COOLING CONNECTIONS STATUS REPORT:
SECTOR FITTINGS

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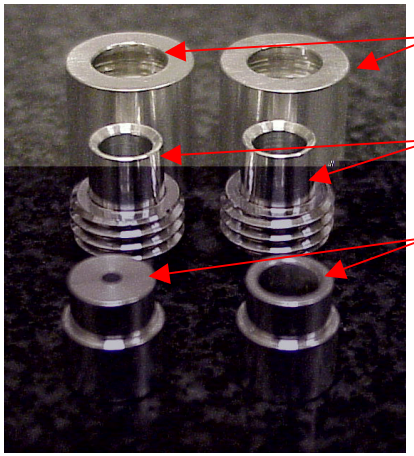
Current Status

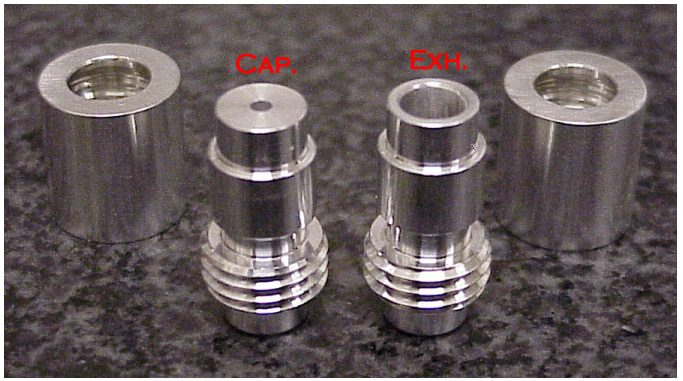
- **Fittings – as of last pixel week**
  - Fitting cross sections optimized for low mass
  - Indium and Luer Lock variants machined
  - Sector, exhaust, and capillary size fittings created
- **Laser welding**
  - New fittings could not be laser welded
  - Problem was traced to fitting material type
    - Original material was AL6063
      - Lower silicon, lower magnesium
      - Originally considered less important than choice of tubing material
    - New fittings were made in AL6061
      - More readily available
      - Alloys were considered similar enough to use interchangeably
  - A smaller set of new fittings were re-made in 6063
    - These were welded successfully (as originally demonstrated)
- **Testing**
  - While laser welding problems were occurring, new fittings were glued and tested for verification regimen
  - Indium fittings could not be made to seal, and were dismissed
  - Luer fittings tested successfully
    - Initially 7 of 10 fittings passed, but were low on torque
    - After tightening (wrench was modified) 5 of 5 passed with no problems

