ATLAS EndCap Signal Feedthrough Project

QA/QC Document: Version 5 (28 March 2002)

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Overview

To ensure the quality of the finished EndCap Signal Feedthrough, a database and detailed form sheets will document all essential quality characteristics of the component and assembly testing procedures throughout the entire project. The sections of the signal feedthroughs that will be integrated with the EndCap cryostat to form part of the cryostat liquid argon space will be manufactured to conform to the ASME Pressure Vessel Codes. For overall quality assurance the Victoria ATLAS team has determined that the following five points are key to producing a quality product.

Material Traceability & Certification

The steel manufacturer for each batch of steel produced will supply a material certification sheet to ATLAS. A distribution sheet will then be generated which will contain the certification sheet number of the low inclusion steel and the type of component being manufactured with that steel. Upon arrival of each component in the EndCap Signal Feedthrough a material certification sheet number will be entered on each component's form sheet. These material certification sheets will be filed in the Victoria ATLAS laboratory for easy reference if a problem arises with the steel properties. Victoria ATLAS will further require that the bellows (316SS) manufacturer and the bellows cuff (304LSS) manufacturer provide material certification sheets.

Physical Characteristics

Upon arrival at the Victoria ATLAS laboratory, dimensions of each component will be measured using precision measuring devices to check that they comply with the tolerances set. Other physical characteristic tests will also be performed specific for each component. For a more detailed description refer to the form sheet for that component.

Assembly Procedures

The assembly procedure for the EndCap Signal Feedthrough is highly detailed, with most assemblies requiring a specific orientation to be assembled properly. A detailed description as well as a graphic depiction of how the components are to be assembled is described on the reverse of the form sheet created for each assembly procedure. Before any assembly that requires a specific orientation is completed, a second person not involved in the assembly must approve the orientation.

Testing Procedures

All leak testing of components and assemblies requires that only leaks determined for each component be acceptable. A helium leak detector described in Appendix B1 will be used to detect any leaks. Leak testing of all components will be done in ambient conditions as well as cryogenic operating conditions. All leak tests performed on the components and assemblies will be documented on form sheets. These tests are specific and highly detailed; for a detailed description see the form sheet and procedure sheets. Electrical test will also be performed. Detailed tests will be performed on each Vacuum Cable and Pigtail Cable upon delivery to Victoria. Further electrical tests will be carried out during and after assembly of each feedthrough. These tests are detailed in the corresponding form sheets and procedure sheets.

Non-Conformity Procedure

A component or assembly which fails any of the materiel requirements, physical characteristics, or testing procedures will be tagged with a coloured sticker and placed on a shelf specific to non-conforming components. This will ensure that a non-conforming component will not be used in an EndCap Signal Feedthrough.

Summary of Primary Tests

Electrical Tests

- Vacuum cables — Chapter 12
  - Cirris continuity/short/cross-wire test
  - Nearest Neighbour Cross talk
  - Precision resistance
  - Impedance
  - Contact resistance
- Pigtail cables — Chapter 13
  - Cirris continuity/short/cross-wire test
  - 64x64 Cross talk (calibration slots only)
- Pigtail assembly — Chapter 16
  - Cirris continuity/short/cross-wire test (100 V)
- Vacuum cable assembly — Chapter 17
  - Cirris continuity/short/cross-wire test (100 V)
- Cold electrical test — Chapter 24
  - Nearest Neighbour Cross talk
  - Cirris continuity/short/cross-wire test
- Final tests — Chapter 27
  - Nearest Neighbour Cross talk
  - Precision Resistance
- CERN Reception tests — Chapter 31
  - Nearest Neighbour Cross talk

Leak Tests

- Pincarriers — Chapter 01
- Funnel assembly — Chapter 06
- Bellows assembly — Chapter 09
- Cold flange assembly — Chapter 14
- Ambient flange assembly — Chapter 15
- Ambient leak test of Feedthrough — Chapter 19
- Cold leak test of Feedthrough — Chapter 23
- CERN Reception leak tests — Chapter 32

Chapter 1
Pin Carriers

1. Detail Drawings

GBL 20011-600147-4 Rev D (7 Row Pin Carrier)
GBL 20011-600148-4 Rev D (8 Row Pin Carrier)
The drawings can be found at http://wwwlhc01.cern.ch/cdd/

2. Material Traceability

All Pin Carriers are fabricated from AISI 304L stainless steel. Atlas Victoria will require the material vendor to supply certification of origin, physical and chemical specification and an Inclusion report, for each batch of material supplied. We will also require the Pin Carrier vendor to verify the supplied steel was used to construct all Pin Carriers and account for remaining material. The specification will be stored in files at ATLAS Victoria. Each Pin Carrier inspected will have an accompanying form sheet, upon which, the relevant material specification sheet number will be entered. All form sheet data will subsequently be transferred to a database.

3. Arrival Information

a. Record the serial number from the Pin Carrier on a new Pin Carrier form sheet.
b. Record the date the Pin Carrier was received on the form sheet.
c. Record the number of rows of the Pin Carrier on the form sheet.
d. Record the name of the person who recorded the above information, on the form sheet.

4. Inspection

a. Visual inspect the condition of the weld lip, checking for any dents or other obvious defects. If the weld lip looks good then write Pass on the form sheet, if the weld lip looks bad then write Fail on the form sheet.
b. Using Vernier Calipers measure the length of the Pin Carrier in millimeters and record the number on the form sheet.
c. Using Vernier Calipers measure the width of the Pin Carrier in millimeters and record the number on the form sheet.
d. Using Vernier Calipers measure the height of the Pin Carrier in millimeters and record the number on the form sheet.
e. Using a UNC 4-40 screw, thread the screw into each hole of the Pin Carrier to ensure that the it was tapped properly. If the screw will not thread in smoothly then enter Fail on the form sheet. If the screw does thread in smoothly then enter Pass on the form sheet.
f. Inspect each row of the Pin Carrier for bent pins. Enter the number of bent pins found, on the form sheet.
g. Using the pin straightener carefully slide it over the row with the bent pin. If the pin is still not straightened then carefully straighten the pin using the alignment hand tool. If all the pins were successfully straightened, check Yes on the form sheet. If they were not successfully straightened check No on the form sheet.
h. Each Pin Carrier must be leak tested after the above tests have been performed. To leak test the Pin Carriers follow the procedures laid out in the Leak Testing section of this document.

Note: After the initial leak test each Pin Carrier will have to be cooled down to 77K, following the Cold Cycling procedure in this document. After the first cold cycle of the Pin Carrier it will have to be leak tested again. After this leak tests each Pin Carrier will then be cold cycle 2 more times. After the last cold cycle each Pin Carrier will be leak tested for a final time. If at any time during the testing a Pin Carrier should fail a leak test refer to the flow chart at the end of this document to determine what test should then be performed on the Pin Carrier.

5. Leak Testing

a. Mount the Pin Carrier into its leak-testing jig, and place it on the leak test platter for leak testing.
b. For this test the DVP500 Pump will be used for a roughing vacuum.
c. Close valves:
   - E 3-Position Valve
   - D Leak Checker Valve
   - A Roughing Vent Valve
   - N Bellows Roughing Valve
d. Open valves:
   - P Roughing Pump Valve

C Roughing Valve

e. Also, turn on the Vacuum Process Controller to monitor the roughing vacuum.
f. Turn on the DVP500 pump and pump down the test apparatus to a vacuum of $3.0x10^{-1}$ or better. When the vacuum reaches $3.0x10^{-1}$ close valve:
   C Roughing Valve
g. Start pumping with the leak checker. When the leak checker reaches $5.0x10^{-1}$ open valve:
   D Leak Checker Valve
h. When the base rate of the leak checker bottoms out, testing can start.
i. Attach the helium line that exits the flow gauge to the Pin Carrier cover and attach a vent line from the other side of the Pin Carrier cover and run the line out of the lab.
j. Enter the base rate of the leak checker on the form sheet.
k. Place the Pin Carrier cover over the Pin Carrier and turn the helium on. Adjust the flow of the helium with the flow gauge 0.5LPM and allow the helium to flow for 1 minute.
l. Record the highest level of helium detected by the leak checker, on the form sheet.
m. Subtract the base rate from the leak rate and enter this number as the actual leak rate.
n. Close valve:
   D Leak Checker Valve
o. Turn on the DVP500 pump and pump until –1 vacuum is achieved, open valve:
   C Roughing Valve
p. Shut off the DVP500 pump and open valve
   A Roughing Vent Valve
q. Vent the leak checker.
r. Enter the name of the person who performed the tests and the date the tests were performed on the form sheet.
s. Using Acetone then Ethanol remove any vacuum grease that may have been used during testing.

6. Cold Cycling

a. Select 12 Pin Carriers (P/C) for cooling and insert the P/C's into the P/C basket. Enter the serial numbers of the 12 P/C's being tested into the P/C logbook.
b. Insert Diode 1 into the steel plate on P/C basket and insert diode A into a P/C.
c. Lower the P/C Basket into the cooler and secure the basket in place with two screws.
d. Turn on the Delta Air products controller and ensure that diode 1 is reading properly. Turn on the temperature controller and ensure that diode A is reading properly.
e. Insert the inner aluminum lid.
f. Clean the o-ring for the lid to the cooler using ethanol. Apply a very small amount of vacuum grease to the o-ring. Stretch the o-ring and place it in the o-ring groove at the top of the P/C cooler.
g. Place the lid on the P/C cooler and check to make sure the o-ring is still in the groove.
h. Log onto WINO and open the Labview program in the following directory:
   Network Neighborhood/ hepserv/ Labview/ Cold Test Station/ SI 9620-1 Monitor.vi
i. In the comment box of the VI program record the following information:
   - Date
   - Which cold cycle it is for which Pin Carriers 1, 2, or 3.
   - Diode locations
   - Any other relevant test information
j. Click on the run button, which is the white arrow, located at the upper left portion of the Labview window. A dialogue box will appear asking for the destination where the data is to be saved. Save the Labview data in the following destination: (Use ddmmyy format for saving the data)
   Network Neighborhood/ Hepcad/ users/ aaron/ Atlas Documents/ Labview Data/ Data Files/ Pin Carriers
k. After the program has been saved in the above directory Labview will be taking data. Set the time on the Labview screen for taking data to 2 minutes.
l. Turn on the cooling water that is located about 4-feet up on the wall beside the entrance to the lab.
m. Turn on the compressor by flicking the green switch on the front of the compressor. Also, turn on the expander by flicking the yellow switch located in the rack, below the Delta Air Products temperature controller.
n. Change the set point on the Delta Air Products temperature controller to 60K. To do this perform the following steps:
   - Press the [MAN] button
   - Press the red * button
   - Press the number 3 button (this button also has set point written on it)
   - Enter 060.0 (The decimal place is placed automatically)

- Press Enter

o. At the end of the day the cooler needs to be evacuated. Evacuate the cooler to a pressure of 8 x 10^{-2}mbar. To Do this follow the steps listed below:
   - Open the nupro valve in the vacuum line
   - Close the nupro valve for helium gas
   - Close the vent valve
   - Turn on the vacuum process controller to monitor the pressure
   - Turn on the Edwards pump until the pressure reaches 8 x 10^{-2}mbar
   - Close the nupro valve in the vacuum line
   - Shut off the Edwards pump
   - Open the vent valve

p. The next morning the vacuum should be in the 10^{-4} to 10^{-2} range and there may be a separation in the temperature of the steel plate and the Pin Carriers. To lower the temperature of the Pin Carriers to the temperature of the steel plate follow the steps listed below.
   - Purge the line from the helium bottle
   - Attach the helium line to the connection above nupro valve for helium gas
   - Slowly open the nupro valve for helium gas until the pressure in the P/C cooler reaches 1 or 2 x 10^{-2}mbar
   - Close the nupro valve for helium gas

q. When the temperature of the Pin Carriers reaches 77°K turn off the expander, compressor, and the water.

r. Change the set point on the Delta Air Products temperature controller to 285°K. To do this perform the following steps:
   - Press the [MAN] button
   - Press the red * button
   - Press the number 3 button (this button also has set point written on it)
   - Enter 285.0 (The decimal place is placed automatically)
   - Press Enter

s. When the temperature of the cooler is at room temperature, print the Labview screen and file the plot in the blue binder.

t. Press the stop button in Labview located in the upper left corner of the window and then close the program.

u. Vent the P/C cooler following the steps listed below:
   - Open the nupro valve in the vacuum line
   - Open the Helium line valve

v. Remove the lid of the P/C cooler and remove the inner aluminum lid.

w. Remove the screws holding the P/C basket in place and remove the basket from the P/C Cooler.

x. Remove the diodes from the steel plates and remove the Pin Carriers from the basket.

y. Perform leak test.

7. Remove residual gold from weld lips and rinse with acetone and alcohol

a. The weld lips should be cleaned with Scotch Bright to remove any remaining gold residue.

b. Place each pincarrier first into a beaker of acetone and then into a beaker of alcohol, rinsing thoroughly each time. Set the pincarriers out to dry thoroughly before carrying on with the next (1000 Volt HiPot test) series of tests.

8. 1000 Volt HiPot Tests

a. Each pincarrier should be HiPot tested using the Cirris tester with wirelist PCHIPOT.WIR Use the custom built Jig for this test, and ensure that the jig is grounded to the Cirris tester. Use the special Cirris connect marked *shorted* for this test. The pincarrier should be vacuumed before the test, and any failed channels should be examined under a microscope or video camera and retested after debris is removed**. The pincarrier must be protected from any further debris contamination after completion of this test!**

Note: If a pin carrier leaks at or above 1x10^{-9} mbar-l/s then it has failed and this should be circled at the bottom of the form sheet. Also, if the Pin Carrier has failed then a rejection sticker needs to be placed on the Pin Carrier and it needs to be stored on the reject shelf.

If the Pin Carrier has passed all tests then Pass must be circled on the bottom of the form sheet.

9. Database Entry

a. Record the information from the form sheet into the database.

b. Record the name of the person and the date the information was recorded into the database, on the form sheet.

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Pin Carrier

Arrival Information

Serial Number# _____ Date Received _____

Material Traceability Form # _____ Number of Rows _____

Recorded By: _____

Visual Inspections

Weld Lip Condition _____ Quality of Threads _____

Length (105.12mm +0, -0.15) _____ Number of Bent Pins _____

Width (7row 64.94 8row 73.63 +0, -0.15) _____ Bent Pins Repaired ☐ Y

Leak Tests

Leak Test #1

Base Rate If Zeroed _____

Base Rate For Test _____

Leak Rate (He) _____

Actual Leak Rate _____

Date Tested _____ Initial _____

Leak Test #2

Base Rate If Zeroed _____

Base Rate For Test _____

Leak Rate (He) _____

Actual Leak Rate _____

Date Tested _____ Initial _____

Leak Test #3

Base Rate If Zeroed _____

Base Rate For Test _____

Leak Rate (He) _____

Actual Leak Rate _____

Date Tested _____ Initial _____

Leak Test #4

Base Rate If Zeroed _____

Base Rate For Test _____

Leak Rate (He) _____

Actual Leak Rate _____

Date Tested _____ Initial _____

Pin Carrier Walls Leak Checked: ☐

Cold Cycle Information

Cold Cycle #1

Lowest Temp _____

Date Tested _____

Cold Cycle #2

Lowest Temp _____

Date Tested _____

Cold Cycle #3

Lowest Temp _____

Date Tested _____

HiPot Test: ☐ **Gold Removed from Weld Lip:** ☐

Weld Date: _____ Flange #: _____

Recorded in Database By: _____ Date Recorded (ddmmyy): _____

Comments: _____

PASS / FAIL

Chapter 2
Cold Signal Flange

1. Detail Drawing

PDE-0202D ATLAEFS 0001
Drawings can be found at http://wwwlhc01.cern.ch/cdd/

2. Material Traceability

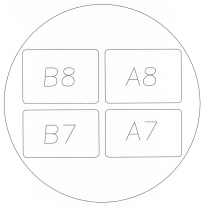
All Cold Signal Flanges are fabricated from Low Inclusion AISI 304L stainless steel. Atlas Victoria will require the material vendor to supply certification of origin, physical and chemical specification and an Inclusion report, for each batch of material supplied. We will also require the Cold Signal Flange vendor to verify the supplied low inclusion steel was used to construct all Cold Signal Flanges and account for remaining material. The specification will be stored in files at ATLAS Victoria. Each Cold Signal Flange inspected will have an accompanying form sheet, upon which, the relevant material specification sheet number will be entered. All form sheet data will subsequently be transferred to a database.

3. Arrival Information

a. Using the electronic scribe, scribe a new serial number on the side of the flange that the Pin Carriers are welded to. Check the database to find the last serial number inscribed on a flange. The serial number on each flange is to increase by one.
b. Clean each flange using dish soap and water. Clean all drilled holes with q-tips to remove as much oil as possible.
c. Place the flange on the counter to air dry.
d. Enter information requested on the form sheet.

4. Testing

a. Using Vernier Calipers measure the outside diameter on both sides and enter these numbers on the form sheet. Inspect the weld lip for any defects, enter pass or fail on the form sheet.
b. Using Vernier Calipers measure the width and lengths of slot A7, B7, A8, and B8. The positions of these slots can be found below. Enter these numbers on the form sheet.



Note: Pin carrier weld lip is up for proper slot arrangement.

c. Inspect the weld lips for each pin carrier, checking for any defects, enter pass or fail on the form sheet.

Note: If any of the inspections failed then the Cold Signal Flange has failed and this should be circled at the bottom of the form sheet. Also, if the Cold Signal Flange has failed then a rejection sticker needs to be placed on the Cold Signal Flange and it needs to be stored on the reject shelf. If the Cold Signal Flange has passed all tests then Pass must be circled on the bottom of the form sheet.

d. Carefully package the flange for ultrasonic cleaning at Triumf.
e. At Triumf lower the flange into the ultrasonic bath for 5 minutes. Raise the flange and clean all holes with cleaning tips attached to drills. Lower the flange into the ultrasonic bath for another 5 minutes and then remove it from the bath.
f. Rinse the flange with water and then dry with purified air.
g. Seal the flange in polyethylene bags.
h. Enter the date the ultrasonic cleaning was tested on the form sheet

5. Database Entry

a. Record the information from the form sheet into the database.
b. Record the name of the person and the date the information was recorded into the database, on the form sheet.

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Cold Signal Flange

Arrival Information

Serial Number# _____ Date Received _____

Material Traceability Form # _____

Recorded By: _____

Testing

Outside Diameter (mm) Bellows (278.92 - 279.17) _____

Outside Diameter (mm) Funnel (278.75 - 279.00) _____

Outside Weld Lip Condition ☐ P ☐ F

Pin Carrier Slot A7

Width 64.97-65.12 mm _____

Length 105.15-105.30 mm _____

Weld Lip Condition ☐ P ☐ F

Pin Carrier Slot B7

Width 64.97-65.12 mm _____

Length 105.15-105.30 mm _____

Weld Lip Condition ☐ P ☐ F

Pin Carrier Slot A8

Width 73.66-73.81 mm _____

Length 105.15-105.30 mm _____

Weld Lip Condition ☐ P ☐ F

Pin Carrier Slot B8

Width 73.66-73.81 mm _____

Length 105.15-105.30 mm _____

Weld Lip Condition ☐ P ☐ F

Date Tested _____ Tested By: _____

Date Ultrasonic Cleaned _____

Recorded in Database By: _____

Date Recorded (ddmmyy) _____

Comments: _____

Pass / Fail

Chapter 3
Ambient Signal Flange

1. Detail Drawing

PDE-0203D ATLAEFS 0002
Drawings can be found at http://wwwlhc01.cern.ch/cdd/

2. Material Traceability

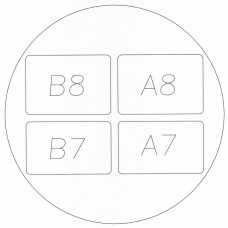
All Ambient Signal Flanges are fabricated from Low Inclusion AISI 304L stainless steel. Atlas Victoria will require the material vendor to supply certification of origin, physical and chemical specification and an Inclusion report, for each batch of material supplied. We will also require the Ambient Signal Flange vendor to verify the supplied low inclusion steel was used to construct all Ambient Signal Flanges and account for remaining material. The specification will be stored in files at ATLAS Victoria. Each Ambient Signal Flange inspected will have an accompanying form sheet, upon which, the relevant material specification sheet number will be entered. All form sheet data will subsequently be transferred to a database.

3. Arrival Information

a. Using the electronic scribe, scribe a new serial number on the side of the flange that the heater plate is mounted too. Check the database to find the last serial number inscribed on a flange. The serial number on each flange is to increase by one.
b. Clean each flange using dish soap and water. Clean all drilled holes with q-tips to remove as much oil as possible.
c. Place the flange on the counter to air dry.
d. Enter information requested on the form sheet.

4. Testing

a. Using Vernier Calipers measure the outside diameter and enter this number on the form sheet. Inspect the weld lip that mates with the Bellows Seal Ring for any defects, enter pass or fail on the form sheet.
b. Using Vernier Calipers measure the width and lengths of slot A7, B7, A8, and B8. The positions of these slots can be found below. Enter these numbers on the form sheet.



Note: Pin carrier weld lip is up for proper slot arrangement.

c. Inspect the weld lips for each pin carrier, checking for any defects.

Note: If any of the inspections failed then the Ambient Signal Flange has failed and this should be circled at the bottom of the form sheet. Also, if the Ambient Signal Flange has failed then a rejection sticker needs to be placed on the Ambient Signal Flange and it needs to be stored on the reject shelf. If the Ambient Signal Flange has passed all tests then Pass must be circled on the bottom of the form sheet.

d. Carefully package the flange for ultrasonic cleaning at Triumf.
e. At Triumf lower the flange into the ultrasonic bath for 5 minutes. Raise the flange and clean all holes with cleaning tips attached to drills. Lower the flange into the ultrasonic bath for another 5 minutes and then remove it from the bath.
f. Rinse the flange with water and then dry with purified air.
g. Seal the flange in polyethylene bags.
h. Enter the date the ultrasonic cleaning was tested on the form sheet

5. Database Entry

a. Record the information from the form sheet into the database.
b. Record the name of the person and the date the information was recorded into the database, on the form sheet.

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Ambient Signal Flange

Arrival Information

Serial Number# _____ Date Received _____

Material Traceability Form # _____

Recorded By: _____

Testing

Outside Diameter 271.04-271.17 mm _____

Outside Weld Lip Condition ☐ **P** ☐ **F**

Pin Carrier Slot A7

Width 64.97-65.12 mm _____

Length 105.15-105.30 mm _____

Weld Lip Condition ☐ **P** ☐ **F**

Pin Carrier Slot B7

Width 64.97-65.12 mm _____

Length 105.15-105.30 mm _____

Weld Lip Condition ☐ **P** ☐ **F**

Pin Carrier Slot A8

Width 73.66-73.81 mm _____

Length 105.15-105.30 mm _____

Weld Lip Condition ☐ **P** ☐ **F**

Pin Carrier Slot B8

Width 73.66-73.81 mm _____

Length 105.15-105.30 mm _____

Weld Lip Condition ☐ **P** ☐ **F**

Date Tested _____ Tested By: _____

Date Ultrasonic Cleaned _____

Recorded in Database By: _____

Date Recorded (ddmmyy) _____

Comments: _____

Pass / Fail

Chapter 4
Funnel Base

1. Detail Drawing

PDE-0206D ATLAEFS 0005
Drawings can be found at http://wwwlhc01.cern.ch/cdd/

2. Material Traceability

All Funnel Bases are fabricated from Low Inclusion AISI 304L stainless steel. Atlas Victoria will require the material vendor to supply certification of origin, physical and chemical specification and an Inclusion report, for each batch of material supplied. We will also require the Funnel Base vendor to verify the supplied low inclusion steel was used to construct all Funnel Bases and account for remaining material. The specification will be stored in files at ATLAS Victoria. Each Funnel Base inspected will have an accompanying form sheet, upon which, the relevant material specification sheet number will be entered. All form sheet data will subsequently be transferred to a database.

3. Arrival Information

a. Using the electronic scribe, scribe a new serial number on the outside face of Funnel Base. Check the database to find the last serial number inscribed on a flange. The serial number on each flange is to increase by one. Enter this serial number on the form sheet.
b. Record the date received on the form sheet
c. A material traceability form for the Funnel Bases can be found filed under M in the top drawer of the filing cabinet in Paul Birneys office. There is a unique number to this form, record this number on the form sheet.
d. Enter the name of the person who recorded the above information, on the form sheet.

4. Testing

a. Using Vernier Calipers measure the inside diameter of the offset hole and enter the number on the form sheet.
b. Using Vernier Calipers measure the outside diameter of the weld lip and enter the number on the form sheet.
c. Using the template made for the placement of the offset hole check to see that the offset is correctly machined and enter Pass on the form sheet if it is correctly machined, and Fail if it is incorrectly machined.
d. Enter the name of the person who tested the flange and the date the flange was tested on the form sheet.

5. Shipping

a. Carefully wrap the Funnel Base in bubble wrap and place it in the crate to be shipped to Specific Mechanical.
b. Enter the name of the person who packaged the Funnel Base in the crate, on the form sheet.
c. Enter the date that the crates of Funnel Bases were shipped to Specific Mechanical.

6. Database Entry

a. Record the information from the form sheet into the database.
b. Record the name of the person and the date the date the information was recorded into the database, on the form sheet.

Note: If any of the tests failed then the Funnel Base has failed and this should be circled at the bottom of the form sheet. Also, if the Funnel Base has failed then a rejection sticker needs to be placed on the Funnel Base and it needs to be stored on the reject shelf.

If the Funnel Base has passed all tests the Pass must be circled on the bottom of the form sheet.

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Funnel Base

Arrival Information

Serial Number# _____ Date Received _____

Material Traceability Form # _____

Recorded By: _____

Testing

Inside Diameter of Offset Hole (137.00 - 137.20mm) _____

Outside Diameter of Weld Lip (278.92 - 279.17mm) _____

Offset Distance ☐ P ☐ F

Tested By: _____ Date Tested: _____

Shipping (To Specific Mechanical)

Packed By: _____ Shipping Date: _____

Recorded in Database By: _____

Date Recorded (ddmmyy) _____

Comments: _____

Pass / Fail

Chapter 5
Lower Funnel Tube

1. Detail Drawings

PDE-0212D ATLAEFS 0011
Drawings can be found at http://www.lhc01.cern.ch/cdd/

2. Material Traceability

All Lower Funnel Tubes are fabricated from AISI 304L stainless steel. Atlas Victoria will require Lower Funnel Tube vendor to supply certification of the suitability of the material to be used in a pressure vessel. The specification will be stored in files at ATLAS Victoria. Each Lower Funnel Tube inspected will have an accompanying form sheet, upon which, the relevant material specification sheet number will be entered. All form sheet data will subsequently be transferred to a database.

3. Arrival Information

a. Using the electronic scribe, scribe a new serial number on the outside face of the Lower Funnel Tube. Check the database to find the last serial number inscribed on a Lower Funnel Tube. The serial number on each Lower Funnel Tube is to increase by one. Enter this serial number on the form sheet.
b. Record the date received on the form sheet
c. A material traceability form for the Lower Funnel Tube can be found filed under M in the top drawer of the filing cabinet in Paul Birney's office. There is a unique number to this form, record this number on the form sheet.
d. Enter the name of the person who recorded the above information, on the form sheet.

4. Testing

a. Each Lower Funnel Tube will undergo an initial inspection upon arrival at ATLAS Victoria. Itemized below are a number of tests that each Lower Funnel Tube will be subject to upon arrival at Victoria.
b. If a Lower Funnel Tube does not pass all the tests it will be tagged with a blue sticker and placed in an area designated for defective components.
c. Each of the dimensions labeled A, B, C, D, E and F on the drawing below of the Lower Funnel Tube will be measured using Vernier Calipers to ensure they fall within the allowable tolerances laid out on the form sheet.
d. After testing, record who did the testing and the date the Lower Funnel Tube was tested.

If the outer tube passed all the above required tests then circle "PASS" in the lower right corner of the form sheet. If it failed any of the above tests and the defect was not repaired then circle "FAIL" on the form sheet. If it failed any of the above tests and the defect was repaired then circle "PASS" in the lower right corner of the form sheet.

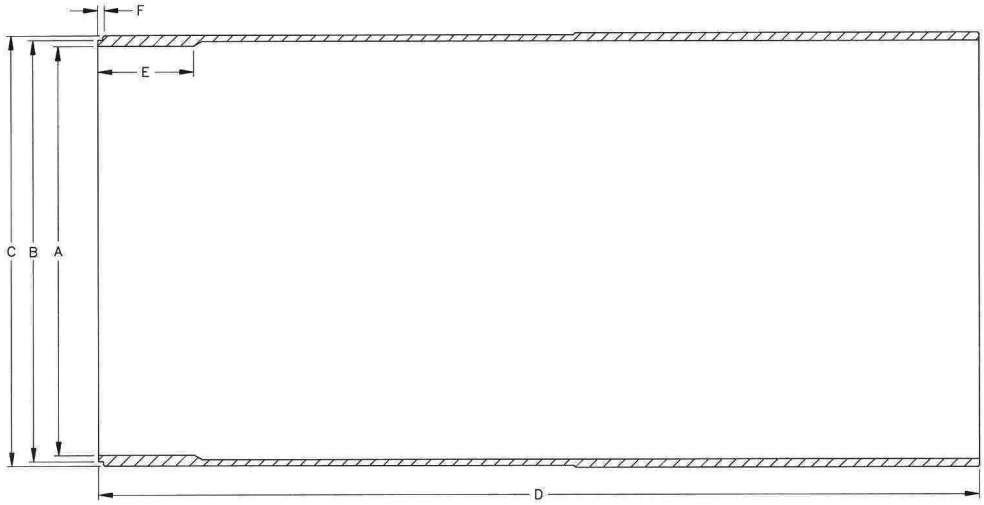
Note: If the Lower Funnel Tube failed any of the above tests, then the Funnel Assembly has failed and this should be circled at the bottom of the form sheet. Also, if the Lower Funnel Tube has failed then a rejection sticker needs to be placed on the Lower Funnel Tube and it needs to be stored on the reject shelf.

If the Lower Funnel Tube has passed all tests then Pass must be circled on the bottom of the form sheet.

5. Database Entry

a. Record the information from the form sheet into the database.
b. Record the name of the person and the date the information was recorded into the database, on the form sheet.

6. Dimension Diagram



Atlas Endcap Signal Feedthrough Project

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Lower Funnel Tube

Arrival Information

Serial Number# _____ Date Received _____

Material Traceability Form # _____

Recorded By: _____

Testing

Dimension A 133.15-133.00 mm _____ Dimension D 285.25-284.75 mm _____

Dimension B 136.90-136.65 mm _____ Dimension E 31.25-29.75 mm _____

Dimension C 140.20-139.8 mm _____ Dimension F 1.85-1.35 mm _____

Tested By: _____ Date Tested: _____

Shipping

Packed By: _____ Shipping Date: _____

Recorded in Database By: _____

Date Recorded (ddmmyy) _____

Comments: _____

Pass / Fail

Chapter 6
Funnel Assembly

1. Detail Drawing

PDE-0204D ATLAEFS 0003
Drawings can be found at http://wwwlhc01.cern.ch/cdd/

2. Welding

All welds for the Funnel Assembly will be performed at Specific Mechanical, Saanichton, BC. All welds will conform to the requirements of the A.S.M.E. Pressure Vessel Code, and must be suitable for Vacuum service. The welds will require a WPS Sheet (Welding Procedure Specifications, QW-482), PQR Sheet (Procedure Qualification Records, QW-483), and a WPQ Sheet (Welding Operator Performance Qualifications, QW-484). These sheets are included in the University Of Victoria TRIUMF Hadronic End Cap Signal Feedthrough Welding Plan located in Appendix A.

3. Arrival Information

a. Record the serial number for the Funnel Base on the form sheet. This serial number can be found on the outside face of the Funnel Base.
b. Record the serial number for the Lower Funnel Tube on the form sheet. This serial number can be found on the outside of the Lower Funnel Tube.
c. Record the date the Funnel Assembly arrived from Specific Mechanical on the form sheet.
d. Enter the name of the person who recorded the above information, on the form sheet.

4. Testing

a. Remove the funnel assembly from its sealed bag.
b. Slide the Upper Funnel Tube over the Go/No-Go Gauge. If the Upper Funnel Tube slides over the Go/No-Go gauge enter Pass on the form sheet, if it does not slide over enter Fail on the form sheet.
c. Bolt a Blank CF Flange to the CF Flange that is welded to the Lower Funnel Tube; use a copper gasket.
d. Mount the Funnel Assembly into its leak-testing jig, and place it on the leak test platter for leak testing.
e. For this test the DVP500 Pump will be used for a roughing vacuum. So, close valves E, D, A, and N. Open valves P and C. Also, turn on the Vacuum Process Controller to monitor the roughing vacuum.
f. Turn on the DVP500 pump and pump down the test apparatus to a vacuum of $3.0x10^{-1}$ or better. When the vacuum reaches $3.0x10^{-1}$ close valve C.
g. Start pumping with the leak checker. When the leak checker reaches $5.0x10^{-1}$ open valve D. When the base rate of the leak checker bottoms out, testing can start.
h. To leak test the Lower Tube Weld to the Funnel Base, first enter the base rate of the leak checker on the form sheet. Slowly run the helium wand around the join between the Lower Funnel Tube and the Funnel Base, and enter the maximum leak rate registered by the leak checker during this test.
i. Subtract the base rate from the leak rate and enter this number as the actual leak rate.
j. Repeat steps 7 & 8 for The Upper Tube weld to the Funnel Base, and the Lower Tube Weld to the CFF.
k. Shut Valve D, turn on the DVP500 pump and pump until –1 vacuum is achieved, open valve C, shut off the DVP500 pump and open valve A to vent the system. Vent the leak checker.
l. Enter the name of the person who performed the tests and the date the tests were performed on the form sheet.
m. Using Acetone then Ethanol remove any vacuum grease that may have been used on the muff ring.
n. Place the Funnel Assembly back in its back and seal the bag.

Note: There must be leak detected in the Funnel Assembly (leak rate < $4x10^{-10}$ mbar-l/s). If any of the tests failed then "FAIL" should be circled at the bottom of the form sheet, a rejection sticker placed on the Funnel Assembly and the assembly stored on the reject shelf.

If the Funnel Assembly has passed all tests then Pass must be circled on the bottom of the form sheet.

5. Database Entry

a. Record the information from the form sheet into the database.
b. Record the name of the person and the date the information was recorded into the database, on the form sheet.

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Funnel Assembly

Arrival Information

Funnel Assembly Serial # _____ Date Received _____

Funnel Base Serial # _____ UT Serial Number _____

Lower Funnel Tube Serial # _____

Recorded By: _____

Testing

Inside Diameter Gauge Test _____

Leak Test Lower Tube Weld

Base Rate (No He) _____

Leak Rate (He) _____

Actual Leak Rate _____

Leak Test Upper Tube Weld

Base Rate (No He) _____

Leak Rate (He) _____

Actual Leak Rate _____

Leak Test Lower Tube Weld to CFF

Base Rate (No He) _____

Leak Rate (He) _____

Actual Leak Rate _____

Tested By: _____ Date Tested _____

Cleaned By: _____ Date Cleaned _____

Recorded in Database By: _____

Date Recorded (ddmmyy) _____

Comments: _____

Pass / Fail

Chapter 7
Bellows Seal Ring

1. Detail Drawing

PDE-0208D ATLAEFS 0007
Drawings can be found at http://wwwlhc01.cern.ch/cdd/

2. Material Traceability

All Bellows Seal Rings are fabricated from Low Inclusion AISI 304L stainless steel. Atlas Victoria will require the material vendor to supply certification of origin, physical and chemical specification and an Inclusion report, for each batch of material supplied. We will also require the Funnel Base vendor to verify the supplied low inclusion steel was used to construct all Funnel Bases and account for remaining material. The specification will be stored in files at ATLAS Victoria. Each Bellows Seal Ring inspected will have an accompanying form sheet, upon which, the relevant material specification sheet number will be entered. All form sheet data will subsequently be transferred to a database.

3. Arrival Information

a. Using the electronic scribe, scribe a new serial number on the outside of the Seal Ring. Check the database to find the last serial number inscribed on a Seal Ring. The serial number on each Seal Ring is to increase by one. Enter this serial number on the form sheet.
b. Record the date received on the form sheet
c. A material traceability form for the Seal Rings can be found filed under M in the top drawer of the filing cabinet in Paul Birney's office. There is a unique number to this form, record this number on the form sheet.
d. Enter the name of the person who recorded the above information, on the form sheet.

4. Testing

a. Using Vernier Calipers measure dimension A, B, C, D, E, and F. Record the dimensions on the form sheet. All numbers obtained should fall within the tolerances provided on the front of the form sheet. If the dimensions do not fall within the tolerances, follow the instructions in the note below. A Diagram of the dimensions is shown below.
b. Enter the name of the person who performed the tests and the date the tests were performed on the form sheet.

Note: If any of the tests have failed then the Seal Ring is non-conforming and "fail" should be circled at the bottom of the form sheet. Also, if the Seal Ring has failed then a rejection sticker needs to be placed on the Seal Ring and it needs to be stored on the reject shelf.

If the Seal Ring has passed all tests then Pass must be circled on the bottom of the form sheet.

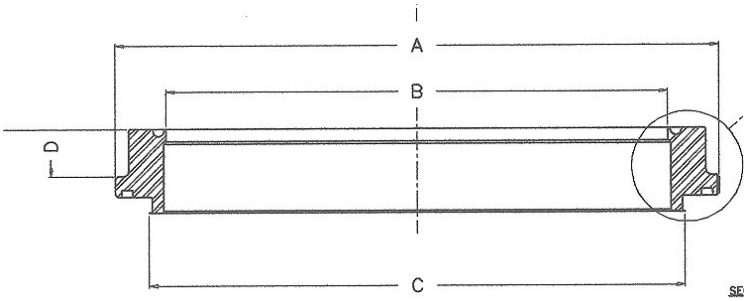
5. Shipping

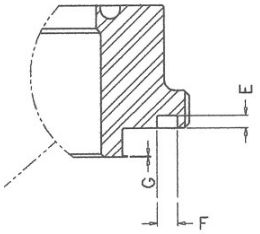
a. Carefully wrap the Seal Ring in bubble wrap and place it in the crate to be shipped to American BOA.
b. Enter the name of the person who packaged the Seal Ring in the crate, on the form sheet.
c. Enter the date that the crates of Seal Rings were shipped to American Boa.

6. Database Entry

a. Record the information from the form sheet into the database.
b. Record the name of the person and the date the information was recorded into the database, on the form sheet.

7. Dimension Diagrams





Atlas Endcap Signal Feedthrough Project

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Bellows Seal Ring

Arrival Information

Serial Number# _____ Date Received _____

Material Traceability # _____

Recorded By: _____

Testing

Dimension A _____ Dimension D _____

271.22 - 271.35mm (Inside Diameter) 3.86 - 3.99mm (O-ring Depth)

Dimension B _____ Dimension E _____

289.43 - 289.69mm (Bellows Weld Lip) 6.07 - 6.20mm (O-ring Width)

Dimension C _____ Dimension F _____

11.39 - 11.52mm (Protrusion Thickness) 0.38 - 0.43 (Bellows Weld Lip Thickness)

Tested By: _____ Date Tested _____

Shipping (To American BOA)

Packed By: _____ Shipping Date: _____

Recorded in Database By: _____

Date Recorded (ddmmyy) _____

Comments: _____

Pass / Fail

Chapter 8
Bellows Cuff Ring

1. Detail Drawing

PDE-0209D ATLAEFS 0008
Drawings can be found at http://wwwlhc01.cern.ch/cdd/

2. Material Traceability

All Bellows Cuff Rings are fabricated from AISI 304L stainless steel. Atlas Victoria will require the material vendor to supply certification of origin, physical and chemical specification for each batch of material supplied. The specification will be stored in files at ATLAS Victoria. Each Bellows Cuff Ring inspected will have an accompanying form sheet, upon which, the relevant material specification sheet number will be entered. All form sheet data will subsequently be transferred to a database.

3. Arrival Information

a. Using an electronic scribe, scribe a serial number on the inside of the Cuff Ring. Check the form sheets and the database to check the last serial number used. The serial numbers are incremented by one and start with CR. Record this serial number on the form sheet.
b. Record the date that the Cuff Rings were received.
c. Record the name of the person who recorded the above information, on the form sheet.

4. Testing

a. Using Vernier Calipers measure dimension A, B, C, D, and E. Record the dimensions on the form sheet. All numbers obtained should fall within the tolerances provided on the front of the form sheet. If the dimensions do not fall within the tolerances, follow the instructions in the note below. A Diagram of the dimensions is shown below.
b. Enter the name of the person who performed the tests and the date the tests were performed on the form sheet.

Note: If any of the tests have failed then the Cuff Ring is non conforming and "fail" should be circled at the bottom of the form sheet. Also, if the Cuff Ring is non conforming then a rejection sticker needs to be placed on the Cuff Ring and it needs to be stored on the reject shelf.

If The Cuff Ring has passed all tests then Pass must be circled on the bottom of the form sheet.

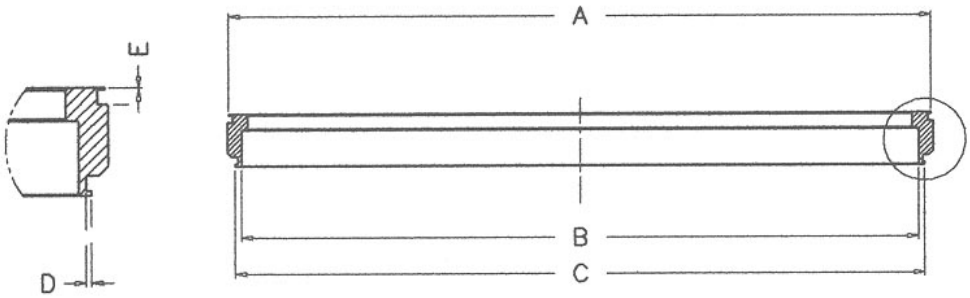
5. Shipping

a. Carefully wrap the Cuff Ring in bubble wrap and place it in the crate to be shipped to American BOA.
b. Enter the name of the person who packaged the Cuff Ring in the crate, on the form sheet.
c. Enter the date that the crates of Cuff Rings were shipped to American Boa.

6. Database Entry

a. Record the information from the form sheet into the database.
b. Record the name of the person and the date the information was recorded into the database, on the form sheet.

7. Dimension Diagrams



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Bellows Cuff Ring

Arrival Information

Serial Number# _____ Date Received _____

Recorded By: _____

Testing

Dimension A$^{289.43\text{-}289.69\ mm}$ _____ Dimension D$^{1.00\text{-}1.25\ mm}$ _____

Dimension B$^{279.20\text{-}279.40\ mm}$ _____ Dimension E$^{.33\text{-}.43\ mm}$ _____

Dimension C$^{284.07\text{-}284.33\ mm}$ _____

Tested By: _____ Date Tested _____

Shipping (To American Boa)

Packed By: _____ Shipping Date: _____

Recorded in Database By: _____

Date Recorded (ddmmyy) _____

Comments: _____

Pass / Fail

Chapter 9
Bellows Assembly

1. *Detail Drawings*

PDE-0207D ATLAEFS 0006
Drawings can be found at http://wwwlhc01.cern.ch/cdd/

2. *Arrival Information*

a. Record the Bellows serial number on the form sheet. The Bellows serial number is the same as the Seal Ring serial number.
b. Record the Cuff Ring serial number on the form sheet.
c. Record the name of the person who recorded the above information, on the form sheet.

3. *Inspection*

a. Record the date the ultrasonic cleaning was done on the Bellows Assembly and also enter the name of the person or persons who cleaned the Bellows Assembly, on the form sheet.
b. Inspect the Cuff Ring weld lip for any dents or defects. If any dents or defects are found check the Fail box on the form sheet. If no dents or defects are found check the Pass box on the form sheet.
c. Inspect the Seal Ring weld lip for any dents or defects. If any dents or defects are found check the Fail box on the form sheet. If no dents or defects are found check the Pass box on the form sheet.
d. Count the number of convolutions on the Bellows and enter the number on the form sheet.
e. Using a measuring tape measure the overall length of the Bellows Assembly in four places and add the four measurement together and divide the sum by 4 to obtain a mean length, enter the mean length on the form sheet.
f. Record the date the above inspection was completed.

4. *Cleaning*

The Bellows assemblies are taken to Triumf in Vancouver to be cleaned in the Ultrasonic cleaning bath.

5. *Leak Testing*

a. Mount the Bellows Assembly into its leak-testing jig, and place it on the leak test platter for leak testing.
b. For this test the DVP500 Pump will be used for a roughing vacuum.
c. Close valves:
   - E 3-Position Valve
   - D Leak Checker Valve
   - A Roughing Vent Valve
   - N Bellows Roughing Valve
d. Open valves:
   - P Roughing Pump Valve
   - C Roughing Valve
e. Turn on the Vacuum Process Controller to monitor the roughing vacuum.
f. Turn on the DVP500 pump and pump down the test apparatus to a vacuum of $3.0x10^{-1}$ or better. When the vacuum reaches $3.0x10^{-1}$ close valve:
   - C Roughing Valve
g. Start pumping with the leak checker. When the leak checker reaches $5.0x10^{-1}$ open valve:
   - D Leak Checker Valve
h. When the base rate of the leak checker bottoms out the testing can start.
i. To leak test the Bellows weld to the Seal Ring, first enter the base rate of the leak checker on the form sheet. Slowly run the helium wand around the join between the Bellows and the Seal Ring, and enter the maximum leak rate registered by the leak checker during this test.
j. Subtract the base rate from the leak rate and enter this number as the actual leak rate.
k. Repeat steps 7 & 8 for the Bellows to Cuff Ring weld and the Bellows seam weld.
l. Close valve:
   - D Leak Checker Valve
m. Turn on the DVP500 pump and pump until –1 vacuum is achieved, open valve:
   - C Roughing Valve
n. Shut off the DVP500 pump and open valve:
   - A Roughing Vent Valve

o. Vent the leak checker.
p. Enter the name of the person who performed the tests and the date the tests were performed on the form sheet.
q. Using Acetone then Ethanol remove any vacuum grease that may have been used during testing.
r. Place the Bellows Assembly back in its back and seal the bag.

Note: There should be no detectable leak (leak rate < 4 x 10^{-10} mbar-l/s) in the Bellows Assembly. If any of the tests failed then the Bellows Assembly has failed and "FAIL" should be circled at the bottom of the form sheet. Also, if the Bellows Assembly has failed then a rejection sticker needs to be placed on it and the assembly must be stored on the reject shelf. If The Bellows Assembly has passed all tests then "Pass" must be circled on the bottom of the form sheet.

6. Database Entry

a. Record the information from the form sheet into the database.
b. Record the name of the person and the date the information was recorded into the database, on the form sheet.

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Bellows Assembly

Arrival Information

Bellows Serial Number#:(Seal Ring#) _____

Cuff Ring Serial Number# _____

Date Received _____ Recorded By: _____

Testing

Cuff Ring Weld Lip ☐ P ☐ F

Seal Ring Weld Lip ☐ P ☐ F

Convolutions _____

Tested By: _____

Mean Length: _____

Leak Test Bellows To Cuff Ring

Base Rate (No He) _____

Leak Rate (He) _____

Actual Leak Rate _____

Leak Test Bellows Test #2

Base Rate (No He) _____

Leak Rate (He) _____

Actual Leak Rate _____

Leak Test Bellows Test #3

Base Rate (No He) _____

Leak Rate (He) _____

Actual Leak Rate _____

Date Tested: _____ Tested By: _____

Date Ultrasonic Cleaned _____ Cleaned By: _____

Recorded in Database By: _____

Date Recorded (ddmmyy) _____

Comments: _____

Pass / Fail

Chapter 10
Modified VCR Gland

1. Detail Drawing

- PDE-0213B (Modified VCR Gland)
  Drawings can be found at http://wwwlhc01.cern.ch/cdd/

2. Arrival Information

a. Record the serial number of the Modified VCR Gland on the form sheet.
b. Record the date the Gland arrived on the form sheet.
c. Record the name of the person who recorded the above information on the form sheet

3. Testing (optional)

a. Visually inspect the gland for any obvious defects, specifically large dings in the sealing face. If there is nothing noticeable enter Pass on the form sheet if there is noticeable defects on the gland enter Fail.
b. Mount the Modified VCR Gland on the vacuum station next to the Valve B. On the end of the VCR gland closest to the valve use a copper gasket, on the end furthest from the valve use a solid rubber gasket.
c. For this test the DVP500 Pump will be used for a roughing vacuum.
d. Close valves:
   - E 3-Position Valve
   - D Leak Checker Valve
   - A Roughing Vent Valve
   - N Bellows Roughing Valve
e. Open valves
   - P Roughing Pump Valve
   - B VCR Test Valve
   - C Roughing Valve
f. Turn on the Vacuum Process Controller to monitor the roughing vacuum.
g. Turn on the DVP500 pump and pump down the test apparatus to a vacuum of $3.0x10^{-1}$ or better. When the vacuum reaches $3.0x10^{-1}$ close valve:
   - C Roughing Valve
h. Start pumping with the leak checker. When the leak checker reaches $5.0x10^{-1}$ open valve:
   - D Leak Checker Valve
i. When the base rate of the leak checker bottoms out testing can start.
j. To leak check the Modified VCR Gland first enter the base rate of the leak checker on the form sheet. Then using the helium wand slowly run it around the VCR connection closest to Valve B. Enter the largest leak rate registered by the leak checker on the form sheet.
k. Subtract the base rate from the leak rate, this will give the actual leak rate of that end of the Modified VCR Gland, record this number on the form sheet.
l. Close valve:
   - D Leak Checker Valve
m. Turn on the DVP500 pump and pump until –1 vacuum is achieved.
n. Open valve:
   - C Roughing Valve
o. Shut off the DVP500 pump and open valve:
   - A Roughing Vent Valve
p. Vent the leak checker.
q. Repeat steps 2 through 8 for the opposite side of the Gland.

Note: If any of the tests failed then the Modified VCR Gland has failed and this should be circled at the bottom of the form sheet. Also, if the Gland has failed then a rejection sticker needs to be placed on it and it needs to be stored on the reject shelf.

If The Gland has passed all tests then Pass must be circled on the bottom of the form sheet.

4. Database Entry

a. Record the information from the form sheet into the database.

b. Record the name of the person and the date the date the information was recorded into the database, on the form sheet.

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Modified VCR Gland

Arrival Information

Serial Number# **GL** _____ Date Received _____
Recorded By: _____

Testing

Visual Inspection _____

Recorded in Database By: _____
Date Recorded (ddmmyy) _____

Comments: _____

Pass / Fail

Chapter 11
Bolt Ring

1. Detail Drawing

PDE-0205D ATLAEFS 0004
Drawings can be found at http://wwwlhc01.cern.ch/cdd/

2. Arrival Information

a. Using an electronic scribe, scribe a serial number on the inside of the Bolt Ring. Check the form sheets and the database to check the last serial number used. The serial numbers are incremented by one and start with CR. Record this serial number on the form sheet.
b. Record the date that the Bolt Rings were received.
c. Record the name of the person who recorded the above information, on the form sheet.

3. Testing

a. Using the template check to see if the Bolt Ring was properly machined. Check either the "Y" or "N" depending on whether or not the Bolt Ring holes matches the template on the form sheet.
b. Visually check to make sure all of the holes have been taped. Check either the "Y" or "N" depending on whether or not the Bolt Ring holes have been properly tapped.
c. Enter the name of the person who performed the tests and the date the tests were performed on the form sheet.

Note: If any of the tests failed then the Bolt Ring has failed and this should be circled at the bottom of the form sheet. Also, if the Bolt Ring has failed then a rejection sticker needs to be placed on the Bolt Ring and it needs to be stored on the reject shelf.

If The Bolt Ring has passed all tests then Pass must be circled on the bottom of the form sheet.

4. Database Entry

a. Record the information from the form sheet into the database.
b. Record the name of the person and the date the information was recorded into the database, on the form sheet.

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Bolt Ring

Arrival Information

Serial Number# _____ Date Received _____

Recorded By: _____

Testing

Bolt Hole Pattern Alignment ☐ **Y** ☐ **N**

Tapped Holes ☐ **Y** ☐ **N**

Tested By: _____ Date Tested: _____

Recorded in Database By: _____

Date Recorded (ddmmyy) _____

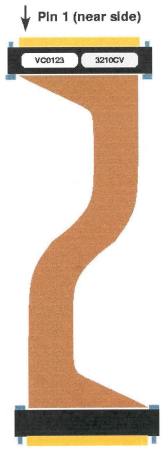
Comments: _____

Pass /Fail

Chapter 12
Vacuum Cables

1. Arrival Information

a. Record the serial number for the Vacuum Cable on the form sheet. The serial number should be written as VC followed by a 4-digit number. The serial number can be found on one of the plastic cases.
b. Record the date the Vacuum cable was received, on the form sheet.
c. Record the FCI serial number on the form sheet. This serial number can be found stamped on the kapton coating. The serial number is usually a series of two 4-digit numbers. Occasionally there is only one 4-digit number.
d. The slot designation will be determined after testing and analysis is performed on the cables and will have to be entered on the form sheet in a later step.
e. Record the name of the person, on the form sheet, who recorded the arrival information.
f. The box # refers to the box that the set of cables is stored in. This number will be obtained after all electrical tests have been performed on the cable, and will be asked for in a later step.
g. The feedthrough # will not be determined until the cable is installed in a feedthrough, this number will be asked for in a later step.
h. Using a green felt tip marker mark the orientation of pin 1 on the Vacuum Cable. The placement of pin 1 can be found in the diagram below.



Note: If any of the tests failed then the Vacuum Cable has failed and this should be circled at the bottom of the form sheet. Also, if the Vacuum Cable has failed then it needs to be placed in the Vacuum Cable rejection box on the cable shelf. If The Vacuum Cable has passed all tests then Pass must be circled on the bottom of the form sheet.

2. Testing

a. Check that there are no bent spring clip segments, and, to ensure a reasonable degree of 'spring clip bow', check that daylight can be seen between the spring clips (ground shields) and the plastic housing when viewed end on.
b. Check that the cable length is in the 340mm to 350mm range.
c. Check that there are no tears or any other obvious defects on the kapton stripline coating. Also ensure that there is no glue residue transferred to the kapton from the packaging.
d. Check that the plastic case has been welded correctly (i.e., no significant gap between the halves) and that there is no significant bowing of the plastic housing when viewed end on. The nominal pincarrier slot spacing spacing is 8.7 mm; the maximum tolerable case width is 8.85 mm, however those cables with case widths greater than 8.7 mm should be flagged on the form sheets.
e. Ensure that the plastic spacer is not up side down.
f. Each Vacuum Cable is to be put through a series of electrical tests. These test are to be performed on each cable in the following order: Cirris Continuity Test, Cross Talk Tests, Impedance, Resistance, and Contact Resistance Measurements.

3. Cirris Continuity Tests

This test checks for intermittent signal trace faults using the Cirris tester.

a. Load the wirelist **VAC.WIR**.

b. Ensure that the Cirris tester is in **continuous** mode.

For each cable to be tested:

c. Connect a vacuum cable to the Cirris tester, with the pin 1 mark of the vacuum cable placed adjacent to the pin 1 mark of the **J1**/**J2** Cirris port.
d. Gently move (wiggle...) the stripline back and forth to observe any potential faults.
e. In event of failure, document which line(s) failed in the **comment** section of the Vacuum Cable form sheet.
f. No Cirris data, aside from a simple pass/fail, is saved for this test.

4. Cross Talk Tests

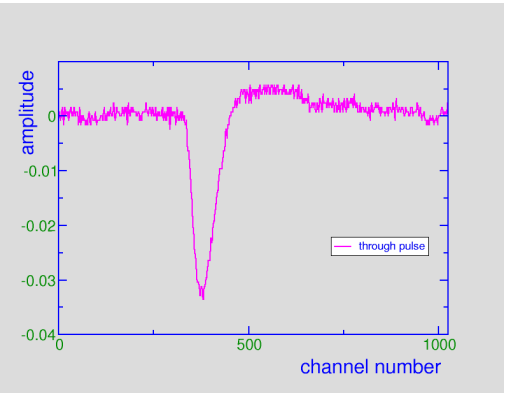
The Cross Talk tests can be carried out on either the mobile cross talk station, using the Tek2440 scope, or the fixed cross talk station, using the Lecroy 8818 Transient Recorder. Instructions are given for the mobile cross talk station. Instructions for the fixed cross talk station are analogous.

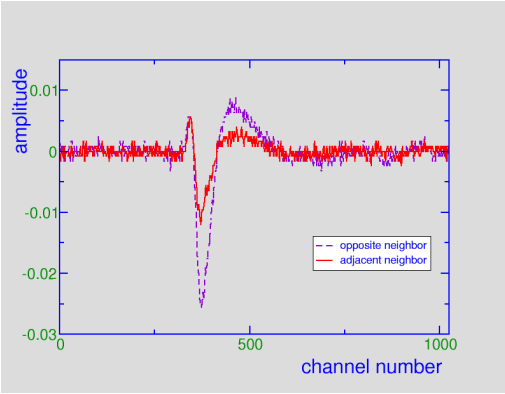
a. Log onto the cold test station computer (WINO) and start the program shown below from Windows Explorer: **Network Neighborhood/ Strange/ Electrical Tests/ Pro/ Exe/ Vacuum Cables/ Crosstalk/ ScopeF01.bat** (This assumes that the UBC fanout F01 is mounted on the mobile cross talk station, rather than F02, which is normally at the fixed cross talk station.)
b. In the VI window that should now appear, start the VI by pressing the RUN button (right arrow).
c. Follow the instructions on the pup-up window to set the properties of the BNC pulser. Note that **the pulser should be turned on at least 30 minutes before data collection** to allow it to warm up.

