

RFQ/EFCD/ACS/2023

***Request for quote (RFQ)  
for  
Realization & Supply of  
of Ablative lined nozzles for control  
Thrusters***

## 1. INTRODUCTION

Ablative lined nozzles for control Thrusters are used in one of the ISRO's launch vehicles as part of roll control system (RCS). Ablative lined nozzles for control Thrusters consists of two sub-assemblies, namely, Chamber Assembly (CA) and Divergent Assembly (DA). Ablative liners that are used in CA & DA are described below;

Ply orientation & Ablative material:

Sl No.	Name of Sub-assembly	Name of Ablative liner	Ply orientation	Material
1.	Chamber assembly (CA)	Throat backup liner (TBU)	90°	Silica phenolic
		Throat insert (TI)	90°	Silica phenolic
		Top liner (TL)	90°	Silica phenolic
		Bottom liner (BL)	90°	Silica phenolic
2.	Divergent assembly (DA)	Divergent liner (DL)	90°	Silica phenolic

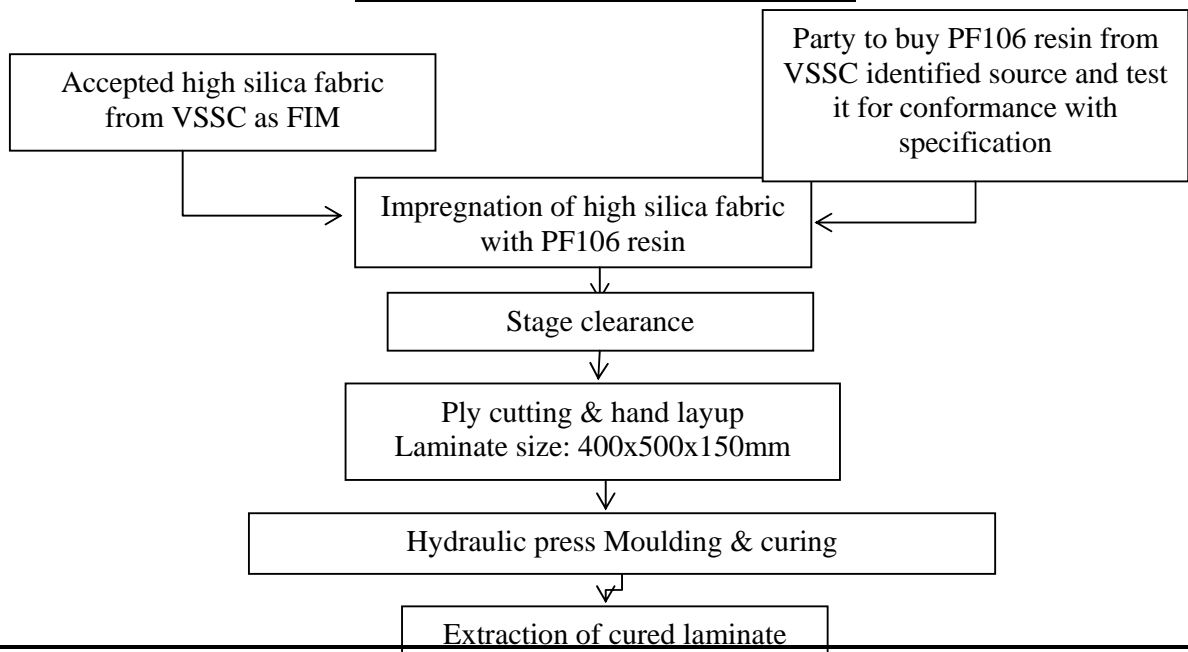
- ❖ Chamber laminate of size 400mm x 500mm x 150mm (L x w x T) (3no) (230±15 plies) shall be realized through 90° layup & press moulding. TBU, TI, TL & BL shall be obtained from this laminate by machining.
- ❖ Divergent laminate of size 450mm x 450mm x 150mm (L x w x T) (230±15 plies) shall be realized through 90° layup & press moulding. DL shall be obtained from this laminate by machining.

