INCOMPRESSIBLE FACE SEALS—COMPUTER CODE IFACE

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Capabilities

(WOULD NOT SCAN)

- 2-D incompressible isoviscous flow
- Rotation of both rotor and housing
- Roughness in both rotor and housing
- Arbitrary film thickness distribution, including steps, pockets and tapers
- 3 degrees of freedom
- Dynamic coefficients
- Prescribed Force and Moments
- Pocket pressures or orifice size
- Turbulence, Couette and Poiseuille
- Cavitation
- Inertia pressure drops at inlets to film (from seal ends and from pressurized pockets)

Assumptions

- Small film thickness
- Constant pocket pressures
- Isotropic roughness
- Negligible film inertia

Arbitrary Film Thickness

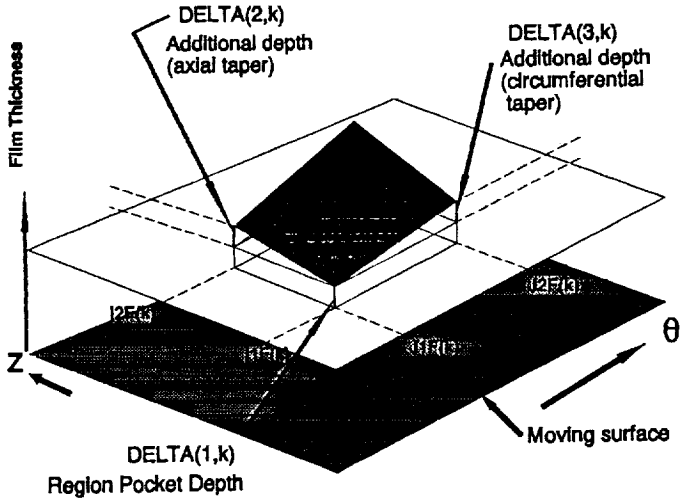
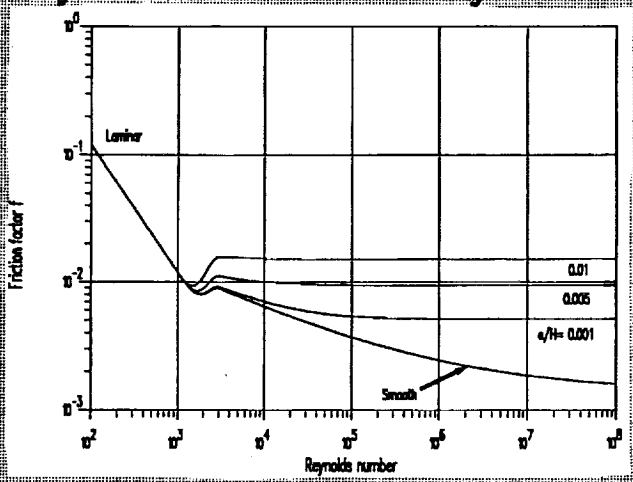


Figure 10 Arbitrary film thickness specification

Friction Factor

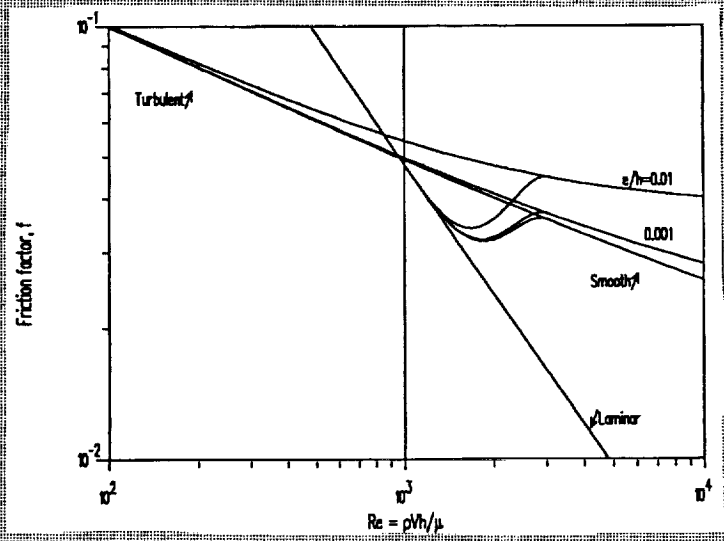
- Curve Fit by Nelson to Moody's Data*



*Nelson, C. C., Ngyen, D. T., *Comparison of Hir's Equation with Moody's Equation for Determining Rotordynamic Coefficients of Annular Pressure Seals*, Trans ASME, Journal of Tribology, Jan. 1987, pp. 144-148