Note: The pigtail test harnesses to be used for the vacuum cable cross talk tests are as follows:

Mobile Station:	**F/O Pigtail – MD2884/001**
	Scanner Pigtail – MD2884/003
Camac Station:	**F/O Pigtail – MD2883/003**
	Scanner Pigtail – MD2883/018

d. Attach the Vacuum Cable to test to the two Pin Carriers at the cross talk station. The Vacuum Cable should be attached to the two slots marked with red dots, and pin 1 of the Vacuum Cable should be adjacent to pin 1 of the Pin Carrier marked with a green dot.
e. Run your finger along the bottom of the Vacuum Cable to move any `loops' between the two striplines to one end or the other.
f. Press **Scan** to start the scanning procedure.
g. In the popup window that now appears, enter the directory name for the data to be stored. The directory name should be the serial number of the Vacuum Cable, e.g., **vc0123**. If a cable is being re-measured for any reason, use **vc0123.1** (or **vc0123.2**... etc). Enter **Save** to proceed.
h. Another popup window now appears instructing you to set the attenuator box (white box with toggle) to **Through Pulses**. Do so, and press **OK** to continue. Be sure to watch the first few pulses on the scope screen to ensure that they appear reasonable, i.e., clean negative pulses (see figure below).
i. Once the **Through Pulses** are completed (~ 1 minute) another popup window appears instructing you to set the attenuator box to **Cross Talk** Pulses. Do so, and press **OK** again to proceed. As before, watch the first few pulses on the scope screen to ensure that they appear reasonable, i.e. bipolar pulses (see figure below).
j. After all 64 lines are scanned (~ 3 minutes), remove the Vacuum Cable and proceed with measuring the next.
k. Note that the jackscrew sockets on the scanner and the pincarrier should be lubricated every 5 - 10 plugins to prevent gauling.





Typical Through Pulse ***Typical Cross Talk Pulses***

5. Impedance, Resistance, and Contact Resistance Measurements

Impedance, resistance, and contact resistance measurement are performed at the **Impedistance** test station.

a. Log onto the computer at the Impedistance test station (**STRANGE**) and start the Impedistance **Vi** at Strange\Data\ElectricalTests\pro\exe\VacuumCables\Impedistance\Impedistance.VI.
b. In the **VI** window that should now appear, start the **VI** by pressing the **RUN** button (right arrow).
c. Turn the power on for the Keithley micro Ohmmeter, the network analyzer, **armadillo**, **Phred**, and **Phreda**.

6. Impedance Measurements

a. Attach the vacuum cable to the Impedance measuring device (Armadillo). The green dot on the surface of Armadillo marks the connector corner corresponding to pin 1. Connect the terminator block (looks like a kite handle...) to the Vacuum Cable first. This must be done very carefully to avoid bending the pins. Note that to get the pin 1 orientation correct, the green dot marking the pin 1 position on the Vacuum Cable will be on the connector attached to the terminator block. Now hang the terminator block handle over the vertical support structure, and carefully plug the other end of the Vacuum Cable into Armadillo.
b. Start scanning the cable by pressing the **Scan** button on the **Armadillo** area of the **Impedistance VI** screen.
c. Watch the first couple of measured traces on the network analyzer to ensure that they are changing. If not, **Armadillo**'s power is probably off!
d. After the six traces have been scanned, a popup window will prompt you for the filename to be used for the saved data. This should be the serial number of the Vacuum Cable, e.g., **vc01234.dat**. If a cable is re-measured, use **vc01234.1.dat** (or **vc01234.2.dat**...).
e. The ambient temperature and humidity during this measurement should be recorded on the form sheet.

7. Resistance Measurements

a. Attach the vacuum cable to the Resistance measuring device (**Phred**). This must be done very carefully, with feeling... The green dot, marking pin 1 on the vacuum cable should be placed adjacent to the green dot, marking pin 1 on the surface of **Phred**. Note that ***during measurements with Phred, there must be no vacuum cable connected to the Contact Resistance measuring device*** (**Phreda**).
b. Start scanning the cable by pressing the **Scan** button on the **Phred** area of the **Impedistance VI** screen.
c. Watch the first few measured values to ensure that they are reasonable, i.e., ~ 0.8 - 1.0 Ohms.
d. After the 64 traces have been scanned, a popup window will prompt you for the filename to be used for the saved data. This should be the serial number of the Vacuum Cable, e.g., **vc01234.dat**. If a cable is re-measured, use **vc01234.1.dat** (or **vc01234.2.dat**...).

8. Contact Resistance Measurements

a. Use the spring clip tool to carefully unclip any spring clip segments that might be caught over the top edge of the plastic housing on the vacuum cable connector. If the spring clip tool won't fit under the top edge of the spring clip segment, then that segment does not require un-springing. in other words, ***don't try too hard, or else you risk damaging the spring clip***... Note that the Contact Resistance should be the last measurement done in order to avoid further sticking of the spring clips.
b. Attach the vacuum cable to the Contact Resistance measuring device (**Phreda**). The green dot, marking pin 1 on the vacuum cable should be placed adjacent to the green dot, marking pin 1 on the surface of **Phreda**.
c. Start scanning the cable by pressing the **Scan** button on the **Phreda** area of the **Impedistance VI** screen.
d. Watch the first few measured values to ensure that they are reasonable, i.e., ~ 15 - 20 milli Ohms.
e. If an open is encountered, a popup window will give you the option to **retest** or **skip**. You may opt to reseat the connectors and retest. If the segment fails again, just press the **skip** button to continue. It is not unexpected to have up to ~ 3 opens on a single cable.
f. After the 26 segments have been scanned, a popup window will prompt you for the filename to be used for the saved data. This should be the serial number of the Vacuum Cable, e.g., **vc01234.dat**. If a cable is re-measured, use **vc01234.1.dat** (or **vc01234.2.dat**...).

9. Offline Analysis

Offline analysis of the cross talk data, impedance data, resistance data, and contact resistance data is performed on a UNIX workstation. Cross talk for adjacent lines should be < 1%, and the average impedance for each stripline should nominally lie in the range $Z = 33 \pm 4\ \Omega$. Cables whose impedance is measured to be within 1 Ω outside this nominal range will still be considered for use, but will be flagged for use only matched with a 25 Ω pigtail (T48 or T52) if 28 Ω

< Z < 29 Ω, or with a 50 Ω pigtail (T47, T49, T50, or T51) if 37 Ω < Z < 38 Ω. Vacuum cable pairs whose resistances all lie within a 50 mΩ band will be flagged for use in Pin Carrier slots designated for calibration signals. A vacuum cable is failed and will be returned to the supplier if any trace has a resistance that falls out of the range 0.6 Ω < R < 1.2 Ω. Any vacuum cable having an abnormally high contact resistance (> 20 mΩ) for more than two consecutive spring clip segments or more than three segments in total on one side of the cable will be considered failed and returned to the supplier.

10. Database Entry

a. Record the information from the form sheet into the database.

b. Record the name of the person and the date the information was recorded into the database, on the form sheet.

Atlas Endcap Signal Feedthrough Project

Revision #: 010330

Vacuum Cable

Arrival Information

Serial Number# _____ Date Received _____
FCI Serial Number: _____ Slot Designation _____
Recorded By: Initials: _____ Box # _____
Feedthrough#: _____ Pin 1 Mark _____

Testing

Spring Clips: ☐ P ☐ F Kapton Coating: ☐ P ☐ F
Length 340mm-350mm ☐ P ☐ F Plastic Case ☐ P ☐ F
Center Spacer ☐ P ☐ F Room Temp: _____
Humidity: _____

Trace Resistance Initials: _____
Ground Contact Resistance Initials: _____
Impedance Initials: _____
Crosstalk Initials: _____
Cirris Wiggle Test Initials: _____

Calibration Cable ☐ Y ☐ N

Recorded in Database By: Initials: _____
Date Recorded (ddmmyy) _____

Comments: _____

Pass / Fail

Chapter 13
Pigtails

1. Arrival Information

a. Record the serial number of the Pigtail on the form sheet.
b. Record the date that the Pigtail arrived on the form sheet.
c. Record the Impedance of the cable on the form sheet. This information is found on the label, in the same place the serial number is found. The impedance for each type is as follows:

T47	**50** W
T48	**25** W
T49	**50** W
T50	**50** W
T51	**50** W
T52	**25** W
LV	**----**

d. Record the type of pigtail on the form sheet.
e. Record the *original* slot position of the cable on the form sheet. This can also be found in the same location the serial number is found. Due to a labeling error at Axon, there are no pigtails arriving with labels designated for slots A1, B1, A14, B14, A15, and B15. Consequently, all pigtails are relabeled once they arrive at UVIC, with an effort to duplicate the original position label whenever possible.
f. The actual slot designation will be determined at a later date. The original slot designation may not necessarily be where the cable is being positioned. The slot designation will be determined at a later date, a sticker will be placed on each cable showing its proper slot designation, and this number is what will be entered in the Actual Slot Designation space on the form sheet.
g. Visually Inspect the spring clips for any defects such as dents or creases. If no defects are found check Good on the form sheet. If defects are found check No Good on the form sheet.
h. Measure the overall length of the pigtail. If the pigtail is the correct length then check Good on the form sheet. If the pigtail is not the correct length then check No Good on the form sheet. The nominal lengths for each type of pigtail are listed in the following table. The tolerances are ±1 cm for cables < 1 meter in length, and ±2 cm for cables > 1 meter in length.

T47	**90 cm**
T48	**90 cm**
T49	**265 cm**
T50	**265 cm**
T51	**265 cm**
T52	**430 cm**
LV	**265 cm**

2. Cirris Pigtail Continuity Tests

a. Mount a 2x32 pin connector to the **J1/J2** Cirris port and a µD female connector to the **J3/J4** Cirris port.
b. Note that the HEC signal pigtails must be tested as jumpered pairs, using 2x32 pin connectors on both Cirris ports. The HEC signal cables must be jumpered with each block of one cable jumpered to the corresponding block of the other cable. The HEC LV cables are tested singly, but with each block self jumpered.
c. Load the wirelist. Use, for example, **T47.WIR** for **type 47** cables, and **T48.WIR for type 48** cables.
d. Ensure that the Cirris tester is in **single test** mode (Test Control / single test).
e. The pigtails should be tested in sequence of serial number in order to associate test results with specific pigtail cables.

f. Insert a blank floppy disk into the floppy drive of the Cirris tester.
g. Press **Test Cable** on the Cirris tester.
h. For each cable to be tested:
i. Connect a pigtail cable to the Cirris tester, with the pin 1 mark on the ATI connector placed adjacent to the pin 1 mark of the **J1/J2** Cirris port.
j. Press **START TEST** to test the cable.
k. Remove the pigtail cable and proceed with the next cable.
l. In the event a cable must be retested, make a note in the PigTails logbook the sequence number of the repeated test.
m. When all pigtail cables of the test session have been tested, press **CANCEL** and observe the green light on the floppy disk drive to ensure that the data is being written to the floppy disk.
n. Enter into the PigTails logbook the time and date of the test session, and the range of pigtail serial numbers tested.

3. Cirris Pigtail Data Instructions

a. Open explorer and navigate to:
Network Neighborhood\Strange\Data\ElectricalTests\pro\dat\PigTailCables\Cirris
In this directory create a new folder using the following format:
YYMMDD.X Where: **YY** (Year) of delivery to ATLAS Victoria
MM (Month) of delivery to ATLAS Victoria
DD (Day) of delivery to ATLAS Victoria
.X is the testing run done for that delivery
Example: 000329.3 The delivery of the cables to ATLAS Victoria was 29-March-2000, and this is the third run of tests.
b. Copy the file created on the floppy disk from the Cirris tester to the following directories: **Neighborhood\Strange\Data\ElectricalTests\pro\dat\PigTailCables\Cirris\yymmdd.x** created in step "a" (and set its property to ***read only***) and also to the Cirris directory in your own home directory.
c. Remove the floppy disk from the disk drive.
d. Start the SPC Link program, and click on ***Read from Data Collection Files***.
e. Use the **browse** option and select the file that is saved in the Cirris directory in your home directory.
f. After you have selected the file and opened it, select the **Read** button in the window. It will read the file and a new window will appear telling you it read the data successfully. Note that once read, the data file in your home directory will be deleted automatically.
g. A new window will appear after the file has been read; select the **OK** button.
h. In the window that is now on the screen select the **Choose Data to Write to a Text File** button.
In the **DATA RANGE** pull down menu select **Today** if the tests were done today; if not select the appropriate choice.
i. Select (click on) the desired line in the **Cable List** window. Then select the desired line in the **Test Group** window.
j. After the desired line has been selected in the test group window, there is a directory at the bottom of the window for saving the information. You want this file to be the Cirris directory in your home directory, so click **browse** and select the Cirris directory in your home directory. Change the name of the file to the type of cables that were tested (eg, t47, t48,…). Press the **write** button and then press **OK**. Copy the three newly created **.MVF**, **.SUM**, and **.ERR** files to the **Data** folder created in step "a" and set their properties to ***read only***.
k. Start **Microsoft Excel** and read in the newly created **.MVF** file.
l. Select the ***Delimited*** button and then press ***Next***.
m. Select the ***comma*** button (under ***delimiters***) and then press ***Finish***.
n. Use the first mouse button (and the Ctrl key if necessary) to select all of the good data (i.e., skip the failed trials that were subsequently repeated).
o. Press the ***Chart Wizard*** button.
p. Select the ***Line*** chart type and then press ***Next***.
q. Select ***Columns*** and then press ***Finish***.
r. Start the ***Paint*** program (Start -> Programs -> Accessories -> Paint).
s. Copy the newly created chart into ***Paint*** and save the **.bmp** file in the same directory where the other data has been saved.
t. Use **notepad** to create a **readme.txt** file describing the tests done, including any problems, type of cable, serial numbers (the *range* of serial number is sufficient) and the date tested in the **Data** directory created in step "a".
u. Replace the floppy disk into the floppy drive and delete the **cirris** data file. ***This should be done only after the data has been safely stored and processed in the primary data storage in \Strange\Data\ElectricalTests\pro\dat\PigTailCables\Cirris.***
v. Enter the name of the data file for the pigtail on the pigtail form sheet

4. Cross Talk Tests

Cross Talk tests for pigtail cables are carried out only for those pigtails to be connected to pincarrier slots designated to carry calibration signals. The Cross Talk tests can be carried out on either the mobile cross talk station, using the Tek2440 scope, or the fixed cross talk station, using the Lecroy 8818 Transient Recorder. Instructions are given here for the mobile cross talk station. Instructions for the fixed cross talk station are analogous.

a. Log onto the ColdTest station computer (**WINO**) and start the program *Strange\Data\ElectricalTests\pro\exe\PigTailCables\CrossTalk\ScopeFO1.bat* (This assumes that the UBC fanout **FO1** is mounted on the mobile cross talk station, rather than **F02** which is nominally at the fixed cross talk station.)
b. In the **VI** window that should now appear, start the **VI** by pressing the **RUN** button (right arrow).
c. Follow the instructions on the popup window to set the properties of the BNC pulser. Note that ***the pulser should be turned on at least 30 minutes before data collection*** to allow it to warm up.
d. Press the **test type** button to set the test mode to **64x64**.
e. Connect the **PigTail Cable Under Test** between the **scanner** and the Pin Carrier at the cross talk station. The **PigTail Cable Under Test** should be attached with pin 1 of the ATI connector matched to ***pin 2*** of the pigtail (**MD2884/001**) connected between the **fanout** and the Pin Carrier.
f. Press **Scan** to start the scanning procedure.
g. In the popup window that now appears, enter the directory name for the data to be stored. The directory name should be the serial number of the Vacuum Cable, eg, **pt0123**. If a cable is being remeasured for any reason, use **pt0123.1** (or **pt0123.2**... etc). Enter **Save** to proceed.
h. Another popup window now appears instructing you to set the attenuator box (white box with toggle) to **Through Pulses**. Do so, and press **OK** to continue. Be sure to watch the first few pulses on the scope screen to ensure that they appear reasonable (see the **Through Pulse** figure in the Vacuum Cables chapter).
i. Once the **Through Pulses** are completed (~ 1 minute) another popup window appears instructing you to set the attenuator box to **CrossTalk** Pulses. Do so, and press **OK** again to proceed. As before, watch the first few pulses on the scope screen to ensure that they appear reasonable (see the **Cross Talk Pulses** figure in the Vacuum Cables chapter). Note that the 64x64 cross talk measurement takes several hours to acquire all data.
j. After all 64 lines are scanned, remove the PigTail Cable and proceed with measuring the next. Note that the jackscrew sockets on the scanner and the Pin Carrier should be lubricated every 5 - 10 plugins to prevent gauling.

5. Offline Analysis

Offline analysis of the cross talk data is performed on a UNIX workstation. Cross talk for adjacent lines should be < 1%.

Note: If any of the above tests and inspections failed, then the Pigtail has failed and this should be circled at the bottom of the form sheet. Also, if the Pigtail has failed, then it needs to be placed in the Pigtail rejection box on the cable shelves.

If The Pigtail has passed all tests then Pass must be circled on the bottom of the form sheet.

6. Database Entry

a. Record the information from the form sheet into the database.
b. Record the name of the person and the date the information was recorded into the database, on the form sheet.

Atlas Endcap Signal Feedthrough Project

Revision #: 010330

Pigtails

Arrival Information

Serial Number# _____ Date Received _____
Recorded By: _____ Impedance: _____
Pigtail Type: _____ Original Slot Label: _____
Actual Slot Designation _____

Testing

Spring Clips ☐ **G** ☐ **NG**
Overall Length ☐ **G** ☐ **NG**

Cirris Tested: ☐ P ☐ F Initials: ☐ Cross Talk: (Calibration Cables only) Initials ☐

Date Tested: (ddmmyy)_____ Data File #: _____

Recorded in Database By: _____
Date Recorded (ddmmyy) _____

Comments: _____

PASS / FAIL

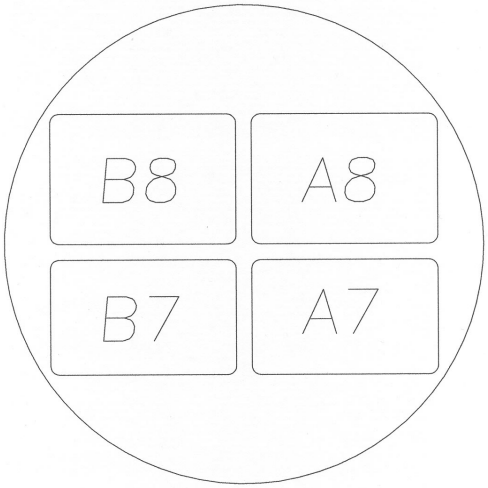
Chapter 14
Cold Flange Assembly

1. Detail Drawing

- PDE-0210D ATLAEFS 0009
  Drawings can be found at http://wwwlhc01.cern.ch/cdd/

2. Preparation

a. Select a Cold Signal Flange that has passed all testing and inspection. To ensure that it has passed all testing and inspection refer to the form sheet & Database for that flange.
b. Select four Pin Carriers that have passed all testing and inspection. To ensure that each pin carrier has passed testing and inspection refer to the form sheet & Database for each Pin Carrier.
c. Remove the Cold Signal Flange from its bagging and carefully inspect it for cleanliness. The flange should be very clean. If any residue from the ultrasonic cleaning is found on the flange use acetone then alcohol to remove the residue.
d. Using acetone then alcohol carefully clean the outside of each Pin Carrier, as well as the weld lip on each Pin Carrier.
e. Place the Pin Carriers in slots A7, A8, B7, and B8. Refer to the diagram pinned on the wall by the welding station for the orientation of each slot on the Cold Signal Flange.
f. Enter all the information requested on the Cold Flange Assembly form sheet in the Preparation box.



Note: For proper orientation of the Cold Signal Flange when inserting the Pin Carriers the weld lip on the Cold Signal Flange must be facing up. The picture above is looking from the cold funnel side.

3. ***Welding***

The welding plan can be found in Appendix A

a. Specific Mechanical will be doing all the welding for each feedthrough. Before the welder starts welding make sure that a plate is covering the pins on each Pin Carrier and that the welder is wearing cotton gloves.
b. On the Cold Flange Assembly form sheet, in the Welding box, enter the name of the welder and the date the weld was performed. After the welder has completed the welding, vacuum the pincarrier and then use alcohol to clean all the welds, then initial the form sheet.

4. Testing

a. Place the Cold Signal Flange in its leak testing apparatus and place the leak testing apparatus on the leak test platform.
b. For this test the DVP500 Pump will be used for a roughing vacuum. So, close valves E, D, A, and N. Open valves P and C. Also, turn on the Vacuum Process Controller to monitor the roughing vacuum.
c. Turn on the DVP500 pump and pump down the test apparatus to a vacuum of $3.0x10^{-1}$ or better. When the vacuum reaches $3.0x10^{-1}$ close valve C.
d. Start pumping with the leak checker. When the leak checker reaches $5.0x10^{-1}$ open valve D. When the base rate of the leak checker bottoms out, testing can start.

e. Before testing each Pin Carrier weld enter the base rate in column 1 next to the Pin Carrier being tested. Run the helium wand around the weld for that Pin Carrier and through the pin slots for that Pin Carrier. Enter the leak rate in Column 1. Subtract the base rate from the leak rate and enter the actual leak rate in column 1.
f. Shut Valve D, turn on the DVP500 pump and pump until –1 vacuum is achieved, open valve C, shut off the DVP500 pump and open valve A to vent the system. Vent the leak checker.
g. Enter the date the testing was performed and the person who performed the tests on the form sheet. Clean the vacuum grease used on the assembly with acetone then alcohol. Enter the cleaning information on the form sheet.
h. If an entire flange including all pin carriers together leaks at or above 1×10^{-9} mbar-l/s then it has failed
i. Record the information from the form sheet into the database.
j. Record the name of the person and the date the information was recorded into the database, on the form sheet.

Atlas Endcap Signal Feedthrough Project

Revision #: 010330

Cold Flange Assembly

Preparation

Flange Serial #

Pin Carrier A7 Serial # _____ Pin Carrier B7 Serial # _____

Pin Carrier A8 Serial # _____ Pin Carrier B8 Serial # _____

Flange Cleaned By: _____ Pin Carriers Cleaned By: _____

Prepared By: _____ Date Prepared: _____

Welding

Welded By: _____ Date Welded: _____

Cleaned By: _____

Testing

Base Rate If Zeroed _____

Leaktest Slot A7	**1**	**2**	**Leaktest Slot B7**	**1**	**2**
Base Rate (No He)			Base Rate (No He)		
Leak Rate (He)			Leak Rate (He)		
Actual Leak Rate			Actual Leak Rate		

Leaktest Slot A8	**1**	**2**	**Leaktest Slot B8**	**1**	**2**
Base Rate (No He)			Base Rate (No He)		
Leak Rate (He)			Leak Rate (He)		
Actual Leak Rate			Actual Leak Rate		

Tested By: _____ _____ Date Tested: _____ _____

Cleaned By: _____ _____ Date Cleaned: _____ _____

Recorded in Database By: _____

Date Recorded (ddmmyy) _____

Comments: _____

Pass / Fail

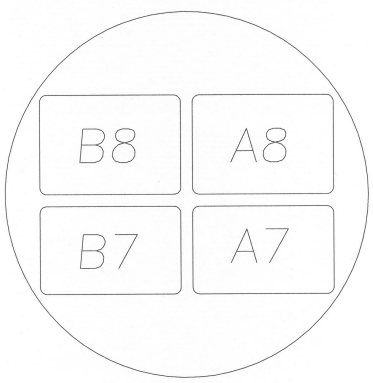
Chapter 15
Ambient Flange Assembly

1. Detail Drawing

PDE-0211D ATLAEFS 0010
Drawings can be found at http://wwwlhc01.cern.ch/cdd/

2. Preparation

a. Select an Ambient Signal Flange that has passed all testing and inspection. To ensure that it has passed all testing and inspection refer to the form sheet & Database for that flange.
b. Select four Pin Carriers that have passed all testing and inspection. To ensure that each pin carrier has passed testing and inspection refer to the form sheet & Database for each Pin Carrier.
c. Select two Modified VCR Glands that have passed all testing and inspection. To ensure that they have passed all testing and inspection refer to the form sheet & Database for each gland.
d. Remove the Ambient Signal Flange from its bagging and carefully inspect it for cleanliness. The flange should be very clean. If any residue from the ultrasonic cleaning is found on the flange use acetone then alcohol to remove the residue.
e. Using acetone then alcohol carefully clean the outside of each Pin Carrier, as well as the weld lip on each Pin Carrier.
f. Place the Pin Carriers in slots A7, A8, B7, and B8. Refer to the diagram below for the orientation of each slot on the Ambient Signal Flange.



For proper orientation of the Ambient Signal Flange when inserting the Pin Carriers the weld lip on the Ambient Signal Flange must be facing up. The picture above is looking from the bellows side.

g. Place the Modified VCR Glands in the Ambient Signal Flange. The 8-Row Gland is the one next to the 8-Row Pin Carriers, and the 7-Row Gland is next to the 7-Row Pin Carriers.
h. Enter all the information requested on the Ambient Flange Assembly form sheet in the Preparation box.

3. Welding

The welding plan can be found in Appendix A

a. Specific Mechanical will be doing all the welding for each feedthrough. Before the welder starts welding make sure that a plate is covering the pins on each Pin Carrier and that the welder is wearing cotton gloves.
b. On the Ambient Flange Assembly form sheet, in the Welding box, enter the name of the welder and the date the weld was performed. After the welder has completed the welding, vacuum the pin carriers, use alcohol to clean all welds, and then initial the form sheet.

4. Testing

a. Remove all the covers that were placed over the pins on the Pin Carriers and place rubber bungs in each Modified VCR Gland.
b. Place the Ambient Signal Flange in its leak testing apparatus and place the leak testing apparatus on the leak test platform.
c. For this test the DVP500 Pump will be used for a roughing vacuum. So, close valves E, D, A, and N. Open valves P and C. Also, turn on the Vacuum Process Controller to monitor the roughing vacuum.
d. Turn on the DVP500 pump and pump down the test apparatus to a vacuum of $3.0x10^{-1}$ or better. When the vacuum reaches $3.0x10^{-1}$ close valve C.
e. Start pumping with the leak checker. When the leak checker reaches $5.0x10^{-1}$ open valve D. When the base rate of the leak checker bottoms out, testing can start.
f. Before testing each Pin Carrier weld enter the base rate in column 1 next to the Pin Carrier being tested. Run the helium wand around the weld for that Pin Carrier and through the pin slots for that Pin Carrier. Enter the leak rate in Column 1. Subtract the base rate from the leak rate and enter the actual leak rate in column 1.
g. Repeat step 6 for all four Pin Carriers and the Modified VCR Glands. If all the actual leak rates are zero then circle pass at the bottom of the Ambient Flange Assembly form sheet.
h. Shut Valve D, turn on the DVP500 pump and pump until –1 vacuum is achieved, open valve C, shut off the DVP500 pump and open valve A to vent the system. Vent the leak checker.
i. Enter the date the testing was performed and the person who performed the tests on the form sheet. Clean the vacuum grease used on the assembly with acetone then alcohol. Enter the cleaning information on the form sheet.
j. If an entire flange including all pin carriers together leaks at or above $1x10^{-9}$ mbar-l/s then it has failed

5. Database Entry

a. Record the information from the form sheet into the database.
b. Record the name of the person and the date the information was recorded into the database, on the form sheet.

Atlas Endcap Signal Feedthrough Project

Revision #: 010330

Ambient Flange Assembly

Preparation

Flange Serial # _____

Pin Carrier A7 Serial # _____ Pin Carrier B7 Serial # _____

Pin Carrier A8 Serial # _____ Pin Carrier B8 Serial # _____

7-row Gland# _____ 8-Row Gland# _____

Flange Cleaned By: _____ Pin Carriers Cleaned By: _____

Prepared By: _____ Date Prepared: _____

Welding

Welded By: _____ Date Welded: _____

Cleaned By: _____

Testing

Base Rate If Zeroed _____

Leaktest Slot A7	**1**	**2**	**Leaktest Slot B7**	**1**	**2**
Base Rate (No He)			Base Rate (No He)		
Leak Rate (He)			Leak Rate (He)		
Actual Leak Rate			Actual Leak Rate		

Leaktest Slot A8	**1**	**2**	**Leaktest Slot B8**	**1**	**2**
Base Rate (No He)			Base Rate (No He)		
Leak Rate (He)			Leak Rate (He)		
Actual Leak Rate			Actual Leak Rate		

VCR Glands Leak Checked: ☐

Tested By: _____ _____ Date Tested: _____ _____

Cleaned By: _____ _____ Date Cleaned: _____ _____

Recorded in Database By: _____

Date Recorded (ddmmyy) _____

Comments: _____

Pass / Fail

Chapter 16
Pigtail Assembly

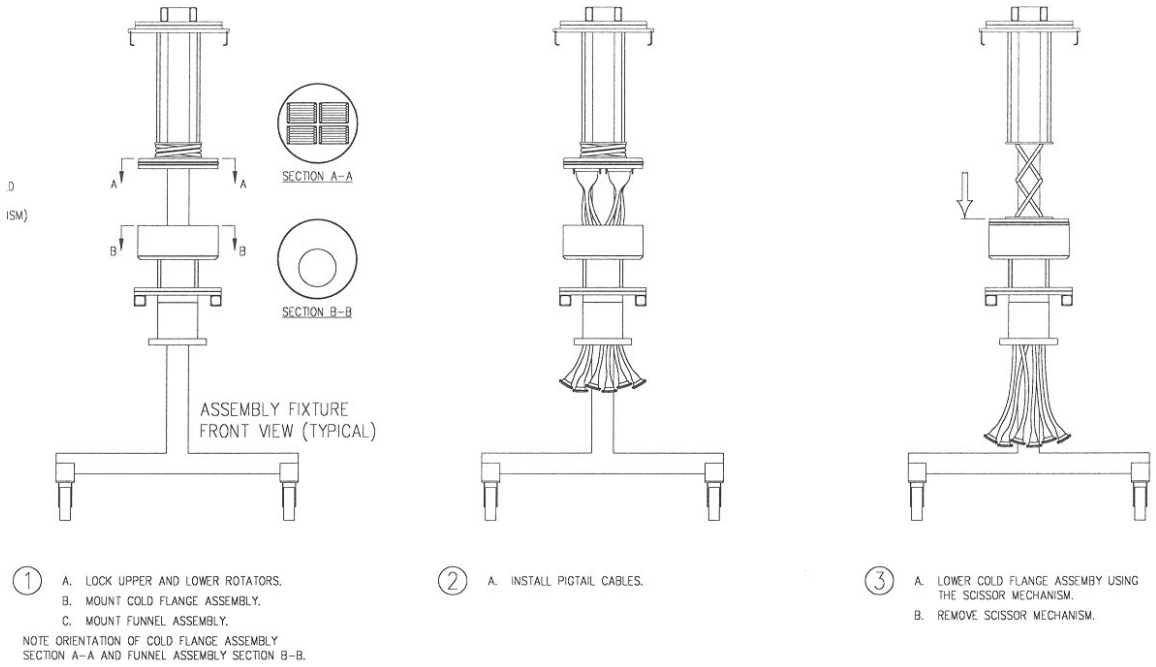
1. Detail Drawing

- PDE-0216D (Pigtail Installation)

Drawings can be found at http://wwwlhc01.cern.ch/cdd/

2. Assembly Procedures

Before Assembly 30 Pigtails, 1 Cold Flange Assembly, and 1Funnel Assembly will be selected. Make sure that they have passed all tests performed on them. Before a component is used in the assembly the form sheet for each component in the assembly must be compiled and each form sheet must have PASS circled in its lower right corner and check the database to ensure each component has passed. Below is a list of assembly procedure and drawings of the installation. Also note on the **Pigtail Assembly** form sheet the serial number of the Cold Flange, and also the name of the person who mapped the slot number designation for each pigtail.



a. Ensure that the Assembly Jig pin is rotated in its left position (as viewed from the front).
b. Place the Funnel Assembly in the assembly jig
c. Make sure that the funnel offset is towards the front of the jig
d. Complete the ferrite tests on the funnel assembly for the lower funnel tube to funnel base weld
e. Thread the 4 M8 bolts into the Funnel Base of the Funnel Assembly making sure that the bellows alignment jig is correctly placed opposite to the offset of the lower funnel tube (i.e., toward the back of the jig), then lower the Funnel Assembly into the assembly jig. The funnel assembly should be offset towards the front.
f. Install the scissor jack using 4-M12 ready rod. Make sure the scissor jack is in the fully retracted position, as shown in drawing 1.
g. Inspect all of the pins in the cold flange for straightness.
h. Put four plastic cover plates onto the cold flange pin carriers – bellows side.
i. Vacuum the pincarriers on the funnel side.
j. Mount the Cold Flange Assembly to the scissor jack using the 4-M5 holes in the Cold Signal Flange. If assembled properly the weld lip for the Pin Carriers should be facing the Funnel Assembly. The 7-row pincarriers should at the front.
k. Make sure that the locking pin is located on the left-hand side.

Pigtail Assembly

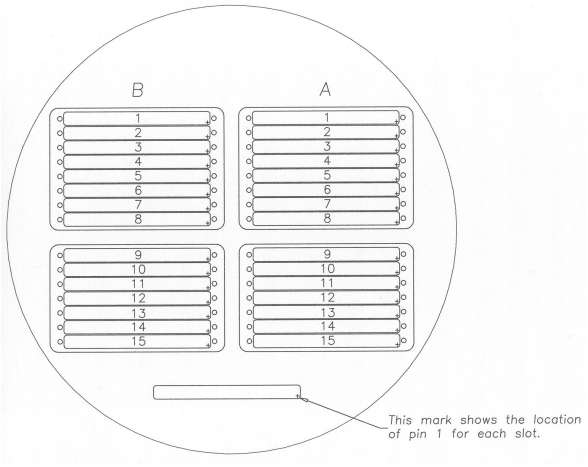
l. There is slot designated for each Pigtail. These slots are labeled A1 to A15 and B1 to B15. A form sheet for this assembly will have the map of where each Pigtail cable is to be positioned. When a Pigtail Cable is placed in one of these slots initial the box next to the serial number on the Pigtail Assembly form sheet. A drawing of the orientation of the flange and slots is shown below.

m. Rotate the assembly jig to the horizontal position.

n. Place bubble wrap on the con-flat flange edge to protect the pigtails.

o. The outer edges of the ATI connectors to be placed in the outside pincarrier slots (1, 7 or 8, and 15) must be filed in order that they fit properly.

Back of assembly jig here



Cold Flange viewed from LAR (funnel) side

Note: For proper orientation of the Cold Signal Flange when inserting the Pigtails the weld lip on the Cold Signal Flange must be facing down towards the floor.

p. After each pigtail has been installed, a second person must check the installation to ensure that the serial number of the pigtail is in the slot designated on the form sheet.

q. After each pair of pigtails has been installed (e.g. 1A and 1B) use the appropriately marked pigtail jumper to connect the two pigtails together. For **Standard** and **FCAL** feedthroughs, use either jumper set **A** or jumper set **B** to jumper the pigtails together, always using the appropriately numbered jumper for the corresponding numbered pigtails. If using jumper set **A**(**B**), match the **A**(**B**) label of the jumper to the pigtail of slot **A**(**B**). For **HEC** feedthroughs, use the following jumpers:

slot	jumper
1	12B
2	13B
3	14B
4	15B
5-13	plastic jumper
14-15	Plastic ‘self’ jumper

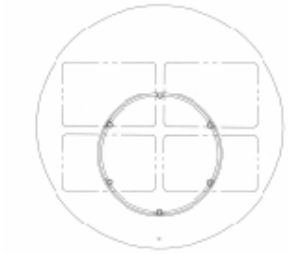
For the **T49**, **T50**, and **T51 HEC** signal cables, use the plastic jumpers to connect each block of the pigtail in slot **A** with the corresponding block of the pigtail in slot **B**. For the **HEC LV** cables, use a plastic “self jumper” to each block of the pigtail.

For **Special** feedthroughs, use the following jumpers:

slot	jumper
1	1A
2	8B
3	8A
4	9A
5	2A
6	3A
7	4A
8	5A
9	10A
10	11A
11	12A
12	6A
13	13A
14	9B
15	10B

r. Test for continuity with the Cirris tester. For **T47** and **T48** pigtails, use wirelist **ASS.WIR** with test leads **MD3209/01** to connect the **J1/J2** port with the **A** side and **MD3209/02** to connect the **J3/J4** with the **B** side. The **HEC LV** lines are tested singly, not in pairs, with the **J1/J2** Cirris port. Use the appropriate wirelist **ASS-T49.WIR**, **ASS-T50.WIR**, **ASS-T51.WIR**, **ASS-T52.WIR**, or **ASS-LV.WIR** for pigtails which are not **T47** or **T48**.) **Ensure that the assembly jig is grounded!** The data collected with this Cirris test need not be saved since another Cirris test will be performed before the feedthrough is welded. Note that ASS.WIR performs a 100 Volt HiPot test with 0.1 second soak time and 0.1 second dwell time.

s. After all pigtails have been checked by a second person, carefully lower the Cold Flange with Pigtails into the Funnel Assembly. The final position of the assembly should look like the drawing below.



Cold Flange viewed from LAR (funnel) side; 7-row pincarriers are at the bottom (front), 8-row pincarriers are at the top (back).

t. Rotate the assembly jig back to the vertical position.

u. Remove the scissor jack from the assembly jig.

v. Check for ground shorts with the multimeter once the pincarriers on the bellows side of the cold flange have been uncovered. Use the probe with the custom blunt probe for these checks.

3. Database Entry

a. Record the information from the form sheet into the database.
   Hepserv/home/atlas/ feedthrough database/ Secure atlas feedthrough DB.mdb
   - click on feedthroughs
   - click add
   - create new feedthrough
   - enter all the available data for the feedthrough such as pigtails, cold flange and the funnel assembly.

b. Record the name of the person and the date the date the information was recorded into the database, on the form sheet.

c. Check to make sure that the gap between the funnel and cold flange is 1.7mm. Check this off on the form sheet.

ATLAS Endcap Signal Feedthrough Project Revsion 010615

Pre Pigtail Cable Assembly Checklist

(initial each entry)

Jig pin rotated to left side (as viewed from front) of jig _____

Funnel offset toward front of jig _____

Ferrite tests done for ***lower funnel tube to funnel base*** weld _____

7-row pincarriers over funnel offset _____

Atlas Endcap Signal Feedthrough Project

Revision #: 010724

Pigtail Assembly

Cold Flange Serial # _____ Funnel Assembly Serial #: _____

Date Installed (ddmmyy)_____ Funnel Assembly UT #:

Slot #	Pigtail Serial Number	Type Of Pigtail	Installer Initails	Checked By Initails	Grnd Shorts
Slot A1					
Slot A2					
Slot A3					
Slot A4					
Slot A5					
Slot A6					
Slot A7					
Slot A8					
Slot A9					
Slot A10					
Slot A11					
Slot A12					
Slot A13					
Slot A14					
Slot A15					
Slot B1					
Slot B2					
Slot B3					
Slot B4					
Slot B5					
Slot B6					
Slot B7					
Slot B8					
Slot B9					
Slot B10					
Slot B11					
Slot B12					
Slot B13					
Slot B14					
Slot B15					

Mapped By: _____

Has the Flange been correctly seated? (approx. 1.7mm) ☐

Recorded In Database By: _____ Date Recorded (ddmmyy) _____

Comments: _____

Pass / Fail

Chapter 17
Vacuum Cable Assembly

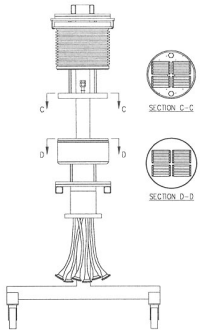
1. Detail Drawing

PDE-0216D (Vacuum Cable Installation)
Drawings can be found at http://wwwlhc01.cern.ch/cdd/

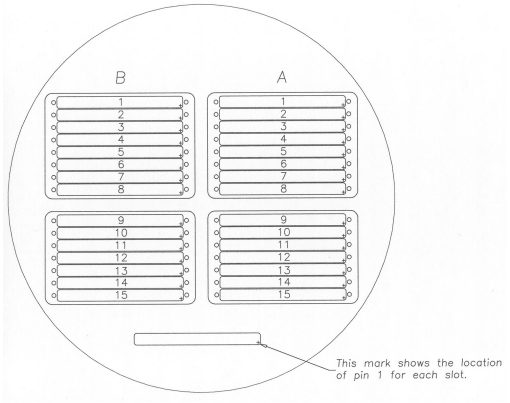
2. Assembly Procedures

Before assembly, 30 Vacuum Cables, one Pigtail Assembly, Ambient Flange Assembly, and one Bellows Assembly will be selected, making sure that they have passed all tests performed on them. Before a component is used in the assembly the form sheet for each component in the assembly must be completed and each form sheet must have PASS circled at the bottom, and also check the database to see that the cable has passed. Below is a list of assembly procedures and drawings of the installation.

a. Record the Cold Flange, Ambient Flange, and Bellows serial numbers on the vacuum cable assembly form sheet, as well as the date of installation.
b. Install the four M12 ready Rods.
c. Clean the weld lips of the bellows and flanges with ethanol.
d. Using the four hooks at the top of the assembly jig raise the Bellows Assembly over the Ambient Flange Assembly securing it in place with the four hooks (See Drawing Below).

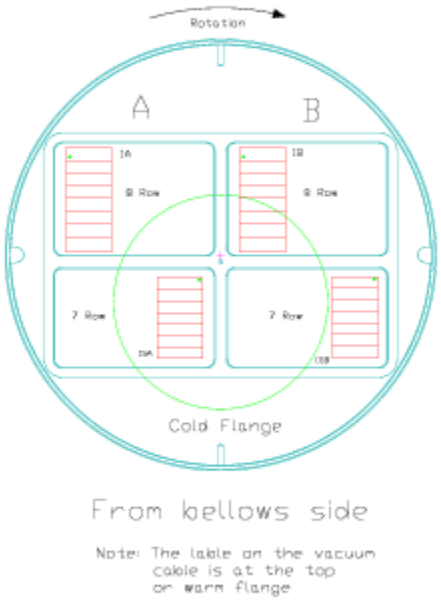


e. Using the 4-12mm ready rods secure the Ambient Flange Assembly. If the Ambient Flange assembly is oriented properly the weld lip for the Pin Carriers will be facing the Funnel Assembly. Also, the 7 & 8-row Pin Carriers will be directly above the 7 & 8-row Pin Carriers in the Cold Flange Assembly, (See Drawing Below).
f. The pincarriers should be vacuumed before installation of the vacuum cables.
g. Plastic washers must be placed on each jackscrew of the vacuum cables to prevent the vacuum cable ground shield from bottoming out.
h. During installation, the vacuum cables should not be bottomed out until an entire pincarrier is filled
i. There is slot designated for each Vacuum Cable. These slots are labeled A1 to A15 and B1 to B15. A form sheet for this assembly will have the map of where each vacuum cable is to be positioned. When a Vacuum Cable is placed in one of these slots initial the box next to the serial number on the Vacuum Cable Assembly form sheet. A drawing of the orientation of the ambient flange and slots, viewed from the bellows side, is shown below.



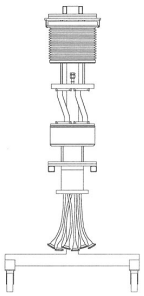
Ambient Flange viewed from the bellows side

j. Note that the orientation of the vacuum cables is reversed when inserting into the 7-row pincarriers (slots 9 – 15). See the figure below for the proper orientation, where the stripline is represented in red. The correct orientation for the HEC LV vacuum cables is defined such that: 1) the end of the cable where the Axon serial number label appears on the same side as the ATI pin 1 mark is at the bottom (i.e., the cold flange end), and 2) the ATI pin 1 mark at the cold flange end is mated to ATLAS pin 63 of the LV slot in the cold flange.



k. After each vacuum cable is installed, a second person must check the installation to ensure that the serial number of the Vacuum Cable is in the slot designated on the form sheet and that the pin one of the vacuum cable is in the proper location. The person doing the check should then initial the form sheet.

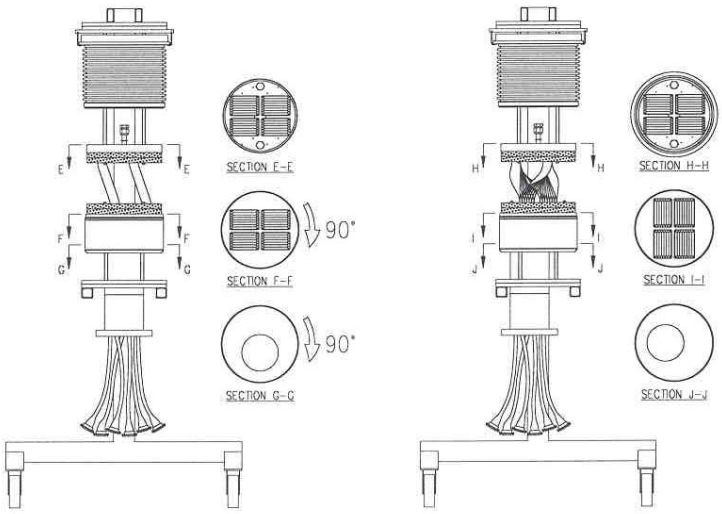
a. Also after each pair of vacuum cables is installed, the continuity should be checked with the Cirris tester (**ASS.WIR** with 100 Volt HiPot test) using the procedures outlined in the *Pigtail Assembly* chapter above. (Use the appropriate wirelist **ASS-T49.WIR**, **ASS-T50.WIR**, **ASS-T51.WIR**, **ASS-T52.WIR**, or **ASS-LV.WIR** for pigtails which are not **T47** or **T48**. The **HEC LV** lines are tested singly, not in pairs, with the **J1/J2** Cirris port.) **Ensure that the assembly jig is grounded!** No data need be saved for these checks. Checks for ground shorts should also be done with the multimeter as each vacuum cable is plugged in. Use the probe with the custom blunt probe for these checks.



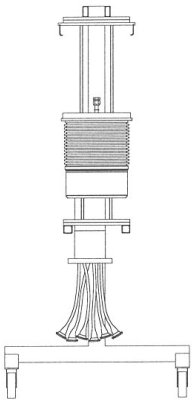
l. Install rohacell

1. Collect and clean or vacuum all of the items required for the rohacell installation.
   (2) 19mm spacer plates – (one with 19mm holes, one without)
   (2) 25mm comb plates – (one with 19mm holes, one without)
   (4) Pieces 11.5mm x 104mm x 19mm thick
   (2) Aluminized mylar sheets. (one with 19mm holes, one without)
   (8) M5 x 70 studs, (16) M5 nuts, (8) type LL M5 washers
2. Cut the 25mm plates in half with the band saw and vacuum any rohacell dust
3. For the cold flange, get a 19 mm spacer plate and a 25mm comb plate (without the 19mm holes). Place the spacer plate (both halves) on the flange.
   Place the two 11.5mm x 104mm x 19mm pieces between the pin carriers.
   With the help of the comb guide, insert the comb plate one half at a time. Place the side with the dimples toward the flange. Thread in the four M5 x 70 studs.
   With scissors cut one of the aluminized mylar sheets (without 19mm holes) in four places and install it on top of the rohacell comb. Note that two of the rectangular pockets are for the 7-row cables and the other two are for the 8-row cables.
   Install four type LL M5 washers.
   Use a locked double nut to tighten the studs into the cold flange.
   Unlock the nuts and snug them finger tight against the rohacell and mylar sheet, if required use a wrench to snug the nuts. Re-lock the M5 Nuts.
4. This procedure is repeated for the warm flange except the rohacell and aluminized mylar must have 19mm holes at the pumping ports. For this flange it is easier to put the 25mm comb plates on first and then install the spacer plates.
5. Check to make sure the pumping ports are clear for both the rohacell and the mylar (the mylar sheets for the ambient flange have holes cut out for this) and initial this in the ***pre bellows drop*** section of the **Post Vacuum Assembly Checklist**.
6. Check that the vacuum cables are in the correct configuration (i.e., check that the vacuum cables for rows 9-15 are correctly rotated relative to those for rows 1-8; compare with the canonical drawings in the maroon binder) and that all eight nuts and bolts for the rohacell and mylar are in place and tight. Initial these checks in the ***pre bellows drop*** section of the **Post Vacuum Assembly Checklist**.
7. Vacuum all rohacell dust from inside the bellows.

m. After all the Vacuum Cables have been checked by a second person the lower half of the assembly (cold flange,pigtails & funnel) is rotated clockwise by 90°. Have a second person check for the correct rotation and initial the check in the ***pre bellows drop*** section of the **Post Vacuum Assembly Checklist**.



n. After the Assembly has been rotated the Bellows Assembly can be lowered into to position to prepare for the electrical testing & welding. Check for the correct alignment of the seal ring with the alignment jig and also check that the cold flange has been correctly seated with the 1.7 mm gap. Initial these checks in the ***post bellows drop*** section of the **Post Vacuum Cable Assembly Checklist**.



3. Cirris Pre Weld Electrical Tests

b. Mount a 2x32 pin connector to each of the **J1/J2** and **J3/J4** Cirris ports.
c. Load the wire list **ASS.WIR**, with 100 Volt HiPot test, on the Cirris Cable Tester**.** (Use the appropriate wirelist **ASS-T49.WIR**, **ASS-T50.WIR**, **ASS-T51.WIR**, **ASS-T52.WIR**, or **ASS-LV.WIR** for pigtails which are not **T47** or **T48**.)
d. Ensure that the Cirris tester is in **single test** mode (Test Control / single test).
e. Ensure that the assembly jig is grounded!
f. Insert a blank floppy disk into the floppy drive of the Cirris tester.
g. Press **Test Cable** on the Cirris tester.
h. Note that each pair of pigtails must be jumpered before these tests are done. Record in the **Feedthroughs** logbook which set of jumpers (**A** or **B**) is used for the test, and ensure that the jumpers are correctly matched to the pigtails, e.g., use jumper (**A** or **B**) **1** to connect pigtails **1A** and **1B**.
i. The warm flange slots should be tested in order **A/B1** ⇒ **A/B15**.
j. For each slot to be tested:
k. Use the 1.2-meter test harness **MD3209/01** to connect the **J1/J2** Cirris port to the **A** slot to be tested of the Feedthrough warm flange. The test harness is marked with a **C** on the ATI connector to be attached to the Cirris tester, and with a **WF** on the ATI connector to be attached to the warm flange. These marks also designate the pin 1 positions of the Cirris tester and warm flange. Use test harness **MD3209/02** to connect the **J3/J4** Cirris port to the corresponding **B** slot. (The **HEC LV** lines are tested singly, not in pairs, with the **J1/J2** Cirris port.)
l. Press **START TEST** to test the cable.
m. Detach the test harnesses from the warm flange and proceed with the next pair of slots.
n. Note that the jackscrews on the test harness should be lubricated every 5 - 10 plugins to prevent gauling.

o. In the event a cable must be re-tested, make a note in the **Feedthroughs** logbook of the sequence number of the repeated test.
p. When all 15 slot pairs have been tested, press **CANCEL** and observe the green light on the floppy disk drive to ensure that the data is being written to the floppy disk.
q. Enter into the **Feedthroughs** logbook the time and date of the test session.
r. Following the instructions analogous to those given in the Cirris Pigtail Data Instructions process the collected data saved on the floppy disk. The data will be saved in the directory \Strange\Data\ElectricalTests\pro\dat\assembly\Cirris\ftxx, where ftxx is the serial number of the feedthrough being tested.
s. Note that if a pigtail jumper is subsequently removed and reinstalled before the feedthrough is cold tested, the Cirris tests should be repeated to ensure that the jumper was reinstalled correctly.

4. Database Entry

a. Record the information from the form sheet into the database.
b. Record the name of the person and the date the information was recorded into the database, on the form sheet.

Atlas Endcap Signal Feedthrough Project

Revision #: 010524

Vacuum Cable Assembly

FT #:

Cold Flange Serial # _____ Warm Flange Serial # _____

Bellows Serial# _____ Date Cables Installed (ddmmyy) _____

Slot #	CableDesigantion						Serial Number	Spacer	Installer Initails	Checked By Initails
Slot A1	Signal		Power		Calibration					
Slot A2	Signal		Power		Calibration					
Slot A3	Signal		Power		Calibration					
Slot A4	Signal		Power		Calibration					
Slot A5	Signal		Power		Calibration					
Slot A6	Signal		Power		Calibration					
Slot A7	Signal		Power		Calibration					
Slot A8	Signal		Power		Calibration					
Slot A9	Signal		Power		Calibration					
Slot A10	Signal		Power		Calibration					
Slot A11	Signal		Power		Calibration					
Slot A12	Signal		Power		Calibration					
Slot A13	Signal		Power		Calibration					
Slot A14	Signal		Power		Calibration					
Slot A15	Signal		Power		Calibration					
Slot B1	Signal		Power		Calibration					
Slot B2	Signal		Power		Calibration					
Slot B3	Signal		Power		Calibration					
Slot B4	Signal		Power		Calibration					
Slot B5	Signal		Power		Calibration					
Slot B6	Signal		Power		Calibration					
Slot B7	Signal		Power		Calibration					
Slot B8	Signal		Power		Calibration					
Slot B9	Signal		Power		Calibration					
Slot B10	Signal		Power		Calibration					
Slot B11	Signal		Power		Calibration					
Slot B12	Signal		Power		Calibration					
Slot B13	Signal		Power		Calibration					
Slot B14	Signal		Power		Calibration					
Slot B15	Signal		Power		Calibration					

Mapped By: Jackscrews tight:

Pre-Weld Warm Continuity Test

Tested By: ____ Date Tested:(dd/mm/yr) _____ Data Dir: _____ Grounded: ☐

Recorded In Database By: _____ Date Recorded (ddmmyy) _____

Comments: _____

Pass / Fail

ATLAS Endcap Signal Feedthrough Project Revsion 010704

Post Vacuum Cable Assembly Checklist

pre bellows drop: *(initial each entry)*

Pumping ports clear, including both mylar and rohacell _____

Correct configuration and alignment for vacuum cables _____

All eight nuts and bolts in place and tightened _____

Cold Box rotated clockwise as viewed from bellows side _____

post bellows drop: *(initial each entry)*

Correct alignment of seal ring; slot on seal ring must line up with alignment jig _____

Cold flange correctly seated (1.7 mm) _____

Multi-meter ground short check: _____

Chapter 18
Final Assembly - Welding

Note: This procedure is a continuation of the "Feedthrough Assembly" procedure. All of the Feedthrough components should already be assembled in the Assembly jig and ready for welding. Gloves must be worn at all times when handling the Feedthrough.

1. Prep
   a. Clean all weld areas with ethanol.

2. Welding
   a. Specific Mechanical will be doing all of the welds on the Feedthrough.
   b. There are three different welds to done to complete the Final Assembly of the Feedthrough.
      i. Upper Tube to Cold Signal Flange
      ii. Cuff Ring to Cold Signal Flange
      iii. Seal Ring to Ambient Signal Flange
   c. For specific information on the welds being done refer to the "University of Victoria TRIUMF Hadronic End Cap Signal Feedthroughs Welding Plan". The welding plan has all the information in great detail about each type of weld that will be done on the Feedthrough.

3. Form and Database Entry
   a. Record on the "Final Assembly – Welding" form sheet the Feedthrough serial number, the Cold Flange serial number, the Bellows serial number, the Ambient Flange serial number and the Funnel Assembly serial Number. The serial number for each Feedthrough is to be increased by one.
   b. Enter the name of the person who recorded the above information, on the form sheet.
   c. Enter the name of the welder that did the Upper Tube to Cold Signal Flange weld and the date it was welded on, on the form sheet.
   d. Enter the name of the welder that did the Cuff Ring to Cold Signal Flange weld and the date it was welded on, on the form sheet.
   e. Enter the name of the welder that did the Seal Ring to Ambient Signal Flange weld and the date it was welded on, on the form sheet.
   f. Repeat steps "a" through "e" to record the above information in the Atlas Secure Database
   g. Record the name of the person and the date the information was recorded in the database, on the form sheet.
   h. The Feedthrough is now ready for the Ambient Leak tests, refer to the procedure labeled "Final Assembly – Ambient Leak Test".

Atlas Endcap Signal Feedthrough Project

Revision #: 020110

Final Assembly (Welding)

Component Serial Numbers

Feedthrough Serial # _____

Cold Flange _____ Bellows (Seal Ring #) _____

Ambient Flange _____ Funnel Assembly (Funnel Base #) _____

Funnel Assembly (UT #) _____

Recorded By _____

Welding

Upper Tube to Cold Signal Flange

Welded By: _____ Date Welded _____

Cuff Ring to Cold Signal Flange

Welded By: _____ Date Welded _____

Seal Ring to Ambient Signal Flange

Welded By: _____ Date Welded _____

Cleaned By: _____

Recorded By: _____

Dye Penetrant Tests completed ☐ Pass ☐ Fail Date: _____

Ferrite Measurements Tests (Should be approx 6.5)

Lower Funnel Tube to Funnel Base	_____	Date: _____
Upper Funnel Tube to Funnel Base	_____	Date: _____
Upper Funnel Tube to Cold Flange	_____	Date: _____
Upper Funnel Tube Butt Weld	_____	Date: _____

Recorded in Database By: _____

Date Recorded (ddmmyy) _____

Comments _____

PASS / FAIL

Chapter 19

Ambient Leak Test Outside the Leak Test Station

Note: Gloves must be worn at all times when handling the Feedthrough and Pigtails.

1. Turn on the Leak Checker

a. The Leak checker must be on for a minimum of 30 minutes for it to be properly warmed up

2. Remove the Feedthrough from the Assembly Jig

a. Place the old cradle on the table under the collapsible crane
b. Wheel the assembly jig over so that it is under the collapsible crane
c. Rotate the assembly jig to the horizontal position
d. Maneuver the assembly jig so that the Feedthrough is over the cradle
e. Lower Feedthrough onto cradle 1
f. Remove the M12 ready rods from the warm flange
g. Remove the M8 bolts from the funnel base
h. Remove the pigtail bag and protector bucket from the Feedthrough
i. Carefully pass the lower funnel tube & pigtails through the assembly jig
j. Move the assembly jig clear of the Feedthrough
k. Install the four bellows support bars
l. Install The hoist Brackets To The Bellows Supports

3. Place Feedthrough on one of the modern cradles

a. Place a modern cradle (Type 2) onto one of the Triumf Carts
b. Using the Collapsible crane, hook onto the rotating sling
c. Use the crane to pick up and lower feedthrough onto the cradle
d. Remove the hoist brackets from the bellows support brackets on the Feedthrough
e. Wheel the Feedthrough over to the left-hand side of the Cold Test Station next to the electronics rack.

4. Connect up Feedthrough to the Leak Test Station

a. Connect up the 420mm long conflat to VCR adapter to the test port at valve B.
b. Slowly move the Feedthrough so that the VCR gland on the Feedthrough is in line with the VCR adapter. Be careful not to bang the VCR gland against the VCR adapter.
c. Connect the VCR gland on the Feedthrough up to the VCR adapter. Use the black Neoprene with a hole in the centre for sealing.
d. Use the rubber plugs to seal the remaining three open VCR gland openings on the Feedthrough.

