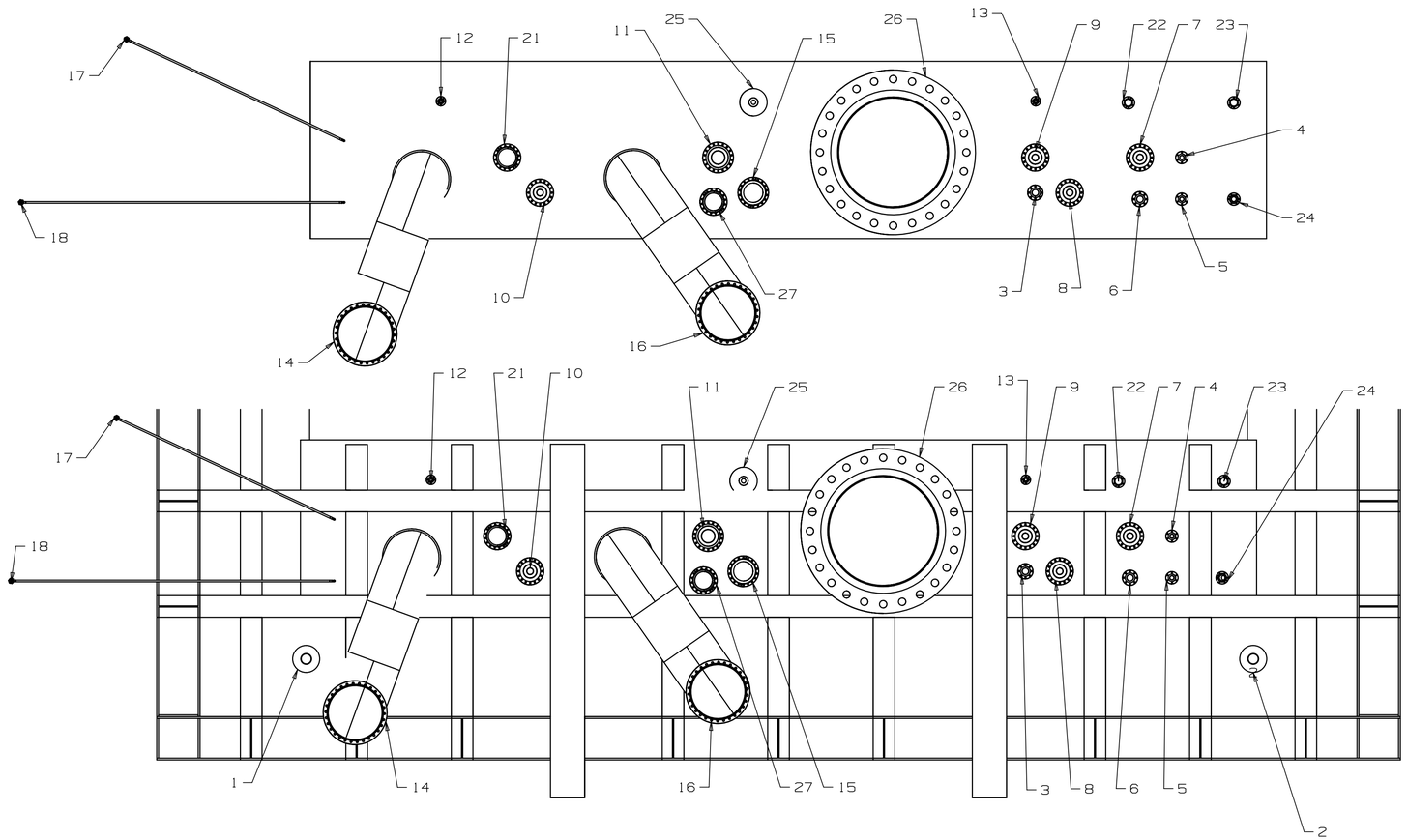
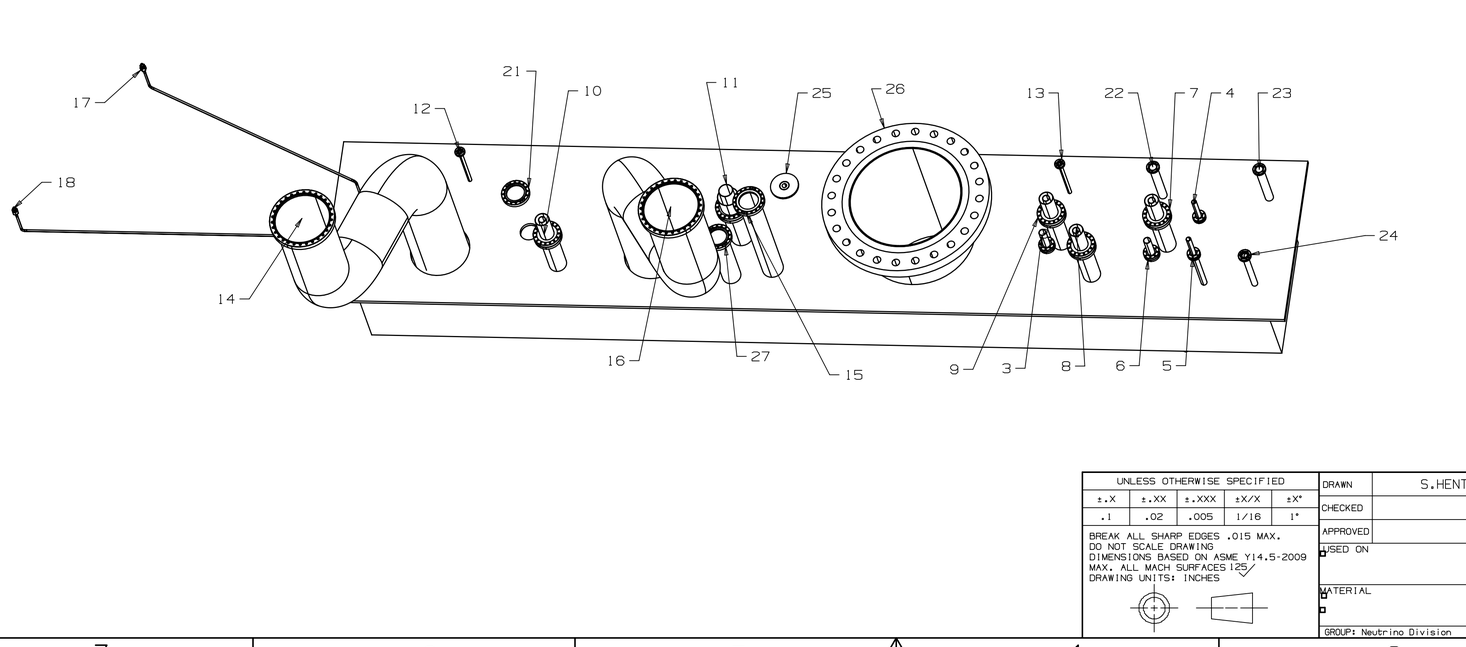
Port #	Port Type	Cryogenics Feedthroughs as marked on F10041250.1 (sheet 1)		Specify sizes (also see sketches for types of connections)					Interface # and type	
				standoff tube	vacuum tube	inner tube	CF on standoff	Quantity	per P&ID	where
1,2,19,20	**4b**	Argon purge gas	Supply and return of purge gas to the insulation space (located on the periphery of the fixed plate, go to insulation space)	2" SCH 10 pipe with ANSI 150# flange	none	none	none	4	none	none
3	**3**	Argon gas cooldown	Supply of argon gas to atomize liquid argon	3.00 x 0.083"	none	1.25"NPS sch.10 (DN32) w/2.75" CF	4.625" CF bored	1	1.6	internal
4	**3**	Argon purge gas	Purge gas for purification push purge	3.00 x 0.083"	none	1.25"NPS sch.10 (DN32) w/2.75" CF	4.625" CF bored	1	1.4	internal
5	**3**	Argon make up gas	Make up gas to maintain pressure	3.00 x 0.083"	none	1.25"NPS sch.10 (DN32) w/2.75" CF	4.625" CF bored	1	1.3	internal
6	**3**	Argon gas momentum	Supply of argon gas for momentum circulation during cooldown	3.00 x 0.083"	none	1.25"NPS sch.10 (DN32) w/2.75" CF	4.625" CF bored	1	1.5	internal
7	**1**	Argon liquid cooldown path to condenser	Argon liquid path to condenser and return from tube phase separator	3.75" x 0.083"	3.5" x 0.065"	1.5" NPS sch.10 (DN40) w/3.375" CF	6" CF bored	1	1.10	internal
8	**1**	Argon liquid cooldown	Supply of argon liquid for cooldown	3.75" x 0.083"	3.5" x 0.065"	1.5" NPS sch.10 (DN40) w/3.375" CF	6" CF bored	1	1.7	internal
9	**1**	Argon liquid to cold roof	Argon liquid spray under roof (probably not needed - will be spare)	3.75" x 0.083"	3.5" x 0.065"	1.5" NPS sch.10 (DN40) w/3.375" CF	6" CF bored	1	1.9	internal
10	**1**	Argon liquid distribution	Argon liquid return to cryostat	3.75" x 0.083"	3.5" x 0.065"	1.5" NPS sch.10 (DN40) w/3.375" CF	6" CF bored	1	1.8	internal
11	**2**	Argon gas boil-off	Argon boil-off gas return to condenser	4.75" x 0.083	4.5" x 0.065"	2.5"NPS sch.10 (DN65)	6.75" CF bored	1	none	none
12,13	**4c**	Liquid level probes	Liquid level probes	0.75" x 0.083"	none	N/A	2.125" CF bored	2	none	none
14	**4a**	Argon gas vent port	Vent to pressure reliefs	12" x 0.375"	none	none	14" CF	1	1.14	none
15	**4c**	spare port	spare	4.75" x 0.083	N/A	N/A	6.75" CF bored	1	none	none
16	**4a**	Argon vacuum relief	Air intake	12" x 0.375"	none	none	14" CF	1	1.16	external
17	**4d**	Instrumentation port	Ullage pressure	0.375" x 0.035"	none	none	3/8" Swagelok VCR	1	none	none
18	**4d**	Instrumentation port	Ullage pressure	0.375" x 0.035"	none	none	3/8" Swagelok VCR	1	none	none
21,27	**4c**	Instrumentation port	T sensors from inside cryostat	4.0" x 0.083	N/A	N/A	6.00" CF bored	2	none	none