Transition Friction Factor

- Cubic polynomial to match values and slopes at both ends



Sample Problems

Case	Mesh size MxN	Variables specified	Variables calculated	NPADS	run time (sec)	features
1	5x11	EX, ALFA			3.75	variable grid, DELTA(1,1)
2A	5x31	FXG, MXG, MYG	EX,ALFA, BETA	3	125	prescribed force & moments, DELTA(5,1)
3A	7x41	PPOCK	DORIF, K,B	4	404	4-pocket, calculation of orifice & coefficients
3B	7x41	DORIF, EX,BETA	PPOCK	4	352	4-pocket, prescribed displacements
3C	7x41	DORIF, FXG, MXG,MYG	PPOCK, EX, ALFA,BETA	4	566	4-pocket, prescribed force & moments, pressures read
13	9x37		K, B	4	1093	preloaded pads, roughness multiple cases, DELTA(4,1)
17	9x65	ALFA		8	103	8 Rayleigh steps
15A	10x61	PPOCK	DORIF, K,B	4	2115	4-pocket with XKE=1
15B	10x61	DORIF, EX, MXG, MYG	ALFA,BETA, PPOCK	4	1368	4-pocket finding angular position, pressures read

Table 3 Summary of sample cases

Sample 13, Effect of Roughness on Torque and Direct Stiffness

roughness (mils)		torque	K_{zz}	$K_{\alpha\alpha} = K_{\beta\beta}$
rotor	housing	(in-lb)	(10^8lb/in)	(10^8lb-in/rad)
0.02	0.02	2,900	245	1,956
0.02	0.00	2,354	158	1,153
0.00	0.02	2,366	263	2,035
0.00	0.00	2,006	184	1,337

