



International Linear Collider Engineering Release

ER # ILC-000008

Completed by initiator

Project name (line 1 from drawing title block) ILC CRYOMODULE

| Drawing number | Rev | Description (lines 2 and 3 from drawing title block) |
|----------------|-----|--|
| 812765 | A | HELIUM VESSEL – G3 He VESSEL ASSEMBLY |
| 812815 | A | HELIUM VESSEL – G3 HELIUM VESSEL WELDMENT |
| 844675 | A | HELIUM VESSEL – TUNER RING PIEZO END |
| 844685 | A | HELIUM VESSEL – TUNER RING COUPLER END |
| 812995 | A | HELIUM VESSEL – TUBE FLD PROBE END |
| 813005 | A | HELIUM VESSEL – TUBE MC END |
| 813065 | A | HELIUM VESSEL – INVAR ROD CLAMPING PIN |
| 813165 | A | HELIUM VESSEL – ROLLER PAD WIDE |
| 813205 | A | HELIUM VESSEL – CF FLANGE CUSTOM KNIFE EDGE |
| 844695 | A | HELIUM VESSEL – VESSEL SUPPORT BRACKET |
| 844705 | A | HELIUM VESSEL - SPANNER ROD |
| 813035 | A | HELIUM VESSEL – PIPE SUPPORT PLATE |

Completed by CHUCK GRIMM Date 01JAN09
Initiator

Completed by project engineer

Check one box only

| X | Order (instructions in notes below) | Task Number | % | Date Required |
|---|-------------------------------------|------------------|---|------------------------|
| | Reference only | 18.1.7.2.2.2.4.2 | | |
| | Other (see notes below) | | | ILC Distribution 001 |

Notes:

Order - (20) G3 HELIUM VESSEL WELDMENTS Part #812815-A

Order - (20) 2-PHASE PIPE ASSEMBLIES part #813155-A

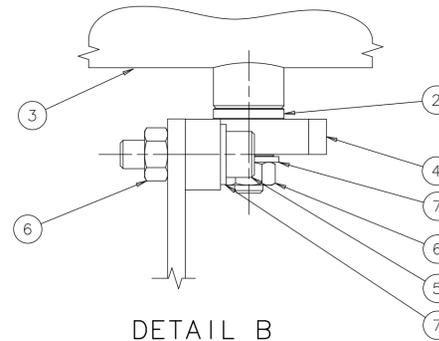
(1) of each part number is a required deliverable to Fermilab for acceptance before the balance of (19) of each assembly is ordered.

Completed by Donald Mitchell - 14JAN09
Project engineer

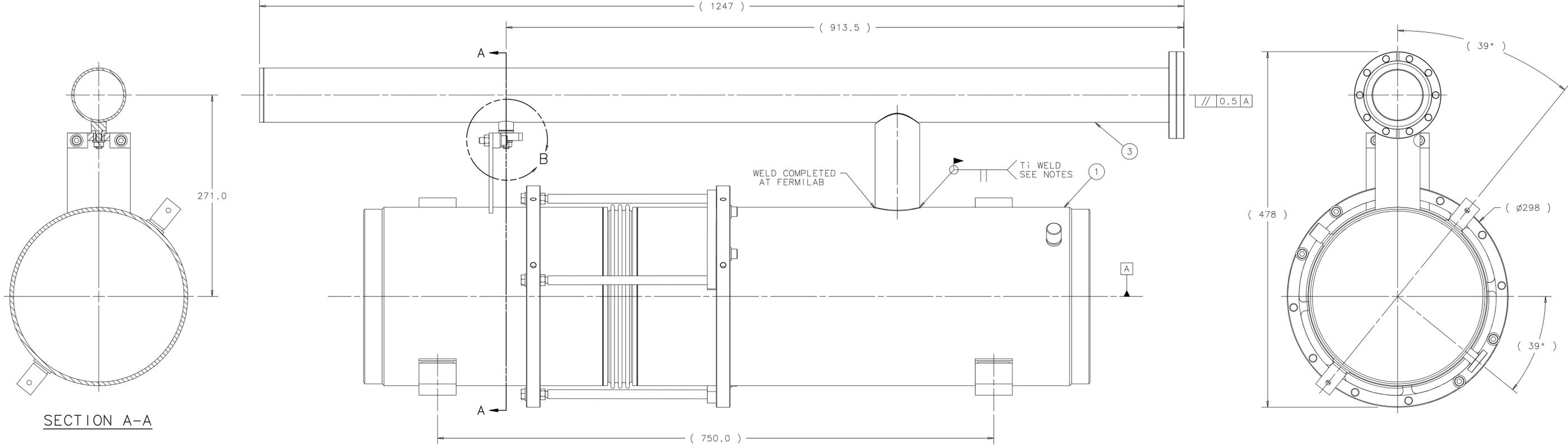
NOTES (UNLESS OTHERWISE SPECIFIED):

1. FIELD WELDS TO BE SMOOTH FOR COSMETIC APPEARANCE.
2. SEALING SURFACES ON FLANGES MUST BE FREE FROM ANY NICKS AND RADIAL SCRATCHES.
3. ASSEMBLY MUST BE FREE FROM DIRT, GREASE, OIL AND CHIPS AND PROPERLY PACKAGED TO AVOID DAMAGE DURING SHIPPING.
4. ALL WELDS MUST BE CONTAMINANT FREE. WELD JOINT MUST BE CLEANED PROPERLY TO REMOVE MILL SCALE, DIRT, DUST, GREASE OIL, MOISTURE AND OXIDATION.
5. ALL CLEANING AND WELDING PROCEDURES WILL CONFORM TO THE AMERICAN WELDING SOCIETY SPECIFICATION: AWS G2.4M: 2007, "GUIDE FOR THE FUSION WELDING OF TITANIUM AND TITANIUM ALLOYS."
6. FIELD WELD MUST BE PERFORMED WITH AN ARGON PURGED ROTARY WELDER. A CONTINUOUS ARGON FLOW IS REQUIRED INSIDE THE TUBE TO GET THE OXYGEN COUNT OF 30 PPM OR LESS. WELD MUST BE FREE OF ALL TITANIUM OXIDATION AND DISCOLORATION.
7. WRITTEN PROCEDURE DESCRIBING THE CLEANING & WELDING PROCEDURE MUST BE SUPPLIED TO FERMILAB FOR APPROVAL PRIOR TO ANY PRODUCT WELDING.
8. WELDER MUST BE QUALIFIED IN TITANIUM WELDING. VERIFICATION DOCUMENTS AS WELL AS SAMPLE WELDS MUST BE SUPPLIED TO FERMILAB PRIOR TO ANY PRODUCT WELDING.
9. ALL WELDS TO BE VACUUM TIGHT. NO LEAK SHALL BE DETECTABLE ON THE MOST SENSITIVE SCALE OF A HELIUM LEAK DETECTOR WITH A MINIMUM SENSITIVITY OF 2×10^{-10} ATM. CC/SEC.

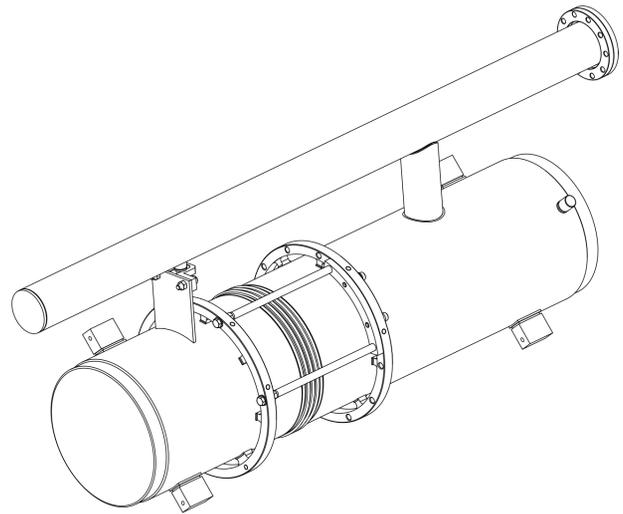
| REVISION HISTORY | | | | |
|---|-----|----------------------------------|------|----------|
| CAD MAINTAINED. CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY. | | | | |
| ZONE | REV | DESCRIPTION | DATE | APPROVED |
| | A | INITIAL RELEASE - ER# ILC-000008 | | |



DETAIL B
SCALE = 1:1



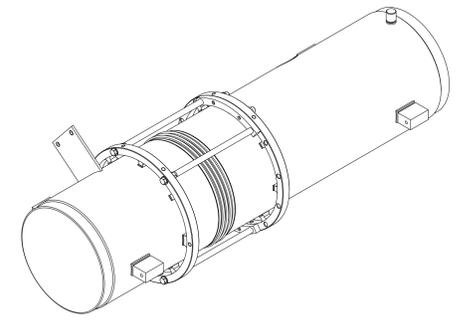
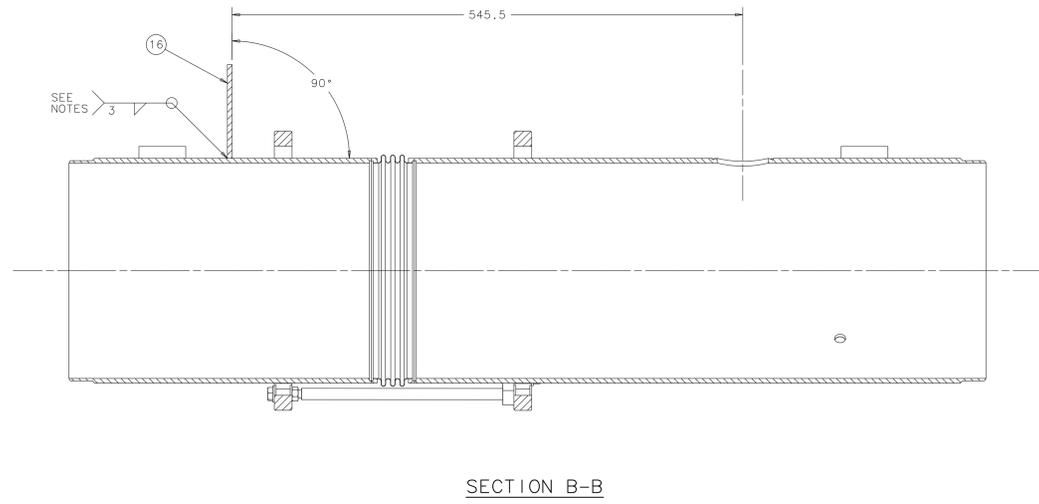
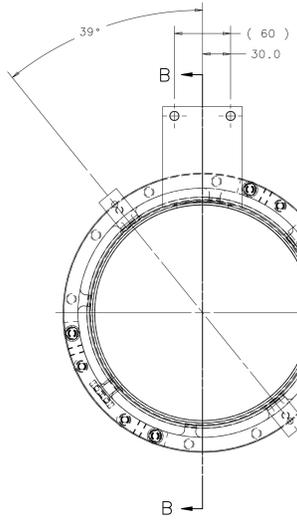
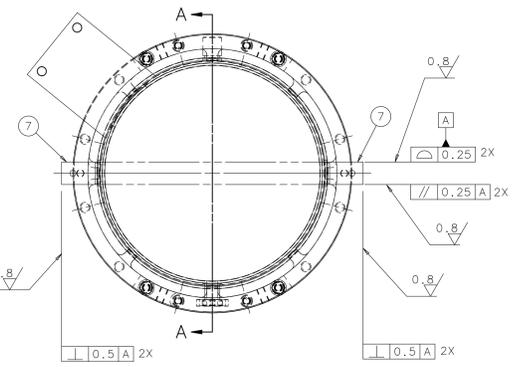
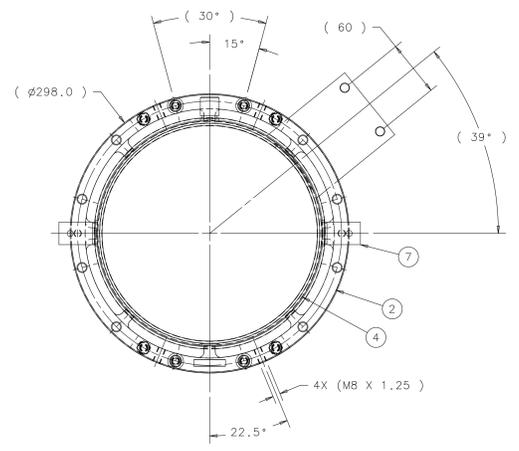
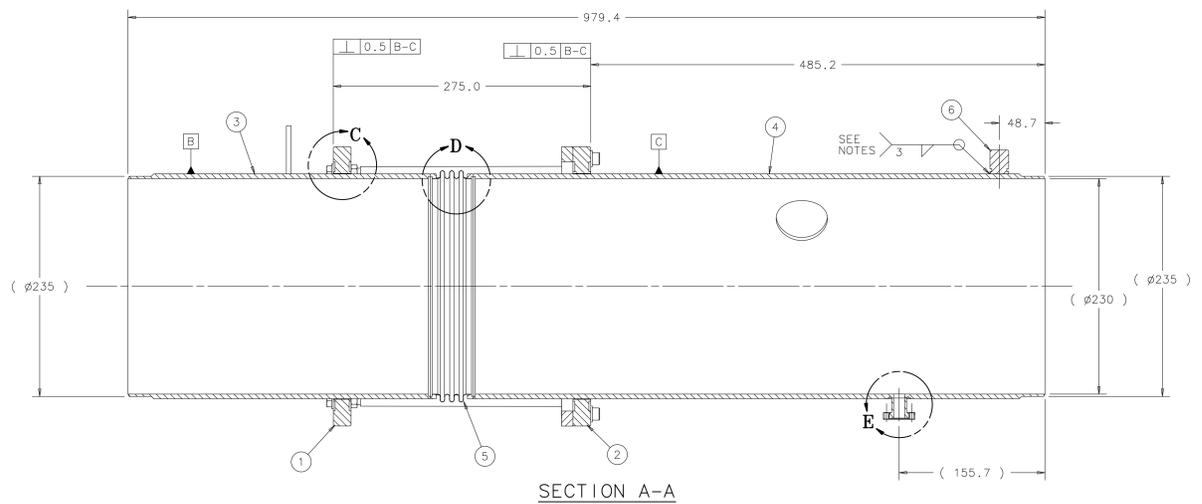
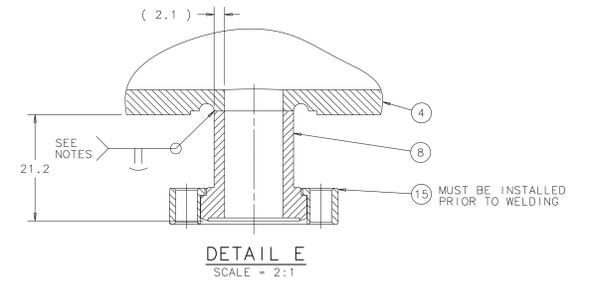
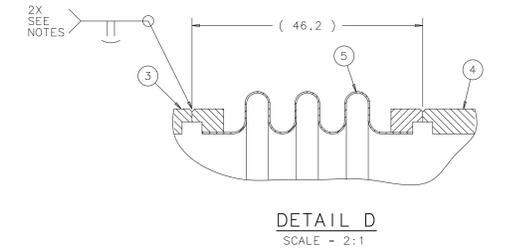
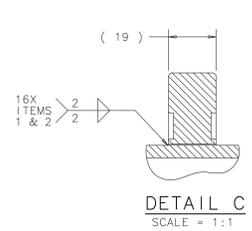
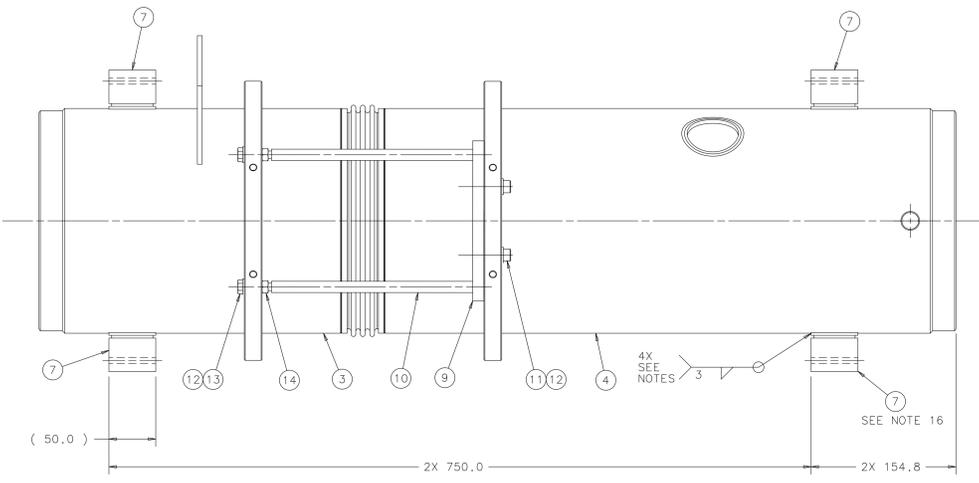
| ITEM | P. I. N. | DESCRIPTION | QTY |
|------|----------|--|-----|
| 7 | COML | FLAT WASHER FOR M8 SCREW 304 STAINLESS STEEL | 3 |
| 6 | COML | M8 X 1.25 HEX NUT SILICON BRONZE | 3 |
| 5 | COML | M8 X 1.25 X 30 LG. HEX HEAD SCREW - 304 STAINLESS STEEL | 2 |
| 4 | 813175 | SUPPORT PLATE ADAPTER | 1 |
| 3 | 813155 | 2-PHASE PIPE ASSEMBLY | 1 |
| 2 | 813045 | PIPE BUSHING | 1 |
| 1 | 812815 | G3 HELIUM VESSEL WELDMENT | 1 |



| | | | | |
|-------------------------------|---|------------------------------|------------------------------------|--|
| FINISH N/A | UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS INTERPRET DIM PER ASME Y14.5M-1994 BREAK ALL SHARP EDGES 0.5 MAX. ALL MACH. SURFACES 3.2 MAX. | DRAWN BY C. GRIMM | DATE 15DEC08 | <p>FERMI NATIONAL ACCELERATOR LABORATORY UNITED STATES DEPARTMENT OF ENERGY P.O. BOX 500, BATAVIA, IL 60510-0500</p> |
| MATERIAL SEE PARTS LIST | TOLERANCES X ± 2 X ± 0.8 .XX ± 0.13 ANGLE ± 1° | CHECKED BY D. MITCHELL | DATE 14JAN09 | |
| THIRD ANGLE PROJECTION | | ENGINEERED BY D. MITCHELL | DATE 14JAN09 | TITLE ILC CRYOMODULE HELIUM VESSEL G3_He_VESSEL_ASSEMBLY |
| NEXT ASSY USED ON APPLICATION | | DATABASE DESY EDMS | TEAM/GROUP T4CM DESIGN | SIZE A1 |
| | | CAD I-DEAS | SOLID MODEL NO. D00000000623013 | CAGE CODE OU5R6 |
| | | | | DWG NO. D00000000812765 |
| | | | | SCALE 3:8 |
| | | | | DO NOT SCALE DRAWING |
| | | | | SHEET 1 OF 1 |

- NOTES (UNLESS OTHERWISE SPECIFIED):
- ALL FILLET WELDS TO BE SMOOTH FOR COSMETIC APPEARANCE.
 - ITEMS 9 AND 10 MUST BE INSTALLED AS SHOWN, PRIOR TO LEAK TEST TO PROTECT BELLOWS ASSY AND REMAIN INSTALLED THRU DELIVERY TO FERMI LAB.
 - MOUNTING HOLES FROM TUNER RINGS, ITEM 1 AND ITEM 2 ARE TO BE IN-LINE WITHIN ±0.15mm.
 - ITEMS 1 AND 2 MUST BE CONCENTRIC WITH EACH OTHER WITHIN ±0.15mm.
 - ASSEMBLY MUST BE FREE FROM DIRT, GREASE, OIL AND CHIPS AND PROPERLY PACKAGED TO AVOID DAMAGE DURING SHIPPING.
 - ALL WELDS MUST BE CONTAMINANT FREE, EACH JOINT MUST BE CLEANED PROPERLY TO REMOVE MILL SCALE, DIRT, DUST, GREASE, OIL, MOISTURE AND OXIDATION.
 - ALL CLEANING AND WELDING PROCEDURES WILL CONFORM TO THE AMERICAN WELDING SOCIETY SPECIFICATION: AWS G2.4/G2.4M:2007, *GUIDE FOR THE FUSION WELDING OF TITANIUM AND TITANIUM ALLOYS.*
 - VENDOR'S OPTION:
AS AN ALTERNATE TO NOTE 6 ABOVE, AN ACCEPTABLE PICKLE BATH MAY BE IMPLEMENTED TO CLEAN THE WELD JOINT MATERIAL. USE A BATH OF 35% VOL. NITRIC ACID (70% CONCENTRATION) AND 5% VOL. HYDROFLUORIC ACID (48% CONCENTRATION). RINSE WITH COLD WATER AND THEN RINSE WITH HOT WATER TO FACILITATE FASTER DRYING. INSURE THAT PARTS ARE CLEAN, COMPLETELY DRY AND OXIDATION FREE PRIOR TO WELDING.
 - ALL WELDS MUST BE PERFORMED INSIDE OF A PURGED GLOVEBOX WITH AN OXYGEN COUNT OF 30 PPM OR LESS. WELDS MUST BE FREE OF ALL TITANIUM OXIDATION AND DISCOLORATION.
 - THE VENDOR'S WRITTEN PROCEDURE DESCRIBING THE CLEANING & WELDING PROCEDURE MUST BE SUPPLIED TO FERMI LAB FOR WRITTEN APPROVAL PRIOR TO ANY PRODUCT WELDING.
 - WELDER MUST BE QUALIFIED IN TITANIUM WELDING. VERIFICATION DOCUMENTS AS WELL AS SAMPLE WELDS MUST BE SUPPLIED TO FERMI LAB PRIOR TO ANY PRODUCT WELDING.
 - ON A DAILY BASIS, PRIOR TO PRODUCT WELDING, WELD COUPONS OF COMPARABLE SIZE AND TYPE WILL BE PREPARED BY THE WELDER. THESE COUPONS WILL BE ETCHED WITH THE DATE, TIME, AND WELDER'S NAME AND KEPT FOR RECORD. THE WELD COUPONS WILL BE PART OF THE DELIVERABLE TO FERMI LAB.
 - INSPECTION OF WELDS TO BE CONDUCTED AT FERMI LAB PRIOR TO ANY ULTRASONIC OR WIRE-BRUSH CLEANING. DO NOT MODIFY THE FINAL WELDS PRIOR TO PRODUCT ACCEPTANCE.
 - WELDS SHOWN IN DETAILS D & E ARE TO BE FULL PENETRATION AND VACUUM TIGHT. NO LEAK SHALL BE DETECTABLE ON THE MOST SENSITIVE SCALE OF A HELIUM LEAK DETECTOR WITH A MINIMUM SENSITIVITY OF 2 X 10⁻¹⁰ ATM. CC/SEC.
 - MATERIAL CERTIFICATIONS ARE REQUIRED AND MUST BE INCLUDED WITH SHIPPING. THERE WILL BE NO PRODUCT ACCEPTANCE WITHOUT THE PROPER MATERIAL CERTIFICATIONS.
 - NOTE ORIENTATION OF TUNER RING HOLES AND WELD TABS IN RELATION TO ROLLER PADS.

