Cooling Connections Testing and Development: Progress Report

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Recent Developments

- **Fitting testing regimen begun**
  - Specific tests and sequence defined
    - Vacuum He leak test
    - Proof test at 8 bar, 1 hour
    - 1 bar pressure He leak test
    - Cold versions of above tests
    - 50 mrad Irradiation
  - New apparatus constructed and tested
    - Ability to Internally pressurize fitting with he and leak check
    - Ability to cool fittings and perform same tests
- **Seals and Joining Methods tested**
  - Seals
    - Variseals
    - C-rings
    - Metal/metal (Leur-Loc, indium washer)
  - Joining Methods
    - Brazing
    - Gluing
    - Laser Welding
- **Work on ceramic electrical breaks suspended**

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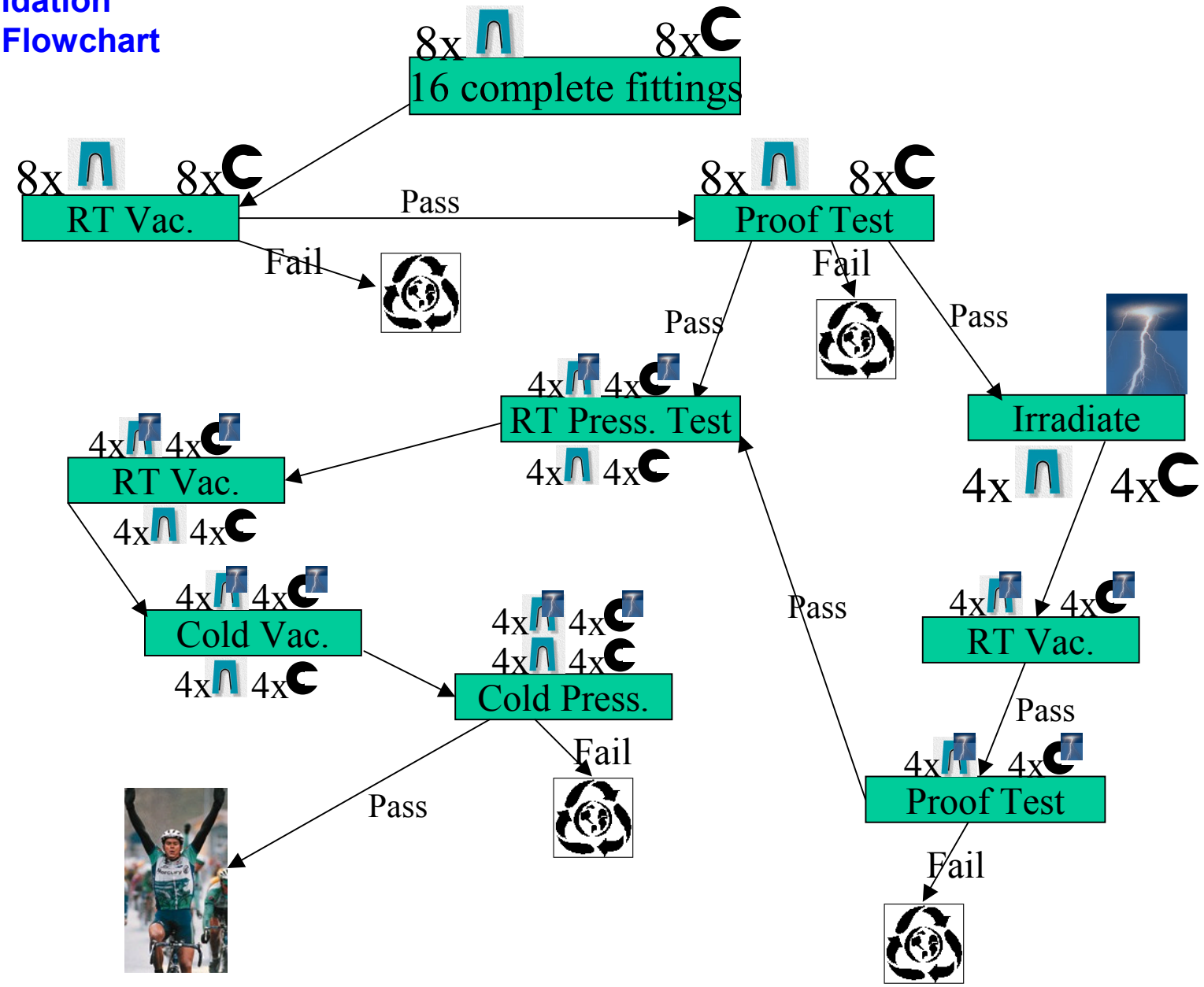
Seal Validation Testing Flowchart



