

भारत सरकार/**GOVERNMENT OF INDIA**  
अंतरिक्ष विभाग/**DEPARTMENT OF SPACE**

क्रय यूनिट-III/**PURCHASE UNIT-III**

विक्रम साराभाई अंतरिक्ष केंद्र/**VIKRAM SARABHAI SPACE CENTRE**

तिरुवनंतपुरम/**THIRUVANANTHAPURAM - 695 022**

विज्ञा. सं. वीएसएससी/एसपीआरई-क्रय/19-1 दि. 28/07/2021

**ADVT. NO. VSSC/SPRE-PUR/19-1 DT. 28/07/2021**

भारत के राष्ट्रपति के लिए तथा उनकी ओर से वरिष्ठ प्रधान, क्रय एवं भंडार, विक्रम साराभाई अंतरिक्ष केंद्र (वीएसएससी), तिरुवनंतपुरम, निम्नलिखित के लिए ई-प्रापण के माध्यम से (क्रम सं. 1 के लिए) निविदाएं आमंत्रित करता है:-

For & on behalf of the President of India, the Sr. Head Purchase & Stores, Vikram Sarabhai Space Centre (VSSC), Thiruvananthapuram invites Tenders **through e-procurement (for Sl. No. 1)** for the following :-

क्रम सं. Sl. No	निविदा सं. Tender No.	वर्णन / Description	मात्रा Qty.	निविदा शुल्क Tender Fee
1	VSSC/PURCHASE UNIT III (SPRE)/ASOE/2021001796 [लोक निविदा - दो भाग/ <b>PUBLIC TENDER- TWO PART</b> ]	वीएसएससी में क्षैतिज रूप से आरोपित ऊष्मा-निर्वात कक्ष की अभिकल्पना, संविचन, परिवहन, परीक्षण, संस्थापन तथा कमीशनिंग  <b>Design, Fabrication, Transportation, Testing, Installation and Commissioning of Horizontally mounted Thermo vacuum chamber at VSSC</b>	1 सं./No.	लागू नहीं / NA

**विशेष टिप्पणी/Special Note:-**

विदेशी विक्रेताओं को निविदा प्रस्तुत करने की अनुमति नहीं है। मेक इन इंडिया नीति के अनुसार केवल श्रेणी-I और श्रेणी-II के स्थानीय आपूर्तिकार इस बोली में भाग लेने हेतु पात्र हैं। विदेशी ओईएम से सीधे प्राप्त उद्धरणों/या विदेशी ओईएमओं की ओर से उद्धरण प्रस्तुत कर रहे एजेंटों को इस निविदा में भाग लेने की अनुमति नहीं है।

Foreign vendors are not permitted to quote. Only Class-I and Class-II Local suppliers as per Make in India Policy are eligible to participate in the bid. Quotations directly from foreign OEM/ or from agents quoting on behalf of foreign OEMs are not allowed to participate in this tender.

क्रम सं. Sl. No.	बोली प्रस्तुत करने की समय-सीमा Time limit for submission of Bid	बोली खोलने की तिथि Bid Opening date
1.	दिनांक 18.08.2021 [14:00 बजे तक]	दिनांक 18.08.2021 [14:01 बजे ]

क्रम सं. 01 के लिए, ब्यौरे इसरो ई-प्रापण पोर्टल <https://eproc.vssc.gov.in> पर उपलब्ध हैं।  
For Sl. No. 01., details are available on ISRO e-procurement portal <https://eproc.vssc.gov.in>.

शुद्धिपत्र, यदि कोई हो तो, हमारे वेबसाइट [www.vssc.gov.in](http://www.vssc.gov.in) / [www.isro.gov.in](http://www.isro.gov.in) में मात्र प्रकाशित किया जाएगा।

Corrigendum, if any will be published in our websites : [www.vssc.gov.in](http://www.vssc.gov.in) / [www.isro.gov.in](http://www.isro.gov.in) only.

हस्ताक्षरित/Sd/-

वरि. प्रधान, क्रय एवं भंडार / Sr. Head, Purchase & Stores

E-Procurement No. VSSC/PURCHASE UNIT III(SPRE)/ASOE/2021001796 Dt. 06/07/2021 and Website Advertisement ref. No. VSSC/SPRE-PUR/19-1 DT. 28/07/2021. E-Tenders are invited for *Design, fabrication, transportation, testing, installation and commissioning of horizontally mounted Thermo vacuum chamber at VSSC* through our E-procurement site <https://eproc.vssc.gov.in>. Bids can be submitted upto 18.08.2021 [14:00 Hrs.], Technical Bid Opening date : 18.08.2021 [14:01 Hrs.].

Only online tenders will be accepted. No manual / Postal / e-mail / fax offers will be entertained. No manual tender document will be issued. Parties interested to participate in this e-Tender are required to register themselves as vendors, if not already registered, in our e-procurement portal <https://eproc.vssc.gov.in> by downloading plugins and help demos listed on the home page of the e-procurement link mentioned above to complete the vendor registration process. They can seek help from help desk 0471-2565454 also as provided in the home page of e-procurement portal in case of any problem for registration and subsequent process. Vendors may please note that without registering in our e-procurement portal, they will not be able to quote for this e-tender.

Important Notice : Tender will be automatically closed on the due date [ie. **18.08.2021 14:00 Hrs**], if at least one offer is received. If the tender could not be opened on the first day due to any technical snag, it will be opened on the subsequent day as per the schedule.

This being a Two Part Tender, Cost shall be mentioned in the Price Bid Only. All the documents being uploaded like quote split up details, AMC cost etc should not contain the rates/costs. However a copy of your PRICE BID,AMC quote etc WITHOUT PRICE SHALL BE UPLOADED in the Documents Solicited from the Vendor Field [available in Bid forms] TO KNOW THE PATTERN OF QUOTE. [ENSURE NOT TO MENTION ANY PRICE,OTHERWISE THE QUOTE WILL BE INVALID].

**THE TECHNICAL DOCUMENTS NEED TO BE ATTACHED ONLINE AS A SINGLE PDF FILE WITHOUT ANY PRICE INFORMATION, TECHNICAL BID CONTAINING PRICE DETAILS WILL BE TREATED AS REJECTED.**

**GOVERNMENT OF INDIA  
DEPARTMENT OF SPACE  
VIKRAM SARABHAI SPACE CENTRE (VSSC)  
THIRUVANANTHAPURAM**

Signer: APPANU P  
Wed Jul 07 12:07:42 IST 2021

**Tender for Thermovacuum chamber**

**Bids to be submitted online**

**Tender No.: VSSC/PURCHASE UNIT III (SPRE)/VS202100179601 dated 06-07-2021**

## A. Tender Details

Tender No :	VSSC/PURCHASE UNIT III (SPRE)/VS202100179601
Tender Date :	06-07-2021
Tender Classification:	GOODS
Purchase Entity :	PURCHASE UNIT III (SPRE)
Centre :	VIKRAM SARABHAI SPACE CENTRE (VSSC)

### **Design , Fabrication, Transportation, Testing, Installation and Commissioning of Horizontally Mounted Thermo Vacuum Chamber**

1. Last minute clarification on tenders will not be entertained.
2. This is an E Tender. Hence Postal/Fax/Email tenders will not be accepted.
3. This is a Two-Part tender i.e. Techno Commercial(Containing Documents Solicited Vendor [available in Bid forms] & Vendor Specified Terms) and Price Bid . Hence all technical & commercial details shall be furnished in the Documents Solicited from Vendor & Vendor Specified Terms Fields while price shall be indicated only in the Price Bid.
4. IMPORTANT NOTE: This being a Two Part Tender, Cost/rates shall only be mentioned in the Price Bid Only. All the documents being uploaded like quote split up details, AMC cost etc should not contain the rates/costs. However a copy of your PRICE BID,AMC quote etc WITHOUT PRICE SHALL BE UPLOADED in the Documents Solicited from the Vendor Field[available in Bid forms] TO KNOW THE PATTERN OF QUOTE.[ENSURE NOT TO MENTION ANY PRICE,OTHERWISE THE QUOTE WILL BE INVALID.
5. Foreign vendors are not permitted to quote.  
Quotations directly from foreign OEM/ or from agents quoting on behalf of foreign OEMs are not allowed to participate in this tender.  
Only Class-I and Class-II Local suppliers as per Make in India Policy are eligible to participate in the bid.  
a)The percentage of local content should be specifically mentioned in the offer, without which it will be summarily rejected.  
b)Preference will be given to Class-I Local Supplier and in their absence, Class-II Local Supplier will be considered.

#### **A.1 Tender Schedule**

Bid Submission Start Date : **07-07-2021 14:00**

Bid Clarification Due Date : **27-07-2021 12:00**

Bid Submission Due Date : **18-08-2021 14:00**

Bid Opening Date : **18-08-2021 14:01**

Price Bid Opening Date : **31-08-2021 12:00**

## B. Tender Attachments

### Technical Write-up/Drawings

Document : compliance matrix

Document : general terminology

Document : specifiaction

Document : Layout for LN2 YARD & SIV lines

### Instructions To Vendors

5. Foreign vendors are not permitted to quote.

Only Class-I and Class-II Local suppliers as per Make in India Policy are eligible to participate in the bid.

a)The percentage of local content should be specifically mentioned in the offer, without which it will be summarily rejected.

b)Preference will be given to Class-I Local Supplier and in their absence, Class-II Local Supplier will be considered.

6. This is a Two-Part tender i.e. Technon Commercial(Containing Documents Solicited Vendor [available in Bid forms] & Vendor Specified Terms) and Price Bid . Hence all technical & commercial details shall be furnished in the Documents Solicited from Vendor & Vendor Specified Terms Fields while price shall be indicated only in the Price Bid.

7. IMPORTANT NOTE: This being a Two Part Tender, Cost shall be mentioned in the Price Bid Only. All the documents being uploaded like quote split up details, AMC cost etc should not contain the rates/costs. However a copy of your PRICE BID, AMC quote etc WITHOUT PRICE SHALL BE UPLOADED in the Documents Solicited from the Vendor Field[available in Bid forms] TO KNOW THE PATTERN OF QUOTE.[ENSURE NOT TO MENTION ANY PRICE,OTHERWISE THE QUOTE WILL BE INVALID.

## 8. PPP Make in India(Non- Divisible Items-Class I & II Local Suppliers Only)

1. In line with Public Procurement (Preference to Make in India), Order 2017 & its amendments issued by Govt. of India from time to time with a view to support the Indian industries, ISRO has implemented "Purchase Preference Policy". The "Purchase Preference" is applicable for the "Class-I Local Supplier" for the goods/ services/ works covered in this tender, subject to the following terms & conditions:-

2. a) The subject item falls under Non-divisible category. b) The offers sought only from Class-I & Class-II local suppliers

3. Definitions: A supplier or service provider, whose goods, services or works offered for procurement, has local content: i. Equal to or more than 50%: Class-I local supplier. ii. More than 20% but less than 50%: Class-II local supplier. iii. Less than or equal to 20%: Non-local supplier.

4. 'Local content' means the amount of value added in India (i.e. indigenous items/services added in the offered products/ services/ works) be the total value of the item offered (excluding net domestic indirect taxes) minus the value of imported content in the item (including all customs duties/IGST) as a proportion of the total value (excluding net domestic indirect taxes), in percent.

5. The margin of Purchase Preference shall be up to 20%.

6. 'Margin of purchase preference' means the maximum extent to which the price quoted by the "Class-I local supplier" above the L1 (landed cost).

7. 'L1' means the lowest technically accepted tender / bid / quotation (i.e. lowest landed cost including duties, taxes and freight & Insurance).

8. Works means all works as per Rule 130 of GFR- 2017, and will also include 'turnkey works'. Works includes Engineering, Procurement and Construction (EPC) contracts and services include System Integrator (SI) contracts.

9. Purchase Preference Policy:- Goods/Works which are not divisible (ie., required quantity is 1 or as a package) and Services:

a) If L1 is from a 'Class-I local supplier', the contract will be awarded to L1 bidder.

b) If L1 is not from a 'Class-I local supplier', the lowest bidder among the 'Class-I local supplier' will be invited to match the L1 price subject to local supplier's quoted price falling within the margin of purchase preference (i.e. 20%) and the contract shall be awarded to such 'Class-I local supplier' subject to matching the L1 price (inclusive of duties, taxes and freight & insurance).

c) In case such lowest eligible 'Class-I local supplier' fails to match the L1 price, the 'Class-I local supplier' with the next higher bid within the margin of purchase preference shall be invited to match the L1 price and so on, and order/contract shall be awarded accordingly. In case where none of the



'Class-I local supplier' within the margin of purchase preference agree to match the L1 price, then the order/contract shall be awarded to the original L1 Bidder.

10. The 'Class-I & II local supplier' should provide a "Self Certification" along with technical offer indicating that the item offered meets the minimum local content [as per SI. No.(3)] as called for in the tender and provide the percentage of local content along with details of the location(s) at which the local value addition is made. In case of two bid tenders, it is mandatory to indicate compliance to MLC(minimum Local Content) in technical bid zone.

11. In cases the quoted price is in excess of Rs.1000 Lakhs (including duties, taxes and freight & Insurance) the 'Class-I & II local supplier shall provide a certificate from the statutory auditor or cost auditor of the company (in the case of companies) or from a practicing cost accountant or practicing chartered accountant (in case of suppliers other than companies) giving the percentage of local content.

12. A committee (with an external expert from a practicing cost accountant or practicing chartered accountant, if required) constituted for independent verification shall verify the self-declarations & auditor's / accountant's certificates on random basis, as per the requirements.

13. The ink-signed certificate shall be provided on vendors letter head along with the offer (in case of online tender, copy of ink-signed certificate shall be uploaded along with your offer under concerned tab. Original in Hard copy shall be produced on request). In case of non-submission of certificate, the purchase preference shall not apply.

14. In case of a complaint received from any local supplier indicating a need for review / verification of Local content of successful vendor / awarded vendor, for accepting a complaint from such complainant (w.r.t the false declaration given by the successful vendor on the local content), a complaint fee of Rs.2Lakhs or 1% of the locally manufactured items being procured (subject to a maximum Rs. 5Lakhs), whichever was higher, to be paid by demand draft by the complainant. In case, the complaint is found to be incorrect, the complaint fee shall be forfeited. In case, the complaint is upheld and found to be substantially correct, deposited fee of the complainant would be refunded without any interest.

15. False declarations will be in breach of code of the integrity for which a bidder or its successor's will not be eligible/debarred for purchase preference from further tenders / pending tenders for two years along with other actions as may be applicable.

16. The Public Procurement (Preference to Make in India), Order 2017 issued by Govt. of India indicates that if there are any general or specific restrictive clauses to restrict participation of Indian companies in those countries procurement tenders, reciprocity clause need to be invoked as per the order. Hence, if ISRO or Govt. of India come across that Indian suppliers of an item are not allowed to participate and / or compete in procurement by your government, the bid submitted by you will be not

be considered and excluded from eligibility for procurement. Please note this point.

## **9. PROFORMA FOR INSTRUCTIONS TO TENDERERS AND TERMS & CONDITIONS OF TENDER where the indent value is Rs. 2.00 lakhs & above for indigenous stores items**

1. Preference will be given to those tenders offering supplies from ready stocks and on the basis of FOR destination/delivery at site.

### **2. REJECTED STORES:**

Rejected stores will remain at destination at the Contractor's risk and responsibility. If instructions for their disposal are not received from the Contractor within a period of 14 days from the date of receipt of the advice of rejection, the purchaser or his representative has, at his discretion, the right to scrap or sell or consign the rejected stores to Contractor's address at the Contractor's entire risk and expense, freight being payable by the Contractor at actuals.

3. The term 'Stores' shall mean what the Contractor agrees to supply under the Contract as specified in the Purchase Order including erection of plants & machinery and subsequent testing, should such a condition is included in the Purchase Order.

4. **SECURITY DEPOSIT:** Wherever, the Purchase Order value is Rs. 5.00 Lakhs or more, on acceptance of the tender, the Contractor shall, at the option of the Purchaser and within the period specified by him, deposit with him, in cash or in any other form as the Purchaser may determine, security deposit not exceeding ten percent of the value of the Contract as the Purchaser shall specify. If the Contractor is called upon by the Purchaser to deposit, 'Security' and the Contractor fails to provide the security within the period specified, such failure shall constitute a breach of the Contract, and the Purchaser shall be entitled to make other arrangements for the re-purchase of the stores Contracted at the risk of the Contractor in terms of Sub-Clause (ii) and (iii) of clause regarding Delivery. (b) hereof and/or to recover from the Contractor, damages arising from such cancellation.

5. Sales Tax and/or other duties/levies legally leviable and intended to be claimed should be mentioned in the price bid template. If nothing is mentioned, then it will be presumed that the rate quoted is inclusive of all taxes/duties.

## **6. TERMS & CONDITIONS OF TENDER**

7. **TEST CERTIFICATE:** Wherever required, test certificates should be sent along with the despatch documents.

8. The Purchaser reserves the right to place order on the successful tenderer for additional quantity up to 25% of the quantity offered by them at the rates quoted.

9. The authority of the person signing the tender, if called for, should be produced.

10. The purchaser shall be under no obligation to accept the lowest or any tender and reserves the right of acceptance of the whole or any part of the tender or portions of the quantity offered and the tenderers shall supply the same at the rates quoted.

11. (a) All available technical literature, catalogues and other data in support of the specifications and details of the items should be furnished along with the offer.

(b) Samples, if called for, should be submitted free of all charges by the tenderer and the Purchaser shall not be responsible for any loss or damage thereof due to any reason whatsoever. In the event of nonacceptance of tender, the tenderer will have to remove the samples at his own expense. <br>

(c) Approximate net and gross weight of the items offered shall be indicated in your offer. If dimensional details are available the same should also be indicated in your offer. <br>(d)

Specifications: Stores offered should strictly confirm to our specifications. Deviations, if any, should be clearly indicated by the tenderer in his quotation. The tenderer should also indicate the Make/Type number of the stores offered and provide catalogues, technical literature and samples, wherever necessary, along with the quotations. Test Certificates, wherever necessary, should be forwarded along with supplies. Wherever options have been called for in our specifications, the tenderer should address all such options. Wherever specifically mentioned by us, the tenderer could suggest changes to specifications with appropriate response for the same.

