MIRACLES (ESS) Bunker Wall Insert
Technical Specifications

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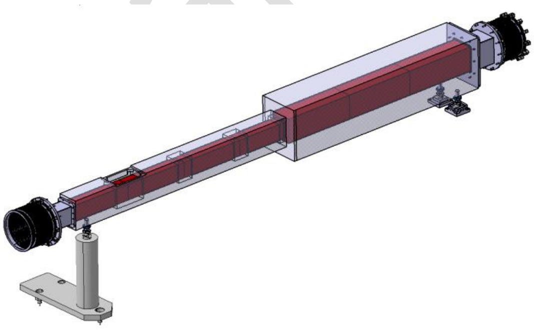

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TABLE OF CONTENTS

1. information and General requirements ... 6
1.1. Scope of document ... 6
1.2. Terms ... 6
1.3. Document structure ... 6
1.4. List of further applicable documents ... 6
1.5. Operation time, mean time between failure (MTBF), service time ... 7
1.6. Technical Documentation ... 7
2. Scope of Supply ... 8
2.1. An introduction to the European Spallation Source ... 8
2.2. Working at ESS ... 9
2.3. Scope of the supply: the Bunker Wall Insert ... 9
2.4. Scope of Work ... 11
2.5. Definition of terms and systems of reference ... 12
3. Neutron Optics ... 13
3.1. General information ... 13
3.2. Interfaces ... 13
3.3. Detailed functional requirements ... 13
3.3.1. Surface geometry ... 14
3.3.2. Entrance and exit dimensions ... 14
3.3.3. Segment length error ... 14
3.3.4. Step alignment error ... 14
3.3.5. Waviness ... 14
3.3.6. Local defects ... 15
3.3.7. Coatings ... 15
3.3.8. Substrate thickness ... 16
4. Shielding Jackets, Support & Alignment ... 16
4.1. Shielding jackets: General information ... 16
4.2. Shielding jackets: Detailed functional requirements and tolerances ... 17
4.3. Support and Alignment: General information ... 17
4.4. Supports and Alignment: Detailed functional requirements and tolerances ... 17
4.4.1. Provisions for alignment with respect to external axis ... 17
4.4.2. Alignment marks ... 18
4.4.3. Alignment equipment compatibility ... 18

4.5. Interfaces 19
5. Mechanical Assembly 21
5.1. The Vacuum Vessel Assembly: General Information 21
5.2. Vacuum General Requirements 22
5.3. Mechanical General Requirements 23
5.4. Labeling 23
5.5. Supports 23
5.6. External interfaces (towards environment) 24
6. Specific BWI requirements 25
6.1. Operating conditions 25
6.2. Service life 25
6.3. Allowed Materials 25
6.3.1. High purity copper 26
6.3.2. General construction. 26
6.4. Surface treatment 27
6.5. Stress relief 27
6.6. Mechanical integrity 27
6.7. Requirements for Vacuum 27
6.8. Requirements for materials handling 28
7. Project management requirements 29
7.1. Project Phases 29
7.1.1. Phase 1: Detailed Design 29
7.1.2. Phase 2: Manufacturing and verification 29
7.1.3. Phase 3: Delivery and Integration 30
7.2. Verification and Integration 30
7.3. Project milestones (PMS), deliverables and meetings 32
7.3.1. Project kick-off 33
7.3.2. Preliminary design review (PDR) 33
7.3.3. Critical Design Review (CDR) 33
7.3.4. Factory Acceptance Test (FAT) 33
7.3.5. Site Acceptance Test (SAT) 34
7.3.6. Communication / Delivery note 34
7.4. Acceptance and release of project phases 34
8. Quality assurance requirements 35

8.1. Quality management system 35
8.2. Handling, packing, and transport 35
8.2.1. Handling and packing 35
8.2.2. Transportation for delivery to ESS 35
8.2.3. Handing over of packaged parts responsibility 36
9. List of Acronyms 37

LIST OF FIGURES

Figure 1. The ESS Initial instrument suite 9
Figure 2. Section of the Bunker showing the location of the Bunker Wall Insert. 9
Figure 3. Section of BWI with optical assembly highlighted in red. 10
Figure 4. (Top) Image BWI MIRACLES Optical Assembly (purple); Vessel Assembly (green & grey); Shim Box (red) and Supports (Bottom): Bunker Wall Insert breakdown. 11
Figure 5. Definition of coordinate axes. 12
Figure 6. BWI unit structure. 13
Figure 7. Representative neutron reflectivity curves for m=4.0 supermirror guide coatings 15
Figure 8. Illustration showing the increasing thickness of the BWI due to the jacket. 16
Figure 9. BWI support and alignment features. 17
Figure 10. System Interface points 19
Figure 11. Anti-streaming step at the bunker wall insert. Substrate thickness increases by 30 mm while considering a clearance gap between optics and steel casing of 3 mm (10x rule). 20
Figure 12. Vacuum vessel assembly. Access aperture for alignment in the housing. 21

LIST OF TABLES

Table 1. Documents attached along with the technical specification 6
Table 2: Applicable international standards 7
Table 3: Applicable ESS documents 7
Table 4. Characteristics of neutron optics. 14
Table 5. Coating definition. 15
Table 6. A 10 mm gap is considered between all surfaces of steel casing and shims, therefore, step in downstream housing follows 8x rule (80 mm step). 22
Table 7. Operating conditions requirements - Normal operation. 25
Table 8. Operating conditions requirements - Storage and Transport. 25
Table 9. Approved construction materials. 26
Table 10. Direct beam materials. 26
Table 11. Scattered beam materials. 27

Table 12 Acceptable materials for vacuum vessels 28
Table 13: Milestones, Meetings, Reviews and Deliverables of project phases 32
Table 14: Deliverables for kick-off meeting 33

1. INFORMATION AND GENERAL REQUIREMENTS

1.1. Scope of document

This document in conjunction with referenced annexes establishes the requirements for the design, manufacture and test of the Bunker Wall Insert (BWI) for the MIRACLES instrument (PBS number: 13.6.16.1.2.1.2) to be installed on the W05 beam port at the European Spallation Source in Lund Sweden. MIRACLES is part of the ESS-Bilbao involvement as Spanish In-Kind partner.

1.2. Terms

Herein, the terms ‘contractor’ shall refer to the parties responsible for providing the scope of work defined below, and ‘customer’ shall refer to the purchaser (ESS-Bilbao) and its representatives, including the ESS. The contractor is responsible for fabrication, inspection, testing, packaging, shipping, and other stipulated services in accordance with the requirements of this specification.

1.3. Document structure

Information and requirements in this document have been structured a tiered manner:

- General information, constraints and requirements concerning all components of the assembly are indicated in common sections found at the start and end of the document.
- Additional requirements applicable to specific groups of components or sub-assemblies are indicated within the relevant sub-section.

1.4. List of further applicable documents

The following files will be supplied together with this specification (Table 1).

DOCUMENT NUMBER	TITLE
MRCL-BL-0010.03	MIRACLES BWI (drawing)
ESS-0092801.1_1.5	MIRACLES Feedthru W5 (housing envelope)

Table 1. Documents attached along with the technical specification

Applicable International Standards are outlined below (Table 2):

No.	Doc ID	Title
1.	DIN EN ISO 1101 or equivalent	Geometrical product specifications (GPS) - Geometrical tolerancing
2.	ISO 128-1 or equivalent	Mechanical drawing standard
3.	ISO 129-1 or equivalent	Technical drawings. Indication of dimensions and tolerances. General principles
4.	ISO 5725-1 or equivalent	Accuracy (trueness and precision) of measurement methods and results
5.	DIN EN 60617 or equivalent	Graphical symbols for diagrams

6.	DIN EN 10204 or equivalent	Metallic product – types of inspection doc.

Table 2: Applicable international standards

Applicable ESS internal standards are outlined below (Table 3):

No.	Doc ID	Rev	Title
1.	ESS-0037830	Latest version	ESS Template for Project Quality Plan
2.	ESS-0047989	Latest version	ESS Rules for Quality regulation for mechanical equipment
3.	ESS-0127031	Latest version	ESS Rules for CE marking
4.	ESS-0002411	Latest version	ESS Procedure for Mechanical Engineering Design
5.	ESS-0012895	Latest version	ESS Vacuum Handbook
6.	ESS-0012977	Latest version	ESS Guideline for survey and alignment fiducials

Table 3: Applicable ESS documents

1.5. Operation time, mean time between failure (MTBF), service time

After successful completion of acceptance, ESS ERIC will be the entity towards warranty must be granted. The warranty period extends to 5 years after SAT (described in the Cover Letter, PCAP).

All systems must be designed and manufactured to achieve:

- The sequence: continuous operation time 24/7 for six months within full radiation field followed by 1-3 months within residual radiation from surrounding component activation.
- No access for component maintenance within the expected component lifetime.
- A minimum lifetime of 20 years.

