

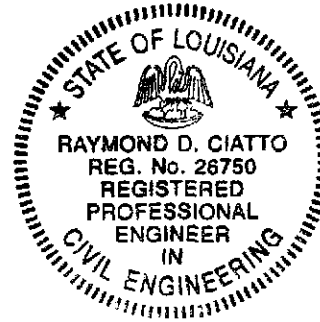
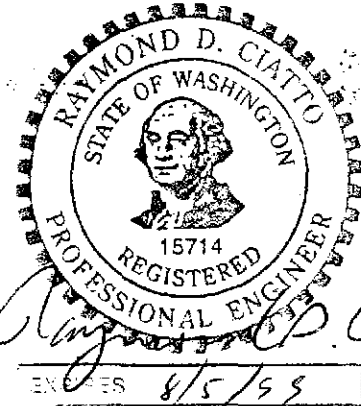
TITLE: SPECIFICATION FOR PIPING DESIGN AND MATERIAL

**SPECIFICATION FOR
PIPING DESIGN AND MATERIAL**

FOR

LIGO VACUUM EQUIPMENT

Hanford, Washington
And
Livingston, Louisiana



JUN 01 1998

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| REV LTR. | BY-DATE | APPD. DATE | DESCRIPTION OF CHANGE |
|-------------------|---------------|-------------------|--|
| 7 | REC. 5/28/98 | PFH/REB | REVISED T3 SPEC PER RFC V049-092 REVISED C1 SPEC. - ADDED PURGE DEO#0616 |
| 6 | REC. 12/15/97 | REB | ADDED SILICON NUTS TO S15 C.F. BOLTS CLASS T3 T4 S75 PER RFC V049-086, DEO#0582 |
| 5 | DM 1/14/97 | D.M.W. 1-15-97 | Clarified 1B1 flange/gasket requirements DEO # 0411 |
| 4 | REC 11/27/96 | D.M.W. 11-28 | REVISED T3 CLASS, MAT'L TO BE 304S/S, 17 WAS 304L. DEO 0369 |
| 3 | DM 10/16/96 | D.M.W. 10-17-96 | Added "C1", Spec. sh for cryogenic copper lines. REVISED 1B1-FLANGES DEO# 0317 |
| 2 | REC. 8/24/96 | PFH/REB 8/28/96 | REVISED "T4" SPEC SH7.17, 17BMS. RELEASED FOR PURCHASE. DEO. 249 |
| 1 | REC. 7/26/96 | REB 8/13/96 | REVISED "T4" SPEC. SH7.17 RELEASED FOR PURCHASE DEO#0236 |
| 0 | REC. 1-19-96 | D.M.W. | RELEASED FOR DESIGN & QUOTES DEO#0044 |
| | | | PROCESS SYSTEMS INTERNATIONAL, INC. SPECIFICATION |
| INITIAL APPROVALS | PREPARED | DATE | APPROVED DATE |
| | R. Ciatto | 1-11-96 | D.M.W. 1-18-96 |
| | | Number | Rev. |
| | | A V049-2-037 | 7 |
| | | LIGO-E960008-07-V | |

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1.0 SCOPE

The following piping and material specifications define the piping and fittings to be used for the LIGO Vacuum Equipment.

2.0 CODES AND STANDARDS

2.1 Priority of Codes and Standards

Priority of documents shall be as follows:

1. Codes (highest priority)
2. This specification

2.2 Applicable Codes and Standards

ANSI - American National Standards Institute

- B31.3 Chemical Plant and Petroleum Refinery Piping (for process piping only)
- B31.5 Refrigeration Piping
- B36.19 Stainless Steel Pipe
- B16.5 Pipe Flanges and Flange Fittings

ASTM - American Society of Testing and Materials

- A380-88 Standard Practice for Cleaning and Descaling Stainless Steel
- E427-71(81) Standard Practice for Testing for Leaks Using the Halogen Leak Detector
- E493-73(80) Standard Practice for Testing for Leaks Using the Mass Spectrometer Leak Detector in the Inside-Out Testing Mode
- E498-73(80) Standard Test Method for Leaks Using the Mass Spectrometer Leak Detector or Residual Gas Analyzer in the Tracer Probe Mode
- E499-73(80) Standard Methods of Testing for Leaks Using the Mass Spectrometer Leak Detector Probe Mode

