Specification for the TENDER No: DPS/IRPU/

Specification for fabrication, supply, erection and testing of radiation shielding enclosures (hutches) for BL-2 and BL-10

Government of India
Department of Atomic Energy
Raja Ramanna Centre for Advanced Technology
Accelerator Programme
Indore-452013
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Specifications for fabrication, supply, erection and testing of radiation shielding enclosures (hutches) for BL-2 and BL-10

1. Introduction

Two beamlines namely Engineering Application Beamline (BL-2) and Angle Resolved Photo Electron Spectroscopy (ARPES) beamline (BL-10) are planned to be installed in Indus-2. For radiation protection of personnel working on these beamlines during operation, radiation shielding enclosures (hutches), which will enclose these beamlines, are required to be installed. Also a control cabin is to be installed adjacent to BL-16 beamline hutch. This specification covers the requirement for the procurement of material, fabrication, quality control, supply, site erection and testing of these radiation shielding enclosures.

2. General description

The hutches shall be installed in the experimental hall of Indus-2 synchrotron radiation source (For more details about Indus-2, you may visit http://www.rrcat.gov.in). There are already a number of hutches installed in experimental hall. A view of experimental hall is shown Figure 1.

Figure 1: Existing Hutches in Indus-2 Experimental Hall
The following are technical information about the experimental hall.

a) **Experimental hall floor slab:**
   - Thickness: 150 mm
   - Young's Modulus: 22 GPa (M20 grade of concrete)

b) **Tunnel Wall:**
   - The tunnel wall is 1.5 m thick and is made of high-density reinforced concrete (2500 N/mm$^3$).
   - Compression strength: 20 MPa.

### 3. Hutch layout

The hutches for the Engineering Application Beamline (BL-2) and ARPES beamline (BL-10) shall be freestanding, self-supported structure fixed to the floor. These hutches shall be modular in construction.

Where the Cold Rolled Close Annealed (CRCA) steel panels are specified the construction shall be as given below:

The assembled sections made out of CRCA steel sheets must create a structural system capable of supporting the hutch panels and attach utilities. For lead sandwich panels, the panel shall be manufactured as lead sheet sandwiched between two CRCA steel sheets as shown in the drawings DRG.NO.-RRCAT/ISUD/IND-2/BL-HUCH/2014/BL-2 & 10 Sheet 3, 4 & 5 of 11.

Where the composite aluminum panels and glass panels are specified the construction shall be as given below:

At every cross section one composite aluminum panel is required for the inside wall of the hutch and another composite aluminum panel is required for outside. For aluminum and glass panel hutch walls, the supplier shall make a stable aluminum frame of standard construction. (See DRG.NO.-RRCAT/ISUD/IND-2/BL-HUCH/2014/BL-2 & 10 Sheet 10 of 11).

The existing tunnel shielding of the Indus-2 ring forms parts of the walls.

The hutch walls must fit to the external wall of existing Indus-2 tunnel shielding without radiation leakage. The hutch includes standard features such as double-sliding doors with lead glass windows, penetrations for compressed air, water, electrical, and exhaust ventilation.

The shielding hutches shall be delivered to Indus-2 experimental hall in panels, to be assembled and installed on site by the supplier.

The hutches shall have internal height of 2.5 m.

