Title: Low Cost PDV fiber optic vessel feed through study.

PDV Workshop
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LANL, WX-4

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Outline

- Goals
- Cost of parts and assembly for a 9 channel feed-thru.
- Reference documentation and equivalent HE load.
- Describe certification test shot.
- What criteria does a feed through have to meet to pass.
- Review test shot data.
- Present some work on higher channel count feed-thru.
- Summary

Goals

- To build and test a low cost 9 channel fiber optic feed through. This feed-thru should use as many off the shelf parts as possible and be easy to assemble.
- Certify that the new feed-thru is good, by conducting proof shots using the Small Experiment Containment Vessel (SECV).
- Look at the possibility of using the same design to build a higher channel count feed-thru.

Parts for a 9 channel Feed thru cost $620.

Modified vacuum fittings

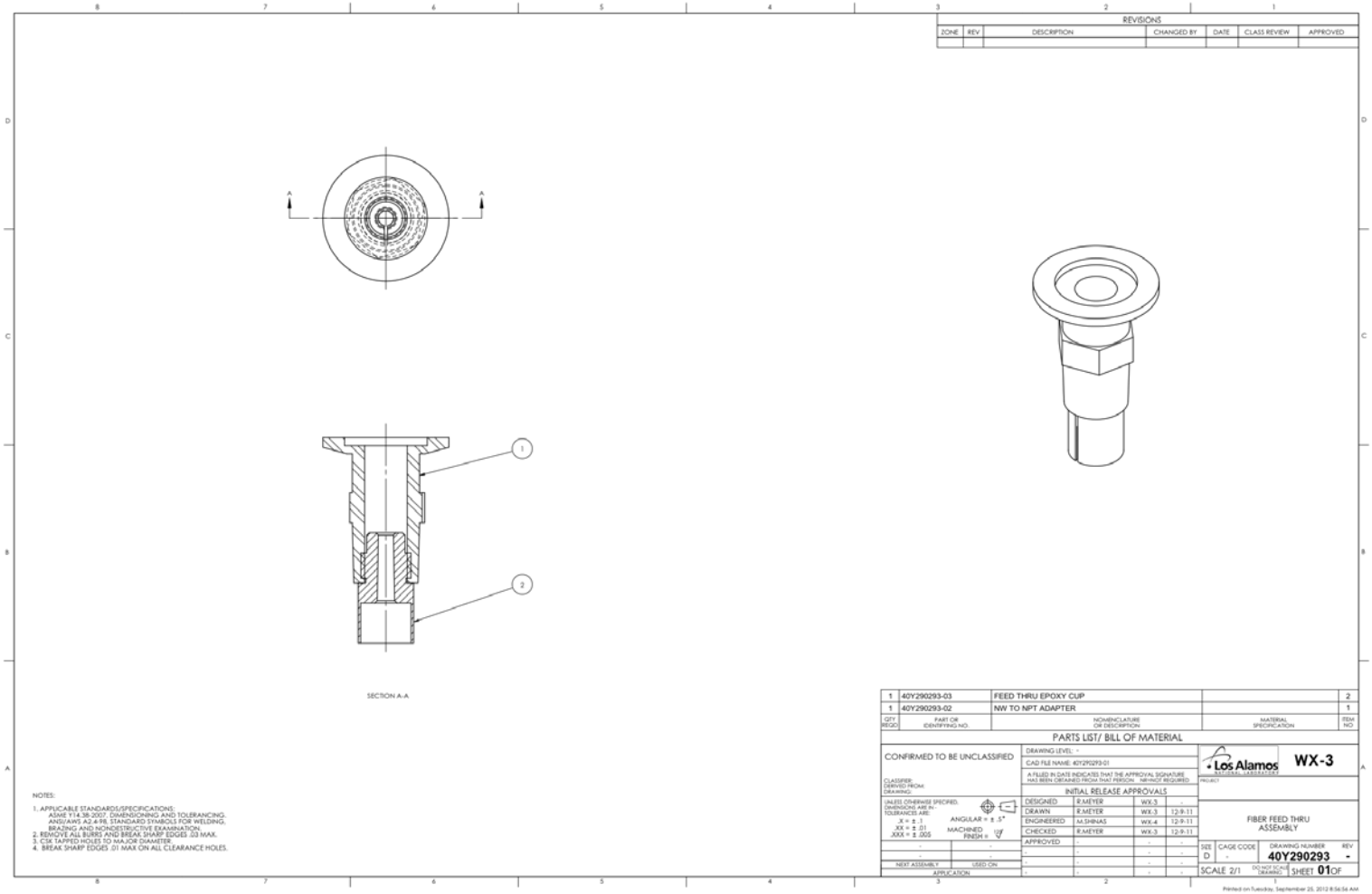
9 ea. Single mode fibers

Epoxy

Tri-BOND F113SC

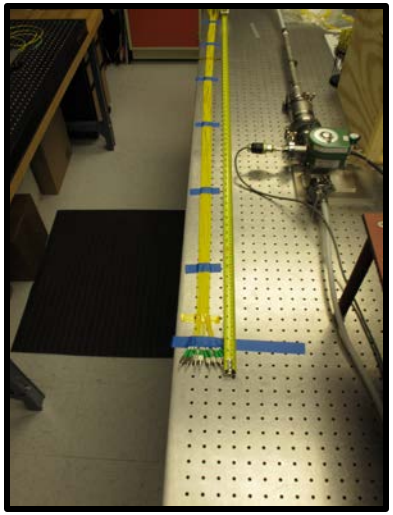
Epoxy Application Syringe

Feed-thru assembly drawing.