| REVISION HISTORY | | | |
|------------------|-----------------|----------------|------|
| ZONE | REV | DESCRIPTION | DATE |
| A | INITIAL RELEASE | ER# ILC-000008 | |



| ITEM | P. I. N. | DESCRIPTION | QTY |
|------|----------|--|-----|
| 16 | 813035 | PIPE SUPPORT PLATE | 1 |
| 15 | COML | FLANGE CF 1-1/3" ROTATABLE BODY 316L S.S. KURT LESKER PT.# F0133X00R | 1 |
| 14 | COML | M8 X 1.25 HEX NUT SILICON BRONZE | 4 |
| 13 | COML | M8 X 1.25 X 40 LONG HEX HEAD SCREW - SILICON BRONZE | 4 |
| 12 | COML | FLAT WASHER FOR M8 SCREW 304 STAINLESS STEEL | 8 |
| 11 | COML | M8 X 1.25 X 30 LONG HEX HEAD SCREW - SILICON BRONZE | 4 |
| 10 | 844705 | SPANNER ROD | 4 |
| 9 | 844695 | VESSEL SUPPORT BRACKET | 2 |
| 8 | 813205 | CF FLANGE CUSTOM KNIFE EDGE | 1 |
| 7 | 813165 | ROLLER PAD WIDE | 4 |
| 6 | 813065 | INVAR ROD CLAMPING PIN | 1 |
| 5 | COML | 247mm OD X 230mm ID GR2 TITANIUM BELLOWS - #844575-A; AMERIFLEX INC. | 1 |
| 4 | 813005 | TUBE MC END | 1 |
| 3 | 812995 | TUBE FLD PROBE END | 1 |
| 2 | 844685 | TUNER RING COUPLER END | 1 |
| 1 | 844675 | TUNER RING PIEZO END | 1 |

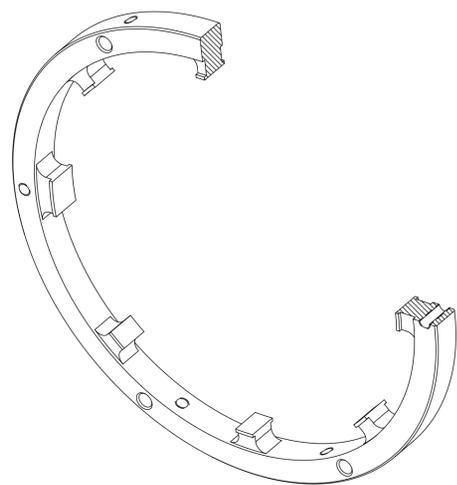
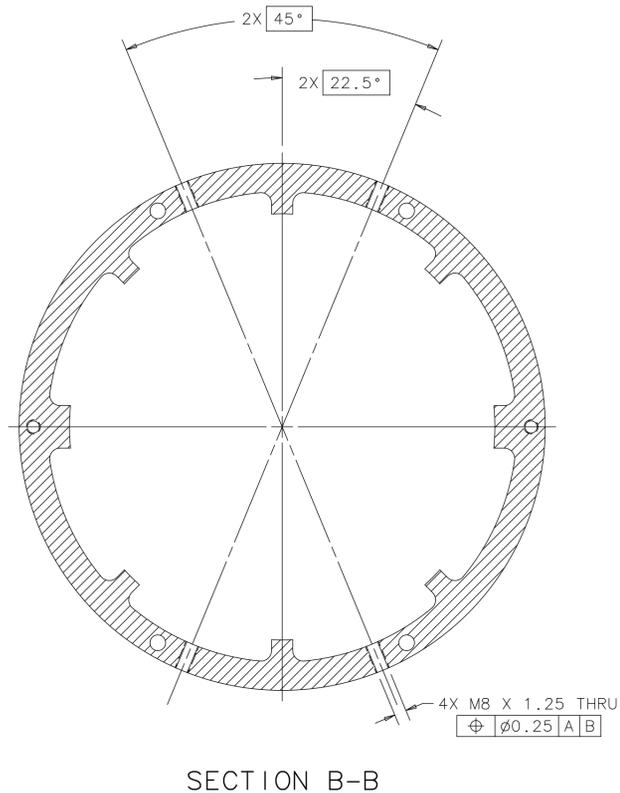
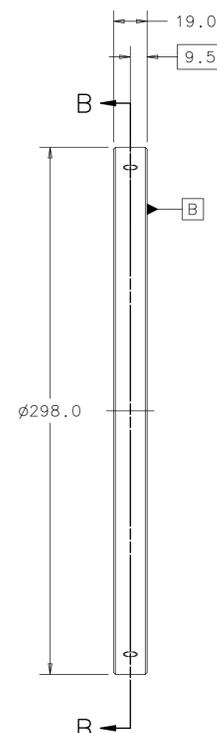
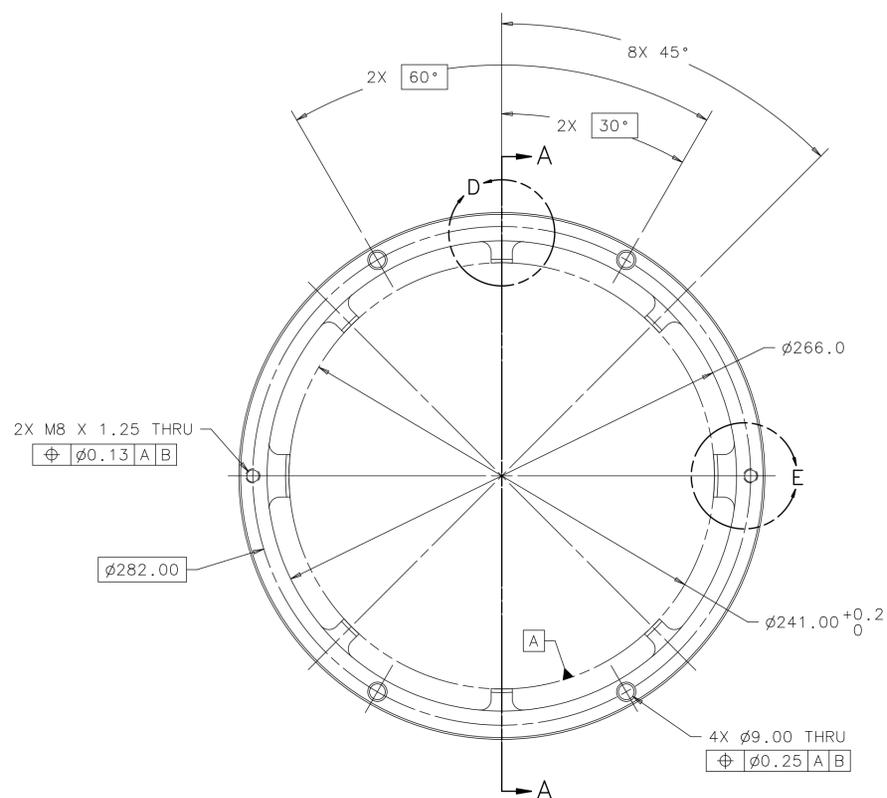
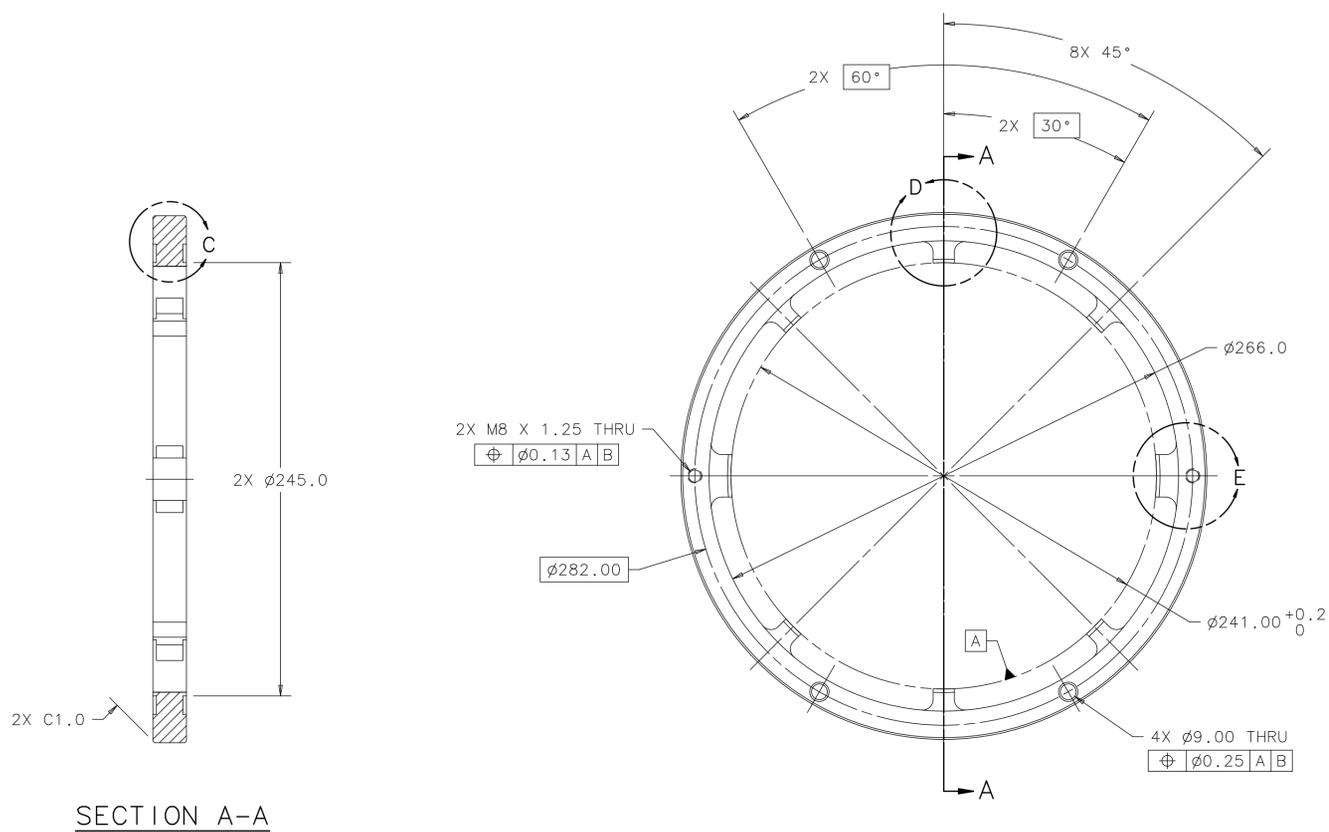
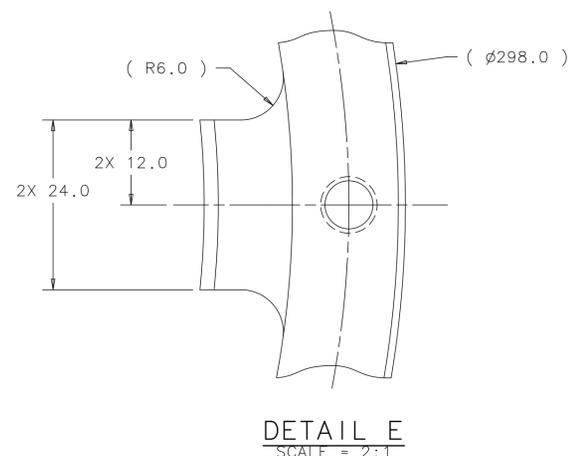
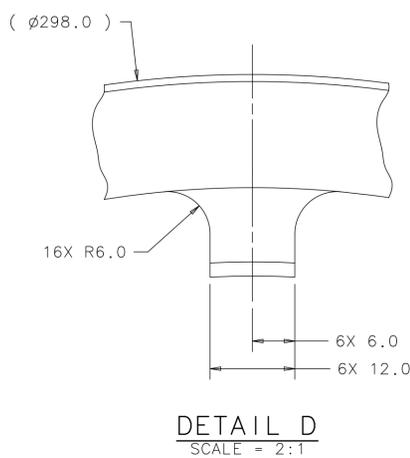
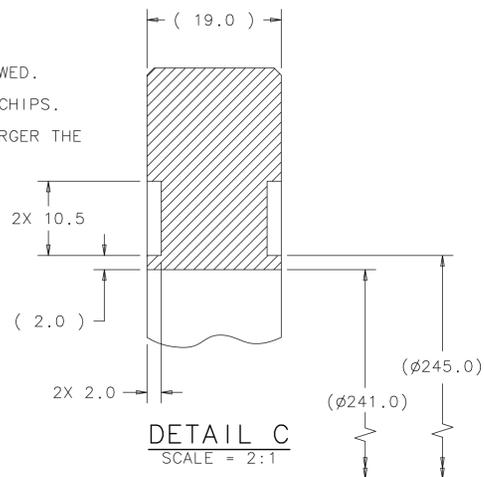
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|----------|----------------|---|-----------------------------------|------------------------------|
| FINISH | N/A | UNLESS OTHERWISE SPECIFIED: | DRAWN BY C. GRIMM | DATE 15DEC08 |
| MATERIAL | SEE PARTS LIST | DIMENSIONS ARE IN MILLIMETERS INTERPRET DIM PER ASME Y14.5M-1994 BREAK ALL SHARP EDGES 0.5 MAX. ALL MACH. SURFACES ±0.2 MAX. | CHECKED BY D. MITCHELL | DATE 14JAN09 |
| | | TOLERANCES | THIRD ANGLE PROJECTION | DATE 14JAN09 |
| | | X + 0.2 | | ENGINEERED BY D. MITCHELL |
| | | Y ± 0.8 | | DATE 14JAN09 |
| | | Z ± 0.13 | DESIGNED BY DESJ.EDMS | DATE 14JAN09 |
| | | ANGLE ± 1° | TEAM/GROUP T4CM DESIGN | DATE 14JAN09 |
| | | | CAD 1-DEAS | DATE 14JAN09 |
| | | | SOLID MODEL NO. D0000000082033 | DATE 14JAN09 |
| | | | SCALE 1:1 | DATE 14JAN09 |

TITLE: ILC CRYOMODULE HELIUM VESSEL G3 HELIUM VESSEL WELDMENT
 SHEET OF 1

NOTES (UNLESS OTHERWISE SPECIFIED):

1. PART TO BE FREE OF ALL SHARP EDGES, CORNERS AND BURRS. A MAXIMUM OF 0.5mm X 45° IS ALLOWED.
2. PART MUST BE FREE OF DIRT, GREASE, OIL AND CHIPS.
3. ALL HOLES TO HAVE A 90° CSK 0.5mm TO 1mm LARGER THE (MAJOR) DIAMETERS (TO REMOVE BURRS).

| REVISION HISTORY | | | | |
|------------------|-----|----------------------------------|------|----------|
| ZONE | REV | DESCRIPTION | DATE | APPROVED |
| | A | INITIAL RELEASE - ER# ILC-000008 | | |

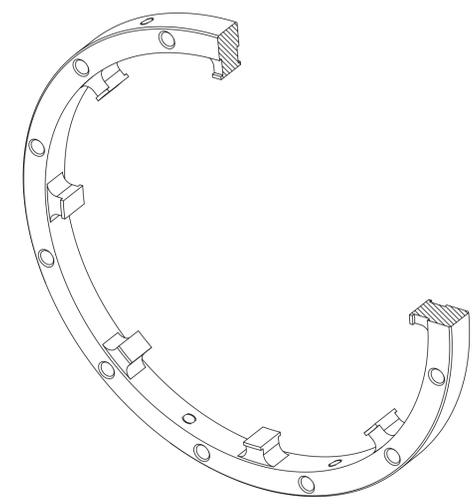
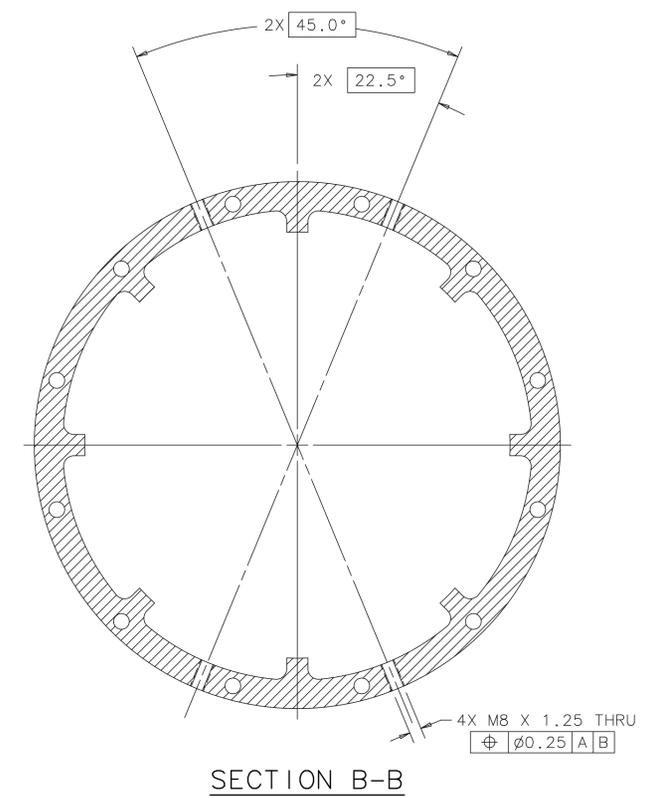
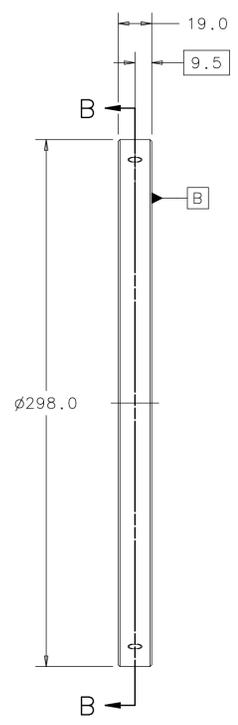
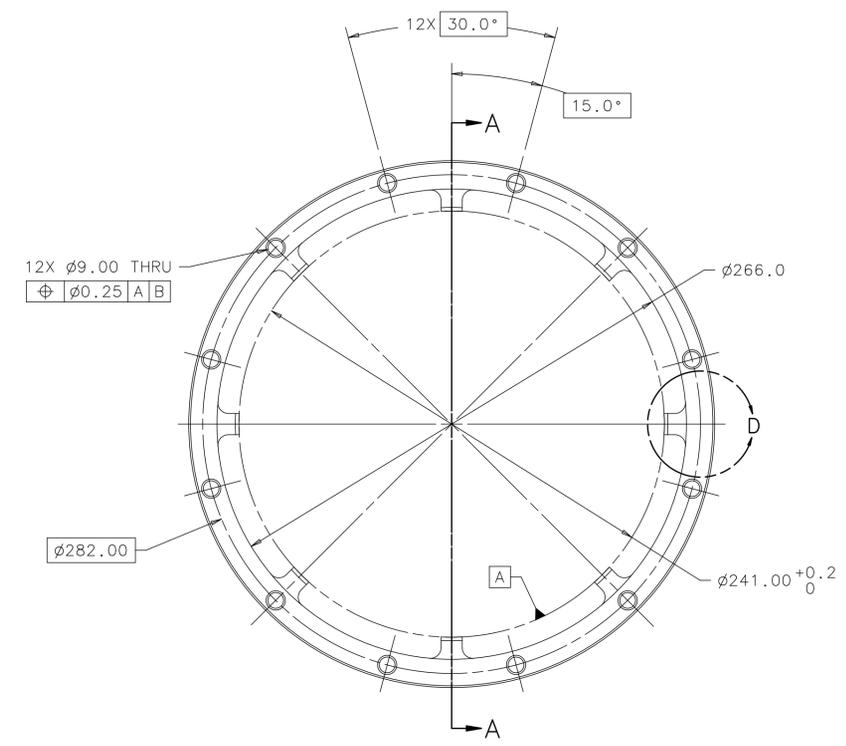
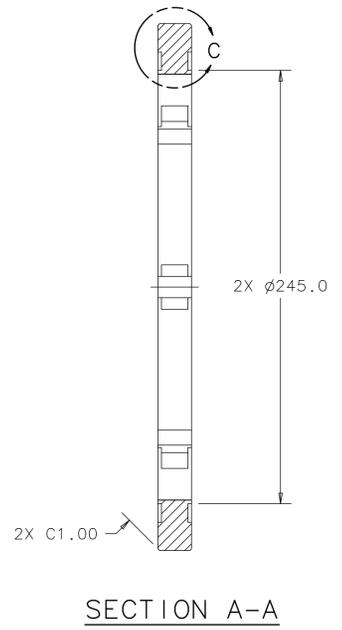
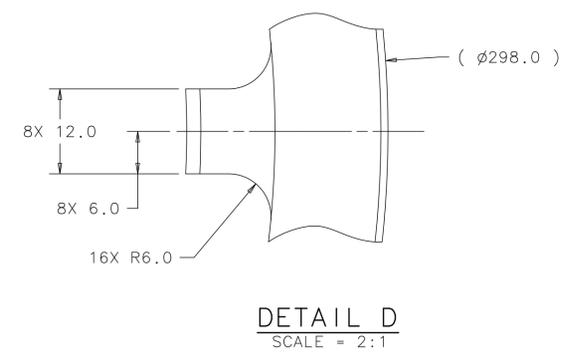
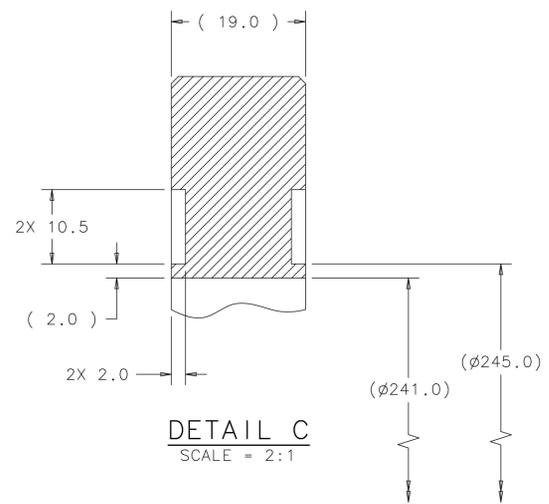


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|---|---|------------|---|---------------------------|--|------------------------------------|--|--------------|
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| | MATERIAL TITANIUM GRADE 2 | TOLERANCES | THIRD ANGLE PROJECTION | CHECKED BY D. MITCHELL | | DATE 14JAN09 | | |
| X ± 2 .X ± 0.8 .XX ± 0.13 ANGLE ± 1° | | | ENGINEERED BY D. MITCHELL DATE 14JAN09 | DATABASE DESJ EDMS | TEAM/GROUP CAD I-DEAS | SOLID MODEL NO. D00000000957472 | TITLE ILC CRYOMODULE HELIUM VESSEL TUNER_RING_PIEZO_END | |
| 812815 NEXT ASSY APPLICATION | 812765 USED ON APPLICATION | | | SIZE A1 | CAGE CODE OU5R6 | DWG NO. D00000000844675 | REV A | SCALE 1:2 |

NOTES (UNLESS OTHERWISE SPECIFIED):

- PART TO BE FREE OF ALL SHARP EDGES, CORNERS AND BURRS. A MAXIMUM OF 0.5mm X 45° IS ALLOWED.
- PART MUST BE FREE OF DIRT, GREASE, OIL AND CHIPS.
- ALL HOLES TO HAVE A 90° CSK 0.5mm TO 1mm LARGER THEN (MAJOR) DIAMETERS (TO REMOVE BURRS).

