OVERVIEW OF SEAL DEVELOPMENT AT ALBANY INTERNATIONAL TECHNIWEAVE, INC.

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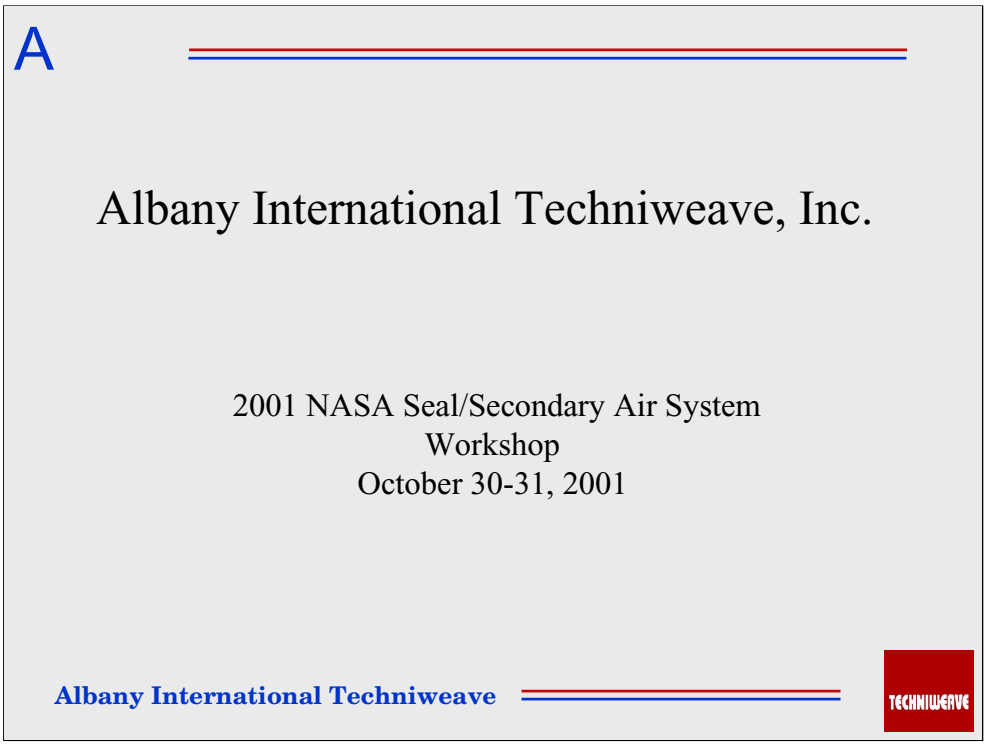
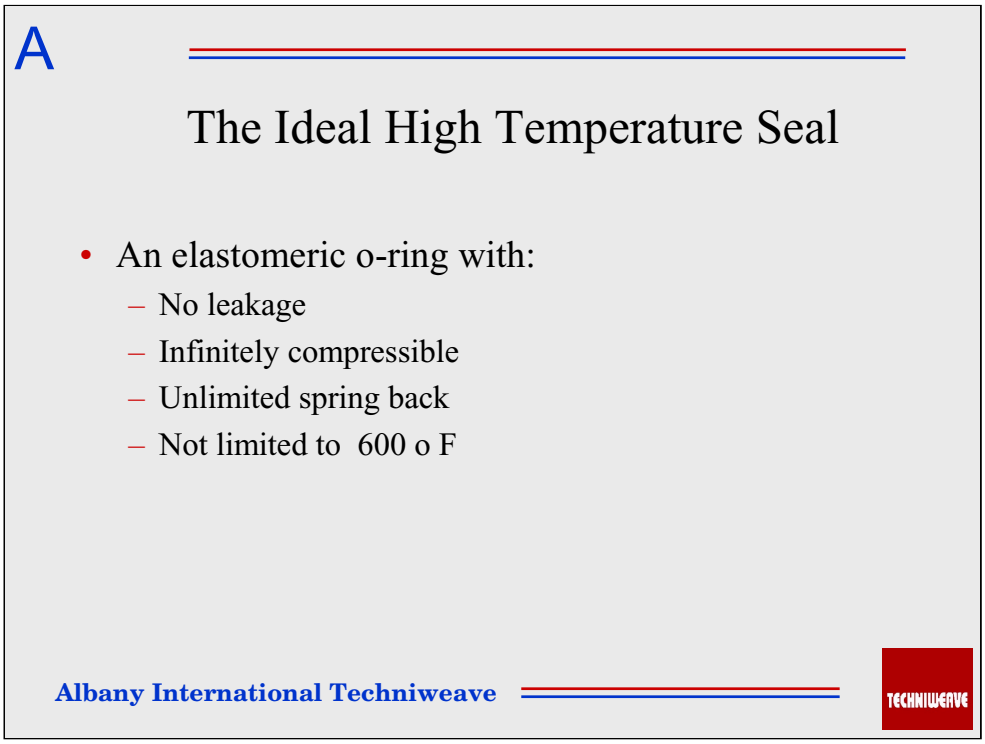
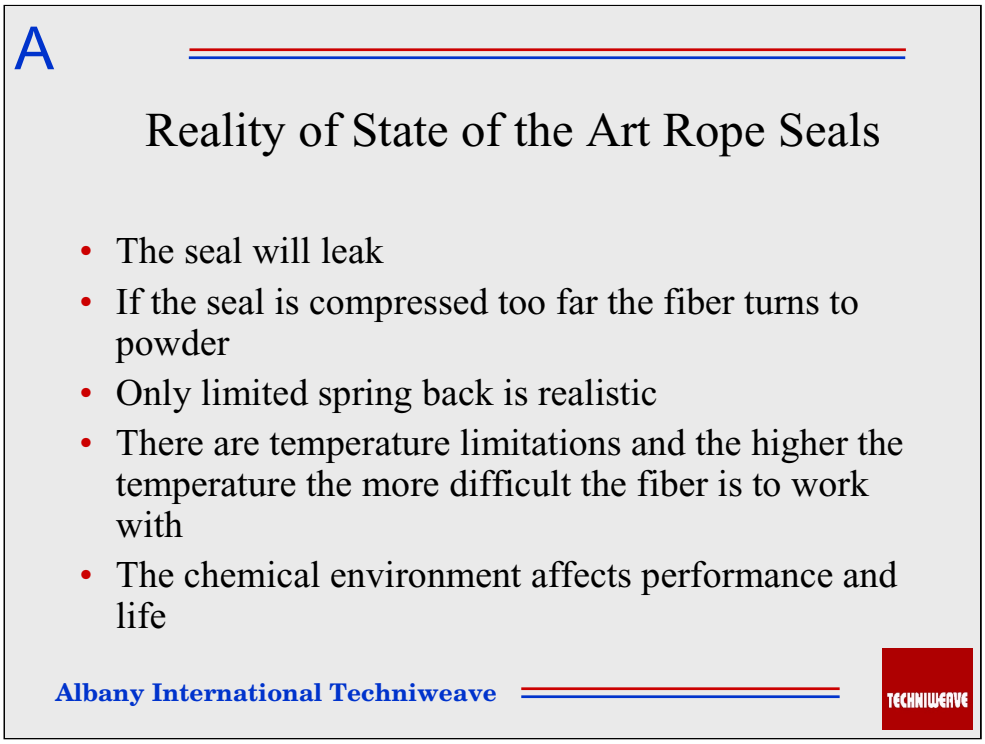




