COOLING CONNECTIONS STATUS REPORT:
LBNL EFFORT

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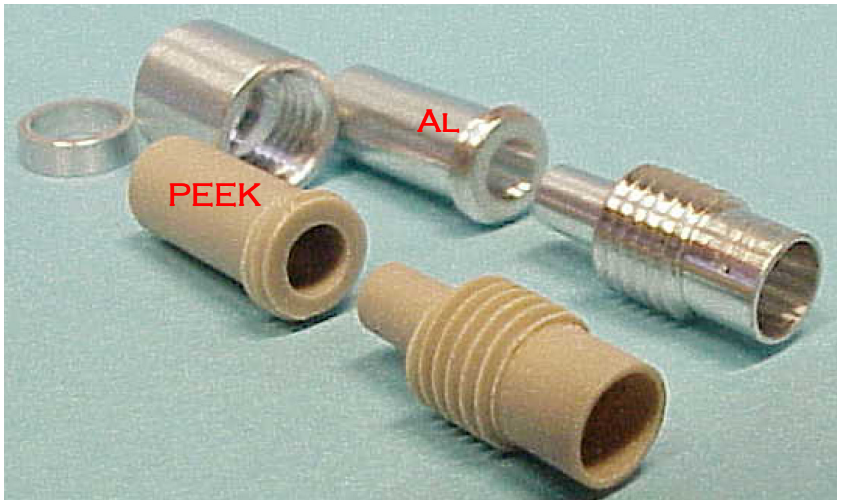
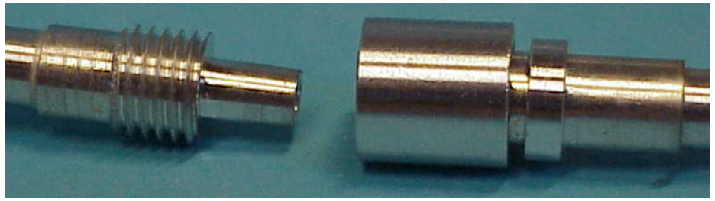
Current Status

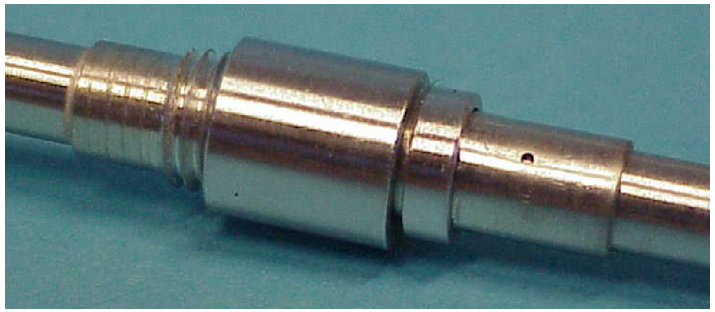
- **Luer Lock leak tests**
  - Initial Al/Al fittings fully Qualified
- **Luer lock demating tests**
  - Al/Al luer locks have not shown binding under even very conservative test conditions
- **Laser Welding**
  - Material problems solved (for 3003 and 1060)
  - Have successfully welded sector tube with variseal fittings
  - Must do more tests for higher confidence
- **Other tubing sizes**
  - 4 mm, 8 mm, and Capillary tubing have all been obtained in aluminum for testing
- **Fitting Comparisons**
  - Lower Mass fittings have been designed and await fabrication
  - Both Luer lock and indium, for sector size, in al

Fitting Test Specimens – Baseline Luer Lock



Luer Lock Pieces (PEEK and Aluminum).





Assembled Fitting.

