Cooling Connections Status Report

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Current Status

- **New Leak Rate Requirements as of last meeting**
  - Newest testing regimen agreed upon
  - Based on rough system pressure calculations
- **Luer Locks**
  - Initial Al/AL fittings fully tested
  - Initial Al/PEEK fittings fully tested (electrical breaks)
- **Laser Welding**
  - Current problems
  - Material Testing
  - Possible Solution
- **Gluing**
  - All current Luers were glued
  - Some may have had glue failures – these are being investigated
- **Fitting Comparisons**
  - Mass and size
- **Other work**

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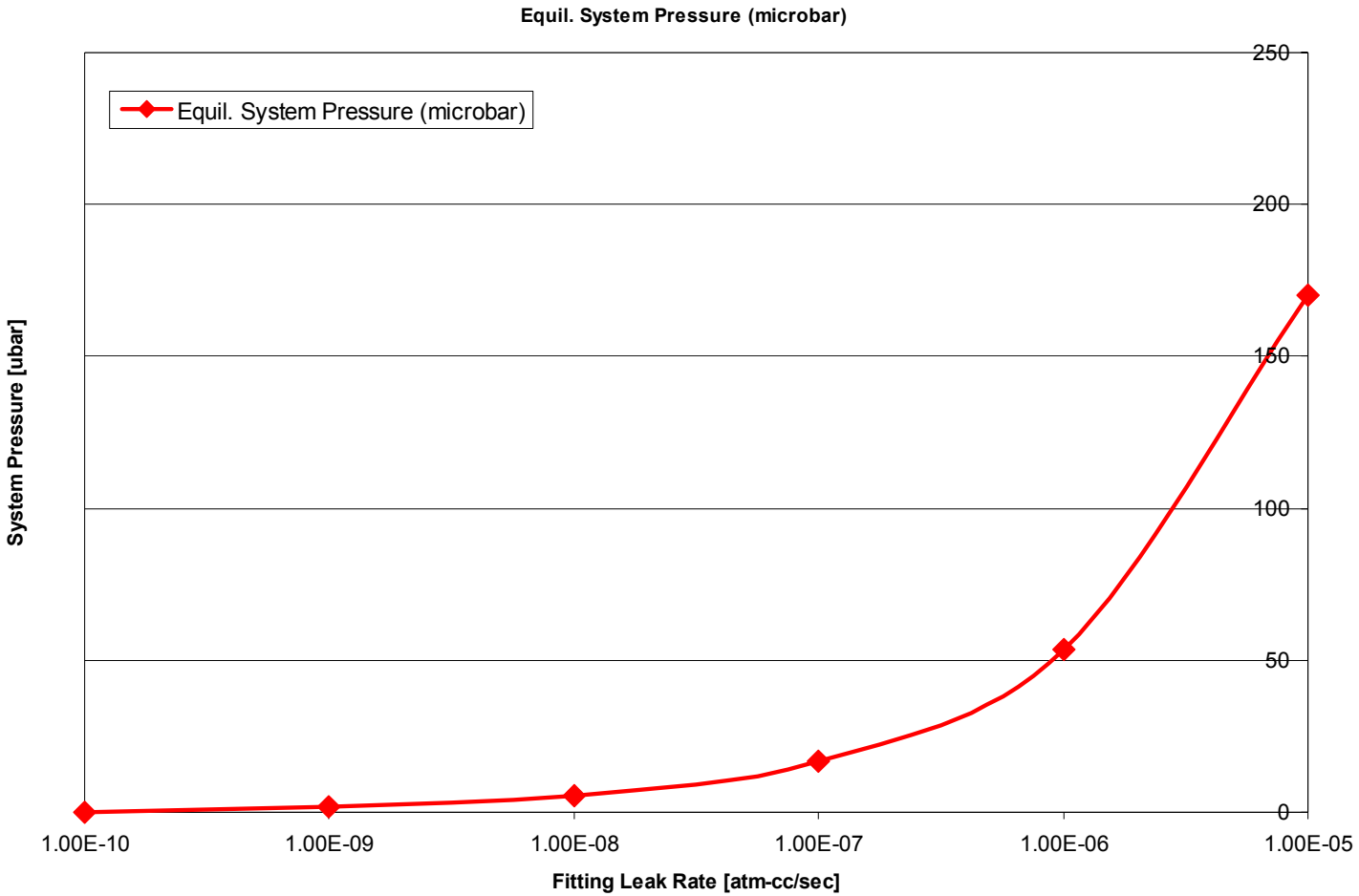
Common Testing Regimen
(stave and sector and all type 0/1 tubes)

