

PRESSURE BALANCED, LOW HYSTERESIS FINGER SEAL TEST RESULTS

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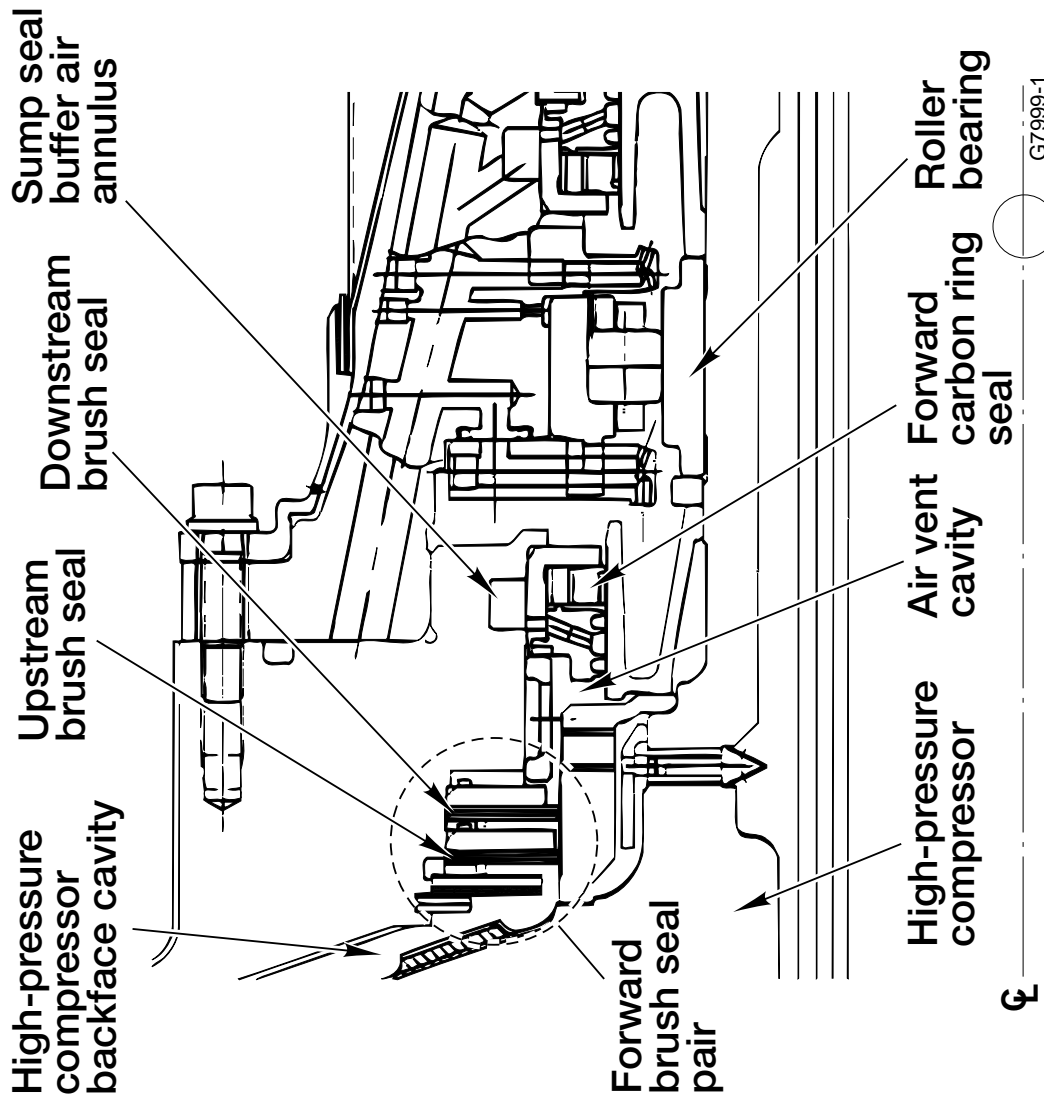
Pressure Balanced, Low Hysteresis Finger Seal Test Results

**Gul K. Arora
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**Margaret P. Proctor and Bruce M. Steinetz
NASA Glenn Research Center at Lewis Field**

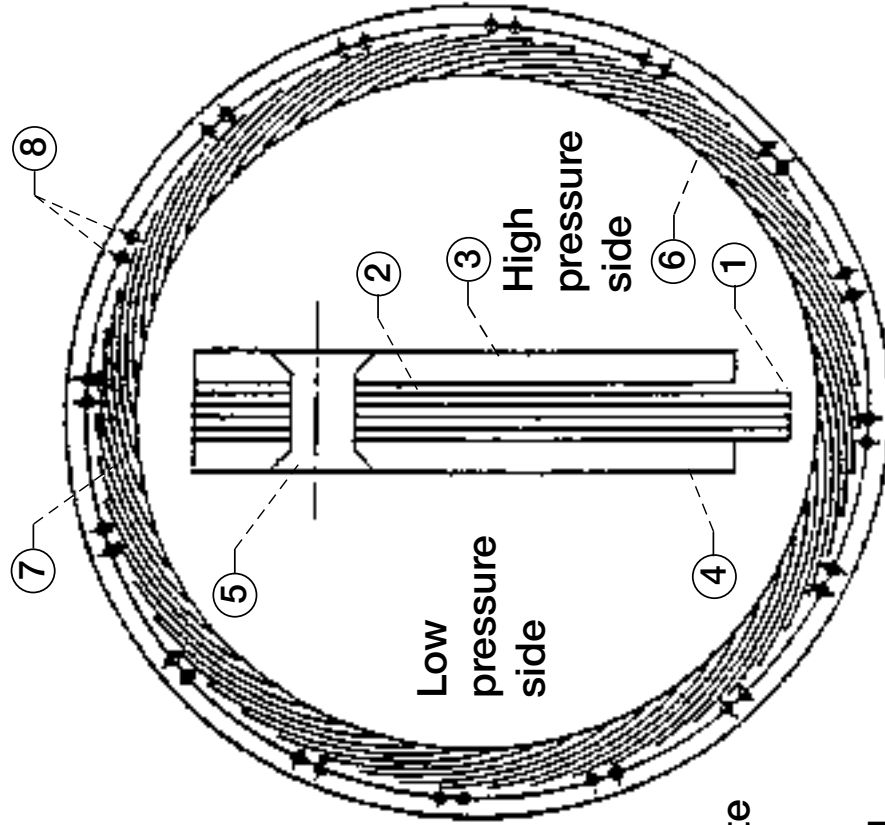
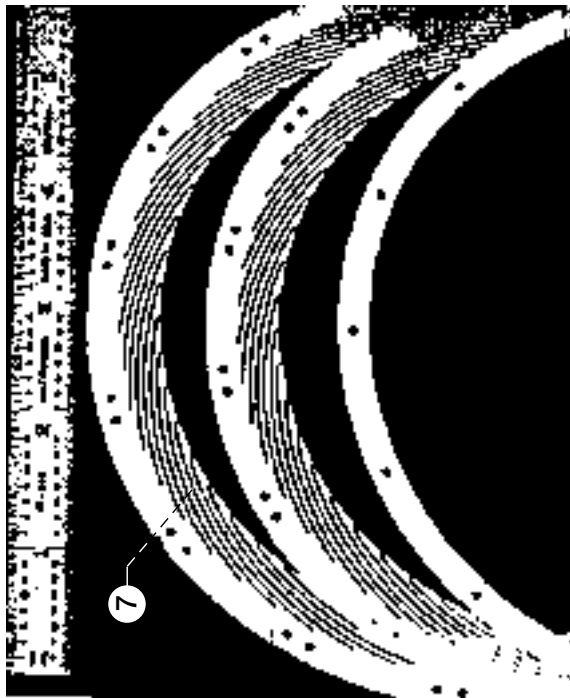
**Irebert R. Delgado
Army Research Laboratory
NASA Glenn Research Center at Lewis Field**