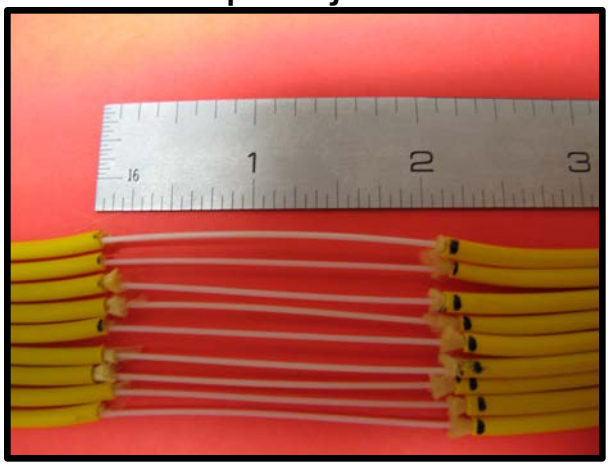


Cost of assembly: 7hrs X $130/hr = $910

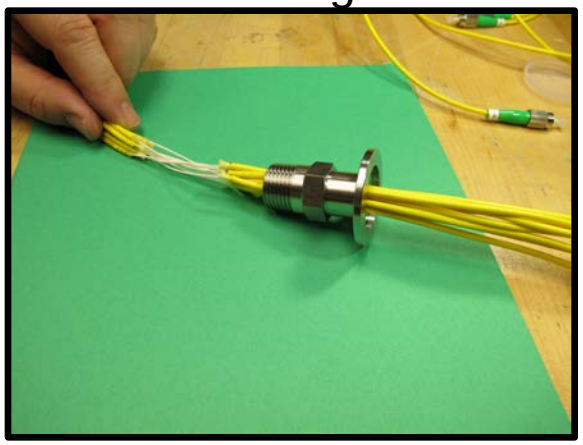
#1 Mark fibers



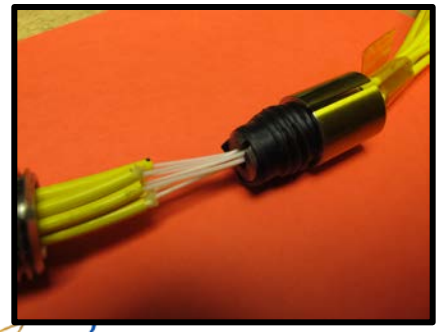
#2 Strip off jacket



#3 Thread fibers through vacuum fitting

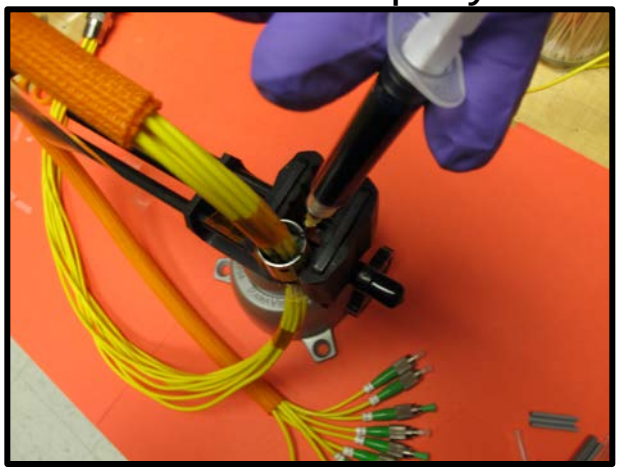


#4 Feed fibers through epoxy cup