12. The tenderer should supply along with his tender, the name of his bankers as well as the latest Income-Tax clearance certificate duly countersigned by the Income-Tax Officer of the Circle concerned under the seal of his office, if required by the Purchaser.

13. The term Contractor shall mean, the person, firm or company with whom or with which the order for the supply of Stores is placed and shall be deemed to include the Contractor's successors, representative, heirs, executors and administrators unless excluded by the Contract.

14. The term Purchaser shall mean the President of India or his successors or assigns.

15. (a) All available technical literature, catalogues and other data in support of the specifications and details of the items should be furnished along with the offer. <br>

(b) Samples, if called for, should be submitted free of all charges by the tenderer and the Purchaser shall not be responsible for any loss or damage thereof due to any reason whatsoever. In the event of nonacceptance of tender, the tenderer will have to remove the samples at his own expense.

(c) Approximate net and gross weight of the items offered shall be indicated in your offer. If dimensional details are available the same should also be indicated in your offer.

(d) Specifications: Stores offered should strictly confirm to our specifications. Deviations, if any, should be clearly indicated by the tenderer in his quotation. The tenderer should also indicate the Make/Type number of the stores offered and provide catalogues, technical literature and samples, wherever

necessary, along with the quotations. Test Certificates, wherever necessary, should be forwarded along with supplies. Wherever options have been called for in our specifications, the tenderer should address all such options. Wherever specifically mentioned by us, the tenderer could suggest changes to specifications with appropriate response for the same.

#### 16. ACCEPTANCE OF STORES:

- (a) The stores shall be tendered by the Contractor for inspection at such places as may be specified by the purchaser at the Contractor's own risk, expense and cost.
- (b) It is expressly agreed that the acceptance of the stores Contracted for, is subject to final approval by the purchaser, whose decision shall be final.
- (c) If, in the opinion of the purchaser, all or any of the stores do not meet the performance or quality requirements specified in the Purchase Order, they may be either rejected or accepted at a price to be fixed by the purchaser and his decision as to rejection and the prices to be fixed shall be final and binding on the Contractor.
- (d) If the whole or any part of the stores supplied are rejected in accordance with Clause No. (c) above, the purchaser shall be at liberty, with or without notice to the Contractor, to purchase in the open market at the expense of the Contractor stores meeting the necessary performance and quality Contracted for in place of those rejected, provided that either the purchase, or the agreement to purchase, from another supplier is made within six months from the date of rejection of the stores as aforesaid.

17. As a Government of India Department, this office is exempted from payment of Octroi and similar local levies. Tenderers shall ensure that necessary Exemption Certificates are obtained by them from the Purchase Officer concerned to avoid any payment of such levies.

18. DESPATCH: The Contractor is responsible for obtaining a clear receipt from the Transport Authorities specifying the goods despatched. The consignment should be despatched with clear Railway Receipt/Lorry Receipt. If sent in any other mode, it shall be at the risk of the Contractor. Purchaser will take no responsibility for short deliveries or wrong supply of goods when the same are booked on 'said to contain' basis. Purchaser shall pay for only such stores as are actually received by them in accordance with the Contract.

#### 19. GUARANTEE & REPLACEMENT:

- (a) The Contractor shall guarantee that the stores supplied shall comply fully with the specifications laid down, for material, workmanship and performance.
- (b) For a period of twelve months after the acceptance of the stores, if any defects are discovered therein or any defects therein found to have developed under proper use, arising from faulty stores design or workmanship, the Contractor shall remedy such defects at his own cost provided he is called upon to do so within a period of 14 months from the date of acceptance thereof by the purchaser who shall state in writing in what respect the stores or any part thereof are faulty.
- (c) If, in the opinion of the purchaser, it becomes necessary to replace or renew any defective stores

such replacement or renewal shall be made by the Contractor free of all costs to the purchaser, provided the notice informing the Contractor of the defect is given by the purchaser in this regard within the said period of 14 months from the date of acceptance thereof.

(d) Should the Contractor fail to rectify the defects, the purchaser shall have the right to reject or repair or replace at the cost of the Contractor the whole or any portion of the defective stores.

(e) The decision of the Purchaser notwithstanding any prior approval or acceptance or inspection thereof on behalf of the Purchaser, as to whether or not the Stores supplied by the Contractor are defective or any defect has developed within the said period of 12 months or any other period or as to whether the nature of defects requires renewal or replacement, shall be final, conclusive and binding on the Contractor.

(f) To fulfill guarantee conditions outlined in (a) to (e) above, the Contractor shall, at the option of the Purchaser, furnish a Bank Guarantee (as prescribed by the Purchaser)

**20. PACKING FORWARDING & INSURANCE:** The Contractor will be held responsible for the stores being sufficiently and properly packed for transport by rail, road, sea or air to withstand transit hazards and ensure safe arrival at the destination. The packing and marking of packages shall be done by and at the expense of the Contractor. The purchaser will not pay separately for transit insurance, all risks in transit being exclusively of the Contractor and the Purchaser shall pay only for such stores as are actually received in good condition in accordance with the Contract.

**21. PRICES:** Tender offering firm prices will be preferred. Where a price variation clause is insisted upon by a tenderer, quotation with a reasonable ceiling should be submitted. Such offers should invariably be supported by the base price taken into account at the time of tendering and also the formula for any such variation/s.

**22. a)** Your offer should be valid for 90 days from the date of opening of the tender.

**b)** Prices are required to be quoted according to the units indicated in the annexed tender form. When quotations are given in terms of units other than those specified in the tender form, relationship between the two sets of units must be furnished.

**23. d)** The term 'Purchase Order' shall mean the communication signed on behalf of the Purchaser by an Officer duly authorised intimating the acceptance on behalf of the Purchaser on the terms and conditions mentioned or referred to in the said communication accepting the tender or offer of the Contractor for supply of stores or plant, machinery or equipment or part thereof.

## **10. Specific Terms and Conditions to Tender**

1. Please quote applicable GST separately.

(a) We are eligible for partial exemption of IGST vide Notification No: 47/2017-Integrated Tax (Rate) dtd 14/11/2017 and 45/2017-Central Tax (Rate) dtd 14/11/2017 issued by Dept. of Revenue, Ministry of Finance. Necessary Exemption Certificates will be issued on demand.

- (b) We are eligible for partial exemption of CGST and SGST vide Notification No: 45/2017 dtd 14/11/2017 and No: 169/2017/TAXES dtd 15/11/2017 respectively. Necessary Exemption Certificates will be issued on demand.
2. Please upload the Technical Details / Catalogue / Data Sheets (wherever applicable)
3. The other attached forms are our standard terms and conditions, which are to be complied with. If any conflict arise between the specific terms and standard terms, then in those cases, the specific terms will prevail over the standard terms.
4. Wherever samples are required to be submitted along with the quotation, offer without sample will not be considered.
5. If any bidder submits forged / false document along with the tender, offer of such vendors will be summarily rejected and such bidders will be blacklisted for all future tenders.
6. In order to avail of the benefits extended to by Govt. of India to the Micro and Small Sectors, please submit attested copy of the valid Entrepreneur Memorandum Part-II signed by the General Manager, District Industries Centre / Udyog Adhar / NSIC Registration Certification along with your offer.
7. Note: SD, LD and PBG clauses are mandatory and offers of the vendors who have not agreed for the above conditions will be excluded from the procurement process. Micro and Small Vendors are not exempted from the submission of Security Deposit. Only Govt Departments/PSUs/PSEs can submit Indemnity Bond instead of Bank Guarantee towards SD/PBG.
8. Security Deposit: Wherever the offer value is Rs. 5.00 Lakhs or above, the successful tenderer should submit Security Deposit @ 3% of the order value by way of Bank Guarantee / FD Receipt. The Bank Guarantee shall be obtained from any Scheduled Bank on Rs.200/- Non Judicial Stamp Paper and should be valid beyond 2 months from the completion of all contractual obligations. If the Contractor is called upon by the Purchaser to deposit, Security and the Contractor fails to provide the security within the period specified, such failure shall constitute a breach of the Contract, and the Purchaser shall be entitled to make other arrangements for the re-purchase of the stores Contracted at the risk of the Contractor. In case if Security Deposit is submitted and the contractor fails to execute the order, then the security deposit will be forfeited.
9. Performance Bank Guarantee: Wherever products offered carry warranty, the warranty should be for one year or as per manufacturers standard warranty term. Against such cases, please confirm submission of Performance Bank Guarantee. The Performance Bank Guarantee should be for 3% of the order value covering the warranty period obtained from any Scheduled Bank on Rs.200/- Non Judicial Stamp Paper and should be valid beyond 2 months from the completion of the warranty period. Alternately vendors can request for withholding 3% payment till completion of the warranty period.

10. Liquidated Damages: The delivery period quoted should be realistic. The delivery period so quoted and mentioned in the order is the essence of the order/contract. In case of delay in delivery of material as per the delivery schedule, Liquidated Damage @ 0.5% per week or part thereof on the undelivered portion subject to a maximum of 10% of the contract value shall be levied. Wherever, installation and commissioning is also involved, the supply will be deemed to have been completed only when the entire Stores is supplied, installed and accepted.

11. Our standard payment term is 100% within 30 days for indigenous orders.

12. Our standard delivery term is FOR, VSSC. In case any vendor offers delivery term of Ex-works, Packing and Forwarding charges if any should be indicated separately either as a percentage of the quoted rate or as a Lumpsum amount.

13. CUSTOMS DUTY: We are eligible for concessional payment of Customs Duty vide Notification Ref: 050/2017 CUSTOMS Dtd. 30/06/2017 Sl. No. 539(b) as amended by Notification No. 5/2018 dtd.25/01/2018. Please Note.

14. Offer Validity:- Please keep and confirm the offer validity minimum 90 days[in case of Single part Tender]from the date of opening of tender/180 days [For Two Part Tenders, 120 Days after opening Part-I and 90 days after opening Part-II].

11. Note IMPORTANT:- Wherever Security Deposit (SD) & Performance Bank Guarantee (PBG) are mentioned in the tender. It should be 3% of the total order value instead of 10% mentioned therein. This is as per Latest Govt. of India Guidelines.

## C. Bid Templates

### C.1 Technical Bid - Thermovacuum chamber

**1. THERMOVAC CHAMBER : - Design , fabrication, transportation, testing, installation and commissioning of horizontally mounted Thermo vacuum chamber at ASOE/VSSC/ISRO.**

**1. Detailed specification as per specification documents attached.**

#### Item specifications for THERMOVAC CHAMBER

SI No	Specification	Value	Compliance	Offered Specification	Remark
1	Design , fabrication, transportation, testing, installation and commissioning of horizontally mounted Thermo vacuum chamber at ASOE/VSSC/ISRO.	-	Yes / No / Explain		

#### Common Specifications (Applicable for all items)

SI No	Specification	Value	Compliance	Offered Specification	Remark
1	Design , fabrication, transportation, testing, installation and commissioning of horizontally mounted Thermo vacuum chamber at ASOE/VSSC/ISRO. 1. Detailed specification as per specification documents attached.	-	Yes / No / Explain		

#### Supporting Documents required from Vendor

**1. Overall equipment layout including all systems**



**2. Detailed cost splitup including foreign components if any**

**3. Product catalogue**

**4. Your Quotation in PDF format WITHOUT PRICE PART**

**5. Local Content Declaration**

**6. Any other documents**

5 additional documents can be uploaded by the vendor

## C.2 Commercial Terms / Bid

Sl. No.	Description	Compliance	Vendor Terms
1	Nil	Yes / No / Explain	
2	Warranty	Yes / No / Explain	
3	<p>Definitions: A supplier or service provider, whose goods, services or works offered for procurement, has local content:</p> <p>a) Equal to or more than 50% : Class-I local supplier.</p> <p>b) More than 20% but less than 50% : Class-II local supplier.</p> <p>c) Less than or equal to 20% : Non-local supplier.</p> <p>Mention your category.</p>	Yes / No / Explain	
4	<p>Foreign vendors are not permitted to quote.</p> <p>Only Class-I and Class-II Local suppliers as per Make in India Policy are eligible to participate in the bid.</p>	Yes / No / Explain	
5	<p>The Class-I &amp; II local supplier should provide a Self Certification along with your offer in PDF format indicating that the item offered meets the minimum local content as called for in the tender as mentioned above and provide the % of local content along with details of the location(s) at which the local value addition is made. In case of two part tenders, it is mandatory to indicate compliance to MLC(minimum local content) in technical bid itself. Confirm attachment of Self declaration along with the offer.</p>	Yes / No / Explain	
6	<p>Local content means the amount of value added in India (i.e. indigenous items/services added in the offered products/services/works) be the total value of the item offered (excluding net domestic indirect taxes) minus the value of imported content in the item (including all customs duties/IGST) as a proportion of the total value (excluding net domestic indirect taxes), in percent. Indicate extent of Minimum Local Content in offered product/service and location of such value additions.</p>	Yes / No / Explain	
7	<p>PO Ordering Address with Name and Contact Details of Sales Person concerned (e-mail and phone number).</p>	Yes / No / Explain	

8	Taxes and other costs, if any . [Note: VSSC is a Public Funded Research Institution under the administrative control of Department of Space and is eligible for partial exemption of IGST @5% vide Notfn No. 45/2017, 47/2017 dt 14.11.2017 respectively. Necessary IGST EXEMPTION CERTIFICATE shall be issued.]	Yes / No / Explain	
9	Security Deposit (Applicable if Offer Value is Rs. 5 Lakhs or above. MSME/NSIC Units are NOT EXEMPTED from the payment of SD. Bank Guarantee @ 3% of Order Value valid till 60 days from the date of supply to be submitted. Mandatory compliance required. Only Government Bodies/PSUs/PSEs can submit Indemnity Bond in lieu of BG. In the event of non-performance of contractual obligations, SD will be forfeited).	Yes / No / Explain	
10	Delivery Terms.	Yes / No / Explain	
11	Delivery Period	Yes / No / Explain	
12	Liquidated Damages (Applicable beyond the delivery period mentioned in this tender @ 0.5% per week or part thereof on the undelivered portion subject to a maximum of 10% of the contract value. Mandatory compliance required).	Yes / No / Explain	
13	Warranty	Yes / No / Explain	
14	Performance Bank Guarantee (PBG) Bank Guarantee @ 3% of Order Value valid till the completion of warranty period plus 2 months claim period to be submitted. Mandatory compliance required. Only Government Bodies/PSUs/PSEs can submit Indemnity Bond in lieu of BG. In the event of non-performance of warranty obligations, PBG will be forfeited).	Yes / No / Explain	

15	Payment Term: (Our Defalut payment term: For indigenous orders: 100% within 30 days after receipt and acceptance of item at our site. NOTE: CONSEQUENT TO COVID 19 PANDEMIC AND AS PER EXTANT GUIDELINES FROM DEPARTMENT OF SPACE, NO ADVANCE PAYMENT IS PAYABLE TO THIS TENDER).	Yes / No / Explain	
16	IMPORTANT NOTE: This being a Two Part Tender, Cost shall be mentioned in the Price Bid Only. All the documents being uploaded like quote split up details, AMC cost etc should not contain the rates/costs. However a copy of your PRICE BID, AMC quote etc WITHOUT PRICE SHALL BE UPLOADED in the Documents Solicited from the Vendor Field[available in Bid forms] TO KNOW THE PATTERN OF QUOTE.[ENSURE NOT TO MENTION ANY PRICE,OTHERWISE THE QUOTE WILL BE INVALID. NOTE/CONFIRM.	Yes / No / Explain	
17	Offer Validity	Yes / No / Explain	
18	Any other terms	Yes / No / Explain	

### C.3 Price Bid

Sl. No.	Item	Quantity	Unit Price	Currency	Total Price	Remark
1	THERMOVA C CHAMBER	1.00 Nos.		-		

### Common charges (Applicable for all items)

Transportation Charges	
Installation & Commissioning Charges	
Essential Spares for 10 Year Operation	
AMC Charges for 1st Year after warranty period	

<b>AMC Charges for 5th Year after warranty period</b>	
<b>AMC Charges for 6th Year after warranty period</b>	
<b>AMC Charges for 7th Year after warranty period</b>	
<b>AMC Charges for 2nd Year after warranty period</b>	
<b>AMC Charges for 3rd Year after warranty period</b>	
<b>AMC Charges for 4th Year after warranty period</b>	

## General terminology, abbreviations and definitions used

AISI	American Iron and Steel Institute
AMC	Annual Maintenance Contract
ASME	American Society of Mechanical Engineers
ASOE	Aero Space Ordnance Entity
DAS	Data Acquisition System
DRDO	Defence Research & Development Organization
EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Interference
FMECA	Failure Mode Effects and Criticality Analysis
GN <sub>2</sub>	Gaseous Nitrogen
G-M	Gifford-McMahon
GUI	Graphical User Interface
HAZOP	Hazard and operability study
IPC	Industrial Personal Computer
ISRO	Indian Space Research Organisation
kg	Kilogram
K	Kelvin
kW	Kilowatt
LN <sub>2</sub>	Liquid Nitrogen
m	Metre
mbar	Milli bar = 10 <sup>2</sup> Pa
mbar L/s	Milli bar Litre/Second for leak rate
MOU	Memorandum Of Understanding
MSHLD	Mass Spectrometer Helium Leak Detector
MTBF	Mean Time Between Failure
PESO	Petroleum and Explosives Safety Organisation
PLC	Programmable Logic controller
QA	Quality Assurance
QC	Quality Control
RTD	Resistance Temperature Detector
SIV	Super Insulated Vacuum jacketed
SMPV	Static Mode Pressure Vessel
SS	Stainless Steel
Sub-system	Major subdivision of total system
System	Total system under the scope of the document
T/C or TC	Thermocouple
TCU	Thermal Conditioning Unit

TIG	Tungsten Inert Gas
TMP	Turbo Molecular Pump
TPIA	Third party Inspection Agency
TVC	Thermo Vacuum Chamber
TVF	Thermo Vacuum Facility
UPS	Uninterrupted Power Supply
VSSC	Vikram Sarabhai Space Centre



### **Specification/features of Thermo vacuum Chamber**

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Design, fabrication, transportation, testing, installation and commissioning of horizontally mounted Thermo vacuum chamber at ASOE/VSSC/ISRO as per the following specification:

- 1.0 General specification:
- 1.1 Thermo vacuum chamber shall be with adequate vacuum pumping system and automatic control of temperature to any desired set point under specified vacuum level.
- 1.2 Specimen envelope size (usable test space): Test space shall be optically tight comprising of a double embossed thermal shroud (mouse trap shape) and a single embossed thermal plate at the bottom as shown in figure 1. The test space shall be able to house a test article with a maximum size of 600 mm (width) x 600 mm (depth) x 450 mm (height) resting on the thermal plate.
- 1.3 Vacuum chamber: Vacuum chamber shall be designed as per unfired pressure vessel code ASME-Section VIII Division I for external pressure vessel & inspected as per ASME Section IX or equivalent. It shall be horizontal, front loading, cylindrical, stainless steel (AISI 304L) designed for optimum space to accommodate test space as mentioned in 1.2 above.
- 1.4 Chamber size shall be around 1000 mm dia x 700 mm (length of cylindrical portion). Vendor shall design for optimum space to accommodate service / feed lines and test space as mentioned in 1.2 above.
- 1.5 Ultimate vacuum level for a clean degassed chamber without test article shall be  $5.0 \times 10^{-7}$  mbar or better. Time to achieve vacuum level for a clean degassed chamber without test article shall be as following:
  - 1.5.1 Ambient to vacuum level of  $1 \times 10^{-6}$  mbar at ambient temperature shall be reached in less than 60 minutes (excluding start up time for cryo pump).
  - 1.5.2 Vacuum level of  $1 \times 10^{-6}$  mbar at 380K shall be reached in less than 3Hours
- 1.6 Pumping chain: Active double chain with Rotary, Roots, Turbo pump and a single chain Cryo Pump.
- 1.7 PLC based control system shall be provided for vacuum as well as thermal system with necessary safety interlocks (for equipment & general safety).