Typical Brush Seal Arrangement



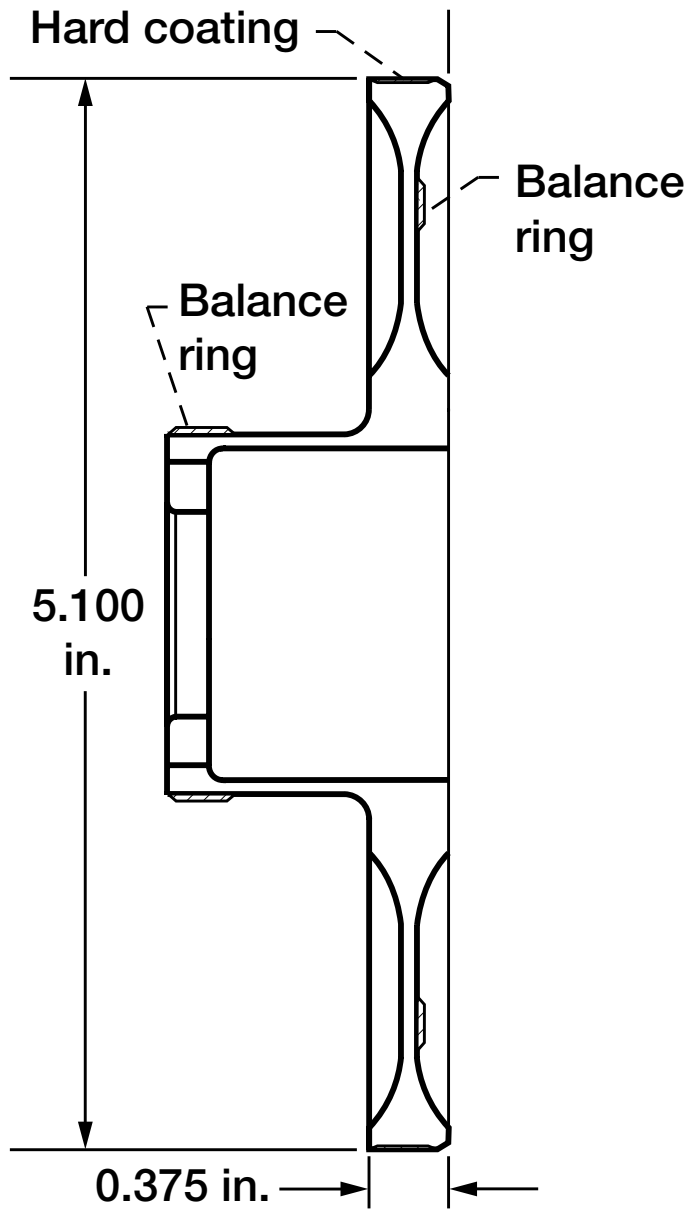
CD-99-79381

Baseline Finger Seal and Its Nomenclature



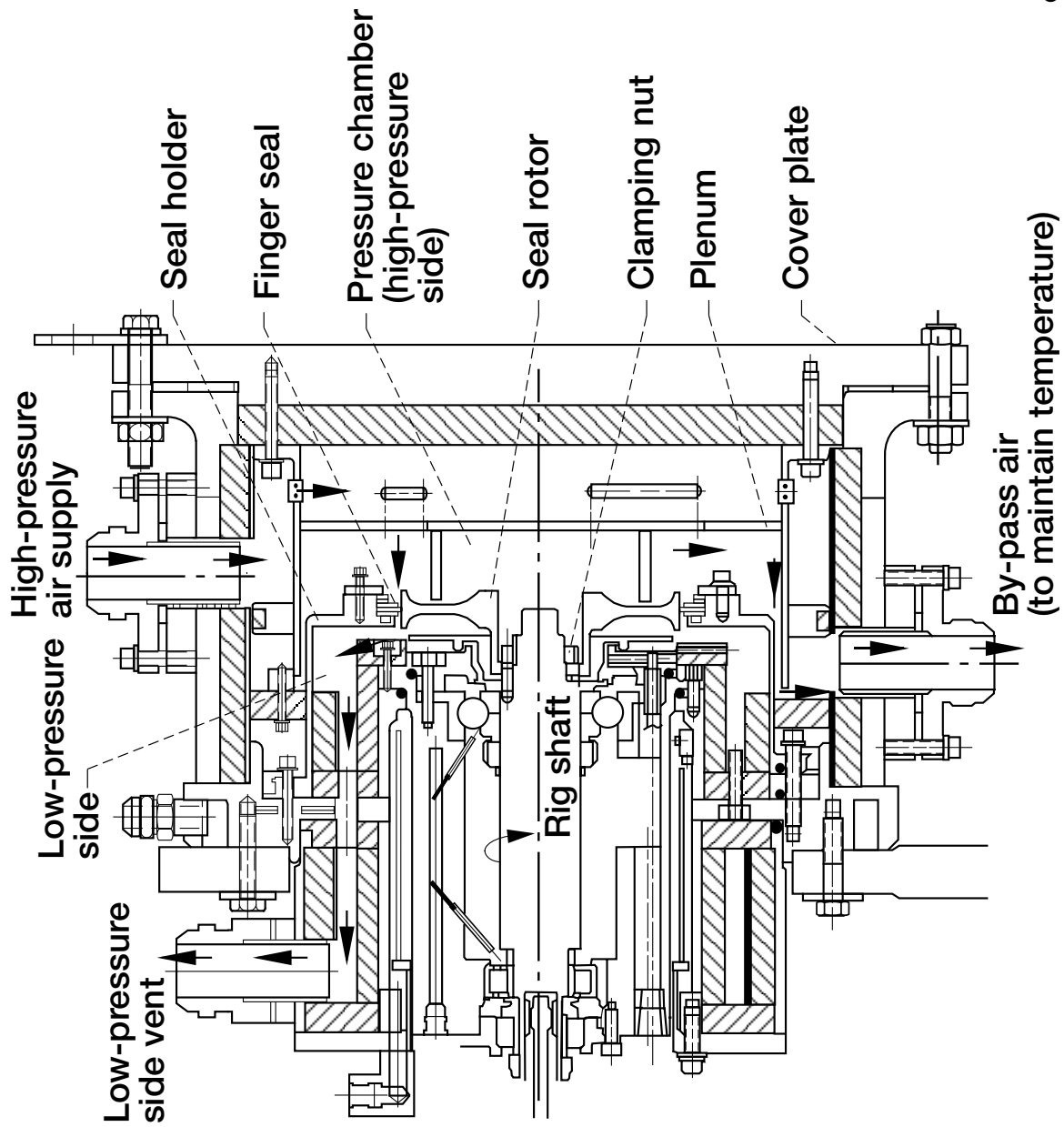
1. Finger element
2. Spacer
3. Forward cover plate
4. Aft cover plate
5. Rivet
6. Finger contact pad
7. Finger
8. Indexing and rivet holes

Finger Seal Test Rotor



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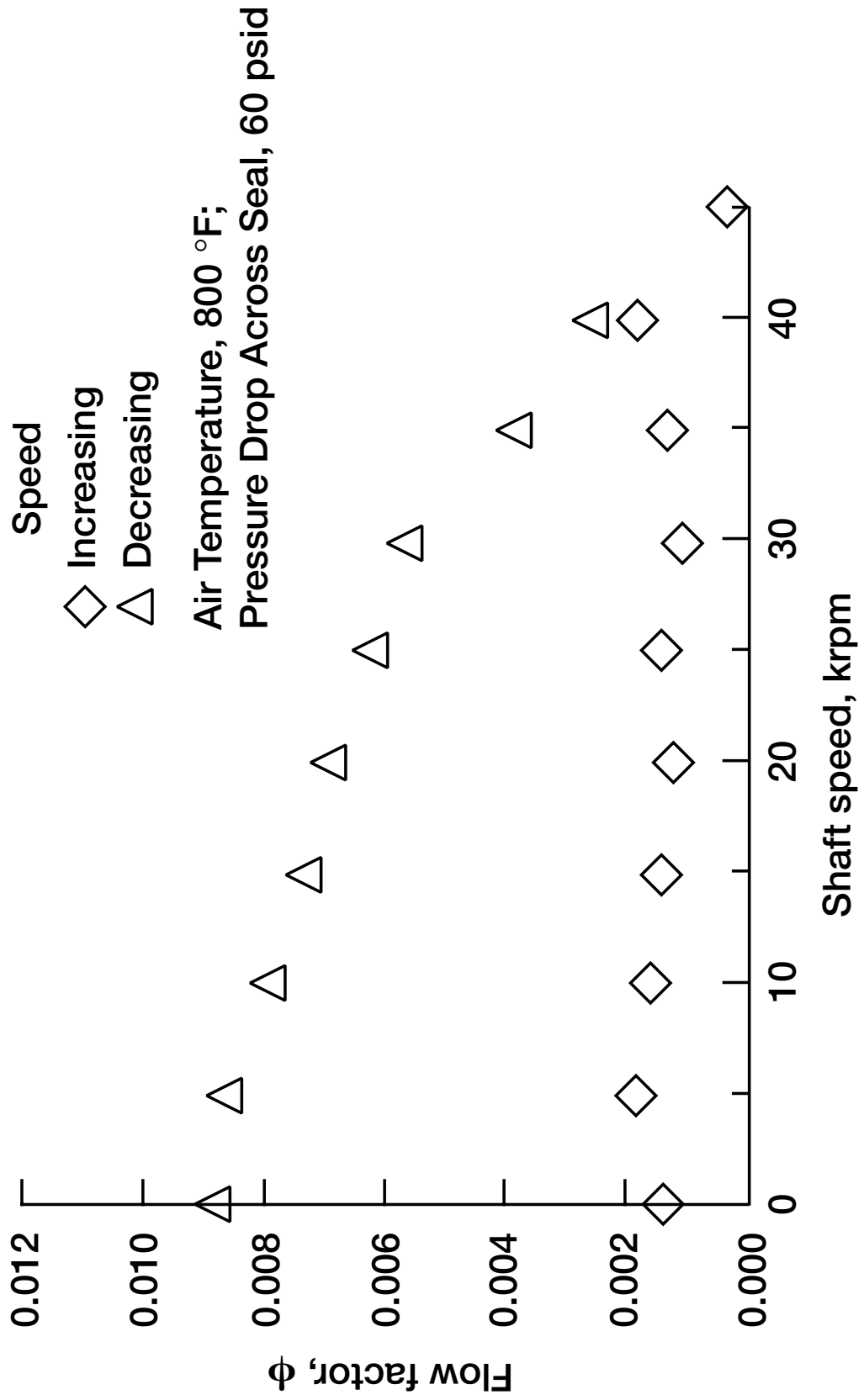
NASA Glenn Seal Rig Cross Section



