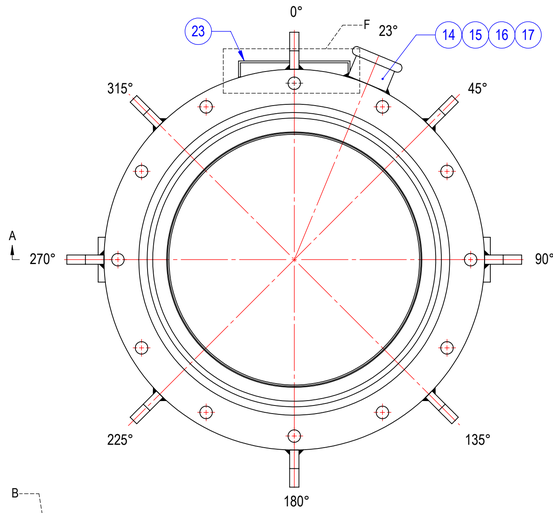
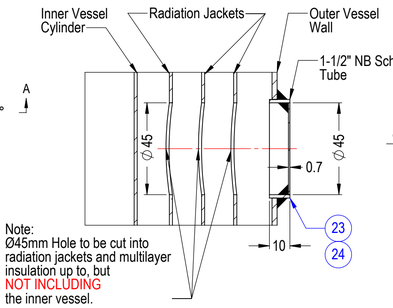
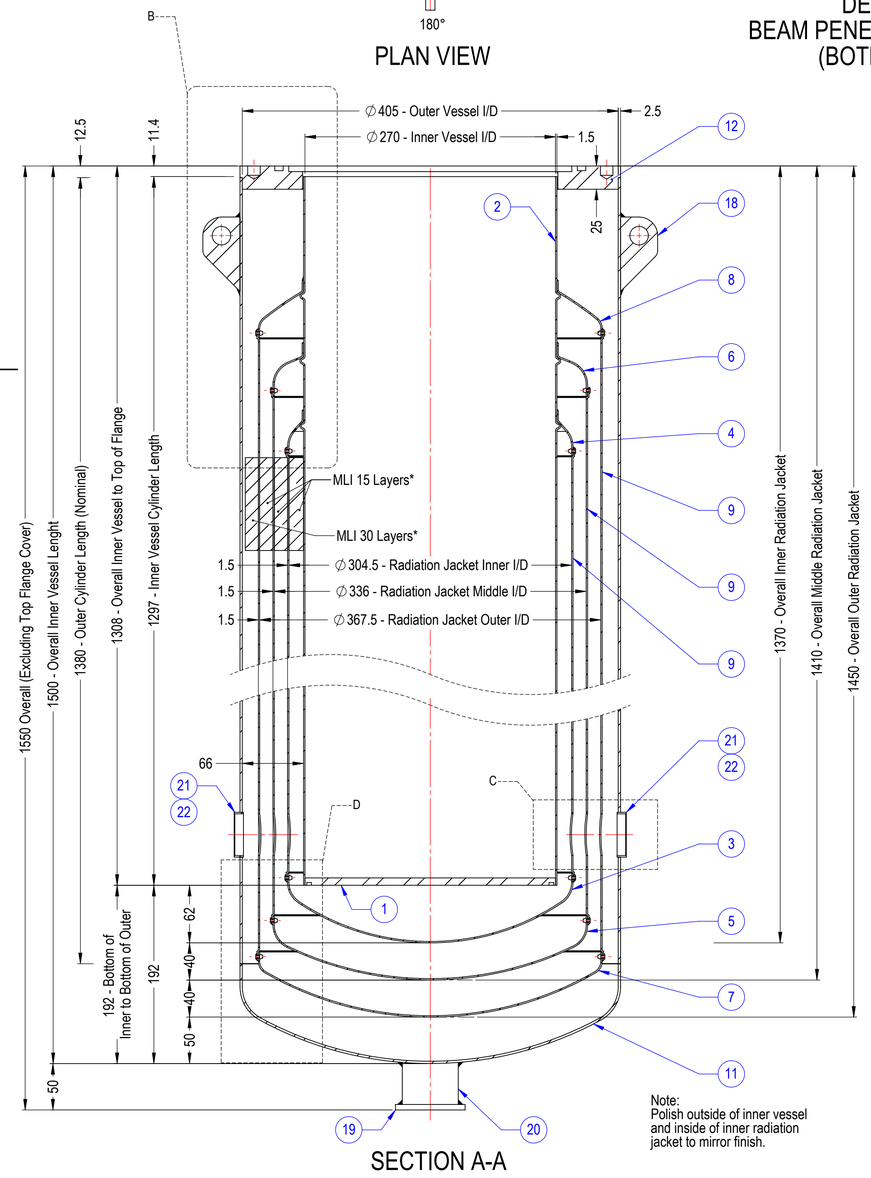