1.6. Technical Documentation

All documentation must be in English language.

Depending on the nature of a milestone (design, intermediary, manufacturing or installation) documentation has to be supplied by the contractor.

The contractor shall consider that the purpose of the documentation is to allow ESS-Bilbao and ESS to verify that the design meets the specified requirements, that quality management was properly applied and to properly document all systems being installed at the ESS site.

The documentation shall include a set of mechanical drawings including the specific definition of the system interface points (SIP) to the ESS systems. The following drawings shall be provided:

- An overall assembly drawing, showing the outline dimensions of the complete systems.
- Individual assembly drawings for safe transportation and positioning
- Any manufacturing drawings necessary for the CDR documentation.

Additionally, a 3D CAD-File of the complete assembly must be provided. That model file will solely be used for integration planning in the building, so any internal components may be deleted.

The part list shall list all components down to all user replaceable parts. At least it shall include:

- Any mechanical commercial off-the-shelf component
- The contractors part number plus the original manufacturers detailed type information including the order code.
- Components size and weight for any component heavier than 5kg.
- The part list can be either a single list or can be organized hierarchical with individual lists for subassemblies.
- It must be provided as electronic copy in Excel format.

2. SCOPE OF SUPPLY

2.1. An introduction to the European Spallation Source

The European Spallation Source (ESS) is a European Research Infrastructure Consortium (ERIC), a multi-disciplinary research facility based on the world's most powerful neutron source with a vision to enable scientific breakthroughs in research related to materials, energy, health and the environment, and address some of the most important societal challenges of our time.

The initial suite of neutron instruments will consist of 15 instruments and a test beam line with further integration of instruments following to complete the projected suite of 22 instruments. ESS-Bilbao is the main partner in the design and construction of MIRACLES for which the components that are subject in this tender is designated.

Every neutron instrument will operate as a coherent system independently of other instruments but may share resources with other instruments. Specific experimental conditions or preparations that may be required by the experimental programmes will be supported by ESS laboratories or other partner laboratories.

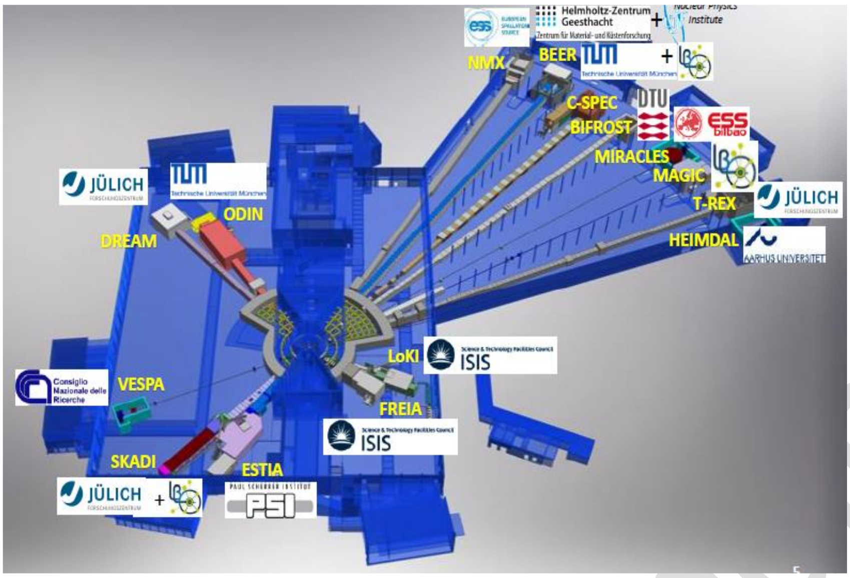


Figure 1. The ESS Initial instrument suite

2.2. Working at ESS

Access and work at the ESS Site is subject to Swedish and to ESS internal regulations, depending on the nature of work to be performed a specific professional certifications may be required. Foreign certifications shall be assessed for validity in Sweden. Access to site is regulated and all external personnel will undergo an induction course on site (90min) and will need to obtain an ID06 access card, the time required to obtain such card can be lengthy and shall be considered when planning installation work. More information regarding working on site can be found here:

https://europeanspallationsource.se/procurement#working-site.

2.3. Scope of the supply: the Bunker Wall Insert

The Bunker is a closed structure providing common radiation shielding functionality to the first section of the ESS neutron instruments. The bunker wall insert (Figure 2) complements this shielding functionality of the wall in correspondence of the instrument's dedicated penetration.

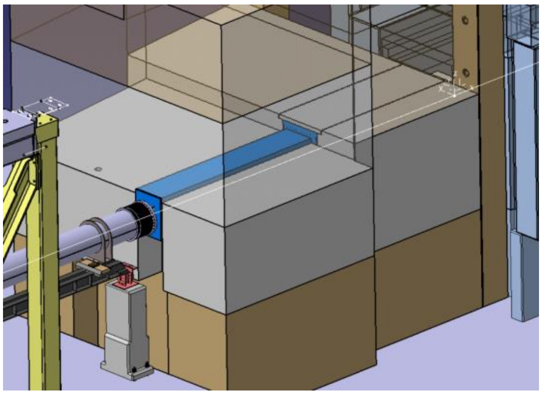


Figure 2. Section of the Bunker showing the location of the Bunker Wall Insert.

The Bunker Wall Insert (BWI) is the connecting component between the in-bunker optics and the out-bunker optics. It transports the neutron beam efficiently through the bunker wall and acts as shielding for high energy neutrons and gamma rays.

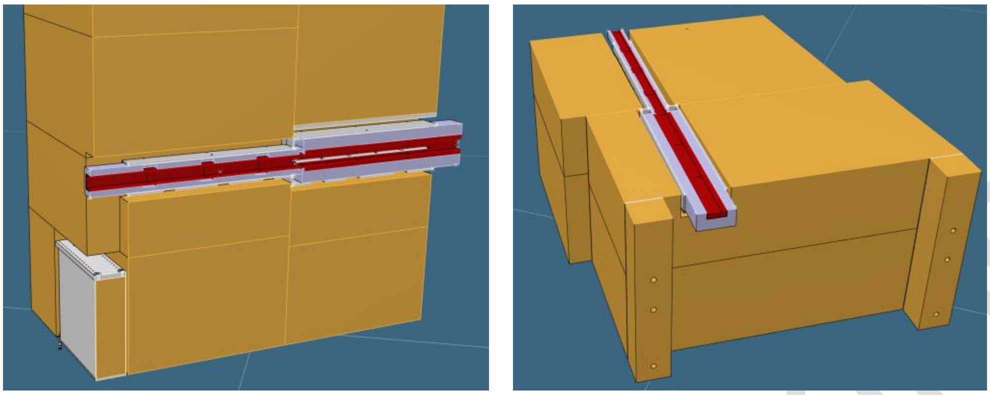
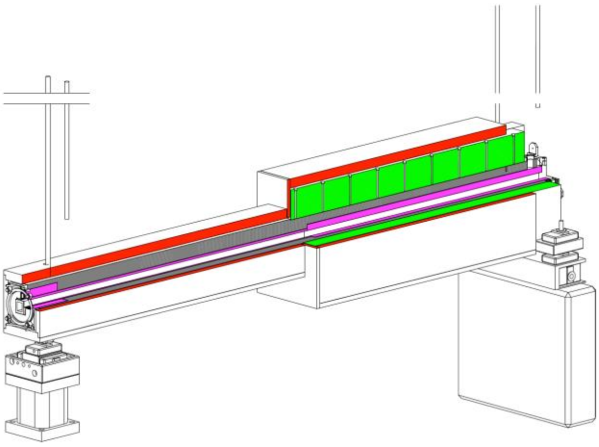


Figure 3. Section of BWI with optical assembly highlighted in red.

Thus, the whole BWI assembly consists of: (a) the BWI optical assembly (neutron guide + jackets); (b) the BWI mechanical assembly (vessel); (c) the shim box.

The mechanical assembly is, in turn, composed of two sub-systems: (a) the vessel assembly; (b) the alignment features; (c) the supports.



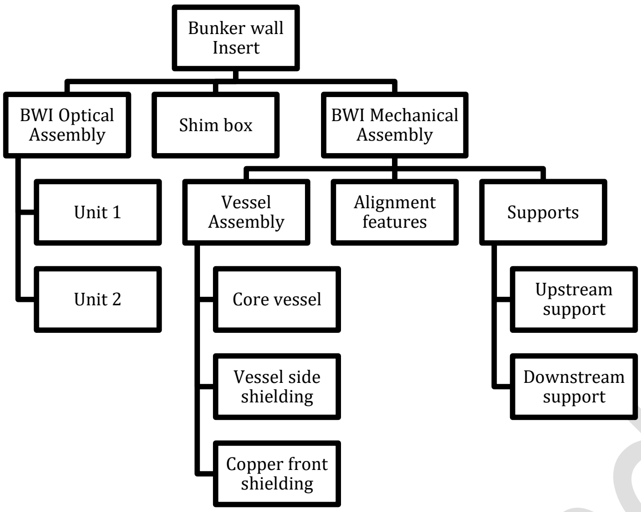


Figure 4. (Top) Image BWI MIRACLES Optical Assembly (purple); Vessel Assembly (green & grey); Shim Box (red) and Supports (Bottom): Bunker Wall Insert breakdown.