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Baseline Finger Seal Hysteresis Test

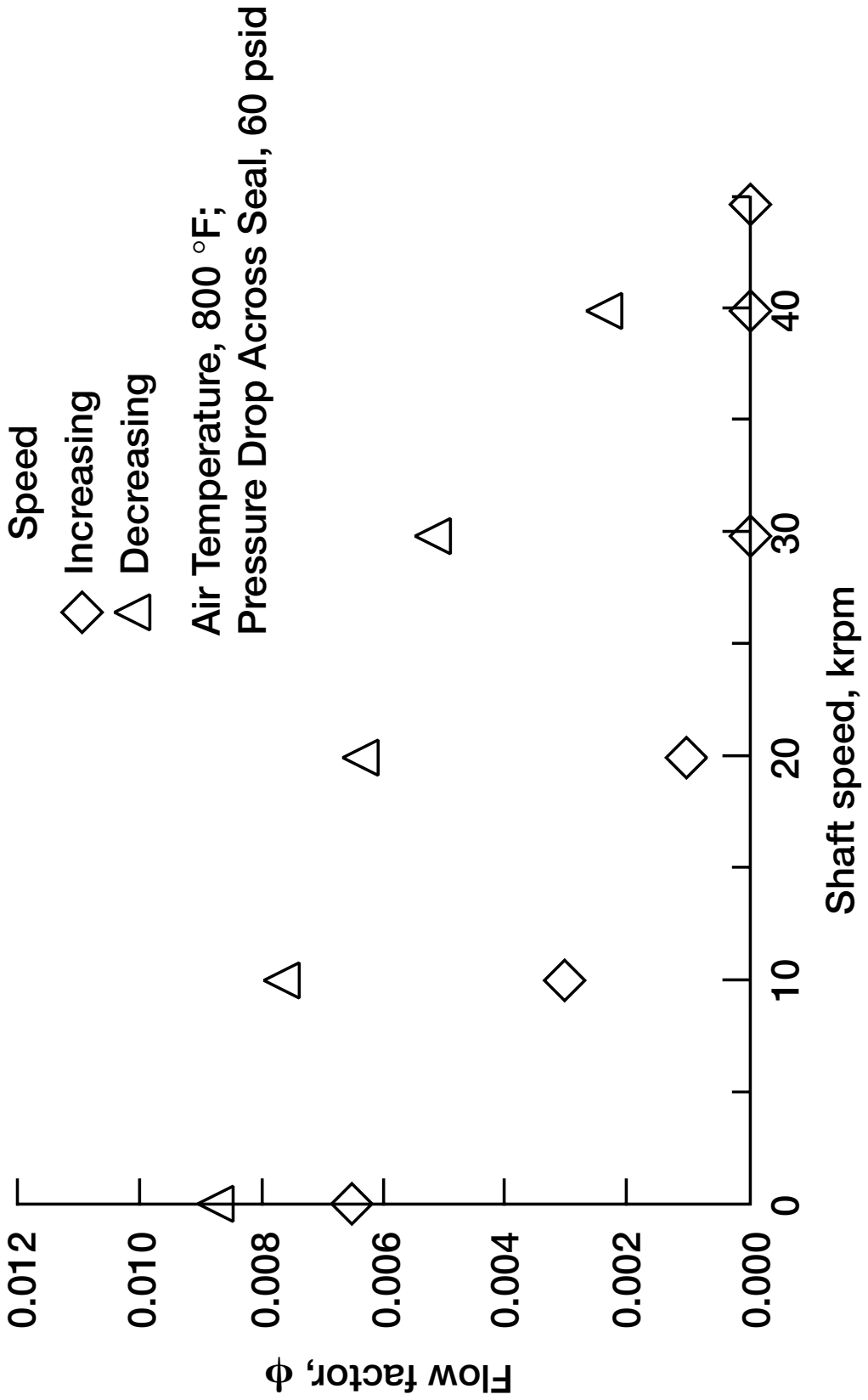
Speed Ramp Cycle 1



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Baseline Finger Seal Hysteresis Test