The ideal high temperature seal would have the same properties as an elastomeric O-ring but without the temperature limitations.



The reality of high temperature seals is often far from the ideal. Engineers are forced to find innovative methods for utilizing ceramic seals.

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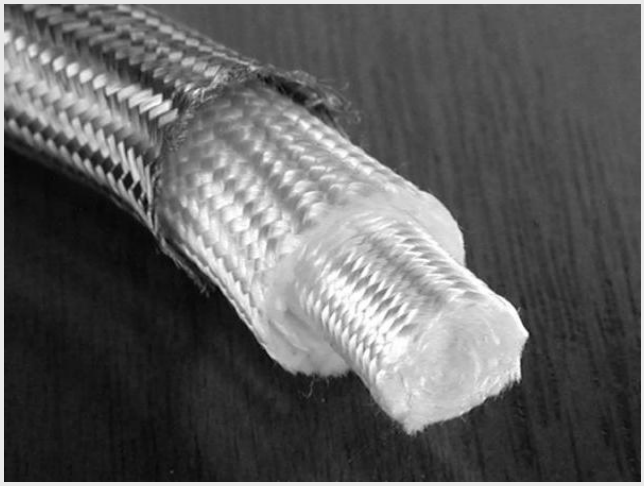
Hybrid Rope Seal