Pixel Detector

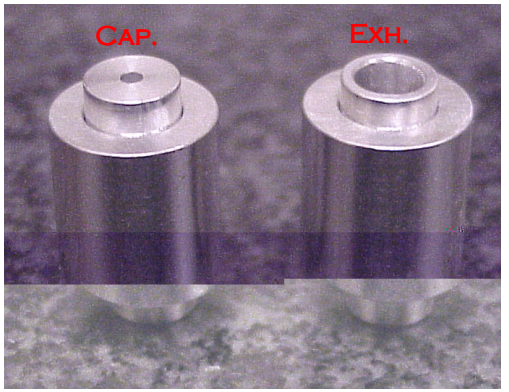
"Reduced-Mass" Luer Fittings



Nut, Male, Female Fitting Pieces



Male and Female Pieces Assembled



In/Out Side - Assembled

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%

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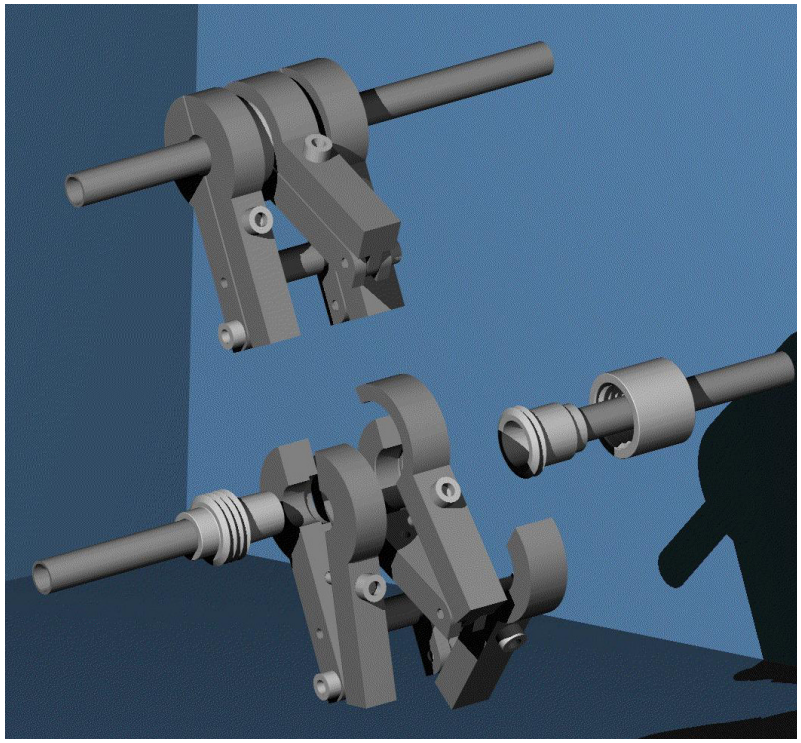
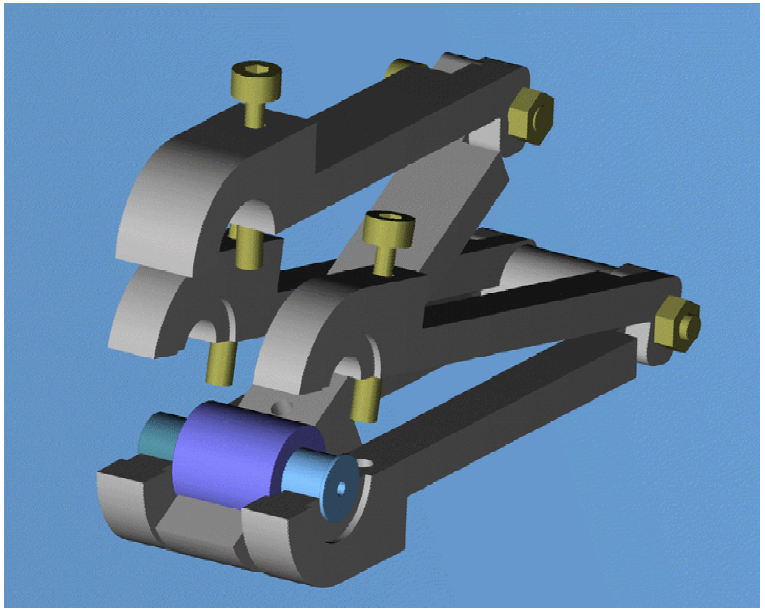
Fitting Wrench



Old Wrench

- Prevents differentially torquing the two joining tubes
- Provides for assembly as well as disassembly
- Had to be modified for higher torque (larger screws and longer arm)



New Wrench

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Latest Test Results

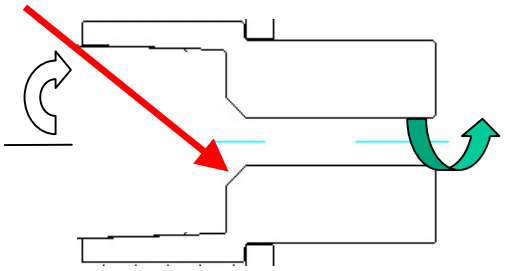
TEST RESULTS - NEW LEAK SPECs as of JULY 2001 (Spec shown for each test Category) - INDICATE Pass/Fail for each test.
All pressures are in absolute units, and all temperatures are Celsius. All Leak rates in Torr-L/sec (TL/sec). 1 Torr-L/sec = 1.3 atm-cc/sec.