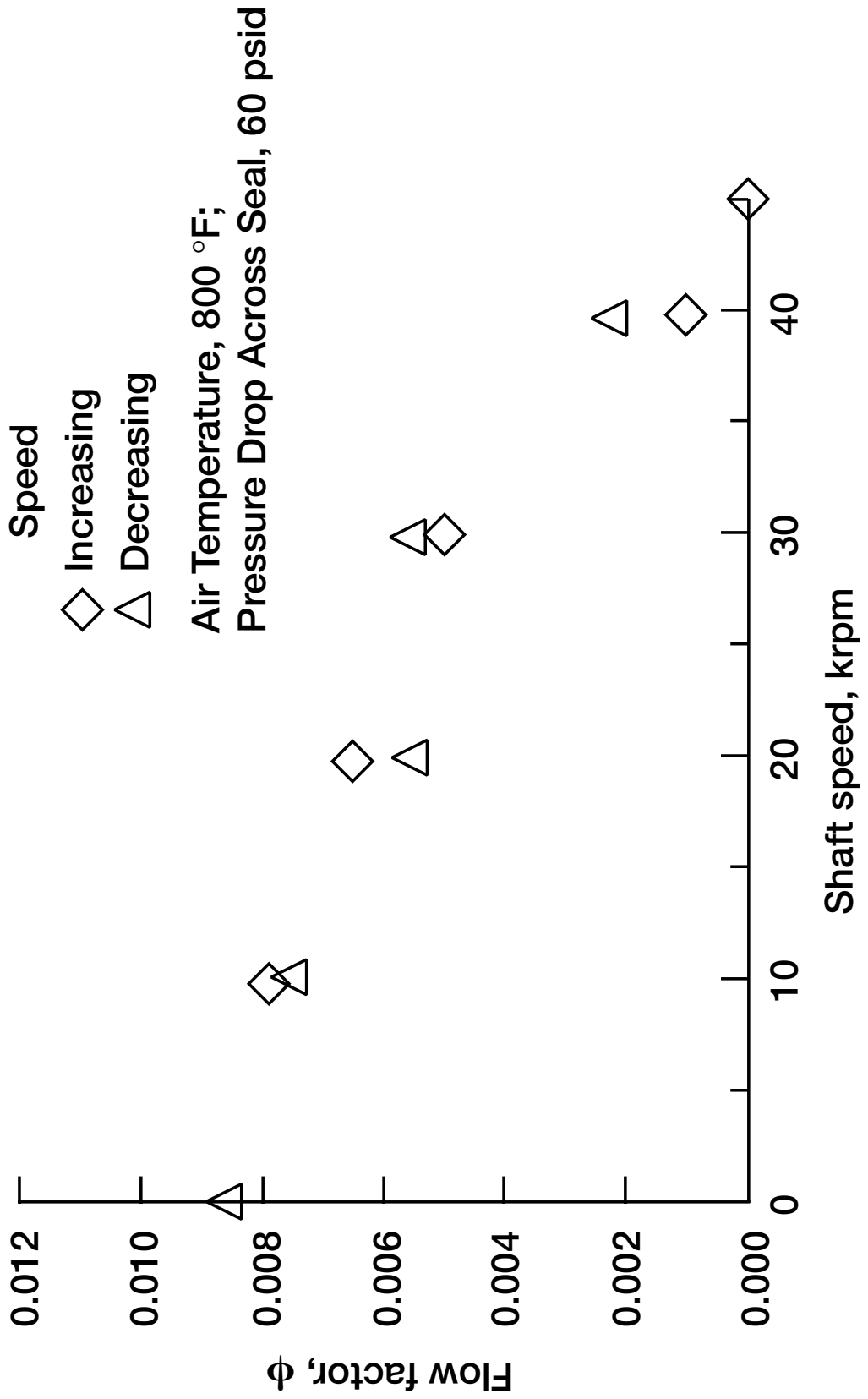
Speed Ramp Cycle 2



CD-99-79386b

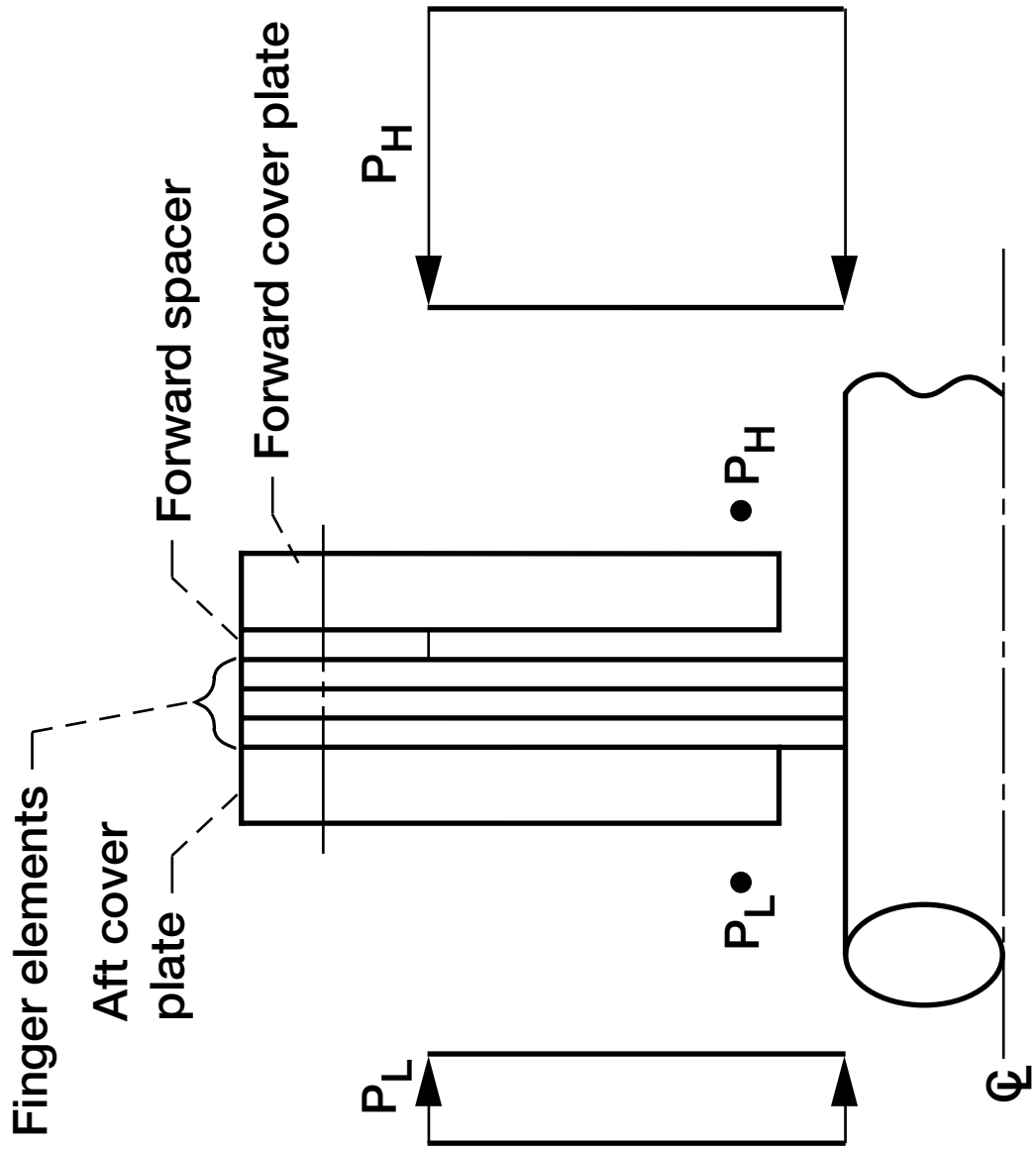
Baseline Finger Seal Hysteresis Test

Speed Ramp Cycle 3

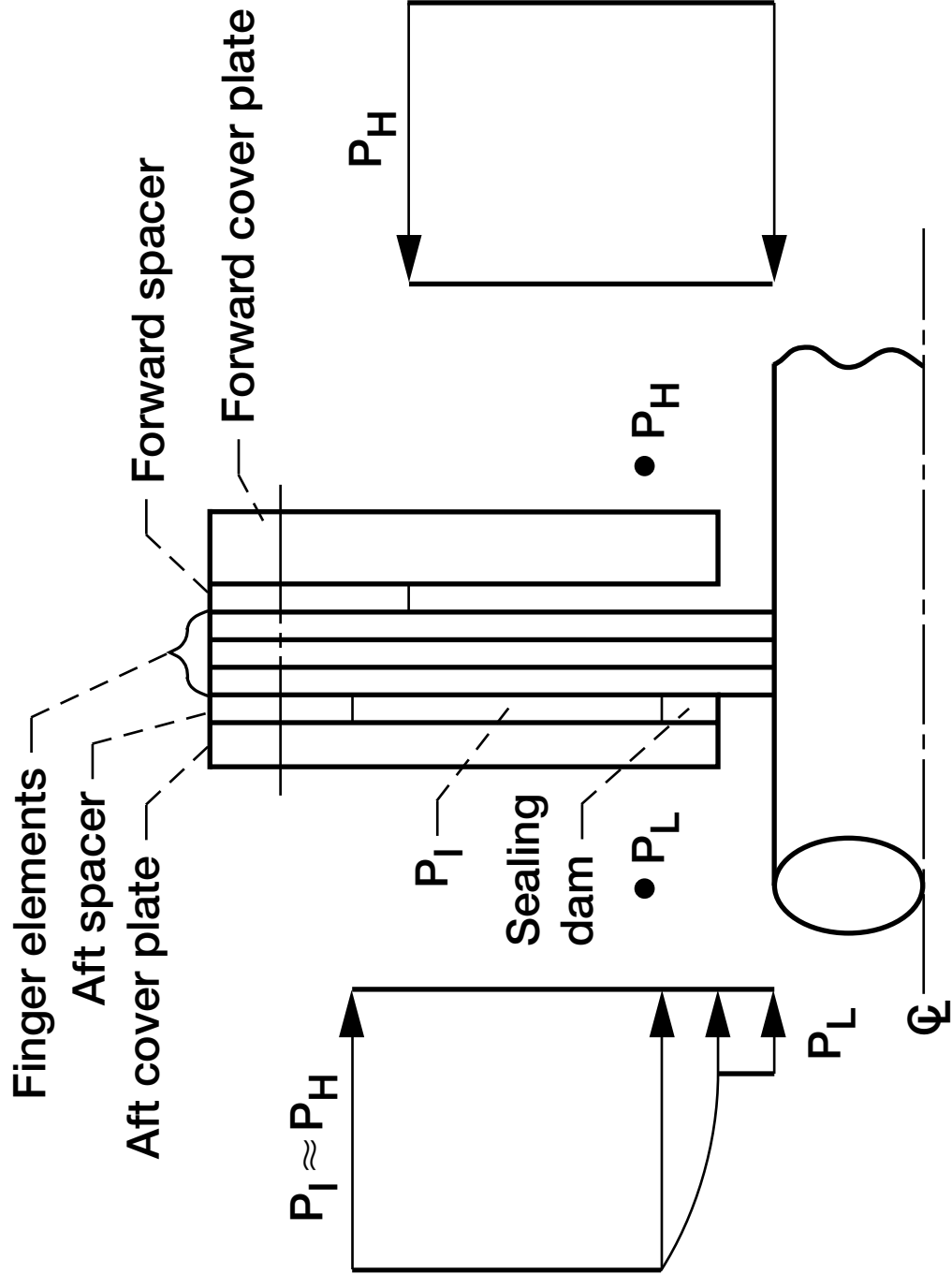


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Baseline Finger Seal Force Balance