| REVISION HISTORY | | | | |
|------------------|-----|----------------------------------|------|----------|
| ZONE | REV | DESCRIPTION | DATE | APPROVED |
| | A | INITIAL RELEASE - ER# ILC-000008 | | |

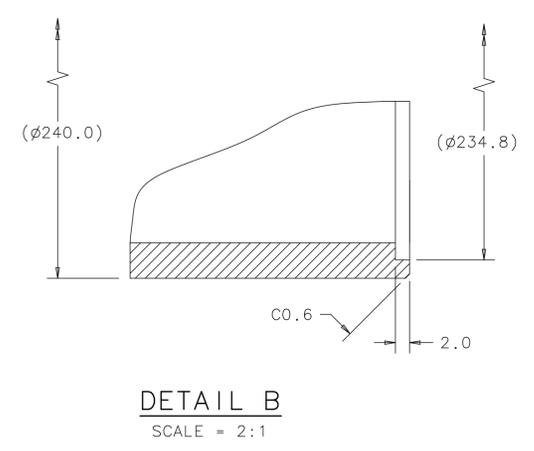
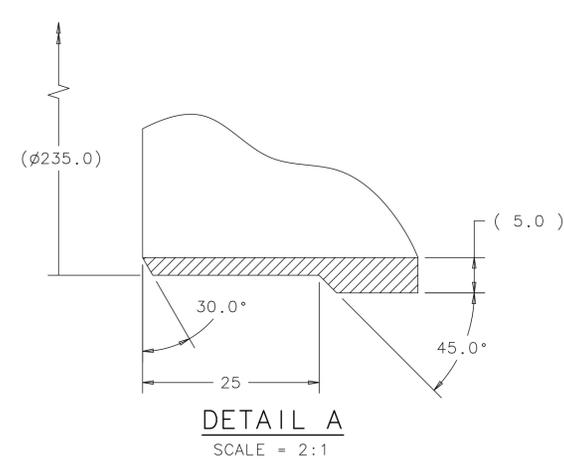
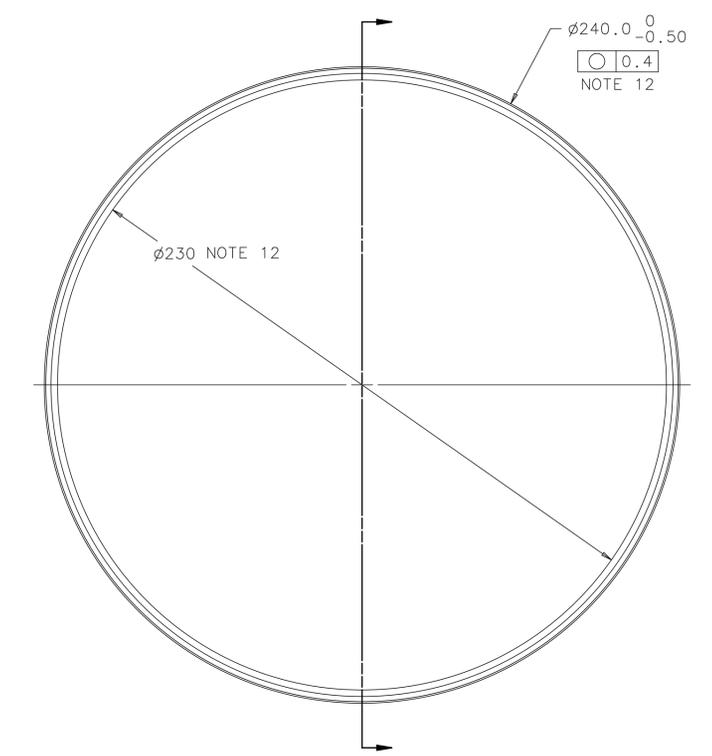
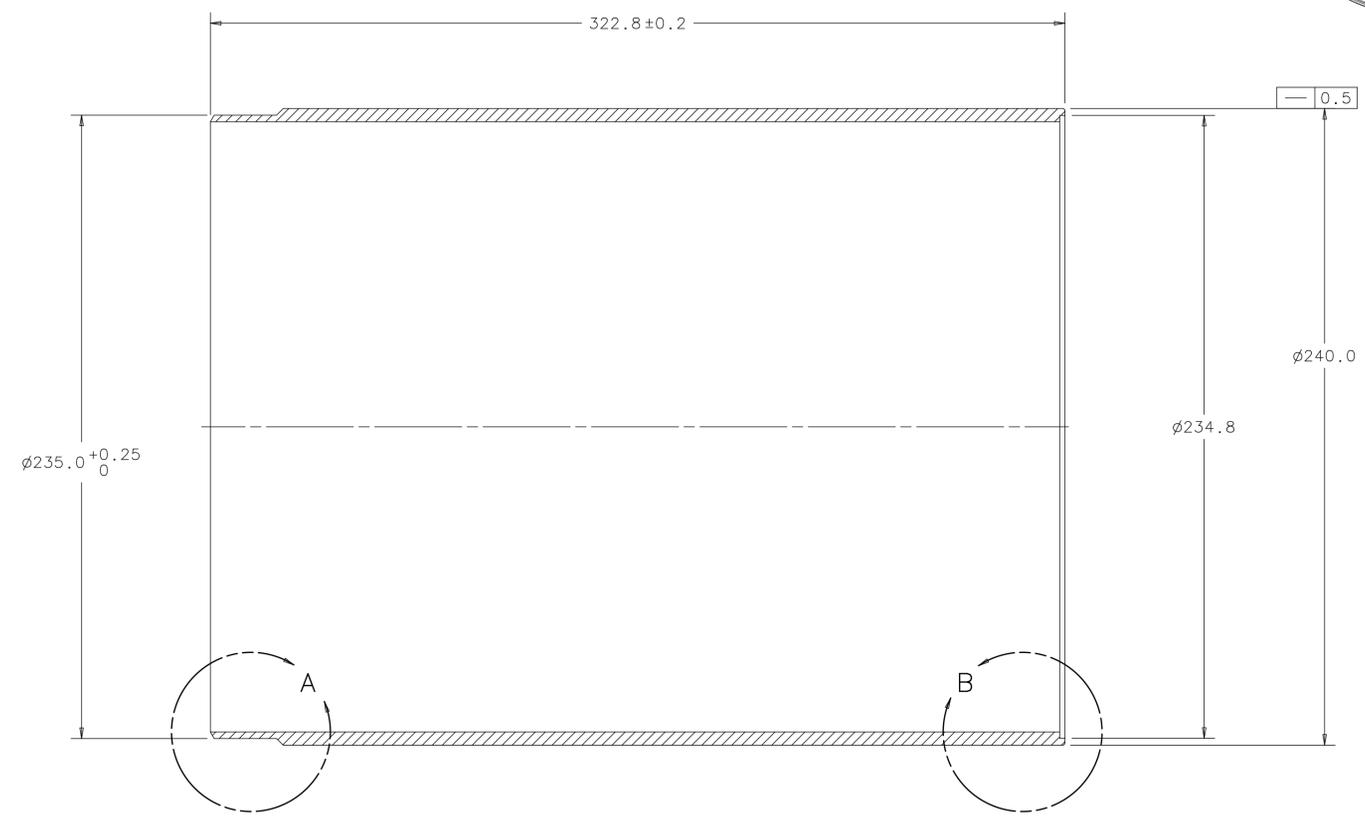
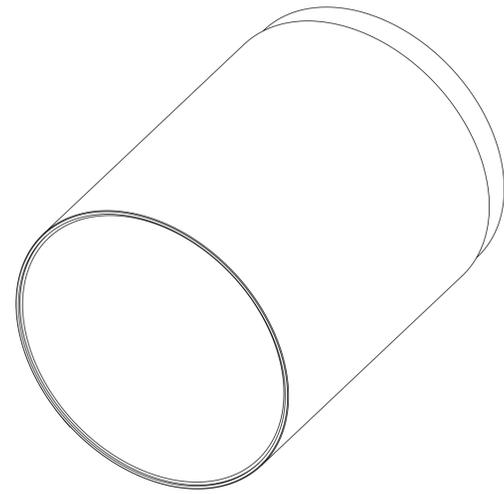


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|---|---|------------------------|------------------------------|------------------------------------|--|
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| | MATERIAL TITANIUM GRADE 2 | TOLERANCES | THIRD ANGLE PROJECTION | CHECKED BY D. MITCHELL | |
| X ± 2 .X ± 0.8 .XX ± 0.13 ANGLE ± 1° | | | ENGINEERED BY D. MITCHELL | DATE 14JAN09 | TITLE ILC CRYOMODULE HELIUM VESSEL TUNER_RING COUPLER_END |
| NEXT ASSY USED ON 812765 812815 | APPLICATION | DATABASE CAD I-DEAS | TEAM/GROUP | SOLID MODEL NO. D00000000957462 | SIZE A1 CAGE CODE OU5R6 DWG NO. D00000000844685 SCALE 1:2 DO NOT SCALE DRAWING SHEET 1 OF 1 |

NOTES (UNLESS OTHERWISE SPECIFIED):

- TUBE MAY BE ROLLED AND WELDED TO ACHIEVE DESIRED PART. ANY OUTSIDE WELDS ARE TO BE GROUND FLUSH AND PART IS TO BE VACUUM LEAK CHECKED. ALL WELDS TO BE VACUUM TIGHT. NO LEAK SHALL BE DETECTABLE ON THE MOST SENSITIVE SCALE OF A HELIUM LEAK DETECTOR WITH A MINIMUM SENSITIVITY OF 2×10^{-10} ATM. CC/SEC.
- DO NOT BREAK SHARP EDGES.
- PART MUST BE FREE FROM DIRT, GREASE, OIL AND CHIPS AND PROPERLY PACKAGED TO AVOID DAMAGE DURING SHIPPING.
- MATERIAL CERTIFICATIONS ARE REQUIRED AND MUST BE INCLUDED WITH SHIPPING. THERE WILL BE NO PRODUCT ACCEPTANCE WITHOUT THE PROPER MATERIAL CERTIFICATIONS.
- ALL CLEANING AND WELDING PROCEDURES WILL CONFORM TO THE AMERICAN WELDING SOCIETY SPECIFICATION: AWS G2.4/G2.4M:2007, "GUIDE FOR THE FUSION WELDING OF TITANIUM AND TITANIUM ALLOYS."
- VENDORS OPTION: AS AN ALTERNATE TO NOTE 5 ABOVE, AN ACCEPTABLE PICKLE BATH MAY BE IMPLEMENTED TO CLEAN THE WELD JOINT MATERIAL. USE A BATH OF 35% VOL. NITRIC ACID (70% CONCENTRATION) AND 5% VOL. HYDROFLUORIC ACID (48% CONCENTRATION). RINSE WITH COLD WATER AND THEN RINSE WITH HOT WATER TO FACILITATE FASTER DRYING. INSURE THAT PARTS ARE CLEAN, COMPLETELY DRY AND OXIDATION FREE PRIOR TO WELDING.
- ALL WELDS MUST BE PERFORMED INSIDE OF A PURGED GLOVEBOX WITH AN OXYGEN COUNT OF 30 PPM OR LESS. WELDS MUST BE FREE OF ALL TITANIUM OXIDATION AND DISCOLORATION.
- THE VENDOR'S WRITTEN PROCEDURE DESCRIBING THE CLEANING & WELDING PROCEDURE MUST BE SUPPLIED TO FERMILAB FOR WRITTEN APPROVAL PRIOR TO ANY PRODUCT WELDING.
- WELDER MUST BE QUALIFIED IN TITANIUM WELDING. VERIFICATION DOCUMENTS AS WELL AS SAMPLE WELDS MUST BE SUPPLIED TO FERMILAB PRIOR TO ANY PRODUCT WELDING.
- ON A DAILY BASIS, PRIOR TO PRODUCT WELDING, WELD COUPONS OF COMPARABLE SIZE AND TYPE WILL BE PREPARED BY THE WELDER. THESE COUPONS WILL BE ETCHED WITH THE DATE, TIME, AND WELDER'S NAME AND KEPT FOR RECORD. THE WELD COUPONS WILL BE PART OF THE DELIVERABLE TO FERMILAB.
- INSPECTION OF WELDS TO BE CONDUCTED AT FERMILAB PRIOR TO ANY ULTRASONIC OR WIRE-BRUSH CLEANING. DO NOT MODIFY THE FINAL WELDS PRIOR TO PRODUCT ACCEPTANCE.
- TO ACHIEVE DESIRED O.D. TOLERANCE AND CIRCULARITY, I.D. MAY BE SLIGHTLY INCREASED TO ALLOW EXTRA MATERIAL FOR MACHINING OF THE TUBE.
- AS AN OPTION: THIS PART CAN BE MANUFACTURED FROM P/N 845645, "G3 HELIUM VESSEL TUBE", WHICH IS MANUFACTURED FROM A RAW TUBE P/N 849685.

| REVISION HISTORY | | | | |
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| CAD MAINTAINED. CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY. | | | | |
| ZONE | REV | DESCRIPTION | DATE | APPROVED |
| | A | INITIAL RELEASE - ER# ILC-000008 | | |



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| 812765 | 812815 |
| NEXT ASSY | USED ON |
| APPLICATION | |

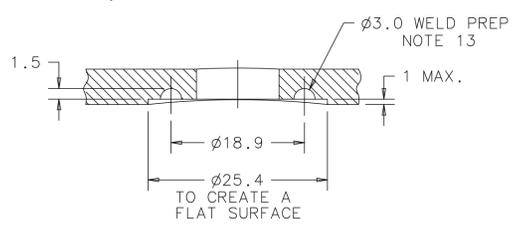
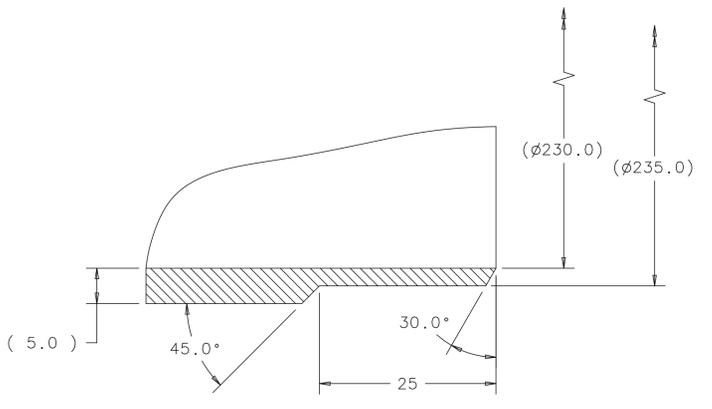
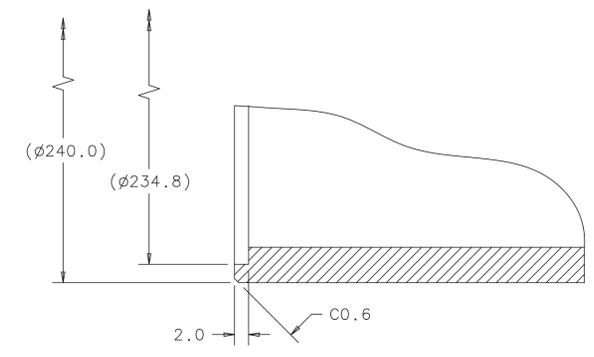
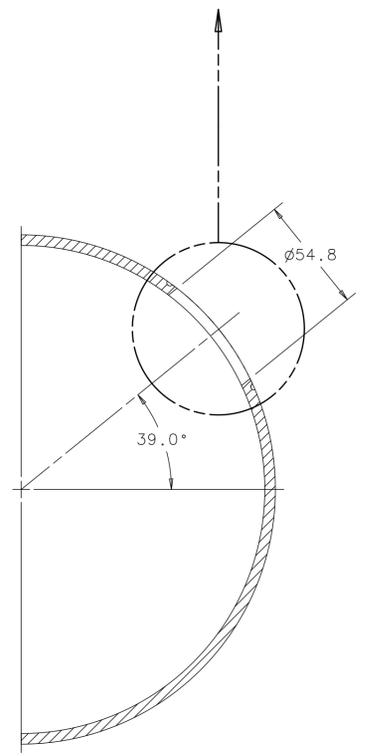
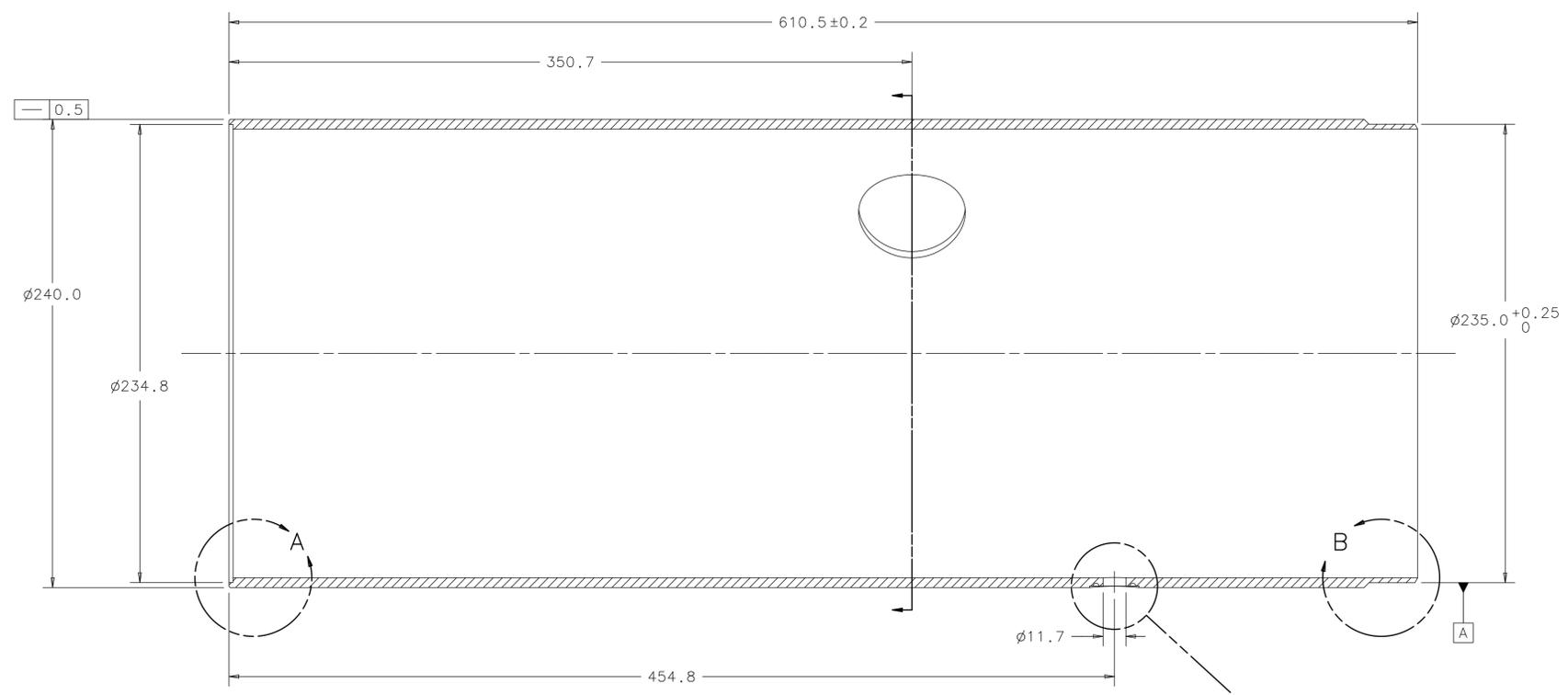
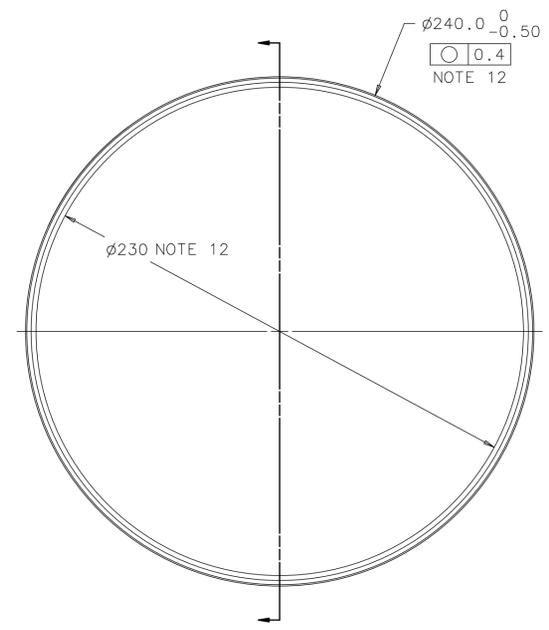
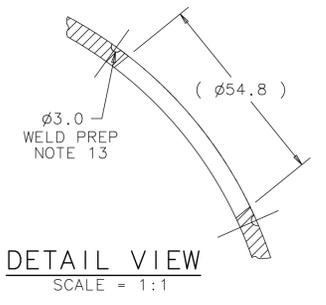
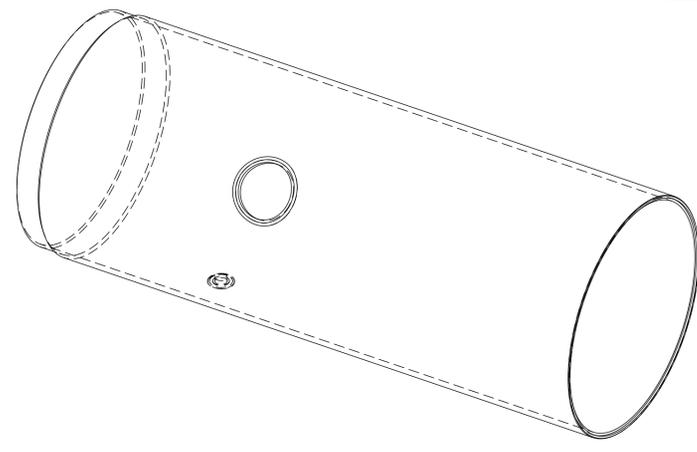
| | | | | |
|---------------------------------|---|------------------------------|------------------------------------|--|
| FINISH N/A | UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS INTERPRET DIM PER ASME Y14.5M-1994 BREAK ALL SHARP EDGES 0.5 MAX. ALL MACH. SURFACES 3.2 MAX. | DRAWN BY C. GRIMM | DATE 15DEC08 | FERMILAB UNITED STATES DEPARTMENT OF ENERGY P.O. BOX 500, BATAVIA, IL 60510-0500 |
| | | CHECKED BY D. MITCHELL | DATE 14JAN09 | |
| MATERIAL TITANIUM GRADE 2 | TOLERANCES X ± 2 .X ± 0.8 .XX ± 0.13 ANGLE ± 1° | ENGINEERED BY D. MITCHELL | DATE 14JAN09 | TITLE ILC CRYOMODULE HELIUM VESSEL TUBE_FLD_PROBE_END |
| | | DATABASE DESY_EDMS | TEAM/GROUP T4CM DESIGN | SIZE A1 |
| | THIRD ANGLE PROJECTION | CAD I-DEAS | SOLID MODEL NO. D00000000827682 | CAGE CODE OU5R6 |
| | | | | DWG NO. D00000000812995 |
| | | | | REV A |
| | | | | SCALE 3:4 |
| | | | | DO NOT SCALE DRAWING |
| | | | | SHEET 1 OF 1 |

NOTES (UNLESS OTHERWISE SPECIFIED):

- TUBE MAY BE ROLLED AND WELDED TO ACHIEVE DESIRED PART. ANY OUTSIDE WELDS ARE TO BE GROUND FLUSH AND PART IS TO BE VACUUM LEAK CHECKED. ALL WELDS TO BE VACUUM TIGHT. NO LEAK SHALL BE DETECTABLE ON THE MOST SENSITIVE SCALE OF A HELIUM LEAK DETECTOR WITH A MINIMUM SENSITIVITY OF 2×10^{-10} ATM. CC/SEC
- DO NOT BREAK SHARP EDGES.
- PART MUST BE FREE FROM DIRT, GREASE, OIL AND CHIPS AND PROPERLY PACKAGED TO AVOID DAMAGE DURING SHIPPING.
- MATERIAL CERTIFICATIONS ARE REQUIRED AND MUST BE INCLUDED WITH SHIPPING. THERE WILL BE NO PRODUCT ACCEPTANCE WITHOUT THE PROPER MATERIAL CERTIFICATIONS.
- ALL CLEANING AND WELDING PROCEDURES WILL CONFORM TO THE AMERICAN WELDING SOCIETY SPECIFICATION; AWS G2.4/G2.4M:2007, "GUIDE FOR THE FUSION WELDING OF TITANIUM AND TITANIUM ALLOYS."
- VENDORS OPTION:
AS AN ALTERNATE TO NOTE 5 ABOVE, AN ACCEPTABLE PICKLE BATH MAY BE IMPLEMENTED TO CLEAN THE WELD JOINT MATERIAL. USE A BATH OF 35% VOL. NITRIC ACID (70% CONCENTRATION) AND 5% VOL. HYDROFLUORIC ACID (48% CONCENTRATION). RINSE WITH COLD WATER AND THEN RINSE WITH HOT WATER TO FACILITATE FASTER DRYING. INSURE THAT PARTS ARE CLEAN, COMPLETELY DRY AND OXIDATION FREE PRIOR TO WELDING.