- 1.8 Thermo vacuum chamber along with the thermal system shall be fully automatic with additional features for manual mode (with safety interlocks) & expert mode (with all manual override option).
- 1.9 Passwords for expert mode of operation shall be given to VSSC at end of warranty period. All other passwords (for operation & re-installation etc) shall be given to VSSC at the time of commissioning the facility.
- 1.10 System shall go into fail-safe mode with audible and visual alarms in case of electrical power failure / other service failure.
- 1.11 Overall system shall be designed so as to mount the sub system on a single platform on ground for easy service/maintenance.
- 1.12 Thermal system shall comply with the following requirements:
  - 1.12.1 Mouse trap shaped laser welded & inflated thermal shroud shall be of double embossed made of stainless steel (SS316L).
  - 1.12.2 Operating temperature: 153K to 423K
  - 1.12.3 Thermal plate shall be of AISI 304 with provisions for fixing the test article. There shall be provision for heating and cooling (153K to 423K) the thermal plate.
  - 1.12.4 Single thermal conditioning unit capable of circulating cold / hot fluid through the thermal shroud & thermal plate shall be used.
  - 1.12.5 Cooling / heating fluid: Low pressure closed loop GN2 (423 K to 153K)
  - 1.12.6 Ramp rate (hot & cold): 5 K / minute (settable between 1 to 5 K / minute)
  - 1.12.7 Heat load expected from test article: 1 KW (max) apart from chamber loads. Test article is passive and mostly of stainless steel (15 kg max).
  - 1.12.8 Temp. uniformity on thermal shroud, End closures and on thermal plate (at steady state): better than  $\pm 2$  K
  - 1.12.9 Temp. uniformity on thermal shroud, End closures and on thermal plate (at transient):  $\pm 15$  K
  - 1.12.10 Control Accuracy :  $\pm 1$  K
  - 1.12.11 The thermal system shall be capable to follow any set profile (with multiple cycles over the entire range) without manual intervention. A typical cycle is shown in Figure 2.
  - 1.12.12 Low pressure closed loop GN2 is envisaged. If supplier is suggesting any other type of thermal system for achieving the specified parameters,

details on the methodology, heritage, previous experience, reliability aspects, actual achieved parameters etc shall be submitted along with quote for due evaluation by the committee.

- 1.12.13 If the thermal conditioning system is from a sub-contractor and is not realised solely by the vacuum chamber fabricator, then details of the MOU agreed upon by the supplier shall be provided especially with reference to meeting schedule, maintaining quality, performance testing, guarantee on performance, after sales support for hardware as well as software, maintenance support during / post warranty period etc.

1.13 Liquid Nitrogen tanks (2 Nos) with the following requirements:

- 1.13.1 Two vertical tanks each of 6000 l capacity
- 1.13.2 Design of tanks & pipings shall be as per ASME Sec VIII Division I, ASME B31.3 or equivalent.
- 1.13.3 Tanks shall be erected as per layout drawing in figure 3.
- 1.13.4 Tanks shall be configured such that all necessary parameters like pressure etc shall be maintained for the efficient operation of thermal system.
- 1.13.5 Net Evaporation Rate of each tank shall be less than 0.25% by volume per day (of maximum capacity)
- 1.13.6 Vital data like tank pressure, LN2 level etc shall be visible at the control console of the thermo vacuum chamber.
- 1.13.7 All valve operation shall be performed from the control console of the thermo vacuum chamber.
- 1.13.8 Redundant chain of safety relief valve & burst discs with diverter valve shall be provided for each tank.
- 1.13.9 Necessary Super Insulated vacuum jacketed (SIV) lines (as shown in figure 3) shall be provided.
- 1.13.10 All valves & safety devices fixed shall be of good heritage & of international repute.

2.0 Scope of VSSC:

- 2.1 Space, electricity, water, helium gas and liquid nitrogen (for testing & commissioning at VSSC) will be provided by VSSC/ISRO.
- 2.2 MSHLD & technical support for carrying out helium fine leak test at VSSC site.



- 2.3 Providing necessary fencing, crash guards, fire extinguishers etc as per layout for obtaining PESO clearance.
- 2.4 Necessary site layout drawings for obtaining PESO clearance.
- 2.5 Foundation work, earthing for the LN2 tanks. (Foundation design & drawings shall be provided by vendor well in advance)
- 2.6 Earthing pit for special earthing
- 2.7 Logistic support within VSSC
- 3.0 **General Requirements:**
- 3.1 Total system and all other sub-systems shall be designed for minimum of 400 hours of continuous operation without failure. This, apart from reliability of components, shall also ensure that there is no need for regeneration of the Cryo pump during operation of the system spanning about 600hours.
- 3.2 The proposed configuration shall be optimally designed with respect to the requirement/specification of VSSC/ISRO.
- 3.3 The proposed configuration shall ensure highest level of reliability, precision and controllability combined with operational and maintenance ease meeting the safety requirements of VSSC/ISRO.
- 3.4 The following guidelines shall be adhered to:
  - 3.4.1 Selection of mechanical / electrical / electronic equipment / components shall have established generic reliability, good heritage and long standing in international market.
  - 3.4.2 Judicious incorporation of full or partial redundancy as required while maintaining its cost effectiveness.
  - 3.4.3 Modular design concept allowing future augmentation.
  - 3.4.4 High quality workmanship using well trained, well qualified and certified personnel under expert supervision.
  - 3.4.5 Use of standard/recommended fabrication and assembly procedures and construction practice.
  - 3.4.6 All gauges, sensors, transducers and instruments shall be supplied with catalogues and calibration reports valid for one year from the date of supply ensuring full traceability. If calibration validity is over during the warranty period. Party shall do re-calibration of all gauges, sensors, transducers and

instruments at VSSC during AMC period.

- 3.4.7 Full documentation of procedures followed, standards adhered to and non-conformances disposed of during course of execution.
- 3.5 Efforts (if any) shall be put in during design and execution stage for delivering safe and reliable system and wherever possible, Mean time between failure (MTBF) values for equipment shall be indicated.
- 3.6 Pumps and other machineries shall be rated for more than 400 hours of continuous operation
- 3.7 The site for the proposed facility is about 200 m from the sea shore and hence the entire system including associated electronics shall be able to operate in a salty and humid ambience. Likewise, all fasteners material shall be also of corrosion resistant stainless steel.
- 3.8 Complete system performance shall be demonstrated for test cycles and acceptance testing as per mutually agreed test plan. During these tests, the system as well as its sub-systems is expected to be exercised to their respective design limits.
- 3.9 Fabrication, transportation and installation schemes shall be compatible with the conditions of local roads and utilities available at the site.
- 3.10 System layout shall be neat and all elements shall be easily accessible for maintenance.
- 3.11 The Thermo-Vacuum Facility (TVF) chamber shall be operable through Industrial PC (IPC) and control console(s) with necessary override provisions for operation at IPC.
- 3.12 The chamber shall be fail safe and hazard free during interruption of power, LN2 or compressed air supplies, loss of chamber vacuum etc.
- 3.13 Particle and chemical cleanliness shall be ensured at all stages of facility establishment as per standard vacuum practices.
- 3.14 All elements requiring periodic maintenance shall conform to the following:
  - 3.14.1 Convenient access, easy assembly procedure
  - 3.14.2 Adequate illumination
  - 3.14.3 Minimum disturbance to surrounding elements
  - 3.14.4 Locking system, identification marks, keyways, alignment provision
  - 3.14.5 Necessary steps, platforms, handling support wherever necessary



- 3.15 The equipment and sub-system layout shall conform to the existing building layout.
- 3.16 Third party certification at design stage and at all identified stages of fabrication is essential.
- 3.17 The necessary instrumentation, control, safety interlocks (inter and intra system and subsystem levels) and display of operating parameters of the entire system are to be provided as required to prove the system capability and reliability.

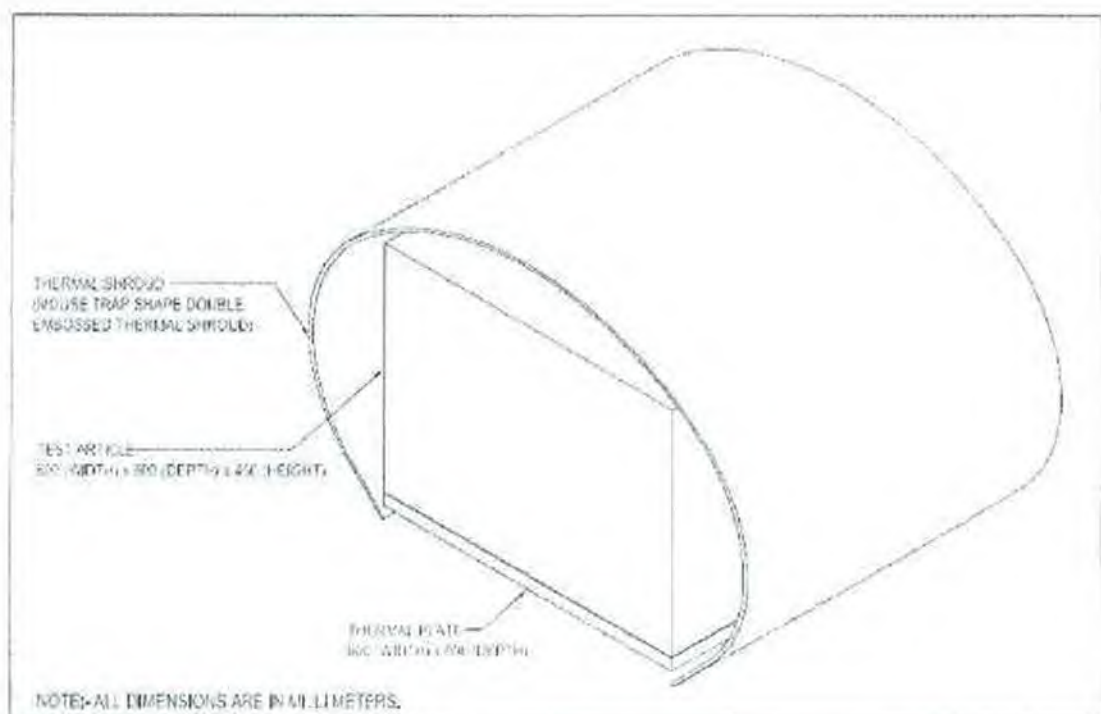


Figure 1: Tentative schematic of Thermal Shroud with Thermal plate

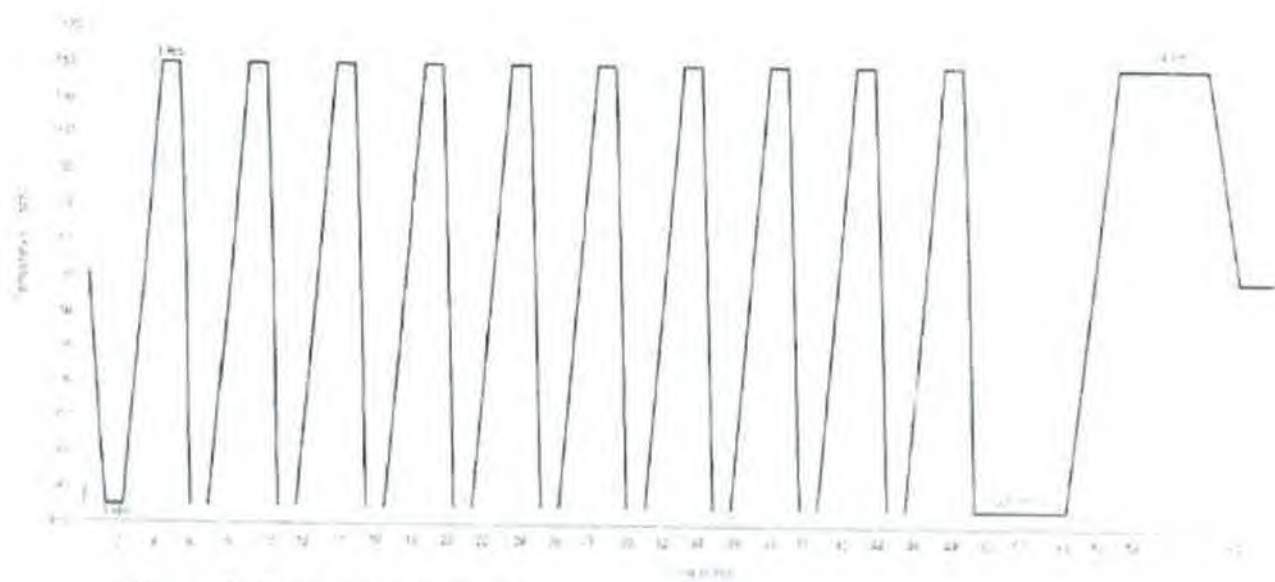


Figure 2: Typical test profile

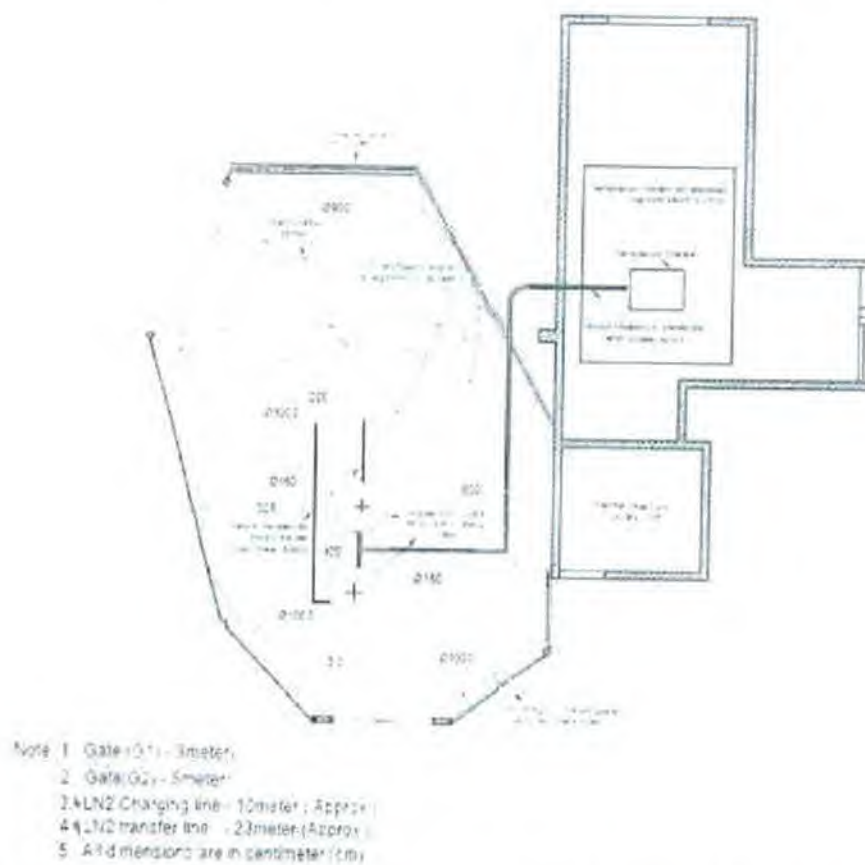


Figure 3: Layout for LN2 yard (For obtaining PESO license) & SIV lines

**4.0 Detailed Features/ specification:**

**4.1 Vacuum chamber**

- 4.1.1 The vessel of the Thermo vacuum system shall be designed for external pressure operation (vacuum). The chamber shall be cylindrical with tori spherical end dish. The chamber shall be made of stainless-steel type AISI 304L.
- 4.1.2 Ultimate vacuum achievable inside the chamber is  $5.0 \times 10^{-7}$  mbar.
- 4.1.3 All hardware components used inside chamber shall be made of stainless steel or a high vacuum compatible material.
- 4.1.4 Utility Flanges shall be of CF type with metallic gaskets for all vacuum pumps, vacuum gauges and instrumentation feed through.
- 4.1.5 The Internal dimensions of the chamber shall be such that to accommodate the thermal shroud, including a gap between the vessel internal surface and the shroud for accommodating fluid pipes, wiring and any required subsystems.
- 4.1.6 The chamber front dish shall be clamped using pneumatic clamps (Minimum 4 nos) with operable from control console & there shall be status indication in the control console.
- 4.1.7 All the welded joints shall be leak tested with Helium Mass Spectrometer Leak Detector to an Individual leak rate of less than  $1 \times 10^{-9}$  mbar l/s of Helium. The chamber shall be compatible for high vacuum of  $1 \times 10^{-7}$  mbar or better.
- 4.1.8 Necessary handling provisions shall be provided.
- 4.2 Vacuum chamber Dimensions:**
  - 4.2.1 Diameter: The diameter of the chamber shall be arrived at to house the proposed mouse trap thermal shroud and test article resting on the thermal plate. The size of the thermal plate shall be designed suitably according to the test article. Depth: 700 mm (tentative), with a minimum working space of 600 mm depth inside the shroud.
  - 4.2.2 Chamber axis height from ground level: 1200 mm
  - 4.2.3 Material of construction: SS 304 L (vender shall provide TPIA material certificate stating mechanical and chemical properties with traceability)



- 4.2.4 To minimize the gas loads, the internal surface of vacuum vessel shall be fabricated as follows
1. Pre polished plates with 3 triangle finish Ra 0.025 to 1.6µm for all vacuum exposed surfaces.
  2. Material stainless steel type AISI 304L chemically cleaned.
  3. High vacuum compatible weld design.
  4. Final internal polishing to ensure low emissivity less than 0.15
  5. Post weld chemical treatment is required.
- 4.3 **Vacuum chamber orientation:**  
The chamber shall be oriented horizontally and mounted using SS structure meeting all structural requirements.
- 4.4 **Vacuum chamber end dishes:**
1. **Front dish:** Torri-spherical dished door welded with flange. The opening stroke of the door shall allow complete access to thermal plate. 'O' ring in the chamber door shall be of molded type. Uniform compression of 'O' ring throughout shall be ensured during closing of chamber. Clamping shall be released once vacuum is achieved.
  2. **Rear dish:** Torri-spherical dished end welded to the chamber shell.
- 4.5 **Vacuum Chamber ports:**  
The chamber shall be provided with ports of various sizes mentioned in Table 1
- 4.5.1 All ports shall have metallic gaskets and shall be fitted with specified feed through.
- 4.5.2 SS dummy flanges shall be provided for all ports. Vacuum exposed surface & sealing surface of the dummy flanges also shall conform to the surface finish mentioned in section 4.6.1
- 4.5.3 Opening shall be provided in the thermal shroud corresponding to view port as indicated in table 1.
- 4.5.4 The number of ports and their sizes mentioned in table 1 are indicative for the ports required for the user. It does not include the ports required for shroud inlet / outlet piping, liquid feed throughs etc. The actual number of ports and their respective sizes shall be arrived at by the supplier considering all aspects of thermo vacuum chamber design.