5. Rough out the Bellows on the Feedthrough and prepare the Leak Checker

a. Make sure the following valves are closed:
    - N Bellows Roughing Valve
    - Q Insulating Vacuum Valve
    - R Funnel Roughing Valve
    - A Roughing Vent Valve
    - X Calibrated Leak Valve
    - D Leak Checker Valve
    - E 3-Position Valve
b. Open the following valves:
    - B VCR Test Valve
    - P Roughing Pump Valve
    - C Roughing Valve
c. Turn on the 303 Vacuum Process Controller
d. Turn on the DVP 500 Roughing Pump
e. It may take over night to rough out the Bellows.
f. When the vacuum inside the bellows reaches approximately $2.0E^{-1}$, close valve;
    - C Roughing Valve
g. Push the “START/STOP” Button on the Leak Checker
h. When the Leak Checker reaches $5.0E^{-1}$ open valve:

D Leak Checker Valve

i. When the base rate of the Leak Checker bottoms out, hold down the zero button on the Leak Checker for about 4 seconds until the zero has been turned off.

6. Leak test the Ambient Signal Flange to Bellows

a. Before testing, enter the base rate of the Leak Checker on to the form sheet under the Ambient Signal Flange to Bellows column.
b. Turn on the helium and run the wand around the weld connecting the Ambient Signal Flange to the bellows. Record the leak rate on the form sheet under the Ambient Signal Flange to bellows column. Subtract the base rate from the leak rate and enter the actual leak rate on the form sheet.
c. Enter the date the testing was preformed and the person who preformed the tests on the form sheet.

7. Leak test the Cold Signal Flange to Bellows

a. Before testing, enter the base rate on the Leak Checker on to the form sheet under the Cold Signal Flange to Bellows column.
b. Turn on the helium and run the wand around the weld connecting the Cold Signal Flange to the bellows. Record the leak rate on the form sheet under the Cold Signal Flange to bellows column. Subtract the base rate from the leak rate and enter the actual leak rate on the form sheet.
c. Enter the date the testing was preformed and the person who preformed the tests on the form sheet.
d. There is an option to spray He into the cold funnel to test the cold flange pin carriers at this point.
e. If an entire flange including all pin carriers together leaks at or above $1x10^{-9}$ mbar-l/s then it has failed.

8. Shut off equipment and update the database

a. Close valve:
   D Leak Checker Valve
b. Turn on the DVP500 Roughing Pump and pump until vacuum reaches approximately E^{-1}
c. Open valve:
   C Roughing Valve
d. Turn off the DVP500 Roughing Pump
e. Open valve:
   A Roughing Vent Valve
f. Push the “START/STOP” button on the Leak Checker to vent.
g. Turn off the Leak Checker
h. Turn off the 303 Vacuum Process Controller

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Ambient Leak Tests Outside CTS

Feedthrough Serial # _____

Base Rate If Zeroed _____

Ambient Signal Flange to Bellows
Base Rate (No He) _____
Leak Rate (He) _____
Actual Leak Rate _____
Date Tested _____ Initial _____

Cold Signal Flange to Bellows
Base Rate (No He) _____
Leak Rate (He) _____
Actual Leak Rate _____
Date Tested _____ Initial _____

Leak Test of Pin Carriers in Cold Flange
Base Rate (No He) _____
Leak Rate (He) _____
Actual Leak Rate _____
Date Tested _____ Initial _____

Recorded in Database By: _____
Date Recorded (ddmmyy) _____

Comments _____

Pass / Fail

Chapter 20

Insertion of A Feedthrough into the Cold Test Station

Note: Gloves must be worn at all times when handling the Feedthrough and Pigtails.

1. ***Prepare the Feedthrough for the insertion into the vacuum station***
   a. Bundle the pigtails as required. Note that the pigtail jumpers should already be installed at this point.
   b. Wrap each bundle with a green plastic bag.
   c. Attach a 1 meter long nylon cord to each of the four groups of pigtails
   d. Place the pigtail protector bucket back onto the feedthrough
   e. Install The Rotating Sling Brackets To The Bellows Supports
   f. Using the Collapsible crane hook onto the rotating sling
   g. Use the crane to pick up and lower feedthrough onto the trolley
   h. Disconnect the rotating sling from the feedthrough
   i. Remove the rotating sling brackets from the bellows support brackets on the Feedthrough
   j. Wheel the Feedthrough over to the cold test station

2. Insert the Feedthrough into the vacuum station
   a. Turn on the Scientific Instruments Temperature Indicator Model 9300 located in the electronics rack beside the cold test station.
   b. Check to make sure all diodes are connected and working properly
   c. Fix or replace any diodes that are not working
   d. Remove the pigtail protector bucket from the feedthrough
   e. Install the lifting connector in the groove of the CF flange - long side towards back
   f. Clean the CF flange on the feedthrough with ethanol
   g. Place a cooper gasket on the CF flange
   h. Lower the winch through the cold test station and attach to lifting connector
   i. Feed the pigtail cables up through the vacuum station
   j. Tighten winch to take the slack out of the hoist rope
   k. Cover the two Ln2 tubes at the top of the cold test station to protect pigtails
   l. Clean the o-ring surface on the bottom of the cold test station
   m. Remove the four bellows support bars, ensuring the winch is supporting the Feedthrough
   n. Clean the o-ring groove on the seal ring using ethanol
   o. Clean the o-ring for the seal ring, using ethanol, and place it in the groove
   p. Install copper belt onto the lower funnel tube, using the alignment guide, vacuum grease and large hose clamp to tighten
   q. Slowly begin raising the Feedthrough
   r. Use the 1 m long strings to help pass the pigtails through the main chamber of the vacuum station
   s. Watch the pigtails closely at this stage because the pigtails can easily get snagged or hung up on something
   t. Just before the cold flange goes through the bottom of the Cold Test Station insert diode B at the back and Diode D at the front of the cold flange
   u. Secure the diodes in place by tying them down with fishing line
   v. Check to make sure that the diodes are reading correctly
   w. If the diodes are not reading correctly:
      i. lower the feedthrough and fix the diode(s)
      ii. return to step 3 line n
   x. Pull the pigtails one group at a time through the CF Flange on the vacuum station
   y. Guide the Feedthrough into the cold test station – watch that the diodes don't get pinched or damaged going through the bottom of the vacuum station
   z. When the Feedthrough reaches the top check its rotation and insert 20 M8 Bolts into the special CF Flange, the proper rotation is when the funnel is offset to the back of the feedthrough.

3. The final touches

a. Insert The Bolt Ring and 16 M8x50 Bolts
b. Remove the lifting connector from the special CF Flange
c. Install the M10 Bolt into the copper belt
d. Close the Copper Band Access Port with the CF Blank
e. Remove the LN2 covers
f. Install the LN2 fill tube into the funnel ensuring diode "C" is securely attached
g. Install the LN2 vent tube (points up)
h. Install the LN2 level
i. Install the Pin Carrier diode (Diode A)
j. Vacuum out any Rohacell dust from upper chamber
k. Remove the green plastic bags.
l. Remove the four 1m long nylon cords
m. Install the inner part of the pigtail bucket and insulation
n. Coil the pigtails into the inner bucket
o. Clean the groove and o-ring that seal the pigtail bucket and then install the o-ring
p. Install the outer pigtail bucket with the 10 M8 bolts
q. Connect the VCR Tee to the Cold Test Station. Make sure the rubber seals have **HOLES** in them!
r. Install rubber bungs into the remaining open VCR Tee's (3)
s. The Installation is complete: Make sure to record the date and feedthrough number in the Feedthroughs logbook.
t. Proceed to the procedure, “Ambient Leak Test of A Feedthrough in the Cold Test Station”.
u. **Check the pins on warm flange for ground shorts and check that the conflat flange on the funnel doesn’t leak before cooling!**

Chapter 22

Cool Down of A Feedthrough in Cold Test Station

Note: This procedure is a continuation of the Ambient Leak Test of a Feedthrough in the Cold Test Station. The cool down procedure should not be done before the ambient leak test. This procedure assumes that the ambient tests have been completed, the turbo pump is still running, the temperature indicators are still on and all valves have not been touched since the Ambient Leak Test. The vacuum inside the insulating chamber and the inner bellows chamber should be at approximately $5.0E^{-5}$.

1. Order Liquid Nitrogen

a. The Liquid nitrogen needs to be ordered three days prior to the desired cool down test.
b. To Order the Liquid nitrogen:
   i. Call the Liquid Nitrogen supplier. The supplier is:
      Airgas Canada Inc.
      1-931 Ellery St
      Victoria BC
      Ph#: 383-2442
   ii. The standing Purchase Order number is: ***S0000965***
   iii. This standing purchase Order Expires: 31 March 2002
   iv. Request a low pressure dewar

Day 1 (Afternoon)

2. Open Temp monitor Vi

a. Log on to the computer named "WINO"
b. Start the LabVIEW program by double clicking on the LabVIEW shortcut on the desktop.
c. A LabVIEW msgbox will appear on the screen. Click on the button labeled "Open VI"
d. Locate and open the VI program located in the following directory:
   Network Neighborhood \ Hepserv \ LabVIEW \ Cold Test Station \ Temp monitor.vi
e. The LabVIEW vi will now load. In the comment box of the LabVIEW window, enter the all the appropriate information pertaining to this test such as: current date, the Feedthrough number, the diodes being used to run this test (A-D) and their positions. The diode positions should be:
   Diode A = Center of Cold Flange
   Diode B = Back of Cold Flange
   Diode C = Bottom of Nitrogen Flow tube
   Diode D = Front of Cold Flange
f. In the box labeled "Number of Plots" enter the number 4
g. In the box labeled "Delay" enter 1 minute
h. Press the white arrow on the menu bar to run the Vi
i. A msgbox window will appear asking you where to save the data. Save the data in the following directory:
   D:\ users \ Cold Tests \ Data Files Cold Test Station
   Enter the filename as dd/mm/yy – corresponding to the date of the test. Hit the save button. This will start lab view.

3. Turn on the cold head

a. Turn on the cold head by flipping the green switch on the front of the compressor. This switch turns on both the compressor and expander.
b. Make sure that there is water flowing out of the compressor into the drain
c. If no water is flowing, turn off compressor and refer to the compressor manual to determine problem.
d. The cold head should run through the night.

4. Purge out the Helium from the upper chamber

a. Wheel the dewar next to the Cold Test Vacuum Station
b. Install the ¼" polyflow vent line to the vent line on the Cold Test Station

c. Connect up the dry Nitrogen tank to the helium/nitrogen admittance line using 3/8" polyflow tubing
d. Open the nitrogen valve on the Nitrogen tank
e. Open the following valve:
   V Helium/Nitrogen Purge Valve
f. After 30 seconds close valve:
   V Helium/Nitrogen Purge Valve
g. Open valve:
   S Helium/Nitrogen Admittance valve
   U N2 Vent Valve
h. After 2 minutes close valves:
   U N2 Vent Valve
   S Helium/ Nitrogen Admittance valve

5. Connect up flow gauges to the Cold Test Vacuum Station

a. Connect a 1/4" polyflow tube from the back of the flow gauges to the upper chamber vent.

Day 2 (Morning)

6. Preparations for cool down

a. In LabVIEW change box labeled "Delay" enter 0.5 seconds
b. Turn on the leak checker at lunch time.

7. Add Liquid Nitrogen

a. Connect a hose from the dewar liquid line to the Cold Test Vacuum Station via the LN_2 input line
b. Open the main liquid line valve on the Nitrogen Dewar to full.
c. Open the following valve:
   W Nitrogen Purge Valve
d. Let the line purge out for approximately 30 seconds
e. Close the following valves:
   W Nitrogen Purge Valve
   Y Boil Off Relief Valve
f. Open the following valves:
   T LN2 Admittance valve
   U N2 Vent Valve
g. Watch the temperature sensors to make sure that there is no liquid nitrogen hitting the cold flange.
h. Diode C can be approximately 100 degrees cooler than diodes A, B, and D.
i. Diodes A, B, and D should not have a temperature difference greater than 30.

8. Cooling down the Feedthrough

a. It will take approximately 5 to 6 hours to cool down the feedthrough to 77 degrees Kelvin.
b. To control the rate of cool down, simply adjust the flow rate by turning the knob on the left flow gauge to increase or decrease the amount of liquid nitrogen boil off.
c. When the left flow gauge reaches its maximum flow rate:
   i. Turn the left flow gauge knob down to approximately 40.
   ii. Open the boil off relief valve a small amount to decrease the pressure inside the feedthrough.
      Y Boil Off Relief Valve
   iii. Readjust the flow gauge to achieve the desired cool down rate.
d. Step "c" will have to be repeated several times throughout the cool down.
e. When Diodes A, B and D are at or below 200 Degrees Kevin, turn on the power to the resistors on the warm flange. Set the power to 10 watts.
f. When diodes B and D are at or below 110 degrees Kelvin the boil off relief valve can be fully opened.
   Y Boil Off Relief Valve
g. When the diodes A, B, and D all reach 85 degrees Kelvin close the following valve:
   T LN_2 Admittance Valve
h. Turn the Boil Off Relief Valve so that the handle points toward the 3psi pressure relief valve.
i. The Feedthrough is now ready for the cold leak and pressure tests.

j. Proceed to the next section, “Cold Leak and Pressure tests in the Cold Test Station”.

Chapter 23

Cold Leak and Pressure Tests in the Cold Test Station

Note: This test is done after the feedthrough has been cooled down to 77 degrees Kelvin. This procedure is a continuation of the cool down procedure and assumes that all valves and equipment are in the same state as from the cool down procedure.

Pressure Test

a. Start the lab view program that monitors the cold funnel pressure.
Network Neighborhood / strange / data / mechanical tests / pro / src / LabVIEW / funnel pressure / robinsonhalpern.vi

b. To start the pressure test, close the LN2 inlet and vent valves.
T LN2 Valve
U LN2 Vent Valve

c. As the liquid Nitrogen boils off, the pressure will increase until it reaches the set point of the first pressure relief valve at 2.8 bar absolute or 1.8 bar gauge. After ten minutes close the valve to this relief valve. The pressure will now continue to increase until the set point of 3.5 bar absolute on the second relief valve is reached. The pressure is left at 3.5 bar for 30 minutes.

d. Slowly open a vent valve to vent the N2 gas until the pressure is down to one Atmosphere. The pressure should decrease at the rate of .35 bars per min.

e. Print the plot from labview showing the pressure test cycle.

Cold Leak Test of Funnel Welds and Cold Flange Pin Carriers.

1. Open Leak Checker up to the main line

a. Push the "START/STOP" button on the Leak Checker
b. Close valve:
H Turbo Valve
c. Let the leak checker pump for approximately 3 minutes against the valve:
D Leak Checker Valve
d. Open valve:
D Leak Checker Valve
e. Watch the Pressure gauge and make sure the pressure doesn't increase greater than approximately $5.0E^{-4}$
f. If the pressure increases to greater than $5.0E^{-4}$ then:
i. Close the valve:
D Leak Checker Valve
ii. Open valve:
H Turbo Valve
iii. Repeat steps "b" through "e" several times. If the problem persists, end this procedure and assess the problem.
g. The leak Checker is now open to the insulating chamber and inside the bellows.
h. Hold down the "ZERO" button on the leak checker for approximately 4 seconds until the zero has been turned off.
i. Record in the Feedthrough logbook and the form sheet labeled "Final Assembly (Leak & Pressure Test") the base rate. This number should be in the low E^{-9} mbar l/s

2. Wait for the LN_2 to boil off

a. This procedure cannot continue until all of the Liquid Nitrogen in the Feedthrough has boiled off.
b. Watch both the flow gauge and LabVIEW for indications of warm up.
i. One indication of complete boil off is when the ball on the flow gauge drops to zero
ii. Another indication is when LabVIEW shows diodes A, B and D all beginning to rise
c. While still watching for signs of warm up:
i. Connect up the dry Helium bottle to the Cold Test Station via the helium/Nitrogen admittance port, bypassing the flow gauges.
ii. Turn on the 303 Vacuum Process Controller pressure gauge
iii. Connect the vent 3/8" poly vent line to the vent port on the Cold Test station

d. When both the flow gauge and LabVIEW shows that the Liquid Nitrogen has boiled off, continue to step 3.

3. Pull a vacuum in the upper chamber

a. Turn on the DVP-500 roughing Pump
b. Close the following valves:
   U Vent Valve
   T LN_2 Valve
c. Open the following valves:
   P Roughing Pump Valve
   R Funnel Roughing Valve
d. It will take a few minutes to pump out the upper chamber
e. When the 303 Vacuum Process controller Pressure gauge reads approximately 1 mbar, the upper chamber has been pumped out, close the following valves:
   R Funnel Roughing Valve
   P Roughing Pump Valve

4. Leak test the Feedthrough

a. The rest of this test will require 2 people
b. One person should be constantly watching the Leak Checker for any signs of leaks.
c. The second person will do the purging of lines, opening and closing of valves and any other miscellaneous tasks.
d. Open the valve on the dry helium tank.
e. Open the valve:
   V Helium/Nitrogen Purge Valve
f. Wait for approximately 10 seconds then close the valve:
   V Helium/Nitrogen Purge Valve
g. Open valve:
   S Helium/Nitrogen Admittance valve
h. Once the pressure in the upper chamber reaches 1 bar close valve
   S Helium Gas Admittance Valve
i. Close the valve on the helium tank
j. Hold the pressure in the upper chamber for 2 to 3 minutes
k. Record the leak rate in logbook and on the form sheet labeled “Final Assembly (Leak & Pressure Tests)”.
l. Subtract the base rate from the leak rate and enter the actual leak rate on the form sheet.
m. If there are no leaks then continue to step 6
n. If an entire flange including all pin carriers together leaks at or above $1x10^{-9}$ mbar-l/s then it has failed.

5. Feedthrough Leaks

a. Close the following valves:
b. M Bellows Valve
c. Insulating Vacuum Valve
d. Wait for the base rate on the leak checker to re-stabilize
e. Open valve
f. M Bellows Valve
g. Record the leak rate in logbook.
h. If there is a leak, this means that there is a leak in the welds from the funnel assembly to the cold flange. Make sure to record this information in the logbook
i. Close valve
j. M Bellows Valve
k. Wait for the base rate on the leak checker to re-stabilize
l. Open Valve
m. Insulating Vacuum
n. Record the leak rate in logbook.
o. If there is a leak, this means that there is a leak through the pin carriers. Make sure to record this information in the logbook

6. Purge out the helium from the upper chamber

a. Turn the Helium/Nitrogen admittance port on the Cold test Station from helium to dry Nitrogen
b. Open the valve on the dry Nitrogen tank.
c. Open the valve:
   V Helium/Nitrogen Purge Valve

d. Wait for approximately 10 seconds then close the valve:
   V Helium/Nitrogen Purge Valve
e. Open the following valves:
   U Vent Valve
   S Helium/Nitrogen Admittance valve
f. While the nitrogen gas is purging out the upper chamber (approximately 2 minutes)
   i. Close the following valves
      D Leak Checker Valve
   ii. Open the following valves
      H Turbo Valve
      M Bellows Valve
      O Insulating Vacuum Valve
   iv. Push the vent button on the leak checker
   v. Turn off the leak checker
   vi. Turn off the 303 Vacuum Process Controller pressure gauge

g. When the nitrogen gas has purged the upper chamber for approximately 2 minutes then close valve
   S Helium Gas Admittance Valve

6. Preparation to re-fill the Feedthrough in the Cold Test Station – If Required.

a. Connect a 3/8" polyflow line from the back of the flow gauges to the upper chamber vent.
b. Turn on the Fluke 77 Multimeter - set it to DC Amperage
c. Turn on the PE 1542 DC Power Supply.
d. Close valve:
   Y Boil Off Relief Valve
e. Look at the temperatures of the diodes on the Temperature gauge
   i. If the temperature of diodes A, B and D are 110 Degrees Kelvin or less then go to step 7.
   ii. If the temperature of diodes A, B and D are greater than 110 degrees Kelvin then go to Step 8.

7. If the temperature of diodes A, B and D are 110 Degrees Kelvin or less

a. Open the main liquid line valve on the Nitrogen Dewar to full.
b. Open the valve:
   W Nitrogen Purge Valve
c. Remove the 3/8" polyflow line from the vent port on the Cold Test Station
d. Let the line purge out until liquid nitrogen starts to spit out the purge line
e. Close the valve:
   W Nitrogen Purge Valve
f. Open the following valves:
   T LN2 Admittance valve
   Y Boil Off Relief Valve
g. When the current on the multimeter reaches 6.94mA, close the main liquid line valve on the Nitrogen Dewar
h. Reattach the ¼" Polyflow line from the flow gauges to the vent port on the Cold Test Station
i. Continue to step 9.

8. If the temperature of diodes A, B and D are greater than 110 degrees Kelvin

a. Watch the temperature sensors to make sure that there is no liquid nitrogen hitting the cold flange.
b. Diodes A, B, and D should not have a temperature difference greater than 30.
c. To control the rate of cool down, simply adjust the flow rate by turning the knob on the left flow gauge to increase or decrease the amount of liquid nitrogen boil off.
d. When the left flow gauge reaches its maximum flow rate:
   j. Turn the left flow gauge knob down to approximately 40.
   iv. Open the boil off relief valve a small amount to decrease the pressure inside the feedthrough.
      Y Boil Off Relief Valve
   v. Readjust the flow gauge to achieve the desired cool down rate.
e. When diodes A, B and D are at or below 110 degrees Kelvin the boil off relief valve can be opened full.
   Y Boil Off Relief Valve
f. When the current on the multimeter reaches 6.94mA, close the main liquid line valve on the Nitrogen Dewar

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Cold Leak & Pressure Tests in the Cold Test Station

Feedthrough Serial # _____

Base Rate If Zeroed _____

Cold Signal Flange to Funnel Assembly

Base Rate (No He) _____
Leak Rate (He) _____
Actual Leak Rate _____
Date Tested _____ Initial _____

Leak Test of Pin Carriers in Cold Flange

Base Rate (No He) _____
Leak Rate (He) _____
Actual Leak Rate _____
Date Tested _____ Initial _____

Pressure Test

Pressure _____

Date Tested _____
Tested By _____

Recorded in Database By: _____
Date Recorded (ddmmyy) _____

Comments _____

PASS / FAIL

Chapter 24
Cold Electrical Tests

Note: The Cold Electrical Tests should be done immediately after the Feedthrough in the Cold Test Station has been topped up with Liquid Nitrogen. It takes approximately 5 hours for the Liquid Nitrogen to completely boil off. This should be enough time to complete all of the Cold Electrical Tests.

Extra care should be taken when inserting the connectors into the Pin Carriers to ensure that no pins get damaged.

1. *Cold Cross Talk Tests*

a. Two people should be used for this job, one for attaching the cables, and the other for driving the VI. Approximately two hours should be sufficient to complete the cross talk tests.
b. The Pulser and other electronics should be turned on at least 30 minutes before tests start.
c. Wheel the mobile cross talk station to a point between the computer and the feedthrough, and offset toward the weld station to allow access under the feedthrough.
d. Place the foamy mattress under the feedthrough.
e. Detach the ATI ends of the pigtails from the bottom side of the Pin Carriers of the mobile cross talk station. Pigtail MD2884/001 should still be attached to the Fanout, and pigtail MD2884/003 should be attached to the scanner.
f. Start up the VI by running scopeFO1.bat located in *STRANGE\Data\ElectricalTests\pro\exe\ColdTests\CrossTalk*.
g. Follow the instructions on the pop-up message (after starting the VI) for the correct pulser settings.
h. Use the multi-pin straightener to ensure that all pins are straight before connecting the test harnesses. Use the single-pin straightener to straighten any bent pins.
i. Attach the cable from the Fanout to slot A1, and the cable from the scanner to slot B1. The `pin 1' marks on the ATI connectors go to pins 2 on the Pin Carriers.
j. Ensure that the correct cable type (T47, T48, T49…) is selected in the CrossTalk VI.
k. Click on `SCAN' to start recording data. For ftxx (where ftxx is the Feedthrough serial number) and slots 1, data will be saved in folder *STRANGE\Data\ElectricalTests\pro\dat\ColdTests\CrossTalk\ftxx\slot01*. The directory ftxx will have to be created first by hand. A pop-up message will remind you to switch to the appropriate attenuation on the attenuator box. This will happen again after about one minute.
l. Watch the scope for at least the first few `through' pulses, and also the first few `crosstalk' pulses to ensure the pulses look reasonable.
m. Repeat steps “h” to “k” for slots 2 -> 15.

Note: If any of the tests failed then the nature of the failure and the channels involved should be indicated in the comments section of the *Final Assembly (Cold Electrical Tests)* form sheet. Cross talk for adjacent channels should be < 2%.

If the Feedthrough has passed all the electrical tests then the Pass must be circled on the bottom of the form sheet.

2. *Cold Continuity Tests with Cirris Tester*

a. Note that this test should be performed last to allow the most time for the vacuum cable connectors at the cold flange to cool down.
b. Two people should be used for this job, one for attaching the cables, and the other for driving the Cirris tester. Approximately ten minutes should be sufficient to complete the Cirris tests.
c. Wheel the Cirris tester on its low cart next to the test area, on the side facing the weld station.
d. Place the foamy mattress under the feedthrough.
e. Make sure that the Cirris tester is clear of old unsaved data.
f. Load Wirelist COLD.WIR (Test Setup / Retrieve Wirelist), and ensure that the Cirris tester is set to `single' mode, *not* `continuous' mode. A 100 Volt HiPot test is **not** included here. (Use the appropriate wirelist **COLD-T49.WIR**, **COLD-T50.WIR**, **COLD-T51.WIR**, **COLD-T52.WIR**, or **COLD-LV.WIR** for pigtails which are not **T47** or **T48**.)
g. Use the multi-pin straightener to ensure that all pins are straight before connecting the test harnesses. Use the single-pin straightener to straighten any bent pins.
h. Hang two 1.2 meter test harnesses between the Cirris tester and slots A1 and B1 of the feedthrough, routing the test

harnesses over the horizontal bar of the cold test station for support

i. Connect test harness **MD3209/01** between **J1/J2** of the Cirris tester and slot **A1** of the Warm Flange:
   - The end of the test harness to be attached to the Cirris tester is marked with a `C' on the ATI connector, which also indicates the `pin 1' location. The `pin 1' location on the Cirris tester is marked with a `1'. The end of the test harness to be attached to the Warm Flange is marked with `WF', and the `pin 1'location on the ATI connector is marked with a green dot. The slot A1 and pin 1 locations on the Warm Flange are indicated on the frame of the Cold Test Station, visible while lying under the feedthrough.
   - Use test harness **MD3209/02** to connect **J3/J4** of the Cirris tester with slot **B1** of the Warm Flange, following the same instructions listed above.

j. Test the A1/B1 continuity.
k. Repeat steps “h” -> “j” for slots A2/B2 -> A15/B15.
l. Make sure that a blank disk is in the Cirris tester.
m. Press either HOME or CANCEL and watch that the data gets written to the floppy disk.
n. Save and Process the Cirris data as for the pigtails, but under the ColdTests directory. The directory on NT for ftxx will be Strange\Data\ElectricalTests\pro\dat\ColdTests\Cirris\ftxx.

3. Form and Database Entry

a. Record on the Final Assembly (Cold Electrical Tests) form sheet the person who completed the Cold Continuity Tests and the date the test was done.
b. Record on the from sheet the person who completed the Cold Cross Talk Tests and the date the test was completed
c. Enter in the database all the information that has been recorded on the form sheet.
d. Record on the form sheet the date the information was recorded into the database and the name of the person who recorded it.

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Cold Electrical Tests

Feedthrough Serial # _____

Cold Electrical Tests

Cold Continuity	Tested By: _____	Date: _____	Data Dir: _____
Cold Cross Talk	Tested By: _____	Date: _____	Data Dir: _____

Recorded in Database By: _____

Date Recorded (ddmmyy) _____

Comments _____

PASS / FAIL

Chapter 25

Warm up of A Feedthrough in the Cold Test Station

Note: This procedure is a continuation of the "Cold Leak and Pressure Tests" procedure. All valves, pumps and gauges should be in the same state they were left in from the "Cold Leak and Pressure Tests". It is very important that no air be introduced to the upper chamber anytime during the warm up.

1. ***Ensure that No pressure can build up in the upper chamber and that No air can be introduced to the upper chamber.***
   a. It is important that the following valves are checked to ensure that they are open so that there is no pressure build up in the Feedthrough.
      U Vent valve
      Y Boil Off Relief Valve
   b. The arrow on the handle of the boil off relief valve should be pointing towards the 1 psi Vent Valve
   c. Check to make sure that the following valve is closed:
      T Ln2 Admittance Valve
   d. Remove the 3/8" Polyflow line from the vent port on the Cold Test Station
   e. Plug the vent port on the Cold Test Station with the 3/8" Polyflow plug.

2. ***Turn off the Turbo Pump***
   a. Close Valve:
   b. H Turbo Valve
   c. I Turbo Backing Valve
   d. Push the "STOP" button on the Seiko-Seiko STP Control Unit
   e. It will take approximately 20 minutes for the Turbo Pump to wind down.
   f. Turn off the Tri-Scroll Pump

3. ***Purge out the Insulating Vacuum and inside the Bellows with dry Nitrogen***
   a. Close Valve:
      J Middle Valve
   b. Turn on the DVP-500 Roughing Pump
   c. Open valve:
      P Roughing Pump Valve
   d. Turn on the 303 Vacuum Process Controller Pressure Gauge
   e. When the 303 Vacuum Process controller Pressure gauge reads approximately $3.0E^{-1}$, close the following valve:
      P Roughing Pump Valve
   f. SLOWLY open the following valve:
      N Bellows Roughing Valve
   g. The pressure on the Balzers Pressure Gauge should increase from approximately E^{-8} to E^{-1}mbar.
   h. Open the valve on the dry Nitrogen Tank
   i. Purge N_2 gas for 10 seconds.
   j. SLOWLY open valve:
      A Roughing Vent Valve
   k. After the pressure on the Balzers Pressure Gauge reads 200 mbar close valves:
      A Roughing Vent Valve
      N Bellows Roughing Valve

4. ***Completion of Warm Up***
   a. Decrease the power to resistors on the warm flange to approximately 5 watts to prevent condensation from forming on the pin carriers
   b. In LabVIEW change the box labeled "Delay" to read 5 minutes.
   c. It will take approximately 13 hours for the Feedthrough to completely warm up to 294 degrees Kelvin (room temperature).
   d. It is safe to let the Feedthrough warm up overnight as long as step 1 (one) was followed exactly.
   e. Once all the diodes reach a temperature of 294 degrees Kelvin or higher print the screen on lab view showing the graph of the entire cool down and warm up.
   f. Print out another detailed page of just the cool down
   g. Print out another detailed page of just the warm up

h. Once all the pages have been printed out, staple them together and put them into the blue binder labeled “Pin Carrier and Vacuum Station LabVIEW Printouts”

Chapter 26

Removal of A Feedthrough from the Cold Test Station

Note: gloves must be worn at all times when handling the feedthrough and pigtails. The Feedthrough cannot be removed from the cold test station until the temperatures of all 4 diodes read 294 degrees Kelvin or higher. This procedure requires 3 people.

1. Remove the main components from the Cold Test Station and Feedthrough

a. Disconnect the VCR Tee from the Cold Test Station
b. Place the rubber gaskets in one of the blue storage baskets for future use.
c. Disconnect the power supply from the resistor plate
d. Remove the 10 M8 bolts that hold the outer pigtail bucket and place them into the blue container bucket labeled " Pigtail Bucket Bolts".
e. Remove the outer pigtail bucket
f. Take the o-ring that is in the pigtail bucket o-ring groove and place it in a Ziplock bag labeled "Pigtail Bucket O-Ring"
g. Uncoil the pigtails and support them up with the overhead I-Beam with rope
h. Remove the insulation from the inner part of the pigtail bucket
i. Remove the inner part of the pigtail bucket
j. Remove the pigtail jumpers from the pigtail cables.
k. Place the pigtail jumpers in their green plastic static free bags
l. Place the 3" plastic bags onto every pigtail connector. Secure each bag with a rubber band
m. Remove the Pin Carrier diode (Diode A)
n. Remove the LN_2 level
o. Remove the LN_2 vent tube
p. Remove the LN_2 Fill tubes. Be careful not to damage the diode "C", which is attached to the bottom of the left fill tube
q. Install the LN_2 protective covers
r. Bundle the pigtails into four separate groups with Saran wrap
s. Attach a 1m long string to each bundle
t. Remove the 6" (100mm) CF blank from the Copper Band Access Port that allows access to the copper belt. Place these bolts into the blue container labeled "Copper Band Access Port".
u. Remove the M10 bolt from the copper belt and store it in a Ziplock bag container labeled "Copper Belt" and place this bag in the blue plastic container labeled "Copper Band Access Port".
v. Remove the Bolt Ring, store the bolts in the blue storage container labeled "Bolt Ring Bolts".

2. Remove the Feedthrough from the Cold Test Station

a. Install the lifting connector in the groove of the Special CF flange - long side towards back
b. Connect the lifting connector up to the overhead crane
c. Tighten the winch on the overhead crane to take out the slack in the rope
d. Remove the 20 M8 bolts from the special CF Flange. The Winch may have to be continuously tightened to take the weight off the remaining bolts. Store the bolts in the blue plastic container labeled " Special CF Flange".
e. Using the winch lower the Feedthrough down through the cold test station – watch that the diodes don't get pinched or damaged going through the bottom of the vacuum station
f. Watch the pigtails closely at this stage because the pigtails can easily get snagged or hung up on something
g. Just after the cold flange goes through the bottom of the Cold Test Station remove diode E at the back and Diode D at the front of the cold flange by cutting the fishing line.
h. Place the diodes out of the way so that they won't get in the way or get damaged
i. Use the 1m long string to help pass the pigtails through the main chamber in vacuum station
j. Position the trolley with the big hole in it for the VCR glands underneath the Feedthrough
k. Slowly lower the feedthrough onto the trolley
l. Once the Feedthrough is properly positioned on the trolley keep the tension in the hoist rope tight to prevent the bellows from collapsing.
m. Remove the copper band from the lower funnel tube
n. Clean the lower funnel tube with acetone and ethanol
o. Install the four bellows support bars on the Feedthrough
p. Once the bellows support bars are securely attached to the Feedthrough remove the slack in the hoist rope.

q. Disconnect the lifting connector from the overhead crane
r. Wheel the feedthrough out from underneath the Cold Test Station. Guiding the pigtails out from the Cold Test Station. Take special care with the pigtails, ensuring that they don't get caught or snagged on anything.

3. Clean Up

a. Remove the lifting connector
b. Place the Pigtail protector bucket onto the Feedthrough
c. Install the Rotating Sling brackets to the bellows support bars
d. Take the o-ring out of the out of the seal ring groove and place it in a Ziplock bag labeled "Seal Ring"
e. Remove the copper CF gasket from the special CF flange on the Feedthrough and place it in the cupboard for possible future use
f. Turn off the Scientific Instruments Temperature Indicator

4. Place Feedthrough on one of the modern cradles

a. Wheel the Feedthrough underneath the collapsible crane
b. Place a modern cradle (Type 2) onto one of the Triumf Carts
c. Using the Collapsible crane hook onto the rotating sling
d. Use the crane to pick up and lower feedthrough onto the cradle
e. Disconnect the rotating sling from the feedthrough
f. Remove the rotating sling brackets from the bellows support bars
g. Remove the three black rubber plugs from the VCR glands on the Feedthrough. Store the rubber plugs in the Blue box labeled "VCR Plugs"

Chapter 27
Final Assembly Warm Electrical Tests

The Cross Talk tests can be carried out on either the mobile cross talk station, using the Tek2440 scope, or the fixed cross talk station, using the Lecroy 8818 Transient Recorder. Instructions are given here for the mobile cross talk station. Instructions for the fixed cross talk station are analogous.

1. Cross Talk Tests

a. Log onto the ColdTest station computer (**WINO**) and start the program *Strange\Data\ElectricalTests\pro\exe\FinalTests\CrossTalk\ScopeFO1.bat* (This assumes that the UBC fanout **FO1** is mounted on the mobile cross talk station, rather than **F02** which is nominally at the fixed cross talk station.)
b. In the **VI** window that should now appear, start the **VI** by pressing the **RUN** button (right arrow).
c. Follow the instructions on the popup window to set the properties of the BNC pulser. Note that ***the pulser should be turned on at least 30 minutes before data collection*** to allow it to warm up.
d. **For T47, t48, and t52 cables only** (see below for HEC feedthrough procedures)**:** connect the warm flange slot to be tested to the scanner using the test harness pigtail **MD2884/009.** The pin 1 mark on the ATI connector of the test harness pigtail is marked with a yellow dot.
e. Connect the corresponding pigtail to the fanout.
f. Press **Scan** to start the scanning procedure.
g. In the popup window that now appears, enter the directory name for the data to be stored. A new directory must first be made by hand, using the serial number of the feedthrough as the name of the directory, eg, **ft12**. Make sure that the newly created directory hangs from **FinalTests\Crosstalk**! The subdirectories for the cross talk data collected for this feedthrough will hang below the newly created (e.g. **ft12**) directory. The subdirectory name for the saved cross talk data for each slot should be the slot number being tested, eg, **slot01a**. If a cable is being remeasured for any reason, use **slot01a.1** (or **slot01a.2**... etc). Enter **Save** to proceed.
h. Another popup window now appears instructing you to set the attenuator box (white box with toggle) to **Through Pulses**. Do so, and press **OK** to continue. Be sure to watch the first few pulses on the scope screen to ensure that they appear reasonable.
i. Once the **Through Pulses** are completed (~ 1 minute) another popup window appears instructing you to set the attenuator box to **CrossTalk** Pulses. Do so, and press **OK** again to proceed. As before, watch the first few pulses on the scope screen to ensure that they appear reasonable.
j. After all 64 lines are scanned, proceed with measuring the next slot.
k. Note that the jackscrews of the test harness and the jackscrew sockets of the μ-D connector on the fanout should be lubricated every 5 – 10 plugins to prevent gauling.
l. **Note that the procedure differs for the HEC feedthroughs:**
- For slots 1-4 the procedure is the same as that for the standard feedthroughs.
- For each cable of slots 5-13, jumper each connector block with the corresponding block of the corresponding type of prototype HEC cable, with the ATI end of the HEC prototype cable plugged into a PCT pincarrier. The orientation of the jumpered HEC cables should be as follows:

Use pigtail test harness **MD2884/09** to complete the connection to the **scanner**, with the ATI pin 1 mark of the HEC prototype test harness matched to pin 2 of the pigtail test harness.
- No cross talk is measured for slots 14 and 15.
- The connection between the warm flange and the **fanout** is done with pigtail test harness **MD2884/001.**

m. The cross talk for adjacent channels should be < 1%.

2. Resistance Measurements

Resistance measurements are performed at the **Impedistance** test station.

a. Log onto the computer at the Impedistance test station (**STRANGE**) and start the Impedistance **Vi** at Strange\Data\ElectricalTests\pro\exe\VacuumCables\Impedistance\Impedistance.VI.
b. In the **VI** window that should now appear, start the **VI** by pressing the **RUN** button (right arrow).
c. Turn the power on for the Keithley micro Ohmmeter and **Phred**.
d. Connect the warm flange slot to be tested to **Phred** using the 1.2 meter test harness **MD3209/01**. The ATI

connector to be attached to the warm flange slot of the feedthrough is marked with a **WF**, which also designates the pin 1 position. The ATI connector to be attached to **Phred** is marked with a **P**, and that mark should be placed adjacent to the yellow dot on **Phred**. Connect the corresponding pigtail for that slot to the μ-D socket on **Phred**.

e. A new directory to hold the collected data must be made by hand, using the serial number of the feedthrough as the name of the directory, eg, **ft12**. The files for the resistance data collected for this feedthrough will hang from this directory, eg, *\Strange\Data\ElectricalTests\pro\dat\FinalTests\Phred\ft01\slot01a.dat*.

f. Start scanning the cable by pressing the **Scan** button on the **Phred** area of the **Impedistance VI** screen.

g. After the 64 traces have been scanned, a popup window will prompt you for the filename to be used for the saved data. This should be the slot number being tested, eg, **slot01a.dat**. If a cable is remeasured, use **slot01a.1.dat** (or **slot01a.2.dat**...).

h. Note that the jackscrews of the test harness and the jackscrew sockets of the μ-D connector on **Phred** should be lubricated every 5 – 10 plugins to prevent gauling.

i. After the resistance measurements with **Phred**, manually check all pins for ground shorts using a multimeter and the custom made blunt ended probe. Make a note in the *Comments* section of the *Final Assembly (Final Warm Electrical Tests)* form sheet of any failed channels encountered.

j. Note that the procedure differs for the HEC feedthroughs:

- For slots 1-4 the procedure is the same as that for the standard feedthroughs.
- For each cable of slots 5-13, jumper each connector block with the corresponding block of the T51 (calibration) prototype HEC cable, with the ATI end of the prototype cable plugged into a PCT pincarrier. The orientation of the jumpered HEC cables should be as follows:

Use 1.2 meter test harness **MD3209/05** to complete the connection to the *ground* side of Phred, with the ATI pin 1 mark of the 1.2 meter test harness matched to pin 2 of the T51 prototype cable at the pincarrier end, and the ATI pin 1 mark at the Phred side placed next to the green dot.

- For slots 14 and 15, use the same procedure as for slots 5-13 except that the LV prototype should be used instead of the T51 cable, and the orientation of the jumpered HEC cables should be as shown below. Note that channels 47, 48, 61, and 62 will test open for the tests of slots 14 and 15; this is normal.

- Make the connection between the warm flange and Phred in the usual way with 1.2 meter test harness **MD3209/01**.

k. The resistance data for each channel of the full feedthrough is compared with the known resistances of the previously measured vacuum cables, which dominate both the magnitude and spread of the feedthrough resistance. By this comparison one is able to determine that the correct vacuum cables are indeed in the correct slots and in the correct orientations.

3. Database Entry

a. Record the information from the form sheet into the database.

b. Record the name of the person and the date the information was recorded into the database, on the form sheet.

Atlas Endcap Signal Feedthrough Project

Revision #: 020114

Final Assembly Warm Electrical Tests

Feedthrough Serial # _____

Final Warm Electrical Tests

Precision Resistance	Tested By:	_____	Date Tested:	_____
Cross Talk	Tested By:	_____	Date Tested:	_____

Recorded in Database By: _____

Date Recorded (ddmmyy) _____

Comments _____

PASS / FAIL

Chapter 28
Ambient Flange Heaters

The ambient flange of each Feedthrough must be heated during normal operation of ATLAS to prevent condensation on the flange due to heat leakage through the Feedthrough, mostly by conduction through the vacuum cables. The heaters can also provide emergency heating to the ambient flange in case of catastrophic vacuum failure in the bellows. Under good vacuum conditions, the power required to hold the ambient flange of a Standard, Special, or FCAL Feedthrough at 25°C has been measured to be approximately 16 – 20 Watts. Due to the higher copper cross section of the HEC LV vacuum cables, the power required for HEC Feedthroughs is approximately 8 Watts higher. With the bellows volume held at 1 bar, the power required for Standard, Special, or FCAL Feedthroughs has been measured to be approximately 75 Watts, while at 1.5 bar, the power required is approximately 120 – 150 Watts. The heaters for each Feedthrough will be powered nominally by 50 Watt power supplies (LAL responsibility), with the option of switching to 150 Watt power supplies for exceptional operation.

The End Cap Signal Feedthrough ambient flange heaters are based on a design using six 75 Ω resistors wired in parallel (12.5 Ω equivalent) and arranged on the outside perimeter of an aluminum heater plate. The resistors are Vishay Dale RH-50 wire wound and aluminum housed, each with a power rating of 50 Watts (30 Watts military rating). A pad of Furon ThermaCool C695 thermally conductive graphite tape is placed beneath each resistor to improve heat conduction to the heater plate. A pad of Furon COHRlastic TC-100 thermally conductive silicone rubber sheet (0.025 inches thick) is similarly placed between the heater plate and ambient flange to improve heat conduction to the flange. Each of the resistors is individually fused, so that the failure of any one of the six resistors will not impact the operation of the others. The fuses are Bussmann MCR-2 2 amp PCB. Two Pt100 temperature sensors are located at the center of the heater plate to allow the temperature of the heater to be controlled. The temperature sensors are from Critides Technical Associates, 100 Ω, 4-wire, with 28 AWG kapton wire (DIN 0.00385). The resistor power wires and temperature sensor wires exit the pedestal through a filter box to prevent electronic noise from being introduced into the pedestal volume.

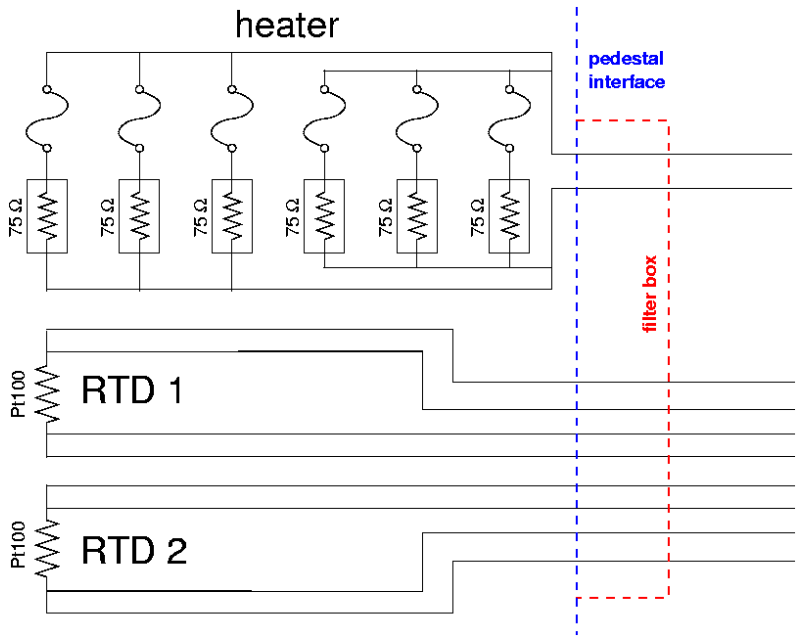


Figure 28a Schematic of the power resistor and temperature sensor wiring of the ambient flange heaters.

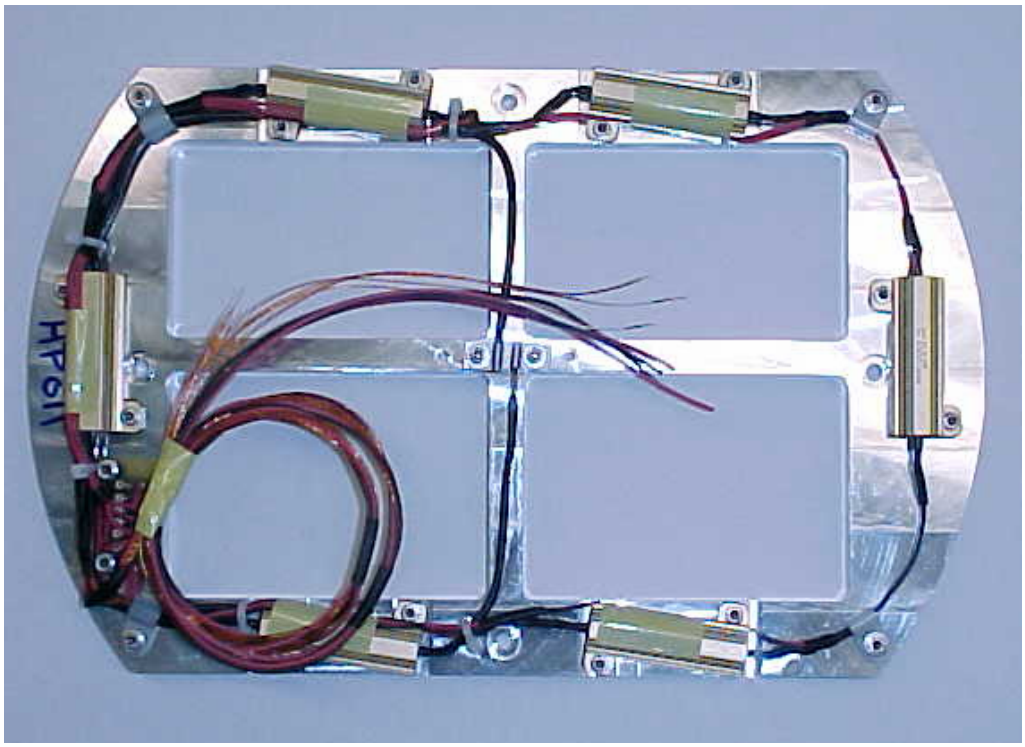


Figure 28b Photograph of an ambient flange heater, before the connectors have been installed on the power or sensor wires.

Chapter 29
Feedthrough Shipment Prep to CERN

Revision #:011009

Note: These Feedthroughs are heavy and are not to be moved by one person – two people minimum.

Feedthrough Serial Number: _____ **FT Type:** _____

Feedthrough Serial Number: _____ **FT Type:** _____

Feedthrough Serial Number: _____ **FT Type:** _____

Feedthrough Serial Number: _____ **FT Type:** _____

Initial Each Following Entry:

Foam has been installed on all Bellows braces for all 4 Feedthroughs _____

Cover plates are covering all Warm Flange Pin Carriers _____

Two screws are used to hold each cover plate in place _____

All documentation is included in FT crate for each FT _____

2 desiccant bags are installed on each FT using paper envelopes _____

Feedthroughs back filled with Nitrogen and sealed _____

15g Shock watch placed on inner crates and triggered _____

25g Shock watch placed on outer crate and triggered _____

Date Shipped From UVIC: _____

Date Received At CERN:_____

Comments: _____

_____

_____

_____

_____

_____

_____

_____

_____

PASS / FAIL

ATLAS Endcap Signal Feedthrough Project FT

ALL FORM SHEETS REQUIRED FOR A COMPLETE FEEDTHROUGH

- **Final Feedthrough Report**

Divider Name: PIN CARRIERS

- **Pin Carrier Form sheets (8)**

Divider Name: MECHANICAL COMPONENTS

- **Cold Signal Flange**

- **Ambient Signal Flange**

Funnel Base
Lower Funnel Tube
Funnel Assembly
Bellows Seal Ring
Bellows Cuff Ring
Bellows Assembly
Modified VCR Gland (position 7)
Modified VCR Gland (position 8)

Divider Name: PIGTAIL / VACUUM CABLES
Pigtail Form Sheets (30)
Vacuum Cable Form sheets (30)

Divider Name: ASSEMBLY / INSTALLATION
Cold Flange Assembly
Ambient Flange Assembly
Pre-Pigtail Cable Assembly Checklist
Pigtail Assembly
Vacuum Cable Assembly

Post Vacuum Cable Assembly Checklist

Final Assembly – Welding
Dye Penetrant Test (located on Final Assembly – Welding)
Final Assembly – Ambient Leak Tests Outside CTS
Final Assembly – Cold Leak and Pressure Tests
Final Assembly (Cold Electrical Tests)
Final Assembly (Final Warm Electrical Tests)
NDE Report
Histograms

Crated on: _____
Shipped on: _____

For CERN copy:

CERN Feedthrough Reception

CERN Reception Leak Tests

CERN Reception Electrical Tests
CERN Post Weld Electrical Tests

Chapter 30
CERN Feedthrough Reception

- Note the date shipped from UVIC and the date received at CERN, and record the dates in the 'CERN Feedthrough Reception' traveler sheet, along with the Feedthrough serial number and type.

- Check the 25g Shock Watch on the outer shipping crate. Check off the appropriate checkbox on the 'CERN Feedthrough Reception' traveler sheet.

- Open the outer shipping crate and check the 15g Shock Watch attached to one of the inner Feedthrough crates. Check off the appropriate checkbox on the 'CERN Feedthrough Reception' traveler sheet.

Atlas Endcap Signal Feedthrough Project

CERN Feedthrough Reception

Revision #:010913

Note: Gloves must be worn at all times when handling the Feedthrough and pigtails. Two people minimum are required when lifting a Feedthrough.

Feedthrough Serial Number: _____ **FT Type:** _____

Date Shipped From UVIC: _____

Date Received At CERN:_____

Shock Watch Condition 15g: Pass / Fail

Shock Watch Condition 25g: Pass / Fail

Copies of Customs papers sent to UVIC: ☐

Receivers Name: _____

Comments: _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

PASS / FAIL

Chapter 31

CERN Feedthrough Reception – Electrical Tests

The procedures used to measure the crosstalk at CERN are, for the most part, the same as those used in Victoria for the Final Electrical Tests. A brief outline of the CERN Reception Crosstalk Tests are listed below:

- The pulse generator must be powered on at least 30 minutes before the start of the tests.

- If a slot requires re-measurement (eg, slot 2a of ft05):
- save (in the Crosstalk VI) the re-measured data as slot2a.1
  - in a Cygwin window:
  - cd /home/uvatlas/atlas/ElectricalTests/pro/dat/ReceptionTests/CrossTalk/ft05
  - mv slot2a slot2a.0
  - ln -s slot2a.1 slot2a

- Run the analysis (on, eg, ft05) in a Cygwin window as follows:
  - cd /home/uvatlas/atlas/ElectricalTests/pro/exe/ReceptionTests/CrossTalk
  - crunch ft05 standard
    (or specify special, fcal, or hec if the feedthrough is not a standard)

- Now check the results of the analysis. The minimum and maximum Crosstalk are listed in rtxmima.dat.ft05. The maximum Crosstalk is typically about 0.5 or 0.6 for Standard, Special, and HEC feedthroughs, or about 0.7 for FCAL feedthroughs, and no crosstalk from adjacent channels should exceed 1%.
  - cd ft05
  - cat rtxmima.dat.ft05

- Check the analysis with PAW (while still in the directory /home/uvatlas/atlas/ElectricalTests/pro/exe/ReceptionTests/CrossTalk/ft05):
  - paw
  - rtxt ft*xx*

Atlas Endcap Signal Feedthrough Project

Revision #: 010913

CERN Reception Electrical Tests

Feedthrough Serial # _____ **FT Type:** _____

Final Warm Electrical Tests

Precision Resistance	Tested By:	_____	Date Tested:	_____
Cross Talk	Tested By:	_____	Date Tested:	_____

Data Sent To Victoria ☐ Date Sent: _____

Comments _____

PASS / FAIL

Atlas Endcap Signal Feedthrough Project

Revision #: 010913

CERN Post Weld Electrical Tests

Feedthrough Serial # _____ **FT Type:** _____

Final Warm Electrical Tests

Precision Resistance	Tested By:	_____	Date Tested:	_____
Cross Talk	Tested By:	_____	Date Tested:	_____

Data Sent To Victoria ☐ Date Sent: _____

Comments _____

PASS / FAIL

Chapter 32

CERN Feedthrough Reception – Leak Tests

PUMPING

1. Place feedthrough on rolling table.
2. Remove the lid of the crate
3. Cut the plastic bag protecting the feedthrough back
4. remove the desiccant form the funnel
5. Remove all the plastic covers from the micro-D's
6. Place a new copper gasket over the pigtails
7. Place the pigtails inside the pumping bucket and bolt the bucket in place
8. Wheel the feedthrough to the pumping station
9. Using the rubber CF Gaskets bolt the feedthrough to the pumping station (Do not tighten the bolts too much as the rubber gasket seals easily)
10. Turn on the pressure gauge that reads the pressure at the Turbo Pump and at the Manifold.
11. Open the valve between the turbo and the roughing pump
12. Open one of the pumping valves to vent the station to atmosphere, then close it
13. Open the turbo valve
14. Make sure that the Gas Ballast valve is closed on the roughing pump
15. Open the valve on the feedthrough being pumped down
16. Close the valve to the leak checker.
17. Turn on the roughing pump
18. When the pressure reaches approximately 1mbar turn the water for the turbo and then the turbo on. (Let the turbo pump overnight)

LEAKCHECKING

1. Turn the leak checker on and allow 10 minutes for internal calibration
2. Press the green cycle button on the leak checker and allow a couple of minutes to pump down
3. Open the valve from the leak checker to the manifold, and allow a couple of minutes for the pressure to stabilize.
4. Close the turbo valve and wait for the leak rate on the leak checker to stabilize, should take 5-10 minutes
5. Zero the leak checker if necessary.
6. Record the zeroed base rate, and the Date in the vacuum test logbook.
7. Turn on the helium in the back room and get a slow steady stream of helium from the helium wand (check the flow by immersing the wand in cup of water).
8. Run the helium over the pincarriers and welds needing testing (they are laid out on the form sheet)
9. A feedthrough will be failed if there is any weld that leaks at a rate greater than 4×10^{-10} mbar-l/s, or if any flange with pincarriers leaks at a rater greater than 1×10^{-9} mbar-l/s.

VENTING TO ATMOSPHERE

1. When testing is finished close the valve to the feedthrough being tested. Remove the feedthrough from the manifold.
2. Close the valve from the Leak checker to the manifold, and vent the leak checker
3. Leaving the water and the roughing pump running; shut the turbo off.
4. When the TMP has spun down (about 30 minutes), shut the valve from the roughing pump to the leak checker and turn the gas ballast valve wide open.
5. Vent the manifold to atmosphere.
6. Let the roughing pump run from 30 minutes to 1 hour, until all the water is gone (the little bubbler dial on the left hand side of the roughing pump should have black liquid in it).
7. Close the gas ballast valve on the roughing pump and turn the roughing pump off
8. Turn the water off for the Turbo Pump.

******The same procedure as above is followed for testing the bellows of the feedthrough, except rubber bungs are placed in the VCR Glands and a O-ring with a hole in the center is used for the pumping port.

******For testing multiple feedthroughs the procedure is the same, remembering to shut the valve to the feedthroughs not being tested. As well before opening the next feedthrough close the one that's finished testing, open the turbo valve and the next feedthrough to be tested (Allow a couple minutes for the pressure to stabilize) and then close the turbo valve again, before testing.

