NASA CR-135302

FEASIBILITY STUDY OF NEGATIVE LIFT CIRCUMFERENTIAL TYPE SEAL FOR HELICOPTER TRANSMISSIONS

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Prepared for

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Cleveland, Ohio 44135

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Fluid System Components Division
NASA/Lewis Research Center
Cleveland, OH 44135

16. Abstract

A new seal concept, the negative lift circumferential type seal, was evaluated under simulated helicopter transmission conditions. The bore of the circumferential seal contains step type geometry which produces a negative lift that urges the sealing segments towards the shaft surface. The seal size was a 2.5 inch bore and the test speeds were 7000 and 14,250 rpm. During the 300 hour test at typical transmission seal pressure (to 2 psig) the leakage was within acceptable limits and generally less than 0.1 cc/hour during the last 150 hours of testing. The wear to the carbon segments during the 300 hours was negligible.

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FOREWARD

This program was funded by the National Aeronautics And Space Administration under contract NAS3-20598. The period of performance was February 1977 to September 1977.

The work was performed in its entirety at Stein Seal Company utilizing a modified Stein Seal test rig and seal hardware designed and constructed especially for this project.

LIST OF ILLUSTRATIONS

LIST OF TABLES

APPENDIX

INTRODUCTION

A circumferential seal (see Figs. I & II) consists of a ring of carbon segments making rubbing contact with the outer diameter of a rotating shaft. The segments are held to the shaft by the pressure differential and by a circumferential garter spring. The secondary leakage path between the transverse face of the carbon and the housing is sealed by the use of axial springs in conjunction with the axial pressure force.

Use of the circumferential seals in strictly gas atmosphere has been generally successful. Use of circumferential seals in liquid environments or in gas-liquid environments under high speed conditions has often resulted in high leakage, due to the liquid penetrating the rubbing interface. The carbon segments are thus subjected to bearing forces generated in the film and are lifted from the shaft. We call this surfboarding. The low cost, and high speed, high temperature capabilities of circumferential seals necessitated a solution of the surfboarding problem.

One method of overcoming surfboarding is through the use of "negative lift" pockets on the bore of the carbon segments. This is a method of sealing, developed by Stein Seal Company and approved for patent December 27, 1977. These pockets are machined in the carbon and are open to sealing pressure at the trailing edge of the pocket and evacuated by the fluid drag of the shaft over the pocket. The evacuation causes a lower

pressure in the bore of the carbon, thus increasing the specific loading on the seal. In addition, the liquid on the shaft is evacuated before a film develops.

The negative lift feature is extremely useful in applications where either liquid or gas can be encountered. Under gas conditions, the pocket pressure, which is a function of viscosity, is slight, giving a circumferential loading due only to the spring and the normal pressure breakdown across the seal dam. The light seal loading is desirable to keep thermal distortions, power consumption and wear at a minimum. Liquid seals are subjected to more instability, due to surfboarding and drag forces and thus require more seal loading. This is provided by the negative lift pockets. The viscosity of the liquid provides substantial suction at the bore of the seal, thereby creating a higher specific loading. If the environment returns to gas, the specific loading again lessens.

The negative lift seal is especially well suited to helicopter transmissions because the possibility of occasional dry operation exists. The customary elastomeric lip seals are unable to tolerate prolonged high speed operation at the moderately high temperatures involved and even face seals that are sometimes used, are the victims of the heavy face loads needed to insure face contact when sealing liquids.

For these reasons, a test was designed to fit a specific heli-

copter transmission under conditions similar to those seen in normal helicopter conditions. The test was essentially a wear and demonstration test.

APPARATUS AND TEST PROCEDURE

The seal unit was tested in a Stein Seal test rig (see Figs. III, IV and V). The test rig shaft was ball bearing mounted with the drive and test end bearings lubricated with single oil jets. An air buffered standard back to back carbon circumferential seal unit was used at the drive end to contain the bearing oil, air at approximately 5 psig being injected between the carbons. The rig shaft was driven with a flat belt pulley from a jack shaft powered by a one horsepower electric motor. The motor to jack shaft connection had a timing belt drive.

The chrome plated seal runner, Fig. VI, was clamped to the test end of the shaft so that the area between the seal and the rig bearing simulate the sort of turbulence anticipated with the actual application. In addition, the seal housing was specifically designed to fit a small helicopter transmission with the proper geometry and direction of shaft rotation.

Turbine oil, MIL Spec. 7808 was used as the bearing lubricant in the rig and was directed on the bearings through a .040 inch diameter orifice nozzle set on the horizontal axis. Oil inlet pressure was kept at a constant 25 psig and the oil inlet temperature readings were thermocouple instrumented and recorded hourly.

The lube oil scavenge line at the bottom vertical center line was similarly monitored. Averages of the recorded oil inlet and outlet temperatures appear in Table I.

Chamber pressure was monitored by a pressure gage located at the cavity on the bearing side away from the seal. The chamber pressure was maintained at 0, 1 and 2 psig as specified for the various test points. The oil flow was slightly effected by chamber pressure, since the oil inlet pressure was constant. However, change in bearing oil flow was small since chamber pressure variation was only 2 psi maximum. Fig. VII shows the calibrated rate of oil inlet flow for the .040 inch diameter orifice used.

Leakage rates were recorded for six test points of approximately fifty hours each. Leak rates are summarized in Table I.

The various carbon seal segments were carefully measured prior to the start of the test program and a wear measurement made after 63 hours and upon completion of the running schedule. A calibrated 0 to 1 inch Starrett ball micrometer was used and all measurements were taken with same instrument and by the same inspector. A tabulation of measurements is shown in Table II and the location of the measuring points is illustrated in Fig. VIII.

RESULTS AND DISCUSSION

The test program was performed at Stein Seal Company and involved an experimental evaluation of a 2.500 inches diameter segmented carbon circumferential seal unit having a negative lift bore geometry. The seal was designed to operate at conditions typical of those encountered with a helicopter transmission.

In accordance with the statement of work provided by NASA, the seal assembly was tested in excess of 300 hours on a hard chrome plated shaft runner at surface speeds of approximately 5000 and 10000 feet per minute. An oil jet was directed against a ball bearing just inboard of the seal unit. The oil jet provided about .16 gpm (610 cubic centimeters per minute) and the seal used to contain the oil-air mist was operated with the bearing chamber maintained at 0 to 2 psig.

The seal unit was trouble free throughout the test cycle and was run rountinely. Shaft speed was about 7% lower than specified velocity because available pulley combinations were utilized. Seal leak rates at operating conditions were uniformly good with the exception of occasional increase from normal levels when the rig was started each day and prior to stabilization of thermal conditions. It is noted that leak rates appeared to steadily improve with running time. No static leakage was observable.

The seal assembly was removed from the test rig only once during the 300 hours test period after having been run a total of about 63 hours. (14 hours into test point #2) At that time, it was decided that the pressurized seal leak rate, although satisfactory, was somewhat greater than anticipated from previous experience with this type of seal design. Since this carbon seal size was a new one, it was decided to rework the carbon lap plug and then reburnish the seal unit.

A horsepower consumption test was made on the seal, using a watt-meter. The test seal was then removed and the wattage was remeasured. Results indicated seal power consumtpion of less than 1/2 HP.

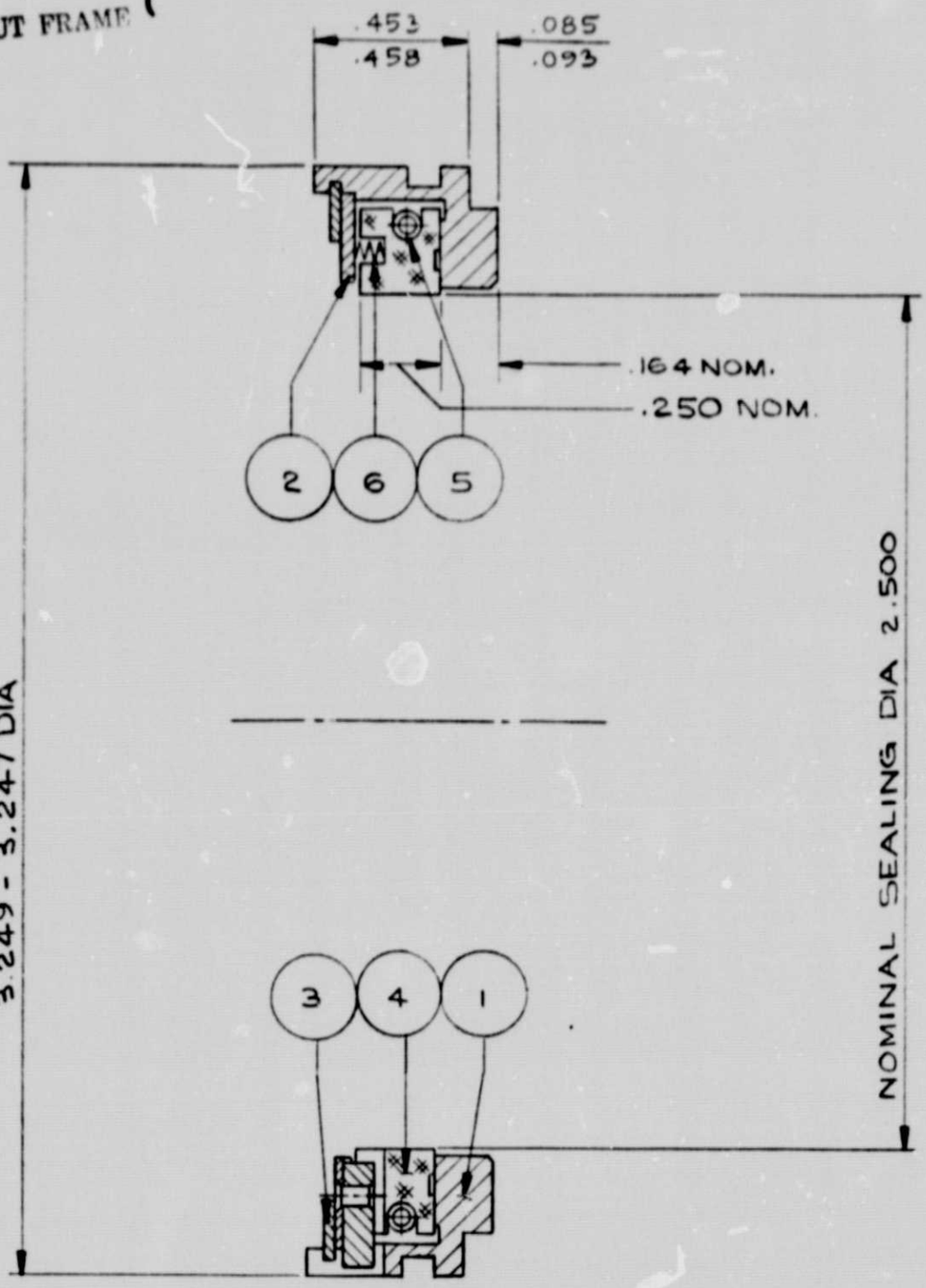
Wear of the carbon segments was checked (see Fig. VIII and Table II) after the initial 63 hours run and at the end of the test period and was found to be negligible. The test seal indicated only a slight uniform burnish at the bore diameter. The shaft surface was in excellent condition. (See Fig. VI)