- ALL WELDS MUST BE PERFORMED INSIDE OF A PURGED GLOVEBOX WITH AN OXYGEN COUNT OF 30 PPM OR LESS. WELDS MUST BE FREE OF ALL TITANIUM OXIDATION AND DISCOLORATION.
- THE VENDOR'S WRITTEN PROCEDURE DESCRIBING THE CLEANING & WELDING PROCEDURE MUST BE SUPPLIED TO FERMILAB FOR WRITTEN APPROVAL PRIOR TO ANY PRODUCT WELDING.
- WELDER MUST BE QUALIFIED IN TITANIUM WELDING. VERIFICATION DOCUMENTS AS WELL AS SAMPLE WELDS MUST BE SUPPLIED TO FERMILAB PRIOR TO ANY PRODUCT WELDING.
- ON A DAILY BASIS, PRIOR TO PRODUCT WELDING, WELD COUPONS OF COMPARABLE SIZE AND TYPE WILL BE PREPARED BY THE WELDER. THESE COUPONS WILL BE ETCHED WITH THE DATE, TIME, AND WELDER'S NAME AND KEPT FOR RECORD. THE WELD COUPONS WILL BE PART OF THE DELIVERABLE TO FERMILAB.
- INSPECTION OF WELDS TO BE CONDUCTED AT FERMILAB PRIOR TO ANY ULTRASONIC OR WIRE-BRUSH CLEANING. DO NOT MODIFY THE FINAL WELDS PRIOR TO PRODUCT ACCEPTANCE.
- TO ACHIEVE DESIRED O.D. TOLERANCE AND CIRCULARITY, I.D. MAY BE SLIGHTLY INCREASED TO ALLOW EXTRA MATERIAL FOR MACHINING OF THE TUBE.
- WELD PREP TO BE CREATED WITH A 3mm DIAMETER BALL END-MILL FOLLOWING THE PATH AS DEFINED BY THE 3-D SOLID MODEL. THE INNER EDGE WILL CONFORM TO THE O.D. OF THE MATING PIPE.
- AS AN OPTION: THIS PART CAN BE MANUFACTURED FROM P/N 845645, "G3 HELIUM VESSEL TUBE", WHICH IS MANUFACTURED FROM A RAW TUBE P/N 849685.

| REVISION HISTORY | | | | |
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| CAD MAINTAINED. CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY. | | | | |
| ZONE | REV | DESCRIPTION | DATE | APPROVED |
| | A | INITIAL RELEASE - ER# ILC-000008 | | |



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|---------------|---|---|---------------------------|------------------------------------|--|
| FINISH N/A | UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS INTERPRET DIM PER ASME Y14.5M-1994 BREAK ALL SHARP EDGES 0.5 MAX. ALL MACH. SURFACES 3.2 MAX. | | DRAWN BY C. GRIMM | DATE 15DEC08 | <p>FERMI NATIONAL ACCELERATOR LABORATORY UNITED STATES DEPARTMENT OF ENERGY P.O. BOX 500, BATAVIA, IL 60510-0500</p> |
| | MATERIAL TITANIUM GRADE 2 | TOLERANCES X ± 2 XX ± 0.8 XXX ± 0.13 ANGLE ± 1° | CHECKED BY D. MITCHELL | DATE 14JAN09 | |
| | THIRD ANGLE PROJECTION | DATABASE DESJ EDMS | TEAM/GROUP T4CM DESIGN | SOLID MODEL NO. D00000000827732 | SIZE A1 |
| | | CAD I-DEAS | | | CAGE CODE OU5R6 |
| | | | | | DWG NO. D00000000813005 |
| | | | | | REVISION A |
| | | | | | SCALE 3:4 |
| | | | | | DO NOT SCALE DRAWING |
| | | | | | SHEET 1 OF 1 |

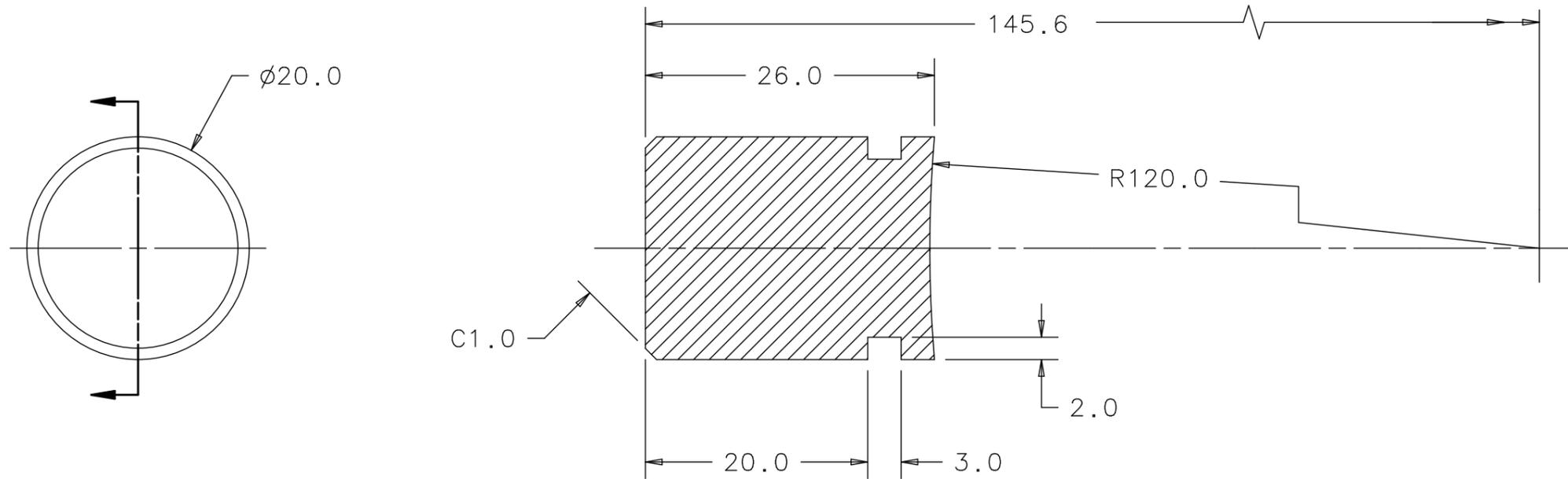
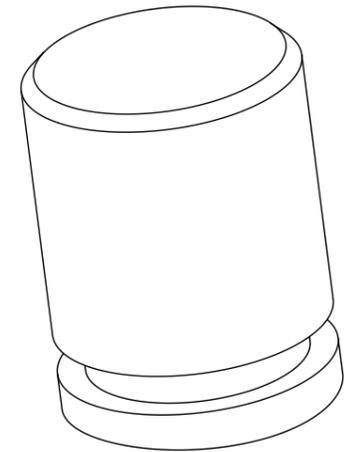
REVISION HISTORY

CAD MAINTAINED. CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY.

| ZONE | REV | DESCRIPTION | DATE | APPROVED |
|------|-----|----------------------------------|------|----------|
| | A | INITIAL RELEASE - ER# ILC-000008 | | |

NOTES (UNLESS OTHERWISE SPECIFIED):

- PARTS TO BE FREE OF ALL SHARP EDGES, CORNERS AND BURRS. A MAXIMUM CHAMFER OF 0.5mm X 45° IS ALLOWED.
- PARTS MUST BE FREE OF DIRT, GREASE, OIL AND CHIPS.



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| 815765 | 812815 |
| NEXT ASSY | USED ON |
| APPLICATION | |

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| FINISH N/A | UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS INTERPRET DIM PER ASME Y14.5M-1994 BREAK ALL SHARP EDGES 0.5 MAX. ALL MACH. SURFACES 3.2/ MAX. | | DRAWN BY C. GRIMM | DATE 15DEC08 |
| MATERIAL TITANIUM GRADE 2 | TOLERANCES | THIRD ANGLE PROJECTION | CHECKED BY D. MITCHELL | DATE 14JAN09 |
| | X ± 2 .X ± 0.8 .XX ± 0.13 ANGLE ± 1° | | ENGINEERED BY D. MITCHELL | DATE 14JAN09 |
| | | | DATABASE DESY EDMS | TEAM/GROUP T4CM DESIGN |
| | | | CAD I-DEAS | SOLID MODEL NO. D00000000827712 |

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| FERMI NATIONAL ACCELERATOR LABORATORY UNITED STATES DEPARTMENT OF ENERGY P.O. BOX 500, BATAVIA, IL 60510-0500 | | | |
| TITLE ILC CRYMODULE HELIUM VESSEL INVAR_ROD_CLAMPING_PIN | | | |
| SIZE A3 | CAGE CODE OU5R6 | DWG NO. D00000000813065 | REV A |
| SCALE 2:1 | DO NOT SCALE DWG | SHEET 1 OF 1 | |

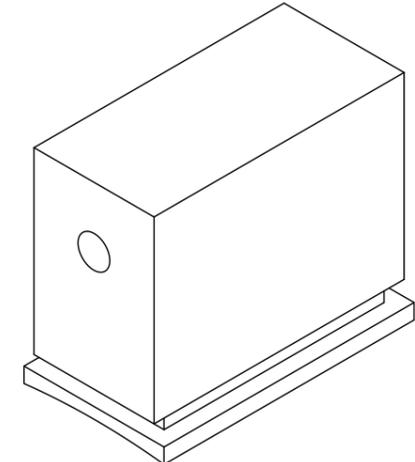
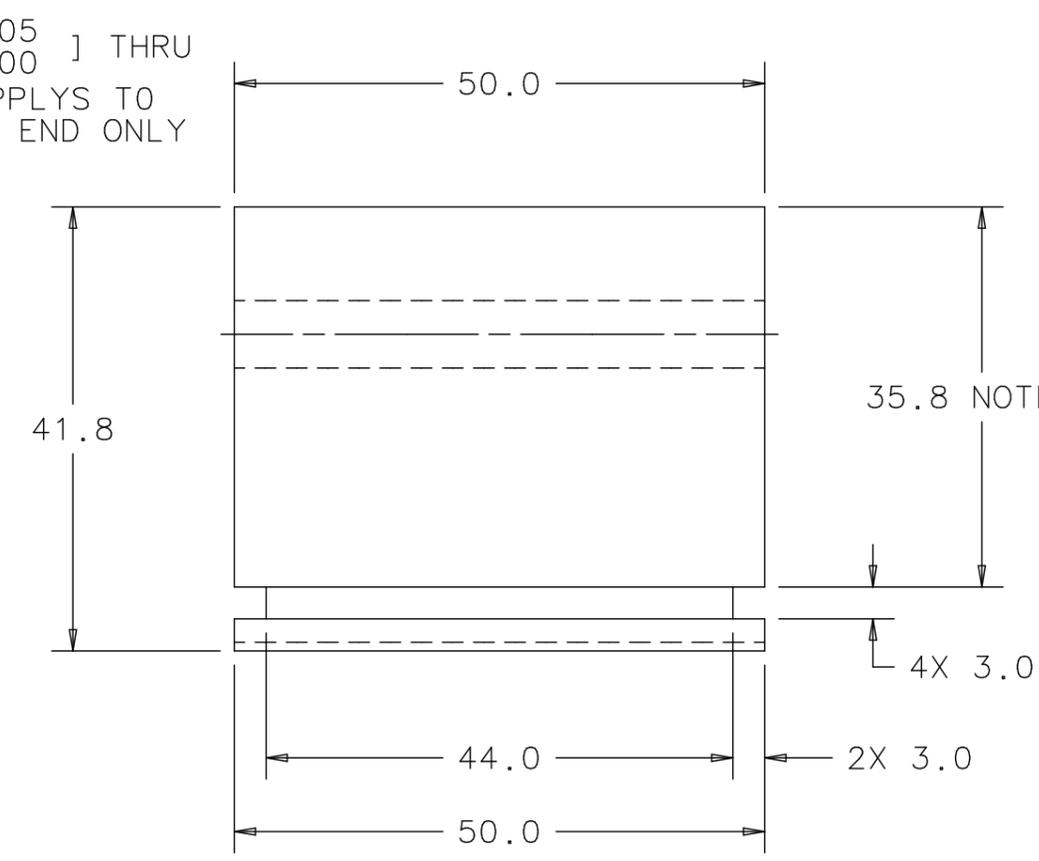
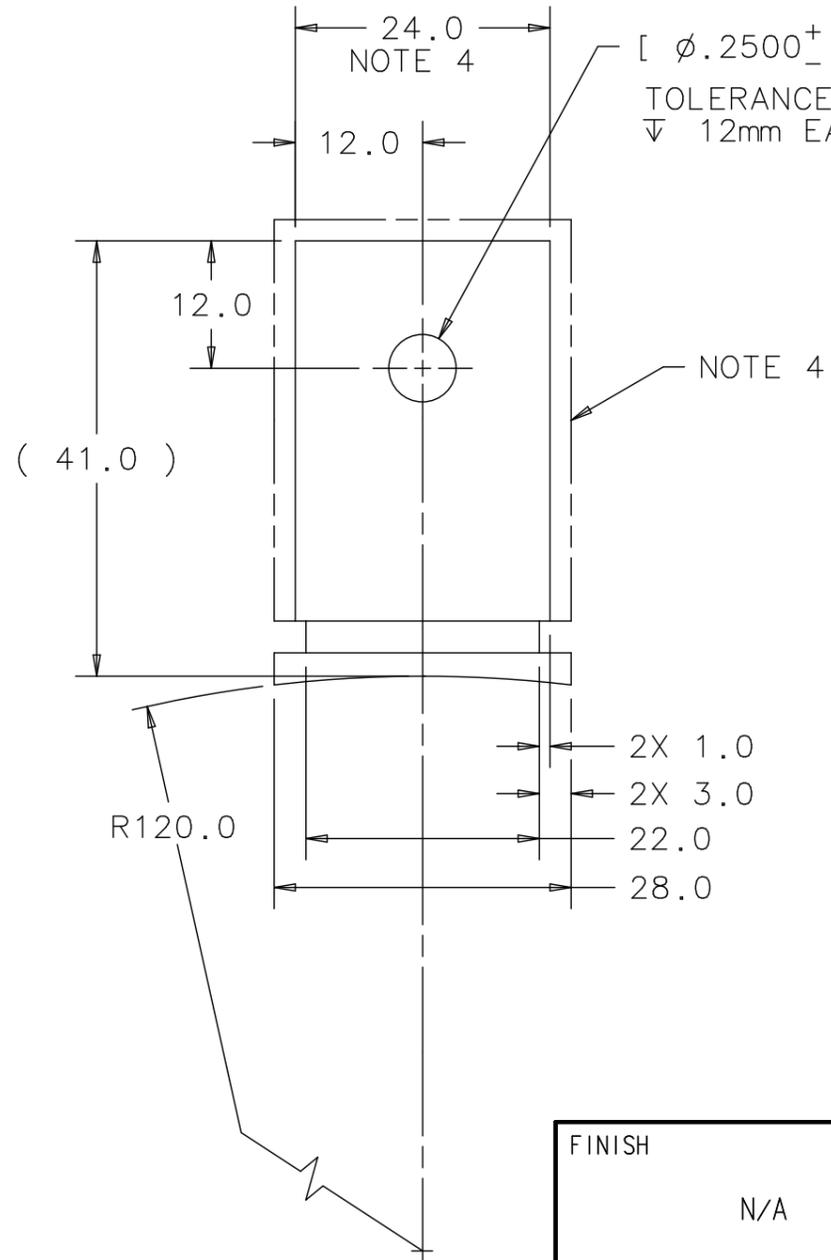
NOTES (UNLESS OTHERWISE SPECIFIED):

- PARTS TO BE FREE OF ALL SHARP EDGES, CORNERS AND BURRS. A MAXIMUM CHAMFER OF 0.5mm X 45° IS ALLOWED.
- PARTS MUST BE FREE OF DIRT, GREASE, OIL AND CHIPS.
- ALL DIMENSIONS ARE IN MILLIMETERS; DIMENSIONS IN [.XX] ARE IN INCHES.
- ALL DIMENSIONS REPRESENT FINAL MACHINED SIZES. EXTRA MATERIAL STOCK WILL BE REQUIRED, SEE DRAWING 812815 FOR FINAL MACHINED SPECIFICATION OF THIS PART.

REVISION HISTORY

CAD MAINTAINED. CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY.

| ZONE | REV | DESCRIPTION | DATE | APPROVED |
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| | A | INITIAL RELEASE - ER# ILC-000008 | | |



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| 812765 | 812815 |
| NEXT ASSY | USED ON |
| APPLICATION | |

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|---------------------------------|---|----------------------------|------------------------------|------------------------------------|
| FINISH N/A | UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS INTERPRET DIM PER ASME Y14.5M-1994 BREAK ALL SHARP EDGES 0.5 MAX. ALL MACH. SURFACES 3.2 / MAX. | | DRAWN BY C. GRIMM | DATE 15DEC08 |
| MATERIAL TITANIUM GRADE 2 | TOLERANCES X ± 2 .X ± 0.8 .XX ± 0.13 ANGLE ± 1° | THIRD ANGLE PROJECTION | CHECKED BY D. MITCHELL | DATE 14JAN09 |
| | | | ENGINEERED BY D. MITCHELL | DATE 14JAN09 |
| | | | DATABASE DESY EDMS | TEAM/GROUP T4CM DESIGN |
| | | | CAD I-DEAS | SOLID MODEL NO. D00000000838612 |

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| FERMI NATIONAL ACCELERATOR LABORATORY UNITED STATES DEPARTMENT OF ENERGY P.O. BOX 500, BATAVIA, IL 60510-0500 | | | |
| TITLE ILC CRYOMODULE HELIUM VESSEL ROLLER_PAD_WIDE | | | |
| SIZE A3 | CAGE CODE OU5R6 | DWG NO. D00000000813165 | REV A |
| SCALE 1.5:1 | DO NOT SCALE DWG | SHEET 1 OF 1 | |

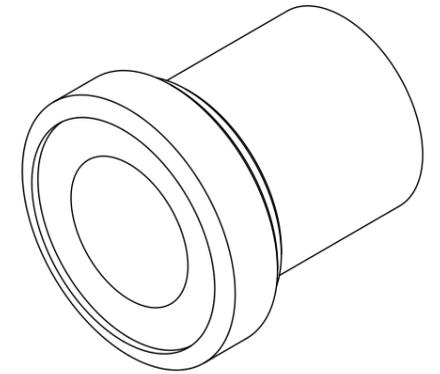
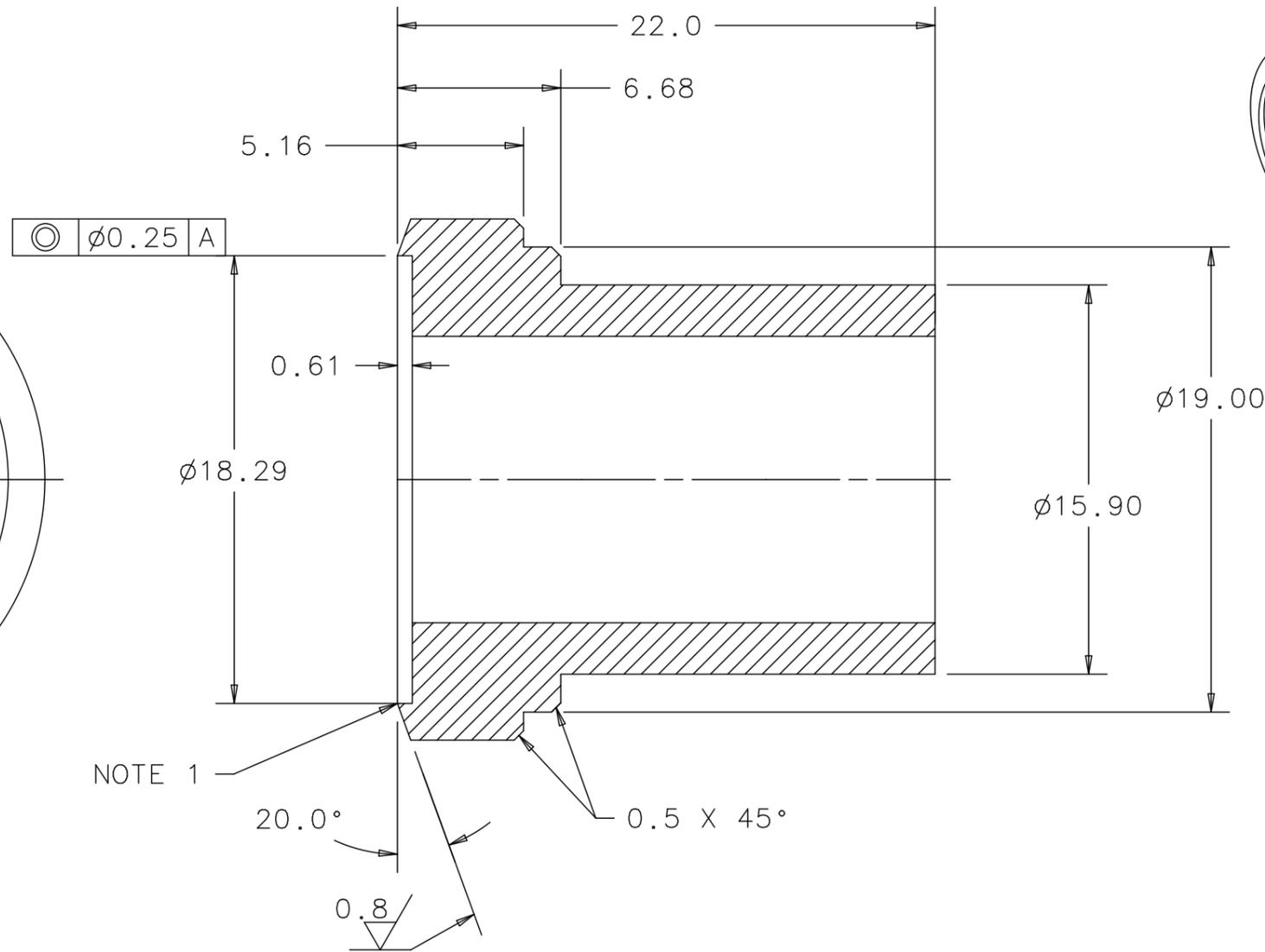
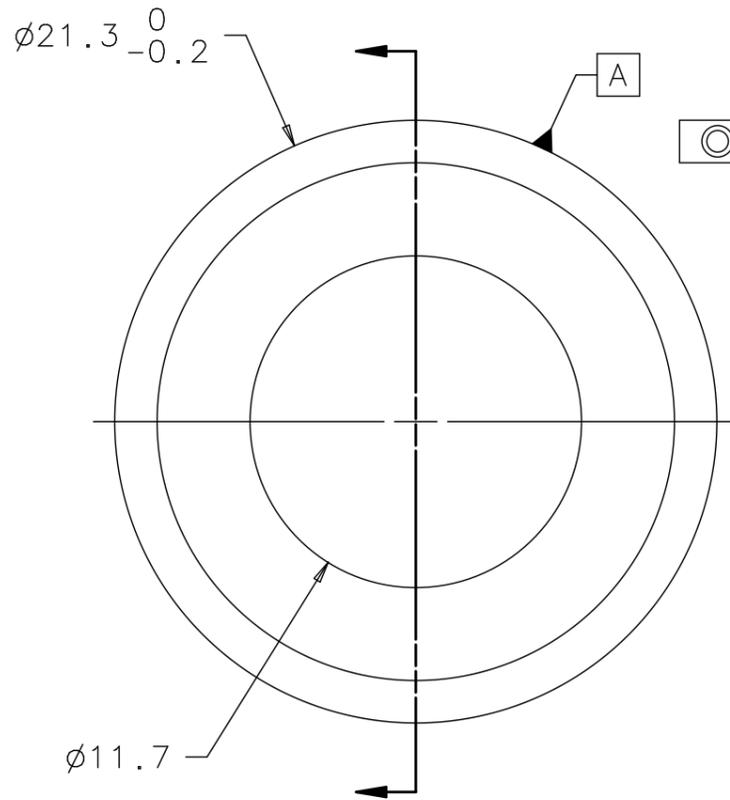
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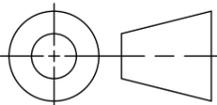
- DO NOT BREAK KNIFE EDGE, KEEP SHARP. ANGLE SURFACE TO BE FREE OF SCRATCHES, WITH NO RADIAL SCORING.
- PARTS MUST BE FREE OF DIRT, GREASE, OIL AND CHIPS.

