N92-15095

SEAL RELATED DEVELOPMENT ACTIVITIES AT EG&G

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Fluid Components Technology Group
EG&G

A brief introduction is made describing EG&G Fluid Components Technology Group and FCT Group R&D capabilities.

Seal related development activities, including modeling, analysis and performance testing are described for several current seal related projects. These include noncontacting, high speed, high pressure gas sealing systems for turbomachinery, brush seals for gas path sealing in gas turbines and tribological material evaluation for wear surfaces in sealing systems.

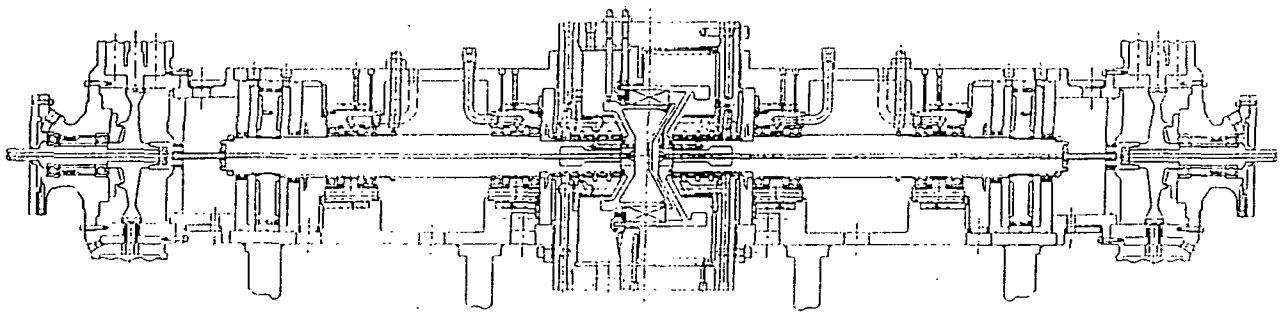
GROUP R & D

Staffed and equipped for:

- Material Characterization and Analysis
- Tribological Characteristics, Testing and Evaluation
- High Temperature, High Pressure and High Speed Testing of Seals and Sealing Systems
- Mechanical Design of Products and Specialized Testing Equipment
- Modeling of Systems and Components, Design Analysis and Performance Parameters
- Manufacturing Process Development

ADVANCED AEROSPACE TEST RIG

- **Rig Capabilities (Counter Rotating Configuration)**
  - Spindle Speed/24,000 RPM each shaft
  - Power/43 HP at 17,000 RPM, 32 HP at 26,000 RPM
  - Temperature of Test Chamber/600°F
  - Test Chamber Pressure/100 PSI
  - Axial Travel/±.0625 inch each shaft
- **Single Shaft (Brush Seal Testing)**
  - Spindle Speed/24,000 RPM
  - Power/43 HP at 17,000 RPM, 32 HP at 26,000 RPM
  - Temperature of Test Chamber/1000°F
  - Test Chamber Pressure/ 100 PSI
  - Axial Travel/±.0625 inches



SEAL RELATED DEVELOPMENT ACTIVITIES

BRUSH SEAL DEVELOPMENT PROGRAM
U. S. AIR FORCE PRDA-11
IN-HOUSE BRUSH SEAL TESTING

NON-CONTACTING GAS FILM SEALS
DEVELOPMENT AND TESTING

TRIBOLOGICAL MATERIAL EVALUATION
ANALYSIS AND TRIBOLOGICAL TESTING

Brush Seal Development Program

U. S. Air Force

Integrated High Performance Turbine Engine Technology – IHPTET

PRDA – II

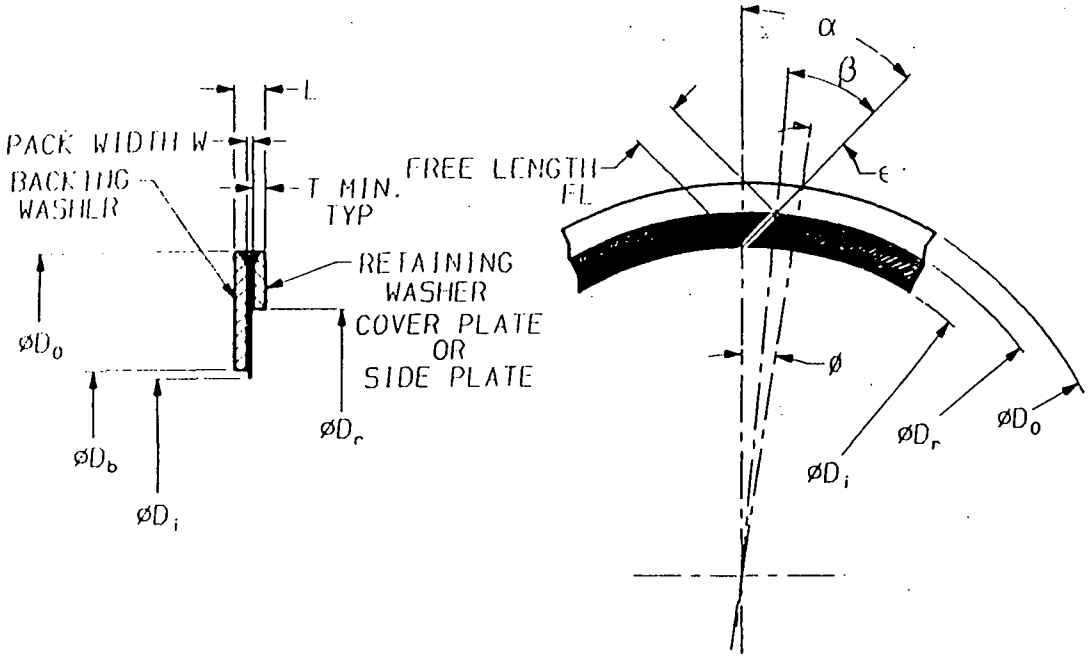
Objective: Develop a comprehensive design methodology for Brush Seals using