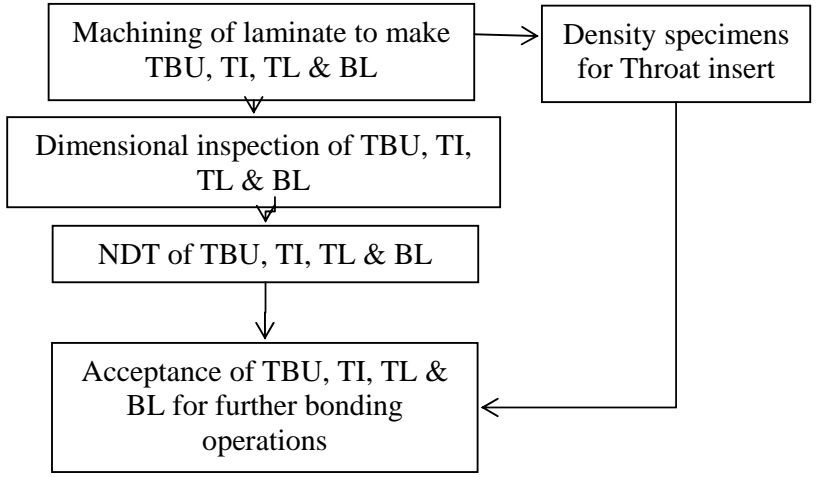
## 2. Process sequence:

### 2.1. Processing of Chamber Assembly:

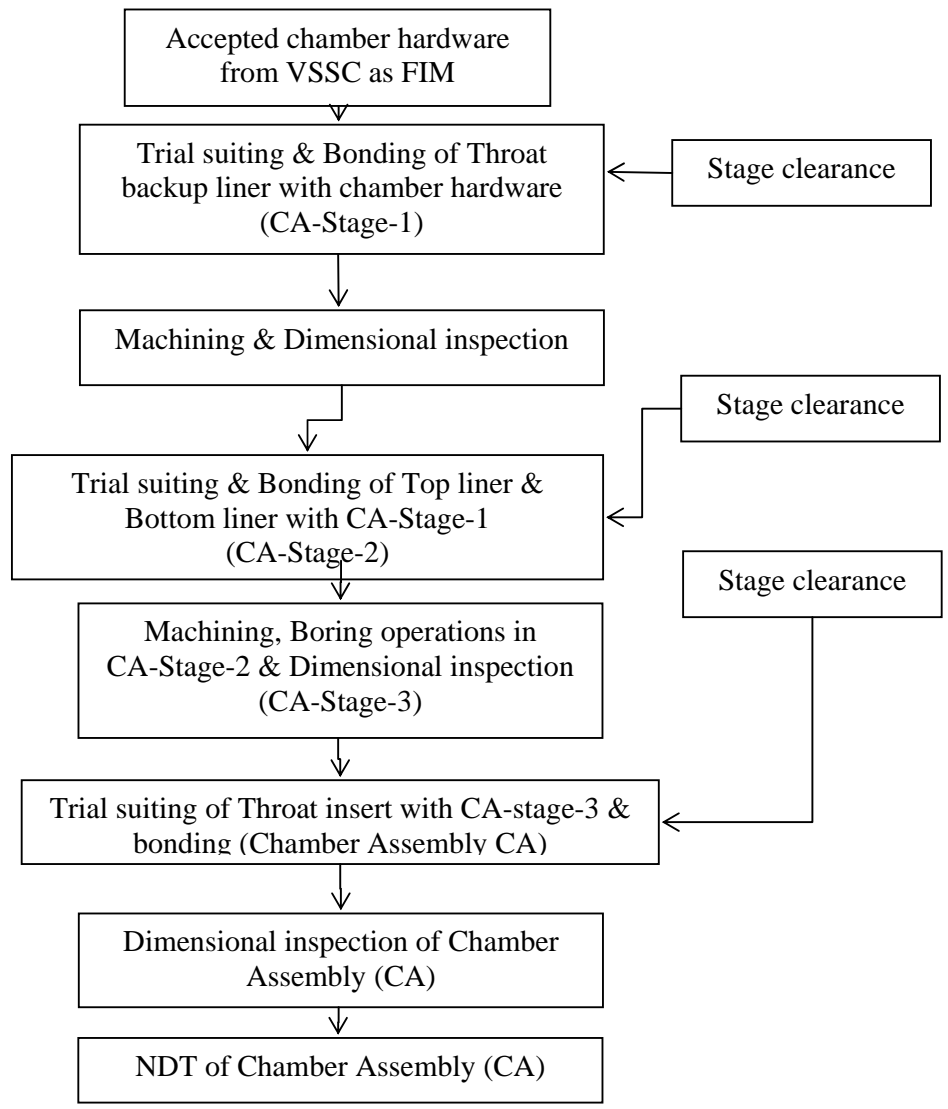
- ❖ High silica fabric is issued as FIM from VSSC. Party shall buy phenolic resin (PF106) from VSSC identified source. Process flow chart for TBU, TI, TL & BL shall be as follows;

