N95-13590

EG&G AND NASA FACE SEAL CODES COMPARISON

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EG&G Sealol
Cranston, Rhode Island

- Codes Received from NASA

- Seal Hardware and Application

- Description of EG&G's Code

- Description of NASA Code

- Results and Discussion

- Conclusions and Future Works

Codes Received from NASA

- 'SPIRALG' - Gas Lubricated Spiral-Grooved Cylindrical and Face Seals.

- 'GCYL' - Gas Lubricated Cylindrical.

- 'ICYL' - Cylindrical Seals Lubricated by Incompressible Fluids.

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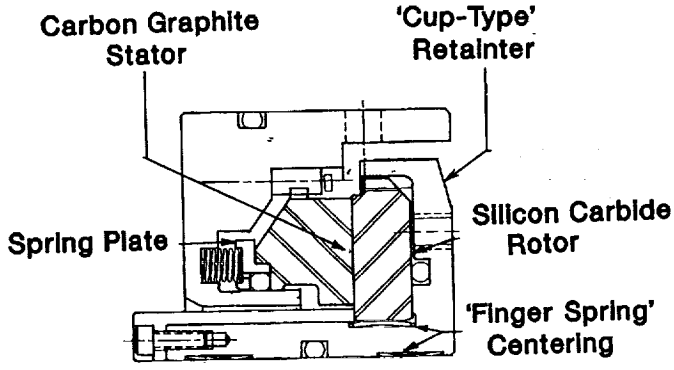
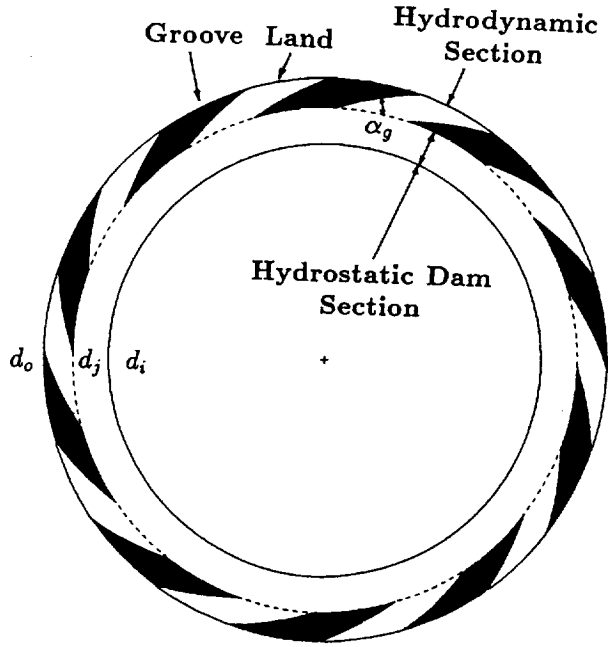
Schematic Diagram



Used in Centrifugal Gas Compressors

Spiral-Groove Seal Face



Maximum Operating Conditions

- Pressure - 1500 psig
- Temperature - 400 °F
- Surface Speed - 550 ft/s

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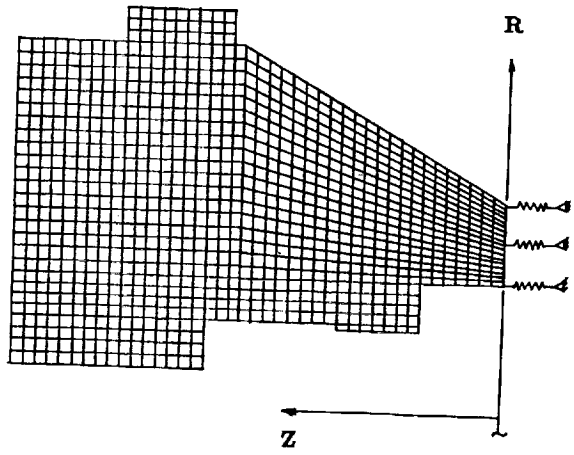
* Seal Face Distortions

- Pressure (Finite Element)
- Thermal
- Centrifugal

Pressure Distortion



Finite Element Mesh - Stator

* Fluid Pressure Distribution

- Hydrodynamic Section
  2D Compressible Reynolds Eqn

- Hydrostatic Section
  1D Compressible Flow

  • Choking

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"SPIRALG" CODE

Gas Lubricated Spiral-Grooved Cylindrical and Face Seals

- Narrow Groove Theory. $N_g \gg 2\,\pi\,\sin\beta$
- Compressible Reynolds Equation Over the Entire Seal Face.
- Inertial Effects Neglected.
- Face Deformations Not Considered.
- Calculates Frequency Dependent Film Stiffness and Damping.

