



भारत सरकार/Government of India
अंतरिक्ष विभाग/Department of Space
समानव अंतरिक्ष उड़ान केंद्र/HUMAN SPACE FLIGHT CENTRE
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Ref No: HSFC/EoI/01/Nov/2023/ संदर्भ संख्या: एच.एस.एफ.सी./ईओआई/01/नवंबर/2023

दिनांक: 21 नवंबर /November 21, 2023

“आर्द्रता बफरिंग के लिए बहुउद्देश्यीय केबिन लाइनर के स्वदेशी रूप से निर्माण करने के लिए अभिरुचि की अभिव्यक्ति” हेतु निमंत्रण

INVITATION FOR “EXPRESSION OF INTEREST FOR INDIGENOUS DEVELOPMENT OF MULTI-PURPOSE CABIN LINER FOR HUMIDITY BUFFERING”

1.1.1

1.1.2 “समानव अंतरिक्ष उड़ान केंद्र [एच.एस.एफ.सी. इसरो], भारत सरकार अंतरिक्षयात्रियों के एक दल के साथ पृथ्वी की निचली कक्षा में समानव अंतरिक्ष उड़ान शुरू करने हेतु गगनयान कार्यक्रम के लिए आवश्यक प्रौद्योगिकियों और बुनियादी ढांचे के तत्वों का डिजाइन और विकास करने हेतु केवल भारतीय घरेलू विक्रेताओं से अभिरुचि की अभिव्यक्ति आमंत्रित करता है।” संक्षिप्त विवरण इसरो की वेबसाइट www.isro.gov.in पर ‘निविदाएं’ के अंतर्गत उपलब्ध है।

1.1.3 “Human Spaceflight Centre [HSFC, ISRO], Government of India invites Expression of Interest only from Indian domestic vendors for Gaganyaan Program to Design and Develop necessary Technologies and Infrastructure Elements to undertake Human Spaceflight to Low Earth Orbit with a Crew of Astronauts.” Brief Specification is available in the ISRO website www.isro.gov.in under ‘Tenders’.

1.1.4

ऐसे इच्छुक विक्रेताओं जो पर्याप्त जानकारी, अनुभव, आवश्यक सुविधाएं और वित्तीय पृष्ठभूमि रखते हैं, को अपने हस्ताक्षरित और मुहरबंद लिफाफे को एच.एस.एफ.सी. बेंगलुरु में जमा करने के लिए अपनी अभिरुचि अभिव्यक्ति करने के लिए आमंत्रित किया जाता है।

Interested Vendors having sufficient know-how, experience, required facilities and financial background are invited to express their interest to submit their signed and sealed Envelope to HSFC, Bengaluru.

कृपया “अभिरुचि की अभिव्यक्ति” के साथ निम्नलिखित जानकारी भी विस्तार से प्रस्तुत करें: /Along with “Expression of Interest” please furnish the following information also in detail:

1	फोन, फैक्स, ईमेल, वेब आदि के साथ पंजीकृत पता / Registered address with Phone, Fax, Email, Web etc.	8	परियोजना विकास से संबंधित प्रत्येक क्षेत्र में विशेषज्ञता प्राप्त जनशक्ति का विवरण / Details of Specialized Manpower in each area related to the Project Development
2	कंपनी की स्थिति (मालिकाना/साझेदारी/निजी लिमिटेड आदि) मालिक, साझेदारों, निदेशक मंडल आदि के नाम और पते के साथ / Company Status (Proprietary / Partnership / Private Ltd. Etc.) with Name and Address of Proprietor, Partners, Board of Directors etc.	9	वित्तीय क्षमता/ऋण सुविधाएं उपलब्ध / Financial Capacity / Credit facilities available