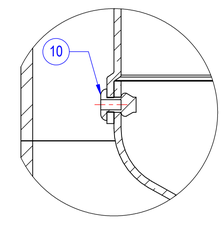

PLAN VIEW




DETAIL C
BEAM PENETRATION ZONE
(BOTH SIDES)

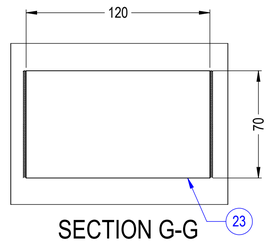



SECTION A-A

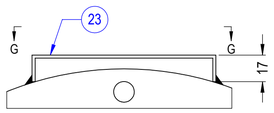



Radiation jackets to be pop riveted in four locations around top and bottom ends to aid assembly.

DETAIL E
RADIATION JACKET
(FIXING)

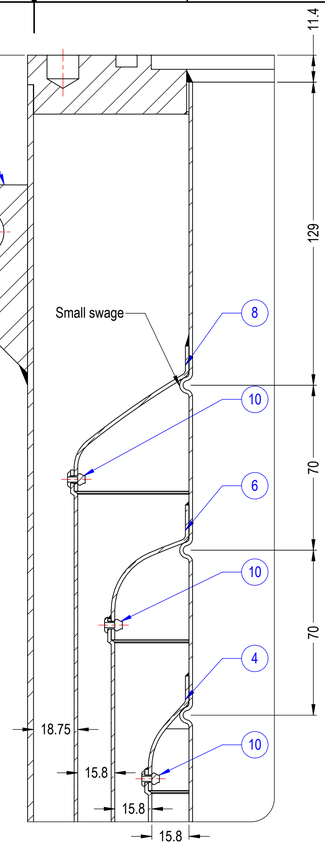



SECTION G-G

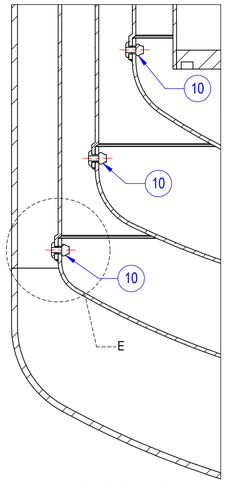



DETAIL F
DATA PLATE BRACKET

Note: Data plate location shown on General Arrangement drawing 9918-3003




DETAIL B
UPPER SECTION




DETAIL D
LOWER SECTION

Manufacturing Notes

This vessel is to be manufactured in accordance with the following standard:

EN 13458 - Cryogenic vessels. Static vacuum insulated vessels.

Significant attention must be practised, so that all testing is to be carried out in accordance with the above standard. Furthermore, all non-destructive testing personnel, procedures, equipment and materials shall be qualified for purpose according to BS EN ISO 9712 & BS EN ISO 17636.

NDT Requirements

X-ray examination shall be carried out in accordance with EN 1435 or ISO 1106-1 (If Radiography Company are aware of any amendments to the aforementioned standards WCL are to be informed immediately). Radioscopy may also be used and shall be carried out in accordance with EN 13068-3.

1) The following MUST be radiographed in accordance to EN 1435 or ISO 1106-1

- 2% Longitudinal Seams.
- 10% Tee Junctions - min 1 Tee
- 2% of Circumferential Seams.

2) Nozzle butt joints to be examined with dye penetrant.

Visual examination of all weld deposits using an x5 lens if necessary shall be carried out. In instances of uncertainty, surface crack detection can be utilized to compliment the procedure.
Areas which have been subject to the removal of temporary attachments and arc strike contact points shall be ground smooth and subjected to surface crack detection.

Production Control Test Plates:

Production Control Test Plates shall be produced and tested for the inner vessel as follows:
One test per vessel for each welding procedure on longitudinal joints
After 10 sequential test plates to the same procedure have been successfully passed, the tests, testing may be reduced to one test plate per 100m of longitudinal joint.
The number and type of test specimens is directly linked to the material and thickness and shall be in accordance to Tables 4&5 of EN 13458-2 for the relevant material and thickness.

The test is to consist of:

- 1 Face Bend Test to BS EN ISO 5173:2010+A1:2011
- 1 Root Bend Test to BS EN ISO 5173:2010+A1:2011
- 1 Tensile Test To BS EN 4136:2011
- 1 Macro Etch

Important Note

All welds, edges, corners etc. MUST be thoroughly de-burred. No "ragged" edges will be deemed acceptable.
All edges must be thoroughly inspected prior to final closure of the vessel, pipeline etc. Hold point must be put on traveller/quality plan to ensure that the inspection takes place.

