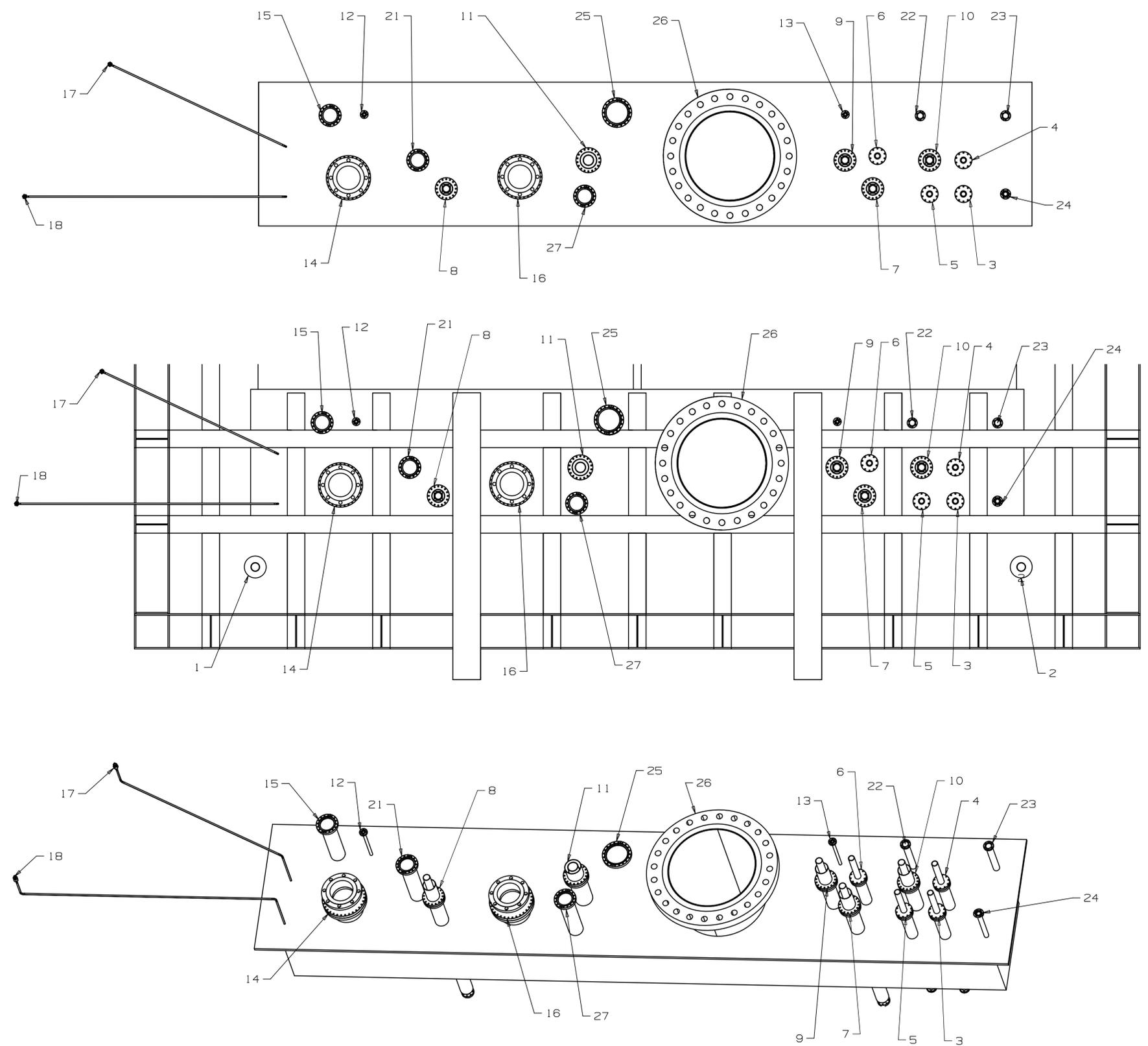


Port #	Port Type	Cryogenics Feedthroughs as marked on F10041250.1 (sheet 1)		Specify sizes (also see sketches for types of connections)			CF on standoff	Quantity	Interface # and type	
				standoff tube	vacuum tube	inner tube			per P&ID	where
1, 2, 19, 20	4b	Argon purge gas	Supply and return of purge 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 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
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 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
6	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
7	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
8	1	Argon liquid distribution (bottom)	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
9	1	Argon liquid distribution (top)	Argon liquid return to cryostat (optional)	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 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
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
14	4a	Argon gas vent port	Vent to pressure reliefs	8.625" x 0.322"	none	none	12" CF	1	1.14	none
15	4c	spare port	spare	4.00" x 0.083"	N/A	N/A	6.00" CF bored	1	none	none
16	4a	spare port	spare	8.625" x 0.322"	none	none	12" CF	1	1.16	external
17	4d	Instrumentation port	Ullage pressure	0.375" x 0.083"	none	none	3/8" Swagelok VCR	1	none	none
18	4d	Instrumentation port	Ullage pressure	0.375" x 0.083"	none	none	3/8" Swagelok VCR	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
21, 27	4c	Instrumentation ports	T sensors from inside cryostat	4.0" x 0.083"	N/A	N/A	6.00" CF bored	2	none	none
22, 23	4c	Spare ports	spare	1.75" x 0.083"	N/A	N/A	2.75" CF bored	2	none	none
24	4c	Spare ports	spare	1.25" x 0.083"	N/A	N/A	2.75" CF bored	1	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 make up gas	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 gas momentum	3.00" x 0.083"	4.625" CF bored	1