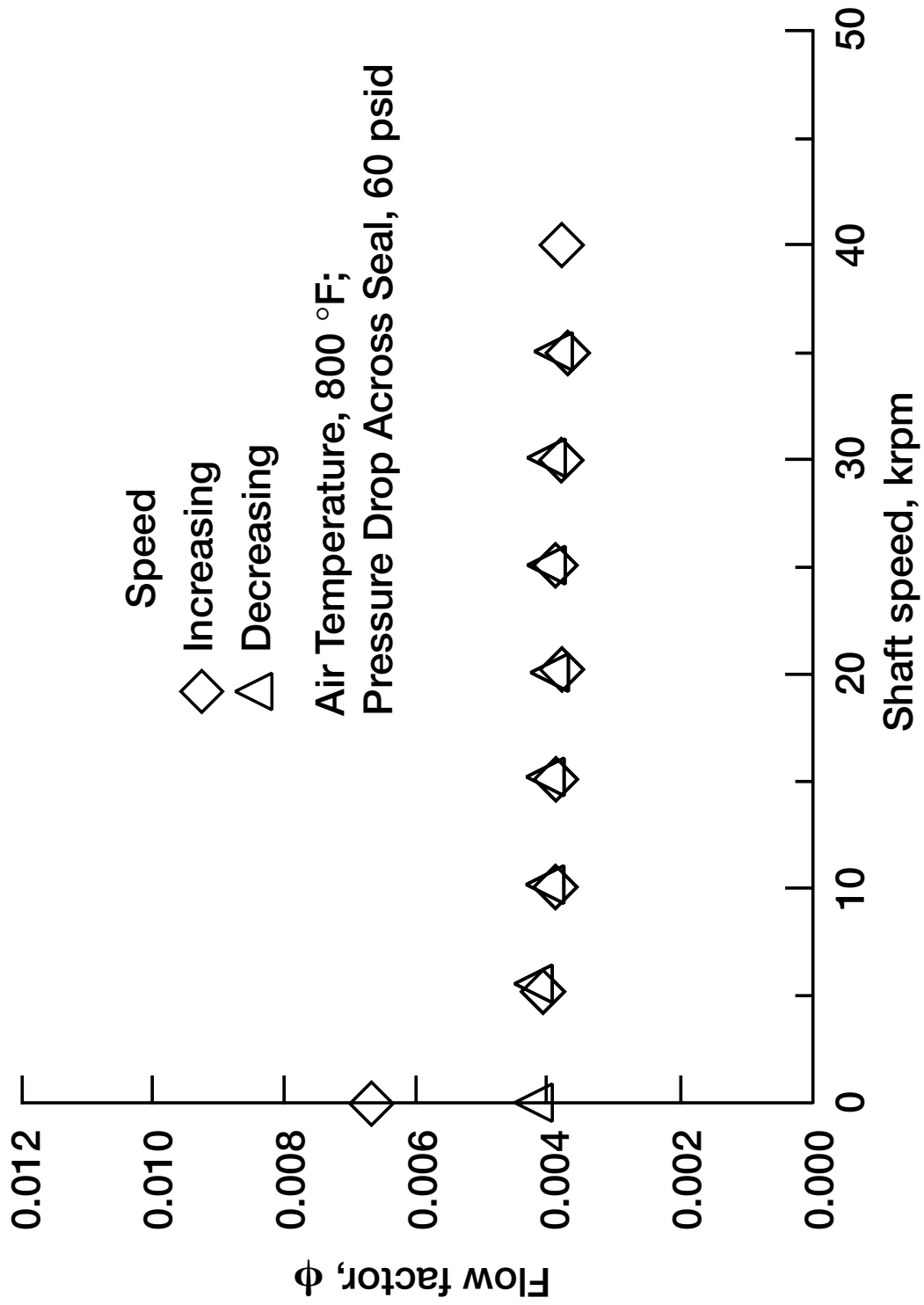


Pressure Balanced Finger Seal Force Balance



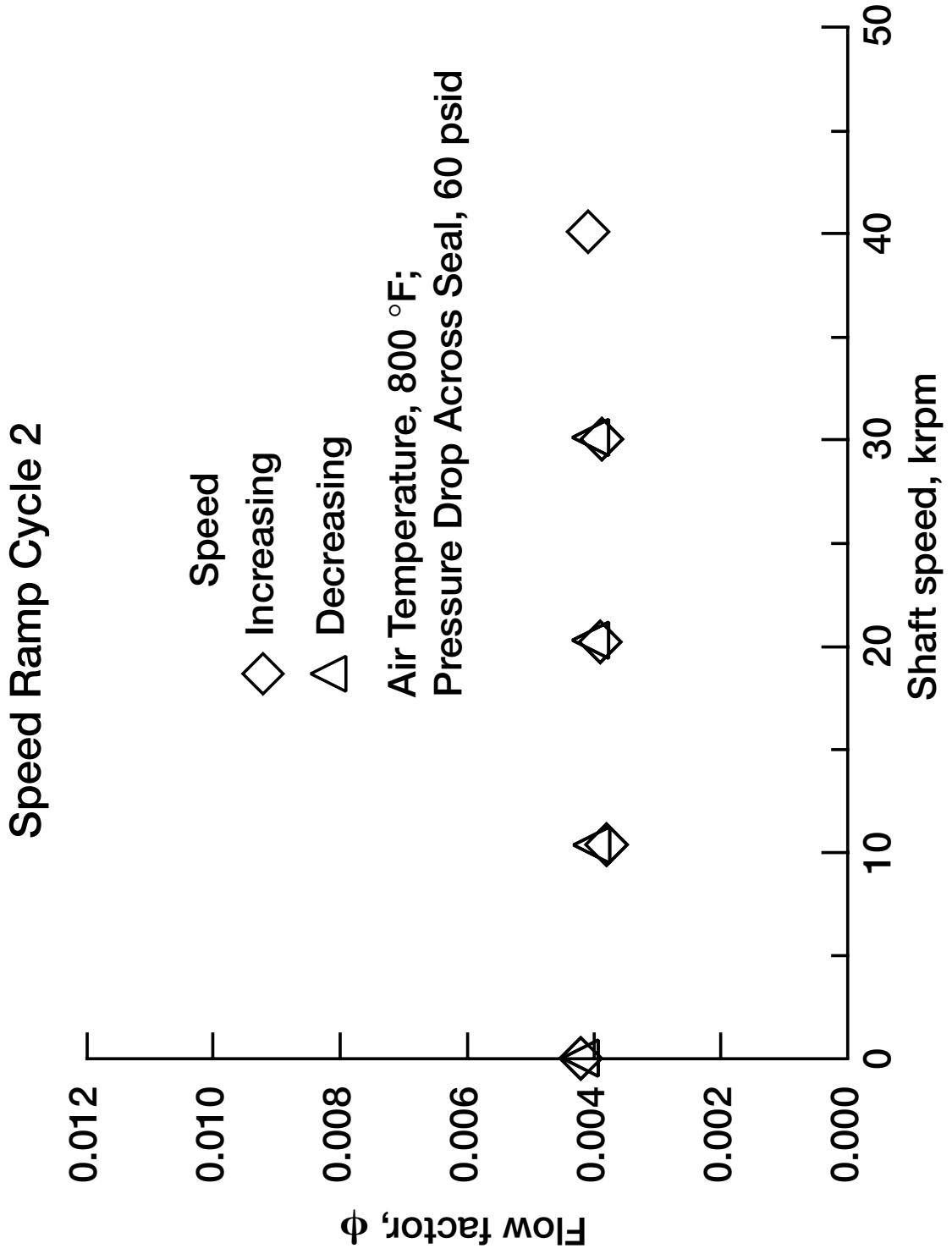
Pressure Balanced Finger Seal Hysteresis Test

Speed Ramp Cycle 1



CD-99-79389a

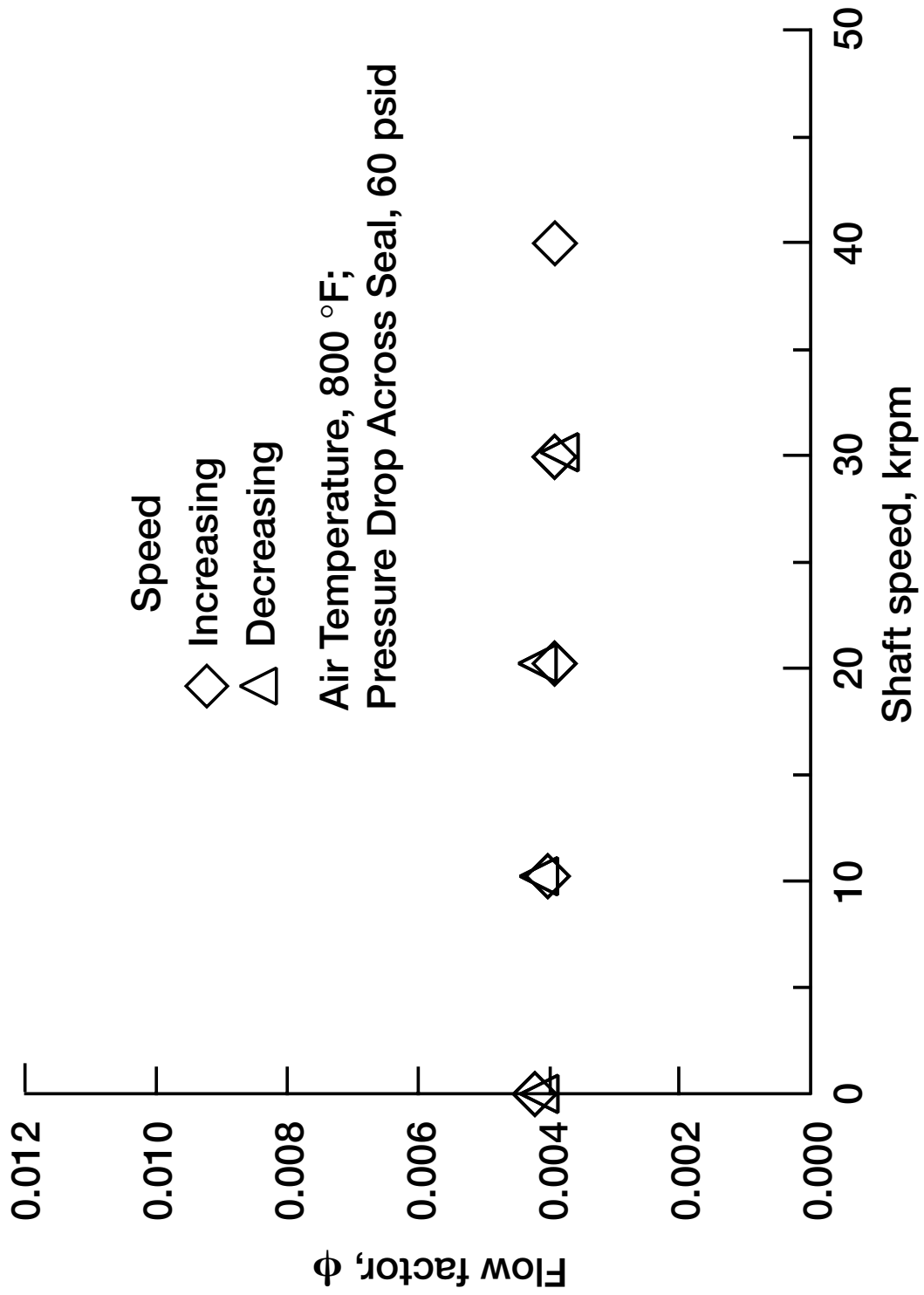
Pressure Balanced Finger Seal Hysteresis Test