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2.3 Specification Compliance

The equipment shall comply with any drawings, data sheets, specifications, codes and standards (latest editions) referred to or attached as part of this specification. State or local codes or regulations, if applicable, will be provided as an attachment to this specification. The vendor is responsible for compliance with such standards, specifications, codes and regulations, if attached.

3.0 MATERIAL/MANUFACTURING REQUIREMENTS

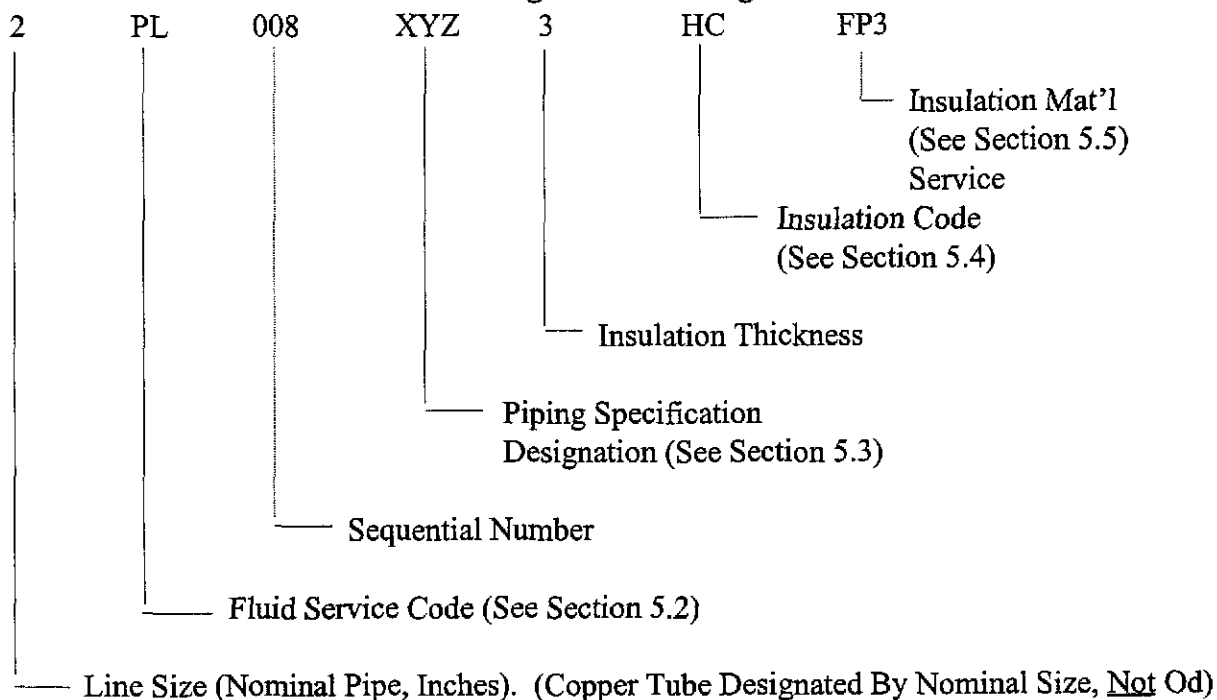
3.1 All materials used to manufacture the piping, tubing, flanges or fittings, as designated per this specification, are to be of U.S.A. origin and manufacture.

4.0 EXAMINATION AND TESTING

Examination and Pressure Testing as required by ANSI B31.3-1990 Chapter VI.