1. Application requirements from engine manufacturer
2. Experimental characterization of seal design and tribological pairs

Goals:
1. Substantially lower leakage than laby seals
2. Seal life consistent with man–rated mission requirements
3. Achieve maximum pressure sealing capability with single or multiple stages

Provide:
1. Comprehensive seal design manual
2. Man–rated brush seal for test in an IHPTET engine

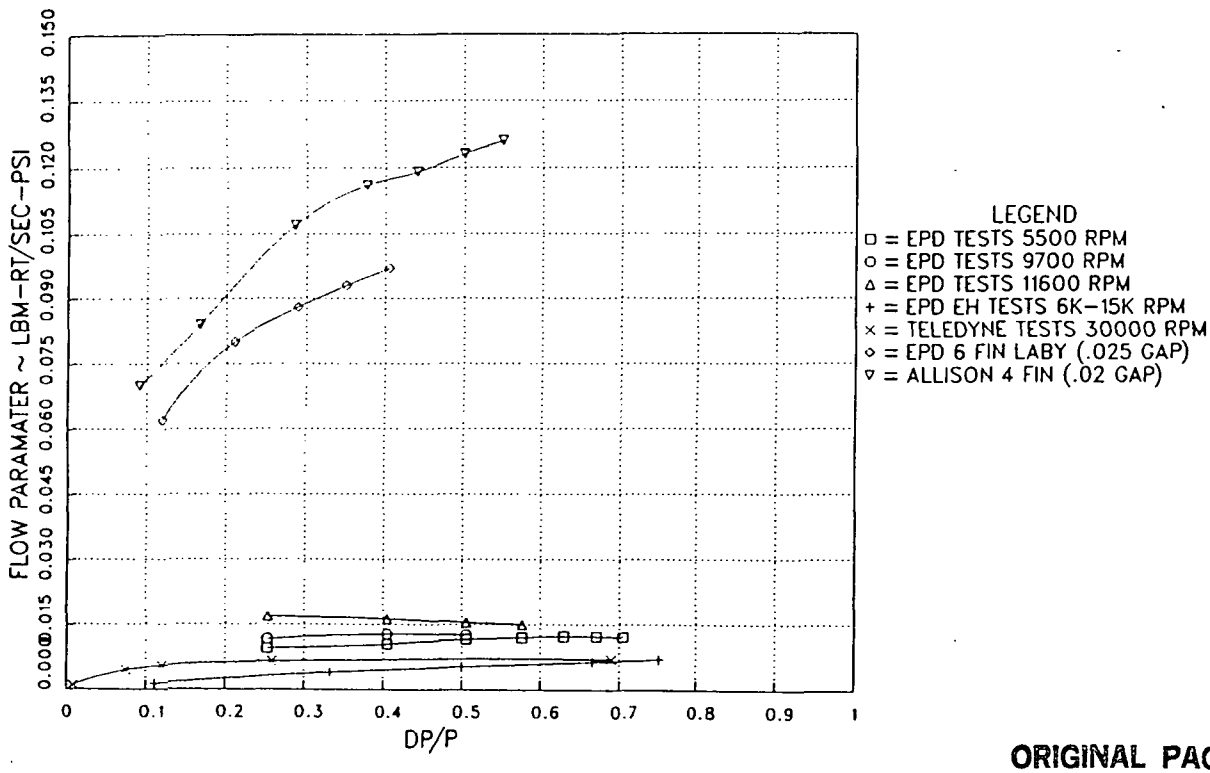
Project duration is two and one half years, started July 1990