Table 4 Effect of roughness on torque and direct stiffnesses

4-Pocket Seal, Film thickness and Pressure Distribution

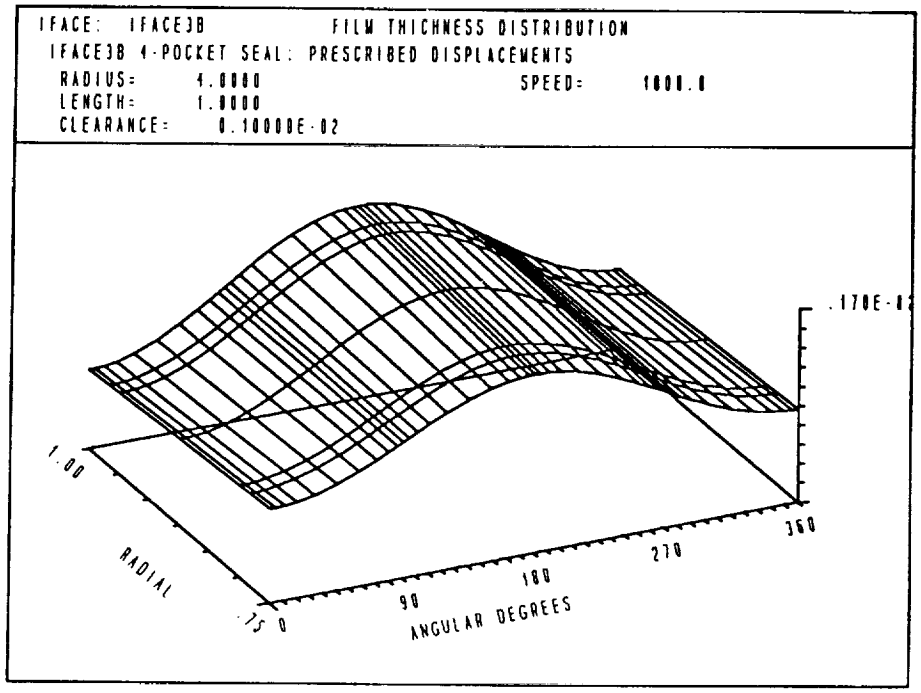


Figure 15 Film thickness distribution for sample 3B

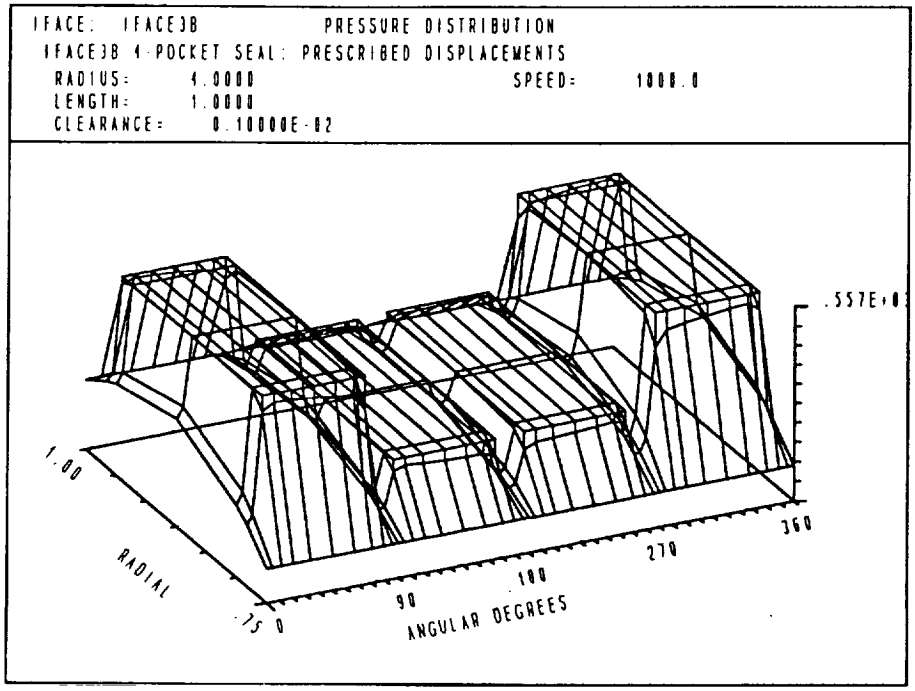


Figure 16 Pressure distribution for sample 3B.

Preloaded Pads With Rough Housing

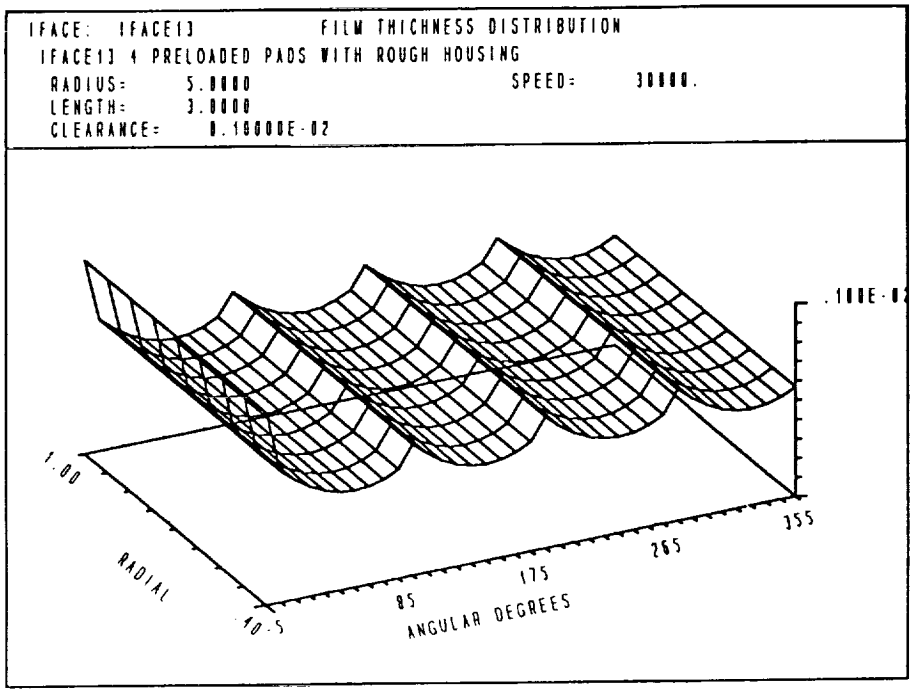


Figure 17 Film thickness distribution for sample 13.