Port #	Description	Standoff tube/pipe	Flange/CF on standoff	Quantity
1,2,19,20	Argon purge gas	2" SCH 10 pipe with ANSI 150# flange	none	4
3	Argon gas cooldown	3.00 x 0.083"	4.625" CF bored	1
4	Argon purge gas	3.00 x 0.083"	4.625" CF bored	1
5	Argon make up gas	3.00 x 0.083"	4.625" CF bored	1
6	Argon gas momentum	3.00 x 0.083"	4.625" CF bored	1
7	Argon liquid cooldown path to condenser	3.75" x 0.083"	6" CF bored	1
8	Argon liquid cooldown	3.75" x 0.083"	6" CF bored	1
9	Argon liquid to cold roof	3.75" x 0.083"	6" CF bored	1
10	Argon liquid distribution	3.75" x 0.083"	6" CF bored	1
11	Argon gas boil-off	4.75" x 0.083	6.75" CF bored	1
12,13	Liquid level probes	0.75" x 0.083"	2.125" CF bored	2
14	Argon gas vent port	12" x 0.375"	14" CF	1
15	spare port	4.75" x 0.083	6.75" CF bored	1
16	Argon vacuum relief	12" x 0.375"	14" CF	1
17	Instrumentation port	0.375" x 0.035"	3/8" Swagelok VCR	1
18	Instrumentation port	0.375" x 0.035"	3/8" Swagelok VCR	1
21,27	Instrumentation port	4.0" x 0.083	6.00" CF bored	2