3	सहयोगी /Associates: केवल घरेलू विक्रेता/Only Domestic Vendors	10	प्रतिष्ठान का माल सेवा कर(जी.एस.टी.), पंजीकरण संख्या, पैन नंबर, आईएसओ प्रमाणन या समकक्ष, यदि कोई हो/Establishment's Goods Service Tax Registration Number, PAN Number, ISO Certification or equivalent if any
4	प्रमुख ग्राहकों की सूची, उनका पूरा पता और उनके संपर्क व्यक्तियों की सूची /List of Major Customers with full address and their Contact Persons	11	व्यापार संघ जिससे आप संबंधित हैं/Trade Association to which you belong to
5	अन्य संविदाओं का विवरण, यदि कोई अभी उपलब्ध हो /Details of other Contracts, if any now in hand	12	बैंकर्स का नाम और पता /Name and Address of the Bankers
6	स्वामित्व/उपलब्ध अवसंरचना सुविधाओं का विवरण/Details of Infrastructure Facilities owned / available	13	व्यवसाय की प्रकृति/Nature of Business
7	नवीनतम वार्षिक रिपोर्ट की प्रति के साथ पिछले तीन वर्षों की पूंजी और टर्नओवर /Capital and Turnover for last Three years with copy of latest Annual Report	14	कोई अन्य जानकारी जिसे आप प्रासंगिक मानते हैं/Any other information you consider relevant

उपरोक्त सभी जानकारी के साथ अभिरुचि की अभिव्यक्ति लिफाफे पर ईओआई नंबर लिखते हुए निम्नलिखित पते पर पहुंचनी चाहिए: **दिनांक 21.11.2023 का एच.एस.एफ.सी./ईओआई/01/नवंबर/2023 । ईओआई जमा करने की नियत तारीख 22 दिसंबर 2023 14.00 बजे IST है।**

The Expression of Interest with all the above information should reach the following address superscribing the envelope as **Eol No: HSFC/Eol/01/Nov/2023 dated 21.11.2023. The Due Date for submission of Eol is December 22, 2023 at 14.00 Hours IST.**

**क्रय एवं भण्डार अधिकारी/ Purchase & Stores Officer,
समानव अंतरिक्ष उड़ान केंद्र, इसरो मुख्यालय परिसर/ Human Space Flight Centre, ISRO HQ Campus
न्यू बीईएल रोड, अंतरिक्ष भवन/ New BEL Road, Anthariksh Bhavan,
बेंगलुरु - 560 094/Bengaluru – 560 094**

ईओआई कवर में "प्रेषक" पता और एच.एस.एफ.सी. संदर्भ संख्या अंकित होनी चाहिए। किसी भी स्पष्टीकरण के लिए आप कृपया हमसे +91-080-2217 2655/71 और ईमेल आईडी kalpana-hsfc@isro.gov.in पर संपर्क कर सकते हैं। नियत तिथि और समय के बाद प्राप्त ईओआई पर मूल्यांकन के लिए विचार नहीं किया जाएगा। एच.एस.एफ.सी. ऐसे सभी या किसी भी "अभिरुचि की अभिव्यक्ति" को स्वीकार करने या बिना कोई कारण बताए अस्वीकार करने का अधिकार रखता है।

The Eol cover should indicate "SENDERS" Address and HSFC Reference Number. For any clarification you may please contact us on +91-080-2217 2655/71 and email ID kalpana-hsfc@isro.gov.in Eol received after due date and time will not be considered for evaluation. HSFC reserves the right to accept or reject all or any such "Expression of Interest"; without assigning any reasons what so ever.

हस्ताक्षर/Sd/-
वरिष्ठ प्रधान, क्रय एवं भंडार/Sr Head, Purchase & Stores



Expression of Interest for prequalification of parties for Indigenous development of Multi-Purpose Cabin Liner for Humidity Buffering

1. Scope of work

As part of Gaganyaan Program which is India's Human spaceflight project, HSFC requires development of Cabin liner which serves as a Humidity Buffer.