6	Argon gas cooldown	3.00" x 0.083"	4.625" CF bored	1
7	Argon liquid cooldown	3.75" x 0.083"	6" CF bored	1
8	Argon liquid distribution (bottom)	3.75" x 0.083"	6" CF bored	1
9	Argon liquid distribution (top)	3.75" x 0.083"	6" CF bored	1
10	Argon liquid cooldown path to condenser	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	8.625" x 0.322"	12" CF	1
15	spare port	4.00" x 0.083"	6.00" CF bored	1
16	spare port	8.625" x 0.322"	12" CF	1
17	Instrumentation port	0.375" x 0.083"	3/8" Swagelok VCR	1
18	Instrumentation port	0.375" x 0.083"	3/8" Swagelok VCR	1
21,27	Instrumentation port	4.0" x 0.083"	6.00" CF bored	2
22, 23	Spare ports	1.75" x 0.083"	2.75" CF bored	2
24	Spare port	1.25" x 0.083"	2.75" CF bored	1

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Port #	Description	Diameter Standoff tube/pipe	FLANGE/CF ON STANDOFF	Qty.
1,2,19,20	Argon Purge Gas	2" SCH 10 Pipe with ANSI 150# Flange	NONE	4
3	Argon Make Up Gas	3.00" X .083"	4.625" CF BORED	1
4	Argon Purge Gas	3.00" X .083"	4.625" CF BORED	1
5	Argon Gas Momentum	3.00" X .083"	4.625" CF BORED	1
6	Argon Gas Cooldown	3.00" X .083"	4.625" CF BORED	1
7	Argon Liquid Cooldown	3.75" X .083"	6.0" CF BORED	1
8	Argon Liquid Distribution	3.75" X .083"	6.0" CF BORED	1
9	Argon Liquid to Cold Roof	3.75" X .083"	6.0" CF BORED	1
10	Argon Liquid Path to Condenser	3.75" X .083"	6.0" CF BORED	1
11	Argon Gas Boil-off	4.75" x .083"	6.75" CF Bored	1
12,13	Liquid Level Probes	0.75" X .083"	2.125" CF Bored	2
14	Argon Gas Vent Port	8.625" X .322"	12" CF	1
15	Spare Port	4.0" X .083"	6.0" CF Bored	1
16	SPARE	8.625" X .322"	12" CF	1
17	Instrumentation Port	.375" X 0.083"	3/8" Swagelok VCR	1
18	Instrumentation Port	.375" X 0.083"	3/8" Swagelok VCR	1
21, 27	Instrumentation Port	4.0" X .083"	6.00" CF Bored	2
22, 23	Spare Ports	1.75" X .083"	2.75" CF Bored	2
24	Spare Port	1.25" X .083"	2.75" CF Bored	1

Port #	Description	Diameter (mm)	Qty.
25	High Voltage Feedthrough	203.2	1
26	Manhole	609	1

