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FINAL REPORT
ON

Performance Tests With 4.75 Inch Bore Tapered-Roller Bearings At High Speeds

by
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16. Abstract

The performance of 120.65 mm (4.75 inch) tapered-roller bearings was investigated in a series of high speed parametric tests.

Prior to performing these tests, additional instrumentation was installed on the test machine for measuring shaft, bearing cone and cone-rib temperatures, separator and spindle rotative speeds, and radial spindle excursion.

Two additional test machines, built in an earlier program, were operated for a total of 50 hours each, and their reliable performance was demonstrated.

The tapered-roller bearings were tested at speeds to 15,000 rpm which results in a cone-rib tangential velocity of 130 m/sec. (25,500 ft/min). Lubrication was applied either by jets or directly to the cone-rib, augmented with jets. Additional test parameters included thrust loads to 53,400 N (12,000 lbs), radial loads to 26,700 N (6,000 lbs), lubricant flow rates from 1.9×10^{-3} to 15.1×10^{-3} m^3/min. (0.5 to 4.0 gpm), and lubricant inlet temperatures of 350°K and 364°K (170°F and 195°F). Temperature distribution, separator speed, and drive-motor power demand were determined as functions of these test parameters.

The limitations of jet lubrication and the advantages of cone-rib lubrication were demonstrated. "Balanced" bearing operating temperatures were achieved by combining cone-rib lubrication with external cup cooling.

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1. SUMMARY

The program reported herein was a multi-task effort with the primary objective to investigate the performance of 120.65 mm (4.75 inch) bore tapered-roller bearings at high speeds.

Before initiating the tapered-roller bearing tests, the instrumentation of the test machine was complemented with features to measure shaft, bearing cone and cone-rib temperatures, as well as separator and spindle rotative speeds, and radial spindle excursion.

Two additional tapered-roller bearing test machines, built in an earlier program, were operated for a total of 50 hours each. In a series of tests, these machines were run with 53,400 N (12,000 lbs) thrust and 26,700 N (6,000 lbs) radial load, using commercial tapered-roller bearings. To demonstrate the machine performance at high speeds, the tapered-roller bearings were replaced by high performance split-inner ring ball bearings, and the machines were run at speeds to 20,000 rpm. The qualification tests demonstrated satisfactory and stable operation of both machines, including their subsystems and instrumentation.

The operating characteristics of 120.65 mm (4.75 inch) bore tapered-roller bearings were measured at shaft speeds to 15,000 rpm. The cone-rib tangential velocity at this speed was 130 m/sec. (25,500 ft/min). Lubrication was applied either by jets or directly to the cone-rib through holes from a manifold at the cone bore, augmented with jets at the roller small end side. The test conditions included thrust loads to 53,400 N (12,000 lbs), radial loads to 26,700 N (6,000 lbs), lubricant flow rates from 1.9×10^{-3} to 15.1×10^{-3} m^3/min. (0.5 to 4.0 gpm), and lubricant inlet temperatures of 350°K and 364°K (170°F and 195°F). Temperature distribution, separator speed, and drive motor power demand

were determined as functions of shaft speed, thrust and radial loads, lubricant flow rate, lubricant introduction method and inlet temperatures.

During the course of testing the limitations of jet lubrication became clearly visible. By combining cone-rib lubrication with external cup cooling, it was possible to temperature "tune" the individual bearing components, and reliable, low temperature operation could be achieved at high speeds.

2. INTRODUCTION

Tapered-roller bearings combine the radial load capacity of cylindrical roller bearings with the ability of ball bearings to carry heavy thrust loads. They offer advantages such as smaller envelope dimensions and lower weight in applications where heavy combined radial and thrust loads must be transmitted. However, reliable operation has been limited mostly to low or moderate speed applications.

Research efforts conducted under contracts by the U.S. Armed Forces and NASA have advanced the high-speed tapered-roller bearing technology. Laboratory tests reported in references [1] and [2] have shown that tapered-roller bearings can be operated at very high speeds if special attention is given to designing and lubricating these bearings. The method of supplying lubricant to the critical cone-rib contact is of particular importance. From research references [1] and [3] it was concluded that highly loaded tapered-roller bearings operate most successfully at high speeds when lubricant is supplied directly to the cone-rib contact through holes from a manifold at the cone bore.

Computer programs have been developed and are now available to aid in the design of high speed tapered-roller bearings. These programs, described in references [4] and [5], consider the lubrication requirements in the analysis of the kinematic and thermal bearing performance. Experimental data of bearing performance at high speeds and under combined loading, as presented in this report, are now needed to evaluate and verify the predictions of these analytical programs.

The research reported herein was conducted in the test facilities of Industrial Tectonics, Inc., Bearing Division, on an ITI developed tapered-roller bearing test machine described in reference [6]. As part of this program, additional features

were added to the instrumentation of this machine, increasing its versatility during bearing performance testing.

Two tapered-roller bearing test machines of the same type, which are intended for future life testing, were built by ITI under a previous NASA contract, NAS 3-17355. These machines were operated and their reliable performance was successfully demonstrated.

The primary objective of this program was to investigate the performance of 120.65 mm (4.75 inch) bore tapered-roller bearings at speeds up to 15,000 rpm (1.81×10^6 DN*). The maximum cone-rib tangential velocity at this speed was 130 m/sec. (25,500 ft/min) Lubrication was applied either by jets or directly to the cone-rib through holes from a manifold at the cone-bore, augmented with jets at the roller small end side. These tests resulted in a clear definition of the operating characteristics and temperature distribution of the bearing for various shaft speeds, thrust and radial loads, lubricant flow rates, lubricant introduction methods and oil inlet temperatures.

*DN, a bearing speed parameter, is equal to the product of the bearing bore in millimeters and the shaft speed in rpm.

3. TEST FACILITY PREPARATION

3.1 Test Rig

3.1.1 Mechanical Arrangement

In the tapered-roller bearing test machine, L-197, each of the two (2) test bearings is mounted in its own test head as shown in Figure 1. The right (rear) test head assembly is mounted rigidly to the machine frame, while the left (front) one is axially movable on linear rolling contact bearings. Thrust load is applied to the test bearings by hydraulic jacks acting to separate the two test head assemblies. The hydraulic radial load actuator is centered between the test bearings and transmits its force to the machine spindle through a pair of radial roller bearings. One end of the tubular test spindle accepts a drive pulley for the high speed flat belt. Oil is supplied through the other end by a stationary lubrication probe. Annular grooves or channels at the spindle bore direct the lubricant through radial holes to the test bearings and load bearings for inner ring lubrication and cooling. For jet lubrication of the test bearings, two jet probes are located 180° apart at the roller small end of each test bearing.

The test spindle is driven by flat belts. A 3,600 rpm, 75 kw (100 hp), 460 volt, 3 phase electric motor is controlled by a reduced voltage starter to select the desired acceleration rate during start-up. Test spindle speeds from 6,000 to 20,000 rpm are chosen by exchanging drive pulleys at the motor. The pair of flat belts are guided by an idler pulley arrangement which maintains a controlled pre-load on the slack side of the belts. Some of these drive system components are visible in Figure 2.

3.1.2 Lubrication System

The oil flow from a 45.4 X 10^{-3} m^3/min. (12 gpm), 690 X 10^3 N/m^2 (100 psi) gear pump passes through a 10 micron filter and an oil to water heat exchanger before branching off into five (5) lubricant circuits. These circuits supply oil to the test

bearings for cone-rib lubrication, jet lubrication and outer ring cooling and to the cylindrical roller bearings for lubrication and ring cooling. The flow through each circuit is infinitely adjustable with flow control valves and can be measured with a flow rate indicator. The oil inlet temperature is adjustable by controlling the rate of flow passing through or by-passing the heat exchanger. Scavenging of oil from the test bearing and cylindrical roller bearing housings is by large capacity gravity drain lines. Flow and level switches, relief valves, and pressure gages protect the hydraulic circuits.

3.1.3 Load System

The hydraulic system pressure for both the thrust and the radial load actuators are controlled by air pressure regulators and air to oil pressure boosters. Accumulators which are part of each oil pressure loop assure easy control and stable loads throughout the adjustment range.

3.1.4 Instrumentation

Thermocouples are installed for temperature measurements of each test bearing cup, both load bearing outer rings, and the oil inlets and outlets of the load and test bearing housings. A strip chart recorder connected to the thermocouples provides a permanent temperature log for all test stations. An adjustable relay terminates a test if bearing ring temperature limits are exceeded. Provisions exist to measure test bearing cone-face temperatures with an infrared pyrometer aimed through an air purged sight tube assembly. Additional temperature measuring capabilities, described in paragraph 3.2.3, were added to the machine as part of this contract.

The machine vibration level is measured with piezoelectric accelerometers which automatically shut-down the test when the machine vibration exceeds a pre-determined level as may be due to a bearing failure. Flow switches and oil level switches protect the test machine in the event of lubrication system malfunction. Meters indicate line current and voltage to the drive spindle motor.

3.2 Provisions for Additional Instrumentation

The first program objective was to complement the existing instrumentation of the test machine. The following features were added:

3.2.1 Measurement of Separator and Spindle Speeds

Proximity probes were installed to measure the test bearing inner ring and separator rotational speeds. The measured values are displayed on digital tachometers at the control console, Figure 3.

3.2.2 Measurement of Spindle Excursion

The radial excursion of the test spindle from its rotational centerline is measured with proximity probes located in the test housings near the spindle ends. The output from these probes is displayed on an oscilloscope showing the amplitude of the shaft excursion in the two (2) planes represented by the axes of the probes (X-Y display) for each of the two (2) test spindle locations.

3.2.3 Additional Temperature Measurements

The test machine was further upgraded by adding thermocouples to record temperatures of the rear test bearing housing at either side of the test bearing, as well as at the inside diameter of the test bearing cone, the cone-rib, and at the test spindle on either side of the test bearing. The output from the shaft thermocouples was wired through a slip ring system which, later on in the program, was replaced with a FM multiplex wireless data system. The transmitter was

mounted with an adaptor to the belt pulley at the test spindle. A special FM receiver indicates the measured temperatures on a digital display.

3.3 Demonstration of Test Rigs

Under contract NAS 3-17355, Industrial Tectonics, Inc. built two (2) additional test machines of the type L-197. These machines, serial numbers 2 and 3, are shown in Figure 4. They are of identical design as the initial test rig, serial number 1, which was fabricated under contract NAS 3-16812 and was described earlier in this report and in reference [6]. All three machines, shown in Figure 5, are connected to the same services and share the central control console shown in Figure 3. In a future program this entire facility will be used to perform a series of high speed tapered-roller bearing fatigue tests. For consistent results in such a program the operational characteristics of all machines must be identical.

To check out their performance, the machines serial number 2 and serial number 3 were subjected to a series of tests. The contractual test conditions for these check-out runs duplicated those used to demonstrate the initial rig.

The qualification tests demonstrated satisfactory and stable operation of both machines, serial number 2 and serial number 3, including their subsystems and instrumentation. Based on the test results, which are further detailed below, it was concluded that both machines meet all specified requirements. They exhibited the same operational characteristics as machine serial number 1.

3.3.1 Load System, Instrumentation, Safety Equipment

During this intial check-out phase, the load systems and the output from all thermocouples were calibrated against known standards. The safety equipment and shut-down devices were checked by functional tests.

All components operated in accordance with the equipment specifications. The safety and shut-down systems operated satisfactorily and within tolerance.

The load calibration curves are given in Figures 6 through 9.

3.3.2 Operation at High Loads and Low Speeds

Using commercial tapered-roller bearings (Timken, type TS, Cone: 795 Class 3; Cup: 792 Class 2) in the test chambers, each machine was operated for 24 hours at 3,000 rpm, with a thrust load of 35,600 N (8,000 lbs) and a radial load of 13,350 N (3,000 lbs) per bearing. The cup and cone-rib temperatures were held below 436°K (325°F).

Without changing the speed or bearing temperatures the machines were then operated for one (1) additional hour with 53,400 N (12,000 lbs) thrust and 26,700 N (6,000 lbs) radial load per bearing, which represent maximum machine design loads.

The machine and bearings operated smoothly without sign of distress to any component. The loads and all operating parameters remained stable and all subsystems and instruments performed reliably. The lab data sheets of this test sequence are given in Table I for machine serial number 2 and in Table II for machine serial number 3.

3.3.3 Operation at High Speed with Low Loads

The tapered-roller bearings were replaced with high precision split-inner ring ball bearings. The performance data of these bearings was known from earlier investigations, reported in reference [7].

A fifteen (15) hour test run was then conducted with each machine at 15,000 rpm under 26,700 N (6,000 lbs) thrust load and 4,450 N (1,000 lbs) radial load. Test bearing inner and outer ring temperatures were held below 489°K (420°F).

In a final test, the machines were run for ten (10) hours at a speed of 20,000 rpm with no radial load and 26,700 N (6,000 lbs) thrust load. The inner and outer rings of the test ball bearings were maintained at a temperature of 489°K $\pm$ 8° (420°F $\pm$ 15°F).

During the tests both machines operated without a sign of distress to any of their components. The loads and all operating parameters remained stable. All subsystems and instruments operated reliably. The lab data sheets from these tests are shown in Table III for machine serial number 2 and in Table IV for machine serial number 3.

3.3.4 Post-Test Inspection

Upon conclusion of the tests described in paragraph 3.3.2 and 3.3.3,which represent a total of fifty (50) hours of operation, the machines were dismantled and thoroughly inspected.

No visible or measurable damage or distress was observed in any of the machines, their components, or the test bearings.

4. PARAMETRIC STUDY

4.1 Test Facilities

The high speed tapered-roller bearing test machine L-197, serial number 1, described in the preceeding section of this report was used for these studies. Measurements were made of bearing inner ring speed, bearing separator speed, test spindle excursion, oil flow, and machine vibration level. Thermocouples recorded the operating temperatures at the test bearing cup, cone bore and cone-rib, the test bearing housing and spindle, as well as of the oil at the inlets and outlets to the test bearing housing. The thermocouple locations are illustrated in Figure 10.

For jet lubrication of the test bearings, two jet probes as shown in Figure 10 were located 180° apart at the roller small end. Each jet probe contained two holes directed at the test bearing. Two-thirds of the jet flow was directed toward the inside diameter of the separator and one-third was directed toward its outside diameter. The orifice diameters were varied to maintain jet velocities in the range between 15 and 33 m/sec. (45 and 100 feet per second). Cone-rib lubrication was accomplished through radial oil holes at the machine spindle.

Drive spindle power loss was determined by measuring line-to-line voltage and line current to the test rig drive motor. Motor drive power was then calculated as a function of line current, reflecting bearing power usage at the various operating conditions.

4.2 Test Bearings

The test bearings were class 2 tapered-roller bearings with 120.65 mm (4.75 inch) bore and 206.38 mm (8.125 inch) outside diameter. The cup angle was 34°, and the roller included angle

was 3° 10'. The bearing contained 25 rollers with a large end diameter of 18.288 mm (0.720 inch) and overall length of 34.618 mm (1.3452 inch). The rollers were fully crowned with a crown radius of 25.4 m (1,000 inch) and had a spherical end radius equal to 80% of the apex length.

The material of the cup, cone and rollers was case-carburized consumable electrode vacuum melted AISI 4320 steel. The one piece, roller riding separator was silver plated AISI 1010 steel. The hardnesses, case depth and surface finish specifications are shown in Table V.

The cone contained forty (40) oil holes, 1.016 mm (0.040 inch) diameter, drilled through from a manifold on the cone-bore to the undercut at the large end of the cone, as shown in Figure 11.

The basic dynamic load ratings for this bearing are 74,700 N (16,800 lbs) radial load and 58,700 N (13,200 lbs) thrust load. The rating is defined as the thrust or radial load which gives a 10% life of 90 million cone revolutions. The AFBMA basic dynamic capacity is 288,000 N (64,800 lbs).

4.3 Lubricant

The oil used for the demonstration runs of the test rigs and for the parametric studies was a 5 centistoke neopentylpolyol (tetra) ester. This type II oil is qualified to MIL-L-23699 as well as to the internal oil specification of most major aircraft engine manufacturers. Properties of the oil are presented in Table VI.

4.4 Test Procedure

The test procedure was adjusted according to the test conditions to be evaluated. Generally, a program cycle was defined which would allow the evaluation of a number of conditions without a

major interruption. With the exception of speed, all test parameters such as load, lubricant flow rate and oil temperature could be adjusted while the test was in operation. During a test, the machine and test bearings were allowed to reach an equilibrium condition before data were recorded and before proceeding to another test condition.

Two (2) test series were performed. These were as follows:

Phase A - Objective and Test Conditions

The objective was to record bearing performance for a matrix of loads and speeds shown in Table VII. Oil inlet temperatures of 350°K and 364°K (170°F and 195°F) were chosen and oil flow rates were varied using both, jet and cone-rib lubrication. When cone-rib lubrication was used, a constant jet flow of $3.8 \times 10^{-3} \times m^3$/min. (1.0 gpm) was also used to assure lubrication of the roller small ends.

When in the course of testing it became apparent that a particular combination of test conditions would result in distress to the test bearing or would generate a bearing temperature above 436°K (325°F), the test was aborted or omitted. In Table VII such tests have been indicated.

The lab data sheets from Phase A tests are shown in Table VIII.

Phase B - Objective and Test Conditions

Tests were run at shaft speeds of 12,500 rpm, a thrust load of 53,400 N (12,000 lbs), radial load of 26,700 N (6,000 lbs) and an oil inlet temperature of 350°K (170°F). A constant jet lube oil flow rate of 3.8×10^{-3} m^3/min. (1.0 gpm) was maintained. The objective was to establish the cone-rib lube oil flow and outer ring cooling oil flow rates which produce a cup and cone operating temperature of 416°K $\pm$ 3° (290°F $\pm$ 5°F). The oil flow rates achieved were intended to

be used during a tapered-roller bearing fatigue test investigation in a subsequent contract.

The data from the Phase B tests are documented in Table IX.