5.0 LINE NUMBER SYSTEM

4.1 lines shall be numbered according to the following chart:



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5.2 Fluid Codes

| <u>Code</u> | <u>Fluid</u> |
|-------------|---------------------------------|
| IA | Instrument Air |
| CA | Class 100 Clean Air |
| CWS | Cooling Water Supply |
| CWR | Cooling Water Return |
| NGS | Natural Gas Supply |
| LN2 | Liquid Nitrogen |
| GN2 | Gaseous Nitrogen |
| PV | Process Vacuum |
| PUV | Process Ultra High Vacuum |
| VA | Vent and Relief to ATM |
| N2 | Nitrogen Gas |
| N | Nitrogen (Either Gas or Liquid) |

5.3 Piping Specification Designation

4.4.1 "X" First Digit Identifiers

1 = 150 # ANSI

4.4.2 "Y" Second Digit Identifiers

A = 6061 T6 Aluminum
B = 304 Stainless Steel
C = Type L Copper Tubing
T = Stainless Steel Tubing

4.4.3 "Z" Third Digit Identifiers

1 = Cryogenic
2 = Non-Cryogenic
3 = Vacuum
4 = Ultra High Vacuum
5 = Class 100 Clean Air

5.4 Insulation Service

Insulation

Symbol

HC

C

PC

PH

VJ

Insulation Service

Hot and Cold

Cold Conservation

Personnel Protection Cold

Personnel Protection Hot

Vacuum Jacketed

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1B1

PIPING DESIGN AND MATERIAL SPECIFICATION

Service: Cryogenic
Primary Rating: 150# ANSI 304 SSTL

Design Conditions:
Pressure 0 To 192 psig
Temperature -320°F To 350°F
Corrosion Allowance Zero

Pipe:
12" and smaller ASTM A312 TP304

Pipe Schedule:
1 1/2" and smaller Schedule 10S SMLS
8" and smaller Schedule 10S SMLS or EFW
10" thru 12" Schedule 10S EFW

Note: Vacuum jacketed piping will be designed and fabricated in accordance with the manufacturer's standard, and PSI Spec. V049-2-016.

FITTINGS:
1 1/2" AND SMALLER SOCKET WELDED 3000#
2" AND LARGER BUTT WELD
ASTM A403 WP304 WPS, WPW
O'LET'S ASTM A182-F304

Flanges: Not allowed, except on atmospheric vent lines as indicated on PSID's. Flanges on the vent line, (which mate to a flat faced flange on the vacuum equipment) shall be stainless steel raised-face design. Flanged joints shall have spiral wound, stainless steel gaskets, Flexitallic or equal.

Valves: Valves shall be furnished under their own unique specification.

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1B1

BRANCH CONNECTIONS:

Run
Size "

| | | | | | | | | | | | | | |
|----|----|----|----|----|----|----|----|----|----|----|----|--|---------------|
| ½ | 04 | | | | | | | | | | | | 04 - Tee |
| ¾ | 06 | 04 | | | | | | | | | | | 05 - Sockolet |
| 1 | 12 | 06 | 04 | | | | | | | | | | 06 - Tee Then |
| 1½ | 05 | 05 | 06 | 04 | | | | | | | | | Reducer or |
| 2 | 05 | 05 | 06 | 06 | 04 | | | | | | | | Reducing Tee |
| 3 | 05 | 05 | 05 | 05 | 06 | 04 | | | | | | | 12 - Bw O'let |
| 4 | 05 | 05 | 05 | 05 | 12 | 06 | 04 | | | | | | |
| 6 | 05 | 05 | 05 | 05 | 12 | 12 | 06 | 04 | | | | | |
| 8 | 05 | 05 | 05 | 05 | 12 | 12 | 12 | 06 | 04 | | | | |
| 10 | 05 | 05 | 05 | 05 | 12 | 12 | 12 | 12 | 06 | 04 | | | |
| 12 | 05 | 05 | 05 | 05 | 12 | 12 | 12 | 12 | 12 | 06 | 04 | | |

| | | | | | | | | | | | |
|-------------|---|---|---|----|---|---|---|---|---|----|----|
| Branch Size | ½ | ¾ | 1 | 1½ | 2 | 3 | 4 | 6 | 8 | 10 | 12 |
|-------------|---|---|---|----|---|---|---|---|---|----|----|