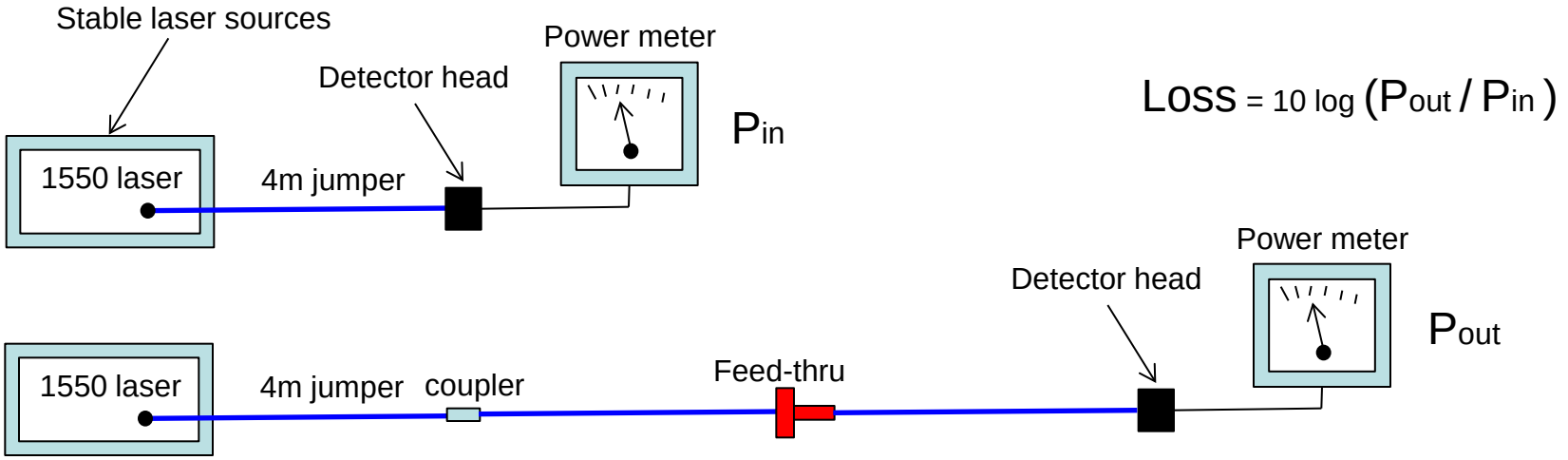


#5 Seal one side

#6 Fill with epoxy



Attenuation measurement.



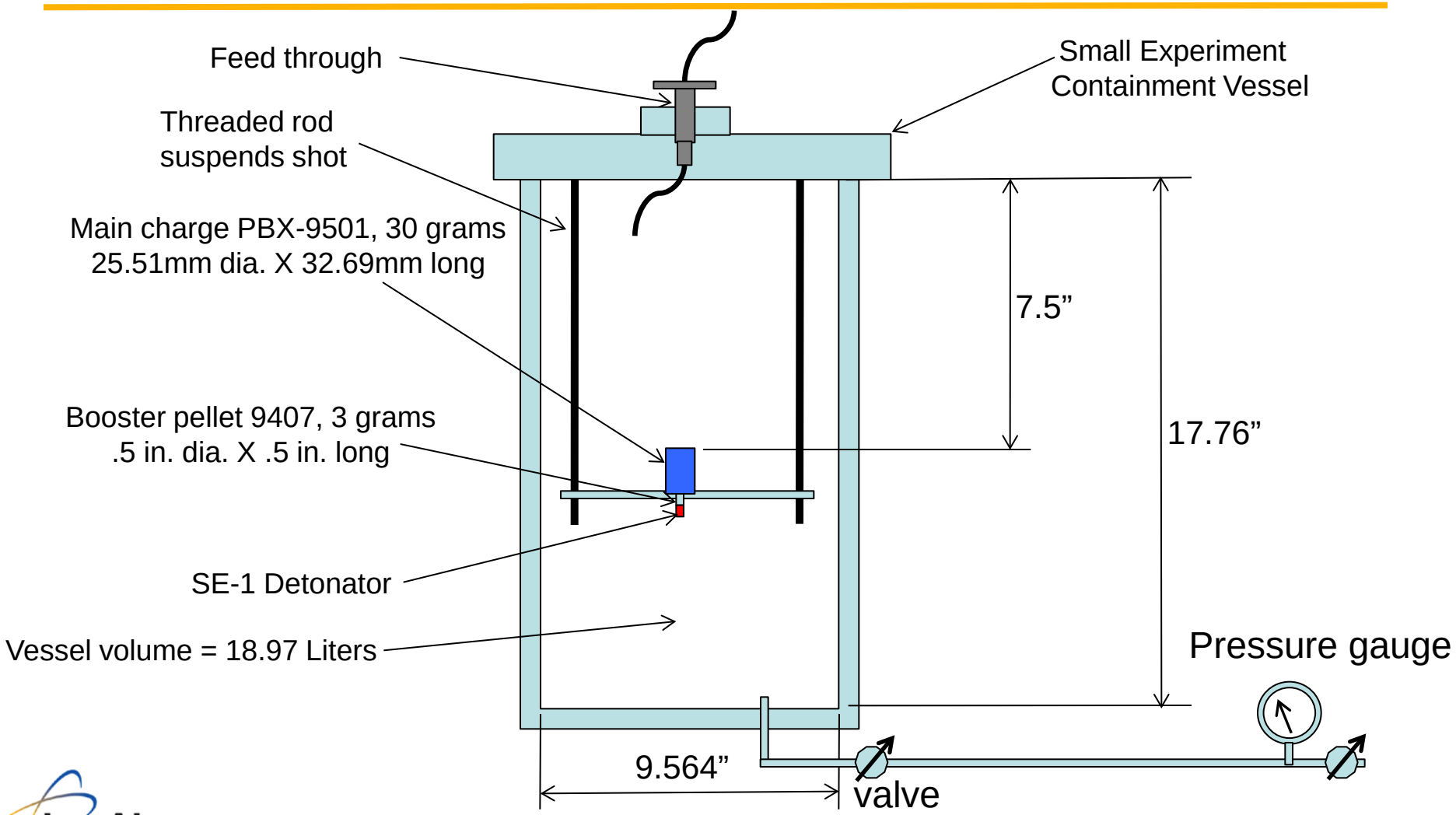
Average loss per fiber before potting = -.27 dB ± .24

Average loss per fibers after potting = -.36 dB ± .28

Reference documentation and equivalent HE load.