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Example Case

Design Parameters :

Seal OD	=	6.0 in
Seal ID	=	4.6 in
Groove Angle	=	*
Groove Depth	=	*
Number of Grooves	=	12
Width Ratio	=	*
(Land/Groove)	=	
Spiral Span	=	*

Operating Parameters :

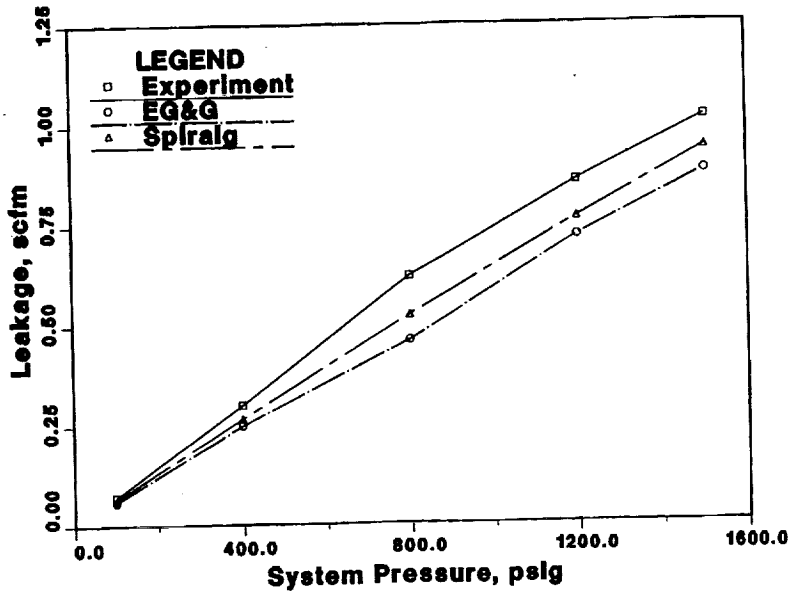
System Pressures	=	100 - 1500 psig
Discharge Pressure	=	0 psig
Speeds	=	7500, 15000 RPM
Temperatures	=	95, 170 ° F

*Proprietary information of EG&G Sealol.