Pressure Test:

The inner vessel shall be subject to a pressure test and exhibit overall leak tightness.
The pressure test shall be conducted according to work procedure PT-001 – PT 006 with confirmed continuous vacuum interspace.

Prior to the pressure test being undertaken, a full H&S hazard assessment and risk analysis must be undertaken. The test must be carried out in attendance with a Lloyds inspector.
Where the test is undertaken hydraulically, the pressure shall be raised gradually to the test pressure holding it for thirty minutes. The pressure shall then be reduced to the design pressure so that visual examination of all surfaces and joints can be examined. The vessel shall not exhibit any signs of gross plastic deformation or leakage.
Following on from the pressure test, the vessel and all associated pipework must be dried thoroughly and completely to avoid corrosion if tested with water.

Manufacturing Tolerances:

Material Thicknesses:
Thickness checks must be carried out on all materials used to fabricate the inner and outer heads and shells and must confirm that no thickness is less than that shown on drawings.

Plate alignment:
Misalignment –
- for longitudinal welds : not more than 15% of the thickness of the plate / sheet
- for circumferential : not more than 25% of the thickness of the thinner plate / sheet
In no case shall the surface on any plate lie between the centre line of the two adjoining plates.

Dished End Tolerances:
The depth of the dished end excluding the straight flange, must not be less than that shown on the dished end drawing. The knuckle radius must not be less than specified and the crown radius shall not be greater than that specified. Any variation of the profile shall not be abrupt but shall merge gradually into the specified shape.

Cylinders:
The actual circumference shall not deviate from the circumference calculated from the diameter by more than +/- 1.5%, dished ends must be "paired" to match to allow these tolerances to exist.
Out of roundness,
Inner cylinder : 1.5% permitted out of roundness
Outer cylinder : 1.5% permitted out of roundness.

Any individual bulges on dents shall be inspected by QA dept for acceptance, however, prior to acceptance confirmation that the dents and bulges are within the above tolerances must be provided by Q.A. dept. Q.A. to review section 5.5.4 of EN 13458-2 in full prior to acceptance.

All edges must be thoroughly de-burred, no "ragged" edges are permitted. All edges must be thoroughly inspected prior to final closure of vessel, pipeline etc. Hold point must be put on "Traveller" to ensure this inspection takes place.

Welding:

Temporary attachments
Temporary attachments must be kept to an absolute minimum
Temporary attachments must be welded to vessels using materials as approved by design dept prior to attachment.
Temporary attachments must be removed prior to any testing. During removal and after the inner or outer vessels integrity shall not be impaired. This includes no reduction in thickness of the vessel parts. The area of the inner vessel from where the temporary attachments have been removed shall be dressed smooth and examined by appropriate NDT. See Q.A. dept for NDT method to be adopted.

Welded joints:

Where any part of the vessel (inner or outer) is made by two or more courses, the longitudinal seams of adjacent courses shall be staggered
by 100mm measured centre to centre of welds.

Important Note

Material used for inner shell and heads must be ordered and subsequently certified to demonstrate additional 15% value on 1% yield.

Cleaning

Inner surfaces of vessel including all parts in contact with fluids must be cleaned in accordance with EN 12300.
All outer surfaces of the vessel and pipework to be exposed to vacuum must be cleaned thoroughly in accordance with WCL cleaning procedure MP04.

