	Charcoal Coating with Cryogenic Adhesive on Copper Panels	Tender No.
		GEM/2025/B/6288227

Title	GeM Bid No. GEM/2025/B/6288227 for Charcoal Coating with Cryogenic Adhesive on Copper Panels
Subtitle	PART-A(II): Scope of Supply, Scope of Work and Technical Specifications





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Acronyms and definitions

Acronym	Definition
BET	Brunauer–Emmett–Teller
CAD	Computer Aided Design
DNB	Diagnostics Neutral Beam
INTF	Indian test facility
ITP	Inspection and Test Plan
LN2	Liquid Nitrogen
OFHC	Oxygen Free High Conductivity

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1 Introduction:

Indian test facility (INTF) is being developed at IPR which is a full-scale prototype to establish and test the performance of the Diagnostic Neutral Beam (DNB) for the International Thermonuclear Experimental Reactor (ITER). To characterize ITER Diagnostic Neutral Beam (DNB) in Indian test facility (INTF), $\sim 1.2 \times 10^6$ ℓ/s installed pumping speed is required to ensure low re-ionization losses and stripping losses of extracted negative hydrogen ions from the ion source in presence of ~ 14.6 Pa.m³/s hydrogen gas throughputs. Such large pumping speed will be provided using 12 cryopumps based on cryosorption mode of operation and are dispersed symmetrically along the 9 m length of the test vessel. Each pump has a pumping speed of $\sim 1 \times 10^5$ ℓ/s . The engineering configurations of the pumps are charcoal based cryosorption type with cryopanel temperature of 15 K – 20 K, cooled by a cryocooler. The pumping surface (cryopanel) is surrounded by Chevron shaped liquid nitrogen (LN2) cooled radiation shield at 85 K temperature. The pumping surface dimension is 2806 mm length X 330 mm width X 3 mm thick and pumping is performed from both sides of the cryopanel. The aim of the present tender is onsite (ITER-India Lab, IPR) charcoal coating on 12 nos. copper panels / cryopanel (2806 mm length X 330 mm width X 3 mm thick) using given specifications of Activated Charcoal and Cryogenic Adhesive.

2 General Information for the Service provider for Bidding:

Service provider must read all the technical and commercial information provided in the tender document and assess the scope, expertise and quality requirement. Wherever there is a compliance requirement mentioned, service provider must confirm/accept the same reading all the technical information provided. The work involves knowledge of handling of the sorbents (charcoals) and chemicals (adhesives). All the technical challenges in that direction must be accounted while bidding. Relaxation on technical scope will not be provided. The service provider must fill, sign, and stamp the [Annexure – 4](#) as part of compliance to the requirements.

3 Scope of Service:

There are twelve (12) nos. of cryopanel made of OFHC copper and their coating area details is provided in **Table 3-1**. These copper panels will be provided by ITER-India mounted in fixtures with masking of uncoated area with Teflon sheet and onto these panels coatings have to be done. All the coating related activities have to be carried out at the ITER-India Lab, IPR. The available space for performing coating activity at ITER-India Lab, IPR is Length: 4 m, Width: 4 m, Height: 3 m.


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Table 3-1: Details of Cryopanel and Fixtures

Sr. No.	Material	Drawing & Fixture Reference	No. of panels and fixtures	Indicative Coating area per panel (m ²)	Indicative Total coating area (m ²)
1.	OFHC Copper Panel	Appendix – 1	12	1.85 m ²	22.2 m ²
2.	Aluminium Fixtures	Appendix – 2	12	-	-

Note: The surface roughness (Ra) of OFHC Copper Panels are around 0.2 to 0.8 µm.

4 Scope of Work:

4.1 Following are the list of activities under the scope of the service provider:

4.1.1. Understanding ITER-India's requirement based on the drawings and technical information provided in this document.

4.1.2. Procurement or manufacturing of Activated Charcoal and Cryogenic Adhesive. Refer **Section 6.1** for technical specifications of Activated Charcoal and Cryogenic Adhesive refer.