Atlas Endcap Signal Feedthrough Project

Revision #: 010913

CERN Feedthrough Reception Leak Tests

Feedthrough Serial # _____ **FT Type:** _____

Bellows Side Leak Test

Leak Test # 1		**Leak Test # 2**	
Date & Initials:		Date & Initials:	
Base Rate If Zeroed:		Base Rate If Zeroed:	
Base Rate For Test:		Base Rate For Test:	
Welds To Be Leak Tested		**Welds To Be Leak Tested**	
Warm Flange To Seal Ring	☐	Warm Flange To Seal Ring	☐
Seal Ring To Bellows	☐	Seal Ring To Bellows	☐
Bellows Seam	☐	Bellows Seam	☐
Bellows To Cuff Ring	☐	Bellows To Cuff Ring	☐
Cuff Ring To Cold Flange	☐	Cuff Ring To Cold Flange	☐
Warm Flange Pin Carriers Pins & Welds	☐	Warm Flange Pin Carrier Pins & Welds	☐
Cold Flange Pin Carriers	☐	Cold Flange Pin Carriers	☐
VCR Gland 7 Row Side	☐	VCR Gland 7 Row Side	☐
VCR Gland 8 Row Side	☐	VCR Gland 8 Row Side	☐
Leak Rate (He):		Leak Rate (He):	
Actual Leak Rate:		Actual Leak Rate:	

Funnel Side Leak Test

Leak Test # 1		**Leak Test # 2**	
Date & Initials:		Date & Initials:	
Base Rate If Zeroed:		Base Rate If Zeroed:	
Base Rate For Test:		Base Rate For Test:	
Welds To Be Leak Tested		**Welds To Be Leak Tested**	
Upper Funnel To Cold Flange	☐	Upper Funnel To Cold Flange	☐
Upper Funnel Seam	☐	Upper Funnel Seam	☐
Upper Funnel To Funnel Base	☐	Upper Funnel To Funnel Base	☐
Funnel Base To Lower Funnel	☐	Funnel Base To Lower Funnel	☐
Leak Rate (He):		Leak Rate (He):	
Actual Leak Rate:		Actual Leak Rate:	

Data Sent To Victoria: ☐ Date Sent & Initials: _____

Comments: _____

PASS / FAIL

Appendix A

Electrical Testing Equipment

A.1 Precision Resistance

Resistance measurements of each vacuum cable are made using a Keithley model 580 micro-ohmmeter. The micro-ohmmeter is operated in single trigger and pulse mode, with the range set to 20 Ω. A computer controlled switching device is used to scan through all 64 traces of the vacuum cable under test. The switching device has been designed so that the Kelvin points of the four-wire probes are within 1 mm of each end of each signal trace under test, thus ensuring that the lead resistance in each measurement is negligible (< 1 mΩ).
The computer control of the switching device and of the micro-ohmmeter is done with a LabView VI, and all data collected is stored on the computer for later offline analysis. A vacuum cable is failed and will be returned to the supplier if any trace has a resistance that falls out of the range 0.6 Ω < R < 1.2 Ω. Vacuum cables to be used in the EM calibration slots (slots 15 of the Standard feedthroughs and slots 3 and 4 of the HEC feedthroughs) are chosen such that the resistance of all traces of the two (Standard feedthroughs) or four (HEC feedthroughs) vacuum cables of those slots fall within a band of 50 mΩ for each feedthrough. Vacuum cables to be used in the EM calibration slots will also be chosen such that the measured impedance falls at the high end of the acceptable impedance range (see A.3), so that they better match the impedance of the T47 (50 Ω) pigtail cables.
The same apparatus is also used to measure the resistance of each channel of the completed feedthroughs. By comparing with the known resistance of the previously measured vacuum cables, which dominate the resistance and have a larger spread in resistance than the pigtail cables, one is able to verify that the correct vacuum cables are indeed in the feedthrough, and in the correct orientation.

A schematic of the test setup to measure the vacuum cable resistance is shown in figure A1.1.

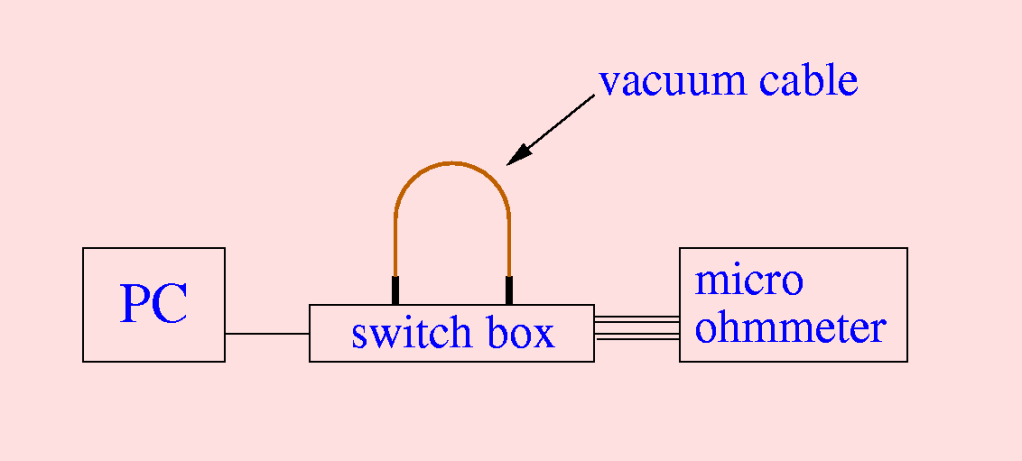


Figure 1.1 Schematic of the test setup to measure the resistance of each signal trace of a vacuum cable.

A photograph of the precision resistance measuring setup is shown below.

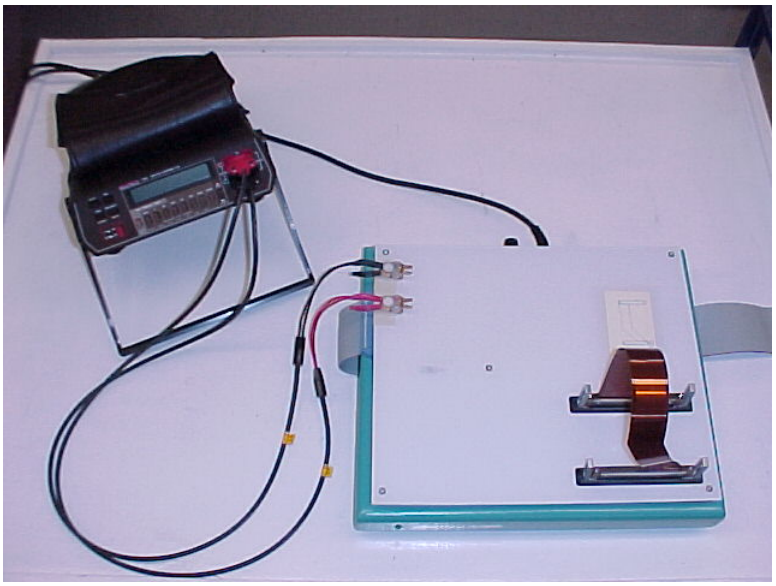


Figure 1.1 Photograph of the test setup to measure the resistance of each signal trace of a vacuum cable.

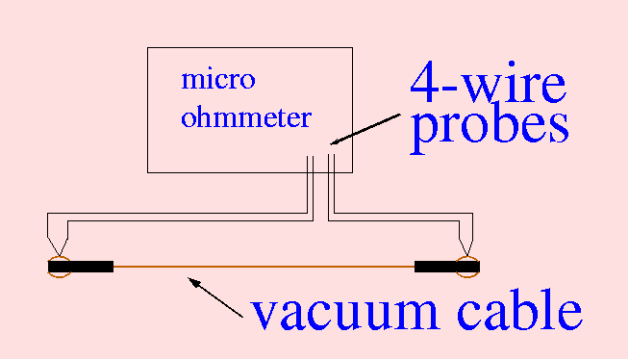
A.2 Ground Contact Resistance

Precision resistance measurements are made in order to verify good contact between the Pin Carrier and the ground spring clips of the vacuum cables, and also between the ground spring clips on one end of the cable with those on the opposite end. This test is designed to detect flat, bent, or otherwise defective spring clips. The test will also detect poor electrical contact between the spring clip and the ground traces of the vacuum cable stripline.

The vacuum cable spring clips are each divided into 13 segments, and so contact the Pin Carrier at 13 different points at each side of each cable connector. A computer controlled measuring device similar to the precision resistance measuring device (appendix A1) is used to scan through each of the 13 contact points, precisely measuring the resistance from a spring clip segment on one end of the cable to the corresponding spring clip segment on the opposite end. The measurement is done for both sides of the cable, for a total of 26 measurements for each cable. Fake Pin Carrier sockets are used to receive each of the two vacuum cable connectors, with gold plated 4-wire Kelvin point contacts to coincide with each of the 13 spring clip segments.

The resistance between spring clips at opposite ends of a cable is typically about 7 mΩ, while the ground contact resistance for each spring clip should be no greater than 1 mΩ. Any cable having an abnormally high resistance (> 20 mΩ) for more than two consecutive spring clip segments or more than three segments in total on one side of the cable will be considered failed and returned to the supplier.

As in the case of the precision resistance measuring device, the ground contact resistance measurements are made with a Keithley model 580 micro-ohmmeter, and the computer control of the switching device and of the micro-ohmmeter is done with a LabView VI. All data collected is stored on the computer for later offline analysis.



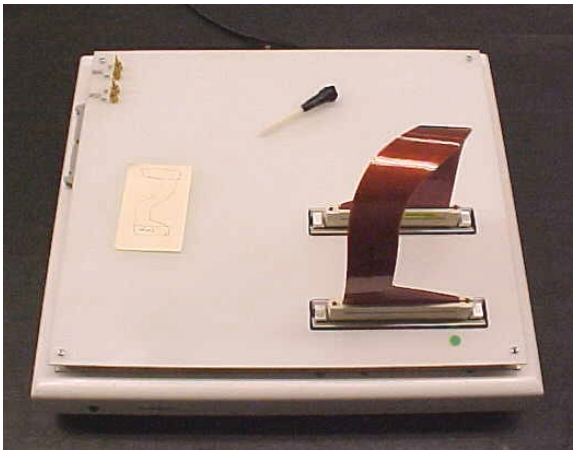


Figure A2.1 A schematic and photo of the test setup to measure the spring clip-to-spring clip resistance.

A.3 Impedance

The impedance of six representative striplines are measured on each vacuum cable using a Hewlett Packard 8753B network analyzer, with a Hewlett Packard 85047A S-Parameter test set operating in the 300 KHz to 3 GHz range. The network analyzer is operated in a time domain low pass step mode, with `minimum' windowing (essentially no windowing) and 801 points (frequency samples). For each vacuum cable, the impedance of three striplines is measured on each of the two flex circuits. The six channels measured for each vacuum cable are 1, 14, 25, 40, 51, and 64. Data acquisition is automated, using a Hewlett Packard 8769K microwave switch with 18 GHz bandwidth to switch among the six striplines, and a LabView VI to control the microwave switch and to store the data collected from each stripline on the computer for later offline analysis. The lines being measured are each terminated with precisely measured 50Ω resistors to help calibrate the system. A vacuum cable is failed and will be returned to the supplier if the average impedance of the three striplines of either flex circuit falls out of the range $28\ \Omega < Z < 38\ \Omega$.

Figure A3 Photograph of the impedance measuring apparatus.

A.4 Cross Talk

Cross talk in all vacuum cables will be measured according to the following procedure:

1) One end (henceforth referred to as the 'input' end, and the opposite end is referred to as the 'output' end) of one stripline is injected with a pulse generated from a BNC Model BL-2, set to `tail pulse' mode, with exponential rise and decay times of 3 ns and 100 ns respectively, and with an amplitude of approximately +1V. A plot of a typical input pulse is shown in figure A4.1.

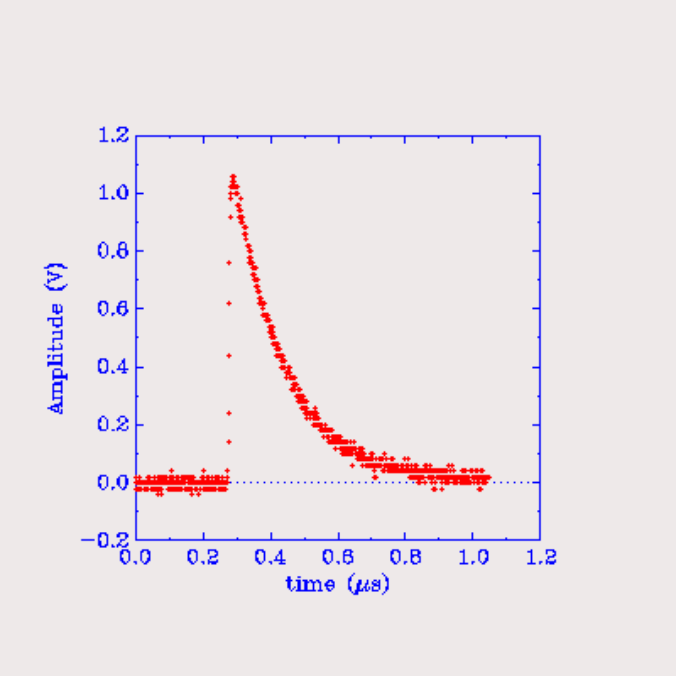


Figure A4.1 A typical pulser signal, with exponential rise time of 3 ns and exponential decay time of 100 ns.

2) The output signals from the output end of the pulsed stripline and of each nearest neighbor of the pulsed stripline are amplified and shaped with a CR-RC2 shaper with a peaking time of 40 ns. `Nearest neighbor' is defined here as the two **adjacent** striplines on the same flex circuit as the pulsed stripline (or one **adjacent** stripline in the cases where the pulsed stripline is at either edge of the flex circuit) and also the stripline immediately across (**opposite**) from the pulsed stripline on the other flex circuit. Plots of typical amplified and shaped signals from a pulsed stripline and a nearest neighbor are shown in figure A4.2.

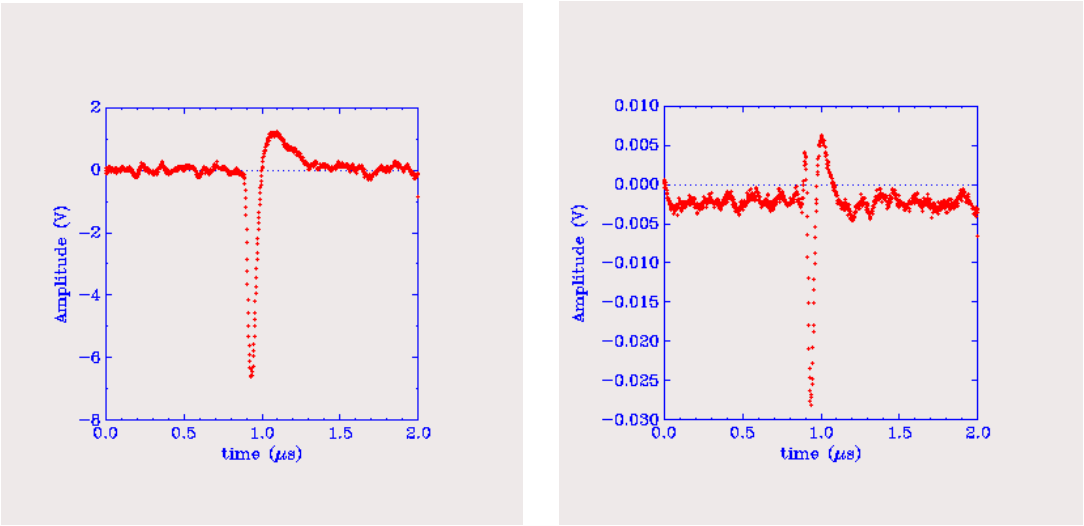


Figure A4.2 A typical shaped and amplified pulse from a pulsed (reference) stripline and a typical shaped and amplified signal from an adjacent (crosstalk) stripline. The ratio of the peak-to-peak crosstalk amplitude to the peak-to-peak reference amplitude is the crosstalk.

3) The ratio of the peak-to-peak amplitude of the amplified and shaped output signal from each nearest neighbor to the peak-to-peak amplitude of the amplified and shaped output signal from the pulsed stripline is then calculated. This ratio is taken as a cross talk measurement, with three measurements for each stripline (or two measurements in the case of an ‘edge’ stripline).
4) These measurements are repeated for each stripline.

For the testing of each cable, a fanout device under computer control is used to select which stripline is pulsed at each step of the test. Likewise, a scanner device under computer control is used to select which stripline is read out. All signal transients measured in the tests are digitized using a Tektronix 2440 digital storage oscilloscope. Interconnections between the fanout and scanner devices and the vacuum cable under test are made with pincarriers of the type used in the ATLAS signal feedthroughs, and ‘pigtails’ consisting of 64 coaxial 50 Ohm lines, also of the type used in the ATLAS signal feedthroughs. The computer control of the fanout and scanner devices and of the Tektronix 2440 oscilloscope is done with a LabView VI, and all data collected is stored on a computer for later offline analysis. A schematic of the test setup is shown in figure A4.3.

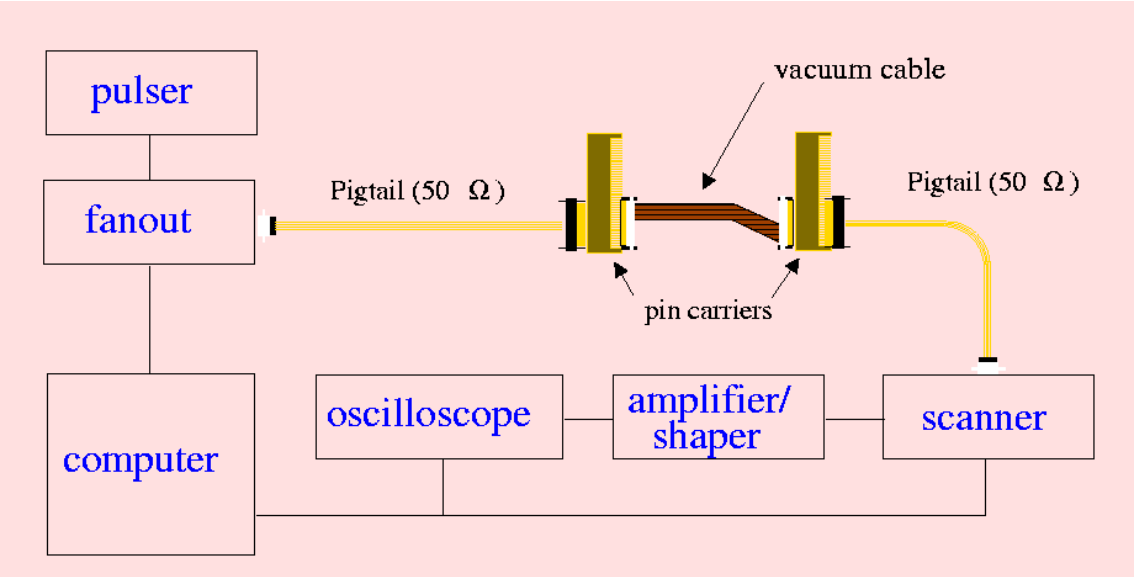
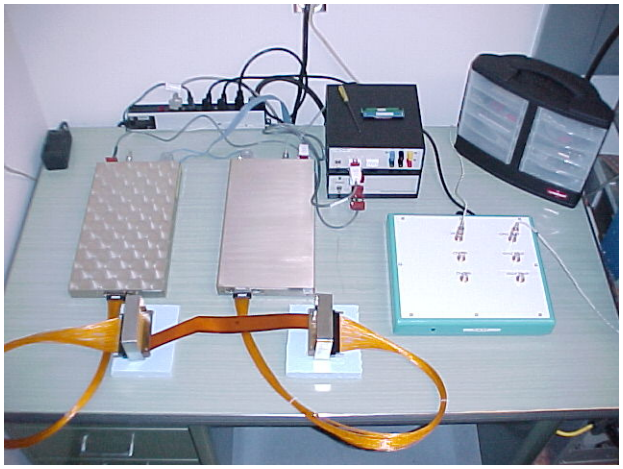


Figure A4.3 A schematic of the test setup to measure cross talk.

A photograph of the cross talk measuring setup is shown below:



The same apparatus is also used to measure the crosstalk from nearest neighbors for the completed feedthroughs, at both ambient temperature and also with the pigtails and cold flange at liquid nitrogen temperature. In the case of the ambient measurements, pulses are inserted at the end of the pigtails, and scanned at the corresponding slot of the ambient flange pincarrier. In the case of the cold measurements, pulses are injected at an 'a' side slot in the ambient flange pincarrier and scanned at the corresponding 'b' side slot in the ambient flange pincarrier. The two pigtails corresponding to the two slots are jumpered together with cables of the same construction as the pigtails.

For the testing of vacuum cables, and for the feedthrough Final Warm Electrical Tests performed in Victoria and the Reception Electrical Tests performed at CERN, the crosstalk measured for **adjacent** neighbors must be < 1%. For the Cold Electrical Tests, where the pigtails are jumpered together and consequently the measured crosstalk is from a combination of two feedthrough channels, the crosstalk for **adjacent** neighbors must be < 2%. Abnormally high crosstalk measured for **adjacent** neighbors can indicate a discontinuous ground trace somewhere in the transmission line. Since the grounds of the two flex circuits of the vacuum cables are not connected, the crosstalk measured for **opposite** neighbors provides no useful information regarding possible discontinuous ground traces. The crosstalk measured for the **opposite** neighbors is dominated by the fact that the signal traces of the vacuum cables of the two flex circuits lie against each other, and can range as high as 2% for the vacuum cable measurements and the Final Warm and Reception Electrical Tests, and even higher for the Cold Electrical Tests. If the two opposite traces of a vacuum cable are shorted together, the crosstalk for those opposite neighbors would be ~100%.

A.5 Continuity

Continuity, insulation resistance, and cross wiring are tested for each vacuum cable and pigtail cable with a Cirris Touch 1 cable tester. The Cirris cable tester is also used to check each slot during the cabling of the feedthroughs, as well as during the Cold Electrical tests. The connection resistance sensitivity of the Cirris Touch 1 is +/- 4% +/- 0.1 Ω, and the insulation resistance sensitivity is 100 KΩ. For the tests during feedthrough cabling, the cable tester also performs a 100 V HIPOT test to ensure there are no shorts or "near" shorts, either to ground or to other channels. Pincarriers are also checked before welding with the Cirris cable tester, with a 1000 V HIPOT test to ensure that there are no bits of conductive debris remaining at the base of the pins. The time required to test one 64-trace cable or pincarrier is approximately two seconds.

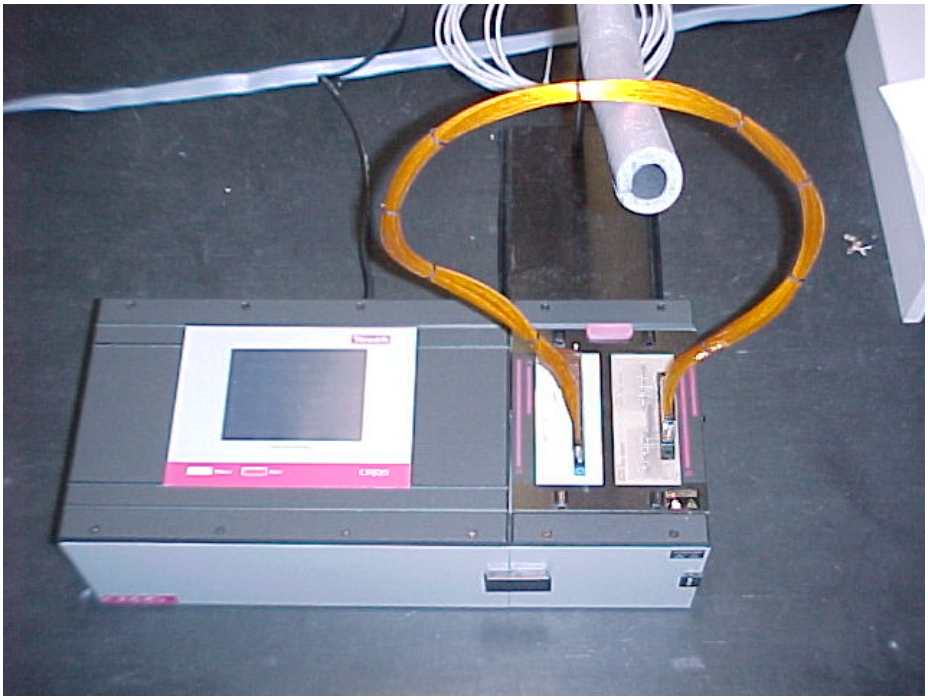


Figure A5.1 Photograph of the Cirris cable tester and a pigtail cable.

Appendix B

Leak Detection

Leak Detection

A vacuum system has been designed specifically for leak testing the components, subassemblies, and final feedthrough assemblies for the Atlas endcap signal feedthrough project. The vacuum is provided primarily by a Seiko-Seiki STP 300 TMP backed by a Varian TriScroll 300 dry scroll pump. Leak detection is accomplished with a Balzers HLT 270 helium leak detector, a fully self-contained instrument with an onboard turbo molecular pump and diaphragm roughing pump. The smallest detectable leak for the HLT 270 is 5×10^{-12} mbar-l/s for helium, although in practice with the background rate from the vacuum test system, the smallest detectable leak for a component, subassembly, or final feedthrough attached to the vacuum test system is 4×10^{-10} mbar-l/s.

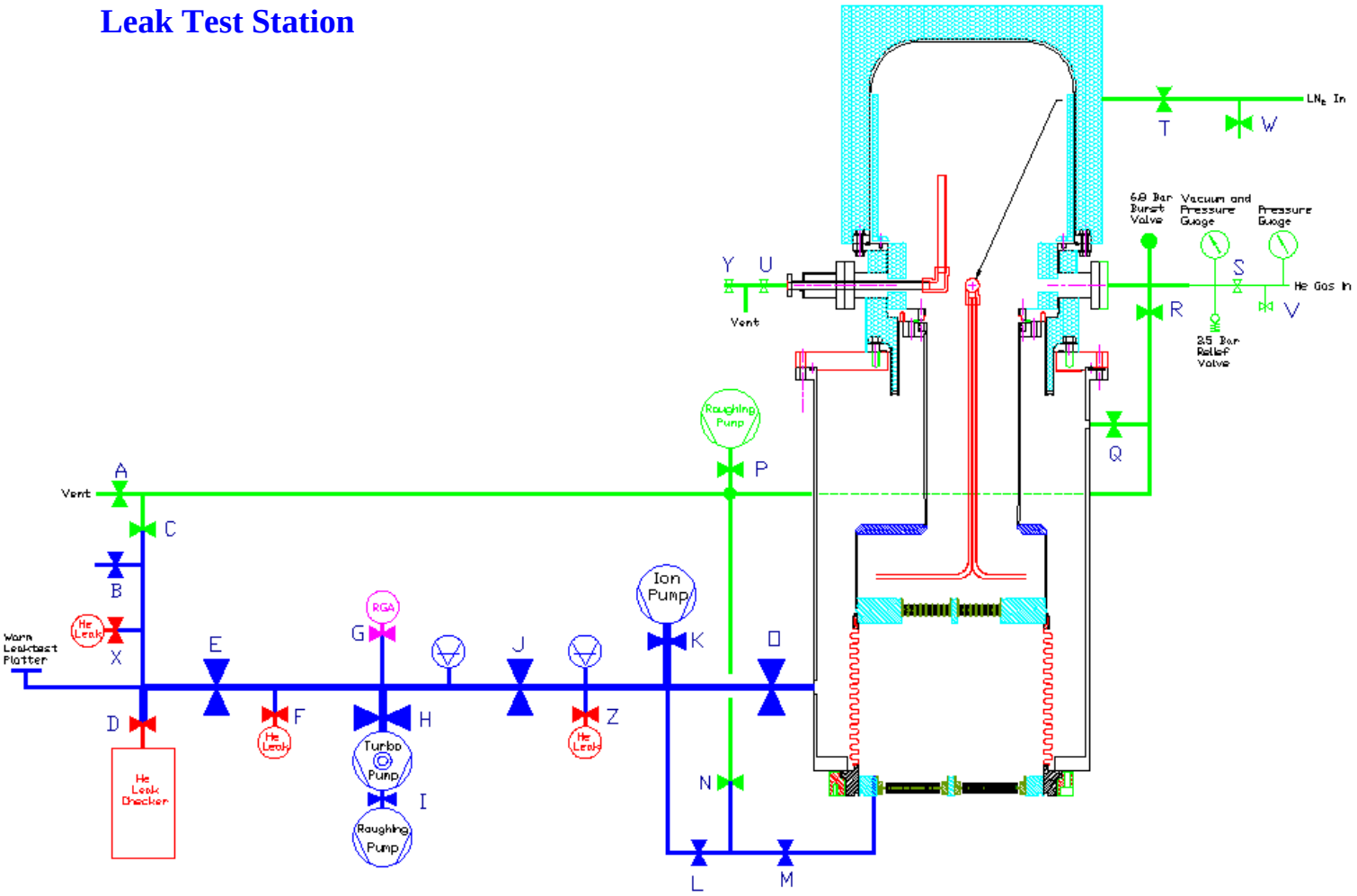
A Balzers QMS 200 quadruple mass spectrometer is also incorporated into the vacuum system and available for leak detection. The QMS 200 has a mass range of 200AMU, with a detection limit of $< 1 \times 10^{-11}$ mbar operated in Faraday mode, and $< 1 \times 10^{-14}$ mbar operated in multiplier mode.

Further instrumentation includes two Balzers PKR 260 full-range pressure gauges.

Cryogenic temperatures can also be achieved in the vacuum system with refrigeration provided by an APD Cryogenics DE-102 expander and HC-2 compressor, together with LN2 introduced from an external source. This allows leak testing of the feedthrough assemblies under the same cryogenic conditions that will be encountered when installed in the ATLAS detector.

A schematic of the vacuum system is shown in figure B1

Leak Test Station

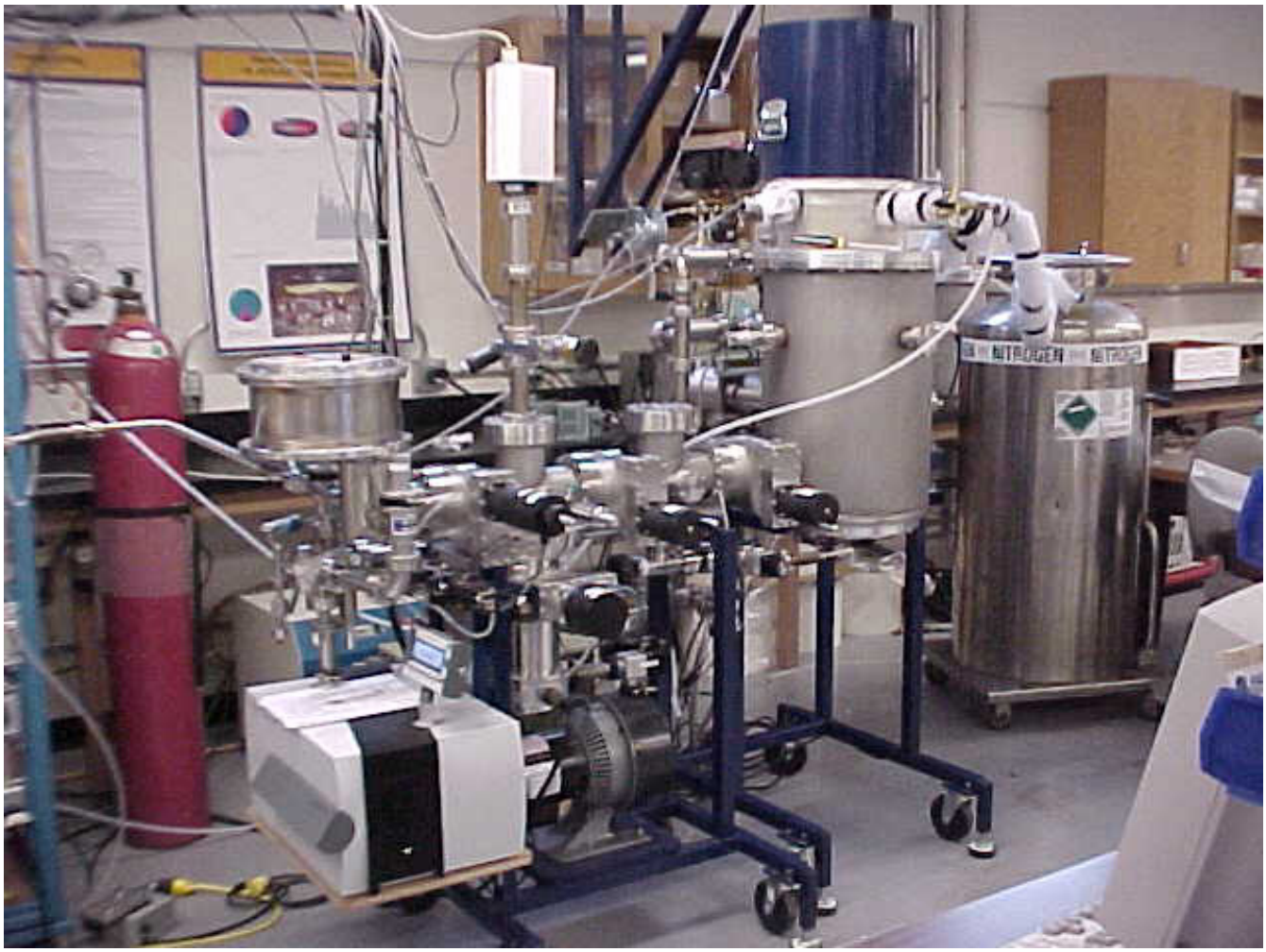


Leak Test Station Valve List			
A	Roughing Vent Valve	**N**	Bellows Roughing Valve
B	VCR Test Valve	**O**	Cold Test Station
C	Roughing Valve	**P**	Roughing Pump Valve
E	Leak Checker Valve	**Q**	Insulation Roughing Valve
E	3-Position Valve	**R**	Funnel Roughing Valve
F	Calibrated Leak Valve	**S**	Helium/Nitrogen Admittance Valve
G	RGA Valve	**T**	LN2 Admittance Valve
H	Turbo Valve	**U**	Vent Valve
I	Turbo Backing Valve	**V**	Helium/Nitrogen Purge Valve
J	Middle Valve	**W**	Liquid Nitrogen Purge Valve
K	Ion Pump Valve	**X**	Calibrated Leak Valve
L	Metal Seal Valve	**Y**	Boil Off relief Valve
M	Bellows Valve	**Z**	Calibrated Leak Valve

Figure B1 – Leak Test Station Schematic

Appendix B – Leak Detection

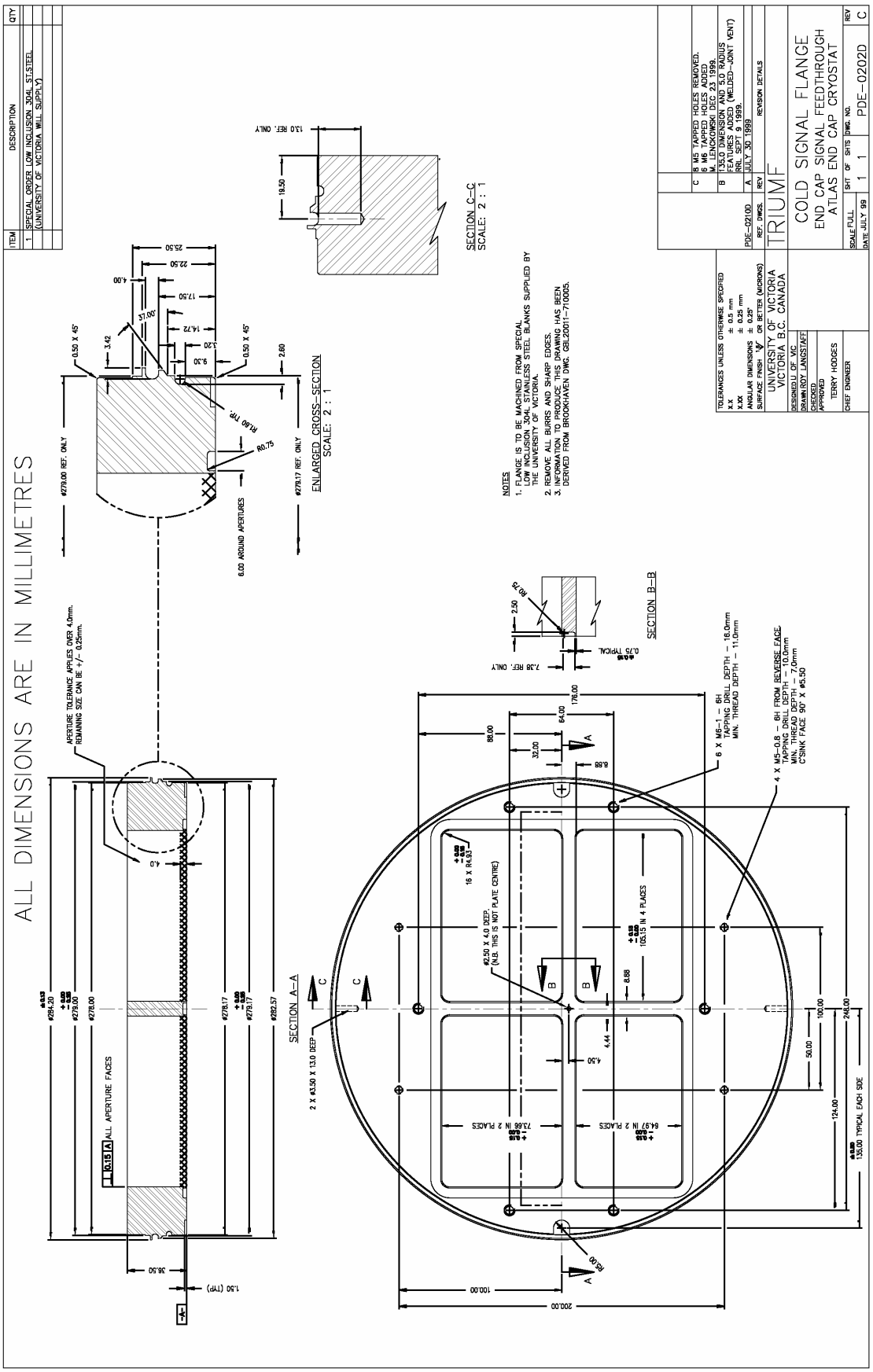
A photograph of the Actual Leak Test Station is shown below:



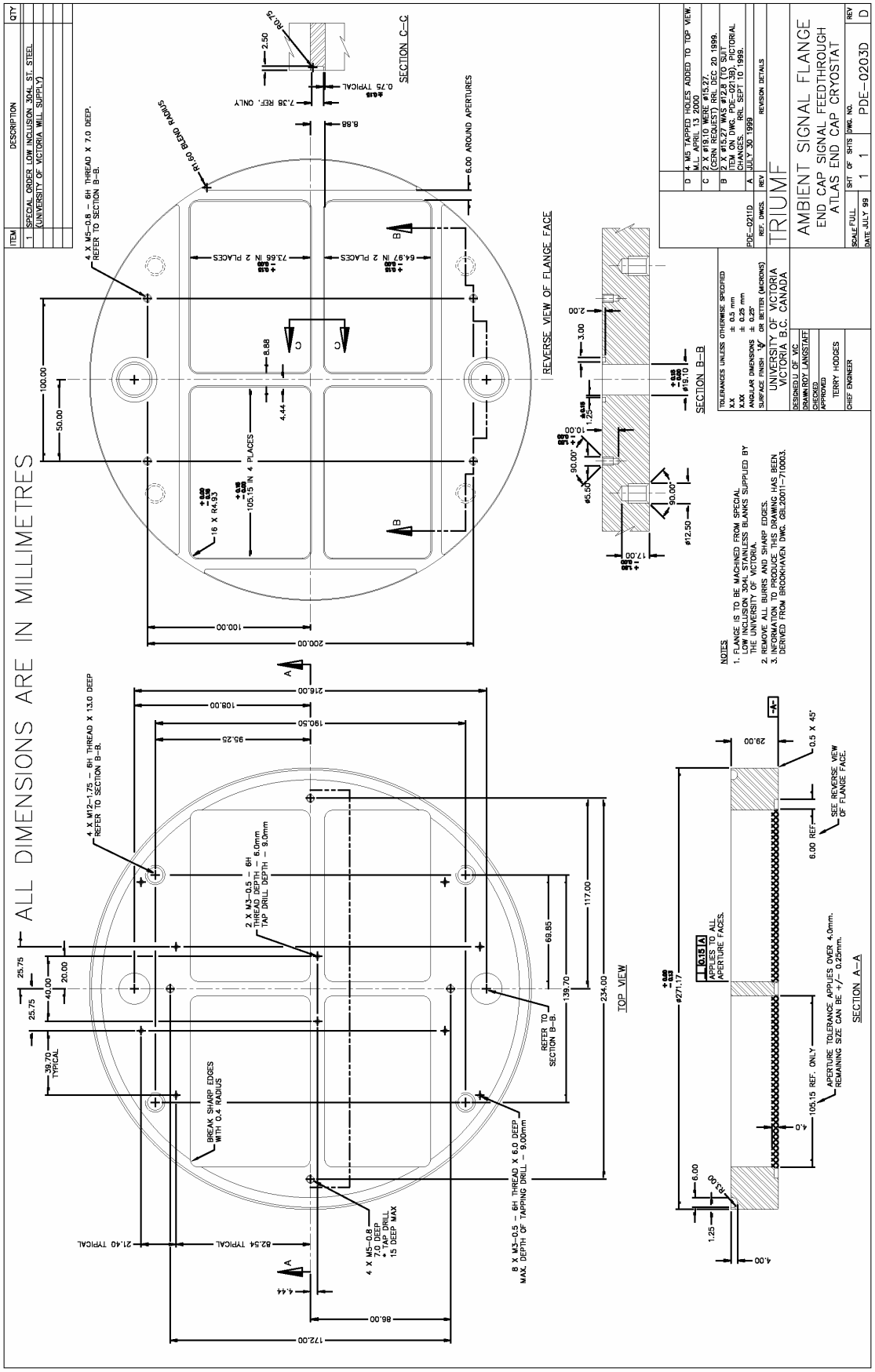
Appendix C

AutoCAD Drawings

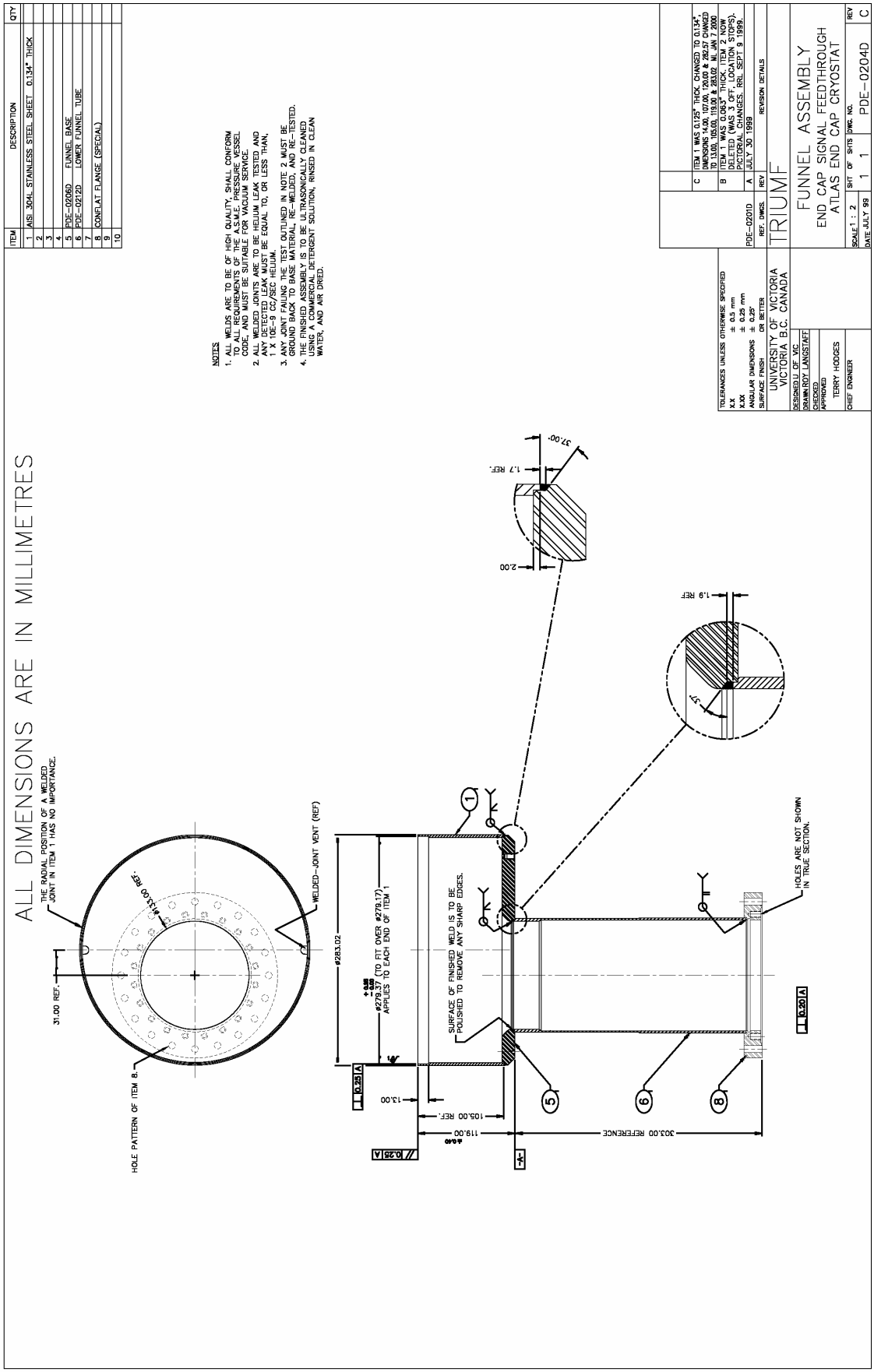
End CAP Feedthrough – Cold Signal Flange Drawing # PDE-0202D Atlas # **ATLAEFS_0001**



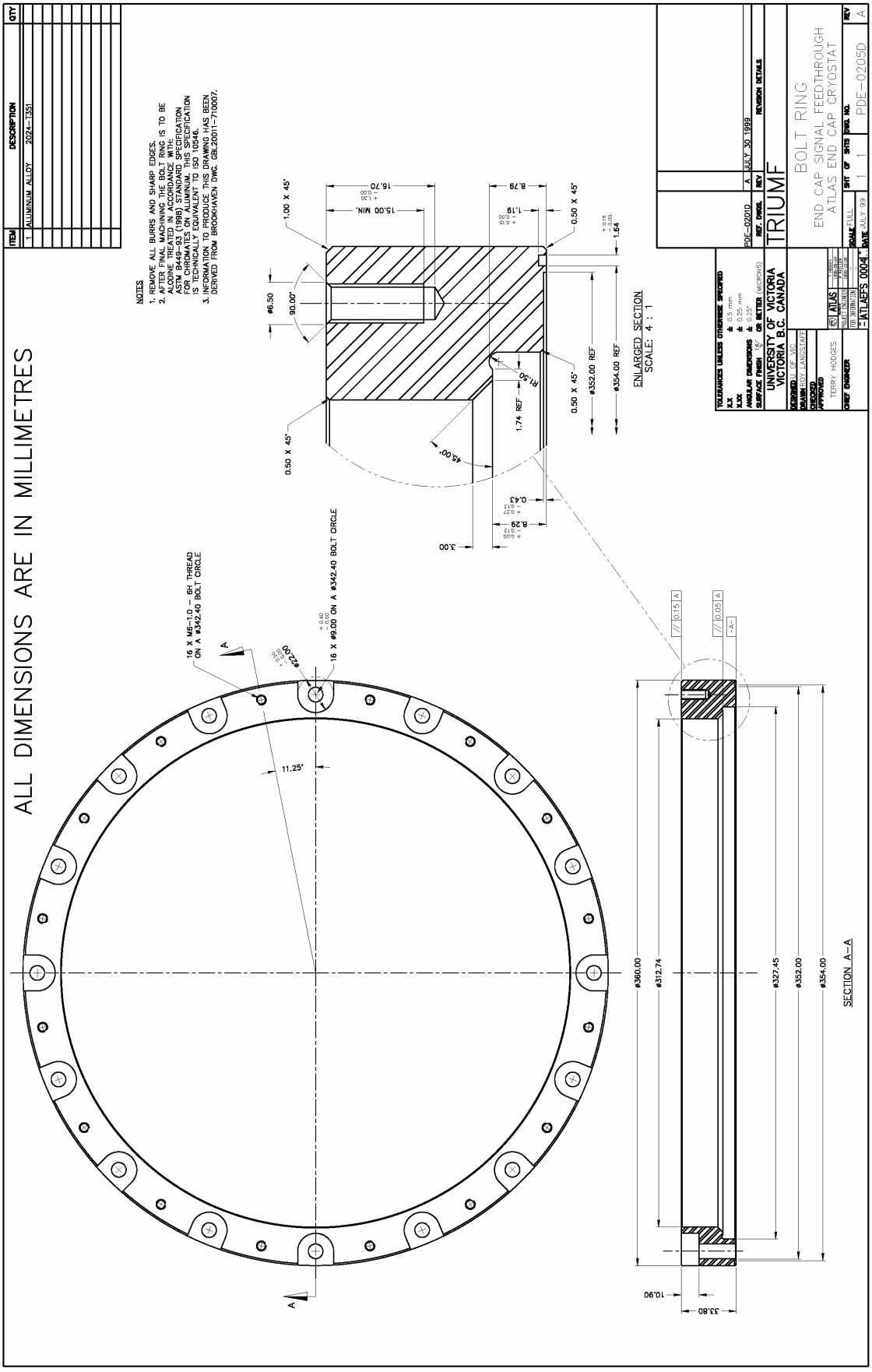
End CAP Feedthrough – Ambient Signal Flange Drawing # PDE-0203D Atlas # **ATLAEFS_0002**



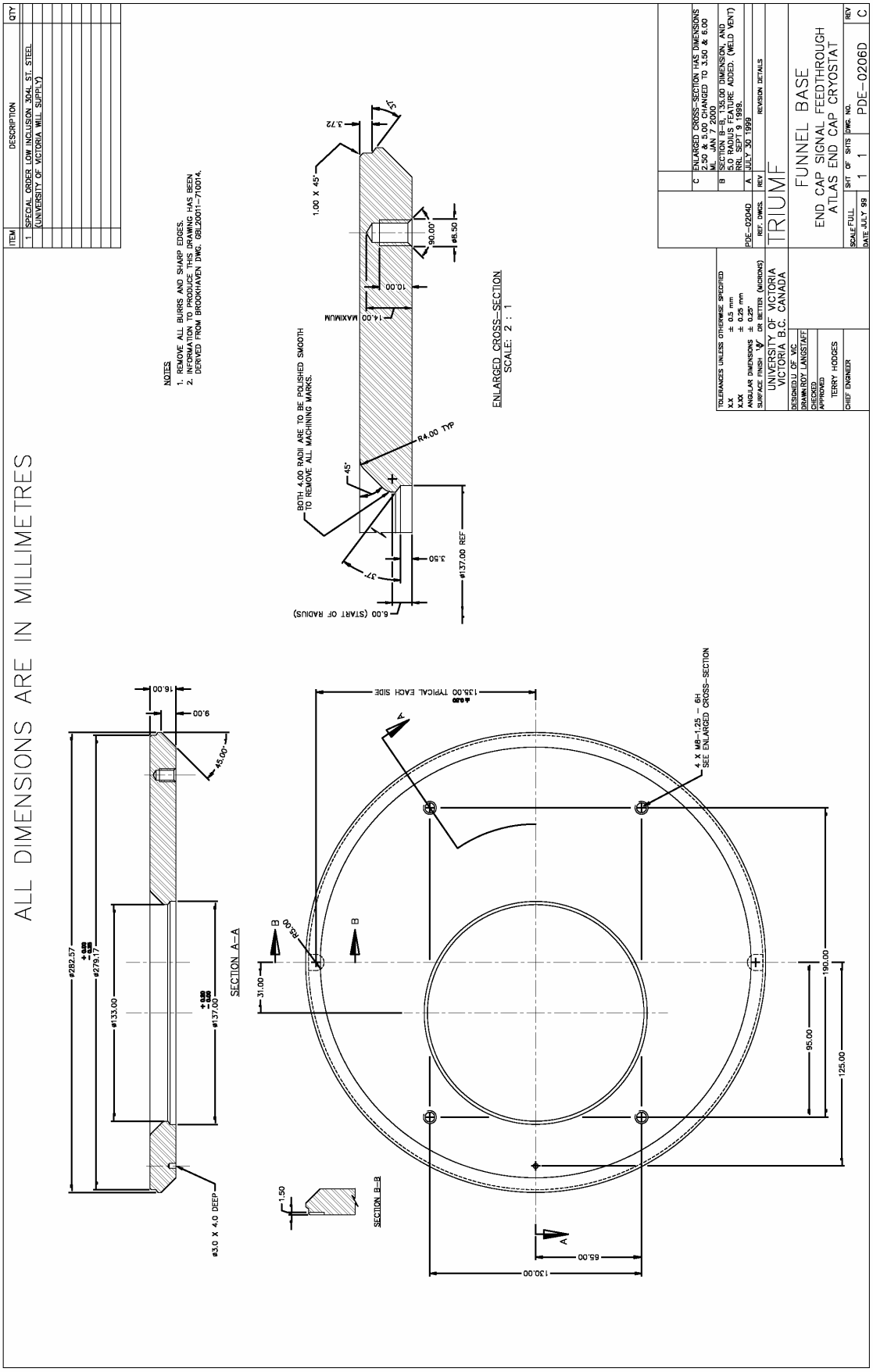
End CAP Feedthrough – Funnel Assembly Drawing # PDE-0204D Atlas # **ATLAEFS_0003**



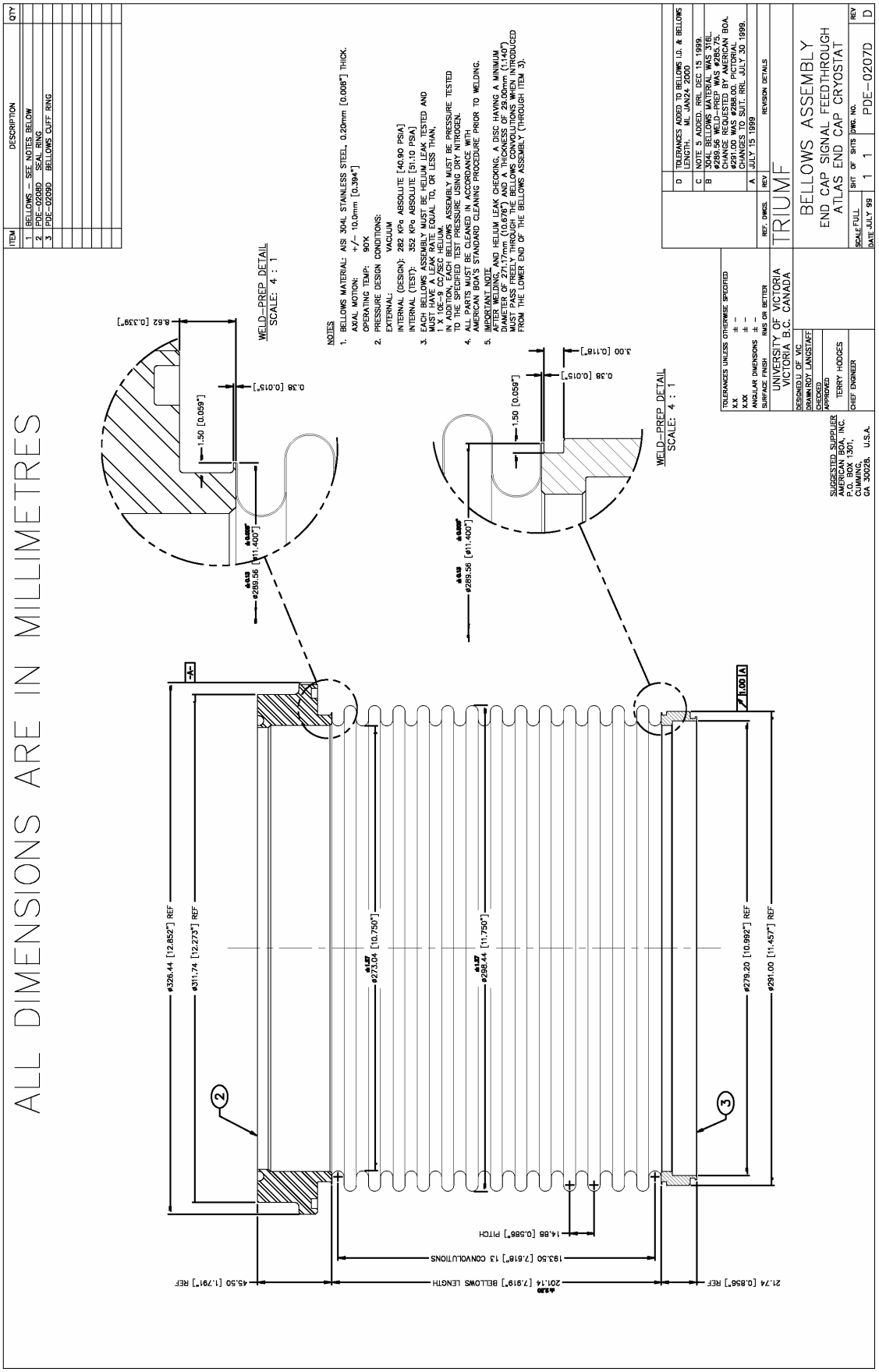
End CAP Feedthrough – Bolt Ring Drawing # PDE-0205D Atlas # **ATLAEFS_0004**