**Table 1:** Detail of hutch shielding walls and roof for BL-2

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Description</th>
<th>Detail of lead sandwiched in shielding walls</th>
<th>Dimensions*</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Optics Hutch shielding walls</td>
<td>Lead sheet of 1 mm has to be used for side walls. Lead sheet of 3 mm has to be used for front wall.</td>
<td>Approximate total length of 1mm lead shielded wall is: 15550 mm. Approximate total length of 3 mm lead shielded wall is: 2900 mm.</td>
<td>Items marked (1) and (1A) in drg. RRCAT/ISUD/ IND-2 /BL-HUCH/ 2014/BL-2 &amp; 10 Sheet 1 of 11</td>
</tr>
<tr>
<td>Sr.</td>
<td>Description</td>
<td>Detail of lead sandwiched in shielding walls</td>
<td>Dimensions*</td>
<td>Remarks</td>
</tr>
<tr>
<td>-----</td>
<td>-------------------------------------------------</td>
<td>---------------------------------------------</td>
<td>-------------</td>
<td>---------</td>
</tr>
<tr>
<td>1</td>
<td>Optics hutch shielding walls</td>
<td>Lead sheet of 1 mm has to be used for side walls. Lead sheet of 3 mm has to be used for front wall.</td>
<td>Approximate total length of 1 mm lead shielded wall is: 14650 mm. Approximate total length of 3 mm lead shielded wall is: 6810 mm.</td>
<td>Items marked (1) and (1A) in drg. RRCAT/ISUD/ IND-2 /BL-HUTCH/ 2014/BL-2 &amp; 10 Sheet 2 of 11</td>
</tr>
<tr>
<td>2</td>
<td>Monochromator hutch shielding walls</td>
<td>No lead</td>
<td>Approximate total length of the walls is: 23550 mm.</td>
<td>Items marked (2) in drg. RRCAT/ISUD/ IND-2 /BL-HUTCH/ 2014/BL-2 &amp; 10 Sheet 2 of 11</td>
</tr>
<tr>
<td>3</td>
<td>Roof of optics hutch for BL-10 and 11</td>
<td>No lead</td>
<td>Approximate area of this portion of the hutch is 31.4 m².</td>
<td>Roof with 2 mm CRCA steel sheet. Items marked (R) in drg. RRCAT/ISUD/ IND-2 /BL-HUTCH/ 2014/BL-2 &amp; 10 Sheet 2 of 11</td>
</tr>
</tbody>
</table>

Table 2: Detail of hutch shielding walls and roof for BL-10
Table 3: Details of BL-16 Control cabin

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Description</th>
<th>Detail of lead sandwiched in shielding walls</th>
<th>Dimensions*</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BL-16 Control cabin</td>
<td>No lead</td>
<td>Approximate total length of side wall is: 13650 mm</td>
<td>Items marked (1) in drg. RRCAT/ISUD/IND-2/BL-HUTCH/2014/BL-2 &amp; 10 Sheet 11 of 11</td>
</tr>
</tbody>
</table>

**Note:** Refer to the drawing RRCAT/ISUD/IND-2/BL-HUTCH/2014/BL-2 & 10 Sheet 1 to 11. Dimensions mentioned in the above table are only for reference, Dimensions given in the drawing shall be final.

4. **Scope of work**

The scope of work involves design, fabrication, assembly, inspection, testing at supplier’s works, delivery to purchaser’s site, installation of radiation enclosure hutches for Engineering Application and ARPES beamlines at BL-2 & BL-10, local shieldings (as shown in the drawing) and BL-16 Control cabin in experimental hall, Indus-2 at Raja Ramanna Center for Advanced Technology, Indore.

The supplier has to carry out following specific jobs:

1) Fabrication and installation of hutch as per drawing and specifications.
2) Powder coating of complete hutch structure and painting of local shielding structure.
3) Fabrication and installation of local shielding as per drawing and specifications.
4) Supply and installation of CRCA steel sheets, Aluminum sheets, lead sheets and lead bricks as per the specification.
5) Supply of complete structure to Indus-2 RRCAT, Indore.
6) Supply and installation of ventilation fan systems, perforated cable trays, power distribution boards, standard parts and fasteners as per specifications.
7) Supply and installation of fixtures for cable tray, lighting and electrical fittings.
8) Site erection and assembly of the doors and electric lock with limit switches.
9) Modification of side walls of existing BL-11 hutch.
10) Fixing of the viewing lead glass and plane glass windows.
11) Site erection and assembly of the hutch structure.
12) Stacking of lead bricks in local shielding structure with proper grouting.
13) Performance testing of hutch.