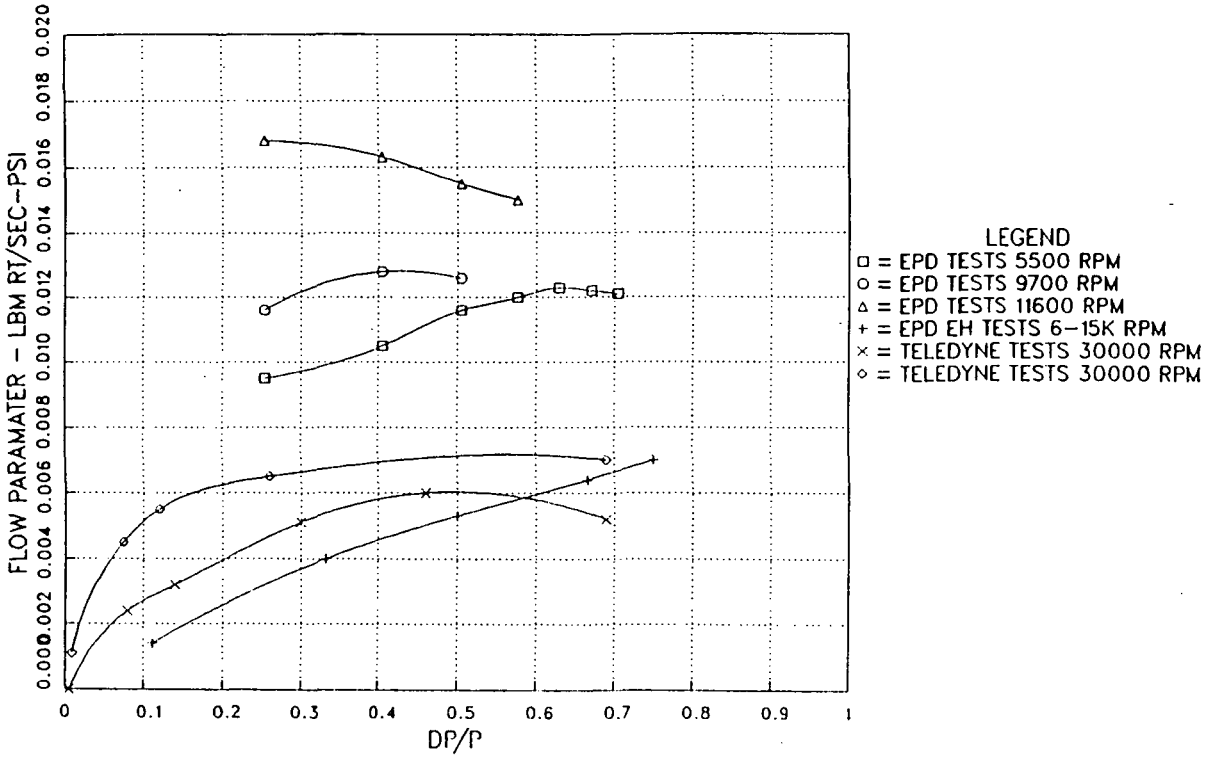
WIRE DIAMETER- d
TOTAL NUMBER OF BRISTLES- n_t
WIRE DENSITY- ρ

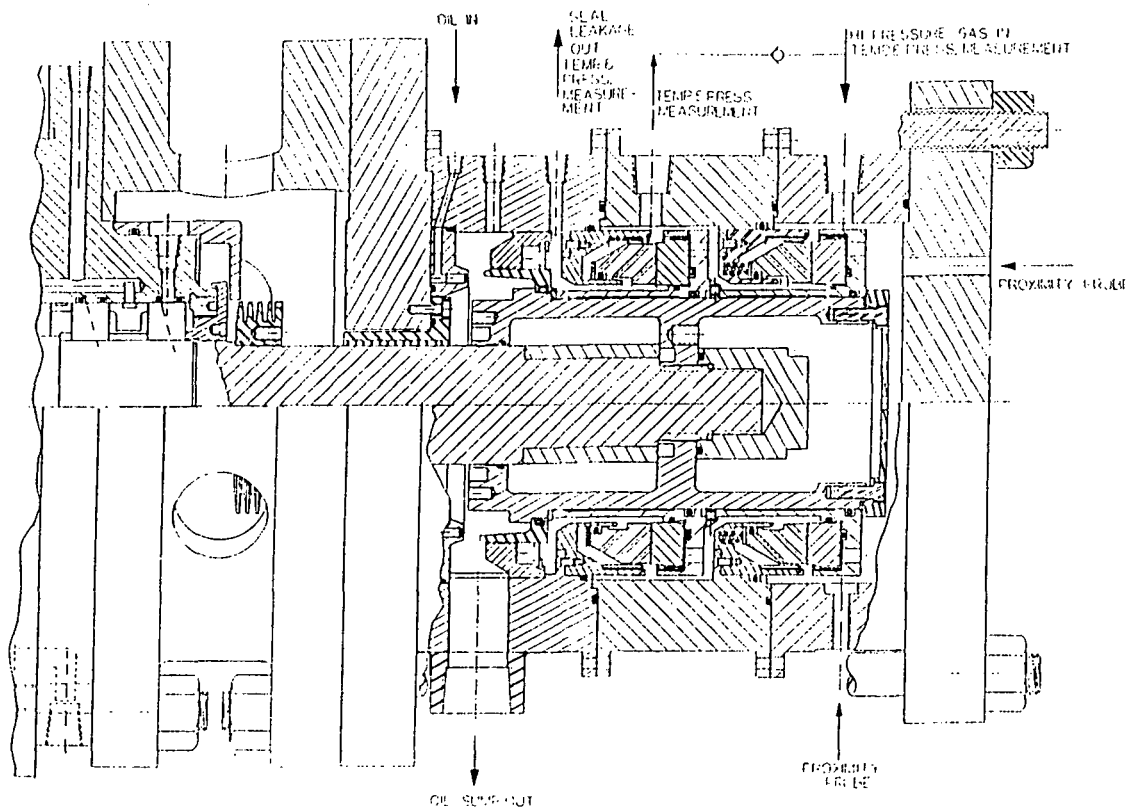
BRUSH SEAL ASSY.