REVISION HISTORY

CAD MAINTAINED. CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY.

| ZONE | REV | DESCRIPTION | DATE | APPROVED |
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| | A | INITIAL RELEASE - ER# ILC-000008 | | |

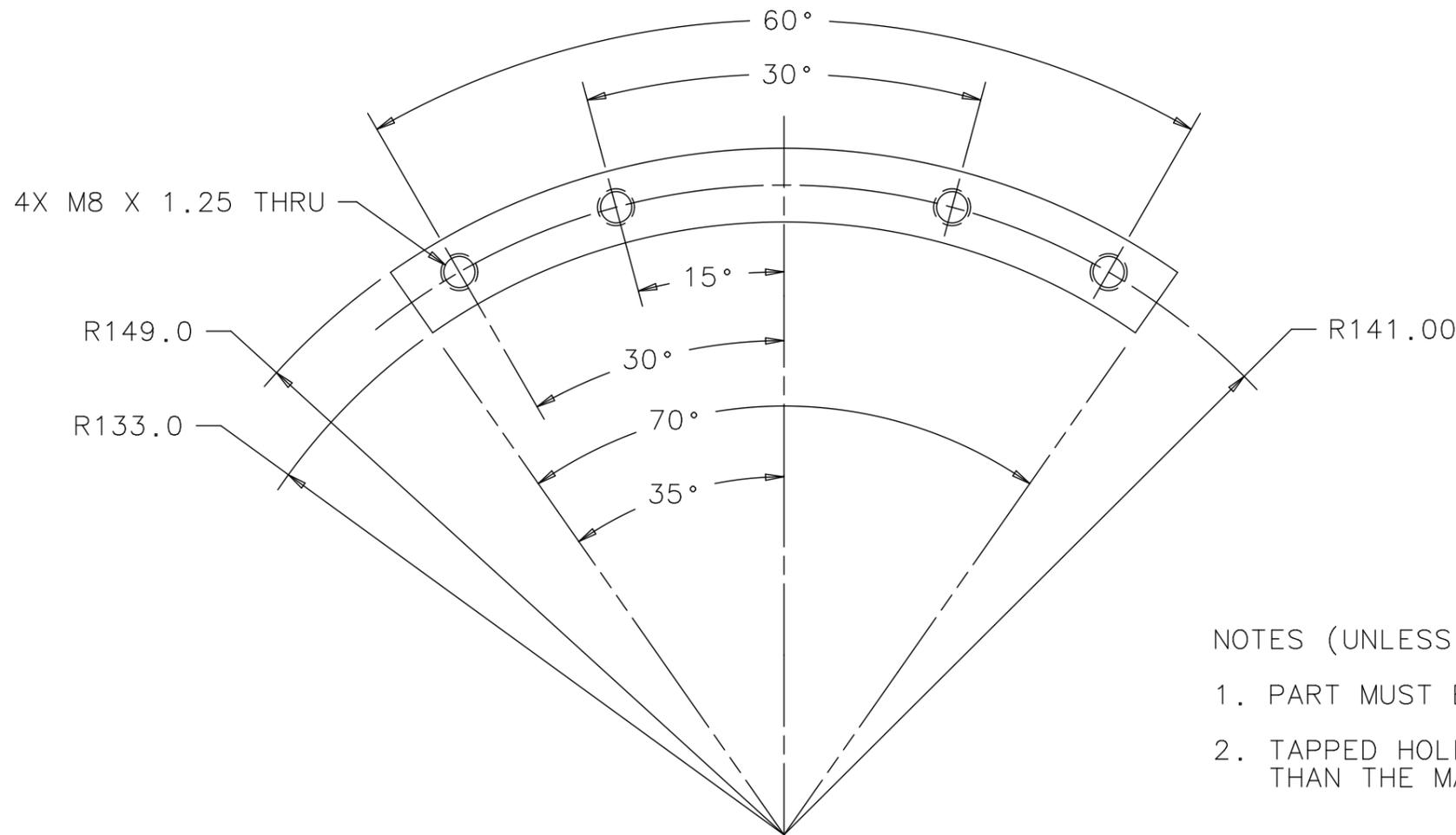
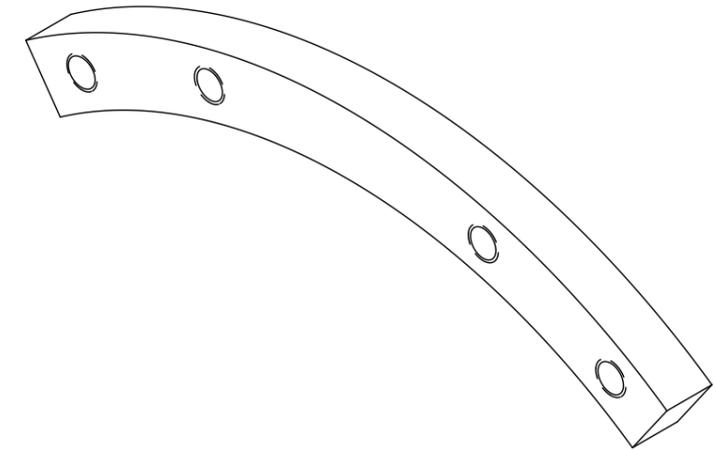


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|---------------------|--------|---|--|---|--|------------------------------------|--|--|--------------------|-----------------------------------|----------|
| FINISH | | UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS INTERPRET DIM PER ASME Y14.5M-1994 BREAK ALL SHARP EDGES .75 MAX. ALL MACH. SURFACES 3.2 / MAX. | | DRAWN BY C. GRIMM | | DATE 15DEC08 | |  FERMI NATIONAL ACCELERATOR LABORATORY UNITED STATES DEPARTMENT OF ENERGY P.O. BOX 500, BATAVIA, IL 60510-0500 | | | |
| MATERIAL | | TOLERANCES | | CHECKED BY D. MITCHELL | | DATE 14JAN09 | | | | | |
| TITANIUM GRADE 2 | | THIRD ANGLE PROJECTION | | ENGINEERED BY D. MITCHELL | | DATE 14JAN09 | | TITLE ILC CRYOMODULE HELIUM VESSEL CF_FLANGE_CUSTOM_KNIFE_EDGE | | | |
| APPLICATION | | X ± 2 .X ± 0.8 .XX ± 0.13 ANGLE ± 1° | |  | | DATABASE DESY EDMS | | TEAM/GROUP T4CM DESIGN | | | |
| 812765 | 812815 | | | CAD I-DEAS | | SOLID MODEL NO. D00000000827692 | | SIZE A3 | CAGE CODE OU5R6 | DWG NO. D00000000813205 | REV A |
| | | | | | | SCALE 4:1 | | DO NOT SCALE DWG | | SHEET 1 OF 1 | |

REVISION HISTORY

CAD MAINTAINED. CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY.

| ZONE | REV | DESCRIPTION | DATE | APPROVED |
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| | A | INITIAL RELEASE - ER# ILC-000008 | | |



NOTES (UNLESS OTHERWISE SPECIFIED):

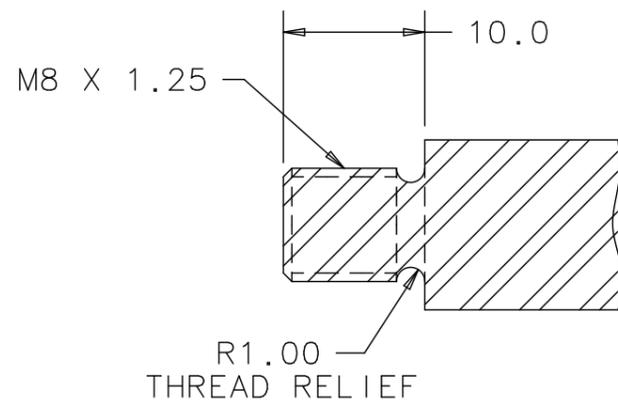
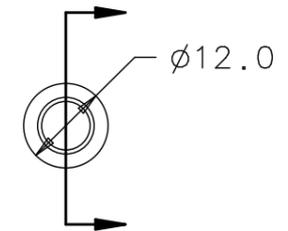
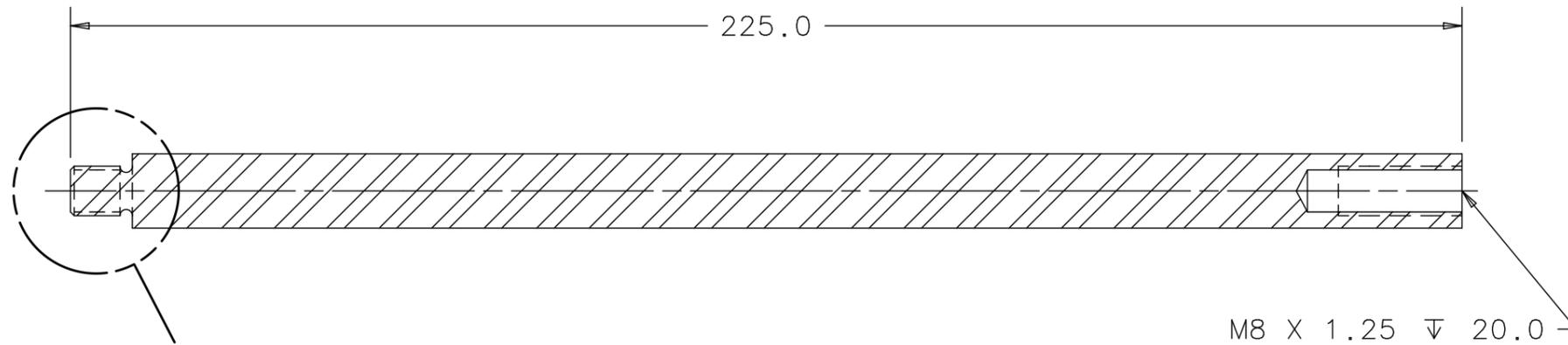
- PART MUST BE FREE OF DIRT, GREASE, OIL AND CHIPS.
- TAPPED HOLES TO HAVE A 90° CSK 0.5mm TO 1.0mm LARGER THAN THE MAJOR DIAMETER (TO REMOVE BURRS).

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|--|--------|---|----------------------------|------------------------------|-----------------|---|--|------------|--------------------|--|----------|
| FINISH ELECTRO-POLISH | | UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS INTERPRET DIM PER ASME Y14.5M-1994 BREAK ALL SHARP EDGES 0.5 MAX. ALL MACH. SURFACES 3.2 / MAX. | | DRAWN BY C. GRIMM | DATE 15DEC08 | FERMI NATIONAL ACCELERATOR LABORATORY UNITED STATES DEPARTMENT OF ENERGY P.O. BOX 500, BATAVIA, IL 60510-0500 | | | | | |
| MATERIAL 304 STAINLESS STEEL OR EQUIV. | | TOLERANCES X ± 2 .X ± 0.8 .XX ± 0.13 ANGLE ± 1° | THIRD ANGLE PROJECTION | CHECKED BY D. MITCHELL | DATE 14JAN09 | | | | | TITLE ILC CRYOMODULE HELIUM VESSEL VESSEL_SUPPORT_BRACKET | |
| 812815 | 812765 | APPLICATION | | ENGINEERED BY D. MITCHELL | DATE 14JAN09 | DATABASE DESY EDMS | TEAM/GROUP SOLID MODEL NO. D00000000957492 | SIZE A3 | CAGE CODE OU5R6 | DWG NO. D00000000844695 | REV A |
| NEXT ASSY APPLICATION | | | | USED ON | SCALE 3:4 | DO NOT SCALE DWG | SHEET 1 OF 1 | | | | |

REVISION HISTORY

CAD MAINTAINED. CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY.

| ZONE | REV | DESCRIPTION | DATE | APPROVED |
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| | A | INITIAL RELEASE - ER# ILC-000008 | | |



DETAIL VIEW
SCALE = 2:1

NOTES (UNLESS OTHERWISE SPECIFIED):

- PART MUST BE FREE OF DIRT, GREASE, OIL AND CHIPS.
- TAPPED HOLE TO HAVE A 90° CSK 0.5 TO 1.0mm LARGER THAN THE MAJOR DIAMETER (TO REMOVE BURRS).

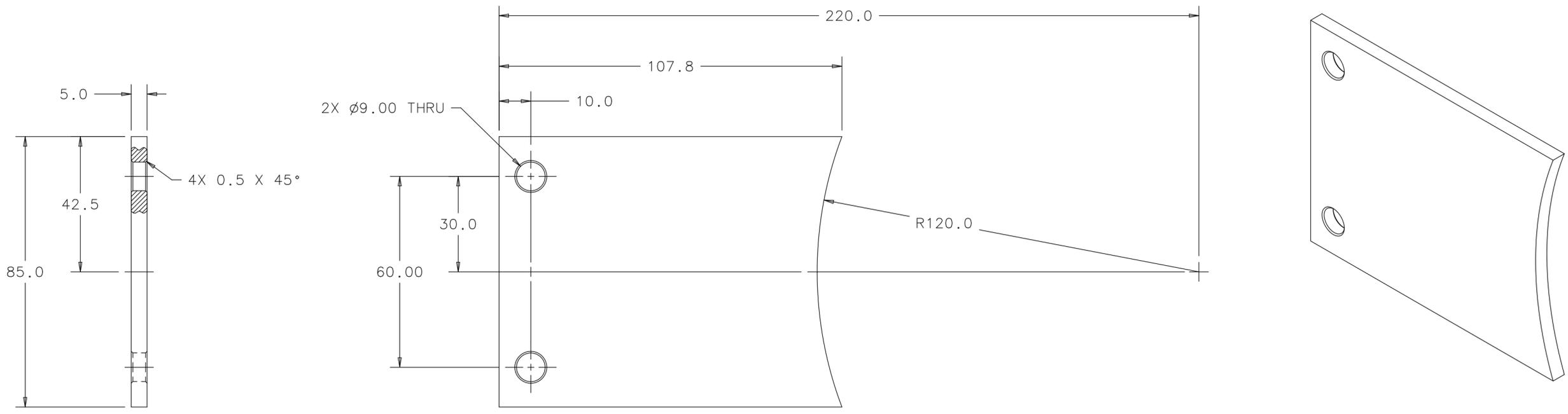
| | | | | | | | | | | | | | | | |
|---|--|--|--|------------------------------|--|--|--|---|--|--------------------|--|---|--|--|--|
| FINISH ELECTRO-POLISH | | UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS INTERPRET DIM PER ASME Y14.5M-1994 BREAK ALL SHARP EDGES 0.5 MAX. ALL MACH. SURFACES 3.2/ MAX. | | DRAWN BY C. GRIMM | | DATE 15DEC08 | | FERMI NATIONAL ACCELERATOR LABORATORY UNITED STATES DEPARTMENT OF ENERGY P.O. BOX 500, BATAVIA, IL 60510-0500 | | | | | | | |
| MATERIAL 304 STAINLESS STEEL OR EQUIV. | | TOLERANCES X \pm 2 .X \pm 0.8 .XX \pm 0.13 ANGLE \pm 1° | | CHECKED BY D. MITCHELL | | DATE 14JAN09 | | | | | | TITLE ILC CRYOMODULE HELIUM VESSEL SPANNER_ROD | | | |
| APPLICATION 812765 NEXT ASSY 812815 USED ON | | THIRD ANGLE PROJECTION | | ENGINEERED BY D. MITCHELL | | DATE 14JAN09 | | SIZE A3 | | CAGE CODE OU5R6 | | | | | |
| | | | | DATABASE DESY EDMS | | TEAM/GROUP SOLID MODEL NO. D00000000957482 | | SCALE 1:1 | | DO NOT SCALE DWG | | SHEET 1 OF 1 | | | |

8 7 6 5 4 3 2 1

| REVISION HISTORY | | | | |
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| CAD MAINTAINED. CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY. | | | | |
| ZONE | REV | DESCRIPTION | DATE | APPROVED |
| | A | INITIAL RELEASE - ER# ILC-000008 | | |

NOTES (UNLESS OTHERWISE SPECIFIED):

- PARTS TO BE FREE OF ALL SHARP EDGES, CORNERS AND BURRS. A MAXIMUM CHAMFER OF 0.5mm X 45° IS ALLOWED.
- PARTS MUST BE FREE OF DIRT, GREASE, OIL AND CHIPS.



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| 812765 | 812815 |
| NEXT ASSY | USED ON |
| APPLICATION | |

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|---------------|---|---|------------------------------------|--|--|
| FINISH N/A | UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS INTERPRET DIM PER ASME Y14.5M-1994 BREAK ALL SHARP EDGES 0.5 MAX. ALL MACH. SURFACES 3.2 MAX. | | DRAWN BY C. GRIMM | DATE 15DEC08 | FERMI NATIONAL ACCELERATOR LABORATORY UNITED STATES DEPARTMENT OF ENERGY P.O. BOX 500, BATAVIA, IL 60510-0500 |
| | MATERIAL TITANIUM GRADE 2 | TOLERANCES X ± 2 .X ± 0.8 .XX ± 0.13 ANGLE ± 1° | THIRD ANGLE PROJECTION | CHECKED BY D. MITCHELL | |
| APPLICATION | | ENGINEERED BY D. MITCHELL | DATE 14JAN09 | TITLE ILC CRYOMODULE HELIUM VESSEL PIPE_SUPPORT_PLATE | |
| | | DATABASE DESY EDMS | TEAM/GROUP T4CM DESIGN | SIZE A2 | CAGE CODE OU5R6 |
| | | CAD I-DEAS | SOLID MODEL NO. D00000000827612 | DWG NO. D00000000813035 | REV A |
| | | SCALE 1:1 | | DO NOT SCALE DWG | SHEET 1 OF 1 |

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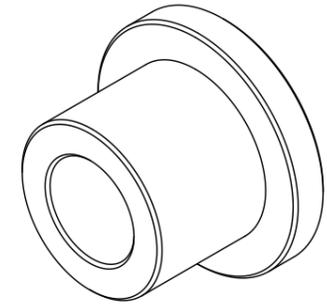
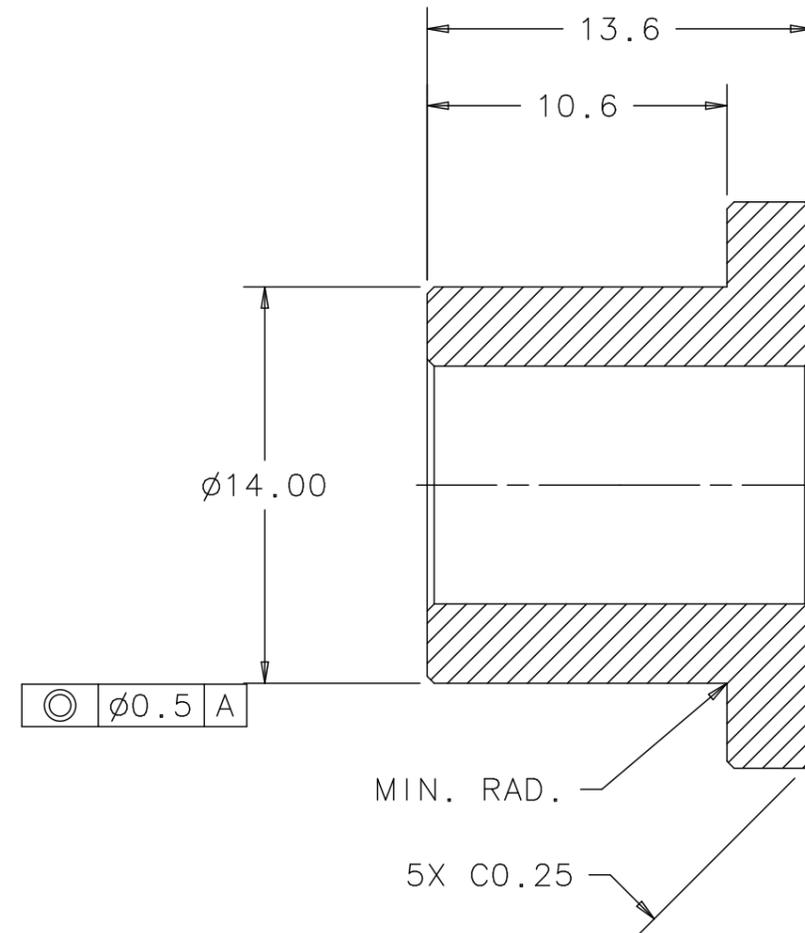
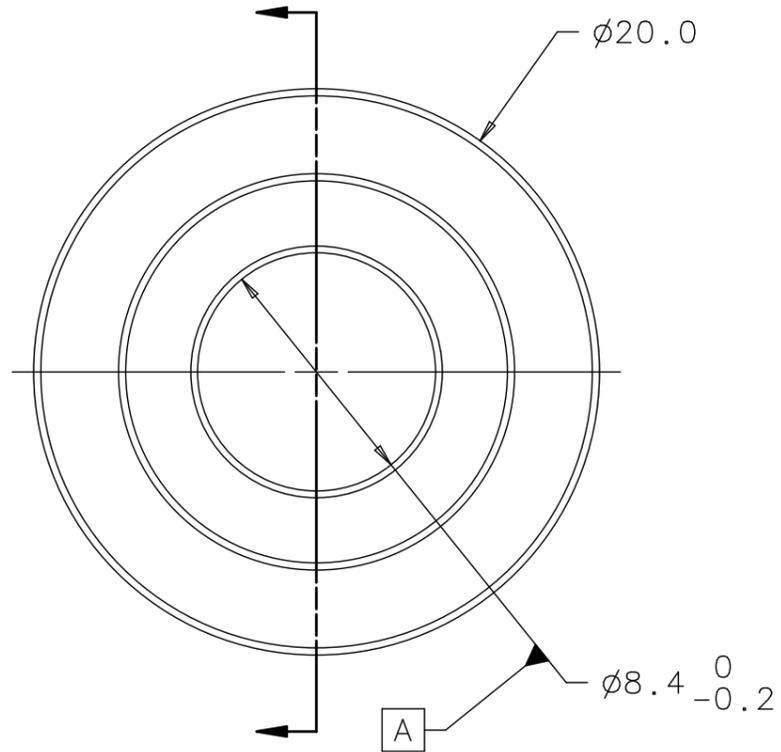
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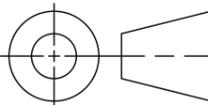
1. PARTS MUST BE FREE OF DIRT, GREASE, OIL AND CHIPS.