4.5 Discussion of Results

The test results presented in Tables VIII and IX were reviewed for consistency and reasonableness. In this process the effects of lubricant flow, shaft speed and method of lubrication became apparent. The results have been further examined and can be illustrated in several ways.

4.5.1 Effect of Lubricant Flow

Figures 12 through 14 show test bearing and oil outlet temperatures as function of lubricant oil flow rates. Figure 12 illustrates these results at 6,000 rpm, Figure 13 at 10,000 rpm, and Figure 14 at 15,000 rpm. The graphs represent test runs with 53,400 N (12,000 lbs) thrust load and 26,700 N (6,000 lbs) radial load. The trends for lower loads were identical, though in some cases the temperatures were insignificantly lower.

At 6,000 rpm the bearing temperatures decreased by an average of 28°K (50°F) as flows were increased from 1.9×10^{-3} to 7.6×10^{-3} m^3/min. (0.5 to 2.0 gpm) with jet lubrication. At higher flow rates, the rate of temperature decrease diminished.

Similar effects are seen for cone-rib lubrication, where the total flow rate includes 3.8×10^{-3} m^3/min. (1.0 gpm) of lubricant through jets at the roller small end of the bearing. Thus, the data points at 3.8×10^{-3} m^3/min. (1.0 gpm) are for zero cone-rib flow rate.

The first test at 10,000 rpm with a jet flow rate of 3.8×10^{-3} m^3/min. (1.0 gpm) at an oil inlet temperature of 350°K (170°F) resulted in surface distress of the cone-rib on one of the test bearings. The test bearing on which cone-face and cone-bore temperatures were measured was not damaged. Further tests at this flow rate and below were not run. By examination of Figure 13(a) we find that a temperature greater than 433°K (320°F) would be expected by extrapolation of the cone-face temperature curve. When the temperature limitations of the AISI 4320 material of the cone and rollers are considered along with the severity of the rolling/sliding contact, the occurrence of surface damage under these conditions is not unexpected.

Information for the cone-rib flow rates as low as 1.9×10^{-3} m^3/min. (0.5 gpm), i.e. a total flow rate of 5.7×10^{-3} m^3/min. (1.5 gpm) was obtained for 10,000 rpm for both oil-in temperatures. At the higher oil-in temperature, the maximum cone face temperatures at this flow rate was only 404°K (267°F).

Only one (1) test was run at 15,000 rpm with jet flow, the lower flow conditions were eliminated due to predictable bearing distress. Readings were obtained for all desired flow rates with cone-rib flow at 350°K (170°F) oil-in temperature. Tests with 364°K (195°F) oil-in temperature and total flow rates less than 7.6×10^{-3} m^3/min. (2.0 gpm) were not run due to temperature limitations.

An increased effect of flow rate on the oil-out temperature is seen at a shaft speed of 15,000 rpm, whereas the flow rate effect on bearing temperatures is not significantly different from that at the lower speeds.

It is generally observed that, as flow rates increase, the reductions in bearing temperature diminishes. Bearing temperatures are affected only little by flow rates above 11.4 X 10^{-3} m^3/min. (3.0 gpm). Therefore, greater flow rates do not seem to be warranted for bearings at these conditions, especially where cone-rib lubrication is used.

4.5.2 Effects of Radial and Thrust Loads

Figures 15 and 16 show that radial and thrust loads have little influence on the cone face temperature. This observation is typical throughout the range of data taken. Hence, regardless of speed, oil-in temperature, or flow rates, changes in load had little effect on bearing or oil-out temperatures.

4.5.3 Effect of Shaft Speed and Lubrication Method

Figures 17 and 18 show the effect of shaft speed on cone face temperatures for oil inlet temperatures of 350°K (170°F) and 364°K (195°F), respectively. Cone face temperatures increased nearly 50°K (90°F) by increasing shaft speed from 6,000 rpm to 15,000 rpm when 15.2 X 10^{-3} m^3/min. (4.0 gpm) jet lubrication was used. If the curves of Figure 17(a) for jet lubrication with 350°K (170°F) oil-in are projected to 15,000 rpm, we find an oil flow of at least 7.6 X 10^{-3} m^3/min. (2.0 gpm) will be required to keep the cone face temperature below 436°K (325°F). It becomes further apparent that, even with the maximum jet flow of 15.1 X 10^{-3} m^3/min. (4.0 gpm), the temperature limit of 436°K (325°F) would be reached at approximately 16,500 rpm. Similarly, all curves of Figure 18(a) for 364°K (195°F) oil-in extrapolate to unacceptably high cone face temperatures for speeds above 13,000 rpm.

Shaft speed has less effect on the cone face temperature when cone-rib lubrication is used. Satisfactory cone-race temperatures were measured at 15,000 rpm with a total flow rate as low as 5.7×10^{-3} m^3/min. (1.5 gpm) for 350°K (170°F) and with 7.6×10^{-3} m^3/min. (2.0 gpm) for 364°K (195°F) oil inlet temperatures. Extension of the curves in Figures 17(b) and 18(b) indicate satisfactory operating temperatures may be expected at speeds to 20,000 rpm.

The advantage of cone-rib lubrication is further illustrated in Figure 19, which shows the difference of cone-face temperatures with jet lubrication and with cone-rib lubrication. Cone-rib lubrication lowers cone face temperature as much as 34°K (62°F) at 15,000 rpm. A temperature improvement is even found at 6,000 rpm, where the benefit is approximately 13°K (23°F).

It can be observed from Figures 12 through 14, that when cone-rib lubrication is used, the highest bearing temperatures are measured at the cup outside diameter. When jet lubrication alone is used, the highest temperatures were on the cone face. This is further demonstrated in Figure 20 where the temperatures are plotted against shaft speed for an oil-in temperature of 364°K (195°F) and a total oil flow of 11.4×10^{-3} m^3/min. (3.0 gpm). Cone bore and oil-out temperatures for jet lubrication and for cone-rib lubrication are not significantly different.

4.5.4 Controlled Bearing Temperature Tests

It was the primary objective of this program phase to find a "safe" lubricant flow condition which would produce a uniform bearing temperature of 416°K $\pm$ 3° (290°F $\pm$ 5°F) at 12,500 rpm.

Balanced bearing temperatures were achieved by combining the previously described method of cone-rib lubrication with cup cooling. The latter was accomplished by flowing oil in the cup housing in contact with the outside diameter of the cup. The influence of this outer ring cooling is illustrated in Figure 21. The data shown was obtained with 5.7×10^{-3} m^3/min. (1.5 gpm) total lubricant flow at 364°K (195°F) inlet temperature. The addition of 2.6×10^{-3} m^3/min. (0.7 gpm) cup cooling flow is represented by solid symbols in Figure 21. The cup outside temperature decreased by 14°K (25°F) without significantly changing the cone face and cone bore temperatures. The oil outlet temperature was 6°K (11°F) lower because of the heat removed by the cup cooling oil.

Some additional tests, shown in Table IX, were run to explore other operating conditions that would meet the test objective. From the data available it can be extrapolated that a balanced bearing temperature of 416°K (290°F) is achieved by raising the oil inlet temperature to 366°K (200°F) and otherwise maintaining all operating parameters of the previously described test. When the oil inlet temperature is further raised to 379°K (222°F) and the cup cooling oil flow is increased to 3.4×10^{-3} m^3/min. (0.9 gpm), the balanced bearing operating temperature is 422°K (300°F).

4.5.5 Power Measurements

Voltage and current measurements for the electric motor driving the test machine were recorded in all tests. While small individual irregularities have been noticed in relation to this data, the trends appear to be valid.

The range of machine power demand was compared for jet lubrication and cone-rib lubrication. While a substantial overlap exists, the power demand is generally greater for jet lubrication. This is shown in Figure 22 where power demand was plotted for both jet and cone-rib total lubricant flow at 10,000 rpm.

The increasing power demand with increasing speed is shown in Figure 23.

The machine power varied only little due to variations in thrust or radial loads as shown in Figure 24.

4.5.6 Separator Speed

Separator speed was measured at each test condition except at 15,000 rpm. The ratio of the separator speed to the shaft speed remained constant at about 0.44987 for all the tests measured.

No significant rolling element slip was discovered.

4.6 Conclusions

The results from the parametric performance tests described in the previous paragraphs lead to the following conclusions:

1. There are definite limitations in using jets for the lubrication of tapered-roller bearings at high speeds. A 15.1 X 10^{-3} m^3/min. (4.0 gpm) flow with 350°K (170°F) oil was required to operate at 15,000 rpm. Lowering the flow or increasing the oil inlet temperature produced cone face temperatures above 436°K (325°F). At speeds greater than 16,500 rpm, unacceptably high cone-face temperatures can be expected.

2. Tapered-roller bearing operation at high speeds was most successful with cone-rib lubrication, augmented with jets at the roller small end side. At 15,000 rpm, lubrication was

adequate with 5.7 X 10^{-3} m^3/min (1.5 gpm) flow of 350°K (170°F) oil, or with 7.6 X 10^{-3} m^3/min. (2.0 gpm) flow of 364°K (195°F) oil. No benefits were observed by increasing the total oil flow above 11.4 X 10^{-3} m^3/min. (3.0 gpm). Satisfactory operating temperatures can be expected to at least 20,000 rpm.

3. The highest temperatures in a jet lubricated high speed tapered-roller bearing was measured at the cone-rib. When applying cone-rib lubrication, this component temperature drops, but the cup temperature is increased. By combining cone-rib lubrication with external cup cooling, the individual bearing components can be temperature tuned, and reliable, low temperature bearing operation can be achieved at high speeds.

4. Bearing temperatures and test rig power requirements increased with increasing shaft speed, but changed very little due to changes in either radial or thrust loads.

5. As the lubricant flow rate increased, bearing temperatures decreased and the required drive power increased. Power required was less with cone-rib lubrication than with jet lubrication.

6. At 6,000 rpm, flow rates as low as 1.9 X 10^{-3} m^3/min. (0.5 gpm) provided stable bearing operation for all conditions tested.

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TABLE I

LAB DATA SHEETS - MACHINE S/N 2 - PERFORMANCE TESTS AT HIGH LOADS AND LOW SPEED

INDUSTRIAL TECTONICS, INC.

REP. BY V. MILLER

CHKD BY

TAPERED ROLLER BEARING TEST MACHINE L-197 CHECKOUT PERFORMANCE TESTS TRB #2

DATE 7-16-75 PAGE 1 OF 3

CUSTOMER NASA

TEST NO. IIIa

TEST OBJECTIVES

Test Brgs.	Speed RPM
TAPERED R/B	3,000

LOADS

Thrust	Radial
8000	3000

LUBRICATION

Type MIL-L-23699A

DRIVE SYSTEM

Time to Reach Full Speed

Cold	Hot
3.6 SEC	3 SEC

SETTINGS

Start-Up

Voltage	Time Delay
65 %	31 SEC

Lube Flow Switches

Test Brg.	Slave Brg.
2.0 GPM	1.5 GPM

Time Delay Pump	Bearing Temp.
70 SEC	<325 °F

Vibration 20 %

NOTES:

(1) COLD VALVE CLOSED. HOT VALVE FULL OPEN. METERED WATER THRU Hx TO SET TEST TEMP.

TIME (HRS)					2.3	6.3	10.3	14.3
Load lbs.	Thrust PER				8000	8000	8000	8000
	Radial /BRG.				3000	3000	3000	3000
SPINDLE SPEED (RPM)					3130	3130	3130	3130
TEMPERATURES °F	1.	Brg. Outer Ring	Test	Front	#1	200	213	192	191
	2.				#2	197	211	189	189
	3.			Rear	#1	188	199	179	180
	4.				#2	188	201	178	180
	5.		Slave	Front		162	174	134	135
	6.			Rear		158	171	129	129
	7.	Lube Oil Out		Front		201	210	190	191
	8.			Rear		184	191	178	177
	9.	Cooling Oil Out		Front		182	208	166	167
	10.			Rear		180	192	163	164
	11.	Oil In		Test Brg.		177	190	154	156
	12.			Slave Brg.		150	159	115	115
	INFRA-RED			I.R.		—	—	—	—
FLOW GPM	Inner Ring JETS ONLY			Test Brg.		4.3	4.8	2.5	2.5
	Oil			Slave Brg.		3.2	3.5	2.0	2.0
	Cooling Oil			Test Brg.		1.3	∅	1.0	1.0
				Slave Brg.		1.1	∅	1.3	1.3
MOTOR	VOLTAGE (VOLTS)					—	—	—	—
	CURRENT (AMPS)					—	—	—	—
	H.P. (CALCULATED)					—	—	—	—
VIBRATION %						∅	∅	<10	<10
Shaft Excursion (inch-T.I.R.)				Front		—	—	.0016	.0016
				Rear		—	—	.0017	.0017
								(1)	(1)

TABLE I (Continued)

INDUSTRIAL TECTONICS, INC.

REF. BY V. Miller

CHKD BY

TAPERED ROLLER BEARING
TEST MACHINE L-197
CHECKOUT PERFORMANCE
TESTS TRB #2

DATE 7-18-75 PAGE 2 OF 3

CUSTOMER NASA

TEST NO. IIIa

TEST OBJECTIVES

Test Brgs.	Speed RPM
TAPERED R/B	3000

LOADS

Thrust	Radial
8000	3000

LUBRICATION

Type: MIL-L-23699A

DRIVE SYSTEM

Time to Reach Full Speed

Cold	Hot
3.6 SEC	3.0 SEC

SETTINGS

Start-Up

Voltage	Time Delay
65 %	31 SEC

Lube Flow Switches

Test Brg.	Slave Brg.
2.0 GPM	1.5 GPM

Time Delay Pump	Bearing Temp.
70 SEC	<325 °F

Vibration: 20 %

NOTES:

(1) COLD OIL VALVE CLOSED. HOT OIL VALVE FULL OPEN. METERED WATER THRU Hx TO SET TEST TEMP.

(2) HOT OIL VALVE CLOSED. COLD OIL VALVE. FULL OPEN. Hx WATER FULL OPEN.

TIME (HRS.)							20.1	22.9	24.0
Load lbs.	Thrust PER / BRG.						8000	8000	8000
	Radial / BRG.						3000	3000	3000
SPINDLE SPEED (RPM)							3130	3130	3130
TEMPERATURES °F	1.	Brg. Outer Ring Test	Front	#1			190	192	163
	2.			#2			188	190	160
	3.		Rear	#1			179	181	153
	4.			#2			178	180	152
	5.	Brg. Outer Ring Slave	Front				134	134	132
	6.		Rear				128	128	126
	7.	Lube Oil Out	Front				190	191	164
	8.		Rear				176	178	150
	9.	Cooling Oil Out	Front				166	167	132
	10.		Rear				162	164	128
	11.	Oil In	Test Brg.				154	156	114
	12.		Slave Brg.				114	113	112
	INFRA-RED		I.R.				—	—	—
FLOW GPM	Inner Ring Oil (JETS ONLY)		Test Brg.				2.5	2.5	2.5
			Slave Brg.				2.0	2.0	2.0
	Cooling Oil		Test Brg.				1.0	1.0	1.0
			Slave Brg.				1.3	1.3	1.3
MOTOR	VOLTAGE (VOLTS)						—	—	—
	CURRENT (AMPS)						—	—	—
	H.P. (CALCULATED)						—	—	—
VIBRATION %							<10	<10	<10
Shaft Excursion (inch-T.I.R.)			Front				.0016	.0016	.0016
			Rear				.0017	.0017	.0017
							(1)	(1)	(2)

TABLE I (Continued)

INDUSTRIAL TECTONICS, INC.

REF. BY V. MILLER

CHKD BY

TAPERED ROLLER BEARING
TEST MACHINE L-197
CHECKOUT PERFORMANCE
TESTS TRB #2

DATE 7-22-75 PAGE 3 OF 3

CUSTOMER NASA

TEST NO. III b

TEST OBJECTIVES

Test Brgs.	Speed RPM
TAPERED R/B	3000

LOADS

Thrust	Radial
12,000	6000

LUBRICATION

Type: MIL-L-23699A

DRIVE SYSTEM

Time to Reach Full Speed

Cold	Hot
3.5 SEC	2.2 SEC

SETTINGS

Start-Up

Voltage	Time Delay
65 %	30 SEC

Lube Flow Switches

Test Brg.	Slave Brg.
2.0 GPM	1.5 GPM

Time Delay Pump	Bearing Temp.
70 SEC	<325 °F

Vibration	
20 %	

NOTES:

① HOT OIL VALVE CLOSED. COLD OIL VALVE FULL OPEN.

② HOT OIL VALVE FULL OPEN. COLD OIL VALVE CLOSED. FULL Hx FLOW (WATER).

TIME (HRS.)						0.4	1.0	
Load lbs.	Thrust PER					12,000	12,000	
	Radial BRG.					6,000	6,000	
SPINDLE SPEED (RPM)						3130	3130	
TEMPERATURES °F	1.	Brg. Outer Ring	Test	Front	#1	168	197	
	2.				#2	165	193	
	3.			Rear	#1	155	182	
	4.				#2	153	181	
	5.		Slave	Front		136	135	
	6.			Rear		130	130	
	7.	Lube Oil Out		Front		170	195	
	8.			Rear		150	180	
	9.	Cooling Oil Out		Front		134	170	
	10.			Rear		132	165	
	11.	Oil In		Test Brg.		115	156	
	12.			Slave Brg.		114	115	
		INFRA-RED I.R.				—	—	
FLOW GPM		Inner Ring JETS ONLY		Test Brg.		2.5	2.5	
		Oil		Slave Brg.		2.0	2.0	
		Cooling Oil		Test Brg.		1.0	1.0	
				Slave Brg.		1.3	1.3	
MOTOR		VOLTAGE (VOLTS)				—	—	
		CURRENT (AMPS)				—	—	
		H.P. (CALCULATED)				—	—	
VIBRATION %						<10	<10	
Shaft Excursion (inch-T.I.R.)				Front		.0016	.0016	
				Rear		.0017	.0017	
						①	②	

TABLE II

LAB DATA SHEETS - MACHINE S/N 3 - PERFORMANCE TESTS AT HIGH LOADS AND LOW SPEED

INDUSTRIAL TECTONICS, INC.