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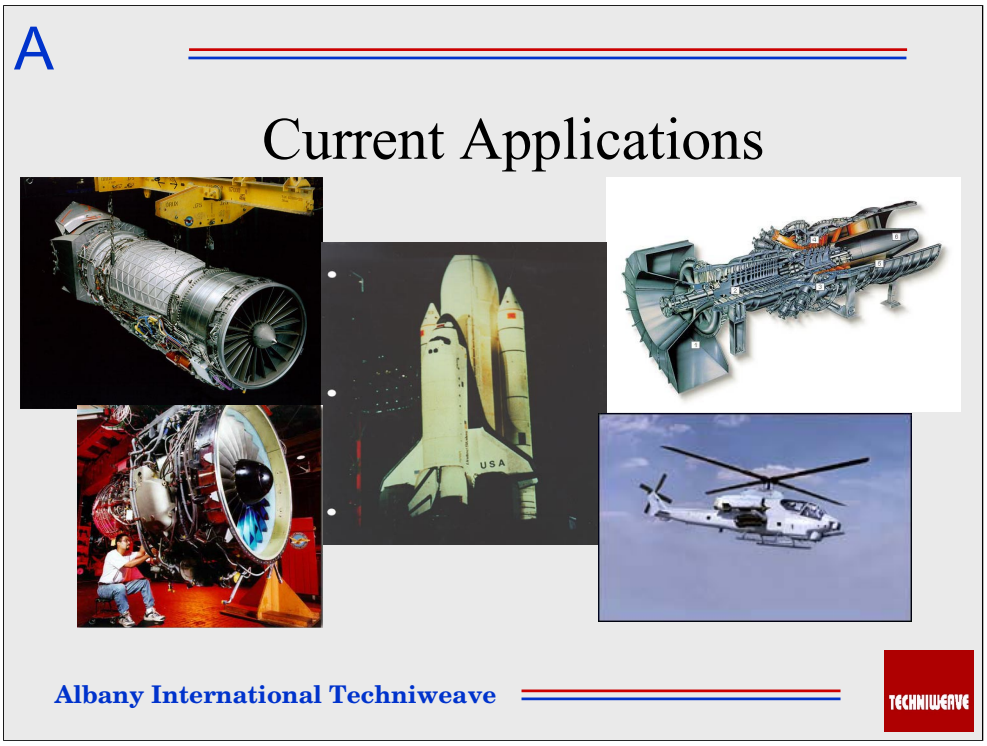
Our most popular seal combines the high temperature resistance and insulating properties of the relatively resilient ceramic fiber core with an overbraid of Haynes 188 wire for wear and vibration resistance.



Currently our rope seals are used in three major applications

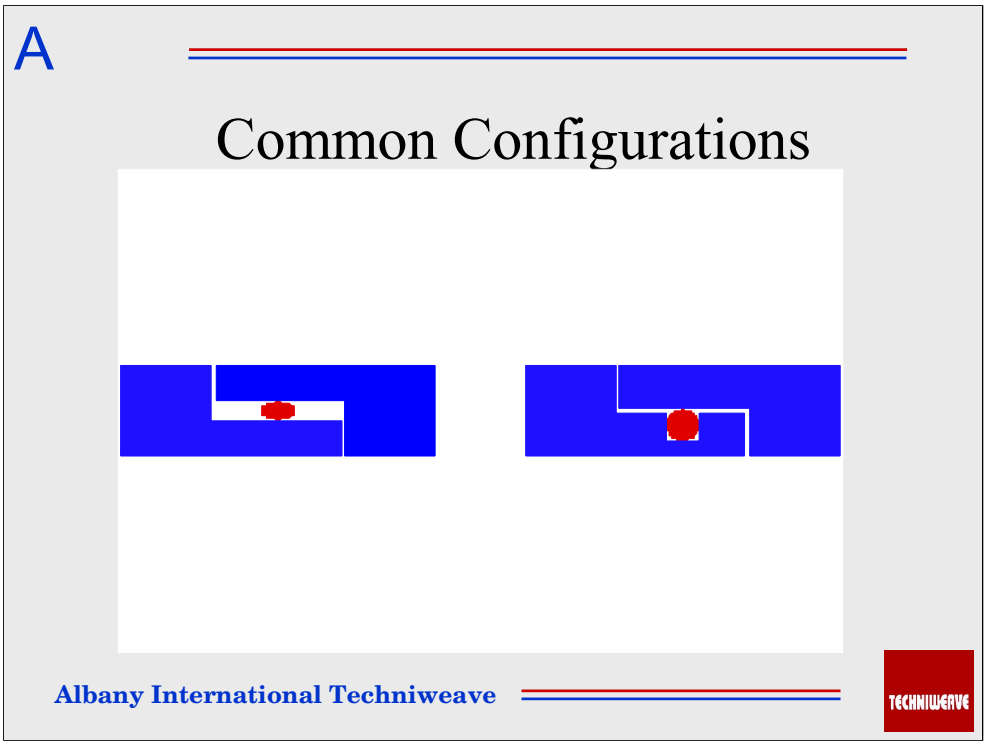
•Advanced aircraft engines such as the P&W F-119 (upper left)

