



Terms of Reference (TOR)

Technical Specifications

Fabrication of Beam Position Monitor (BPM) Prototype for SPS-II

1. General

Synchrotron Light Research Institute (SLRI) is a Thai research institute responsible for the design, construction and operation of Siam Photon Source II (SPS-II), the second synchrotron light source in Thailand. The SPS-II machine consists of a 270 MeV linac, a 3 GeV booster ring and a 3 GeV storage ring with the beam current of 300 mA. SLRI will procure 280 set of Beam Position Monitor (BPM) assemblies (two BPM feedthroughs welded onto BPM flanges) for SPS-II storage ring.

The fabrication of BPM prototypes is a critical step in ensuring that the BPMs for SPS-II perform as intended. It also deepens understanding of engineering design and enables practical validation prior to mass production. The BPM prototype development comprises two main manufacturing components, BPM feedthroughs and BPM flanges, followed by final assembly through welding of these components.

2. Responsibility

2.1 Responsibility of the SLRI

The SLRI is responsible for:

- The reference engineering design of the BPM feedthrough and BPM flange that shows the basic requirements
- The reference assembly design of the interface between the BPM feedthrough and the BPM flange

2.2 Responsibility of the supplier

The supplier (also called contractor) is responsible for:

- The engineering design of the BPM feedthrough and BPM flange, the assembly drawing, with consideration of the manufacturing process, including the CAD model and any related document.
- The manufacturing of BPM flange
- The manufacturing of BPM feedthrough
- The assembly of BPM flange and feedthrough
- The factory acceptance test
- The packing and delivery to the SLRI site

3. Design

The BPMs for the SPS-II storage ring are of a removable type, which allows installation, replacement, and maintenance to be performed without removing or venting the main vacuum

chamber. This design significantly minimizes contamination risk, and provides flexibility for inspection, repair, or future upgrades.

Each BPM assembly consists of four button pickup electrodes mounted on BPM flanges, as shown in Figure 1. Each BPM flange accommodates two BPM feedthroughs.

Figure 2 shows the concept design of BPM feedthrough. It is designed with a 6 mm diameter BPM button made of molybdenum, connected via a central pin to a reverse-polarity female 2.92 mm connector, forming a 50 Ω impedance feedthrough. A borosilicate glass insulator is installed between the BPM button and the outer conductor to ensure electrical insulation and vacuum integrity.

The BPM button separation distance is 10.84 mm. Due to the SPS-II vacuum chamber design, which features an elliptical cross-section of 40 mm (width) × 16 mm (height), a smooth geometric transition to the BPM chamber is required. Accordingly, the feedthroughs are positioned at an angle of 6.40 degrees relative to the vertical plane as shown in Figure 4. The BPM button height is offset by +0.2 mm with respect to the tangent of the inner surface of the elliptical vacuum chamber.

The BPM flange incorporates a reference plane to ensure high-precision orientation during insertion into the vacuum chamber as shown in Figure 3.