FLOW PARAMATER VS DP/P. COMPARISON OF BRUSH SEAL AND LABYRINTH SEAL LEAKAGE

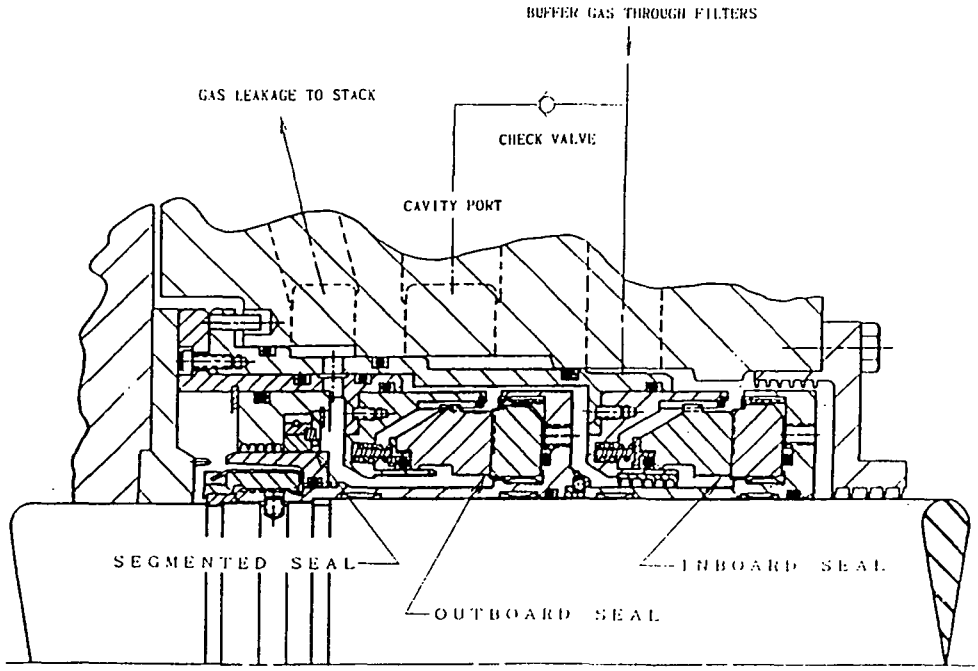


BRUSH SEAL LEAKAGE VS PRESSURE DROP



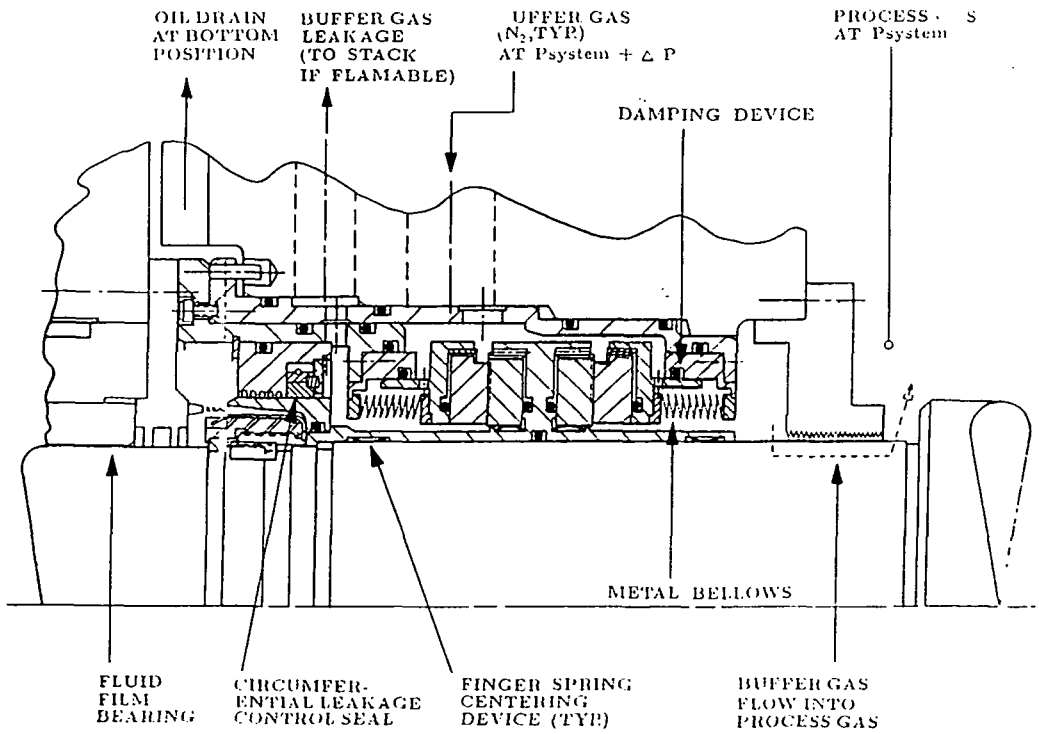


Test Seal As Installed In Seals Test Rig