- **He vacuum leak check (quanitative)**
- **10 bar proof test (visual, assure that fitting doesn't mechanically explode, no more than 1 minute)**
- **4 bar He pressurized leak check at 0 Celsius (quanitative)**
- **1 bar He pressurized leak check at -35 Celsius (quanitative)**
- **He vacuum leak check (quanitative)**
- **Thermally cycle fitting assembly 50 times (20 to -35 C)**
- **Pressure cycle fitting assembly 50 times (1 to 4 bar)**
- **Repeat tests 1,3,4,5 (all quanitative, in that order)**

Rough System Pressure Calculations

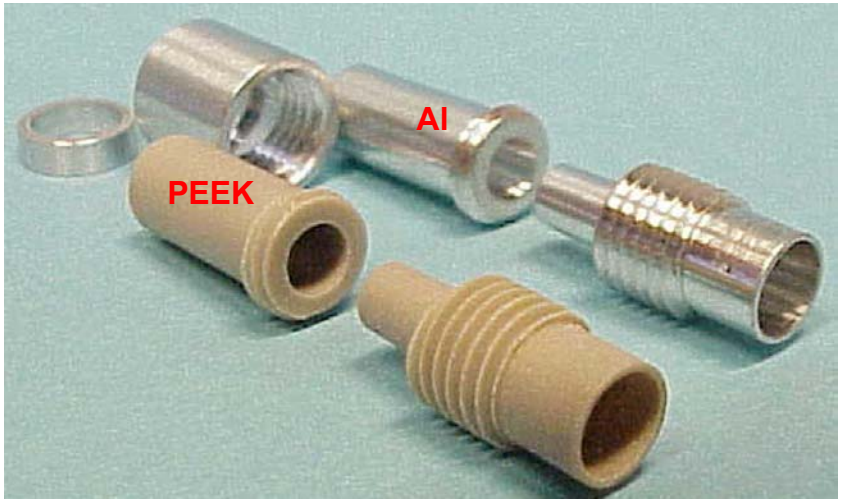


Based on conductance calcs assuming all fittings leak at same rate, and that Allowed system pressure on introduction Of c3f8 is 200 microbar. Assumes 10 Sets of fittings per circuit (all the way to cooling plant).

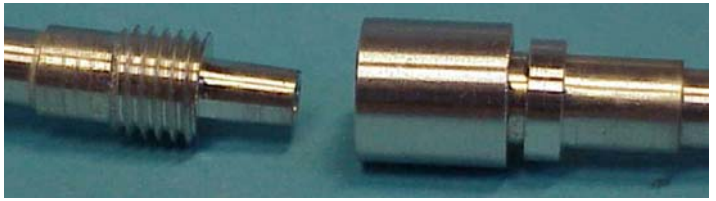
Newest Leak Specifications

- **Permanent connections – welds**
  - 1x10-7 atm-cc/sec
- **Leak Rates at 1 bar**
  - 3e-5 atm-cc/sec
- **Leak Rates at 4 bar**
  - 1e-4 atm-cc/sec

Fitting Test Specimens – Luer Lock Type



Luer Lock Pieces (PEEK and Aluminum).



Assembled Fitting.