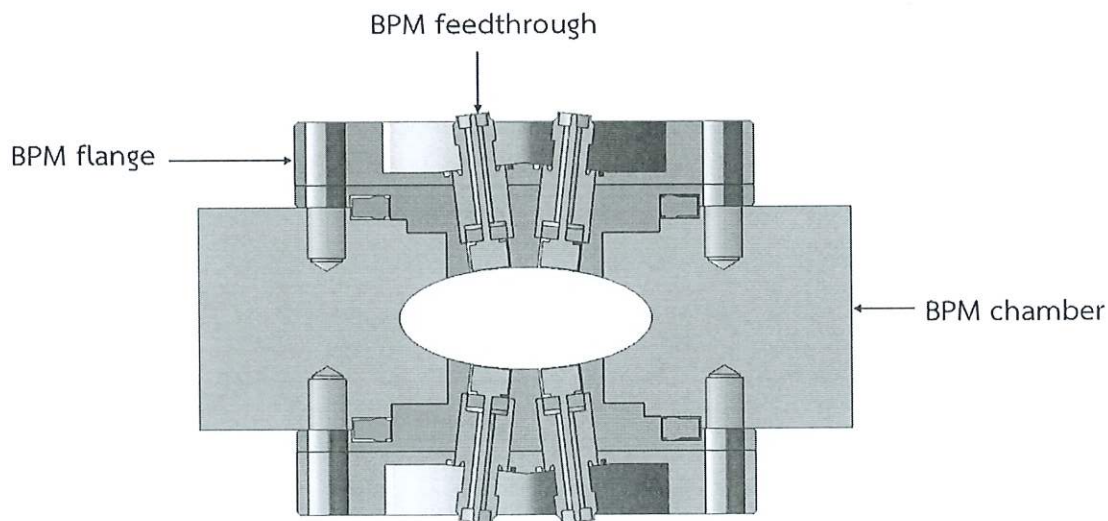


Figure 1: Cross section of the BPM flange installed to elliptical vacuum chamber

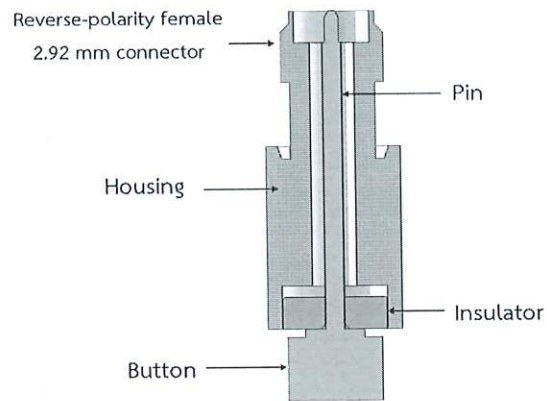


Figure 2: Cross section of BPM feedthrough

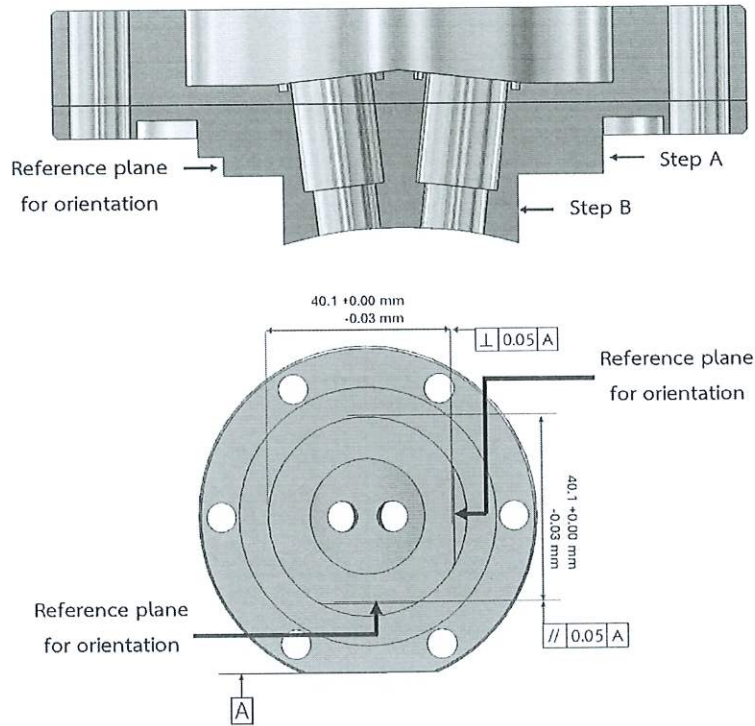


Figure 3: Cross section (top) and top view (bottom) of BPM flange

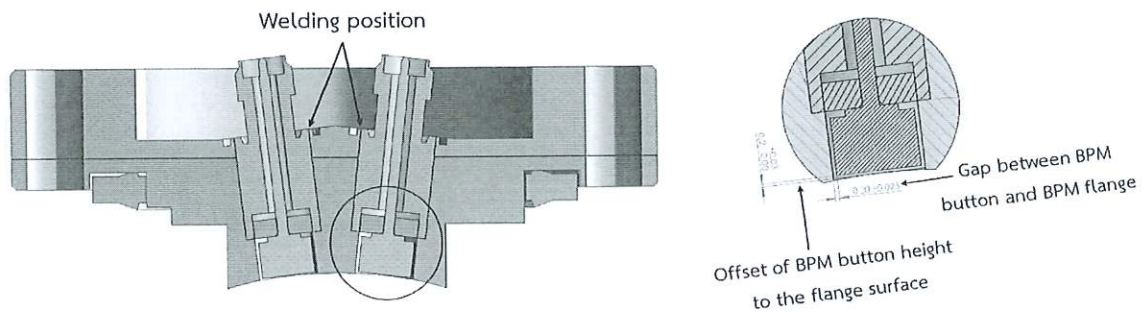


Figure 4 Cross section of BPM feedthrough assembled on the BPM flange

4. Engineering design

The reference engineering drawings for the BPM flange and feedthrough, including the reference assembly drawings, are shown in Drawing No. SLRI-SPSII-SR-BPM-G-01 Item No.1 and 2. The design shall comply with the specifications listed below:

4.1 Material

- Feedthrough insulator: Borosilicate glass ($\epsilon_r = 4.0-4.1$)
- Feedthrough housing: SUS 316 L
- Flange: SUS 316 L
- Button and Pin: Molybdenum

4.2 BPM feedthrough connector type: Reverse-polarity female connector, compliant with the 50 Ohms standard 2.92 mm adapter interface.

4.3 Welding method between BPM flange and BPM feedthrough: Electron beam welding or Laser beam welding or Micro TIG welding

4.4 Hermeticity: 1.0×10^{-9} torr.l/sec He

4.5 Bakeout temperature: 300 °C maximum

4.6 Tolerance:

- Diameter of BPM button: $\leq \pm 25 \mu\text{m}$.
- Gap between BPM button and BPM flange: $\leq \pm 25 \mu\text{m}$.
- Distance between reference plane and edge of BPM flange at step A: $\leq \pm 30 \mu\text{m}$.
- Diameter of BPM flange at step B: $\leq \pm 50 \mu\text{m}$.
- Distance between a pair of BPM buttons (center to center): $\leq \pm 100 \mu\text{m}$.
- Offset of BPM button height to the flange surface: 0 to +30 μm .
- Other areas: Based on approved engineering drawing

4.7 Modification: Prior to commencement of BPM fabrication, the Supplier shall submit detailed engineering design drawings of the BPM flanges and BPM feedthroughs, including complete assembly drawings and dimensional inspection test data, to SLRI for review and approval. Fabrication shall not commence until written approval has been obtained from SLRI. Any modifications to the design originally proposed by SLRI that are required for manufacturing or fabrication purposes may be proposed by the Supplier; however, such

modifications shall not be implemented unless they have been formally reviewed and approved in writing by SLRI.

5. Final assembly

Final BPM welding shall be performed by the Supplier following the successful completion of the BPM feedthroughs and flanges, including all associated quality control inspections. The proposed welding method and welding procedure shall be fully described and submitted to SLRI for review and approval prior to implementation.

6. Quantity

The Supplier shall provide the following items:

- 1) Two (2) sets of BPM flanges. Each set shall consist of one BPM flange with two (2) BPM feedthroughs welded onto the corresponding flange.
- 2) Two (2) BPM feedthroughs (not welded to flanges).