REVISION HISTORY

CAD MAINTAINED. CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY.

| ZONE | REV | DESCRIPTION | DATE | APPROVED |
|------|-----|----------------------------------|------|----------|
| | A | INITIAL RELEASE - ER# ILC-000008 | | |

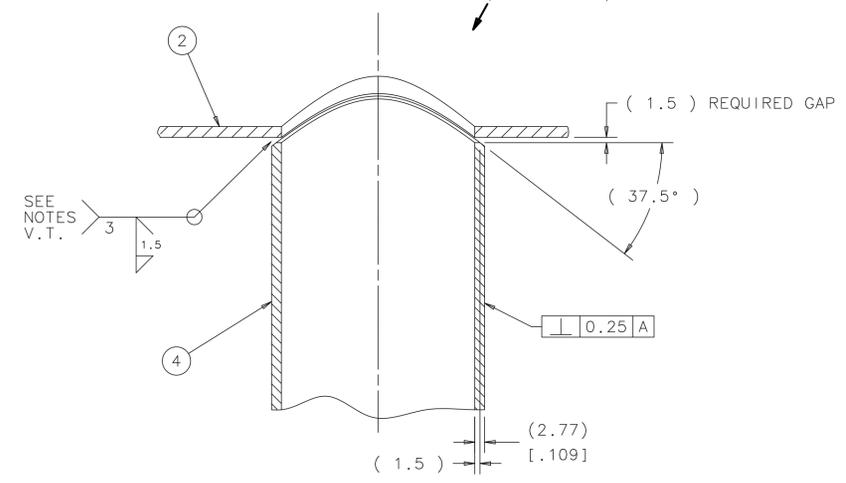
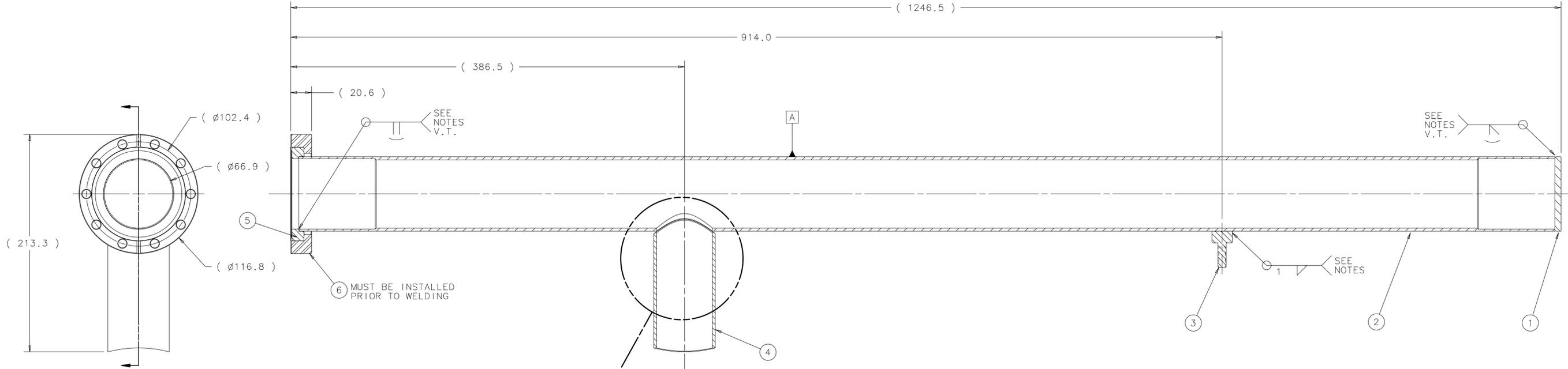
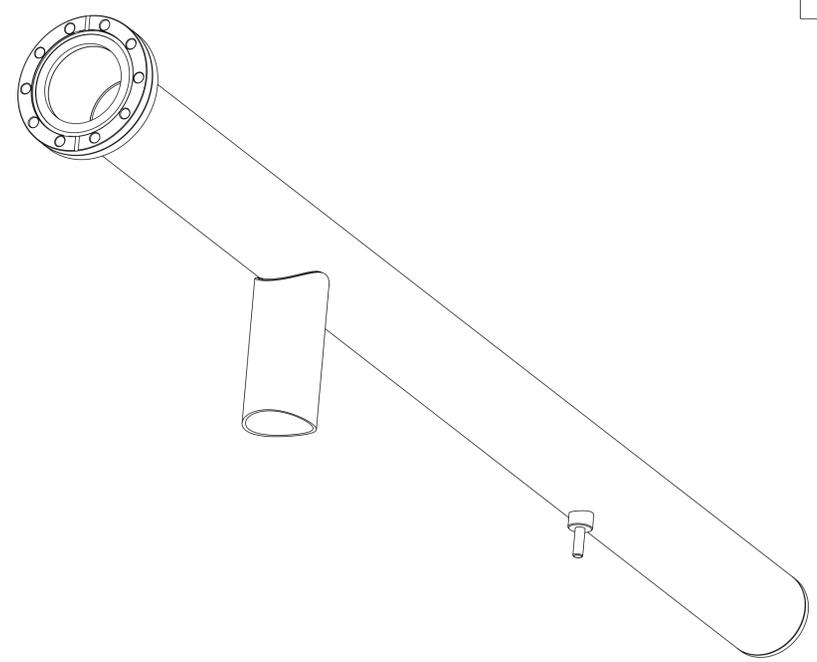


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|-------------|--|---------------------|--|--|--|--|--|---|--|--|--|-------------------|--|--|--|--------------------|--|-----------------------------------|--|
| FINISH | | N/A | | UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS INTERPRET DIM PER ASME Y14.5M-1994 BREAK ALL SHARP EDGES 0.5 MAX. ALL MACH. SURFACES 3.2/ MAX. | | DRAWN BY C. GRIMM | | DATE 15DEC08 | |  FERMI NATIONAL ACCELERATOR LABORATORY UNITED STATES DEPARTMENT OF ENERGY P.O. BOX 500, BATAVIA, IL 60510-0500 | | | | | | | | | |
| MATERIAL | | TITANIUM GRADE 2 | | TOLERANCES | | THIRD ANGLE PROJECTION | | CHECKED BY D. MITCHELL | | | | DATE 14JAN09 | | | | | | | |
| APPLICATION | | 812765 NEXT ASSY | | 812815 USED ON | | $X \pm 2$ $.X \pm 0.8$ $.XX \pm 0.13$ ANGLE $\pm 1^\circ$ | |  | | ENGINEERED BY D. MITCHELL | | DATE 14JAN09 | | TITLE ILC CRYOMODULE HELIUM VESSEL PIPE_BUSHING | | | | | |
| | | | | | | | | DATABASE DESY EDMS | | TEAM/GROUP T4CM DESIGN | | SIZE A3 | | | | CAGE CODE OU5R6 | | DWG NO. D00000000813045 | |
| | | | | | | | | CAD I-DEAS | | SOLID MODEL NO. D00000000827602 | | SCALE 4:1 | | DO NOT SCALE DWG | | SHEET 1 OF 1 | | | |

| REVISION HISTORY | | | | |
|---|-----|----------------------------------|------|----------|
| CAD MAINTAINED. CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY. | | | | |
| ZONE | REV | DESCRIPTION | DATE | APPROVED |
| A | | INITIAL RELEASE - ER# ILC-000008 | | |

NOTES (UNLESS OTHERWISE SPECIFIED):

- ITEM 6 PART SPECIFICATION IS IN INCHES.
- ALL FILLET WELDS TO BE SMOOTH FOR COSMETIC APPEARANCE.
- SEALING SURFACES ON FLANGES MUST BE FREE FROM ANY NICKS AND RADIAL SCRATCHES.
- ASSEMBLY MUST BE FREE FROM DIRT, GREASE, OIL AND CHIPS AND PROPERLY PACKAGED TO AVOID DAMAGE DURING SHIPPING.
- ALL WELDS MUST BE CONTAMINANT FREE. EACH JOINT MUST BE CLEANED PROPERLY TO REMOVE MILL SCALE, DIRT, DUST, GREASE OIL, MOISTURE AND OXIDATION.
- ALL CLEANING AND WELDING PROCEDURES WILL CONFORM TO THE AMERICAN WELDING SOCIETY SPECIFICATION: AWS G2.4M:2007 "GUIDE FOR THE FUSION WELDING OF TITANIUM AND TITANIUM ALLOYS".
- THE VENDOR'S WRITTEN PROCEDURE DESCRIBING THE CLEANING & WELDING PROCEDURE MUST BE SUPPLIED TO FERMILAB FOR WRITTEN APPROVAL PRIOR TO ANY PRODUCT WELDING.
- ALL WELDS MUST BE PERFORMED INSIDE A PURGED GLOVEBOX WITH AN OXYGEN COUNT OF 30 PPM OR LESS. WELDS MUST BE FREE OF ALL TITANIUM OXIDATION AND DISCOLORATION.
- INSPECTION OF WELDS TO BE CONDUCTED AT FERMILAB PRIOR TO ANY ULTRASONIC OR WIRE-BRUSH CLEANING. DO NOT MODIFY THE FINAL WELDS PRIOR TO PRODUCT ACCEPTANCE.
- ALL WELDS MARKED V.T. (VACUUM TIGHT) ARE TO BE FULL PENETRATION AND VACUUM TIGHT. NO LEAK SHALL BE DETECTABLE ON THE MOST SENSITIVE SCALE OF A HELIUM LEAK DETECTOR WITH A MINIMUM SENSITIVITY OF 2×10^{-10} ATM. CC/SEC.
- MATERIAL CERTIFICATIONS ARE REQUIRED AND MUST BE INCLUDED WITH SHIPPING. THERE WILL BE NO PRODUCT ACCEPTANCE WITHOUT THE PROPER MATERIAL CERTIFICATIONS.

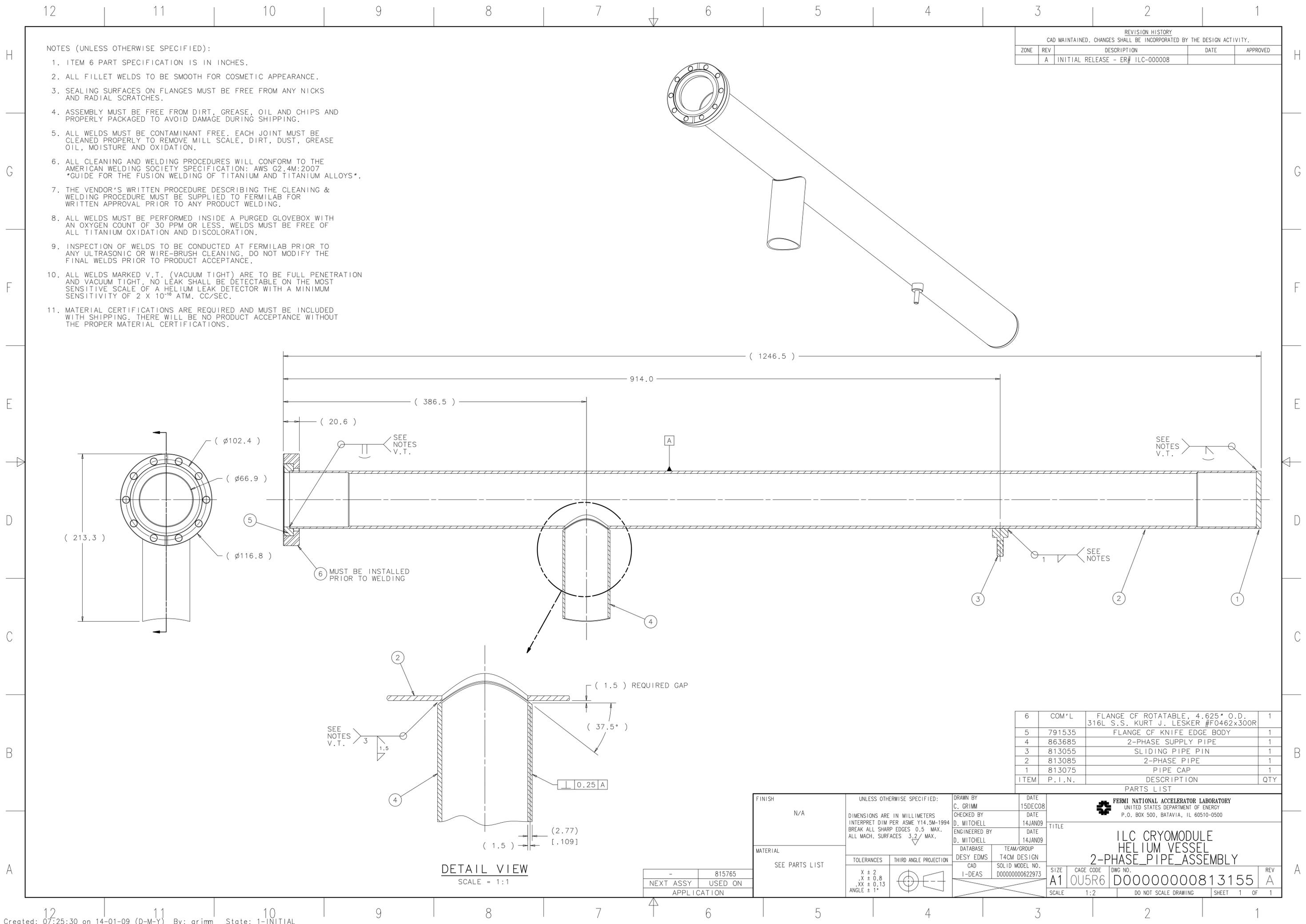


DETAIL VIEW
SCALE = 1:1

| ITEM | P. I. N. | DESCRIPTION | QTY |
|------|----------|---|-----|
| 6 | COM'L | FLANGE CF ROTATABLE, 4.625" O.D. 316L S.S. KURT J. LESKER #F0462x300R | 1 |
| 5 | 791535 | FLANGE CF KNIFE EDGE BODY | 1 |
| 4 | 863685 | 2-PHASE SUPPLY PIPE | 1 |
| 3 | 813055 | SLIDING PIPE PIN | 1 |
| 2 | 813085 | 2-PHASE PIPE | 1 |
| 1 | 813075 | PIPE CAP | 1 |

| | | | | |
|----------------------------|---|------------------------------|---|--|
| FINISH N/A | UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS INTERPRET DIM PER ASME Y14.5M-1994 BREAK ALL SHARP EDGES 0.5 MAX. ALL MACH. SURFACES 3.2 MAX. | DRAWN BY C. GRIMM | DATE 15DEC08 | FERMILAB NATIONAL ACCELERATOR LABORATORY UNITED STATES DEPARTMENT OF ENERGY P.O. BOX 500, BATAVIA, IL 60510-0500 |
| | | CHECKED BY D. MITCHELL | DATE 14JAN09 | |
| MATERIAL SEE PARTS LIST | TOLERANCES X ± 2 .X ± 0.8 .XX ± 0.13 ANGLE ± 1° | ENGINEERED BY D. MITCHELL | DATE 14JAN09 | TITLE ILC CRYOMODULE HELIUM VESSEL 2-PHASE PIPE ASSEMBLY |
| | | THIRD ANGLE PROJECTION | | |
| | | DATABASE CAD I-DEAS | TEAM/GROUP T4CM DESIGN SOLID MODEL NO. D00000000622973 | SIZE A1 |
| | | | | CAGE CODE OU5R6 |
| | | | | DWG NO. D00000000813155 |
| | | | | SCALE 1:2 |
| | | | | DO NOT SCALE DRAWING |
| | | | | SHEET 1 OF 1 |

| | |
|-------------|---------|
| | 815765 |
| NEXT ASSY | USED ON |
| APPLICATION | |



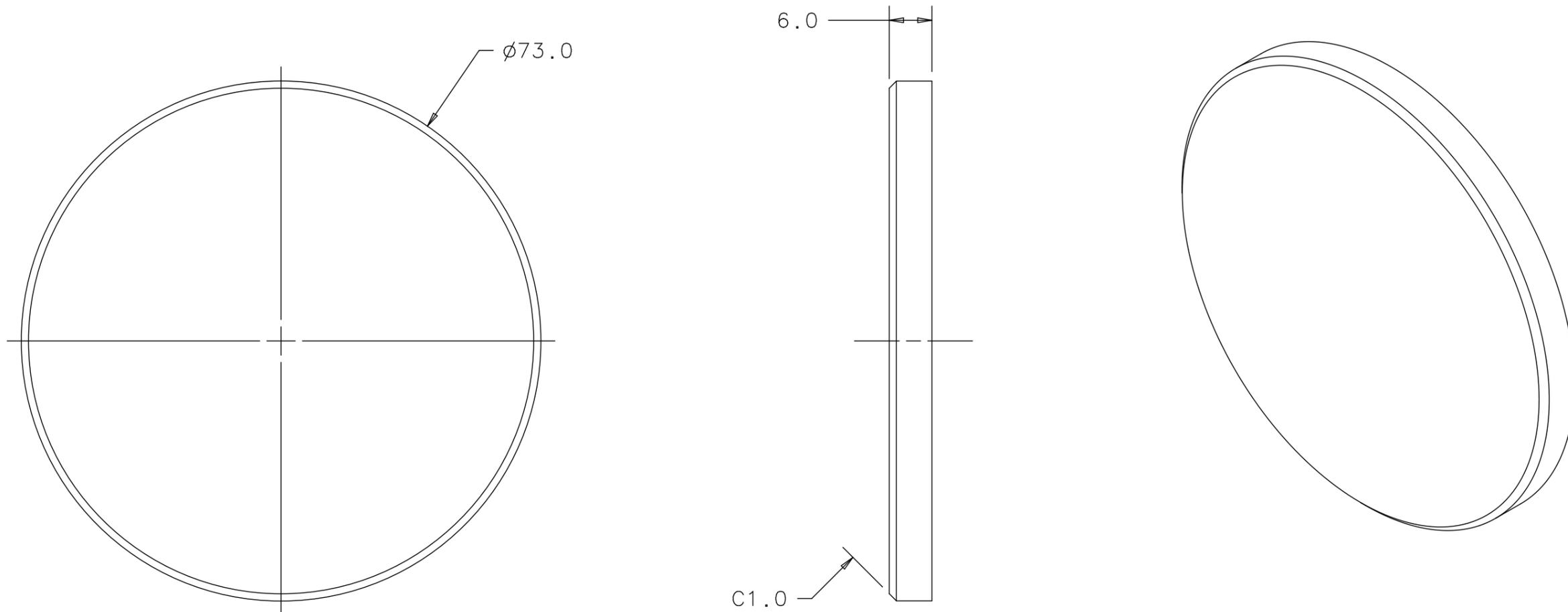
NOTES (UNLESS OTHERWISE SPECIFIED):

- PARTS TO BE FREE OF ALL SHARP EDGES, CORNERS AND BURRS. A MAXIMUM CHAMFER OF 0.5mm X 45° IS ALLOWED.
- PARTS MUST BE FREE OF DIRT, GREASE, OIL AND CHIPS.

REVISION HISTORY

CAD MAINTAINED. CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY.