CONCLUSION

The segmented circumferential carbon seal, which has been used for years under rugged speed and temperature environments in gases, can be used in a liquid environment if negative lift pockets are added. This negative lift seal unit performed with complete satisfaction at simulated helicopter transmission

conditions. Leakage was well within tolerable limits and wear was not measurable after 300 hours of operation.

FOLDOUT FRAME 1



DRAWN RRK	CHECKED
DATE 4-7-77	DATE

STEIN SEAL COM

20th STREET & INDIANA AVE
PHILADELPHIA 32, PA.

REVISIONS			
LTR	DESCRIPTION	DATE	APVD
A	RELEASED	5-20-77	JWE 5/23

FOLDOUT FRAME 2

NOMINAL SEALING DIA 2.500

Fig. I Cross section of circumferential seal

ITEM	REQ'D	PART NO.	DESCRIPTION	MATL.	MATL. SPE
6	12	SSCY 5158-2	COMPRESSION SPRING	INCONEL X-750	AMS 5699 C AMS 5698
5	1	SSCY 6127-2	EXTENSION SPRING	INCONEL X-750	AMS 5698
4	1	SSCY 6127-1	HYDRO LOAD SEAL RING	C-GPH	
3	1	SSCY 6126-3	RETAINING RING	SST	AISI 302
2	1	SSCY 6126-2	BACK PLATE	SST	AISI 410
1	1	SSCY 6126-1	SEAL HOUSING	SST	AISI 410

LIST OF MATERIALS

2.500 DIA HYDRO-LOAD SEAL ASSEMBLY

REV A

STEIN SEAL COMPANY

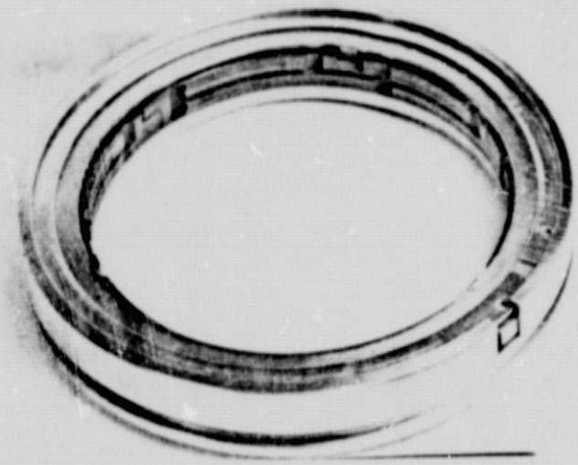
20th STREET & INDIANA AVENUE
PHILADELPHIA 32, PA.

