEDULE OF QUANTITY

The bidder shall offer the price bid for items mentioned in Sections 8.1, 8.2 and 8.3 of tender document as per the schedule of quantity provided below

S. No.	Description of item	Quantity
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1.	Furnace type-1 + accessories	4
2.	Furnace type-2 + accessories	6
3.	Furnace type-3 + accessories	6
4.	PID temperature controller with accessories	8
5.	Electrical cable type-1	1000 m
6.	Electrical cable type-2	1000 m
7.	Electrical cable type-3	1000 m
8.	Electrical cable type-4	1000 m
9.	Electrical cable type-5	1000 m
10.	K-type thermocouple	50 Nos.
11.	N-type thermocouple	50 Nos.

The bidder shall submit a price break-up sheet for all the items described above. The technical evaluation for arriving at the lowest technically acceptable offer will be based on full compliance of technical specifications and the total price of all the items.

9.0 TENTATIVE QUALITY ASSURANCE PLAN

- a). The bidder shall submit detailed quality assurance plan (QAP) for the entire manufacturing process of each of the items listed in Section 8.5 of the tender document to the purchaser for approval. If changes, modifications are suggested by the purchaser, the bidder shall accordingly revise the QAP and submit the revised version for approval. This shall be considered as scope of work for the tender and purchase order.
- b). Once it is approved by the purchaser, the QAP shall be reviewed by the TPI, and if any changes are suggested by it, it shall be immediately brought to the notice of the purchaser. In such a case, the decision of the purchaser shall be final.
- c). The QAP shall provide all details pertaining to the quantum of check for each item and whether it shall be by the purchaser or TPI. It may be noted here that the scope of the TPI shall be as per Section 4.0 of tender document. Additionally, 10% of in-process inspection shall be witnessed by the purchaser or representative of the purchaser.
- d). The final inspection shall be carried out jointly by the purchaser or representative of the purchaser and the TPI.
- e). The bidder shall submit separate QAP for Items 1-3, Item 4, Items 5-9 and Items 10-11 to the purchaser for approval.
- f). The QAP for furnace shall include the drawings of the furnace with dimensions as per the technical specifications, drawings of thermocouples, and the manufacturing plans. It shall also include BIS, IS, ASTM, IEC and IEEE standards wherever applicable.
- g). Tentative QAP plan for the items is given in the table below. The bidder shall accordingly modify and fill in the details and submit it to the purchaser before initiating the manufacturing of the items.
- h). The bidder shall confirm in their price bid that they shall accordingly modify the QAP provided in the tender document and

TABLE 1: TENTATIVE QUALITY ASSURANCE PLAN FOR MAUFACTURING, ASSEMBLY, TESTING AND INSPECTION OF PIT-TYPE FURNACES, PID TEMPERATURE CONTROLLER, ELECTRICAL CABLES AND THERMOCOUPLES

Client Name:									
Ref. PO No.:									
QUALITY ASSURANCE PLAN FOR PIT-TYPE FURNACE AND PID CONTROLLER									
S. No.	Description	Requirements	Type of check	Quantum of check Purchaser /TPI	Acceptance norms/procedures	Format of record	Remarks by firm with date	Remarks by purchaser with date	Recommendations (Accepted/Not accepted/To be revised and checked again Note: TPI inspection report shall be included wherever applicable.)
I. RAW MATERIAL INSPECTION									
1.	Heating elements	Chemical/mechanical properties	Verification of mill TC	100%	As per technical specifications and standards	Mill TC			
2.	Insulation	Chemical properties (shall not be in form of loose flakes, shall be dust free)	Verification of mill TC	100%	As per technical specifications and standards	Mill TC			

3.	Controlling thermocouple	Shall be K-type/N-type	Testing and calibration	100 %	As per technical specifications and standards and QAP attached	Calibration report/TC/other reports as applicable			
4.	Alumina tube/muffle, Shall be recrystallized, >99.9% or higher	Visual and dimensional inspection, chemical composition/mechanical test certificate,	Dimensional inspection report, verification of mill TC	100%	As per technical specifications, approved drawings and standards	Visual and dimensional examination reports and mill TC			
5.	Electrical component	Visual inspection	Verification of mill TC	100 %	As per standards and technical specifications	Test report/ mill TC			
6.	PID controller, single channel	Visual inspection, checking of internal components, electrical connections, safety	Verification of test reports of various components	100%	As per technical specifications and standards	Test report/certificate of compliance/operational report			