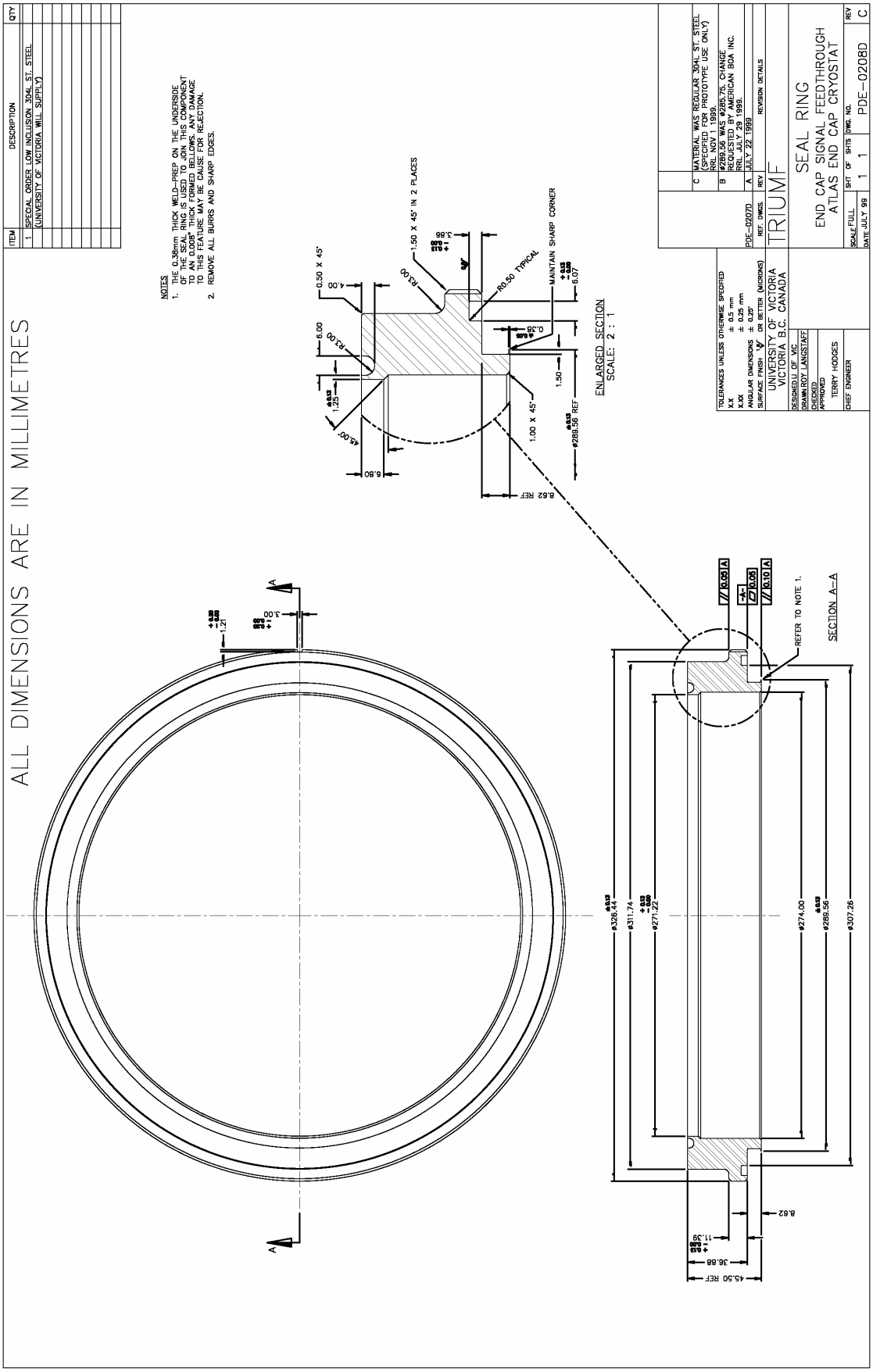
End CAP Feedthrough – Funnel Base Drawing # PDE-0206D Atlas # **ATLAEFS_0005**



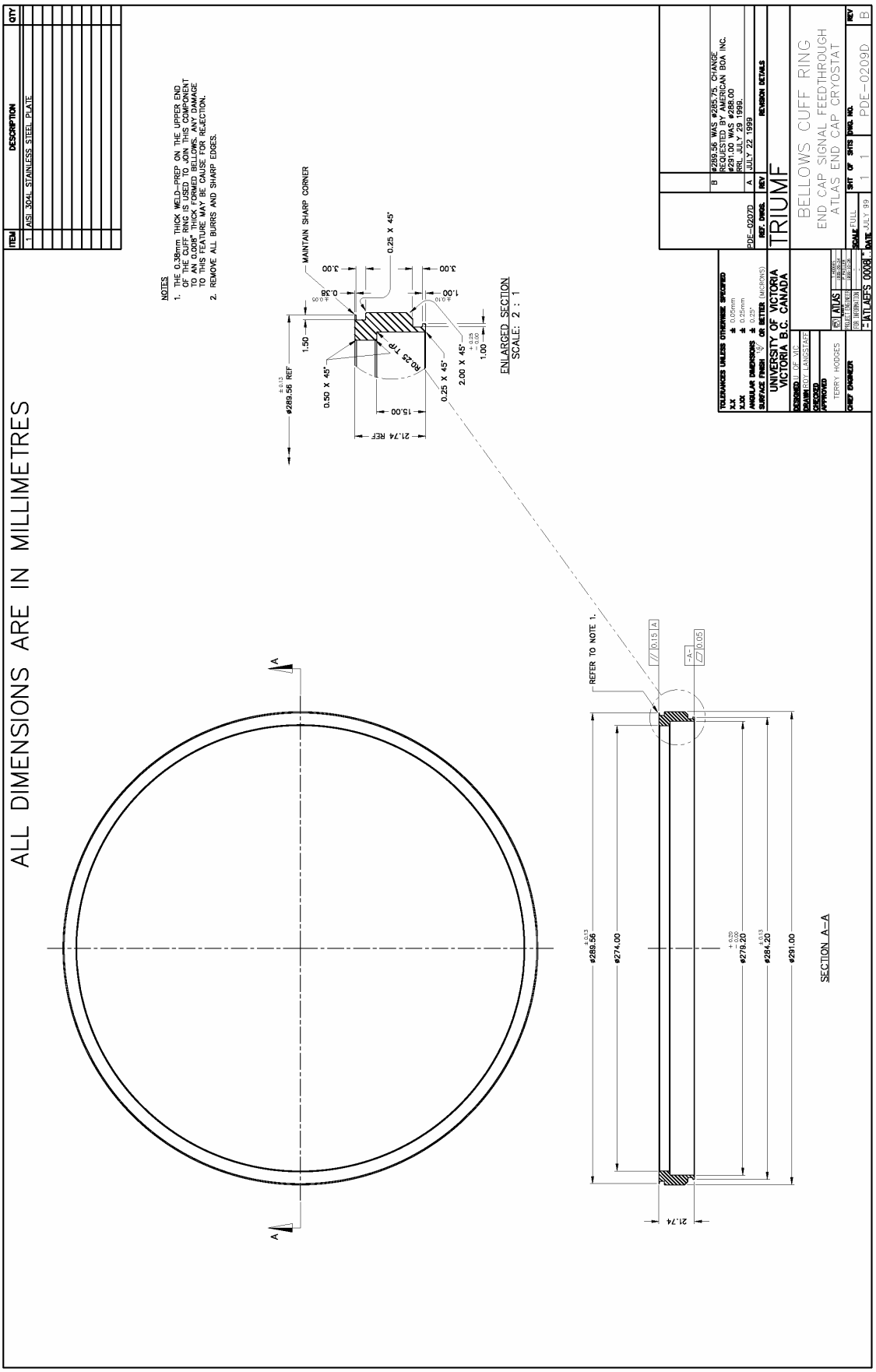
End CAP Feedthrough – Bellows Assembly Drawing # PDE-0207D Atlas # **ATLAEFS_0006**



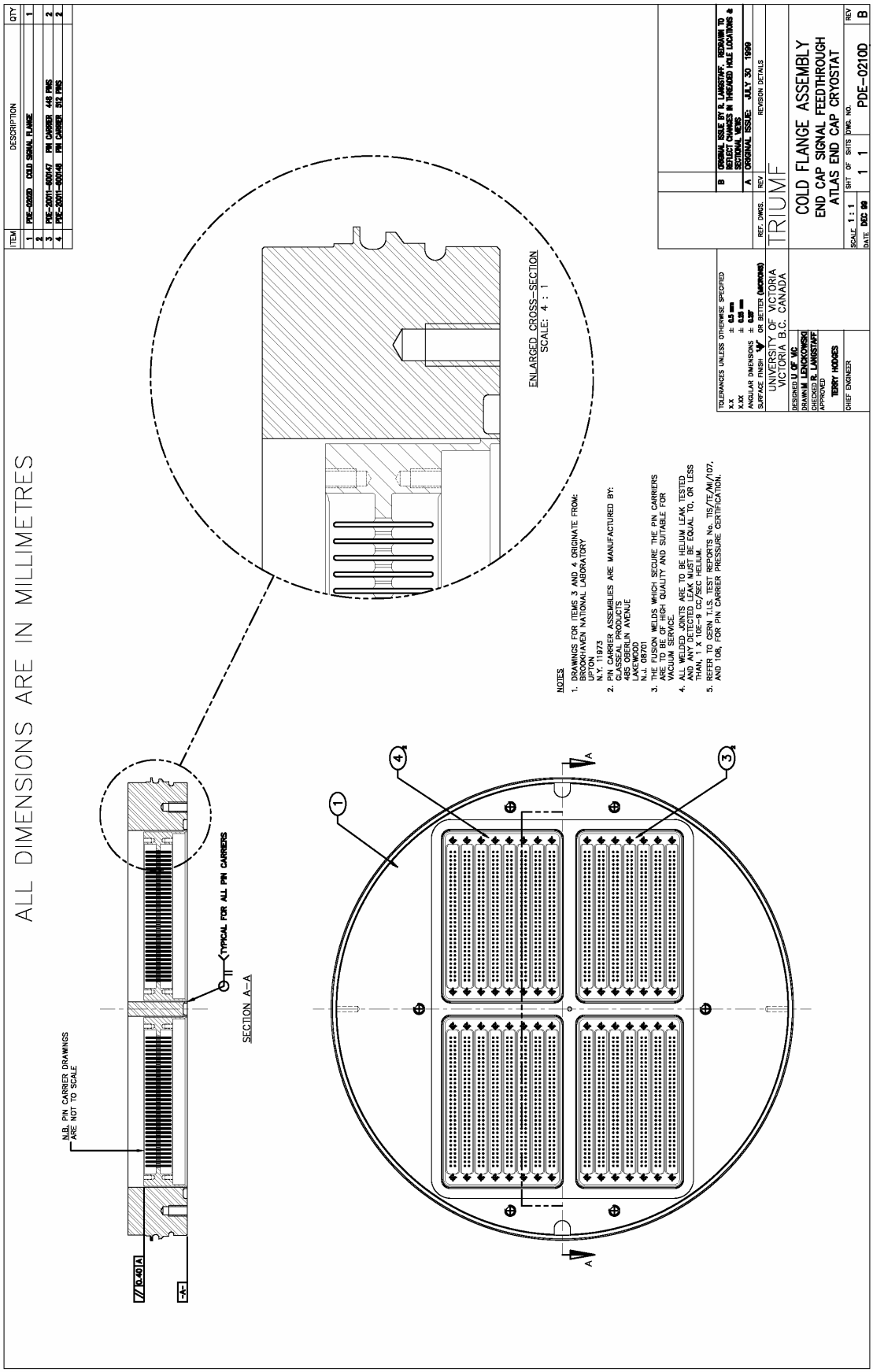
End CAP Feedthrough – Seal Ring Drawing # PDE-0208D Atlas # **ATLAEFS_0007**



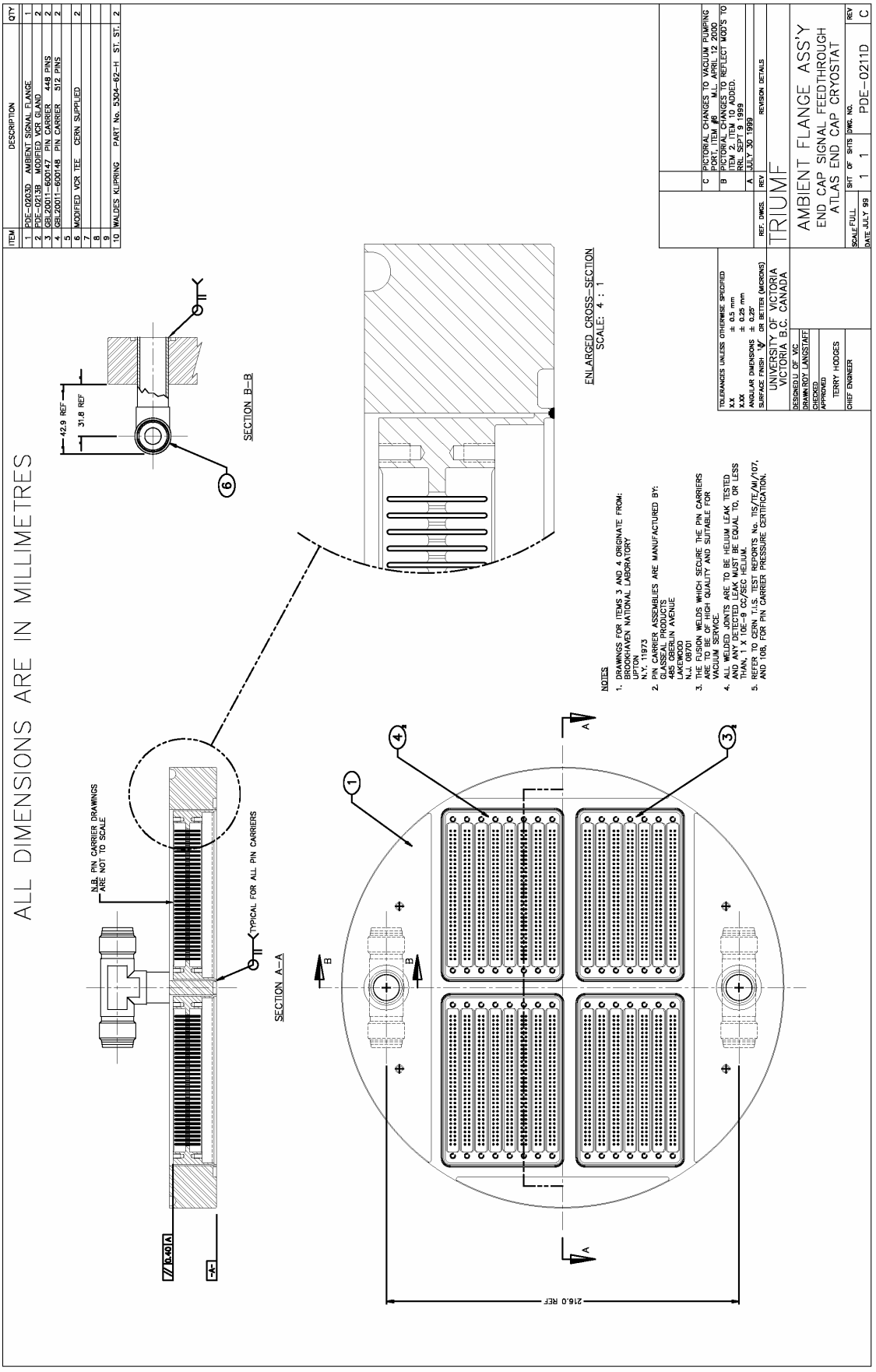
End CAP Feedthrough – Bellows Cuff Ring Drawing # PDE-0209D Atlas # **ATLAEFS_0008**



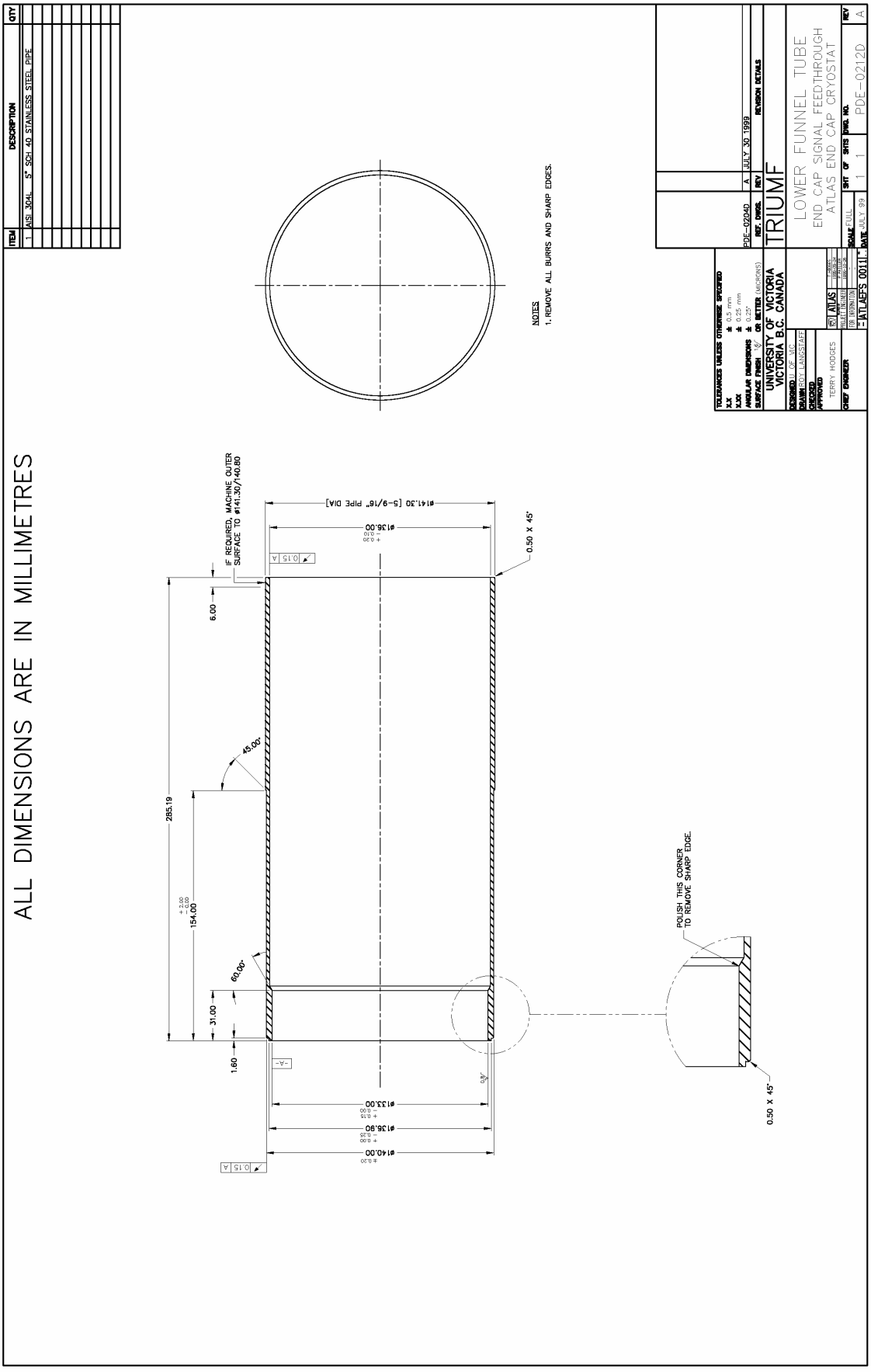
End CAP Feedthrough – Cold Flange Assembly Drawing # PDE-0210D Atlas # **ATLAEFS_0009**



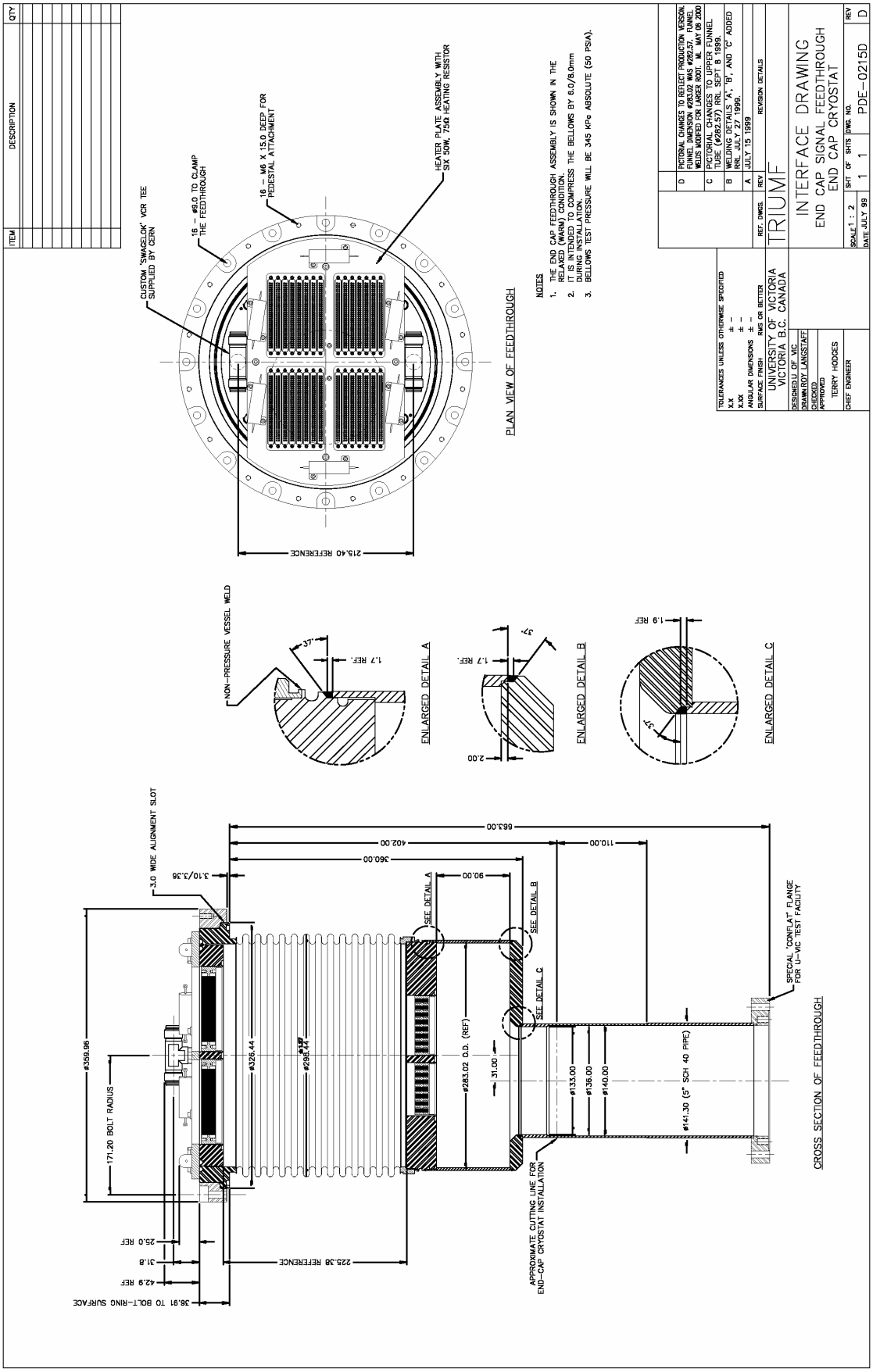
End CAP Feedthrough – Ambient Flange Assembly Drawing # PDE-0211D Atlas # **ATLAEFS_0010**



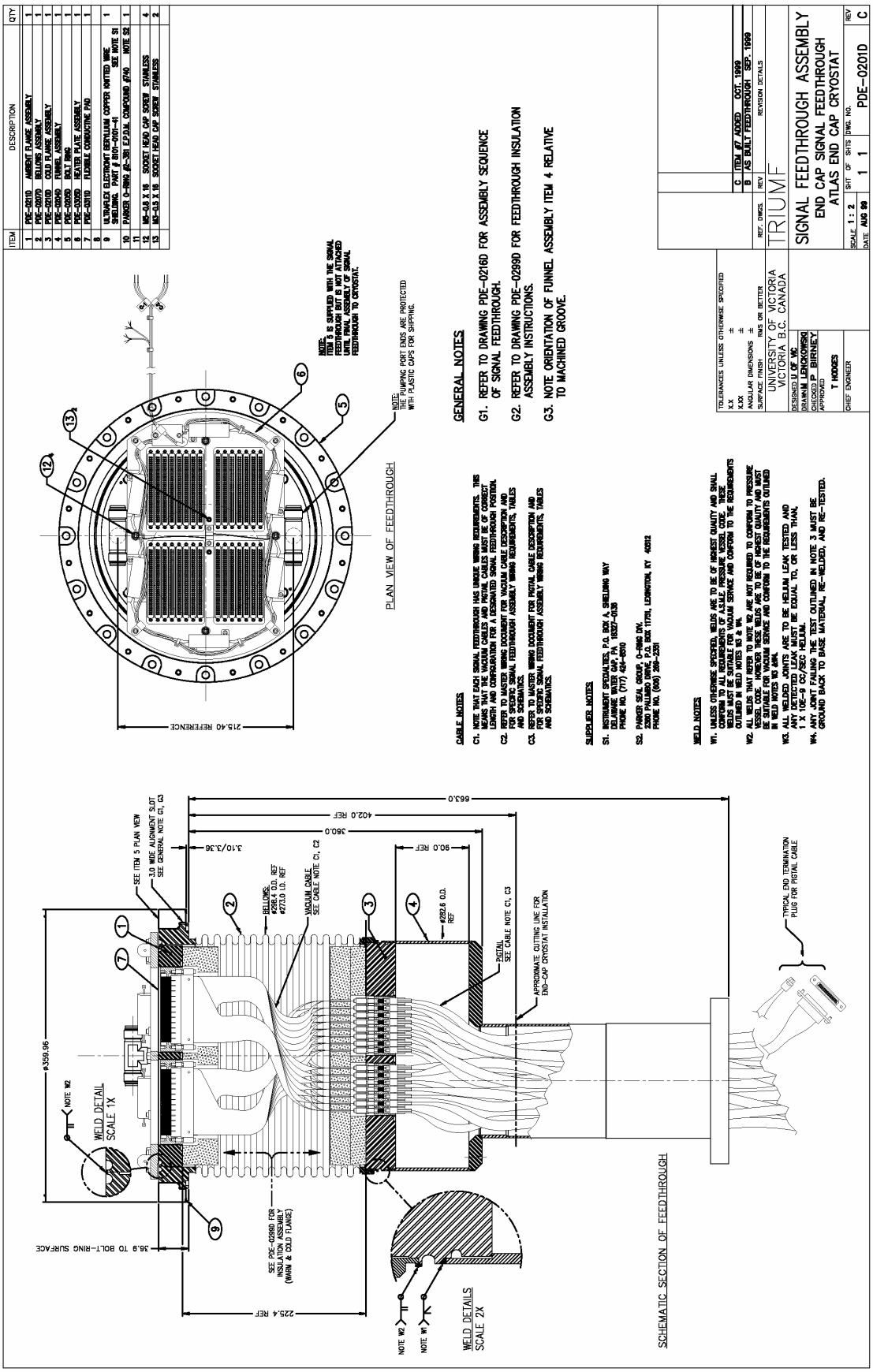
End CAP Feedthrough – Lower Funnel Tube Drawing # PDE-0212D Atlas # **ATLAEFS_0011**



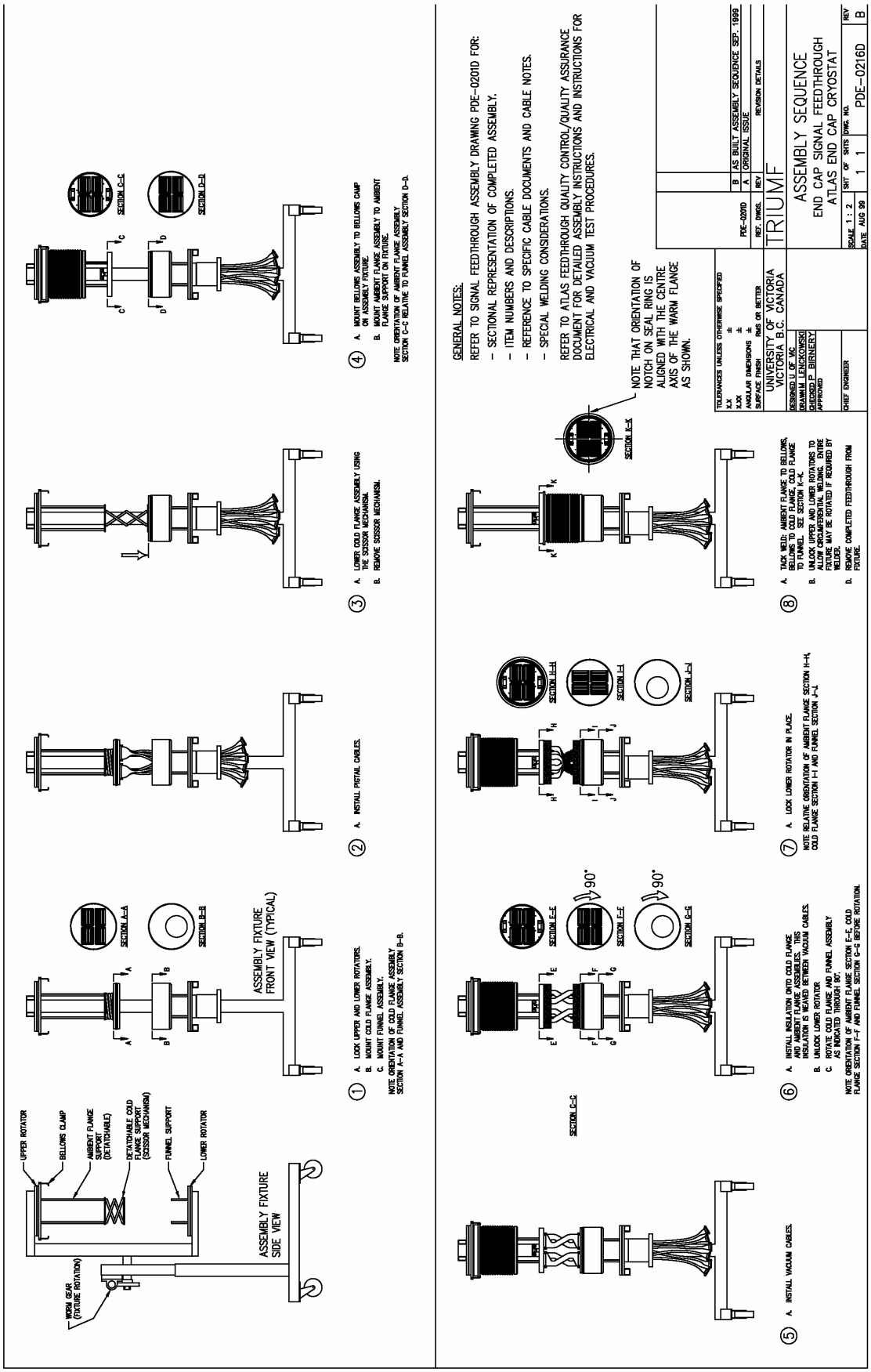
End CAP Feedthrough – Interface Drawing Drawing # PDE-0215D Atlas # **ATLAEFS_0012**



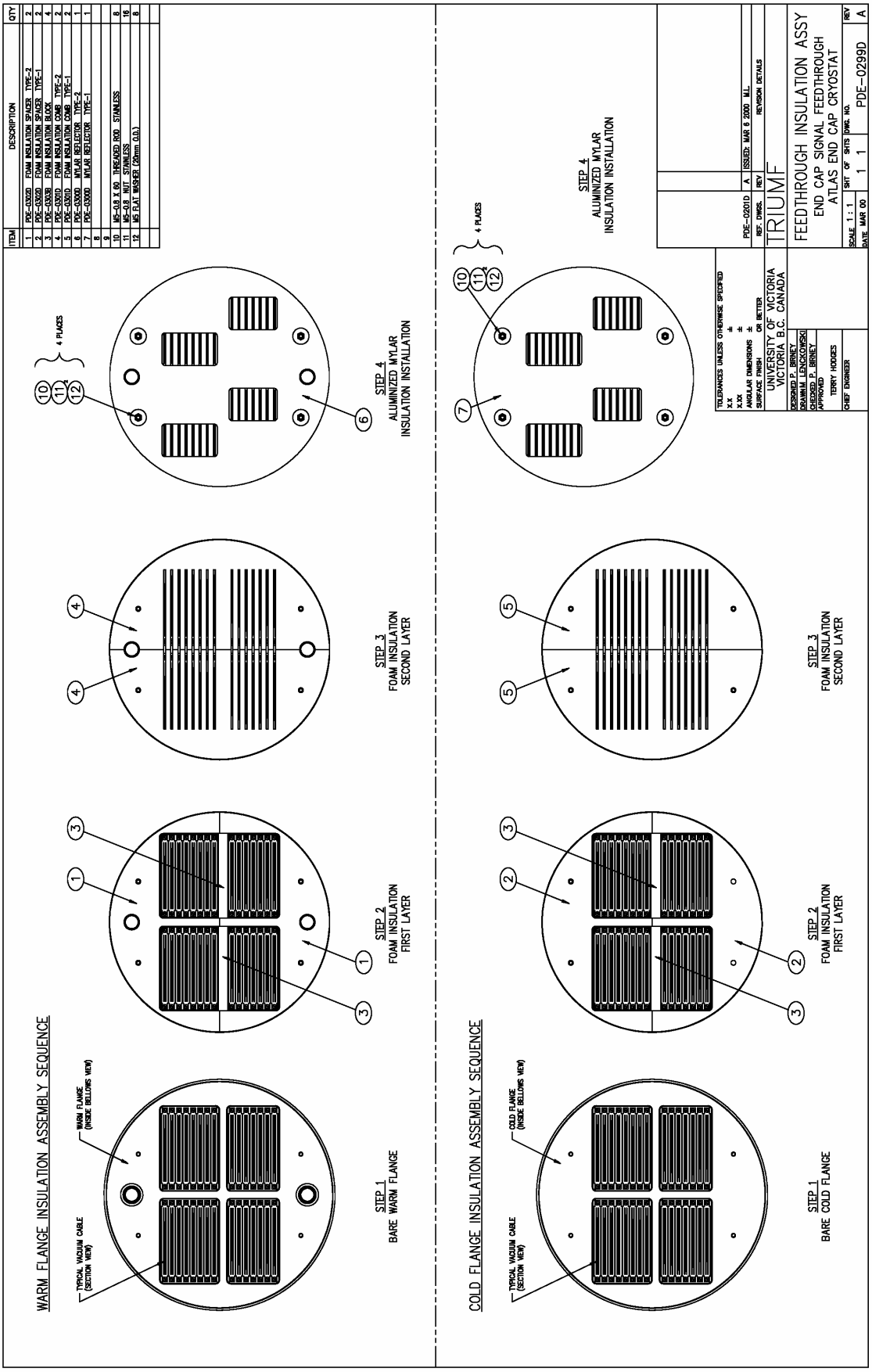
End CAP Feedthrough – Feedthrough Assembly Drawing # PDE-0201D Atlas # **ATLAEFS_0013**



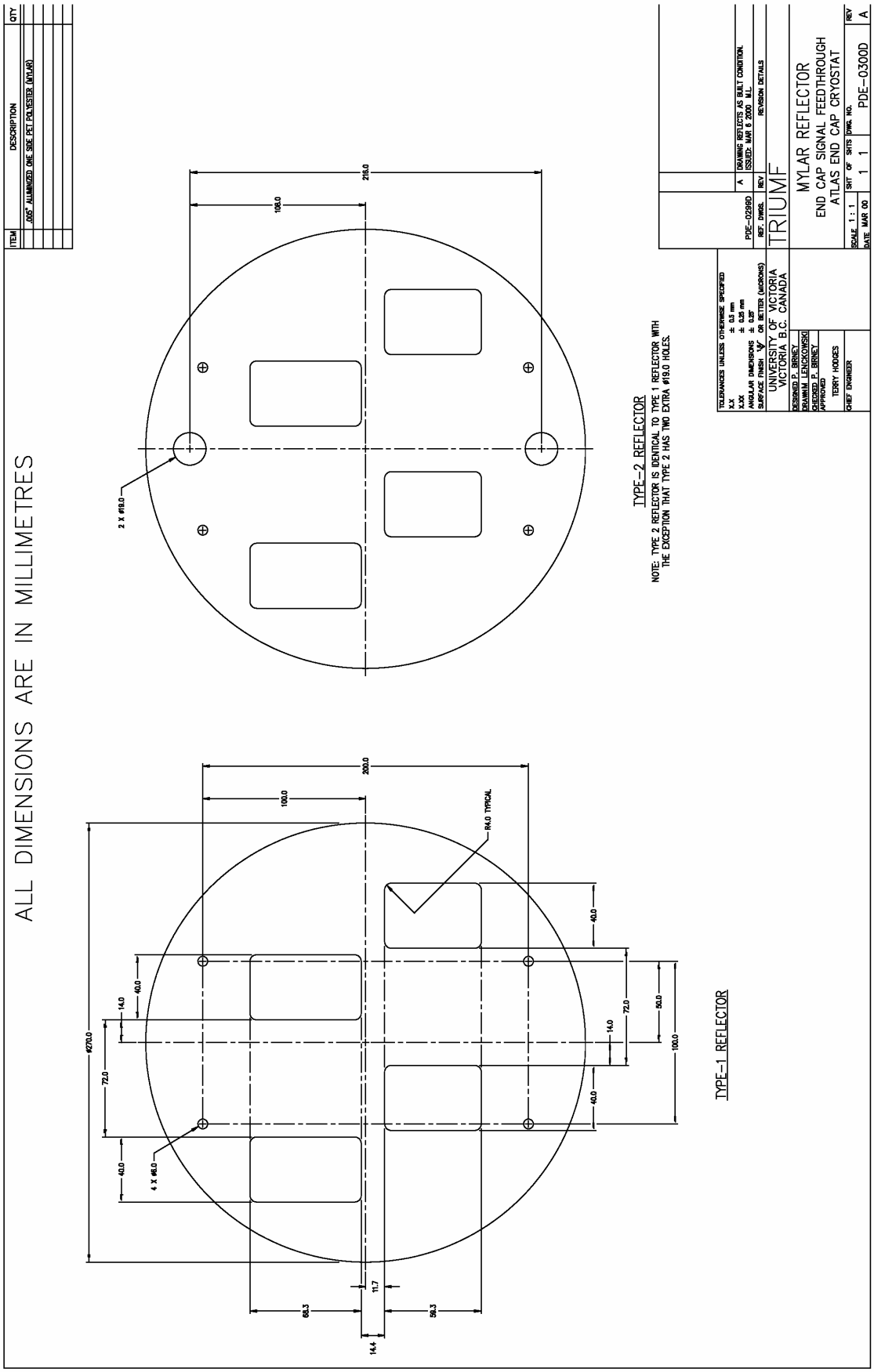
End CAP Feedthrough – Assembly Sequence Drawing # PDE-0216D Atlas # **ATLAEFS_0014**



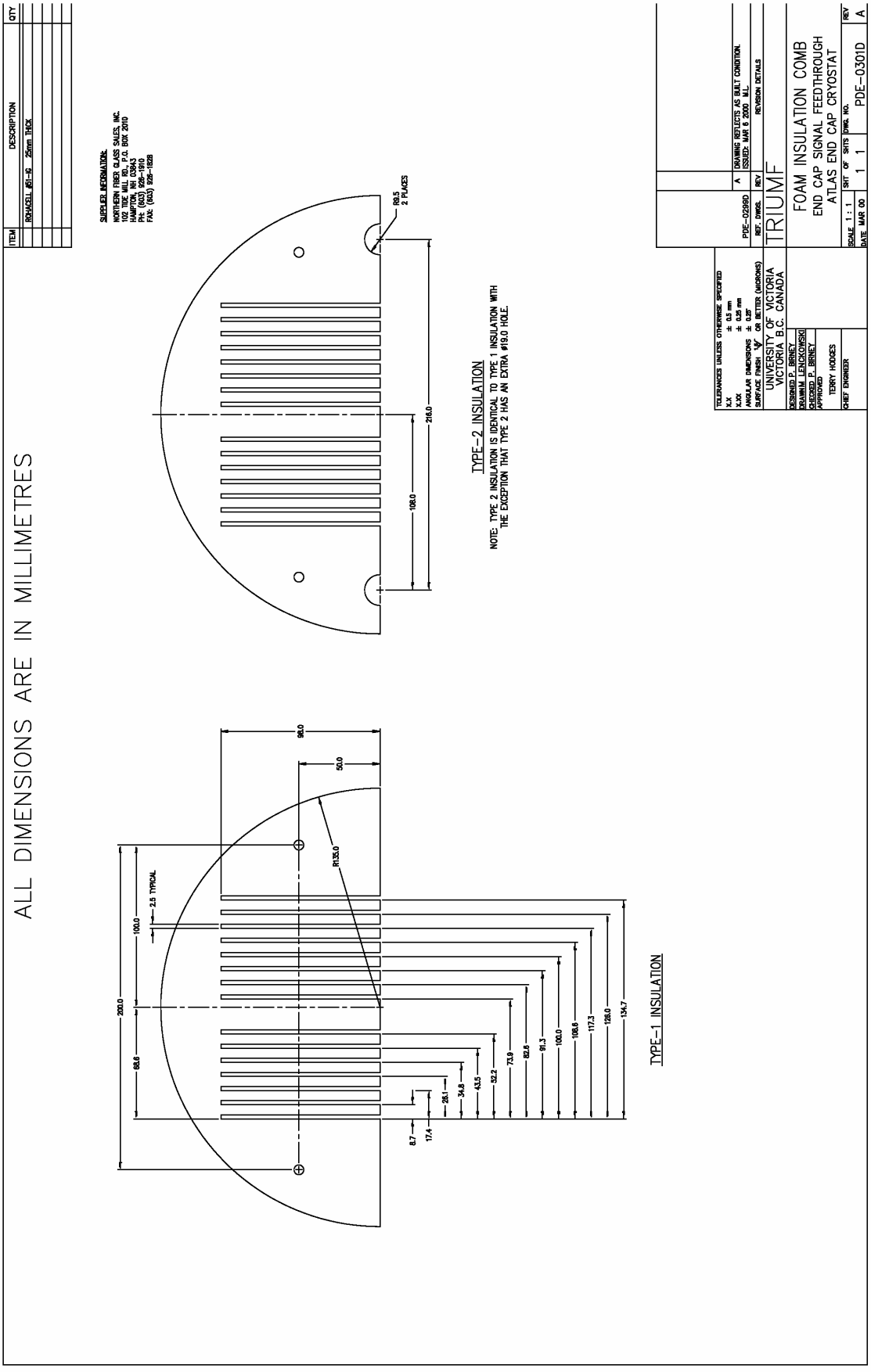
End CAP Feedthrough – Insulation Assembly Drawing # PDE-0299D Atlas # **ATLAEFS_0015**



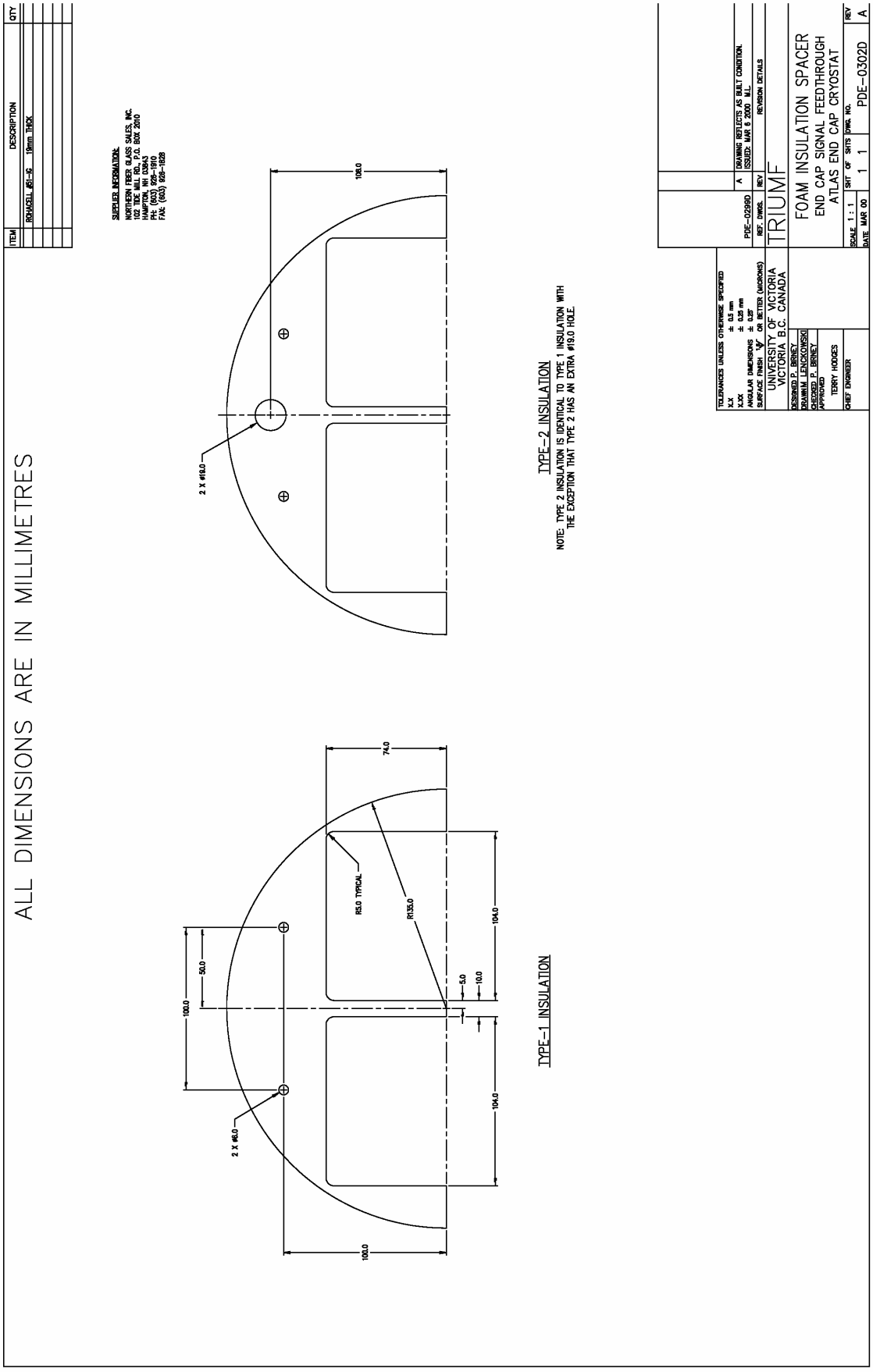
End CAP Feedthrough – Mylar Reflector Drawing # PDE-0300D Atlas # **ATLAEFS_0016**



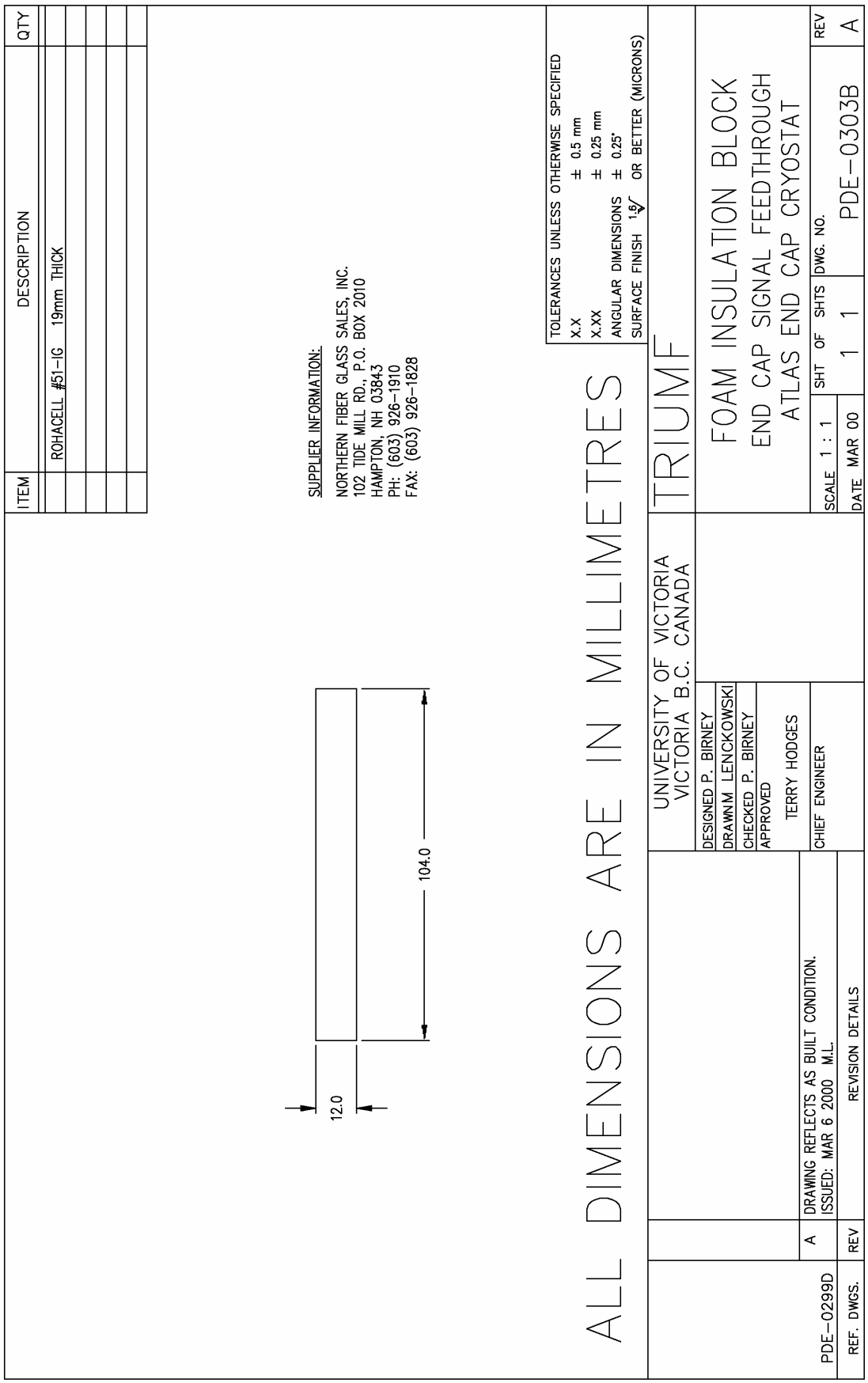
End CAP Feedthrough – Foam Insulation Comb Drawing # PDE-0301D Atlas # **ATLAEFS_0017**



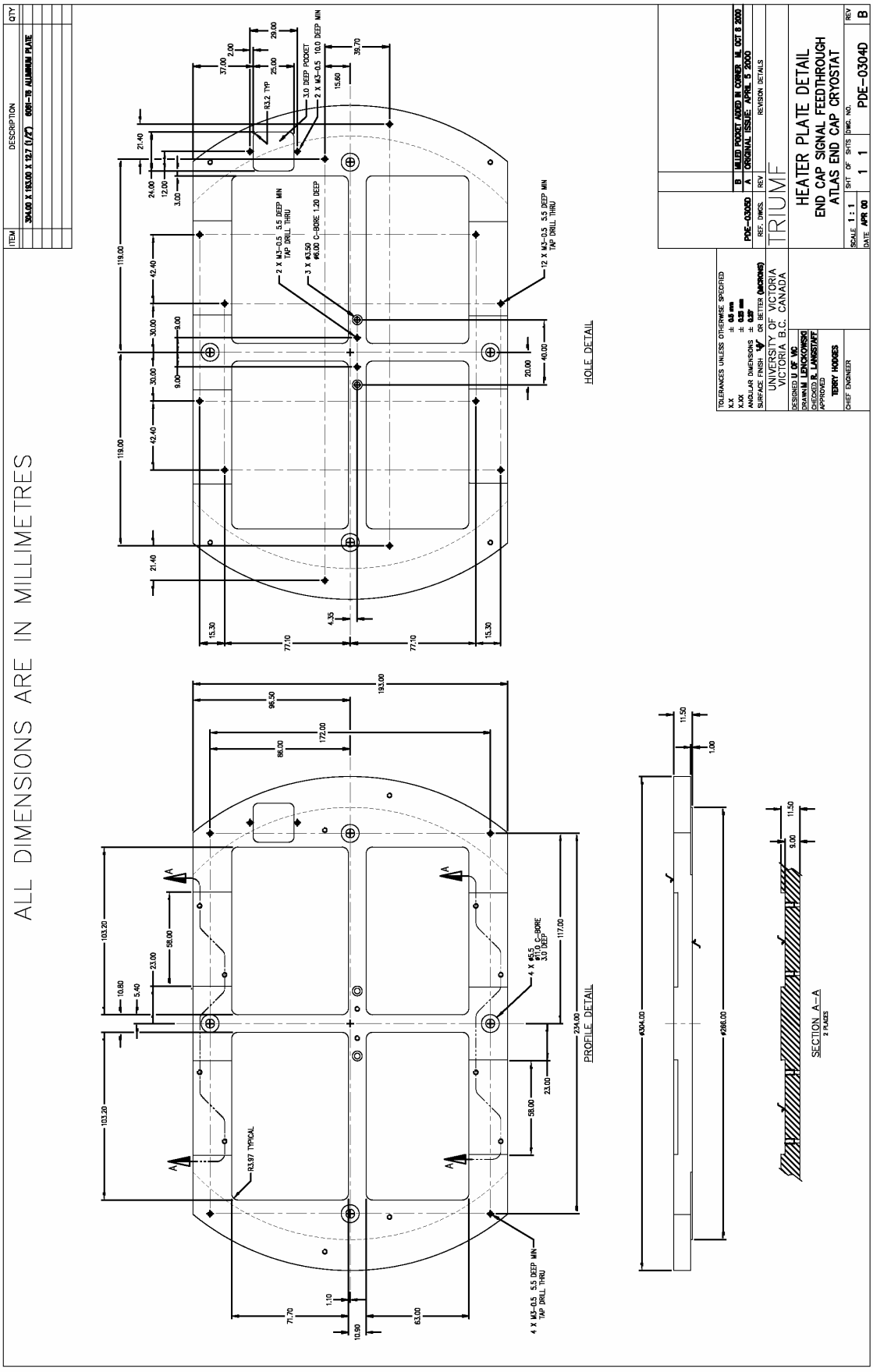
End CAP Feedthrough – Foam Insulation Spacer Drawing # PDE-0302D Atlas # **ATLAEFS_0018**



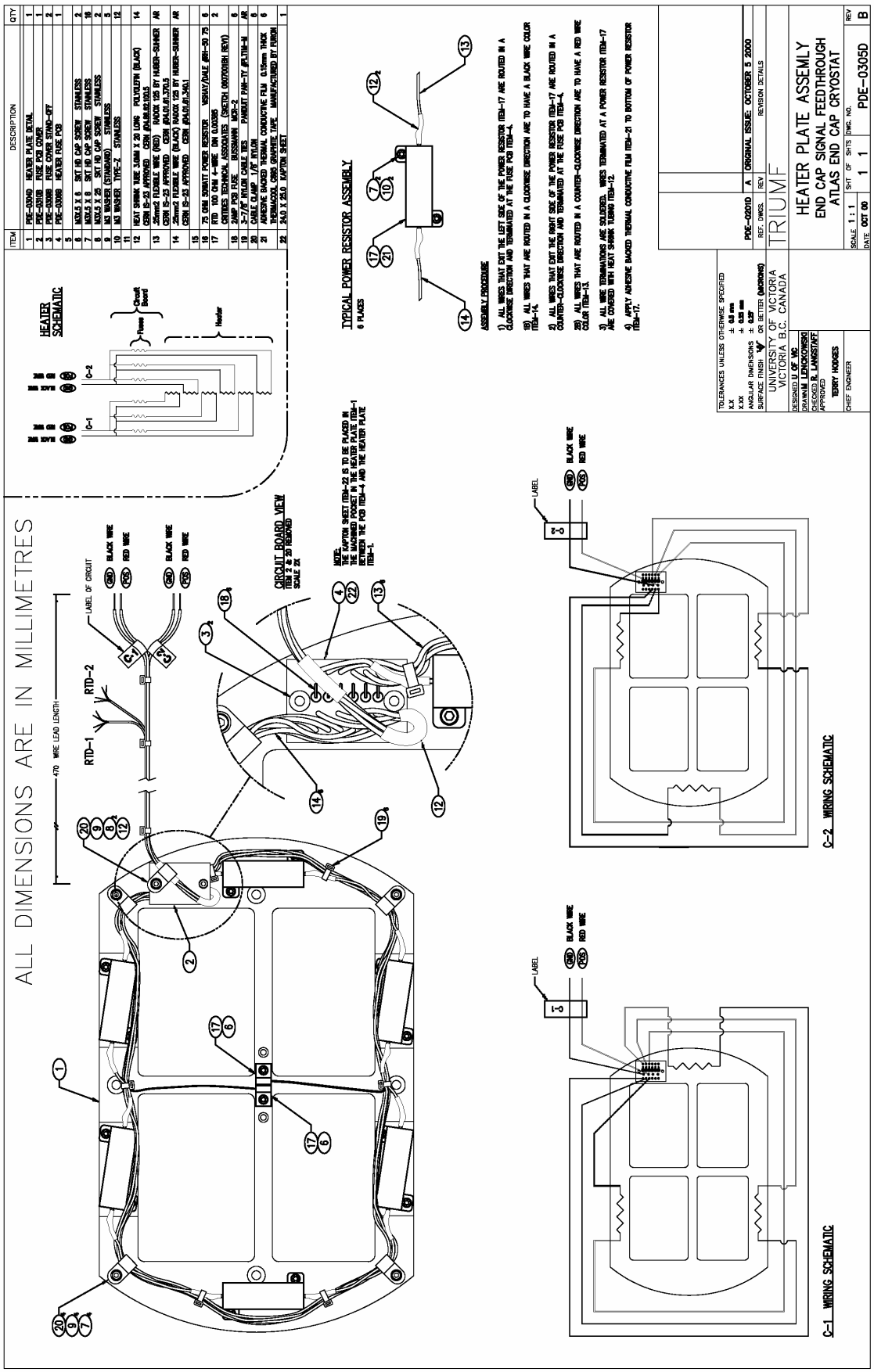
End CAP Feedthrough – Foam Insulation Block Drawing # PDE-0303B Atlas # **ATLAEFS_0019**