SCALE 2/1

NUMBER 61266127

STEIN SEAL COMPANY

PAGE NO. ____



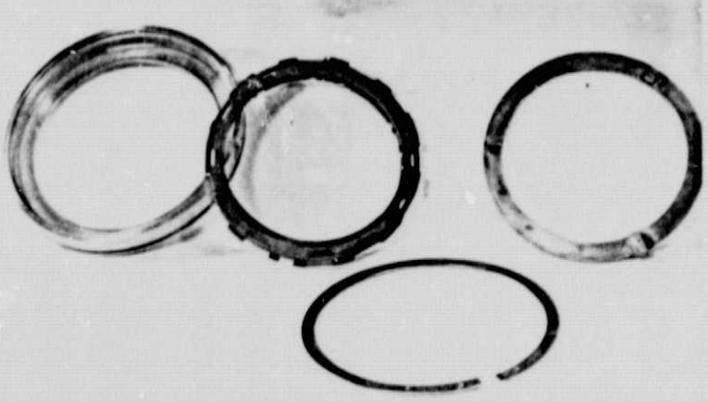


Fig. II Photographs of assembled and disassembled test seal after test

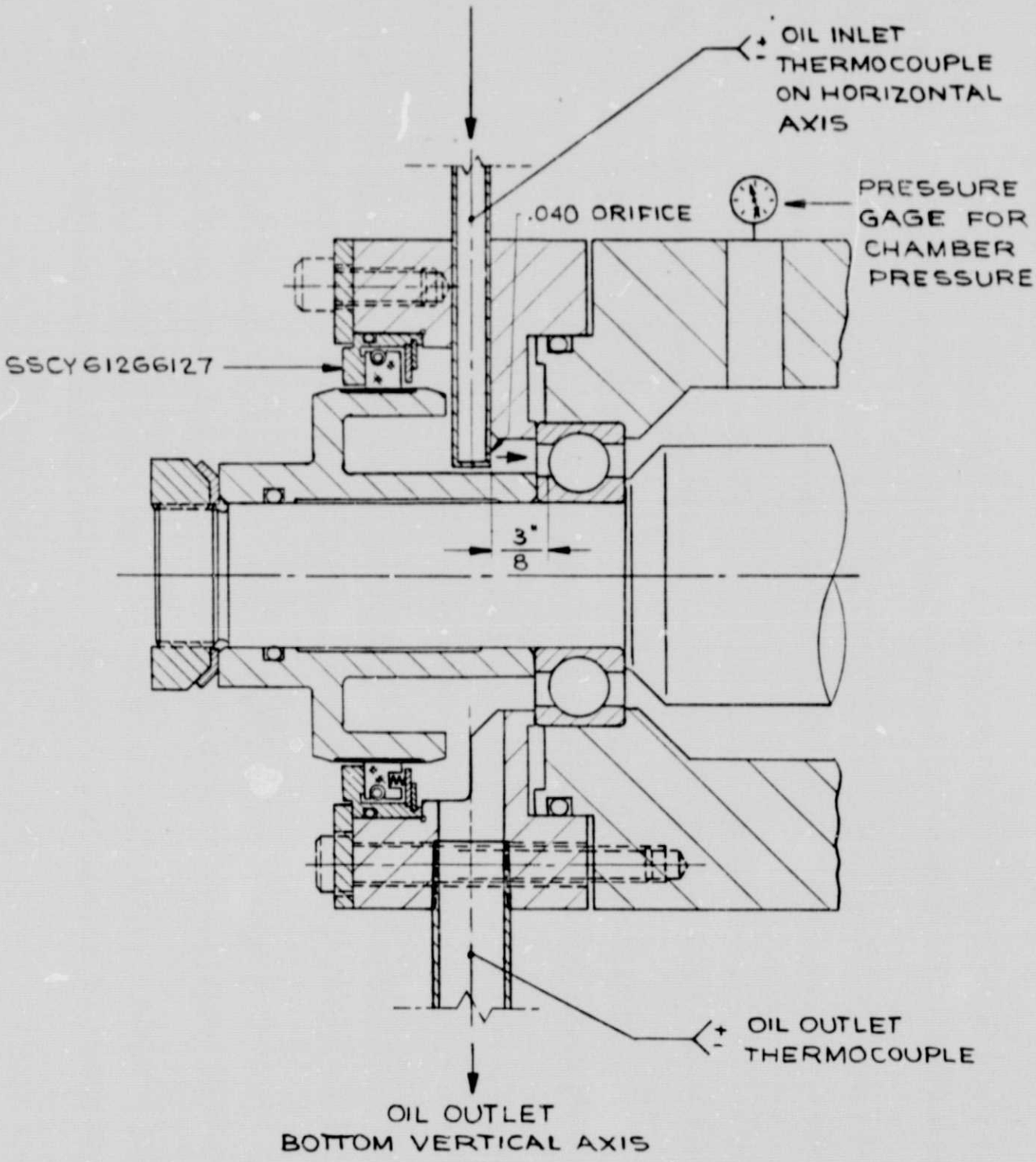


Fig. III Test end of rig showing seal unit mounted for test

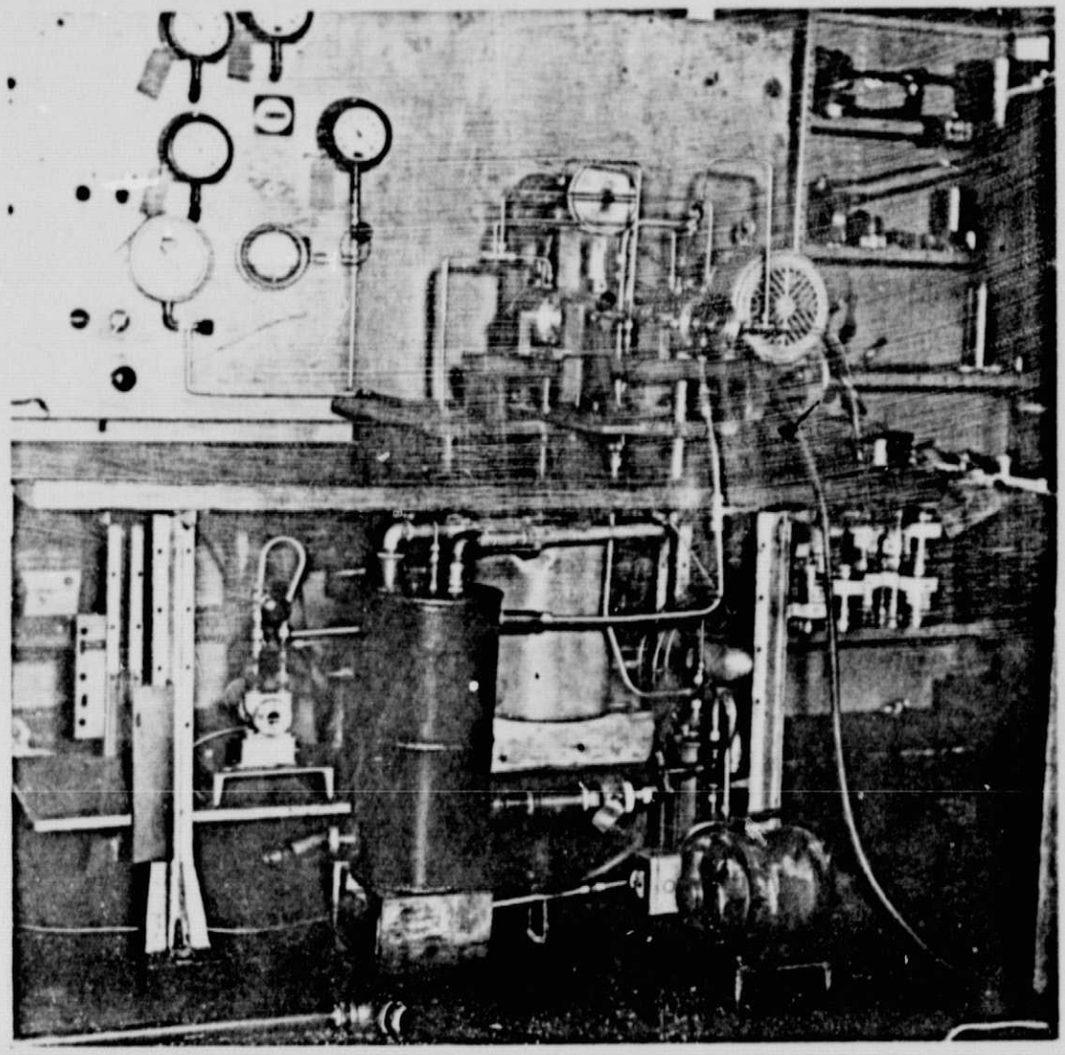


Fig. IV Photograph of test rig

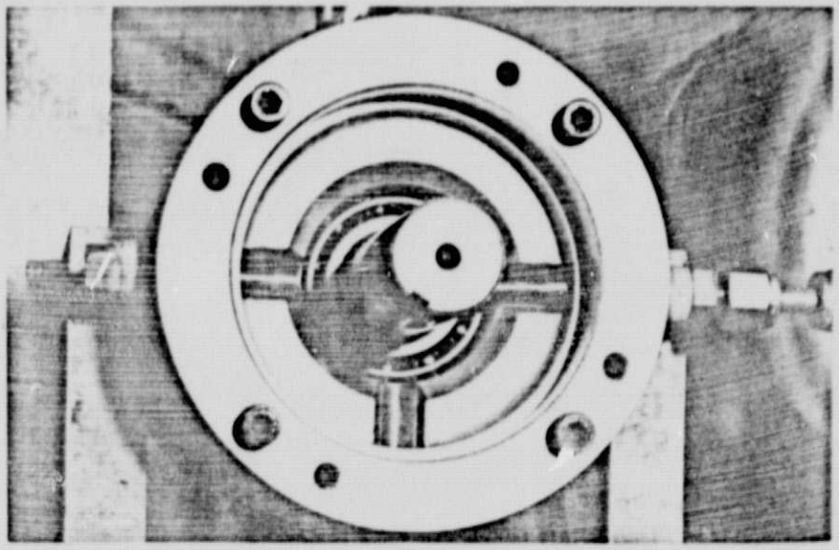


Fig. V Photograph of test end of seal rig after test

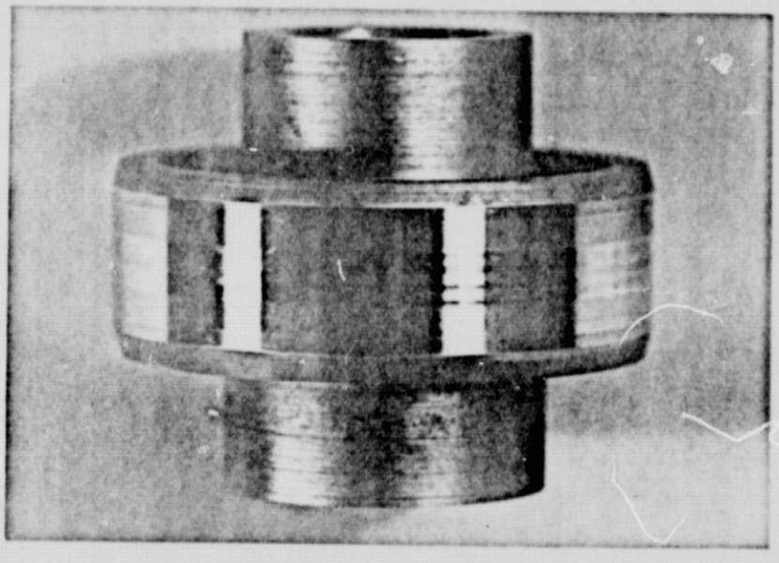


Fig. VI Photograph of seal shaft runner after test

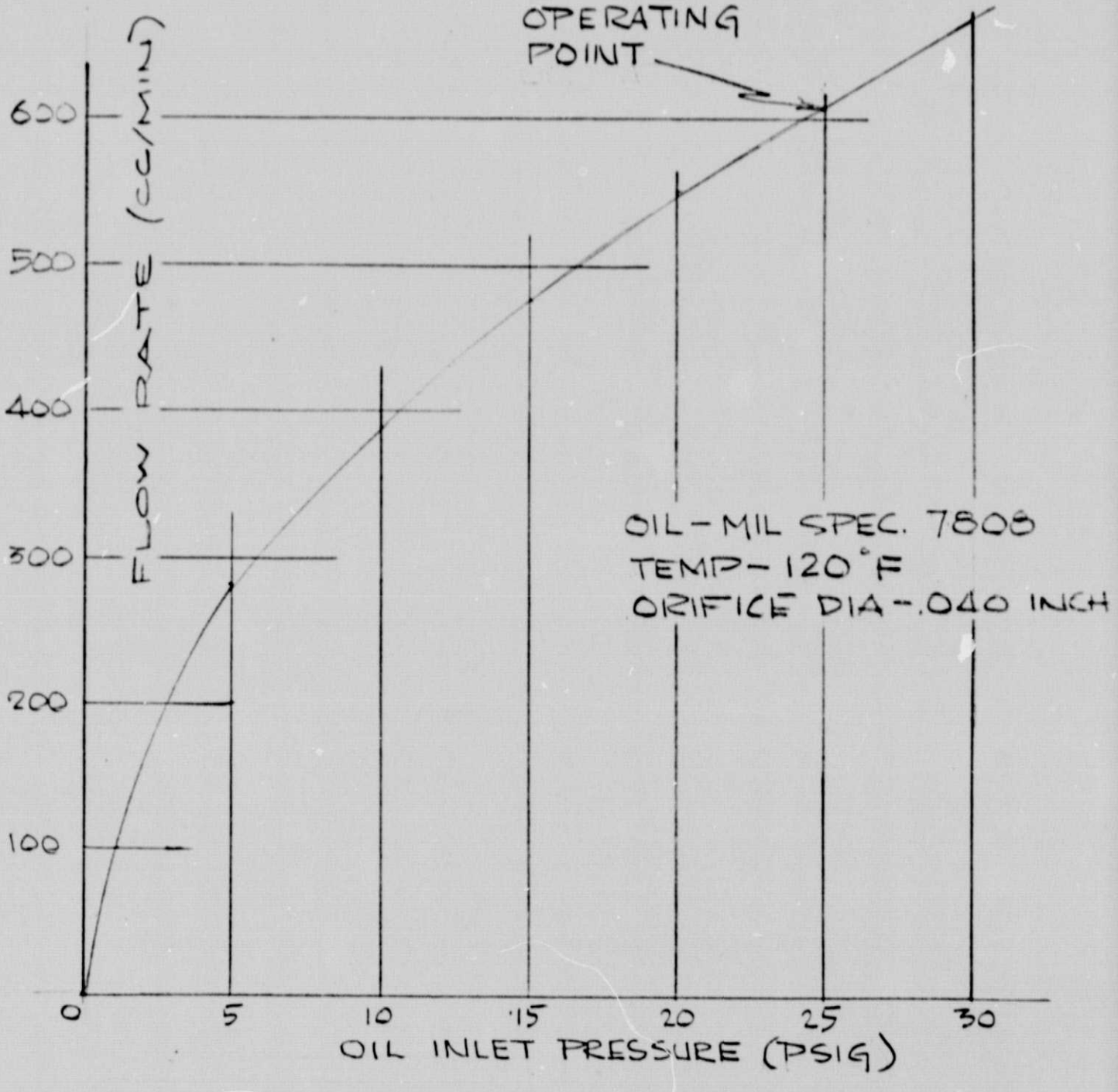
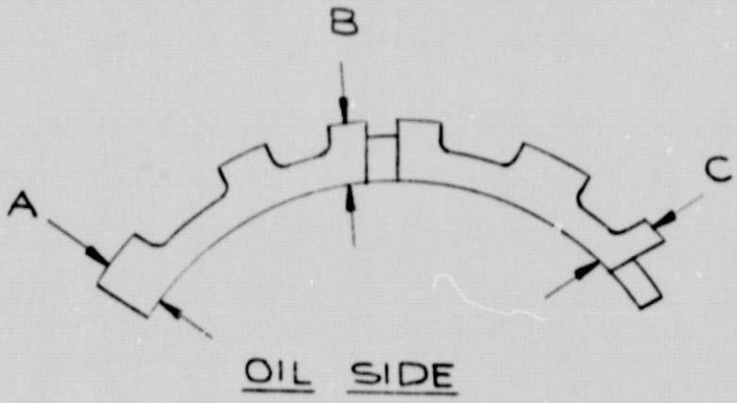