5. **Applicable drawings**

Drawing No.: RRCAT/ISUD/IND-2/BL-HUTCH/2014/BL-2 & 10, Sheet 1 of 11
6. **Applicable standards**

Following standards of latest issue, in force at the time of placing order, shall govern various aspects of the work:

- IS: 800 - 1984 code of practice for use of structural steel in building construction
- IS: 808 - Dimensions of rolled steel sections for structural use
- IS: 811 - Specification for cold-formed light gauge structural steel sections
- IS: 816 - 1969 Metal arc welding for general construction in mild steel
- IS: 2062 - Specification for weldable structural steel
- AWS 5.1-81 Specification for covered carbon steel arc welding electrodes OR
- IS: 814 - Covered electrodes for manual metal arc welding of carbon and carbon-manganese steel - specifications
- IS 3757 - Specification for high strength structural bolts
- IS: 4000 - High strength bolts in steel structures – Code of practice
- IS: 7215 – Tolerance for fabrication of steel structures
- ASTM: B749- Standard specification for lead and lead alloy strip, sheet and plate products
- ASTM: D3359-97- Standard test methods for measuring adhesion by tape test
- ASTM: D3363-00- Standard test method for film hardness by pencil test
- ASTM: B117 – Practice for Salt spray test apparatus
- ASTM: D 1654- Evaluation of painting and coating specimen subjected to corrosive environment

7. **Technical requirements**

7.1. **Design Requirements**

The design of the hutches for Engineering Application, ARPES beamlines and BL-16 Control Cabin is defined in the drawings and the applicable standards are listed in Section 6 of this technical specification.

7.1.1. **Shielding Requirements**


- a) Lead shielding requirements for the side walls of optics hutch and white beam experimental hutch of BL-2 hutch is 1 mm (minimum) sandwiched between two steel sheets. These side
walls are marked as (1) and (2) in drawing RRCAT/ISUD/ IND-2 /BL-HUTCH/ 2014/BL-2 & 10, Sheet 1 of 11. Lead shielding requirements for front walls of optics hutch and white beam experimental hutch is 3 mm sandwiched between two steel sheets. These side walls are marked as (1A) and (2A) in drawing RRCAT/ISUD/ IND-2 /BL-HUTCH/ 2014/BL-2 & 10 Sheet 1 of 11.

b) Lead shielding requirement for monochromatic beam experimental hutch of BL-2 is 1 mm (minimum) thick lead sheet sandwiched between two steel sheets. These walls are marked as (3) in drawing RRCAT/ISUD/ IND-2 /BL-HUTCH/ 2014/BL-2 & 10, Sheet 1 of 11.

c) The optics hutch portion of the BL-2 hutch shall be provided with roof of 2 mm CRCA steel sheet.

d) Lead shielding requirements for the side walls of optics hutch of BL-10 and BL-11 is 1 mm (minimum) sandwiched between two steel sheets. These side walls are marked as (1) in drawing RRCAT/ISUD/ IND-2 /BL-HUTCH/ 2014/BL-2 & 10, Sheet 2 of 11. Lead shielding requirements for the front walls of optics hutch of BL-10 and BL-11 is 3 mm (minimum) sandwiched between two steel sheets. These side walls are marked as (1A) in drawing RRCAT/ISUD/ IND-2 /BL-HUTCH/ 2014/BL-2 & 10, Sheet 2 of 11.

e) The optics hutch portion of the BL-10 and BL-11 hutch shall be provided with roof of 2 mm CRCA steel sheet.

f) Radiation tightness at the joints of the panel structure, doors, viewing windows, penetrations, junctions between the hutch, concrete floor slab and walls, junctions between the roof and the walls of the hutches, is to be achieved and is one of the most important aspects of this work. The RRCAT shall carry out radiation tests during the Indus-2 machine operation. It is required that a representative of the supplier be present during these tests. Any local leak from these joints, lead viewing window, penetrations overlaps found during the radiation test shall be repaired at the supplier’s expense. The methods of manufacturing shall be adapted such that the result conforms to specifications.

g) The analysis room of BL-2 and BL-16 Control Cabin (as shown in the drawings) does not contain lead sheet. There is no roof in both the areas.

### 7.1.2. Local Shielding

#### Table 4: Detail of local shielding requirement

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Description</th>
<th>Lead detail</th>
<th>Remarks</th>
</tr>
</thead>
</table>
| 1   | Local shielding for BL-2 beamline hutch | 500 mm X 1000 mm X 50 mm (thick). | 1. Refer Dwg RRCAT/ISUD/ IND-2 /BL-HUTCH/ 2014/BL-2 & 10, Sheet 9 of 11.  
2. For local lead shielding supplier shall assemble the pre-cast lead bricks in MS fabricated structure.  
3. The structure shall be rigid enough to take care of weight of the shielding blocks.  
4. There shall be space available in the support structure for adding 50 mm more lead if required in the future. |
There shall be space available in the support structure for adding 50mm more lead if required in the future.

