GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION
SPONSORED PROJECT INITIATION

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Date: January 13, 1978

Project Title: Modify the Existing Bearing Test Facility and Perform Evaluation Tests of the MS6001A #2 Bearing

Project No: E-25-682

Co-Project Directors: Ward O. Winer and Scott S. Bair

Sponsor: General Electric Company; Gas Turbine Manufacturing Department; Schenectady, NY 12345

Agreement Period: From 12/5/77 Until 6/1/78

Type Agreement: P. O. No. 087-EXBM-79825, dated 12/5/77

Amount: $26,050 (Fixed Price)

Reports Required: Final Report

Sponsor Contact Person (s):

Technical Matters

Mr. J. R. Maynard
Building 53, Room 330
General Electric Company
One River Road
Schenectady, NY 12345

Contractual Matters
(thru OCA)

Mr. C. J. Kowalski
Purchasing Department
General Electric Company
Gas Turbine Manufacturing Department
P. O. Box 952
Schenectady, NY 12345

Defense Priority Rating: N/A

Assigned to: Mechanical Engineering (School/Laboratory)

COPIES TO:

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- Project Code (GTRI)
- Other ____________

CA-3 (3/76)

GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

SPONSORED PROJECT TERMINATION

Date: February 22, 1979

Project Title: Modify the Existing Bearing Test Facility and Perform Evaluation Tests of the MS6001A #2 Bearing

Project No: E-25-682

Co-Project Directors: Ward O. Winer and Scott S. Bair

Sponsor: General Electric Company; Gas Turbine Manufacturing Department; Schenectady, NY 12345

Effective Termination Date: 6/1/78

Clearance of Accounting Charges: —

Grant/Contract Closeout Actions Remaining:

- X Final Invoice
- _ Final Fiscal Report
- _ Final Report of Inventions
- _ Govt. Property Inventory & Related Certificate
- _ Classified Material Certificate
- _ Other ______________________

Assigned to: Mechanical Engineering (School/Laboratory)

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Project File (OCA)
Project Code (GTRI)
Other ______________________

CA—4 (3/76)

FINAL REPORT

G. E. Service Agreement
P. O. 087–EXBM–79825

MS6001A NO. 2 BEARING INVESTIGATION

By

Co–Principal Investigators:
Ward O. Winer, Professor
Scott Bair, Research Engineer

Sponsored by

General Electric Company
Large Gas Turbine Division
Schenectady, New York 12345

December, 1978

GEORGIA INSTITUTE OF TECHNOLOGY
SCHOOL OF MECHANICAL ENGINEERING
ATLANTA, GEORGIA 30332

1978

GEORGIA INSTITUTE OF TECHNOLOGY
School of Mechanical Engineering
Atlanta, Georgia

FINAL REPORT

MS6001A NO. 2 BEARING INVESTIGATION

G. E. SERVICE AGREEMENT
P. O. 087-EXBM-79825

by

Ward O. Winer
Professor
and
Principal Investigator

Scott Bair
Research Engineer
and
Principal Investigator

Sponsored by

General Electric Company
Large Gas Turbine Division
Schenectady, New York 12345

December, 1978

MS6001A NO. 2 BEARING INVESTIGATION

SUBMITTED TO

J. R. Maynard
Bearing and Sealing System Design
General Electric Company
Schenectady, New York 12345

SUBMITTED BY

Ward O. Winer
Professor
and
Principal Investigator

Scott Bair
Research Engineer
Principal Investigator

Georgia Institute of Technology
School of Mechanical Engineering
Atlanta, Georgia

December, 1978

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Ward O. Winer, Professor
School of Mechanical Engineering

MS6001A NO. 2 BEARING INVESTIGATION

SUMMARY

Tests were conducted on the MS6001A No. 2 Bearing under simulated operating conditions to determine the effectiveness of fifth stage air in cooling and sealing the bearing housing and to insure that sufficient oil flowrate is obtained at the operating oil inlet pressure. To determine the performance characteristics of the seals, fifth stage air was supplied at various flowrates while supply pressures, drain cavity pressures, and drain vent air flows were measured (Figure 1). Oil flow tests (Figures 2 and 3) indicated that the lubricant flowrate at the operating pressure of 20 psig was 7.5 gpm rather that the 16 gpm thought desirable. The liner was modified to incorporate a groove in the lower half of the liner (Figure 4) extending downward from each inlet slot about two inches. The modification increased the flowrate to 10 gpm at 20 psig inlet. A hot environment (440F-475F) test was run. Temperatures and pressures were recorded as reported in Table I. No oil accumulation outside the housing due to oil leakage was observed even when operating with no sealing air.