The purpose of this EOI is to assess the profile and technical capability of India-registered enterprises including start-ups (DPIIT registered) for development of the required item. The enterprise profile and technical capability will be used to prequalify enterprises which fulfil the selection criterion (given in Section 7) for the following activities:

- End to end design and development of fabric cabin liner material which works as humidity buffer as per requirements give in section 2 to 4.
- Optimisation of weave pattern, fabric material and fabric structure based on developmental tests to get best possible functionality. The functional requirements and target values are given in section 2.
- Supply of developed fabric for development tests and for flights as per HSFC requirement

Upon completion of the pre-qualification evaluation as per section 7, HSFC, ISRO will include the selected parties in a roster of pre-qualified developers who may directly be invited to submit technical and financial bids in response to upcoming *Request for Proposal (RFP)* for development of the same.

2. System functional Requirements

Cabin liner is a fabric used to cover all the components inside crew module(CM) of Gaganyaan and will be positioned as shown in Figure 1. Crew module is a closed compartment where crew resides during the entire phase of mission. Along with covering the exposed components of CM from astronaut, it also serves various other requirements. The primary requirement of the cabin liner is to act like a Humidity Buffer to control the Relative Humidity(RH) inside the cabin within the specified range during ascent and descent phase.

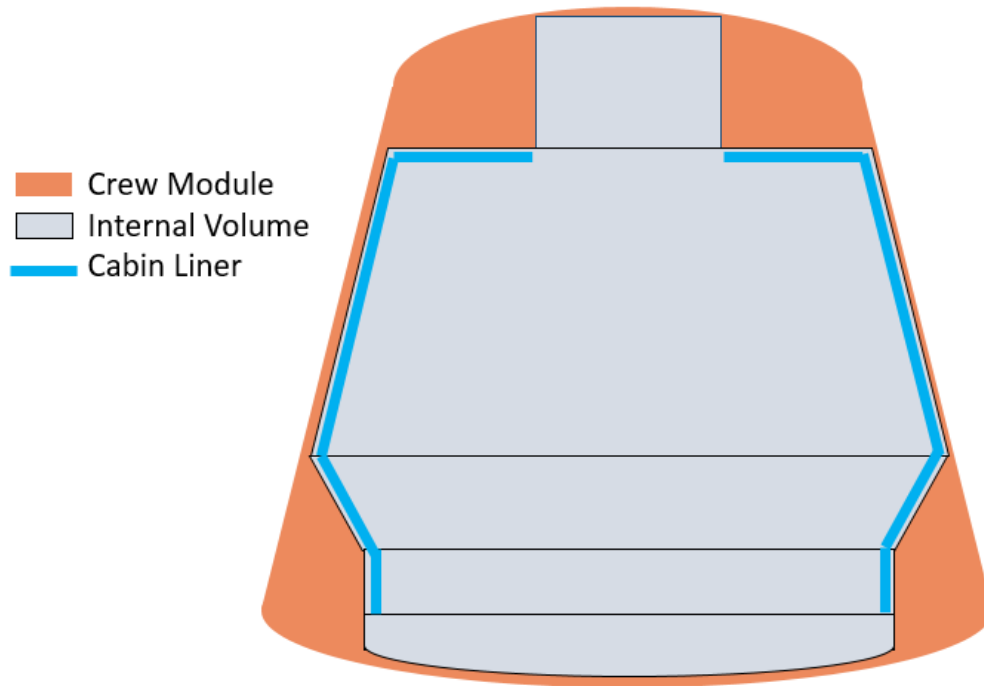


Figure 1 Liner Position

Functional requirements of Cabin Liner are as follows

2.1. Humidity Buffering

Humidity control inside the crew module during ascent and descent phases of flight can be achieved using a hygroscopic liner by a technique called humidity buffering.

Humidity buffering refers to the ability of materials to moderate spikes in relative humidity by absorbing/ desorbing water vapor from/ into surrounding air. Humidity buffering is used as a passive indoor climate control reducing the need for air conditioning and ventilation.