2.4. Scope of Work

The scope of work includes all the necessary tasks and deliverables for the operation of the BWI:

1) Conceptual design
2) Detailed design
3) Production and assembly
4) Factory acceptance tests (FAT)
5) Delivery to ESS storage facility
6) Transport to ESS and installation
7) Site acceptance test (SAT) of the complete system
8) Documentation

The scope of this supply includes:

a) Development and detailed design of the BWI, demonstrating the fulfilment of the functional and geometrical requirement as well as compliancy with the defined interfaces;
b) Specification of interfaces and alignment features to the BWI;
c) Fabrication and assembly of one BWI assembly;
d) Packaging and shipment to ESS premises;
e) Validation and verification reviews;
f) Documentation;
g) Integration of the BWI optical assembly at ESS Site in the BWI mechanical assembly, alignment and fiducialisation with respect to mechanical assembly's survey mounts.
h) Integration of the BWI assembly at the ESS Site in the bunker wall, and alignment to the MIRACLES theoretical line;
i) All necessary flanges, windows and gaskets to perform vacuum tightness tests and for future performance;

j) Any minor part not specifically defined, but required for the complete assembly, shall be considered included herein, unless specifically excluded.
k) Warranty

The scope of this supply excludes:

a) The BWI shim box (case provided by the ESS)
b) Vacuum adaptors to the in-bunker and out-of-bunker guides.

2.5. Definition of terms and systems of reference

The origin of the optics for MIRACLES is its Instrument Specific Coordinate System (ISCS), defined with respect to the absolute coordinates of the ESS Target Coordinate System (TCS). Any drawing or 3D model shall include both coordinate systems as a reference.

Reference systems associated with instrument components adopt the following conventions:

X axis (Front – back): The ISCS has its X-axis parallel to the neutron beam direction. The face closest to the neutron source is defined as the front. Values in X increase downstream.

Y axis (Left – right): In the horizontal plane 'left' and 'right' are defined with respect to the direction of transport of neutrons. Left is defined as positive values of Y as that seen as left by neutrons (see Figure 5).

Z axis (Up – down): In the vertical plane curvature 'up' (positive) and 'down' are defined with respect to gravity.

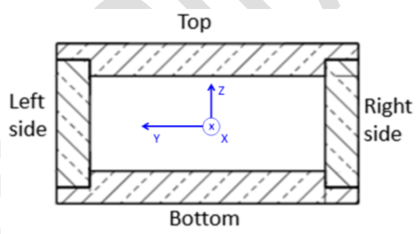


Figure 5. Definition of coordinate axes

3. NEUTRON OPTICS

This chapter describes the functional group “Neutron Optics”.

3.1. General information

The Neutron beam optics will have a total length of around 3400mm (split into 2 units).

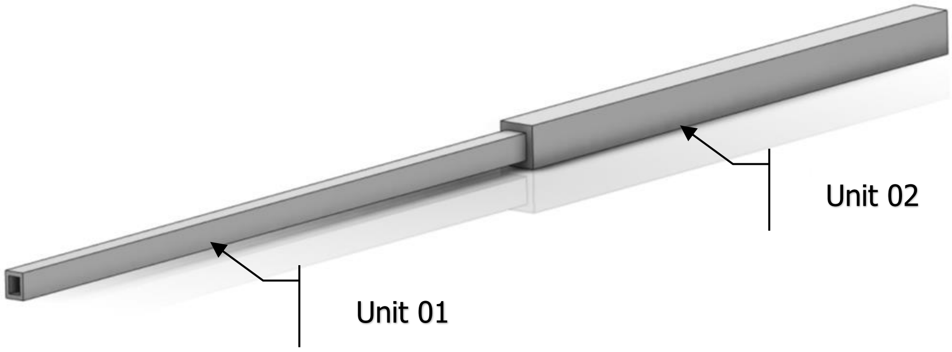


Figure 6. BWI unit structure.

The two units are composed by neutron guides of about 0.5 m long (4 for Unit 1 + 3 for Unit 2), aiming at a better reproducibility (polygonal approximation) of the curvature (2025 m radius) of the guide at the BWI position. Between the optics of the units, a small gap will be established to permit independent alignment and to compensate for any thermal expansion in the system.

The optics will be supported on fixtures situated towards its forward and rear ends. This will permit their independent alignment and their secure location in all load conditions. Parts of the external surfaces of the optics will be ‘jacketed’ with thick sleeves of shielding material.

3.2. Interfaces

The Neutron Optics are in direct physical contact with the Support and Alignment fixtures. The supplier is responsible for the detailed design of these interfaces, according to the position and envelopes of the related drawings that are part of this specification. Furthermore, the shielding jackets should have a direct contact interface with the Neutron Optics. It is possible to make a combined part out of the Neutron optics substrate and the shielding jacket, if the supplier finds this appropriate and justifiable.

3.3. Detailed functional requirements

MIRACLES will be built on beamport W5 in the west Hall of ESS. The MIRACLES BWI is described in drawing “MIRACLES Bunker Wall Insert - drawing – v1

All unit lengths are nominal and to be used for purposes of tender. Exact unit lengths will be confirmed at the time of placement of order and during the detailed design.

Tolerance on trajectory: The deviation of the nominal trajectory between adjacent sections within an assembled unit shall be < +/- 0.02mm.

Unit number	Nominal unit length (mm)	Hor. Radius Curvature (m)	Cross section dimensions (mm)	Substrate	m-value			
					Left	Right	Top	Bottom
01	1826	2025	80 (h) x 100 (v)	Cu	2.0	2.5	2.0	2.0
02	1709.5	2025	80 (h) x 100 (v)	Cu	2.0	2.5	2.0	2.0

Table 4. Characteristics of neutron optics.

3.3.1. Surface geometry

The term ‘surface geometry’ is defined as the full description of a reflective surface at a point along the beam trajectory. Note that each reflective surface of guide present at that point will possess a surface geometry independently.

The guide describes a curve of radius R=2025 m, being the inner surface of the curve the left side (m=2.0), and the outer surface of the curve the right side (m=2.5)

3.3.2. Entrance and exit dimensions

For the BWI optics, the profile consists of a straight section with same dimensions at the entrance and the exit: 80 mm in the horizontal section and 100 mm in the vertical section. Dimension are indicated for information only. All dimensions are nominal and to be used for purposes of tender. Exact unit dimensions will be confirmed at the time of placement of order. Positions are measured from ISCS.

3.3.3. Segment length error

Segment length error is defined as the deviation of the length of the assembled guide unit as measured between the entry and exit faces along the guide axis.

The maximum permissible deviation from the nominal values is length: ± 0.2 mm.

3.3.4. Step alignment error

Step alignment error is defined as lateral positioning error between consecutive individual guide elements or substrates within an assembled unit.

The deviation between two adjacent surfaces shall be ± 0.02 mm.

3.3.5. Waviness

Waviness is defined as the angular deviation from a perfectly flat surface, as measured by optical means.

- On all reflective surfaces the angle between any two surface normals must remain within a cone of semi-angle: $\alpha < 1.5 \cdot 10^{-4}$ radian RMS (Root Mean Square deviation).
- The maximum peak value of acceptance of any point is $\alpha < 3.5 \cdot 10^{-4}$ radian.

3.3.6. Local defects

On all coated surfaces, the cumulative surface of all scratches, greyness, open bubbles, scuff marks, sleeks or other defect shall remain < 0.02% of the total useful area of the component.

On the chamfers, the cumulative surface of cracks or chips must remain < 5% of the edge surface.

3.3.7. Coatings

All coatings shall be of type Ni/Ti 'super mirror'. Table 5 defines the required coating qualities (m-value) of the inner surfaces of the Neutron Optics.

The guide coatings are specified to achieve a minimum critical angle of m times the critical angle of a natural Ni coating (m × 1.73 mrad/Å). For all coatings, the neutron reflectivity is expected to be 99% or greater up to a critical angle of m = 1 (Q_c^{Ni}).