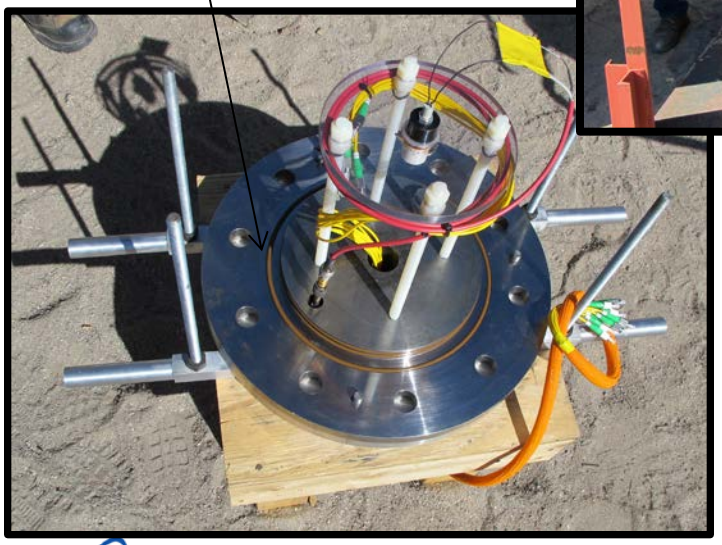
- The procedure titled: (SECV FEEDTHROUGH TESTS 2011) was followed to qualify the feed through in this presentation.
- Benjamin J. Yeamans of W-14 modeled our Small Experiment Containment Vessel with 30 grams of 9501.
- Yeamans determined that the peak pressure seen on our feed-thru in the Small containment vessel is approximately the same as the peak pressure seen on a 6 foot DARHT vessel with 30lb. of PBX-9501.

Feed through proof test set up.



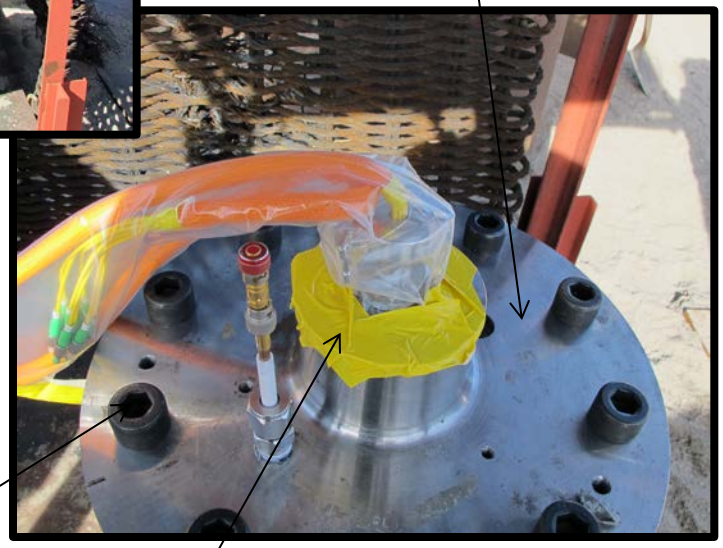
Vessel preparation on shot day.

Install feed thru, Det. cable and HE in vessel lid (upside down.)



Lowering shot into vessel

Seal up Vessel and perform Helium leak tested



Bolts torque to 150 ft. lbs.

Sealed bag around feed through for post shot sampling

What criteria does a feed through have to meet to pass?

- ✓ Before the shot, verify that the vessel and test feed through is leak tight. *The vessel is filled with Helium to a pressure of 8 psi above atmosphere. A Helium Mass spec. leak detector is used on this step to determine if the vessel/feed-thru is leak tight.*
- ☐ Confirm there is no visual leak observed around the feed through during the dynamic experiment. *A video camera was used to verify this criteria.*
- ☐ The feed through being tested is bagged pre shot and gas sampled post shot. The feed through is allowed to outgas from the initial explosive impulse, but can not have a continuous leak post shot. *A V ray multi-channel gas analyzer was used to verify this criteria.*
- ☐ Post shot, the Small Experiment Containment Vessel has to hold pressure. *Post shot a remote valve was opened and a constant pressure was observed on a gauge for 10 minutes.*
- ☐ Post shot, the feed through has to be leak tight. *The vessel is vented to atmosphere and filled with Helium to a pressure of 8 psi above atmosphere. A Helium Mass spec. leak detector is used on this step to determine if the feed-thru is leak tight.*

Feed through #1 Post shot Data.

Name of Feed Thru test	PDV-1	
Leak Rate pre-test at 8 psi	2 x 10^-6 Atm*cc/sec (no leak)	Performed by: Don Martinez
Leak Rate post-test at 8 psi	2 x 10^-6 Atm*cc/sec (no leak)	Performed by: Don Martinez
Proof Test Number	QE-19437	
Firing Site	Q-Site	
Date Tested	1/26/12	
Main charge	PBX-9501	
Amount of HE (g)	30	
Main charge dimensions	32.69 mm long X 25.51 mm dia. Cylinder	
Booster pellet	9407	
Amount of HE (g)	3	
Booster dimensions	1/2" x 1/2" cylinder	
Detonator	SE-1	
Diagnostics	Video Camera (Angelo Cartelli)	
	Gas Monitoring (Brandy Duran)	
Observations:	A video camera was used to observe the proof-test; no visual leaking was observed. The feed thru was bagged to accommodate for gas sampling. After the shot the gas sampling detected a slight leak of 3 PPM of CO, the can held pressure at 39 psi. Brandy called this leak a burp, which is commonly observed on other feed thrus tested using these same methods. Don Martinez performed a post shot leak rate measurement on the feed thru and determined it was tight.	
Pass or Fail	**Pass**	
Comments on Feed Thru Assembly:	The feed thru assembly was done by Mike Shinas. Note: The feed thru epoxy cup was potted separately from the modified NW to NPT adapter. A build procedure was documented by Mike Shinas.	