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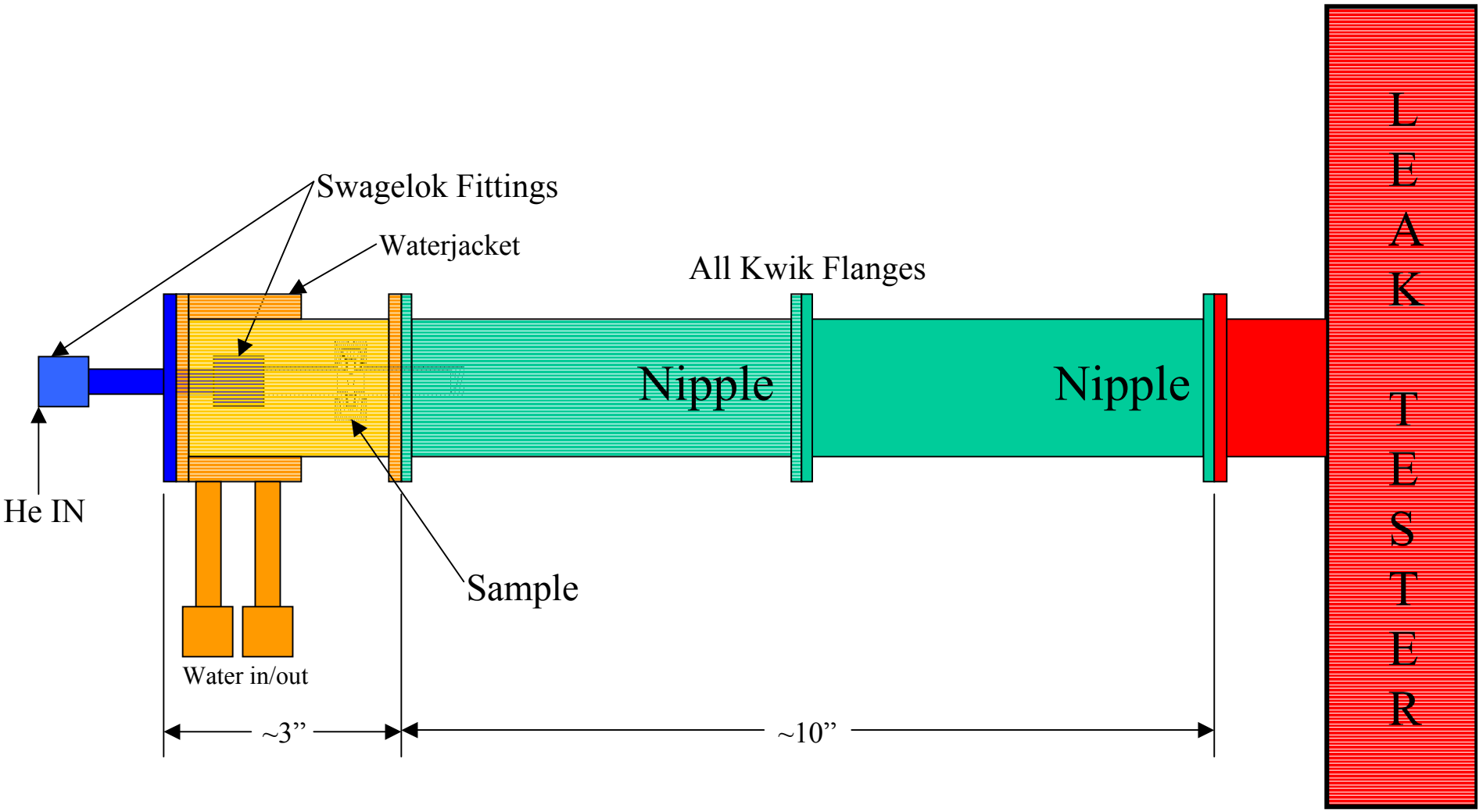
He Pressurized Leak Testing Setup