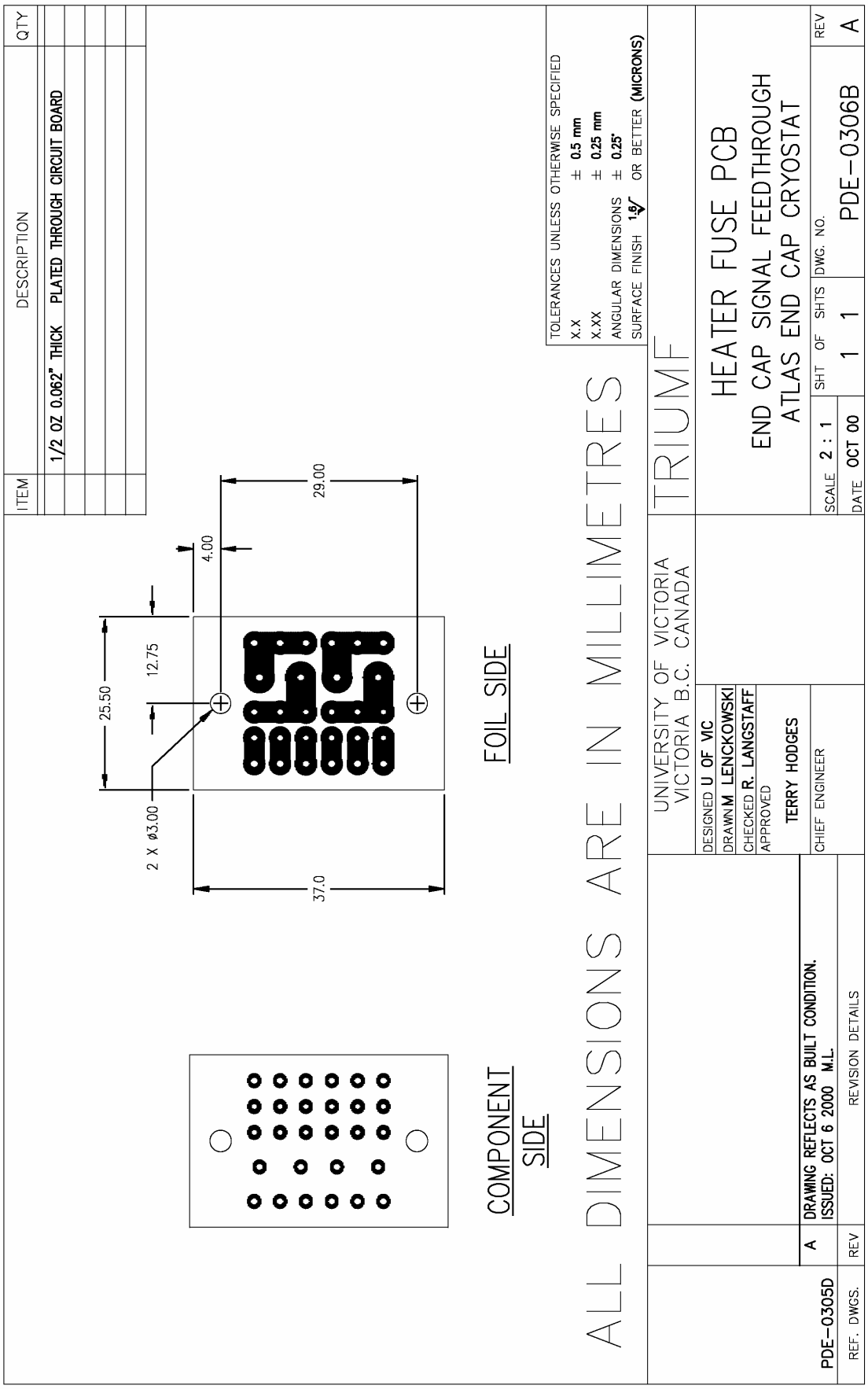
End CAP Feedthrough – Heater Plate Detail Drawing # PDE-0304D Atlas # **ATLAEFS_0020**



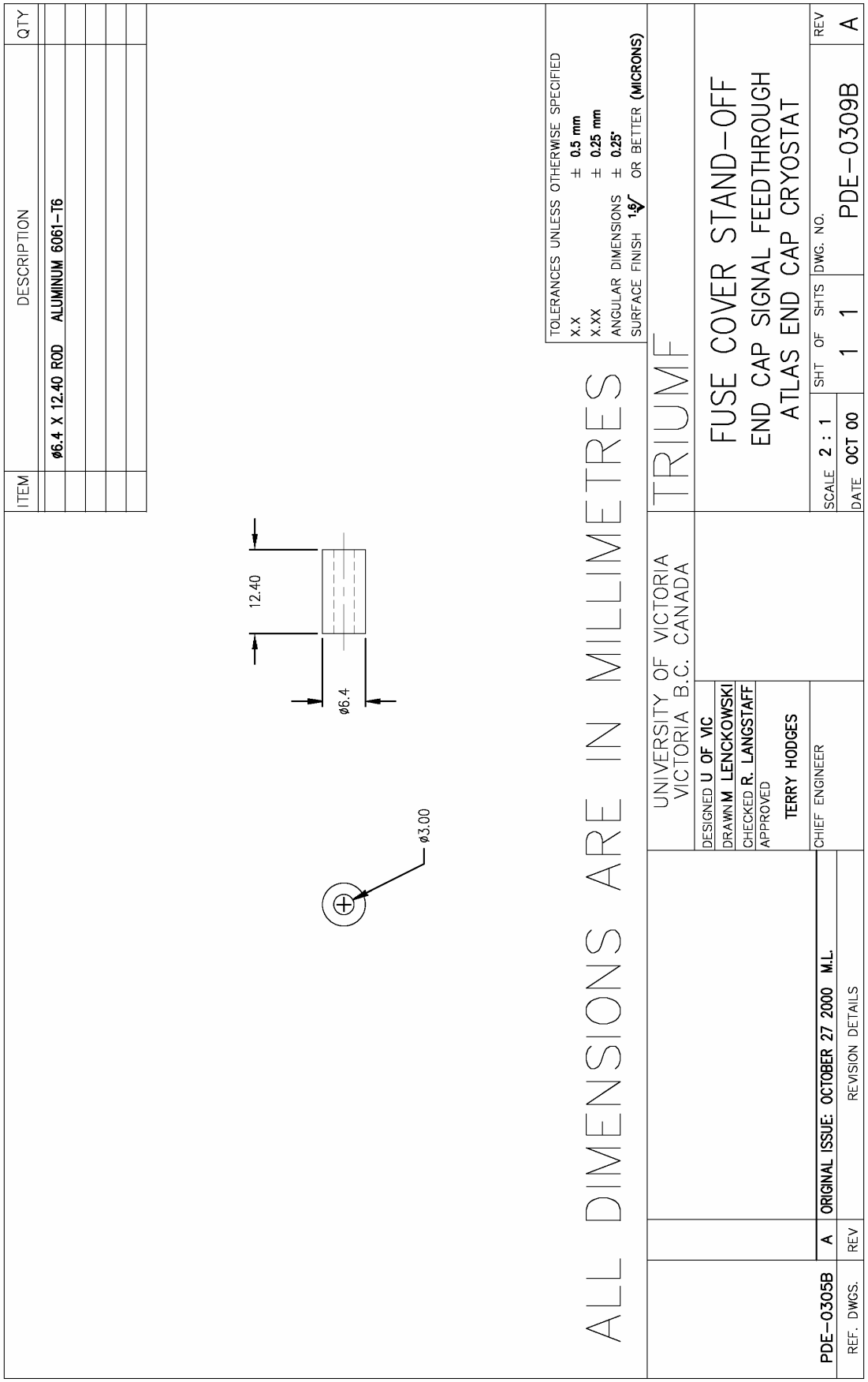
End CAP Feedthrough – Heater Plate Assembly Drawing # PDE-0305D Atlas # **ATLAEFS_0021**



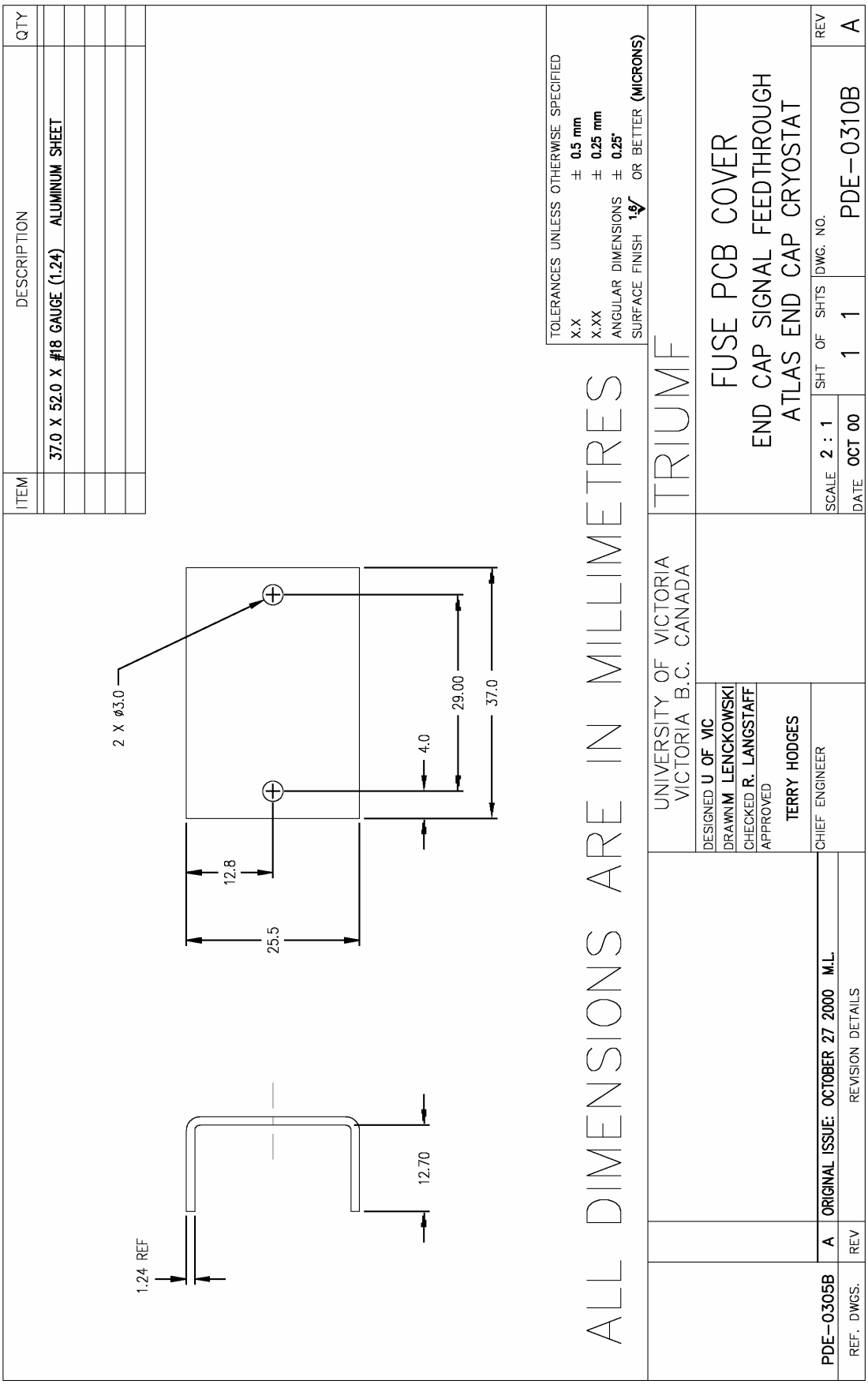
End CAP Feedthrough – Heater Fuse PCB Drawing # PDE-0306B Atlas # **ATLAEFS_0022**



End CAP Feedthrough – Fuse Cover Stand-Off Drawing # PDE-0309B Atlas # **ATLAEFS_0023**



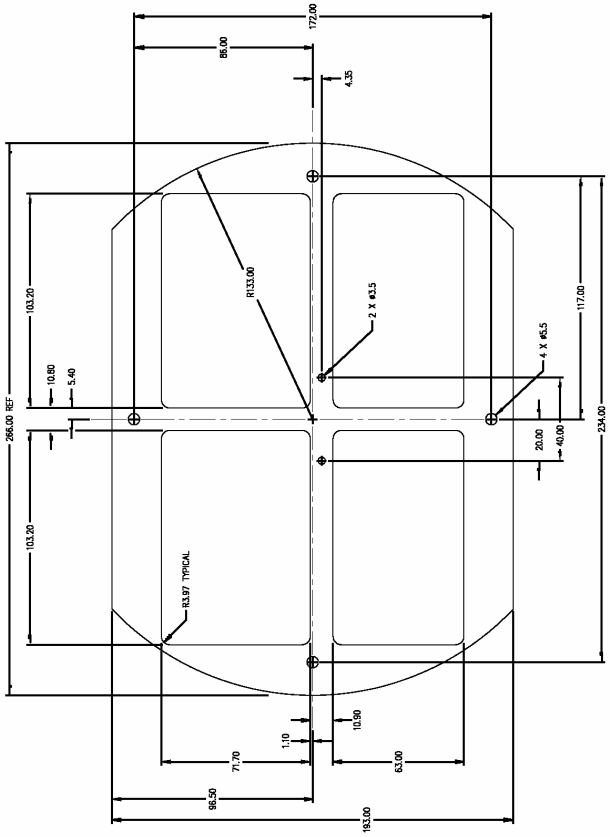
End CAP Feedthrough – Fuse PCB Cover Drawing # PDE-0310B Atlas # **ATLAEFS_0024**



End CAP Feedthrough – Flexible Conductive Pad Drawing # PDE-0311D Atlas # **ATLAEFS_0025**

ITEM	DESCRIPTION	QTY
	0.025" THERMALLY CONDUCTIVE SOLID SILICONE RUBBER PAD100	

ALL DIMENSIONS ARE IN MILLIMETRES



TOLERANCES UNLESS OTHERWISE SPECIFIED
XX ± 0.5 mm
XX.X ± 0.25 mm
ANGULAR DIMENSIONS ± 0.5°
SURFACE FINISH: 1/2 OR BETTER (MACHINED)

UNIVERSITY OF VICTORIA
VICTORIA B.C. CANADA

DESIGNED U. OF VIC.
DRAWN M. LEMCKOWSKI
CHECKED R. LANGSTAFF
APPROVED
TERRY HODGES
CHIEF ENGINEER

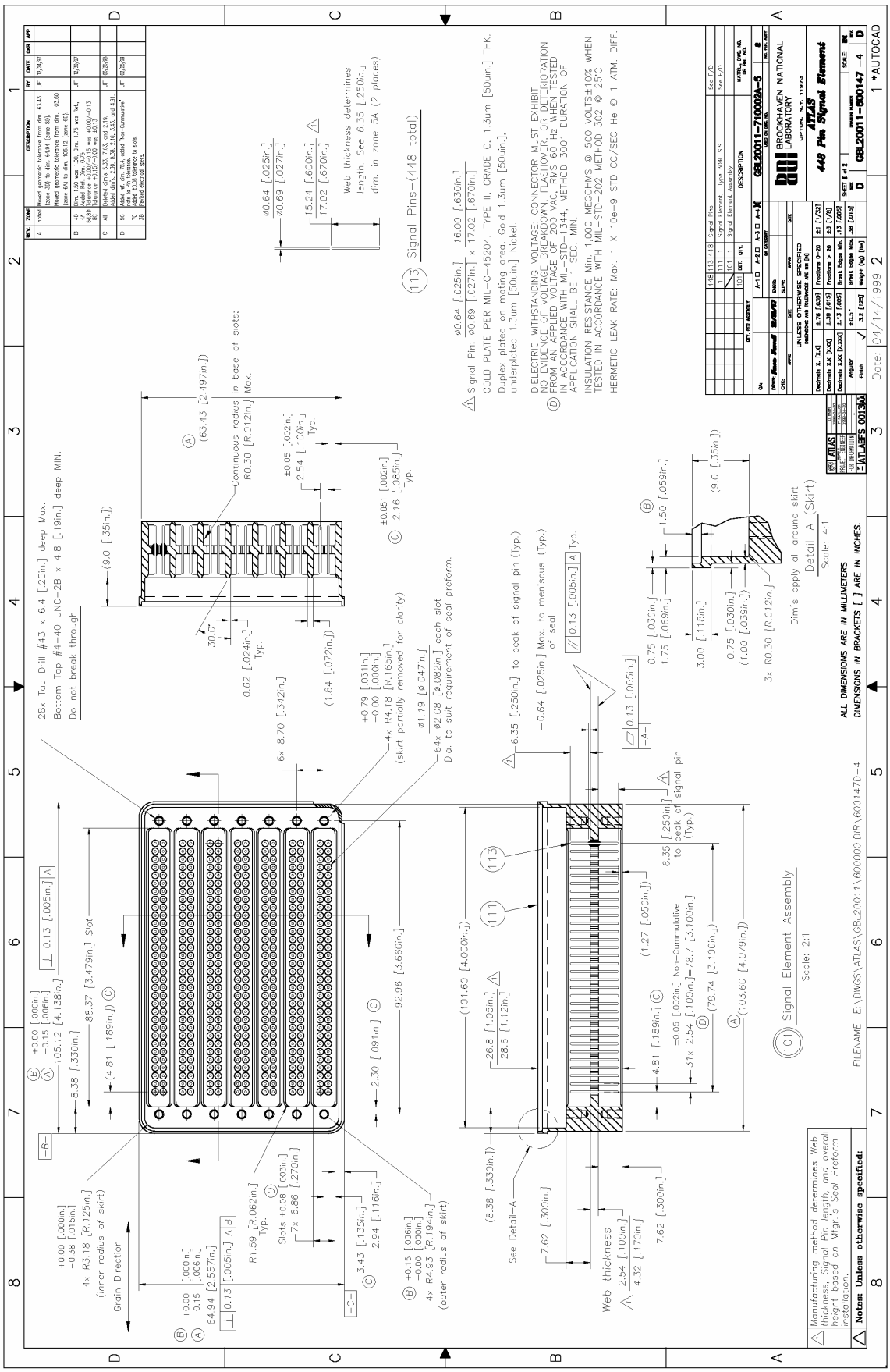
TRIUMF

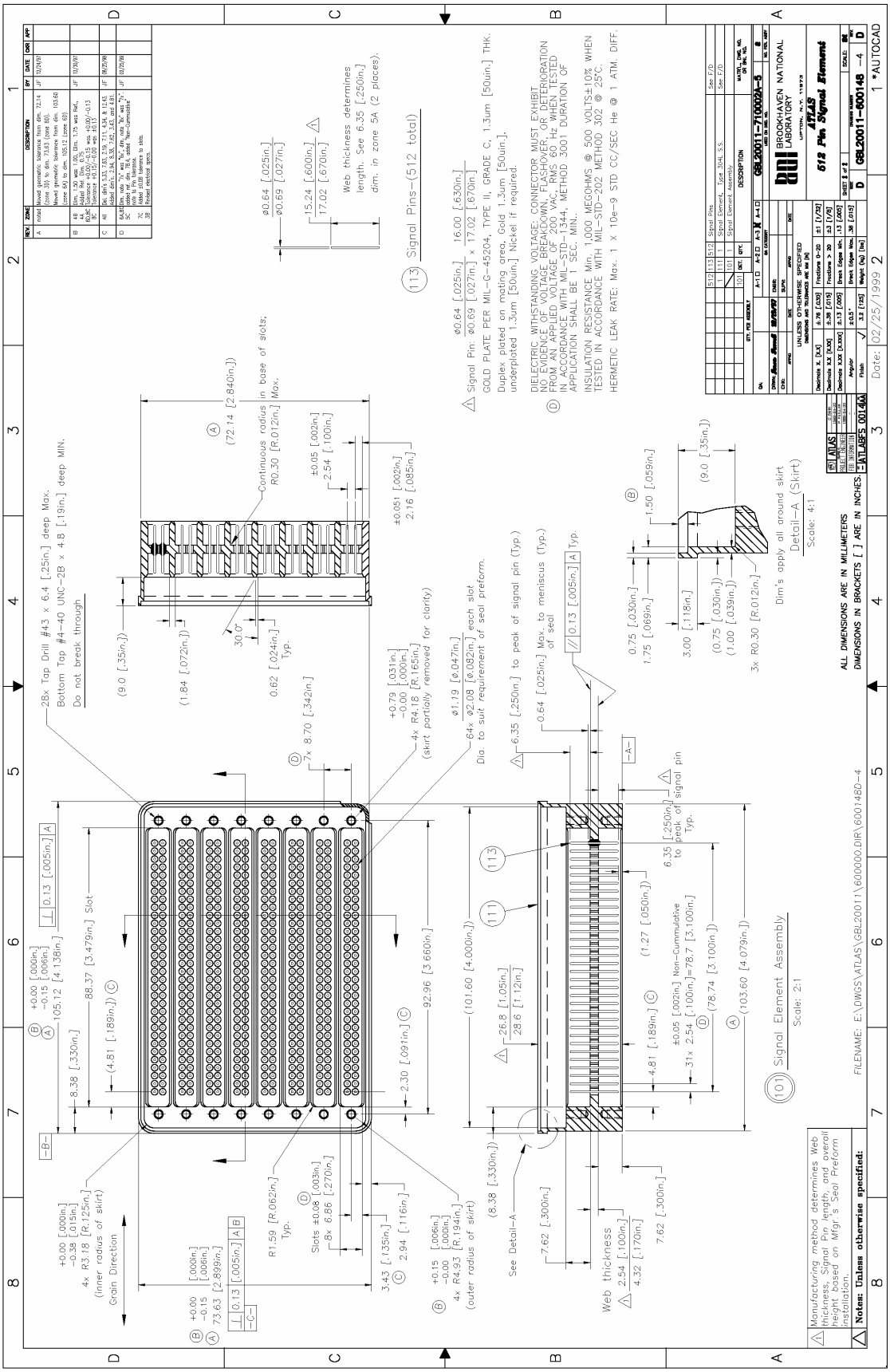
REF. DWGS.	REV	REVISION DETAILS
PDE-0310D	A	ORIGINAL ISSUE: APRIL 5 2000

FLEXIBLE CONDUCTIVE PAD
END CAP SIGNAL FEEDTHROUGH
ATLAS END CAP CRYOSTAT

SCALE 1 : 1 | SHT 1 OF 1 SHTS | DWG. NO. PDE-0311D | REV A
DATE APR 00

End CAP Feedthrough – 7 Row Pin Carrier Drawing # GBL20011-600147-4 Atlas # **ATLABFS_0013**





Appendix D - Weld Plan

Part A – Funnel and Cold Flange Welds

Part B – Bellows and Ambient Flange Welds

University of Victoria TRIUMF

Hadronic End Cap Signal Feedthroughs

Welding Plan – Part A

Date of issue: **1 September 2000**

Revision: **FINAL**

Notes:

1. SCOPE

This specification covers the welding procedures to be employed in the construction of those parts of the Hadronic End Cap Signal Feedthroughs which form part of the End Cap Cryostat, and are therefore required to conform to the Pressure Vessel Code.

2. APPLICABLE CODE AND SPECIFICATION

ASME Boiler and Pressure Vessel Code,
Section IX, Welding and Brazing Qualifications

3. QUALIFICATION OF WELDING PROCEDURES AND WELDERS

3.1 Procedure Qualification

Before any welding is done, all welding procedures to be used are to be qualified in accordance with the provisions of ASME Section IX of the Pressure Vessel Code.

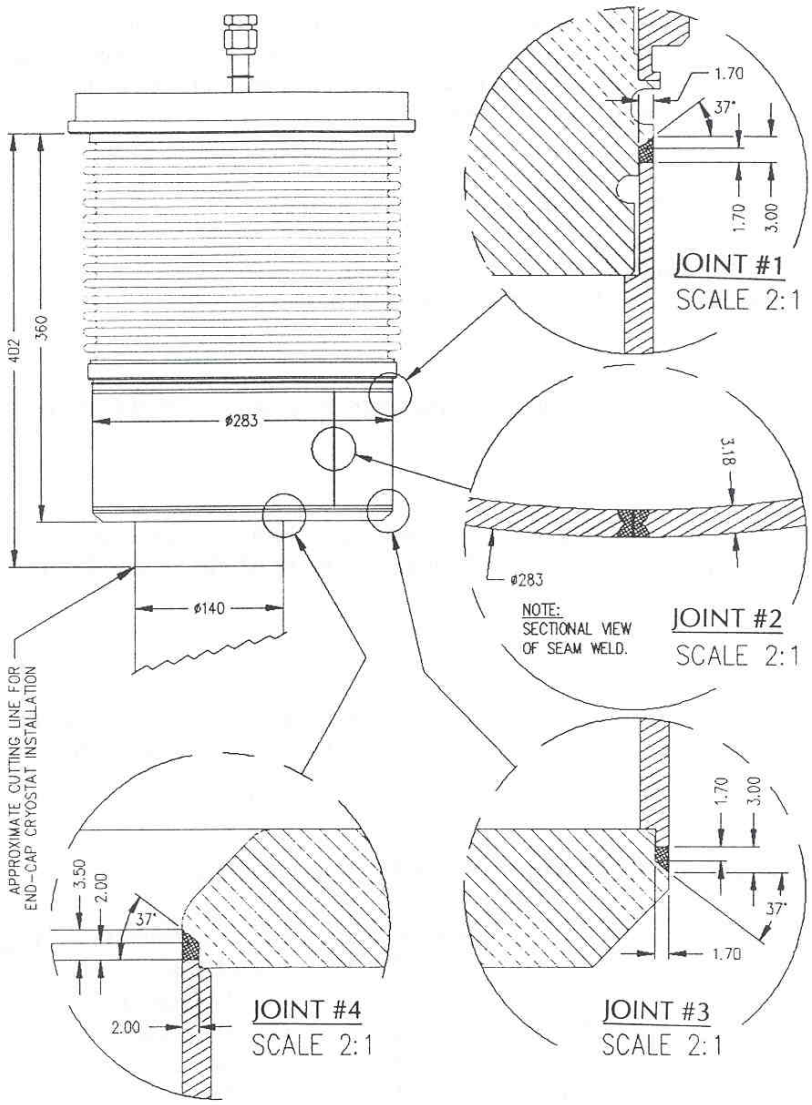
3.2 Performance Qualification

Only welders who have passed the performance qualification tests in accordance with ASME Section IX of the Pressure Vessel Code will be permitted to do the welding.

4. SUPPORTING WELD PROCEDURE SPECIFICATIONS

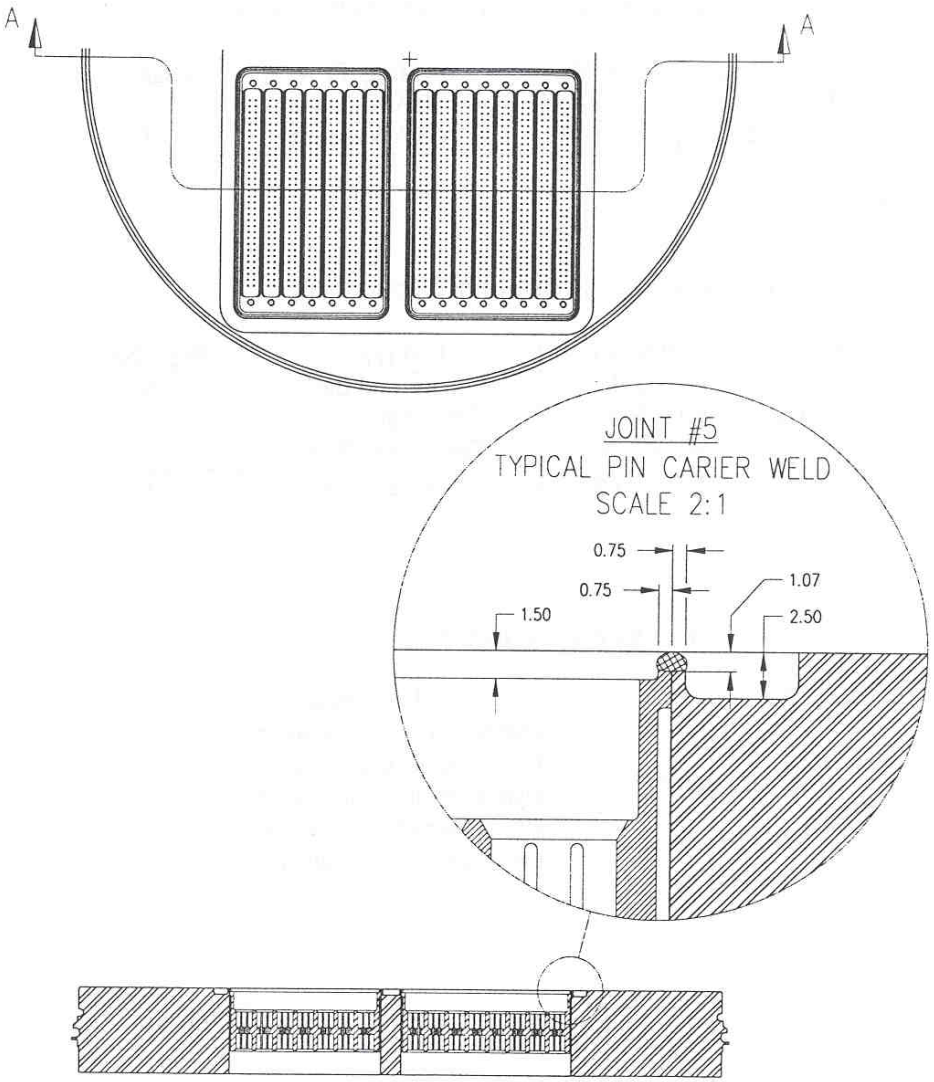
Joint No.	W.P.S No.	P.Q.R No.	Welding process	Page No.
01	WUVT-1	PUVT-1	GTAW manual	5
02	WUVT-2	PUVT-2	GTAW manual	7
03	WUVT-1	PUVT-1	GTAW manual	5
04	WUVT-1	PUVT-1	GTAW manual	5
05	WUVT-3	PUVT-2	GTAW manual	9

2
5. WELD MAPS



HEC Feedthrough – Weldmap A1

3



HEC Feedthrough – Weldmap A2

4

6. SUPPORTING PROCESS QUALIFICATION RECORDS

P.Q.R. No.	P No.	Welding Process	Page No.
PUVT-1	8	GTAW manual	11
PUVT-2	8	GTAW manual	13

7. SUPPORTING PROCESS QUALIFICTION TESTS

P.Q.R No.	W.P.S No.	Test type	Page No.
PUVT-1	WUVT-1	Tensile and Bend	16
PUVT-1	WUVT-1	Radiographic	17
PUVT-2	WUVT-2&3	Tensile and Bend	15
PUVT-2	WUVT-2&3	Radiographic	17

8. MANDATORY TEST PROCEDURES

Joint No.	Test Procedure
1	Dye penetrant examination
2	Radiographic examination
3	Dye penetrant examination
4	Dye penetrant examination
ALL	Ferrite content measurement

QW-482 SUGGESTED FORMAT FOR WELDING PROCEDURE SPECIFICATION (WPS)
(See QW-200.1, Section IX, ASME Boiler and Pressure Vessel Code)

Company Name SPECIFIC MECHANICAL SYSTEMS LTD. By: TOM GOLOBACH
Welding Procedure Specification No. WUVT-1 Date FEB. 14/2000 Supporting PQR No.(s) PUVT-1, PUVT-2
Revision No. 2 Date MAY 23/2001 By: DARREN COMBS
Welding Process(es) GTAW Type(s) MANUAL
(Automatic, Manual, Machine, or Semi-Auto.)

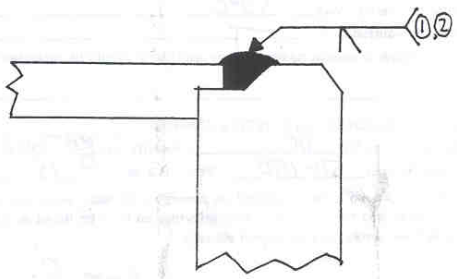
JOINTS (QW-402)
Joint Design SINGLE BEVEL VEE GROOVE
Backing (Yes) YES (No) —
Backing Material (Type) BASE METAL - RETAINERS NOT USED
(Refer to both backing and retainers.)

☑ Metal ☐ Nonfusing Metal
☐ Nonmetallic ☐ Other

Sketches, Production Drawings, Weld Symbols or Written Description should show the general arrangement of the parts to be welded. Where applicable, the root spacing and the details of weld groove may be specified.

(At the option of the Mfgr., sketches may be attached to illustrate joint design, weld layers and bead sequence, e.g. for notch toughness procedures, for multiple process procedures, etc.)

Details



(NOT TO SCALE)

*BASE METALS (QW-403)
P-No. 8 Group No. 1 to P-No. 8 Group No. 1
OR
Specification type and grade SA 240 - 304 / 304L
to Specification type and grade SA 240 - 304 / 304L
OR
Chem. Analysis and Mech. Prop. —
to Chem. Analysis and Mech. Prop. —
Thickness Range:
Base Metal: Groove 1.5MM TO 3.5 MM Fillet
Pipe Dia. Range: Groove 73 MM TO UNLIMITED Fillet
Other

*FILLER METALS (QW-404)	①	②	
Spec. No. (SFA)	NONE	5.9	
AWS No. (Class)	—	ER 308-L	
F-No.	—	6	
A-No.	—	8	
Size of Filler Metals	—	1.6MM TO 2.4MM ⚠2	
Weld Metal Thickness Range: Groove	—	1.6MM TO 3.5MM	
Fillet	—	—	
Electrode-Flux (Class)	—	—	
Flux Trade Name	—	—	
Consumable Insert	—	—	
Other	—	—	

Each base metal-filler metal combination should be recorded individually.

(12/91) This form (E00006) may be obtained from the Order Dept., ASME, 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300. REPRINT 8/93

QW-482 (Back)

WPS No. WUVT-1 Rev. 2

POSITIONS (QW-405)
Position(s) of Groove: FLAT AND HORIZONTAL
Welding Progression: Up — Down —
Position(s) of Fillet: —

POSTWELD HEAT TREATMENT (QW-407)
Temperature Range: —
Time Range: —

PREHEAT (QW-406)
Preheat Temp. Min.: 10°C
Interpass Temp. Max.: 50°C
Preheat Maintenance: —
(Continuous or special heating where applicable should be recorded)

GAS (QW-408)

	Gas(es)	Percent Composition (Mixture)	Flow Rate
Shielding	ARGON	100%	7.5 L/MIN.
Trailing	—	—	—
Backing	ARGON	100%	3 L/MIN.

ELECTRICAL CHARACTERISTICS (QW-409)
Current AC or DC: DC Polarity: STRAIGHT
Amps (Range): 50-150 Volts (Range): 9-15
(Amps and volts range should be recorded for each electrode size, position, and thickness, etc. This information may be listed in a tabular form similar to that shown below.)

Tungsten Electrode Size and Type: 1.6mm Ø 2% THORIATED
(Pure Tungsten, 2% Thoriated, etc.)

Mode of Metal Transfer for GMAW: —
(Spray arc, short circuiting arc, etc.)

Electrode Wire feed speed range: —

TECHNIQUE (QW-410)
String or Weave Bead: STRING OR WEAVE
Orifice or Gas Cup Size: 10 MM Ø CUP
Initial and Interpass Cleaning (Brushing, Grinding, etc.): WIRE BRUSH BEFORE EACH PASS
Method of Back Gouging: —
Oscillation: AS REQUIRED
Contact Tube to Work Distance: —
Multiple or Single Pass (per side): MULTIPLE (AS REQUIRED)
Multiple or Single Electrodes: SINGLE
Travel Speed (Range): —
Peening: —
Other: ALL WELDING IS OUT OF CHAMBER. CURRENT MAY BE PULSED OR NOT PULSED.

Weld Layer(s)	Process	Filler Metal Class	Filler Metal Dia.	Current Type Polar.	Current Amp. Range	Volt Range	Travel Speed Range	Other (e.g., Remarks, Comments, Hot Wire Addition, Technique, Torch Angle, Etc.)

QW-482 SUGGESTED FORMAT FOR WELDING PROCEDURE SPECIFICATION (WPS)
(See QW-200.1, Section IX, ASME Boiler and Pressure Vessel Code)

Company Name SPECIFIC MECHANICAL SYSTEMS By: TOM GOLDBACH
Welding Procedure Specification No. WUVT-2 Date FEB. 14/2000 Supporting PQR No.(s) PUVT-2
Revision No. Ø Date
Welding Process(es) GTAW Type(s) MANUAL
(Automatic, Manual, Machine, or Semi-Auto.)

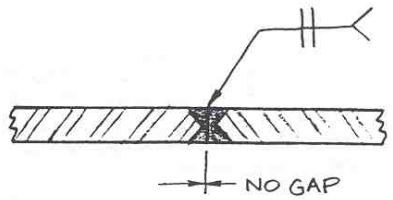
JOINTS (QW-402)
Joint Design SQUARE BUTT WELD
Backing (Yes) (No) NO
Backing Material (Type) BACK/RETAINERS NOT USED
(Refer to both backing and retainers.)

☐ Metal ☐ Nonfusing Metal
☐ Nonmetallic ☐ Other

Sketches, Production Drawings, Weld Symbols or Written Description should show the general arrangement of the parts to be welded. Where applicable, the root spacing and the details of weld groove may be specified.

(At the option of the Mfgr., sketches may be attached to illustrate joint design, weld layers and bead sequence, e.g. for notch toughness procedures, for multiple process procedures, etc.)

Details



*BASE METALS (QW-403)
P-No. 8 Group No. 1 to P-No. 8 Group No. 1
OR
Specification type and grade SA240 - 304/304L
to Specification type and grade SA240 - 304/304L
OR
Chem. Analysis and Mech. Prop.
to Chem. Analysis and Mech. Prop.
Thickness Range:
Base Metal: Groove 0.063" - 0.14" Fillet
Pipe Dia. Range: Groove 27/8" - UNLIMITED Fillet
Other

*FILLER METALS (QW-404)		
Spec. No. (SFA) NONE		
AWS No. (Class)		
F-No.		
A-No.		
Size of Filler Metals		
Weld Metal		
Thickness Range:		
Groove		
Fillet		
Electrode-Flux (Class)		
Flux Trade Name		
Consumable Insert		
Other		

*Each base metal-filler metal combination should be recorded individually.

(12/91) This form (E00006) may be obtained from the Order Dept., ASME, 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300. REPRINT 8/93

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QW-482 (Back)

WPS No. WUVT-2 Rev. Ø

POSITIONS (QW-405)
Position(s) of Groove: FLAT
Welding Progression: Up ____ Down ____
Position(s) of Fillet ____

POSTWELD HEAT TREATMENT (QW-407)
Temperature Range: N.A.
Time Range ____

PREHEAT (QW-406)
Preheat Temp. Min.: 50° F
Interpass Temp. Max.: 120° F
Preheat Maintenance ____
(Continuous or special heating where applicable should be recorded)

GAS (QW-408)

	Gas(es)	Percent Composition (Mixture)	Flow Rate
Shielding	ARGON	100%	15 CFH
Trailing	NONE		
Backing	ARGON	100%	5 CFH

ELECTRICAL CHARACTERISTICS (QW-409)
Current AC or DC: DC Polarity: STRAIGHT
Amps (Range): 50-150 Volts (Range): 9-15
(Amps and volts range should be recorded for each electrode size, position, and thickness, etc. This information may be listed in a tabular form similar to that shown below.)

Tungsten Electrode Size and Type: 1/16" Ø, 2% THORIATED
(Pure Tungsten, 2% Thoriated, etc.)

Mode of Metal Transfer for GMAW ____
(Spray arc, short circuiting arc, etc.)

Electrode Wire feed speed range ____

TECHNIQUE (QW-410)
String or Weave Bead: STRING
Orifice or Gas Cup Size: 3/8" Ø CUP
Initial and Interpass Cleaning (Brushing, Grinding, etc.): WIRE BRUSH BEFORE EACH PASS.
Method of Back Gouging: NOT USED
Oscillation: NONE
Contact Tube to Work Distance ____
Multiple or Single Pass (per side): SINGLE
Multiple or Single Electrodes: SINGLE
Travel Speed (Range) ____
Peening: NOT USED
Other: ALL WELDING IS OUT OF CHAMBER
PULSED CURRENT OR NOT PULSED CURRENT

Weld Layer(s)	Process	Filler Metal Class	Filler Metal Dia.	Current Type Polar.	Current Amp. Range	Volt Range	Travel Speed Range	Other (e.g., Remarks, Comments, Hot Wire Addition, Technique, Torch Angle, Etc.)

QW-482 SUGGESTED FORMAT FOR WELDING PROCEDURE SPECIFICATION (WPS)
(See QW-200.1, Section IX, ASME Boiler and Pressure Vessel Code)

Company Name SPECIFIC MECHANICAL SYSTEMS By: TOM GOLDBACH
Welding Procedure Specification No. WUVT-3 Date FEB. 14/2000 Supporting PQR No.(s) PUVT-2
Revision No. Ø Date
Welding Process(es) GTAW Type(s) MANUAL
(Automatic, Manual, Machine, or Semi-Auto.)

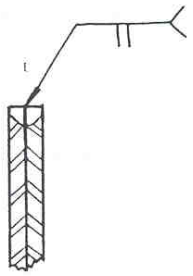
JOINTS (QW-402)
Joint Design EDGE WELD
Backing (Yes) YES (No)
Backing Material (Type) BASE METAL; RETAINERS NOT USED.
(Refer to both backing and retainers.)

☑ Metal ☐ Nonfusing Metal
☐ Nonmetallic ☐ Other

Sketches, Production Drawings, Weld Symbols or Written Description should show the general arrangement of the parts to be welded. Where applicable, the root spacing and the details of weld groove may be specified.

(At the option of the Mfgr., sketches may be attached to illustrate joint design, weld layers and bead sequence, e.g. for notch toughness procedures, for multiple process procedures, etc.)

Details



*BASE METALS (QW-403)
P-No. 8 Group No. 1 to P-No. 8 Group No. 1
OR
Specification type and grade SA240 - 304/304L
to Specification type and grade SA240 - 304/304L
OR
Chem. Analysis and Mech. Prop.
to Chem. Analysis and Mech. Prop.
Thickness Range:
Base Metal: Groove Fillet
Pipe Dia. Range: Groove Fillet
Other 0.02" THICK TO 0.06" THICK

*FILLER METALS (QW-404)		
Spec. No. (SFA)	NONE	
AWS No. (Class)		
F-No.		
A-No.		
Size of Filler Metals		
Weld Metal Thickness Range:		
Groove		
Fillet		
Electrode-Flux (Class)		
Flux Trade Name		
Consumable Insert		
Other		

*Each base metal-filler metal combination should be recorded individually.

(12/91) This form (E00006) may be obtained from the Order Dept., ASME, 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300. REPRINT 8/93

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QW-482 (Back)

WPS No. WUVT-3 Rev. Ø

POSITIONS (QW-405)
Position(s) of Groove: FLAT
Welding Progression: Up _____ Down _____
Position(s) of Fillet _____

POSTWELD HEAT TREATMENT (QW-407)
Temperature Range: N.A.
Time Range _____

PREHEAT (QW-406)
Preheat Temp. Min.: 50° F
Interpass Temp. Max.: 120° F
Preheat Maintenance _____
(Continuous or special heating where applicable should be recorded)

GAS (QW-408)

	Gas(es)	Percent Composition (Mixture)	Flow Rate
Shielding	ARGON	100%	15 CFH
Trailing	NONE		
Backing	ARGON	100%	5 CFH

ELECTRICAL CHARACTERISTICS (QW-409)
Current AC or DC: DC Polarity: STRAIGHT
Amps (Range): 20-30 Volts (Range): 9-11
(Amps and volts range should be recorded for each electrode size, position, and thickness, etc. This information may be listed in a tabular form similar to that shown below.)

Tungsten Electrode Size and Type: 1/16" Ø, 2% THORIATED
(Pure Tungsten, 2% Thoriated, etc.)

Mode of Metal Transfer for GMAW _____
(Spray arc, short circuiting arc, etc.)

Electrode Wire feed speed range _____

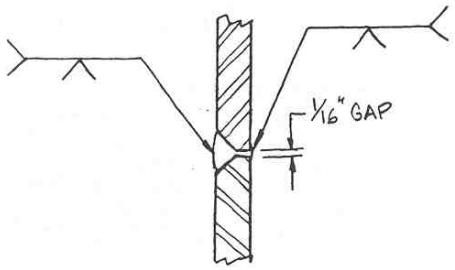
TECHNIQUE (QW-410)
String or Weave Bead: STRING
Orifice or Gas Cup Size: 3/8" Ø CUP
Initial and Interpass Cleaning (Brushing, Grinding, etc.): WIRE BRUSH BEFORE EACH PASS
Method of Back Gouging: NOT USED
Oscillation: NONE
Contact Tube to Work Distance _____
Multiple or Single Pass (per side): SINGLE
Multiple or Single Electrodes: SINGLE
Travel Speed (Range) _____
Peening: NOT USED
Other: ALL WELDING IS OUT OF CHAMBER.
PULSED CURRENT OR NOT PULSED CURRENT.

Weld Layer(s)	Process	Filler Metal Class	Filler Metal Dia.	Current Type Polar.	Current Amp. Range	Volt Range	Travel Speed Range	Other (e.g., Remarks, Comments, Hot Wire Addition, Technique, Torch Angle, Etc.)

QW-483 SUGGESTED FORMAT FOR PROCEDURE QUALIFICATION RECORDS (PQR)
(See QW-200.2, Section IX, ASME Boiler and Pressure Vessel Code)
Record Actual Conditions Used to Weld Test Coupon

Company Name SPECIFIC MECHANICAL SYSTEMS
Procedure Qualification Record No. PUVT-1 Date JAN. 19/2000
WPS No. WUVT-1
Welding Process(es) GTAW
Types (Manual, Automatic, Semi-Auto.) MANUAL

JOINTS (QW-402)



Groove Design of Test Coupon

(For combination qualifications, the deposited weld metal thickness shall be recorded for each filler metal or process used.)

BASE METALS (QW-403)
Material Spec. SA240
Type or Grade 304/304L
P-No. 8 to P-No. 8
Thickness of Test Coupon 0.134"
Diameter of Test Coupon
Other GROUP 1 TO GROUP 1

POSTWELD HEAT TREATMENT (QW-407)
Temperature NOT APPLIED
Time
Other

GAS (QW-408)

	Gas(es)	Percent Composition (Mixture)	Flow Rate
Shielding	ARGON	100%	15 CFH
Trailing	NONE		
Backing	ARGON	100%	5 CFH

FILLER METALS (QW-404)
SFA Specification 5.9
AWS Classification ER308L
Filler Metal F-No. 6
Weld Metal Analysis A-No. 8
Size of Filler Metal 3/32"
Other
Weld Metal Thickness 0.134"

ELECTRICAL CHARACTERISTICS (QW-409)
Current DC
Polarity STRAIGHT
Amps. 60 - 110 Volts 10-12
Tungsten Electrode Size 1/16" ø
Other 2% THORIATED

POSITION (QW-405)
Position of Groove 2G
Weld Progression (Uphill, Downhill)
Other

TECHNIQUE (QW-410)
Travel Speed
String or Weave Bead STRING AND WEAVE
Oscillation AS REQUIRED
Multipass or Single Pass (per side) SINGLE AND MULTI
Single or Multiple Electrodes SINGLE
Other WIRE BRUSH BEFORE EACH PASS, BACK PURGE ALL PASSES.

PREHEAT (QW-406)
Preheat Temp. 40°F - 50°F
Interpass Temp. 120°F
Other

(12/94) This form (E00007) may be obtained from the Order Dept., ASME, 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300. REPRINT 8/95

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QW-483 (Back)

PQR No. PUVT-1

Tensile Test (QW-150)

Specimen No.	Width	Thickness	Area	Ultimate Total Load lb	Ultimate Unit Stress psi	Type of Failure & Location
01A-T1	0.748"	0.125"	0.094 in²	7930	84361	DUCT./W.M.
01A-T2	0.746"	0.126"	0.094 in²	7780	82766	DUCT./W.M.

Guided-Bend Tests (QW-160)

Type and Figure No.	Result
FACE BEND, 01A-F1	ACCEPTABLE
FACE BEND, 01A-F2	ACCEPTABLE
ROOT BEND, 01A-R1	ACCEPTABLE
ROOT BEND, 01A-R2	ACCEPTABLE

Toughness Tests (QW-170)

Specimen No.	Notch Location	Specimen Size	Test Temp.	Impact Values ft. lb	Impact Values % Shear	Impact Values Mils	Drop Weight Break (Y/N)

Fillet-Weld Test (QW-180)

Result – Satisfactory: Yes _____ No _____ Penetration into Parent Metal: Yes _____ No _____

Macro – Results _____

Other Tests

Type of Test RADIOGRAPHIC

Deposit Analysis TUNGSTEN INCLUSION (MODERATE) – ACCEPTABLE

Other _____

Welder's Name GREG FISHER Clock No. 9 Stamp No. 01

Tests conducted by: BACON DONALDSON Laboratory Test No. TA-15

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Manufacturer SPECIFIC MECHANICAL SYSTEMS LTD.

Date FEB. 1/2000 By TOM GOLDBACH

(Detail of record of tests are illustrative only and may be modified to conform to the type and number of tests required by the Code.)

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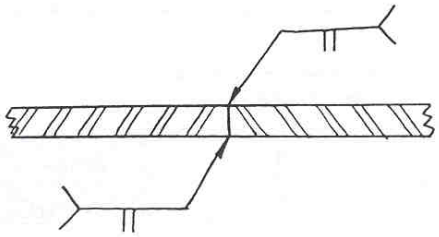
QW-483 SUGGESTED FORMAT FOR PROCEDURE QUALIFICATION RECORDS (PQR)
(See QW-200.2, Section IX, ASME Boiler and Pressure Vessel Code)
Record Actual Conditions Used to Weld Test Coupon

Company Name SPECIFIC MECHANICAL SYSTEMS
Procedure Qualification Record No. PUVT-2 Date JAN. 19/2000
WPS No. WUVT-2, WUVT-3
Welding Process(es) GTAW
Types (Manual, Automatic, Semi-Auto.) MANUAL

JOINTS (QW-402)



Groove Design of Test Coupon
(For combination qualifications, the deposited weld metal thickness shall be recorded for each filler metal or process used.)

BASE METALS (QW-403)
Material Spec. SA240
Type or Grade 304/304L
P-No. 8 to P-No. 8
Thickness of Test Coupon 0.134"
Diameter of Test Coupon
Other GROUP 1 TO GROUP 1

POSTWELD HEAT TREATMENT (QW-407)
Temperature NOT APPLIED
Time
Other

GAS (QW-408)

	Gas(es)	Percent Composition (Mixture)	Flow Rate
Shielding	ARGON	100%	15 CFH
Trailing	NONE		
Backing	ARGON	100%	5 CFH

FILLER METALS (QW-404)
SFA Specification NONE
AWS Classification
Filler Metal F-No.
Weld Metal Analysis A-No.
Size of Filler Metal
Other
Weld Metal Thickness

ELECTRICAL CHARACTERISTICS (QW-409)
Current DC
Polarity STRAIGHT
Amps. 60-110 Volts 10-12
Tungsten Electrode Size 1/16"
Other 2% THORIATED

POSITION (QW-405)
Position of Groove 1G
Weld Progression (Uphill, Downhill)
Other

TECHNIQUE (QW-410)
Travel Speed
String or Weave Bead STRING
Oscillation NONE
Multipass or Single Pass (per side) SINGLE
Single or Multiple Electrodes SINGLE
Other WIRE BRUSH BEFORE EACH PASS, BACK PURGE BOTH PASSES.

PREHEAT (QW-406)
Preheat Temp. 40°F - 50°F
Interpass Temp. 120°F
Other

(12/94) This form (E00007) may be obtained from the Order Dept., ASME, 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300. REPRINT 8/95

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QW-483 (Back)

PQR No. PUVT-2

Tensile Test (QW-150)

Specimen No.	Width	Thickness	Area	Ultimate Total Load lb	Ultimate Unit Stress psi	Type of Failure & Location
01B-T1	0.744"	0.134"	0.100 in^2	8690	86900	DUCT./W.M.
01B-T2	0.742"	0.133"	0.099 in^2	8530	86161	DUCT./W.M.

Guided-Bend Tests (QW-160)

Type and Figure No.	Result
01B-F1, FACE BEND	ACCEPTABLE
01B-F2, FACE BEND	ACCEPTABLE
01B-R1, ROOT BEND	ACCEPTABLE
01B-R2, ROOT BEND	ACCEPTABLE

Toughness Tests (QW-170)

Specimen No.	Notch Location	Specimen Size	Test Temp.	Impact Values			Drop Weight Break (Y/N)
				ft. lb	% Shear	Mils	

Fillet-Weld Test (QW-180)

Result – Satisfactory: Yes _____ No _____ Penetration into Parent Metal: Yes _____ No _____

Macro – Results _____

Other Tests

Type of Test RADIOGRAPHY

Deposit Analysis POROSITY (MINOR) – ACCEPTABLE

Other _____

Welder's Name GREG FISHER Clock No. 9 Stamp No. 01

Tests conducted by: BACON DONALDSON Laboratory Test No. TA-15

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Manufacturer SPECIFIC MECHANICAL SYSTEMS LTD.

Date FEB. 1/2000 By TOM GOLDBACH

(Detail of record of tests are illustrative only and may be modified to conform to the type and number of tests required by the Code.)

Bacon Donaldson
12271 Horseshoe Way
Richmond, BC, Canada V7A 4V4

Phone: (604) 277-2322
Fax: (604) 274-7235

Consulting Engineers
A Rockwood Company

15

ISO 9002

WELD PROCEDURE QUALIFICATION TEST

SPECIFIC MECHANICAL SYSTEMS
6848 Kirkpatrick Crescent
Saanichton, BC
V8M 1Z9

Date: January 5, 2000
File No: 9L0553
P.O. No: Verbal
Report No: 2

Attention: Mr. Tom Goldbach

Sample Description: Butt Weld Stainless Steel Test Plate

Procedure No: 01A
Base Material: SA240-304/304L
Test Sample Size: 0.140"

Welding Process: --
Filler Material: --
Welder ID: --

Test Specification: ASME Section IX

TENSILE TEST

Specimen Identification	Width (in)	Thickness (in)	Area (in^2)	Ultimate Load (lbs)	U.T.S. (psi)	Character and Location of Failure
01A - T1	0.748	0.125	0.094	7,930	84,400	Ductile, Weld Metal
01A - T2	0.746	0.126	0.094	7,780	82,800	Ductile, Weld Metal

Note: The minimum specified tensile strength requirement for SA240 type 304 material is 75,000 psi.

BEND TEST

Specimen Identification	Type of Bend	Results	Specimen Identification	Type of Bend	Results
01A - F1	Face	Acceptable	01A - R1	Root	Acceptable
01A - F2	Face	Acceptable	01A - R2	Root	Acceptable

- Province of British Columbia authorized testing agency for boiler, pressure vessel and pressure piping: No. TA-15.
- Test machine calibrated to ASTM E4 and CSA A23.2-9C specifications.
- Specimens will be disposed of after 30 days unless alternate provisions are made.

BACON DONALDSON

Alex Wong, AScT

9L0553R2-3

16

16
Bacon Donaldson

Bacon Donaldson
12271 Horseshoe Way
Richmond, BC, Canada V7A 4V4

Phone: (604) 277-2322
Fax: (604) 274-7235

Consulting Engineers
A Rockwood Company

ISO 9002

WELD PROCEDURE QUALIFICATION TEST

SPECIFIC MECHANICAL SYSTEMS
6848 Kirkpatrick Crescent
Saanichton, BC
V8M 1Z9

Date: January 5, 2000
File No: 9L0553
P.O. No: Verbal
Report No: 3

Attention: Mr. Tom Goldbach

Sample Description: Butt Weld Stainless Steel Test Plate

Procedure No: 01B
Base Material: SA240-304/304L
Test Sample Size: 0.140"

Welding Process: --
Filler Material: --
Welder ID: --

Test Specification: ASME Section IX

TENSILE TEST

Specimen Identification	Width (in)	Thickness (in)	Area (in^2)	Ultimate Load (lbs)	U.T.S. (psi)	Character and Location of Failure
01B - T1	0.744	0.134	0.100	8,690	86,900	Ductile, Weld Metal
01B - T2	0.742	0.133	0.099	8,530	86,200	Ductile, Weld Metal

Note: The minimum specified tensile strength requirement for SA240 type 304 material is 75,000 psi.

BEND TEST

Specimen Identification	Type of Bend	Results	Specimen Identification	Type of Bend	Results
01B - F1	Face	Acceptable	01B - R1	Root	Acceptable
01B - F2	Face	Acceptable	01B - R2	Root	Acceptable

- Province of British Columbia authorized testing agency for boiler, pressure vessel and pressure piping: No. TA-15.
- Test machine calibrated to ASTM E4 and CSA A23.2-9C specifications.
- Specimens will be disposed of after 30 days unless alternate provisions are made.

BACON DONALDSON

Alex Wong, AScT

9L0553R2-3

Bacon Donaldson
12271 Horseshoe Way
Richmond B.C.,Canada, V7A 4V4
Consulting Engineers
c: (604) 277-2322
(604) 274-7235
ISO 9002

RADIOGRAPHIC EXAMINATION REPORT

TO: SPECIFIC MECHANICAL SYSTEMS
6848 Kirkpatrick Crescent
Saanichton, BC
V8M 1Z9

ATTN: Tom Goldbach

PROJECT: Weld Test Plates
WORK LOCATION: Bacon Donaldson Shop
MANUFACTURER: Specific Mechanical
ACCEPTANCE STANDARD: ASME Sec. IX

PAGE: 1 REPORT #: 1
DATE: December 30, 1999
OUR JOB #: 9L0553
PO #: Verbal
PROCEDURE #: 7
MATERIAL TYPE: Stainless Steel

No.	Identification	View	Film Type	SFD	Thickness	Accept (✓)	Reject (✗)	Remarks
1	Plate #01A	0-25	M	21"	0.140"	✓		Tungsten Inclusion (Moderate)
2	Plate #01B	0-25	M	21"	0.140"	✓		Porosity (Minor)
3	Plate #02A	0-25	M	21"	0.140"	✓		
4	Plate #02B	0-25	M	21"	0.140"	✓		Tungsten Inclusion (Minor)

Radiation Source: Ir 192 [✓] X-ray [ ] _____ Kv
Effective Focal Spot: 3.4 mm
Film used: 4 pcs. Size: 70mm x 17" Brand: Kodak
____ pcs. Size: ____ x ____ Brand: _____

TOTAL HOURS ST OT Shift
Technician's Name: J. Dupuis _____ _____ Day [ ]
2nd Technician's Name: _____ _____ _____ Night [ ]
Other Charges: No [ ] Yes [ ] Kilometres: _____

SIGNATURES
Technician: (Signature on original)
Certification: CGSB / ASNT Level II
Client Rep.: _____

University of Victoria TRIUMF

Hadronic End Cap Signal Feedthroughs

Welding Plan – Part B

Date of issue: **1 September 2000**

Revision: **FINAL**

Notes:

1. SCOPE

This specification covers the welding procedures to be employed in the construction of those parts of the Hadronic End Cap Signal Feedthroughs not covered in Part A

2. APPLICABLE CODE AND SPECIFICATION

The section of the End Cap Signal Feedthrough dealt with in this section of the weld plan does not form part of the End Cap Cryostat and is not required to conform to the Pressure Vessel Code. However, the Code procedures will be employed as a quality control over the assembly.