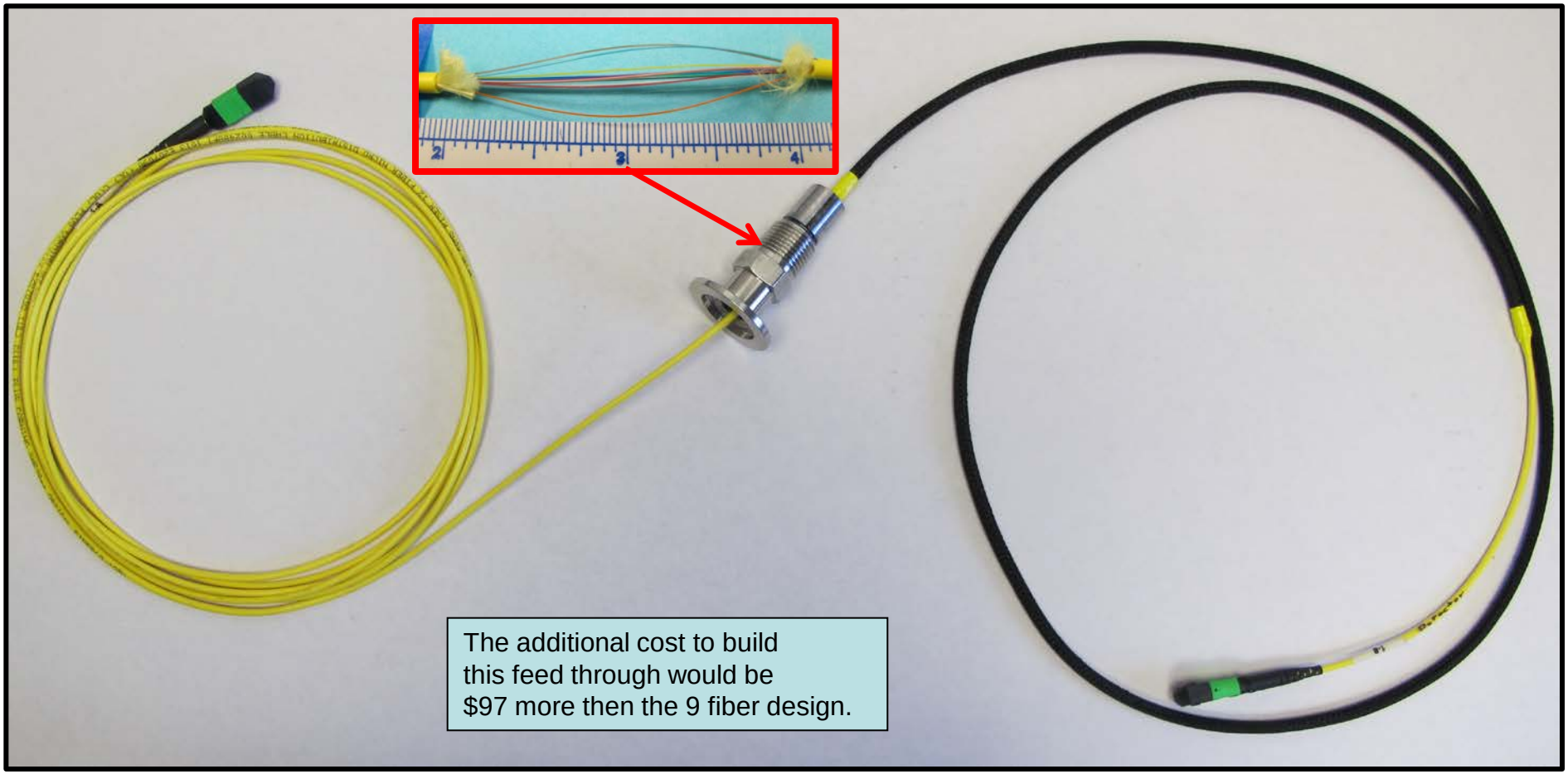
Feed through #2 Post shot Data.