#### Process flow chart for TBU, TI, TL & BL



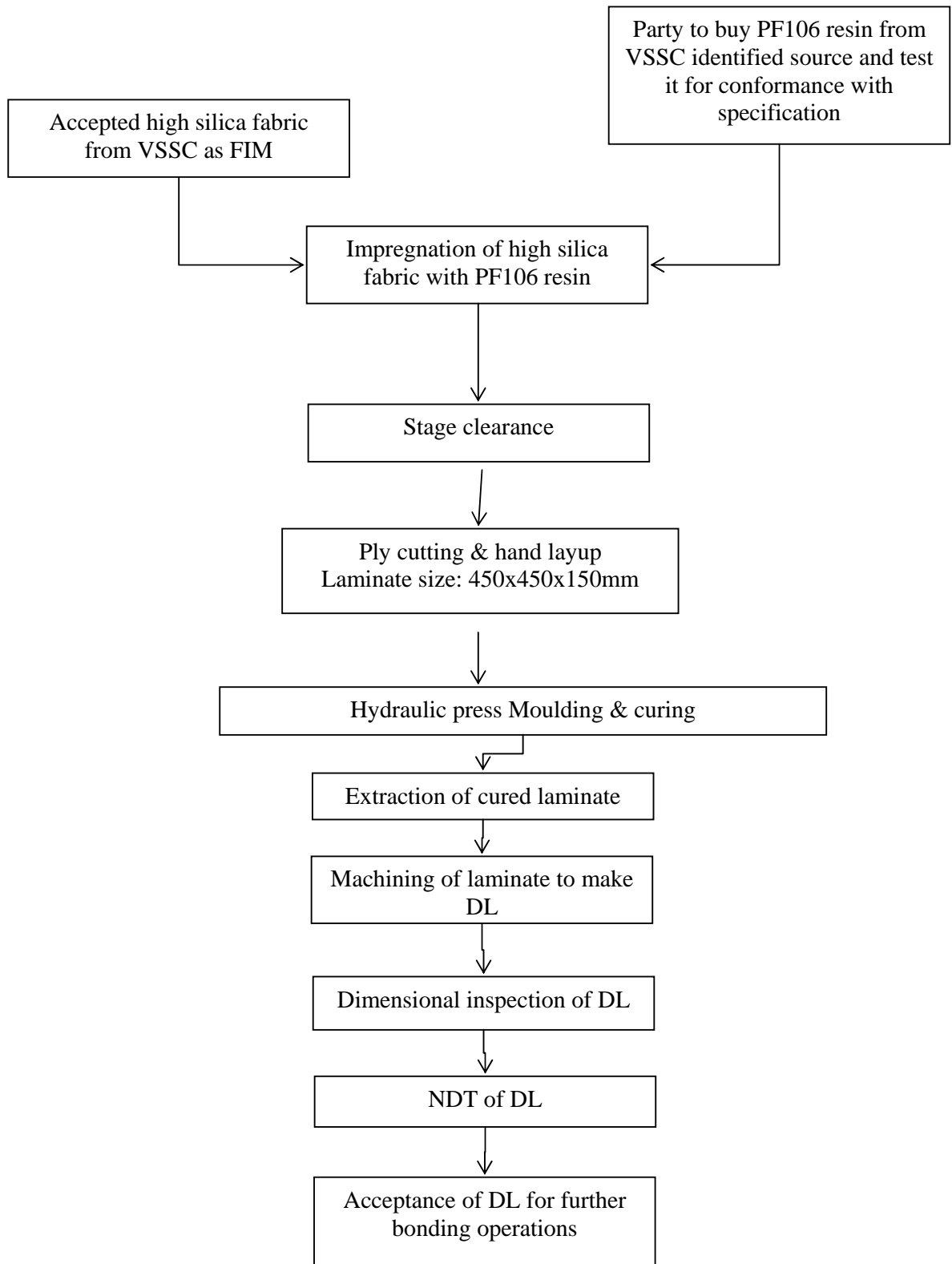


**2.2. Bonding & machining operations for Chamber Assembly**

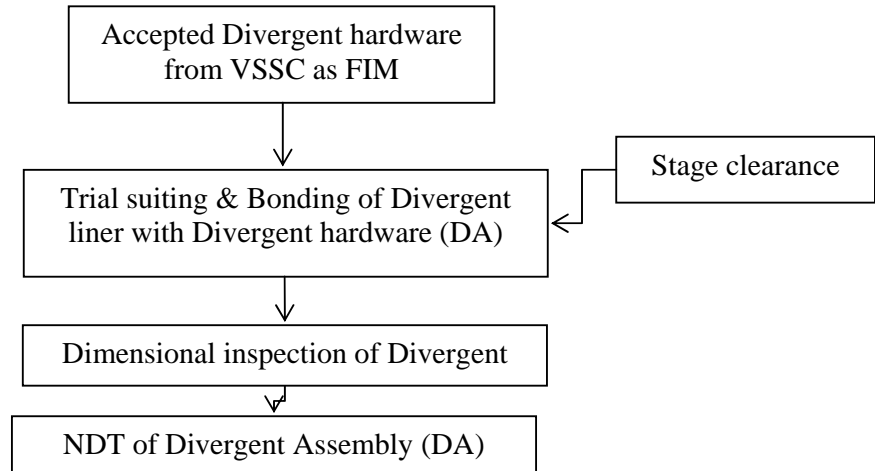


**2.3. Processing of Divergent Assembly:**

- ❖ High silica fabric is issued as FIM from VSSC. Party shall buy phenolic resin (PF106) from VSSC identified source. Process flow chart for DL shall be as follows;



#### 2.4 Bonding & Machining operations for Divergent Assembly



**The RFQ document has to be read and understood thoroughly from beginning to end. In case of any doubts, clarification can be sought. The document as such is a comprehensive package and hence all clauses/conditions/specifications etc specified in the documents needs to be strictly complied.**

### **3.0 ELIGIBILITY FOR PARTICIPATING IN THE BID:**

Considering the complexity of the process and product, Vendors with the following are only eligible to participate in the bid.

1. Submission of a non-disclosure agreement along with the quote.
2. All facilities and equipments listed in section 7.1 shall be available with the vendor and fully operational as on date of issue of this tender.