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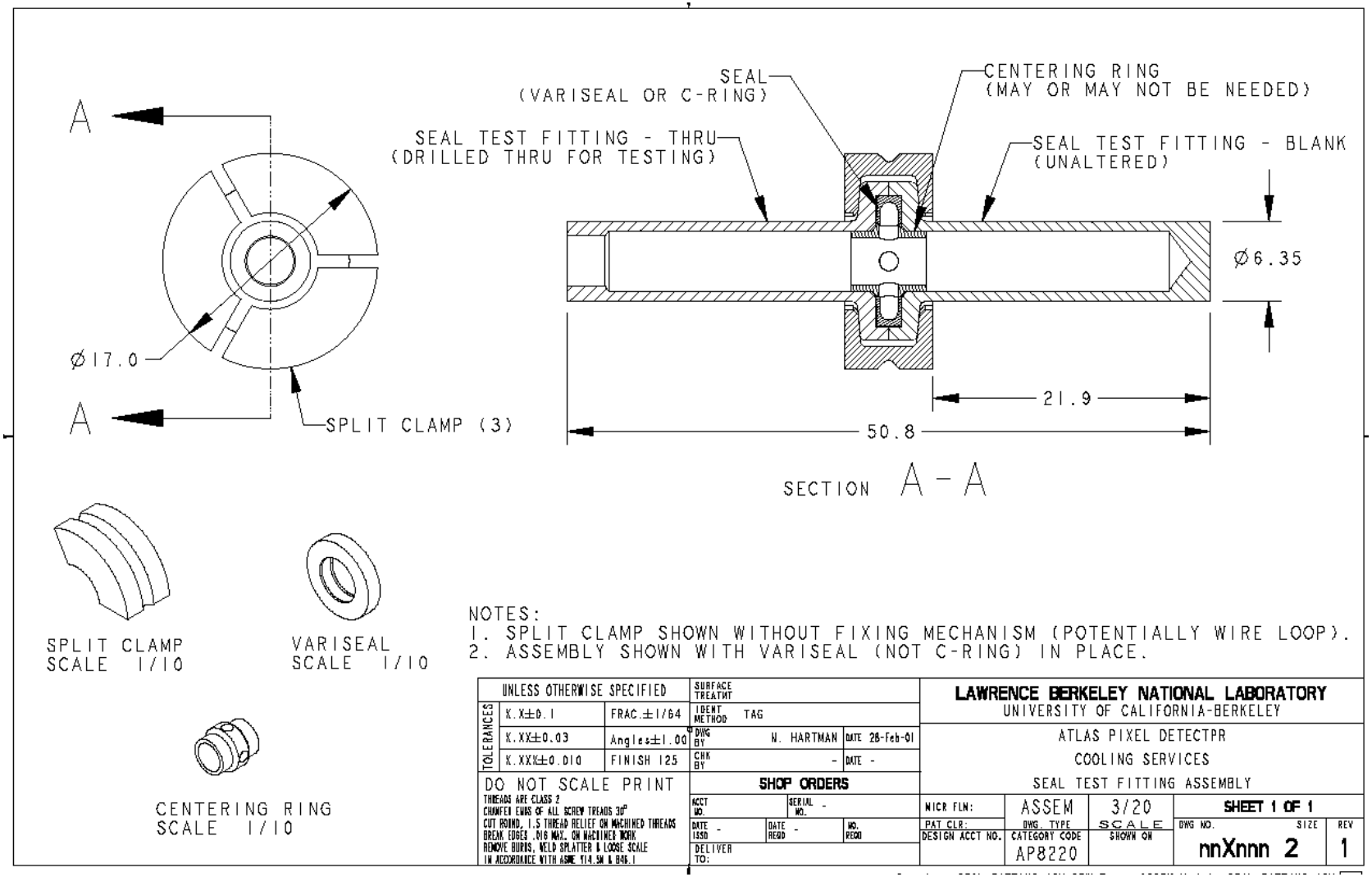
Fitting Geometry – split clamp style