7. Inspection and Acceptance Tests

- 7.1 Dimensional inspection:** The inspection drawings identifying the required dimensional measurements for the BPM flange, feedthrough, and assembly are shown in SLRI Dimensional Test No. SPSII-STR-BPM-DTR-2026-03. Prior to delivery, the Supplier shall perform dimensional inspections in accordance with the requirements specified in these drawings and shall submit the inspection results to SLRI for review and approval prior to shipment.
- 7.2 Bakeout temperature:** Each BPM feedthrough shall successfully pass a bakeout temperature test. The feedthrough shall withstand bakeout temperatures of up to 300 °C without exhibiting any leakage.
- 7.3 Hermeticity:** The BPM feedthrough before and after assembly with BPM flange shall be hermetic. Hermeticity shall be verified by helium leak testing, with a maximum allowable leak rate of 1.0×10^{-9} torr.l/sec. Test results shall be submitted to SLRI for review and approval.
- 7.4 Capacitance:** The capacitance of each BPM feedthrough shall be measured. The standard deviation of the measured capacitance values shall be less than 0.05 pF. All measurement results shall be submitted to SLRI for review.

8. Documentation and quality records

- **Engineering design:** The Supplier shall submit 3D models and 2D detailed fabrication drawings to SLRI for review and approval prior to the commencement of fabrication.
- **Material properties:** The Supplier shall provide SLRI with details of all materials used in manufacturing. The material properties of the glass insulator and molybdenum components shall be documented and submitted to SLRI.
- **Test results:** All inspection and test results specified in Section 7 shall be properly recorded and submitted to SLRI as part of the acceptance documentation.

9. Guarantee

The Supplier shall guarantee the equipment supplied for a period of **one (1) year** from the date of delivery. Defective items shall be repaired or replaced at no additional cost.