3. Submission of written concurrence from proposed sub-contractors along with full details of sub-contractors including their name, address, details of the equipments for RT, impregnation plant, chemical test facility & DI should be submitted with quote if subcontracting is planned by vendor.
4. Vendor shall have prior experience in fabrication of ablative nozzles for aerospace/defense applications. Necessary supportive documents (P O copies) for prior experience shall be attached with tender
5. Vendor shall be a single registered business entity with in India.
6. The Annual Turnover of the vendor shall be minimum Rs 50 lakhs for last three consecutive financial years. The net worth shall be minimum Rs 50 lakhs for last three consecutive financial years.
7. Vendor shall have an ISO/AS/NADCAP certified quality system for product manufacturing.
8. Exclusive concurrence to do the following activities to be provided in the offer.
  - o Collection of FIM from VSSC, Trivandrum, Kerala & Transportation of FIM to Vendor's site

- Transportation of finished Ablative lined nozzles for control Thrusters to VSSC, Trivandrum, Kerala
- Transportation charges should be borne by the party.
- VSSC will strive to limit the number of trips to 16 (VSSC to workcentre) for FIM collection & 16 (workcentre to CMSE, VSSC, Vattiyoorkavu) for sub-assembly delivery
- Trips beyond the mentioned figures will be managed by VSSC.