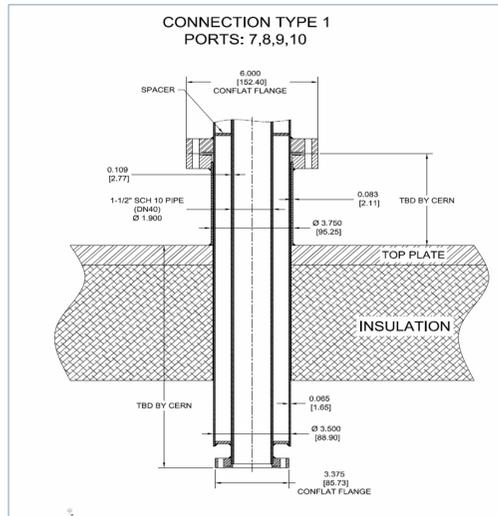
UNLESS OTHERWISE SPECIFIED					DRAWN	S.HENTSCHEL	DATE	16-Dec-2014
±.X	±.XX	±.XXX	±X/X	±X"	CHECKED		DATE	
.1	.02	.005	1/16	1"	APPROVED		DATE	
BREAK ALL SHARP EDGES .015 MAX. DO NOT SCALE DRAWING DIMENSIONS BASED ON ASME Y14.5-2009 MAX. ALL MACH SURFACES 125 DRAWING UNITS: INCHES					USED ON			
					MATERIAL			
					GROUP: Neutrino Division		CAGE CODE: QUSR6	

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 UNITED STATES DEPARTMENT OF ENERGY

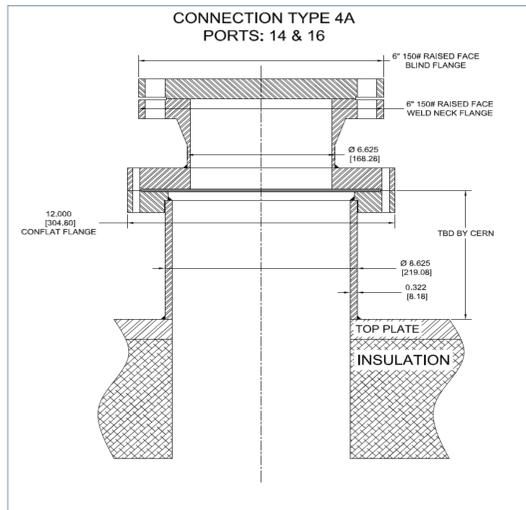
NAME  
 SBN FIXED COVER FEEDTHROUGHS  
 15B M3 CRYOSTAT VER 3 REV 2

SCALE	SIZE	DRAWING NUMBER	SHEET	REV
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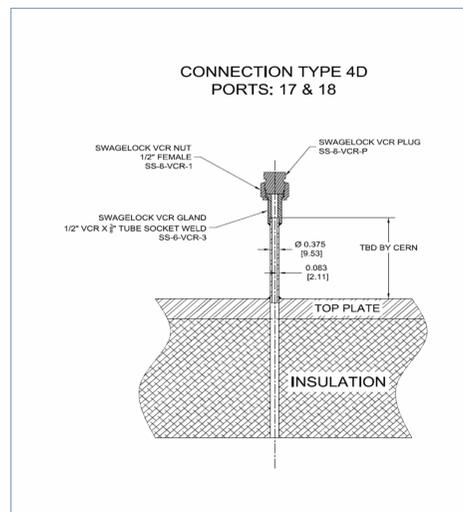
**Ports 7,8,9,10 (see Table for dimensions)**



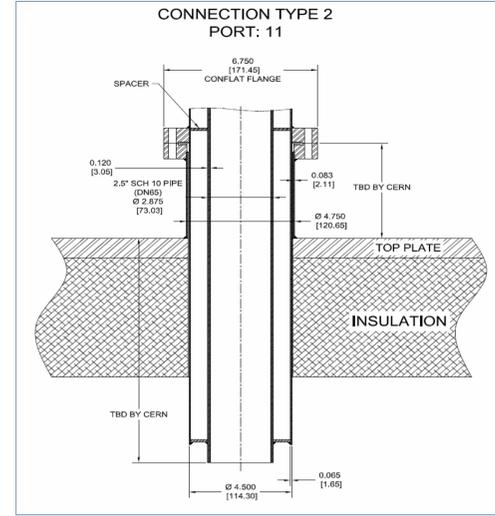
**Ports 14,16 (see Table for dimensions)**