Fig. VII Calibration curve of bearing oil jet



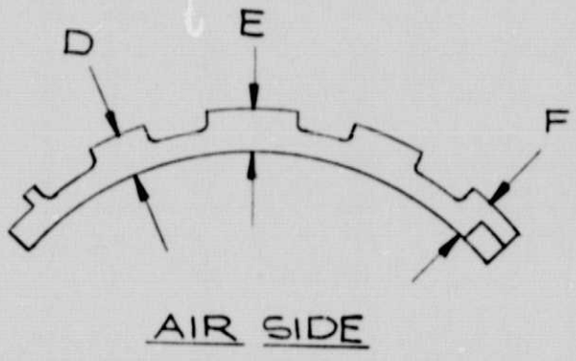


Fig. VIII Measurement locations on each seal ring segment

Test Point	Velocity Ft/Min.	Chamber Press. PSIG	In Oil Temp. °F	Out Oil Temp. °F	Time Test Point Hr:Min.	Leak Rate cc/Hr.
1	8327	0	114	158	50:34	0.006
2	9327	1	119	159	14:18	1.343

Relapped Seal Ring Bore

See Tabulation of Seal Ring Measurements

2	9327	1	114	155	33:55	0.150
3	9327	2	114	158	50:57	1.870
4	4588	0	117	135	57:27	.009
5	4588	1	114	130	50:00	.020
6	4588	2	113	127	50:35	.065

TEST LOG SUMMARY

TABLE I

Segment No.	Location	Before Testing	After 63 hrs. and 26 Min.	Wear	After Lapping At End of Test	Wear
1	A	.2550	NO CHANGE WAS DETECTED WITHIN INSTRUMENT MEASUREMENT ACCURACY	--	.2547	NO CHANGE WAS DETECTED WITHIN INSTRUMENT MEASUREMENT ACCURACY --
	B	.2503		--	.2499	--
	C	.2494		--	.2488	--
	D	.2493		--	.2487	--
	E	.2504		--	.2497	--
	F	.2547		--	.2541	--
2	A	.2516		--	.2513	--
	B	.2495		--	.2489	--
	C	.2513		--	.2507	--
	D	.2503		--	.2497	--
	E	.2494		--	.2490	--
	F	.2511		--	.2508	--
3	A	.2563		--	.2561	--
	B	.2552		--	.2548	--
	C	.2532		--	.2530	--
	D	.2541		--	.2533	--
	E	.2552		--	.2546	--
	F	.2563		--	.2560	

TABULATION OF SEAL RING MEASUREMENTS

TABLE II

A P P E N D I X

Test Log Sheets

STEIN SEAL COMPANY

PAGE NO. _____

20th STREET & INDIANA AVENUE, PHILADELPHIA 32, PA.

TEST NO. 6050 - 1 RIG NO. 7 SHEET 1 OF _____

OBSERVER H.D. DATE 8-1-77

SPECIMENS CASING : 6126-1 S/N 057701
CARBONS : 6127-1-8

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	TIME	SPEED	OIL	OIL	OIL	OIL	OIL							
3			IN	CHAM	IN	OUT	LKG							
4			PRESS	PRESS	TEMP	TEMP	RATE							
5	HR	RPM	PSIG	PSIG	°F	°F	CC/HR							
6														
7	2135	14250	25	0	118	165	-		START RIG			GRAD IN		
8	2235	14250	25	0	118	165	-							
9	2335	14250	25	0	115	162	-							
10	2435	14250	25	0	115	162	-							
11	0135	14250	25	0	115	162	-							
12	0235	14250	25	0	115	162	-							
13	0335	14250	25	0	115	162	-				NO	LKG		
14	0336	0							STOP RIG			GRAD OUT		
15						8-2-77								
16														
17	1900	14250	25	0	86	129	-		START RIG			GRAD IN		
18	2000	14250	25	0	116	162	-							
19	2100	14250	25	0	116	162	-							
20	2200	14250	25	0	116	162	-							
21	2300	14250	25	0	116	162	-							
22	2400	14250	25	0	116	162	-							
23	0100	14250	25	0	116	162	-							
24	0200	14250	25	0	116	162	-							
25	0300	14250	25	0	116	162	-							
26	0400	14250	25	0	116	162	-				NO	LKG		
27	0405	0							STOP RIG			GRAD OUT		
28						8-3-77								
29	0710	14250	25	0	79	121	-		START RIG			GRAD IN		
30	0800	14250	25	0	115	160	-							
31	0900	14250	25	0	117	164	-							
32	1000	14250	25	0	116	162	-							
33	1100	14250	25	0	116	162	-							
34	1200	14250	25	0	116	162	-							
35	1210	14250	25	0	116	162	-				NO	LKG		
36	1211	0							STOP RIG			GRAD OUT		

STEIN SEAL COMPANY

20th STREET & INDIANA AVENUE, PHILADELPHIA 32, PA.

PAGE NO. ____

TEST NO. 6050 -1 RIG NO. 7 SHEET 2 OF ____

OBSERVER H.D. DATE 8-8-77

SPECIMENS CASING : SSCY 6126 -1 S/N 057701
CARBONS: SSCY 6127-1-8

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	TIME	SPEED	OIL	OIL	OIL	OIL	OIL							
3			IN	CHAM	IN	OUT	LKG							
4			PRESS	PRESS	TEMP	TEMP	RATE							
5	HR	RPM	PSIG	PSIG	°F	°F	cc/HR							
6														
7	0715	14250	25	0	86	130	-		START RIG			GRAD IN		
8	0815	14250	25	0	118	162	-							
9	0915	14250	25	0	118	162	-							
10	1015	14250	25	0	118	162	-							
11	1115	14250	25	0	118	162	-		1 DROP VISIBLE					
12	1130	0							STOP RIG			GRAD OUT		
13														
14					8-	11-77								
15														
16	0700	14250	25	0	81	125	-		START RIG			GRAD IN		
17	0800	14250	25	0	115	159	-							
18	0900	14250	25	0	118	165	-							
19	1000	14250	25	0	118	165	-							
20	1100	14250	25	0	118	165	-							
21	1200	14250	25	0	118	165	-							
22	1300	14250	25	0	118	165	-							
23	1400	14250	25	0	118	165	-							
24	1500	14250	25	0	118	165	-							
25	1515	0							STOP RIG			GRAD OUT		
26														
27					8-	15-77								
28														
29	0700	14250	25	0	81	125	-		START RIG			GRAD IN		
30	0800	14250	25	0	118	162	-							
31	0900	14250	25	0	118	162	-							
32	1000	14250	25	0	118	162	-							
33	1100	14250	25	0	119	163	-							
34	1200	14250	25	0	119	163	-							
35														
36														

STEIN SEAL COMPANY

20th STREET & INDIANA AVENUE, PHILADELPHIA 32, PA.