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1B2

PIPING DESIGN AND MATERIAL SPECIFICATION

Service: Non-Cryogenic – Clean

Primary Rating: 150# ANSI 304 SSSL

Design Conditions:

Pressure 0 to 192 psig
Temperature -20>°F to 350°F
Corrosion Allowance Zero

Pipe:

12" and smaller ASTM A312 TP304

Pipe Schedule:

1 1/2" and smaller Schedule 10S SMLS
8" and smaller Schedule 10S SMLS or EFW
10" thru 12" Schedule 10S EFW

Fittings:

1 1/2" and smaller Socket Welded 3000#
2" and larger Butt Weld
ASTM A403 WP304 WPSs, WPW
Elbow O'Let ASTM A182-F304

Flanges: 2" and larger ANSI 150# RF, ASTM A182 F304, Weldneck with o-ring gaskets.

Gaskets: O-ring, Viton non-lubricated, cleaned and sealed for shipment.

Valves: Valves shall be furnished under their own unique specification.

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1B2

Branch Connections:

| Run Size " | | | | | | | | | | | |
|-------------|----|----|----|----|----|----|----|----|----|----|---------------|
| ½ | 04 | | | | | | | | | | 04 - Tee |
| ¾ | 06 | 04 | | | | | | | | | 05 - Sockolet |
| 1 | 12 | 06 | 04 | | | | | | | | 06 - Tee Then |
| 1½ | 05 | 05 | 06 | 04 | | | | | | | Reducer Or |
| 2 | 05 | 05 | 06 | 06 | 04 | | | | | | Reducing Tee |
| 3 | 05 | 05 | 05 | 05 | 06 | 04 | | | | | 12 - BW O'let |
| 4 | 05 | 05 | 05 | 05 | 12 | 06 | 04 | | | | |
| 6 | 05 | 05 | 05 | 05 | 12 | 12 | 06 | 04 | | | |
| 8 | 05 | 05 | 05 | 05 | 12 | 12 | 12 | 06 | 04 | | |
| 10 | 05 | 05 | 05 | 05 | 12 | 12 | 12 | 12 | 06 | 04 | |
| 12 | 05 | 05 | 05 | 05 | 12 | 12 | 12 | 12 | 12 | 06 | 04 |
| Branch Size | ½ | ¾ | 1 | 1½ | 2 | 3 | 4 | 6 | 8 | 10 | 12 |

Note:

1. Piping and fittings to be internally cleaned, dried and ends sealed during shipping, storing and installation.
2. ID of pipe and fittings to be free of hydrocarbon contamination, or dirt. of any kind.
3. Surface finish to be standard white pickled ID and O.D.
4. Tube bending - the following is not allowed: Sand packing, Mechanical scratches on tube I.D., Any type of lubricant.
5. Material manufactures certificate of compliance to applicable ASTM specifications are required and must accompany shipment.
6. Tubing, flanges and fittings to be etched or stamped with manufacturers name, part number and material type.

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C2

PIPING DESIGN AND MATERIAL SPECIFICATION

Service: Gaseous Nitrogen, Cooling Water, Instrument Air

Design Conditions:

Pressure 200 PSIG
Temperature -20°F To 150°F
Corrosion Allowance Zero

Tube: All Sizes Type "L" Copper - Hard Drawn ASTM B88, B280, Copper Tube Designated By Its Nominal Sizes, Not OD on P&ID's and Piping Drawings.

Note: Copper tube and fittings are to be specified on PSI BOM's by the actual O.D. of the tube.

Fittings: All sizes Wrought Copper ASTM B75
All Fittings to be female solder cup ends.
Brass Parker CPI tube fittings (or equal).

Unions: 1/4" to 1" Brass Parker CPI tube fittings (or equal) may also be used.

Valves: Valves shall be furnished under their own unique specification.

Soldering: All joints in wrought copper fittings shall be soldered using 95-5 Tin-Antimony.