This local shielding will have beamline penetration hole*.

For local lead shielding supplier shall assemble the pre-cast lead bricks in MS fabricated structure.

The structure shall be rigid enough to take care of weight of the shielding blocks.

*The lead bricks shall be placed close enough in the local shielding to pass the beam pipe flange with a proper clearance. Lead balls of diameter ~1 mm-2 mm and total weight of balls 100 kg shall be supplied along with the local shielding of BL-2 and BL-10 hutches. These balls will be used to prevent the radiation leakage around the hole in BL-2 and BL-10 hutches (and also will be used as future requirement for preventing radiation leakage around the hole at higher beam current).

7.1.3. **Mechanical**

The hutches must be self-supporting structures, which have sufficient in-built safety factors to withstand:

7.1.3.1. Self weight of the structure.

7.1.3.2. Dead load due to utility services like pneumatic, electrical cabling, water line, supporting 20 kg per linear meter of wall.

7.1.3.3. Live loads shall include dynamic loads of pneumatic door open/closing.

7.1.3.4. Design loads shall include loads that can occur during construction and installation of the hutch. An installation crew of 2 persons walking may be considered.

7.1.4. **Construction**

The construction and design of the enclosure shall be rigid, quick removal and interchangeable type.

a) The vertical and horizontal (top and floor) load bearing supports shall be fabricated out of cold rolled closed annealed (CRCA steel) sheet of minimum 10G (3.15 mm) in folded channel section.

b) The outside panel shall be fabricated out of 1250 mm X 2500 mm CRCA steel sheet of 20G (0.9 mm) in folded sheet metal form.

c) Lead sheet of 1 mm (1250 mm X 1200 mm) as per the requirement shall be sandwiched by another 18G (1.2 mm). Where lead sheet of 3 mm is specified, 3 mm lead sheet shall be used.

d) CRCA steel sheet of 1250 mm X 1200 mm of 18G from inside forms the basic hutch construction.

e) The construction shall have the provision to add or remove the lead sheet based on the radiation survey.

f) In order to maintain the interchangeability, holes on the frames and the sheet metal panels shall be made at equal distance. Holes on the lead sheet shall be drilled using proper template jig.
The supplier is free to propose his own design for the hutch structure and fixing the lead/CRCA steel sheet. The purchaser shall approve the design in advance before starting the fabrication work.

7.1.5. Personnel Access Doors

There are 4 nos. of personnel access doors in the BL-2 hutch and there are 4 numbers of personnel access doors in BL-10 and BL-11 hutch. Please refer drg: RRCAT/ISUD/ IND-2 /BL-HUTCH/ 2014/BL-2 & 10, Sheet 7 and 8 of 11 for details about sliding doors. All the doors are sliding doors actuated manually. Locking of the doors will be with electric solenoid. The height of the doors is 1.9 m. The construction of the doors shall be same as panel construction described in clause 7.1.4 of the specification. Sliding door frame shall consist of heavy-gauge anodized aluminum of 6063T-5 alloy not less than 3.2 mm thickness with safety radius corners on all vertical rails. Sliding rail required for fixing to door panel shall be from reputed make like Henderson Germany or equivalent. Continuous extruded header section of the rail shall be with ball bearing wheels on nylon-covered support track. The door movement (opening/closing) shall be jerk free. Overlapping at the door and hutch junction shall be ensured to avoid any radiation streaming. The door marked D5 in drg. RRCAT/ISUD/ IND-2 /BL-HUTCH/ 2014/BL-2 & 10, Sheet 1 of 11 shall be made of Aluminum and glass panel. The door marked D1 in drg. RRCAT/ISUD/ IND-2 /BL-HUTCH/ 2014/BL-2 & 10, Sheet 11 of 11 shall be made of Aluminum and glass panel.