Leakage Correlation

Face Deformations Suppressed in EG&G Code

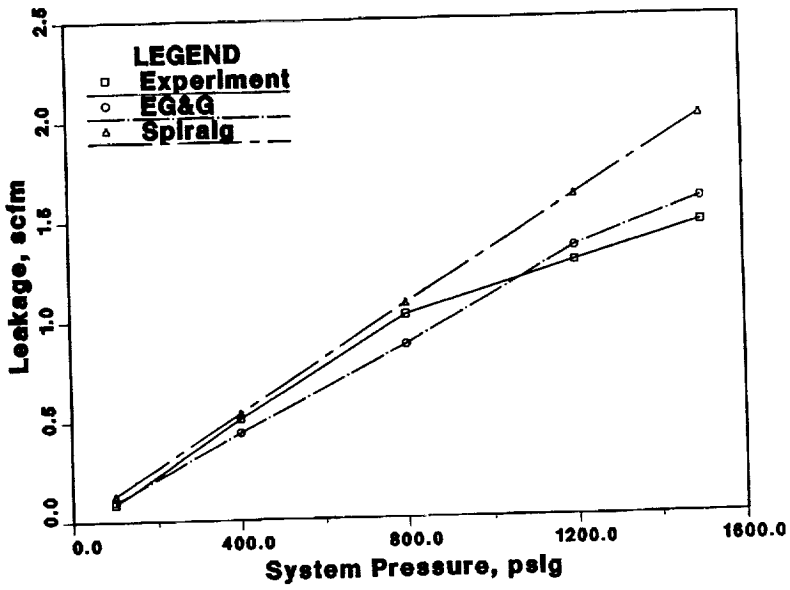
7500 RPM



Leakage Correlation

Face Deformations Suppressed in EG&G Code

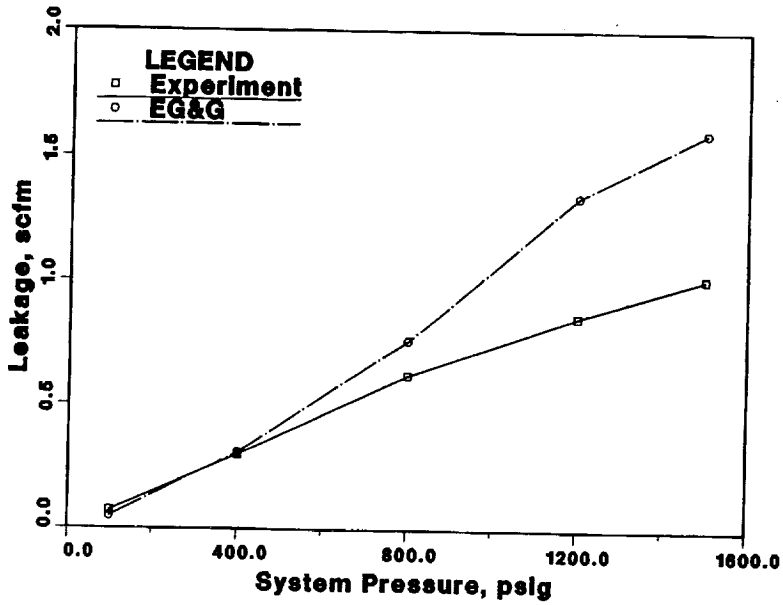
15000 RPM



Leakage Correlation

Face Deformations Activated in EG&G Code

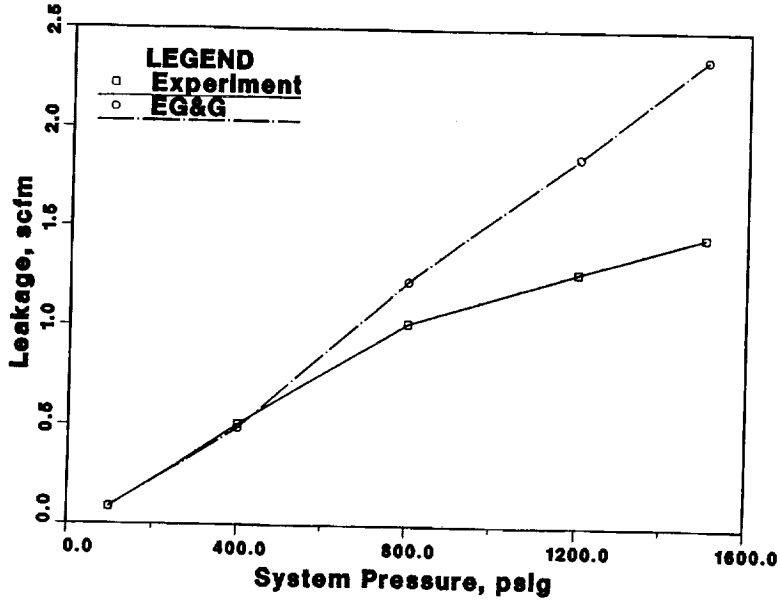
7500 RPM



Leakage Correlation

Face Deformations Activated in EG&G Code

15000 RPM



Film Stiffness & Damping

Design & Operating Parameters

h = 100 μin
α_g = 15°
N = 16000 RPM

Stiffness & Damping Data

Inlet Pressure p_o (psia)	EG&G K 0 rpm (lbf/μin)	SPIRALG K 0 rpm (lbf/μin)	SPIRALG C 0 rpm (lbf.s/in)	SPIRALG K 16000 rpm (lbf/μin)	SPIRALG C 16000 rpm (lbf.s/in)
114.7	13.42	26.00	-7087	18.7	-3731
314.7	15.81	28.10	-1312	27.0	-1229
514.7	17.52	29.65	641	30.0	594
1014.7	20.36	33.09	2750	33.9	2670
1514.7	21.68	36.38	3560	37.1	3520

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Conclusions

For the Example Case :

- EG&G code with face deformations suppressed and "SPIRALG" agree well with each other as well as with the experimental data.

- '0 RPM' stiffness data calculated by EG&G code are about 70-100% lower than that by "SPIRALG".

- Not an appreciable difference between '0 RPM' and '16000 RPM' stiffness and damping coefficients calculated by 'SPIRALG'.

- The film damping above 500 psig calculated by "SPIRALG" is much higher than the O-Ring secondary seal damping (e.g. 50 lbf.s/in).

Future Works

- Annular Seal Analysis with 'GCYL'