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Pressure Balanced Finger Seal Hysteresis Test

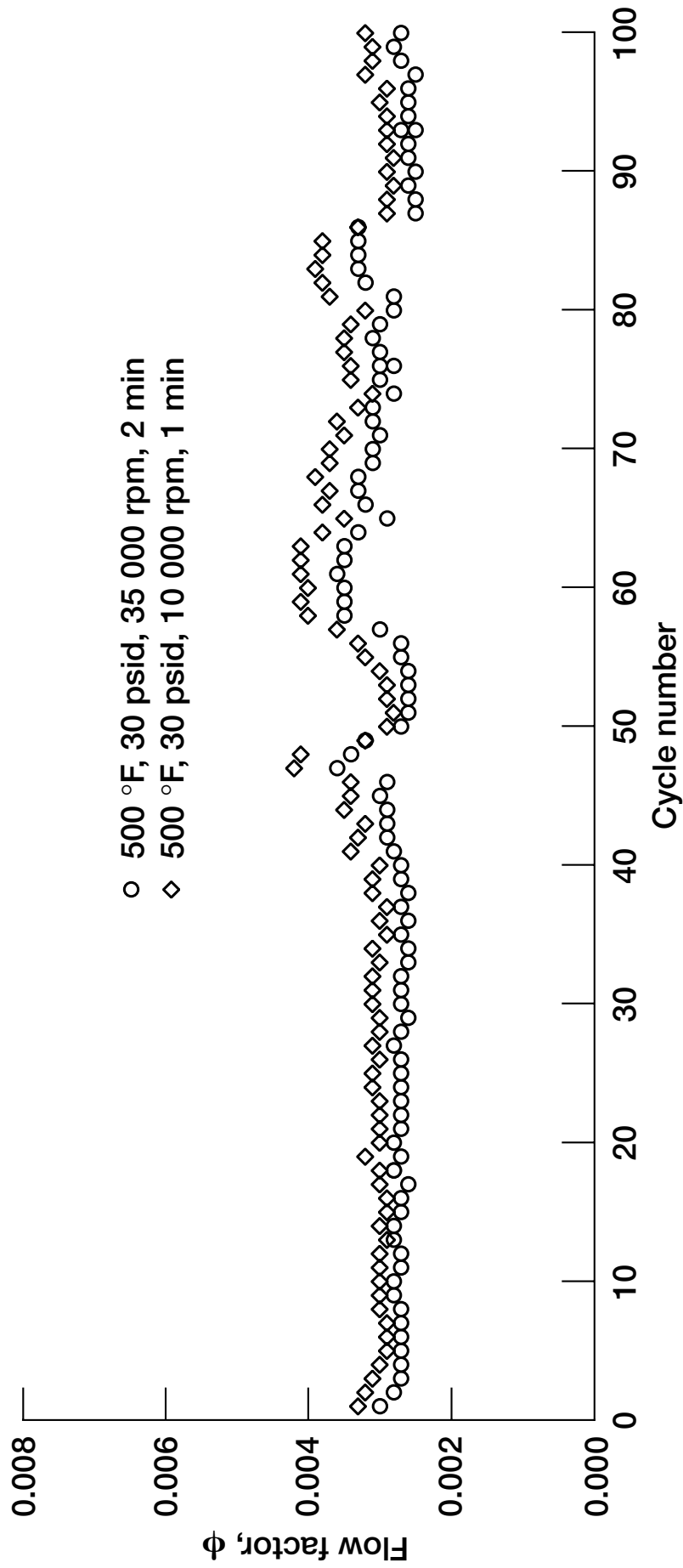
Speed Ramp Cycle 3



CD-99-79889c

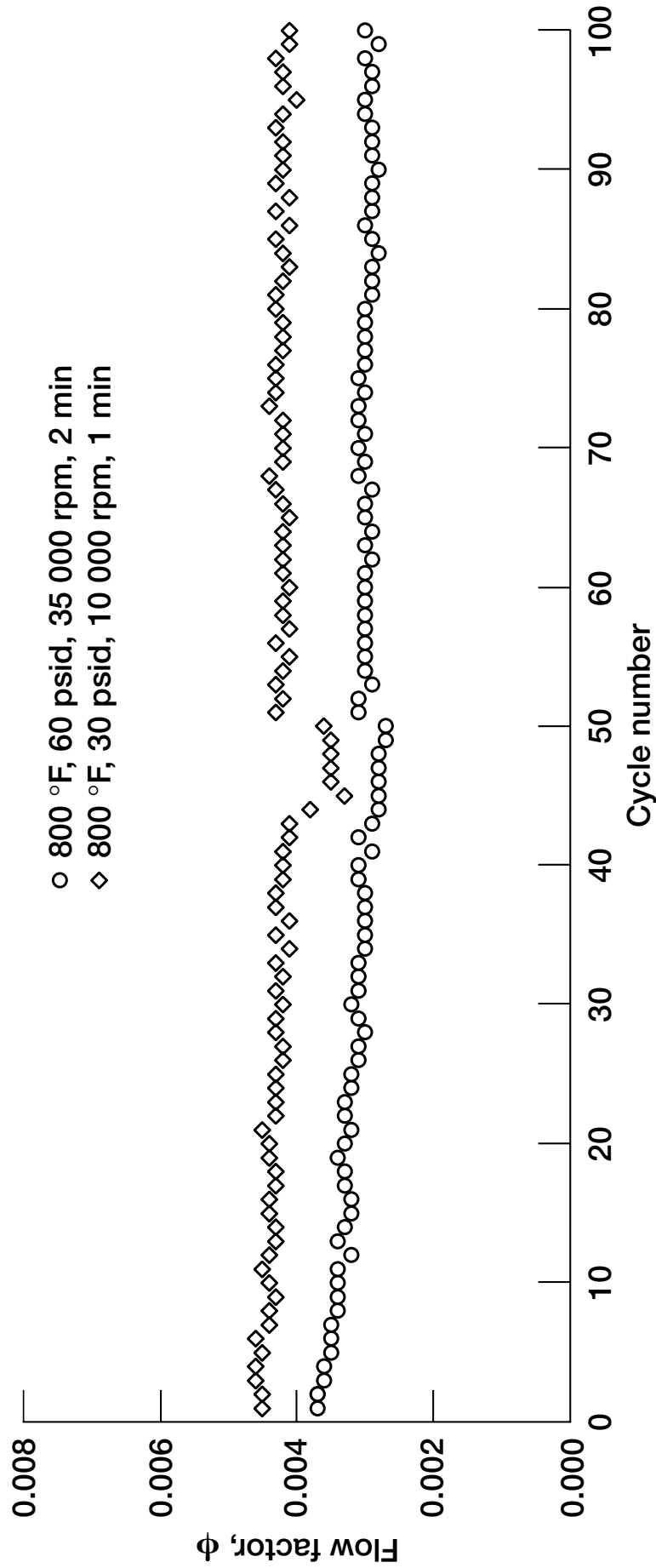
Segment 1