Param.\coating	m=1.5	m=2	m=2.5	m=3	m=3.5	m=4.0
$\boldsymbol{Q_c^{min}}$	1.49 Q_c^{Ni}	1.99 Q_c^{Ni}	2.49 Q_c^{Ni}	2.99 Q_c^{Ni}	3.49 Q_c^{Ni}	3.99 Q_c^{Ni}
$\boldsymbol{Q_c^{avg}}$	1.5 Q_c^{Ni}	2.0 Q_c^{Ni}	2.5 Q_c^{Ni}	3.0 Q_c^{Ni}	3.5 Q_c^{Ni}	4.0 Q_c^{Ni}
$\boldsymbol{R_{Qc}^{min}}$	0.94	0.91	0.89	0.87	0.82	0.78
$\boldsymbol{R_{Qc}^{avg}}$	0.95	0.92	0.90	0.88	0.83	0.79
$\boldsymbol{A_{min}}$	0.031 Å^{-1}	0.041 Å^{-1}	0.049 Å^{-1}	0.059 Å^{-1}	0.068 Å^{-1}	0.076 Å^{-1}
$\boldsymbol{A_{avg}}$	0.032 Å^{-1}	0.042 Å^{-1}	0.051 Å^{-1}	0.061 Å^{-1}	0.070 Å^{-1}	0.078 Å^{-1}

Table 5. Coating definition.

Depending on the coating, a minimum (Q_c^{min}) and average (Q_c^{avg}) critical cutoff, and a minimum (R_{Qc}^{min}) and average (R_{Qc}^{avg}) reflectivity at that critical cutoff are specified. The quality of the supermirror coating on an individual piece is not solely determined by its reflectivity at the nominal supermirror critical angle. The reflectivity profile between Q_c^{Ni} and Q_c^{avg} must decline, on average no faster than, linearly between the R_0 = 0.99 value at Q_c^{Ni} and R_{Qc}. Requirements are placed on the integrated reflectivity over the entire curve for both minimum and average pieces.

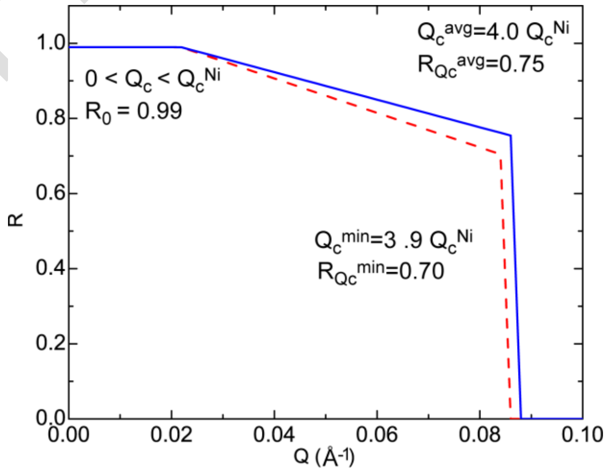


Figure 7. Representative neutron reflectivity curves for m=4.0 supermirror guide coatings

The area under a simplified supermirror reflectivity curve are given by the following expression:

$$A = Q_c^{\mathrm{Ni}}\left[R_0 + \frac{1}{2}\left(R_0 + R_{Qc}\right)\left(m-1\right)\right]. \qquad (1)$$

The minimum required area under the normalized reflectivity curve for any piece is A_{min}, likewise, the area under the required average reflectivity curve is $A_{avg.}$ The parameters for the guide coating described in this specification are provided in the table below

The average profile is shown in blue. The minimum acceptable profile is shown in red. If the Seller's coatings exceed the performance specifications outlined in Table 4, these parameters shall be included in their proposal documentation.

3.3.8. Substrate thickness

A nominal thickness of range: 8-15 mm (preferably 8 mm) is established for all coated substrates in order to ensure sufficient neutron shielding and mechanical robustness. Locally this thickness may be increased by the addition of material or reduced to avoid clashes or production reasons within the range indicated. Deviation from the nominal thickness may be proposed by the supplier during the design phase and will be confirmed by the buyer at the CDR.

Details on the geometry and thickness of substrates for the insert are included in the attached drawing *MIRACLES Bunker Wall Insert - drawing - v1*.

4. SHIELDING JACKETS, SUPPORT & ALIGNMENT

This chapter describes the functional groups "shielding jackets, support and alignment".

4.1. Shielding jackets: General information

At about half the length of the BWI, additional thickness of shielding material is required around the optical substrates of the neutron optics in conjunction with the inner surface of the Mechanical Assembly, creating a shielding chicane. This local increase in thickness of material around the coated substrates with the shielding purpose is referred to as a 'shielding jacket' (see Figure 8).

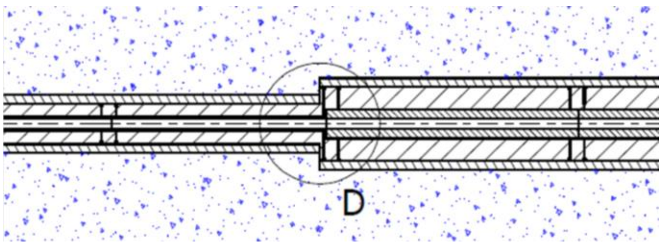


Figure 8. Illustration showing the increasing thickness of the BWI due to the jacket.

Shielding jackets shall be securely affixed to the coated substrates without gap for the service life of the unit and in all conditions. The method of fixation of jacket will be proposed by the supplier and is subject to agreement by the customer during the design phase prior to the CDR.

4.2. Shielding jackets: Detailed functional requirements and tolerances

a) The step between the neutron optics substrate and the shielding jacket shall be as indicated in the drawing.

b) The internal surface of jackets shall be in gapless contact with that of coated substrates. Contact shall be maintained over >90% of adjacent surfaces.

c) Loads placed by jackets on coated substrates shall not measurably deform coated surfaces.

4.3. Support and Alignment: General information

The support and alignment components are responsible for correctly supporting, retaining and aligning the neutron optics components of each unit with respect to each other. The bunker wall insert optical assembly is built of independent sections individually supported and constrained via dedicated alignment features provided by the guide manufacturer.

The resulting neutron guide axis is then referenced to the fiducial mounts of the mechanical assembly for further alignment of the integrated assembly to the instrument neutron beam.

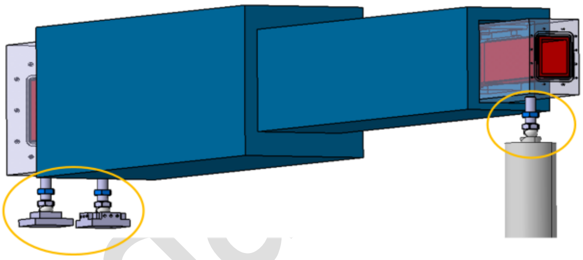


Figure 9. BWI support and alignment features.

Positioning devices are located such as to ensure a secure location without hyper-stability and positioning of the required precision. To ensure consistent contact in all load conditions elastic elements (e.g. springs) or counter screws located opposite rigid positioners will apply a contact force. The mobile part of the positioner bearing against the neutron optical unit is equipped with a non-damaging contact face. The contact point with the unit is situated within a pocket such that the unit remains captive in all load and thermal expansion conditions.

It is up to the guide manufacturer to identify the most suitable solution, to provide specifications and, if necessary, to provide the feature to be integrated. The interfaces will be defined in the final form during the detailed design phase and agreed between the parties.

4.4. Supports and Alignment: Detailed functional requirements and tolerances

4.4.1. Provisions for alignment with respect to external axis

Positioning devices shall be used to support, align and secure each optical unit. The proposed concept assume that units are rigid and supported on 3 points in one plane and 2 points on a second perpendicular plane (the three points should be used on the widest face).

Elastic elements may be employed to ensure consistent contact while allowing differential thermal expansion. All components requiring alignment shall be equipped by the supplier with features for measurement compatible with the specified alignment methodology and equipment type.

Requirements

- Positioners shall ensure the stability of units in operation without hyper-stability.
- Rigid positioners shall be employed below optics components and on the inside side of the curve on curved guides.
- Elastic components shall be employed on the opposite.
- Positioning devices shall be capable of positive locking.
- Positioning devices shall permit the compensation for thermal expansion whilst retaining alignment within tolerance across the range of operation temperatures specified.
- Positioners shall have an adjustment range for the optics of ± 2mm with respect to the nominal position.
- Positioners shall allow the alignment of each guide section's axis to the next one with accuracy ±0.02 mm.
- The contractor will carry out the alignment of the guide units inside the vessel, and measures the position with respect to the external vessel fiducials. Based on this reference, the ESS Survey and Alignment Group will install and align the insert, which will be documented for the SAT.
- The super-mirror surface of the neutron guide shall be within a profile tolerance of ±0.02 mm relative to the true taper profile. This profile tolerance extends the full length of the neutron guide assembly. Individual guide segments (as required) shall be aligned to meet this overall profile tolerance requirement.

4.4.2. Alignment marks

Alignment marks are required on components to permit visual pre-alignment and verification.

- 3 marks shall be made on the front and rear faces of each assembled unit.
    - 2 marks for height, 1 on each vertical side plate at the midpoint of the guide height.
    - 1 mark for width, on the top plate at the midpoint of the guide width.
- Marks shall be visible by the naked human eye at a distance of 1m.
- Marks shall be indelible and remain visible during the lifetime of the guide.
- The maximum permissible deviation from the nominal position is ± 0.1mm.