II. APPROVAL OF FURNACE DRAWINGS

1.	Drawings of pit-type furnaces + overall electrical	Checking of all dimensions, electrical connections. Corrections and	Verification of submitted drawings, correction	100 %	As per technical specifications (to be approved by	Design to be submitted for approval by the purchaser. Iterations in		To be approved by the purchaser	
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	connection and location of controlling thermocouple	modifications, if any to be provided by the purchaser	and modifications if so desired by the purchaser		purchaser)	drawings, if any shall be considered as under scope of work			
III. TESTING AND INSPECTION OF ASSEMBLED FURNACE									
1.	Dimensions	Overall visual and dimensional inspection, overall finishing of the assembled product, finishing of packing, marking of manufacturer's name	Measurements of diameter, height, muffle dimensions (outer/inner) etc. any sharp edges, defects, burrs, loose ends, workmanship	100%	As per approved drawings and technical specifications	Visual and dimensional inspection report			
2.	Continuity check	For heating element	Elements to be checked for overall continuity and consistency, measurement	100%	As per technical specifications	Internal test report			

			ent of total resistance						
3.	Furnace run test	Temperature rise, skin/body surface temperature, stability of temperature, heat losses if any	Testing	100 %	As per approved procedures and technical requirements of the furnaces	Test and operations report			
4.	Calibration test + PID controller test	Accuracy of temperature, operation of PID controller (programming mode to be tested)	Testing to be coupled with III.3	100 %	As per approved procedures	Test and operations report			
5.	Packing	As per established procedures							
6.	Documentation	To be submitted (2 copies) hard bound(to be combined with the documentation of all other items	All details as per I, II and III			All reports as per I, II, III and other reports as applicable		Documentation shall contain the QMS certificates of the bidder, PO copy, approved drawings, approved procedures and all	TPI report, Purchaser's report

								test reports	
TESTING AND INSPECTION CARRIED OUT BY (ON BEHALF OF MANUFACTURER) :									
APPROVED BY									
PURCHASER OR REPRESENTATIVE OF PURCHASER									
TECHNICAL ACCEPTANCE REMARKS BY PURCHASER									
NAME AND SEAL									
DATE:									
QUALITY ASSURANCE PLAN FOR FIBER GLASS WIRES									
S. No.	Description	Characteristics/ Requirements	Type of check	Quantum of check	Acceptance norms/procedures	Format of record	Remarks by firm with date	Remarks by purchaser with date	Recommendations (Accepted/Not accepted/To be revised and checked again)
I. RAW MATERIAL INSPECTION									
1.	Conductor	Dimensional check, annealing and elongation check, tinning test, surface finishing check	As per IS 8130, Section 6.1	Min. 10% of entire length	As per IS: 8130, Section 3.2, 5.4 and 6.1	Mill TC/test report from testing and calibration facility			
2.	Fiber glass insulation	Type, thermal and insulation properties	As per manufacturing standard	1 sample per lot					
II. IN-PROCESS INSPECTION									
1.	Conductor	Diameter of	Physical			Test report			

	bunching	bunched conductor, number of strands and diameter, conductor resistance at 20 °C, surface finishing check	check or electrical (As per IS: 8130)			from testing and calibration unit			
2.	Insulation over conductor	Insulation thickness, color coding, diameter over insulation marking, varnishing	As per manufacturing standard and approved datasheet (Physical/ Visual/ Electrical)			Test report from testing and calibration unit			
III.POST INSPECTION									
3.	Packing		As per established procedures						
4.	Documentation	To be submitted (2 copies) hard bound (to be combined with the documentation of all other items)							TPI report, Purchaser's report
TESTING AND INSPECTION CARRIED OUT BY (ON BEHALF OF MANUFACTURER) :									

APPROVED BY
PURCHASER OR REPRESENTATIVE OF PURCHASER

TECHNICAL ACCEPTANCE REMARKS BY PURCHASER

NAME AND SEAL

DATE:

QUALITY ASSURANCE PLAN FOR PVC SHIELDED CABLES

S. No.	Description	Characteristics/ Requirements	Type of check	Quantum of check	Acceptance norms/procedures	Format of record	Remarks by firm with date	Remarks by purchaser with date	Recommendations (Accepted/Not accepted/To be revised and checked again)
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I. RAW MATERIAL INSPECTION