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Luer Lock Results

TEST RESULTS - NEW LEAK SPECs as of JULY 2001 (Spec shown for each test Category) - INDICATE Pass/Fail for each test.
All pressures are in absolute units, and all temperatures are Celsius. All Leak rates in Torr-L/sec (TL/sec). 1 Torr-L/sec = 1.3 atm-cc/sec.

TEST FITTING	TEST CATEGORY (TESTS ARE SEQUENTIAL LEFT TO RIGHT)											
	1 >	2 >		3 >	4 >	5 >	6 >	7 >	8 >	9 >	10 >	11 >
	He VAC (2e-5 TL/sec)	10 Bar Proof (1 min. visual)	MEGA RAD?	4 bar/0 C (7e-5 TL/sec)	1 bar/-35 C (2e-5 TL/sec)	He VAC (2e-5 TL/sec)	Therm Cycles (50 X -35/20 C)	Press. Cycles (50 X 1/4 bar)	He VAC (2e-5 TL/sec)	4 bar/0 C (7e-5 TL/sec)	1 bar/-35 C (2e-5 TL/sec)	He VAC (2e-5 TL/sec)
Luer Lock (Al/PEEK)												
2	1/7			A	A	A	A	A	A	A	A	A
3	3/9			A	BREAK							
4	2/8			3/6	3/6	2/6			2/6	4/7	7/7	2/6
5	9/9		N/A	1/8	3/7	3/9			3/9	8/9	2/6	4/9
6	1/8		N/A	2/7	3/8	6/9			6/9	A	A	A
7	1/8		N/A	9/6	2/9	5/9			5/9	A	5/7	2/8
Luer Lock (Al/Al)												
AA#2	2/10		N/A	4/9	9/10	1/9			1/9	4/9	4/7	1/8
AB#1	6/10		N/A	2/8	3/9	1/9			1/9	1/8	5/7	1/8
AC#3	7/10		N/A	1/8	3/9	A			A	A	A	3/7
AD	8/10		N/A	2/9	2/9	1/9			1/9	1/8	6/7	3/10

NOTES:	
	Passes test at prescribed leak spec.
A	Leak greater than 1x10-5 Atm-cc/sec. May be larger, but could not be measured with the available equipment.
X/Y	Leak rate given in shorthand form - X/Y = leak of Xx10-Y atm-cc/sec.