Sl. No.	Port Size	Qty	Location	Use	Remarks	Shroud cut-outs
1	To be decided by supplier	3	0° to 90°. Quadrant on chamber belly 100mm from front dish	T-Type Thermocouple Feed through with 26 pin having end connectors on both sides	For temperature data collection from Test article (Through and through feed-through with 2 m cable length inside the chamber and sufficient cable length routed up to control panel)	No
2	To be decided by supplier	2	0° to 90°. Quadrant on chamber belly 100mm from front dish	K-Type Thermocouple Feed through with 26 pin having end connectors on both sides	For temperature data collection from Test article (Through and through feed-through with 2 m cable length inside the chamber and sufficient cable length routed up to control panel)	No
3	To be decided by supplier	4	0° to 90°. Quadrant on chamber belly	32 pin with 10 A rating electrical feed through, with both side end connectors	For device function test (Through and through feed-through with 2 m cable length inside the chamber)	No
4	CF 40	2 each	0° on chamber belly	Vacuum gauge connecting ports	Vacuum measurements	No
5	CF 200	1	At the centre of the front dish	View port on front dish	For visibility	Yes
6	CF 40	1	315° on chamber belly	10mm SS tube (operating pressure 500 bar) both ends fitted with closures welded to CF blank flange	for pressurization of the test article	Yes
7	CF 60	2	315° on chamber belly	Dummy flange with closure		

*Table No: 1 Chamber ports details (given are tentative & shall be firmed up during design review stage)*

**Note**

(1) Angular Convention: 0° coincides with 12 O' clock position of front dish while the front dish being viewed from the front, observer facing the front dish and angular increments from 0° to 360° in clockwise direction.

(2) Ports for vacuum pumping system, LN2 inlet/outlet to the shrouds, water vapour panel, Vacuum instrumentation, Control thermocouples, heater power inputs, etc. to be worked out and added by the Contractor in addition to the above user ports.

**4.6 Internal finish and emissivity:**

4.6.1 Surface finish for all vacuum exposed surfaces and sealing surfaces shall be between 0.025 to 1.6  $\mu\text{m}$  (Ra value).

4.6.2 The O ring grooves & sealing surfaces shall be protected from any scratch mark at all stages of fabrication as well as transportation & integration.

4.6.3 Emissivity of all vacuum exposed surfaces including thermal shroud (external surface) shall be less than 0.15.

**5.0 Vacuum System**

5.1.1 Initial vacuum level of  $1 \times 10^{-6}$  mbar from ambient shall be reached in less than 60 minutes for double chain and in less than 90 minutes for single chain respectively. (without using water vapour panel)

5.1.2 The chamber shall be capable to reach a minimum of  $1 \times 10^{-6}$  mbar at 380K in less than 3 hours. (without using water vapour panel)

5.1.3 The vacuum pump shall be integrated with the vacuum chamber through gate valve, SS piping of suitable size, flexible bellows, monitoring and control instrumentation etc. so that a smooth sequencing of the operation is possible for achieving the specified vacuum inside the chamber.

5.1.4 The vacuum level in the chamber shall be controlled by PLC. This system shall be fully automatic and provided with interlocks for a safe operation even in manual override mode.

5.1.5 Redundant air admittance valve shall be provided for re-pressurization of vacuum chamber with atmospheric air.

5.1.6 Pumping system shall have adequate pumping capacity and redundancy for continuous operation up to 400 hours at a time



## **5.2 High Vacuum Pumping System**

The proposed vacuum pumping system contains the following:

- 5.2.1 Rotary and Roots pumps in series (roughing)
- 5.2.2 Turbo-Molecular Pumps (TMP)
- 5.2.3 Cryo pump
- 5.2.4 Chamber air admittance valves and Electro-pneumatic valves
- 5.2.5 Vacuum monitoring and instrumentation system
- 5.2.6 Backing pumps for TMP and Cryo pump
- 5.2.7 Feed-throughs, dummy blank flanges for all the ports
- 5.2.8 Provision for independent control and operation of each unit in the System shall be there as on demand
- 5.2.9 Venting provisions shall be provided for all pumping lines.

## **5.3 Cryo pumping system and controller.**

- 5.3.1 There shall be a single Cryo pump operating based on G-M cycle for its two stages with Helium compressor. The Cryo pump shall be connected to the chamber through electro pneumatic gate valve.
- 5.3.2 There shall be a removable cold-water vapour panel of size Dia. 600 mm behind the rear end closure inside the chamber provided with necessary electro pneumatic valves, drip trays, temperature sensors with flexible inlet & outlet pipes /bellows and heating system for removing the condensate after the test.
- 5.3.3 The Cryo pump shall be capable of achieving a vacuum level of less than  $5.0 \times 10^{-7}$  mbar.
- 5.3.4 The control system shall be able to control the entire cryogenic pump at its cooling, heating and regeneration & fore vacuum pumping stages.
- 5.3.5 The Cryogenic pump shall be regenerated using a dedicated multistage roots vacuum pump.
- 5.3.6 Cryo compressor shall have appropriate cooling mechanism (If water cooling is selected, necessary chillers & necessary plumbing lines also shall be included in the scope of supply).

## **5.4 Backup pumping system details**

- 5.4.1 The Multi stage Roots pump shall be selected based on the above requirements mentioned regarding the Cryo pump.

- 5.4.2 The Multi stage roots pump shall have appropriate cooling mechanism.
- 5.4.3 There shall be a vacuum gauge between the Cryo pump and backup pump.
- 5.4.4 Appropriate isolation valve shall be provided between Cryo pump and multi stage Roots pump
- 5.5 Turbo Molecular pump and controller:**
  - 5.5.1 There shall be two separate lines of Turbo molecular pumps (TMP), with independent connection to the ports on chamber through electro pneumatically operated gate valves and bellows.
  - 5.5.2 Each chain shall have one TMP, and one back-up rotary vane pump (RVP) in series with a vacuum gauge in between.
  - 5.5.3 The Turbo Molecular Pumps (TMP) shall be capable of achieving a vacuum level of less than  $1 \times 10^{-7}$  mbar.
  - 5.5.4 Each Turbo pumps shall be provided with Stainless steel body and connected on chamber belly through CF type flange.
  - 5.5.5 Each TMP shall have appropriate cooling mechanism.
  - 5.5.6 Each TMP shall have a standalone controller mounted in a rack, which shall be provided with suitable voltage stabilizer, spike arrestor etc.
  - 5.5.7 Appropriate isolation valve shall be provided between TMP and Rotary vane pump.
  - 5.5.8 Pumping speed -1200Ltr/sec (minimum)
  - 5.5.9 Quantity: 2 Nos.
- 5.6 Backing pump details for each TMP:**
  - 5.6.1 Each backing pump shall be selected based on the above requirements mentioned regarding the TMP.
  - 5.6.2 Each back up pump shall have appropriate cooling mechanism.
  - 5.6.3 There shall be a vacuum gauge between the TMP and backup pump.
  - 5.6.4 Quantity: 2 Nos.
- 5.7 Rough vacuum system**
  - 5.7.1 There shall be two separate lines of roughing skids with independent connection to the ports on chamber through electro pneumatically operated valves and bellows.
  - 5.7.2 Roughing skids shall be capable of achieving a vacuum level of  $5 \times 10^{-3}$  mbar.



- 5.7.3 Each roughing skid shall have one Roots pump and one back-up rotary vane pump (RVP) in series.
- 5.7.4 The Roots pumps shall be integrated with an overflow valve so that this can be switched on together with the backing pump even at atmospheric pressure.
- 5.7.5 The pumps itself shall have built-in cooling provision for cooling the pumps.
- 5.7.6 Vacuum gauge shall be provided for each stage.
- 5.7.7 Quantity: 2 Nos.
- 5.8 Vacuum isolation / vent valves**
- 5.8.1 Based on the system design, vendor shall provide appropriately sized vacuum valves (Electro-pneumatic) of the following:
- 5.8.2 Controlled air admittance valve for chamber venting(one each for coarse as well as fine)-Quantity : 2Nos
- 5.8.3 Vacuum valve for chamber rough vacuum - Qty : 4 Nos.
- 5.8.4 Vacuum valve for TMP high vacuum side & TMP backup (electro pneumatic valve)- Quantity : 4 Nos (2 Nos. each).
- 5.8.5 Vacuum valve for Cryo pump & multi stage roots backup (electro pneumatic valve). -Quantity: 2 Nos(1 No. each).
- 5.8.6 *As per the system design the vendor can provide additional gate valves if needed.*
- 5.8.7 *CF type valves with stainless steel body shall be provided along with CF type pump flanges for better ultimate vacuum.*
- 5.9 Vacuum pipe lines**

Suitably sized SS 304 L pipes (seamless) and flexible bellows of 316 L shall be used for vacuum line piping works.
- 5.10 Re-pressurization System:**

For re-pressurizing (or venting) the chamber after the test, clean air shall be used. Necessary 5  $\mu$  filters & air admittance valve shall be provided. Venting lines shall be designed such that the venting operation is completed in 10 minutes.

## 6.0. Thermal System

When the vacuum chamber is maintained in operational vacuum ( $5.0 \times 10^{-7}$  mbar), the thermal shroud & thermal plate shall be heated or cooled by circulating GN2 to achieve the set temperature on the thermal plate surrounded by an optically tight thermal shroud.

Apart from the thermal conditioning system, the thermal system shall consist of a double embossed Thermal Shroud and a single embossed Thermal Plate. A single common thermal conditioning system shall supply heating / cooling GN2 to both thermal shroud & thermal plate. The test article shall be kept on the thermal plate. The temperature on the thermal shroud and thermal plate shall be automatically controlled to any set temperature through PLC based system. There shall be also a provision to use a temperature sensor on the test article too as a control sensor (selected from consoles in certain cases). The thermal system shall be capable to follow any set profile (with multiple cycles over the entire range) without manual intervention. A typical cycle is shown in Figure 2.

### 6.1 Thermal Shroud and thermal plate

- 6.1.1 Shape : Double embossed Mouse trap.
- 6.1.2 Size : The shroud shall be able to house a test article with maximum envelope of 600 mm (width) x 600 mm (depth) x 450 mm (height) on the thermal plate.
- 6.1.3 End shrouds : Two separate active shroud panel attached to front and rear dish of chamber shall also be provided.
- 6.1.4 Operating Temperature : 153K to 423 K
- 6.1.5 Construction : Double embossed laser welded & inflated. Each sheet shall be of 1.5mm thick (minimum)
- 6.1.6 Material of construction: SS316L
- 6.1.7 Cooling / heating fluid: Low pressure closed loop GN2 (423 K to 153K).
- 6.1.8 Ramp rate (hot & cold): 5 K / minute (settable between 1 to 5 K / minute)
- 6.1.9 Heat load expected from test article: 1 KW (max) apart from chamber loads. Test article is passive and mostly of stainless steel (15 kg max).
- 6.1.10 Temperature uniformity on thermal shroud, End closures and on thermal plate (at steady state) : better than  $\pm 2$  K



- 6.1.11 Temperature uniformity on thermal shroud, End closures and on thermal plate (at transient) :  $\pm 15$  K
- 6.1.12 Control Accuracy / Temp uniformity in time :  $\pm 1$  K
- 6.2 **Thermal System - General requirements. (Refer fig No 1)**
- 6.2.1 There shall be an interlock for preventing operation of thermal system up to a minimum vacuum level of  $1.0 \times 10^{-5}$  mbar.
- 6.2.2 A single common thermal conditioning system shall supply heating / cooling GN2 to both thermal shroud & thermal plate.
- 6.2.3 Super insulated vacuum jacketed lines shall be used in the thermal conditioning unit to prevent moisture condensation.
- 6.2.4 Care shall be taken in the selection of equipment / devices as VSSC site is very near to seashore with high humidity & salty environment. For certain case where super insulated vacuum jacketed lines are not feasible inside the thermal conditioning unit, such lines shall be properly insulated with Aerogel insulation along with necessary water vapour barrier.
- 6.2.5 Environmental friendly Insulation material alone shall be used. It shall be mentioned while quoting.
- 6.2.6 The shroud shall be inflated to an annular gap. To ensure leak tightness after repeated usage, Laser welded pitches with additional laser seam weld and TIG weld at edges of shroud shall be provided.  
Shroud panels shall be designed for service temperatures of 77 K and 423 K and internal pressures of at least 1.75 times the circulating GN2 pressure.
- 6.2.7 The thermal plate shall have internal channel for circulating GN2 for cooling / heating the test article.
- 6.2.8 The thermal plate shall have array of threaded holes' pitch 50mm x 50mm for mounting the test article.
- 6.2.9 Thermal shroud shall be of optically tight arrangement.
- 6.2.10 Thermal shroud shall have 'active end closures'(each on front and rear side)
- 6.2.11 Necessary bellows / flexible joints shall be provided for preventing thermal stresses during long duration thermal cycling operations.
- 6.2.12 The shroud and thermal plate with all accessories like liquid feed through, welding joints etc. shall be suitable for thermal cycling of 77 K to 423 K.

- 6.2.13 Leak tightness of the welded joints in the shroud, thermal plate and feed through shall be  $<1 \times 10^{-9}$  mbar lit/sec of Helium. This will have to be demonstrated again after thermal cycling at VSSC site.
- 6.2.14 The test space environment which includes the inner surface of shroud, both active end shrouds and top surface of thermal plate shall be painted with qualified thermal paint meeting the out-gassing requirements for space environment. The outside of the shroud, active end shrouds and thermal plate shall be electro polished.
- 6.2.15 The thermal plate and thermal shroud shall be with demountable circulating fluid inlet / outlet feed lines so as to enable easily removal from chamber for maintenance & cleaning purpose. Such joints shall be easily accessible.
- 6.2.15.1 The temperature controller shall have an inbuilt programmable profile and control shall be through a computer with Graphic User Interface (GUI) program / SCADA.
- 6.2.16 The GUI shall have provisions for customizing the thermal cycling profile, store it and execute it at desired time.
- 6.2.17 Provision shall be there to resume the test (resumption after electrical power failure)
- 6.2.18 Material used for insulation shall be environmentally friendly & easily dis-assembled in case of thermal system repair.
- 6.2.19 Super insulated vacuum jacketed lines shall be provided for all LN2 lines up to the vacuum chamber.

### 6.3 Specification of black thermal paint:

Internal surface of the thermal shroud & its enclosures shall be painted with black thermal paint to improve radiation heat transfer.

Make	:	Aerogiaze
Solar absorption	:	$>0.95$
Normal Emissivity	:	0.90
Out-gassing : % TML	:	$< 1$



## **7.0 Control and Instrumentation system**

The control and instrumentation system of the chamber comprises of the following

- 7.1 PLC modules with its execution software
- 7.2 Electrical power distribution and switching panel
- 7.3 Control and instrumentation panel
- 7.4 Data acquisition system
- 7.5 Vacuum gauges/sensors and associated instrumentation
- 7.6 Temperature sensors and associated instrumentation
- 7.7 Temperature controllers / thermal conditioning system
- 7.8 Online UPS with sufficient backup (1-hour backup time) to enable to switch all systems to safe mode, in case of a power failure.

## **8.0 Electrical Power distribution and switching panel**

Electrical Power distribution and switching panel is in the scope of the supplier. Hence supplier shall install it to facilitate power distribution for all the electrical equipment through appropriately sized starters/relays, switches etc. and to ensure proper switching of all equipment and safety of personnel as well as equipment.

### **8.1 Special earthing:**

Special earthing & routing shall be in the scope of the supplier. Earthing pit alone will be in the scope of VSSC.

### **8.2 Control and instrumentation panel**

- 8.2.1 All the systems like vacuum and temperature shall be controlled from the control and instrumentation panel located close (3 to 5m) to the chamber facilitating the operators to control and monitor the operation of the chamber.
- 8.2.2 The electrical cabling to and from the panels shall be done professionally as per industry standards and shall be ensured that the routing and clamping doesn't interfere with routine operations and facilitate periodic maintenance and repair works.
- 8.2.3 Every input and output cable shall be properly identified and tagged. Detailed documentation of the electrical wiring and interconnections shall be provided.