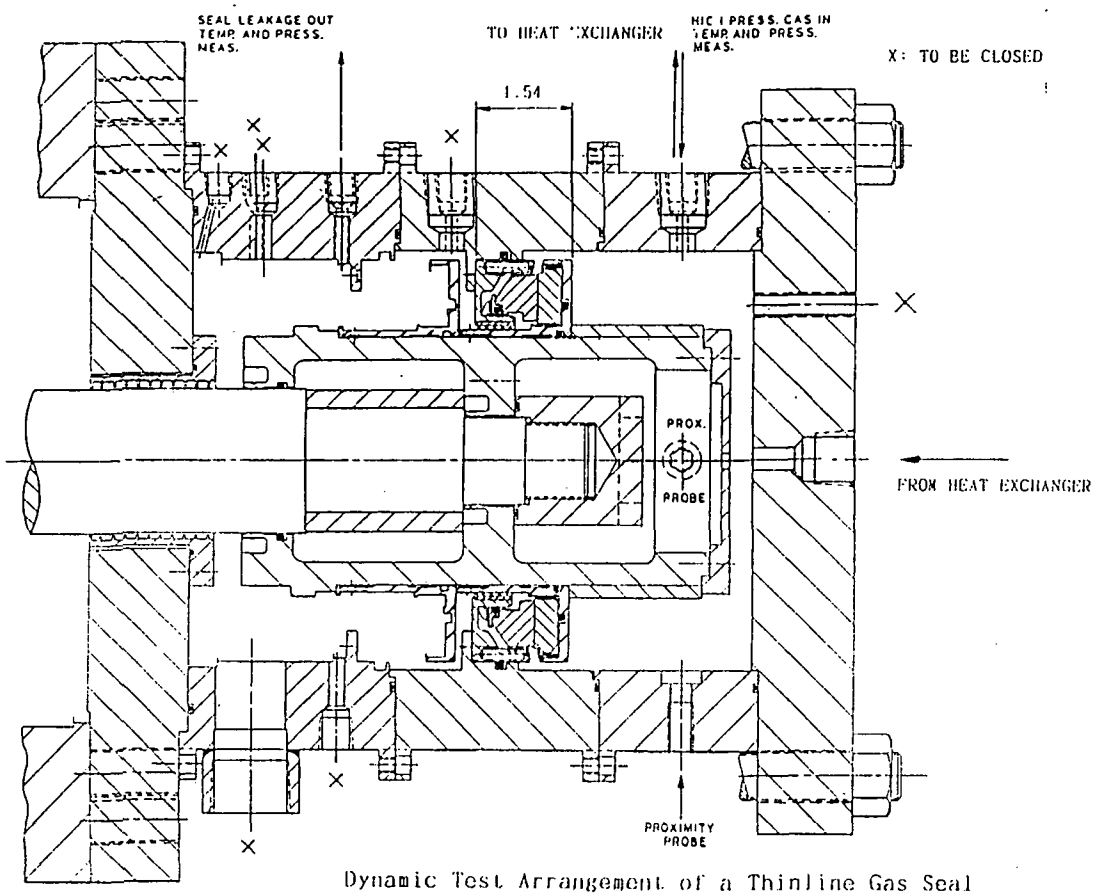


PATENT PENDING

Tandem Gas Face Seal - Shown in Thermodyn Centrifugal Gas Compressor



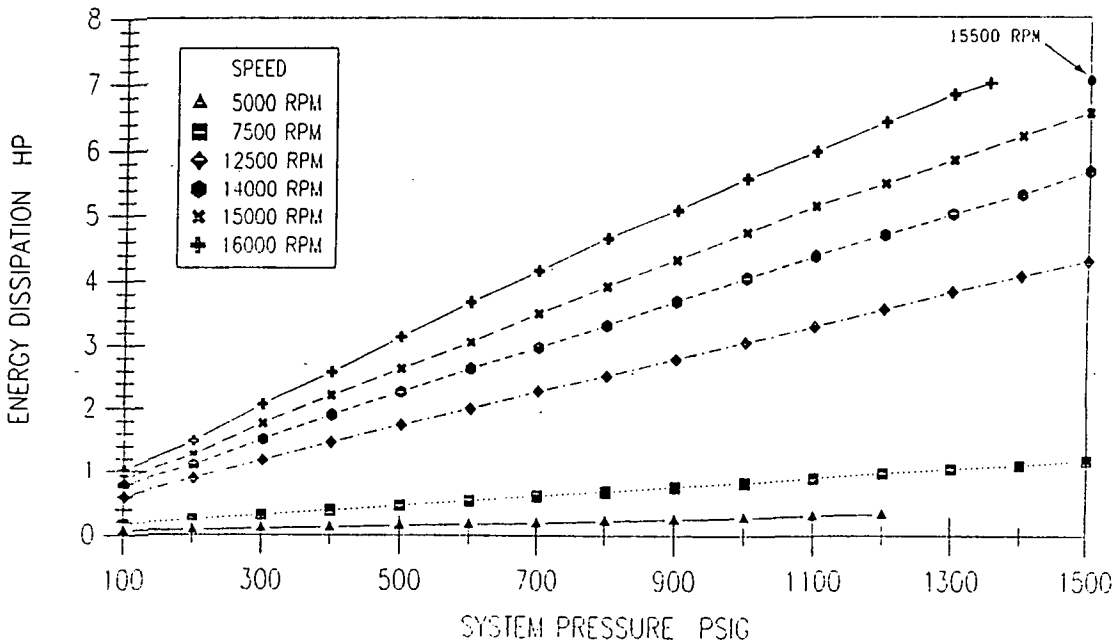
METAL BELLOWS GAS SEAL (PATENT PENDING)
(BUFFER GAS ARRANGEMENT)