#### **4. VENDOR SELECTION CRITERIA**

1. Vendors who meet the eligibility criteria mentioned only will be considered for further evaluation. Hence the Vendor has to submit proof for each of the items given in the eligibility criteria along with the manpower details and facility details.
2. Even if an applicant meets the eligibility criteria, they shall be subject to disqualification if they are found to have
  - (i) made misleading or false representations in the forms, statements, affidavits and attachments submitted in proof of the qualification requirements.
  - (ii) records of poor performance such as abandoning the work, rescission of the contract for reasons which are attributable to non-performance of the contractor, inordinate delays in completion, consistent history of litigation resulting in awards against the contractor, or financial failure due to bankruptcy.
3. Vendors who permit VSSC technical evaluation team to audit vendor facilities during the vendor evaluation phase only will be considered.
4. The lowest bidder will be arrived based on the combined lowest of all items together.

Department reserves the rights to split the purchase order quantity, if L2 agree to come to L1 price then L2 shall be provided 40% of purchase order quantity and L1 shall be provided 60 % of order quantity.

#### **5. GENERAL INSTRUCTIONS FOR SUBMISSION OF BIDS**

- a) Bids have to be submitted in two parts namely,
  - i. Technical and Commercial (part-I) and
  - ii. Price bid (Part-II)
- b) Bidders shall submit proposals in response to this tender in English, unless otherwise permitted by the tender, and cost in Indian Rupees.
- c) Bidders may submit revised proposals only if requested or allowed by the Department.

- d) If the Bidders include data in their proposals, that they do not want disclosed to others for any purpose, or used by the Department except for evaluation purposes, shall mark the title page with such a legend.
- e) The Bidder shall be responsible for all regulatory record keeping requirements associated with the use of licenses and license exemptions/exceptions.
- f) The Department may reject any or all proposals if such action is in the Department's interest.
- g) The Bidder's initial proposal should contain the Bidder's best terms from a technical, commercial or price standpoint. The Department reserves the right to conduct discussions if the department later determines them to be necessary.
- h) The Department will not be giving any financial support for setting up the facilities. The bidder shall set up all the facilities with own resources. Also the industry is solely responsible for installation and commissioning of facilities.

### **TECHNO-COMMERCIAL BID**

The Technical Proposal shall provide the method for accomplishing the work specified in this Request for Quote (RFQ); the resources that will be devoted to the effort; knowledge of the elements comprising the effort; and measures that will be taken to ensure effective, efficient, timely, and quality performance.

The proposal should be organized according to the following general outline. This general outline is provided for organizational purposes only.

- a) Understanding Technical Requirements
  - Technical Approach to Statement of Work
  - Technical Approach to Similar Tasks in the past
- b) Management Plan and Approach
- c) Quality control and Management

### **Understanding Technical Requirements**

The Bidder shall demonstrate a thorough understanding of the requirements of the RFQ, providing detailed technical approach for each element in the Statement of Work.

This technical response shall consist of the following:

- a) Technical Approach to Statement of Work

The Bidder shall provide the following information for each element in order to demonstrate their understanding of the work and ability to cover and perform all aspects of the Technology Area outlined in the Statement of Work:

1. The subtasks/operations for each components of the product shall be detailed in chronological order from raw material to finished component.
2. Technical approaches for accomplishing the requirements presented, including basis for approaches used.

### **Quality control and Management**

- a. Quality management structure
- b. Planned approach for quality control and management.

Following details should be furnished in the commercial bid.

- a. Details about the company like nature of ownership, products, sales turnover, number of employees in different categories, details of top management, list of key personnel and their expertise, etc.
- b. Core competence of the industry and strengths in composite field.
- c. Copy of last three years IT clearance certificate and balance sheet.
- d. GST Registration Number, Delivery terms like Ex-works, Door Delivery, FOR-Destination etc.
- e. Bidder can quote on fixed price basis or the basic price along with price escalation clause. Price will be firm and fixed till 18 months from DATE OF PO.
- f. Applicability and rate of GST, Packing and Forwarding Charges.
- g. Delivery schedule.
- h. Security deposit of 3 % of the contract value shall be submitted by the bidder on signing of the contract which shall be valid till completion of contract.
- i. Since the item is accepted after all the necessary tests and a pre-delivery review, warranty is not applicable for this product.
- j. Payment terms
  - i. Our normal payment terms of "100% within 30 days of receipt and acceptance of the item at our site".
  - ii. Advance payment will be governed by government regulation and department rules.
  - iii. L D will be applicable for any delays in the program. Current rate of LD is 0.5 % per week delay and the maximum LD applicable is 10 %. The pattern in which LD deduction is done for the first nozzle is shown in the following table. LD is applicable for all the nozzles if there is a delay in the delivery with respect to the delivery schedule given in section10.0.