4.4.3. Alignment equipment compatibility

The alignment process shall be conducted employing a laser tracker system or a theodolite, using the vessel fiducials.

4.5. Interfaces

The Optical Assembly will be installed into a close-fitting pocket machined into the Mechanical Assembly. In order to reduce the leakage of radiation between the optical components and the housing the gap between all surfaces has been reduced to the minimum required for installation and alignment. The nominal gap is 2mm horizontally and 3mm vertically.

A schematic representation of the System Interface Points (S.I.P) is described on Figure 10:

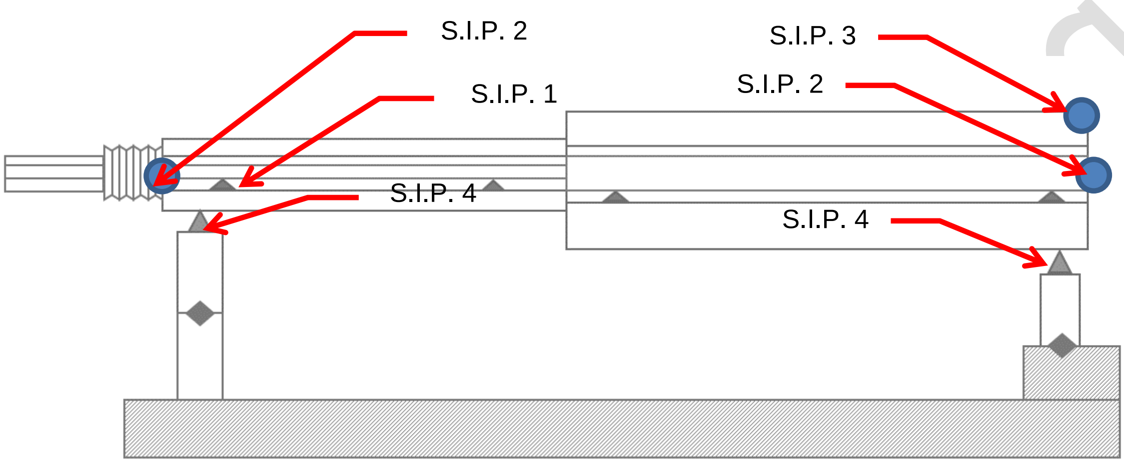


Figure 10. System Interface points

The external physical interface of the Optical Assembly is with the internal surface of the Mechanical Assembly. The geometry of this interfaces is not known at the moment and will be defined in agreement with the design of the Mechanical Assembly. Attached drawing (MIRACLES Bunker Wall Insert – drawing – v1) provides a preliminary space reservation for neutron optics, shielding jackets and supports interfaces, optimization of this interfaces will be possible in consultation with the Customer. The interfaces will be frozen at PDR.

During the design process the Seller is encouraged to propose minor modifications to envelope which reduce costs or simplify production. All modifications must be formally submitted for approval by the Customer.

<u>S.I.P. 1 BWI Optical Assembly: Guide / Support</u>

The bunker wall insert optical assembly is built up from 2 main units of copper substrate, a design built upon 7 independent guide segments and it is supported and constrained via fine screws or dedicated features provided by the guide manufacturer. The final interface will be agreed between the parties at PDR.

The beam height in the area of the bunker wall feedthrough is 1637 mm. Note that in the upstream position a defined support pillar is provided by ESS (Figure 12).

The upstream segments (Unit 1) have 8 mm thick substrate and the downstream unit (Unit 2) shall have an increased substrate thickness or additional shielding jackets, particularly 38 mm substrate thickness. A 3mm gap is considered between guide and steel casing, therefore, step in substrate follows 10x rule (30 mm step). This 10x rule is applied to all downstream surfaces of the substrate.

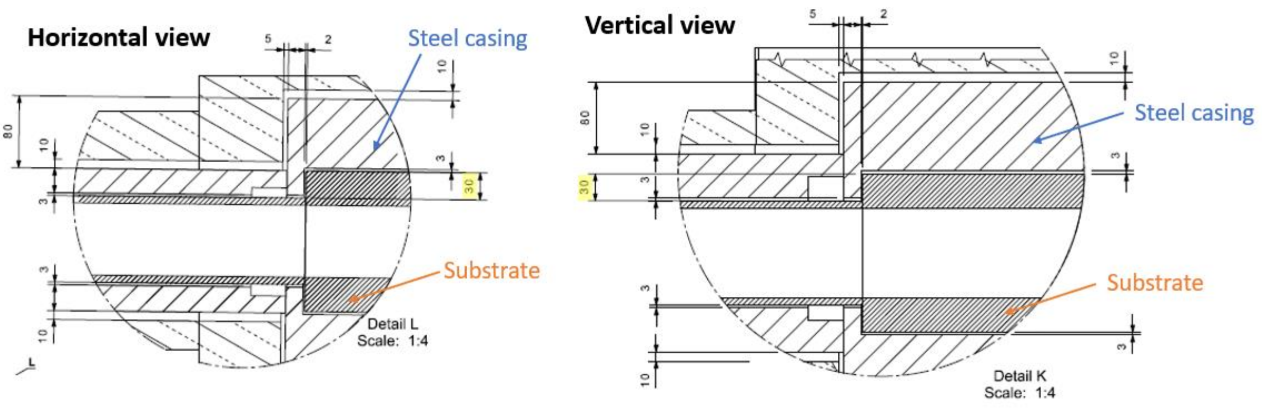


Figure 11. Anti-streaming step at the bunker wall insert. Substrate thickness increases by 30 mm while considering a clearance gap between optics and steel casing of 3 mm (10x rule)

<u>S.I.P. 2 BWI Optical Assembly / BWI Mechanical Assembly (Vacuum Vessel)</u>

The upstream flange connects the vacuum of the mechanical assembly to the upstream section of neutron guides and their vacuum vessels

The downstream flange connects the vacuum of the mechanical assembly to the downstream section of the neutron guides and their vacuum vessels.

5. MECHANICAL ASSEMBLY

This chapter describes the functional group "Mechanical Assembly".

The BWI Mechanical assembly is, in turn, comprised of two main assemblies: (a) the Vacuum Vessel, and (b) the Supports.

5.1. The Vacuum Vessel Assembly: General Information

The Vacuum Vessel assembly provides:

- Shielding functionality to prevent undesired neutrons and gamma photons to escape the bunker volume through the wall penetration.
- Vacuum functionality to provide a vacuum atmosphere and minimizing losses.

For this reason, around a core vacuum tight vessel, steel shielding elements are tightly connected to the vessel to provide, together with the shim box, a radiation tight labyrinth.

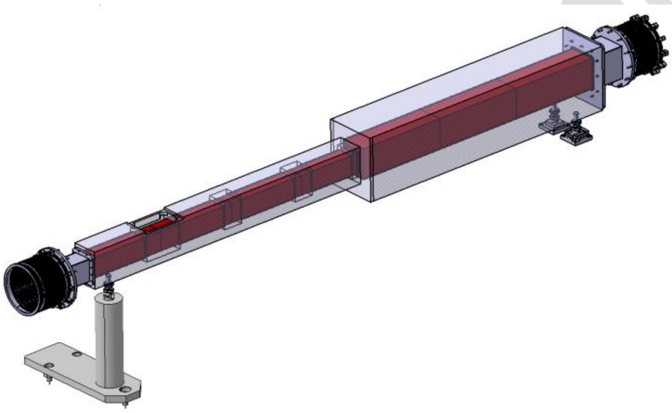


Figure 12. Vacuum vessel assembly. Access aperture for alignment in the housing.

Although it can be divided into upstream and downstream sections, the supplier is free to change this if there is any advantage in the design, fabrication or installation works.

The upstream section should include a removable copper block surrounding the neutron guide, to provide protection towards the radiological activation of the steel invested by neutron flux.

The MIRACLES beamline has a rotation angle of 1º to the right, and the optics are following a 2025 m radius curve centered to the left; this means that the guide passes through the bunker wall with an angle of 0.65º through the wall. The angular deviation of the optics is compensated by the grouted sleeve in the bunker wall.

Both the upstream & downstream ends of the steel casing have an adaptor for the transition from cylindrical to rectangular geometry of housings. Both adaptors are connected to the in-bunker and out of the bunker housings respectively with a metal bellow and share the same vacuum with the rest of the guide.

Alignment holes must be included in the top plate of the housing to properly access the transition between guide units. A concept of an alignment aperture is shown in the attached drawing *MIRACLES Bunker Wall Insert – drawing – v1*, Figure 12.

The vessel shall be mounted on kinematic mounts on the support structure. There shall be coarse alignment features offering an alignment range of +/- 25 mm. Additional precision alignment features shall offer a range of +/- 5 mm with a precision of +/- 0.01 mm.

The following table shows the housing thickness is increased by means of 80 mm step in the downstream, keeping 8mm gap between housing and shimming (8x rule).