FACILITY

The bearing test facility as used on previous bearing studies for General Electric* was modified to accept the MS6001A No. 2 bearing. A new submerged oil drain was constructed with a co-axial

*"No. 3 Bearing Study", General Electric Company, March 1978, (W. O. Winer, D. M. Sanborn, S. Bair).

feed pipe. The drain was vented to the oil reservoir to simulate an unsubmerged drain and to allow measurement of air flow from the drain. A belt drive system was fabricated to rotate the shaft at 5100 rpm. Fifth stage air supply (0.2 lbm/sec, 250F) was simulated by mixing the burner exhaust with cool supply air. In all tests the lubricant was SUNVIS 916 (31.3 cs at 100F).

INSTRUMENTATION

Instrumentation consisted of 31 thermocouples, six pressure taps in the housing and five pressure taps in the liner, three orifice plate flowmeters, and a Hasler mechanical tachometer used at shaft end. Instrumentation location is shown on G.E. Drawing 1502-77-25-1 and listed in Table I.

TEST PROCEDURE

Fifth stage air at ambient temperature was supplied at .04 to .32 lbm/sec for the air flow tests of the seals. Rotor was stationary. Pressures were measured at the cooling and sealing air supply channels behind the fore and aft seals and in the top of the drain cavity fore and aft. Air flowrate from the drain was measured by a pitot probe in the drain vent. Results are reported in Figure 1.

Oil flow tests were conducted with an inlet temperature of about 130F. Inlet pressure, as measured by a bourdon tube gauge in the feed line was varied with a valve upstream of the pressure gauge. An oil over mercury manometer was used to measure the pressure drop across an orifice flowmeter. Shaft speed was either zero or 5000 rpm (measured by a mechanical tachometer driven directly by the shaft.)

The hot test involved operation for two hours to reach steady temperatures at all thermocouple locations. Twelve thermocouples in various positions in the environmental chamber indicated ambient temperatures of 380F-465F. Fifth stage air was maintained at 1.92 lbm/sec and 225F. Oil supply was 16 gpm for inlet conditions of 73 psig and 128F. Temperatures and pressures are reported in Table I.

The housing split line and shaft seals were inspected for oil leaks after each test.

CONCLUSIONS

The estimated air pressure drop across the seals of 1.5 psi for 1.82 lbm/sec flowrate was verified in the air flow test.

Oil flowrate was below that called for in tests on the initial liner. Removal of the bearing strap which allowed the oil to bypass the liner showed a large improvement in flow with no rotation (Figure 2). This indicated that the oil flow was restricted substantially by the liner as well as the metering orifice in the housing. The modifications to the liner (Figure 4) were successful in increasing oil flowrate (Figures 2 and 3).

In the hot environment test, no unusually high temperatures were recorded (Table I).

Results of the leak inspections are summarized in Appendix A. At times the bearing was operated with oil flow and at running speed with no sealing air provided and no accumulation of oil leakage was observed.