REF. BY V. Miller CHKD BY

TAPERED ROLLER BEARING TEST MACHINE L-197 CHECKOUT PERFORMANCE TESTS TRB#3

DATE 8-12-75 PAGE 1 OF 3

CUSTOMER NASA

TEST NO. III a

TEST OBJECTIVES

Test Brgs.	Speed RPM
TAPERED R/B	3000

LOADS

Thrust	Radial
8000	3000

LUBRICATION

Type: MIL-L-23699A

DRIVE SYSTEM

Time to Reach Full Speed

Cold	Hot
3.5 SEC	2.2 SEC

SETTINGS

Start-Up

Voltage	Time Delay
65 %	30 SEC

Lube Flow Switches

Test Brg.	Slave Brg.
GPM	1.8 GPM

Time Delay Pump	Bearing Temp.
60 SEC	<325 °F

Vibration: 20 %

NOTES:

[1] COLD OIL VALVE SLIGHTLY OPEN. HOT OIL VALVE FULL OPEN. FULL Hx WATER FLOW.

[2] COLD OIL VALVE CLOSED. HOT OIL VALVE FULL OPEN. METERED WATER THRU Hx TO SET TEST TEMP.

TIME (HRS.)				1.0	6.0	10.6	13.3
Load lbs.	Thrust PER			8000	8000	8000	8000
	Radial BRG.			3000	3000	3000	3000
SPINDLE SPEED (RPM)				3130	3130	3130	3130
TEMPERATURES °F	1.	Brg. Outer Ring	Test Front	#1	200	200	193	191
	2.			#2	198	196	190	189
	3.		Test Rear	#1	193	193	184	183
	4.			#2	190	190	181	180
	5.		Slave Front		182	172	131	131
	6.		Slave Rear		184	175	131	131
	7.	Lube Oil Out	Front		203	205	195	195
	8.		Rear		194	195	178	179
	9.	Cooling Oil Out	Front		179	170	169	168
	10.		Rear		176	169	164	164
	11.	Oil In	Test Brg.		180	184	154	155
	12.		Slave Brg.		167	155	113	115
	INFRA-RED		I.R.		—	—	—	—
GPM FLOW	Inner Ring Oil	JETS ONLY	Test Brg.		4.0	4.0	2.5	2.5
			Slave Brg.		2.2	2.2	2.0	2.0
	Cooling Oil		Test Brg.		-0-	-0-	1.0	1.0
			Slave Brg.		1.3	1.3	1.3	1.3
MOTOR	VOLTAGE (VOLTS)				—	—	—	—
	CURRENT (AMPS)				—	—	—	—
	H.P. (CALCULATED)				—	—	—	—
VIBRATION %					—	—	—	—
Shaft Excursion (inch-T.I.R.)			Front		—	—	.0014	.0012
			Rear		—	—	.0005	.0007
							[1]	[2]

TABLE II (Continued)

INDUSTRIAL TECTONICS, INC.

REF. BY V. Miller CHKD BY

TAPERED ROLLER BEARING
TEST MACHINE L-197
CHECKOUT PERFORMANCE
TESTS TRB#3

DATE 8-15-75 PAGE 2 OF 3

CUSTOMER NASA

TEST NO. IIIa

TEST OBJECTIVES

Test Brgs.	Speed RPM
TAPERED R/B	3000

LOADS

Thrust	Radial
8000	3000

LUBRICATION

Type: MIL-L-23699A

DRIVE SYSTEM

Time to Reach Full Speed

Cold	Hot
3.5 SEC	2.2 SEC

SETTINGS

Start-Up

Voltage	Time Delay
65 %	30 SEC

Lube Flow Switches

Test Brg.	Slave Brg.
GPM	1.8 GPM

Time Delay Pump	Bearing Temp.
60 SEC	<325 °F

Vibration: 20 %

NOTES:

① COLD OIL VALVE SLIGHTLY OPEN. HOT OIL VALVE FULL OPEN. METERED WATER THRU Hx. TO SET TEST TEMP.

② HOT OIL VALVE CLOSED. COLD OIL VALVE FULL OPEN. FULL Hx. FLOW (WATER).

						18.8	21.2	22.8	24.0
TIME (HRS)									
Load lbs.	Thrust PER /					8000	8000	8000	8000
	Radial /BRG.					3000	3000	3000	3000
SPINDLE SPEED (RPM)						3130	3130	3130	3130
TEMPERATURES °F	1.	Brg. Outer Ring	Test	Front	#1	191	190	192	164
	2.				#2	189	188	190	161
	3.			Rear	#1	184	182	185	157
	4.				#2	180	179	181	153
	5.		Slave	Front		136	130	133	129
	6.			Rear		136	130	133	129
	7.	Lube Oil Out		Front		193	193	193	164
	8.			Rear		178	178	180	152
	9.	Cooling Oil Out		Front		167	167	169	133
	10.			Rear		163	162	164	126
	11.	Oil In		Test Brg.		155	155	155	113
	12.			Slave Brg.		118	114	115	113
	INFRA-RED			I.R.		—	—	—	—
FLOW GPM	Inner Ring Oil (JETS ONLY)			Test Brg.		2.5	2.5	2.5	2.5
				Slave Brg.		2.0	2.0	2.0	2.0
	Cooling Oil			Test Brg.		1.0	1.0	1.0	1.0
				Slave Brg.		1.3	1.3	1.3	1.3
MOTOR	VOLTAGE (VOLTS)					—	—	—	—
	CURRENT (AMPS)					—	—	—	—
	H.P. (CALCULATED)					—	—	—	—
VIBRATION %						—	—	—	—
Shaft Excursion (inch-T.I.R.)				Front		.0012	.0012	.0012	.0012
				Rear		.0007	.0007	.0007	.0007
						①	①	①	②

TABLE II (Continued)

INDUSTRIAL TECTONICS, INC.

REP. BY V. MILLER

CHKD BY

TAPERED ROLLER BEARING
TEST MACHINE L-197
CHECKOUT PERFORMANCE
TESTS TRB#3

DATE 8-15-75 PAGE 3 OF 3

CUSTOMER NASA

TEST NO. IIIb

TEST OBJECTIVES

Test Brgs.	Speed RPM
TAPERED R/B	3000

LOADS

Thrust	Radial
12000	6000

LUBRICATION

Type MIL-L-23699A

DRIVE SYSTEM

Time to Reach Full Speed

Cold	Hot
3.5 SEC	2.2 SEC

SETTINGS

Start-Up

Voltage	Time Delay
65 %	30 SEC

Lube Flow Switches

Test Brg.	Slave Brg.
GPM	1.8 GPM

Time Delay Pump	Bearing Temp.
60 SEC	<325 °F

Vibration 20 %

NOTES:

(1) HOT OIL VALVE CLOSED. COLD OIL VALVE FULL OPEN. FULL Hx WATER FLOW.

(2) HOT OIL VALVE. FULL OPEN. COLD OIL VALVE CLOSED. FULL Hx WATER FLOW.

						(1)	(2)
TIME (HRS)						0.4	1.0
Load lbs.	Thrust PER					12000	12000
	Radial /BRG.					6000	6000
SPINDLE SPEED (RPM)						3130	3130
TEMPERATURES °F	1.	Brg. Outer Ring Test	Front	#1		168	198
	2.			#2		166	195
	3.		Rear	#1		159	187
	4.			#2		156	185
	5.	Brg. Outer Ring Slave	Front			134	135
	6.		Rear			134	135
	7.	Lube Oil Out		Front		171	199
	8.			Rear		150	182
	9.	Cooling Oil Out		Front		135	174
	10.			Rear		129	167
	11.	Oil In		Test Brg.		115	157
	12.			Slave Brg.		115	114
	INFRA-RED			I.R.		—	—
FLOW GPM	Inner Ring JETS ONLY			Test Brg.		2.5	2.5
	Oil			Slave Brg.		2.0	2.0
	Cooling Oil			Test Brg.		1.0	1.0
				Slave Brg.		1.3	1.3
MOTOR	VOLTAGE (VOLTS)					—	—
	CURRENT (AMPS)					—	—
	H.P. (CALCULATED)					—	—
VIBRATION %						—	—
Shaft Excursion (inch-T.I.R.)				Front		.0012	.0012
				Rear		.0007	.0007

TABLE III

LAB DATA SHEETS - MACHINE S/N 2 - PERFORMANCE TESTS AT LOW LOADS AND HIGH SPEEDS

INDUSTRIAL TECTONICS, INC.

REP. BY S.DAMITIO

CHKD BY

TAPERED ROLLER BEARING
TEST MACHINE L-197
CHECKOUT PERFORMANCE
TESTS TRB#2

DATE 11-19-75 PAGE 1 OF 2

CUSTOMER NASA

TEST NO. IV d

TEST OBJECTIVES

Test Brgs.	Speed RPM
BALL BEARINGS #13116 MODIFIED	15,000

LOADS

Thrust	Radial
6000	1250

LUBRICATION

Type: MIL-L-23699A

DRIVE SYSTEM

Time to Reach Full Speed

Cold	Hot
30 SEC	— SEC

SETTINGS

Start-Up

Voltage	Time Delay
80 %	30 SEC

Lube Flow Switches

Test Brg.	Slave Brg.
2.0 GPM	1.5 GPM

Time Delay Pump	Bearing Temp.
70 SEC	HIGHEST ATTAINABLE °F

Vibration: 20 %

NOTES:

TIME (HRS)				3.9	7.0	10.1	14.4
Load lbs.	Thrust PER			6000	6000	6000	6000
	Radial BRG.			1250	1250	1250	1250
SPINDLE SPEED (RPM)				15145	15145	15145	15145
TEMPERATURES °F	1.	Brg. Outer Ring Test	Front	#1	366	369	369	347
	2.			#2	—	—	—	—
	3.		Rear	#1	369	372	371	350
	4.			#2	—	—	—	—
	5.	Brg. Outer Ring Slave	Front		307	309	316	280
	6.		Rear		290	292	299	266
	7.	Lube Oil Out	Front		345	347	350	326
	8.		Rear		331	335	336	313
	9.	Cooling Oil Out	Front		325	329	327	304
	10.		Rear		337	339	339	304
	11.	Oil In	Test Brg.		297	299	304	275
	12.		Slave Brg.		199	199	212	150
	INFRA-RED		I.R.		—	—	—	—
FLOW GPM	Inner Ring Oil		Test Brg.		3.5	3.5	3.5	3.5
			Slave Brg.		1.8	1.8	1.8	1.8
	Cooling Oil		Test Brg.		.35	.35	.50	.50
			Slave Brg.		.55	.55	.55	.55
MOTOR	VOLTAGE (VOLTS)				—	—	—	—
	CURRENT (AMPS)				—	—	—	—
	H.P. (CALCULATED)				—	—	—	—
VIBRATION %					11	12	14	12
Shaft Excursion (inch-T.I.R.)			Front		.0019	.0019	.0019	.0019
			Rear		.0014	.0014	.0014	.0014

TABLE III (Continued)

INDUSTRIAL TECTONICS, INC.

TAPERED ROLLER BEARING
TEST MACHINE L-197
CHECKOUT PERFORMANCE
TESTS TRB #2

DATE 11-26-75 PAGE 2 OF 2

CUSTOMER NASA

REF. BY S. DAMITIO CHKD BY

TEST NO. IV e

TEST OBJECTIVES

Test Brgs.	Speed RPM
BALL BEARINGS #1316 MODIFIED	20,000

LOADS

Thrust	Radial
6000	⊖

LUBRICATION

Type: MIL-L-23699A

DRIVE SYSTEM

Time to Reach Full Speed

Cold	Hot
30 SEC	25 SEC

SETTINGS

Start-Up

Voltage	Time Delay
80 %	30 SEC

Lube Flow Switches

Test Brg.	Slave Brg.
1.8 GPM	⊖ GPM

Time Delay Pump	Bearing Temp.
70 SEC	420±15 °F

Vibration: 20 %

NOTES:
* THIS FIGURE REPRESENTS FLOW TO STUB-SHAFT SUPPORT BRG.

TIME (HRS)							5.0	8.1	9.8
Load lbs.	Thrust PER/						6000	6000	6000
	Radial /BRG.						⊖	⊖	⊖
SPINDLE SPEED (RPM)							20,375	20,375	20,375
TEMPERATURES °F	1.	Brg. Outer Ring	Test	Front	#1		410	416	416
	2.				#2		—	—	—
	3.			Rear	#1		410	419	418
	4.				#2		—	—	—
	5.		Slave	Front			—	—	—
	6.			Rear			—	—	—
	7.	Lube Oil Out		Front			388	390	391
	8.			Rear			368	371	373
	9.	Cooling Oil Out		Front			346	345	345
	10.			Rear			347	348	348
	11.	Oil In		Test Brg.			312	310	310
	12.			Slave Brg.			—	—	—
		INFRA-RED I.R.					419	423	423
FLOW GPM		Inner Ring Oil		Test Brg.			2.5	2.5	2.5
				Slave Brg.*			.4	.4	.4
		Cooling Oil		Test Brg.			1.1	1.1	1.1
				Slave Brg.			—	—	—
MOTOR		VOLTAGE (VOLTS)					—	—	—
		CURRENT (AMPS)					—	—	—
		H.P. (CALCULATED)					—	—	—
VIBRATION %							<10	<10	<10
Shaft Excursion (inch-T.I.R.)				Front			—	—	—
				Rear			.0021	.0021	.0021

TABLE IV

LAB DATA SHEETS - MACHINE S/N 3 - PERFORMANCE TESTS AT LOW LOADS AND HIGH SPEEDS

INDUSTRIAL TECTONICS, INC.

REP. BY V. MILLER

CHKD BY

. TAPERED ROLLER BEARING
TEST MACHINE L-197
CHECKOUT PERFORMANCE
TESTS TRB #3

DATE 8-29-75 PAGE 1 OF 2

CUSTOMER NASA

TEST NO. IV d

TEST OBJECTIVES

Test Brgs. BALL BEARING #1316 MODIFIED

Speed RPM 15000

LOADS

Thrust	Radial
6000	1250

LUBRICATION

Type MIL-L-23699A

DRIVE SYSTEM

Time to Reach Full Speed

Cold	Hot
30 SEC	— SEC

SETTINGS

Start-Up

Voltage	Time Delay
80 %	30 SEC

Lube Flow Switches

Test Brg.	Slave Brg.
2.0 GPM	2.0 GPM

Time Delay Pump	Bearing Temp.
70 SEC	HIGHEST ATTAINABLE °F

Vibration 20 %

NOTES:

(1) COLD OIL VALVE CLOSED. HOT OIL VALVE FULL OPEN.

TIME (HRS)				4.7	8.5	11.1	14.7
Load lbs.	Thrust PER			6000	6000	6000	6000
	Radial BRG.			1250	1250	1250	1250
SPINDLE SPEED (RPM)				15120	15120	15120	15120
TEMPERATURES °F	1. Brg. Outer Ring Test	Front	#1	349	353	352	354
	2.		#2	—	—	—	—
	3.	Rear	#1	339	341	340	349
	4.		#2	—	—	—	—
	5. Slave	Front		276	283	281	285
	6.	Rear		265	293	289	290
	7. Lube Oil Out	Front		343	342	343	345
	8.	Rear		330	329	327	336
	9. Cooling Oil Out	Front		310	311	311	315
	10.	Rear		306	306	306	320
	11. Oil In	Test Brg.		285	287	285	291
	12.	Slave Brg.		186	192	190	195
	INFRA-RED	I.R.		—	—	—	—
FLOW GPM	Inner Ring Oil	Test Brg.		3.75	3.75	3.75	3.75
		Slave Brg.		2.55	2.55	2.55	2.55
	Cooling Oil	Test Brg.		0.5	0.5	0.5	0.5
		Slave Brg.		0.65	0.65	0.65	0.65
MOTOR	VOLTAGE (VOLTS)			—	—	—	—
	CURRENT (AMPS)			—	—	—	—
	H.P. (CALCULATED)			—	—	—	—
VIBRATION %				<10	<10	<10	<10
Shaft Excursion (inch-T.I.R.)		Front		.0013	.0015	.0014	.0015
		Rear		.0012	.0012	.0014	.0016
WATER OUT TEMP @ Hx, °F				209	213	214	222
				(1)	(1)	(1)	(1)

TABLE IV. (Continued)

INDUSTRIAL TECTONICS, INC.

REP. BY V. MILLER

CHKD BY

TAPERED ROLLER BEARING
TEST MACHINE L-197
CHECKOUT PERFORMANCE
TESTS TRB #3

DATE 10-6-75 PAGE 2 OF 2

CUSTOMER NASA

TEST NO. IV e

TEST OBJECTIVES

Test Brgs.	Speed RPM
BALL BEARINGS #1316 MODIFIED	20,000

LOADS

Thrust	Radial
6000	0

LUBRICATION

Type MIL-L-23699A

DRIVE SYSTEM

Time to Reach Full Speed

Cold	Hot
30 SEC	25 SEC

SETTINGS

Start-Up

Voltage	Time Delay
80 %	30 SEC

Lube Flow Switches

Test Brg.	Slave Brg.
1.8 GPM	– GPM

Time Delay Pump	Bearing Temp.
70 SEC	420±15 °F

Vibration 20 %

NOTES:
* THIS FIGURE REPRESENTS FLOW TO STUB-SHAFT SUPPORT BRG.