Pressure Balanced Finger Seal Rotor Run-Out Test



Segment 2

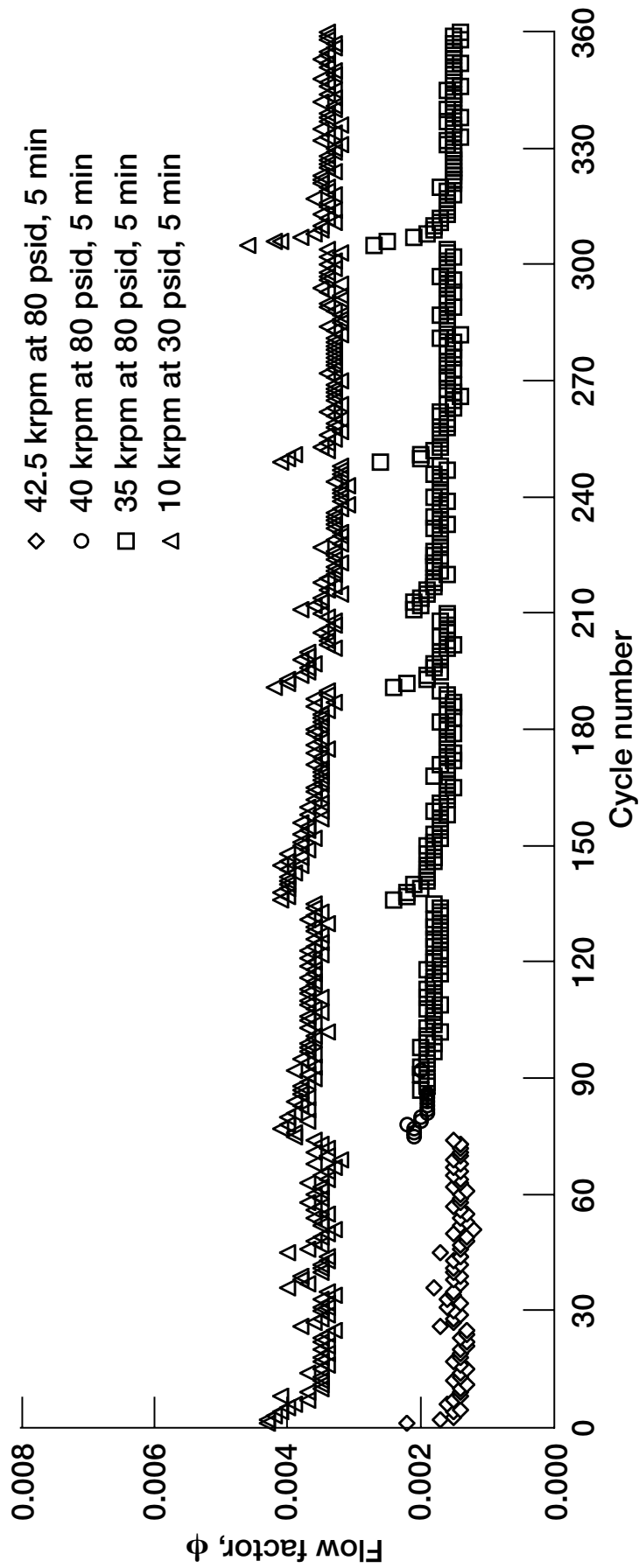
Pressure Balanced Finger Seal Rotor Run-Out Test



CD-99-79391

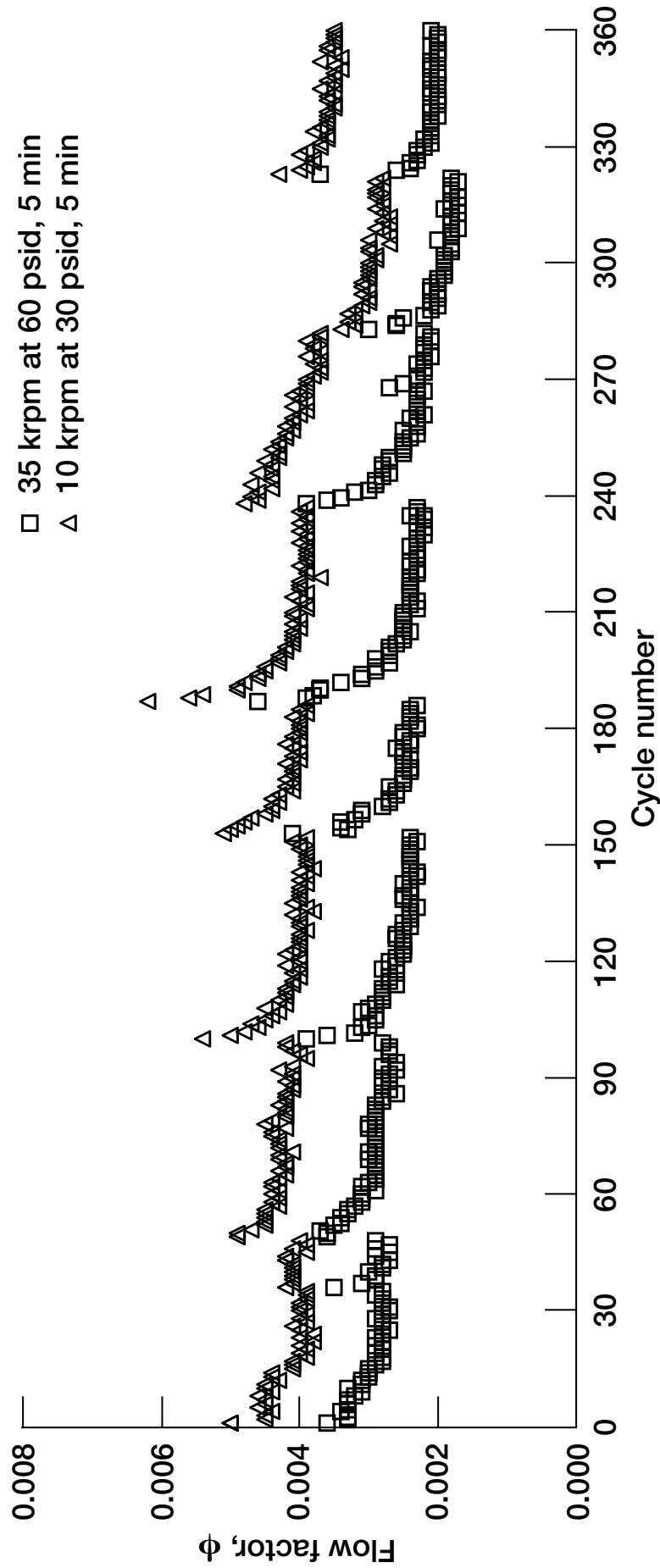
Segment 1 Pressure Balanced Finger Seal Endurance Test