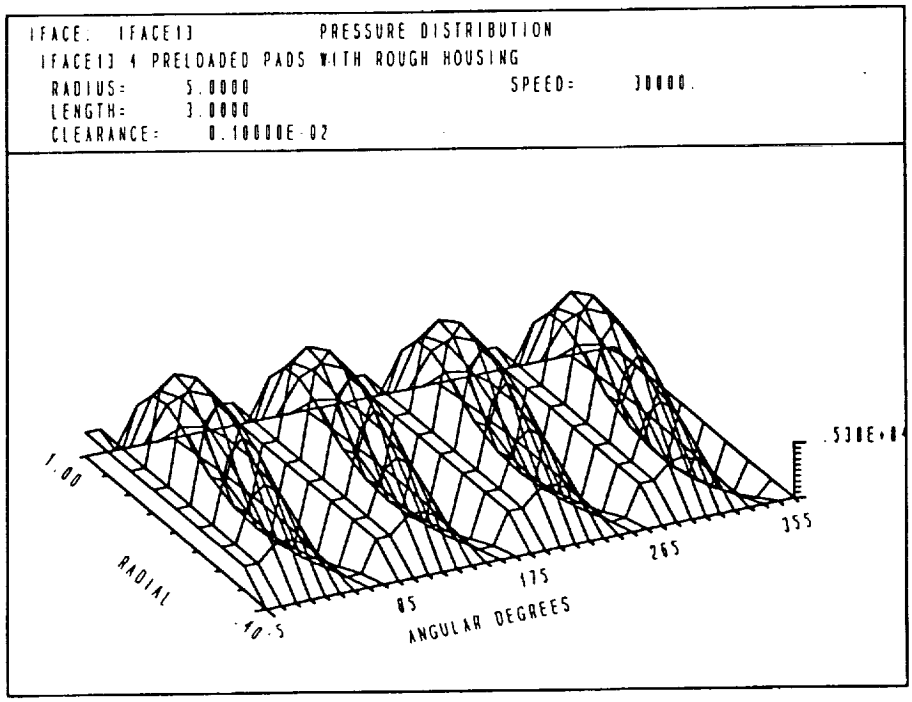


Figure 18 Pressure distribution for sample 13.

Rayleigh-step Seal Fed From Groove I.D.