DESCRIPTION: 158 M3 CRYOSTAT VER 3 REV 2
CATEGORY: CRYOSTAT PROJECT: LBNEForDetector

REV	REVISION CONTROL DOCUMENT	DATES	SIGNATURES
-	F10035424---RCD		DRAWN
			APPROVED





Port #	Description	Diameter	Qty.
1,2,19,20	Argon Purge Gas	2" SCH 10 Pipe with ANSI 150# Flange	4
3	Argon Gas Cooldown	3"	1
4	Argon Purge Gas	3"	1
5	Argon Make Up Gas	3"	1
6	Argon Gas Momentum	3"	1
7	Argon Liquid Cooldown Path to condenser	3.75"	1
8	Argon Liquid Cooldown	3.75"	1
9	Argon Liquid to Cold Roof	3.75"	1
10	Argon Liquid Distribution	3.75"	1
11	Argon Gas Boil-off	4.75"	1
12,13	Liquid Level Probes	0.75"	2
14	Argon Gas Vent Port	12"	1
15	Spare Port	4.75"	1
16	Argon Vacuum Relief	12"	1
17	Instrumentation Port	3.75"	1
18	Instrumentation Port	3.75"	1
22,23	Spare Port	1.75"	2
24	Spare Port	1.25"	1
21,27	Instrumentation Port	4.0"	2

Pos.	Description	Diameter (mm)	Qty.
25	High Voltage Feedthrough	156	1
26	Manhole	609	1

UNLESS OTHERWISE SPECIFIED

±.X	±.XX	±.XXX	±X/X	±X°
.1	.02	.005	1/16	1°

BREAK ALL SHARP EDGES .015 MAX.
DO NOT SCALE DRAWING
DIMENSIONS BASED ON ASME Y14.5-2009
MAX. ALL MACH SURFACES 125
DRAWING UNITS: INCHES