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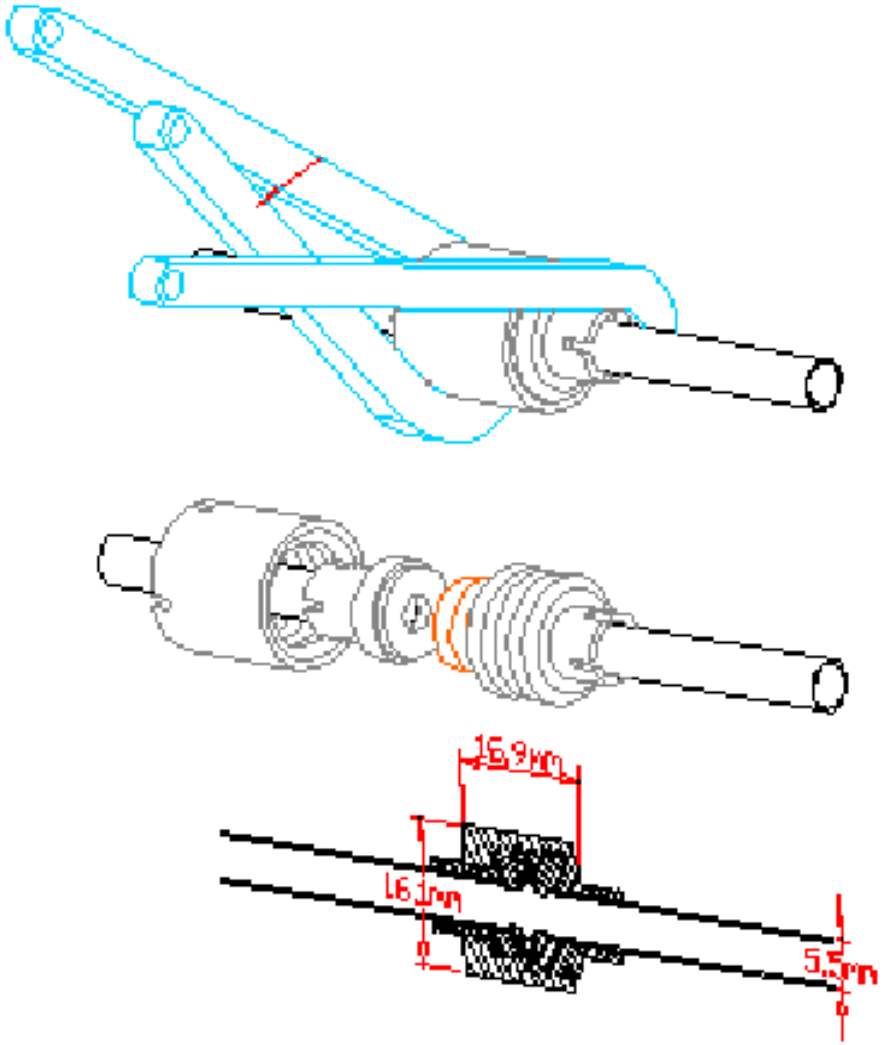
Fitting Geometry – metal seal, screw type