		Thickness **upstream** section [mm]			
		Top	Bottom	Left (to W4)	Right (to W6)
Housing		49	49	28	28
Housing - shim GAP		10	10	10	10
STEP	8x rule	80	80	80	80

Table 6. A 10 mm gap is considered between all surfaces of steel casing and shims, therefore, step in downstream housing follows 8x rule (80 mm step).

5.2. Vacuum General Requirements

The Optical Assembly is contained within a closed vessel designed to maintain vacuum. The vessel is sealed through a vacuum flange that connects it to the rest of the neutron guide system.

A pumping port on the top of the vessel allows the vessel to be evacuated.

Although the instrument can be operated up to $1x10^{-1}$ mbar the vacuum system is designed to achieve and maintain a minimum operating pressure of $2x10^{-2}$ mbar.

Among the corrosion protection treatments inside the vacuum vessel, nickel plating, zinc plating (conveniently passivated), hot spraying of aluminium can be accepted.

General Requirements:

a) *The helium leak rate (individual leaks) of the vacuum vessel shall be better than $1x10^{-7}$ mbar*l/s.*
b) *Total gas load (Air leak rate +degasing) shall be less than $1x10^{-5}$ mbar·l/(s·cm^2) for the complete Bunker Wall Insert*
c) *The vacuum housing and the components within shall not have volumes that could trap air causing a virtual leak.*
d) *All internal surfaces shall be degreased and clean from impurities*

Vacuum Ports and flanges

Due to the proximity to the neutron beam and considering that MIRACLES loses the direct line of sight of the moderator downstream after the BWI, upstream and downstream flanges shall be compatible to the use of aluminum wire gaskets, or other metallic gaskets.

For the pumping port, located outside the bunker, near the downstream end, a metallic CF40 flange is considered.

For access to alignment screws, the ESS metallic gasket solution (preferable Al No. 2.4365) is considered.

5.3. Mechanical General Requirements

Threaded holes for lifting points shall be arranged to minimize deformation of the vessel in correspondence of the alignment features supporting the Optical Assembly during lifts and transportation (with respect to the vessel resting on its own supports).

During integration, the neutron guides inside the vessel are first aligned with respect to one another with accuracy of ±0.02 mm, the alignment happen while the vessel is supported in correspondence of the actual supports. Care shall be adopted to ensure that after pumping down and transportation, the deformations of the vessel do not modify the final alignment of the guides.

5.4. Labeling

<u>General Requirements:</u>

1. *For the substrate: Serial and part number.*
2. *Mechanical assemblies: Supplier´s name, name of assembly, serial and part number, weight, if more than 15kg, any potentially useful functional information. (Labeling is only necessary for units to be separately installed or maintained. Parts and sub-assemblies under this level do not need labeling. For the components that are controlled, need maintenance, or have safety function, ESS shall provide the FBS number and shall be labeled according to ESS-0094091)*
3. *For the guide assemblies: Serial and part number, weight if more than 15kg, information about orientation, if necessary.*

5.5. Supports

The vacuum vessel assembly is suspended on its ends inside and outside the bunker by supports placed on two pillars (not in the scope of this tender), integrating the alignment features of the vessel. The supports of the mechanical assembly are based on kinematic mounts supporting the vessel in 3 points (one upstream and 2 downstream).

By action on the adjustments under these points it shall be possible to perform lateral and vertical adjustments of the position of both ends of the mechanical assembly. The alignment (and survey) should be possible without disconnecting from the neutron guide.

On the downstream side the BWI is supported in two points and acting on these it shall be possible to displace laterally and vertically and to correct the angular orientation of the BWI.

Both upstream and downstream support shall integrate the necessary spacers to interface with the surfaces. The design shall be further developed to define the final technical solution.

<u>General requirements:</u>

a) *Alignment features of the Bunker wall insert shall allow the lateral and height alignment of ±10mm on both ends with resolution of 10µm.*
b) *Supports shall allow a coarse alignment range of ±10mm (additional to the fine).*
c) *The alignment of the BWI shall be possible without disconnecting the upstream neutron guide.*

5.6. External interfaces (towards environment)

A schematic representation of the System Interface Points (S.I.P) is described on Figure 10:

S.I.P. 3 BWI Vacuum pumping port

The vacuum port will be used to pump the BWI and adjacent sections of the guide during operation. It also will be used during testing.

S.I.P.4 BWI Mechanical Assembly (Kinematic supports) / Guide supports

The kinematic supports at both ends will include adjustment features for precise alignment of the housing. The kinematic mounts are placed on the block supports, also located at both sides of the bunker.

S.I.P 5 BWI Mechanical Assembly (Vacuum Vessel) / BWI Case (Shim box)

The shim box functionality is to allow prepositioning of the BWI feedthrough inside the bunker wall accounting for the wall surface deviation and building sinking overtime.

MIRACLES BWI will follow a vertical installation. After assembly of the bunker wall, the shim box will be installed in the bunker wall penetration to offer a precise interface to the BWI Mechanical Assembly. After installation of the shim box, its inner surfaces are expected to find themselves within ±1 mm from their nominal position with respect to the vessel.

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6. SPECIFIC BWI REQUIREMENTS

6.1. Operating conditions

Normal operation	**nominal**	**limits**
Temperature	20°C	10°C – 30°C
Atmosphere	Vacuum	
Exposure (at 5MW)	Neutron capture flux (cold/thermal) : $\Phi = 5\times10^{10}$ cm^{-2}.s^{-1} Neutron capture flux (epithermal) : $\Phi = 5\times10^{10}$ cm^{-2}.s^{-1} High energy hadron flux (1MeV-2GeV) : $\Phi = 5\times10^{12}$ cm^{-2}.s^{-1} X-ray to Gamma flux (1KeV-2GeV) : $\Phi = 5\times10^{12}$ cm^{-2}.s^{-1}	
Duration p.a.	4000hr	4000 – 6000hr

Table 7. Operating conditions requirements - Normal operation.

Storage and Transport.	**nominal**	**limits**
Temperature	10°C	-10°C – 30°C
Atmosphere	Normal atmospheric pressure and humidity	60%
Exposure	Not applicable	
Duration	Up to 6 months	

Table 8. Operating conditions requirements - Storage and Transport.

6.2. Service life

All major components shall operate for 20 years without degradation effecting performance.

6.3. Allowed Materials

The material for construction is mandatory for the following components that are specified in the following table.

Description	**Material**
Guide substrates	High purity copper
Guide shielding	High purity copper
Guide coatings	Nickel / Titanium

Mechanical Fixations & Springs	See materials for general construction
Structural components	See materials for general construction

Table 9. Approved construction materials.

The use of any material not indicated in this paragraph is expressly prohibited without the prior consultation and approval by the customer.

6.3.1. High purity copper

High purity copper is defined as “Oxygen free (OF) pure copper”.

AFNOR	Euronorm	Material nr.
CuC1	CW008A	2.0040

6.3.2. General construction.

All components for which a construction material is not explicitly specified shall be constructed from the materials indicated for general construction. Components shall be classified in relation to their distance from the neutron beam and materials should be selected from the corresponding table.

All components installed at distances of less than 50mm from the edge of the direct beam shall be constructed from the materials indicated in the table ‘direct beam’.

Construction use ‘Direct beam’	Euronorm	Material nr.	DIN
Aluminium alloy	EN AW 5083	3.3547	AlMg4.5Mn
Aluminium alloy	EN AW 5754	3.3535	AlMg3
Fixation			
Low alloy steel	S235JR	1.0038	
Low cobalt content (Co < 0.05%) stainless steel 316L		1.4404	

Table 10. Direct beam materials.

All components installed at distances of greater than 50mm and less than 500mm from the edge of the direct beam shall be constructed from the materials indicated in the table ‘scattered beam’.

Construction use ‘Scattered beam’	Material nr.	Euronorm	DIN
Aluminium alloy	-	EN AW 6081	AlSi0,9MgMn
Aluminium alloy	3.1325	EN AW 2017A	AlCu4MgSi
Aluminium alloy	3.3547	EN AW 5083	AlMg4.5Mn0.7
Aluminium alloy	3.3535	EN AW 5754	AlMg3

Fixation			
Mild steel		AISI 1005	
Mild steel		S355JR (prefer)	
Mild steel	1.0038	S235JR	
Mild steel	1.0044	S275JR	
Mild steel	ASTM A570 Grade 33		
Low cobalt content (Co < 0.05%) stainless steel 316L	1.4404		

Table 11. Scattered beam materials.

6.4. Surface treatment

The selection of the surface treatment type and the method of application is left to the discretion of the supplier and will be communicated to the customer for approval prior to the CDR. All components subject to corrosion from acids at operating temperature shall be surface treated to ensure corrosion protection unless otherwise indicated on drawings.