DRAWN	S.HENTSCHEL	DATE	16-Dec-2014
CHECKED		DATE	
APPROVED		DATE	

USED ON

MATERIAL

GROUP: Neutrino Division | CAGE CODE: 0U5R6

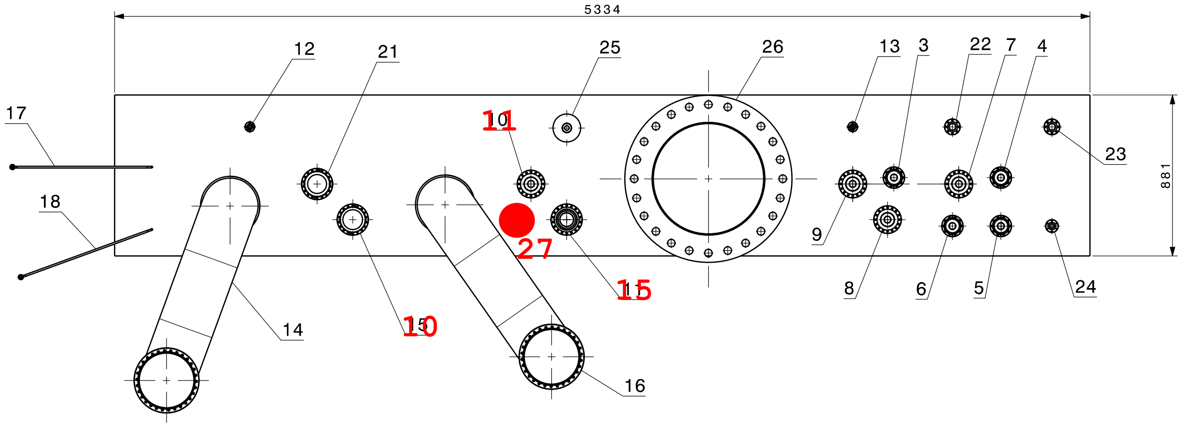
FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY

NAME
SBN FIXED COVER FEEDTHROUGHS
158 M3 CRYOSTAT VER 3 REV 2

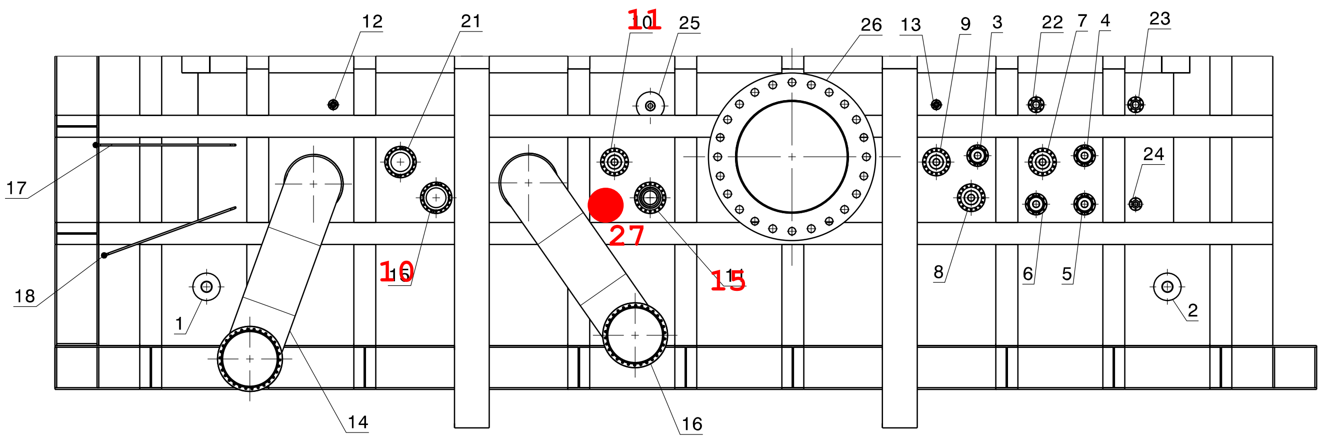
SCALE	SIZE	DRAWING NUMBER	SHEET	REV
1:1	D	F10035424	1 OF 1	-

fix top plate
1:15

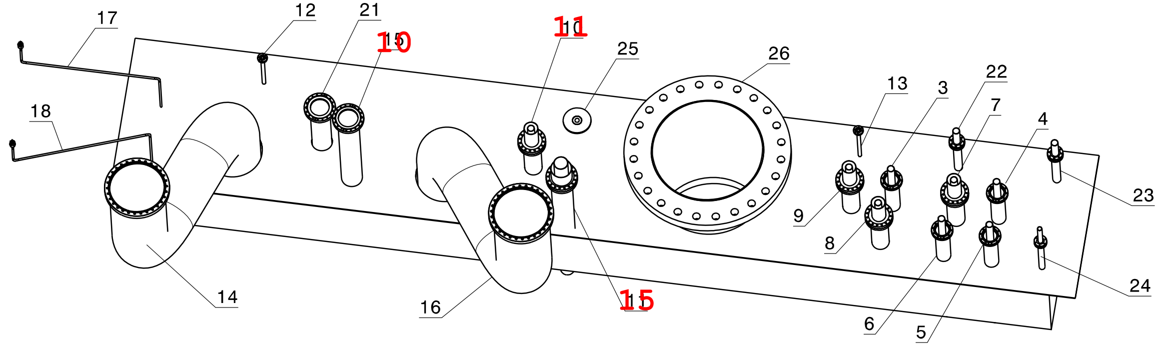
Older version (CERN)