The major factors that define the performance of humidity buffering materials are the

- 1) Moisture storage function (sorption isotherm) – the capacity of material to hold moisture. The required moisture storage capacity of the fabric is tabulated below

S. No	Parameter	Specification
1.	Cabin RH	30%RH-70% RH
2.	Cabin Temperature	18 degC
3.	Surface area of Liner (one side)	~9m ²
4.	Minimum Amount of moisture to be absorbed in ~1hr from 60%RH to 70%RH	120 grams

- 2) Water vapour permeability – the capacity of material to allow diffusion of water vapour. The selected material should have low vapour diffusion resistance factor. (Target value < 13 when tested as per ASTM (D))
- Party may select the best performing material satisfying the requirements mentioned below.

2.2. Other Requirement

Apart from the primary functional requirement of humidity buffering, the liner shall also satisfy the following **essential requirements**.

- I. Oxygen compatibility - The LOI of liner shall be greater than or equal to 40% at 50kPa or greater than or equal to 30% at 101kPa as per ASTM D2863
- II. Off-gassing – The liner shall satisfy off gassing criteria i.e. toxicity less than 0.5 as per as per ISO 14624-3.
- III. Out-gassing – The liner shall satisfy the outgassing criteria i.e. TML: <1% CVCM: <0.1% as per ASTM E 595
- IV. Fire resistance – Fabric shall be ‘A’ rated, when tested as per NASA STD 6001B for upward flame propagation test.
- V. Weight – The density of the fabric shall be within 450GSM
- VI. Bio-compatibility - The fabric shall be bio-compatible when tested for bio-toxicity and anti-microbial activity as per ISO 10993-10-2010.
- VII. ESD compatibility requirement - Surface resistivity should be less than 10^9 ohm per square in conductive or dissipative range at 50% RH for ambient air.

The following are the **preferred requirements**.

- I. Odor – The fabric shall be odorless.
- II. Mechanical properties – The tensile strength at yield shall be greater than 50MPa
- III. Acoustic properties - Noise reduction coefficient shall be at least 0.7 when tested as per ASTM C423 and E795, Mounting A
- IV. Color – Light blue or any color with low reflectivity.
- V. The fabric shall have the ability to be stitched into cylinder/curvature/right angle as per crew module internal shape.
- VI. The fabric shall be compatible with adhesives for Velcro bonding

After achieving the essential requirements, that particular fabric can be modified (Viz., providing an appropriate coating) to satisfy preferred requirements without affecting the final performance.

3. Proposed fabric structure

Based on the literature survey and preliminary analysis, a 3D spacer fabric made up of Nylon-6 is preferred. However, party is free to propose different material meeting the requirements specified in section 2. It is proposed to have the structure and weaving pattern as following.

- I. Liner consists of two layers with definite weave pattern and an intermediate layer of thread interconnecting the top and bottom layers.
- II. The ends per inch (EPI) and Picks per inch (PPI) should be around 50.
- III. Thread thickness/diameter in both warp and weft direction of top and bottom layer should be $\sim 0.05\text{-}0.07\text{ mm}$
- IV. Thread thickness/diameter of interweaving layer should be around 0.16mm . Use of tubular(hollow) interweaving thread to increase moisture absorbing capacity also may be explored.
- V. The thickness of the fabric liner (interweaving layer height) should be around 4.5mm

These parameters may be considered as initial input to start with the development iterations.