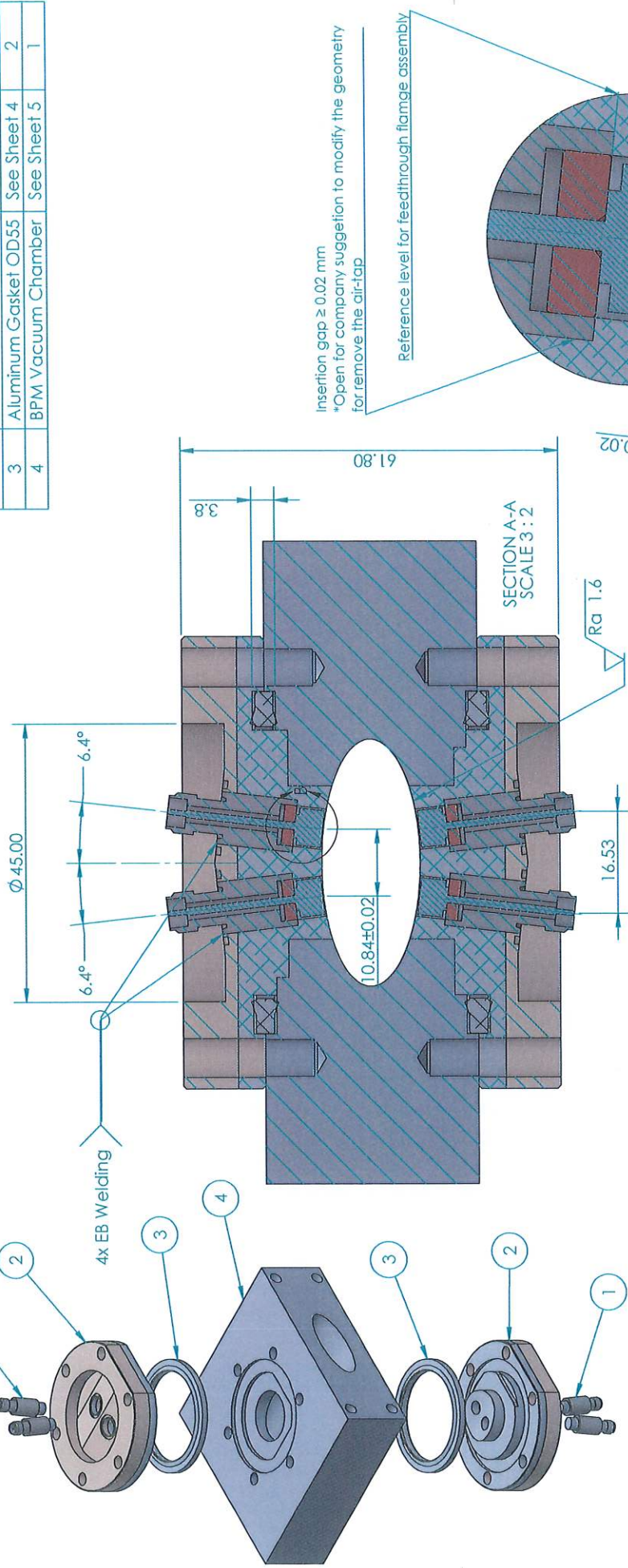
10. Delivery authorization

Shipment shall be authorized only after successful completion of all inspections and tests and approval of inspection and test reports.

Signature.....*พริมาพร สุขุมเมือง*.....
(Miss Porntip Sudmuang)

Signature.....*ศักดิ์นิยม นามสุภาพ*..... Purchaser
(Mr. Sakdinan Naeosuphap)

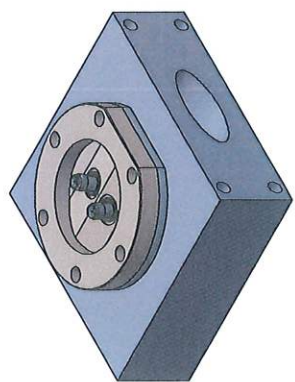
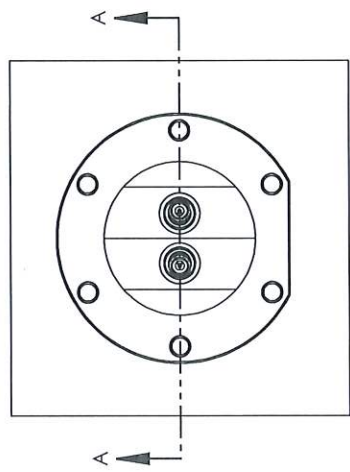
ITEM NO.	PART NAME	DESCRIPTION	QTY.
1	BPM Feedthrough	See Sheet 2	4
2	BPM Flange	See Sheet 3	2
3	Aluminum Gasket OD55	See Sheet 4	2
4	BPM Vacuum Chamber	See Sheet 5	1



Insertion gap ≥ 0.02 mm
 *Open for company suggestion to modify the geometry for remove the air-tap