TEST FITTING	TEST CATEGORY (TESTS ARE SEQUENTIAL LEFT TO RIGHT)										
	1 >	2 >		3 >	4 >	5 >	6 >	7 >	8 >	9 >	10 >
	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)
LuerLok Al/Al ver 2											
							~60 cycles	125 #		60#	
1	2.8E-10	pass	N/A	5 E-10	3 E-8	<1.2 E-10	done	done	4.2 E-10	1 E-8	3 E-8
2	2.6 E-10	pass	N/A		4 E-10	<1.2 E-10	done	done	4 E-10	8.2 E-9	3 E-10
3	1.3E-10	pass	N/A			<1.2 E-10	done	done	4 E-10		
4	2.4 E-10	pass	N/A	1 E-9	3 E-10	<1.2 E-10	done	done	4 E-10	9 E-10	8 E-10
5	2.0 E-10	pass	N/A			<1.2 E-10	done	done	4 E-10		
6	2.5 E-10	pass	N/A	2 E-9	4 E-10	<1.2 E-10	done	done	3.5 E-10	5 E-10	1.5 E-9
7	1.4 E-10	pass	N/A	6 E-9	2 E-8	< 1.2 E- 10	done	done	3 E-10	4 E-9	5 E-10
8	1.4 E-10	pass	N/A	1 E-9	1 E-9	2 E-10	done	done	8 E-10	1 E-9	3 E-10
9	2.4 E-10	pass	N/A	2 E-9	2 E-9	5 E-10	done	done	7.5 E-10	9 E-10	3 E-10
10	2.4 E-10	pass	N/A	1 E-9	1.4 E-9	2 E-9	done	done	7 E-10	4.6 E-10	4 E-10
trial #2 A	June 4 02			second		trial		after		retorque	
							~ 50 cycles	145 #		60 # 0C	60 # -35C
2	1 E-10	pass	N/A	8 E-9	8 E-9	2 E-9	done	done	1 E -10	1.2 E-10	1.0 E-10
3	1 E-10	pass	N/A	5 E-9	6 E-10	3 E-10	done	done	1 E-10	2.4 E-10	3.5 E -10*
5	1.5 E-10	pass	N/A	3.9 E-9	2.5 E-10	4 E-9	done	done	1 E -10	2.0 E -10	2.2 E-10
7	1.6 E-10	pass	N/A	2.4 E-9	2.5 E-9	1.6 E-10	done	done	1.2 E-10	1.6 E-10	2 E-10
9	1 E-10	pass	N/A	3.9 E-9	2 E-10	1.6 E-10	done	done	1.1 E-10	1.5 E-10	2 E-10
NOTES:		Passes test at prescribed leak spec.									
		Leak greater than 1x10-5 Atm-cc/sec. May be larger, but could not be measured with the available equipment.									

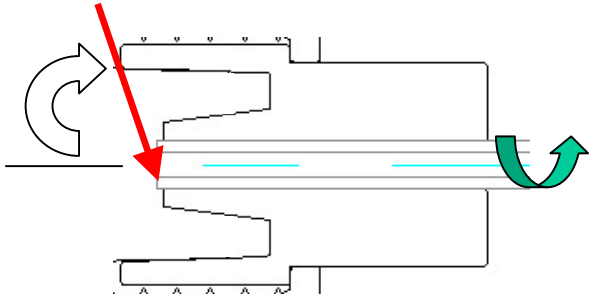
Initial set of fittings included 10 samples. After three partial failures, the three failed Fittings and two additional ones were disassembled, cleaned, and reassembled with a Higher torque setting (using a modified wrench). This reduced set of five fittings passed With no failures.