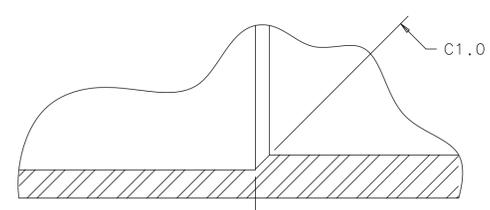
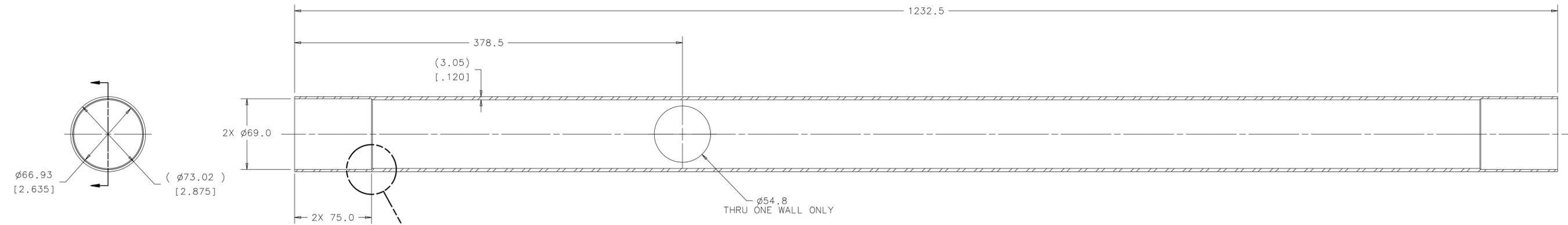
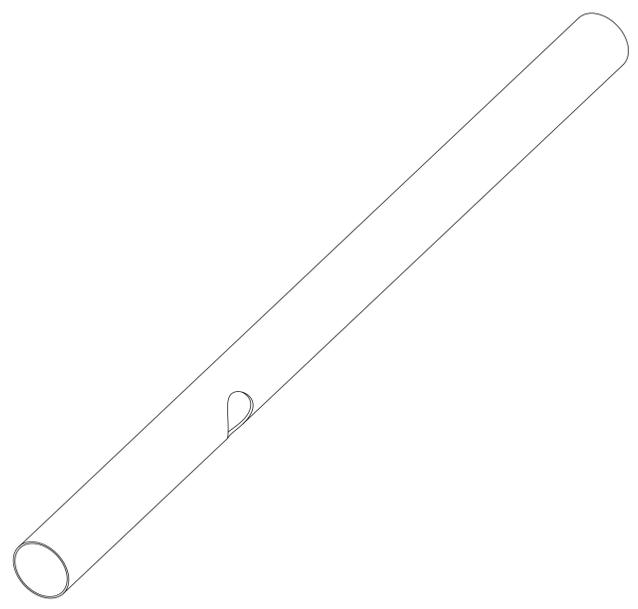
| ZONE | REV | DESCRIPTION | DATE | APPROVED |
|------|-----|----------------------------------|------|----------|
| | A | INITIAL RELEASE - ER# ILC-000008 | | |



| | | | | | | | | | | | | | | | |
|---|---------|--|----------------------------|---------------------------|------------------------------------|--------------------------------|-----------------|-----------------------|---|----------------------|--------------------|---|--|--|--|
| <table border="1"> <tr> <td>812765</td> <td>813155</td> </tr> <tr> <td>NEXT ASSY</td> <td>USED ON</td> </tr> <tr> <td colspan="2">APPLICATION</td> </tr> </table> | | 812765 | 813155 | NEXT ASSY | USED ON | APPLICATION | | FINISH N/A | UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS INTERPRET DIM PER ASME Y14.5M-1994 BREAK ALL SHARP EDGES 0.5 MAX. ALL MACH. SURFACES 3.2 / MAX. | DRAWN BY C. GRIMM | DATE 15DEC08 | FERMI NATIONAL ACCELERATOR LABORATORY UNITED STATES DEPARTMENT OF ENERGY P.O. BOX 500, BATAVIA, IL 60510-0500 | TITLE ILC CRYOMODULE HELIUM VESSEL PIPE_CAP | | |
| 812765 | 813155 | | | | | | | | | | | | | | |
| NEXT ASSY | USED ON | | | | | | | | | | | | | | |
| APPLICATION | | | | | | | | | | | | | | | |
| MATERIAL TITANIUM GRADE 2 | | TOLERANCES X ± 2 .X ± 0.8 .XX ± 0.13 ANGLE $\pm 1^\circ$ | THIRD ANGLE PROJECTION | CHECKED BY D. MITCHELL | DATE 14JAN09 | ENGINEERED BY D. MITCHELL | DATE 14JAN09 | DATABASE DESY EDMS | TEAM/GROUP T4CM DESIGN | SIZE A3 | CAGE CODE OU5R6 | DWG NO. D00000000813075 | REV A | | |
| | | | | CAD I-DEAS | SOLID MODEL NO. D00000000827642 | SCALE 1.5:1 DO NOT SCALE DWG | | SHEET 1 OF 1 | | | | | | | |

| REVISION HISTORY | | | |
|---|-----|----------------------------------|------|
| CAD MAINTAINED. CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY. | | | |
| ZONE | REV | DESCRIPTION | DATE |
| A | | INITIAL RELEASE - ER# ILC-000008 | |

- NOTES (UNLESS OTHERWISE SPECIFIED):
- PARTS TO BE FREE OF ALL SHARP EDGES, CORNERS AND BURRS. A MAXIMUM CHAMFER OF 0.5mm X 45° IS ALLOWED.
 - PARTS MUST BE FREE OF DIRT, GREASE, OIL AND CHIPS.
 - ALL DIMENSIONS ARE IN MILLIMETERS; DIMENSIONS IN [.XX] ARE IN INCHES. MATERIAL SPECIFICATION IS IN INCHES.



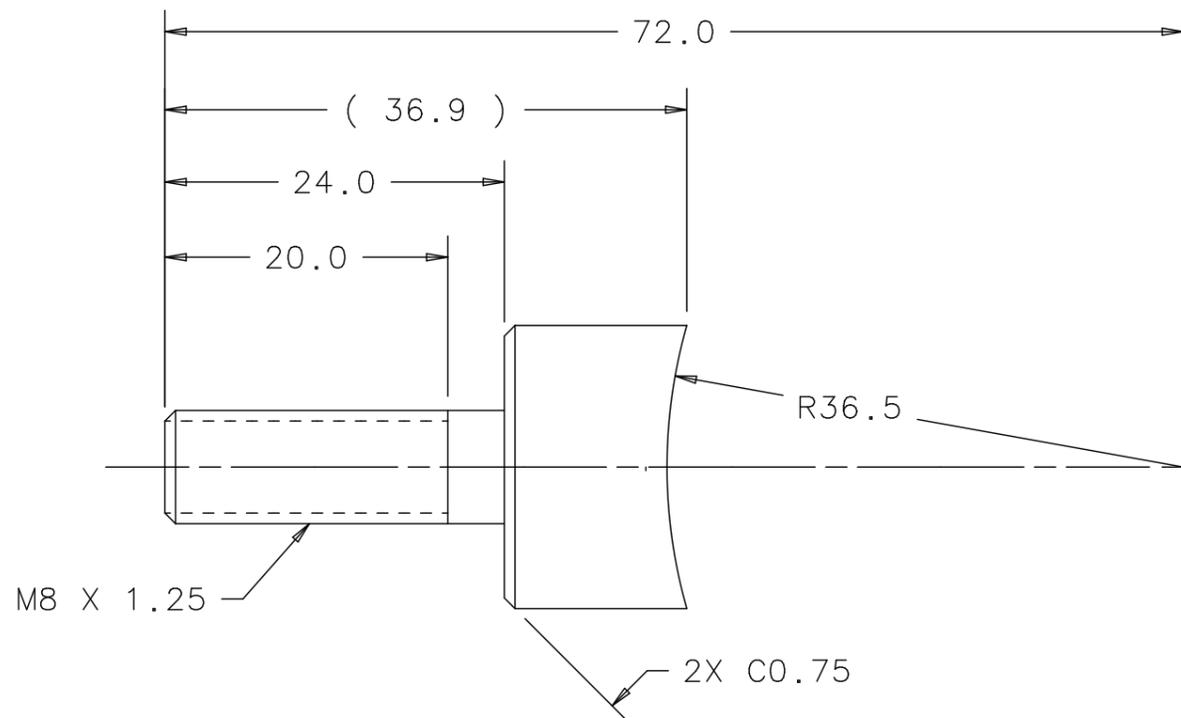
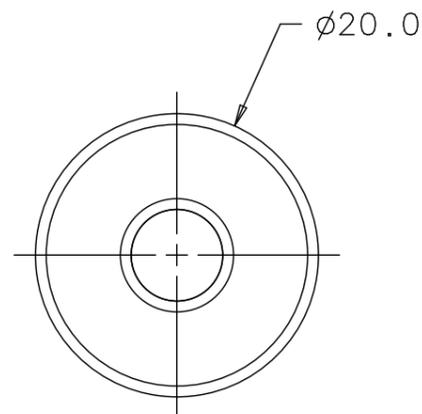
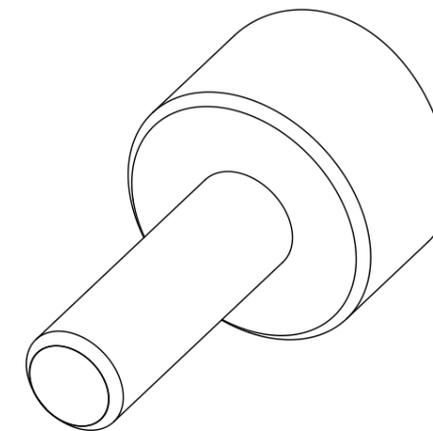
DETAIL VIEW
SCALE = 4:1
2 PLACES

| | | | | | |
|---------------|---|---|------------------------------|------------------------------------|---|
| FINISH N/A | UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS INTERPRET DIM PER ASME Y14.5M-1994 BREAK ALL SHARP EDGES 0.5 MAX. ALL MACH. SURFACES 3.2 MAX. | | DRAWN BY C. GRIMM | DATE 15DEC08 | FERMIONATIONAL ACCELERATOR LABORATORY UNITED STATES DEPARTMENT OF ENERGY P.O. BOX 500, BATAVIA, IL 60510-0500 |
| | MATERIAL 2-1/2" SCHED 10 PIPE TITANIUM GRADE 2 | TOLERANCES X ± 2 .X ± 0.8 .XX ± 0.13 ANGLE ± 1° | THIRD ANGLE PROJECTION | CHECKED BY D. MITCHELL | |
| | | | ENGINEERED BY D. MITCHELL | DATE 14JAN09 | TITLE ILC CRYOMODULE HELIUM VESSEL 2-PHASE PIPE |
| | | | DATABASE CAD | TEAM/GROUP T4CM DESIGN | SIZE A1 |
| | | | 1-DEAS | SOLID MODEL NO. D00000000827652 | CAGE CODE OU5R6 |
| | | | APPLICATION | | DWG NO. D00000000813085 |
| | | | | | REV A |
| | | | | | SCALE 1:2 & AS NOTED |
| | | | | | DO NOT SCALE DRAWING |
| | | | | | SHEET 1 OF 1 |

NOTES (UNLESS OTHERWISE SPECIFIED):

- PARTS TO BE FREE OF ALL SHARP EDGES, CORNERS AND BURRS. A MAXIMUM CHAMFER OF 0.5mm X 45° IS ALLOWED.
- PARTS MUST BE FREE OF DIRT, GREASE, OIL AND CHIPS.

| REVISION HISTORY | | | | |
|---|-----|----------------------------------|------|----------|
| CAD MAINTAINED. CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY. | | | | |
| ZONE | REV | DESCRIPTION | DATE | APPROVED |
| | A | INITIAL RELEASE - ER# ILC-000008 | | |



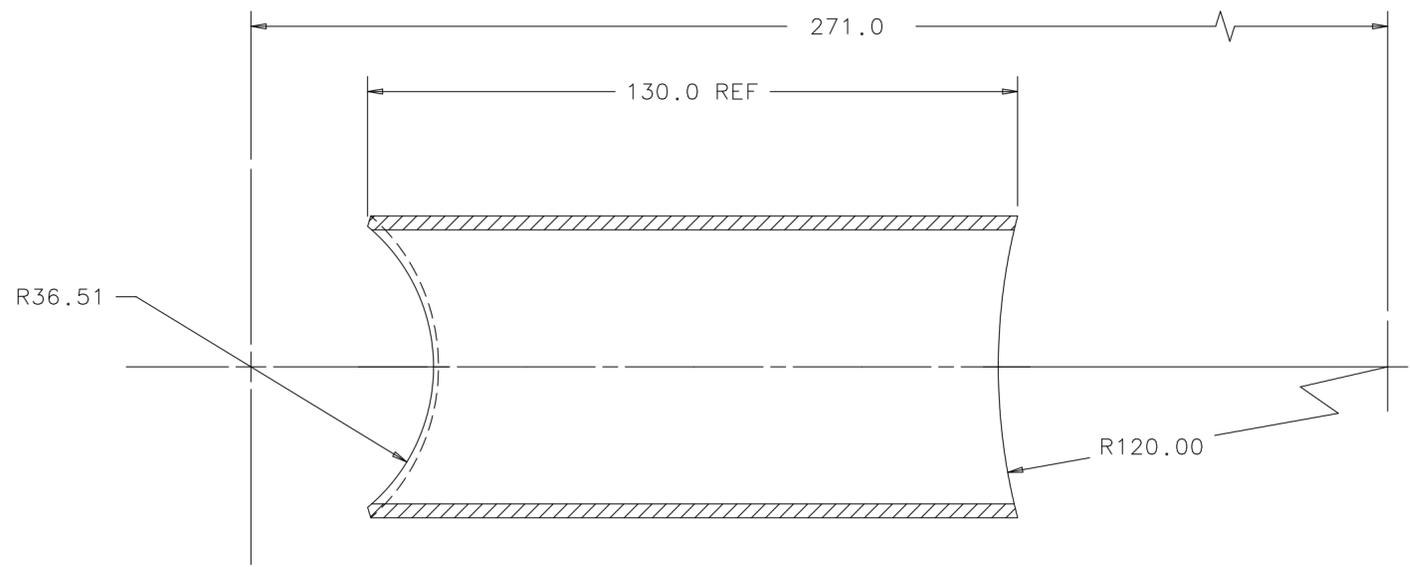
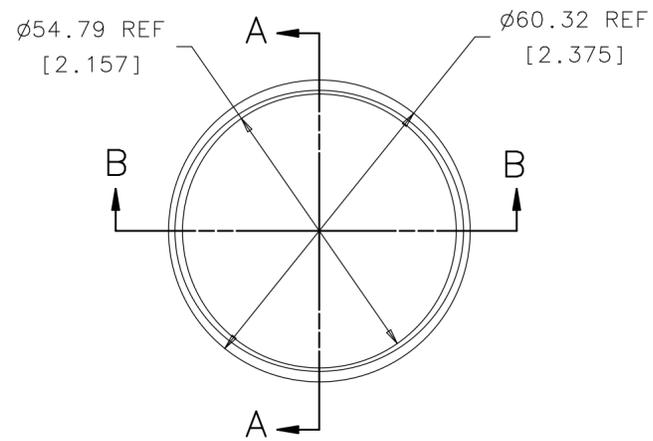
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|-------------|--|---------------------|--|--|--|--|--|---------------------------|--|--|--|-------------------|--|---|--|-----------------------------------|--|----------|--|
| FINISH | | N/A | | UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS INTERPRET DIM PER ASME Y14.5M-1994 BREAK ALL SHARP EDGES 0.5 MAX. ALL MACH. SURFACES 3.2/ MAX. | | DRAWN BY C. GRIMM | | DATE 15DEC08 | | FERMI NATIONAL ACCELERATOR LABORATORY UNITED STATES DEPARTMENT OF ENERGY P.O. BOX 500, BATAVIA, IL 60510-0500 | | | | | | | | | |
| MATERIAL | | TITANIUM GRADE 2 | | TOLERANCES | | THIRD ANGLE PROJECTION | | CHECKED BY D. MITCHELL | | | | DATE 14JAN09 | | | | | | | |
| APPLICATION | | 812765 NEXT ASSY | | 813155 USED ON | | $X \pm 2$ $.X \pm 0.8$ $.XX \pm 0.13$ ANGLE $\pm 1^\circ$ | | | | ENGINEERED BY D. MITCHELL | | DATE 14JAN09 | | TITLE ILC CRYOMODULE HELIUM VESSEL SLIDING_PIPE_PIN | | | | | |
| | | | | | | | | DATABASE DESY EDMS | | TEAM/GROUP T4CM DESIGN | | SIZE A3 | | CAGE CODE OU5R6 | | DWG NO. D00000000813055 | | REV A | |
| | | | | | | | | CAD I-DEAS | | SOLID MODEL NO. D00000000827632 | | SCALE 2:1 | | DO NOT SCALE DWG | | SHEET 1 OF 1 | | | |

8 7 6 5 4 3 2 1

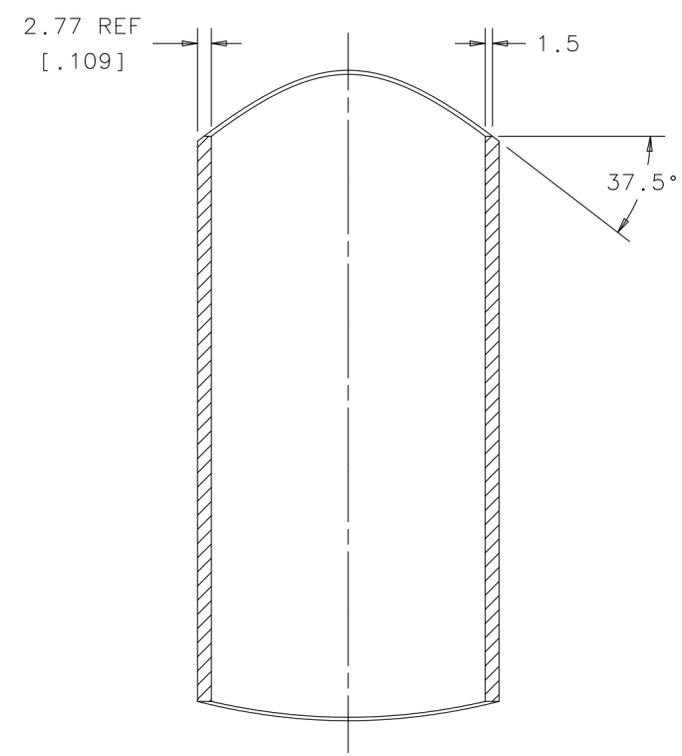
| REVISION HISTORY | | | | |
|---|-----|----------------------------------|------|----------|
| CAD MAINTAINED. CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY. | | | | |
| ZONE | REV | DESCRIPTION | DATE | APPROVED |
| | A | INITIAL RELEASE - ER# ILC-000008 | | |

NOTES (UNLESS OTHERWISE SPECIFIED):

- PARTS TO BE FREE OF ALL SHARP EDGES, CORNERS AND BURRS. A MAXIMUM CHAMFER OF 0.5mm X 45° IS ALLOWED.
- PARTS MUST BE FREE OF DIRT, GREASE, OIL AND CHIPS.
- ALL DIMENSIONS ARE IN MILLIMETERS; DIMENSIONS IN [.XX] ARE IN INCHES. MATERIAL SPECIFICATION IS IN INCHES.



SECTION A-A



SECTION B-B

| | |
|-------------|---------|
| 812765 | 813155 |
| NEXT ASSY | USED ON |
| APPLICATION | |

| | | | | | | | | | |
|----------|--------------------------------------|---|------------------------|------------------------------|-----------------|--|--------------------|---------------------------|--|
| FINISH | N/A | UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS INTERPRET DIM PER ASME Y14.5M-1994 BREAK ALL SHARP EDGES 0.5 MAX. ALL MACH. SURFACES 3.2 MAX. | | DRAWN BY C. GRIMM | DATE 15DEC08 | FERMI NATIONAL ACCELERATOR LABORATORY UNITED STATES DEPARTMENT OF ENERGY P.O. BOX 500, BATAVIA, IL 60510-0500 | | | |
| MATERIAL | 2" SCHED 10 PIPE TITANIUM GRADE 2 | TOLERANCES | THIRD ANGLE PROJECTION | CHECKED BY D. MITCHELL | DATE 14JAN09 | | | | TITLE ILC CRYOMODULE HELIUM VESSEL 2-PHASE_SUPPLY_PIPE |
| | | X ± 2 .X ± 0.8 .XX ± 0.13 ANGLE ± 1° | | ENGINEERED BY D. MITCHELL | DATE 14JAN09 | SIZE A2 | CAGE CODE OU5R6 | DWG NO. D0000000863685 | REV A |
| | | | | DATABASE DESY EDMS | TEAM/GROUP | SCALE 1:1 | DO NOT SCALE DWG | SHEET 1 OF 1 | |

8 7 6 5 4 3 2 1

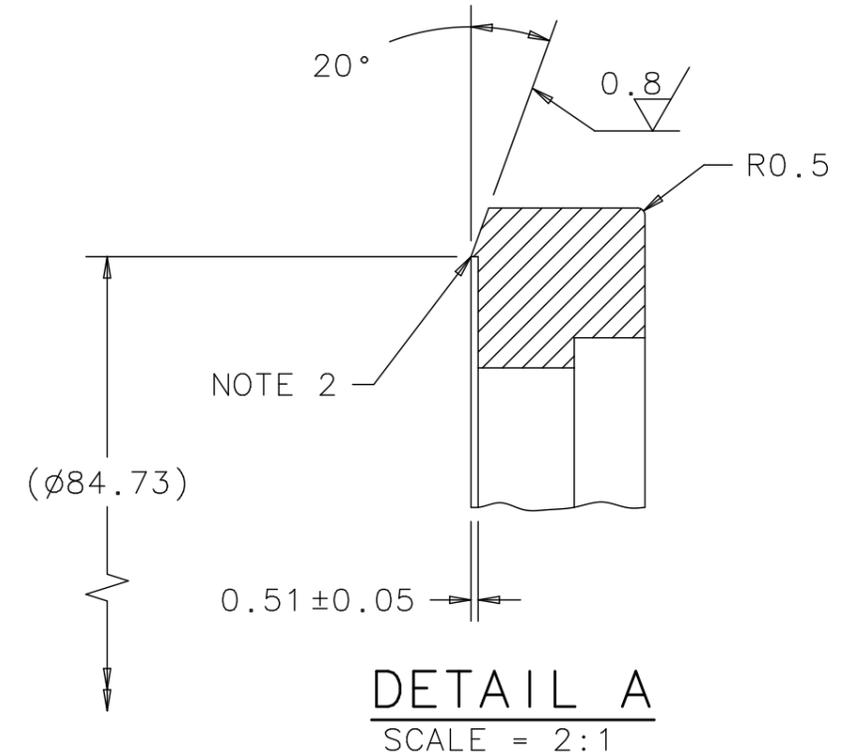
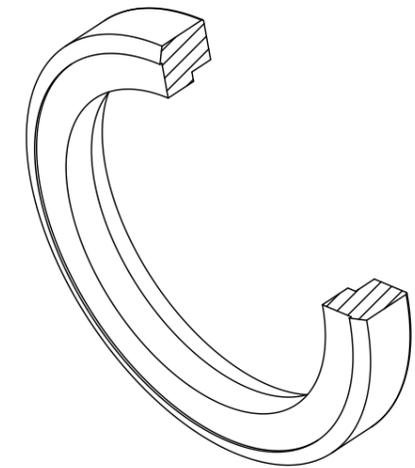
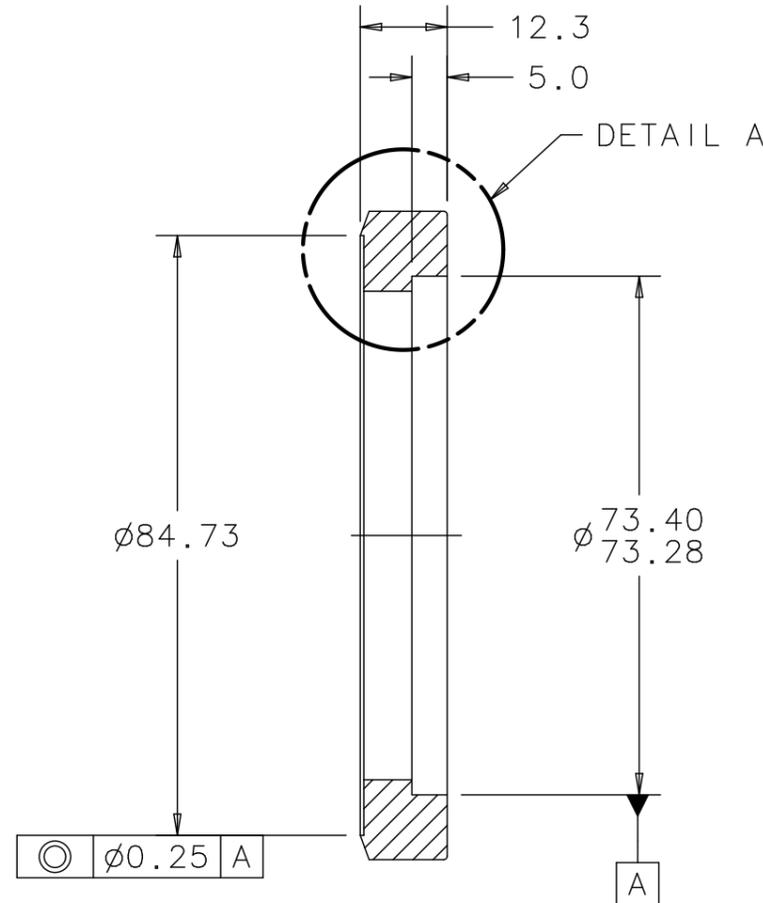
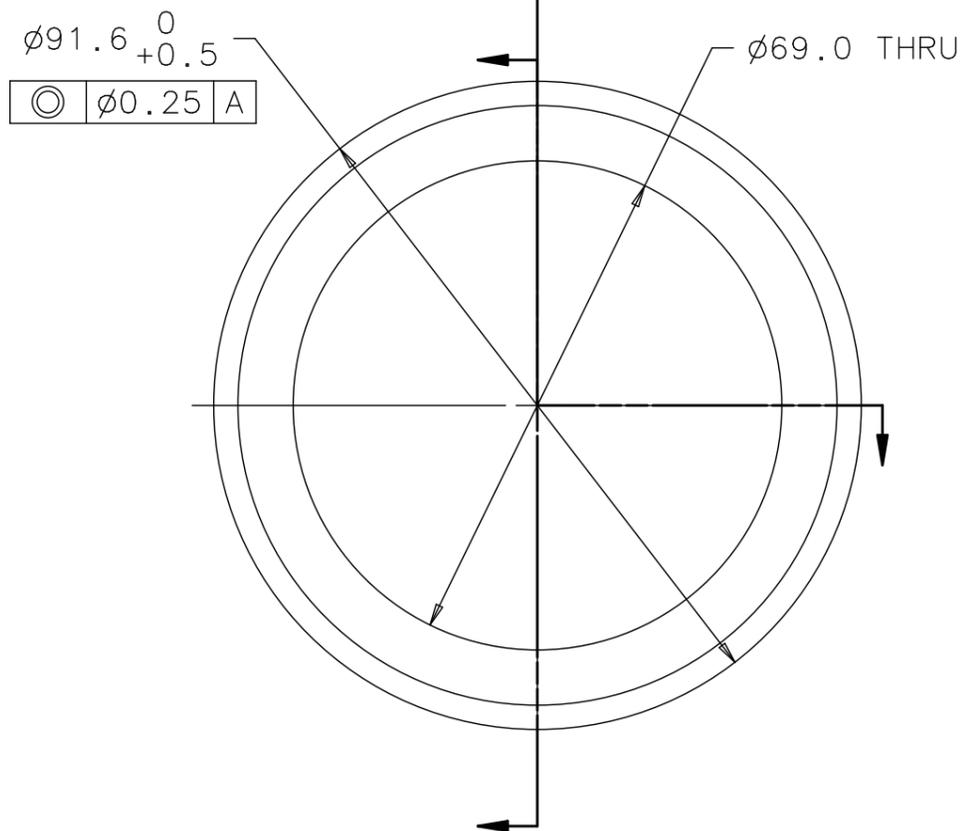
NOTES:

- PART MUST BE FREE OF DIRT, GREASE, OIL AND CHIPS.
- DO NOT BREAK KNIFE EDGE, KEEP SHARP. ANGLE SURFACE TO BE FREE OF SCRATCHES, DENTS AND NICKS.