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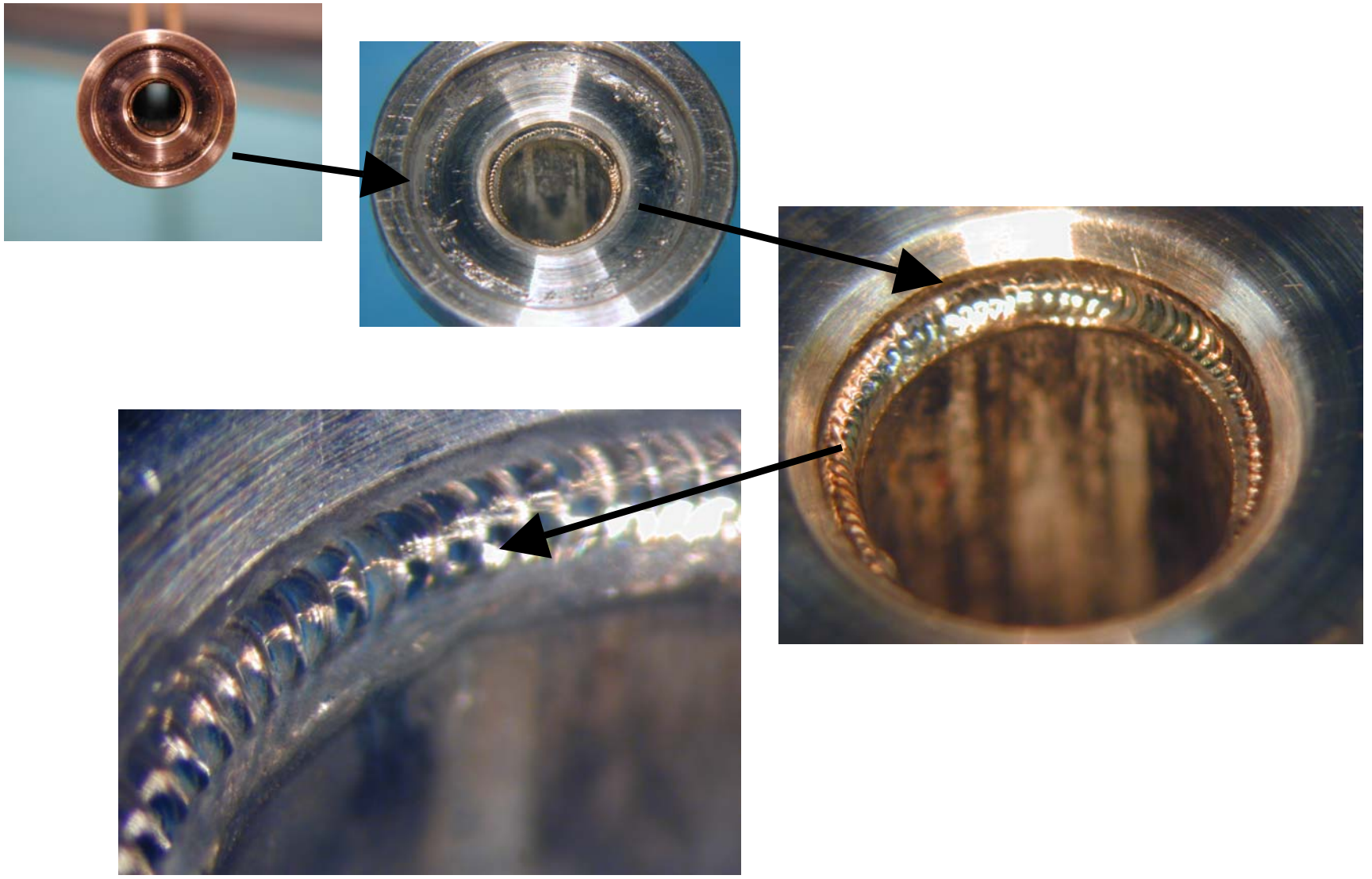
Joining Methods – Laser Welding



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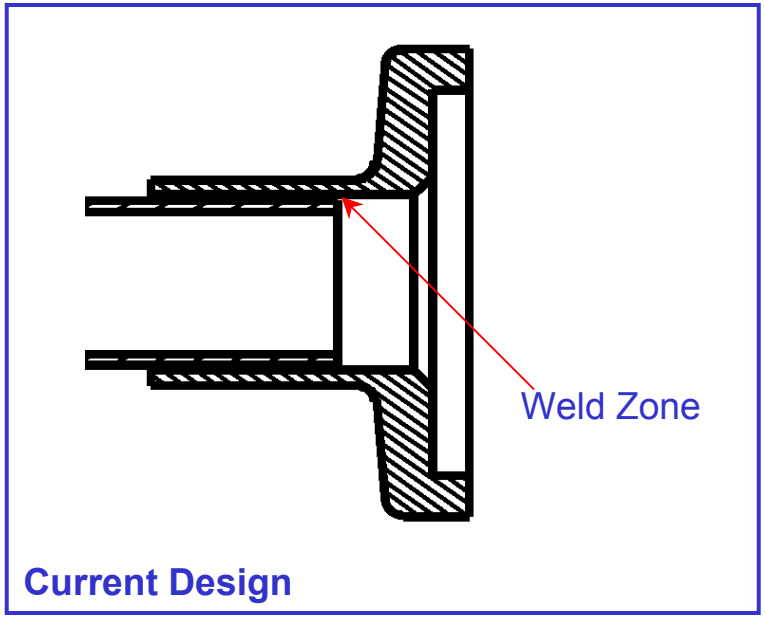
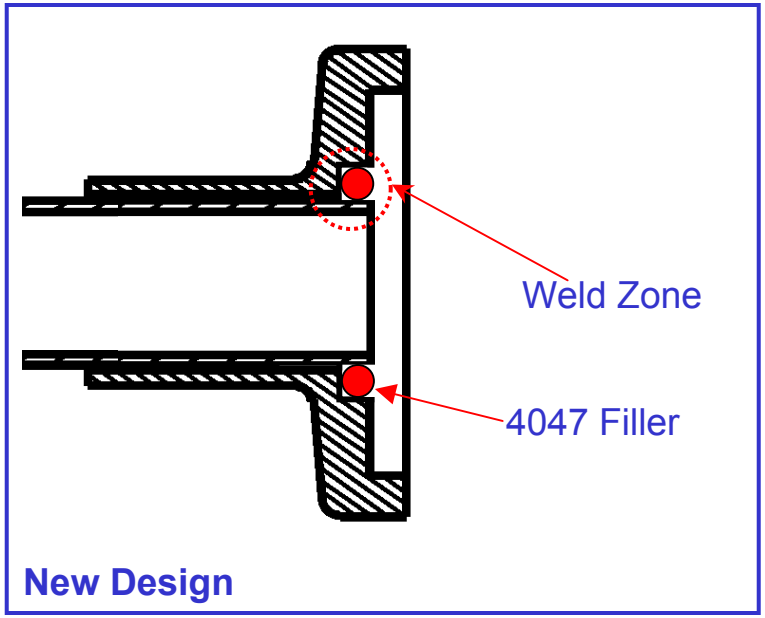
Laser Welding Problems