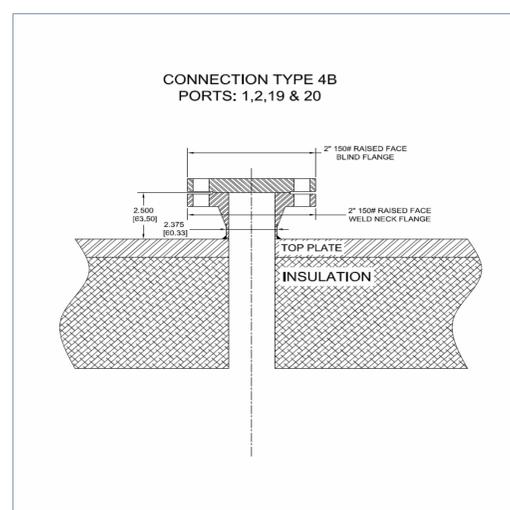
**Ports 17,18 (see Table for dimensions)**



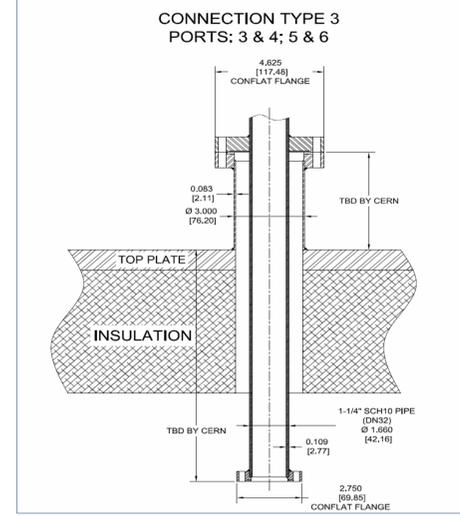
**Port 11 (see Table for dimensions)**



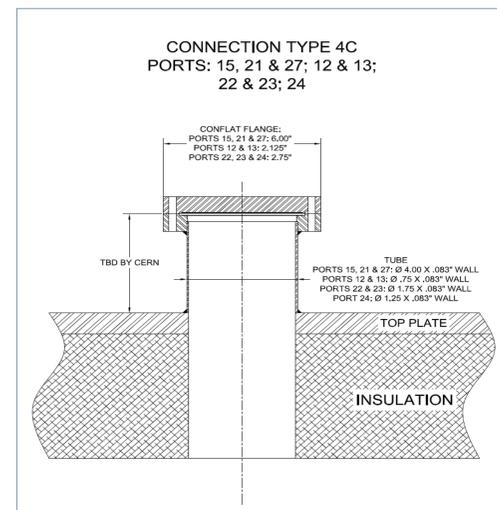
**Ports 1,2,19,20 (see Table for dimensions)**



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



**Ports 12,13,15,21,22,23,24 (see Table for dimensions)**



## SBND Interface Control Document

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SBND INTERFACE POINTS ON P&ID DRAWINGS						Pressure Rating, Bar abs		Temperature Rating, K		Flow Rating, kg/s for liquid and m <sup>3</sup> /hr for gas		Connection	
# per P&ID	DRAWING NUMBER	FLUID	DESCRIPTION	LOCATION	TYPE	Operating (assumed)	Design (maximum)	Design	Range	Design	Maximum	(described as provided by CERN)	(described as provided by Fermilab)
1.3	F10041250.1 NP-03-80-AG8	GAr	GAr make-up gas Proximity<->Internal: NP-03-80-AG8	In the cryostat	(Type 3) Inner: 1.25"NPS sch.10 (DN32)	1.35	10	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 NP-03-80-AG10	GAr	GAr purge gas Proximity<->Internal: NP-03-80-AG10	In the cryostat	(Type 3) Inner: 1.25"NPS sch.10 (DN32)	3	10	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 NP-03-80-AG11	GAr	GAr gas momentum Proximity<->Internal: NP-03-80-AG11	In the cryostat	(Type 3) Inner: 1.25"NPS sch.10 (DN32)	3	10	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 NP-03-80-AG12	GAr	GAr gas cooldown Proximity<->Internal: NP-03-80-AG12	In the cryostat	(Type 3) Inner: 1.25"NPS sch.10 (DN32)	3	10	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	Liquid cooldown Proximity<->Internal: NP-03-30-A6 LAr	In the cryostat	(Type 1) VJ: 3.5" x 0.065" Inner: 1.5"NPS sch.10 (DN40)	3	10	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/3.375" CF Pressure tested at Fermilab on the bench.  Outer: vacuum jacket
1.8	F10041250.1 NP-03-30-A0	LAr	Liquid distribution (bottom) Proximity<->Internal: NP-03-30-A0 LAr	In the cryostat	(Type 1) VJ: 3.5" x 0.065" Inner: 1.5"NPS sch.10 (DN40)	3	10	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/3.375" CF Pressure tested at Fermilab on the bench.  Outer: vacuum jacket
1.9	F10041250.1 NP-03-30-A10	LAr	Liquid distribution (top) Proximity<->Internal: NP-03-30-A10 LAr	In the cryostat	(Type 1) VJ: 3.5" x 0.065" Inner: 1.5"NPS sch.10 (DN40)	3	10	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/3.375" CF Pressure tested at Fermilab on the bench.  Outer: vacuum jacket
1.10	F10041250.1 NP-03-30-A9	LAr	LAr return to condenser Proximity<->Internal: NP-03-30-A9 LAr	In the cryostat	(Type 1) VJ: 3.5" x 0.065" Inner: 1.5"NPS sch.10 (DN40)	3	10	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/3.375" CF Pressure tested at Fermilab on the bench.  Outer: vacuum jacket
1.14	F10041250.1 NP-03-90-AV1 & AV2	GAr	GAr to external pressure relief Proximity<->External: NP-03-90-AV1 & AV2	Outside cryostat above the top plate to diverter valve HV-8009A	(Type 4A) 12" CF	1.35	10	300	253 – 311	5500 GAr at design pressure	N/A	12" CF	12" CF