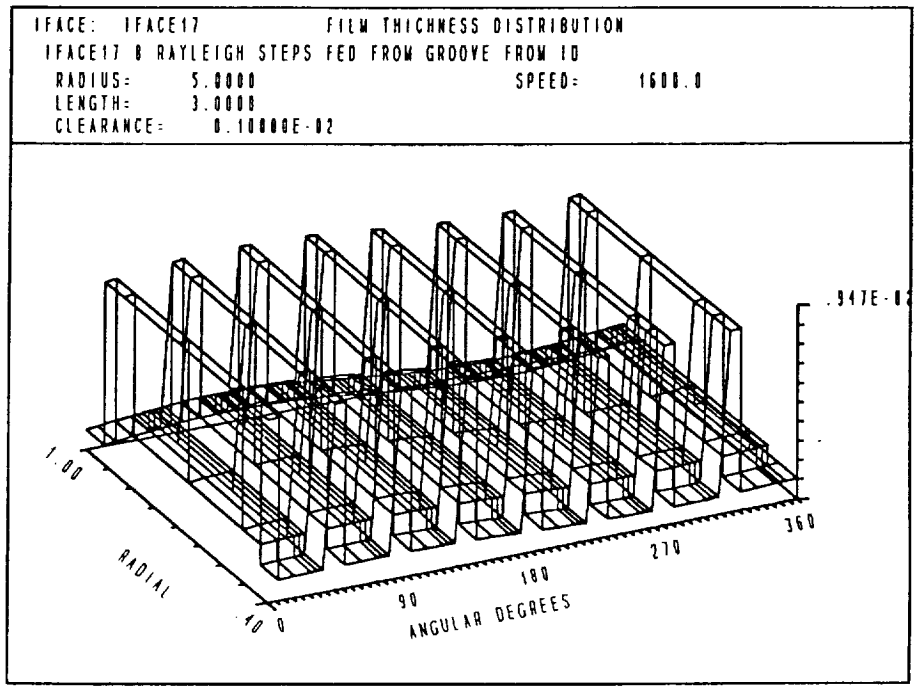


Figure 19 Film thickness distribution for sample 17.

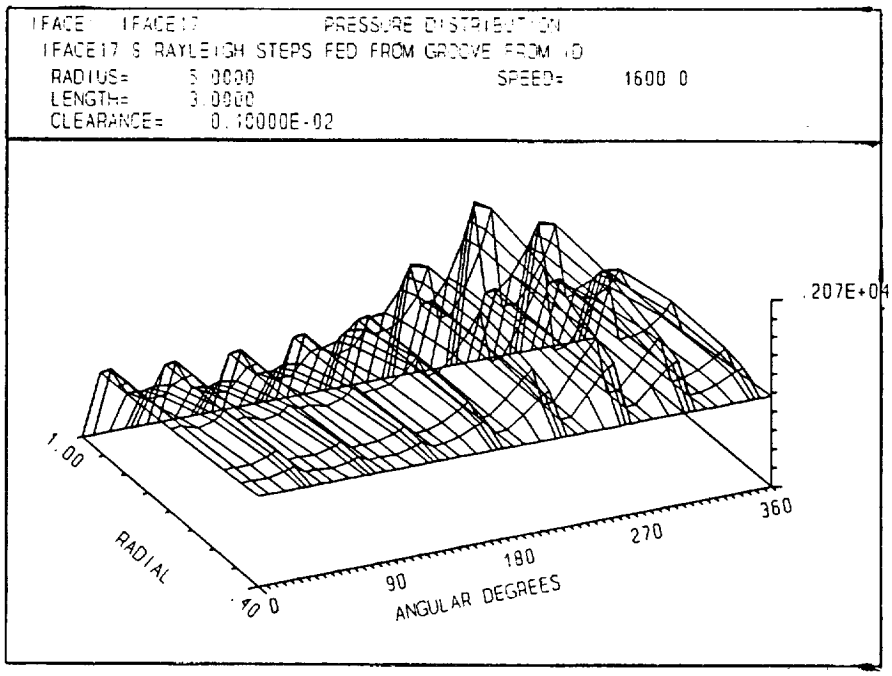


Figure 20 Pressure distribution for sample 17.