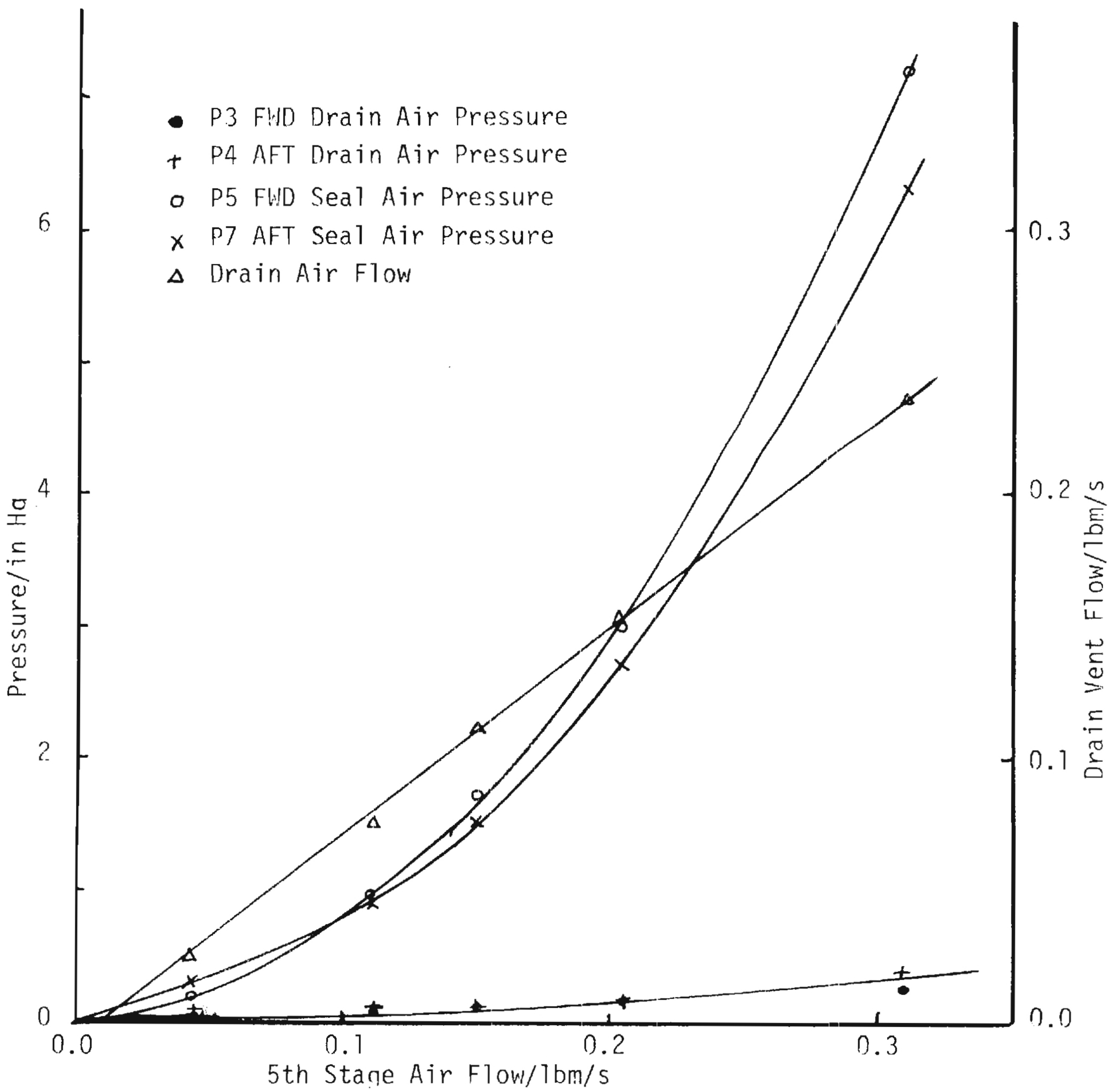

Figure 1. Sealing Air Flow Test (Rotor Stationary, Ambient Temp)