The proposed schematic of the fabric is shown in **Figure 2**

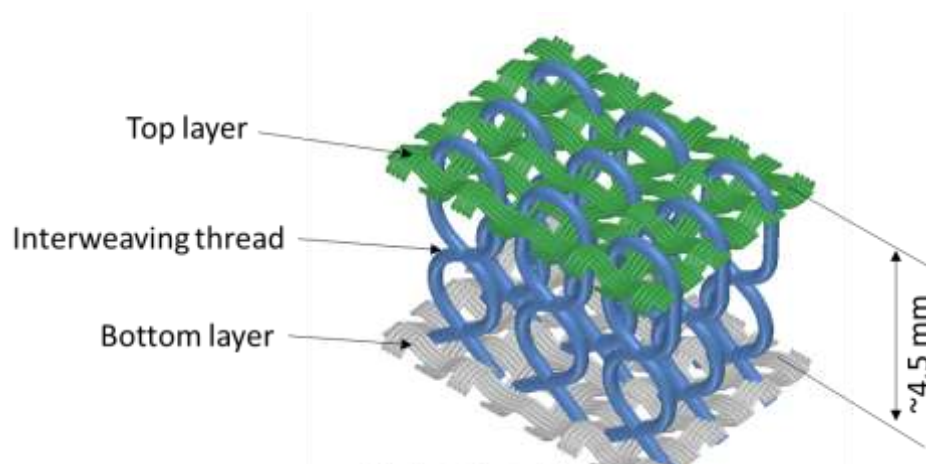


Figure 2 Proposed Liner Structure

It may be noted that this structure should only be used as a reference. The party can modify the weaving pattern, material, fabric structure, GSM, EPI, PPI, thread thickness, etc. based on capabilities available with them while satisfying the requirements specified in section 2.

4. Testing Procedure for Humidity Buffering properties

To test the humidity buffering capacity of the fabric developed by the party, three types of tests can be conducted at ISRO facilities for evaluation of humidity buffering capacity. The test procedure shall be as follows

Objective

- To assess the humidity buffering ability for different samples and evaluate the moisture storage capacity. (g of water absorbed /g of fabric)

Types of test

a) Test conducted at increasing RH

The liner fabric is subjected to increasing RH conditions. The test is performed to simulate the actual flight ascent/ descent conditions. The initial conditions for the test shall be 60% RH and 18degC. There will be continuous humidity addition at the rate of 2.78g/min. During the test, change in the mass of fabric is measured at regular intervals to measure the amount of water vapour absorbed with respect to time (dM/dt) along with the RH profile inside the cabin. Duration of the test will be decided based on mission profile. The tests may be repeated for different initial conditions and durations.

b) Test conducted at decreasing RH

The liner fabric is subjected to decreasing RH conditions. This test is performed to evaluate the desorption capability of the liner. The initial conditions for the test shall be 70% RH and 23degC. The humidity removal rate shall be 0.9g/min (TBD). During the test, change in the mass of fabric is measured at regular intervals to measure the amount of water vapour released with respect to time (dM/dt).

c) Test conducted at constant RH till the liner is saturated

The liner fabric is subjected to constant RH conditions. This test is performed to determine the moisture storage capacity of the material at different RH levels (30% RH-90% RH at an interval of 10) and to get the moisture absorption isotherm as indicated in figure 3.

$$\text{Equilibrium absorption capacity} = \frac{\text{Final weight} - \text{Dry weight of fabric (at 30\% RH)}}{\text{Dry weight of fabric (at 30\% RH)}}$$

