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Specifications of 9L Front End
For Canted Beamlines XIL and SIS

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1. Introduction

The Swiss light Source (SLS) is a dedicated high brightness synchrotron radiation source at the Paul Scherrer Institute (PSI) in Villigen, Switzerland.

These specifications cover the design, manufacture and modification the existing 9LFE. Tenderers are requested to comment upon the specifications and are encouraged to make alternative proposals to PSI in addition to the quotation according to these specifications. However, after the contract has been placed, departures from the agreed specifications will not be allowed, except with written permission of the PSI.

2. General Description

The new X09LFE will host two beams:

- from Undulator U70 for X-ray Interference Lithography beamline (XIL)
- from Undulator UE212 for Surface and Interface Spectroscopy beamline (SIS)

The two canted beams have an angle of 1.85 mrad, the new layout will use the most parts of existing X09LFE with some modifications. The detail information for the existing X09LFE is in the Specifications of the SLS Front Ends for the Spectroscopy Beamline X09L and the Microscopy Beamline X11M, SLS-TME-TA-1999-0010, July, 1999. Here in these specifications only the new requirements are described. The new general layout is in the drawings 0-30040.50.223.

The following document is an integral part of these specifications:

- UHV materials and technologies for SLS front ends and beamlines, SLS-TME-TA-1998-0014

2.1 Components

All components are shown in drawing 0-30040.50.225.

A1. All-metal gate valve (VG0), pneumatically-actuated, VAT series 48, DN63 CF-F, with axial length 75 mm.

A2. Hydroformed metal bellows, CF63F/CF63R, with axial length 150 mm

A3. Pumping chamber, CF63F/CF63R, with axial length 672 mm.

One CF150R flange is in the horizontal position. It is used to connect to an ion pump (V1) in the horizontal position.

A4. Hydroformed metal bellows, CF63F/CF63R, with inner diameter 66 mm and axial length 150 mm.

From A5 on all axial components will be shifted to the wall direction 5 mm.

A5. The Diaphragm (DI), CF63F/CF63F, with axial length 260 mm.

It must be made according to the drawing 1-30040.51.2154, and must fulfill the following specifications:

The OFHC copper block has cylinder-shaped ends, onto which two tubes are brazed for connection to flanges. On the top of the cylinder-shaped ends, there are four 6 mm diameter holes for alignment purposes.

Inside the OFHC copper block, there are two tapered square openings with a distance of 25 mm. The dimensions of two openings are 5 mm and 7.6 mm at the narrowest point for XIL and SIS, respectively. The angle of the wall with respect to the center line of the cone is 7° for each side wall and for the upper and lower walls.

There are 8 identically configured water channels in both side parts of the block. Water enters through the central 4 channels and returns via the two outer sets of 2 channels. Two covers, brazed onto the side parts of the block, cover the water channels. On each cover there is one port for water in, two ports for water out.

In the middle part there are 4 holes in vertical direction to form a water cooling system.

There are totally 3 thermocouples for measuring the temperature of the Diaphragm. The locations are indicated in the drawing 30040.51.2154 .

A6. Photon Shutter (PH), CF63R/CF63R with axial length 372 mm.

This is shown in the drawing 0-30040.51.2168.

All is the same as the existing one, except for the inlet and outlet flange, drawing 1-30040.51.2169.

V2, V3, V4 and V5 are mounted on it.

A7. All-metal gate valve (VG1), pneumatically-actuated, VAT series 48, DN63 CF-F, with axial length 75 mm.

A8. Hydroformed metal bellows, CF63F/CF63R, with inner diameter 63 mm and axial length 150 mm.

A9. Fast valve (FV), VAT Series 75, DN63 CF-F, with axial length 150 mm.

A10. Hydroformed metal bellows, CF63F/CF63R, with inner diameter 63 mm and axial length 150 mm.