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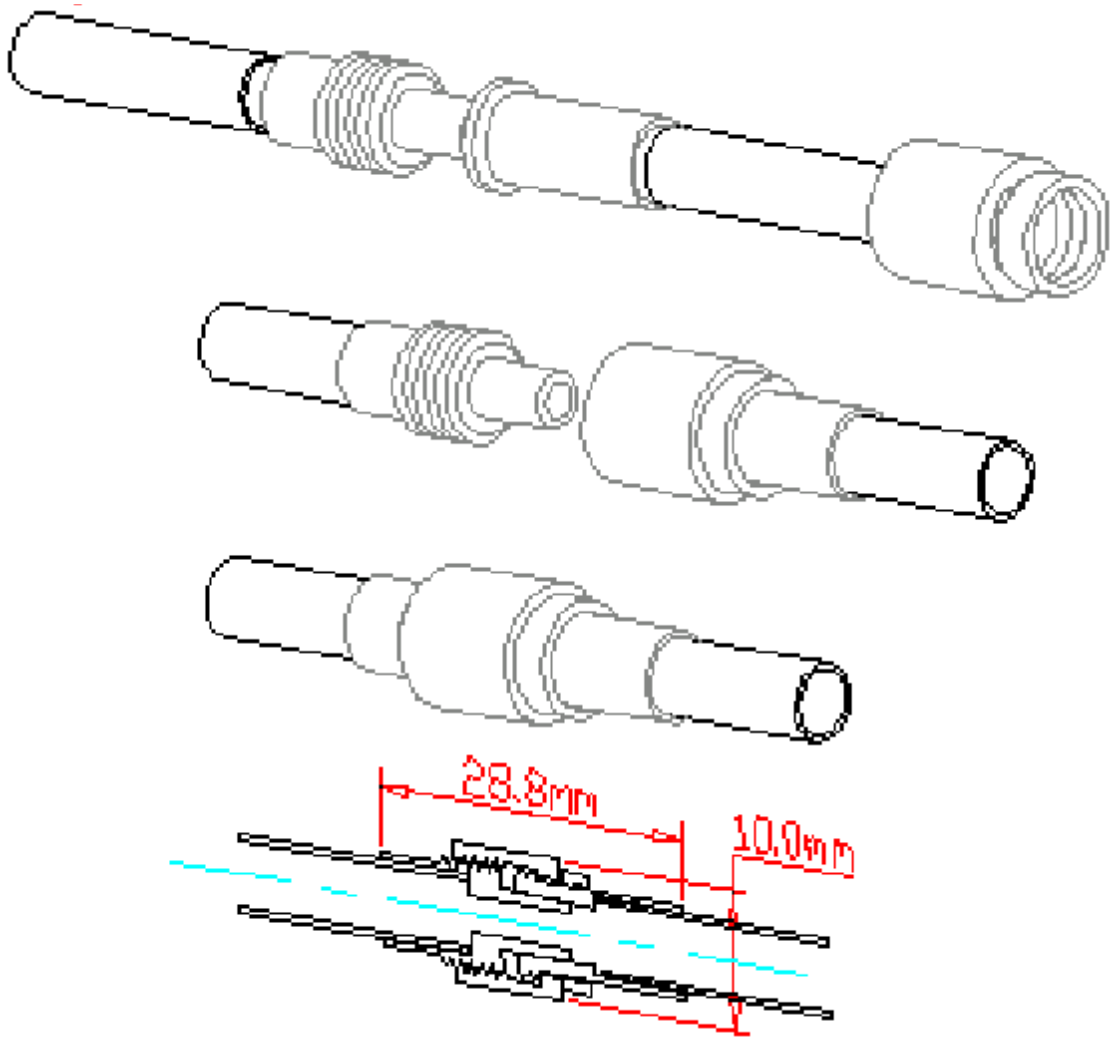
Fitting Geometry – metal seal, Luer-Loc



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Recent Seal Tests

- **Variseals**
  - Initial set of fittings
    - Fittings made slightly undersize
    - 8 samples assembled
    - 7 samples passed vac check at < 1e-10, 1 at 1e-9 (Torr-L/sec)
    - 8 samples passed proof test (<5% pressure change at 8 bar)
    - 4 samples irradiated
      - 3 passed vac test at < 5e-8 Torr-L/sec
      - 1 meets spec at 1e-6 Torr-L/sec
  - Second set of fittings
    - Fittings made correct size (to meet desired clamping force)
    - 4 samples assembled and vac checked – all passed at < 1e-9 Torr-L/sec
- **C-rings**
  - Problems fitting rings in gland
    - Gland is right size, but fittings require 600 N preload to close
    - Free height of c-ring is 2.5 mm, gland depth is 2 mm
  - Attempted pre-forming c-rings
    - Free height reduced from 2.5 mm to 2.2 mm
    - Surface damaged some during setting – would not seal
- **Metal/metal seals**
  - Leur-Loc fittings just back from shop
  - Indium washer fittings just back from shop
  - Testing to begin immediately