**Table 5: Detail of personnel access doors in BL-2 hutch**

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Door size</th>
<th>Lead Sandwich detail</th>
<th>Qty</th>
<th>Remarks</th>
</tr>
</thead>
</table>
| 1   | 2500 mm Sliding door (made as two parts) | 1 mm lead sheet | 2 Nos. | 1. Item No D1 and D2 of Dwg: RRCAT/ISUD/ IND-2 /BL-HUTCH/ 2014/BL-2 & 10, Sheet 1 of 11  
2. Electric lock shall be provided in both door with solenoid, a pair of reed switches and limit switches.  
3. Lead glass viewing windows (size 200 mm x 300 mm with equivalent lead thickness of 1 mm) shall be provided on this door. |
| 2   | 2500 mm Sliding door (made as two parts) | 1 mm lead sheet | 1 No. | 1. Item No D3 of Dwg: RRCAT/ISUD/ IND-2 /BL-HUTCH/ 2014/BL-2 & 10, Sheet 1 of 11.  
2. Electric lock shall be provided in the door with solenoid, a pair of reed switches and limit switches.  
3. Lead glass viewing windows (size 200 mm x 300 mm with equivalent lead thickness of 1 mm) shall be provided on this door. |
| 3   | 800 mm Sliding door | 3 mm lead sheet | 1 No. | 1. Electric lock shall be provided the door with solenoid, a pair of reed switches and limit switches.  
2. Item No D4 of Dwg: RRCAT/ISUD/ IND-2 /BL-
### Table 6: Detail of personnel access doors in BL-10 &11 hutch

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Door size</th>
<th>Lead Sandwich detail</th>
<th>Qty</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2500 mm Sliding door (made as two parts)</td>
<td>1 mm lead sheet</td>
<td>1 Nos.</td>
<td>1. Item No D1 of Dwg: RRCAT/ISUD/ IND-2 /BL-HUTCH/ 2014/BL-2 &amp; 10, Sheet 2 of 11&lt;br&gt;2. Electric lock shall be provided in door with solenoid, a pair of reed switches and limit switches.&lt;br&gt;3. Lead glass viewing windows (size 200 mm x 300 mm with equivalent lead thickness of 1 mm) shall be provided on this door.</td>
</tr>
<tr>
<td>2</td>
<td>2500 mm Sliding door (made as two parts)</td>
<td>No lead sheet</td>
<td>1 No.</td>
<td>1. Item No D2 of Dwg: RRCAT/ISUD/ IND-2 /BL-HUTCH/ 2014/BL-2 &amp; 10, Sheet 2 of 11.&lt;br&gt;2. Electric lock shall be provided in the door with solenoid, a pair of reed switches and limit switches.&lt;br&gt;3. Glass viewing windows (size 200 mm x 300 mm shall be provided on this door.</td>
</tr>
<tr>
<td>3</td>
<td>800 mm Sliding door</td>
<td>No lead sheet</td>
<td>1 No.</td>
<td>1. Electric lock shall be provided in the door with solenoid, a pair of reed switches and limit switches.&lt;br&gt;2. Item No D3 of Dwg: RRCAT/ISUD/ IND-2 /BL-HUTCH/ 2014/BL-2 &amp; 10, Sheet 2 of 11.</td>
</tr>
<tr>
<td>4</td>
<td>1000 mm, Sliding door</td>
<td>3 mm lead sheet</td>
<td>1 Nos.</td>
<td>1. Item No D4 of Dwg: RRCAT/ISUD/ IND-2 /BL-HUTCH/ 2014/BL-2 &amp; 10, Sheet 2 of 11.&lt;br&gt;2. Electric lock shall be provided in the door with solenoid, a pair of reed switches and limit switches.</td>
</tr>
</tbody>
</table>

#### 7.2. Material requirements

The supplier shall use the materials specified in the drawings, and this technical specification, and certification of materials used in the fabrication shall be submitted to the purchaser.

**7.2.1. General**

All materials used inside the hutch shall be capable of withstanding a high X-radiation environment. All materials used for enclosure shall be fire resistance/ fire retardant grade.

Proper lighting has to be provided inside the hutch using electrical tube lights (including the hutch sitting area).
7.2.2. Lead

All lead parts produced shall have a minimum relative density of 11.3 g/cm³. They shall be free of visible cracks and holes and free of grease, oil or any other slippery substance. Pb-glass windows must have an equivalent Pb-thickness at least equal to the minimum Pb-thickness. The given lead thickness values are minimum thickness. The lead parts shall not be damaged, hammered or otherwise spoiled before or during assembly.