Reference level for feedthrough flange assembly

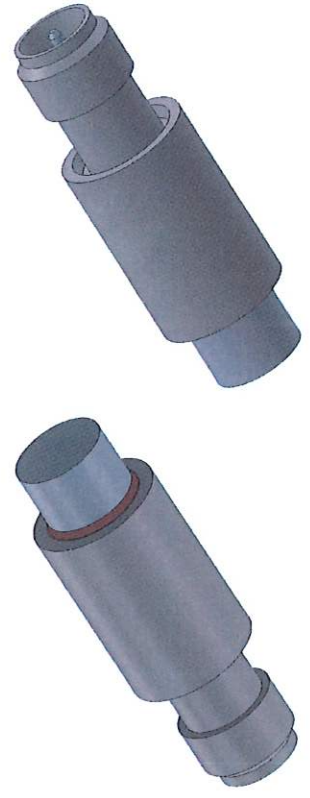
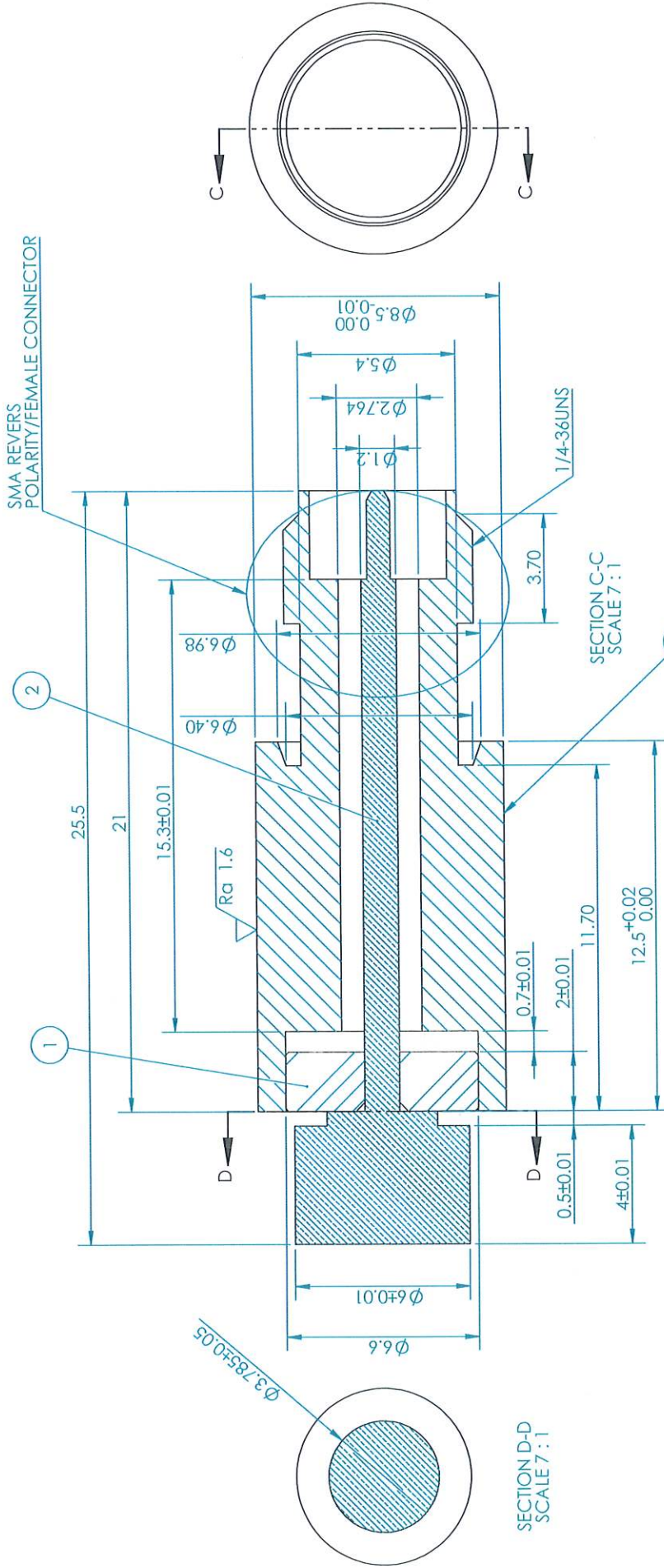
DETAIL B
 SCALE 6 : 1



Synchrotron Light Research Institute (Public Organization)			
APPROVAL	DATE	SIGNATURE	SCALE
DESIGN	26-Feb-26		1:1
DRAWN	27-Feb-26		SHEET
CHECKED			1
RELEASED			
APPROVED			
GENERAL TOLERANCES ISO 2768-PM		DRAWING NO. SLR-SF3I-SR-BPM-G-01	
STANDARD DRAWING ISO 5457		SITE A4	
PRODUCTION		MATERIAL	
TITLE SPS-II Storage Ring BPM (Class Feedthrough)		PART NAME	

NO.	PART NAME	MATERIAL	QTY.
1	GLASS	7070 GLASS or KC-1	1
2	PIN	MOLYBDENUM	1
3	CASE	SUS 316L	1

SMA REVERS POLARITY/FEMALE CONNECTOR



APPROVAL		DATE	Synchrontron Light Research Institute (Public Organization)	
DESIGN	Haqqum W.	26-Feb-26	TITLE: SPS-II Storage Ring BPM Feedthrough	
DRAWN	Haqqum W.	27-Feb-26		
CHECKED	Sakulhan N.	27-Feb-26	PART NAME: BPM Feedthrough	
RELEASED	Partip S.		MATERIAL: SUS 316L	
APPROVED	Pumip S.		SCALE: 1:1	
GENERAL TOLERANCES -ISO 2768-mk		SIZE: A4	DRAWING NO.: SLR-SPSII-SR-BPM-G-01	
STANDARD DRAWING ISO 5457		PROJ. NO.:	SHEET: 2	