•Land based gas turbines such as the Siemens Westinghouse 501G (upper right)

•Space Shuttle solid rocket booster manufactured by Thiokol (carbon rope seal)

•New commercial aircraft engines, P&W 6000 (lower left)

•High temperature exhaust gasketing, Bell Helicopters Cobra



Rope seals are typically used in two basic configurations.

•The left diagram shows a seal captured between two surfaces with no distinct O-ring groove. In this application the rope seal may carry the entire compressive load. This configuration can be used to isolate ceramic components for metal support fixtures and hence mitigate the effects of widely varying CTE's

•The more conventional looking O-ring grove on the right allows the seal to reduce the leakage between two surfaces by expanding upward to follow the irregularities of the mating part. The seal is an adjunct to joint and only servers to further reduce the flow between two closely mated surfaces. Typically the seal does not carry all of the compressive forces in this configuration.

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Rope Seal Styles

Style	Diameter [in]	Core	Sheath
9032	.125	Nextel 312	HS-188
9021	.157	Nextel 312	HS-188
9046	.25	Nextel 312	HS-188
9024	.375	Nextel 312	HS-188

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We offer several standard rope seal styles as readily available products. A large portion of our business is fabricating custom seal to meet our customers specific needs. Please feel free to contact us with your requirements.

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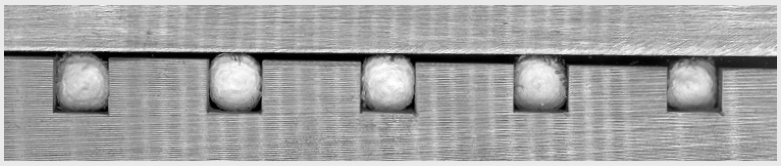
Compression with Changing Volume (Constant Width)



Width:	0.360”	0.360”	0.360”	0.360	0.360”
Depth:	0.356”	0.338”	0.319”	0.300”	0.281”
Area:	0.128 in^2	0.122 in^2	0.115 in^2	0.108 in^2	0.101 in^2

*Note, photos are for demonstration purposes only; testing was performed one seal at a time

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In certain applications it is desirable to place the seal in a groove which is slightly narrower than the diameter of the seal to facilitate installation and retention during assembly. A family of curves can be established using different loads per linear inch and various groove depths..

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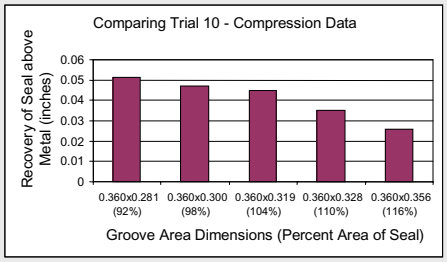
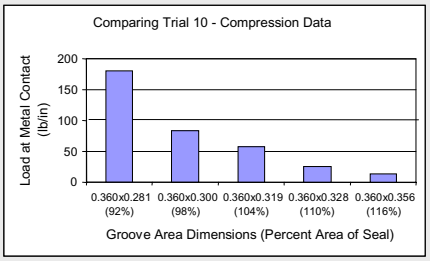
Compression of Seal into Constant Width and Variable Depth Groove