Name of Feed Thru test	PDV-2	
Leak Rate pre-test at 8 psi	2 x 10^-6 Atm*cc/sec (no leak)	Performed by: Don Martinez
Leak Rate post-test at 8 psi	2 x 10^-6 Atm*cc/sec (no leak)	Performed by: Don Martinez
Proof Test Number	QE-19438	
Firing Site	Q-Site	
Date Tested	1/30/12	
Main charge	PBX-9501 The main charge was centered on the feed thru	
Amount of HE (g)	30	
Main charge dimensions	32.69 mm long X 25.51 mm dia. Cylinder	
Booster pellet	9407	
Amount of HE (g)	3	
Booster dimensions	1/2" x 1/2" cylinder	
Detonator	SE-1	
Diagnostics	Video Camera (Angelo Cartelli)	
	Gas Monitoring (Brandy Duran)	
Observations:	A video camera was used to observe the proof-test; no visual leaking was observed. The feed thru was bagged to accommodate for gas sampling. After the shot the gas sampling detected a slight leak of 2 PPM of CO, the can held pressure at 39 psi. Brandy called this leak a burp, which is commonly observed on other feed thrus tested using these same methods.	
Pass or Fail	**Pass**	
Comments on Feed Thru Assembly:	The feed thru assembly was done by Mike Shinas. Note: The feed thru epoxy cup was potted after screwing it into the modified NW to NPT adapter. A build procedure was documented by Mike Shinas.	

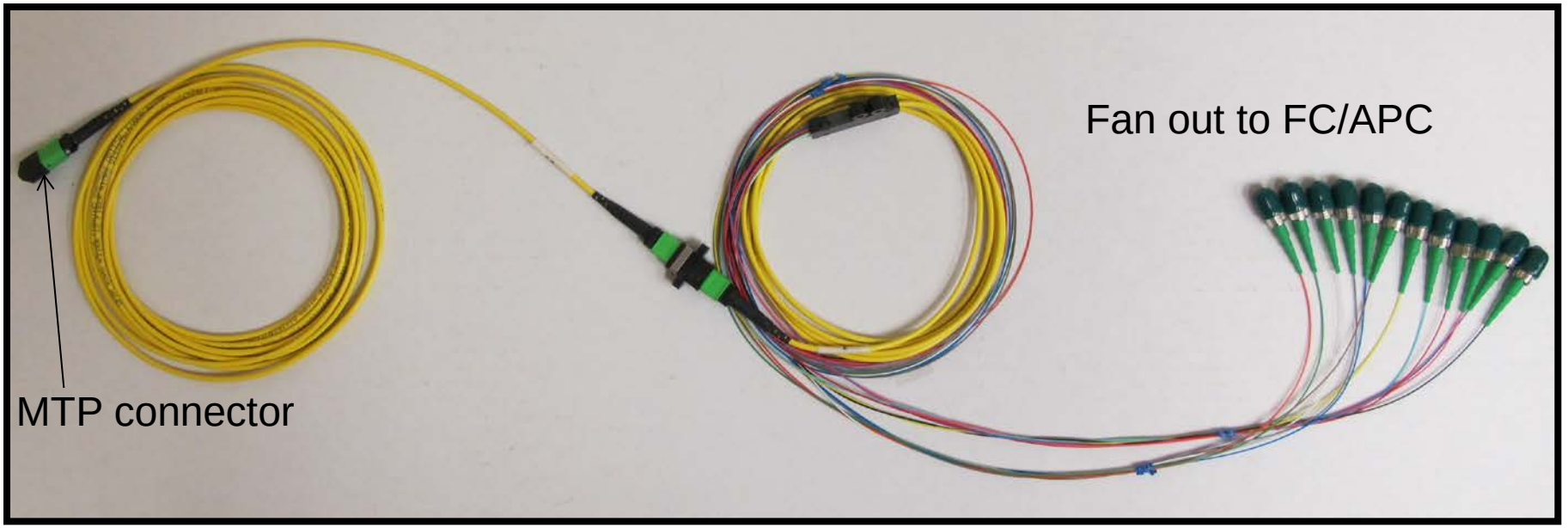
Feed through #3 Post shot Data.

Name of Feed Thru test	PDV-3	
Leak Rate pre-test at 8 psi	2 x 10^-6 Atm*cc/sec (no leak)	Performed by: Don Martinez
Leak Rate post-test at 8 psi	2 x 10^-6 Atm*cc/sec (no leak)	Performed by: Don Martinez
Proof Test Number	QE-19439	
Firing Site	Q-Site	
Date Tested	1/30/12	
Main charge	PBX-9501 The main charge was centered on the feed thru	
Amount of HE (g)	30	
Main charge dimensions	32.69 mm long X 25.51 mm dia. Cylinder	
Booster pellet	9407	
Amount of HE (g)	3	
Booster dimensions	1/2" x 1/2" cylinder	
Detonator	SE-1	
Diagnostics	Video Camera (Angelo Cartelli)	
	Gas Monitoring (Brandy Duran)	
Observations:	A video camera was used to observe the proof-test; no visual leaking was observed. The feed thru was bagged to accommodate for gas sampling. After the shot the gas sampling detected no leak, the can held pressure at 39 psi. Don Martinez performed a post shot leak rate measurement on the feed thru and determined it was tight.	
Pass or Fail	**Pass**	
Comments on Feed Thru Assembly:	The feed thru assembly was done by Mike Shinas. Note: The feed thru epoxy cup was potted after screwing it into the modified NW to NPT adapter. A build procedure was documented by Mike Shinas.	

MTP Feed-Through (12 fiber per 3mm cable)



Attenuation measurement on the 12 fiber MTP feed-thru.