fix top plate & steel structure



Isometric view
1:14



Port #	Description	Diameter	
1,2,19,20	Argon purge gas	2" SCH 10 pipe with ANSI 150# flange	4
3	Argon gas cooldown	3"	1
4	Argon purge gas	3"	1
5	Argon make up gas	3"	1
6	Argon gas momentum	3"	1
7	Argon liquid cooldown path to condenser	3.75"	1
8	Argon liquid cooldown	3.75"	1
9	Argon liquid to cold roof	3.75"	1
10	Argon liquid distribution	3.75"	1
11	Argon gas boil-off	4.75"	1
12,13	Liquid level probes	0.75"	2
14	Argon gas vent port	12"	1
15	spare port	4.75"	1
16	Argon vacuum relief	12"	1
17	Instrumentation port	0.375"	1
18	Instrumentation port	0.375"	1
22,23	spare port	1.75"	2
24	spare port	1.25"	1
21,27	Instrumentation port	4.0"	2

Detector penetrations

Pos.	Description	Diameter [mm]	Qty.
25	High Voltage Feedthrough	156	1
26	Manhole	609	1

This component is described by 3 assosiated drawings:
-1/3: CENSNDCI0001 (main sheet)
-2/3: CENSNDCI0002
-3/3: CENSNDCI0003

SBND Cryostat Integration
INTEGRATION ASSEMBLY STEEL STRUCTURE & TOP CAP SBND

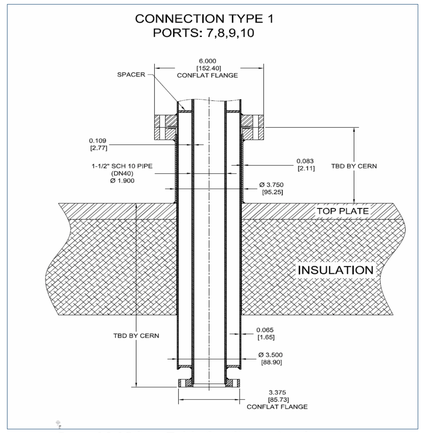
DRAWN	E. Seletskaya	2015-12-01
CONTROLLED		
RELEASED		
APPROVED		
CAD Document Number	ST0726654_03	
REPLACES		

NON VALABLE POUR EXECUTION
NOT VALID FOR EXECUTION

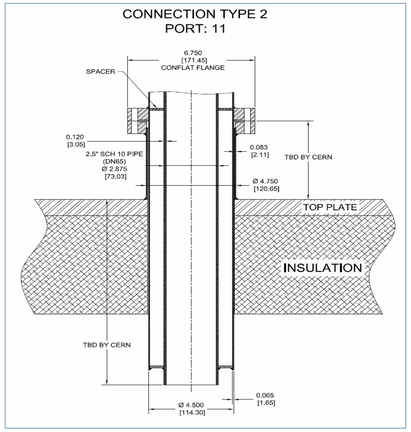
CENSNDCI0002 1

For official drawing, see Teamcenter item F10056435

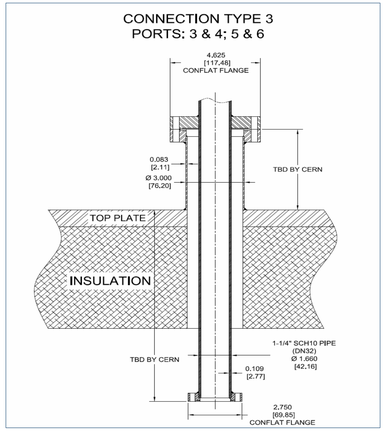
Ports 7,8,9,10 (see Table for dimensions)



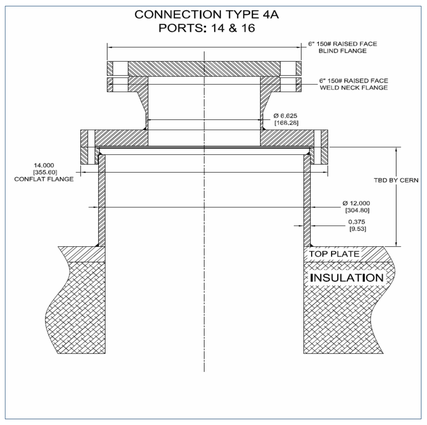
Port 11 (see Table for dimensions)



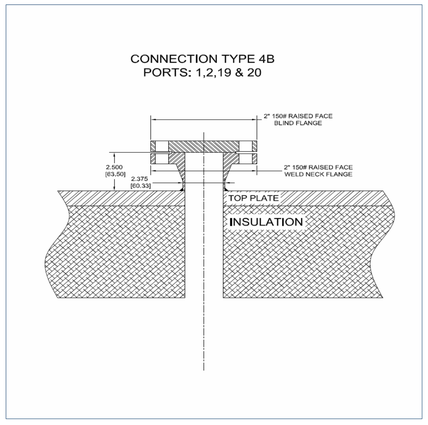
Port 3,4,5,6 (see Table for dimensions)