6.5. Stress relief

During operation components shall be exposed to cycles of heating and cooling. In order to conserve dimensional stability and remain within the stipulated tolerance during the duration of the service life stress relief may be required. The identification of components requiring stress relief shall be conducted during the design process by the supplier. If required, stress relief measures of components or assemblies shall be conducted by the supplier as part of the scope of supply.

6.6. Mechanical integrity

Assemblies shall be designed whenever practical to maintain mechanical integrity and alignment in the case of partial degradation of fastenings. Mechanical design shall be realized such that the geometry of reflective surfaces is retained in case of the failure of a single fastening or support. Calculations and FEA analysis demonstrating the compliancy of the system shall be part of Phase 1 data package at CDR.

6.7. Requirements for Vacuum

Following integration and alignment of the Optical Assembly into the Mechanical Assembly, the whole assembly will be evacuated; the treatment is followed by conditioning within a pure helium atmosphere. During operation the vessel will remain closed and contamination of the atmosphere through degassing of components will be minimised. Requirements for vacuum are those stated on Section 5.2.

6.8. Requirements for materials handling

Provisions for handling during manufacture and transport are left to the discretion of the Seller. Provisions for handling during storage at ESS and installation shall be agreed with the Customer at the CDR and indicated in the Component Operation and Maintenance Manual.

Each component or assembly of components, with a finished weight exceeding 25kg shall be equipped with provisions for handling with lifting equipment. Special tooling required for handling at any stage where necessary is at the charge of the Seller and shall be supplied as part of the scope.

Materials requirements

a) Materials for construction of vacuum housing shall be chosen among those listed in.
b) All surfaces shall be treated against oxidation and corrosion.
c) If mild steel is used as vacuum housing material, inner surfaces shall be treated against oxidation and corrosion with a vacuum compatible treatment.
d) Surface treatments based on Zn deposition shall not be used.
e) If applicable, vacuum housings shall be accompanied by a CE declaration of conformity, in alternative, a declaration of non-applicability shall be provided.
f) The use of stainless steel is in general to be avoided because of the risk of activation of Cobalt impurities; where strictly necessary, and after agreement with ESS, EN 1.4404 or EN 1.4406 with Cobalt impurities smaller than 0.2% shall be used. Materials different than those listed shall be agreed with ESS.

Material type	Material denomination
Mild steel	AISI 1005 EN 10025 S355JR (preferred) EN 1.0044 (EN10025 S275JR) EN 1.0037 (EN10025 S235JR) ASTM A570 Grade 33
Aluminium	EN AW 6065 T6 EN AW 6061 T6 EN AW 5083 EN AW 5754 EN AW 6082
Copper	CW008A

Table 12 Acceptable materials for vacuum vessels

7. PROJECT MANAGEMENT REQUIREMENTS

7.1. Project Phases

The scope of work is broken down into three Phases

7.1.1. Phase 1: Detailed Design

Phase 1 starts with Kick-off meting and ends with the successful Critical Design Review (CDR).

Phase 1 is the detailed design and engineering phase that prepares for and precedes the manufacturing of the system. Within Phase 1 the design shall be detailed and verified by way of analysis and/or test down to the lowest level selected by the Seller.

In this stage the conceptual design shall be expanded and consolidated, the conformity between the proposed design and the requirements shall be developed and demonstrated. Eventually the detailed design shall be elaborated so that:

i. A thorough and complete evaluation of the ability of the design to fulfil the requirements is possible and is supported by an appropriate traceability between the requirements and the proposed design features;
ii. The development process is well established including manufacturing methods, processing and tooling requirements;
iii. The procurement documentation is ready for manufacturing. This includes technical specifications and statements of work.

The **Phase 1 data package** shall be delivered at PDR and CDR and includes:

a) System Requirement Document and compliancy matrix;
b) Design description;
c) Updated Interface Description Documents;
d) System Integration Plan;
e) Certificate of Conformity for Hazardous Materials and Sustainability;
f) Component Operation and Maintenance Manual (Preliminary);
g) Updated System Verification Plan (SAT/FAT Plan);
h) The updated Project Schedule for manufacturing, verification and delivery;
i) Preliminary CE declaration of inclusion (if applicable);
j) Risk Analysis;
k) Proof to achieve coating requirements
l) Proof to achieve geometrical requirements by means of best practice.

7.1.2. Phase 2: Manufacturing and verification

Phase 2 starts upon successful completion of Critical Design Review (CDR) and ends with the successful completion of the System Acceptance Test (SAT).

Phase 2 is the phase for realizing the system based on the design descriptions produced during Phase 1 and carrying out the verification of the system elements, this includes:

i. Manufacturing according to specification accepted at CDR;
ii. Intermediate verifications during the fabrication at the factory e.g. inspection of material certificates, part dimensions, reflectometry tests;
iii. Verification activities as defined in the verification plan;

iv. Present the verification outcomes during the Factory Acceptance Test.

The Contractor is responsible for the verification that the manufactured components fulfil the system requirements given in technical specification paragraph of this document.

The **Phase 2 data package (FAT/SAT)** shall be delivered at FAT and IRR and includes:

a) "as-built" design descriptions;
b) Verification Reports in accordance with the System Verification Plan;
c) Updated Interface Description Document, if necessary;
d) Updated System Integration Plan;
e) Component Operation and Maintenance Manual (Final);
f) CE declaration of inclusion, if applicable.

As part of the FAT package, the seller shall submit a small sample of each batch of materials used in the construction including a sample of standard components such as screws bolts, springs etc. in the same state as the final product. Dimensions of the samples will be agreed at CDR.

7.1.3. Phase 3: Delivery and Integration

Phase 3 starts with successful Site Acceptance Test (SAT) and terminates with the successful System Acceptance Review (SAR).

The Seller shall deliver the system to the ESS according to DAP 2010 Incoterms. The Seller must inform per time the Customer about quantity, size and mass of the delivered packages including special handling and storage requirements.

It is responsibility of the Seller to provide transport safe packaging and shipment of the element. It is faculty of ESS to provide and equip the packages with additional shock detection elements before the boxes are closed for shipment at the Seller's premises.

After delivery, the Seller shall integrate the Optical Assembly into the Mechanical Assembly and then reference the position of the Optical Assembly with respect to the Mechanical Assembly fiducials. Further handling and integration of the BWI into the ESS Bunker wall are outside the scope of this specification. The Seller shall support the integration of the Mechanical Assembly by providing the installation instructions. The integration procedure shall be agreed at CDR and shall be documented in the System Integration Plan.

The **Phase 3 data package (SAT/SAR)** includes:

a) Delivery to ESS ERIC
b) Installation protocol in accordance to the System Verification Plan.
c) Alignment and survey report

7.2. Verification and Integration

System Verification Plan

The System Verification Plan (or inspection plan) shall describe the verification activities (reflectivity, metrology fiducialization and tests) planned by the seller to ensure the compliancy to the requirements, in addition it shall also describe the Verification Reports to be provided at FAT and SAT.

Verification Reports shall include at least the following items:

a) Neutron reflectometry of the coated surface of a representative number of segments minimum 2 surfaces per sputtering batch specified by ESS at CDR;
b) Collection of materials data sheet for the substrate materials used;
c) Materials certificates of all components (exceptions shall be agreed with the Customer at PDR);
d) Geometrical measurements protocol;
e) Surface waviness measurement protocol;
f) Material samples to be delivered to ESS for later reference.

Design Descriptions for all stages shall include at least:

a) System Design Description document describing in detail the features of the solution;
b) 2D drawings: Assembly of the system and detailed part drawings enough to verify functionality, safe transport, proper integration, maintenance and eventually decommissioning of the system. The drawings shall also show the compliancy to the requirements;
c) 2D Manufacturing drawings to verify compliancy of the final assembly to requirements;
d) Calculations and analysis performed during the design phase;
e) 3D model of system;
f) Bill of materials including weight and material for each component and identifiers of commercial components in .xls format;

The 3D model shall include an ESS reference system to be defined and the position of its survey monuments shall be adjusted to provide exact position with respect to the reflective surfaces.

System Integration Plan for all stages shall include at least:

a) All information needed to manage the deliverables during their lifecycle;
b) Work Instruction for the integration and alignment of the supplied components identifying the principal steps;
c) Work force required and the duration of the integration activities;
d) Space requirements, environmental conditions and equipment needs;
e) Hazard analysis (for the execution of the sole installation activities);
f) Installation plan.

CE Declaration of Inclusion

It is the Seller's responsibility to ensure that the system is compliant with European Directives, and CE marked if these are applicable, and that the following obligations have been carried out and complied with:

a. Identify the applicable directive(s) and harmonized standards;
b. Perform a documented risk assessment;
c. Identify whether an independent conformity assessment (by a notified body) is necessary;
d. Test the product and check its conformity;
e. Verify product specific requirements;

f. Draw up and make available, upon request, all the required technical documentation (in English). Keep such technical documentation for the time periods specified in the applicable directives;
g. Draw up and issue an Operations Manual or Instructions for incorporation (in English);
h. Draw up and issue the EU Declaration of Conformity (in English);
i. Affix CE marking, if applicable.