SPS-II Storage Ring BPM Dimensional Test (Number: SPSII-STR-BPM-DTR-2026-03)

1. Dimensional Inspection for BPM Feedthrough

Table 1-1: Testing requirement for the BPM Feedthrough

Item No.	Specification	Dimension	Tolerance		Units	Note
			Minus	Plus		
FT1	Diameter	6.00	0.01	0.01	mm	
FT2	Length	4.00	0.01	0.01	mm	
FT3	Length	12.50	0.00	0.02	mm	
FT4	Diameter	8.50	0.01	0.00	mm	
FT5	Length	17.00	0.02	0.04	mm	
FT6	Roughness	Ra 1.6	-	-	μm	Ra
FT7	Concentricity	-	0.03	0.03	mm	Concentricity of FT1 and FT4
FT8	Connector type	-	-	-	-	e.g., 1/4-36 UNS-2A

** Note: All BPM Feedthroughs shall be inspected.

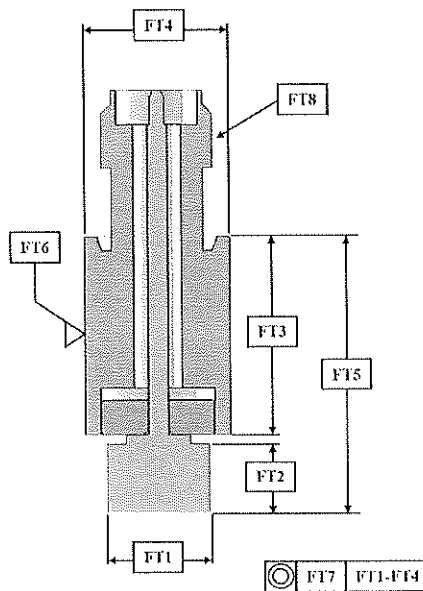


Figure 1-1: Details of dimensional inspection of the BPM Feedthrough

2. Dimensional Inspection for BPM Flange

Table 2-1: Testing requirement for the BPM Flange

Item No.	Specification	Dimension	Tolerance		Units	Note
			Minus	Plus		
FG1	Length	40.00	0.01	0.00	mm	
FG2	Length	40.00	0.01	0.00	mm	
FG3	Length	14.00	0.02	0.02	mm	
FG4	Diameter	63.20	0.05	0.05	mm	
FG5	Perpendicularity	-	0.01	0.01	mm	Perpendicularity with datum A
FG6	Parallelism	-	0.01	0.01	mm	Parallelism with datum A
FG7	Diameter	24.80	0.01	0.00	mm	
FG8	Diameter	42.85	0.01	0.00	mm	
FG9	Diameter	55.50	0.00	0.03	mm	
FG10	Length	3.90	0.01	0.00	mm	
FG11	Length	7.22	0.01	0.00	mm	
FG12	Length	1.90	0.01	0.00	mm	
FG13	Length	1.90	0.02	0.00	mm	
FG14-R	Angle	6.40	0.025	0.025	Deg	
FG14-L	Angle	6.40	0.025	0.025	Deg	
FG15	Parallelism	-	0.01	0.01	mm	Parallelism with datum B
FG16	Roughness	Ra 1.6	-	-	µm	Ra
FG17	Roughness	Ra 0.8	-	-	µm	Ra
FG18-R	Diameter	8.50	0.00	0.01	mm	Insertion gap with FT4 ≤ 0.02 mm
FG18-L	Diameter	8.50	0.00	0.01	mm	Insertion gap with FT4 ≤ 0.02 mm
FG19-R	Length	12.50	0.01	0.00	mm	
FG19-L	Length	12.50	0.01	0.00	mm	
FG20-R	Diameter	6.60	0.00	0.01	mm	
FG20-L	Diameter	6.60	0.00	0.01	mm	
FG21-R	Length	4.70	0.01	0.01	mm	
FG21-L	Length	4.70	0.01	0.01	mm	
FG22-R	Concentricity	-	0.03	0.03	mm	Concentricity of FG18-R and FG20-R
FG22-L	Concentricity	-	0.03	0.03	mm	Concentricity of FG18-L and FG20-L
FG23-R	Roughness	Ra 1.6	-	-	µm	Ra
FG23-L	Roughness	Ra 1.6	-	-	µm	Ra