4.1.3. Activities for qualification of Activated Charcoal

4.1.3.1. Sending test report of Activated Charcoal for the following tests.

4.1.3.1.1. BET Pore surface area ([m² gm⁻¹]), pore size (Å) and particle size (mm).


4.1.3.2. The activated charcoal will be qualified by meeting the acceptance criteria of BET Pore surface area ([m² gm⁻¹]), pore size (Å) and particle size (mm) given in **Table 6-1**.

4.1.3.3. ITER-India may witness these tests while being performed. Service provider shall intimate to ITER-India at least 15 days prior to the tests to be performed.


4.1.3.4. In case of non-compliance of activated charcoal to ITER-India's requirement, service provider must arrange fresh batch of activated charcoal at no extra cost to ITER-India. Maximum 3 trials shall be permitted to service provider for qualifying the activated charcoal. If activated charcoal do not pass in 3 trials, future course of action will be decided mutually.

4.1.4. Activities for qualification of Cryogenic Adhesive and Coating work Personnel

4.1.4.1. The Cryogenic Adhesive shall meet the specifications mentioned in **Table 6-2**.

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- 4.1.4.2. Sending of Technical data sheet for Cryogenic Adhesive conforming to the specifications mentioned in Table 6-2 including recommended procedure provided by adhesive manufacturer for preparedness and application of cryogenic adhesive during charcoal coating.
- 4.1.4.3. After approval of Technical data sheet for Cryogenic Adhesive, sending of adhesive coated (02 nos.) and charcoal coated (02 nos.) sample disks for testing and qualification in thermal cycling as described in **Section 6.2**. Preparation and sending coated sample disks are in the service provider's scope.
- 4.1.4.4. Cryogenic Adhesive will be qualified by meeting the acceptance criteria for thermal cycling given in **Table 6-2**.
- 4.1.4.5. The record of personnel who coated the sample disks and qualified in thermal cycling test shall be maintained by service provider. These personnel shall be considered as qualified coating work personnel.
- 4.1.4.6. In case of disqualification of the coated sample disks, service provider must send fresh coated sample disks at no extra cost to ITER-India. Maximum 3 trials shall be permitted to service provider for qualifying the Cryogenic Adhesive. If Cryogenic Adhesive do not pass in 3 trials, future course of action will be decided mutually.
- 4.1.4.7. Samples coating area are not to be included in indicative coating area mentioned in **Table 3-1**.
- 4.1.5. On ITER-India's approval for Activated Charcoal and Cryogenic Adhesive, 12 nos. Cryopanel coating activities will be started using approved charcoal and approved cryogenic adhesive by qualified coating work personnel (section 4.1.4.5). In case of non-availability of personnel for coating of 12 nos. Cryopanel who coated the sample disks, re-qualification of personnel will be required. In this case service provider shall prepare 01 no. adhesive coated and 01 no. charcoal coated sample disk before start of coating on 12 nos. Cryopanel. ITER-India will perform thermal cycling test on these samples. After successful completion of thermal cycling test for qualification of coating work personnel by meeting the acceptance criteria for thermal cycling given in Table 6-2, the new personnel shall be allowed to start coating work in 12 nos. Cryopanel.**
- 4.1.6. The activated charcoal, cryogenic adhesive used in qualification (**Section 4.1.3** and **Section 4.1.4**) and the charcoal coating of 12 nos. of cryopanel (**Section 4.1.5**) shall be of same batch/category/process so that there is no deviation of specification at the end application.
- 4.1.7. Coating of 12 nos. cryopanel as detailed in **Section 3, Table 3-1**. Following are the list of activities to be considered during coating of 12 nos. cryopanel.
 - 4.1.7.1. Surface cleaning of the cryopanel with Alcohol, Acetone or mutually agreed solvents.