**Lead castings:** The composition of cast lead brick shall be as follows:
- Antimony: 4 ± 0.5%
- Impurities: < 1%
- Lead remainder: At least 95% (all by weight)

**Physical Properties:** (Melting temp): 327 °C
- Density: 11.35 gm/cm³

The fabricator is free to choose the casting process. For good casting it shall be ensured by the fabricator that the temp of the molten lead as well as the die surface is 400 °C -500 °C. This shall be maintained and recorded suitably. The die/mould with the necessary allowances shall be given for purchaser’s approval prior to the casting.

Lead being a poisonous and high-density material, with a low melting temperature, care must be taken by the fabricator for its safe handling during melting and casting. All necessary precautions must be taken in order to avoid inhalation of any fumes of lead by the workers.

These lead bricks are to be used for radiation shielding, therefore these must be free from casting defects like blowholes, porosity, shrinkage cavity, hot tear etc.

7.2.3. Steel/Aluminum

The material used in the construction of the outer panels, inner panels, frame supports shall be fabricated out of cold rolled closed annealed (CRCA STEEL) sheet. The entire sheet shall be free of scales, blisters, laminations, cracked edges and defects of any sorts. Samples of the materials shall be tested in approved laboratory for mechanical properties. Test reports shall be supplied to RRCAT before starting fabrication.

**Table 7:** Minimum values (in gauge/mm) for sheet metal for hutch construction

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Type</th>
<th>Material</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frame</td>
<td>Sheet</td>
<td>CRCA steel</td>
<td>10G (3 mm)</td>
</tr>
<tr>
<td>Outer panel</td>
<td>Sheet</td>
<td>CRCA steel</td>
<td>20G (0.9mm)</td>
</tr>
<tr>
<td>Inner panel</td>
<td>Sheet</td>
<td>CRCA steel</td>
<td>18G (1.2mm)</td>
</tr>
<tr>
<td>Roof</td>
<td>Sheet</td>
<td>Aluminum</td>
<td>3mm</td>
</tr>
<tr>
<td>Roof</td>
<td>Sheet</td>
<td>CRCA steel</td>
<td>2mm</td>
</tr>
</tbody>
</table>

7.2.4. Fasteners

All the fasteners used shall be structural bolts of property class 4.6 or above, as per IS 3757 – 1985. Anchor fasteners required for fixing to concrete floor and wall shall be from reputed make like Fischer, Hilti or equivalent. Supplier must ensure the fixing of the anchors as per the design catalogues of the manufactures. Repair of the floor after the anchoring is the responsibility of the supplier.
Note: Any special drill bit or tooling required for drilling holes in the concrete wall, for fixing the anchor fasteners shall also be provided by the supplier.

7.3. Fabrication requirements

Fabrication of the hutches and local shielding are defined in the drawings and this technical specification. Welding for local shielding shall be done by skilled welders. Fillet welds at all the location shall be such that the root penetration is ensured. Weld beads should have smooth profile and be free from visual defects such as cracks, undercuts, and incomplete penetration. Proper clamping and pre-heating of structural components shall be done to avoid weld distortions and cracks.

Any subcontracted work shall be clearly mentioned in the offer. Minor modifications in structures, if required, shall be done by the supplier without any extra cost.

7.4. Assembly and workmanship

- The parts shall be free of burrs and sharp edges, and free of dents, gouges and scratches.
- The parts shall be clean and free of dirt, oil and grease with the exception of the appropriate lubrication on moving bearing surfaces.
- All fasteners on moving devices shall be locked by washers or similar locking devices to prevent loosening.

7.5. Surface protection/Painting

All the sections shall have surface protection against rusting. CRCA steel panels and frames shall be cleaned and phosphated (with zinc phosphate solution) in a seven-tank metal cleaning process. Thereafter it shall be powder coated for 25-30 micron thickness with semi glossy finish of polyester based epoxy powder coating. All the relevant standards of testing of coating thickness shall be adhered as given in this technical specification. For local shielding structures, one coat of good quality red oxide primer shall be given to all parts. Two coats of PU-paint of golden yellow finish shall be given before dispatch of material to RRCAT. All the lead bricks and lead sheets shall be epoxy painted.