Notes:

1. Tubing is to be internally cleaned and the ends sealed during shipping, storing and installation. Spools are to have all flux residue, grit, splatters or dirt removed before installation.
2. Fittings are to be cleaned after manufacturing and sealed in plastic during shipping, storing and installation.

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T1

PIPING DESIGN AND MATERIAL SPECIFICATION

Service: Cryogenic

Design Conditions:

Pressure 0 to 300 psig
Temperature -320°F to 350°F
Corrosion Allowance Zero

Tube:

All Sizes ASTM A269 GR 304L SMLS
Tube sizes designated by OD dimensions.

| <u>Tube Size (Od):</u> | <u>Minimum Wall Thickness (Inches)</u> |
|------------------------|--|
| 1/4" | 0.035" |
| 3/8" | 0.035" |
| 1/2" | 0.049" |
| 3/4" | 0.049" |
| 1" | 0.065" |

Fittings: All Fittings to be Parker Weld tube fittings SA479 Or ASTM A276 GR TP316 and ASTM A182 GR TP316, or equal.

Valves: Valves shall be furnished under their own unique specification.

Note:

1. Tubing to be internally cleaned, dried and ends sealed during shipping, storing and installation. Tube ID to be free of hydrocarbon contamination.
2. Fittings to be cleaned after manufacturing and sealed in plastic bags during shipping, storing and installation.
3. Tubing surface finish to be standard white pickled I.D. & O.D.

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T2

PIPING DESIGN AND MATERIAL SPECIFICATION

Service: Non-Cryogenic

Design Conditions:

Pressure 0 to 300 psig
Temperature -20°F To 350°F
Corrosion Allowance Zero

Tube:

All Sizes ASTM A269 GR TP304 SMLS
Tube sizes designated by OD dimensions.

Tube Size (Od): Minimum Wall Thickness (Inches)

| | |
|------|--------|
| 1/4" | 0.035" |
| 3/8" | 0.035" |
| 1/2" | 0.049" |
| 3/4" | 0.049" |
| 1" | 0.065" |

Fittings: All fittings to be Parker A-LOK tube fittings SA479 or ASTM A276 GR TP316 and ASTM A182 GR TP316 or equal.

Valves: Valves shall be furnished under their own unique specification.

Note:

1. Tubing to be internally cleaned, dried and ends sealed during shipping, storing and installation. Tube ID to be free of hydrocarbon contamination.
2. Fittings to be cleaned after manufacturing and sealed in plastic bags during shipping, storing and installation.
3. Tubing surface finish to be standard white pickled I.D. & O.D.

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T3

PIPING DESIGN AND MATERIAL SPECIFICATION

Service: Process Vacuum

Design Conditions:

| | |
|---------------------|--|
| Pressure | Vacuum 10 ⁻⁵ Torr to 2 psig |
| Temperature | -20°F to 150°F |
| Corrosion Allowance | Zero |

Tube: (Tube Sizes Designated By OD Dimensions)

| | |
|--------------------|-------------------------------------|
| All sizes up to 1" | ASTM A269 GR TP304L SMLS |
| 1 1/2" and larger | ASTM A269 GR TP304L SMLS or welded. |

| Tube Size (OD): | Minimum Wall Thickness (Inches) | Conflat Flange Size | No. Bolts | B.C. Dia. | Thru Hole Dia. |
|------------------------|--|----------------------------|------------------|------------------|-----------------------|
| 1/4" | 0.035" | 1 1/3" Nom. O.D. | 6 | 1.062" | .172" |
| 3/8" | 0.035" | 1 1/3" Nom. O.D. | 6 | 1.062" | .172" |
| 1/2" | 0.035" | 1 1/3" Nom. O.D. | 6 | 1.062" | .172" |
| 3/4" | 0.035" | 2 1/8" Nom. O.D. | 4 | 1.625" | .265" |
| 1"1 | 0.065" | 2 3/4" Nom. O.D. | 6 | 2.312" | .265" |
| 1 1/2" | 0.065" | 2 3/4" Nom. O.D. | 6 | 2.312" | .265" |
| 2" | 0.065" | 3 3/8" Nom. O.D. | 8 | 2.85" | .332" |
| 2 1/2" | 0.065" | 4 1/2" Nom. O.D. | 8 | 3.628" | .332" |
| 4" | 0.083" | 6" Nom. O.D. | 16 | 5.128" | .332" |
| 6" | 0.083" | 8" Nom. O.D. | 20 | 7.128" | .332" |
| 8" | 0.120" | 10" Nom. O.D. | 24 | 9.128" | .332" |
| 10" | 0.120" | 12" Nom. O.D. | 32 | 11.181" | .332" |
| 12" | 0.120" | 14" Nom. O.D. | 30 | 12.810" | .390" |
| 14" | 0.120" | 16 1/2" Nom. O.D. | 36 | 15.310" | .390" |