4- Pocket Face Seal with Prescribed Moments

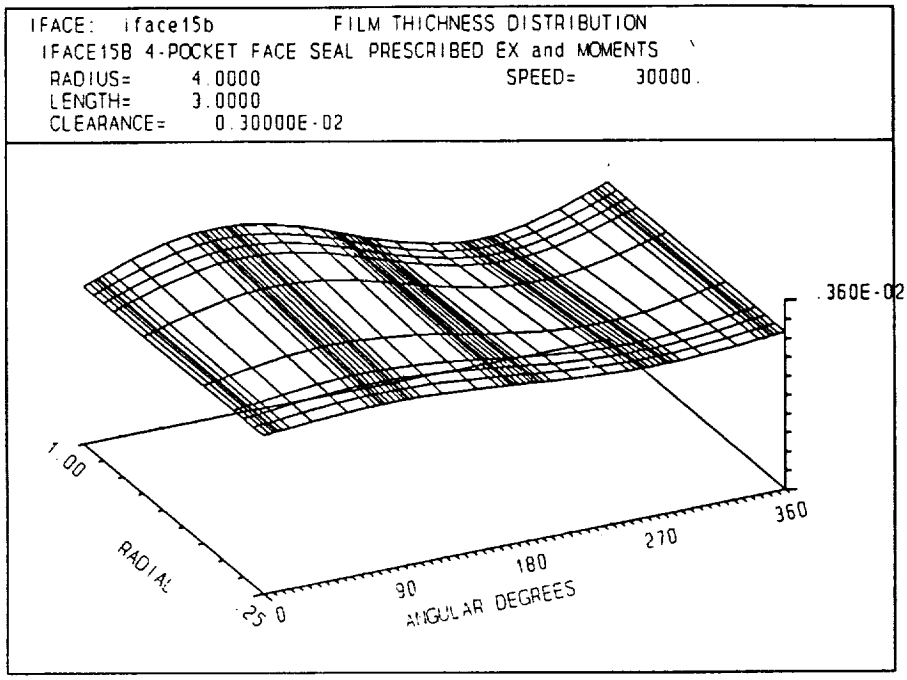


Figure 21 Film thickness distribution for sample 15B.

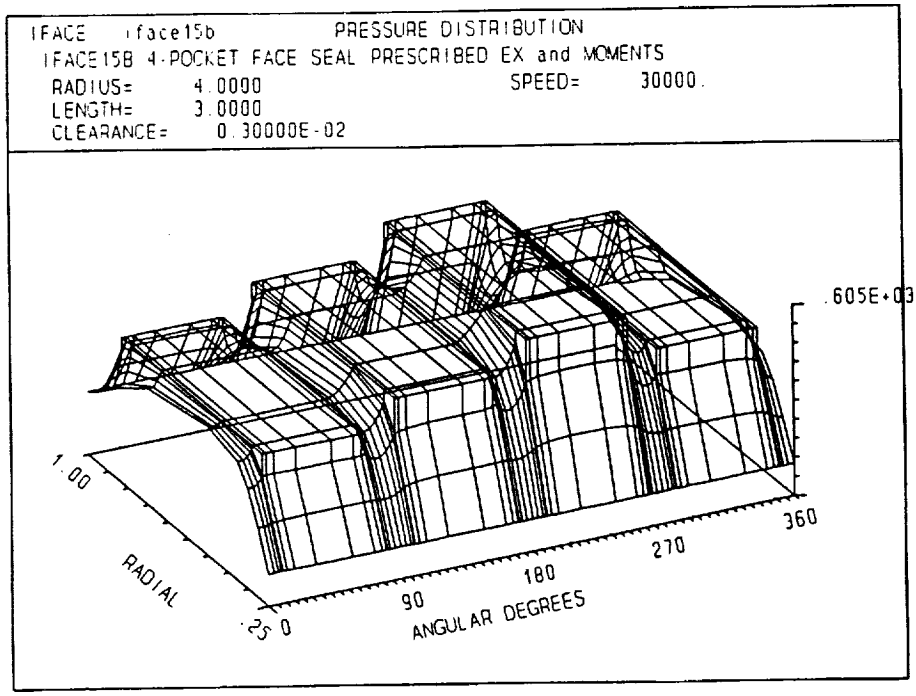


Figure 22 Pressure distribution for sample 15B.

Verification

	GBEAR	ICYL IFRIC=0	ICYL IFRIC=3	ICYL IFRIC=4
Recess flow (in^3/s)	25.75	25.21	20.931	22.316
Orifice diam. (in)	0.0833	0.0820	0.0752	0.0776
Torque (lb-in)	14.38	14.32	8.791	9.771
Power (Lb-in/s)	45,171	44,971	27,617	30,696
Fx (Lb)	3,694	3,358	3,352	3,477
Fy (Lb)	-3,488	-3,122	-3,083	-3,346
Kxx (10^6 Lb/in)	2.352	2.267	2.329	2.344
Kxy (10^6 Lb/in)	-1.461	-1.378	-1.280	-1.397
Kyx (10^6 Lb/in)	-1.998	-1.874	-1.871	-1.961
Kyy (10^6 Lb/in)	1.573	1.481	1.406	1.564
Bxx (Lb/in)	232.08	234.79	269.01	274.46
Bxy (Lb/in)	-175.53	-175.87	-194.38	-199.65
Byx (Lb/in)	-174.78	-174.10	-192.40	-200.56
Byy (Lb/in)	173.87	173.79	187.57	196.53

Table 5 Comparison against GBEAR.