TIME (HRS)					4.5	8.9	10.0	
Load lbs.	Thrust PER				6000	6000	6000	
	Radial /BRG				0	0	0	
SPINDLE SPEED (RPM)					20365	20365	20365	
TEMPERATURES °F	1.	Brg. Outer Ring	Test	Front	#1	423	410	412	
	2.				#2	–	–	–	
	3.			Rear	#1	417	410	412	
	4.				#2	–	–	–	
	5.		Slave	Front		–	–	–	
	6.			Rear		–	–	–	
	7.	Lube Oil Out		Front		390	382	386	
	8.			Rear		365	365	368	
	9.	Cooling Oil Out		Front		354	344	347	
	10.			Rear		350	341	345	
	11.	Oil In		Test Brg.		310	305	308	
	12.			Slave Brg.		–	–	–	
		INFRA-RED I.R.				–	415	419	
FLOW GPM		Inner Ring Oil		Test Brg.		2.5	2.5	2.5	
				Slave Brg.*		.4	.4	.4	
		Cooling Oil		Test Brg.		1.1	1.1	1.1	
				Slave Brg.		—	—	—	
MOTOR		VOLTAGE (VOLTS)				–	–	–	
		CURRENT (AMPS)				–	–	–	
		H.P. (CALCULATED)				–	–	–	
VIBRATION %						<10	<10	<10	
Shaft Excursion (inch-T.I.R.)				Front		.0018	.001	.001	
				Rear		.0012	.0021	.0022	
WATER OUT TEMP @ Hi °F						94	94	96	

TABLE V - TEST BEARING SPECIFICATIONS

Case hardness, Rockwell C	58 to 64
Core hardness, Rockwell C	25 to 48
Case depth (to 0.5% carbon level after final grind), cm(in.):	
Cup and cone	0.086 to 0.185 cm (0.034 to 0.073 in.)
Roller	0.091 to 0.201 cm (0.036 to 0.079 in.)
Surface finish[1] µm (µin.) rms:	
Cone raceway	0.15 (6)
Cup raceway	0.20 (8)
Cone-rib	0.18 (7)
Roller taper	0.13 (5)
Roller spherical	0.15 (6)

[1]measured values.

TABLE VI

PROPERTIES OF TETRAESTER LUBRICANT

Additives	Antiwear Oxidation Inhibitor Antifoam
Kinematic viscosity, cS, at -	
311 K (100°F)	28.5
372 K (210°F)	5.22
477 K (400°F)	1.31
Flash point, K (°F)	533 (500)
Fire point, K (°F)	Unknown
Autoignition temperature, K (°F)	694 (800)
Pour point, K (°F)	214 (-75)
Volatility (6.5 hr at 477 K (400°F)), wt.%	3.2
Specific heat at 477 K (400°F), J/(kg)(K), (Btu/(lb)(°F))	2340 (0.54)
Thermal conductivity at 477 K (400°F), J/(m)(sec)(K), (Btu/(hr)(ft)(°F))	0.13 (0.075)
Specific gravity at 477 K (400°F)	0.850

TABLE VII

Matrix of Test Conditions

Test Phase A

(S.I. Units)

Shaft Speed, Rpm	Thrust Load, N	Radial Load, N	350°K Front Brg. S/N	350°K Rear Brg. S/N	364°K Front Brg. S/N	364°K Rear Brg. S/N	Total Lube Flow Rate, $m^3/min. \times 10^{-3}$																Test Sheet No.	
							350°K Oil In									364°K Oil In								
							Jet					∇ Cone-Rib				Jet					∇ Cone-Rib				
							1.9	3.8	7.6	11.4	15.1	5.7	7.6	11.4	13.3	15.1	1.9	3.8	7.6	11.4	15.1	5.7	7.6	11.4	13.3	15.1	350°K	364°K
6000	26,700	13,350	5	1	5	1	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	I	7
		20,000	5	1	5	1										✓										✓	1	7
		26,700	5	1	5	1	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	2	8
	40,000	13,350	5	1	5	1	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	3	9
		20,000	5	1	5	1										✓										✓	3	9
		26,700	5	1	5	1	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	4	10
	53,400	13,350	5	1	5	1	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	5	11
		20,000	5	1	5	1										✓										✓	5	11
		26,700	5	1	5	1	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	6	12
10000	26,700	13,350	4	1	5	1		*	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	13	21
		20,000	4	1	5	1			✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	14	22
	40,000	13,350	4	1	5	1			✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	15	23
		20,000	4	1	5	1			✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	16	24
		26,700	4	1	5	1			✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	17	25
	53,400	13,350	4	1	5	1			✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	18	26
		20,000	4	1	5	1			✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	19	27
		26,700	4	1	5	1			✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	20	28
15000	40,000	4,450	6	1	6	1					✓	✓	✓	✓	✓	✓					#		✓	✓	✓	✓	29	34
		9,000	6	1	6	1					✓	✓	✓	✓	✓	✓							✓	✓	✓	✓	30	35
	53,400	13,350	6	1	6	1					✓	✓	✓	✓	✓	✓							✓	✓	✓	✓	31	36
		20,000	6	1	6	1					✓	✓	✓	✓	✓	✓							✓	✓	✓	✓	32	37
		26,700	6	1	6	1					✓	✓	✓	✓	✓	✓							#	✓	✓	✓	33	38

✓ Successful test with temperature data.
* Cone-rib failure.
\# Shut-down, temperature limit reached.

∇ Cone-rib flow includes 3.8×10^{-3} $m^3/min.$ jet flow.
☐ Unsafe area; did not run.

TABLE VII (Con't)

Matrix of Test Conditions

Test Phase A

(English Units)

Shaft Speed, Rpm	Thrust Load, Lbs.	Radial Load, Lbs.	170°F Front Brg. S/N	170°F Rear Brg. S/N	195°F Front Brg. S/N	195°F Rear Brg. S/N	Total Lube Flow Rate, gal/min. — 170°F Oil In — Jet 0.5	Jet 1.0	Jet 2.0	Jet 3.0	Jet 4.0	∇ Cone-Rib 1.5	∇ Cone-Rib 2.0	∇ Cone-Rib 3.0	∇ Cone-Rib 3.5	∇ Cone-Rib 4.0	195°F Oil In — Jet 0.5	Jet 1.0	Jet 2.0	Jet 3.0	Jet 4.0	∇ Cone-Rib 1.5	∇ Cone-Rib 2.0	∇ Cone-Rib 3.0	∇ Cone-Rib 3.5	∇ Cone-Rib 4.0	Test Sheet No. 170 °F	Test Sheet No. 195 °F
6000	6000	3000	5	1	5	1	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	1	7
		4500	5	1	5	1										✓										✓	1	7
		6000	5	1	5	1	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	2	8
	9000	3000	5	1	5	1	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	3	9
		4500	5	1	5	1										✓										✓	3	9
		6000	5	1	5	1	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	4	10
	12000	3000	5	1	5	1	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	5	11
		4500	5	1	5	1										✓										✓	5	11
		6000	5	1	5	1	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	6	12
10000	6000	3000	4	1	5	1		*	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	13	21
		4500	4	1	5	1			✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	14	22
	9000	3000	4	1	5	1			✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	15	23
		4500	4	1	5	1			✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	16	24
		6000	4	1	5	1			✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	17	25
	12000	3000	4	1	5	1			✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	18	26
		4500	4	1	5	1			✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	19	27
		6000	4	1	5	1			✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	20	28
15000	9000	1000	6	1	6	1					✓	✓	✓	✓	✓	✓					#		✓	✓	✓	✓	29	34
		2000	6	1	6	1					✓	✓	✓	✓	✓	✓							✓	✓	✓	✓	30	35
	12000	3000	6	1	6	1					✓	✓	✓	✓	✓	✓							✓	✓	✓	✓	31	36
		4500	6	1	6	1					✓	✓	✓	✓	✓	✓							✓	✓	✓	✓	32	37
		6000	6	1	6	1					✓	✓	✓	✓	✓	✓							#	✓	✓	✓	33	38

✓ Successful test with temperature data.
* Cone-rib failure.
\# Shut-down, temperature limit reached.
∇ Cone-rib flow includes 1.0 gpm jet flow.
☐ Unsafe area; did not run.

Table VIII

Test Results - Parametric Study - Phase A

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 + IV a

FRONT BEARING S/N 5 REAR BEARING S/N 1

Notes: (Unless Otherwise Specified)

1. Cone face T/C at ~3.14 inch radius.

CONSTANT TEST SETTINGS: Shaft Speed 6000 rpm; Thrust Load 6000 lbs; Oil Inlet Temp 220 °F

SYMBOLS: △ Test Condition (Setting); ⟷ Reference Data Only; ★ Calculated Value

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) CONE RIB △	SUPPORT I.R. ⟷	SUPPORT O.R. ⟷	JETS △	OIL PRES. OUT BRG. ⟷	OIL PRES. INLET ⟷	BRG. LOADS THRUST △	BRG. LOADS RADIAL △	REAR BEARING TEMP °F: BRG. O.B. 1	OUTER RING #1 2	OUTER RING #2 3	OUTER RING #3 4	IRB I.R. 5	IRB I.R. 6	TORB I.R. 7	TORB I.R. 8	SHAFT I.R. 9	SHAFT I.R. 10	FRONT BEARING TEMP °F: OUTER RING #1 11	OUTER RING #2 12	OUTER RING #3 13	INNER RING #1 14	INNER RING #2 15	INNER RING #3 16	OIL OUTLET △ 17	CAGE TEMPERATURE (Front Bearing) 18	CAGE TEMPERATURE (Front Bearing) 19	CAGE TEMPERATURE (Front Bearing) 20	SHAFT DEFLECTION (Front) In × 10⁻³	SHAFT DEFLECTION (Rear) In × 10⁻³	VIB LEVEL %	MOTOR I	MOTOR V	MOTOR HP *	TEST LAB (°F)	NOTES	DATE BY
A6dII4.0	6070	2730	⊖	1.5	0.2	4.0	92	98	6000	3020	200	201	202	199	181	195	203	201	178	-	195	201	201	203	190	197	171	204	198	172	.9	1.25	<10	40.0	458	27.5	82	*6 JETS	2-10-75 BD
A6dII3.0	6100	2745	⊖	1.5	0.2	3.0	91	90	6000	3000	205	204	206	202	179	199	209	206	181	-	197	206	205	206	190	202	171	203	196	173	.9	1.25	<10	38.5	451	25	59	*5 JETS	2-24-75 BD
2.0	6105		⊖	1.5	0.2	2.0	109	113	6000	3000	220	216	217	213	187	208	223	215	185	-	210	217	216	217	187	212	170	203	195	169	.9	1.25	<10	37.0	452	23	73	*5 JETS	2-24-75 BD
1.0	6090	2740	⊖	1.5	0.2	1.0	106	112	6000	3000	241	237	240	235	202	222	241	232	197	-	232	239	239	241	189	238	171	202	196	171	.9	1.25	<10	35.5	465	22.3	74	#1 JETS	2-27-75 BD
RERUN 1.0	6085	2740	⊖	1.5	0.2	1.0	100	105	5963	2990	241	236	239	234	198	224	241	232	198	-	221	239	239	240	190	236	171	205	197	172	.9	1.25	<10	34.0	457	19.5	69	#1 JETS	2-27-75 BD
0.5	6095	2740	⊖	1.5	0.2	0.5	105	110	6000	2990	268	268	272	265	220	244	269	259	214	-	248	270	270	272	195	267	170	209	202	177	.9	1.25	<10	31.9	458	16.3	76	#1 JETS	2-27-75 BD
A6dRI3.0	6080	2735	2.9		1.5	0.2	1.0	105	110	5963	2980	195	212	215	212	194	180	185	202	188	-	193	211	214	214	190	205	169	200	196	173	.9	1.25	<10	37.5	454	24	73	#1 JETS	2-17-75 BD
2.5																																									
2.0	6080	2735	2.0		1.5	0.2	1.0	94	100	6000	3000	195	212	217	212	189	160	189	204	164	-	195	214	214	215	140	202	169	204	197	174	.9	1.25	<10	36.5	458	23	67	#1 JETS	2-19-75 BD
1.0	6085	2740	1.0		1.5	0.2	1.0	93	98	5970	3000	209	219	222	217	194	186	195	208	189	-	203	220	220	221	189	210	169	202	196	171	.9	1.25	<10	35.3	458	21.5	76	#1 JETS	2-19-75 BD
0.5	6085	2740	0.5		1.5	0.2	1.0	100	106	6000	2970	222	225	228	223	196	175	204	212	190	-	214	226	226	228	188	218	169	202	195	170	.9	1.25	<10	35.8	459	22.2	75	#1 JETS	2-19-75 BD
A6eRI3.0	6070	2730	2.9	-	1.5	0.2	1.0	105	110	6000	4520	195	211	214	211	191	180	185	200	183	-	192	210	211	212	-	190	205	169	197	175	.9	1.25	<10	36.7	457	23	72	#1 JETS	2-17-75 BD

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a

Notes: (Unless Otherwise Specified)

1. Cone face T/C at ~3.14 inch radius.

CONSTANT TEST SETTINGS: Shaft Speed 6000 rpm
Thrust Load 6000 lbs
Oil Inlet Temp 170 °F

SYMBOLS: △ Test Condition (Setting)
⟷ Reference Data Only
* Calculated Values

FRONT BEARING S/N 5 REAR BEARING S/N 1

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) SYNC RIB △		SUPPORT I.R. ⟷	SUPPORT O.R. ⟷	JETS △	OIL PRES. SUPP REG. ⟷	OIL PRES. TEST REG. ⟷	BRG. LOADS THRUST △	BRG. LOADS RADIAL △	TEMPERATURE °F REAR BEARING ISG. O.B. 1	REAR BEARING OUTER RING #1 2	REAR BEARING OUTER RING #2 3	REAR BEARING OUTER RING #3 4	REAR BEARING ISG. I.B. 5	REAR BEARING SHAFT I.B. 6	REAR BEARING CONE FACE 7	REAR BEARING CONE I.D. 8	REAR BEARING SHAFT I.D. 9	10	FRONT BEARING LUBE OUT (X) 11	FRONT BEARING OUTER RING #1 12	FRONT BEARING OUTER RING #2 13	FRONT BEARING OUTER RING #3 14	FRONT BEARING LUBE OUT 15	FRONT BEARING LUBE OUT 16	OIL IN △ 17(1)	SLAVE BEARING FRONTRIER IN 18(2)	19(3)	20(4)	SHAFT EXCURSION FRONT In x 10^{-3}	SHAFT EXCURSION REAR In x 10^{-3}	VIB LEVEL g	MOTOR I	MOTOR V	MOTOR HP *	TEST LAB (°F)	NOTES	DATE BY
A6FJI 4.0	6015	2130	⊖		1.5	0.2	4.0	92	98	6000	6030	199	199	200	197	179	193	201	200	177	-	193	199	199	201	190	195	169	206	199	170	.9	1.25	<10	40.5	457	28.2	82	#6 JETS	2-24-75 AD
3.0	6105	2745	⊖		1.5	0.2	3.0	91	91	6000	5970	205	204	206	202	180	200/201	208	206	183	-	198	206	205	207	191	201	171	207	200	173	.9	1.25	<10	390	451	25.7	62	#5 JETS	2-24-75 AD
2.0	6105	2745	⊖		1.5	0.2	2.0	110	113	5963	5980	220	216	217	213	188	209/201	223	215	186	-	210	216	216	217	190	211	171	206	199	171	.9	1.25	<10	39.2	452	23.2	74	#4 JETS	2-24-75 AD
1.0	6090	2735	⊖		1.5	0.2	1.0	100	106	6037	6000	242	236	239	235	201	224	242	233	200	-	231	239	239	241	190	236	170	208	200	171	.9	1.25	<10	349	456	20.5	70	#1 JETS	2-24-75 AD
0.5	6095	2740	⊖		1.5	0.2	0.5	105	112	6000	6000	268	266	270	264	221	245	266	257	214	-	248	267	268	271	193	266	170	210	203	173	.9	1.25	<10	33	459	18.0	76	#1 JETS	2-24-75 AD
A6FJI 3.0	6015	2735	2.9		1.5	0.2	1.0	104	110	6000	6040	195	210	213	211	191	179	185	200	184	-	195	214	214	216	192	201	169	204	198	174	.9	1.25	<10	40.0	459	27.8	72	#1 JETS	2-24-75 AD
2.5																																									
2.0	6085	2735	2.0		1.5	0.2	1.0	94	100	6000	5970	195	211	216	211	189	179	189	204	186	-	196	214	214	215	192	202	169	206	199	174	.9	1.25	<10	365	459	23.0	68	#1 JETS	2-13-75 AD
1.0	6085	2740	1.0		1.5	0.2	1.0	93	98	6000	5970	208	218	220	217	192	185	195	208	189	-	204	219	219	221	190	209	169	205	198	170	.9	1.25	<10	362	458	22.7	75	#1 JETS	2-13-75 AD
0.5	6085	2735	0.5		1.5	0.2	1.0	101	106	6037	6000	222	225	228	224	197	196	205	214	193	-	215	226	226	228	190	219	170	206	199	170	.9	1.25	<10	36.6	460	22.2	74	#1 JETS	2-13-75 AD

Table VIII - Continued

3

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a

FRONT BEARING S/N 5 REAR BEARING S/N 1

Notes: (Unless Otherwise Specified)

1. Cone face T/C at ~3.14 inch radius.

CONSTANT TEST SETTINGS: Shaft Speed 6000 rpm; Thrust Load 9000 lbs; Oil Inlet Temp 170 °F