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- 4.1.7.2. Drying of the cryopanel in air or by using heating gun or any suitable method.
- 4.1.7.3. Dust removal from activated charcoal by sieving or any suitable method. Sieving of charcoal for dust removal should be avoided inside the lab. This can be done outside the lab or service provider may bring the charcoal which are already cleaned and free from dust.
- 4.1.7.4. Preparation of the cryogenic adhesive for the charcoal coating on the cryopanel.
- 4.1.7.5. Application of the adhesive during charcoal coating as per the recommended procedure provided by the service provider/manufacturer of the adhesive. Recommended procedure for preparedness and application of cryogenic adhesive shall be provided.
- 4.1.7.6. Necessary drying and curing as per the **Table 6-2** of adhesive properties.
- 4.1.7.7. Removal of the uncoated charcoal granules.
- 4.1.7.8. Packing of coated panels with polythene.
- 4.1.8. The coating work of 12 nos. cryopanel will be carried out at the ITER-India Lab, IPR. Necessary surface roughness preparation and proper cleaning of cryopanel before coating, arrangement of necessary tools for surface roughness preparation and surface roughness measurement at ITER-India Lab, IPR are in the service provider's scope. Also, the arrangement of required consumables during coating work are in the service provider's scope.
- 4.1.9. To carry the work at ITER-India Lab, IPR, service provider may bring the required coating items/tools/consumables to ITER-India Lab, IPR prior to commencement of the coating work. In addition, the required PPE for coating work personnel shall be brought by service provider.

4.2 Following are the list of activities under the scope of ITER-India:

- 4.2.1. Review the Activated Charcoal test report and providing necessary approval to the service provider for Activated Charcoal.
- 4.2.2. Testing of the adhesive coated (02 nos.) and charcoal coated (02 nos.) sample disks in thermal cycling (14 K to 300 K) for qualification and providing necessary approval to the service provider for Cryogenic Adhesive.
- 4.2.3. Supply of 12 nos. cryopanel mounted in fixture ([Appendix – 2](#)) for handling during and after charcoal coating.
- 4.2.4. Masking of area with Teflon sheet which will be kept uncoated.
- 4.2.5. Acceptance at ITER-India as per the **Section 9**.

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5 Scope Responsibility Matrix between ITER-INDIA and Service Provider:

Table 5-1: Scope Responsibility Matrix

Sr. No.	Description	Responsible Party
1)	Activated Charcoal Testing (Section 4.1.3)	Service provider
2)	Preparation of 02 nos. adhesive coated and 02 nos. activated charcoal coated Copper Disk (Section 6.2)	Service provider
3)	Thermal Cycling Test (adhesive qualification of coated Copper Disk provided in Sr. No. 2)	ITER-India
4)	Providing 12 Nos. Copper Panels attached in Support Fixtures with masking of uncoated area	ITER-India
5)	Charcoal coating of 12 nos. copper panels (22.2 sq. meter total) at ITER-India Lab, IPR site (Section 3)	Service provider
6)	Final visual inspection	Service provider and ITER-India
7)	Final Acceptance	ITER-India
8)	Packing of 12 nos. coated panels along with support fixtures in air bubble polythene sheet (Clause 11 of Part-A(III) of ATC)	Service provider


6 Technical Specifications:

6.1 Activated Charcoal and Cryogenic Adhesive:

- 6.1.1. Selection of suitable Activated Charcoal will be on service provider's scope.
Service provider must assure the desired specification as per **Table 6-1**.

Table 6-1: Specifications for Activated Charcoal


Sr. No.	Charcoal specification	Requirement
1)	Type	Activated Charcoal
2)	Iodine number (as per ASTM D 4607) [mg gm ⁻¹]	≥ 1335
3)	Particle size [As per ASTM D 2862-10]	4X8 Mesh (4.75-2.36 mm) 8X20 Mesh
4)	BET Pore surface area ([m ² gm ⁻¹])	≥ 1300
5)	Pore Size (Å)	5 to 10 (micropore)

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6.1.2. Selection of suitable Cryogenic Adhesive will be on service provider's scope. Service provider must assure the desired specification as per **Table 6-2**.