- **Tube Material – Batch 1**
  - Reported as 3003 AL
  - Laser Welding very Successful
  - Later found to be 1060 AL (almost commercially pure)
- **Tube Material – Batch 2**
  - Ordered 3003 AL – different vendor
  - Tested as 3003 AL
  - Will not laser weld (microcracks on cooldown)
- **Tube Material – Batch 3**
  - Ordered 3003 AL
  - Material is now being tested (same vendor as batch 1)
  - Laser welding is on hold pending test results

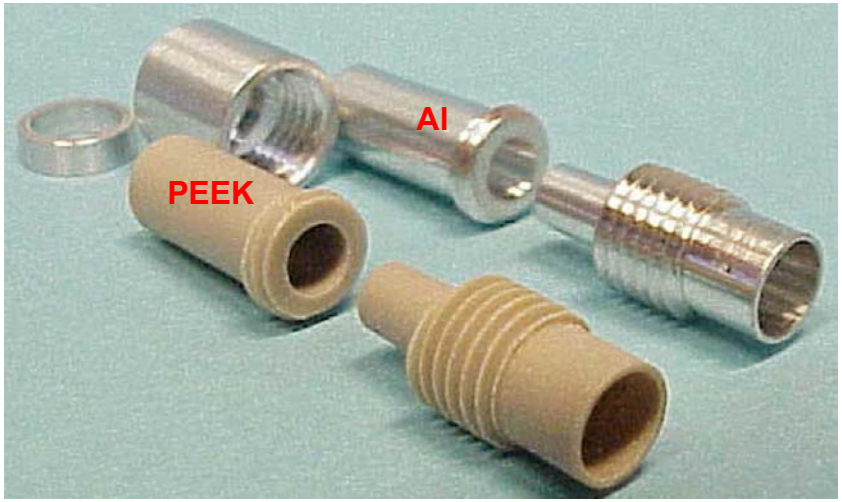
Possible Laser Weld Solution

- **Additional Weld material**
  - Add 4047 Al Ring to joint
  - Material can weld to both 3003 and 6063 (fitting)
  - Provides buffer between two incompatible alloys