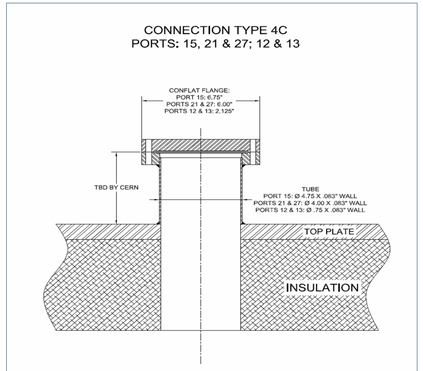
Ports 14,16 (see Table for dimensions)



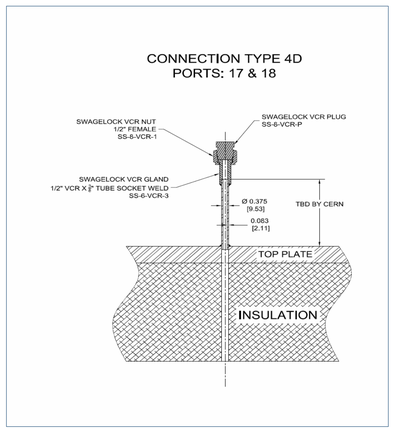
Ports 1,2,19,20 (see Table for dimensions)



Ports 15,21,12,13 (see Table for dimensions)



Ports 17,18 (see Table for dimensions)



SBND INTERFACE POINTS ON P&ID DRAWINGS						Pressure Rating, Barg (psig)		Temperature Rating, K		Flow Rating, kg/s for liquid and m^3/hr for gas		Connection	
#	DRAWING NUMBER	FLUID	DESCRIPTION	LOCATION	TYPE	Design	Maximum	Design	Range	Design	Maximum	(described as provided by CERN)	described as provided by Fermilab)
1.3	F10041250.1 Gas line	GAr	Proximity<->Internal: GAr make-up gas	In the cryostat	(Type 3) - Inner: 1.25"NPS sch.10 (DN32)	0.35 (5.0)	9.0 (132.3)	87	85 – 311	>10 GAr	100 GAr	Inner – DN32 sch.10 w/2.75" CF Comes from CERN pressure tested.	Inner – 1.25" sch.10 NPS w/2.75" CF. Open to cryostat; no pressure test.
1.4	F10041250.1 Gas line	GAr	Proximity<->Internal: GAr purge gas	In the cryostat	(Type 3) - Inner: 1.25"NPS sch.10 (DN32)	2.0 (29.4)	9.0 (132.3)	300	85 – 311	>40 GAr	100 GAr	Inner – DN32 sch.10 w/2.75" CF Comes from CERN pressure tested.	Inner – 1.25" sch.10 NPS w/2.75" CF. Open to cryostat; no pressure test.
1.5	F10041250.1 Gas line	GAr	Proximity<->Internal: GAr gas momentum	In the cryostat	(Type 3) - Inner: 1.25"NPS sch.10 (DN32)	2.0 (29.4)	9.0 (132.3)	300	87 – 311	>10 GAr	100 GAr	Inner – DN32 sch.10 w/2.75" CF Comes from CERN pressure tested.	Inner – 1.25" sch.10 NPS w/2.75" CF. Open to cryostat; no pressure test.
1.6	F10041250.1 Gas line	GAr	Proximity<->Internal: GAr gas cooldown	In the cryostat	(Type 3) - Inner: 1.25"NPS sch.10 (DN32)	2.0 (29.4)	9.0 (132.3)	300	87 – 311	>10 GAr	100 GAr	Inner – DN32 sch.10 w/2.75" CF Comes from CERN pressure tested.	Inner – 1.25" sch.10 NPS w/2.75" CF. Open to cryostat; no pressure test.
1.7	F10041250.1 NP-03-30-A6	LAr	Proximity<->Internal: NP-03-30-A6 LAr liquid cooldown	In the cryostat	(Type 1) VJ: 3.5" x 0.0465" Inner: 1.5"NPS sch.10 (DN40)	2.0 (29.4)	9.0 (132.3)	87	85 – 311	>0.25 LAr	0.6 LAr	Inner – DN40 sch.10 w/3.37" CF Comes from CERN pressure tested. Outer: vacuum jacket	Inner: 1.5” sch.10 " w/3.37" CF Pressure tested at Fermilab on the bench. Outer: vacuum jacket
1.8	F10041250.1 NP-03-30-A0	LAr	Proximity<->Internal: NP-03-30-A0 LAr liquid distribution	In the cryostat	(Type 1) VJ: 3.5" x 0.0465" Inner: 1.5"NPS sch.10 (DN40)	2.0 (29.4)	9.0 (132.3)	87	85 – 311	>1 LAr	3.5 LAr	Inner – DN40 sch.10 w/3.37" CF Comes from CERN pressure tested. Outer: vacuum jacket	Inner: 1.5” sch.10 " w/3.37" CF Pressure tested at Fermilab on the bench. Outer: vacuum jacket
1.9	F10041250.1 NP-03-30-A10	LAr	Proximity<->Internal: NP-03-30-A10 LAr liquid to cold roof	In the cryostat	(Type 1) VJ: 3.5" x 0.0465" Inner: 1.5"NPS sch.10 (DN40)	2.0 (29.4)	9.0 (132.3)	87	85 – 311	>0.13 LAr	0.3 LAr	Inner – DN40 sch.10 w/3.37" CF Comes from CERN pressure tested. Outer: vacuum jacket	Inner: 1.5” sch.10 " w/3.37" CF Pressure tested at Fermilab on the bench. Outer: vacuum jacket
1.10	F10041250.1 NP-03-30-A9	LAr	Proximity<->Internal: NP-03-30-A9 LAr return to condenser	In the cryostat	(Type 1) VJ: 3.5" x 0.0465" Inner: 1.5"NPS sch.10 (DN40)	2.0 (29.4)	9.0 (132.3)	87	85 – 311	>0.25 LAr	0.6 LAr	Inner – DN40 sch.10 w/3.37" CF Comes from CERN pressure tested. Outer: vacuum jacket	Inner: 1.5” sch.10 " w/3.37" CF Pressure tested at Fermilab on the bench. Outer: vacuum jacket