Table 6-2: Specification for Cryogenic Adhesive

Sr. No.	Specification	ITER-India Range/values
1)	Adhesive shall hold charcoal on metal surface under vacuum, heating and cryogenic conditions	Shall provide excellent bond with Copper with charcoal
2)	Operating temperature range	14 K to 300 K
3)	Adhesive shall be spreadable on surface, and shall not enter charcoal pores	Shall be easily spread on the surface without entering charcoal pores.
4)	Adhesive working at different temperatures	Adhesive shall easily withstand thermal cycling without development of cracks and can hold charcoal intact between 14 K to 300 K
5)	Vacuum compatibility	Shall be compatible with working in high vacuum range $\sim 1.0 \times 10^{-6}$ mbar
6)	Shelf life	Greater than or equal to 3 months
7)	Hardness at room temperature after curing	> 50 shore D
8)	Tensile strength at room temperature after curing	> 20.68 N/mm ²
9)	Thermal conductivity of the Adhesive	>0.45 W/m-K or higher at room temperature (300 K)

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6.2 Sample Disks: Adhesive and Charcoal Coating on the Copper Substrate:

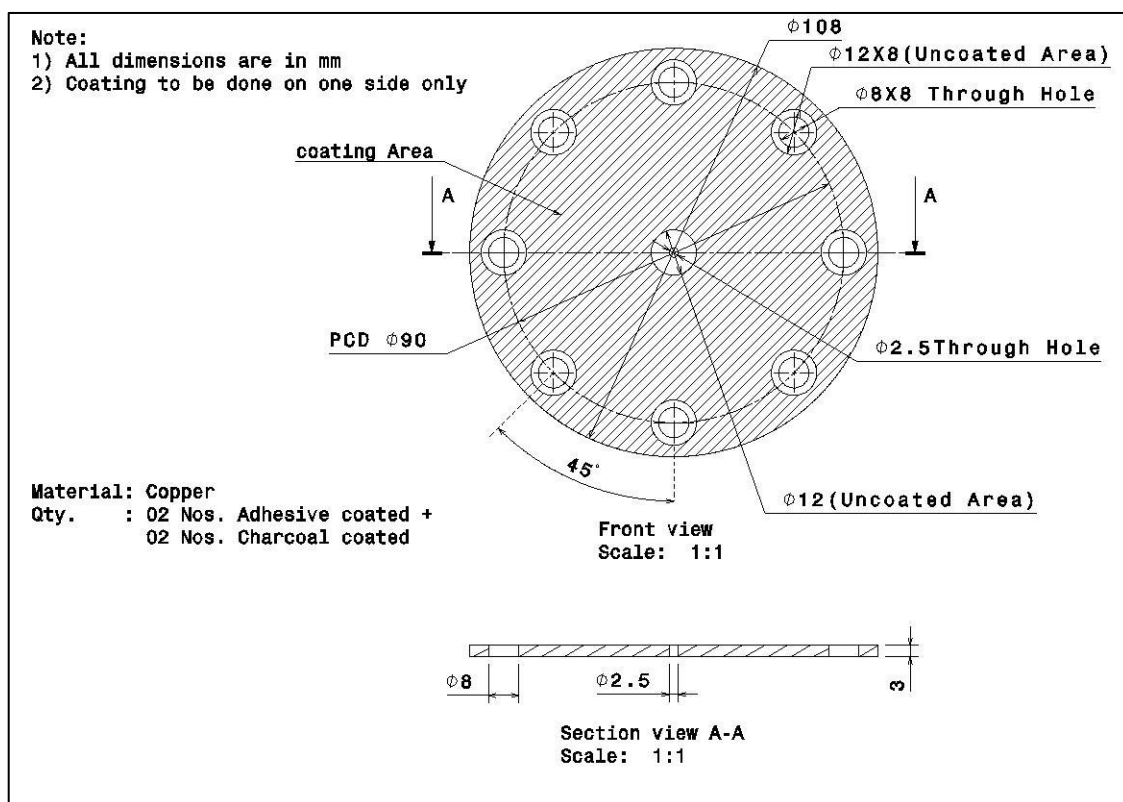



Figure 1: Sample Disks Dimensions and Coating Details

- 6.2.1. After approval of activated charcoal, service provider must prepare 02 nos. adhesive coated and 02 nos. charcoal coated samples on a copper substrate (sample disks) as per **Figure 1** The area marked as “Uncoated Area” in **Figure 1**. shall be kept uncoated while coating being done on sample disks.
- 6.2.2. Preparation of the coated sample disks will be in the service provider’s scope. The cryogenic adhesive to be used in coated sample disks shall meet the specifications mentioned in **Table 6-2**.
- 6.2.3. Coated sample disks have to be packed and sealed assuring no damage during transportation.
- 6.2.4. Packing, transportation and supply of coated sample disks (refer **Figure 1**) will be on service provider’s scope. Coated sample disks will be supplied at ITER-India Lab, IPR.
- 6.2.5. Testing of the adhesive coated and charcoal coated sample disks involve thermal cycling test from 14 K to 300 K temperature. Any developed cracks on the coating results in disqualification of the coated samples.
- 6.2.6. Testing of the coated sample disks will be on ITER-India’s scope. On successful testing and qualification of coated sample disks, ITER-India will provide the necessary clearance to initiate the 12 nos. cryopanel coating work.

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7 Witness of Coating:

ITER-India personnel will witness the coating job for inspection and quality conformation.

8 Document deliverables:

Following is the list of documents to be delivered by service provider at different stages of contract.

- 8.1. Test report of Activated Charcoal for the tests mentioned in **Section 4.1.3.1.1**.
- 8.2. Technical data sheet for Cryogenic Adhesive conforming to the specifications mentioned in **Table 6-2** including recommended procedure provided by adhesive manufacturer for preparedness and application of cryogenic adhesive during charcoal coating.
- 8.3. Repair / rectification procedure of charcoal coating. Repair procedure shall be agreed between ITER-India and Service provider
- 8.4. [APPENDIX – 3](#): Minimum required Key Points of the Contract signed by ITER-India at different stages.
- 8.5. Warranty certificate for the performance of the coatings as mentioned in **Clause No. 14 of Part-A(III) of ATC**.

9 Final Acceptance at ITER-India:


- 12.1. Visual Inspection to ensure the coating quality will be witnessed by ITER-India's personnel. Coating shall be uniform.
- 12.2. If any coating defects like crack, peel off etc. found in visual inspection, service provider shall repair / rectify the same as per approved repair / rectification procedure. Repair procedure to be agreed between ITER-India and Service provider before start of such rectification.

10 Input drawings / documents:

- 14.1. Drawing of Copper Panel showing dimensions and charcoal coating area is given in [Appendix-1](#).
- 14.1. CAD image of fixture for handling of cryopanel is given in [Appendix-2](#).
- 14.1. Compliance Sheet to be filled by service provider is given in [Appendix-4](#).


11 General Terms & Conditions

- 15.1. All the necessary consumables will be on service provider's scope. Service provider shall estimate the requirement beforehand with sufficient buffer stock.
- 15.2. Work permission in IPR premises can be given during weekdays (Monday to Friday except government holidays) and IPR working hours only (i.e. 09:00 AM to 5:30 PM). In view of this, service provider shall plan their work accordingly.

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- 15.3. Safety issues: Service provider shall follow the recommended Safety norms/precautions followed for site activities in routine work.
- 15.4. Service provider must follow necessary safety guidelines during the execution of the work. IPR will not be responsible for any damage.
- 15.5. The service provider shall follow all safety measures and IPR safety rules during the execution of the work to protect the personnel and investment. The IPR Safety Protocols are given in link provided below.

https://www.ipr.res.in/documents/safety_protocols.html

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Appendix – 1: Copper Panel Dimensions and Charcoal Coating Area:

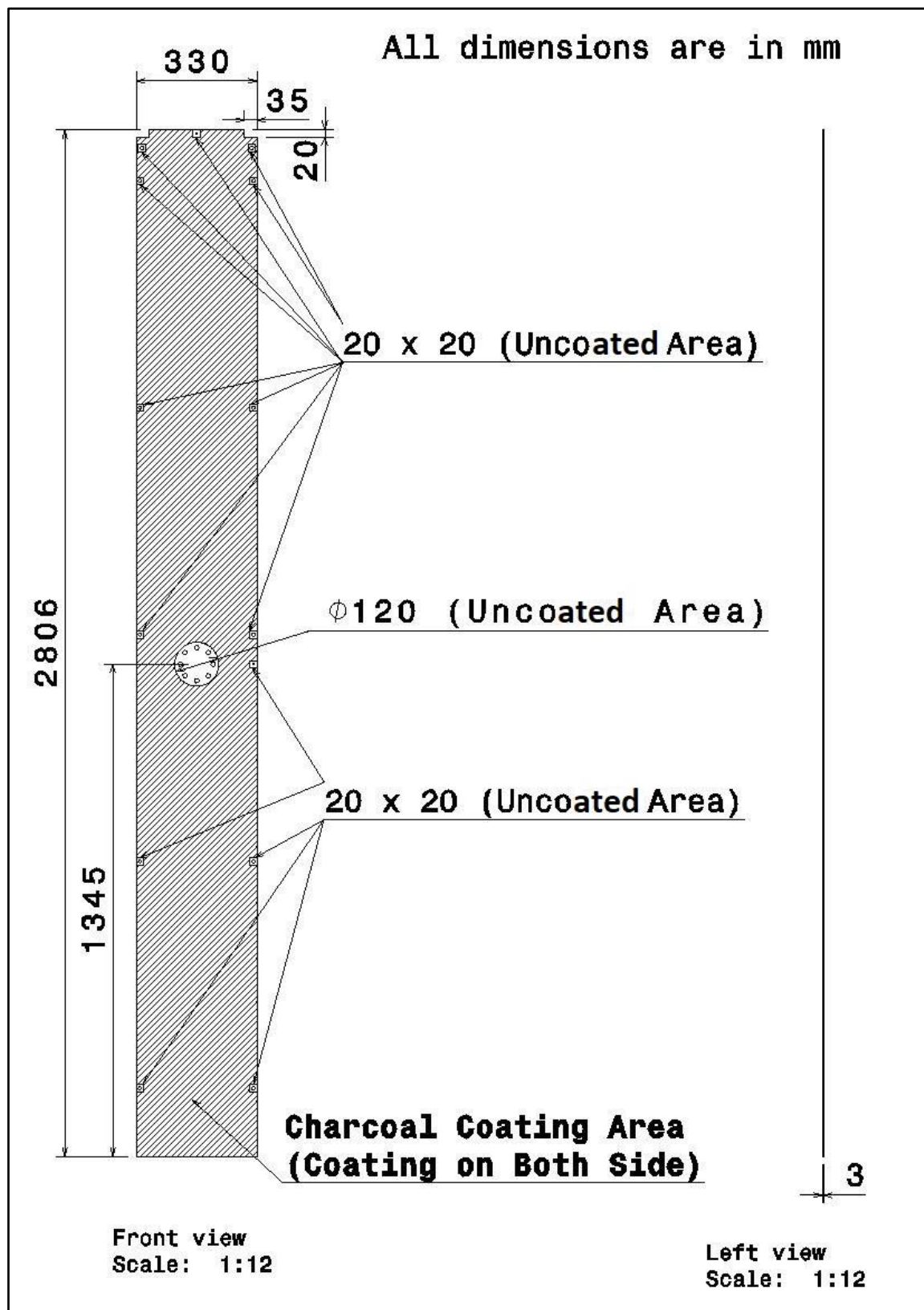



Figure 2: Copper Panel Dimensions and Charcoal Coating Area

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Appendix – 2: Fixture for handling of Cryopanel