PAGE NO. ____

TEST NO. 6050-1 RIG NO. 7 SHEET 3 OF ____

OBSERVER H.D. DATE 8-15-77

SPECIMENS CASING: 6126-1 S/N 057701
CARBONS: 6127-1-8

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	TIME	SPEED	OIL	OIL	OIL	OIL	OIL							
3			IN	CHAM	IN	OUT	LKG							
4			PRESS	PRESS	TEMP	TEMP	RATE							
5	HR	RPM	PSIG	PSIG	°F	°F	CC/HR							
6														
7	1300	14250	25	0	119	163	-							
8	1400	14250	25	0	119	163	-							
9	1500	14250	25	0	119	163	-							
10	1600	14250	25	0	118	163	-							
11	1700	14250	25	0	117	162	-							
12	1724	14250	25	0	117	161	-							
13	1725	0							STOP RIG			GRAD OUT		
14														
15														
16														
17					8-16-77									
18														
19	0725	14250	25	0	86	125	-		START RIG			GRAD IN		
20	0825	14250	25	0	116	129	-		.30	cc	IN GRAD			
21	0925	14250	25	0	119	164	.05		.35	cc	IN GRAD			
22	1025	14250	25	0	119	164	-		.35	cc	IN GRAD			
23	1125	14250	25	0	122	165	.05		.40	cc	IN GRAD			
24	1225	14250	25	0	122	165	.10		.50	cc	IN GRAD			
25	1325	14250	25	0	122	165	.05		.55	cc	IN GRAD			
26	1425	14250	25	0	122	165	.05		.60	cc	IN GRAD			
27	1425	START	POINT TWO OF TEST PROGRAM											
28	1426	14250	25	1	122	165	-		.60	cc	IN GRAD			
29	1526	14250	25	1	122	169	1.95		2.55	cc	IN GRAD			
30	1626	14250	25	1	122	169	1.35		3.90	cc	IN GRAD			
31	1726	14250	25	1	122	169	1.20		5.10	cc	IN GRAD		GRAD OUT	
32	1900	14250	25	1	122	165	-		0	cc	IN GRAD		GRAD IN	
33	2000	14250	25	1	122	169	1.20		1.20	cc	IN GRAD			
34	2100	14250	25	1	122	169	1.20		2.40	cc	IN GRAD			
35	2200	14250	25	1	122	169	1.60		4.00	cc	IN GRAD			
36														

STEIN SEAL COMPANY

20th STREET & INDIANA AVENUE, PHILADELPHIA 32, Pa.

TEST NO. 6050-1 RIG NO. 7 SHEET 4 OF ____

OBSERVER H.D. + E.L. DATE 8-16-77

SPECIMENS CASING: 6126-1 S/N 057701
CARBONS: 6127-1-8

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	TIME	SPEED	OIL	OIL	OIL	OIL	OIL							
3			IN	CHAM	IN	OUT	LKG							
4			PRESS	PRESS	TEMP	TEMP	RATE							
5	HR	RPM	PSIG	PSIG	°F	°F	cc/HR							
6														
7	2300	14250	25	1	122	169	1.40		5.40	cc	IN GRAD			
8	2400	14250	25	1	122	169	1.60		6.00	cc	IN GRAD			
9	0100	14250	25	1	122	169	1.40		7.40	cc	IN GRAD			
10	0200	14250	25	1	122	169	1.60		1.60	cc	IN GRAD			
11	0300	14250	25	1	122	169	2.20		3.80	cc	IN GRAD			
12	0330	14250	25	1	122	169	1.20		4.40	cc	IN GRAD			
13	0335	0						STOP RIG					GRAD	OUT
14														
15						8-17-77								
16	0706	14250	25	1	81	81	-	START RIG					GRAD	IN
17	0720	14250	25	1	115	150	-		5.00	cc	IN GRAD			
18	0820	14250	25	1	120	167	1.70		6.70	cc	IN GRAD			
19	0920	14250	25	1	120	167	1.20		7.90	cc	IN GRAD		GRAD	OUT
20	0921	0						STOP RIG						
21				RELAP CRB. BORE - BURNISHING PLUG										
22	1343	14250	25	0	100	-	-	START RIG						
23	1345	14250	25	1	102	104	-							
24	1400	14250	25	1	122	157	-						GRAD	IN
25	1500	14250	25	1	136	181	-		0	cc	IN GRAD			
26	1600	14250	25	1	152	188	-		0	cc	IN GRAD			
27	1700	14250	25	1	122	171	-		0	cc	IN GRAD			
28	1720	14250	25	1	122	170	-		0	cc	IN GRAD			
29	1722	0						STOP RIG					GRAD	OUT
30														
31														
32														
33														
34														
35														
36														

STEIN SEAL COMPANY

20th STREET & INDIANA AVENUE, PHILADELPHIA 32, PA.

PAGE NO. _____

TEST NO. 6050-1 RIG NO. 7 SHEET 5 OF _____

OBSERVER E.L. DATE 8-19-77

SPECIMENS CASING 6126-1 S/N 057701
CARBONS: 6127-1-8

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	TIME	SPEED	OIL	OIL	OIL	OIL	OIL							
3			IN	CHAM	IN	OUT	LKG							
4			PRESS	PRESS	TEMP	TEMP	RATE							
5	HR	RPM	PSIG	PSIG	°F	°F	CC/HR							
6														
7	0740	14250	25	1	70	70	-	START	RIG				GRAD	IN
8	0800	14250	25	1	96	147	-							
9	0900	14250	25	1	108	156	.80		.80	cc	IN GRAD			
10	1000	14250	25	1	111	159	.20		1.00	cc	IN GRAD			
11	1100	14250	25	1	111	159	.50		1.50	cc	IN GRAD			
12	1200	14250	25	1	111	159	.50		2.00	cc	IN GRAD			
13	1300	14250	25	1	115	162	.70		2.70	cc	IN GRAD			
14	1400	14250	25	1	115	162	.20		2.90	cc	IN GRAD			
15	1500	14250	25	1	115	162	-		2.90	cc	IN GRAD			
16	1600	14250	25	1	115	162	-		2.90	cc	IN GRAD			
17	1700	14250	25	1	115	162	-		2.90	cc	IN GRAD			
18	1800	14250	25	1	115	162	-		2.90	cc	IN GRAD			
19	1900	14250	25	1	115	162	.10		3.00	cc	IN GRAD			
20	2000	14250	25	1	115	162	-		3.00	cc	IN GRAD			
21	2100	14250	25	1	115	162	-		3.00	cc	IN GRAD			
22	2200	14250	25	1	115	162	.10		3.10	cc	IN GRAD			
23	2300	14250	25	1	115	162	.10		3.20	cc	IN GRAD			
24	2400	14250	25	1	115	162	.10		3.30	cc	IN GRAD			
25	2430	0						STOP	RIG				GRAD	OUT
26														
27														
28														
29														
30														
31														
32														
33														
34														
35														
36														

STEIN SEAL COMPANY

20th STREET & INDIANA AVENUE, PHILADELPHIA 32, PA.

PAGE NO. ____

TEST NO. 6050-1 RIG NO. 7 SHEET 6 OF ____

OBSERVER H.D DATE 8-23-77

SPECIMENS CASING: 6126-1 S/N 057701
CARBONS: 6127-1-8

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	TIME	SPEED	OIL	OIL	OIL	OIL	OIL							
3			IN	CHAM	IN	OUT	LKG							
4			PRESS	PRESS	TEMP	TEMP	RATE							
5	HR	RPM	PSIG	PSIG	°F	°F	cc/HR							
6														
7	1130	14250	25	1	81	129	-	START RIG					GRAD IN	
8	1145	14250	25	1	102	145	-							
9	1245	14250	25	1	115	162	.40		.40	cc	IN GRAD			
10	1345	14250	25	1	115	162	.20		.60	cc	IN GRAD			
11	1445	14250	25	1	115	162	.10		.70	cc	IN GRAD			
12	1545	14250	25	1	115	162	.10		.80	cc	IN GRAD			
13	1645	14250	25	1	115	162	.10		.90	cc	IN GRAD			
14	1745	14250	25	1	115	162	.10		1.00	cc	IN GRAD			
15	1845	14250	25	1	115	162	.10		1.10	cc	IN GRAD			
16	1945	14250	25	1	115	162	.10		1.20	cc	IN GRAD			
17	2045	14250	25	1	115	162	.10		1.30	cc	IN GRAD			
18	2047	0						STOP RIG					GRAD OUT	
19														
20						8-22-77								
21	0745	14250	25	1	75	75	-	START RIG					GRAD IN	
22	0810	14250	25	1	105	148	-							
23	0910	14250	25	1	111	159	.40		.40	cc	IN GRAD			
24	1010	14250	25	1	111	159	.10		.50	cc	IN GRAD			
25	1110	14250	25	1	115	161	-		.50	cc	IN GRAD			
26	1230	14250	25	1	117	165	-		.50	cc	IN GRAD			
27			BEGIN		POINT	THREE	OF		TEST		PROGRAM			
28	1231	14250	25	3	117	165	-		.50	cc	IN GRAD			
29	1331	14250	25	3	118	165	5.60		6.10	cc	IN GRAD			
30	1421	14250	25	3	118	166	5.60		10.8	cc	IN GRAD		GRAD OUT	
31	1424	14250	25	2	118	169	-						GRAD IN	
32	1524	14250	25	2	118	169	1.60		1.60	cc	IN GRAD			
33	1624	14250	25	2	119	170	2.10		3.70	cc	IN GRAD			
34	1724	14250	25	2	122	171	1.70		5.40	cc	IN GRAD			
35	1725	0						STOP RIG					GRAD OUT	
36														

ERROR OVER PRESSURIZED

STEIN SEAL COMPANY

20th STREET & INDIANA AVENUE, PHILADELPHIA 32, PA.