A11. 1st Pinhole Monitor, CF63F/CF100F, with axial length 278 mm

It must be made according to the drawing 1-30040.51.2167, and must fulfill the following specifications:

It consists of a vacuum chamber with a water-cooled head, which moving in the horizontal and vertical directions.

The vacuum chamber is a cylinder of 150 mm inner diameter. Laterally CF63F and CF100F flanges coaxial to the beam are used to connect to the parts A10 and A12 of the X09LFE.

One CF150F flange on the top is used to fix the head. A CF150R flange at the bottom of the chamber is used to connect an ion pump (V6). There are two CF40F flanges on the chamber; they are closed by blank flanges.

The water cooled Copper head will be in three positions:

- in the middle the beam passing through
- in the down position XIL beam passing through, the hole of diameter 0.2 mm scans SIS beam by moving manipulator ± 5 mm with a step 0.02 mm in Horizontal and vertical.

- in the up position SIS beam passing through, the hole of diameter 0.2 mm scans XIL beam by moving manipulator ± 5 mm with a step 0.02 mm in Horizontal and vertical.

The distance between two 0.2 mm holes must be 27.7 mm in horizontal. The inner opening of the head must be made in the way that one beam is free passing when another beam is under scanning in the position with maximum offset.

The manipulator has a vertical stroke of 60 mm and horizontal 10 mm with a resolution of 0.01 mm and a backlash of less than 0.01 mm. A load capacity of 300 N is required. Both motorized and manual movements are necessary; the movement must be irreversible; the driving motors are stepping motors. An optical encoder with a resolution of 0.01 mm and travel of 60 mm and 12 mm is used to detect the position of the head in horizontal and vertical, respectively. The two bakeable microswitches, type Mio, two in each end, are mounted in a box, and their position is adjustable. They stop the motor when it reaches the limit position.

The water cooling pipe must be located as close as possible to the beam. Two thermocouples (K- type) are inserted into the head near by the small holes to monitor the temperatures close to the edge.

Four reference holes of 6^{H6} mm diameter on the top of the chamber serve for alignment purposes.

The chamber is supported by three feet. The feet must be able to adjust this system to a certain position within ± 0.1 mm and to be able to fix it in this position. Therefore a kinematic mounting is required. The height from the beam center to the top surface of the frame is 195 mm.

A12. Welded Bellows, CF100F/CF100R, with inner diameter 100 mm and axial length 150 mm. It must have strokes of lateral ± 10 mm and axial ± 5 mm.

A13. L-slits 1, CF100F/CF100R, with axial length 240 mm.

This slits is for XIL beam in the up and the wall directions.

It must be made according to drawing 1-30040.51.2162, and must fulfill the following specifications:

It consists of a copper block with a bellows and a two direction manipulator. The copper block has an opening as shown in the drawing. There are two cutting edges in the Up and Wall positions of the XIL beam with a tilted angle of 8° . The distance from the inlet flange to the cutting edges is 82 mm. A water cooling channels must be set as close as the cutting edges. The block will be moved by the manipulator in vertical and horizontal directions with ± 5 mm.

The SIS beam must be free when the block is in the position with the maximum offset. Three thermocouples (K- type) are inserted into the head to monitor the temperatures close to the edge.

The manipulator has a maximum travel of 10 mm in both vertical and horizontal directions, with a resolution of 0.01 mm and a backlash of less than 0.01 mm. Both motorized and manual movements are necessary; the movement must be irreversible; the driving motors are stepping motors. An optical encoder with a resolution of 0.01 mm and travel of 12 mm is used to detect the position of the copper head. The two bakeable microswitches, type Mio, one in each end, are mounted in a box, and their position is adjustable. They stop the motor when it reaches the limit position.

The bellows must have an inner diameter of 100 mm. The strokes of lateral ± 10 mm and axial ± 5 mm are needed.

There are four reference holes of 6^{H6} mm diameter on the top of the base plate serve for alignment purposes.