Flanges: All flanges to be Conflat, ISO Large Flange or KF tube fittings 304L Stainless Steel. Flange bolts and washers to be stainless steel with silicon bronze nuts.

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Fittings: All fittings to be 304L butt weld or flanged O.D. tube, wall thickness to match tube wall thickness listed above.

Valves: Valves shall be furnished under their own unique specification.

Notes:

1. Tubing to be internally cleaned, dried and ends sealed during shipping, storing and installation. Tube ID to be free of hydrocarbon contamination.
2. Fittings to be cleaned after manufacturing and sealed in plastic bags during shipping, storing and installation.
3. Tubing surface finish to be standard white pickled I.D. & O.D. bright-annealed finish is allowed as an alternate.
4. Tube bending - The following is not allowed: Sand packing, mechanical scratches on tube I.D., or any type of lubricant.
5. Material manufactures certificate of compliance to applicable ASTM specifications are required and must accompany shipment.
6. Tubing, flanges and fittings to be etched or stamped with manufacturers name, part number and material type.
7. Conflat flanges to be made from either electro slag remelt, vacuum remelt or cross forged material.
8. Gaskets for ISO flanges to be 304S/S with baked Viton o-rings.

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T4

PIPING DESIGN AND MATERIAL SPECIFICATION

Service: Process Ultra High Vacuum

Design Conditions:

| | |
|---------------------|---|
| Pressure | Vacuum 10 ⁻¹⁰ Torr to 2 psig |
| Temperature | -20°F to 150°F |
| Corrosion Allowance | Zero |

Tube: (Tube sizes designated by OD dimensions)

| | |
|--------------------|-------------------------------------|
| All sizes up to 1" | ASTM A269 GR TP304L SMLS |
| 1 1/2" and larger | ASTM A269 GR TP304L SMLS or welded. |

| Tube Size (Od): | Minimum Wall Thickness (Inches) | Conflat Flange Size | No. Bolts | B.C. Dia. | Thru Hole Dia. |
|------------------------|--|----------------------------|------------------|------------------|-----------------------|
| 1/4" | 0.035" | 1 1/3" Nom. O.D. | 6 | 1.062" | .172" |
| 3/8" | 0.035" | 1 1/3" Nom. O.D. | 6 | 1.062" | .172" |
| 1/2" | 0.035" | 1 1/3" Nom.. O.D. | 6 | 1.062" | .172 |
| 3/4" | 0.035" | 2 1/8" Nom.. O.D. | 4 | 1.625" | .265" |
| 1" | 0.065" | 2 3/4" Nom. O.D. | 6 | 2.312" | .265" |
| 1 1/2" | 0.065" | 2 3/4" Nom.. O.D. | 6 | 2.312" | .265" |
| 2" | 0.065" | 3 3/8" Nom. O.D. | 8 | 2.85" | .332" |
| 2 1/2" | 0.065" | 4 1/2" Nom.. O.D. | 8 | 3.628" | .332" |
| 4" | 0.083" | 6" Nom. O.D. | 16 | 5.128" | .332" |
| 6" | 0.083 | 8" Nom. O.D. | 20 | 7.128" | .332" |
| 8" | 0.120 | 10"Nom. O.D. | 24 | 9.128" | .332" |
| 10" | 0.120 | 12"Nom. O.D. | 32 | 11.181" | .332" |
| 12" | 0.120 | 14"Nom. O.D. | 30 | 12.810" | .390" |
| 14" | 0.120 | 16 1/2"Nom. O.D. | 36 | 15.310" | .390" |