The purchaser shall decide final colour at the time of painting/coating.

7.6. Exhaust fans

Roof mounted exhaust fans (propeller type) shall be provided in the hutches as shown in the drawing (Dwg: RRCAT/ISUD/ IND-2 /BL-HUTCH/ 2014/BL-2 & 10, Sheet 1 and 2 of 11). These fans shall have the capacity 1000 CFM for each enclosure. The exhaust fans shall be "quiet" type with noise level less than 65db.

7.7. Cable trays

Three perforated cable trays (one for BL-2 hutch, one for BL-10 hutch and one for BL-11 hutch, along the length of the hutches) of size 150 mm X 100 mm shall be provided on the side shielding wall with proper fixtures. The cable trays and fixtures shall be duly power coated as per the specifications.
8. **Erection/Installation of Hutches at site**

Installation and commissioning of the shielding enclosure (hutch) shall be as per the technical specifications and drawings. For working at height, proper access ladder and hoist shall be arranged by the supplier. The supplier must ensure the safety of personals and components during erection and installation. There is a 2 MT EOT crane and hydraulic scissor lift available in the experimental hall. The supplier is responsible for any kind of accident of his personal and components. The supplier has to take all the necessary safety precautions during installation work to avoid damage to nearby beamline equipments at erection site. Local shielding shall be installed after completion of the hutch. No spray painting is permitted inside Indus-2 experimental hall.

The supplier may visit Indus-2 RRCAT site before offering the bid, to get a feel of installation work.

9. **Inspection and testing**

9.1. **General**

Responsibility of ensuring the quality of fabrication as specified in this specification will be with the fabricator. The purchaser in general will have the role of verifying the quality control measures taken by the supplier. However, the purchaser will be free to inspect any components or the processes and will take decision about acceptance or rejection of the processes or the components as per this specification. In case of dispute the decision of the purchaser shall be final and binding. The authorized representative appointed by the purchaser will have access to the manufacturer’s works at all reasonable times for the purpose of witnessing the manufacture, inspection and testing of individual items and complete structures. Inspection documents and records generated by the contractor’s inspection department shall be freely accessible to the purchaser for the verifications etc.

9.2. **Inspection**

- All the structural and other materials used in fabrication shall be new and certified.
- Reconditioned, modified, tempered, used or second-hand materials or components shall not be used in construction and will be a cause of rejection. All raw materials shall be examined visually to detect suspect or counterfeit parts, obvious defects and the state of cleanliness. Any component having dent marks or poor surface finish resulting from corrosion will be a cause of rejection.
- Weld joints of local shielding structure shall be DPT tested on 10% of weld-length to ensure that the welds are free from detrimental defect. Dimensional checking of all the components as per the drawings as per clause 6 shall be done at the fabricator’s site before dispatch to RRCAT.

9.3. **Acceptance testing**

The following items are the minimum requirements for the acceptance tests:

1) Verification of overall dimensions as per the drawings (RRCAT/ISUD/ IND-2 /BL-HUTCH/ 2014/BL-2 & 10).
2) Verification of Door Panel Motion: The motion of each door shall be tested for the following: Range of motion, Locking, Rubbing or Scraping, and Wobbling.

3) Chemical analysis of the lead bricks and lead sheet: The chemical composition of the lead bricks and lead sheet shall be as per specification and the standard.

4) Verification of Radiation leakages: The radiation shielding streaming for ionizing X-radiation from joints, Lead viewing window and penetrations after erection of the hutch shall be demonstrated and verified.

5) Verification of surface coating as per relevant standard.

6) Lead bricks casting as mentioned in 7.2.2.

7) Flow rate and noise level of exhaust fans as mentioned.

10. **Sub-contract**

   The supplier shall clearly indicate any work intended to be sub contracted to any other party in the offer. Sub-contracting will be permitted only if purchaser is satisfied with the capability of the sub-contractor. The supplier is responsible for all the operations carried out by the sub-contractor, including the inspection.

11. **Delivery schedule**

   Supplier shall submit the drawings, including details of bills of materials, door actuator system scheme, all relevant manufacture and assembly procedures, welding procedure and qualifications for approval.