PAGE NO. ____

TEST NO. 6050-1 RIG NO. 7 SHEET 7 OF ____

OBSERVER H.D. DATE 8-23-77

SPECIMENS CASING: 6126-1 S/N 057701
CARBONS: 6127-1-8

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	TIME	SPEED	OIL	OIL	OIL	OIL	OIL							
3			IN	CHAM	IN	OUT	LKG							
4			PRESS	PRESS	TEMP	TEMP	RATE							
5	HR	RPM	PSIG	PSIG	°F	°F	CC/HR							
6														
7	0710	14250	25	2	76	76	-	START RIG					GRAD IN	
8	0735	14250	25	2	106	156	-							
9	0835	14250	25	2	117	165	4.40		4.40	CC	IN GRAD			
10	0935	14250	25	2	117	165	2.80		7.20	CC	IN GRAD			
11	1100	14250	25	2	117	165	2.30		10.50	CC	IN GRAD		GRAD OUT	
12	1105	14250	25	2	117	165	-						GRAD IN	
13	1230	14250	25	2	118	165	1.80		2.50	CC	IN GRAD			
14	1330	14250	25	2	118	165	1.60		4.10	CC	IN GRAD			
15	1500	14250	25	2	118	165	1.30		6.10	CC	IN GRAD			
16	1600	14250	25	2	118	165	1.40		7.50	CC	IN GRAD			
17	1715	14250	25	2	118	165	1.40		9.40	CC	IN GRAD			
18	1716	0						STOP RIG					GRAD OUT	
19														
20					8-24-77									
21	0704	14250	25	2	79	79	-	START RIG					GRAD IN	
22	0730	14250	25	2	109	157	-							
23	0830	14250	25	2	116	165	2.70		2.70	CC	IN GRAD			
24	0930	14250	25	2	117	165	1.50		4.20	CC	IN GRAD			
25	1030	14250	25	2	117	165	1.10		5.30	CC	IN GRAD			
26	1130	14250	25	2	118	165	1.70		7.00	CC	IN GRAD			
27	1230	14250	25	2	119	167	1.20		8.20	CC	IN GRAD			
28	1330	14250	25	2	120	168	1.10		1.10	CC	IN GRAD			
29	1430	14250	25	2	122	169	1.00		2.10	CC	IN GRAD			
30	1530	14250	25	2	122	169	1.00		3.10	CC	IN GRAD			
31	1630	14250	25	2	120	168	1.40		4.50	CC	IN GRAD			
32	1715	14250	25	2	120	168	1.50		5.60	CC	IN GRAD			
33	1716	0						STOP RIG					GRAD OUT	
34														
35														
36														

STEIN SEAL COMPANY

20th STREET & INDIANA AVENUE, PHILADELPHIA 32, PA.

PAGE NO.

TEST NO. 6050-1 RIG NO. 7 SHEET 8 OF

OBSERVER H.D. DATE 8-25-77

SPECIMENS CASING: 6126-1 S/N 057701
CARBONS: 6127-1-8

1	2	3	4	5	6	7	8	9	10	11	12	13	14	1
2	TIME	SPEED	OIL	OIL	OIL	OIL	OIL							
3			IN	CHAM	IN	OUT	LKG							
4			PRESS	PRESS	TEMP	TEMP	RATE							
5	HR	RPM	PSIG	PSIG	°F	°F	cc/HR							
6														
7	0704	14250	25	2	69	69	-	START RIG					GRAD I	
8	0725	14250	25	2	100	149	-							
9	0825	14250	25	2	107	157	6.10		6.10	cc	IN GRAD			
10	0945	14250	25	2	108	158	3.70		11.00	cc	IN GRAD		GRAD →	
11	1115	14250	25	2	129	177	2.80		4.20	cc	IN GRAD			
12	1315	14250	25	2	130	178	2.10		8.40	cc	IN GRAD		GRAD →	
13	1415	14250	25	2	130	178	2.30		2.30	cc	IN GRAD			
14	1515	14250	25	2	130	178	2.10		4.40	cc	IN GRAD			
15	1615	14250	25	2	130	178	1.90		6.30	cc	IN GRAD			
16	1715	14250	25	2	130	178	2.10		8.40	cc	IN GRAD			
17	1716	0						STOP RIG					GRAD O	
18														
19						8-26-77								
20	0704	14250	25	2	72	72	-	START RIG					GRAD I	
21	0745	14250	25	2	102	154	-							
22	0845	14250	25	2	108	159	4.20		4.20	cc	IN GRAD			
23	0945	14250	25	2	111	159	3.30		7.50	cc	IN GRAD			
24	1045	14250	25	2	118	162	2.50		10.00	cc	IN GRAD		GRAD →	
25	1145	14250	25	2	118	165	1.80		1.80	cc	IN GRAD			
26	1245	14250	25	2	120	165	2.00		3.80	cc	IN GRAD			
27	1345	14250	25	2	121	165	1.70		5.50	cc	IN GRAD			
28	1445	14250	25	2	122	165	1.00		6.50	cc	IN GRAD			
29	1545	14250	25	2	122	165	1.00		7.50	cc	IN GRAD			
30	1645	14250	25	2	122	165	1.20		8.70	cc	IN GRAD			
31	1715	14250	25	2	122	165	1.00		9.20	cc	IN GRAD			
32	1720	0						STOP RIG					GRAD O	
33														
34					8-	29-77								
35	0720	14250	25	2	80	80	-	START RIG					GRAD I	
36	0800	14250	25	2	-	-	-							

STEIN SEAL COMPANY

20th STREET & INDIANA AVENUE, PHILADELPHIA 32, PA

PAGE NO. ____

TEST NO. 6050-1 RIG NO. 7 SHEET 9 OF ____

OBSERVER H.D. DATE 8-29-77

SPECIMENS CASING: 6126-1 S/N 05770|
CARBONS: 6127-1-8

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	TIME	SPEED	OIL	OIL	OIL	OIL	OIL							
3			IN	CHAM	IN	OUT	LKG							
4			PRESS	PRESS	TEMP	TEMP	RATE							
5	HR	RPM	PSIG	PSIG	°F	°F	CC/HR							
6														
7	0900	14250	25	2	116	165	1.80		1.80	cc	IN GRAD			
8	1000	14250	25	2	122	169	1.70		3.50	cc	IN GRAD			
9	1100	14250	25	2	116	165	1.50		5.00	cc	IN GRAD			
10	1200	14250	25	2	115	169	2.80		7.80	cc	IN GRAD			
11	1300	14250	25	2	119	169	.60		8.40	cc	IN GRAD			
12	1400	14250	25	2	122	169	.80		9.20	cc	IN GRAD			
13	1500	14250	25	2	120	169	–		0 - EMPTY GRAD - 0					
14	1501	0						STOP RIG						
15														
16					8-30-77			START PT. #1 - 7000 RPM						
17	0803	7000	25	0	84	90	–	START RIG					GRAD IN	
18	0900	7000	25	0	116	133	–	TRACE LKG ON CASING						
19	1000	7000	25	0	125	141	–		NO LKG IN GRAD					
20	1100	7000	25	0	129	145	–		NO LKG IN GRAD					
21	1200	7000	25	0	129	145	–		NO LKG IN GRAD					
22	1300	7000	25	0	129	145	–		NO LKG IN GRAD					
23	1400	7000	25	0	129	145	–		0	cc	IN GRAD			
24	1500	7000	25	0	130	146	–		0	cc	IN GRAD			
25	1600	7000	25	0	132	147	–		0	cc	IN GRAD			
26	1700	7000	25	0	132	147	–		0	cc	IN GRAD			
27	1725	7000	25	0	132	147	–	1 DROP IN GRAD						
28	1726	0						STOP RIG					GRAD OUT	
29														
30					8-30-77									
31	0730	7000	25	0	83	83	–	START RIG	~ .10 cc IN GRAD					
32	0830	7000	25	0	115	131	.10		~ .20	cc	IN GRAD		GRAD IN	
33	0930	7000	25	0	121	137	–		~ .20	cc	IN GRAD			
34	1030	7000	25	0	125	140	–		~ .20	cc	IN GRAD			
35	1130	7000	25	0	126	141	.10		~ .30	cc	IN GRAD			
36	1230	7000	25	0	127	141	–		~ .30	cc	IN GRAD			

STEIN SEAL COMPANY

20th STREET & INDIANA AVENUE, PHILADELPHIA 32, PA.

PAGE NO. ____

TEST NO. 6050-1 RIG NO. 7 SHEET 10 OF ____

OBSERVER H.D. DATE 8-31-77

SPECIMENS CASING: 6126-1 S/N 057701
CARBONS: 6127-1-8

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	TIME	SPEED	OIL	OIL	OIL	OIL	OIL							
3			IN	CHAM	IN	OUT	LKG							
4			PRESS	PRESS	TEMP	TEMP	RATE							
5	HR	RPM	PSIG	PSIG	°F	°F	CC/HR							
6														
7	1330	7000	25	0	127	143	-	~	.30	CC	IN GRAD			
8	1430	7000	25	0	127	143	.10	~	.40	CC	IN GRAD			
9	1530	7000	25	0	125	140	-		.40	CC	IN GRAD			
10	1630	7000	25	0	125	140	-		.40	CC	IN GRAD			
11	1720	7000	25	0	125	140	-		.40	CC	IN GRAD			
12	1721	0						STOP RIG					GRAD OUT	
13														
14						9-1-77								
15	0705	7000	25	0	80	81	-	START RIG			.40 CC IN GRAD			
16	0805	7000	25	0	115	130	-		.40	CC	IN GRAD		GRAD IN	
17	0905	7000	25	0	123	139	-		.40	CC	IN GRAD			
18	1005	7000	25	0	124	140	-		.40	CC	IN GRAD			
19	1105	7000	25	0	125	141	-		.40	CC	IN GRAD			
20	1205	7000	25	0	125	141	-		.40	CC	IN GRAD			
21	1305	7000	25	0	125	141	-		.40	CC	IN GRAD			
22	1405	7000	25	0	126	142	-		.40	CC	IN GRAD			
23	1505	7000	25	0	126	142	.10		.50	CC	IN GRAD			
24	1605	7000	25	0	126	142	-		.50	CC	IN GRAD			
25	1705	7000	25	0	126	142	-		.50	CC	IN GRAD			
26	1720	7000	25	0	126	142	-		.50	CC	IN GRAD			
27	1721	0						STOP RIG					GRAD OUT	
28														
29						9-2-77								
30	0715	7000	25	0	81	81	-	START RIG			.50 CC IN GRAD			
31	0815	7000	25	0	115	132	.10		.60	CC	IN GRAD		GRAD IN	
32	0915	7000	25	0	120	138	-		.60	CC	IN GRAD			
33	1015	7000	25	0	119	136	-		.60	CC	IN GRAD			
34	1115	7000	25	0	125	142	-		.60	CC	IN GRAD			
35	1215	7000	25	0	127	143	-		.60	CC	IN GRAD			
36	1315	7000	25	0	127	143	-		.60	CC	IN GRAD			

STEIN SEAL COMPANY

20th STREET & INDIANA AVENUE, PHILADELPHIA 32, PA.