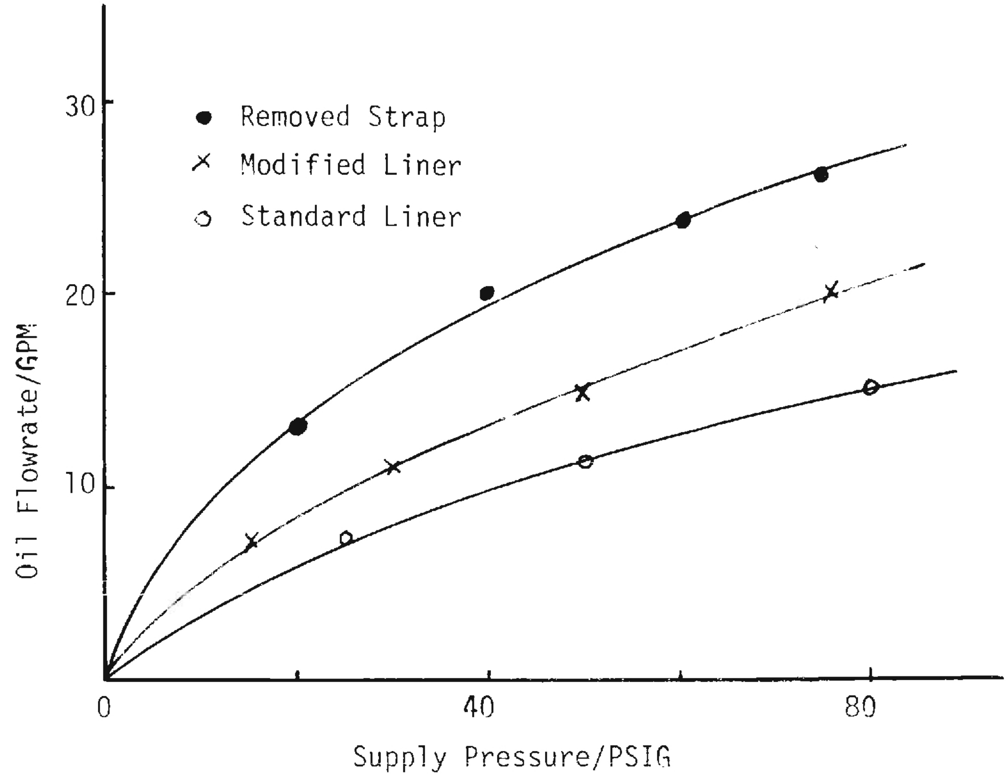

Figure 2. Static Oil Flow Tests (Inlet Temp 130F)

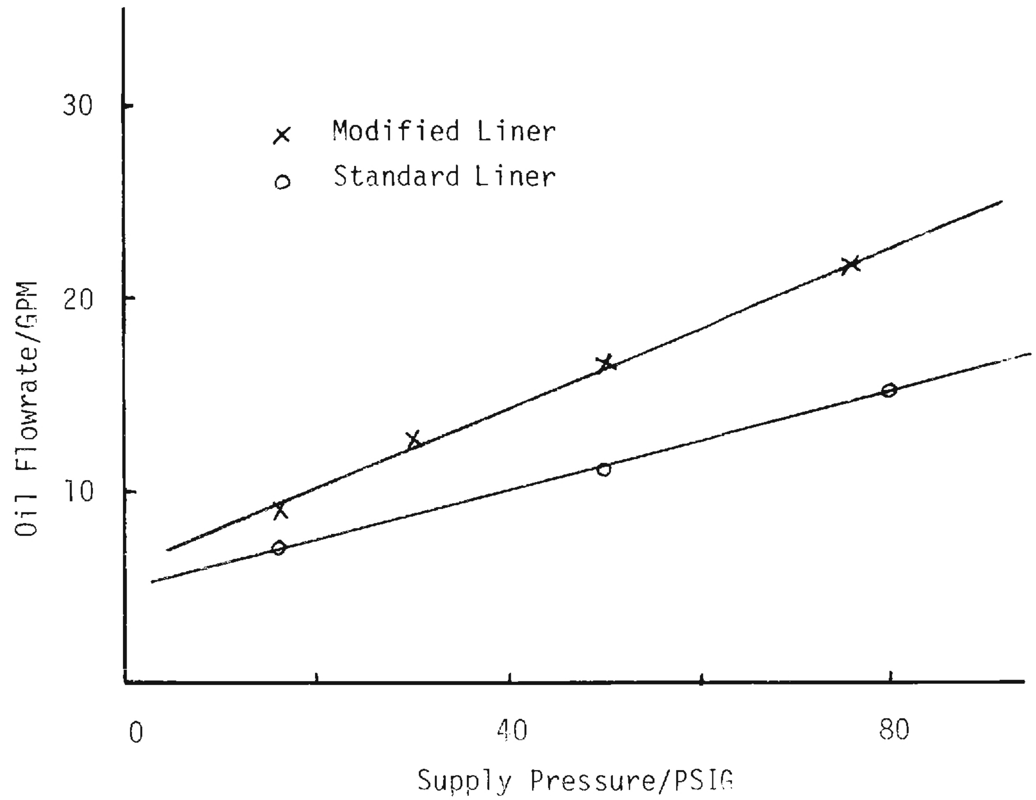

Figure 3.   Oil Flow Tests at 5000 RPM (Inlet Temp 130F)