SYMBOLS: △ Test Condition (Setting); ←→ Reference Data Only; * Calculated Values

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) CONE RIB △		SUPPORT I.R. ←→	SUPPORT O.R. ←→	JETS △	OIL PRES. SUPP BRG. ←→	TEST BRG. ←→	BRG. LOADS THRUST △	RADIAL △	TEMPERATURE °F REAR BEARING BRG. O.B. 1	OUTER RING #1 2	#2 3	#3 4	BRG. I.B. 5	6	CONE RIB FACE 7	8	SHAFT I.D. 9	10	FRONT BEARING LUB. OUT 11	OUTER RING #1 12	#2 13	#3 14	15	LUBE OUT 16	OIL IN △ 17	AVG. BEARING 18	19	20	SHAFT EXTENSION FRONT In x 10⁻³	REAR In x 10⁻³	VIB LEVEL g	MOTOR I	V	HP *	TEST LAB (°F)	NOTES	DATE BY
49dJI 4.0	6075	2735	⊖		1.5	0.2	4.0	92	97	8963	2970	203	204	206	202	181	198	208	205	179	-	197	204	204	206	190	203	171	204	198	172	.9	1.25	<10	40.6	458	28.5	81	#6 Jets	2-6-75 AO
3.0	6100	2740	⊖		1.5	0.2	3.0	92	92	9037	3000	207	209	210	206	162	200	212	209	181	-	201	210	208	210	189	204	171	203	197	171	.9	1.25	<10	40.0	457	27.5	64	#5 Jets	2-24-75 AO
2.0	6105	2745	⊖		1.5	0.2	2.0	110	113	9000	3010	225	221	223	218	191	213/212	229	221	189	-	215	222	221	222	189	218	171	204	197	170	.9	1.25	<10	37.5	452	28.8	76	#5 Jets	2-24-75 AO
1.0	6080	2740	⊖		1.5	0.2	1.0	100	105	9000	3010	247	242	245	240	204	227	247	237	200	-	237	246	245	247	188	243	170	204	197	170	.9	1.25	<10	35.5	455	21.4	72	#1 Jets	2-14-75 AO
0.5	6090	2740	⊖		1.5	0.2	0.5	105	110	9000	3000	274	273	277	271	224	249	274	264	216	-	257	276	275	278	192	272	170	207	199	174	.9	1.25	<10	32.3	458	17.0	76	#1 Jets	2-14-75 AO
A9dRI 3.0	6070	2730	2.9		1.5	0.2	1.0	104	110	8963	2980	199	216	220	216	196	184	187	203	186	-	194	219	219	220	187	204	169	200	195	169	.9	1.25	<10	38.8	459	26.3	72	#1 Jets	2-12-75 AO
2.5																																								
2.0	6080	2735	2.0		1.5	0.2	1.0	95	100	9037	3000	197	217	221	217	193	181	191	208	187	-	199	218	218	219	189	204	169	202	196	173	.9	1.25	<10	37.6	460	25.0	70	#1 Jets	2-13-75 AO
1.0	6080	2735	1.0		1.5	0.2	1.0	94	99	8963	3000	212	224	227	222	196	188	198	212	191	-	208	225	225	227	189	215	170	201	196	170	.9	1.25	<10	36.2	459	22.6	75	#1 Jets	2-13-75 AO
0.5	6085	2740	1.0		1.5	0.2	1.0	101	106	8963	2970	227	230	233	229	199	199	209	218	194	-	219	231	231	233	189	224	170	202	196	170	.9	1.25	<10	36.2	460	22.2	74	#1 Jets	2-13-75 AO
49eRI 3.0	6075	2735	2.9		1.5	0.2	1.0	105	111	8963	4500	196	214	218	215	193	181	188	204	185	-	195	209	208	210	191	204	169	203	198	173	.9	1.25	<10	38.3	461	25.5	75	#1 Jets	2-13-75 AO

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a

Notes: (Unless Otherwise Specified)

1. Cone face T/C at ~3.14 inch radius.

CONSTANT TEST SETTINGS: Shaft Speed 6000 rpm; Thrust Load 8000 lbs; Oil Inlet Temp 170 °F

SYMBOLS: △ Test Condition (Setting); ⟷ Reference Data Only; * Calculated Values

FRONT BEARING S/N 5 REAR BEARING S/N 1

TEST NO.	SPEED (RPM) SHAFT △	SPEED (RPM) SEPARATOR	OIL FLOW (GPM) CONE RIB △	OIL FLOW (GPM) SUPPORT I.R. ⟷	OIL FLOW (GPM) SUPPORT O.P. ⟷	OIL FLOW (GPM) JETS △	OIL PRES. SUPP BRG. ⟷	OIL PRES. TEST BRG.	BRG. LOADS THRUST △	BRG. LOADS RADIAL △	TEMPERATURE °F REAR BEARING HSG. O.D. 1	REAR BEARING OUTER RING #1 2	REAR BEARING OUTER RING #2 3	REAR BEARING OUTER RING #3 4	REAR BEARING HSG. I.B. 5	REAR BEARING SPACER I.B. 6	REAR BEARING CONE FACE 7	REAR BEARING CONE BORE I.R. 8	REAR BEARING SPACER I.D. 9	REAR BEARING 10	FRONT BEARING OUTER RING OUT 11	FRONT BEARING OUTER RING #1 12	FRONT BEARING OUTER RING #2 13	FRONT BEARING OUTER RING #3 14	FRONT BEARING SPACER OUT 15	FRONT BEARING CONE BORE 16	OIL In △ 17(1)	SLAVE BEARING FRONT FLAT IN ⟷	SLAVE BEARING FRONT FLAT IN ⟷	SHAFT EXCURSION FRONT In x 10^{-3}	SHAFT EXCURSION REAR In x 10^{-3}	VIB LEVEL *	MOTOR I	MOTOR V	MOTOR HP *	TEST LAB (°F)	NOTES	DATE BY
A9/IZ4.0	6070	2735	⟷	1.5	0.2	4.0	92	107	9000	6020	204	204	205	201	182	198	208	204	179	-	197	204	204	206	191	204	171	207	200	171	.9	1.25	<10	42.9	458	31.0	81	#6 Jets	2-11-70 BD
3.0	6100	2735	⟷	1.5	0.2	3.0	92	92	9000	6000	208	208	210	206	183	201	212	208	183	-	201	209	207	209	189	208	171	206	199	170	.9	1.25	<10	40.5	451	27.4	66	#5 Jets	2-24-70 BD
2.0	6105	2745	⟷	1.5	0.2	2.0	111	114	9037	6000	224	220	222	221	191	213	229	220	189	-	216	222	221	223	190	217	171	206	199	170	.9	1.25	<10	38	458	25.2	79	#5 Jets	2-24-70 BD
1.0	6080	2735	⟷	1.5	0.2	1.0	100	105	9000	4500	249	243	246	242	206	219	248	239	202	-	238	248	247	249	192	244	171	208	201	172	.9	1.25	<10	35.3	456	21.2	73	#1 Jets	2-24-70 BD
0.5	6090	2740	⟷	1.5	0.2	0.5	105	111	9000	4460	275	275	280	274	226	250	276	266	218	-	256	269	269	272	193	276	170	210	202	173	.9	1.25	<10	33.8	457	19.1	76	#1 Jets	2-24-70 BD
A9/RZ3.0	6075	2730	2.9	1.5	0.2	1.0	105	110	9000	6000	198	214	218	215	194	183	189	205	187	-	196	219	219	220	192	205	170	205	199	175	.9	1.25	<10	39.6	460	22.3	76	#1 Jets	2-13-70 BD
2.5																																							
2.0	6080	2735	2.0	1.5	0.2	1.0	95	100	9000	5970	198	217	221	217	194	181	192	208	188	-	199	218	218	219	191	206	169	206	200	173	.9	1.25	<10	37.9	461	25.4	71	#1 Jets	2-13-70 BD
1.0	6085	2735	1.0	1.5	0.2	1.0	93	99	9037	5970	211	222	226	221	196	187	198	211	191	-	207	225	225	227	190	214	170	205	199	171	.9	1.25	<10	37.3	462	24.5	75	#1 Jets	2-13-70 BD
0.5	6085	2735	0.5	1.5	0.2	1.0	101	106	8963	6000	227	230	233	228	208	199	209	219	195	-	207	231	231	233	190	224	170	205	199	170	.9	1.25	<10	37.1	461	24.1	72	#1 Jets	2-13-70 BD

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a

Notes: (Unless Otherwise Specified)

1. Cone face T/C at ~3.14 inch radius.

CONSTANT TEST SETTINGS: Shaft Speed 6.000 rpm
Thrust Load 12000 lbs
Oil Inlet Temp 170 °F

SYMBOLS: △ Test Condition (Setting)
⟷ Reference Data Only
★ Calculated Values

FRONT BEARING S/N 5 REAR BEARING S/N /

5

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) CONE RIB △	SUPPORT I.R. ⟷	SUPPORT O.R. ⟷	JETS △	OIL PRES. SUPP BRG. ⟷	TEST MANIF. ⟷	BRG. LOADS THRUST △	RADIAL △	REAR BEARING TEMPERATURE OF: BSG. O.D. 1	OUTER RING #1 2	OUTER RING #2 3	OUTER RING #3 4	BSG. I.D. 5	CAGE 6	CONE FACE 7	CONE B 8	CONE I.D. 9	CAGE I.D. 10	FRONT BEARING TEMPERATURE OF: CONE OUT 11	OUTER RING #1 12	OUTER RING #2 13	OUTER RING #3 14	SLEEVE BORE OUT 15	CAGE OUT 16	OIL IN △	LEAVE BEARING TRAINING IN ⟷	17	(2)	19	(3)	20	(1)	SHAFT EXTENSION FRONT ⌈ In x 10^{-3}	REAR In x 10^{-3}	VIB LEVEL *	MOTOR I	MOTOR V	MOTOR HP *	TEST LAB (°F)	NOTES	DATE
12dJI4.0	6070	2735	⊖	1.5	0.2	4.0	92	107	11963	3000	205	206	207	204	183	198	209	206	179	-	201	207	207	208	188	202	171	203	196	169	.9	1.25	<10	428	458	30.9	80	#1 JETS	2-17-75 AD
3.0	6095	2740	⊖	1.5	0.2	3.0	93	93	12037	3000	209	210	212	208	185	20⅛	215	211	183	-	203	213	211	213	187	205	170	202	195	170	.9	1.25	<10	409	451	28.0	68	#3 JETS	2-24-75 AD
2.0	6105	2745	⊖	1.5	0.2	2.0	111	114	11980	3000	226	223	225	220	192	19⅛	231	221	189	-	217	225	223	225	188	218	171	203	196	170	.9	1.25	<10	384	455	25.9	82	#3 JETS	2-24-75 AD
1.0	6085	2740	⊖	1.5	0.2	1.0	100	106	11963	3030	251	246	249	245	208	221	251	240	202	-	241	251	250	252	190	247	170	204	197	171	.9	1.25	<10	364	455	21.4	74	#1 JETS	2-14-75 AD
0.5	6090	2740	⊖	1.5	0.2	0.5	105	111	11963	3000	280	281	286	279	229	255	283	271	221	-	261	286	285	286	193	284	171	207	200	174	.9	1.25	<10	324	457	17.2	76	#1 JETS	2-14-75 AD
2dRI3.0	6075	2730	2.9	1.5	0.2	1.0	106	112	11963	3030	199	217	221	218	196	184	189	206	188	-	195	220	220	221	187	204	169	200	195	168	.9	1.25	<10	406	461	28.7	76	#1 JETS	2-21-75 AD
2.5																																										
2.0	6075	2735	2.0	1.5	0.2	1.0	95	101	12000	2970	201	221	225	221	196	184	195	211	189	-	201	222	221	223	191	209	170	204	197	173	.9	1.25	<10	387	459	26.2	73	#1 JETS	2-21-75 AD
1.0	6080	2735	1.0	1.5	0.2	1.0	94	99	12000	2970	214	226	229	225	198	189	200	215	192	-	209	227	228	229	188	216	169	201	195	170	.9	1.25	<10	361	457	25.2	75	#1 JETS	2-21-75 AD
0.5	6085	2740	0.5	1.5	0.2	1.0	101	106	11963	2970	230	234	237	232	202	201	213	221	196	-	213	235	235	237	189	227	170	202	196	171	.9	1.25	<10	375	462	24.8	73	#1 JETS	2-13-75 AD
AlReRI3.0	6070	2730	2.9	1.5	0.2	1.0	105	111	11963	4480	197	216	220	216	194	182	189	207	186	-	147	219	219	220	190	206	170	201	196	174	.9	1.25	<10	404	462	28.8	76	#1 JETS	2-12-75 AD

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

N. O. 7000-4 - IV a

Notes: (Unless Otherwise Specified)

1. Cone face T/C at ~3.14 inch radius.

CONSTANT TEST SETTINGS: Shaft Speed 6000 rpm
Thrust Load 12000 lbs
Oil Inlet Temp 170 °F

SYMBOLS: △ Test Condition (Setting)
⟷ Reference Data Only
* Calculated Values

FRONT BEARING S/N 5 REAR BEARING S/N 1

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) CONE RIB △		SUPPORT I.R. ⟷	O.R.	JETS △	OIL PRES. SUPP BRG. ⟷	TEST BRG.	BRG. LOADS THRUST △	RADIAL △	TEMPERATURE °F REAR BEARING ENG. O.B. 1	OUTER RING #1 2	#2 3	#3 4	INNER RING I.R. 5	CAGE 6	FRONT FACE 7	I.R. 8	SHAFT I.R. 9	10	FRONT BEARING LUBE OIL 11	OUTER RING #1 12	#2 13	#3 14	CAGE OUT 15	LINE OUT 16	OIL IN △ 17(1)	STAVE BEARING INTERIOR ⟷ IN 18(2)	19(3)	20(4)	SHAFT EXCURSION FRONT In x 10^{-3}	REAR In x 10^{-3}	VIB LEVEL %	MOTOR I	V	HP *	TEST LAB (°F)	NOTES	DATE BY
A12&13	4.0	6070	2730	⊖		1.5	0.2	4.0	92	97	12000	5980	204	204	206	202	182	197	206	205	177	-	197	205	204	206	189	200	170	205	198	170	.9	1.25	<10	430	459	313	81	#6 Jets	2-18-75 MD
	3.0	6095	2740	⊖		1.5	0.2	3.0	93	93	12000	5970	210	210	212	206	185	203	215	211	184	-	203	212	210	213	189	205	170	205	198	169	.9	1.25	<10	406	451	27.5	70	#5 Jets	2-N-75 MD
	2.0	6105	2745	⊖		1.5	0.2	2.0	112	115	12000	6030	226	222	225	220	192	214	230	221	189	-	216	225	223	225	189	219	170	206	198	169	.9	1.25	<10	394	453	26.5	85	#5 Jets	2-N-75 MD
	1.0	6080	2735	⊖		1.5	0.2	1.0	100	106	11963	5970	252	246	250	246	210	232	252	241	202	-	242	252	251	253	191	248	170	207	200	171	.9	1.25	<10	358	456	21.9	76	#1 Jets	2-N-75 MD
	0.5	6090	2735	⊖		1.5	0.2	0.5	105	111	11963	5980	281	281	286	280	230	256	282	271	220	-	212	287	286	288	194	283	170	210	202	174	.9	1.25	<10	329	458	17.8	76	#1 Jets	2-N-75 MD
A14&15	3.0	6070	2730	2.9		1.5	0.2	1.0	105	110	12000	5980	199	216	220	217	195	183	191	207	187	-	197	220	220	221	195	205	169	202	198	173	.9	1.25	<10	412	461	29.5	76	#1 Jets	2-18-75 MD
	2.5																																									
	2.0	6080	2735	2.0		1.5	0.2	1.0	95	101	12014	5978	200	220	225	221	197	193	199	210	190	-	202	222	221	223	192	208	170	206	200	173	.9	1.3	<10	38	460	25.5	75°	#1 Jets	2-N-75 MD
	1.0	6080	2735	1.0		1.5	0.2	1.0	94	99	12000	6030	214	225	229	225	197	189	199	215	192	-	210	228	228	230	190	217	170	205	198	170	.9	1.25	<10	315	459	24.5	74	#1 Jets	2-N-75 MD
	0.5	6085	2740	0.5		1.5	0.2	1.0	101	106	11963	6030	230	233	236	232	202	202	212	221	197	-	214	235	235	237	190	228	170	205	199	170	.9	1.25	<10	371	463	24.5	74	#1 Jets	2-N-75 MD

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

V. O. 7000-4 - IV a

Notes: (Unless Otherwise Specified)

1. Cone face A/C at ~3.14 inch radius.

CONSTANT TEST SETTINGS: Shaft Speed 6000 rpm
Thrust Load 6000 lbs
Oil Inlet Temp 195 °F