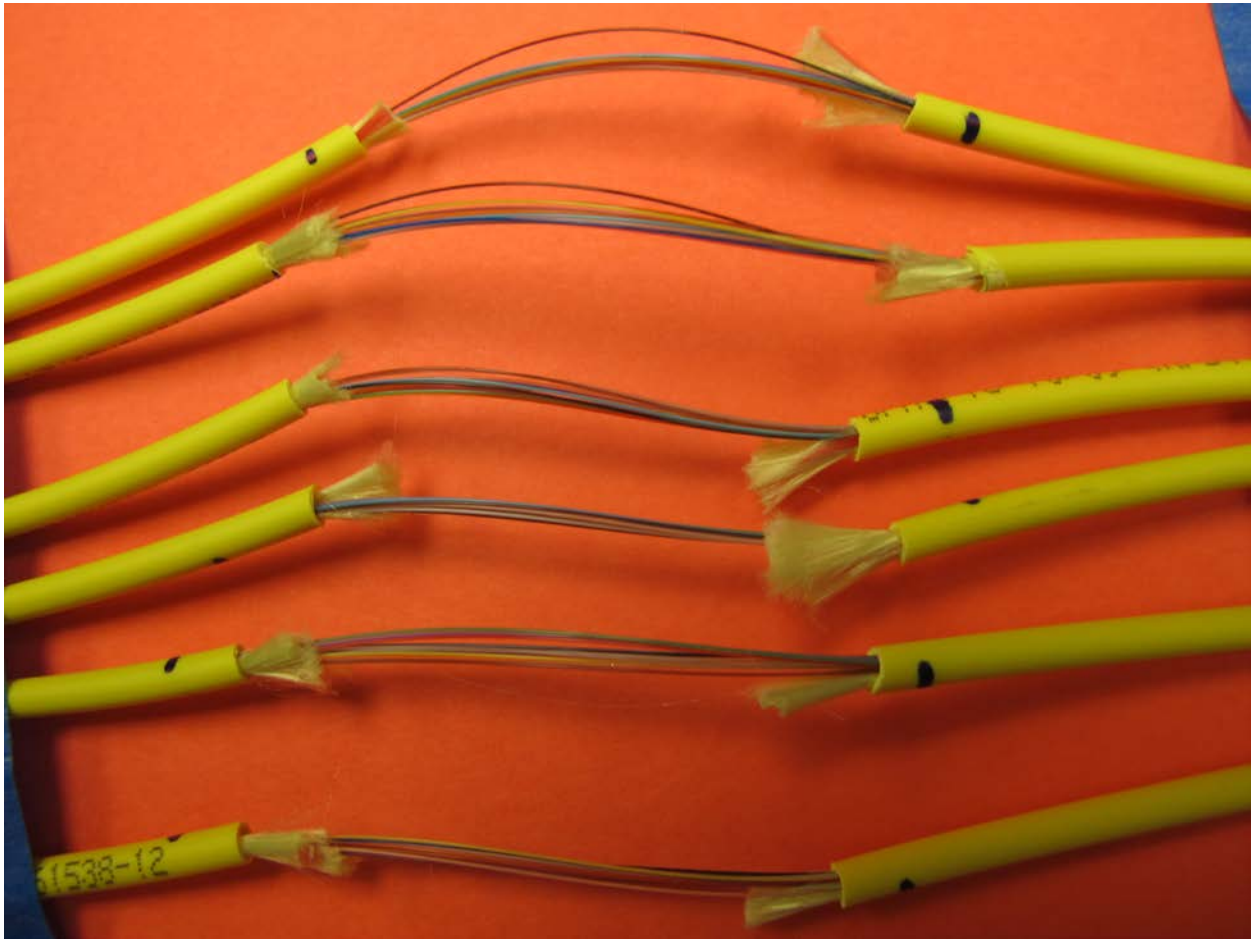
Average loss per fiber before potting = -1.38 dB ± .51