BOM Table

| ITEM NO. | Description | QTY. | Drawing Number | Material | Specification | Product Code |
|---|---|---|---|---|---|---|
| 1 | Inner Bottom Flange - Ø270 x 8mm Thickness | 1 | | 304 Stainless Steel | BS EN 10028-7 1.4301 | 5000-1098 |
| 2 | Inner Cylinder - 2.5mm Thickness | 1 | | 304 Stainless Steel | BS EN 10028-7 1.4301 | 1000-0152 |
| 3 | Radiation shield (Inner) bottom dished end – 304.5 I/D x R254 x r25 x 10sf x 1.5mm Thickness | 1 | 5100-0441 | Copper | BS 2870:1980 | 5100-0441 |
| 4 | Radiation shield (Inner) top dished end – 304.5I/D x R254 x r25 x 10sf x 1.5mm Thickness | 1 | 5100-0440 | Copper | BS 2870:1980 | 5100-0440 |
| 5 | Radiation shield (Middle) bottom dished end – 399 I/D x R355 X R25 X 10SF X 1.5mm Thickness | 1 | 5100-0439 | Copper | BS 2870:1980 | 5100-0439 |
| 6 | Radiation shield (Middle) top dished end – 399I/D x R304 x r25 x 10sf x 1.5mm Thickness | 1 | 5100-0438 | Copper | BS 2870:1980 | 5100-0438 |
| 7 | Radiation shield (Outer) bottom dished end – 367.5 ID x R355 x r13 x 10sf x 1.5mm Thickness | 1 | 5100-0437 | Copper | BS 2870:1980 | 5100-0437 |
| 8 | Radiation shield (Outer) top dished end – 367.5 I/D x R355 x r13 x 10sf x 1.5mm Thickness | 1 | 5100-0436 | Copper | BS 2870:1980 | 5100-0436 |
| 9 | Outer Radiation Cylinder - 1.5mm Thickness | 1 | | Copper | BS 2870:1980 | 1003-0151 |
| 10 | Rivet - Ø3.2 x 10mm | 24 | | A2 Stainless Steel | BS EN ISO 3506 | 1800-8453 |
| 11 | Outer Dished End – 405I/D x R381 x r38 x sf25 x 2.5mm Thickness | 1 | | 304 Stainless Steel | BS EN 10028-7 1.4301 | 1100-0405 |
| 12 | Top Lower Flange – Ø410 x 25mm Thickness | 1 | | 304 Stainless Steel | BS EN 10028-7 1.4301 | 5000-1097 |
| 13 | Outer Cylinder - 2.5mm Thickness | 1 | | 304 Stainless Steel | BS EN 10028-7 1.4301 | TBA |
| 14 | Pump Down Boss | 1 | - | Stainless Steel | - | 5000-3052 |
| 15 | NW 40 KF Pump Down Boss - Cap | 1 | - | Rubber | - | 1037-0002 |
| 16 | O-ring - 1 1/8" ID x 1/8" Section | 1 | - | Nitrile | BS 216 | 1900-0216 |
| 17 | NW 40 KF Pump Down Boss - Plug | 1 | - | Brass | - | 5000-3054 |
| 18 | Cryostat Lifting Eye – 10mm Thickness | 8 | 5100-2331 | 304 Stainless Steel | BS EN 10028-7 | 5100-2331 |
| 19 | Base Plate - Ø75 x 6mm Thickness | 3 | | 304 Stainless Steel | BS EN 10028-7 | 1000-0601 |
| 20 | Leg Up-Stand - 2" NB Sch 10 | 3 | | 304 Stainless Steel | | 1010-0202 |
| 21 | Tube 1-1/2" Sch 5 - 15mm Length | 2 | | 304 Stainless Steel | | 1010-0151 |
| 22 | Disc - Ø45 x 0.7mm Thickness | 2 | | 304 Stainless Steel | BS EN 10028-7 | 1000-0073 |
| 23 | Data Plate Bracket - 2mm Thickness | 1 | | 304 Stainless Steel | | TBA |

* Multi Layered Insulation requirements to be confirmed following discussion between WCL and CERN

Various clarifications yet to be addressed, such as vacuum ball valve gauge. Notes to be confirmed by CERN.

Welding log yet to be included on drawing.

Design Summary

| | Inner Vessel | Outer Vessel |
|---|---|---|
| Design Code | P.E.D. 97 / 23 / EC - EN 13458 | P.E.D. Not Applicable/EN13458 |
| Marking | CE Marked | - |
| Maximum Working Pressure | 0.5 bar g | -1.0 Bar |
| Design Pressure | 1.52 bar abs, in acc. with EN 13458 | -1.0 Bar |
| Test Pressure | 2.15 bar abs | -1.0 Bar |
| Note | Inner vessle to be tested to 2.15 bar abs (1.15 bar g) with confirmed simultaneous vacuum in jacket space. The test fluid is liquid nitrogen | |
| Contents | Liquid Helium | Vacuum Insulated |
| Lowest Temperature | -269°C | +50 / -20°C |
| Capacity (Litres) Gross | 74 | - |
| Capacity (Litres) Net 95% | 70.3 | - |
| Pressure * Volume (p * v) | 37 | - |
| Hazard Catogory | III | - |
| Fluid Group | 2 | - |
| P.E.D Assesment Module | Excluded from the scope of PED | - |
| Corrosion Allowance | None | - |
| Post Weld Heat Treatment | None | - |
| Weld Procedures & Welder Qualifications | BS EN 287 Pt 1, BS EN ISO 15614 Pt 1 | - |
| NDT Radiography | 2% - Long & Circ 10% Tee's in accordance with EN 13458 | None |
| Visual | 100% BS EN 17637 | - |
| Inspection, Testing & Design Approval | Wessington Cryogenics Ltd / Lloyds Register | |
| Notified Body | | |

Revisions

| Rev. | Description | Sign. | Date |
|---|---|---|---|

Title: Cryostat - Fabrication Deatils

| | |
|---|---|
| Created | Mark Armstrong |
| Approved | |
| Date Drawn | 25/03/2014 |
| Design Review No. | 9918-3003 |
| Third Angle Projection | Weight 127.51kg |

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Drawing No. 9018-3003-3 Rev. 0