1.14	F10041250.1 Gas line	GAr	Proximity<->External: GAr to external pressure relief	Outside cryostat above top plate to PSV8009A	(Type 4A) 14” CF	0.35 (5.0)	9.0 (132.3)	300	256 – 311	5500 at design pressure	N/A	14” CF	14” CF
1.16	F10041250.1 Gas line	GAr	Proximity<->External: GAr to external pressure relief	Outside cryostat above top plate to PSV8007A	(Type 4A) 14” CF	0.35 (5.0)	9.0 (132.3)	300	256 – 311	5500 at design pressure	N/A	14” CF	14” CF
2.1	F10041250.2 NP-03-30-A1	LAr/GAr	External<->Proximity: Supply LAr/GAr NP-03-30-A1 from the dewar outside the building to purification	Lines E and M (combined) – Pipe tee on the LAr supply line to LAr filter skids	(Fig.1) Inner – 2”NPS sch.10 with socket weld Outer – 4”NPS sch.5 with clamshell	5.0 (73.5)	9.0 (132.3)	93	85 – 311	>30 GAr	150 GAr	Inner – DN50 sch.10 capped pipe Comes from CERN pressure tested. Outer – DN100 sch.5 capped (with vacuum break)	Inner – 2”NPS sch.10 with socket weld by FNAL and pressure test between FCV7005A, PV7005A, PV7030A, PV7031A, FCV5206A, FCV6002A, and misc. valves via instrumentation port. Outer – 4”NPS sch.5 with clamshell final weld by FNAL
2.2	F10041250.2 Gas line	GAr/H2	External<->Proximity: Supply GAr/H2 mixture from external cryogenics	At 1FLVB filter skid valve box - external valve HV7007A	1” NPS sch. 10 socket weld	2.0 (29.4)	9.0 (132.3)	460	244 – 500	>10 GAr	50 GAr	Inner – DN25 socket connection to HV7007A Comes from CERN pressure tested.	Inner – 1”NPS sch.10 with socket weld by FNAL and pressure test between HV7007A and supply manifold of GAr/H2.
2.3	F10041250.2 Gas line	GAr/H2	External<->Proximity: Supply GAr/H2 mixture from external cryogenics	At 2FLVB filter skid valve box - external valve HV7100A	1” NPS sch. 10 socket weld	2.0 (29.4)	9.0 (132.3)	460	244 – 500	>10 GAr	50 GAr	Inner – DN25 socket connection to HV7100A Comes from CERN pressure tested.	Inner – 1”NPS sch.10 with socket weld by FNAL and pressure test between HV7100A and supply manifold of GAr/H2.
2.4	F10041250.2 Gas line	GAr/H2	External<->Proximity: Supply GAr/H2 mixture from external cryogenics	At FI7200 filter skid - external valve HV7210A	1” NPS sch. 10 socket weld	2.0 (29.4)	9.0 (132.3)	460	244 – 500	>10 GAr	50 GAr	Inner – DN25 socket connection to HV7210 Comes from CERN pressure tested.	Inner – 1”NPS sch.10 with socket weld by FNAL and pressure test between HV7210A and supply manifold of GAr/H2.
2.5	F10041250.2 Gas line	GAr	External<->Proximity: Supply GAr from the dewar outside the building to purification and cryostat	At FI7200 filter skid - external tee downstream of valve PV7208A	1.5” NPS sch. 10 socket weld	2.0 (29.4)	9.0 (132.3)	300	244 – 311	>40 GAr	100 GAr	Inner – DN40 socket connection to HV7211A Comes from CERN pressure tested.	Inner – 1.5”NPS sch.10 with socket weld by FNAL and pressure test between weld and isolation valves supplying GAr to the cryostat.