- 8.2.4 All the manufacturing and installation procedures shall meet relevant Indian/International standard and safety codes. Also, the control system shall be ergonomically designed.
- 8.3 The control and instrumentation panel shall house:
- 8.3.1 PLC (Programmable Logic Controller) for the real time monitoring and control of all equipment in the system
- 8.3.2 The parameters such as: Instrumentation for vacuum pumps and gauges temperature sensors, gate valve position indication, LN2 consumption status etc., shall be available in the rack. The analog/digital process output from these instruments shall be interfaced with a PC through serial/parallel/GPIB/ethernet interface for monitoring and display.
- 8.3.3 A PC based Data Acquisition System (DAS) shall monitor and display the temperature data from all the thermocouples/RTDs fixed on the test article and the thermal shroud & thermal plate inside the chamber.
- 8.3.4 PC system provided with the processor and operating system shall be state of the art. The entire system is in the scope of supplier.
- 8.3.5 On screen displays shall include data plotting of vacuum system, thermal system and auxiliary systems.
- 8.3.6 There shall be a smooth shutdown of the thermo vacuum process without loss of data.
- 8.3.7 A Laser printer shall be provided for hard copy output of stored or displayed data or graphics on the DAS PC
- 8.3.8 PC Software: The PC/computer system in the console shall be provided with suitable PLC/ GUI software along with license in the name of ISRO to fulfill the following tasks:
1. Mimic Diagrams displaying functional status of all system components and safety interlocks.
  2. Display the state of main process regulation loops such as shroud and thermal plate temperature control.
  3. Display, storage and print of all test facility functional data, alarm condition, messages etc.
  4. Display of temperature profiles on shroud and test article with proper scaling of temperature profiles.



- 5. Customizable program for vacuum and temperature profiles for its generation, storage and execution.
- 8.3.9 An extra copy of the software(s) developed for this system shall be provided in installable form to take care of any exigency arising due to software corruption/ overheating of PLC / malfunction that may occur in future.
- 9.0 **Data acquisition system and temperature sensors**
- 9.1 **Data Acquisition System (DAS):**
  - 9.1.1 The system will acquire data from the thermocouples and RTDs on shrouds and thermistors, thermocouples fixed on the test article and also the vacuum parameters of the system.
  - 9.1.2 DAS shall also have extra analogue input channels used for future system expansion.
  - 9.1.3 The data logging system shall have a failsafe mechanism not to lose any test data during electrical power failure/system failure condition.
- 9.2 **Salient features of the DAS Hardware/ Software:**
  - 9.2.1 There shall be provision for 3 modes of operations such as Auto mode, Semi auto mode and manual mode
  - 9.2.2 Auto mode: The temperature and vacuum shall be controlled based on a predefined test profile without any manual intervention.
  - 9.2.3 Semi auto mode: It shall allow the generation of a new test profile, edit (change parameters and set points) an existing one and save in its memory.
  - 9.2.4 Manual mode (Expert mode): Each sub system shall be operated in manual mode (expert mode) and shall be protected with necessary passwords.
  - 9.2.5 Data acquisition for Temperature, Pressure, Time etc. shall be done.
  - 9.2.6 Able to create different test profiles.
  - 9.2.7 An over-view MIMIC diagram of the machine status shall be provided.
  - 9.2.8 All functions to be made selectable by menus and icons.

9.2.9 There shall be provision for switching over to manual mode from the current mode (Auto /Semi auto mode) without any interference in the process of the test.

9.2.10 Real time for graphics and numerical data presentation of selected channels.

9.2.11 Data shall be stored in hard disk periodically for later retrieval

9.2.12 Data file generation, management and storage

9.2.13 Post processing of acquired / stored data

9.2.14 Report generation

### 9.3 Temperature sensors and Instrumentation:

9.3.1 6 Numbers of each T-type thermocouples (24AWG) placed on the shroud and Thermal plate for temperature monitoring.

9.3.2 T-Type Thermocouple Feed through-3Nos and K-Type Thermocouple feed through 2 numbers, with 26 pin having end connectors on both sides are to be provided for test article temperature monitoring.

9.3.3 If RTD's are required for precise temperature control of thermal shroud and base plate, it shall be provided.

9.3.4 "T" type thermocouples for shroud temperature monitoring to be located on the shroud surface inside the chamber and connections taken through thermocouple feed through with miniature T/C connectors at both ends of the feed through harness. Thermocouples and suitable accessories for installing the thermocouples and other sensors shall be sourced from reputed international brands meeting international standards.

9.3.5 The connectors and feed through shall be compact and sealed (maximum admissible leak rate per feed through:  $1 \times 10^{-9}$  mbar l/s) and shall be thermal vacuum compatible

9.3.6 All the temperature sensors located on the shroud surface shall be installed in such a way that they can be removed for calibration and can be replaced after calibration without affecting the performance.

9.3.7 The thermal plate/specimen temperature shall be controlled by precise heating or cooling using PLC controller.



**9.4 Vacuum sensors and instrumentation:**

The pressure/ vacuum at various locations including inside the chamber is measured using:

9.4.1 Vacuum gauge (Bayard-Alpert Pirani Capacitance Diaphragm Gauge) for monitoring the chamber pressure.

9.4.2 Quantity: 2 numbers each

9.4.3 Suitable monitoring/display units having standard PC interfaces / analogue outputs shall be provided along with the vacuum gauges for the use of the measured analogue values by PC/PLC/DAS monitoring/ control purpose.

9.4.4 Supplier shall provide adequate number of vacuum gauges integrated to the vacuum system for controlling the entire vacuum pumping chain.

**10.0 Electrical feed through:**

The chamber needs to be provided with electrical feed through of suitable rating for routing signals and power to and from the device undergoing test. 120 channels electric feed through for device testing, 10 A rating, with mating connectors on both sides shall be provided. Each feed through shall be identified by a unique number and tagged. Each wire in the harness shall also be tagged. At both the ends the harness of each feed through shall be terminated on to 32 pin ITT D type gold plated connectors.

**11.0 Sub system Requirements**

**11.1 Liquid Nitrogen (LN2) Storage Dewar and Installation:**

11.1.1 Procurement and installation of LN2 storage Dewar including obtaining PESO license for the tanks after installation at VSSC is in the scope of supplier.

11.1.2 The storage Dewar shall have adequate / convenient access for ease of operation, approach and maintenance including self-pressurization system.

11.1.3 The TVF control system, in its fully integrated condition, shall monitor the

1. LN2 tank pressure and apply appropriate logic for system start-up/sequencing of operation and supply management of coolant for test facility requirements.

2. The instrumentation needed for monitoring and control of LN<sub>2</sub> storage and supply is in the scope of TVC/TVF supplier and shall be flawlessly integrated with control system PLC.
3. Tanks shall be interconnected and any tank shall be selected for test operation from control console of Thermo Vacuum chamber.
4. Necessary transmitter and display in GUI indicating amount of liquid in the tanks shall be provided.
5. Both tanks shall have provision for draining LN<sub>2</sub> through an extra manual valve for purposes other than thermo vacuum test in the proposed facility. Such valves shall have provisions for locking to prevent inadvertent usage.
6. Necessary filters (cleanable) shall be provide at the outlet of LN<sub>2</sub> tank upstream of Thermal conditioning system.
7. Schematic of the LN<sub>2</sub> supply system shall be submitted along with details of make of each device for approval from VSSC before start of fabrication.

#### 11.2 Detailed specification for LN<sub>2</sub> Dewar

11.2.1	Details of LN <sub>2</sub> Storage Tank	
	Performance/configuration specifications:	
	i) Orientation	Vertical
	ii) Storage capacity	6,000 litre
	iii) Number of tanks	Two
	iv) Outer dia of Dewar	1.6meter (approx)
	v) Design Standard for tank and piping	ASME SEC. VIII Division I, ASME B31.3
	vi) Net evaporation rate	Less than 0.25% by volume of maximum capacity per day.
	vii) Pre-cooling load	To be computed by the Contractor.
	viii) Maximum working pressure	As required for closed loop GN <sub>2</sub> cooling system (with adequate margin to take care of pressure drop etc.). To be specified by thermo vacuum chamber manufacturer
	ix) Design pressure	With standard margin over maximum working pressure as per applicable codes.
	x) Safety provisions	Safety devices like burst discs, relief valves and alarm system and other similar provisions as per applicable code. Safety relief valves shall be provided for



		the lines in LN2 tank circuit where there is chance for trapping of LN2 during operation (by closing of upstream and downstream valves)
	xi) Filling and drawing lines	Permanently connected to thermo vacuum chamber thermal shroud and thermal plate through appropriate feed throughs and super insulated vacuum jacketed lines. Drain lines shall be provided with adequate valves for purging out moisture present in the lines. Additional drain point shall also be provided with necessary valve with provision for locking on each LN2 tank for drawing LN2 for any other purpose other than Thermal conditioning system.
	xii) Pressure, level and flow indications	Digital readout of level, flow and pressure gauges with necessary redundancy and facility for automatic logging of data with respect to time is in the scope of TVC/TVF supplier. This is in addition to mechanical differential pressure gauges and pressure gauges fitted with the tank.
	xiii) Control provisions	<ol style="list-style-type: none"> <li>1) Dewar pressure control shall be user selectable from central control console or manually at local level from stand alone instrument.</li> <li>2) Filling lines of LN2 shall have electro - pneumatically operated valves and manual valves for redundancy.</li> <li>3) LN2 withdrawals shall be central system managed.</li> <li>4) Manual isolation valves shall be provided on filling and withdrawal lines for redundancy.</li> <li>5) All such instruments/control valves positioned outdoor shall be protected from rain as well as inadvertent operation / tampering.</li> </ol>
	xiv) License	The vendor shall obtain PESO clearance for LN2 storage yard. The licensed area shall be fenced by VSSC after providing the safety distances as per SMPV rule.

11.2.2	Foundation & civil work		The foundation required for the tank shall be in the scope of VSSC. Required design drawings / inputs shall be given by the vendor well in advance for completing the activity through CMG / VSSC.
11.2.3	Design and other Guidelines	1)	The liquid nitrogen storage tank shall be super insulated vacuum jacketed type and designed for very low evaporation loss rate.
		2)	All valves, transfer lines shall have low pre-cooling and low heat leak and to be designed for low consumption of liquid nitrogen.
		3)	All valves and devices used in the circuit shall be of very high quality capable of operation in corrosive saline environment. These devices, valves, valve handles, tags etc shall be from corrosion resistant material.
		4)	All flanges, grooves, gaskets shall be of standard dimensions.
		5)	Fabrication, testing and inspection of LN2 tanks and lines shall be done as per approved process.
		6)	All the pressurised systems which are not coming under the purview of SMPV rule shall comply with the provisions of Kerala Factories Rule.
		7)	Suitable drain points with blow down valves shall be provided on LN2 / circuits at suitable locations for initial purging to drive out any resident moisture due to stoppage of system for a long duration for maintenance etc.
		8)	Surfaces shall be painted with two coats of Zinc rich primer followed by two coats of Polyurethane paint. Colours of paint on tanks and piping shall conform to International Codes.

Table No 3.0 : Detailed specification for LN2 Dewar



**11.3 LN2 transfer lines:**

The supplier shall supply and install vacuum insulated pipe lines and its routing from LN2 Dewar to Thermo vacuum chamber. Adequate pressure sensors shall be provided in the LN2 transfer lines. Safety relief valves shall be provided on the LN2 transfer lines where there is chance for trapping of LN2 by closing of upstream and downstream valves.

**11.4 Air Compressor Unit:**

11.4.1 The supplier shall supply clean room compatible portable air compressor with refrigerator type drier of required capacity.

11.4.2 Necessary oil separator & filters shall be provided

11.4.3 SS pipe lines shall be provide to operate the electro pneumatic vacuum valves and other pneumatic operated devices. Flexible PU tubes (Hydrolysis resistant) can be used for short lengths near to actuators & valves.

11.4.4 Redundant air compressor (alternate switchable) shall be provided with necessary interconnections.

**11.5 Chiller Unit:**

11.5.1 The supplier shall supply re-circulating closed circuit water chiller unit having all system/ components designed to operate at high humidity corrosive saline environment.

11.5.2 Chiller capacity shall be worked out based on all service requirements in extreme test cycling temperatures.

11.5.3 Detailed breakup of the cooling requirement shall be submitted

11.5.4 There shall be a margin of 50% over the required cooling capacity.

11.5.5 The chiller shall operate efficiently at the extreme temperature prevalent at VSSC site ( 23° C to 40° C)

11.5.6 Redundant chiller unit (alternate switchable) shall be provided with necessary interconnections.

11.5.7 Necessary coolant additives shall be used for preventing corrosion in pump cooling paths / channels.

**11.6 IPC and Printer:**

Real time data monitoring and printing of chamber temperature (for specimen T/C and chamber sensors) shall be done through IPC& printer.

The IPC shall be isolated from all other networks. The data shall be acquired through dedicated DAQ and processed in ASCII format. Processed data shall be available in .txt format and portable to .xls and .pdf. Data shall be acquired at the rate of 30 samples/s (settable).

**11.6.1 The basic configuration of the external PC will be as follows:**

Processor type: Intel® Core™ i7-880 Processor or advanced, RAM: minimum 8 GB, Hard disk: 1TB, Monitor: LED 32 inch, touch screen, OS: Windows based. The PC shall have provision for data retrieval for processing and report generation (which is editable) based on test data.

ColourA4size Laser-jet printer for printing/plotting of data.

Note:

- 1) PC & Colour Laser-jet Printer supply in Contractor's scope. DAQ software shall be installed in the PC provided. Lifelong license for software shall be provided. Two years post installation software support shall be provided.
- 2) All other instrumentation required for the data acquisition for the operation of the chamber shall be provided by the supplier.

**12.0 General conditions**

**12.1 Welding:**

All welding shall be TIG and multi pass welding. All welds shall be done by qualified welders and all the root pass welds done on the chamber shall be radio graphed and sample radiography after a final weld.

**12.2 Leak Rate:**

The overall leak rate of the shrouds, nitrogen supply lines, LN2 supply lines, and flanges inside the chamber etc. shall be better than  $1 \times 10^{-7}$  mbar l/s and individual leak rate shall be better than  $1 \times 10^{-9}$  mbar l/s as demonstrated by standard calibrated Helium Mass spectrometer leak detector.

**12.3 Thermo-optical requirements of the shroud:**

Surface emissivity on the shroud external side be lower than 0.15 at any temperature. The internal surface of the shroud shall be covered with special space qualified black thermal paint to improve emissivity to 0.9 at any temperature.



**12.4 Materials:**

All parts exposed to vacuum wherever welding is there shall be fabricated with non-magnetic SS AISI 304L. Other parts blank flanges etc can be with SS 304.

**12.5 'O' Rings:**

All the 'O'rings used shall be of Viton.

**12.6 Outer chamber :**

Being a hot & humid place and corrosive environment due to nearness to the sea shore, all outside surfaces (all items) shall be painted with two coats of Zinc rich primer followed by two coats of Polyurethane paint. Colours of paint on piping shall conform to International Codes.

**12.7 Electromagnetic compatibility (EMC) :**

The electric equipment of the thermal vacuum chamber shall not interfere electromagnetically with its own control system or the test specimen undergoing test. All the electrical and electronic equipment installed on the chamber and auxiliary Subassemblies shall confirm to the international EMI/EMC standards. The vendor shall specify the EMI/EMC standards to which the equipment used in the chamber system are compiled to.

**12.8 Noise:**

The noise levels shall be lower than 70 dB A while operating the facility.

**12.9 Thermal Insulation:**

If there are fluid lines without vacuum insulation it shall be provided with clean room compatible insulated lines.

**13.0 Sources**

The names of some internationally known suppliers for various equipments have been provided below based on ISRO experience and or availability of after sales maintenance support. Vendors shall have to select the equipment / systems from the suppliers given below. Equivalent brands are not permitted unless prior approval from VSSC is obtained.

**13.1 Sources of supply for thermal shrouds**

1. M/s. Tranter USA
2. M/s. VG, UK

3. M/s. Bemco, USA
4. M/s. ZiemannSecathen, France
5. M/s Magod Lasermachining (P) Ltd., Bangalore, India
6. M/s FIC, Italy
7. M/s Angelantony, Italy

**13.2 Sources of supply for Thermal plate**

1. M/s. Bemco, ,USA
2. M/s. ZiemannSecathen, , France
3. M/s FIC, Italy
4. M/s. Telstar, Spain
5. M/s Angelantony, Italy

**13.3 Sources of supply for Thermal Conditioning system**

1. M/s. CSL , Leige, Belgium
2. M/s. Telstar, Spain
3. M/s Intespace, France
4. M/s Angelantoni, Italy

**13.4 Sources of supply for Cryo pumps and Turbo molecular pumps**

1. M/s.Leybold Vacuum Germany
2. M/s. HSR, Germany
3. M/s. CTI cryogenics
4. M/s. Pfeiffer Vacuum GmbH, Germany

**13.5 Supply for Roughing and roots pump**

1. M/s. Pfeiffer Vacuum GmbH, Germany
2. M/s.Leybold Vacuum Germany
3. M/s. Agilent

**13.6 Sources of supply for vacuum gate valves**

1. M/s.VAT VakuumventileAG , Switzerland.
2. M/s. Pfeiffer Vacuum GmbH
3. M/s.Leybold Vacuum Germany
4. M/s GNB, USA

**13.7 Sources of Supply of Electrical panel / Instruments**

1. 19" Racks to be sourced from any reputed manufacturer meeting industry standards.
2. Electrical Power panel and switch gear to be sourced from ABB, L&T, Siemens
3. The PLC/GUI to be sourced from any of the reputed makes such as Siemens, Allen Bradley, GE Fanuc or L&T.