**{PRICE BID**

The bids should provide the following prices (unit cost and total cost) separately:

- Processing price per unit
  - including raw materials (other than FIM), consumables, machining, dimensional inspection, NDT, product acceptance tests if any including quality control and associated specimen processing and acceptance testing of raw materials.
- Price of toolings such as moulds, templates, machining fixtures, bonding fixtures and any other process tools as applicable.
- Price escalation clauses if any
- current tax rates shall be clearly mentioned along with applicable GST rates.

Format for submission of price bid is given in the table below.

	<b>PRICE</b>
UNIT PRICE OF ACS THRUSTER (INCLUDING ENGINEERING, DOCUMENTATION, RAW MATERIAL TESTING, OVERHEADS, QUALITY CONTROL, PROCESS CONSUMABLES, ETC)	
Toolings - 2 SETS	
FRP Transportation container- 8 nos.	
P & F Charges	
ANY OTHER CHARGES	
GST	
TOTAL PRICE	



## 6. Scope of work:

- a) Design, realization and qualification of all toolings such as moulding tools, machining fixtures, bonding fixtures, etc. These shall be presented to tool design & review committee (TDRC) of VSSC for approval.
- b) Chamber hardware, Divergent hardware, High silica fabric will be issued as FIM from VSSC. The FIM's supplied by VSSC, shall be stored safely in a controlled environment. All other raw materials like phenolic resin (PF106), bonding adhesive AW106 + HV 953U and all the process consumables required for the processing, machining and bonding operations shall be procured by the industry.
- c) Testing of phenolic resin at receipt and before impregnation shall be done as per the raw material acceptance document issued by VSSC.
- d) Impregnation of high silica fabric with phenolic resin in an impregnation plant with zonal temperature control, speed control, resin pickup control, etc. Silica phenolic prepreg shall be stored in cold storage maintained at +4 deg C.
- e) Ply cutting, hand layup, moulding & curing in hydraulic press, machining, dimensional inspection & NDT
- f) Safe storage and periodical inspection of the metallic hardwares for any surface observations, corrosion, etc.
- g) The mandatory process checks and stage clearance points identified by VSSC shall be meticulously followed by the industry. Preparation of fabrication drawings, process plan and quality/dimensional inspection/Non-Destructive Testing (NDT) plan by the industry based on the baseline document supplied by VSSC. Industry representatives have to present all these documents to the standing review board (process review committee -PRC) of VSSC at Trivandrum for approval.
- h) Industry should supply 2 sets of product report consisting of all the intermediate process logs, NDT reports, dimensional inspection reports, assembly reports, travelling logs etc.,
- i) Based on intimation from VSSC, the party shall collect the Free-Issue-Materials (FIMs) from VSSC.
- j) Dispatch of Ablative lined nozzles for control Thrusters Assembly shall be to CMSE/VSSC, Vattiyoorkkavu. The party shall give a prior intimation to VSSC before final dispatch of these Thrusters to make necessary arrangements for receiving them at destination.

### List of free Issue Materials

The following table gives the list of FIM's which will be supplied by VSSC for processing of nozzle at the industry.

SL.No.	Component	Quantity allowed per thruster
1	High Silica Fabric	30 sq.m
2	Chamber Hardware	1 no
3	Divergent hardware with sleeve	1 no

Total cost of FIM per nozzle is Rs.130000

The free issue material will be issue by Department against submission of Bank guarantee worth the FIM required by the party.