SYMBOLS: △ Test Condition (Setting)
—— Reference Data Only
* Calculated Value

FRONT BEARING S/N 5 REAR BEARING S/N 1

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) OIL RIB △	SUPPORT I.R. →	SUPPORT O.R. →	JETS △	OIL PRES. SUPP BRG. →	OIL PRES. TEST BRG. →	BRG. LOADS THRUST △	BRG. LOADS RADIAL △	TEMPERATURE °F REAR BEARING BRG. O.R. 1	REAR BEARING OUTER RING #1 2	REAR BEARING OUTER RING #2 3	REAR BEARING OUTER RING #3 4	REAR BEARING I.R. 5	REAR BEARING SHAFT I.R. 6	REAR BEARING CONE FACE 7	REAR BEARING CONE BACK 8	REAR BEARING SHAFT I.R. 9	REAR BEARING LOAD OUT 10	FRONT BEARING LOAD IN 11	FRONT BEARING OUTER RING #1 12	FRONT BEARING OUTER RING #2 13	FRONT BEARING OUTER RING #3 14	FRONT BEARING LOAD OUT 15	FRONT BEARING I.R. 16	OIL IN △	GEAR BEARING CONTROL IN (2)	GEAR BEARING CONTROL IN (1)	SHAFT EXTENSION FRONT In x 10^{-3}	SHAFT EXTENSION REAR In x 10^{-3}	VIB LEVEL g	MOTOR I	MOTOR V	MOTOR HP *	TEST LAB (°F)	NOTES	DATE IV
A6dJ2 4.0	6080	2735	⊖	1.5	0.2	4.0	90	86	6037	3020	219	219	220	217	199	215	222	221	200	-	213	220	220	221	211	216	194	224	218	197	.9	1.25	<10	31.9	453	24.5	73	#6 JETS	2-18-76 AD
3.0	6105	2745	⊖	1.5	0.2	3.0	94	94	5963	2980	226	226	228	224	205	220	229	227	205	-	220	227	226	228	214	223	195	226	219	198	.9	1.25	<10	36.2	453	22.0	82	#5 JETS	2-20-76 AD
2.0	6110	2745	⊖	1.5	0.2	2.0	103	106	6000	2980	237	234	235	231	206	225	240	235	206	-	229	234	234	235	215	231	196	227	219	200	.9	1.25	<10	34.8	452	20.2	82	#5 JETS	2-21-76 AD
1.0	6090	2745	⊖	1.5	0.2	1.0	98	103	5940	3010	256	252	255	250	218	237	256	250	219	-	247	256	255	257	217	254	195	229	222	202	.9	1.25	<10	34.0	461	20.0	77	#1 JETS	2-17-76 AD
0.5	6100	2745	⊖	1.5	0.2	0.5	102	108	6000	3000	281	279	283	278	238	259	282	275	236	-	243	283	283	284	221	281	196	234	228	206	.9	1.25	<10	31.7	460	16.0	81	#1 JETS	2-17-76 AD
A6dRI 3.0	6085	2735	2.9	1.5	0.2	1.0	103	108	6000	2978	218	231	234	231	210	206	210	224	206	-	216	234	234	235	217	227	195	222	218	201	.9	1.25	<10	37	452	23.0	75	#1 JETS	1465 1 (REMO)	2-17-76 AD
Rerun 3.0	6085	2735	2.9	1.5	0.2	1.0	104	109	6000	3000	218	232	235	232	214	205	210	223	210	-	216	235	235	236	215	226	195	225	220	200	.9	1.25	<10	31.7	463	26.5	78	#1 JETS		2-17-76 AD
2.5																																							
2.0	6085	2740	2.0	1.5	0.2	1.0	84	89	6000	3000	218	231	234	230	204	204	212	225	206	-	217	233	233	234	215	227	195	227	219	201	.9	1.25	<10	32.8	458	23.5	67	#1 JETS		2-17-76 AD
1.0	6090	2740	1.0	1.5	0.2	1.0	87	92	6000	3000	230	239	242	238	215	210	219	230	214	-	227	240	240	242	216	232	195	228	221	202	.9	1.25	<10	34.1	461	20.1	75	#1 JETS		2-16-76 AD
0.5	6090	2740	0.5	1.5	0.2	1.0	104	110	6000	3000	240	241	244	240	201	216	225	233	211	-	231	242	243	244	215	238	195	227	221	201	.9	1.25	<10	32.9	452	17.5	70	#1 JETS		2-13-76 AD
A6cRII 3.0	6080	2735	2.9	1.5	0.2	1.0	102	108	6037	4478	218	231	235	232	210	206	210	224	208	-	216	235	235	236	215	225	194	224	219	200	.9	1.25	< 10	36.0	456	21.8	78	#1 JETS		2-13-76 AD

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a

FRONT BEARING S/N 5 REAR BEARING S/N 1

Notes: (Unless Otherwise Specified)

1. Cone face T/C at ~3.14 inch radius.

CONSTANT TEST SETTINGS: Shaft Speed 6000 rpm; Thrust Load 6000 lbs; Oil Inlet Temp 195 °F

SYMBOLS: △ Test Condition (Setting); ←→ Reference Data Only; * Calculated Values

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) CONE RIB △	SUPPORT I.R.	SUPPORT O.R. ←→	JETS △	OIL PRES. SUPP MFG.	OIL PRES. TEST BRG.	BRG. LOADS THRUST △	BRG. LOADS RADIAL △	TEMPERATURE OF REAR BEARING O.D. 1	REAR BEARING OUTER RING #1 2	REAR BEARING OUTER RING #2 3	REAR BEARING OUTER RING #3 4	REAR BEARING I.B. 5	REAR BEARING CAGE (C.B.)	REAR BEARING CONE FACE 7	REAR BEARING I.P. 8	REAR BEARING SHAFT I.B. 9	REAR BEARING 10	TEMPERATURE OF LABE OUT 11	FRONT BEARING OUTER RING #1 12	FRONT BEARING OUTER RING #2 13	FRONT BEARING OUTER RING #3 14	FRONT BEARING LOAD CELL 15	FRONT BEARING CAGE 16	OIL IN △ 17(1)	SHAFT EXCURSION (NONCONTACT) IN 18(2)	19(3)	20(4)	SHAFT EXCURSION FRONT In x 10^{-3}	SHAFT EXCURSION REAR In x 10^{-3}	VIB LEVEL g	MOTOR I	MOTOR V	MOTOR HP *	TEST LAB (°F)	NOTES	DATE BY
AGF/RX4.0	6080	2735	0	1.5	0.2	4.0	91	87	6037	6000	221	220	221	219	200	215	223	222	201	-	216	220	221	222	215	221	196	228	221	199	.9	1.25	<10	345	457	25.5	76	#6 Jets	2-17-75 MO
3.0	6110	2745	0	1.5	0.2	3.0	94	94	6000	6030	214	224	226	222	204	15/16	227	226	206	-	218	223	223	226	214	215	195	228	221	198	.9	1.25	<10	314	456	24.0	82	#5 Jets	2-17-75 MO
2.0	6110	2745	0	1.5	0.2	2.0	104	106	6037	6000	237	234	236	231	207	224	239	234	211	-	229	234	234	236	216	231	195	229	222	199	.9	1.25	<10	354	457	21.2	82	#2 Jets	2-17-75 MO
1.0	6090	2740	0	1.5	0.2	1.0	98	103	6037	6020	258	253	256	252	220	241	258	250	221	-	248	256	256	258	218	256	196	232	226	202	.9	1.25	<10	343	461	20.6	78	#1 Jets	2-17-75 MO
0.5	6095	2740	0	1.5	0.2	0.5	102	108	6000	5970	280	278	281	277	238	258	280	273	236	-	263	281	281	284	221	281	195	236	229	206	.9	1.25	<10	319	461	16.8	81	#1 Jets	2-17-75 MO
AGF/RX3.0	6085	2540	2.9	1.5	0.2	1.0	102	108	5963	6030	217	229	233	230	210	204	241	233	207	-	215	232	233	234	216	228	195	225	220	200	.9	1.25	<10	357	453	21.71	72	#1 Jets	2-17-75 MO
2.5																																								
2.0	6085	2740	2.0	1.5	0.2	1.0	85	90	6037	5960	219	232	236	232	206	205	213	225	209	-	218	232	233	233	217	229	195	230	223	201	.9	1.25	<10	363	456	23.1	69	#1 Jets	2-17-75 MO
1.0	6085	2740	1.0	1.5	0.2	1.0	88	92	6000	6000	229	237	241	237	212	209	219	229	212	-	225	239	238	240	217	231	195	230	224	201	.9	1.25	<10	345	461	20.7	75	#1 Jets	2-17-75 MO
0.5	6085	2740	0.5	1.5	0.2	1.0	93	98	6014	5980	241	243	246	242	217	217	226	234	216	-	234	245	245	247	215	241	195	228	221	201	.9	1.25	<10	339	458	19.4	76	#1 Jets	2-17-75 MO

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a

Notes: (Unless Otherwise Specified)

1. Cone face T/C at~3.14 inch radius.

CONSTANT TEST SETTINGS: Shaft Speed 6000 rpm
Thrust Load 9000 lbs
Oil Inlet Temp 125 °F

SYMBOLS: △ Test Condition (Setting)
⟷ Reference Data Only
* Calculated Values

9

FRONT BEARING S/N ____ REAR BEARING S/N 1

Test No.	Speed (rpm) Shaft △	Speed Cage	[illegible] Rib	Oil Flow (GPM) Outer I.R.	Oil Flow O.R.	Oil Flow Jets △	Oil Press. ⟷	Oil Press. ⟷	Load Thrust △	Load Radial △	Rear Bearing Temp. 1	2	3	4	5	6	7	8	9	10	Front Bearing Temp. 11	12	13	14	15	16	Oil In △ 17	Max. Bearing Temp. ⟷			Front Expansion in x 10^-3	Rear Expansion in x 10^-3	Vib Level	I	V	HP *	Test Lab (°F)	Notes	Date
99d/IV 4.0	6075	2730	Ø	1.5	0.2	4.0	92	98	9000	2178	223	224	225	222	204	218	227	226	203	—	216	226	226	227	214	225	196	226	219	199	.9	1.25	<10	37.5	460	27.3	79	#6 Jets	2-17-75
3.0	6105	2745	⊖	1.5	0.2	3.0	94	94	8963	3000	229	230	232	228	208	225/221	233	231	208	-	223	231	230	232	215	230	196	227	221	199			<10	31.8	458	24.8	82	#5 Jets	2-19-75 do
2.0	611[illegible]	2745	⊖	1.5	0.2	2.0	104	111	8963	2970	240	238	239	235	209	229	244	238	209	-	231	239	238	239	214	235	195	226	220	199	.9	1.25	<10	36.0	453	24.1	82	#5 Jets	2-19-75 do
1.0	6095	2740	Ø	1.5	0.2	1.0	98	103	8182	3000	262	259	261	257	225	245	264	256	224	—	254	262	262	264	217	260	196	230	223	202	.9	1.25	<10	34.0	461	19.9	78	#1 Jets	2-17-75
0.5	00	2740	⊖	1.5	0.2	0.5	102	108	9000	3030	286	285	289	284	241	263	289	280	238	-	269	289	289	291	220	285	195	233	226	206	.9	1.25	<10	32.0	460	16.5	82	#1 Jets	2-19-75 do
R9d/RII 3.0	6060	2735	2.9	1.5	0.2	1.0	102	108	9000	3000	220	235	238	235	212	207	212	226	209	-	219	236	237	238	215	229	195	225	219	202	.9	1.25	<10	36.0	453	22.7	78	#1 Jets	2-17-75 do
2.5																																							
2.0	6085	2740	2.0	1.5	0.2	1.0	85	90	9000	3000	221	236	241	236	211	206	216	229	209	-	221	237	238	239	216	231	196	228	221	202	.9	1.25	<10	36.4	459	21.7	71	#1 Jets	2-17-75 do
1.0	6085	2740	1.0	1.5	0.2	1.0	88	93	8963	2970	233	242	246	242	215	210	221	233	215	-	229	244	244	245	217	236	195	228	222	202	.9	1.25	<10	35.9	461	22.6	74	#1 Jets	2-18-75 do
0.5	6085	2735	0.5	1.5	0.2	1.0	93	98	9037	2980	244	247	250	246	217	218	229	238	216	-	237	249	249	251	216	243	195	228	221	201	.9	1.25	<10	34.7	458	20.4	75	#1 Jets	2-14-75 do
A9eRII 3.0	6080	2730	2.9	1.5	0.2	1.0	103	108	9000	4520	221	235	239	236	214	208	213	227	211	-	219	236	237	238	218	229	195	225	220	201	.9	1.25	<10	37.8	452	24.2	80	#1 Jets	2-12-75 do

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a

Notes: (Unless Otherwise Specified)

1. Cone face T/C at ~3.14 inch radius.

CONSTANT TEST SETTINGS: Shaft Speed 6000 rpm
Thrust Load 9000 lbs
Oil Inlet Temp 185 °F

SYMBOLS: △ Test Condition (Setting)
←→ Reference Data (ml)
* Calculated Values

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FRONT BEARING S/N 5 REAR BEARING S/N 1

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) CONE RIB △	SUPPORT I.R. ←→	SUPPORT O.R. ←→	JETS △	OIL PRES. SUPP BRG. ←→	OIL PRES. T.ST BRG. ←→	THRUST △	RADIAL △	REAR BEARING TEMPERATURE °F: BRG. O.B. 1	REAR OUTER RING #1 2	#2 3	#3 4	REAR INNER I.R. 5	REAR INNER O.R. 6	REAR CONE FACE 7	REAR CONE I.R. 8	REAR SHAFT I.R. 9	REAR LUBE OUT 10	FRONT BEARING TEMPERATURE °F: FRONT OUTER RING #1 11	#2 12	#3 13	#4 14	FRONT INNER LUBE OUT 15	FRONT INNER LUBE IN 16	OIL IN △ 17(1)	SEAL BEARING PARTICLES IN 18(2)	19(3)	20(4)	SHAFT EXCURSION FRONT In x 10^{-3}	SHAFT EXCURSION REAR In x 10^{-3}	VIB LEVEL g	AMOR I	AMOR V	AMOR HP *	TEST LAB (°F)	NOTES	DATE BY
R9F/RT4.0	6080	2735	0	1.5	0.2	4.0	93	98	9000	5970	221	222	223	220	202	216	225	223	202	-	218	223	224	225	215	233	195	228	221	198	.9	1.25	<10	39.8	458	27.3	80	#6 Jets	2-18-75 MD
3.0	6105	2745	0	1.5	0.2	3.0	95	95	8990	5970	227	228	230	226	206	233	231	206	-	221	230	229	231	215	229	195	229	222	199	.9	1.25	<10	38.9	460	27.8	81	#5 Jets	2-21-75 MD
2.0	6110	2745	0	1.5	0.2	2.0	104	107	9000	5970	241	239	241	236	210	247	239	212	-	233	239	239	240	215	236	195	229	222	199	.9	1.25	<10	359	453	21.8	82	#5 Jets	2-24-75 MD
1.0	6090	2740	0	1.5	0.2	1.0	98	103	9037	6060	262	258	262	257	224	245	244	256	225	-	253	262	262	263	218	261	196	231	225	202	.9	1.25	<10	355	461	22.0	78	#1 Jets	2-27-75 VM
0.5	6095	2745	0	1.5	0.2	0.5	102	108	9000	5970	289	286	291	285	243	264	290	282	240	-	270	291	290	292	223	287	196	236	230	207	.9	1.25	<10	33.1	460	18.5	81	#1 Jets	2-27-75 MD
R9F/RT3.0	6080	2735	2.9	1.5	0.2	1.0	103	109	9000	6030	219	234	237	234	212	205	211	228	211	-	217	234	236	237	215	226	194	226	221	201	.9	1.25	<10	37.5	453	24.0	75	#1 Jets	2-12-75 MD
2.5																																								
2.0	6085	2735	2.0	1.5	0.2	1.0	85	90	9014	5970	222	236	241	237	212	206	215	228	211	-	22	238	238	239	217	231	195	230	223	201	.9	1.25	<10	37.2	460	24.5	73	#1 Jets	2-27-75 MD
1.0	6085	2735	1.0	1.5	0.2	1.0	88	93	9000	6030	232	241	245	240	215	210	220	233	216	-	227	243	242	244	217	235	194	230	224	201	.9	1.25	<10	36.6	463	22.0	74	#1 Jets	2-27-75 MD
0.5	6090	2740	0.5	1.5	0.2	1.0	96	99	8963	5960	245	247	251	246	218	218	230	237	218	-	238	249	249	251	217	244	195	231	224	201	.9	1.25	<10	34.5	459	20.4	75	#1 Jets	2-27-75 MD

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a

Notes: (Unless Otherwise Specified)

1. Cone face T/C at ~3.14 inch radius.

CONSTANT TEST SETTINGS: Shaft Speed 6000 rpm
Thrust Load 12000 lbs
Oil Inlet Temp 195 °F

SYMBOLS: △ Test Condition (Setting)
—— Reference Data Only
* Calculated Values

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FRONT BEARING S/N 5 REAR BEARING S/N 1

Point ID	Speed (RPM) Limit △	Speed (RPM) Setting	Oil Flow (GPM) Rib △	Oil Flow (GPM) Setting → △	Oil Press. (PSIG) Inlet, Rear → △	Bearing Loads (LBS) Thrust △	Rear Bearing Temperatures (°F) Outer Ring O.D. 1	Outer Ring #1 2	Outer Ring #2 3	Outer Ring #3 4	Inner Ring Bore 5	Inner Ring Face 6	Inner Ring Face 7	Inner Ring Face 8	Inner Ring Face 9	Inner Ring Face 10	Front Bearing Temperatures (°F) Outer Ring O.D. 11	Outer Ring #1 12	Outer Ring #2 13	Outer Ring #3 14	Inner Ring Bore 15	Inner Ring Face 16	Oil Flow (GPM) Inlet △	Oil Flow (GPM) Drain → △	Shaft Excursion (Front) In x 10^{-3}	Shaft Excursion (Rear) In x 10^{-3}	VIB Level %	Noise dB	Noise V	Noise Hz *	Wear Lab (PPM)	Notes	Ball Pass Freq. Hz
A12d/E4.0	6075	2735	○	1.5	0.2	4.0	92	87	11963	3000	224	225	226	223	204	219	228	216	203	-	216	226	226	227	214	221	196	225	219	199	.9	1.25	<10	40.8	457	28.6	81	#1 JETS	2-1/16 BPF 140
3.0	6105	2735	○	1.5	0.2	3.0	95	95	11963	2970	229	230	232	228	207	234	231	207	-	223	233	231	233	213	230	195	225	218	198	.9	1.25	<10	39.5	459	27.2	80	#5 JETS	2-1/16 BPF 140
2.0	6105	2745	○	1.5	0.2	2.0	104	107	11963	3000	243	241	243	238	211	248	239	210	-	234	242	241	242	214	238	195	226	220	198	.9	1.25	<10	36.2	455	22.2	82	#5 JETS	2-1/16 BPF 140
1.0	6090	2740	○	1.5	0.2	1.0	98	103	12037	3040	265	261	264	260	226	247	267	257	225	-	256	266	265	267	217	264	196	229	222	202	.9	1.25	<10	35.2	460	21.5	78	#1 JETS	2-1/16 BPF 140
0.5	6095	2745	○	1.5	0.2	1.0	103	108	11963	3030	291	290	294	289	245	266	293	262	240	-	274	295	294	296	220	290	195	233	226	206	.9	1.25	<10	32.3	461	17.3	80	#1 JETS	2-1/16 BPF 140
A12d/E3.0	6075	2730	2.9	1.5	0.2	1.0	103	108	11963	3000	221	236	239	236	214	206	211	228	208	-	249	260	260	260	215	233	195	222	218	201	.9	1.25	<10	37.7	453	24.0	75	#1 JETS	2-1/16 BPF 140
2.5																																							
2.0	6085	2740	2.0	1.5	0.2	1.0	86	90	12074	3000	223	238	243	239	215	206	217	230	213	-	223	238	240	240	220	235	195	224	220	202	.9	1.25	<10	38.9	460	26.4	72		
1.0	6085	2735	1.0	1.5	0.2	1.0	88	93	11963	3000	235	244	248	244	216	211	224	236	217	-	230	246	246	248	216	239	194	227	221	201	.9	1.25	<10	36.0	462	21.6	74	#1 JETS	2-1/16 BPF 140
0.5	6085	2740	0.5	1.5	0.2	1.0	94	99	11963	3020	247	250	253	249	219	221	232	240	219	-	240	253	252	254	216	247	195	228	221	201	.9	1.25	<10	35.2	459	21.5	75	#1 JETS	2-1/16 BPF 140
A12c/E3.0	6060	2735	2.9	1.5	0.2	1.0	102	108	11963	4540	221	236	240	236	214	209	211	227	209	-	219	236	238	239	216	234	195	225	220	201	.9	1.25	<10	38.4	455	25.5	75	#1 JETS	2-1/16 BPF 140