**13.8 Sources of Supply for Data Acquisition System**

1. M/s.Keithley, Germany
2. M/s. Siemens, Germany



3. M/s. Allen Bradley
- 13.9 Sources of Supply for PLC
  1. M/s. Siemens, Germany
  2. M/s. Allen Bradley
- 13.10 Sources of Supply for vacuum gauges and monitors
  1. M/s. Pfeiffer Vacuum GmbH, Germany
  2. M/s. Leybold Vacuum, Germany
  3. M/s. Inficon, USA
  4. M/s. MKS
- 13.11 Sources of Supply for hermetic thermocouple, heater and power feed through.
  1. M/s. Douglas Electrical components inc, USA
  2. M/s. PLUG in, France
  3. M/s. MDC Vacuum Products, USA
- 13.12 Sources of Supply for thermocouples, thermocouple connector, RTDs and thermistors
  1. M/s. Omega, USA
  2. M/s. TC, UK
- 13.13 Sources of Supply for Cartridge heater
  1. M/s. Electricfor
  2. M/s. Kamenev
  3. M/s. Thermo coax
- 13.14 Sources of Supply for Temperature controllers & Power controllers
  1. M/s. Eurotherm Ltd., UK
  2. M/s. Eurotherm DEL India Ltd.
- 13.15 Sources of Supply for thermal paint
  1. M/s. Aeroglaze,
- 13.16 Sources of Supply for View port (as an assembly only)
  1. M/s. Agilent, Germany
  2. M/s. Pfeiffer vacuum GmbH, Germany
  3. M/s. Leybold Vacuum Germany
- 13.17 Sources of Supply for Compact air compressor
  1. M/s. Atlas Copco, France / India
  2. M/s. ELGI Compressors, India
  3. M/s. Chicago Pneumatic Compressors, India
  4. M/s. Ingersol Rand, India
- 13.18 Sources of Supply for Water Chiller:
  1. M/s. Eurodifroid, France

2. M/s. Werner Finley
3. M/s. Huber

**13.19 Sources of Supply for LN2 Dewar**

1. M/s.Inox, India
2. M/s. Shell n Tube, India
3. M/s. VRV, India
4. M/s. Super cryogenic systems (P) Ltd.India
5. M/s.Cryostartanks and vessels (P) Ltd.India

**13.20 Sources of Supply for flexible bellows, Clamps, Claw clamps, centering ring , `O' ringetc**

1. M/s.MEWASA , Switzerland
2. M/s. Pfeiffer Vacuum GmbH, Germany
3. M/s.Leybold Vacuum, Germany

**13.21 Sources of Supply for blowers**

1. M/s. FIMA
2. M/s. Barber-Nichols

**13.22 Sources of Supply for Cryo valves:**

1. M/s.Herose, Germany
2. M/s.Burkert, Germany
3. M/s.Habonium, Israel

**13.23 Sources of Supply for Pressure Gauges:**

1. M/s.Wika
2. M/s. Emerson

**13.24 Sources of Supply for Safety Relief valves:**

1. M/s.Herose, Germany

**13.25 Sources of Supply for Differential gauge:**

1. M/s.Wika
2. M/s. Dwyer, USA

**13.26 Sources of Supply for level transmitter / pressure transmitters**

1. M/s. Yokogawa, Japan
2. M/s.Hioki, Japan
3. M/s. GE, USA

**13.27 Sources of Supply for Process control valves:**

1. M/s. Flowserve, USA
2. M/s.Burkert, Germany

**13.28 Sources of Supply for Burst disc:**

1. M/s. BS&B

- 13.29 Sources of Supply for Super insulated vacuum jacketed lines:**
1. M/s.Cryo diffusion, France
  2. M/s.Cryo fab, USA
  3. M/s. INOX, India
  4. M/s. Shell N tube, India
- 13.30 Sources of Supply for switch gears & circuit breakers:**
1. M/s. Siemens , Germany
  2. M/s. Schneider, Germany
  3. M/s. ABB
  4. M/s. Allen Bradley
- 13.31 Sources of Supply for online UPS:**
1. M/s. Schneider, Germany
  2. M/s.Reilo
  3. M/s.Pillar, Germany
- 13.32 Sources of Supply for Computers:**
1. M/s. Hewlett Packard (HP)
  2. M/s. Siemens , Germany
- 13.33 Sources of Supply for Actuators :**
1. M/s. Schubert &Salzer,
  2. M/s.Festo, Germany
  3. M/s. Bosch Rexroth,
- 13.34 Sources of Supply for CryoSolenoid valves:**
1. M/s.Weka,
  2. M/s.Burkert, Germany
- 13.35 Sources of Supply for pneumatic Solenoid valves:**
1. M/s. FESTO, Germany
  2. M/s. Rockwell Automation, USA
- 13.36 Sources of Supply for pneumatic PU tubes:**
1. M/s. FESTO, Germany
  2. M/s.Legris, France
- 13.37 Sources of Supply for needle valve / manual valve:**
1. M/s. FESTO, Germany
  2. M/s.Legris, France
  3. M/s. Swagelok
- 13.38 Sources of Supply for ball valve / manual valve:**
1. M/s. FESTO, Germany
  2. M/s.Legris, France

13.39 Sources of Supply for Air admittance valves:

1. M/s. VAT, Switzerland
2. M/s. GNB, USA
3. M/s. Pfeiffer Vacuum GmbH
4. M/s. Leybold Vacuum Germany

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**COMMERCIALTERMS AND CONDITION**

- 1.0 **Scope of supply:** The scope of the supply is Design, fabricate, demonstrate main parameters/specifications at vendor's site, transportation to site, handle at site, integrate, test & demonstrate all sub system & total performance, test, install and commission a horizontally mounted Thermo vacuum chamber at ASOE, Vikram Sarabhai Space centre, ISRO Thiruvananthapuram on turnkey basis as per the attached technical specifications. Mutually agreed third party certification from BVQI / LLOYDS is required at design and at all stages of fabrication from raw material identification till testing at pre delivery inspection stage.
- 2.0 **Bidding process:** The quote shall be presented in TWO parts namely, Techno – Commercial bid and Price bid. Each bid shall be separately sealed and clearly identified.
- 3.0 **Techno-commercial Bid:**
  - 3.1 The techno-commercial bid shall address each and every specification and shall specify values like chamber size, wall thickness, pump sizing, pump down time calculation, assumptions made, details of the thermal system especially with regard to its capacity, temperature uniformity accuracy, control, and major equipment specification etc. Also sources / makes of individual equipment / parts proposed shall be mentioned in the quote for evaluation of the quality aspects of the components used in the realization of the system as a whole.
  - 3.2 Please note that the evaluation by the committee will be based on the inputs provided in the bid. Mere statement stating compliance to certain specification is not sufficient unless it is backed up by clear information, catalogs, and proof of achieving the parameters in earlier supplied items to various national as well as international customers. Bid is likely to be rejected if all necessary information is not provided.
  - 3.3 **Bid shall contain the following:**
    - 3.3.1 The design methodology and specific details of calculations.

- 3.3.2 Schematic of the proposed vacuum pumping system, thermal system, LN2 storage tanks & supply lines. Details shall be given including rating , make of each components / valves / sub systems.
- 3.3.3 Materials used and the standards followed in design.
- 3.3.4 Vendor shall have previous experience in realizing and supplying similar automatic thermo vacuum chambers along with its thermal system to ISRO/DRDO or other reputed firms.
- 3.3.5 Details of previous experience like, chamber size, type of thermal circulation system used, date of supply, Name, Address, e-mail & phone No. of customer, present working status, specification achieved in the supplied system, especially wrt temperature uniformity, control accuracy and temperature range of thermal system.
- 3.3.6 List of essential spares which are provided along with the chamber.
- 3.3.7 Vendor shall provide details of schedule, milestones & Gantt chart depicting all important stages and time required for each. Realistic time schedule alone shall be given as Liquidated damages will be recovered as per Government norms if the milestones are not achieved within agreed time frame.
- 3.3.8 The international standards to which the bought-out items conform to and drawings (if any) depicting the configuration of the system.
- 4.0 **Price bid:** The price bid shall include
  - 4.1 The cost breakup of all major sub systems viz, Chamber, pumping system, thermal conditioning system, thermal shroud & thermal plate, LN2 Dewar (cost breakup for each LN2 Dewar separately. Number of LN2 Dewar will be finalized after technical evaluation committee.)& SIV lines, transportation etc.
  - 4.2 The cost breakup of the essential spare parts proposed for the trouble-free operation of the chamber for a period of 10 years (minimum). The quantity and price shall also be provided.
  - 4.3 List & Cost of the items sourced within India.
  - 4.4 Price for the complete system
  - 4.5 Annual Maintenance Contract (AMC) charges for a period of 7 years after warranty period. This amount will also be taken into consideration for



determining the lowest quote.

- 5.0 For imported parts / systems procured, duty exemption certificates will be provided by ISRO.
- 6.0 The chamber shall be installed and commissioned by the supplier within 12 months from the date of placement of the purchase order.
- 7.0 The offer shall be for the complete Design, fabrication, demonstration of main parameters / specifications at vendor's site, transportation to site, handling at site, integrating, testing & demonstrating all sub system & total performance, installation, final acceptance testing, and commissioning of the Thermo vacuum chamber. Mutually agreed third party certification from BVQI / LLOYDS is required at design and at all stages of fabrication from raw material identification till testing at pre delivery inspection stage. All equipment and consumables required (except for the exclusions stated in the scope of VSSC) will be in the scope of the supplier.
- 8.0. Vendor shall provide a layout diagram of the proposed system showing major equipment with the minimum floor area / space required for installation along with the offer.
- 9.0 Chamber & sub systems supplied by the vendor shall use components and equipment of proven heritage, high reliability and international repute.
- 10.0 Vendor shall specify whether the supplied systems were
  - (a) fully designed and manufactured at vendor's works, or
  - (b) Integrated from outsourced subsystems, if so, provide details.
- 11.0 Vendor shall submit the documentary evidence from the concerned customers' for the satisfactory performance of the 1000 mm dia X 800 mm depth or higher capacity Thermovacuum chambers without any major breakdown over the past 5 years.
- 12.0 VSSC reserves the right to visit vendor's or his customers' premises where the systems have been supplied, for verification of the information provided by the vendor in the technical bid and other infrastructure facilities claimed. Incomplete technical bid of the vendor, which does not meet technical requirements mentioned in this tender is liable to be rejected.
- 13.0 It is mandatory that the vendor shall, in full, provide technical parameters

of the system offered vis-à-vis each point mentioned in the tender specification, with demonstrated values wherever applicable and wherever being asked and with all applicable documentation like drawings, catalogues, data sheets, test results and support calculations as a proof of their claims. Specific conformance on each technical specification shall be provided. Achieved and demonstrated specifications of the system offered shall be presented against each of the technical required specifications in the tender.

- 14.0 Offer shall be for the total system and incomplete/ partial offers will not be considered.
- 15.0 Vendor shall be ready to give a technical presentation to the Technical Committee formed for the purpose of finalizing the procurement at VSSC Thiruvananthapuram. The vendor shall be intimated 15 days in advance for this presentation. This intimation will be sent to the vendor only after the technical evaluation of the proposal and examining its technical suitability.
- 16.0 Vendor shall provide the details of the consumables, such as liquid nitrogen, helium gas required to demonstrate the performance of the chamber at VSSC, Thiruvananthapuram at the time of installation and commissioning.
- 17.0 Vendor shall specify quality standard followed at manufacturing works where system/subsystem are manufactured (conformance to any standard like ISO, CE, UL, TUE etc.)
- 18.0 Vendor shall have Service Centre in India for pre/post guarantee/warranty service back up. Vendor shall submit detailed list of Service Centre/s.
- 19.0 Vendor shall give full details of his proposed Acceptance Test Plan & schedule of activities:
  - 1.0 At vendor's site and
  - 2.0 At VSSC site, Thiruvananthapuram
- 20.0 Vendor shall confirm compliance to all the specifications witnessed by mutually agreed Third Party Inspection Agency (TPIA) and the inspection / tests reports thus generated and vouched by TPIA shall be provided to VSSC well in advance for scrutiny before proceeding for witnessing tests at vendor's site.



- 21.0 Pre-dispatch inspection shall be carried out by VSSC Engineers at vendor's site. As part of pre-dispatch acceptance, Vendor shall carry out and demonstrate salient specifications as per Factory Acceptance Test Plan in presence of VSSC Engineers at their works/site.
- 22.0 Vendor shall be completely responsible for
  - 22.1 Safe transportation of total system; warehouse to warehouse insurance to be provided by vendor .
  - 22.2 Supervise unloading and handling of the system at VSSC site, Thiruvananthapuram.
  - 22.3 Installation and commissioning of total system at VSSC site at Thiruvananthapuram adhering to all safety regulations.
  - 22.4 Demonstration of total performance specifications of the integrated system including vacuum chambers, thermal system and other associated system supplied.
- 23.0 Vendor shall impart detailed training for operation, trouble shooting and maintenance of the system to Engineers & Technicians at VSSC, Thiruvananthapuram at no extra cost.
- 24.0 All the equipment offered by the vendor shall have free guarantee support of at least one year from the date of installation and acceptance of total system at VSSC, Thiruvananthapuram.
- 25.0 Vendor shall attach technical catalogs, literature and detailed data sheets of all items offered by the vendor in support of their technical offer.
- 26.0 Installation, operation and maintenance manuals of all systems shall be supplied with the system. CAD drawings and circuit diagrams relevant to maintenance shall also be included.
- 27.0 Vendor's Company / Associates shall not have been banned or black-listed at any time by any Government Department/ Public Sector Unit/ Court in India. If banned / blacklisted, details with documentary evidence shall be provided.
- 28.0 **Delivery Period:** Vendor shall deliver and commission the Thermovacuum system at VSSC meeting the abovementioned specifications and interface requirements within a period of **twelve months** from the date of release of purchase order / MOU.
- 29.0 Vendor is required to provide the contact details of his representative for any further communication regarding the tender.
- 30.0 Auxiliary systems, if any required, shall be quoted separately with detailed specifications, catalogue and cost.



- 31.0 No query will be entertained at any stage regarding finalization of tender till details are published in the Central Public Procurement Portal.
- 32.0 Prior approval of fabrication drawing: The vendor shall have to submit the fabrication drawing for the vacuum chamber and thermal system and shall get prior approval from VSSC before starting the fabrication works.
- 33.0 **Warranty:** The supplier shall provide a performance warranty of minimum 3 years, from the date of installation, commissioning and acceptance at VSSC, for the entire system against any failure or any failure in meeting the overall performance specifications of the system.
- 34.0 All maintenance related issues shall be addressed within 3 days from the date of intimation from VSSC.
- 35.0 There shall be provision for carrying out maintenance remotely through VPN.
- 36.0 FMECA & HAZOP study for the entire system shall be done and reports submitted to VSSC.
- 37.0 Necessary QA / QC plan shall be prepared by the vendor and the same shall be approved before start of fabrication.
- 38.0 Installation & handling scheme shall be evolved considering the space available at VSSC site.
- 39.0 **Safety:**
  - 39.1 Standard electrical and mechanical safety features as per relevant practices shall be incorporated within the system wherever required.
  - 39.2 The vacuum pumping system shall be protected from reverse phasing, over voltage, under voltage , single phasing , over loading etc. at the panel end. The vacuum system shall be provided with all necessary safety inter locks , oil traps and standard fail safe features required for safety of the machinery, test object and personnel.
- 40.0 **Inspection and Factory Acceptance Test Plan:**

A detailed quality control plan shall be drawn up by the vendor at the design stage itself and shall consists of:

  - 40.1 Demonstration of Chamber leak tightness
  - 40.2 Six thermal cycles as per the system qualification test profile at extreme temperature levels shall be performed on a dummy test article of rated

mass and heat dissipation and the results shall comply with the performance specifications provided.

- 40.3 Demonstration of leak tightness on the already proof pressure tested (witnessed by TPIA) thermal shroud & thermal plate after ensuring that it is subjected to a minimum of three cycles of thermal cycling.
- 40.4 Provision shall be available at supplier's site for repeated cooling & heating of thermal shroud and demonstrating the performance of the total system.
- 41.0 **Inspection and VSSC Site Acceptance Test Plan shall contain:**
  - 41.1 Demonstration of Chamber leak tightness
  - 41.2 Demonstration of thermal shroud & thermal plate leak tightness after ensuring that it is subjected to a minimum of three cycles of thermal cycling.
  - 41.3 Demonstration of all specifications & performance shall be done during site acceptance test for a typical full duration test profile as given in figure 2.
  - 41.4 Functioning of all interlocks shall be demonstrated.
  - 41.5 Usage of both LN2 tanks / switching between tanks etc shall be demonstrated.
  - 41.6 Safe shut down & revival in the event of electrical power failure shall be demonstrated.
  - 41.7 All Safety alarms & its acknowledgment shall be demonstrated.
  - 41.8 Software re-installation shall be demonstrated (if is transported to VSSC in Pre-installed condition). Necessary passwords shall be given to VSSC during commissioning of the facility.
- 42.0 **Liquidated Damages (LD):** LD shall be levied beyond the date of delivery mentioned in this order @ 0.5% per week or part thereof on the undelivered portion subject to a maximum of 10% of the contract value.
- 43.0 **Security Deposit:** Upon receipt of this order, you shall submit a Bank Guarantee towards Security Deposit within 2 weeks along with your order acknowledgement, equivalent to 10% of the order value in Rs.200/- NJ Stamp Paper (as per format attached). This shall be valid up to a period of 60 days from the date of supply and shall be returned upon completion of all contractual obligations.

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Sl No.	VSSC Requirements/ specification	Compliance (Yes/No)	Remarks
1.0	<b>General specification:</b>		
1.1	Thermo vacuum chamber with adequate vacuum pumping system and automatic control of temperature to any desired set point under specified vacuum level.		
1.2	Specimen envelope size (usable test space): The test space shall be able to house a test article with a maximum size of 600 mm (width) x 600 mm (depth) x 450 mm (height) resting on the thermal plate.		
1.3	Vacuum chamber: Vacuum chamber shall be designed as per unfired pressure vessel code ASME-Section VIII Division I for external pressure vessel& inspected as per ASME Section IX or equivalent.		
1.4	Chamber size shall be around 1000 mm dia x 700 mm (length of cylindrical portion).		
1.5	Ultimate vacuum level for a clean degassed chamber without test article shall be $5.0 \times 10^{-7}$ mbar or better. Time to achieve vacuum level for a clean degassed chamber without test article shall be as following:		
1.5.1	Ambient to vacuum level of $1 \times 10^{-6}$ mbar at ambient temperature shall be reached in less than 60 minutes (excluding start up time for cryo pump).		
1.5.2	Vacuum level of $1 \times 10^{-6}$ mbar at 380K shall be reached in less than 3Hours		
1.6	Pumping chain: Active double chain with Rotary, Roots, Turbo pump and a single chain Cryo Pump.		
1.7	PLC based control system shall be provided for vacuum as well as thermal system with necessary safety interlocks (for equipment & general safety).		