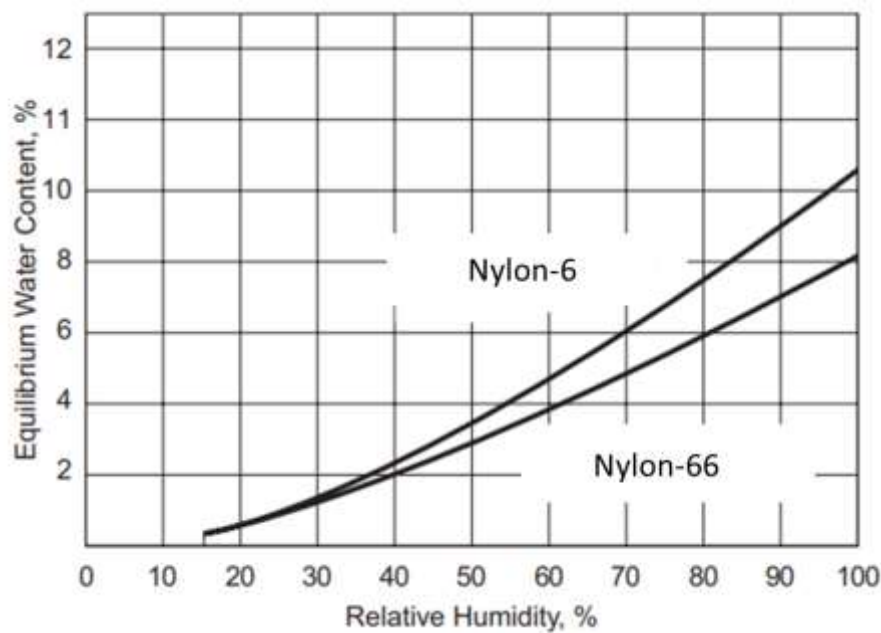


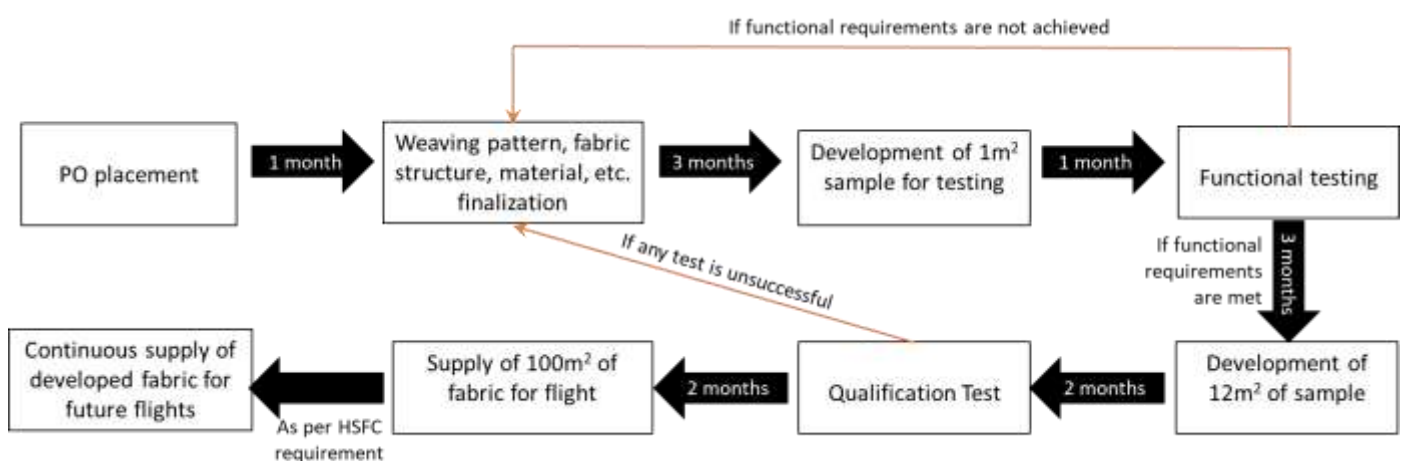
Figure 3

These tests will be carried out by HSFC. Based on the test, relevant results and feedback will be given to the vendors and the weaving pattern, fabric structure and fabric material for the liner should be modified by the vendor to improve humidity buffering properties. The modified sample shall be supplied to HSFC again for evaluation.

Kindly note that the number of iterations depend upon how close the party selects/designs the fabric required by HSFC.

5. Schedule

Based on the mission schedule, the party shall deliver the cabin liner as per the following schedule



The functional test shall include the tests for Humidity Buffering properties whereas the qualification tests shall be for requirements mentioned in Section 2.2

Fabric of 1m² shall be supplied for each development test whereas fabric of 12m² shall be supplied for qualification test. Upon successful testing, party shall supply 100m² of developed fabric in batches of 10 m² for the flight. For future flights, HSFC may have in place a rate contract/ repeat order with the party. Entire development process of the fabric shall be completed in **12 months**.