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O., 7000-4 - IV a

FRONT BEARING S/N 5 REAR BEARING S/N /

Notes: (Unless Otherwise Specified)

1. Cone face T/C at ~3.14 inch radius.

CONSTANT TEST SETTINGS: Shaft Speed 6000 rpm; Thrust Load 12000 lbs; Oil Inlet Temp 185 °F

SYMBOLS: △ Test Condition (Setting); ⟷ Reference Data Only; * Calculated Values

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) CONE RIB △	SUPPORT I.R. ⟷	SUPPORT O.R. ⟷	JETS △	OIL PRES. SUPP BRG. ⟷	OIL PRES. TEST BRG. ⟷	BRG. LOADS THRUST △	BRG. LOADS RADIAL △	REAR BEARING BRG. O.D. 1	REAR BEARING OUTER RING #1 2	REAR BEARING OUTER RING #2 3	REAR BEARING OUTER RING #3 4	REAR BEARING BRG. I.D. 5	REAR BEARING SLOT 6	REAR BEARING CONE FACE 7	REAR BEARING CONE I.D. 8	REAR BEARING SHAFT I.D. 9	REAR BEARING 10	TEMPERATURE, °F OF — FRONT BEARING: OUT (CUP) 11	FRONT BEARING: OUTER RING #1 12	FRONT BEARING: OUTER RING #2 13	FRONT BEARING: OUTER RING #3 14	FRONT BEARING: CUP 15	FRONT BEARING: CUP 16	OIL IN △	GRAV. BEARING (OUTER RING) OUT ⟷	GRAV. BEARING (OUTER RING) IN ⟷	JOINT EXTENSION FRONT In x 10⁻³	JOINT EXTENSION REAR In x 10⁻³	VIB LEVEL g	AMP I	AMP V	AMP HP *	TEST LAB (°F)	NOTES	DATE BY
Run 1	6075	2735	1.5	0.2	4.0	92	98	11963	6000	223	224	225	222	202	218	227	225	201	-	219	224	225	226	214	225	195	228	221	199	.9	1.25	<10	40.7	45.7	28.5	81	#1 JETS	2-17-75 BW
3.0	6100	2745	1.5	0.2	3.0	96	96	11963	6030	229	230	230	229	207	225	234	232	207	-	223	231	231	233	215	231	195	229	222	198	.9	1.25	<10	39.0	46.0	26.8	80	#1 JETS	2-17-75 BW
2.0	6105	2745	1.5	0.2	2.0	105	108	11963	5970	243	241	243	238	211	232	249	239	211	-	234	242	241	242	216	238	195	229	222	198	.9	1.25	<10	36.6	45.9	22.8	82	#1 JETS	2-17-75 BW
1.0	6090	2740	1.5	0.2	1.0	98	103	11963	5970	265	261	264	260	226	246	267	257	226	-	256	265	265	267	217	244	195	231	225	201	.9	1.25	<10	35.2	46.1	21.5	79	#1 JETS	2-17-75 BW
0.5	6095	2745	1.5	0.2	0.5	103	108	11963	6000	293	291	295	290	246	267	293	284	242	-	275	296	295	297	223	292	196	236	230	206	.9	1.25	<10	33.5	46.0	19.0	78	#1 JETS	2-17-75 BW
Run 3.0	6080	2735	2.9	1.5	0.2	1.0	102	108	11963	5970	222	236	240	237	214	207	212	228	209	-	220	241	240	241	218	233	195	227	221	202	.9	1.25	<10	38.2	45.2	24.7	75	#1 JETS	2-17-75 BW
Rerun 3.0	6085	2740	2.9	1.5	0.2	1.0	105	110	11963	5970	222	237	240	237	215	208	214	228	211	-	220	239	240	241	217	231	195	227	221	202	.9	1.25	<10	39.8	46.3	27.8	78	#1 JETS	2-17-75 BW
2.5																																						
2.0	6080	2735	2.0	1.5	0.2	1.0	86	101	12000	5970	223	238	243	239	215	206	216	230	212	-	222	240	239	240	217	233	195	230	223	201	.9	1.25	<10	38.7	46.0	26.2	75	#1 JETS	2-17-75 BW
1.0	6085	2735	1.0	1.5	0.2	1.0	88	93	12000	5970	235	244	249	244	216	211	224	237	217	-	231	246	246	248	218	239	196	231	224	202	.9	1.25	<10	37.2	46.2	24.5	74	#1 JETS	2-17-75 BW
0.5	6085	2735	0.5	1.5	0.2	1.0	94	99	12000	6000	248	250	254	249	220	221	233	241	220	-	241	253	252	255	227	248	195	231	224	201	.9	1.25	<10	36.7	46.0	22.3	75	#1 JETS	2-17-75 BW

Table VIII - Continued

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PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a

FRONT BEARING S/N 4   REAR BEARING S/N 1

Notes: (Unless Otherwise Specified)

1. Cone face T/C at ~3.14 inch radius.

CONSTANT TEST SETTINGS: Shaft Speed 10,000 rpm; Thrust Load 6000 lbs; Oil Inlet Temp. 170 °F

SYMBOLS: △ Test Condition (Setting); ←→ Reference Data Only; * Calculated Values

Test No.	Speed (RPM) Shaft △	Speed (RPM) Separator	Oil Flow (GPM) Cone Rib △		Oil Flow Support I.R.	Oil Flow Support O.R.	Oil Flow Jets △	Oil Disch. Front Brg.	Oil Disch. Test Brg.	Brg. Load Thrust △	Brg. Load Radial △	Temp. °F 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17 △	18	19	20	Shaft Expansion Front In x 10⁻³	Shaft Expansion Rear In x 10⁻³	Vib Level	Motor I	Motor V	Motor HP *	Room Temp (°F)	Notes	Date
B6dJI 4.0	10055	4525	⊖		1.5	0.2	4.0	111	107	5963	3020	230	225	225	220	187	221	241	225	187	-	217	227	230	229	204	229	170	241	226	172	.75	1.3		63.5	450	52.5	78	#6 JeTs	1-22-75 DD
3.0	10065	4530	⊖		1.5	0.2	3.0	94	93	5985	3000	231	232	239	228	194	229	246	230	195	-	226	238	240	241	206	243	171	245	229	174	.75	1.3		60.5	453	50.0	69	#5 JeTs	1-22-75 DD
2.0	10080	4535	⊖		1.5	0.2	2.0	102	105	6000	3010	262	257	253	247	201	246	269	246	201	-	234	255	257	256	206	263	170	245	229	174	.75	1.25		55.5	452	44.5	62	#5 JeTs	1-22-75 DD
1.0																																								
.5																																								
B6dRI 3.0	10075	4530	2.9		1.5	0.2	1.0	103	109	5963	2990	212	242	247	240	208	190	200	224	200	-	210	242	243	245	206	228	170	242	229	175	.8	1.4		54.4	452	43.4	76	#1 JeTs	1-23-75 DD
2.5	10080	4530	2.5		1.5	0.2	1.0	87	92	5963	2970	215	215	251	244	210	191	205	227	202	-	212	246	250	250	211	231	171	241	226	173	.75	1.35		54.2	450	43.0	71	#1 JeTs	1-24-75 DD
2.0	10065	4535	2.0		1.5	0.2	1.0	101	106	6037	2990	220	246	251	245	213	195	205	226	204	-	217	250	251	253	207	237	170	243	228	173	.75	1.35		54.5	451	43.5	77	#1 JeTs	1-24-75 DD
1.0	10080	4535	1.0		1.5	0.2	1.0	103	108	6000	3000	239	252	257	251	211	210	220	233	206	-	23[illegible]	260	265	264	209	256	169	242	226	173	.75	1.35	<10	51.7	454	40.8	69	#1 JeTs	1-27-75 DD
warm 1.0	10200	4590	1.0		1.5	0.2	1.0	103	108	6075	2970	240	252	257	251	211	211	217	231	201	-	232	263	268	267	210	263	170	249	232	175	.95	1.15	<10	53.0	458	42.5	78	#1 JeTs Front Brg S/N 5	1-27-75 DD
.5	10090	4535	0.5		1.5	0.2	1.0	104	109	6000	3000	259	263	267	262	221	227	239	242	210	-	243	273	274	277	211	276	170	245	230	175	.75	1.35		49.5	455	38.5	72	#1 JeTs	1-27-75 DD

Table VIII - Continued

Notes: (Unless Otherwise Specified)

1. Cone face T/C at ~3.14 inch radius.

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a

CONSTANT TEST SETTINGS: Shaft Speed 10,000 rpm; Thrust Load 6,000 lbs; Oil Inlet Temp 170 °F

SYMBOLS: △ Test Condition (Setting); ←→ Reference Data Only; * Calculated Values

FRONT BEARING S/N 4 REAR BEARING S/N 1

TEST NO.	SPEED (RPM) SHAFT △	SPEED (RPM) SEPARATOR	OIL FLOW (GPM) ZONE RIB △	OIL FLOW (GPM) SUPPORT I.R. ←→	OIL FLOW (GPM) SUPPORT O.R. ←→	OIL FLOW (GPM) JETS △	OIL PRES. SUPP BRG. ←→	OIL PRES. TEST BRG. ←→	BRG. LOADS THRUST △	BRG. LOADS RADIAL △	TEMPERATURE °F REAR BEARING B.G. O.D. 1	REAR BEARING OUTER RING #1 2	REAR BEARING OUTER RING #2 3	REAR BEARING OUTER RING #3 4	REAR BEARING BORE I.D. 5	REAR BEARING SHAFT O.D. 6	REAR BEARING CONE FACE 7	REAR BEARING BRG I.R. 8	REAR BEARING SHAFT I.D. 9	REAR BEARING 10	REAR BEARING LUBE OUT 11	FRONT BEARING OUTER RING #1 12	FRONT BEARING OUTER RING #2 13	FRONT BEARING OUTER RING #3 14	FRONT BEARING SHAFT BORE 15	FRONT BEARING LUBE OUT 16	OIL IN △ 17(1)	SLAVE BEARING FRONT 18(2)	SLAVE BEARING REAR 19(3)	SLAVE BEARING IN 20(4)	SHAFT EXCURSION FRONT In x 10^{-3}	SHAFT EXCURSION REAR In x 10^{-3}	VIB LEVEL g	MOTOR I	MOTOR V	MOTOR HP *	TEST LAB (°F)	NOTES	INIT. BY
B6eJI 4.0	10060	4525	0		1.5	0.2	4.0	111	107	6000	4500	230	225	225	221	188	214	243	226	189	–	218	228	230	230	205	229	170	245	230	172	.75	1.3		440	451	53.2	78	#6 JETS	
3.0	10065	4530	0		1.5	0.2	3.0	94	94	6000	4500	239	232	232	229	194	226	246	230	194	–	224	238	239	241	208	242	170	247	232	173	.75	1.3		595	453	48.7	68	#5 JETS	
2.0	10080	4535	0		1.5	0.2	2.0	103	106	6000	4500	262	251	252	247	207	245	268	245	202	–	238	254	257	252	208	262	170	249	234	175	.75	1.25		514	452	46.5	64	#5 JETS	
1.0																																							
.5																																							
B6eRI 3.0	10070	4535	2.9		1.5	0.2	1.0	104	110	6031	4500	214	242	247	241	210	190	200	223	201	–	216	243	246	247	214	228	170	244	231	176	.75	1.35		550	453	44.0	77	#1 JETS	
2.5	10080	4535	2.5		1.5	0.2	1.0	87	92	6000	4500	215	244	249	243	210	188	207	225	203	–	212	245	249	249	207	232	170	246	231	173	.75	1.35		550	452	43.9	74	#1 JETS	
2.0	10080	4530	2.0		1.5	0.2	1.0	101	106	6037	4480	220	245	250	245	212	194	205	225	205	–	216	249	251	253	208	236	170	246	231	173	.75	1.35		516	453	43.6	78	#1 JETS	
1.0	10080	4530	1.0		1.5	0.2	1.0	103	108	6037	4480	240	254	259	254	215	211	222	234	210	–	233	262	266	267	209	259	170	247	232	175	.75	1.35	<10	536	455	42.2	70	#1 Jets	
.5	10090	4535	0.5		1.5	0.2	1.0	104	110	5980	4490	260	244	268	263	223	226	236	243	213	–	247	273	275	278	209	276	170	252	235	176	.75	1.35		500	455	39.0	72	#1 JETS	

Table VIII - Continued

Notes: (Unless Otherwise Specified)

1. Cone face T/C at ~3.14 inch radius.

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a

TEST SETTINGS: Shaft Speed 10,000 rpm
Thrust Load 9000 lbs
Oil Inlet Temp 170 °F

SYMBOLS: △ Test Condition (Setting)
—— Reference Data Only
* Calculated Values

FRONT BEARING S/N 4 REAR BEARING S/N 1

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) CONE RIB △	SUPPORT I.R.	SUPPORT O.R.	JETS △	OUTP BRG.	INLET BRG.	BRG. LOADS THRUST △	RADIAL △	TEMPERATURES °F REAR BEARING OUTER RING BRG. O.D. 1	#1 2	#2 3	#3 4	INNER RACE 5	CAGE 6	OUTER RACE 7	T.P. 8	FRONT I.D. 9	10	LUBE OIL 11	FWD. BLADE ELEMENT #1 12	#2 13	#3 14	SLAW BRG HOUSE 15	OUTLET 16	OIL IN △ 17	GRAVE MARKER PARTICIPANT 18	19	20	SHAFT EXTENSION FRONT In x 10^{-3}	REAR In x 10^{-3}	VIB LEVEL In	AMPS. I	V	HP *	TEST LAB (°F)	NOTES	LOAD PY
89dII	40	10055	4525	0		1.5	0.2	4.0	111	106	9037	2970	234	230	231	226	190	226	247	220	190	-	224	232	233	233	204	232	169	241	227	171	.75	1.3		465	451	55.6	79	#6 Jets	28.75 200
	30	10065	4525	0		1.5	0.2	3.0	94	94	8963	4470	244	238	240	234	198	235	255	238	198	-	235	244	244	246	206	248	170	244	229	173	.75	1.3		615	453	50.9	71	#5 Jets	19.75 200
	20	10060	4535	0		1.5	0.2	2.0	102	105	9020	2980	263	257	259	252	205	250	275	252	204	-	243	260	263	262	206	267	170	246	230	174	.75	1.25		573	453	46.3	65	#5 Jets	30.75 200
	10																																							
	5																																							
89dRI	30	10070	4530	2.9		1.5	0.2	1.0	101	106	9000	3010	217	250	256	250	216	193	204	231	205	-	215	250	251	253	211	234	171	245	230	176	.75	1.4		56.7	453	46.6	81	#1 Jets	23.75 200
	25	10075	4530	2.5		1.5	0.2	1.0	85	91	9000	3022	218	252	258	251	216	192	206	232	206	-	216	251	255	255	211	235	169	242	228	173	.75	1.35	<10	59	465	48.7	76	#1 Jets	24.75 200
	20	10075	4530	2.0		1.5	0.2	1.0	101	107	9000	3000	215	254	258	252	217	199	211	234	209	-	221	255	259	259	211	242	169	243	229	173	.75	1.35		56.3	454	45.7	77	#1 Jets	19.75 200
	10	10080	4535	1.0		1.5	0.2	1.0	103	108	8963	3000	245	261	266	261	220	215	227	242	211	-	229	269	273	273	208	264	171	248	230	175	.75	1.35	<10	63.4	453	42.3	70	#1 Jets	12.75 200
	5	10085	4540	0.5		1.5	0.2	1.0	104	110	8963	3040	262	272	277	271	227	231	247	251	216	-	237	282	283	286	210	284	171	250	232	177	.75	1.35		53.0	455	42.3	73	#1 Jets	27.75 200

Table VIII - Continued

Notes: (Unless Otherwise Specified)
1. Cone face T/C at ~3.14 inch radius.