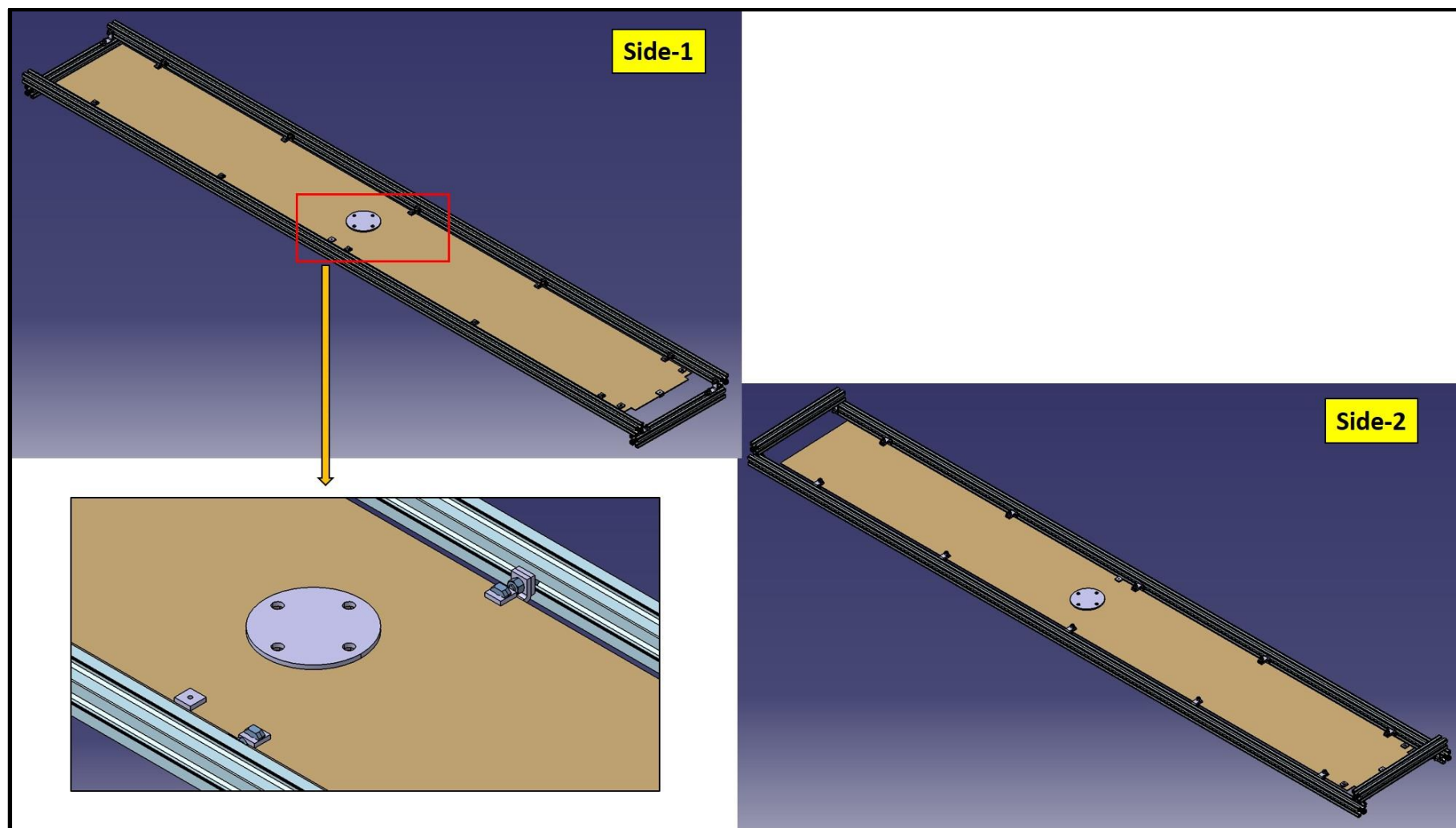


Figure 3: Fixture for handling of Cryopanel



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HP	Hold Point
NP	Notification Point
ATPP	Authorization to Proceed Point
W	Witness of Operation
S1	100% Inspection
S2	Random Inspection
R	Review Report
R&A	Review and Approval
P	Perform