Inlet Air Temperature, 800 °F

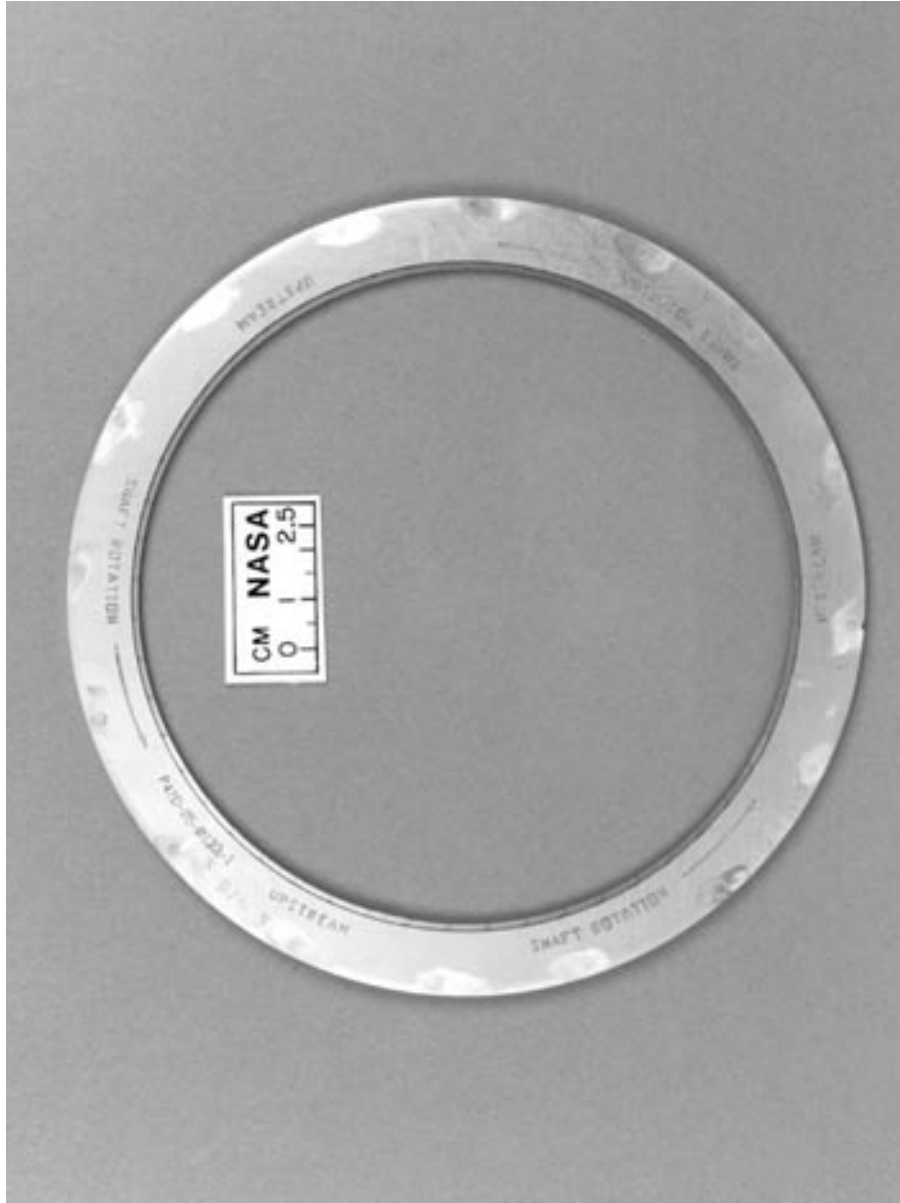


Segment 2 Pressure Balanced Finger Seal Endurance Test

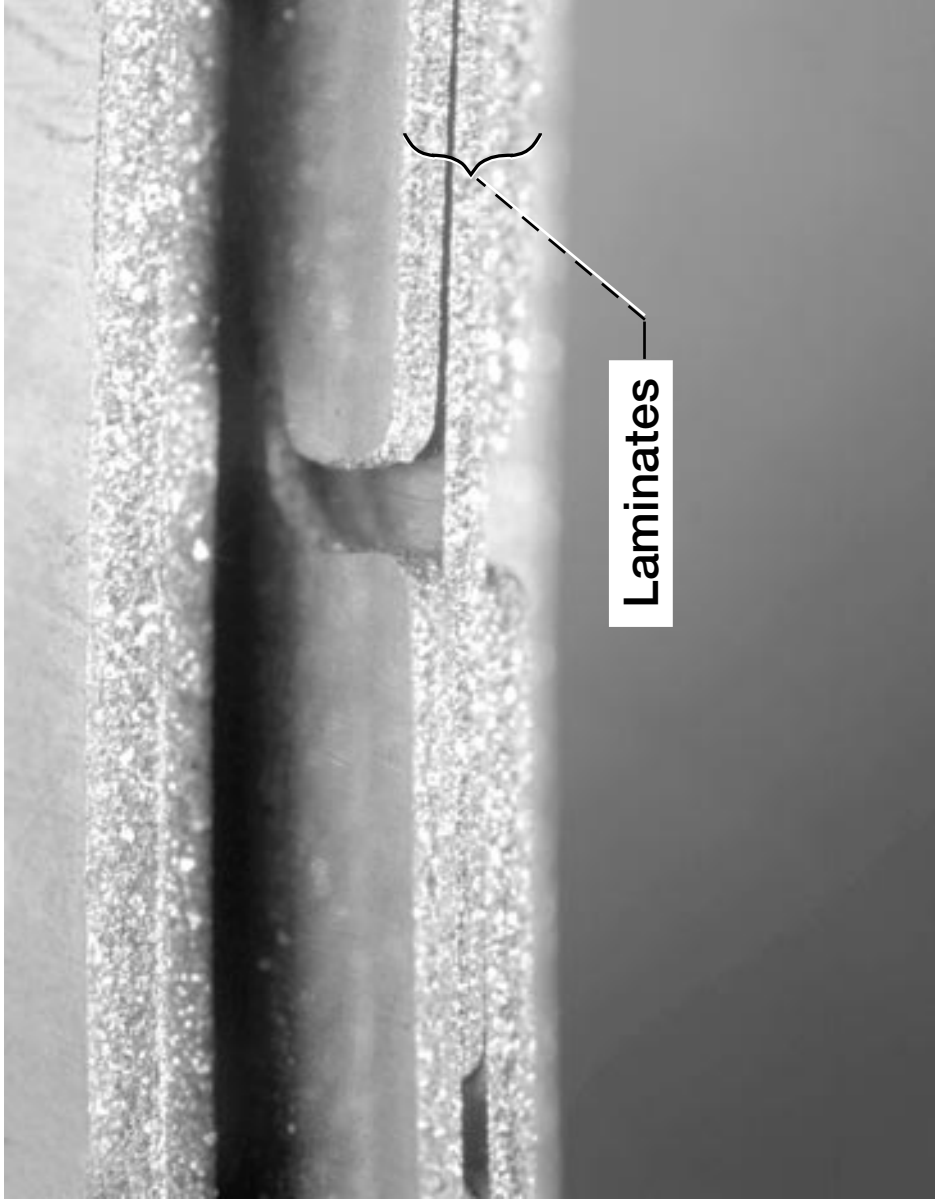
Inlet Air Temperature, 1000 °F



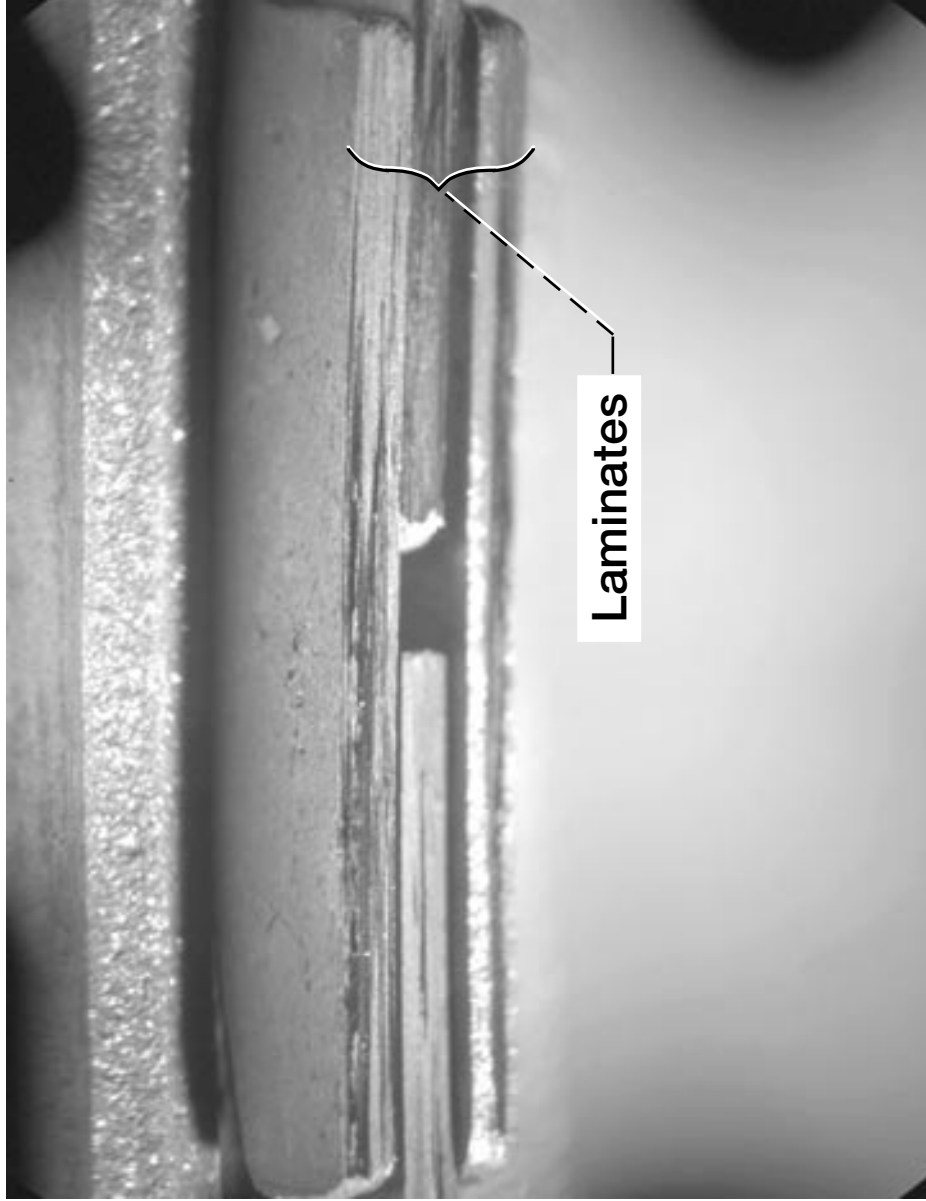
Overview of Pressure Balanced Finger Seal Prior to Endurance Test



Magnified View of Upstream Finger Pad i.d. of Pressure Balanced Finger Seal Prior to Endurance Test



Magnified View of Upstream Finger Pad i.d. of Pressure Balanced Finger Seal After Endurance Test



Conclusions

1. Low cost photoetching fabrication technique demonstrated.
2. Pressure balanced finger seal design demonstrated very low hysteresis in repeated rig testing.
3. Finger seal air leakage is 20 to 70% less than a typical four-knife labyrinth seal with 0.005 inch radial clearance.
4. Finger seal operation demonstrated at: 778 ft/s, 60 psid and 1000 °F.
and 945 ft/s, 80 psid and 800 °F.
5. Rotor-run out and endurance test results indicate finger seals have potential for long life applications.
6. Extensive analytical work and rig testing has resulted in a finger seal design that is ready for engine testing.