Laser Welding – where we are now

- **Sector weld appears ready to go**
  - Yield is not as high as would like (~80%) but we are prepared to make tubes now
  - Carrier is ready (next slide)
  - Have sector fittings in hand (though further refinements may be made)
    - May be lengthened very slightly for increased wrench clamping area
- **Welding of capillary tubing has been demonstrated on dummy fittings**
  - Materials and size are weldable (yield similar to sector fittings)
  - Concerns exist about ability to weld to real capillary fittings
    - Weld angle is lower for real fitting
    - Laser pulse may distort sealing surface
    - May need special capillary fitting design



Current Fitting – low angle



Proposed – high angle

- **Further verifications of laser weld must be completed**
  - In some cases special fittings are needed – these must be prototyped at some point
  - Female fittings must be tested after welding to assure no degradation in sealing quality
    - Laser pulse can impinge on seal surface
    - Only male fittings have been tested after welding

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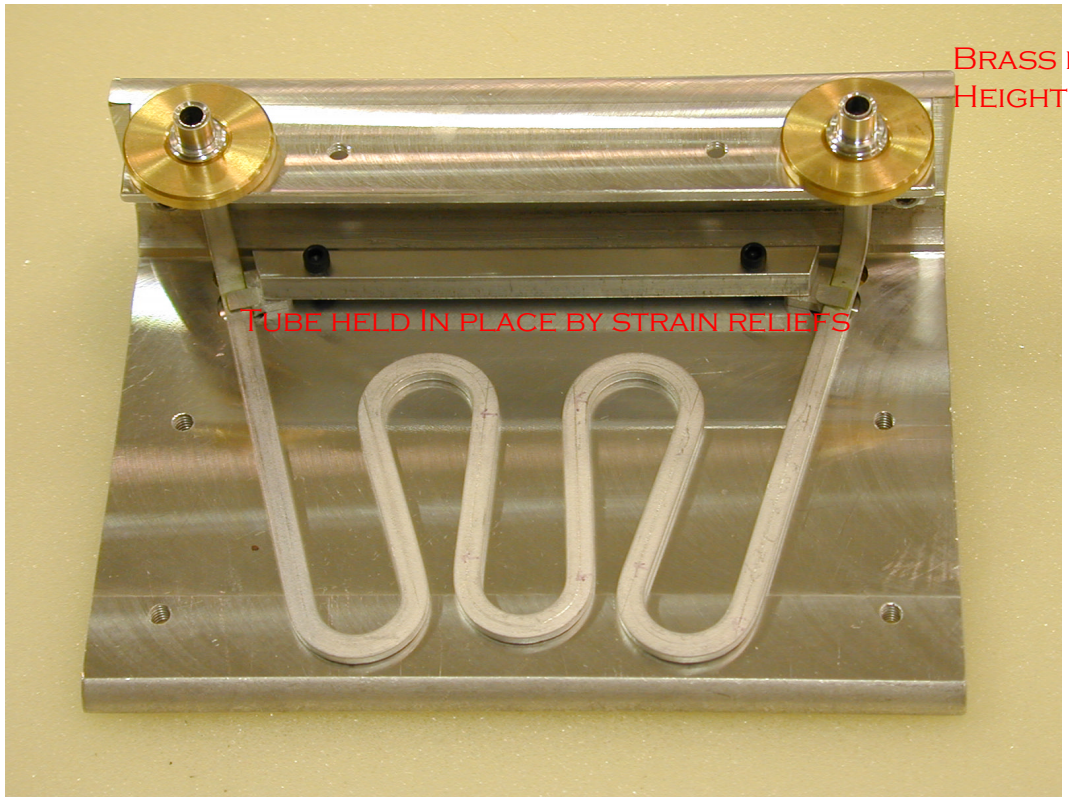
Sector Carriers

- **Carrier holds sector tube while in transit and during welding**
  - Locates fittings relative to tube
  - Protects tube during handling
- **Carriers have been tested and modified as suggested by welder**
  - Ready to weld pre-production sectors