APPENDIX – 3: Minimum required Key Points of the Contract


Activity No.	Description of Activities	Acceptance Criteria	Service Provider	ITER-India	Remarks / Sign
	Tender				
1)	Contract Award for Charcoal Coating with Cryogenic Adhesive on Copper Panels			HP	
	Qualifications				
2)	Qualification of activated charcoal	Specs Clause no. 4.1.3	P	NP, W, R & A	
3)	Approval of Cryogenic Adhesive Technical Data Sheet	Table 6-2	P	R & A	
4)	Qualification of Cryogenic Adhesive and Coating work Personnel. Preparation of 02 nos. adhesive coated and 02 nos. activated charcoal coated samples on a copper substrate (sample disks)	Specs Clause no. 4.1.4, 6.2	P	NP, W	
5)	Thermal Cycling Test	Specs Clause no. 4.2.2, 6.2		P, ATPP	
	Execution				
6)	Handover of 12 Nos. Copper Panels attached in Support Fixtures with masking of uncoated area to Service Provider			P	
7)	Surface roughness preparation and cleaning of Copper Panels		P	W	
8)	Charcoal coating of 12 nos. copper panels at ITER-India Lab, IPR site	Specs Clause no. 4.1.5	P	W	
	Inspection and Acceptance				
9)	Final Visual Inspection	Specs Clause no. 9	P	W, S1	
10)	Final Acceptance	Specs Clause no. 9		P	
11)	Packing of 12 nos. charcoal coated panels along with support fixtures in air bubble polythene sheet	Specs Clause no. 11 of Part-A(III) of ATC	P	W	
12)	Handover of charcoal coated 12 Nos. Copper Panels attached in Support Fixtures with masking of uncoated area to ITER-India in polythene packed condition		P		

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Appendix-4: Technical Compliance Format

The service provider must fill, sign, and stamp the below table as part of compliance to the requirements.

Sr. No.	Specifications for item name from ITER-India		Offered specification (to be filled by the service provider)	Remark (to be filled by the Service provider)
	Specification	Values		
1)	Activated Charcoal Specification			
	Type	Activated Charcoal		
	Iodine number (as per ASTM D 4607) [mg gm-1]	≥ 1335		
	Particle size [As per ASTM D 2862-10]	4 X 8 Mesh (4.75-2.36 mm) 8 X 20 Mesh		
	BET Pore surface area ([m2 gm-1])	≥ 1300		
	Pore Size (A°)	5 to 10 (micropore)		
2)	Cryogenic Adhesive Specification			
	Adhesive shall hold charcoal on metal surface under vacuum, heating and cryogenic conditions	Shall provide excellent bond with Copper with charcoal		
	Operating temperature range	14 K to 300 K		
	Adhesive shall be spreadable on surface, and shall not enter charcoal pores	Shall be easily spread on the surface without entering charcoal pores.		
	Adhesive working at different temperatures	Adhesive shall easily withstand thermal cycling without development of cracks and can hold charcoal intact between 14 K to 300 K		

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	Vacuum compatibility	Shall be compatible with working in high vacuum range $\sim 1.0 \times 10^{-6}$ mbar		
	Shelf life	Greater than or equal to 3 months		
	Hardness at room temperature after curing	> 50 shore D		
	Tensile strength at room temperature after curing	> 20.68 N/mm ²		
	Thermal conductivity of the Adhesive	>0.45 W/m-K or higher at room temperature (300 K)		
3)	Providing test report of activated charcoal Section 4.1.3	Agreed/Not agreed		
4)	Providing 02 nos. Adhesive coated and 02 nos. Charcoal coated sample disks as per Section 4.1.4 and Section 6.2	Agreed/Not agreed		
5)	Sample testing clauses: <ul style="list-style-type: none"> • Packing, transportation and supply of samples will be on service provider's scope. • In case of non-compliance of samples to ITER-India's requirement, service provider must send fresh batch of samples at no extra cost to ITER-India. 	Agreed/Not agreed		
6)	Scope of service and work as per Section 3 and Section 4			