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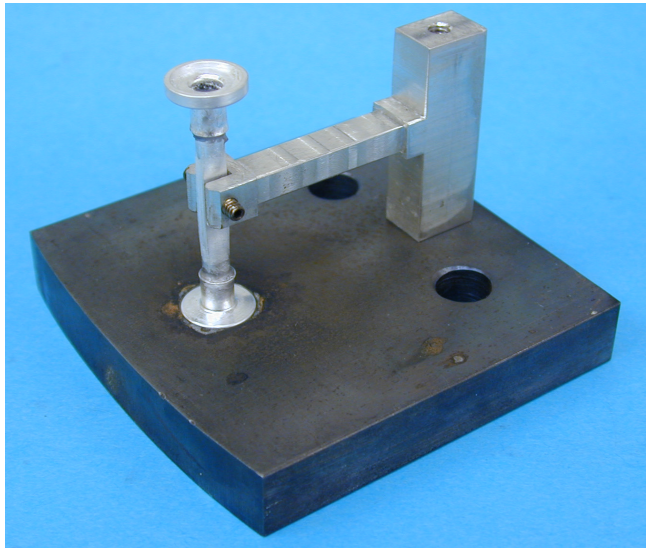
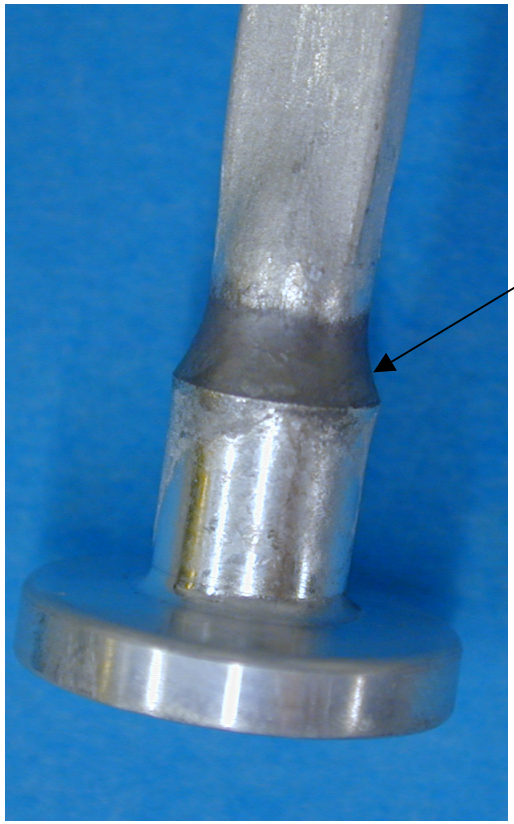
Joining Methods – Brazing