The L-slits assembly is fixed by three feet on a base plate, which is on the existing frame. The feet must be able to adjust this system to a certain position within ± 0.1 mm and to be able to fix it in this position. The height from the beam center to the top surface of the base plate is 310 mm. All dimensions must fix the existing frame.

A14. L-slits 2, CF100F/CF100R, with axial length 240 mm.

This slits is for XIL beam in the down and the ring directions.

It must be made according to drawing 1-30040.51.2163, and must fulfill the following specifications:

It consists of a copper block with a bellows and a two direction manipulator. The copper block has two openings as shown in the drawing 1-30040.51.2163. There are two cutting edges in the down and ring positions of the XIL beam with a tilted angle of 8° in the small opening. The distance from the inlet flange to the cutting edges is 82 mm. The big opening is for SIS passing through. A water cooling channels must be set as close as the cutting edges. The block will be moved by the manipulator in vertical and horizontal directions with ± 5 mm.

The SIS beam must be free when the block is in the position with the maximum offset.

The requirements for the manipulator, bellows, thermocouples, reference holes and support are the same for L-slits1.

A15. L-slits 3, CF100F/CF100R, with axial length 240 mm.

This slits is for SIS beam in the up and the wall directions.

It must be made according to drawing 1-30040.51.2164, and must fulfill the following specifications:

It consists of a copper block with a bellows and a two direction manipulator. The copper block has two openings as shown in the drawing, 1-30040.51.2164. There are two cutting edges in the down and ring positions of the SIS beam with a tilted angle of 8° in the small opening. The distance from the inlet flange to the cutting edges is 82 mm. The big opening is for XIL passing through. A water cooling channels must be set as close as the cutting edges. The block will be moved by the manipulator in vertical and horizontal directions with ± 5 mm.

The XIL beam must be free when the block is in the position with the maximum offset.

The requirements for the manipulator, bellows, thermocouples, reference holes and support are the same for L-slits1.

A16. L-slits 4, CF100F/CF100R, with axial length 240 mm.

This slits is for SIS beam in the UP and the WALL directions.

It must be made according to drawing 1-30040.51.2164, and must fulfill the following specifications:

It consists of a copper block with a bellows and a two direction manipulator. The copper block has an opening as shown in the drawing, 1-30040.51.2164. There are two cutting edges in the Up and Wall positions of the SIS beam with a tilted angle of 8°. The distance from the inlet flange to the cutting edges is 82 mm. A water cooling channels must be set as close as the cutting edges. The block will be moved by the manipulator in vertical and horizontal directions with ± 5 mm.

The XIL beam must be free when the block is in the position with the maximum offset.

The requirements for the manipulator, bellows, thermocouples, reference holes and support are the same for L-slits1.

A17. Beam Stopper (ST), CF100F/CF63R, with axial length 218+376 mm.

It is the same as the standard type, except for the inlet and outlet lengths and flanges.

The section of the inlet and out pipe must be rectangular with the maximum height 35 mm and width 63 mm.

The outlet pipe is covered by four Tungsten block, shown in the drawing, 0-30040.51.2170.

The Tungsten blocks have the following dimensions:

For the blocks in up and down: Width 100 mm, height 25 mm, length 180 mm

For the blocks in two sides: Width 15 mm, height 38 mm, length 180 mm
V7 ion pump is mounted on the chamber.

A18. Hydroformed metal bellows + pipe, CF63F/CF63R, with inner diameter 63 mm and axial length 1225 mm.

A19. Hydroformed metal bellows, CF63F/CF63R, with inner diameter 63 mm and axial length 150 mm.

A20. 2nd Pinhole Monitor, CF63F/CF63R, with axial length 260 mm

It has the same requirement as for the 1st Pinhole, except for the distance of the two beams in horizontal, which is 35.4 mm.

As V8, V9, V10, V11 and V12 vacuum parts are mounted on the chamber, two more CF40 flanges and one CF63 flange are needed.