REVISION HISTORY

CAD MAINTAINED. CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY.

| ZONE | REV | DESCRIPTION | DATE | APPROVED |
|------|-----|-----------------|------|----------|
| | A | INITIAL RELEASE | | |



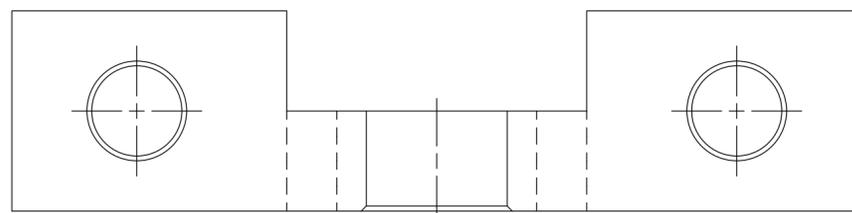
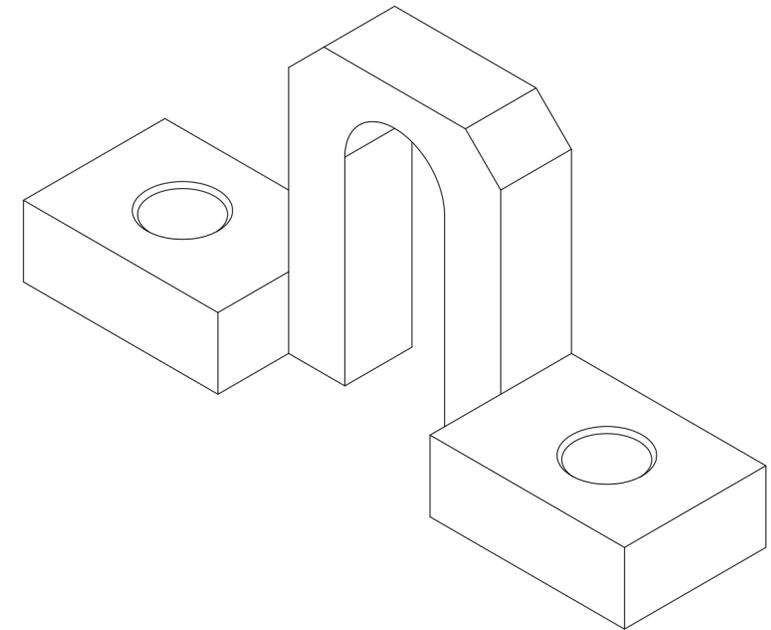
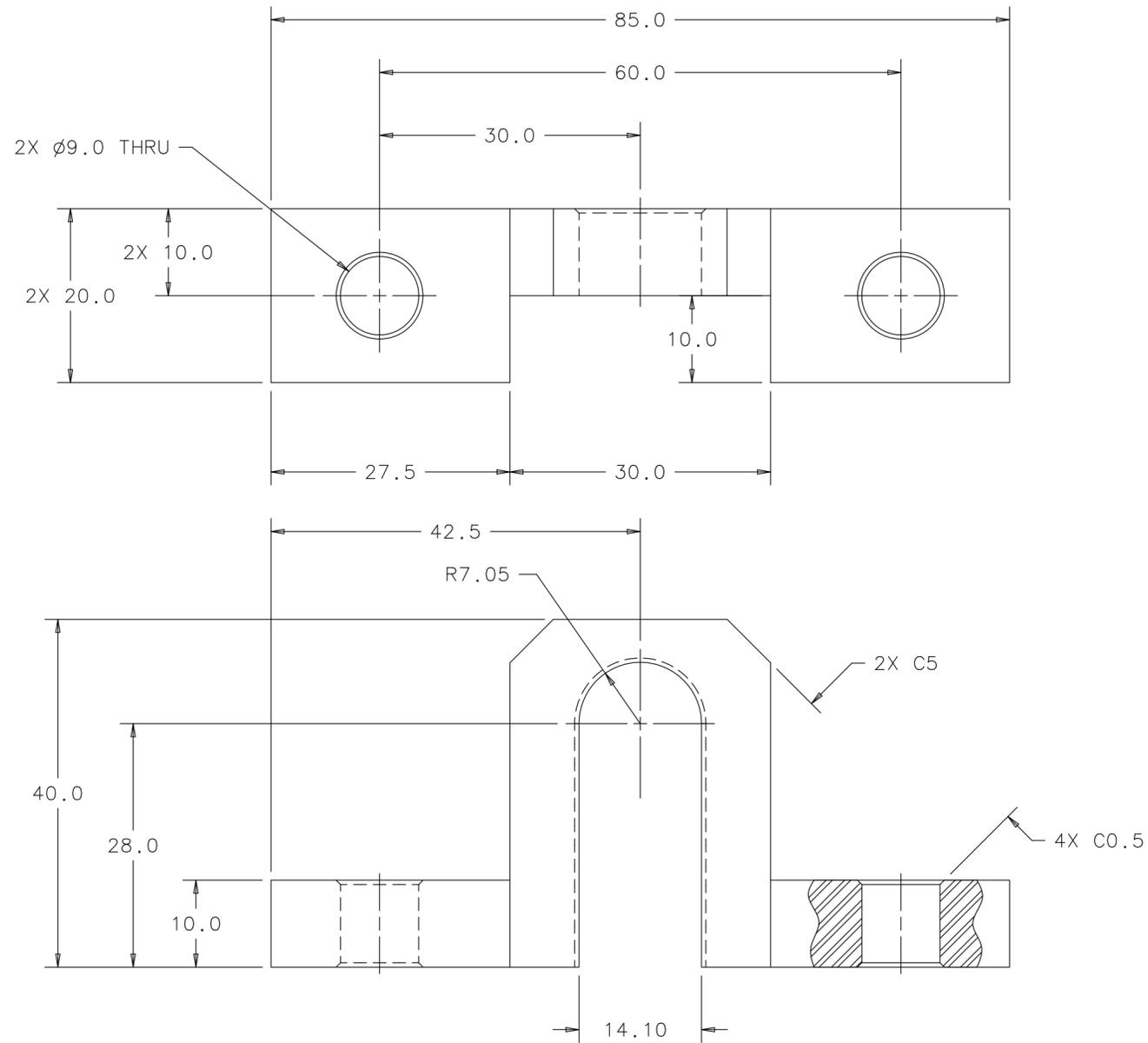
| | |
|-------------|---------|
| 781951 | 777921 |
| NEXT ASSY | USED ON |
| APPLICATION | |

| | | | | | | | |
|---|--|-----------------------|---|---------------------------|--|---|----------------------------------|
| FINISH N/A | UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS INTERPRET DIM PER ASME Y14.5M-1994 BREAK ALL SHARP EDGES 0.5 MAX. ALL MACH. SURFACES 3.2/ MAX. | | DRAWN BY C. GRIMM | DATE 15DEC08 | FERMI NATIONAL ACCELERATOR LABORATORY UNITED STATES DEPARTMENT OF ENERGY P.O. BOX 500, BATAVIA, IL 60510-0500 | | |
| | MATERIAL TITANIUM GRADE 2 | TOLERANCES | THIRD ANGLE PROJECTION | CHECKED BY D. MITCHELL | | DATE 14JAN09 | |
| X ± 2 .X ± 0.8 .XX ± 0.13 ANGLE ± 1° | | | ENGINEERED BY D. MITCHELL | DATE 14JAN09 | | TITLE ILC TYPE IV CRYMODULE HELIUM VESSEL - BLADE TUNER FLANGE_CF_KNIFE_EDGE_BODY | |
| 781951 NEXT ASSY APPLICATION | 777921 USED ON | DATABASE DESY EDMS | TEAM/GROUP SOLID MODEL NO. 759532 | SIZE A3 | | CAGE CODE OU5R6 | DWG NO. D0000000791535 |
| | | SCALE 1:1 | DO NOT SCALE DWG | SHEET 1 OF 1 | | | |

NOTES (UNLESS OTHERWISE SPECIFIED):

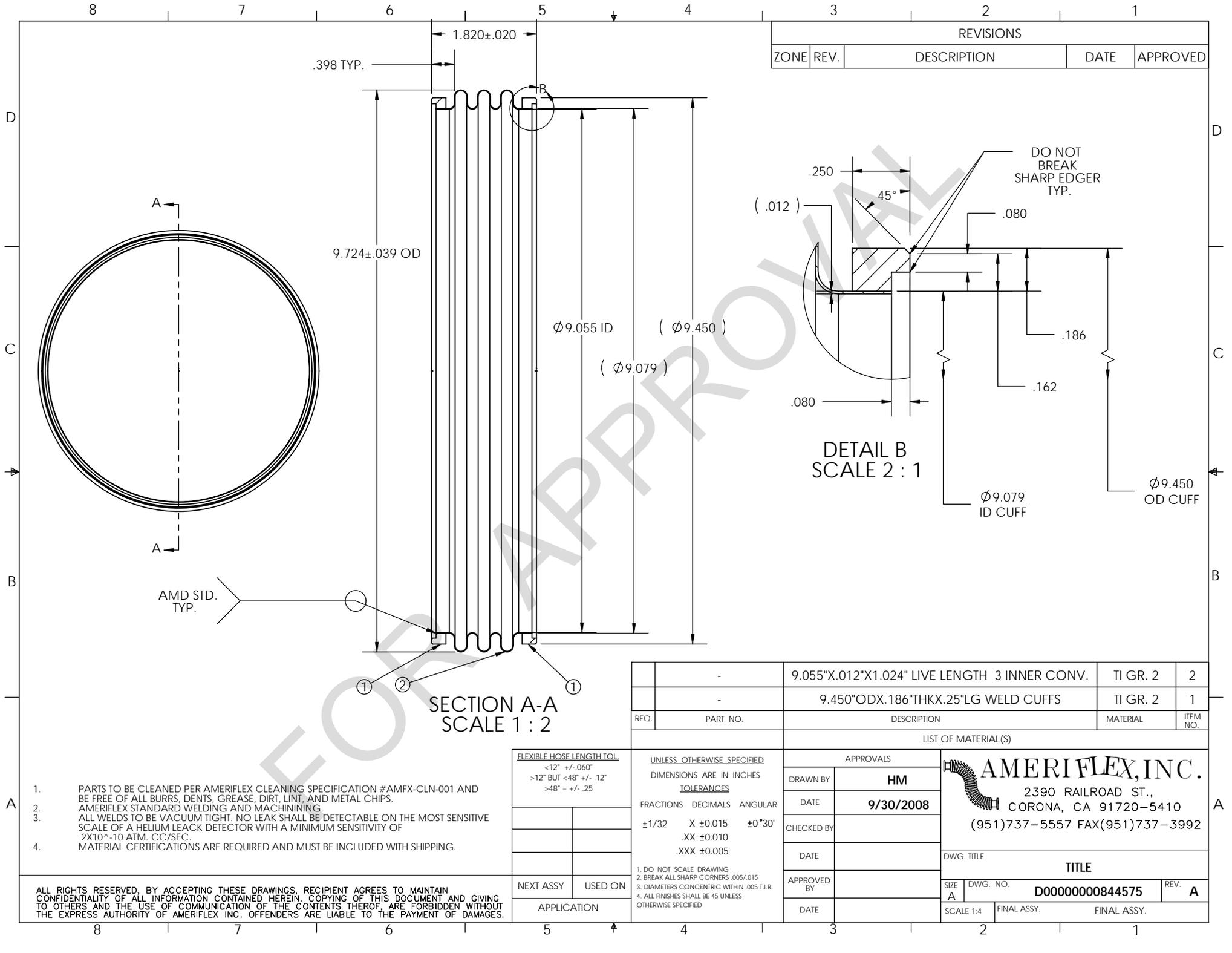
- PARTS TO BE FREE OF ALL SHARP EDGES, CORNERS AND BURRS. A MAXIMUM CHAMFER OF 0.5mm X 45° IS ALLOWED.
- PARTS MUST BE FREE OF DIRT, GREASE, OIL AND CHIPS.

| REVISION HISTORY | | | | |
|---|-----|----------------------------------|------|----------|
| CAD MAINTAINED. CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY. | | | | |
| ZONE | REV | DESCRIPTION | DATE | APPROVED |
| | A | INITIAL RELEASE - ER# ILC-000008 | | |

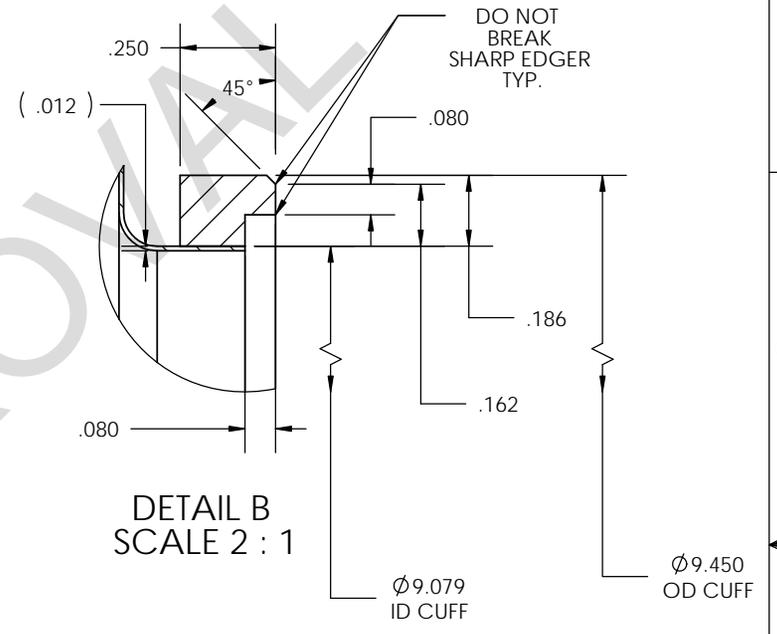
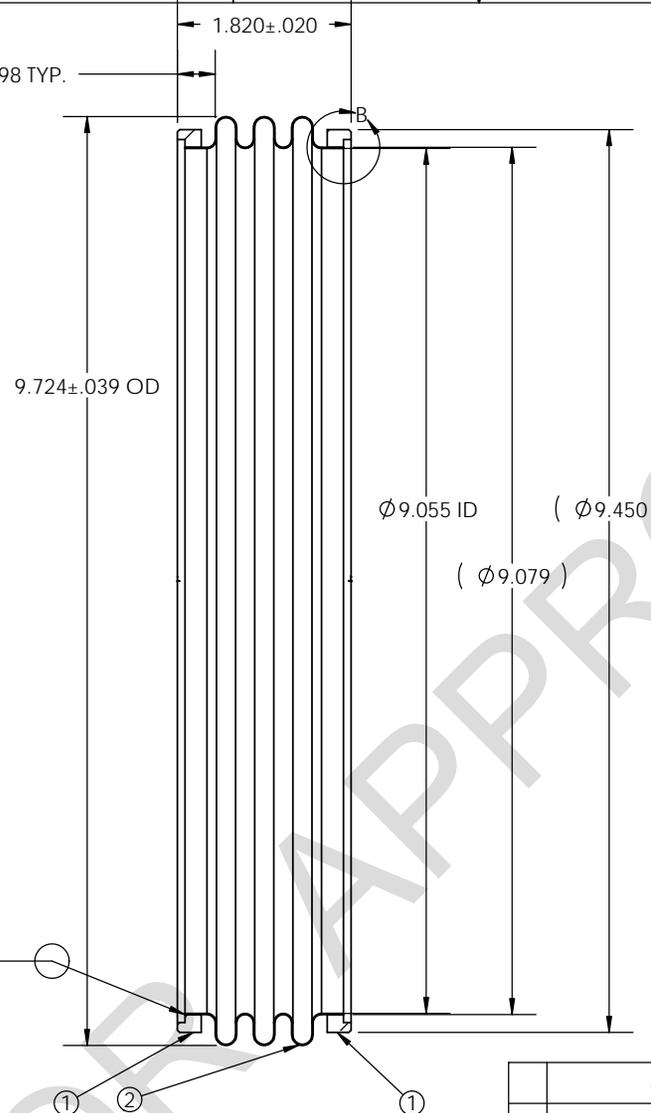


| 812765 | 812815 |
|-------------|---------|
| NEXT ASSY | USED ON |
| APPLICATION | |

| | | | | | |
|---------------|---|---|------------------------|--|--|
| FINISH N/A | UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS INTERPRET DIM PER ASME Y14.5M-1994 BREAK ALL SHARP EDGES 0.5 MAX. ALL MACH. SURFACES 3.2 MAX. | | DRAWN BY C. GRIMM | DATE 15DEC08 | FERMI NATIONAL ACCELERATOR LABORATORY UNITED STATES DEPARTMENT OF ENERGY P.O. BOX 500, BATAVIA, IL 60510-0500 |
| | MATERIAL TITANIUM GRADE 2 | TOLERANCES X ± 2 .X ± 0.8 .XX ± 0.13 ANGLE ± 1° | THIRD ANGLE PROJECTION | CHECKED BY D. MITCHELL | |
| | | ENGINEERED BY D. MITCHELL | DATE 14JAN09 | TITLE ILC CRYMODULE HELIUM VESSEL SUPPORT_PLATE_ADAPTER | |
| | | | DATABASE DESY EDMS | TEAM/GROUP T4CM DESIGN | SIZE A2 |
| | | | CAD I-DEAS | SOLID MODEL NO. D00000000827622 | CAGE CODE OU5R6 |
| | | | | | DWG NO. D00000000813175 |
| | | | | | REV A |
| | | | | | SCALE 2:1 DO NOT SCALE DWG SHEET 1 OF 1 |



| REVISIONS | | | | |
|-----------|------|-------------|------|----------|
| ZONE | REV. | DESCRIPTION | DATE | APPROVED |
| | | | | |



AMD STD.
TYP.

SECTION A-A
SCALE 1 : 2

DETAIL B
SCALE 2 : 1

- PARTS TO BE CLEANED PER AMERIFLEX CLEANING SPECIFICATION #AMFX-CLN-001 AND BE FREE OF ALL BURRS, DENTS, GREASE, DIRT, LINT, AND METAL CHIPS. AMERIFLEX STANDARD WELDING AND MACHINING.
- ALL WELDS TO BE VACUUM TIGHT. NO LEAK SHALL BE DETECTABLE ON THE MOST SENSITIVE SCALE OF A HELIUM LEAK DETECTOR WITH A MINIMUM SENSITIVITY OF 2×10^{-10} ATM. CC/SEC.
- MATERIAL CERTIFICATIONS ARE REQUIRED AND MUST BE INCLUDED WITH SHIPPING.

FLEXIBLE HOSE LENGTH TOL.
<12" +/- .060"
>12" BUT <48" +/- .12"
>48" +/- .25

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES
FRACTIONS DECIMALS ANGULAR
 $\pm 1/32$ X ± 0.015 $\pm 0^{\circ}30'$
.XX ± 0.010
.XXX ± 0.005

- DO NOT SCALE DRAWING
- BREAK ALL SHARP CORNERS .005/.015
- DIAMETERS CONCENTRIC WITHIN .005 T.I.R.
- ALL FINISHES SHALL BE 45 UNLESS OTHERWISE SPECIFIED

NEXT ASSY USED ON APPLICATION

| REQ. | PART NO. | DESCRIPTION | MATERIAL | ITEM NO. |
|------|----------|---|----------|----------|
| - | - | 9.055"X.012"X1.024" LIVE LENGTH 3 INNER CONV. | TI GR. 2 | 2 |
| - | - | 9.450"ODX.186"THKX.25"LG WELD CUFFS | TI GR. 2 | 1 |

LIST OF MATERIAL(S)

APPROVALS

DRAWN BY: **HM**

DATE: **9/30/2008**

CHECKED BY:

DATE:

APPROVED BY:

DATE:

AMERIFLEX, INC.
2390 RAILROAD ST.,
CORONA, CA 91720-5410
(951)737-5557 FAX(951)737-3992

| DWG. TITLE | | TITLE | |
|------------|-----------------------------------|------------------|--|
| SIZE A | DWG. NO. D0000000844575 | REV. A | |
| SCALE 1:4 | FINAL ASSY. | FINAL ASSY. | |

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