1.	Conductor	Dimensional check, annealing and elongation check, tinning test, surface finishing check	Physical	Min. 10 % of coil		Approved datasheet			
2.	PVC insulation and sheath	Type of insulation, tensile strength and elongation, volume resistivity, thermal stability	Physical	1 sample per lot		Approved datasheet			

1.	Conductor	Diameter of	Physical/			Test report			
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	bunching	bunched conductor, number of strands and diameter, conductor resistance at 20 °C, surface finishing check	Electrical as per IS:8130			from testing and calibration unit			
2.	Core insulation	Insulation thickness, color coding, diameter over insulation, spark testing	Physical			Test report from testing and calibration unit			
3.	Core laying	Number of cores and direction of lay	Physical			Test report from testing and calibration unit			
4.	Outer sheathing	Thickness of sheath, color coding, surface finishing (shall be free from porosity)	Physical			Test report from testing and calibration unit			
III. POST-PROCESS ACCEPTANCE TESTS									
1.	Overall cable diameter	As per IS:1554-1	Physical			Test report from testing and calibration unit			
2.	Overall finishing	As per IS:1554-1	Physical			Test report from testing and calibration unit			

3.	Conductor resistance at 20 °C	As per IS:1554-1	Electrical			Test report from testing and calibration unit			
4.	High voltage/Dielectric test	As per IS:1554-1	Electrical			Test report from testing and calibration unit			
5.	Insulation resistance test	As per IS:1554-1	Electrical			Test report from testing and calibration unit			
6.	Annealing test for copper wire	As per IS:1554-1	Electrical			Test report from testing and calibration unit			
7.	Test for insulation and sheath	As per IS:1554-1	Physical			Test report from testing and calibration unit			
8.	Tensile and elongation test	As per IS:1554-1, IS:5831	Physical			Test report from testing and calibration unit			
9.	Printing and marking	As per IS:1554-1	Physical			Test report from testing and calibration unit			
10.	Volume resistivity	As per IS:1554-1	Physical			Test report from testing and calibration unit			
11	Packing								

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12	Documentation	To be submitted (2 copies) hard bound (to be combined with the documentation of all other items							TPI report, Purchaser's report
TESTING AND INSPECTION CARRIED OUT BY (ON BEHALF OF MANUFACTURER) :									
APPROVED BY									
PURCHASER OR REPRESENTATIVE OF PURCHASER									
TECHNICAL ACCEPTANCE REMARKS BY PURCHASER									
NAME AND SEAL									
DATE:									
QUALITY ASSURANCE PLAN FOR THERMOCOUPLES									
S. No.	Description	Characteristics/ Requirements	Type of check	Quantum of check	Acceptance norms/procedures	Format of record	Remarks by firm with date	Remarks by purchaser with date	Recommendations (Accepted/Not accepted/To be revised and checked again
I. RAW MATERIAL INSPECTION									
1.	Inspection of sheathing material	Chemical composition, all mechanical tests and Positive Material	ASTM B166 and other applicable standards	100%	All test certificates such as chemical composition,	Test certificates on chemical composition, PMI and mechanical test			

		identification (PMI)			mechanical tests, PMI shall form part of final test report of the items	reports			
2.	Submission of design/sketch of K-type thermocouple	Detailed drawing shall be submitted to the purchaser		Shall be approved by the purchaser					Written approval of purchaser shall be obtained from the purchaser before manufacturing
II. IN-PROCESS INSPECTION									
1.	Dimensional check	Dimensions	Shall be as per IEC-584 standard						
2.	Electrical continuity check	Continuity	Shall be as per IEC-584 standard						
3.	Thermocouple accuracy and tolerances	Preferred wire diameter, recommender temperature	Shall be as per Clause 3.2, Table 1 in IS: 7358						
4.	Polarity check	Polarity	Shall be as per IEC-584						

			standard						
5.	Calibration test at 12 equal point in the temperature range ambient to 600 °C	To be checked for accuracy	Using calibration standards such as melting point of gold, zinc, gallium, aluminium , tin etc., Shall be as per IS:7358 and IS: 2054-1962						
6.	Insulation resistance test	IR	Using Megger and shall be as per Section 7 of IS 7358: 1984 “Specification for thermocouples” , Should be > 1000 Mohms@ 500 VDC						
7.	Radiograph	Integrity of	ISO/TC						

	y examination of thermocouple tip	junction of thermocouple	135/SC ISO 5576:1997 X-ray radiography (Radiography images shall be submitted by the firm), Shall confirm isolation of tip from the inner walls						
8.	Nitrogen/Helium leak test at 20-30 kg/cm ² for 2-10 minutes	Leakage	By nitrogen diffusion or using MSLD						
9.	Autoclave test	Leak tightness							
10.	LPT test for surface defects	Junction and sheath integrity							
11.	Response time test, thermal lag		Shall be as per ISO/IEC						