6. **Document Submission Requirements**

6.1	Enterprise profile	Details to be furnished
A	<u>Business entities</u> involved in development of 3D spacer fabrics/ technical textiles	<ul style="list-style-type: none"> • Company name & registered address • Business Registration details • Product & services portfolio • Details of users/clients • Last three years' financial statement • MSME category based on investment & turnover • Details of in-house human resource • Details of collaborations – if any • Previous POs related to similar development projects
B	<u>Start-ups (DPIIT registered)</u> involved in development of 3D spacer fabrics/ technical textiles	<ul style="list-style-type: none"> • Company name & registered address • DPIIT Registration details • Profile of founder members and leads • Products & services portfolio • Funding stage & Valuation details • Details of in-house human resource • Details of collaborations – if any
6.2	Technical capability	Details to be furnished
A	<u>Business entities</u> involved in development of 3D spacer fabrics/ technical textiles	<ul style="list-style-type: none"> • Details of prior experience in design, development of 3D spacer fabrics/ technical textile/ textile similar to aforementioned structure with adequate documentary proofs • Details of in-house technical expertise and facilities

		<ul style="list-style-type: none"> • Certification details
B	<u>Start-ups (DPIIT registered)</u> involved in development of 3D spacer fabrics/ technical textiles	<ul style="list-style-type: none"> • Details of prior experience in design, development of 3D spacer fabrics/ technical textile/ textile similar to aforementioned structure. • Details of in-house technical expertise and facilities • Certification details
6.3	<u>Brief description of fabric design and its development plan</u>	<ul style="list-style-type: none"> • Weaving pattern, thread diameter, fabric specification (GSM, EPI, TPI) achievable by party. Development plan and raw material procurement plan with proper sources of supply. • Compliance with delivery schedule/ Achievable delivery schedule in case of non-compliance

The EOI with all applicable documents must be submitted in a sealed envelope indicating “SENDERS” address and HSFC Reference Number to following address:

Purchase & Stores Officer,
Human Space Flight Centre, ISRO HQ Campus,
New BEL Road, Anthariksh Bhavan,
Bengaluru – 560094

The due date for submission of EOI is **December 22nd, 2023 at 14.00 Hours IST**. For any clarification you may please contact us on 080 22172655 or email ID kalpana-hsfc@isro.gov.in. EOI received after due date and time will not be considered for evaluation.

7. Methodology for pre-qualification and selection criteria

The evaluation criteria to pre-qualify enterprises participating in the EOI is tabulated below according to the Evaluation Criteria Number (ECN):

ECN	Evaluation Criteria	Maximum Score	
		Business entities	Start-ups
7.1. Enterprise profile			
7.1.1.	Company name & address with business registration details	5	5
7.1.2.	Products & services portfolio	10	10
7.1.3.	Last three years’ financial statement	10	NA
7.1.4.	DPIIT registration details, profile of founding members and leads	NA	10
7.1.5.	Details of users/clients and projects in relevant field	5	5
7.2. Technical capability			
7.2.1.	Prior experience in design and development of 3D spacer fabrics/ technical textiles. Prior collaborations (if any) with ISRO shall also be indicated.	15	10
7.2.2.	Design documentation of developed/underdevelopment product similar to aforementioned structure.	10	10
7.2.3.	Adequacy of in-house technical resources for design and development (qualified manpower and facilities)	10	10
7.3. Brief description of proposed solution			
7.3.1.	Development and realization plan and tentative delivery schedule	25	30
7.3.2	Willingness to make multiple samples for testing since this is developmental project	5	5
7.3.3	Plan for carrying out LOI test, flammability test, material characterization test, bio-compatibility test, etc. There will be HSFC participation in the testing and necessary guidance will be provided. Also, the functional testing for humidity buffering capacity along with off-gassing test and out-	5	5

	gassing test shall be in the scope of HSFC.		
<u>Total Maximum Score</u>		100	
<u>Minimum score for pre-qualification</u>		60	

The table below draws the scheme for evaluation criteria, referring the Evaluation Criteria Number (ECN) from above table:

ECN	Scoring Scheme	Remarks
7.1.1.	<ul style="list-style-type: none"> Score of 5 rewarded, if all details are furnished. 	Non-submission of details will lead to disqualification
7.1.2.	<ul style="list-style-type: none"> Score of 10 rewarded, if portfolio comprises of 3D spacer fabrics Score of 6 rewarded, if portfolio comprises of technical textiles Score of 3 rewarded, if portfolio comprises generic woven fabrics. 	Portfolio not fitting in textile domain will lead to disqualification
7.1.3.	<ul style="list-style-type: none"> Score of 10 rewarded, if financial statement is audited by third-party Score of 5 rewarded, if financial statement is internally audited 	Non-submission of details will lead to disqualification
7.1.4.	<ul style="list-style-type: none"> Score of 10 rewarded, if all details are furnished 	Non submission of DPIIT registration will lead to disqualification
7.1.5.	<ul style="list-style-type: none"> Score of 5 rewarded to party with highest clients/projects and proportional score to parties thereafter. Score of 0 rewarded in case of no clients/projects 	
7.2.1.	Scoring will be on the discretion of EOI evaluation panel. It may be noted that for 7.2.3, start-ups shall	Non-submission of details will lead to
7.2.2.		

7.2.3.	focus to project the adequacy of manpower with domain expertise	disqualification
7.3.1.	Scoring will be on the discretion of EOI evaluation panel.	Non-submission of details will lead to disqualification
7.3.2.	<ul style="list-style-type: none"> • Score of 5 rewarded, if party is willing • Score of 0 rewarded, otherwise 	Non-willingness will lead to disqualification
7.3.3.	<ul style="list-style-type: none"> • Score of 5 rewarded, if party is willing • Score of 0 rewarded, otherwise 	

8. General Terms and conditions

- 8.1. This EOI does not entail any commitment on the part of HSFC, ISRO or any other participating ISRO agencies, either financial or otherwise. HSFC, ISRO reserves the right to accept or reject any or all EOI without incurring any obligation to inform the affected supplier/s of the grounds.
- 8.2. Requests for Proposal (RFP) and any subsequent purchase order (PO) will be issued in accordance with the rule and procedures of HSFC, ISRO and other participating ISRO agencies.
- 8.3. All documents, information and any items related to product that are received from HSFC shall be kept confidential and shall not be tampered with or disclosed to third parties without explicit written permission from HSFC/ISRO.
- 8.4. Party shall provide a comprehensive presentation to HSFC if required covering all the above points.
- 8.5. The decision of HSFC shall be final and binding, based on inputs furnished by parties backed up with documentary evidence, assessment based on facility visits (if required) and discussions.
- 8.6. Intellectual Property Rights
 - 8.6.1. Each party will ensure appropriate protection of Intellectual Property Rights generated from cooperation pursuant to EOI, consistent with their respective laws, rules and regulations and international agreements to which both parties are committed.

- 8.6.2. Intellectual property rights will be sought by ISRO & the party jointly for the product developed under the scope of this EoI.
- 8.6.3. The party shall not assign any rights and obligations arising out of the IPR generated to inventions/activities carried out under the EoI to any third party without consent of ISRO.
- 8.6.4. ISRO reserves the right to transfer the technology on non-exclusive basis to any third party for production of Cabin Liner to meet ISRO requirements.
- 8.7. **Pre-bid meeting is scheduled on 01-12-2023 (Friday) at 10:00 hours IST in online/offline mode. Interested parties shall provide an intimation before 28-11-2023 via email at kalpana-hsfc@isro.gov.in. Kindly note that attending pre-bid meeting is mandatory.**

9. Glossary of Terms

EOI	Expression of Interest
RFP	Request for Proposal
PO	Purchase Order
HSFC	Human Space Flight Centre
ISRO	Indian Space Research Organisation
Start-up	As defined by Ministry of Commerce and Industry, Government of India
DPIIT	Department for Promotion of industry and Internal Trade
GSM	Grams per square meter
RH	Relative Humidity
EPI	Ends per inch
PPI	Picks per inch
LOI	Limiting Oxygen Index
CM	Crew Module