Average loss per fiber after potting = -1.72 dB ± .45

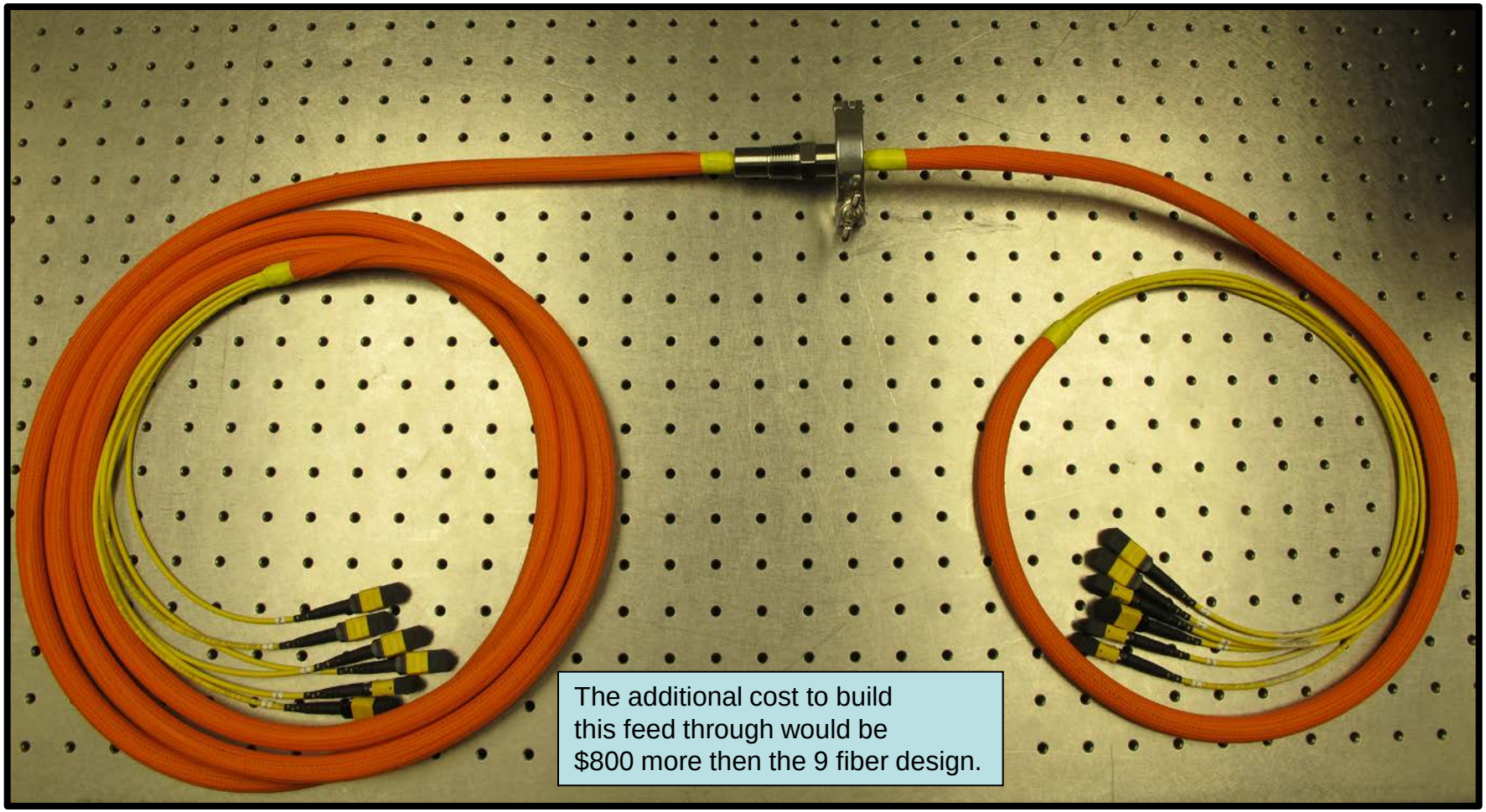
MTP Feed through Post shot Data.

Name of Feed Thru test	PDV-4	
Leak Rate pre-test at 8 psi	2 x 10^-6 Atm*cc/sec (no leak)	Performed by: Don Martinez
Leak Rate post-test at 8 psi	2 x 10^-6 Atm*cc/sec (no leak)	Performed by: Don Martinez
Proof Test Number	QE-19441 H4255	
Firing Site	Q-Site	
Date Tested	2/14/12	
Main charge	PBX-9501 The main charge was centered on the feed thru	
Amount of HE (g)	30	
Main charge dimensions	32.69 mm long X 25.51 mm dia. Cylinder	
Booster pellet	9407	
Amount of HE (g)	3	
Booster dimensions	1/2" x 1/2" cylinder	
Detonator	SE-1	
Diagnostics	Video Camera (Angelo Cartelli)	
	Gas Monitoring (Brandy Duran)	
Observations:	A video camera was used to observe the proof-test; no visual leaking was observed. The feed thru was bagged to accommodate for gas sampling. After the shot the gas sampling detected no leak, the can held pressure at 39.5 psi. Don Martinez performed a post shot leak rate measurement on the feed thru and determined it was tight.	
Pass or Fail	**Pass**	
Comments on Feed Thru Assembly:	The feed thru assembly was done by Mike Shinas. Note: The feed thru epoxy cup was potted first and then potted into the NW to NPT adapter. A build procedure was documented by Mike Shinas.	

72 MTP Feed Through with Timbercon elite MTP connectors.



Assembled 72 fiber feed through.



Summary

- The 9 fiber optic feed through cost only $1530. $170/channel
- All three 9 fiber optic feed-thru pass the certification test shots. The out-gassing from the initial explosive impulse was quite low, ≤ 3 ppm of Carbon monoxide (compared to inside the vessel which is 300,000 ppm), ≤ .001% of gas vented.
- The 12 fiber feed through designed with MTP fiber jumpers, pass the certification shot and cost $1627. $135/channel
- No significant attenuation was seen after potting the feed-thrus.
- A 72 channel feed-thru was built and needs to be tested. The cost of this feed-thru is $2330. $32/channel

Acknowledgment

Design and build Team: Matt Briggs**,** Steve Hare**,** Ross K. Meyer, Theresa V. Montoya, Erik A. Moro, Donald G. Roeder and TA-15 shop, Michael A. Shinas

Fielding team: Angelo R. Cartelli, Brandy L. Duran, Timothy A. Kuiper, Wendy V. McNeil, Gary M. Mc Math, Donald L. Martinez, Theresa V. Montoya, Michael A. Shinas