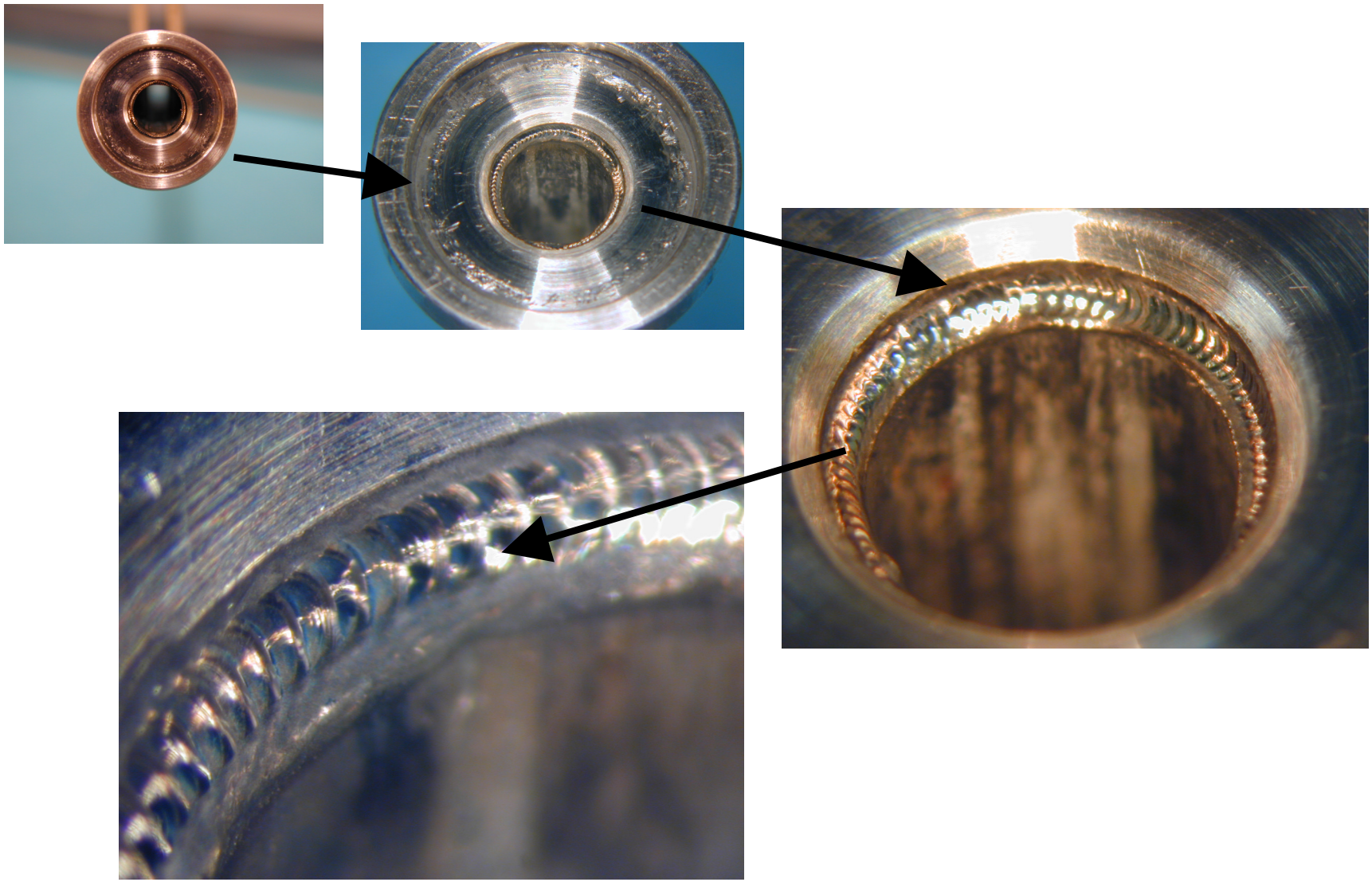
LUER LOCK RESULTS

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
Luer Lock (Al/Al) -		*After 15 mate/demate cycles, submersion in C3F8 for one week, and exposure (while submerged) to 50 Mrad*											
	AA#2	BREAK											
	AB#1	5/10		50	3/6	1/6	5/8	END TEST					
	AD	1/10		50	3/10	2/10	1/10						

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.