3. QUALIFICATION OF WELDING PROCEDURES AND WELDERS

3.1 Procedure Qualification

Before any welding is done, the welding procedures to be used will be qualified in accordance with the provisions of ASME Section IX of the Pressure Vessel Code.

3,2 Performance Qualification

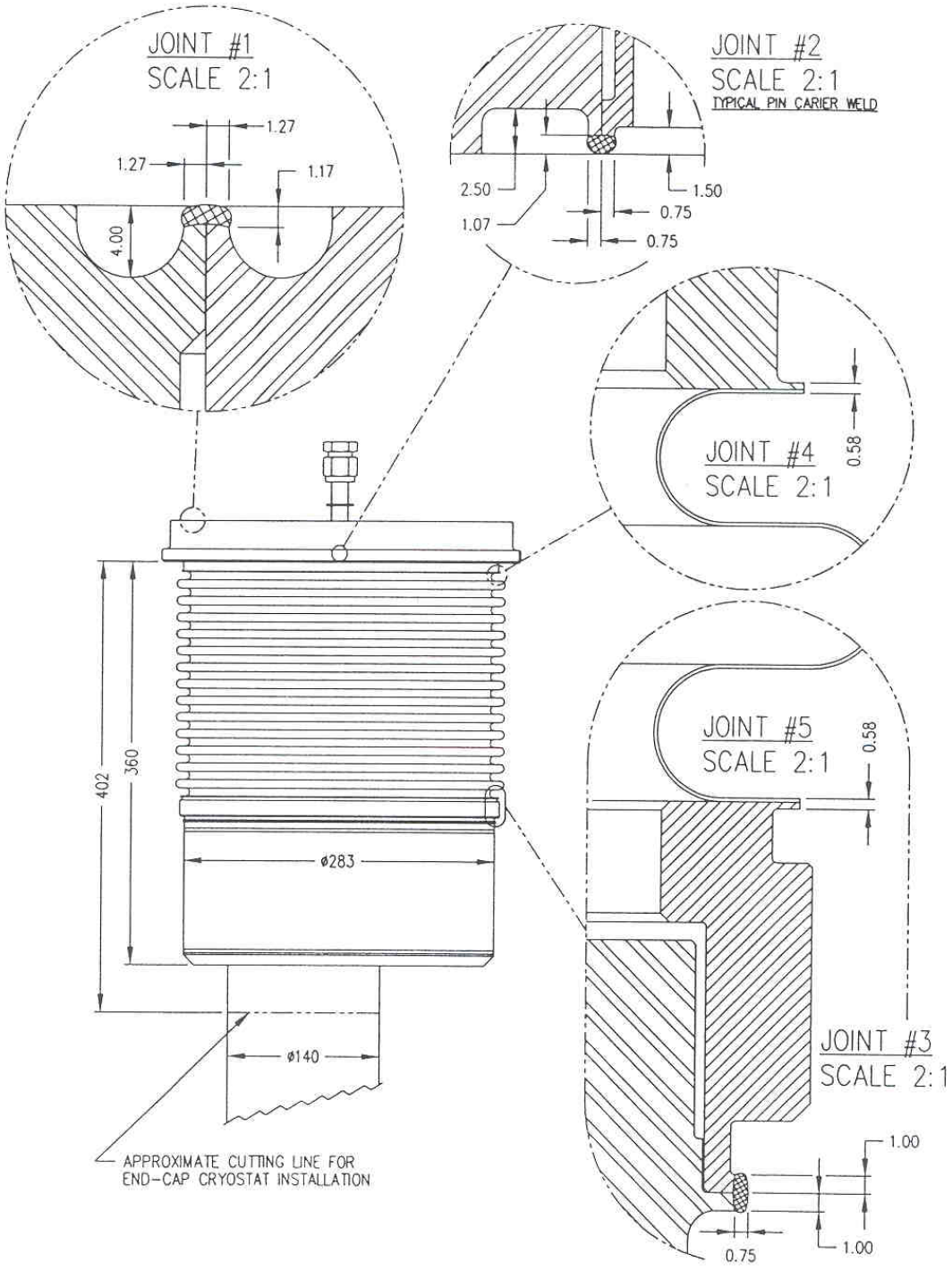
Only welders who have passed the performance qualification tests (see Part A of Weld Plan) will be permitted to do the welding.

4. SUPPORTING WELD PROCEDURE SPECIFICATIONS

Joints No.	W.P.S No.	P.Q.R No.	Welding process	Page No.
1,2 and 3	WUVT-3	PUVT-2	GTAW manual	4
4 and 5	Welds done by bellows manufacturer			

2

5. WELD MAP



HEC Feedthrough – Weldmap B1

6. SUPPORTING PROCESS QUALIFICATION RECORDS

P.Q.R. No.	P No.	Welding Process	Page No.
PUVT-2	8	GTAW manual	6

QW-482 SUGGESTED FORMAT FOR WELDING PROCEDURE SPECIFICATION (WPS)
(See QW-200.1, Section IX, ASME Boiler and Pressure Vessel Code)

Company Name SPECIFIC MECHANICAL SYSTEMS By: TOM GOLDBACH
Welding Procedure Specification No. WUVT-3 Date FEB. 14/2000 Supporting PQR No.(s) PUVT-2
Revision No. Ø Date
Welding Process(es) GTAW Type(s) MANUAL
(Automatic, Manual, Machine, or Semi-Auto.)

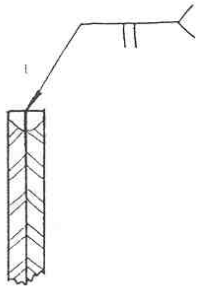
JOINTS (QW-402)
Joint Design EDGE WELD
Backing (Yes) YES (No)
Backing Material (Type) BASE METAL; RETAINERS NOT USED.
(Refer to both backing and retainers.)

☑ Metal ☐ Nonfusing Metal
☐ Nonmetallic ☐ Other

Sketches, Production Drawings, Weld Symbols or Written Description should show the general arrangement of the parts to be welded. Where applicable, the root spacing and the details of weld groove may be specified.

(At the option of the Mfgr., sketches may be attached to illustrate joint design, weld layers and bead sequence, e.g. for notch toughness procedures, for multiple process procedures, etc.)

Details



*BASE METALS (QW-403)
P-No. 8 Group No. 1 to P-No. 8 Group No. 1
OR
Specification type and grade SA240 - 304/304L
to Specification type and grade SA240 - 304/304L
OR
Chem. Analysis and Mech. Prop.
to Chem. Analysis and Mech. Prop.
Thickness Range:
Base Metal: Groove Fillet
Pipe Dia. Range: Groove Fillet
Other 0.02" THICK TO 0.06" THICK

*FILLER METALS (QW-404)		
Spec. No. (SFA) NONE		
AWS No. (Class)		
F-No.		
A-No.		
Size of Filler Metals		
Weld Metal Thickness Range:		
Groove		
Fillet		
Electrode-Flux (Class)		
Flux Trade Name		
Consumable Insert		
Other		

*Each base metal-filler metal combination should be recorded individually.

(12/91) This form (E00006) may be obtained from the Order Dept., ASME, 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300. REPRINT 8/93

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QW-482 (Back)

WPS No. WUVT-3 Rev. Ø

POSITIONS (QW-405)
Position(s) of Groove FLAT
Welding Progression: Up _____ Down _____
Position(s) of Fillet _____

POSTWELD HEAT TREATMENT (QW-407)
Temperature Range N.A.
Time Range _____

PREHEAT (QW-406)
Preheat Temp. Min. 50° F
Interpass Temp. Max. 120° F
Preheat Maintenance _____
(Continuous or special heating where applicable should be recorded)

GAS (QW-408)

	Gas(es)	Percent Composition (Mixture)	Flow Rate
Shielding	ARGON	100%	15 CFH
Trailing	NONE		
Backing	ARGON	100%	5 CFH

ELECTRICAL CHARACTERISTICS (QW-409)
Current AC or DC DC Polarity STRAIGHT
Amps (Range) 20-30 Volts (Range) 9-11
(Amps and volts range should be recorded for each electrode size, position, and thickness, etc. This information may be listed in a tabular form similar to that shown below.)

Tungsten Electrode Size and Type 1/16" Ø, 2% THORIATED
(Pure Tungsten, 2% Thoriated, etc.)

Mode of Metal Transfer for GMAW _____
(Spray arc, short circuiting arc, etc.)

Electrode Wire feed speed range _____

TECHNIQUE (QW-410)
String or Weave Bead STRING
Orifice or Gas Cup Size 3/8" Ø CUP
Initial and Interpass Cleaning (Brushing, Grinding, etc.) WIRE BRUSH BEFORE EACH PASS
Method of Back Gouging NOT USED
Oscillation NONE
Contact Tube to Work Distance _____
Multiple or Single Pass (per side) SINGLE
Multiple or Single Electrodes SINGLE
Travel Speed (Range) _____
Peening NOT USED
Other ALL WELDING IS OUT OF CHAMBER.
PULSED CURRENT OR NOT PULSED CURRENT.

Weld Layer(s)	Process	Filler Metal Class	Filler Metal Dia.	Current Type Polar.	Current Amp. Range	Volt Range	Travel Speed Range	Other (e.g., Remarks, Comments, Hot Wire Addition, Technique, Torch Angle, Etc.)

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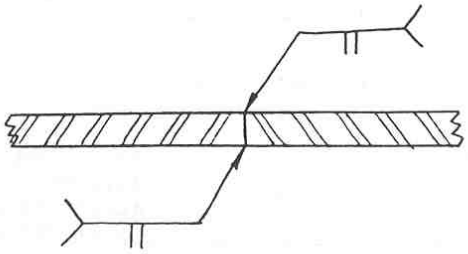
QW-483 SUGGESTED FORMAT FOR PROCEDURE QUALIFICATION RECORDS (PQR)
(See QW-200.2, Section IX, ASME Boiler and Pressure Vessel Code)
Record Actual Conditions Used to Weld Test Coupon

..pany Name SPECIFIC MECHANICAL SYSTEMS
Procedure Qualification Record No. PUVT-2 Date JAN. 19/2000
WPS No. WUVT-2, WUVT-3
Welding Process(es) GTAW
Types (Manual, Automatic, Semi-Auto.) MANUAL

JOINTS (QW-402)



Groove Design of Test Coupon
(For combination qualifications, the deposited weld metal thickness shall be recorded for each filler metal or process used.)

BASE METALS (QW-403)
Material Spec. SA240
Type or Grade 304/304L
No. 8 to P-No. 8
Thickness of Test Coupon 0.134"
Diameter of Test Coupon
Other GROUP 1 TO GROUP 1

POSTWELD HEAT TREATMENT (QW-407)
Temperature NOT APPLIED
Time
Other

GAS (QW-408)

	Gas(es)	Percent Composition (Mixture)	Flow Rate
Shielding	ARGON	100%	15 CFH
Trailing	NONE		
Backing	ARGON	100%	5 CFH

FILLER METALS (QW-404)
SFA Specification NONE
AWS Classification
Filler Metal F-No.
Weld Metal Analysis A-No.
Size of Filler Metal
Other
Weld Metal Thickness

ELECTRICAL CHARACTERISTICS (QW-409)
Current DC
Polarity STRAIGHT
Amps. 60-110 Volts 10-12
Tungsten Electrode Size 1/16"
Other 2% THORIATED

POSITION (QW-405)
Position of Groove 1G
Weld Progression (Uphill, Downhill)
Other

TECHNIQUE (QW-410)
Travel Speed
String or Weave Bead STRING
Oscillation NONE
Multipass or Single Pass (per side) SINGLE
Single or Multiple Electrodes SINGLE
Other WIRE BRUSH BEFORE EACH PASS, BACK PURGE BOTH PASSES.

PREHEAT (QW-406)
Preheat Temp. 40°F - 50°F
Interpass Temp. 120°F
Other

(12/94) This form (E00007) may be obtained from the Order Dept., ASME, 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300. REPRINT 8/95

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QW-483 (Back)

PQR No. PUVT-2

Tensile Test (QW-150)

Specimen No.	Width	Thickness	Area	Ultimate Total Load lb	Ultimate Unit Stress psi	Type of Failure & Location
01B-T1	0.744"	0.134"	0.100 in^2	8690	86900	DUCT./W.M.
01B-T2	0.742"	0.133"	0.099 in^2	8530	86161	DUCT./W.M.

Guided-Bend Tests (QW-160)

Type and Figure No.	Result
01B-F1, FACE BEND	ACCEPTABLE
01B-F2, FACE BEND	ACCEPTABLE
01B-R1, ROOT BEND	ACCEPTABLE
01B-R2, ROOT BEND	ACCEPTABLE

Toughness Tests (QW-170)

Specimen No.	Notch Location	Specimen Size	Test Temp.	Impact Values			Drop Weight Break (Y/N)
				ft. lb	% Shear	Mils	

Fillet-Weld Test (QW-180)

Result – Satisfactory: Yes _____ No _____ Penetration into Parent Metal: Yes _____ No _____

Macro – Results _____

Other Tests

Type of Test RADIOGRAPHY

Deposit Analysis POROSITY (MINOR) – ACCEPTABLE

Other _____

Welder's Name GREG FISHER Clock No. 9 Stamp No. 01

Tests conducted by: BACON DONALDSON Laboratory Test No. TA-15

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Manufacturer SPECIFIC MECHANICAL SYSTEMS LTD.

Date FEB. 1/2000 By TOM GOLDBACH

(Detail of record of tests are illustrative only and may be modified to conform to the type and number of tests required by the Code.)

Appendix E - Metal Invoices and Certification

University of Victoria Feedthroughs

Material Invoices and Certification

Seal Ring 336mm (13 ¼") OD x 254mm (10") ID x 47.6mm (1 7/8") Thick

Invoice #030-56-0082	Heat B0110	Qty 32	P2 / P6
Invoice #129-56-0074	Heat B9872	Qty 35	P3 / P7

Warm Flange 279mm (11") OD x 31.8mm (1 1/4") Thick

Invoice #129-56-0022	Heat B9872	Qty 67	P4 / P7

Cold Flange 289mm (11 3/8") x 41.3mm (1 5/8") Thick

Invoice #030-56-0064	Heat B0110	Qty 21	P5 / P8
Invoice #129-56-0074	Heat B9872	Qty 45	P3 / P7

Funnel Base 289mm (11 3/8") OD x 19mm (3/4") Thick

Invoice #030-56-0064	Heat B0110	Qty 22	P5
Invoice #129-56-0074	Heat B9872	Qty 44	P3

Bellows 304L Strip .20mm (.008") x 610mm (24") Wide

RSM Order No.	9901239	P9

Bolt Ring 2024-T351 Aluminum 38mm (1 1/2") Plate 368mm (14.5") Diam

TW Metals Order No. 4034805	P10

Cuff Ring 304l SS 305mm (12") x 305mm (12") x 28.6mm (1 1/8") thick

TW Metals Order No. 4034805	Cert# 18924 (C.O. Carlson Inc.)	P10 / 11

Upper funnel tube Tube rolled from sheet 3.4mm (.134") Thick SS304L

PO 5250	Outokumpu Polarit Oy	P12 / 13

Lower funnel Tube 141.4mm (5 9/16") OD Pipe SS 304L

Order 0002368/001	Heat 725002	(Avesta Sheffield Pipe Co.)	P14

Pin Carriers	Batch 1	Cern Stores		P15 to P19
	Batch 2	Sandmyer	(S 1)	P20

Batch 3 Sandmyer (S 2) P21
P2

LATROBE STEEL COMPANY
A Timken Company Subsidiary
P.O. Box 31
Latrobe, PA 15650-0031
Telephone: 724-532-6412 Fax: 724-532-6367

PLEASE REMIT TO

LATROBE STEEL COMPANY PO BOX 360434 PITTSBURGH PA 15251-6434

WIRE TRANSFER REMITTANCE ADVICE: Mellon Bank, Mellon Square Pittsburgh, PA 15230 BRN #043-000-261, Latrobe #146-4165, Koncor #146-4958

CUSTOMER ORDER NO. - REQ'N. NO.	CUST. DATE	VENDOR NO.	BR.	SLSM.	CUST. CODE	SPL. BR.	SP. SLSM	BRANCH ORDER NO.	INVOICE DATE	INVOICE NUMBER
P0015016			57	178	92741			079-50677	031700	030-56-0082

CARRIER	D.M.S.	GOV'T CONTRACT NUMBER	SHIP DATE		INV. BR.	SHIP BR.
	NONE		03 17 00	2260102	56	5[illegible]

INVOICE TO:
UNIVERSITY OF VICTORIA
PURCHASING SERVICES
3800 FINNERTY ROAD
PO BX 1700 VICTORIA BC
CANADA V8W 2Y2,

SHIP TO:
UNIVERSITY OF VICTORIA
ROOM 022-ELLIOTT BLDG
3800 FINNERTY ROAD
VICTORIA, BC
CANADA V8P 1A1,

TERMS: NET 30 DAYS FROM INVOICE DATE.
MILL SHIPMENTS TO PACIFIC COAST.
NET 45 DAYS FROM INVOICE DATE.

DEDUCT CASH DISCOUNT OF $28.77 FROM INVOICE
TOTAL IF PAID ON OR BEFORE 04/10/00

THIS AGREEMENT IS SUBJECT TO ALL OF THE CONDITIONS AND PROVISIONS OF SALE ON THE REVERSE SIDE HEREOF INCLUDING THOSE LIMITING WARRANTIES.

PAR. COM.	M	QUANTITY ORDERED	DESCRIPTION	HEAT NO.	MATERIALS SHIPPED: BARS BILLETS	PIECES FORGINGS	WEIGHT	UNIT PRICE	STEEL VALUE
C	04	66	PC 13-1/4 IN OD +1/8 -0 X 10 IN ID +0 -1/8 X 1-7/8 IN C/L -0 +1/8, 304L VAC ARC STN STL, CHEM PER ASTM A479-96, MICRO CLEANLINESS PER ASTM E45-95A WORST FIELD RATING METHOD THIN/HEAVY ABCD DESTN	80110		32	1,056.00	179.7900/PC	5,753.28

ORDER COMP.	PART	PAGE	TOTAL WEIGHT	FREIGHT AND OTHER CHARGES AS NOTED BELOW ARE INCLUDED IN INVOICE TOTAL	PLEASE PAY INVOICE TOTAL
X		1 OF 1	1,056.00		

TOTAL STEEL VALUE	FREIGHT	OTHER	TAX	
5,753.28*				$5,753.28

PLEASE RETURN THIS COPY WITH YOUR REMITTANCE
AN EQUAL EMPLOYMENT OPPORTUNITY EMPLOYER—INVOICE COPY
10000-0298
[illegible]954-X5
03/17/00

PURCHASING DEPARTMENT RECEIVED MAR 30 [illegible]

P3

LATROBE STEEL COMPANY
A Timken Company Subsidiary
P.O. Box 31
Latrobe, PA 15650-0031
Telephone: 724-532-6412 Fax: 724-532-6367

PLEASE REMIT TO
LATROBE STEEL COMPANY PO BOX 360434 PITTSBURGH PA 15251-6434
WIRE TRANSFER REMITTANCE ADVICE: Mellon Bank, Mellon Square Pittsburgh, PA 15230 BRN #043-000-261, Latrobe #146-4165, Koncor #146-495

CUSTOMER ORDER NO. - REQ'N. NO.	CUST. DATE	VENDOR NO.	BR.	SLSM.	CUST. CODE	SPL. BR	SP. SLSM	BRANCH ORDER NO.	INVOICE DATE	INVOICE NUMBER
P0015016			57	178	92741			079-50677	12 20 99	129-56-0074

CARRIER	D.M.S.	GOV'T CONTRACT NUMBER	SHIP DATE		INV. BR.	SHIP BR
	NONE		12 17 99	2260102	56	56

INVOICE TO:
UNIVERSITY OF VICTORIA
PURCHASING SERVICES
3800 FINNERTY ROAD
PO BX 1700 VICTORIA BC
CANADA V8W 2Y2,

SHIP TO:
UNIVERSITY OF VICTORIA
ROOM 022-ELLIOTT BLDG
3800 FINNERTY ROAD
VICTORIA, BC
CANADA V8P 1A1,

TERMS: NET 30 DAYS FROM INVOICE DATE. MILL SHIPMENTS TO PACIFIC COAST. NET 45 DAYS FROM INVOICE DATE.
DEDUCT CASH DISCOUNT OF $75.04
TOTAL IF PAID ON OR BEFORE 01/10/21 FROM INVOICE

THIS AGREEMENT IS SUBJECT TO ALL OF THE CONDITIONS AND PROVISIONS OF SALE ON THE REVERSE SIDE HEREOF INCLUDING THOSE LIMITING WARRANTIES.

PART CODE	ITEM	QUANTITY ORDERED	DESCRIPTION	HEAT NO.	BARS BILLETS	PIECES FORGINGS	WEIGHT	UNIT PRICE	STEEL VALUE
P	02	66	PC 11-3/8 IN RD X 1-5/8 IN C/L -0 +1/8 IN, 304L VAC ARC STN STL RGH TURNED ANNLD. CHEM PER ASTM A479-96, MICRO CLEANLINESS PER ASTM E45-95A WORST FIELD RATING METHOD THIN/HEAVY ABCD DESTN	89872		45	2,340.00	126.1300/PC	5,678.10*
P	03	66	PC 11-3/8 IN RD X 3/4 IN C/L -0 +1/8 IN, 304L VAC ARC STN STL RGH TURNED, ANNLD CHEM PER ASTM A479-96, MICRO CLEANLINESS PER ASTM E45-95A WORST FIELD RATING METHOD THIN/HEAVY ABCD DESTN	89872		44	1,012.00	69.0500/PC	3,038.20*
P	04	66	PC 13-1/4 IN OD +1/8 -0 X 10 IN ID +0 -1/8 X 1-7/8 IN C/L -0 +1/8, 304L VAC ARC STN STL, CHEM PER ASTM A479-96, MICRO CLEANLINESS PER ASTM E45-95A WORST FIELD RATING METHOD THIN/HEAVY ABCD DESTN	89872		35 (124)	1,260.00	179.7900/PC	6,292.65*

OK

ORDER COMP.	PART	PAGE	TOTAL WEIGHT	FREIGHT AND OTHER CHARGES AS NOTED BELOW ARE INCLUDED IN INVOICE TOTAL	PLEASE PAY INVOICE TOTAL
X		1 OF 1	4,612.00		

TOTAL STEEL VALUE	FREIGHT	OTHER	TAX	
15,008.95*				$15,008.95

RECEIVED PURCHASING
JAN 4 A9:05

PLEASE RETURN THIS COPY WITH YOUR REMITTANCE
AN EQUAL EMPLOYMENT OPPORTUNITY EMPLOYER—INVOICE COPY
10000-0298 0672954-XS
2/20/99

P4

P.O. Box 31
Latrobe, PA 15650-0031 I0176233 - PHYS.
Telephone: 724-532-6412 Fax: 724-532-6367

LATROBE STEEL COMPANY PO BOX 360434 PITTSBURGH PA 15251-6434
WIRE TRANSFER REMITTANCE ADVICE: Mellon Bank, Mellon Square Pittsburgh, PA 15230 BRN #043-000-261, Latrobe #146-4165, Koncor #146-4

CUSTOMER ORDER NO. - REQ'N. NO.	CUST. DATE	VENDOR NO.	BR.	SLSM.	CUST. CODE	SPL BR	SP. SLSM	BRANCH ORDER NO.	INVOICE DATE	INVOICE NUMBER
P0015016			57	178	92741			079-50677	120799	129-56-0022

CARRIER	D.M.S.	GOV'T CONTRACT NUMBER	SHIP DATE		INV. BR.
	NONE		12 07 99	2260102	56

INVOICE TO:
UNIVERSITY OF VICTORIA
PURCHASING SERVICES
3800 FINNERTY ROAD
PO BX 1700 VICTORIA BC
CANADA V8W 2Y2,

SHIP TO:
UNIVERSITY OF VICTORIA
ROOM 022-ELLIOTT BLDG
3800 FINNERTY ROAD
VICTORIA, BC
CANADA V8P 1A1,

TERMS: NET 30 DAYS FROM INVOICE DATE. MILL SHIPMENTS TO PACIFIC COAST. NET 45 DAYS FROM INVOICE DATE.
DEDUCT CASH DISCOUNT OF $38.40 FROM INVOICE
TOTAL IF PAID ON OR BEFORE 12/25/99

THIS AGREEMENT IS SUBJECT TO ALL OF THE CONDITIONS AND PROVISIONS OF SALE ON THE REVERSE SIDE HEREOF INCLUDING THOSE LIMITING WARRANTIES.

PART COMP.	ITEM	QUANTITY ORDERED	DESCRIPTION	HEAT NO.	LOTS/BUNDLES	MATERIALS SHIPPED PIECES/FOOTAGE	WEIGHT	UNIT PRICE	STEEL VALUE
	01	66	PC 11 IN RD X 1-1/4 IN C/L -0 + 1/8 IN 304L VAC ARC STN STL RGH TURNED, ANNLD CHEM PER ASTM A479-96, MICRO CLEANLINESS PER ASTM E45-95A WORST FIELD RATING METHOD THIN/ HEAVY ABCD DESTN	B9872		67	2,647.00	114.6200/PC	7,679.54

RECEIVED PURCHASING DIVISION
DEC 14 A10:45

ORDER COMP.	ORDER PART	PAGE	TOTAL WEIGHT	FREIGHT AND OTHER CHARGES AS NOTED BELOW ARE INCLUDED IN INVOICE TOTAL	PLEASE PAY INVOICE TOTAL
	X	1 OF 1	2,647.00		

TOTAL STEEL VALUE	FREIGHT	OTHER	TAX	
7,679.54*				$7,679.54

AN EQUAL EMPLOYMENT OPPORTUNITY EMPLOYER—ORIGINAL INVOICE

R-0-67954-X5
12/07/99

P5

LATROBE STEEL COMPANY
A Timken Company Subsidiary
P.O. Box 31
Latrobe, PA 15650-0031
Telephone: 724-532-6412 Fax: 724-532-6367

PLEASE REMIT TO I 0196685 ▽ UC

LATROBE STEEL COMPANY PO BOX 360434 PITTSBURGH PA 15251-6434

WIRE TRANSFER REMITTANCE ADVICE: Mellon Bank, Mellon Square Pittsburgh, PA 15230 BRN #043-000-261, Latrobe #146-4165, Koncor #146-495

CUSTOMER ORDER NO. - REQ'N. NO.	CUST. DATE	VENDOR NO.	BR.	SLSM.	CUST. CODE	SPL BR	SP. SLSM	BRANCH ORDER NO.	INVOICE DATE	INVOICE NUMBER
P0015016			57	178	92741			079-50677	03 10 00	030-56-0064

CARRIER	D.M.S.	GOV'T CONTRACT NUMBER	SHIP DATE		INV. BR.	SHIP BR
	NONE		03 10 00	2260102	56	56

UNIVERSITY OF VICTORIA
PURCHASING SERVICES
3800 FINNERTY ROAD
PO BX 1700 VICTORIA BC
CANADA V8W 2Y2,

SHIP TO
UNIVERSITY OF VICTORIA
ROOM 022-ELLIOTT BLDG
3800 FINNERTY ROAD
VICTORIA, BC
CANADA V8P 1A1,

TERMS: NET 30 DAYS FROM INVOICE DATE. MILL SHIPMENTS TO PACIFIC COAST. NET 45 DAYS FROM INVOICE DATE.

DEDUCT CASH DISCOUNT OF $20.84 FROM INVOICE
TOTAL IF PAID ON OR BEFORE 03/25/00

THIS AGREEMENT IS SUBJECT TO ALL OF THE CONDITIONS AND PROVISIONS OF SALE ON THE REVERSE SIDE HEREOF INCLUDING THOSE LIMITING WARRANTIES.

PART COMM	ITEM	QUANTITY ORDERED	DESCRIPTION	HEAT NO.	BARS BILLETS	PIECES FORGINGS	WEIGHT	UNIT PRICE	STEEL VALUE
C	02	66	PC 11-3/8 IN RD X 1-5/8 IN C/L -0 +1/8 IN, 304L VAC ARC STN STL RGH TURNED ANNLD. CHEM PER ASTM A479-96, MICRO CLEANLINESS PER ASTM E45-95A WORST FIELD RATING METHOD THIN/HEAVY ABCD DESTN			21	1,021.00	126.1800/PC	2,649.78*
C	03	66	PC 11-3/8 IN RD X 3/4 IN C/L -0 +1/8 IN, 304L VAC ARC STN STL RGH TURNED, ANNLD CHEM PER ASTM A479-96, MICRO CLEANLINESS PER ASTM E45-95A WORST FIELD RATING METHOD THIN/ HEAVY ABCD DESTN			22	497.00	69.0500/PC	1,519.10*

PAY

ORDER COMP.	PART	PAGE	TOTAL WEIGHT	FREIGHT AND OTHER CHARGES AS NOTED BELOW ARE INCLUDED IN INVOICE TOTAL	PLEASE PAY INVOICE TOTAL ▼
	X	1 OF 1	1,518.00		

TOTAL STEEL VALUE	FREIGHT	OTHER	TAX	
4,168.88*				$4,168.83

PLEASE RETURN THIS COPY WITH YOUR REMITTANCE
AN EQUAL EMPLOYMENT OPPORTUNITY EMPLOYER—INVOICE COPY

10000-02954-X5

Timken Latrobe Steel
A Timken Company Subsidiary
Latrobe, PA 15650

CERTIFICATE OF TEST

Production Order Number	Bars/Pieces	Wgt. Shipped	Sales Order No.	Heat No.
10015715-01-01	32	1056	07950677-04	B0110
Customer Order No./Req'n. No.			Delivery Number	
P0015016				

UNIVERSITY OF VICTORIA PURCHASING SERVICES 3800 FINNERTY ROAD PO BX 1700 VICTORIA BC CANADA V8W 2Y2	UNIVERSITY OF VICTORIA ROOM 022-ELLIOTT BLDG 3800 FINNERTY ROAD VICTORIA, BC, V8P 1A1 CANADA

Material Ordered:
13-1/4 IN OD +1/8 -0 X 10 IN ID +0 -1/8 X 1-7/8 IN CL -0 +1/8
304L VAC ARC STN STL, CHEM PER ASTM A479-96, MICRO CLEANLINESS PER ASTM E45 WORST FIELD RATING METHOD THIN/HEAVY ABCD INGOT #2

Chemical Analysis Wt%:

Locn	C	Si	Mn	S	P	Cr	Ni	N
2T	.029	.43	1.63	.001	.018	18.37	10.07	.06
2B	.028	.39	1.54	.001	.017	18.67	9.48	.06

Microcleanliness per ASTM E45-97:

Worst Fields	A		B		C		D	
Locations:	t	h	t	h	t	h	t	h
2T	0	0	0	0	0	0	0	0
2B	0	0	0	0	0	0	0	0

The worst field and total rateable fields frequency requirements were found to be within applicable specification limits.

Macroetch per ASTM E-381: S2, R1, C1

Hardness: 143 HBS

We certify this material to have been manufactured, inspected, and tested; and found the results to conform to all drawing and/or specification requirements and order requirements as applicable. The recording of false, fictitious or fraudulent statements or entries on this document may be punished as a felony under Federal Law, Title 18, Chapter 47.

Linda S. Hostetler 3/14/00

Inspection Department Date
David J. Fidazzo/Supervisor-Metallurgical Certification

Page 1 of 1

Timken Latrobe Steel
A Timken Company Subsidiary
Latrobe, PA 15650

CERTIFICATE OF TEST

Production Order Number	Bars/Pieces	Wgt. Shipped	Sales Order No.	Heat No.
10007538-01-01	67	2647	07950677-01	B9872

Customer Order No./Req'n. No. — Delivery Number
P0015016

3109986-0

Bill To: B92741	Ship To: S92741
UNIVERSITY OF VICTORIA PURCHASING SERVICES 3800 FINNERTY ROAD PO BOX 1700 VICTORIA, BC, V8W 2Y2 CANADA	UNIVERSITY OF VICTORIA ROOM 022-ELLIOTT BLDG 3800 FINNERTY ROAD VICTORIA, BC, V8P 1A1 CANADA

Material Ordered:
11 IN RD X 1/14 IN C/L -0 +1/8 IN 304L VAC ARC STN STL RGH TURNED, ANNLD
CHEM PER ASTM A479-96, MICRO CLEANLINESS PER ASTM E45-95A WORST
FIELD RATING METHOD THIN/HEAVY ABCD INGOT# 1

Chemical Analysis Wt%:

Locn	C	Si	Mn	S	P	Cr	Ni	N2
1T	.028	.38	1.69	.001	.019	18.74	9.72	.03
1B	.026	.38	1.66	.001	.017	18.70	9.62	.03

Hardness: 149 HBS

Macroetch per ASTM E-381: S1, R1, C1

Microcleanliness per ASTM E45-97:

Worst Fields	A		B		C		D	
Locations:	t	h	t	h	t	h	t	h
3T	0	0	0	0	0	0	0	0
3B	0	0	0	0	0	0	0	0

The worst field and total rateable fields frequency requirements were found to be within applicable specification limits.

We certify this material to have been manufactured, inspected, and tested in accordance with the methods prescribed by the governing specifications and order, and that the results conform with applicable requirements. The recording of false, fictitious or fraudulent statements or entries on this document may be punished as a felony under Federal Law. Title 18, Chapter 47.

Linda S. Kostelak 12/7/99

Inspection Department — Date
David J. Fidazzo/Supervisor-Metallurgical Certification

Page 1 of 1

P8

Timken Latrobe Steel
A Timken Company Subsidiary
Latrobe, PA 15650

CERTIFICATE OF TEST

Production Order Number	Bars/Pieces	Wgt. Shipped	Sales Order No.	Heat No.
10015717-01-01	21	1021	07950677-02	B0110

Customer Order No./Req'n. No. — Delivery Number
P0015016

Ship To: S92741
UNIVERSITY OF VICTORIA
ROOM 022-ELLIOTT BLDG
3800 FINNERTY ROAD
VICTORIA, BC, V8P 1A1
CANADA

Bill To: B92741
UNIVERSITY OF VICTORIA
PURCHASING SERVICES
3800 FINNERTY ROAD
1700
VICTORIA, BC, V8W 272
CANADA

Material Ordered:
66 PCS 11-3/8 IN RD X 1-5/8 IN C/L -0 +1/8 IN. 304L VAC ARC
STN STL RGH TURNED ANNLD. CHEM PER ASTM A479-96,
MICROCLEANLINESS PER ASTM E45-95A WORST FIELD RATING METHOD
THIN/HEAVY ABCD INGOT NO. 1

Chemical Analysis Wt%:

Locn	C	Si	Mn	S	P	Cr	Ni	N
1T	.029	.42	1.61	.001	.017	18.58	9.72	.05
1B	.020	.38	1.61	.001	.016	18.63	9.40	.06

Microcleanliness per ASTM E45-97:

Worst Fields	A		B		C		D	
Locations:	t	h	t	h	t	h	t	h
1T	0	0	0	0	0	0	0	0
1B	0	0	0	0	0	0	0	0

The worst field and total rateable fields frequency requirements were found to be within applicable specification limits.

Macroetch per ASTM E-381: S2, R1, C1

Hardness: 140 HBS

We certify this material to have been manufactured, inspected, and tested; and found the results to conform to all drawing and/or specification requirements and order requirements as applicable. The recording of false, fictitious or fraudulent statements or entries on this document may be punished as a felony under Federal Law, Title 18, Chapter 47.

Page 1 of 1

3/8/00

Inspection Department — Date
David J. Fidazzo/Supervisor-Metallurgical Certification

P9

RSM Rahns Specialty Metals Inc.
USINOR GROUP

P.O. Box 26820, Collegeville, PA 19426-0820
1-800-523-1777 • (610) 489-7211 • FAX: (610) 489-2996

SOLD BY:

SOLD AND/OR SHIP TO	AMERICAN BOA INC PO BOX 1301 CUMMING, GA 30130
SHIP TO	AMERICAN BOA INC. 1420 REDI RD. CUMMING GA 30130

UNLESS SOLD TO/SHIP TO OTHERWISE INDICATED

CUSTOMER'S ORDER NO.	RSM ORDER NO.	DATE SHIPPED	SALES CODE
7393	9901239	10/06/99	23/07

EM	QTY. SHIP	DESCRIPTION
	531	.008 X 24.00 304L STAINLESS STRIP ANNEALED TEMPER IN COILS SPEC: A/SA 240/ASTM A240 MARK: 53898AIM

P.O. # 45
P/N 79819
5000000323

HEAT

	C	Mn	Si	S	P	Cr	Ni	Cu	B	Fe	Al
[illegible]	.028	1.695	.272	.001	.030	18.39	9.706	.360			
	Ti	Nb & Ta	Co	Mo	V	Mg	Ca	N	O	H	W
				.442				.022			
		Nb	Ta	Sn	Be						

S SHIPPED PROPERTIES:

TENSILE STR.	YIELD STR.	% ELG.		GRAIN SIZE	HARDNESS		BEND TEST
[illegible]	[illegible]	62			(HRB 75)		

FTER HEAT TREAT PROPERTIES @ ROOM TEMPERATURE:

TENSILE STR.	YIELD STR.	% ELG.		GRAIN SIZE	HARDNESS		BEND TEST

FTER HEAT TREAT PROPERTIES @ °F

TENSILE STR.	YIELD STR.	% ELG.			HARDNESS		

TRESS RUPTURE °F

HOURS % ELG. @ P.S.I.

A01
Q.A. APPROVED
BY: E. Rich 10-18-99

This product has not come in direct contact with Mercury or any of its compounds, nor with any Mercury-containing device employing a single boundary of containment, during the mfg., process, tests and inspections.

I hereby certify that the material and test results conform to the specifications set forth in the RSM order acknowledgment.

[signature]
SIGNATURE

QC Tech
TITLE

Sent by: TW METALS 1 425 806 8466; 12/03/99 10:27AM; JetFax #912; Page 1/4

12/02/1999 20:56 1740432 TW METALS PAGE 01

TW METALS

ORDER NO.: 4034805 FROM: CAMB **PACKING SLIP**
SALES ORDER

CUST NUMBER: 5301186 TOTAL WEIGHT: 1302 REQ.DATE: 11/30/99

SOLD TO:
SICOM INDUSTRIES
19165 94TH AVE
SURREY B C CANADA CN V4N 354

SHIP TO:
SICOM INDUSTRIES
19165 94TH AVE
SURREY B C CANADA CN V4N 354

SALESPERSON: TERESA CARAWAY
TERMS: NET 30 DAYS
F.O.B.: DESTINATION
CUST ORD NO.: 44043

DISTRICT: CAMBRIDGE
VIA: WAREHOUSE CHOI
FREIGHT: PREPAID
RELEASE NO.:
RECEIVING PHONE:

LN	ITEM	ITEM DESCRIPTION				
	WIDTH	LENGTH	ORD QTY	WEIGHT	PIECES	SHIP QTY
01	06204	2024T351 ALUM PLT 1.5000				
	14.5000	14.5000	62 EA	496	62	62 EA
PO:4917317		HT:489183		SLB/CL:N/A		
MTR'S & CERTS W/ MATL						
02	09303	304/304L S/S PLATE HRAP REM 1.1250				
	12.0000	12.0000	62 EA	806	62	62 EA
PO:4916344		HT:9Y420		SLB/CL:TA		
MTR'S & CERTS W/ MATL						

PACK INFO

AREA	TYPE OF PKG	PKGS	WEIGHT	WIDTH	LENGTH	BY
CC	SKIDS	1	850			1007/63
CC	SKIDS	2	580			1038 1186
		3	1430			

RT 000- UNLOAD TYPE: NONE SPECIFIED

To: Bonnie
from: Lisa

Attn: Teresa

Pg 1 of 4

Cindy

[redacted]
604-888-3455
604 888-1343

RECEIVED DEC 0 3 19
SICOM W.O. #
CUST. P.O. # 2
R.I.D. #
DATE SHIPPED
942
DATE FILLED

THANK YOU FOR THIS ORDER

TERMS AND CONDITIONS APPLICABLE TO THE SALE OF THESE PRODUCTS ARE SET FORTH ON THE REVERSE SIDE FOR YOUR CAREFUL REVIEW.

Sent by: TW METALS 1 425 806 8466; 12/10/99 8:53AM; JetFax #349; Page 4/5
RECEIVED: 12/10/99 8:27AM; 17404327881 -> TW METALS ; pg 3
12/10/1999 11:37 1740432 #1 TW METALS PAGE 83

C.O. CARLSON Inc
Producers of Stainless Steel
Nickel Alloys and Titanium
THORNDALE, PA 19372

DATE: 10-NOV-1999 OOC: 18924

TEST CERTIFICATE 18924

**** SOLD TO: ****

TW METALS
760 CONSTITUTION DRIVE
EXTON PA 19341

CUSTOMER ORDER #
M4916344

**** SHIP TO: ****

TW METALS
2105 LARRICK ROAD

CAMBRIDGE OH 43725

CUSTOMER MARK #
M4916344

304L BB HOT ROLLED, ANNEALED, DESCALED
UNS S30403/UNS S30400; 304L/304 PLATE. ASTM A240-98A/ASME SA240, ASME B&P CODE SECT. II, 1998 EDITION, 1999 ADDENDA/AMS-8811G/AMS-5513G; CORROSION TEST ASTM A262-93a PRAC. E; ASTM A666-96D: GENL REQTS. ASTM/ASME A/SA480. CHEMISTRY ONLY TO ASTM/ASME A/SA276/312.

TW METALS
Q.A. APP'D
NOV 24 '99
CS
Q.A. DESIGNEE

Susan S. Haldeman
Quality Assistant
C. O. Carlson, Inc.

I HEREBY CERTIFY THE ABOVE FIGURES ARE CORRECT AS CONTAINED IN RECORDS OF THIS CORPORATION.

SWORN TO AND SUBSCRIBED BEFORE ME THIS _____ DAY OF _____

RECEIVED DEC 16 1999 PAGE *
SICOM W.O.# 7915
CUST. P.O.#
R.I.D.# 9429

SPECIFIC MECHANICAL SYSTEMS

PURCHASE ORDER

No Purchase Order No. 5250
This number MUST be on invoice to receive payment

CIFIC MECHANICAL SYSTEMS LTD
b648 Kirkpatrick Crescent,
Saanichton, BC V8M 1Z9
Phone: (250) 652-2111 Fax: (250) 652-6010

Date: DEC 15/99
PST EXEMPT Y__N__
(154471)

Vendor: ATLAS ALLOYS

Ship To: SPECIFIC MECHANICAL

FOB	Date Required	Ship via	Terms
VICTORIA	ASAP	COMOX	

QTY.	DESCRIPTION	UNIT PRICE	PRICE
10	4 x 10 SA 240 304/304L	1.31/#	
	DUAL GRADE 10 GAUGE		
	.134 THICKNESS		
	RECEIVED DEC 2 0 1999 B.O. 3 SHEETS		
	7 RECEIVED DEC 20/99		

Special Arrangements - Payment Timing - Other

MILL TEST REPORTS REQUIRED
All material to meet A.S.M.E. Code Section VIII, Division I and Section II for Edition 98 and Addenda 99. Material must be clearly marked as per material specification, and received with Mill Test Reports.

G.C.S.
DEC. 15/1999

PST
GST R104957527
TOTAL

Authorized by

White Copy - Supplier Yellow Copy - Accounts Payable Pink Copy - File

12/20/99 10:32:27 Vincent Metal Goods-> 1 604 534 8971 Vincent Metal Goods Page 002

28-55-7109

HT#92970 IDGA PO 5250

OUTOKUMPU POLARIT OY

INSPECTION CERTIFICATE 3.1.B
SFS-EN 10204 3.1.B

584172/001 1(01)
06.07.99

ATLAS ALLOYS,C/O CENTRAL PROC.DEPT.
TRAFFIC & CUSTOMS-MS. LEONIE ATTARD
161 THE WEST MALL, ETOBICOKE
TORONTO, ONTARIO M9C 4V8
CANADA

ATLAS ALLOYS,C/O CENTRAL PROC.DEPT.
TRAFFIC & CUSTOMS-MS. LEONIE ATTARD
161 THE WEST MALL, ETOBICOKE
TORONTO, ONTARIO M9C 4V8
CANADA

ASTM A240/A240M-98H
ASME SA-240 SEC 2 PART A ED 1998
NFA 36209 MAI -90

74617

S-10400
MADE IN FINLAND

COIL , STAINLESS STEEL

AOD

TYPE 304L Z3CN18-10 TYPE 304

POLARIT 720 304L 1

1 2 92970 4X 0,135" X 48" 9766 LBS 1

7413-6629

	C %	Si %	Mn %	P %	S %	Cr %	Ni %	N %
92970	0,027	0,40	1,55	0,024	0,001	18,1	9,0	0,034

		Rp0,2 MPa KSI	Rp1,0 MPa KSI	Rm MPa KSI	A5 %	A50 %	≤	Hardness HRB/HRC	HRB
1	B	37	44	85	58	55			79
	A	38	45	87	55	52			79

JAN 12/00
D. COMBS

Rp0.2 YIELD STRENGTH
Rp1.0 YIELD STRENGTH
Rm TENSILE STRENGTH
A5 ELONGATION PROPORT.
A50 ELONGATION GL 50MM
HR30 ROCKWELL HARDNESS

PO#5250

ASTM A262 PRACTICE E : OK

C < .25%, S < .05%, P <.05%
RM < 800 N/MM2
FREE OF COBAN NICKEL
NO WELDS
FREE FROM MERCURY CONTAMINATION
009-766
HEAT TREATMENT 1050 C
832-36-624

OUTOKUMPU POLARIT OY

Atlas Ideal Metals

CERTIFICATE OF COMPLIANCE
TUOMAS KAUPPI
hereby certify that we can produce documentary evidence
the producing mill or supplier that the material has been
and inspected
QUALITY ASSURANCE REPRESENTATIVE

ATLAS IDEAL METALS
CUSTOMER P.O. # 5250
ATLAS IDEAL METALS SHIPPING ORDER # 205231

DATE

11/17/99 18:55 FAX 514 695 5990 ATLAS IDEAL METAL 014

Aweld Sheffield

****
* CERTIFICATION *
****

HEAT 725002 ORDER 0002368/001 BO0001203 10/29/99

SHIP TO:
TW METALS, INCORPORATED
235 TUBEWAY DRIVE

CAROL STREAM IL 60188

---------- YOUR ORDER & DATE ----------
M4916928 10/29/99 CUST# TWMETA01

---------- ITEM DESCRIPTION ----------
5" SCH40S 304/304L A312
Country of Melt : USA
Country of Mfg. : USA

---------- SPECIFICATIONS ----------
ASTM A312-95A/ASME SA312-95
HRB 85
NO WELD REPAIR.

---------- MECHANICAL & OTHER TESTS ----------

Tensile strength, KSI (MPa)	95.2	(656)
Yield strength, KSI (MPa)	63.3	(436)
Elongation % in 4D	60.0	
Guided Bend Face OK		
Hydrotest PSI (MPa)	1400	(9.65)

---------- CHEMICAL COMPOSITION ----------

Carbon	(C)	.017	Manganese	(Mn)	1.740
Phosphorus	(P)	.026	Sulphur	(S)	.016
Silicon	(Si)	.420	Chromium	(Cr)	18.370
Nickel	(Ni)	8.270	Moly	(Mo)	.170
Nitrogen	(N)	.088			

CAUTION: Processing that produces fumes and dust may cause respiratory disease: Especially alloys containing Chromium and Nickel.

CERTIFICATION: We certify that the analysis figures are correct as contained in the records of the company and that the material is free from mercury and low melting alloy contamination. This product is manufactured in the USA.

HEAT TREATMENT: Solution annealed at a minimum of 1900 F and water quenched to below 800F within 3 minutes.

Knowingly & willfully falsifying or concealing a material act on this form, or making false, fictitious or fraudulent statements or representations herein could constitute a felony punishable under federal statutes.

We hereby certify that the chemical analysis and/or test results shown in this report are correct as contained in the records of the company.

Quality Representative

E. Douglas

Aweld Sheffield Pipe Co.
ADDRESS
1101 North Main Street
Wildwood, Florida 34785-9601
TELEPHONE
(352) 748-1313
Administration (352) 748-2751
Engineering (352) 748-6376
Production Control (352) 748-0139
Quality Assurance (352) 748-0513
TELEFAX

10/08 '98 11:53 FAX +41 22 7679535 ACHATS MAGASIN 002

BUREAU VERITAS
INDUSTRY DIVISION

INSPECTION REPORT N° VST/1 1998-08-17

Page : 1 /2

☐ Interim
☒ Final

Ref. BV : BV AT 329.231/B/880

PROJECT :

Ref. : Contract No. 599.205

BV Client : CERN

P/o n° : Service Order No. 880 (client to BV)

Manufacturer : Avesta Sheffield AB Degerfors/Sweden

P/o n° : NOTZ Order No. 7526 (client to manufact.)

Inspection requested by : CERN

SUPPLY : STAINLESS STEEL PLATES

Dim. 2000 x 1000 x 30,0 mm

ITEM / TAG n°	QTY
W.Nr. 1.4306	3

DOCUMENTS OF REFERENCE :

Title	Reference n°	Rev.	Approved by	Date
Technical Specification	1004	1	CERN	96.06.05
Control and Inspection Plan	BV AT 329.231/B	0	CERN	89.09.26
	CN 132			

INSPECTION :

1. INSPECTION PLACE : Degerfors/Sweden

INSPECTION DATE : 1998-08-12

2. STAGE OF INSPECTION
☐ Before manufacturing
☐ During manufacturing
☐ Final
☐ Packing

3. KIND OF INSPECTION
☐ Review documentation
☐ Witness inspection
☐ Visual
☐ NDE
☐ Tests
☐ Others

4. DIE STAMPS : ☐ No ☒

5. RESULT OF INSPECTION
☒ Satisfactory ☐ Unsatisfactory

6. CONCLUSIONS / REMARKS

TEST/EXAM.

AS PER CIP: ID, CP,MP, PP, UT, V, Dim, M and ED.

MILLSHEET

NO. ENCLOSED: 8080429.R00

MARKING: See page No. 2.

BUREAU VERITAS EXPERT de VERITAS PARIS 1828 REGISTRE INTERNATIONAL

Name and signature: Stellan Kvarforth

10/08 '99 11:53 FAX +41 22 7679535 ACHATS MAGASIN 003

BUREAU VERITAS
INDUSTRY DIVISION

INSPECTION REPORT N° VST/1 1998-08-17
(continued)

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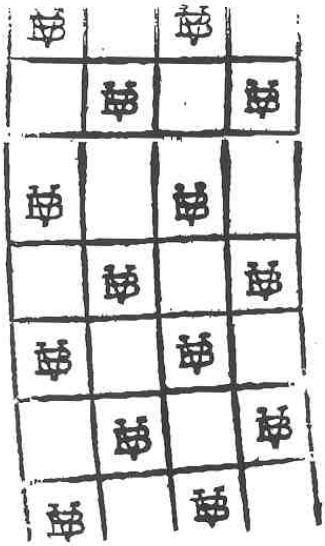
Ref. BV: BV AT 329.231/B/880

8. INSPECTION PERFORMED *(Description)*

Each Plate is marked:
Avesta 19-11L
Sheffield
DIN 17440
W.-NR. 1.4306
LOT NO. 54881
HEAT NO. 881272
PLATE NO. 9587-3901 (-1) (-2) (-3)
THICKNESS 30.0 MM
PO NO. 9587/38
CERN 7526



10/06 '99 11:53 FAX +41 22 7679535 ACHATS MAGASIN 004

Avesta Sheffield

QC-Manager / Hachemi LOUCIF

CERTIFICATE - ZEUGNIS - CERTIFICAT
EN 10 204-3.1.B Anlage zu 3.1.C/BV

Page / Seite 1(2)

Date - Datum: 980812
Lead - Ladung - Charge No: 8080429.R00
Cert.No - Zeugnis Nr:
Avesta Order - Auftrag - Ordre: 802318
Pack - Kolli - Colis Nr:

Your order - Ihre Bestellung - Votre commande:
7526/CERN Genéve
Purchaser - Besteller - Acheteur:
Netz Metall AG
Postfach 1157

CH-2501 BIEL
SCHWEIZ
Dest.:

Requirements - Anforderungen - Exigences:
DIN 17440
Cern Technical Spec. No 1004-Ed 1-05.06 1996
SEL 072-77
EN 10 029
EN 10 029 KL. A
Co= max 0,22%
Klasse N

Product - Erzeugnisform - Produit:
Rostfreies Blech, warmgewalzt
./Ausführungsart:a2

Grade - Werkstoff - Nuance:
19-11L
W.-Nr. 1.4306/X 2 CrNi 19 11

Brand-Mark - Herstellerzeichen - Sigle du Producteur: W
Inspection stamp - Abnahme - Stempel - Estampe de Contrôle: DJ 2
Melting process - Erschmelzungsart - Procédé de fusion: E+AOD

Marking - Kennzeichnung - Marquage:
Blech Nr, Abmessung, Schmelze Nr, Los Nr, Inkl. "

Extent of delivery - Lieferumfang - Etendue de livraison						
Item Pos	Anzahl Nombre	kg	Dimension - Abmessung mm	Heat No. Schmelz-Nr. Coulée	Lot No. Los Nr. Lot No.	
1	3		30 * 1000 * 2000	881272	54881 / 8023181 1	

Plate No: 9587 3901-1,-2,-3
Blech Nr
Tôle No

Chemical composition - Chemische Zusammensetzung - Composition chimique %
Heat - Schmelze - Coulée No

	C	Si	Mn	P	S	Cr	Ni	Co
Min	0.000	0.0	0.0	0.000	0.000	17.0	10.0	0.00
Max	0.030	1.0	2.0	0.045	0.030	20.0	12.5	0.22
881272	0.015	0.3	1.2	0.023	0.000	18.3	10.5	0.13

Test results - Prüfergebnisse - Résultats des essais ((N/mm² = 1 MPa)

Richt. T = Quer L = Länge; Ort F = Kopf B = Fuss; Form P = Flach C = Rund; Lage 1 = Mitte 2 = Oberfläche nah 3 = Norm 4 = 1/4 der Dicke

Mechanische Eigenschaften
Zugversuch EN 10 002/Härteprüfung Brinell

Blech-Nr	Richt.	Ort	Lage	Form	Temp. C	Rp 0,2 N/mm2	Rp 1,0 N/mm2	Rm N/mm2	A5 %	HB
Min						175		450	40	
Max										180
3901	T	F	3	C	20	251	295	573	54	146

Die gestellten Anforderungen sind erfüllt.

Avesta Sheffield AB (publ)
POSTADRESS/POSTAL ADDRESS: S-693 81 DEGERFORS, Sweden
TELEFON / TELEPHONE: Nat 0586 - 470 00, Int +046 (0)586 470 00
TELEFAX: Nat 0586 - 470 16, Int +046 (0)586 470 16

Quality Inspector

CERTIFICATE - ZEUGNIS - CERTIFICAT
EN 10 204-3.1.B Anlage zu 3.1.C/BV

Page / Seite 2(2)

Date - Datum	Lead - Ladung - Charge No	Cert.No - Zeugnis Nr
	980812	8080429.R00

QC-Manager / Hachemi LOUCIF

Metallographie

3901F Prüfung nach Avesta KF-10.3851: ohne Beanstandung

Metallographische Prüfung gem. ASTM E45 Verfahren A:

Blech-Nr	Richt.	Ort	Lage	Form	Temp. C	Max A	Max B	Max C	Max D
Min						2	2	2	2
Max						0	1	0	2
3901	T	F	3	P					

3901F Metallographische Prüfung nach ASTM E112: ohne Beanstandung

Weitere Informationen

Bei 1100 C lösungsgeglüht und in Wasser abgeschreckt.
Aus dem Blech wurden Teilbleche hergestellt:3
Ausmessung, Besichtigung und Verwechslungsprüfung(spektroskopisch):
ohne Beanstandung

Ultraschallprüfung siehe anlage !