** Note: All BPM Flanges shall be inspected.

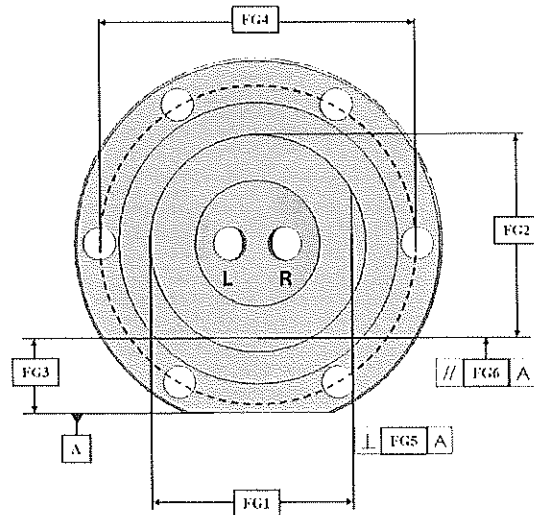


Figure 2-1: Details of dimensional inspection of the BPM Flange

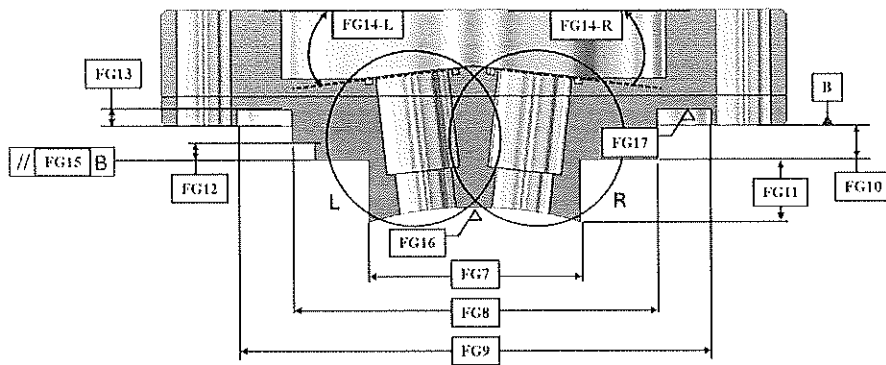


Figure 2-2: Details of dimensional inspection of the BPM Flange

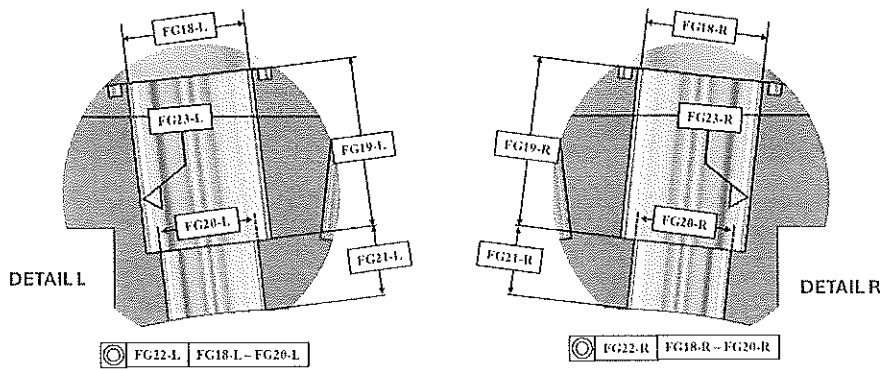


Figure 2-3: Details of dimensional inspection of the BPM Flange