## **7.0 Details of Facilities and Materials Required**

### **7.1 List of essential Facilities;**

1. Cold storage (+4°C) of adequate size.
2. Hydraulic press of 125T(MIN) capacity with hot platens of size 750 x 750 minimum
3. Conventional lathe & Dia.0.5m CNC Lathe
4. Vacuum dust collection equipment
5. Dimensional inspection instruments (Vernier calipers, Micrometers, Weighing balances, feeler gauges etc.)
6. NDT (VT, UT) facility

Note-

- a) Periodic calibration of above equipments/facilities should be ensured and data should be supplied to the department. If there is any error observed in calibration, either it has to be corrected and recalibrated or such instruments have to be replaced.
- b) All facilities must be in-house. Impregnation Plant (SCADA control and recording of all process parameters), Phenolic and epoxy resin chemical test facility including density of cured ablative specimen, RT- 250KV facility & DI facility-CMM can be outsourced with approval of VSSC.

### **7.2 List of Raw Materials to be procured by the Industry**

<b>S.No</b>	<b>Name of raw material</b>	<b>Quantity/ per nozzle (Approx.)</b>	<b>Source</b>
1	Phenolic resin PF-106	5 Kg	IVP, Mumbai
2	Araldite : AW106 Resin + Hardener HV953U	1 kgs	Huntsman
3	Epoxy resin LY556 + Hardener HY 951	0.25 kg	Huntsman
4	Epoxy resin LY556 + Hardener FH972	0.25 kgs	Huntsman, Fine Chemicals

Sr. No. 1&2 – To be tested at party's site.

### **8.1 General Quality Requirements**

- a. All the raw materials procured by the bidder shall be tested prior to use and only accepted raw materials shall be used. Shelf life items shall be stored under controlled environment as per the supplier's recommendations. Batch no. and shelf life shall be marked on every batch with the date of manufacture/date of receipt.
- b. Process plans encompassing the tooling qualification, process, process flow, control parameters, stage clearance points, etc. shall be prepared by the industry and provided to VSSC for review and approval before implementation.
- c. Trail suiting shall be carried out prior to bonding & assembly & shall be referred to VSSC prior to bonding & assembly.

- d. Traceability of density specimens shall be maintained by workcentre & shall be maintained for 5 years from supply of nozzles(in which that particular throat insert is used)
- e. Hardwares shall be inspected upon arrival to workcentre & record shall be maintained by workcentre.
- f. Workcentre shall supply sample of phenolic resin for verification at VSSC.
- g. All the deviations/non-conformance from the specifications observed during the manufacturing and test phases shall be recorded and processed as non-conformances.
- h. Any non-conformance minor/major with reference to the approved plan shall be referred to VSSC for review with root cause analysis, discussion and clearance by non-conformance boards.
- i. It is mandatory for the industry to get the clearances from the Department on any non-conformances before proceeding with the work.
- j. As and when required, additional specimen shall be supplied by the industry for verification by the Department without any extra cost.
- k. The industry shall generate detailed plans for raw materials testing, dimensional inspection and NDT conducted at their facilities which shall contain method and procedure for conducting each test, measurement plan and accuracy of the equipments. All the test results shall be available as part of the log book.
- l. 100% inspection (dimensional inspection and NDT) shall be done on all components and assembly. Radiographic films to be supplied to VSSC for verification.
- m. A comprehensive log shall be maintained for all the operations (raw material reports, process, inspection, dimensional inspection, NDT, acceptance testing, etc) from component level to assembly level including the stage clearance points. Non-conformances and dispositions shall also form a part of the log book.
- n. All the metallic components/hardwares used will be free issue materials from VSSC which shall be accepted based on quality assessment reports provided by VSSC/Department.
- o. All the documents/procedures generated by the industry shall be provided to VSSC for review and acceptance prior to implementation.
- p. Additional reworks/repairs proposed as part of salvaging/non-conformance measurement/NDT/DI has to be carried out by the party.

## **8.2 Manufacturing Quality Control**

The industry shall generate detailed process and tooling plan and provide the same to VSSC for review and acceptance before implementation. The process plans shall include the details of raw materials and their storage and test scheme, intermediate processing steps etc., Logging of all process parameters shall be done during processing which will form part of the product log.

### **8.2.1 Major in-process QC parameters include:**

- Calibration and acceptance of all equipments and facilities
- Verification of acceptance of raw materials.