	(thermal inertia) test		standards and Section 9.4 of IS: 7358, Shall be less than 10 seconds						
12	Packing								
13	Documentation	To be submitted (2 copies) hard bound (to be combined with the documentation of all other items							TPI report, Purchaser's report
<p>TESTING AND INSPECTION CARRIED OUT BY (ON BEHALF OF MANUFACTURER) : APPROVED BY PURCHASER OR REPRESENTATIVE OF PURCHASER</p> <p>TECHNICAL ACCEPTANCE REMARKS BY PURCHASER</p> <p>NAME AND SEAL</p> <p>DATE:</p>									

10.0 DOCUMENTS TO BE SUBMITTED ALONG WITH SHIPMENT OF ITEMS

After the inspection of final finished products, the bidder shall prepare a final documentation consisting of the following documents:

- i). Copy of purchase order and acknowledgement of the bidder to MRPU
- ii). Quality management system certificates of the bidder's firm
- iii). Copy of approved QAPs of all the items
- iv). Approved designs and drawings of the items
- v). Details of all applicable standards used for the manufacturing process, and for testing, calibration and acceptance tests
- v). Test and calibration certificates, original datasheets of raw material, certificates from original manufacturers of bought out items, mill TC, purchaser's inspection report, TPI report etc.
- vi). All testing (physical/visual/electrical) and calibration reports from the bidder's in-house testing and calibration facility mentioning all applicable ASTM, BIS, IS, IEC, IEEE standards

The final document shall be hard bound, preferably in colour, and 2 copies of the same shall be submitted to the purchaser along with the final supply.

11.0 PACKAGING AND DELIVERY

All the items shall be safely packed keeping all the applicable standards in mind while transporting the electrical items. Vibration and shock resistance packaging of the items shall be carried out to avoid internal damage to wiring, electrical boards during transit. All spares shall be packed separately. The packaging shall be dust-proof and there shall be no ingress of moisture or rainwater into the electrical items during the transit. The alumina muffle shall be protected from any breakage during transit.

12.0 GENERAL SPECIFICATIONS OF ITEMS

The raw materials to be used for manufacturing the items mentioned in Section 8.0 shall have the following general specifications:

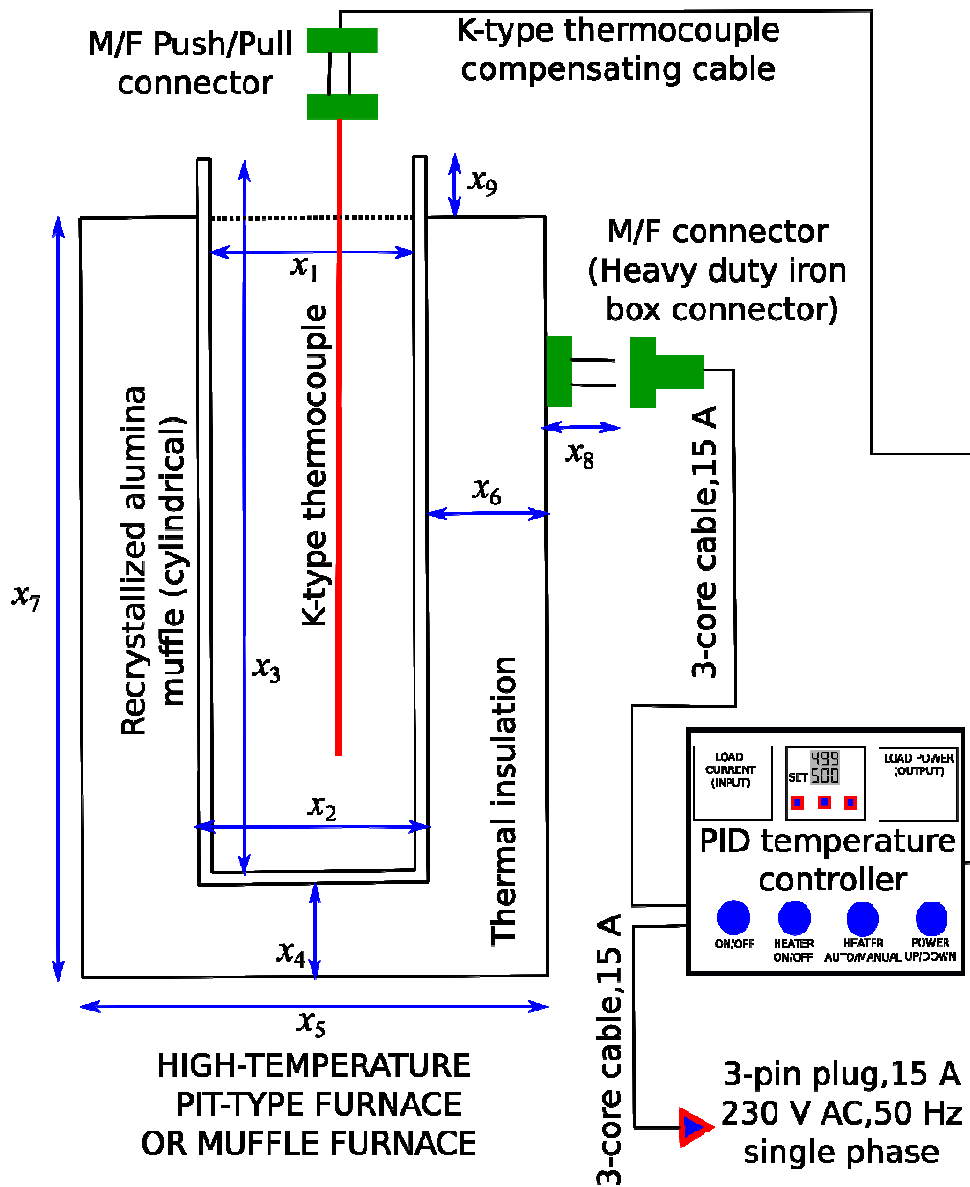
- a). High-temperature furnaces: Shall be as per Section 8.1 of tender document
 - i). Heating element shall be Kanthal APM grade (iron-chromium nickel alloy) having good stability (at least upto 1100 °C) and oxidation resistance with maximum continuous operating temperature of 1425 °C.
 - ii). Thermal insulation boards or ceramic blankets shall be used for wrapping the muffle for achieving low outer body temperature. It shall have good machinability, thermal stability (at least upto 1100 °C) and resistance to thermal shock.
 - iii). Muffle: Shall be of recrystallized alumina with purity >99.7%. Tolerances in outer and inner diameter shall be ±1 mm.
- b). PID temperature controller: shall be as per Section 8.2 of tender document
- c). Thermocouples:
 - i). K-type: Shall have 3.0 mm diameter with 0.10 mm tolerance, ungrounded, Element: Cr-Al, Type: Simplex, ungrounded, End-connector: Male-Female quick connect/disconnect 'Omega'

type connector, Outer sheath: Inconel 600, Insulator: mineral insulated (compacted MgO). Length of thermocouple shall be 600 mm with tolerance of 5 mm.

ii). N-type: Shall have 3.0 mm diameter with 0.10 mm tolerance, ungrounded, Element: Nickel-chromium-silicon/nickel-silicon, Type: Simplex, ungrounded, End-connector: Male-Female quick connect/disconnect 'Omega' type connector, Outer sheath: Inconel 600, Insulator: mineral insulated (compacted MgO), Length of thermocouple shall be 600 mm with tolerance of 5 mm.

13.0 ANNEXURE

The annexure figure (Ref: MC&MFCG/MFRG/MFPD/PPSS/FUR/N8/2020) a general schematic of the high-temperature pit-type furnace and how the PID temperature controller shall be connected to it. The controlling thermocouples (Type-K or Type-N) shall be placed into the muffle and shall be connected to the PID by thermocouple compensating cables. Power rating of the furnace is provided in Section 8.1 and that of PID controller shall be compatible to 230 V, 50 Hz, single phase. All 3-core insulated cables shall be at least 1.5 m long. The compensating cable shall be at least 1.5 m long. The connecting cable to the furnace shall be provided with a heavy-duty iron box connector. The PID controller shall have the PID display unit in the front panel and analog/digital display for input voltage and output power (user selectable). The figure shall be taken into consideration by the bidder while finalizing the technical specifications of the high temperature furnace (as per Section 8.1) and PID temperature controller (as per Section 8.2).



Note: Not to scale

Ref: MC&MFCG/MFRG/MFPD/PPSS/FUR/N8/2020