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1.16	F10041250.1 NP-03-90-AV2	GAr	Proximity<->External: spare	Outside cryostat above top plate (spare, but similar to 1.14)	(Type 4A) 12" CF	1.35	10	300	253 – 311	N/A	N/A	12" CF	12" CF
2.1	F10041250.2 NP-03-30-A1	LAr/GAr	Supply LAr/GAr External<->Proximity: NP-03-30-A1 from the LAr dewar to NP-01-30-A1 outside the building	NP-03-30-A1 from the LAr dewar to NP-01- 30-A1 outside the building	(Fig.1)  Socket weld	3	10	87 LAr 300 GAr	85 – 311	> 0.5 LAr >30 GAr	1 LAr 150 GAr	<u>Inner:</u> DN50 sch.10 capped pipe (comes from CERN pressure tested)  <u>Outer:</u> DN100 sch.5 capped (with vacuum break)	<u>Inner:</u> 2"NPS sch.10 with socket weld by FNAL (pressure tested between isolation valves and using trapped volume relief as pressure port)  <u>Outer:</u> 4"NPS sch.5 with clamshell final weld by FNAL
2.2	F10041250.2 NP-03-70-RB2	GAr/H2	Supply GAr/H2 mixture from external cryogenics External<->Proximity:	At NP-03-40-F1 filter skid 1 valve box - external valve HV-7011A	1" NPS sch. 10 socket weld	3	10	460	244 – 500	>10 GAr	50 GAr	<u>Inner:</u> DN25 socket connection to HV-7011A Comes from CERN pressure tested.	<u>Inner:</u> 1"NPS sch.10 with socket weld by FNAL (pressure tested between isolation valves and using trapped volume relief as pressure port)
2.3	F10041250.2 NP-03-70-RB2	GAr/H2	Supply GAr/H2 mixture from external cryogenics External<->Proximity	At NP-03-40-F2 filter skid 2 valve box - external valve HV-7100A	1" NPS sch. 10 socket weld	3	10	460	244 – 500	>10 GAr	50 GAr	<u>Inner:</u> DN25 socket connection to HV-7100A Comes from CERN pressure tested.	<u>Inner:</u> 1"NPS sch.10 with socket weld by FNAL (pressure tested between isolation valves and using trapped volume relief as pressure port)
2.4	F10041250.2 NP-03-70-RB2	GAr/H2	Supply GAr/H2 mixture from external cryogenics External<->Proximity	At NP-03-40-F3 filter skid 3 - external valve HV-7213A	1" NPS sch. 10 socket weld	3	10	460	244 – 500	>10 GAr	50 GAr	<u>Inner:</u> DN25 socket connection to HV-7213A Comes from CERN pressure tested.	<u>Inner:</u> 1"NPS sch.10 with socket weld by FNAL (pressure tested between isolation valves and using trapped volume relief as pressure port)
2.5	F10041250.2 NP-03-80-AG5	GAr	Supply GAr from the dewar outside the building to purification and cryostat  External<->Proximity:	At NP-03-70-F3 filter skid 3 - external tee downstream of valve PV-7208A	1.5" NPS sch. 10 socket weld	3	10	300	244 – 311	>40 GAr	100 GAr	<u>Inner:</u> DN40 socket connection to HV-7208A Comes from CERN pressure tested.	<u>Inner:</u> 1.5"NPS sch.10 with socket weld by FNAL (pressure tested between isolation valves and using trapped volume relief as pressure port)
2.6	F10041250.2 NP-03-80-AG4	GAr	Supply GAr from the dewar outside the building to purification and cryostat  External<->Proximity:	At NP-03-70-F3 filter skid 3 - external tee upstream of valve HV-7212A	1.5" NPS sch. 10 socket weld	3	10	300	244 – 311	>40 GAr	100 GAr	<u>Inner:</u> DN40 socket connection to HV-7212A Comes from CERN pressure tested.	<u>Inner:</u> 1.5"NPS sch.10 with socket weld by FNAL (pressure tested between isolation valves and using trapped volume relief as pressure port)