1.8	Thermo vacuum chamber along with the thermal system shall be fully automatic with additional features for manual mode (with safety interlocks) & expert mode (with all manual override option).		
1.9	Passwords for expert mode of operation shall be given to VSSC at end of warranty period. All other passwords (for operation & re-installation etc) shall be given to VSSC at the time of commissioning the facility.		
1.10	System shall go into fail-safe mode with audible and visual alarms in case of electrical power failure / other service failure.		
1.11	Overall system shall be designed so as to mount the sub system on a single platform on ground for easy service/maintenance.		
2.0	<b>Scope of VSSC:</b>		
3.0	<b>General Requirements:</b>		
3.1	Total system and all other sub-systems shall be designed for minimum of 400 hours of continuous operation without failure. This, apart from reliability of components, shall also ensure that there is no need for regeneration of the Cryo pump during operation of the system spanning about 600hours.		
3.4	The following guidelines shall be adhered to:		
3.4.3	Modular design concept allowing future augmentation.		
3.4.6	All gauges, sensors, transducers and instruments shall be supplied with catalogues and calibration reports valid for one year from the date of supply ensuring full traceability. If calibration		



	validity is over during the warranty period, Party shall do re-calibration of all gauges, sensors, transducers and instruments at VSSC during AMC period.		
3.6	Pumps and other machineries shall be rated for more than 400 hours of continuous operation		
3.11	The Thermo-Vacuum Facility (TVF) chamber shall be operable through Industrial PC (IPC) and control console(s) with necessary override provisions for operation at IPC.		
3.12	The chamber shall be fail safe and hazard free during interruption of power, LN2 or compressed air supplies, loss of chamber vacuum etc.		
3.15	The equipment and sub-system layout shall conform to the existing building layout.		
3.16	Third party certification at design stage and at all identified stages of fabrication is essential.		
4.0	<b>Detailed Features/ specification:</b>		
4.1	<b>Vacuum chamber</b>		
4.1.1	The vessel of the Thermo vacuum system shall be designed for external pressure operation (vacuum). The chamber shall be cylindrical with tori spherical end dish. The chamber shall be made of stainless-steel type AISI 304L.		
4.1.2	Ultimate vacuum achievable inside the chamber is $5.0 \times 10^{-7}$ mbar.		
4.1.3	All hardware components used inside chamber shall be made of stainless steel or a high vacuum compatible material.		

4.1.4	Utility Flanges shall be of CF type with metallic gaskets for all vacuum pumps, vacuum gauges and instrumentation feed through.		
4.1.6	The chamber front dish shall be clamped using pneumatic clamps (Minimum 4 nos) with operable from control console & there shall be status indication in the control console.		
4.1.7	All the welded joints shall be leak tested with Helium Mass Spectrometer Leak Detector to an Individual leak rate of less than $1 \times 10^{-9}$ mbar l/s of Helium. The chamber shall be compatible for high vacuum of $1 \times 10^{-7}$ mbar or better.		
4.1.8	Necessary handling provisions shall be provided.		
<b>4.2</b>	<b>Vacuum chamber Dimensions:</b>		
4.2.1	Diameter: The diameter of the chamber shall be arrived at to house the proposed mouse trap thermal shroud and test article resting on the thermal plate. The size of the thermal plate shall be designed suitably according to the test article. Depth: 700 mm (tentative), with a minimum working space of 600 mm depth inside the shroud.		
4.2.2	Chamber axis height from ground level: 1200 mm		
4.2.3	Material of construction: SS 304 L (vender shall provide TPIA material certificate stating mechanical and chemical properties with traceability)		
4.2.4	To minimize the gas loads, the internal surface of vacuum vessel shall be fabricated as follows		
	1. Pre polished plates with 3 triangle finish Ra 0.025 to $1.6 \mu\text{m}$ for all vacuum exposed surfaces.		
	2. Material stainless steel type AISI 304L chemically cleaned.		

	3. High vacuum compatible weld design.		
	4. Final internal polishing to ensure low emissivity less than 0.15		
	5. Post weld chemical treatment is required.		
4.3	<b>Vacuum chamber orientation:</b>		
	The chamber shall be oriented horizontally and mounted using SS structure meeting all structural requirements.		
4.4	<b>Vacuum chamber end dishes:</b>		
	<b>1.0 Front dish:</b> Torri-spherical dished door welded with flange.		
	<b>2.0 Rear dish:</b> Torri-spherical dished end welded to the chamber shell.		
4.5	<b>Vacuum Chamber ports:</b>		
	The chamber shall be provided with ports of various sizes mentioned in Table 1		
4.5.1	All ports shall have metallic gaskets and shall be fitted with specified feed through.		
4.5.2	SS dummy flanges shall be provided for all ports.		
4.5.3	Opening shall be provided in the thermal shroud corresponding to view port as indicated in table 1.		
4.6	<b>Internal finish and emissivity:</b>		
4.6.1	Surface finish for all vacuum exposed surfaces and sealing surfaces shall be between 0.025 to 1.6 $\mu\text{m}$ (Ra value).		
4.6.3	Emissivity of all vacuum exposed surfaces including thermal shroud (external surface) shall be less than 0.15.		
5.0	<b>Vacuum System</b>		



5.1.1	Initial vacuum level of $1 \times 10^{-6}$ mbar from ambient shall be reached in less than 60 minutes for double chain and in less than 90 minutes for single chain respectively. (without using water vapour panel)		
5.1.2	The chamber shall be capable to reach a minimum of $1 \times 10^{-6}$ mbar at 380K in less than 3 hours.(without using water vapour panel)		
5.1.4	The vacuum level in the chamber shall be controlled by PLC. This system shall be fully automatic and provided with interlocks for a safe operation even in manual override mode.		
5.1.5	Redundant air admittance valve shall be provided for re-pressurization of vacuum chamber with atmospheric air.		
5.1.6	Pumping system shall have adequate pumping capacity and redundancy for continuous operation up to 400 hours at a time.		
5.2	<b>High Vacuum Pumping System :</b> The proposed vacuum pumping system contains the following:		
5.2.1	Rotary and Roots pumps in series (roughing)		
5.2.2	Turbo-Molecular Pumps (TMP)		
5.2.3	Cryo pump		
5.2.4	Chamber air admittance valves and Electro-pneumatic valves		
5.2.5	Vacuum monitoring and instrumentation system		
5.2.6	Backing pumps for TMP and Cryo pump		
5.2.8	Provision for independent control and operation of each unit in the System shall be there as on demand		
5.2.9	Venting provisions shall be provided for all pumping lines.		

5.3	Cryo pumping system and controller.		
5.3.1	Single Cryo pump operating based on G-M cycle for its two stages with Helium compressor. The Cryo pump shall be connected to the chamber through electro pneumatic gate valve.		
5.3.2	Removable cold-water vapour panel of size Dia. 600 mm behind the rear end closure inside the chamber provided with necessary electro pneumatic valves, drip trays, temperature sensors with flexible inlet & outlet pipes /bellows and heating system for removing the condensate after the test.		
5.3.3	The Cryo pump shall be capable of achieving a vacuum level of less than $5.0 \times 10^{-7}$ mbar.		
5.3.4	The control system shall be able to control the entire cryogenic pump at its cooling, heating and regeneration & fore vacuum pumping stages.		
5.3.5	The Cryogenic pump shall be regenerated using a dedicated multistage roots vacuum pump.		
5.4	<b>Backup pumping system details</b>		
5.4.1	The Multi stage Roots pump shall be selected based on the above requirements mentioned regarding the Cryo pump.		
5.4.3	There shall be a vacuum gauge between the Cryo pump and backup pump.		
5.4.4	Appropriate isolation valve shall be provided between Cryo pump and multi stage Roots pump		
5.5	<b>Turbo Molecular pump and controller:</b>		
5.5.1	There shall be two separate lines of Turbo molecular pumps (TMP), with independent connection to the ports on chamber through electro pneumatically operated gate valves and bellows.		

5.5.2	Each chain shall have one TMP, and one back-up rotary vane pump (RVP) in series with a vacuum gauge in between.		
5.5.3	The Turbo Molecular Pumps (TMP) shall be capable of achieving a vacuum level of less than $1 \times 10^{-7}$ mbar.		
5.5.4	Each Turbo pumps shall be provided with Stainless steel body and connected on chamber belly through CF type flange.		
5.5.6	Each TMP shall have a standalone controller mounted in a rack, which shall be provided with suitable voltage stabilizer, spike arrestor etc.		
5.5.7	Appropriate isolation valve shall be provided between TMP and Rotary vane pump.		
5.5.8	Pumping speed -1200Litr/sec (minimum)		
5.5.9	Quantity: 2 Nos.		
5.6	<b>Backing pump details for each TMP:</b>		
5.6.1	Each backing pump shall be selected based on the above requirements mentioned regarding the TMP.		
5.6.3	There shall be a vacuum gauge between the TMP and backup pump.		
5.6.4	Quantity: 2 Nos.		
5.7	<b>Rough vacuum system</b>		
5.7.1	There shall be two separate lines of roughing skids with independent connection to the ports on chamber through electro pneumatically operated valves and bellows.		
5.7.2	Roughing skids shall be capable of achieving a vacuum level of $5 \times 10^{-3}$ mbar.		
5.7.3	Each roughing skid shall have one Roots pump and one back-up rotary vane pump (RVP) in series.		



5.7.4	The Roots pumps shall be integrated with an overflow valve so that this can be switched on together with the backing pump even at atmospheric pressure.		
5.7.5	The pumps itself shall have built-in cooling provision for cooling the pumps.		
5.7.6	Vacuum gauge shall be provided for each stage.		
5.7.7	Quantity: 2 Nos.		
<b>5.8</b>	<b>Vacuum isolation / vent valves</b>		
5.8.2	Controlled air admittance valve for chamber venting(one each for coarse as well as fine)  Quantity : 2Nos		
5.8.3	Vacuum valve for chamber rough vacuum - Qty : 4 Nos.		
5.8.4	Vacuum valve for TMP high vacuum side & TMP backup (electro pneumatic valve)- Quantity : 4 Nos (2 Nos. each).		
5.8.5	Vacuum valve for Cryo pump & multi stage roots backup (electro pneumatic valve). -Quantity: 2 Nos(1 No. each).		
5.8.7	<i>CF type valves with stainless steel body shall be provided along with CF type pump flanges for better ultimate vacuum.</i>		
5.9	<b>Vacuum pipe lines:</b> Suitably sized SS 304 L pipes (seamless) and flexible bellows of 316 L shall be used for vacuum line piping works.		
5.10	<b>Re-pressurization System:</b> For re-pressurizing (or venting) the chamber after the test, clean air shall be used. Necessary 5 $\mu$ filters & air admittance valve shall be provided. Venting lines shall be designed such that the venting operation is completed in 10 minutes.		

6.0	Thermal System		
6.1	Thermal Shroud and thermal plate		
6.1.1	Shape of shroud : Double embossed Mouse trap.		
6.1.2	Size : The shroud shall be able to house a test article with maximum envelope of 600 mm (width) x 600 mm (depth) x 450 mm (height) on the thermal plate.		
6.1.3	End shrouds : Two separate active shroud panel attached to front and rear dish of chamber shall also be provided.		
6.1.4	Operating Temperature : 153K to 423 K		
6.1.5	Construction : Double embossed laser welded & inflated. Each sheet shall be of 1.5mm thick (minimum)		
6.1.6	Material of construction: SS316L		
6.1.7	Cooling / heating fluid: Low pressure closed loop GN2 (423 K to 153K).		
6.1.8	Ramp rate (hot & cold): 5 K / minute (settable between 1 to 5 K / minute)		
6.1.10	Temperature uniformity on thermal shroud, End closures and on thermal plate (at steady state: better than $\pm 2$ K		
6.1.11	Temperature uniformity on thermal shroud, End closures and on thermal plate (at transient): $\pm 15$ K		
6.1.12	Control Accuracy / Temp uniformity in time: $\pm 1$ K		
6.2	Thermal System - General requirements.		
6.2.1	There shall be an interlock for preventing operation of thermal system up to a minimum vacuum level of $1.0 \times 10^{-3}$ mbar.		

6.2.2	A single common thermal conditioning system shall supply heating / cooling GN2 to both thermal shroud & thermal plate.		
6.2.3	Super insulated vacuum jacketed lines shall be used in the thermal conditioning unit to prevent moisture condensation.		
6.2.6	Shroud panels shall be designed for service temperatures of 77 K and 423 K and internal pressures of at least 1.75 times the circulating GN2 pressure.		
6.2.7	The thermal plate shall have internal channel for circulating GN2 for cooling /heating the test article.		
6.2.8	The thermal plate shall have array of threaded holes' pitch 50mm x 50mm for mounting the test article.		
6.2.9	Thermal shroud shall be of optically tight arrangement.		
6.2.10	Thermal shroud shall have 'active end closures'(each on front and rear side)		
6.2.13	Leak tightness of the welded joints in the shroud, thermal plate and feed through shall be $<1 \times 10^{-9}$ mbar lit/sec of Helium. This will have to be demonstrated again after thermal cycling at VSSC site.		
6.2.14	The test space environment which includes the inner surface of shroud, both active end shrouds and top surface of thermal plate shall be painted with qualified thermal paint meeting the out-gassing requirements for space environment. The outside of the shroud, active end shrouds and thermal plate shall be electro polished.		



6.2.15	The thermal plate and thermal shroud shall be with demountable circulating fluid inlet / outlet feed lines so as to enable easily removal from chamber for maintenance & cleaning purpose. Such joints shall be easily accessible.		
6.2.16	The temperature controller shall have an inbuilt programmable profile and control shall be through a computer with Graphic User Interface (GUI) program / SCADA.		
6.2.17	The GUI shall have provisions for customizing the thermal cycling profile, store it and execute it at desired time.		
6.2.18	Provision shall be there to resume the test (resumption after electrical power failure)		
6.2.20	Super insulated vacuum jacketed lines shall be provided for all LN2 lines up to the vacuum chamber.		
6.3	<p><b>Specification of black thermal paint:</b></p> <p>Internal surface of the thermal shroud &amp; its enclosures shall be painted with black thermal paint to improve radiation heat transfer.</p> <p>Make : Aeroglaze</p> <p>Solar absorption : &gt;0.95</p> <p>Normal Emissivity : 0.90</p> <p>Out gassing : % TML : &lt; 1</p>		
<b>7.0</b>	<b>Control and Instrumentation system</b>		
7.1	PLC modules with its execution software		
7.2	Electrical power distribution and switching panel		
7.3	Control and instrumentation panel		
7.4	Data acquisition system		

7.5	Vacuum gauges/sensors and associated instrumentation		
7.6	Temperature sensors and associated instrumentation		
7.7	Temperature controllers / thermal conditioning system		
7.8	Online UPS with sufficient backup (1-hour backup time) to enable to switch all systems to safe mode, in case of a power failure.		
8.1	<b>Special earthing:</b> Special earthing & routing shall be in the scope of the supplier. Earthing pit alone will be in the scope of VSSC.		
8.2	Control and instrumentation panel		
8.2.1	All the systems like vacuum and temperature shall be controlled from the control and instrumentation panel located close (3 to 5m) to the chamber facilitating the operators to control and monitor the operation of the chamber.		
8.2.3	Every input and output cable shall be properly identified and tagged. Detailed documentation of the electrical wiring and interconnections shall be provided.		
8.3	<b>The control and instrumentation panel shall house:</b>		
8.3.1	PLC (Programmable Logic Controller) for the real time monitoring and control of all equipment in the system		
8.3.2	The parameters such as: Instrumentation for vacuum pumps and gauges temperature sensors, gate valve position indication, LN2 consumption status etc., shall be available in the rack. The analog/digital process output from these instruments shall be interfaced with a PC through		

	serial/parallel/GPIB/ethernet interface for monitoring and display.		
8.3.3	A PC based Data Acquisition System (DAS) shall monitor and display the temperature data from all the thermocouples/RTDs fixed on the test article and the thermal shroud & thermal plate inside the chamber.		
8.3.4	PC system provided with the processor and operating system shall be state of the art. The entire system is in the scope of supplier.		
8.3.5	On screen displays shall include data plotting of vacuum system, thermal system and auxiliary systems.		
8.3.6	There shall be a smooth shutdown of the thermo vacuum process without loss of data.		
8.3.7	A Laser printer shall be provided for hard copy output of stored or displayed data or graphics on the DAS PC		
8.3.8	PC Software: The PC/computer system in the console shall be provided with suitable PLC/ GUI software along with license in the name of ISRO to fulfill the following tasks:		
	1. Mimic Diagrams displaying functional status of all system components and safety interlocks.		
	2. Display the state of main process regulation loops such as shroud and thermal plate temperature control.		
	3. Display, storage and print of all test facility functional data, alarm condition, messages etc.		
	4. Display of temperature profiles on shroud and test article with proper scaling of temperature profiles.		



	5. Customizable program for vacuum and temperature profiles for its generation, storage and execution.		
8.3.9	An extra copy of the software(s) developed for this system shall be provided in installable form to take care of any exigency arising due to software corruption/ overheating of PLC / malfunction that may occur in future.		
9.0	<b>Data acquisition system and temperature sensors</b>		
9.1	<b>Data Acquisition System (DAS):</b>		
9.1.1	The system will acquire data from the thermocouples and RTDs on shrouds and thermistors, thermocouples fixed on the test article and also the vacuum parameters of the system.		
9.1.2	DAS shall also have extra analogue input channels used for future system expansion.		
9.1.3	The data logging system shall have a failsafe mechanism not to lose any test data during electrical power failure/system failure condition.		
9.2	<b>Salient features of the DAS Hardware/ Software:</b>		
9.2.1	There shall be provision for 3 modes of operations such as Auto mode, Semi auto mode and manual mode		
9.2.2	Auto mode: The temperature and vacuum shall be controlled based on a predefined test profile without any manual intervention.		
9.2.3	<b>Semi auto mode:</b> It shall allow the generation of a new test profile, edit (change parameters and set points) an existing one and save in its memory.		
9.2.4	<b>Manual mode (Expert mode):</b> Each sub system shall be operated in manual mode (expert mode) and shall be protected with necessary passwords.		