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Flanges: All flanges to be Conflat, 304L Stainless Steel. Flanges with 1/2 nipples to have a minimum wall thickness per table (page 16), also see note 7.
Bolts and washers to be stainless steel with silicon bronze nuts and washers.

Fittings: All fittings to be 304L butt weld or flanged O.D. tube. Wall thickness to match tube wall thickness listed in table (page 16).

Valves: Valves shall be furnished under their own unique specification. Valves whose seats form part of the UHV boundary shall be all metal.

Cleaning: Surfaces exposed to vacuum shall be cleaned and protected by PSI approved procedures suitable for UHV service.

Note:

1. Tubing to be internally cleaned, dried and ends sealed during shipping, storing and installation. Tube ID to be free of hydrocarbon contamination.
2. Fittings and conflat - 1/2 nipples to be cleaned after manufacturing and sealed in plastic bags during shipping, storing and installation.
3. Tubing surface finish to be standard white pickled I.D. & O.D.
4. Material manufacturers Certificate of Compliance to applicable ASTM specifications are required and must accompany shipment.
5. Tubing, flanges and fittings to be etched or stamped with manufacturers name, part number, material type and customers PO number on the outside surface.
6. Conflats shall be made from 304L material suitable for ultra high vacuum service.
7. All welding exposed to vacuum shall be done by the tungsten-arc inert-gas (TIG) process. Exceptions may be allowed subject to PSI approval. Welding techniques shall be made in accordance with the best ultra high vacuum practice to eliminate any virtual leaks in the welds; i.e., All vacuum welds shall be, wherever possible, internal and continuous; all external welds added to these for structural purposes shall be intermittent to eliminate trapped volumes. Defective welds shall be repaired by removal to sound metal and rewelding. All vacuum weld procedures shall include steps to avoid contamination of the heat affected zone with air, hydrogen, or water. This requires that inert purge gas, such as argon, be used to flood the vacuum side of heated portions. Vendors to provide weld procedures, with weld cleaning procedures to PSI for approval.

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T5

PIPING DESIGN AND MATERIAL SPECIFICATION

Service: Class 100 Clean Air

Design Conditions:

Pressure Vacuum to 2 psig
 Temperature -20°F to 150°F
 Corrosion Allowance Zero

Tube: (Tube sizes designated by OD dimensions)

All sizes up to 1" ASTM A269 GR TP304 SMLS
 1 1/2" and larger ASTM A269 GRTP304 SMLS or Welded.

| Tube Size (Od): | Minimum Wall Thickness (Inches) | Conflat Flange Size | No. Bolts | B.C. Dia. | Thru Hole Dia. |
|------------------------|--|----------------------------|------------------|------------------|-----------------------|
| 1/4" | 0.035" | 1 1/3" Nom. O.D. | 6 | 1.062" | .172" |
| 3/8" | 0.035" | 1 1/3" Nom. O.D. | 6 | 1.062" | .172" |
| 1/2" | 0.035" | 1 1/3" Nom. O.D. | 6 | 1.062" | .172" |
| 3/4" | 0.035" | 2 1/8" Nom.. O.D. | 4 | 1.625" | .265" |
| 1" | 0.065" | 2 3/4" Nom. O.D. | 6 | 2.312" | .265" |
| 1 1/2" | 0.065" | 2 3/4" Nom.. O.D. | 6 | 2.312" | .265" |
| 2" | 0.065" | 3 3/8" Nom. O.D. | 8 | 2.85" | .332" |
| 2 1/2" | 0.065" | 4 1/2" Nom. O.D. | 8 | 3.628" | .332" |
| 4" | 0.083" | 6" Nom. O.D. | 16 | 5.128" | .332" |
| 6" | 0.083 | 8" Nom. O.D. | 20 | 7.128" | .332" |
| 8" | 0.120 | 10" Nom. O.D. | 24 | 9.128" | .332" |
| 10" | 0.120 | 12" Nom. O.D. | 32 | 11.181" | .332" |
| 12" | 0.120 | 14" Nom. O.D. | 30 | 12.810" | .390" |
| 14" | 0.120 | 16 1/2" Nom.. O.D. | 36 | 15.310" | .390" |

Continued on next page.