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3.1	F10041250.3 NP-03-10-N1	LN2	Dewar supply LN2 outside the building to purification External<->Proximity:	From LN2 dewar NP-03-20-NT to NP-03-10-N1 outside the building	(Fig.1) Socket weld	3	10	77	75 – 311	0.75 LN2	1.5 LN2	<u>Inner:</u> DN40 sch.10 capped pipe (comes from CERN pressure tested) <u>Outer:</u> DN80 sch.5 capped (with vacuum break)	<u>Inner:</u> 1.5"NPS sch.10 with socket weld by FNAL (pressure tested between isolation valves and using trapped volume relief as pressure port)  <u>Outer:</u> 3"NPS sch.5 with clamshell final weld by FNAL
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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:

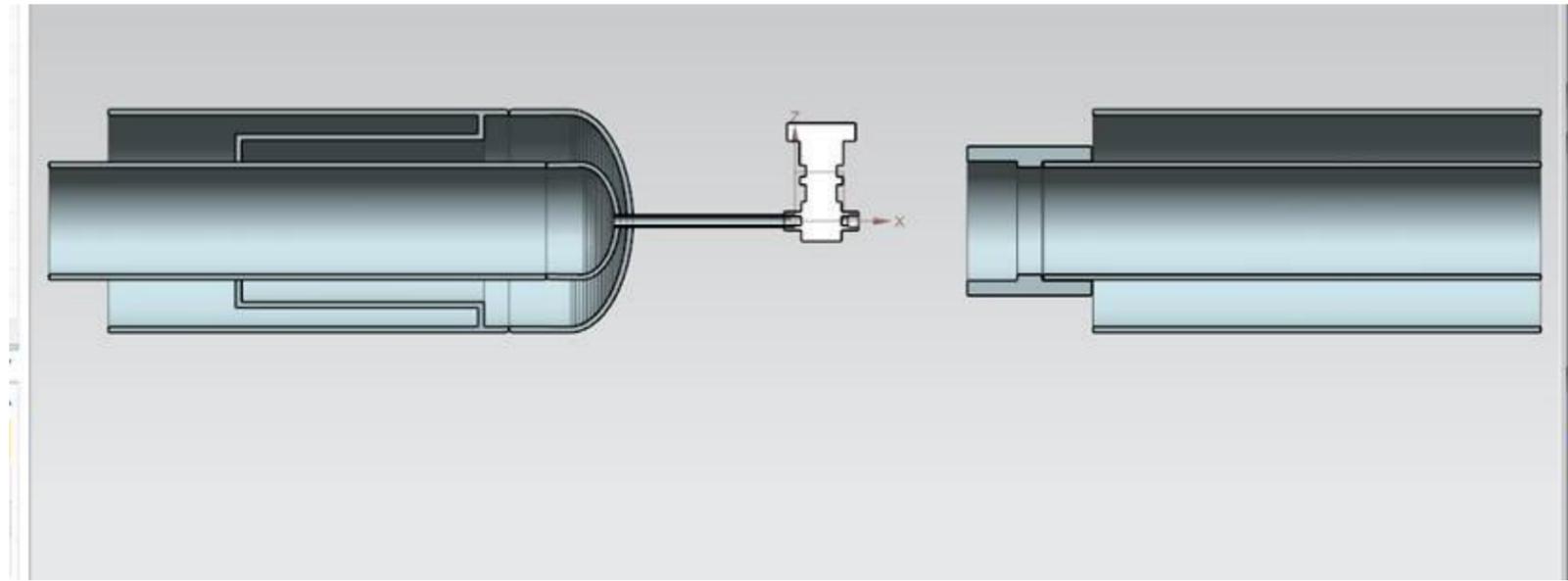


Figure 1 Typical interface between CERN (left) and Fermilab (right) after shipment before installation