- Verification of acceptance of metallic hardware.
- Verification of various parameters during impregnation, press moulding etc.,
- Assessment of interface requirements during trial suiting of liner with metallic hardware
- Control of pot life for resin

**8.2.2 Stage Clearance:**

In the manufacturing cycle of a component, there are stages where mandatory clearance shall be obtained from VSSC for proceeding with the work and are identified as stage clearance points. Normal stage clearance points are the followings

- Prior to moulding /layup
- Before any bonding operation

**8.3 Density specimen & Lap shear specimen:**

Density specimen for throat insert shall be prepared (5nos minimum). Similarly lap shear specimen need to be tested for bonded joints. Density specimens shall be of 15mmx15mmx15mm. Laps shear specimens to be tested by ASTM standard in UTM.

**8.4 Product acceptance Tests**

Dimensional inspection, NDT and density evaluation are the normal product level acceptance tests.

**8.5 Dimensional inspection**

100% dimensional inspection has to be carried out on all components, sub-assemblies as per the approved drawings. The industry shall generate dimensional inspection plan, to be reviewed and accepted by VSSC before implementation.

**8.6 Non-Destructive testing**

100% NDT shall be carried out using techniques such as visual inspection including alcohol wipe test, radiography for the detection of defects such as delaminations, cracks, wrinkles, debonds, etc. Following table gives the NDT requirements at various stages of realization of the ACS.

LINER/SUB-ASSEMBLY	Visual	Radiography
Throat backup liner	✓	✓
Throat insert	✓	✓
Top liner	✓	✓
Bottom liner	✓	✓
Divergent Liner	✓	✓
Chamber Assembly	✓	✓
Divergent Assembly	✓	✓

- ✓ to be done  
The industry shall follow the VSSC NDT plan

**8.7 Nonconformance management**

Any non-conformance with reference to the approved plan shall be referred to VSSC. The deviations either minor or major shall be referred to VSSC for review, discussion and clearance by nonconformance boards of VSSC. It is mandatory for the industry to get clearances on any non-conformance before further proceeding with the work.

**8.8 Acceptance plan for components**

- Acceptance / rejection of components at various stages shall be decided by VSSC based on dimensional inspection, NDT, & tests on specimen.

- The criteria for acceptance is that the component shall meet
  - ❖ Adherence to the VSSC approved process.
  - ❖ Dimensional requirements as per drawing
  - ❖ Specified requirements in specimen tests
  - ❖ Quality of the liner as interpreted with NDT.
- In the event of a component not meeting the above requirements it shall be referred to VSSC for review and a decision will be taken for acceptance/rework/rejection depending on the criticality of the non-conformance.

### **8.9 Change control Plan**

Any change from the VSSC/department approved plans and drawings shall be made only with the knowledge of the department. For this purpose, a request for change proposal shall be given to the department which will be reviewed and the decision communicated.

### **8.10 Rework plan**

Normally no rework is allowed for ablative liners. However, based on the nature of the non-conformance, the possibility of rework shall be communicated to the industry after thorough analysis/review of the deviation at VSSC on a case to case basis. The cost of rework, if any, to be borne by the industry.

### **8.11 Rejection Criteria**

If the approved process is followed properly, and skilled manpower is used under proper supervision, chances of rejection are rare. However considering the complexity of phenolic based composite curing, there are lots of technical risks in the processing which can manifest due to various reasons, some are controllable by utmost care and some are beyond control. The bidder has to assess these technical complexities and risks and properly present their quotes.

### **8.12. Manpower requirements:**

Qualifications:

1. Process Engineer – BE/B.Tech (Mech)/ DME - 1 person
2. QC Engineer QC leader – BE/B.Tech (Mech)/ DME - 1 person
3. Bonding operations: BE/B.Tech (Mech)/ DME - 1 person
4. Maching Engr.- BE/B.Tech (Mech)/ DME- 1 person
5. ITI fitter - 5 persons (3 persons for layup & moulding and 2 persons for bonding)
6. ITI Turner/Machinist - 3 persons

### **8.13 Delivery Schedule:**

T0= Date of PO

T0+1 month  $\implies$  facility readiness along with toolings.

T1= Date of communication for production commencement by VSSC

T1+3months  $\implies$  Dispatch of component

Note:- Delay attributed to VSSC side for in between stage clearances shall not be accounted for LD Calculation.