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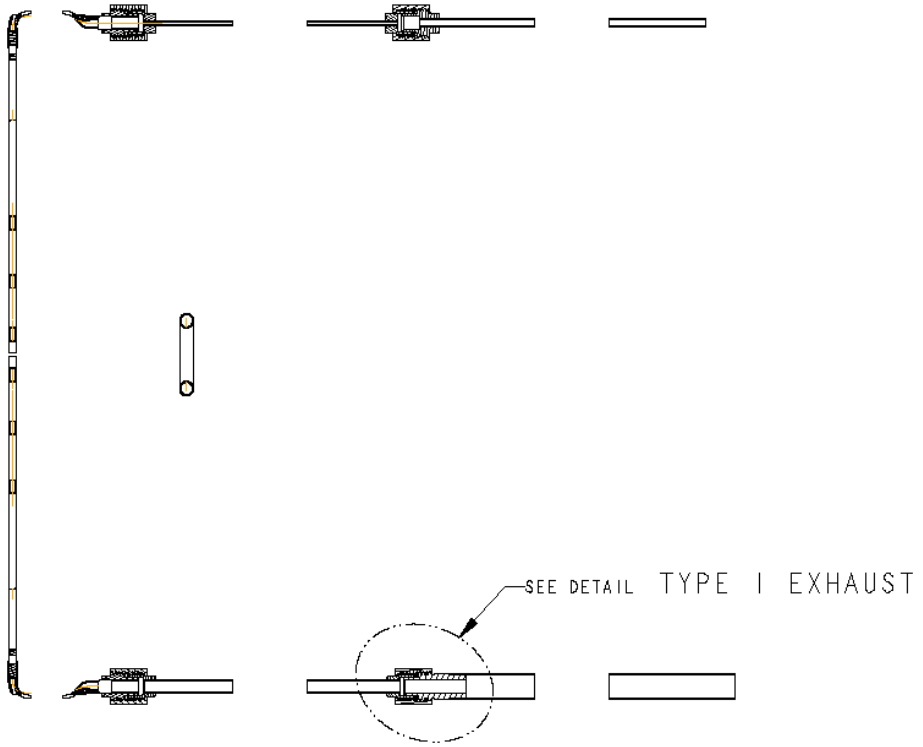
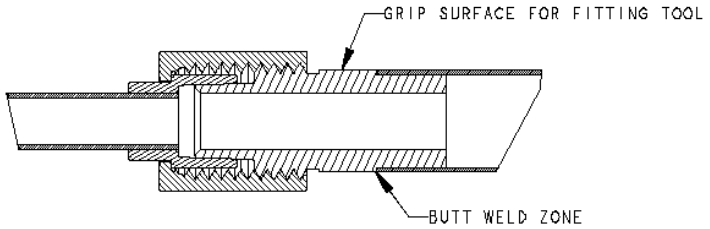
Cooling Circuit



Must Prototype
This junction or
Develop alternate
Connection type



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Plans

- **Fittings**
  - Currently refining fitting dimensions (length)
  - Will make prototypes of all fittings shortly
    - Includes new capillary type
    - Does not include special exhaust junction (previous slide) at the moment
    - All from 6063 (raw material tested for element composition before machining)
- **Laser welding**
  - Will weld sectors and u-tubes with "real" fittings (~10 each) when fittings become available
  - Will weld other tube junctions as well
    - Inlet tubes (current design)
    - Capillary tubes (new design)
    - Exhaust tubes may wait for testing results of the above
- **Testing**
  - 10 sectors will be tested with same regimen as current fittings (which are glued)
    - Will assess effect of laser weld on sealing capability
    - Will test more than the required 10 fittings for validation (only a set of 5 has passed so far)
  - Welded Capillary and inlets will be tested as well
  - Capillary tubing to be sent to Marseille for pressure drop testing