Joining Methods – Laser Welding

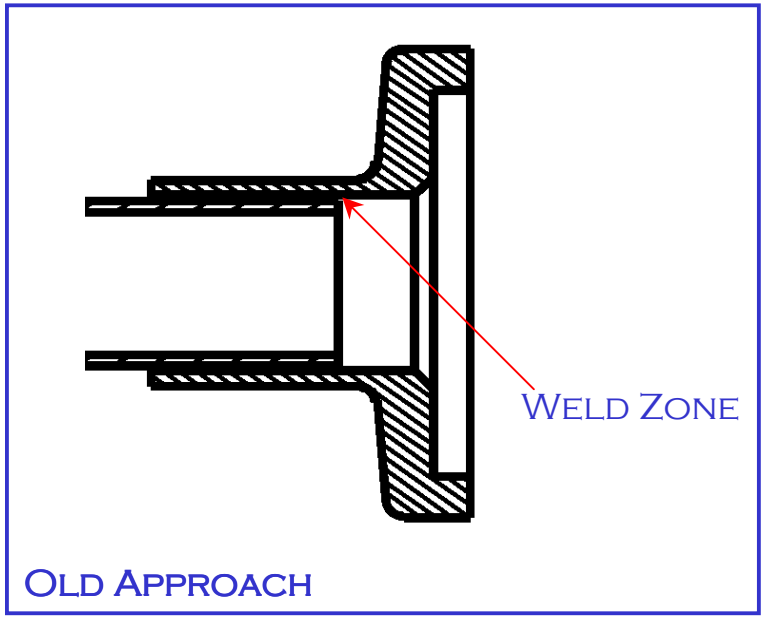


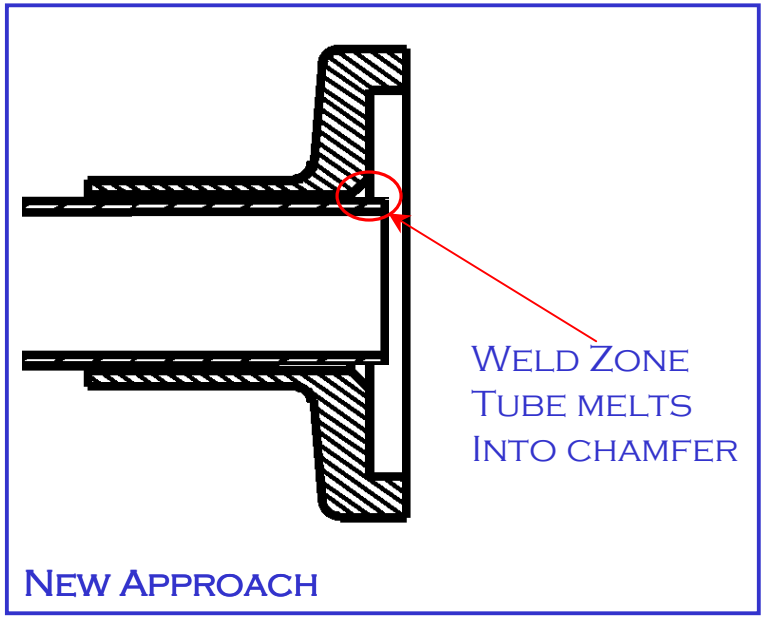
Laser Welding Problems

- **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
  - Would not laser weld (microcracks on cooldown)
- **Tube Material – Batch 3**
  - Ordered 3003 Al
  - Material is 1060 Al
  - Vendor's source is unreliable, and this will not change

Laser Weld Solution

- **Configure joint to favor tube material**
  - Tube material (whether 3003 or 1060) typically has less alloying elements than 6061
  - Joint configuration (raising tube) alloys tube to be preferentially melted, increasing its concentration in melt zone
  - This creates a less alloyed weld region, which is less brittle
  - Successfully demonstrated