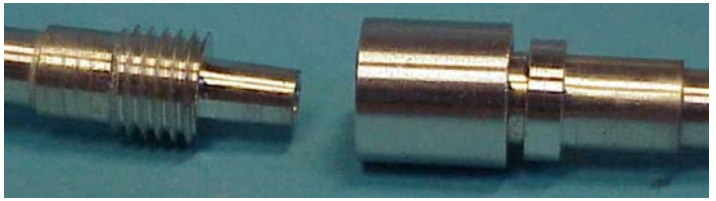




Fitting Test Specimens – Luer Lock Type

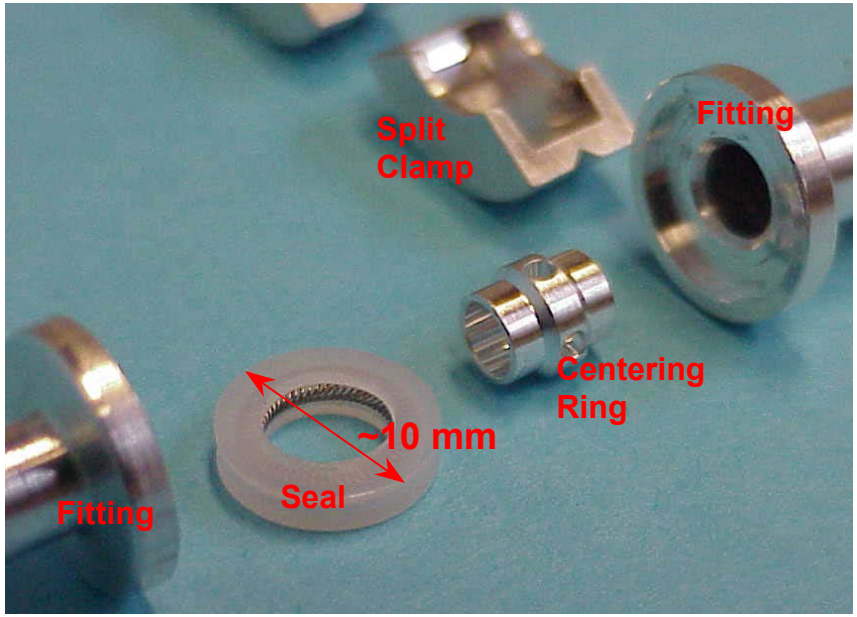


Luer Lock Pieces (PEEK and Aluminum).



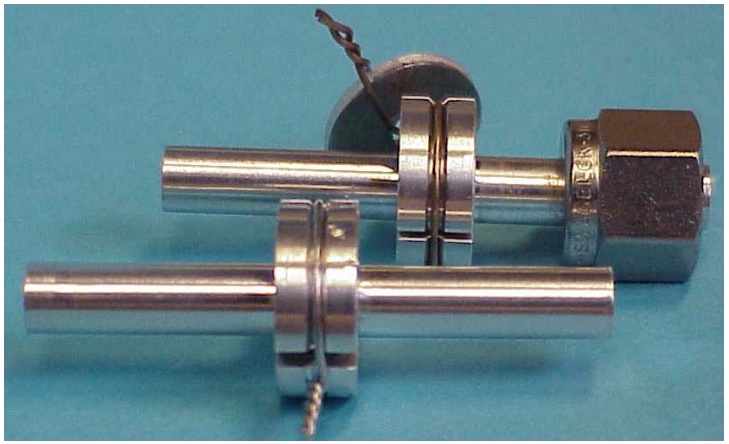
Assembled Fitting.

Fitting Test Specimens – Variseal Type



Fitting Pieces shown disassembled.

Assembled Fitting (one shown with Swage lock connector).