A21. All-metal gate valve (VG2), pneumatically-actuated, VAT series 48, DN63 CF-F, with axial length 75 mm.

The total axial length of New X09LFE from end of the A1 is 5823 mm.

The distance from the last flange of New X09LFE to the middle point of the X09 section is 18900 mm.

3. Scope of Supply

3.1 Components

The components, as defined in the section 2 of this specification, except for A3 (pump chamber), A6 (Shutter), A17 (Stopper), will be delivered to PSI.

3.2 Time schedule

The supplier will provide a detailed time and manpower plan for all the work in this specification within three weeks after placing the contract. The manpower plan will include and specify the key personnel concerned with this contract.

3.3 Drawings

The supplier will produce all the drawings which are necessary to manufacture each component as required in this specification.

All the drawings will be sent to PSI as soon as they are available. The PSI will require approximately two weeks to check the drawings. This check is needed to verify the compatibility of the drawings with the specification, and the manufacturing of the components can only begin after completion of this check. The PSI will then take possession of all the drawings and will be free to use them to manufacture items elsewhere. CAD drawings are required; the supplier is asked to give to PSI floppy disks with the main drawings in DWG (DXF) or STEP format.

3.4 Tools and temporary fixtures

The supplier will provide PSI with a list of all tools and jigs required during the manufacture, together with drawings and descriptions of these items. After completion of the contract, the PSI will take possession of them.

3.5 Certificates and reports

The following material certificates must be provided by the supplier:

- AISI 316LN, Copper OFHC, Tungsten

The following set of inspection documents is required at the end of the contract:

- reports of leak test, accuracy test and vacuum test
- records of bake-out temperature, brazing process and alignment reference
- technical documents concerning components purchased by the contractor

4. Packing and Delivery

The supplier is required to take responsibility for packing and transportation to the SLS site at PSI. The components must be equipped with blank flanges and filled with dry nitrogen. Adequate packing and protection must be provided to prevent damage during transportation.

The following is to be displayed clearly on the outside of the packaging:

-addressed to:

SLS Building

Attn.: Q. Chen CH-5232 Villigen-PSI **Switzerland**

-the PSI contract number

-the weight of the loaded package

-support points for transport and lifting

5. Drawing lists

1/	0-30040.50.223	General layout of XIL-SIS 9LFE
2/	0-30040.50.225	Component layout of XIL-SIS 9LFE
3/	2-30040.51.2164	Diaphragm assembly
4/	0-30040.51.2169	Photon shutter chamber
5/	1-30040.51.2166	1 st Pinhole assembly
6/	1-30040.51.2162	L-slits 1 for XIL up-wall
7/	1-30040.51.2163	L-slits 2 for XIL down-ring
8/	1-30040.51.2164	L-slits 3 for SIS up-wall
9/	1-30040.51.2165	L-slits 4 for SIS down-ring
10/	0-30040.52.2170	Beam stopper assembly
11/	0-30040.52.2171	Beam stopper chamber
12/	1-30040.51.2167	1 st Pinhole assembly
13/	2-30040.26.087	kinematic mounting

6. Components supplied by PSI

-Balzers IKR270 DN40 CF-F Cold-cathode pressure gauge	2 pieces
-Balzers TPR260 DN16 CF-R Pirani pressure gauge	2 pieces
-Varian VacIon Plus 300 l/s ion pump	5 pieces
-VAT series 48, DN63 CF-F, pneumatically actuated, all-metal gate valve	2 piece
-VAT series 57, DN63 CF, manually actuated, right-angle all-metal valve	2 pieces
-VAT series 77, DN40 CF-F, fast valve high-vacuum sensor	1 piece
-VAT series 77, DN63 CF-F, fast valve	1 piece
-motors	12 pieces
-encoders	
stroke 12 mm	10 pieces
stroke 60 mm	2 pieces
-K-type thermocouples	17 pieces