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Quality Inspector

Avesta Sheffield
Hot Rolled Plate Division
S-693 81 Degerfors - Sweden

ULTRASONIC INSPECTION CERTIFICATE
ULTRASCHALLPRÜFZEUGNIS
CERTIFICAT DE CONTRÔLE PAR ULTRA-SONS

Insp. VTQ/ Mats Hulth	Testing date - Prüfungsdatum - Date de contrôle 1998-08-12	Certificate No. - Zeugnis Nr - Certificat N° 8080429.R00
	Date of certificate - Zeugnisdatum - Date de certificat 1998-08-12	Appendix - Anlage - Annexe 1

MATERIAL IDENTIFICATION - MATERIALIDENTIFIKATION - IDENTIFICATION DU MATERIEL

Purchaser - Besteller - Acheteur Notz Metall AG Biel - Schweiz	Your order - Ihre Bestellung - Votre N° de cde 7526/Cem		Avesta Sheffield order - Auftrag - N° de cde 802318	Item - Pos 1
Grade - Werkstoff - Nuance W.-Nr. 1.4306	Lot No. - Los Nr - Lot N° 54881	Heat No. - Schmelze Nr - Coulée N° 881272	Dimension - Abmessungen - Dimension, mm 30x1000x2000	
Plate No. - Blech Nr - Tôle N° 9587 3901-1, -2, -3				

TESTING PRESUMPTIONS - PRÜFVORAUSSETZUNG - CONDITIONS D'ESSAI

Testing method - Prüfmethodik - Méode d'essai Pulse echo/contact technique/ Impuls-Echo Kontakttechnik Contrôle par contact/réflexion	Testing specification - Prüfspezifikation - Spécification d'essai Avesta Sheffield AB specification : KF-10.4277E Other spec. - Andere spez. - Autre : SEL 072	Rev. 0 1977
Inspection by - Überwachung von - Contrôle par Avesta Sheffield AB / Bureau Veritas	Acceptance standard - Zulässigkeitsgrenze - Critère d'acceptation Surfaces: Class 3 Edges: Class 2	
Testing scope - Prüfumfang - Etendue d'essai One main surface. Perpendicular grid lines on nominal 100 mm cc. Edges; 50 mm 100 %		
Notes - Bemerkung - Remarques		

EQUIPMENT - GERÄT - EQUIPEMENT

Instrument - Gerät - Appareil Krautkrämer USK 7		No. - Nr - N° 108	
Probe - Prüfkopf - Palpeur SEB 4 0°	Dim. probe - Abm. Prüfkopf - Dim. palpeur Ø 20 mm	Frequency - Frequenz - Fréquence 4 MHz	Angle - Einschallwinkel - Angle -
Couplant - Ankopplung - Couplage Water + Soap		Notes - Bemerkung - Remarques	

SETTINGS

Reference method - Bezugsmethode - Méthode de référence Bachwall - Reflection (BR)	Ref. level - Bezugshöhe - Écho de référence 1 st BR 80 % of full Screen Height (FSH)	
Sensitivity - Empfindlichkeit - Sensibilité Reference level + 6dB	Scanning rate - Prüfgeschwindigkeit - Vitesse d'essai ≤ 150 mm/s	Pulse energy - Impulsstärke - Puissance 1
Notes - Bemerkung - Remarques		

TESTING CONDITIONS

Surface condition - Oberfläche - Etat de surface Hot rolled, solution annealed and pickled
Notes - Bemerkung - Remarques

TEST RESULTS - PRÜFERGEBNISSE - RESULTAT D'ESSAI

Reporting level - Registrierschwelle - Seuil d'enregistrement		
No discontinuity indications above the reporting level - Keine Fehler größer als Registrierschwelle - Aucune indications supérieure au seuil d'enregistrement ☐ Ses annexes - Siehe Anlage - Voir annexe ☐		
☒ Disposition - Beschluss - Evaluation Accepted - Akzeptiert - Approuvé	☐ Rejected - Kassiert - Rébuté	☐ Further investigation - Weitere Untersuchung - Examen supplémentaire
Notes - Bemerkung - Remarques		

OPERATOR, INSPECTOR - PRÜFER, PRÜFAUFSICHT - OPERATEUR, CONTRÔLEUR

Testing performed by - Abnahme durch - Opérateur Krister Kurkkio Mats Hult	Level acc. to - Niveau gem. - Niveau s. SNT-TC-1A 1 2	Sign. Krister Kurkkio Mats Hulth
Assistant at test - Mitarbeiter - Assistant	Level acc. to - Niveau gem. - Niveau s. SNT-TC-1A	Sign.
Approved by - Akzeptiert von - Approuvé par Avesta Sheffield AB/ Mats Hulth	Inspector - Prüfaufsicht - Contrôleur	Inspector - Prüfaufsicht - Contrôleur
Position - Stellung - Poste Level 2 acc. to SNT-TC-1A	Agency - TÜO - Agence d'inspection	Agency - TÜO - Agence d'inspection
Sign Mats Hulth DJ	Sign.	Sign.
Notes - Bemerkung - Remarques	This certificate is based on internal report - Dieses Zeugnis basiert auf dem internen Prüfbericht - Ce certificat est basé sur le procès-verbal interne	No. UT 8207

CERTIFIED MATERIAL TEST REPORT

SSC ORDER NO. 69595-01

STAINLESS STEEL PLATE AND PLATE PRODUCTS
TOOL AND DIE STEELS
THE COUNTRY'S MOST COMPLETE CUTTING SERVICE ORGANIZATION

ONE SANDMEYER LANE • PHILADELPHIA, PA 19116-3598 • 215-464-7100 • 800-523-3863 • FAX: 215-677-1430

BILL TO

SC

BROOKHAVEN NATIONAL LAB
FISCAL DIVISION
BUILDING 134 B
UPTON, NY 11973
Attn Sandra Brown

CERTIFICATE OF TEST

WE CERTIFY THAT THE CHEMICAL ANALYSIS AND MECHANICAL TEST RESULTS APPEARING IN THIS CERTIFICATE ARE CORRECT AND TRUE AS CONTAINED IN THE RECORDS OF THE COMPANY

SANDMEYER STEEL COMPANY

E. GARDOSH - MANAGER, QUALITY ASSURANCE
QUALITY CONTROL DEPARTMENT

CUSTOMER ORDER NO. BNL-0000046438

DATE: 01/31/01

GRADE: UNS S30403	SPECIFICATION: SA-240 98 Ed 99 Add	HEAT NO.: H9617

PIECES	DESCRIPTION
	SSC TYPE 304L PLATE
100	1-1/4" X 2-7/8" X 9-3/8"
100	1-1/4" X 3-1/8" X 9-3/8"

FEB 7 10 01 AM '01
ACCOUNTS PAYABLE

RECD 2/7/01 HCC OK

(2)

CERT FOR BNL AND VICTORIA DIV CONTRACTORS

HEAT NO.	C	Mn	P	S	Si	Ni	Cr	N
H9617	0.018	1.090	0.030	0.001	0.338	9.060	18.140	0.056

HEAT NO.	Yield *	Tensile *	Elong	Hardness		
H9617	48,900	84,000	53% IN 2"	RB 73		

* LBS/IN2

MATERIAL SOLUTION ANNEALED AT 1900 DEGREES F MINIMUM AND WATER QUENCHED OR RAPIDLY COOLED BY AIR

C-115C 12/91

RECORDS OF ALL TESTS ARE MAINTAINED AT SANDMEYER STEEL COMPANY

CERTIFIED MATERIAL TEST REPORT

SSC ORDER NO. 69595-03

STAINLESS STEEL PLATE AND PLATE PRODUCTS
TOOL AND DIE STEELS
THE COUNTRY'S MOST COMPLETE CUTTING SERVICE ORGANIZATION

ONE SANDMEYER LANE • PHILADELPHIA, PA 19116-3598 • 215-464-7100 • 800-523-3863 • FAX: 215-677-1430

BILL TO

BROOKHAVEN NATIONAL LAB.
FISCAL DIVISION
BUILDING 134 B
P.O. BOX 5000
UPTON NY 11973

CERTIFICATE OF TEST

WE CERTIFY THAT THE CHEMICAL ANALYSIS AND MECHANICAL TEST RESULTS APPEARING IN THIS CERTIFICATE ARE CORRECT AND TRUE AS CONTAINED IN THE RECORDS OF THE COMPANY

SANDMEYER STEEL COMPANY

E. GARDOSH - MANAGER, QUALITY ASSURANCE
QUALITY CONTROL DEPARTMENT

CUSTOMER ORDER NO. BNL-0000046438

DATE: 01/10/02

GRADE: UNS S30403	SPECIFICATION: SA-240 98 Ed 99 Add	HEAT NO.: H9617

PIECES	DESCRIPTION
	SSC TYPE 304L PLATE
550	1-1/4" X 2-7/8" X 4-3/8" BAND SAW CUT
550	1-1/4" X 3-1/8" X 4-3/8" BAND SAW CUT

(1) CERT FOR BNL AND VICTORIA PIN CARRIERS

HEAT NO.	C	Mn	P	S	Si	Ni	Cr	N
H9617	0.018	1.090	0.030	0.001	0.338	9.060	18.140	0.056

HEAT NO.	Yield *	Tensile *	Elong	Hardness		
H9617	48,900	84,000	53% IN 2"	RB 73		

* LBS/IN2

MATERIAL SOLUTION ANNEALED AT 1900 DEGREES F MINIMUM AND WATER QUENCHED OR RAPIDLY COOLED BY AIR

G-115C 12/91

RECORDS OF ALL TESTS ARE MAINTAINED AT SANDMEYER STEEL COMPANY

Appendix F Control Step Document

21/12/2000

Control Step Document

University of Victoria

End Cap Signal Feedthroughs

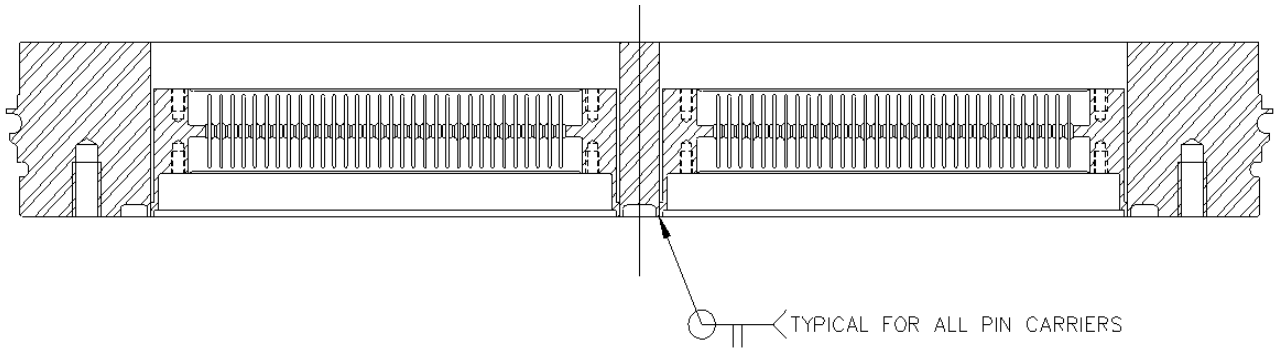
For specific details on acceptance tests, component testing procedures and records of individual components on arrival at the University of Victoria, please refer to ATLAS Victoria's QA/QC Document.

For detailed description of the Welding Procedure Specifications please refer to the "Welding Plan" of the Atlas Victoria's QA/QC Document.

All Welding is carried out at Specific Mechanical Company or at The University of Victoria by the qualified welders of Specific Mechanical Co.

Prepared by Paul Birney
TRIUMF / University of Victoria

The Pin Carrier / Cold Flange - sub assembly:



Procedure:

The four Pin Carriers per flange are welded into the Cold and Ambient Flanges.

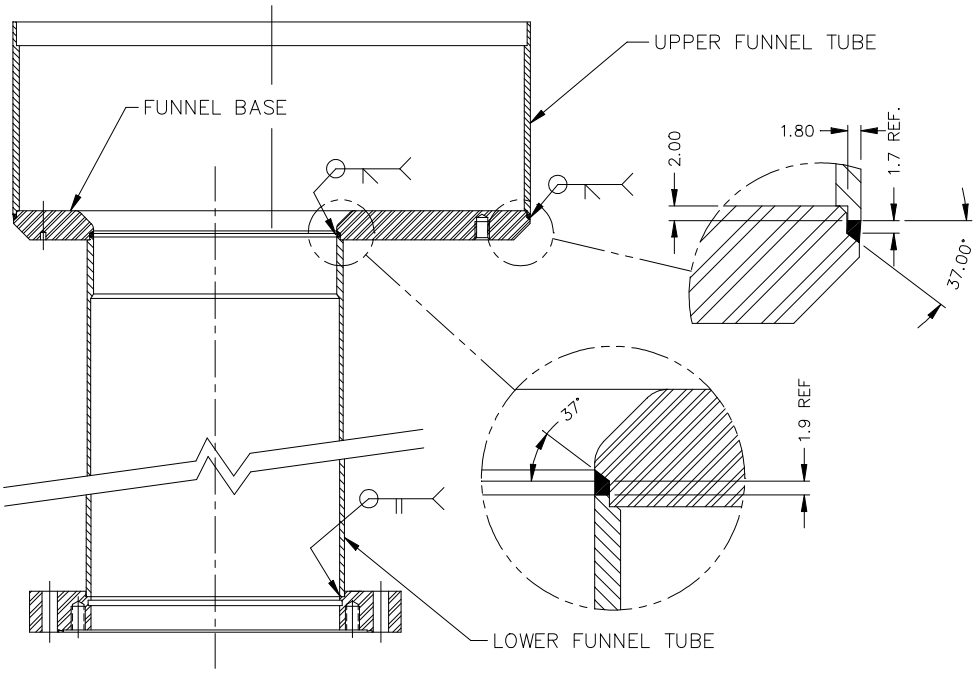
Weld Process / Welders:

The Welding Procedure Specification for this weld is WUVT-3.
The welding will be done by Specific Mechanical who have qualified welders for this weld.

Testing:

The finished Flanges are He leak checked by a UVIC technician with the results recorded on the QA/QC sheets and entered into the database.

Funnel Sub Assembly



Weld Process:

The upper funnel tube is fabricated at the premises of Specific Mechanical Company. The tube has a longitudinal butt weld with a welding procedure specification of WUVT-2.

Inspection:

This weld is inspected by Radiography by an independent inspection company (Canspec). The results are listed in a Radiographic Examination Report.

Procedure:

The Upper and Lower funnel tubes are welded to the Funnel Base.

Weld Process / Welders:

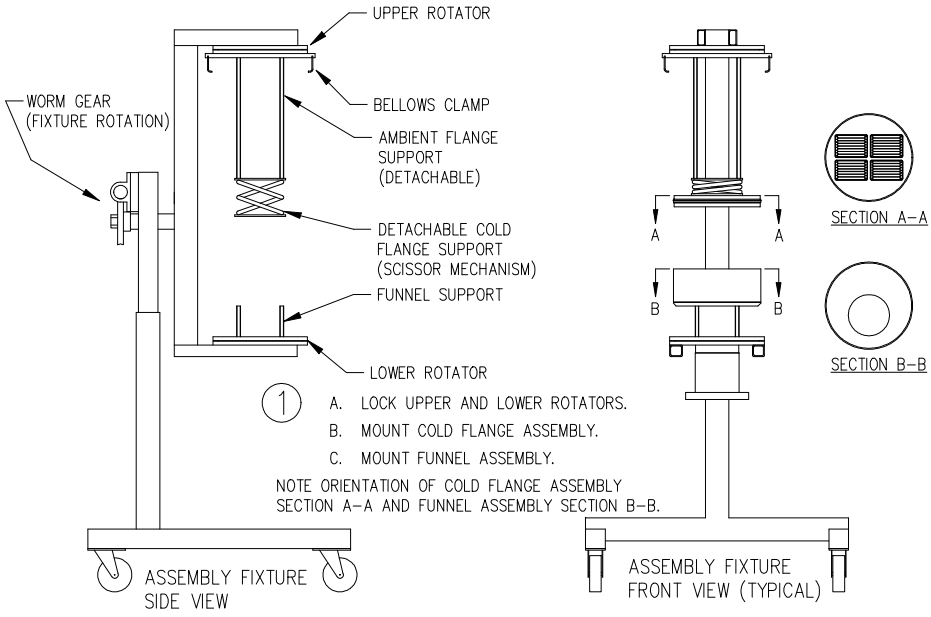
The Welding Procedure Specification for this weld is WUVT-1
The welding is done at Specific Mechanical which has company welders qualified for these welds.

Testing:

The funnel welds are checked with a dye penetrent test by the quality control person at Specific Mechanical. After arriving at UVIC the funnels are cleaned and leak checked on a He leak checker. The welds are checked for their ferrite content using an Elcometer 111-7F by a UVIC technician with the results recorded on the QA/QC traveler sheet and entered into the database.

Step 1

Start of Assembly



Procedure:

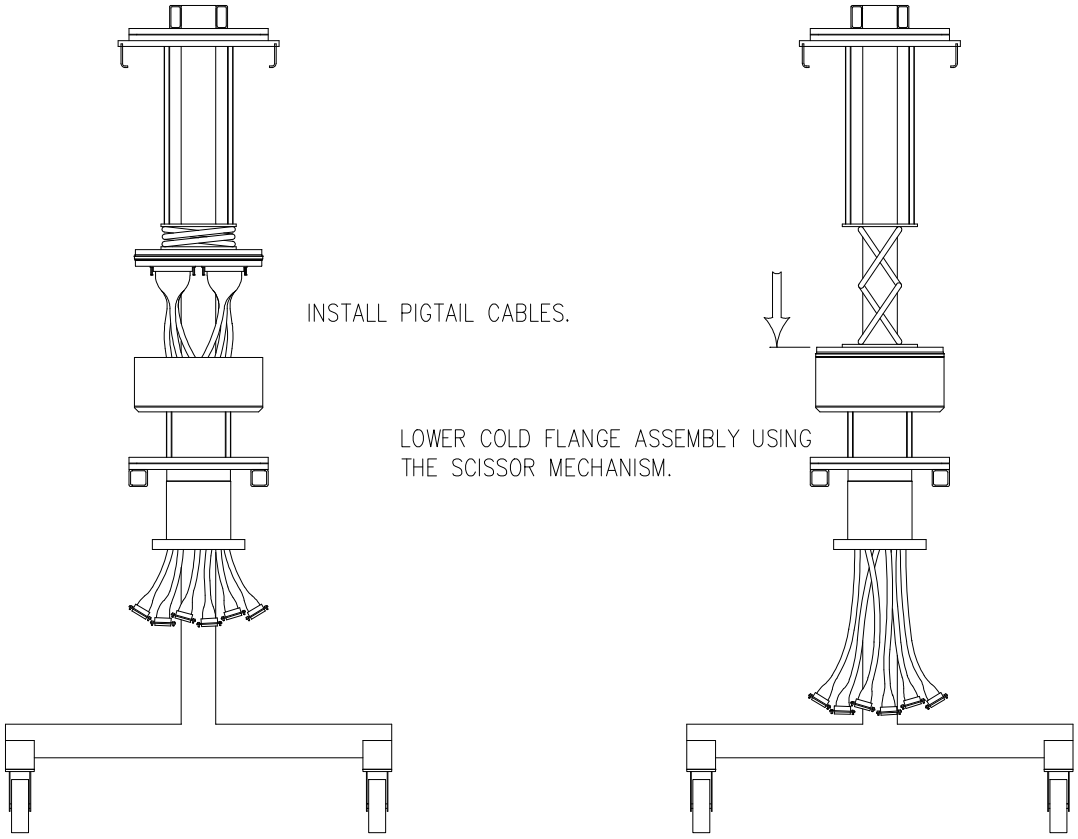
The assembly jig is used to hold the components in place while the cables are installed. The funnel is bolted to the bottom part of the assembly jig, and the cold flange is bolted to the scissor jack, which is attached to the top of the assembly jig. The pigtails are installed on the LAr side of the cold flange.

Inspection:

As each pigtail is installed by a technician, a second technician inspects the cable to ensure the installation was correct. The information is entered on the QA/QC traveler sheet and entered into the database.

Step 2

Pigtail Assembly



Procedure:

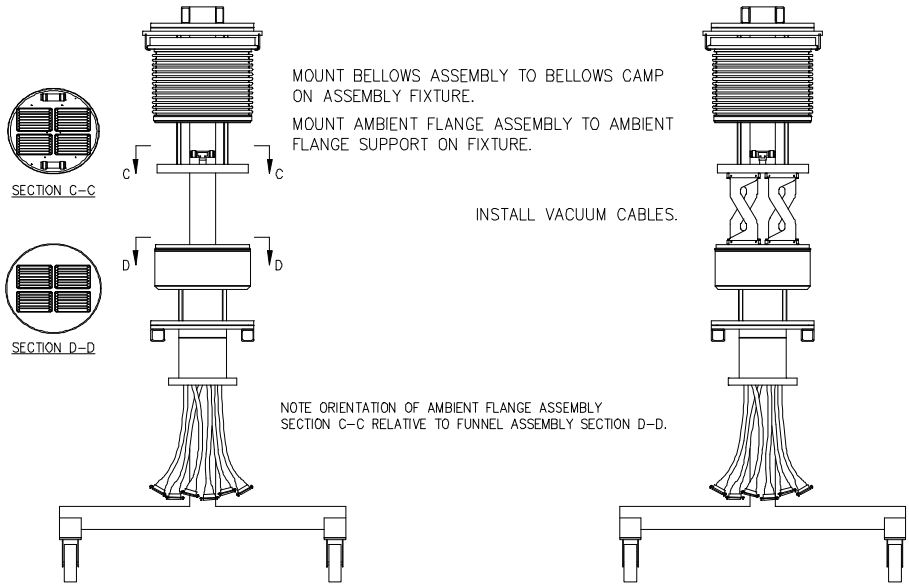
The scissor jack lowers the cold flange onto the funnel. The pigtails are guided through the funnel. The cold flange is positioned onto the cold funnel. The scissor jack is removed from the assembly jig.

Inspection:

The 1.7mm gap, which forms the root of the weld between the funnel and the cold flange, is checked by a UVIC technician to ensure the flange is correctly seated. The inspection is noted on the QA/QC traveler sheet.

Step 3

Installation of Vacuum Cables



Procedure:

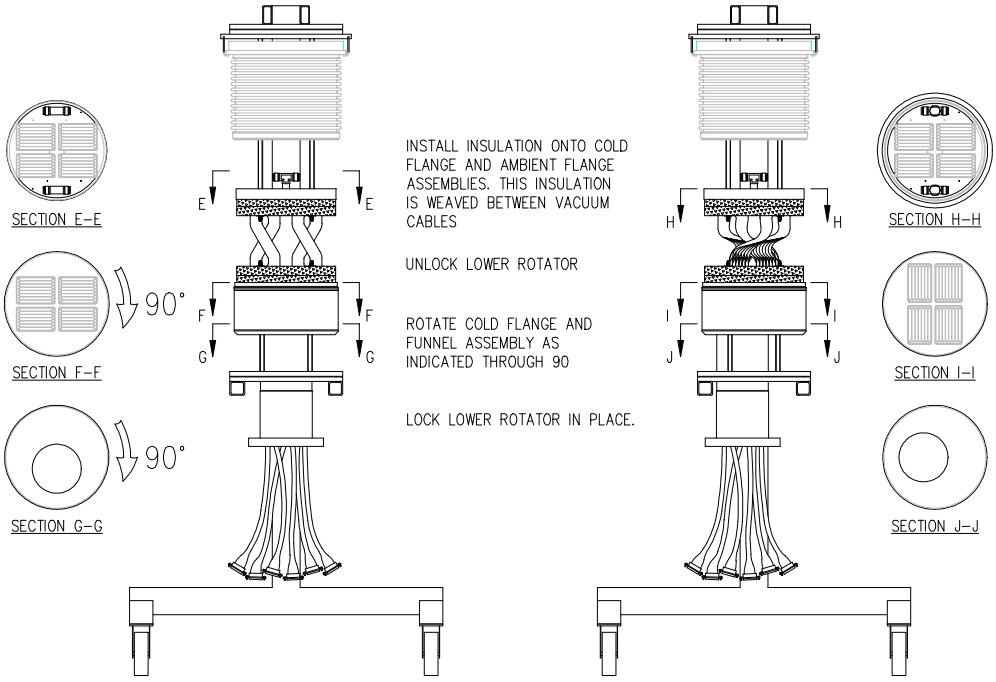
The bellows and warm flange are positioned at the top of the assembly jig.
The Vacuum cables are installed between the cold and ambient flanges.

Inspection:

As each vacuum cable is installed by a technician, a second technician inspects the cable to ensure the installation was correct. The information is entered on the QA/QC traveler sheet and entered into the database.

Step 4

Installation of Rohacell Insulation and Rotation



Procedure:

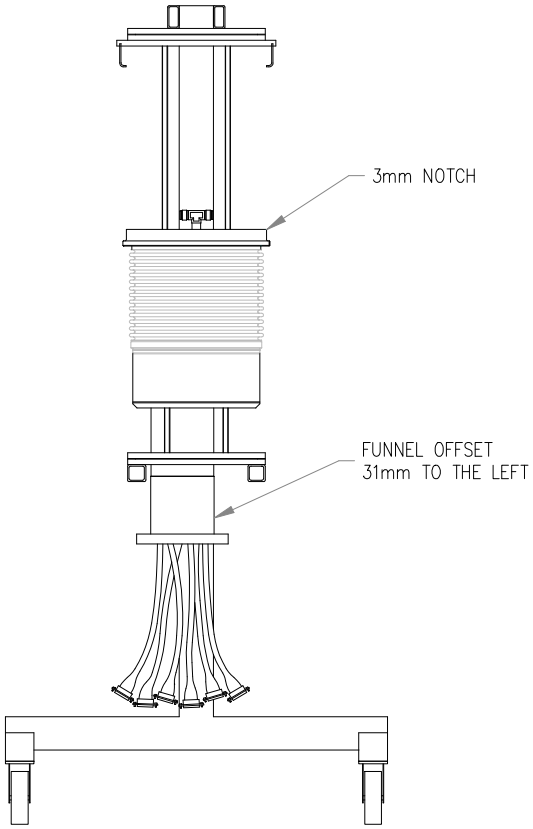
The Rohacell insulation and aluminized Mylar are installed on the cold and ambient flanges. The rotator locking pin is removed at the cold flange and the cold flange is rotated 90 deg. clockwise as viewed from the ambient flange.

Inspection:

A check is made to ensure that the pumping ports on the warm flange are unobstructed. This is noted on the UVIC QA/QC traveler sheet.

Step 5

Bellows Positioning and Continuity Test



Procedure:

The bellows is lowered into position. The seal ring alignment bar is attached and the seal ring is rotated until the 3mm slot in the seal ring is in the correct location.

Continuity Test:

The continuity of each pin of the ambient flange through to the micro-D connector on the pigtails is checked with the Cirris tester. The results are analyzed to ensure all channels are functional.

The feedthrough is now ready for welding.

Step 6

Welding:

The feedthrough is welded shut by three welds; two of these are vacuum seal welds between the ambient flange and the seal ring, and the cuff ring and the cold flange. The last weld is between the funnel and the cold flange and has a welding procedure specification WUVT-1. These three welds will be done at UVIC by one of the qualified welders from Specific Mechanical.

Inspection:

The WUVT-1 weld between the funnel and the cold flange will be inspected by using a dye penetrant inspection preformed by the quality control inspector from Specific Mechanical. The inspection will be recorded in a Non Destructive Examination (N.D.E.) Report. A ferrite measurement will be done by a UVIC technician and recorded on our QA/QC traveler sheet.

He Leak Testing of the Bellows Welds:

The bellows volume is pumped with a roughing pump. After pumping for several hours or over night, the pumps are valved off and a He leak checker is used for the leak test. The weld between the ambient flange and the seal ring, and the weld between the cuff ring and cold flange will be tested. The pin carriers in the cold flange will also be tested at this time. These tests are carried out by a UVIC technician. The results are recorded in the QA/QC traveler sheet and entered into the database.

Warm Testing of the Funnel in the Cold Test Station:

The feedthrough is installed in the Cold Test Station. The chambers for the insulating vacuum and bellows are pumped out, initially with a roughing pump and then a turbo pump. The pumps are valved off and a He leak checker is used to test the cold flange pin carriers and the weld between the funnel and the cold flange. For this test the funnel and pigtail bucket are pumped out to below 1 mbar and back filled with He. This test is preformed by a UVIC technician and recorded on the QA/QC traveler sheet and entered into the database.

Step 7

Cold Testing:

The feedthrough is slowly cooled down over several hours to LN2 temperature. The cooling process is monitored by silicon diodes placed in the cold flange. Our objective is to maintain a temperature gradient of 20 deg. C across the cold flange with a max gradient of 40 degrees.

Cold Pressure Test:

Note: the funnel and bellows are in a vacuum, therefore all pressures are absolute.

The cold pressure test is conducted as follows:
The funnel and pigtail bucket are already at 1 bar.
Ramp up the pressure in the funnel to 2.8 bar at a rate of .35 bar/min.
Hold at the operating pressure (2.8 bar) for 10 minutes.
Ramp up to the test pressure of 3.5 bar at a rate of .35 bar/min.
Hold at 3.5 bar for 30 min.
Ramp the pressure down at a rate of .35 bar / min.

This test will be preformed by a UVIC technician and recorded on the QA/QC traveler sheet and entered into the database.

Cold He Leak Test:

A He leak checker is connected to the bellows and the vacuum around the feedthrough. The funnel and pigtail volumes are pumped out and back filled with He to 1 bar. This tests “cold” all funnel welds and the cold flange pin carriers. This test is done by a UVIC technician and recorded on the QA/QC traveler sheet and entered into the database.

Cold Electrical Tests:

When cold, a continuity test and a cross talk test will be preformed. For these tests the pigtails are connected together in pairs to allow continuity between two pins on the exposed warm flange. These tests are preformed by UVIC technicians and the data is stored on the computer system.

Step 8

Warm Electrical Tests

After removal from the cold test station, the feedthrough is electrically tested for Precision Resistance and Cross Talk.

Appendix G - Tests and Test Reports

Tests Preformed on Feedthrough Components

Pin Carrier Pressure Tests
Funnel Pressure Test
Delta Ferrite Evaluation
Impact Tests
Radiographs of Upper Funnel Tubes
Bellows Squirm Test
Bellows Pressure Test

End Cap Feedthroughs (University of Victoria)

Maximum Design Pressure - 2.7 bar abs (end cap) – 2.8 bar (barrel)
- 1.5 bar abs - Bellows

Required Test Pressure
Test Pin Carrier (5 x 2.8 bar) - 14 bar abs
Test Funnel (3 x 2.8 bar) - 8.4 bar abs
Each Feedthrough (1.25 x 2.8 bar) - 3.5 bar abs

Pin Carrier pressure tests done at CERN on the 15th and 21st of June 1999

Gas pressure test to 15 bar (5 x max working pressure)
Hydraulic pressure test 250 bar (90 x max working pressure)

Reports No. TIS/TE/MI/ 107 Date 15/06/99
TIS /TE/MI/ 108 18/06/99

Note: After each test a leak test was preformed, no leak was found.

Funnel Pressure Test done at CERN in March 2000

A funnel was made up which consisted of one real pin carrier and 3 dummy pin carriers. The test was preformed at CERN as follows:

30 bars at room temperature
4.5 bars at LN2
Warmed up and leak checked
4.5 bars at LN2
Warmed up and leak checked
4.5 bars at LN2
Warmed up and leak checked There were no leaks.

Impact tests and Delta Ferrite Evaluation of Test Samples

Report # 00/04/17 #00/03/03
Mean delta ferrite content of the test welds was 7.6%

Report # TRT 00 So 010-2

	Energy	Toughness	
Mean Impact values at 77 K was	99J	147J/sqcm	-Weld metal
	108J	157J/sqcm	-Heat affecting Zone
	72J	99J/sqcm	-Base Metal

CERN	TECHNICAL INSPECTION AND SAFETY COMMISSION (TIS) *COMMISSION DE L'INSPECTION TECHNIQUE ET DE LA SECURITE (TIS)*	TIS TE	TECHNICAL SERVICES & ENVIRONMENT GROUP MECHANICAL INSPECTIONS SECTION
RAPPORT DE TEST N° TIS/TE/MI/ 107		Date: 15/06/99	Page: 1 de 1

CERTIFICAT D'EPREUVE SOUS PRESSION

Demandeur P. PAILLER & A. GONIDEC Division : EP tél. : 160335 Projet : **ATLAS**	X Epreuve pneumatique O Epreuve hydraulique
Equipement : **TRAVERSEE ETANCHE**	Localisation : **LHC**

FICHE TECHNIQUE

Constructeur : GLASSEAL	Matière inox 304L
Marque :	Dimensions : 103mmX63mm
Type : ...8 fois 64 pines	Pression de service : 2.8 barg
Modèle :	Pression d'épreuve : 15 barg
Dessin N° : GBL20011-600147Rev. D.	Fluide : Argon liquide

EPREUVE

-Le test a été effectuée à température ambiante avec de *l'azote* propre. La pression a été appliquée graduellement à l'intérieur de cet équipement jusqu'à *15barg* et maintenue pendant *1heure*.
Pendant toute la durée du test, aucune baisse de pression notable n'a été décelée.

RESULTAT

-Après le test, une inspection visuelle de l'ensemble a été pratiquée, celle-ci n'a révélé aucun signe évident de déformation importante des composants.

COMMENTAIRES

Photo1 : Montage de test
Photo2 : Lecture de la pression de test

L'examen du passage étanche n'a pas révélé de déformation évidente
Le test d'étanchéité à l'hélium; Pas de fuite décelable à un niveau inférieur à 10-9mbar.l/s.

Effectué par: G. RAVIER / TIS Date: 15/06/99 Signature:	Contrôlé par: C. MARGAROLI / TIS Date: 18/06/99 Signature:

CERN	TECHNICAL INSPECTION AND SAFETY COMMISSION (TIS) *COMMISSION DE L'INSPECTION TECHNIQUE ET DE LA SECURITE (TIS)*	TIS TE	TECHNICAL SERVICES & ENVIRONMENT GROUP MECHANICAL INSPECTIONS SECTION
RAPPORT DE TEST N° TIS/TE/MI/ 108		Date: 18/06/99	Page: 1 de 1

CERTIFICAT D'EPREUVE SOUS PRESSION

Demandeur P. PAILLER & A. GONIDEC Division : EP tél. : 160335 Projet : **ATLAS**	O Epreuve pneumatique X Epreuve hydraulique
Equipement : **TRAVERSEE ETANCHE**	Localisation : **LHC**

FICHE TECHNIQUE

Constructeur : GLASSEAL	Matière inox 304L
Marque :	Dimensions : 103mmX63mm
Type : ...8 fois 64 pines	Pression de service : 2.8 barg
Modèle :	Test destructif
Dessin N° : GBL20011-600147Rev. D.	Fluide : Argon liquide

EPREUVE

-Le test a été effectuée à température ambiante avec de l'eau propre. La pression a été appliquée graduellement à l'intérieur de cet équipement par palier de 5bar.
Le test a été interrompu à 250 barg, suite une fuite au joint de bride en cuivre.

RESULTAT

-Après le test, une inspection visuelle de l'ensemble a été pratiquée, celle-ci n'a révélé aucun signe évident de déformation importante des composants.

COMMENTAIRES

Photo1 : Montage de test
Photo2 : Etat de la traversée apres le test

L'examen du passage étanche n'a pas révélé de déformation évidente
Test d'étanchéité à l'hélium : Pas de fuite décelable à un niveau inférieur à 10-9 mbar.l/s.

Effectué par: G. RAVIER / TIS Date: 18/06/99 Signature:	Contrôlé par: C. MARGAROLI / TIS Date: 18/06/99 Signature: CERN TIS Groupe Ingénierie Mécanique Inspection Mécanique

Radiographs of Butt Welds For the Upper Funnel Tubes

CANSPEC

Canspec Group Inc.
12271 Horseshoe Way
Richmond, BC, Canada V7A 4V4

Phone: (604) 275-3800
Fax: (604) 275-3821

Materials Engineering and Testing
A Rockwood Company

ISO 9002

SPECIFIC MECHANICAL SYSTEMS
SAANICHTON, BC

ATTENTION: TOM GOLDBACH

NONDESTRUCTIVE TESTING
OF
LONG WELD SEAMS
LOCATION: CANSPEC SHOP, RICHMOND, BC

JUNE 23 & 26, 2000

Canspec Group Inc.
12271 Horseshoe Way
Richmond B.C.,Canada, V7A 4V4
Tel: (604) 275-3800
Fax: (604) 275-3821

Materials Engineering and Testing
A Rockwood Company

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RADIOGRAPHIC EXAMINATION REPORT

TO: SPECIFIC MECHANICAL SYSTEMS
6848 Kirkpatrick Crescent
Saanichton, BC
V8M 1Z9

ATTN: Tom Goldbach

PROJECT: Long Weld Seams
WORK LOCATION: Canspec Shop
MANUFACTURER: Specific Mechanical
ACCEPTANCE STANDARD: ASME Sec. VIII UW51

PAGE: 1 REPORT #: ---
DATE: June 23, 2000
OUR JOB #: 0N0465
PO #: 5169
PROCEDURE #: 7
MATERIAL TYPE: Stainless Steel

No.	Identification	Pipe Size ∅	WS	View	Film Type	SFD	Thickness	Accept (✓)	Reject (✗)	Remarks
1	U.T. #042	11"	N/A	0-9	D4	18"	.125"	✓		
2	U.T. #065	11"	N/A	0-9	D4	18"	.125"	✓		
3	U.T. #062	11"	N/A	0-9	D4	18"	.125"	✓		
4	U.T. #044	11"	N/A	0-9	D4	18"	.125"	✓		
5	U.T. #054	11"	N/A	0-9	D4	18"	.125"	✓		
6	U.T. #057	11"	N/A	0-9	D4	18"	.125"	✓		
7	U.T. #063	11"	N/A	0-9	D4	18"	.125"	✓		
8	U.T. #064	11"	N/A	0-9	D4	18"	.125"	✓		
9	U.T. #061	11"	N/A	0-9	D4	18"	.125"	✓		
10	U.T. #052	11"	N/A	0-9	D4	18"	.125"	✓		
11	U.T. #053	11"	N/A	0-9	D4	18"	.125"	✓		
12	U.T. #051	11"	N/A	0-9	D4	18"	.125"	✓		

Radiation Source: Ir 192 ☑ X-ray ☐ _____ Kv
Effective Focal Spot: 3.4 mm
Film used: 36 pcs. Size: 70mm x 8½" Brand: AGFA
____ pcs. Size: _____ x _____ Brand: _____

TOTAL HOURS
Technician's Name: J. Dupuis ST: 6.0 OT: _____ Shift: Day ☑ Night ☐
2nd Technician's Name: _____
Other Charges: No ☐ Yes ☐ Kilometres: --

SIGNATURES
Technician: (Signature on original)
Certification: CGSB / ASNT Level II
Client Rep: _____

Canspec Group Inc.
12271 Horseshoe Way
Richmond B.C.,Canada, V7A 4V4
Materials Engineering and Testing
A Rockwood Company
(604) 275-3800
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ISO 9002

RADIOGRAPHIC EXAMINATION REPORT

TO: SPECIFIC MECHANICAL SYSTEMS
6848 Kirkpatrick Crescent
Saanichton, BC
V8M 1Z9

ATTN: Tom Goldbach

PROJECT: Long Weld Seams
WORK LOCATION: Canspec Shop
MANUFACTURER: Specific Mechanical
ACCEPTANCE STANDARD: ASME Sec. VIII UW51

PAGE: 2 REPORT #: ---
DATE: June 23, 2000
OUR JOB #: 0N0465
PO #: 5169
PROCEDURE #: 7
MATERIAL TYPE: Stainless Steel

No.	Identification	Pipe Size ∅	WS	View	Film Type	SFD	Thickness	Accept (✓)	Reject (✗)	Remarks
13	U.T. #060	11"	N/A	0-9	D4	18"	.125"	✓		
14	U.T. #040	11"	N/A	0-9	D4	18"	.125"	✓		
15	U.T. #056	11"	N/A	0-9	D4	18"	.125"	✓		
16	U.T. #049	11"	N/A	0-9	D4	18"	.125"	✓		
17	U.T. #050	11"	N/A	0-9	D4	18"	.125"	✓		
18	U.T. #055	11"	N/A	0-9	D4	18"	.125"	✓		
19	U.T. #041	11"	N/A	0-9	D4	18"	.125"	✓		
20	U.T. #043	11"	N/A	0-9	D4	18"	.125"	✓		
21	U.T. #046	11"	N/A	0-9	D4	18"	.125"	✓		
22	U.T. #045	11"	N/A	0-9	D4	18"	.125"	✓		
23	U.T. #048	11"	N/A	0-9	D4	18"	.125"	✓		
24	U.T. #018	11"	N/A	0-9	D4	18"	.125"	✓		

Radiation Source: Ir 192 ☐ X-ray ☐ _____ Kv
Effective Focal Spot: _____ mm
Film used: ____ pcs. Size: _____ x _____ Brand: _____
____ pcs. Size: _____ x _____ Brand: _____
(See page 1 for film used)

TOTAL HOURS ST OT Shift
Technician's Name: J. Dupuis _____ _____ Day ☐
2nd Technician's Name: _____ _____ _____ Night ☐
Other Charges: No ☐ Yes ☐ Kilometres: _____ *(See page 1)*

SIGNATURES
Technician: (Signature on original)
Certification: CGSB / ASNT Level II
Client Rep: _____

Canspec Group Inc.
12271 Horseshoe Way
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Materials Engineering and Testing
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ISO 9002

RADIOGRAPHIC EXAMINATION REPORT

O: SPECIFIC MECHANICAL SYSTEMS
6848 Kirkpatrick Crescent
Saanichton, BC
V8M 1Z9

ATTN: Tom Goldbach

PROJECT: Long Weld Seams
WORK LOCATION: Canspec Shop
MANUFACTURER: Specific Mechanical
ACCEPTANCE STANDARD: ASME Sec. VIII UW51

PAGE: 3 REPORT #: ---
DATE: June 23, 2000
OUR JOB #: 0N0465
PO #: 5169
PROCEDURE #: 7
MATERIAL TYPE: Stainless Steel

No.	Identification	Pipe Size ∅	WS	View	Film Type	SFD	Thickness	Accept (✓)	Reject (✗)	Remarks
25	U.T. #007	11"	N/A	0-9	D4	18"	.125"	✓		
26	U.T. #006	11"	N/A	0-9	D4	18"	.125"	✓		
27	U.T. #014	11"	N/A	0-9	D4	18"	.125"	✓		
28	U.T. #023	11"	N/A	0-9	D4	18"	.125"	✓		
29	U.T. #005	11"	N/A	0-9	D4	18"	.125"	✓		
30	U.T. #028	11"	N/A	0-9	D4	18"	.125"	✓		
31	U.T. #047	11"	N/A	0-9	D4	18"	.125"	✓		
32	U.T. #009	11"	N/A	0-9	D4	18"	.125"	✓		
33	U.T. #059	11"	N/A	0-9	D4	18"	.125"		✗	LF(3) @ 0 & 9 (# side)
34	U.T. #026	11"	N/A	0-9	D4	18"	.125"	✓		
35	U.T. #017	11"	N/A	0-9	D4	18"	.125"	✓		
36	U.T. #016	11"	N/A	0-9	D4	18"	.125"	✓		

Radiation Source: Ir 192 ☐ X-ray ☐ _____ Kv
Effective Focal Spot: _____ mm
Film used: ____pcs. Size: _____ x _____ Brand: _____
____pcs. Size: _____ x _____ Brand: _____
(See page 1 for film used)

TOTAL HOURS — ST — OT — Shift
Technician's Name: J. Dupuis _____ _____ Day ☐
2nd Technician's Name: _____ _____ Night ☐
Other Charges: No ☐ Yes ☐ Kilometres: _____ *(See page 1)*

SIGNATURES
Technician: (Signature on original)
Certification: CGSB / ASNT Level II
Client Rep: _____

Canspec Group Inc.
12271 Horseshoe Way
Richmond B.C.,Canada, V7A 4V4
Materials Engineering and Testing
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ISO 9002

RADIOGRAPHIC EXAMINATION REPORT

TO: SPECIFIC MECHANICAL SYSTEMS
6848 Kirkpatrick Crescent
Saanichton, BC
V8M 1Z9

ATTN: Tom Goldbach

PROJECT: Long Weld Seams
WORK LOCATION: Canspec Shop
MANUFACTURER: Specific Mechanical
ACCEPTANCE STANDARD: ASME Sec. VIII UW51

PAGE: 4 REPORT #: ---
DATE: June 26, 2000
OUR JOB #: 0N0465
PO #: 5169
PROCEDURE #: 7
MATERIAL TYPE: Stainless Steel

No.	Identification	Pipe Size ∅	WS	View	Film Type	SFD	Thickness	Accept (✓)	Reject (✗)	Remarks
1	U.T. #013	11"	N/A	0-9	D4	18"	.125"	✓		
2	U.T. #021	11"	N/A	0-9	D4	18"	.125"	✓		TI(2)
3	U.T. #011	11"	N/A	0-9	D4	18"	.125"	✓		
4	U.T. #008	11"	N/A	0-9	D4	18"	.125"	✓		
5	U.T. #019	11"	N/A	0-9	D4	18"	.125"	✓		
6	U.T. #024	11"	N/A	0-9	D4	18"	.125"	✓		
7	U.T. #012	11"	N/A	0-9	D4	18"	.125"	✓		
8	U.T. #010	11"	N/A	0-9	D4	18"	.125"	✓		
9	U.T. #025	11"	N/A	0-9	D4	18"	.125"	✓		
10	U.T. #022	11"	N/A	0-9	D4	18"	.125"	✓		
11	U.T. #015	11"	N/A	0-9	D4	18"	.125"	✓		
12	U.T. #038	11"	N/A	0-9	D4	18"	.125"	✓		

Radiation Source: Ir 192 [✓] X-ray [ ] _____ Kv
Effective Focal Spot: 3.4 mm
Film used: 25 pcs. Size: 70mm x 8½" Brand: AGFA
____ pcs. Size: _____ x _____ Brand: _____

TOTAL HOURS

	ST	OT	Shift
Technician's Name: J. Dupuis	5.0		Day [✓]
2nd Technician's Name:			Night [ ]

Other Charges: No [ ] Yes [ ] Kilometres: --

SIGNATURES
Technician: (Signature on original)
Certification: CGSB / ASNT Level II
Client Rep: _____

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RADIOGRAPHIC EXAMINATION REPORT

TO: SPECIFIC MECHANICAL SYSTEMS
6848 Kirkpatrick Crescent
Saanichton, BC
V8M 1Z9

ATTN: Tom Goldbach

PROJECT: Long Weld Seams
WORK LOCATION: Canspec Shop
MANUFACTURER: Specific Mechanical
ACCEPTANCE STANDARD: ASME Sec. VIII UW51

PAGE: 5 REPORT #: ---
DATE: June 26, 2000
OUR JOB #: 0N0465
PO #: 5169
PROCEDURE #: 7
MATERIAL TYPE: Stainless Steel

No.	Identification	Pipe Size ∅	WS	View	Film Type	SFD	Thickness	Accept (✓)	Reject (✗)	Remarks
13	U.T. #004	11"	N/A	0-9	D4	18"	.125"	✓		
14	U.T. #020	11"	N/A	0-9	D4	18"	.125"	✓		
15	U.T. #032	11"	N/A	0-9	D4	18"	.125"	✓		
16	U.T. #037	11"	N/A	0-9	D4	18"	.125"	✓		
17	U.T. #035	11"	N/A	0-9	D4	18"	.125"	✓		
18	U.T. #031	11"	N/A	0-9	D4	18"	.125"	✓		
19	U.T. #034	11"	N/A	0-9	D4	18"	.125"	✓		
20	U.T. #030	11"	N/A	0-9	D4	18"	.125"	✓		
21	U.T. #033	11"	N/A	0-9	D4	18"	.125"	✓		
22	U.T. #039	11"	N/A	0-9	D4	18"	.125"	✓		
23	U.T. #020	11"	N/A	0-9	D4	18"	.125"	✓		
24	U.T. #036	11"	N/A	0-9	D4	18"	.125"	✓		

Radiation Source: Ir 192 ☐ X-ray ☐ _____ Kv
Effective Focal Spot: _____ mm
Film used: ____pcs. Size: _____ x _____ Brand: _____
____pcs. Size: _____ x _____ Brand: _____
(See page 4 for film used)

TOTAL HOURS ST OT Shift
Technician's Name: J. Dupuis _____ _____ Day ☐
2nd Technician's Name: _____ _____ _____ Night ☐
Other Charges: No ☐ Yes ☐ Kilometres: _____ *(See page 4)*

SIGNATURES
Technician: (Signature on original)
Certification: CGSB / ASNT Level II
Client Rep: _____

Canspec Group Inc.
12271 Horseshoe Way
Richmond B.C.,Canada, V7A 4V4
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Materials Engineering and Testing
A Rockwood Company
ISO 9002

RADIOGRAPHIC EXAMINATION REPORT

TO: SPECIFIC MECHANICAL SYSTEMS
6848 Kirkpatrick Crescent
Saanichton, BC
V8M 1Z9

ATTN: Tom Goldbach

PROJECT: Long Weld Seams
WORK LOCATION: Canspec Shop
MANUFACTURER: Specific Mechanical
ACCEPTANCE STANDARD: ASME Sec. VIII UW51

PAGE: 6 REPORT #: ---
DATE: June 26, 2000
OUR JOB #: 0N0465
PO #: 5169
PROCEDURE #: 7
MATERIAL TYPE: Stainless Steel

No.	Identification	Pipe Size ∅	WS	View	Film Type	SFD	Thickness	Accept (✓)	Reject (✗)	Remarks
25	U.T. #027	11"	N/A	0-9	D4	18"	.125"	✓		

Radiation Source: Ir 192 ☐ X-ray ☐ _____ Kv
Effective Focal Spot: _____ mm
Film used: ____pcs. Size: _____ x _____ Brand: _____
____pcs. Size: _____ x _____ Brand: _____
(See page 4 for film used)

TOTAL HOURS — ST — OT — Shift
Technician's Name: J. Dupuis _____ _____ Day ☐
2nd Technician's Name: _____ _____ _____ Night ☐
Other Charges: No ☐ Yes ☐ Kilometres: _____ *(See page 4)*

SIGNATURES
Technician: (Signature on original)
Certification: CGSB / ASNT Level II
Client Rep: _____

Bellows Pressure and Squirm Tests

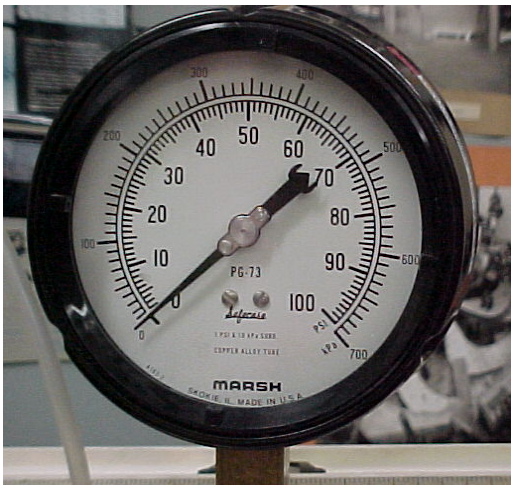
Tests preformed

Squirm Pressure test : 3.5 bar with no offset
Squirm Pressure test: 3.5 bar with 3mm offset
Pressure test: 5 bar

Conditions of Test

The bellows used for this test came from the manufacture welded to the seal ring and cuff ring. A Stainless steel plate was welded to the seal ring and another plate was welded to the cuff ring to complete a vessel that could be pressurized. A frame designed to take a working pressure of 5 bars was constructed to prevent the bellows from expanding under pressure. A Plexiglas cylinder with the same inner diameter as the cryostat chimney was used to limit side movement of the bellows after it squirmed. A Marsh gauge with a 100mm dial was used to monitored the pressure. After the 5 bar pressure test, the bellows was He leak tested; no leak was found.

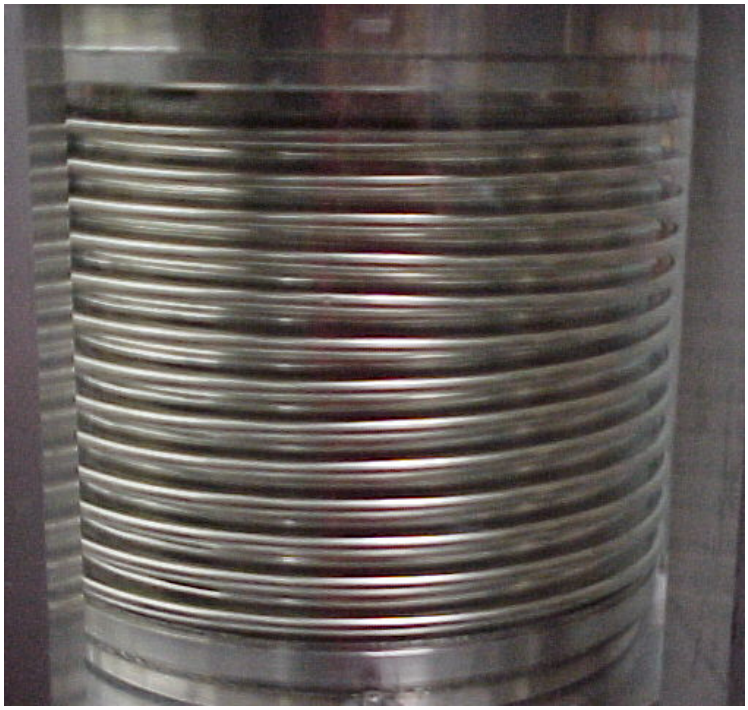
Test Apparatus

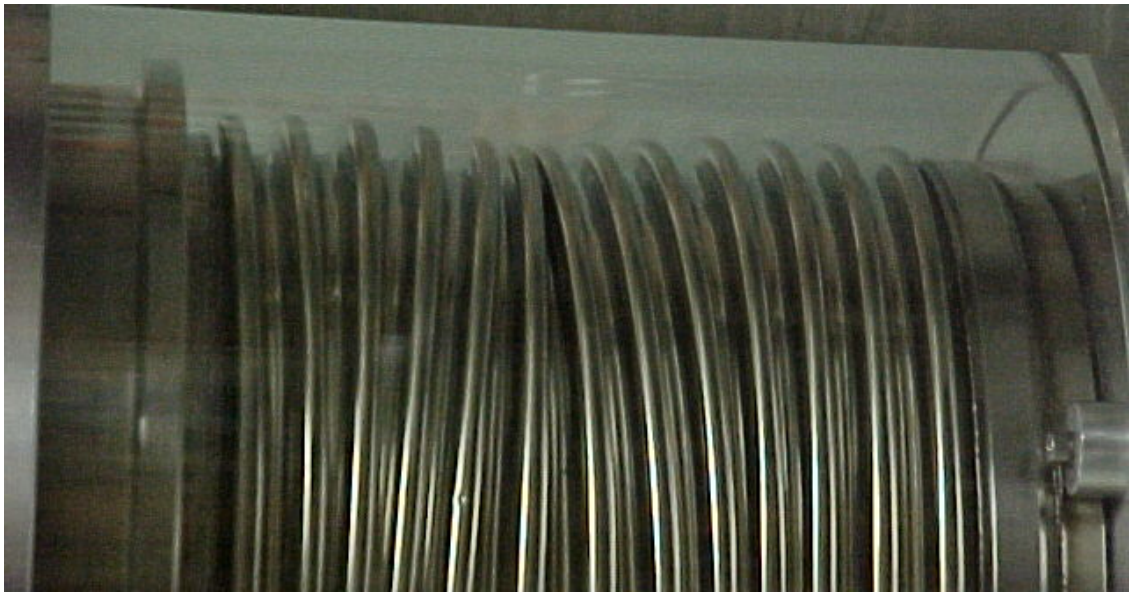


3.5 bar is centre scale on the gauge

Test #1

The bellows was installed with no lateral offset. The pressure was increased in steps to 3.5 bar. Only a little deformation occurred as shown in these pictures.

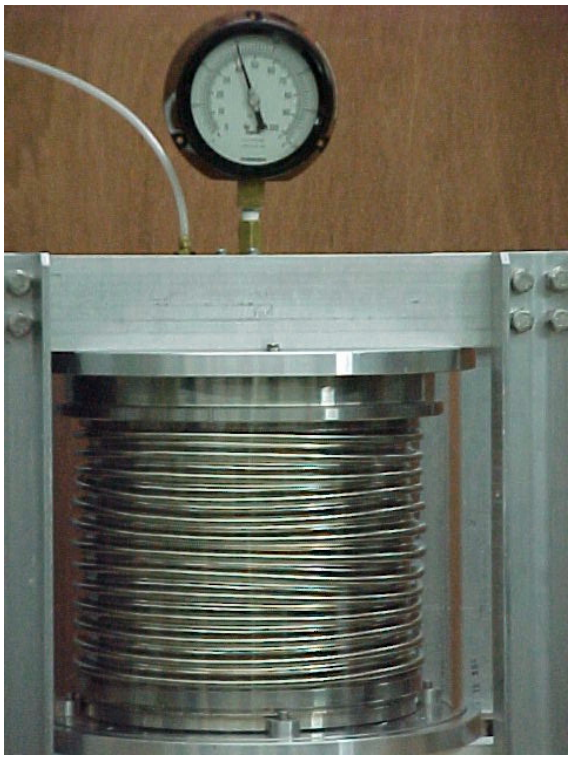




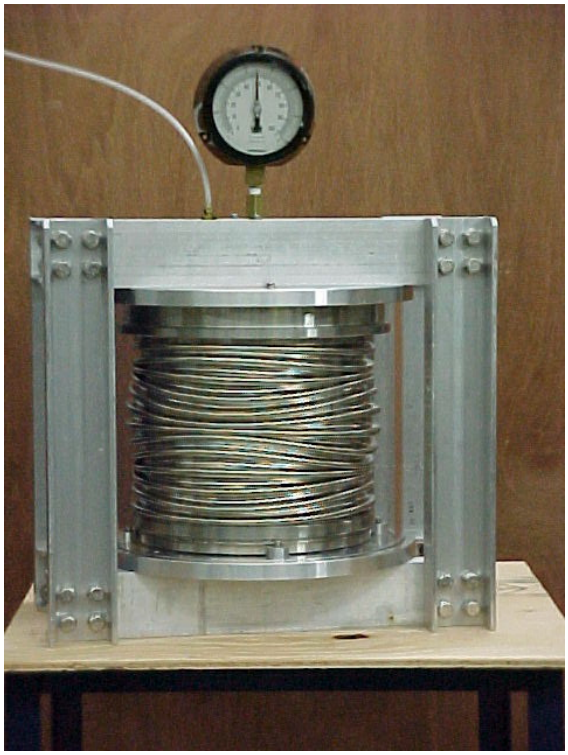
Bellows at 3.5 bar of pressure and no offset.

Test #2

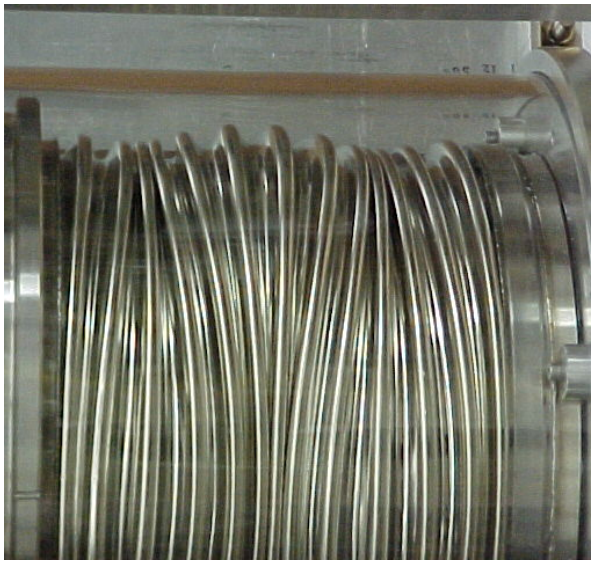
The bellows was installed with an offset of 3mm. The pressure was increased in steps to 3.5 bar.



Bellows at a pressure of 3.0 bar



Bellows at a pressure of 3.4 bar



Bellows at a pressure of 3.5 bar

Test #3

Pressure test to 5 bar

Bellows during pressure test at 5 bar

After the pressure test the bellows was He leak tested, there were no leaks.