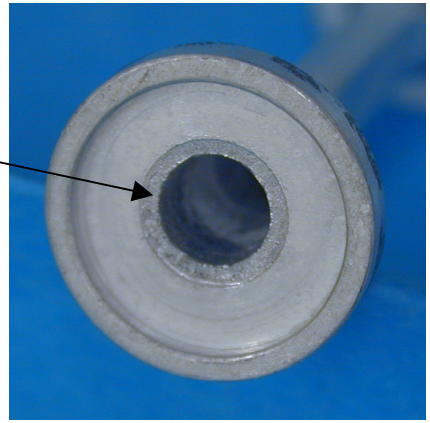


**Fixture Holds tube upright,
Sets fitting position**



**Large,
Uniform
fillet**

**Wetting
Appears
Good in
Many cases**



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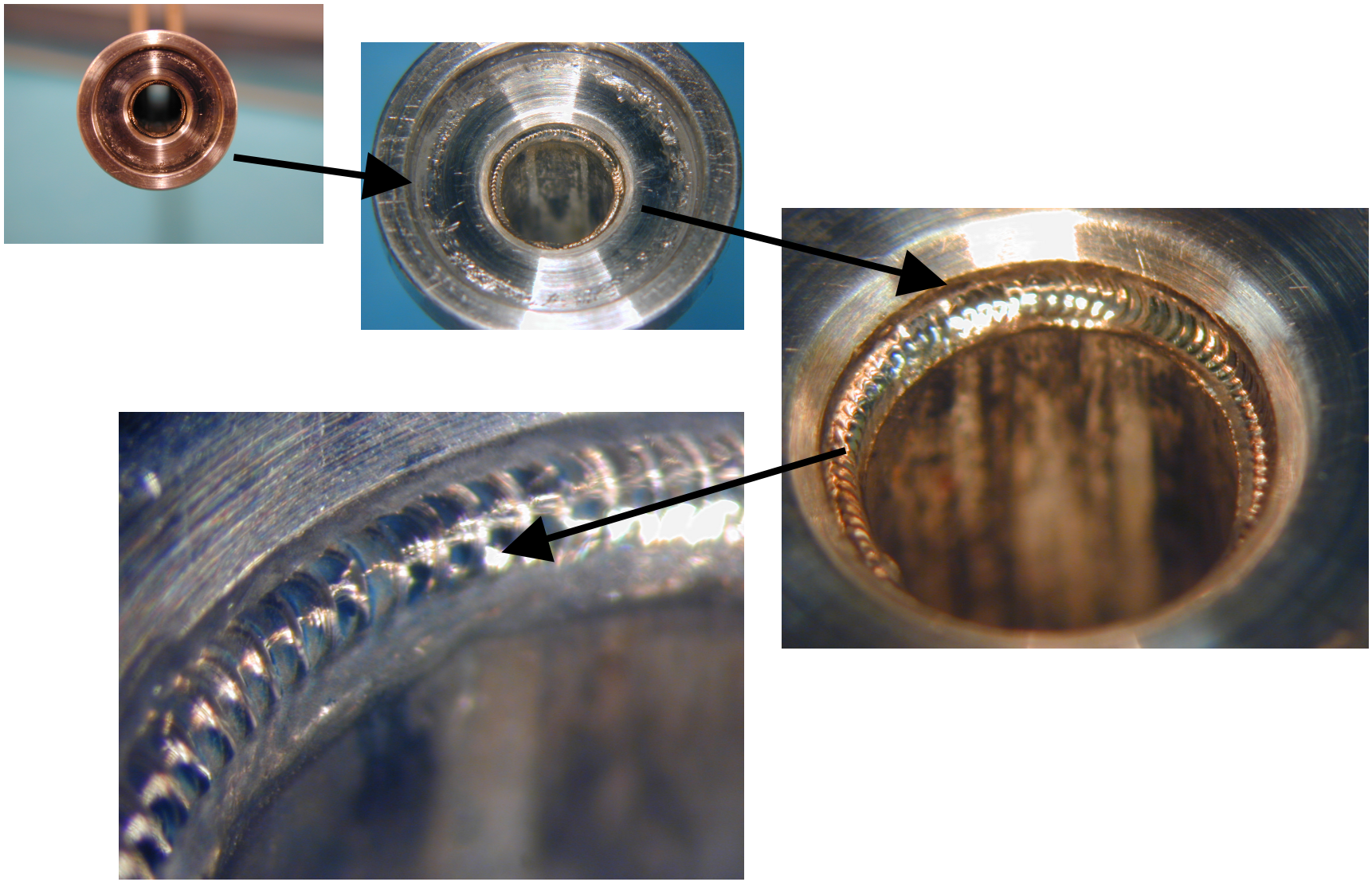
Joining Methods – Laser Welding



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Recent Joining Tests

- **Brazing**
  - Fixture made to braze “dumbbell” tubes
    - Holds tube upright to eliminate bending at temperature
    - Almost no tube deformation seen during brazing process
    - 4 samples fabricated – not yet leak checked
- **Gluing**
  - 4 Glue samples fabricated
    - All samples leak checked at < 1e-10 Torr-L/sec
    - Samples currently undergoing irradiation
- **Laser Welding**
  - 1 sample fabricated at eb industries in Massachusetts
    - Weld penetration approximately 2 times wall thickness
    - Leak checked to < 1e-10 Torr-L/sec
  - Four more “dumbbell” samples currently being made

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Future Plans

- **Finish testing regimen**
  - Variseals and metal seals to finish testing sequence
  - Glued, brazed, and laser welded samples to undergo similar sequence of tests
- **Decision to be made within coming weeks**