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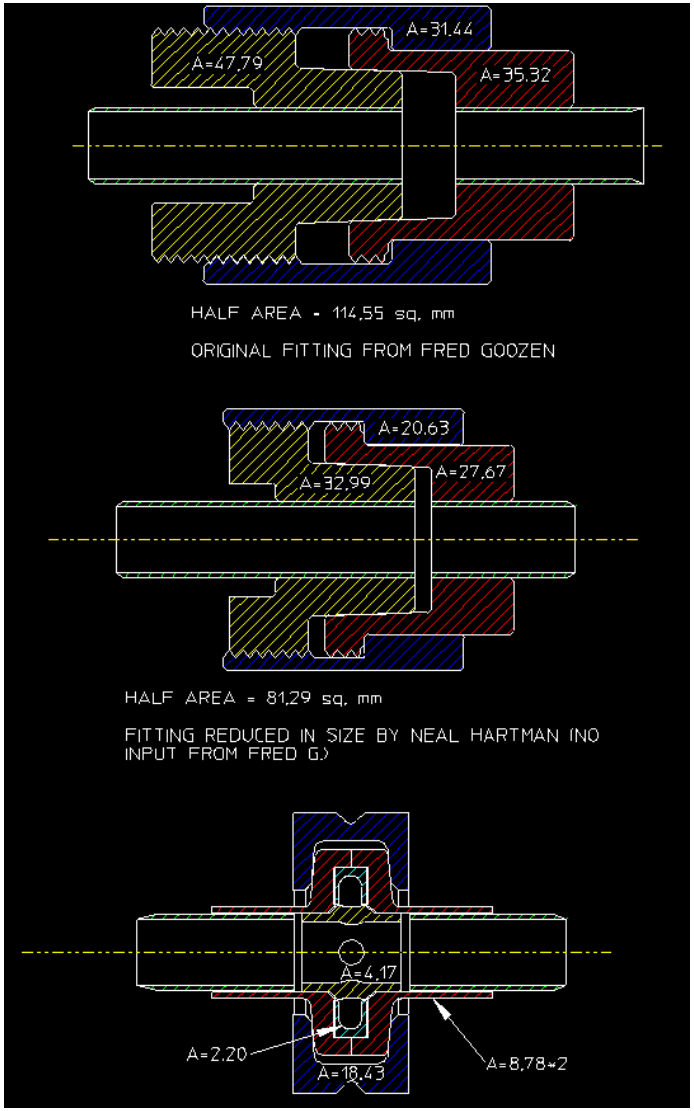
Fitting Comparisons



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Fitting Comparisons

Fitting Comparisons					
Fitting Type	**Metal X-Area**	**Plastic X-Area**	**Max Dia.**	**L at Max Dia.**	**Max. Length**
Luer Lock (All Metal) - Baseline	114.55	0	16.79	17.36	25.53
Luer Lock (All Metal) - MMC*	81.29	0	15.79	14.54	17.61
Luer Lock (Al/PEEK) - Baseline	79.23	35.32	16.79	17.36	25.53
Luer Lock (Al/PEEK) - MMC*	53.62	27.67	15.79	14.54	17.61
Variseal (w/ centering ring)	40.16	2.2	16.97	7	17
Variseal (w/o centering ring)	35.99	2.2	16.97	7	17

Fitting	T metal/fitting	T Plastic/fitting	% X0/fitting	# fittings	%X0
Luer Lock (All Metal) - Baseline	6.00E-05	0.00E+00	0.08%	75	5.63%
Luer Lock (All Metal) - MMC*	4.26E-05	0.00E+00	0.05%	75	3.99%
Luer Lock (Al/PEEK) - Baseline	4.15E-05	1.85E-05	0.06%	75	4.39%
Luer Lock (Al/PEEK) - MMC*	2.81E-05	1.45E-05	0.04%	75	3.02%
Variseal (w/ centering ring)	2.39E-05	9.43E-07	0.03%	75	2.27%
Variseal (w/o centering ring)	2.14E-05	9.43E-07	0.03%	75	2.03%

Fitting Volume Smeared over hoop at radius 210 mm, 50 mm long

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Other Work

Type 0 and type 1 potential tubing has been received

- Marco has proposed two tubing sizes – 4 and 8 mm ID
- Standard U.S. Sized tubing fits this with 350 and 400 micron wall thicknesses

PP1 layout is being made

Standard fittings being investigated

Bellows design will be made soon

Variseal tests with new test sequence are about to begin

- may be attractive solution in order to lower mass
- performance is on par with new leak rate numbers