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| SPECIFICATION | |
| Number: A V049-2-037 | Rev. 7 |

Title:

SPECIFICATION FOR PIPING DESIGN AND MATERIAL

T5

Flanges: All flanges to be Conflat tube fittings 304 Stainless Steel.

Flange bolts and washers to be stainless steel, with silicon bronze nuts.

Fittings: All fittings to be 304 butt weld or flanged O.D. tube. Wall thickness to match the tube wall thickness.

Valves: Valves shall be furnished under their own unique specification.

Cleaning: Internal surfaces shall be cleaned and protected by PSI approved procedures suitable for class 100 air service.

Note:

1. Tubing to be internally cleaned, dried and ends sealed during shipping, storing and installation. Tube ID to be free of hydrocarbon contamination.
2. Fittings to be cleaned after manufacturing and sealed in plastic bags during shipping, storing and installation.
3. Tubing surface finish to be standard white pickled I.D. & O.D.
4. Material manufactures certificate of compliance to applicable ASTM specifications are required and must accompany shipment.
5. Tubing, flanges and fittings to be etched or stamped with manufacturers name, part number and material type.
6. Conflat flanges to be made from either electro slag remelt, vacuum remelt or crossforged material.

SPECIFICATION

Number:

A V049-2-037

Rev.

7

Title: SPECIFICATION FOR PIPING DESIGN AND MATERIAL

C1

PIPING DESIGN AND MATERIAL SPECIFICATION

Service: Cryogenic

Design Conditions:

Pressure 150 PSIG
Temperature -320°F to 350°F
Corrosion Allowance None

Tube:

All sizes Type "1" Copper - Hard Drawn

ASTM B88,B280, copper tube designated by its
Nominal sizes, not OD (UON).

Fittings:

All sizes Wrought copper

ASTM B75

All fittings to be female solder cup ends.

Valves: Valves shall be furnished under their own unique specification.

Brazing;

All joints shall be brazed using brazing alloy bcup-5 (American Welding Society Designation). No flux is required; however a purge with argon or nitrogen is required during heating or brazing periods.

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| SPECIFICATION | |
| Number: | Rev. |
| A V049-2-037 | 7 |

ATTACHMENT "A"
LIGO QUALITY ASSURANCE REQUIREMENTS SUMMARY

| | | | | | | |
|---|----------------------|------------------|-----------------|----------------------------|----------------------|--------------------|
| LIGO VACUUM EQUIPMENT | VENDOR: | | | | | JOB NO.: V59049 |
| EQUIPMENT: PIPE, TUBING & FITTINGS | VENDOR ENG. OFFICE: | | | | | DWG. NO.: |
| PSI P.O. NO: | VENDOR FACTORY: | | | | | SPECNO: V049-2-037 |
| TESTING INSPECTION AND DOCUMENTATION RECORD | Submittal After P.O. | Witnessed by PSI | Approval by PSI | Copies Req'd for PSI Files | Record in Mfr's File | Remarks: |
| | | | | | | Inspector: |
| | | | | | | Date: |
| VENDOR Q.A. PLAN | | | X | 2 | X | |
| CLEANING PROCEDURE | | | X | 2 | X | |
| PREP FOR SHIPMENT PROCEDURE | | | X | 2 | X | |
| CERTIFICATE OF COMPLIANCE | | | | 2 | X | |
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REV 7
 Pg. 1 of 1
 SPEC V049-2-037
 ATTACHMENT "A"