Fitting Comparisons - Mass

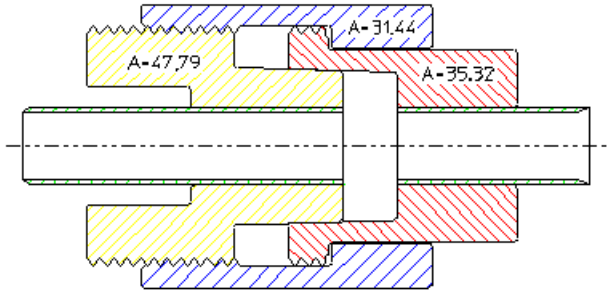
Fitting	Metal X-Area	T Al/fitting	T Plastic/fitting	T Ni,In,Cu/Fitting	% X0/fitting	# fittings	%X0
Luer Lock (Al) - Baseline	115	6.0E-05	0.0E+00	0.0E+00	0.08%	75	5.63%
Variseal (w/ centering ring)	40	2.4E-05	9.4E-07	0.0E+00	0.03%	75	2.27%
Variseal (w/o centering ring)	36	2.1E-05	9.4E-07	0.0E+00	0.03%	75	2.03%
Indium Fitting (Stave Size - CuNi)^	13	0.0E+00	0.0E+00	4.7E-06	0.02%	75	1.75%
Reduced Mass Luer Lock	41	1.6E-05	0.0E+00	0.0E+00	0.02%	75	1.51%
Indium Fitting (Sector Size - Al)*	36	1.3E-05	0.0E+00	3.1E-07	0.02%	75	1.32%

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

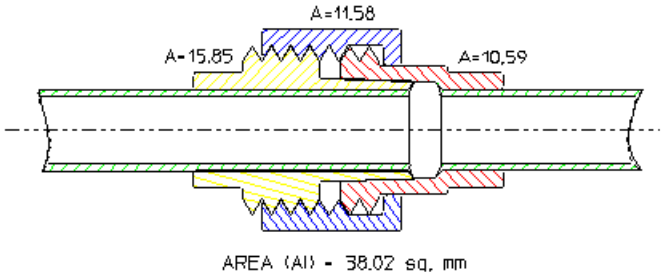
- **Reduced Mass Luer and Sector Size Indium Fittings**
  - Designs completed but not yet fabricated
  - Fittings designed with features for laser welding
  - Expect delivery of parts in mid-January
  - Laser welding and testing to be done in February

Pixel Detector

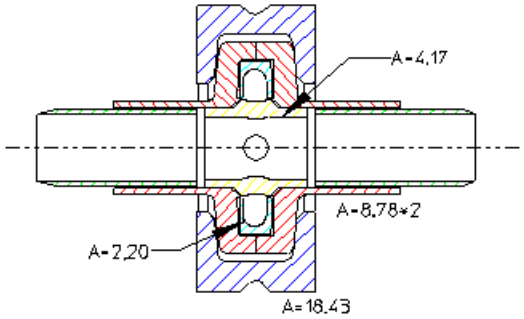
Fitting X-section Comparisons



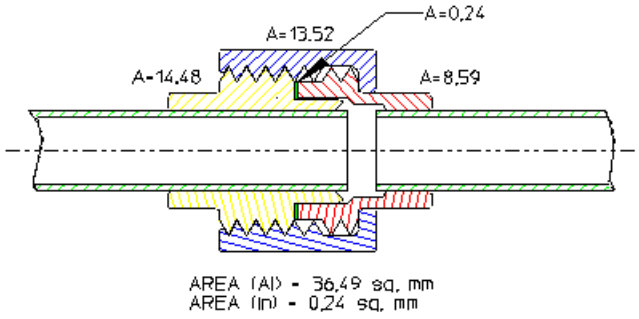
Current Luer Design



New Luer Design



Old Variseal Design



Sector Indium Design

Upcoming Work

- **Reduced mass luer and indium fittings**
  - Testing to be done in February (as mentioned earlier)
- **Capillary testing**
  - Robustness tests
    - Bend/unbend repetitions
    - Pressure/leak testing (with swage lock connectors)
  - Laser Welding tests
    - Made in low mass luer or indium fittings
- **Full system prototype**
  - Complete cooling circuit prototype from pp1 to sector
  - All "real" fittings – all laser welded (including 4/8 mm tubes)
  - Completed sometime before next summer
  - Plans to test in marseille with evaporative cooling plant