   The beamline hutch with all the items shall be delivered to Indus-2, RRCAT site within sixteen weeks from the date of the purchase order. Installation and erection of the hutch shall be completed within three weeks thereafter.

**Notes:**

The following information shall be submitted along with the quotation by the fabricator:

1) List of the fabrication facilities available with the supplier.

2) Give details of similar/equivalent jobs undertaken and the list of clients and their contact addresses.

3) Detailed proposed delivery schedule and payment conditions.

4) The supplier shall give the cost breakup on per square feet basis for hutch panels, doors, and roof.
NOTES:
1. THIS PORTION OF HUTCH IS OPTICS HUTCH OF BL-2
   THE HATCH PORTION OF THE DRAWING HAS TO BE PROVIDED WITH 2mm CASA ROOF
2. FOR LEAD SHIELDING DETAIL SEE THE BILL OF MATERIAL
3. EXHAUST FANS OF CAPACITY 1000 CFM, QTY: 1 EACH
4. HEIGHT OF THE HUTCH = 2.5 MTR
5. HEIGHT OF THE DOOR = 1.9 MTR
6. HEIGHT OF THE CABLE TRAY FROM GROUND = 2.2 MTR
7. SIZE OF THE CABLE TRAY = 150 mm WIDE X 100 HEIGHT
8. PROPER LIGHTING HAS TO BE PROVIDED INSIDE THE HUTCH, INCLUDING SITTING AREA.
9. ALUMINIUM PANELS ARE COMPOSITE TYPE COMMERCIAL ALUMINIUM SHEETS WITH GOOD FINISH.

请参考技术规范单页获取完整细节。
NOTES:
1. THIS PORTION OF HUTCH IS OPTICS HUTCH OF BL-10 AND BL-11
   THE HATCH PORTION OF THE DRAWING HAS TO BE PROVIDED WITH 2mm G.I./C.R.A. ROOF
2. FOR LEAD SHELVING DETAIL SEE THE BILL OF MATERIAL
3. EXHAUST FANS OF CAPACITY 1000 C.F.M., QTY. 2 Nos.
4. HEIGHT OF THE HUTCH = 2.5 MTR
5. HEIGHT OF THE DOOR = 1.9 MTR
6. HEIGHT OF THE CABLE TRAY FROM GROUND = 2.2 MTR
7. SIZE OF THE CABLE TRAY = 150 mm WIDE X 100 HEIGHT
8. PROPER LIGHTING HAS TO BE PROVIDED INSIDE THE HUTCH, INCLUDING SITTING AREA
9. ALUMINUM PANELS ARE COMPOSITE TYPE COMMERCIAL ALUMINUM SHEETS WITH GOOD FINISH.
ASSEMBLY OF INNER AND OUTER PANEL

INNER PANEL
(PASTED WITH LEAD SHEET)
(AS PER TECHNICAL SPECIFICATION)

SUPPORT BRACKET

FLOOR CHANNEL

VERTICAL FRAME

OUTER PANEL
LOCAL SHIELDING—FOR BL-2 & 10 HUTCH

LEAD THICKNESS : 50
QTY: 1 No.

** THERE SHOULD BE SPACE IN SUPPORT STRUCTURE FOR ADDING 50mm MORE LEAD IN FUTURE
* CENTRE HEIGHT MAY VARY. PL CHECK ACTUAL

NOTES:
1. DIAMETER OF LEAD BALLS IS ~1mm - 2mm
2. THE TOTAL WEIGHT OF LEAD BALLS TO BE SUPPLIED IS 100Kgs
1.6 mm thick extruded aluminium

5 mm thick Glass

Composite alum. pannel on both sides
PLEASE REFER TECHNICAL SPECIFICATION SHEET FOR COMPLETE DETAILS

NOTES:

1. THIS PORTION OF HUTCH IS ALREADY EXISTING.
2. HEIGHT OF THE CABIN = 2.5 MTR
3. HEIGHT OF THE DOOR = 1.9 MTR
4. ALUMINUM PANELS ARE COMPOSITE TYPE COMMERCIAL ALUMINUM SHEETS WITH GOOD FINISH.