PAGE NO. ____

TEST NO. 6050-1 RIG NO. 7 SHEET 11 OF ____

OBSERVER H.D DATE 9-2-77

SPECIMENS CASING: 6126-1 S/N 057701
CARBONS: 6127-1-8

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	TIME	SPEED	OIL	OIL	OIL	OIL	OIL							
3			IN	CHAM	IN	OUT	LKG							
4			PRESS	PRESS	TEMP	TEMP	RATE							
5	HR	RPM	PSIG	PSIG	°F	°F	CC/HR							
6														
7	1415	7000	25	0	127	143	-		.60	cc	IN GRAD			
8	1515	7000	25	0	128	144	-		.60	cc	IN GRAD			
9	1525	0						STOP RIG					GRAD OUT	
10														
11						9-6-77								
12	0705	7000	25	0	81	82	-	START RIG	.60	cc	IN GRAD			
13	0805	7000	25	0	113	130	-		.60	cc	IN GRAD		GRAD IN	
14	0905	7000	25	0	120	136	-		.60	cc	IN GRAD			
15	1005	7000	25	0	122	138	-		.60	cc	IN GRAD			
16	1105	7000	25	0	125	142	-		.60	cc	IN GRAD			
17	1205	7000	25	0	125	142	-		.60	cc	IN GRAD			
18	1305	7000	25	0	126	143	-		.60	cc	IN GRAD			
19	1405	7000	25	0	126	143	-		.60	cc	IN GRAD			
20	1505	7000	25	0	126	143	-		.60	cc	IN GRAD			
21	1605	7000	25	0	126	143	-		.60	cc	IN GRAD			
22	1705	7000	25	0	126	143			.60	cc	IN GRAD			
23	1725	0						STOP RIG					GRAD OUT	
24														
25						9-7-77								
26	0705	7000	25	0	80	82	-	START RIG	.60	cc	IN GRAD			
27	0805	7000	25	0	110	132	-		.60	cc	IN GRAD		GRAD IN	
28	0905	7000	25	0	115	132	-		.60	cc	IN GRAD			
29	1005	7000	25	0	115	132	-		.60	cc	IN GRAD			
30	1105	7000	25	0	115	132	-		.60	cc	IN GRAD			
31	1205	7000	25	0	116	133	-		.60	cc	IN GRAD			
32	1305	7000	25	0	118	135	-		.60	cc	IN GRAD			
33	1405	7000	25	0	119	137	-		.60	cc	IN GRAD			
34	1505	7000	25	0	122	138	-		.60	cc	IN GRAD			
35	1605	7000	25	0	122	138	-		.60	cc	IN GRAD			
36														

STEIN SEAL COMPANY

20th STREET & INDIANA AVENUE, PHILADELPHIA 32, PA.

PAGE NO. ____

TEST NO. 6050-1 RIG NO. 7 SHEET 12 OF ____

OBSERVER H.D. + G.W. DATE 9-7-77

SPECIMENS CASING: 6126-1 S/N 057701
CARBONS: 6127-1-8

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	TIME	SPEED	OIL	OIL	OIL	OIL	OIL							
3			IN	CHAM	IN	OUT	LKG							
4			PRESS	PRESS	TEMP	TEMP	RATE							
5	HR	RPM	PSIG	PSIG	°F	°F	CC/HR							
6														
7	1705	7000	25	0	122	138	-		.60	cc	IN GRADE			
8	1725	0						STOP RIG					GRAD OUT	
9														
10						9-8	-77	START PT #2						
11	0705	7000	25	1	78	80	-	START RIG					GRAD IN	
12	0805	7000	25	1	108	128	-	TRACE LKG ON CASING						
13	0905	7000	25	1	111	130	-		0	cc	IN GRD			
14	1005	7000	25	1	114	132	-		0	cc	IN GRD			
15	1105	7000	25	1	118	135	-		0	cc	IN GRD			
16	1205	7000	25	1	119	136	-		0	cc	IN GRAD			
17	1305	7000	25	1	122	140	-		0	cc	IN GRAD			
18	1405	7000	25	1	122	139	-		ONE DROP IN GRAD					
19	1505	7000	25	1	133	140	-		ONE DROP IN GRAD					
20	1605	7000	25	1	124	141	-		ONE DROP IN GRAD					
21	1705	7000	25	1	124	141	-		ONE DROP IN GRAD					
22	1725	7000	25	1	124	141	-		ONE DROP IN GRAD					
23	1726	0						STOP RIG					GRAD OUT	
24														
25						9-9	-77							
26	0705	7000	25	1	75	76	-	START RIG ONE DROP IN GRAD						
27	0805	7000	25	1	108	127	~.10		~.10	cc	IN GRAD		GRAD IN	
28	0905	7000	25	1	111	130	.10		.20	cc	IN GRAD			
29	1005	7000	25	1	113	132	.10		.30	cc	IN GRAD			
30	1105	7000	25	1	115	134	-		.30	cc	IN GRAD			
31	1205	7000	25	1	118	136	.10		.40	cc	IN GRAD			
32	1305	7000	25	1	122	138	-		.40	cc	IN GRAD			
33	1405	7000	25	1	123	139	-		.40	cc	IN GRAD			
34	1505	7000	25	1	123	140	-		.40	cc	IN GRAD			
35	1525	7000	25	1	127	140	-		.40	cc	IN GRAD			
36	1526	0						STOP RIG					GRAD OUT	

STEIN SEAL COMPANY

PAGE NO. _____

20th STREET & INDIANA AVENUE, PHILADELPHIA 32, PA.

TEST NO. 6050-1 RIG NO. 7 SHEET 13 OF _____

OBSERVER G.W. DATE 9-12-77

SPECIMENS CASING: 6126-1 S/N 057701
CARBONS: 6127-1-8

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	TIME	SPEED	OIL	OIL	OIL	OIL	OIL							
3			IN	CHAM	IN	OUT	LKG							
4			PRESS	PRESS	TEMP	TEMP	RATE							
5	HR	RPM	PSIG	PSIG	°F	°F	CC/HR							
6														
7	0800	7000	25	1	67	68	-	START RIG .40 cc IN GRAD						
8	0900	7000	25	1	104	124	-		.40	cc	IN GRAD		GRAD IN	
9	1000	7000	25	1	113	131	-		.40	cc	IN GRAD			
10	1100	7000	25	1	114	132	-		.40	cc	IN GRAD			
11	1200	7000	25	1	114	135	-		.40	cc	IN GRAD			
12	1300	7000	25	1	115	135	-		.40	cc	IN GRAD			
13	1400	7000	25	1	117	136	-		.40	cc	IN GRAD			
14	1500	7000	25	1	118	136	.10		.50	cc	IN GRAD			
15	1600	7000	25	1	118	136	.10		.60	cc	IN GRAD			
16	1700	7000	25	1	118	136	.10		.70	cc	IN GRAD			
17	1725	7000	25	1	118	136	-		.70	cc	IN GRAD			
18	1726	0						STOP RIG					GRAD OUT	
19			30 HRS 5 MIN			@ 1 PSIG		-7000 RPM						
20						9-13-77								
21	0705	7000	25	1	73	76	-	START RIG .70 cc IN GRAD						
22	0805	7000	25	1	113	127	-		.70	cc	IN GRAD		GRAD IN	
23	0905	7000	25	1	117	134	-		.70	cc	IN GRAD			
24	1005	7000	25	1	118	135	.10		.80	cc	IN GRAD			
25	1105	7000	25	1	119	136	-		.80	cc	IN GRAD			
26	1205	7000	25	1	120	137	-		.80	cc	IN GRAD			
27	1305	7000	25	1	120	137	-		.80	cc	IN GRAD			
28	1405	7000	25	1	121	138	-		.80	cc	IN GRAD			
29	1505	7000	25	1	122	138	-		.80	cc	IN GRAD			
30	1605	7000	25	1	123	139	-		.80	cc	IN GRAD			
31	1705	7000	25	1	124	140	-		.80	cc	IN GRAD			
32	1725	7000	25	1	124	140	-		.80	cc	IN GRAD			
33	1726	0						STOP RIG					GRAD OUT	
34														
35														
36														

STEIN SEAL COMPANY

20th STREET & INDIANA AVENUE, PHILADELPHIA 32, PA.