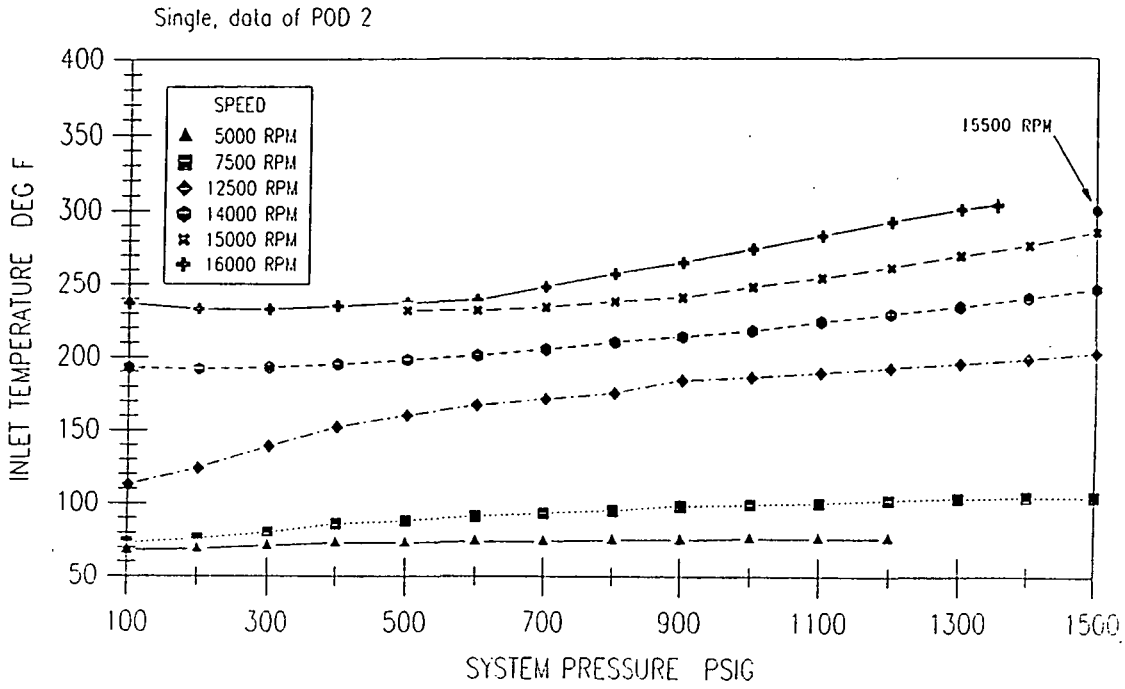
Dynamic Test Arrangement of a Thinline Gas Seal