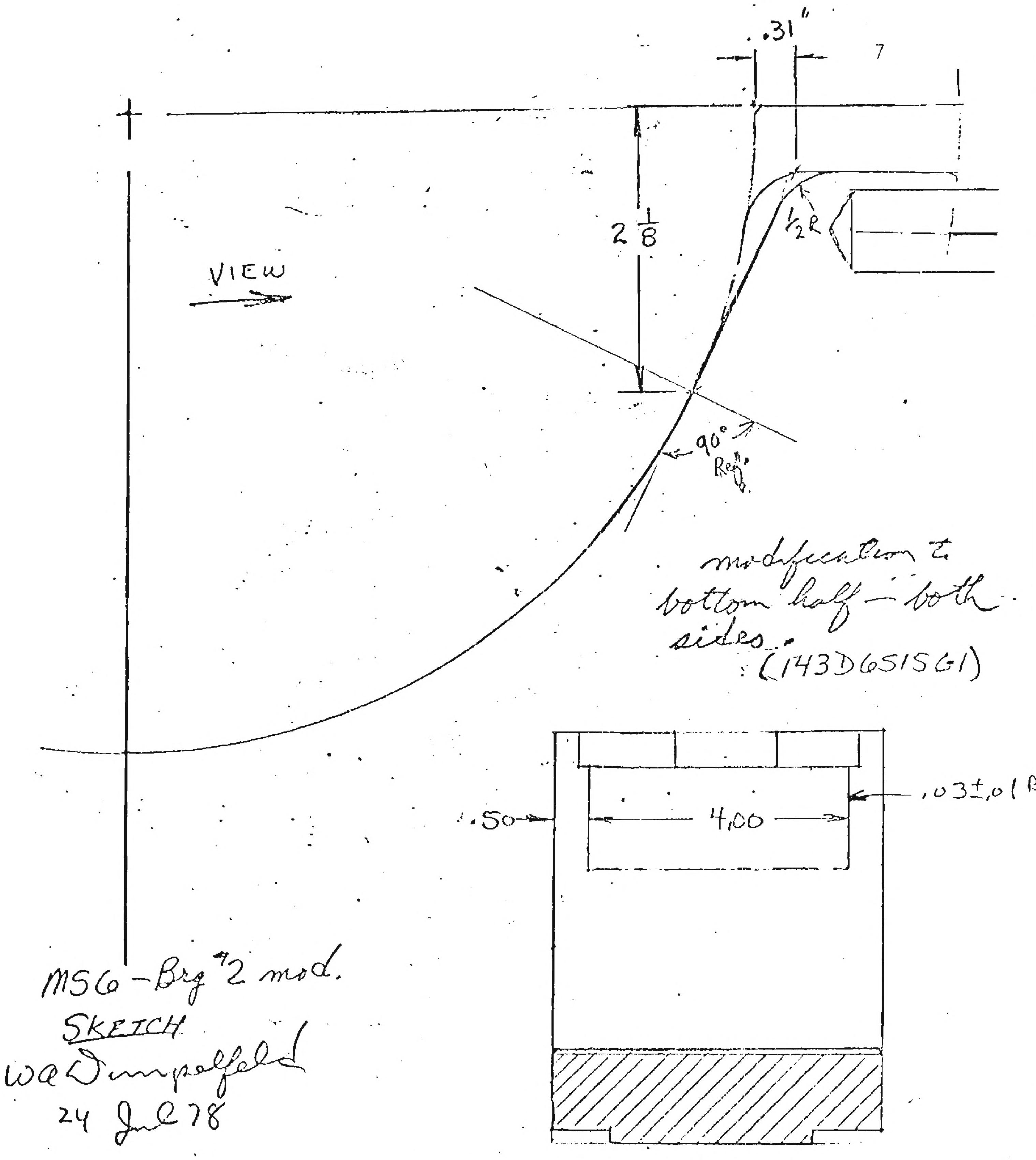

Figure 4. Modification to No. 2 Bearing Liner

Table I. Hot Test Results

TEMPERATURES

G.E. No.	DESCRIPTION	RECORDER NUMBER	TEMP/F
TT-B2-HA-2 "A"	TOP FWD BTW SEALS	10-5	325
TT-B2-HA-3 "A"	TOP FOREWARD DRAIN AIR	8-10	160
TT-B2-HA-4 "A"	TOP AFT DRAIN AIR	8-11	153
TT-B2-HM-1	BOTTOM FOREWARD DRAIN METAL	8-9	224
TT-B2-HM-2	TOP FOREWARD DRAIN METAL	9-6	220
TT-B2-HM-3	TOP MID DRAIN METAL	10-8	260
TT-B2-HM-4	TOP AFT DRAIN METAL	9-3	220
TT-B2-LM-1	LINER METAL	9-12	NOT OPERATIVE
TT-B2-LM-2	LINER METAL	10-1	165
TT-B2-LM-3	LINER METAL	9-8	150
TT-B2-LM-4	LINER METAL	9-10	155
TT-B2-LM-5	LINER METAL	9-4	160
TT-B2-LM-3 Rev	LINER METAL	8-7	NOT OPERATIVE
TT-B2-LM-4 Rev	LINER METAL	8-6	170
TT-B2-LM-5 Rev	LINER METAL	9-1	165
	TANK AIR	8-1	440
	TANK AIR	8-2	465
	TANK AIR	8-3	450
	TANK AIR	8-4	460
	TANK AIR	8-5	445
	TANK AIR	8-12	465
	TANK AIR	9-2	460
	TANK AIR	9-5	455
	TANK AIR	9-7	425
	TANK AIR	9-11	460
	TANK AIR	10-2	380
	TANK AIR	10-3	455

Table I. (Continuation)

G.E. No.	DESCRIPTION	RECORDER NUMBER	TEMP/F
	OIL FEED	11-4	125
	OIL DRAIN PIPE	11-1	165
	OIL DRAIN PIPE	11-2	165
	COOLING AIR SUPPLY	10-9	225

PRESSURES

G.E. No.	DESCRIPTION	RECORDER NUMBER	PRESS/in.Hg.