PAGE NO. _____

TEST NO. 6050-1 RIG NO. 7 SHEET 14 OF _____

OBSERVER G.W. DATE 9-14-77

SPECIMENS CASING: 6126-1 S/N 057701
CARBONS: 6127-1-8

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	TIME	SPEED	OIL	OIL	OIL	OIL	OIL							
3			IN	CHAM	IN	OUT	LKG							
4			PRESS	PRESS	TEMP	TEMP	RATE							
5	HR	RPM	PSIG	PSIG	°F	°F	CC/HR							
6														
7	0705	7000	25	1	77	80	-	START RIG .80 cc IN GRAD						
8	0805	7000	25	1	111	129	.10		.90	cc	IN GRAD		GRAD IN	
9	0905	7000	25	1	118	134	-		.90	cc	IN GRAD			
10	1005	7000	25	1	122	138	.10		1.00	cc	IN GRAD			
11	1105	7000	25	1	123	140	-		1.00	cc	IN GRAD			
12	1205	7000	25	1	124	141	-		1.00	cc	IN GRAD			
13	1305	7000	25	1	125	142	-		1.00	cc	IN GRAD			
14	1405	7000	25	1	125	142	-		1.00	cc	IN GRAD			
15	1505	7000	25	1	126	143	-		1.00	cc	IN GRAD			
16	1605	7000	25	1	126	143	-		1.00	cc	IN GRAD			
17	1705	7000	25	1	126	143	-		1.00	cc	IN GRAD			
18	1725	7000	25	1	126	143	-		1.00	cc	IN GRAD			
19	1726	0						STOP RIG					GRAD OUT	
20														
21						9-15	-77							
22	0705	7000	25	2	70	73	-	START RIG					GRAD IN	
23	0805	7000	25	2	105	122	.20		.20	cc	IN GRAD			
24	0905	7000	25	2	110	129	-		.20	cc	IN GRAD			
25	1005	7000	25	2	113	131	.10		.30	cc	IN GRAD			
26	1105	7000	25	2	115	132	-		.30	cc	IN GRAD			
27	1205	7000	25	2	116	133	-		.30	cc	IN GRAD			
28	1305	7000	25	2	117	135	-		.30	cc	IN GRAD			
29	1405	7000	25	2	118	136	-		.30	cc	IN GRAD			
30	1505	7000	25	2	118	136	-		.30	cc	IN GRAD			
31	1605	7000	25	2	118	136	-		.30	cc	IN GRAD			
32	1705	7000	25	2	118	136	-		.30	cc	IN GRAD			
33	1725	7000	25	2	118	136	-		.30	cc	IN GRAD			
34	1726	0						STOP RIG					GRAD OUT	
35														
36														

STEIN SEAL COMPANY

20th STREET & INDIANA AVENUE, PHILADELPHIA 32, PA.

PAGE NO. _____

TEST NO. 6050-1 RIG NO. 7 SHEET 15 OF _____

OBSERVER G.W. DATE 9-16-77

SPECIMENS CASING: 6126-1 S/N 057701
CARBONS: 6127-1-8

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	TIME	SPEED	OIL	OIL	OIL	OIL	OIL							
3			IN	CHAM	IN	OUT	LKG							
4			PRESS	PRESS	TEMP	TEMP	RATE							
5	HR	RPM	PSIG	PSIG	°F	°F	CC/HR							
6														
7	0705	7000	25	2	73	77	-	START RIG			.30 cc IN GRAD			
8	0805	7000	25	2	105	125	.10		.40	cc	IN GRAD		GRAD IN	
9	0905	7000	25	2	111	132	.10		.50	cc	IN GRAD			
10	1005	7000	25	2	113	132	.10		.60	cc	IN GRAD			
11	1105	7000	25	2	115	135	-		.60	cc	IN GRAD			
12	1205	7000	25	2	117	136	-		.60	cc	IN GRAD			
13	1305	7000	25	2	118	136	-		.60	cc	IN GRAD			
14	1405	7000	25	2	118	136	-		.60	cc	IN GRAD			
15	1505	7000	25	2	119	137	.10		.70	cc	IN GRAD			
16	1525	7000	25	2	120	138	3		1.70	cc	IN GRAD			
17	1526	0						STOP RIG					GRAD OUT	
18														
19						9-19	-77							
20	0705	7000	25	2	77	81	-	START RIG			1.70 cc IN GRAD			
21	0805	7000	25	2	111	132	.10		1.80	cc	IN GRAD		GRAD IN	
22	0905	7000	25	2	117	137	.10		1.90	cc	IN GRAD			
23	1005	7000	25	2	119	139	-		1.90	cc	IN GRAD			
24	1105	7000	25	2	123	144	.10		2.00	cc	IN GRAD			
25	1205	7000	25	2	123	142	-		2.00	cc	IN GRAD			
26	1305	7000	25	2	125	145	-		2.00	cc	IN GRAD			
27	1405	7000	25	2	128	148	-		2.00	cc	IN GRAD			
28	1505	7000	25	2	130	150	-		2.00	cc	IN GRAD			
29	1605	7000	25	2	131	152	-		2.00	cc	IN GRAD			
30	1705	7000	25	2	131	152	-		2.00	cc	IN GRAD			
31	1725	7000	25	2	131	152	-		2.00	cc	IN GRAD			
32	1726	0						STOP RIG					GRAD OUT	
33														
34						9-20	-77							
35	0705	7000	25	2	76	80	-	START RIG			2.00 cc IN GRAD			
36	0805	7000	25	2	111	130	-		2.00	cc	IN GRAD			

STEIN SEAL COMPANY

20th STREET & INDIANA AVENUE, PHILADELPHIA 32, PA.

PAGE NO. _____

TEST NO. 6050-1 RIG NO. 7 SHEET 16 OF _____

OBSERVER G.W. + B.T. DATE 9-20-77

SPECIMENS CASING: 6126-1 S/N 057701
CARBONS: 6127-1-8
45 HRS. AT 1305 9-21-77

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	TIME	SPEED	OIL	OIL	OIL	OIL	OIL							
3			IN	CHAM	IN	OUT	LKG							
4			PRESS	PRESS	TEMP	TEMP	RATE							
5	HR	RPM	PSIG	PSIG	°F	°F	cc/HR							
6														
7	0905	7000	25	2	116	135	.30		2.30	cc	IN GRAD			
8	1005	7000	25	2	118	137	-		2.30	cc	IN GRAD			
9	1105	7000	25	2	121	139	-		2.30	cc	IN GRAD			
10	1205	7000	25	2	122	140	-		2.30	cc	IN GRAD			
11	1305	7000	25	2	123	140	-		2.30	cc	IN GRAD			
12	1405	7000	25	2	123	140	-		2.30	cc	IN GRAD			
13	1505	7000	25	2	123	140	-		2.30	cc	IN GRAD			
14	1605	7000	25	2	123	140	-		2.30	cc	IN GRAD			
15	1705	7000	25	2	119	138	.10		2.40	cc	IN GRAD			
16	1725	7000	25	2	119	137	-		2.40	cc	IN GRAD			
17	1726	0						STOP RIG					GRAD OUT	
18														
19						9-21	-77							
20	0705	7000	25	2	63	81	-	START RIG		2.40 cc	IN GRAD			
21	0805	7000	25	.2	106	123	.20		2.60	cc	IN GRAD		GRAD IN	
22	0905	7000	25	2	110	130	.20		2.80	cc	IN GRAD			
23	1005	7000	25	2	108	128	-		2.80	cc	IN GRAD			
24	1105	7000	25	2	111	127	-		2.80	cc	IN GRAD			
25	1205	7000	25	2	111	128	.10		2.90	cc	IN GRAD			
26	1305	7000	25	2	107	126	.10		3.00	cc	IN GRAD			
27	1405	7000	25	2	108	126	-		3.00	cc	IN GRAD			
28	1505	7000	25	2	110	128	.10		3.10	cc	IN GRAD			
29	1605	7000	25	2	113	132	-		3.10	cc	IN GRAD			
30	1705	7000	25	2	112	131	-		3.10	cc	IN GRAD			
31	1720	7000	25	2	112	131	.10		3.20	cc	IN GRAD			
32	1721	0						STOP RIG					GRAD OUT	
33														
34						9-	22-	77						
35	0705	7000	25	2	67	84	-	START RIG		3.20 cc	IN GRAD			
36	0805	7000	25	2	98	115	.10		3.30	cc	IN GRAD			

STEIN SEAL COMPANY

20th STREET & INDIANA AVENUE, PHILADELPHIA 32, PA.

PAGE NO. _____

TEST NO. 6050-1 RIG NO. 7 SHEET 17 OF _____

OBSERVER B.T. DATE 9-22-77

SPECIMENS CASING: 6126-1 S/N -057701
CARBONS 6127-1-8

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	TIME	SPEED	OIL	OIL	OIL	OIL	OIL							
3			IN	CHAM	IN	OUT	LKG.							
4			PRESS	PRESS	TEMP	TEMP	RATE							
5	HR	RPM	PSIG	PSIG	°F	°F	CC/HR							
6														
7			CHANGE CONDITION TO POINTS 2											
8	0810	7000	25	1	98	115	-		3.30	cc	IN GRAD			
9	0910	7000	25	1	110	129			3.30	cc	IN GRAD			
10	0925	7000	25	1	110	129			3.30	cc	IN GRAD			
11	0926	0						STOP RIG					GRAD OUT	
12														
13														
14														
15														
16														
17														
18														
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