Comparison of 10th Cycle Curves





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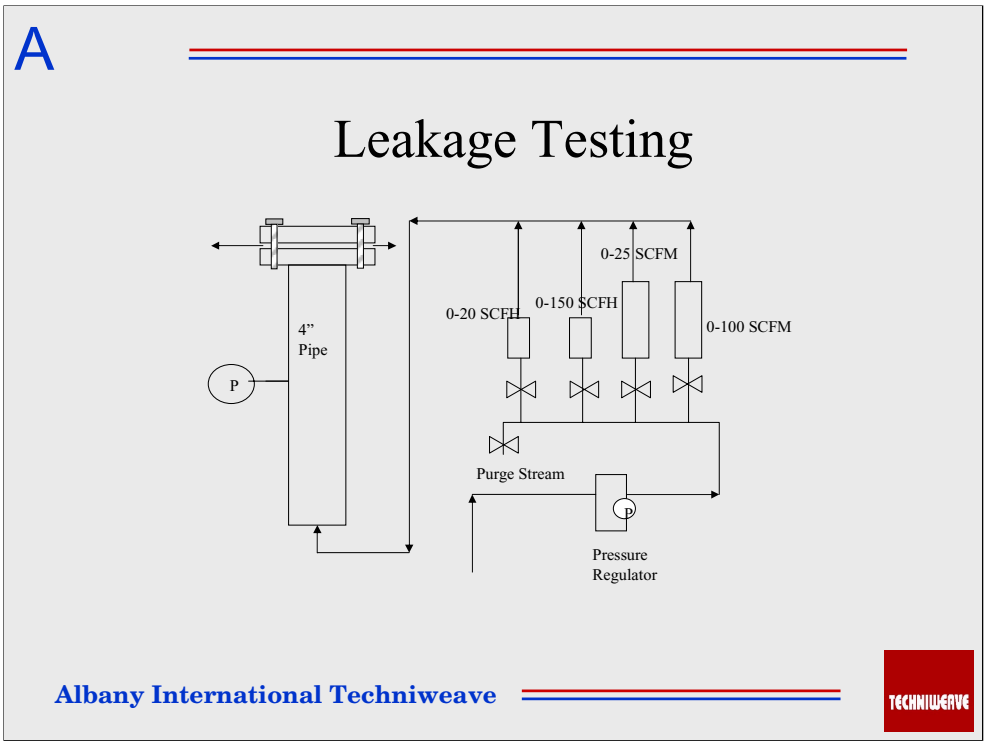
In some instances the anticipated loads would be sufficient to ensure metal to metal contact. The graphs above show the recovery of the seal and the loads required to make metal to metal contact for various groove depths where the width is held to a 0.360 inches.



This apparatus was built over 5 years ago to conduct internal leakage tests on high temperature candle filters. The apparatus was modified to allow room temperature leakage testing of rope seals.