The contractor is responsible to follow the applicable European regulations, and to describe the CE conformance process. The following data must be provided to ESS-Bilbao in the offer technical report. The applied standards on which the conformance declaration is based on a test plan, describing which tests are performed at which stage of the project. After verification the test reports plus the conformance declaration shall be provided.

7.3. Project milestones (PMS), deliverables and meetings

Project phases, reviews, and milestones serve to structure and monitor the project process. The phases 1, 2 and 3 shall be managed by the contractor and contain the milestones described below. The schedules for the milestones are referenced to the Order Placement (OP) and signature of contract, and will be developed based on the date for each call-off in order to allow successful delivery on time. Table 13 defines the project milestones, reviews and tests applicable.

Phase	PMS	Milestone	Documentation delivered	Site / Date	Pay MS
1	KOM	Kick-off meeting	See Table 14	<1 month after OP	
	PDR	Conceptual Design (PDR)	Concept Report		
	Ph1	Detailed design to ESS-Bilbao	Phase 1 Data Package		
	CDR	Critical Design Review	CDR Report	ESS / 3 months after OP	30% after approval
2	Ph2	Phase 2 Package delivered to ESS	Phase 2 Data Package		
	FAT	Inspection of components and review of the test protocols by ESS-Bilbao and ESS representatives for FAT	FAT Report & Handling, Packaging and Transport Specs.)	Contractor's premises/ 12 months after CDR	
	IRR	Installation Readiness Review	IRR Report	ESS / 1 month after FAT	40% after approval
3	SCS	Transport to installation site (e-mail)			
	Ph3	Phase 3 Package delivered to ESS	Phase 3 Data Package	ESS	
	IC	Installation completed		ESS / 2 months after IRR	20% after approval
	SAT	Site Acceptance Test	SAT Report	ESS / 2 months after installation completed	10% after approval

Table 13: Milestones, Meetings, Reviews and Deliverables of project phases

7.3.1. Project kick-off

The ‘project kick-off meeting’ must be held within one month after the contract is awarded or a call-off for the next item has been placed. During the kick-off meeting, the items of Table 14 must be discussed and the deliverables approved by both parties.

No.	Documents
1.	Time schedule/ List of key persons involved (email header)
2.	Discussion on compliance matrix, if applicable
3.	Discussion and agreement on IP generated in the course of the project
4.	Discussion on the Project quality assurance plan (PQAP)
5.	Communication process and platform for handling open issues
6.	Template of the project status report (SR)
7.	Documentation and naming convention specification
8.	Description of the design verification / release for manufacturing procedure(s)
9.	Example of non-conformance report (NCR)
10.	Example of design change request (DCR)

Table 14: Deliverables for kick-off meeting

7.3.2. Preliminary design review (PDR)

At PDR the detailed design of the system is analyzed with its adjacent systems, approving transition from conceptual design to detailed design. The design is reviewed against all design input, including technical and interface requirements. It ensures that technical risks and safety aspects are appropriately covered by the architecture. A successful PDR approves commencing detailed design.

7.3.3. Critical Design Review (CDR)

The Critical Design Review concludes Phase 1. The CDR assesses if the design meets all facility element requirements with acceptable risk and within the cost and schedule constraints. The CDR demonstrates that the maturity of the design is appropriate to support proceeding with full-scale fabrication, assembly, integration, test, and future operation and decommissioning.

The review shall be organized by ESS and will involve the Parties’ and any other stakeholders at the discretion of the review chairman. The chair of the review board is appointed by ESS.

The CDR data package shall contain all deliverables as specified in Section 7.1.1 and shall be submitted to ESS at least 3 weeks prior the review. Acceptance from ESS ERIC of the system design does not relieve the Seller from meeting the final requirements of the contract.

7.3.4. Factory Acceptance Test (FAT)

The FAT review examines the system as manufactured and its documentation, including inspection protocols, demonstration, test data and analyses that support its verification as defined in the

Verification Plan. The review ensures that all system requirements have been satisfied and that the integration can start as defined in the facility element Integration Plan.

The FAT data package shall contain all deliverables as specified in Section 7.1.2 and shall be submitted to ESS at least 3 weeks prior the review.

7.3.5. Site Acceptance Test (SAT)

Upon arrival, the delivery is inspected by the Customer according to the System Validation Plan, the customer will handle and store the crates as specified by the Seller in the Component Operation and Maintenance Manual.

During System Acceptance Review (SAR) it is ensured once again that the integrated system complies with the specified integration requirements. Previous data packages are amended if necessary, to account for as “built” amendments, following installation, reissued and presented for review 1 weeks in advance. The completeness of the scope of work is assessed and documented.

The review shall be organized by ESS and will involve the Parties’ Coordinators, as well as any other stakeholders at the discretion of the review chairman including representatives from the Seller’s manufacturer and any required subject matter experts. The chair of the review board is appointed by ESS.

7.3.6. Communication / Delivery note

The contractor shall have direct communication with ESS Bilbao and ESS ERIC along the duration of all the phases of the contract, in order to solve any issue that can come up in an efficient manner.

The delivery of relevant data between the contractor and ESS-Bilbao such as review documents, data files, or open issues must be formally transferred by a delivery note, through formal e-mail exchange.

7.4. Acceptance and release of project phases

The different project phases are described inside this chapter. Reviews assess completed project phases and start new phases. The reviews are organized as meetings or carried out by email communication. The form and location of the reviews may be changed in mutual agreement.

8. QUALITY ASSURANCE REQUIREMENTS

8.1. Quality management system

The contractor must maintain and apply a project quality assurance plan (PQAP) compliant with ISO-9001 for all processes and services needed to make the product. As a reference, the ESS Project Quality Plan is provided.

The contractor must apply the same project management and quality assurance requirements of this requirements specification for its sub-contractors and suppliers. ESS-Bilbao representatives reserve the right to visit the contractors' suppliers' or sub-suppliers' manufacturing premises upon prior notice to perform an audit or review the progress of the contractual agreed deliverables.

8.2. Handling, packing, and transport

The contractor must create a 'handling, packing, and transport specification'.

The contractor must ensure that if boxes are used, they satisfy the "anti-Bug" requirement for all items shipped overseas into Europe, more specifically FREIGHT ISPM 15 rules.

8.2.1. Handling and packing

1. The packing must have means to use classical handling tools. The packed parts must be protected during transport and storage against possible harms such as weather elements, mechanical shocks, strain, and rubbing which can damage surfaces. Special care must be taken to protect the J-coupler parts against oxidation for at least 6 months.
2. Packing-cases must be of a stout and robust nature suitable for lifting and transportation without damage using a forklift truck or crane.
3. The contractor must inform ESS-Bilbao about the amount and size of packages.
4. Each package must contain a packing list, indicating at least:
    - Serial number
    - Item description
    - Quantity ordered
    - Quantity shipped
    - Packed in sub-package number "nn"

8.2.2. Transportation for delivery to ESS

The start of the shipment will be communicated to ESS by email at least 14 days prior to shipment and confirmed once the shipment is sent, and shall be authorized by the ESS Bilbao project responsible.

Delivery should be Incoterms 2010 Delivered At Place (DAP). The named place of destination is:

European Spallation Source ERIC
F03/Gate E
Transportvägen 5
234 34 LUND, Sweden

All deliveries shall be pre-advised (deliveries@essbilbao.org) 48 hours prior to the arrival at destination via email to logistics@esss.se, a confirmation with time-slot for unloading will follow to the Supplier. All deliveries shall be executed in accordance with ESS Bilbao delivery guidelines [ESSB-840-03-IT gestión de envíos Rev2] and ESS Logistics Guidelines [ESS-0042559].

The package must be marked with:

1. ESS-Bilbao and ESS contact email addresses and phone numbers
2. Weight of the package
3. Support points for transport and lifting

All delivered components shall incorporate to the extent possible the ESS Bilbao logo, along with those from the supplier. ESS Bilbao will provide the logos and corporate identification in adequate timeline, and they will be placed visibly in the external packages when delivered from the Supplier's premises to ESS ERIC.

8.2.3. Handing over of packaged parts responsibility

After the delivery to ESS storage, ESS takes over responsibility for the packaged items. For the later transport from storage to the ESS site and for installation the vendor again takes responsibility for the items being handled.

9. LIST OF ACRONYMS

Acronym	Definition
BWI	Bunker Wall Insert
CDR	Critical Design Review
EU	European Union
ERIC	European Research Infrastructure Consortium
ESS	European Spallation Source
FAT	Factory Acceptance Tests
IRR	Installation Readiness Review
KOM	Kick-Off Meeting
OP	Order Placement
PDR	Preliminary Design Review
PO	Purchase Order
PQAP	Project Quality Assurance Plan
RFM	Ready For Manufacturing
SAR	Site Acceptance Review
SAT	Site Acceptance Test
TS	Target Systems