9.2.5	Data acquisition for Temperature, Pressure, Time etc. shall be done.		
9.2.6	Able to create different test profiles.		
9.2.7	An over-view MIMIC diagram of the machine status shall be provided.		
9.2.8	All functions to be made selectable by menus and icons.		
9.2.9	There shall be provision for switching over to manual mode from the current mode (Auto /Semi auto mode) without any interference in the process of the test.		
9.2.10	Real time for graphics and numerical data presentation of selected channels.		
9.2.11	Data shall be stored in hard disk periodically for later retrieval		
9.2.12	Data file generation, management and storage		
9.2.13	Post processing of acquired / stored data		
9.2.14	<b>Report generation</b>		
9.3	Temperature sensors and Instrumentation:		
9.3.1	6 Numbers of each T-type thermocouples (24AWG) placed on the shroud and Thermal plate for temperature monitoring.		
9.3.2	T-Type Thermocouple Feed through-3Nos and K-Type Thermocouple feed through 2 numbers, with 26 pin having end connectors on both sides are to be provided for test article temperature monitoring.		
9.3.4	“T” type thermocouples for shroud temperature monitoring to be located on the shroud surface inside the chamber and connections taken through thermocouple feed through with		

	miniature T/C connectors at both ends of the feed through harness.		
9.3.5	The connectors and feed through shall be compact and sealed (maximum admissible leak rate per feed through: $1 \times 10^{-9}$ mbar l/s) and shall be thermal vacuum compatible		
9.3.7	The thermal plate/specimen temperature shall be controlled by precise heating or cooling using PLC controller.		
9.4	<b>Vacuum sensors and instrumentation:</b>		
9.4.1	Vacuum gauge (Bayard-Alpert Pirani Capacitance Diaphragm Gauge) for monitoring the chamber pressure		
9.4.2	Quantity: 2 numbers each		
9.4.3	Suitable monitoring/display units having standard PC interfaces / analogue outputs shall be provided along with the vacuum gauges for the use of the measured analogue values by PC/PLC/DAS monitoring/ control purpose.		
10	<b>Electrical feed through:</b> 120 channels electric feed through for device testing, 10 A rating, with mating connectors on both sides shall be provided. Each feed through shall be identified by a unique number and tagged. Each wire in the harness shall also be tagged. At both the ends the harness of each feed through shall be terminated on to 32 pin ITT D type gold plated connectors.		
11.0	<b>Sub system Requirements</b>		
11.1	Liquid Nitrogen (LN2) Storage Dewar and Installation:		

11.1.1	Procurement and installation of LN2 storage Dewar including obtaining PESO license for the tanks after installation at VSSC is in the scope of supplier.		
11.1.3	The TVF control system, in its fully integrated condition, shall monitor the		
	1. LN2 tank pressure and apply appropriate logic for system start-up/sequencing of operation and supply management of coolant for test facility requirements.		
	2. The instrumentation needed for monitoring and control of LN2 storage and supply is in the scope of TVC/TVF supplier and shall be flawlessly integrated with control system PLC.		
	3. Tanks shall be interconnected and any tank shall be selected for test operation from control console of Thermo Vacuum chamber.		
	4. Necessary transmitter and display in GUI indicating amount of liquid in the tanks shall be provided.		
	5. Both tanks shall have provision for draining LN2 through an extra manual valve for purposes		
	6. Necessary filters (cleanable) shall be provide at the outlet of LN2 tank upstream of Thermal conditioning system.		
	7. Schematic of the LN2 supply system shall be submitted along with details of make of each device for approval from VSSC before start of fabrication.		



11.2	Detailed specification for LN2 Dewar : party has to submit the Comply/Non comply statement with justification against the specification document, refer page No.28 & table No.3 ( Detailed specification of LN2 Dewar)		
11.3	<b>LN2 transfer lines:</b> The supplier shall supply and install vacuum insulated pipe lines and its routing from LN2 Dewar to Thermo vacuum chamber. Adequate pressure sensors shall be provided in the LN2 transfer lines. Safety relief valves shall be provided on the LN2 transfer lines where there is chance for trapping of LN2 by closing of upstream and downstream valves.		
11.4	<b>Air Compressor Unit:</b>		
11.4.1	The supplier shall supply clean room compatible portable air compressor with refrigerator type drier of required capacity.		
11.4.2	Necessary oil separator & filters shall be provided		
11.4.3	SS pipe lines shall be provide to operate the electro pneumatic vacuum valves and other pneumatic operated devices. Flexible PU tubes (Hydrolysis resistant) can be used for short lengths near to actuators & valves.		
11.4.4	Redundant air compressor (alternate switchable) shall be provided with necessary interconnections.		
11.5	<b>Chiller Unit:</b>		
11.5.1	The supplier shall supply re-circulating closed circuit water chiller unit having all system/		

	components designed to operate at high humidity corrosive saline environment.		
11.5.3	Detailed breakup of the cooling requirement shall be submitted		
11.5.4	There shall be a margin of 50% over the required cooling capacity.		
11.5.6	Redundant chiller unit (alternate switchable) shall be provided with necessary interconnections.		
11.5.7	Necessary coolant additives shall be used for preventing corrosion in pump cooling paths / channels.		
11.6	<b>IPC and Printer:</b> Real time data monitoring and printing of chamber temperature (for specimen T/C and chamber sensors) shall be done through IPC& printer. The IPC shall be isolated from all other networks. The data shall be acquired through dedicated DAQ and processed in ASCII format. Processed data shall be available in .txt format and portable to .xls and .pdf. Data shall be acquired at the rate of 30 samples/s (settable).		
11.6.1	The basic configuration of the external PC will be as follows:		
11.6.2	Processor type: Intel® Core™ i7-880 Processor or advanced,		
11.6.3	RAM: minimum 8 GB,		
11.6.4	Hard disk: 1TB,		
11.6.5	Monitor: LED 32 inch, touch screen,		

11.6.6	OS: Windows based.  The PC shall have provision for data retrieval for processing and report generation (which is editable) based on test data.		
11.6.7	Colour A4 size Laser-jet printer for printing/plotting of data.		
	1. PC & Colour Laser-jet Printer supply in Contractor's scope. DAQ software shall be installed in the PC provided. Lifelong license for software shall be provided. Two years post installation software support shall be provided.		
	2. All other instrumentation required for the data acquisition for the operation of the chamber shall be provided by the supplier.		
12.0	<b>General conditions</b>		
12.1	<b>Welding:</b> All welding shall be TIG and multi pass welding. All welds shall be done by qualified welders and all the root pass welds done on the chamber shall be radio graphed and sample radiography after a final weld.		
12.2	<b>Leak Rate:</b> The overall leak rate of the shrouds, nitrogen supply lines, LN2 supply lines, and flanges inside the chamber etc. shall be better than $1 \times 10^{-7}$ mbar l/s and individual leak rate shall be better than $1 \times 10^{-9}$ mbar l/s as demonstrated by standard calibrated Helium Mass spectrometer leak detector.		
12.3	<b>Thermo-optical requirements of the shroud:</b> Surface emissivity on the shroud external side be lower than 0.15 at any temperature. The		

	internal surface of the shroud shall be covered with special space qualified black thermal paint to improve emissivity to 0.9 at any temperature.		
12.4	<b>Materials:</b> All parts exposed to vacuum wherever welding is there shall be fabricated with non-magnetic SS AISI 304L. Other parts blank flanges etc can be with SS 304.		
12.5	<b>‘O’ Rings:</b> All the ‘O’ rings used shall be of Viton.		
12.6	<b>Outer chamber:</b> Being a hot & humid place and corrosive environment due to nearness to the sea shore, all outside surfaces (all items) shall be painted with two coats of Zincrich primer followed by two coats of Polyurethane paint. Colours of paint on piping shall conform to International Codes.		
12.7	<b>Electromagnetic compatibility (EMC) :</b> All the electrical and electronic equipment installed on the chamber and auxiliary Subassemblies shall confirm to the international EMI/EMC standards.		
12.8	<b>Noise:</b> The noise levels shall be lower than 70 dBA while operating the facility.		
12.9	<b>Thermal Insulation:</b> If there are fluid lines without vacuum insulation it shall be provided with clean room compatible insulated lines.		
13.0	<b>Sources:</b> The names of some internationally known suppliers for various equipments have been provided in specification document SI No.13.1 to 13.39 , page No. 31 to 35 Vendor have to clearly specify the make.		



COMMERCIALTERMS AND CONDITION			
1.0	<b>Scope of supply:</b> The scope of the supply is Design, fabricate, demonstrate main parameters/specifications at vendor's site, transportation to site, handle at site, integrate, test & demonstrate all sub system & total performance, test, install and commission a horizontally mounted Thermo vacuum chamber at ASOE, Vikram Sarabhai Space centre, ISRO Thiruvananthapuram.		
2.0	<b>Bidding process:</b> The quote shall be presented in TWO parts namely, Techno - Commercial bid and Price bid. Each bid shall be separately sealed and clearly identified.		
3.0	<b>Techno-commercial Bid:</b>		
3.1	The techno-commercial bid shall address each and every specification and shall specify values like chamber size, wall thickness, pump sizing, pump down time calculation, assumptions made, details of the thermal system especially with regard to its capacity, temperature uniformity accuracy, control, and major equipment specification etc. Also sources / makes of individual equipment / parts proposed shall be mentioned in the quote for evaluation of the quality aspects of the components used in the realization of the system as a whole.		
3.2	Please note that the evaluation by the committee will be based on the inputs provided in the bid. Mere statement stating compliance to certain specification is not sufficient unless it is backed up by clear information, catalogs, and proof of achieving the parameters in earlier supplied items to various national as well as international customers.		

	Bid is likely to be rejected if all necessary information is not provided.		
3.3	Bid shall contain the following:		
3.3.1	The design methodology and specific details of calculations.		
3.3.2	Schematic of the proposed vacuum pumping system, thermal system, LN2 storage tanks & supply lines. Details shall be given including rating , make of each components / valves / sub systems.		
3.3.3	Materials used and the standards followed in design.		
3.3.4	Vendor shall have previous experience in realizing and supplying similar automatic thermo vacuum chambers along with its thermal system to ISRO/DRDO or other reputed firms.		
3.3.5	Details of previous experience like, chamber size, type of thermal circulation system used, date of supply, Name, Address, e-mail & phone No. of customer, present working status, specification achieved in the supplied system, especially wrt temperature uniformity, control accuracy and temperature range of thermal system.		
3.3.6	List of essential spares which are provided along with the chamber.		
3.3.7	Vendor shall provide details of schedule, milestones & Gantt chart depicting all important stages and time required for each.		
4.0	Price bid: <b>The price bid shall include</b>		
4.1	The cost breakup of all major sub systems viz, Chamber, pumping system, thermal conditioning system, thermal shroud & thermal plate, LN2 Dewar ( <b>cost breakup for</b>		

	each LN2 Dewar separately. Number of LN2 Dewar will be finalized after technical evaluation committee.)&SIV lines, transportation etc.		
4.2	The cost breakup of the essential spare parts proposed for the trouble-free operation of the chamber for a period of 10 years (minimum). The quantity and price shall also be provided.		
4.3	List & Cost of the items sourced within India.		
4.4	Price for the complete system		
4.5	Annual Maintenance Contract (AMC) charges for a period of 7 years after warranty period. This amount will also be taken into consideration for determining the lowest quote.		
5.0	For imported parts / systems procured, duty exemption certificates will be provided by ISRO.		
6.0	The chamber shall be installed and commissioned by the supplier within 12months from the date of placement of the purchase order.		
7.0	<p>The offer shall be for the complete</p> <p>The offer shall be for the complete Design, fabrication, demonstration of main parameters / specifications at vendor's site, transportation to site, handling at site, integrating, testing &amp; demonstrating all sub system &amp; total performance, installation, final acceptance testing, and commissioning of the Thermo vacuum chamber. Mutually agreed third party certification from BVQI / LLOYDS is required at design and at all stages of fabrication from raw material identification till testing at pre delivery inspection stage. All equipment and consumables required (except for</p>		

	the exclusions stated in the scope of VSSC) will be in the scope of the supplier.		
8.0	Vendor shall provide a layout diagram of the proposed system showing major equipment with the minimum floor area / space required for installation along with the offer.		
11.0	Vendor shall submit the documentary evidence from the concerned customers' for the satisfactory performance of the 1000 mm dia X 800 mm depth or higher capacity Thermovacuum chambers without any major breakdown over the past 5 years.		
15.0	Vendor shall be ready to give a technical presentation to the Technical Committee formed for the purpose of finalizing the procurement at VSSC Thiruvananthapuram. The vendor shall be intimated 15 days in advance for this presentation. This intimation will be sent to the vendor only after the technical evaluation of the proposal and examining its technical suitability.		
16.0	Vendor shall provide the details of the consumables, such as liquid nitrogen, helium gas required to demonstrate the performance of the chamber at VSSC, Thiruvananthapuram at the time of installation and commissioning.		
17.0	Vendor shall specify quality standard followed at manufacturing works where system/subsystem are manufactured (conformance to any standard like ISO, CE, UL, TUE etc.)		
18.0	Vendor shall have Service Centre in India for pre/post guarantee/warranty service back up. Vendor shall submit detailed list of Service Centre/s.		



19.0	Vendor shall give full details of his proposed Acceptance Test Plan & schedule of activities:  1.0 At vendor's site and  2.0 At VSSC site, Thiruvananthapuram		
20.0	Vendor shall confirm compliance to all the specifications witnessed by mutually agreed Third Party Inspection Agency (TPIA) and the inspection / tests reports thus generated and vouched by TPIA shall be provided to VSSC well in advance for scrutiny before proceeding for witnessing tests at vendor's site.		
21.0	Pre-dispatch inspection shall be carried out by VSSC Engineers at vendor's site. As part of pre-dispatch acceptance, Vendor shall carry out and demonstrate salient specifications as per Factory Acceptance Test Plan in presence of VSSC Engineers at their works/site.		
22.0	Vendor shall be completely responsible for		
22.1	Safe transportation of total system; warehouse to warehouse insurance to be provided by vendor .		
22.2	Supervise unloading and handling of the system at VSSC site, Thiruvananthapuram.		
22.3	Installation and commissioning of total system at VSSC site at Thiruvananthapuram adhering to all safety regulations.		
22.4	Demonstration of total performance specifications of the integrated system including vacuum chambers, thermal system and other associated system supplied.		
23	Vendor shall impart detailed training for operation, trouble shooting and maintenance of the system to Engineers & Technicians at VSSC, Thiruvananthapuram at no extra cost.		

24	All the equipment offered by the vendor shall have free guarantee support of at least one year from the date of installation and acceptance of total system at VSSC, Thiruvananthapuram.		
25	Vendor shall attach technical catalogs, literature and detailed data sheets of all items offered by the vendor in support of their technical offer.		
26	Installation, operation and maintenance manuals of all systems shall be supplied with the system. CAD drawings and circuit diagrams relevant to maintenance shall also be included.		
28	<b>Delivery Period:</b> Vendor shall deliver and commission the Thermovacuum system at VSSC meeting the abovementioned specifications and interface requirements within a period of <b>twelve months</b> from the date of release of purchase order / MOU.		
32	Prior approval of fabrication drawing: The vendor shall have to submit the fabrication drawing for the vacuum chamber and thermal system and shall get prior approval from VSSC before starting the fabrication works.		
33	<b>Warranty:</b> The supplier shall provide a performance warranty of minimum 3 years, from the date of installation, commissioning and acceptance at VSSC, for the entire system against any failure or any failure in meeting the overall performance specifications of the system.		
34	All maintenance related issues shall be addressed within 3 days from the date of intimation from VSSC.		
35	There shall be provision for carrying out maintenance remotely through VPN.		
36	FMECA & HAZOP study for the entire system shall be done and reports submitted to VSSC.		

37	Necessary QA / QC plan shall be prepared by the vendor and the same shall be approved before start of fabrication.		
38	Installation & handling scheme shall be evolved considering the space available at VSSC site.		
40.0	<b>Inspection and Factory Acceptance Test Plan:</b> A detailed quality control plan shall be drawn up by the vendor at the design stage itself and shall consists of:		
40.1	Demonstration of Chamber leak tightness		
40.2	Six thermal cycles as per the system qualification test profile at extreme temperature levels shall be performed on a dummy test article of rated mass and heat dissipation and the results shall comply with the performance specifications provided.		
40.3	Demonstration of leak tightness on the already proof pressure tested (witnessed by TPIA) thermal shroud & thermal plate after ensuring that it is subjected to a minimum of three cycles of thermal cycling.		
41.0	<b>Inspection and VSSC Site Acceptance Test Plan shall contain:</b>		
41.1	Demonstration of Chamber leak tightness		
41.2	Demonstration of thermal shroud & thermal plate leak tightness after ensuring that it is subjected to a minimum of three cycles of thermal cycling.		
41.3	Demonstration of all specifications & performance shall be done during site acceptance test for a typical full duration test profile as given in figure 2 in specification document.		
41.4	Functioning of all interlocks shall be demonstrated.		
41.5	Usage of both LN2 tanks / switching between tanks etc shall be demonstrated.		
41.6	Safe shut down & revival in the event of electrical power failure shall be demonstrated.		

41.7	All Safety alarms & its acknowledgment shall be demonstrated.		
41.8	Software re-installation shall be demonstrated (if is transported to VSSC in Pre-installed condition). Necessary passwords shall be given to VSSC during commissioning of the facility.		
42.0	<b>Liquidated Damages (LD):</b> LD shall be levied beyond the date of delivery mentioned in this order @ 0.5% per week or part thereof on the undelivered portion subject to a maximum of 10% of the contract value.		
43.0	<b>Security Deposit:</b> Upon receipt of this order, you shall submit a Bank Guarantee towards Security Deposit within 2 weeks along with your order acknowledgement, equivalent to 10% of the order value in Rs.200/- NJ Stamp Paper (as per format attached). This shall be valid up to a period of 60 days from the date of supply and shall be returned upon completion of all contractual obligations.		