TP-B2-HA-2B	FWD AMBIENT	P2	0.7
TP-B2-HA-3B	FWD DRAIN AIR	P3	0.45
TP-B2-HA-4B	AFT DRAIN AIR	P4	0.5
TP-B2-HA-1B	FWD SEAL AIR	P5	3.6
TP-B2-SA-2B	AFT SEAL AIR	P7	---
TP-B2-LL-1	LINER OIL FILM	1	50 psig
TP-B2-LL-2	LINER OIL FILM	2	50 psig
TP-B2-LL-3	LINER OIL FILM	3	50 psig
TP-B2-LL-4	LINER OIL FILM	4	50 psig
TP-B2-LL-5	LINER OIL FILM	5	50 psig

GEORGIA INSTITUTE OF TECHNOLOGY
ATLANTA, GEORGIA 30332

SCHOOL OF
MECHANICAL ENGINEERING

26 October 1978

Mr. W. Dimpelfeld
Bearing & Sealing System Design
Bldg. #53-334
General Electric Company
One River Road
Schenectady, New York 12345

Dear Bill:

Concerning the MS 6000 No. 2 bearing currently in our test facility, no accumulation of oil leakage external to the housing has been observed at either the split-line joint or the rotor where it centers the housing seals. However, upon completion of each cold oil-flowrate test, the outside of the housing was dampened at the split-line in a manner similar to previous bearing housings tested at our facility. The housing was found to be dry after the hot environment test when the top of the test chamber was removed.

Sincerely,

Scott Bair
Research Engineer

SB:jv