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Test Apparatus

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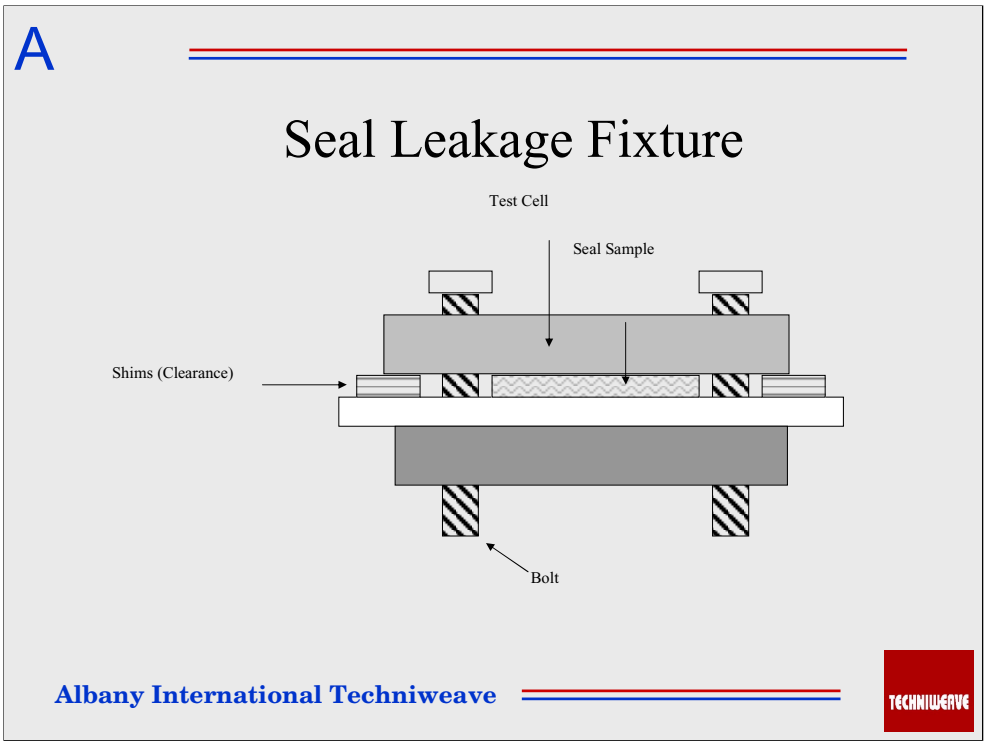
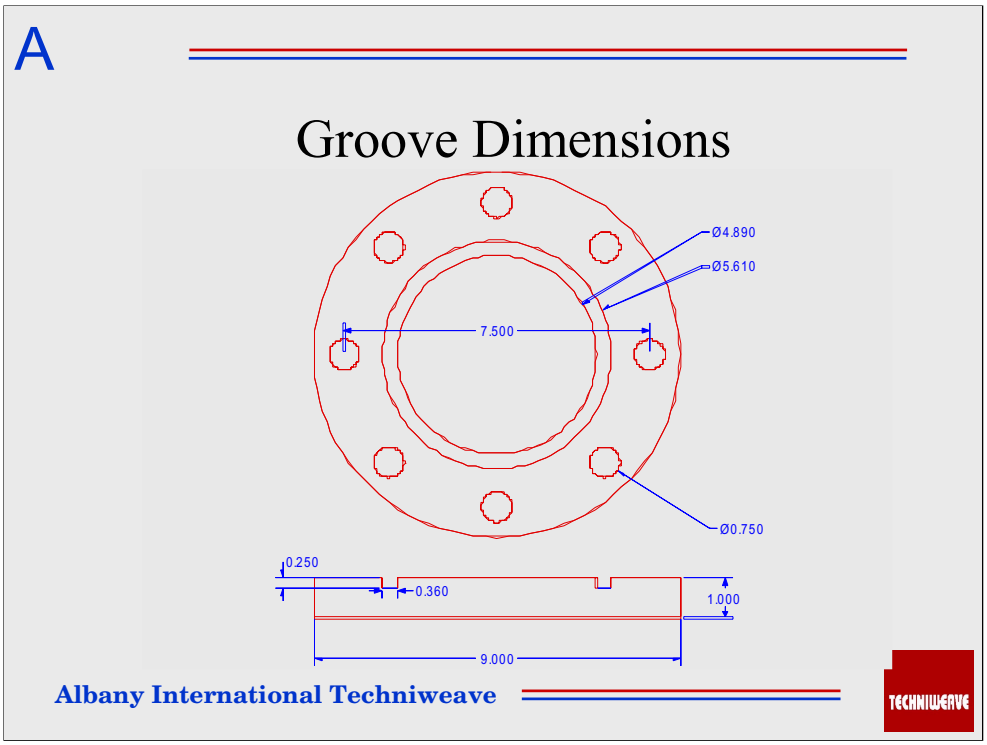
Four flowometers provide measurements from 2 SCFH to 100 SCFM.



The fixture utilized shims at four points to ensure uniform and accurate compression of the seal in the leakage fixture.



A plastic cap was machined as indicated. The mating surface was smooth steel.

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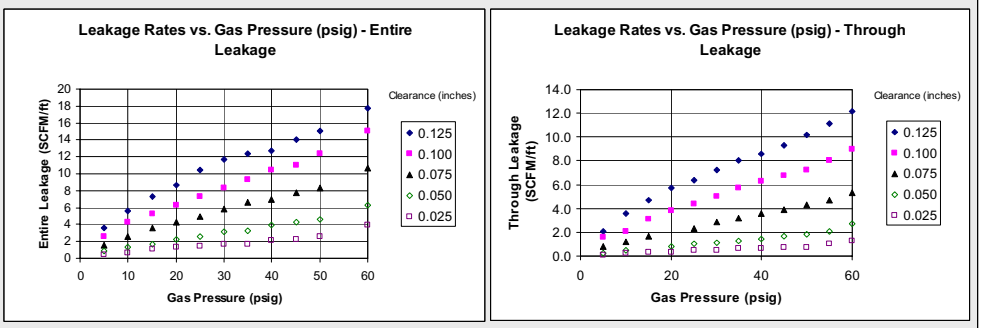
Leakage Data (SCFM/FT)



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The ends of the seal were butted and glued with RTV. The fixture was tightened down to various shim heights. The clearance is the distance between the top plate of the grooved fixture and an smooth steel plate. The use of shims provided a method for ensuring uniform alignment. The data is presented in units of SCFM/FT. The data on the right was generated after the top and bottom surfaces were coated with a thin layer of silicone rubber. This eliminated leakage in that area. In this case roughly 1/3 of all leakage occurred on the top and bottom surfaces of the seal highlighting the importance of architecture and surface finish.

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New Work

- Shape and fiber volumes of seals in grooves
- Lot to lot leakage variation
- Effect of architecture on leakage
- Effect of fiber volume on leakage