Energy Dissipation vs. Pressure

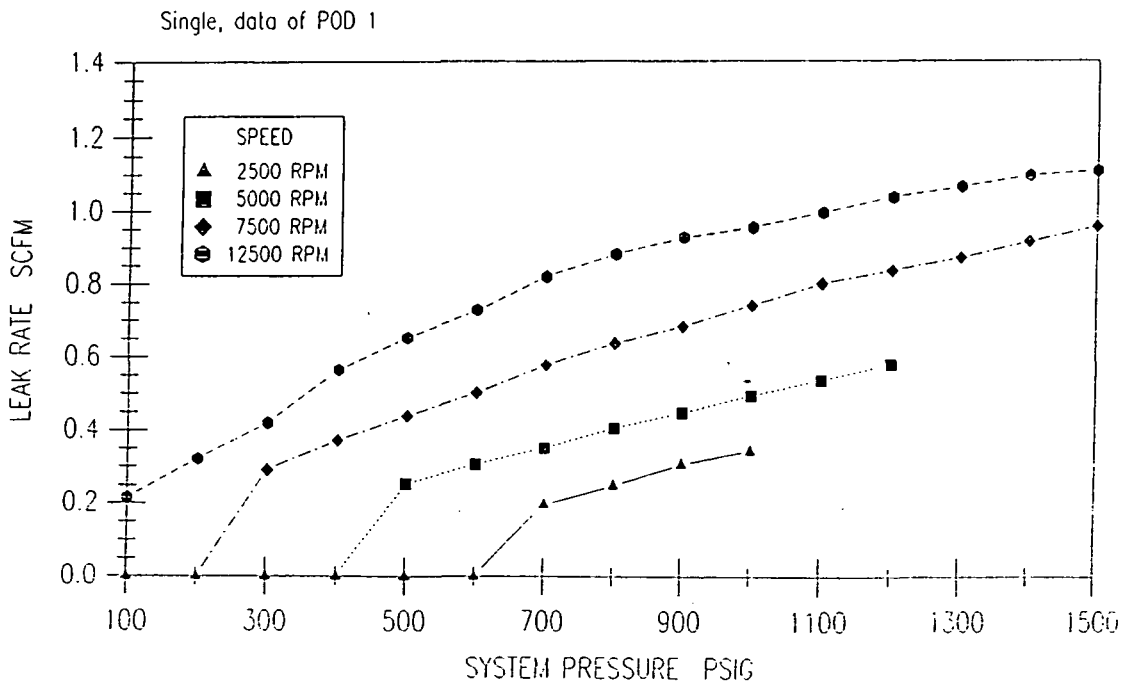
Single, data per pod



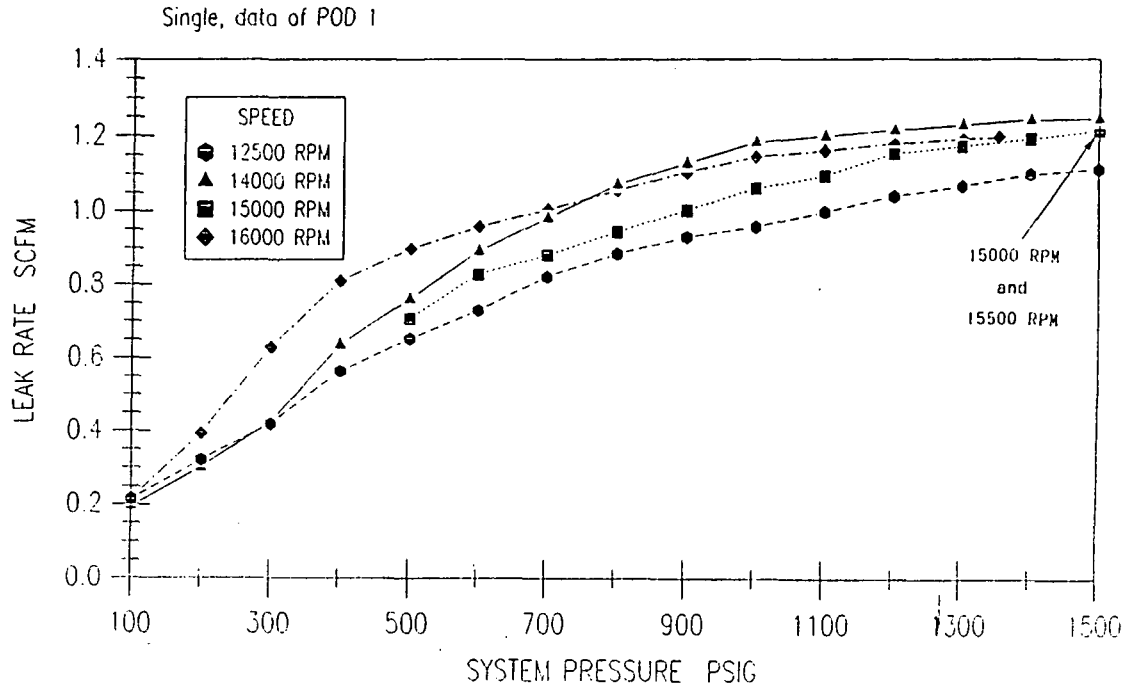
Inlet Temperature vs. Pressure



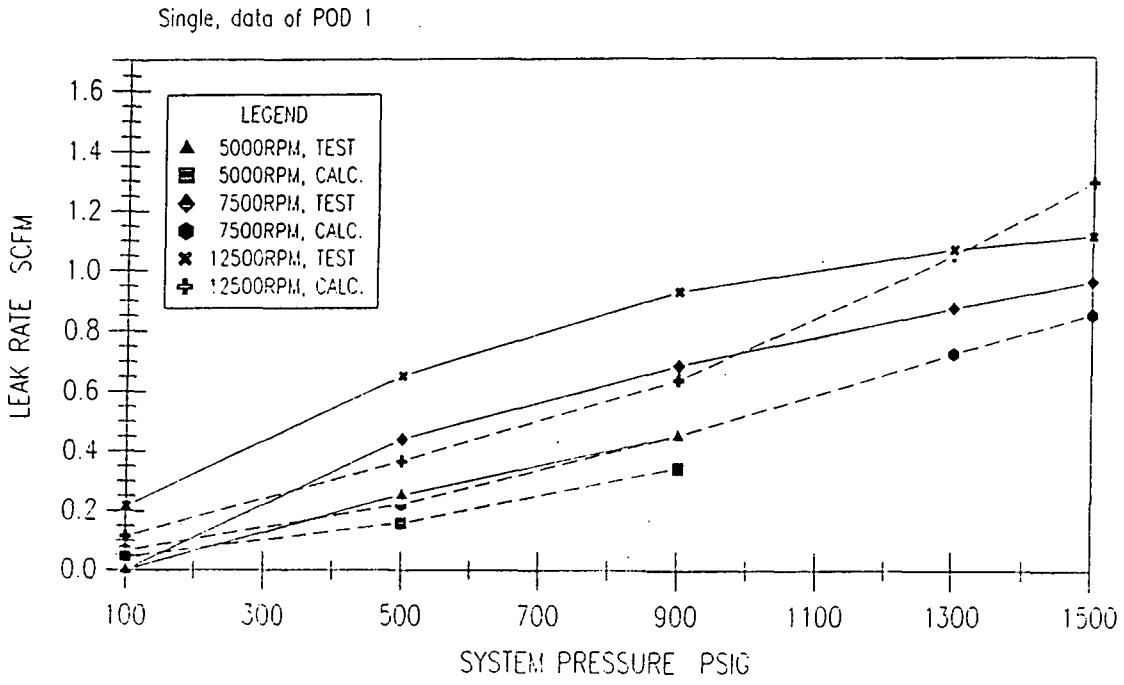
Leakage vs. Pressure



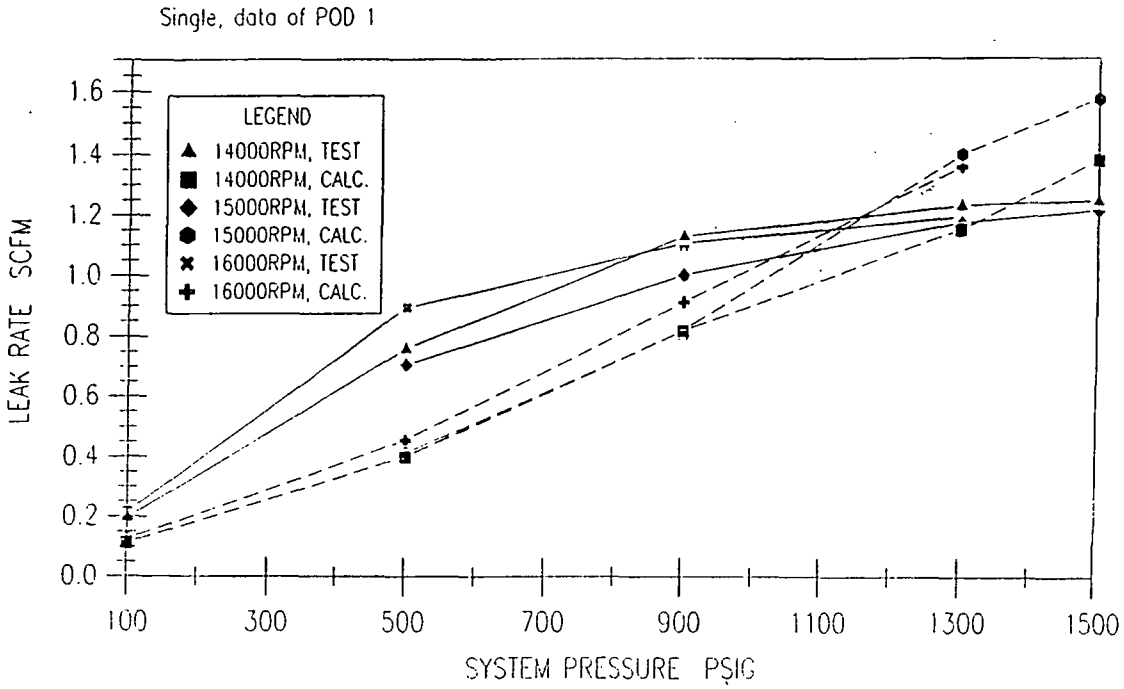
Leakage vs. Pressure



Leakage Correlation



Leakage Correlation



Unique Tribology Test Rigs

High Temperature
Oscillating Test Rig

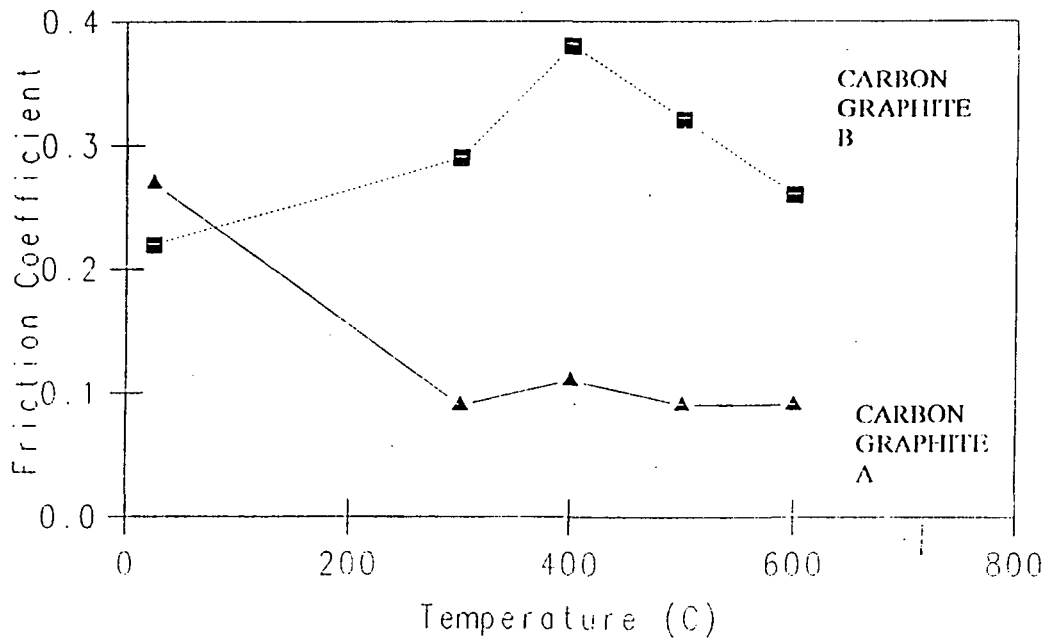
Two unique test rigs have been designed to evaluate the wear and friction of materials for aerospace sealing applications.

The first is a high temperature, oscillating rig used for tribological testing of materials for slide joints, static seals, solenoid valve plungers and similar aerospace applications exhibiting fretting type wear. It was designed and built at Group R&D to accurately record variations in the normal and tangential loads under oscillating conditions at temperatures up to 1400^0. the design of this rig uses a programmable motor which can duplicate acceleration and velocity profiles of various oscillating and low speed unidirectional motions. the test samples are enclosed in a furnace which can be purged using various atmospheres. A pneumatic loading system is designed to achieve high contact pressures (500 psi), applied pneumatically.

High Speed-High Temperature
Test Rig

The second is a high speed/high temperature rig designed to test materials for main shaft and gas-path seal applications where high surface speeds of up to approximately 400 feet per second at a shaft rotation of 60,000 rpm and light loads up to 2psi are used for testing. This rig has the capability of heating the tribo-pairs to 1200^0 while maintaining precise alignment at the seal interface. Loading of the seal face is accomplished using gas pressure applied to a bellows assembly such that precise increments of pressure can be selected for test purposes. This test rig is currently being used to investigate appropriate tribo-pairs for brush seal fibers and runners.

FRICTION OF CARBON GRAPHITE AT HIGH TEMPERATURES



WEAR OF CARBON GRAPHITE AT HIGH TEMPERATURE