2.6	F10041250.2 Gas line	GAr	External<->Proximity: Supply GAr from the dewar outside the building to purification and cryostat	At Fl7200 filter skid - external tee upstream of valve HV7211A	1.5" NPS sch. 10 socket weld	2.0 (29.4)	9.0 (132.3)	300	244 – 311	>40 GAr	100 GAr	Inner – DN40 socket connection to HV7211A Comes from CERN pressure tested.	Inner – 1.5"NPS sch.10 with socket weld by FNAL and pressure test between HV7211A and supply manifold of GAr.
3.1	F10041250.3 NP-03-10-N1	LN2	External<->Proximity: Supply LN2 from the dewar outside the building to purification	Line G - On the LN2 supply line (outside) from LN2 supply dewar TK-0050N to N2 phase separator TK-4000N	(Fig.1) Inner – 2"NPS sch.10 with socket weld Outer – 4"NPS sch.5 with clamshell	2.0 (29.4)	9.0 (132.3)	77	75 – 311	0.75 LN2	1.5 LN2	Inner – DN50 sch.10 capped pipe (comes from CERN pressure tested) Outer – DN100 sch.5 capped (with vacuum break)	Inner – 2"NPS sch.10 with socket weld by FNAL and pressure test between FCV0101N and FCV4010N via PSV4010N Outer – 4"NPS sch.5 with clamshell final weld by FNAL

In addition, all GAr and GN2 vents for proximity cryogenic equipment and piping (including reliefs and purges to atmosphere) are vented to common gas manifolds (responsibility of external cryogenics). Assume back pressure of 0.05 bar

This is a controlled document. Initial approval of this document is required before implementation of contracts. All revisions to this document require the change control procedures of the SBN program before revision approval.

PICD Reviewed by:

Sign Off is required by the following personnel.

SBND External Cryogenics	SBND Proximity Cryogenics
Michael Zuckerbrot - FNAL	Johan Bremer - CERN

X_____ X_____

PICD Approval:

Sign Off is required by the following personnel.

SBND External Cryogenics	SBND Proximity Cryogenics
Michael Geynisman - FNAL	Claudio Montanari - CERN

X_____ X_____

- See connections types for the cryostat top plate in the attached document.
- See connection type for a vacuum jacketed piping (typical) below on Fig.1:

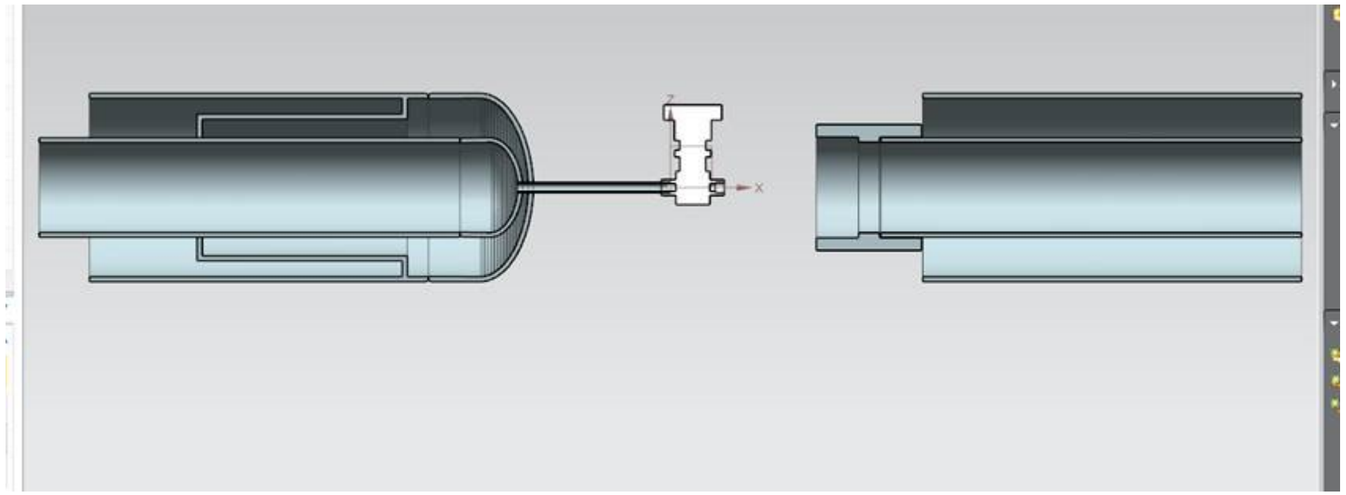


Figure 1 Typical interface between CERN (left) and Fermilab (right) after shipment before installation