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a

CONSTANT TEST SETTINGS: Shaft Speed 10,000 rpm; Thrust Load 9000 lbs; Oil Inlet Temp 170 °F

SYMBOLS: △ Test Condition (Setting); ⟵⟶ Reference Data Only; * Calculated Values

FRONT BEARING S/N 4 REAR BEARING S/N 1

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) CONE RIB △		SUPPORT I.R.	SUPPORT O.R.	JETS △	OIL PRES. SUPP BRG.	OIL PRES. TEST BRG.	BRG. LOADS THRUST △	BRG. LOADS RADIAL △	Rear Brg. O.D. 1	Outer Ring #1 2	Outer Ring #2 3	Outer Ring #3 4	Brg. I.R. 5	6	Cone Face 7	I.R. 8	Shaft I.R. 9	10	Lube Out 11
89eJI 4.0	10055	4525	-0-		1.5	0.2	4.0	110	106	8963	4480	233	229	230	225	190	227	247	230	190	-	216
3.0	10060	4525	-0-		1.5	0.2	3.0	95	94	9000	4480	244	237	239	234	198	235	255	238	198	-	233
2.0	10075	4530	-0-		1.5	0.2	2.0	102	105	9037	4480	268	257	260	253	206	249	275	252	202	-	244
1.0																						
.5																						
89eRI 3.0	10065	4530	2.9		1.5	0.2	1.0	104	109	9000	4460	217	250	255	249	216	191	204	232	205	-	214
2.5	10065	4525	2.5		1.5	0.2	1.0	86	91	9000	4520	218	252	257	251	216	190	204	231	206	-	215
2.0	10080	4535	2.0		1.5	0.2	1.0	102	106	8963	4500	224	253	257	251	216	197	207	232	207	-	221
1.0	10080	4535	1.0		1.5	0.2	1.0	102	107	9000	4500	245	260	265	260	220	215	227	242	214	-	228
.5	10086	4535	0.5		1.5	0.2	1.0	104	110	9000	4520	267	271	276	271	227	229	246	250	216	-	256

TEST NO.	Front Brg. Outer Ring #1 12	#2 13	#3 14	Slave Brg Out 15	Lube Out 16	Oil In △ 17(1)	Slave Bearing Front 18(2)	Rear 19(3)	In 20(1)	Shaft Excursion Front In x 10^{-3}	Rear In x 10^{-3}	VIB LEVEL	MOTOR I	V	HP *	TEST LAB (°F)	NOTES	DATE Hr
89eJI 4.0	232	233	233	204	233	170	245	230	172	.75	1.3		66.0	452	55.2	80	#6 Jets	1-28-75 10
3.0	244	244	246	206	247	169	246	232	172	.75	1.3		64.0	455	53.7	73	#5 Jets	1-29-75 10
2.0	261	263	263	208	268	170	249	234	174	.75	1.25		58.3	452	47.8	66	#5 Jets	1-30-75 10
1.0																		
.5																		
89eRI 3.0	249	250	252	214	232	170	245	232	175	.75	1.4		56.5	452	45.6	80	#1 Jets	1-23-75 10
2.5	251	255	255	207	235	170	247	232	174	.75	1.35		58.2	452	47.4	77	#1 Jets	1-24-75 10
2.0	255	258	259	211	242	170	245	231	174	.75	1.35		57.3	457	47.2	77	#1 Jets	1-24-75 10
1.0	269	272	272	210	244	169	250	232	175	.75	1.3	<10	54.2	453	43.5	70	#1 Jets	1-27-75 10
.5	280	280	284	210	283	170	252	236	176	.75	1.35		52.4	458	42.0	73	#1 Jets	1-27-75 10

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a

Notes: (Unless Otherwise Specified)

1. Cone face T/C at ~3.14 inch radius.

CONSTANT TEST SETTINGS: Shaft Speed 10,000 rpm
Thrust Load 9000 lbs
Oil Inlet Temp 170 °F

SYMBOLS: △ Test Condition (Setting)
—— Reference Data Only
* Calculated Values

FRONT BEARING S/N 4 REAR BEARING S/N 1

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) CONE RIB △	SUPPORT I.R.	SUPPORT O.R.	JETS △	OIL PRES. SUPP ING.	OIL PRES. TEST ING.	BRG. LOADS THRUST △	BRG. LOADS RADIAL △	TEMPERATURE OF REAR BEARING O.B. #1	REAR BEARING OUTER RING #2	REAR BEARING OUTER RING #3	REAR BEARING OUTER RING #4	REAR BEARING I.R. #5	REAR BEARING I.R. #6	REAR BEARING CONE FACE #7	REAR BEARING I.R. #8	REAR BEARING I.R. #9	REAR BEARING #10	OIL OUT #11	FRONT BEARING O.B. #12	FRONT BEARING O.B. #13	FRONT BEARING O.B. #14	FRONT BEARING SLAVE RING #15	FRONT BEARING OUT #16	OIL IN △ (17)	SLAVE BEARING FRICTION △ (18)	SLAVE BEARING FRICTION △ (19)	SLAVE BEARING FRICTION △ (20)	SHAFT EXCURSION FRONT In x 10^{-3}	SHAFT EXCURSION REAR In x 10^{-3}	VIB LEVEL A	MOTOR I	MOTOR V	MOTOR HP *	TEST LAB (°F)	NOTES	DATE BY
3.0	10050	4525	0	1.5	0.2	4.0	110	106	8963	5970	234	229	230	225	190	226	249	231	190	-	222	233	234	234	206	232	170	247	232	171	.75	1.3		655	453	54.9	80	#6 JETS	
3.0	10060	4525	0	1.5	0.2	3.0	106	105	9000	6000	244	238	240	235	198	235	256	239	199	-	232	244	244	246	207	248	170	249	234	171	.75	1.3		61.0	453	53.5	73	#5 JETS	
2.0	10075	4530	0	1.5	0.2	2.0	102	105	9000	6000	267	256	259	252	205	249	276	252	203	-	244	260	262	262	209	268	170	251	236	174	.75	1.25		59.4	452	50.0	66	#5 JETS	
1.0																																							
.5																																							
3.0	10065	4530	2.95	1.5	0.2	1.0	103	109	9000	6030	216	249	254	248	215	190	204	231	207	-	213	249	252	252	211	231	170	245	232	174	.75	1.35		58.0	452	47.2	80	#1 JETS	
2.5	10070	4530	2.9	1.5	0.2	1.0	106	111	9037	6000	216	248	254	247	214	192	204	233	205	-	211	249	250	251	215	232	171	242	231	175	.75	1.3		57.9	461	48.3	79	#1 JETS	
2.5	10065	4535	2.5	1.5	0.2	1.0	86	91	9037	6030	219	252	257	251	216	191	206	233	209	-	215	251	255	255	215	235	170	245	232	174	.75	1.3		58.0	452	47.2	77	#1 JETS	
2.0	10075	4530	2.0	1.5	0.2	1.0	101	106	8963	6040	224	252	257	251	217	197	209	234	210	-	221	255	256	258	218	241	170	250	234	174	.75	1.3		57.4	458	47.4	77	#1 JETS	
1.0	10080	4530	1.0	1.5	0.2	1.0	102	107	9037	6030	245	260	266	260	220	215	227	242	214	-	238	269	272	272	212	263	170	252	236	175	.75	1.3	<10	55.0	453	43.9	70	#1 JETS	
.5	10085	4540	0.5	1.5	0.2	1.0	104	110	8963	6000	267	272	276	271	228	230	246	250	218	-	256	281	282	285	210	283	170	253	237	176	.75	1.35		53.2	458	43.0	73	#1 JETS	

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

M. O., 7000-4 - IV a

Notes: (Unless Otherwise Specified)

1. Cone face T/C at ~3.14 inch radius.

CONSTANT TEST SETTINGS: Shaft Speed 10,000 rpm; Thrust Load 12,000 lbs; Oil Inlet Temp 170 °F

(SYMBOLS: △ Test Condition (Setting), ⟶ Reference Data Only, * Calculated Values

FRONT BEARING S/N 4 REAR BEARING S/N 1

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) CONE RIB △		SUPPORT I.R. ⟶	SUPPORT O.R. ⟶	JETS △	OIL PRES. SUPP BRG. ⟶	OIL PRES. TEST BRG. ⟶	BRG. LOADS THRUST △	BRG. LOADS RADIAL △	TEMPERATURE °F INR BEARING HSG. O.D. 1	INR BEARING OUTER RING #1 2	INR BEARING OUTER RING #2 3	INR BEARING OUTER RING #3 4	INR BEARING HSG. I.D. 5	INR BEARING SHAFT O.D. 6	INR BEARING CONE FACE 7	INR BEARING BRG. I.R. 8	INR BEARING SHAFT I.D. 9	INR BEARING 10	INR BEARING OIL OUT 11	FRONT BEARING OUTER RING #1 12	FRONT BEARING OUTER RING #2 13	FRONT BEARING OUTER RING #3 14	FRONT BEARING SLAM BRG. LAND 15	FRONT BEARING LUBE JET 16	OIL IN △ 17(1)	SLAVE BEARING FRONT 18(2)	SLAVE BEARING REAR 19(3)	SLAVE BEARING IN 20(4)	SHAFT EXCURSION FRONT In x 10^{-3}	SHAFT EXCURSION REAR In x 10^{-3}	VIB LEVEL g	MOTOR I	MOTOR V	MOTOR HP *	TEST LAB (°F)	NOTES	DATE BY
BIRDIE 40	10055	4520	~~0~~		1.5	0.2	4.0	110	106	12000	2990	236	232	234	228	191	230	250	234	190	-	222	235	236	236	205	234	169	241	227	170	.75	1.3		46	465	56.0	80	#6 JETS	1-26-75 MO
30	10060	4525	~~0~~		1.5	0.2	3.0	97	97	11963	3000	246	241	243	231	200	238	258	241	200	-	230	247	247	249	204	250	169	243	229	171	.75	1.3		434	455	53.1	72	#5 JETS	1-27-75 MO
20	10070	4530	~~0~~		1.5	0.2	2.0	102	105	12037	3030	272	261	264	257	208	254	279	256	204	-	246	265	265	266	206	271	170	247	231	174	.75	1.25		59.2	452	58.0	68	#5 JETS	1-25-75 MO
10																																								
5																																								
BIRDIE 30	10060	4525	2.9		1.5	0.2	1.0	103	108	11963	3040	279	291	260	253	218	194	207	236	206	-	217	253	255	256	206	235	170	240	228	174	.8	1.35		62.2	452	51.4	80	#1 JETS	1-25-75 MO
25	10065	4530	2.5		1.5	0.2	1.0	96	91	12000	3020	221	257	263	256	219	194	209	236	209	-	229	256	259	259	211	240	170	244	230	175	.8	1.35		58.7	450	47.4	78	#1 JETS	1-24-75 MO
20	10070	4530	2.0		1.5	0.2	1.0	101	106	11963	3000	229	259	264	258	221	199	215	240	211	-	226	261	263	264	207	246	170	241	228	175	.75	1.35	<10	59.8	460	50.2	76	#1 JETS	1-23-75 MO
10	10075	4535	1.0		1.5	0.2	1.0	102	108	12000	3040	250	266	271	266	225	218	232	248	215	-	243	275	278	278	209	269	171	248	231	176	.75	1.3	<10	58.2	453	48.6	71	#1 JETS	1-24-75 MO
.5	10080	4535	0.5		1.5	0.2	1.0	104	110	12037	3000	272	278	282	278	231	235	251	256	219	-	260	288	289	291	214	290	171	250	232	177	.75	1.35		53.5	460	47.5	73	#1 JETS	1-23-75 MO

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 70007-A - IV a

Notes: (Unless Otherwise Specified)

1. Cone face T/C at ~3.14 inch radius.

CONSTANT TEST SETTINGS: Shaft Speed 10,000 rpm; Thrust Load 12,000 lbs; Oil Inlet Temp 170 °F

SYMBOLS: △ Test Condition (Setting); ←→ Reference Data Only; * Calculated Values

FRONT BEARING S/N 4 REAR BEARING S/N 1

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR ·	OIL FLOW (GPM) CONE RIB △		SUPPORT I.R. ←→	SUPPORT O.R. ←→	JETS △	OIL PRES. SUPP BRG. ←→	OIL PRES. TEST BRG. ←→	BRG. LOADS THRUST △	BRG. LOADS RADIAL △	TEMPERATURE °F REAR BEARING OUTER RING O.B. 1	REAR BEARING OUTER RING #1 2	REAR BEARING OUTER RING #2 3	REAR BEARING OUTER RING #3 4	REAR BEARING INNER RING I.B. 5	REAR BEARING SHAFT I.B. 6	REAR BEARING CONE FACE 7	REAR BEARING CONE BACK I.R. 8	REAR BEARING SHAFT I.B. 9	REAR BEARING LUBE OUT 10	FRONT BEARING OUTER RING #1 12	FRONT BEARING OUTER RING #2 13	FRONT BEARING OUTER RING #3 14	FRONT BEARING SHAFT BACK FACE 15	FRONT BEARING LUBE OUT 16	OIL IN △ 17(1)	SLAVE BEARING FRONT 18(2)	SLAVE BEARING REAR 19(3)	SLAVE BEARING OIL IN 20(4)	SHAFT EXCURSION FRONT In x 10^{-3}	SHAFT EXCURSION REAR In x 10^{-3}	VIB LEVEL	MOTOR I	MOTOR V	MOTOR HP *	TEST LAB (°F)	NOTES	DATE
B12eII 40	10055	4520	0		1.5	0.2	4.0	110	106	11963	4480	236	232	234	229	192	230	251	235	191	-	222	235	236	236	205	235	169	244	230	170	.75	1.3		46.2	458	56.4	79	#6 Jets	1-18-80
30	10060	4525	0		1.5	0.2	3.0	98	98	11963	4500	246	240	243	236	199	237	259	242	201	-	234	247	247	249	209	251	170	245	231	173	.75	1.3		44.2	457	59.3	72	#5 Jets	1-19-80
20	10070	4530	0		1.5	0.2	2.0	102	105	12000	4500	273	262	265	258	209	255	281	258	205	-	246	265	262	267	210	272	169	249	234	173	.75	1.25		59.1	455	48.7	68	#5 Jets	1-20-80
10																																							
5																																							
B12eRI 30	10065	4530	2.9		1.5	0.2	1.0	103	108	12000	4520	219	253	260	253	218	194	206	236	206	-	216	251	251	255	214	235	170	243	231	174	.75	1.35		62.0	452	51.4	79	#1 Jets	1-23-80
25	10050	4525	2.5		1.5	0.2	1.0	89	95	12000	4520	220	255	261	254	218	193	208	236	209	-	218	255	257	258	214	240	170	242	230	175	.75	1.35		61.3	450	50.2	77	#1 Jets	1-24-80
20	10055	4530	2.0		1.5	0.2	1.0	101	106	12000	4520	229	258	263	257	220	199	213	239	212	-	225	260	262	263	214	245	170	242	230	175	.75	1.3		59.3	460	49.7	77	#1 Jets	1-25-80
10	10060	4530	1.0		1.5	0.2	1.0	102	107	11963	4540	250	266	272	267	225	217	231	249	216	-	243	275	278	278	210	269	170	250	234	176	.75	1.3		56.2	453	45.0	72	#1 Jets	1-27-80
.5	10070	4535	0.5		1.5	0.2	1.0	104	110	12000	4500	225	279	285	277	234	237	253	259	221	-	262	289	287	292	213	290	171	253	236	177	.75	1.35		54.2	458	44.1	74	#1 Jets	1-27-80

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS
N. O. 7000-4 - IV a

Notes: (Unless Otherwise Specified)
1. Cone face T/C at 3.14 inch radius.

CONSTANT TEST SETTINGS: Shaft Speed 10,000 rpm; Thrust Load 12,000 lbs; Oil Inlet Temp 170 °F

SYMBOLS: △ Test Condition (Setting); ←→ Reference Data Only; * Calculated Value

FRONT BEARING S/N 4 REAR BEARING S/N 1

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) CONE RIG △		SUPPORT I.R. ←→	SUPPORT O.R. ←→	JETS △	OIL PRES. SUPP ENG. ←→	OIL PRES. TEST ENG. ←→	BRG. LOADS THRUST △	BRG. LOADS RADIAL △	TEMPERATURE °F REAR BEARING ENG. O.D. 1	REAR BEARING OUTER RING #1 2	REAR BEARING OUTER RING #2 3	REAR BEARING OUTER RING #3 4	REAR BEARING ENG. I.D. 5	REAR BEARING SHAFT I.D. 6	REAR BEARING CONE FACE 7	REAR BEARING CONE I.R. 8	REAR BEARING SHAFT I.R. 9	REAR BEARING 10	REAR BEARING LUBE OUT 11	FRONT BEARING OUTER RING #1 12	FRONT BEARING OUTER RING #2 13	FRONT BEARING OUTER RING #3 14	FRONT BEARING SLAVE BRG OUT 15	FRONT BEARING LUBE OUT 16	OIL IN △ 17(1)	SLAVE BEARING REAR 18(2)	SLAVE BEARING REAR 19(3)	SLAVE BEARING IN 20(4)	SHAFT EXCURSION FRONT In x 10^{-3}	SHAFT EXCURSION REAR In x 10^{-3}	VIB LEVEL g	MOTOR I	MOTOR V	MOTOR HP *	TEST LAB (°F)	NOTES	DATE BY
B12FII 40	10050	4520	⊖		1.5	0.2	4.0	110	106	11963	5980	236	232	234	229	193	209	251	234	192	-	224	235	236	236	205	235	169	247	233	171	.75	1.3		46.7	458	57.0	78	#6 Jets	1-26-79 AD
30	10060	4525	⊖		1.5	0.2	3.0	109	108	12000	6000	246	240	243	236	199	236	258	241	200	-	235	237	237	239	207	250	170	248	234	171	.75	1.3		46.0	458	55.2	72	#5 Jets	1-26-79 AD
20	10070	4530	⊘		1.5	0.2	2.0	102	105	12037	6000	273	262	265	259	209	254	280	258	207	-	249	265	267	267	211	274	171	251	237	175	.75	1.25		59.0	457	48.8	68	#5 Jets	1-26-79 AD
10																																								
5																																								
B12FRI 30	10065	4530	2.9		1.5	0.2	1.0	103	108	11963	6000	219	253	299	253	218	193	205	235	206	-	216	253	256	256	210	238	171	250	235	175	.75	1.35		61.5	459	51.7	77	#1 Jets	1-26-79 AD
25	10060	4525	2.5		1.5	0.2	1.0	90	95	12037	6000	221	255	261	255	219	193	207	236	211	-	219	255	259	259	208	240	170	246	232	175	.75	1.35		61.8	451	51.0	78	#1 Jets	1-26-79 AD
20	10065	4530	2.0		1.5	0.2	1.0	100	106	11963	6030	229	258	263	257	220	200	214	240	212	-	225	260	263	264	212	247	170	247	233	175	.8	1.3		58.5	461	48.8	78	#1 Jets	1-26-79 AD
10	10075	4535	1.0		1.5	0.2	1.0	102	107	12000	5980	250	266	272	266	226	220	233	248	217	-	243	275	279	278	214	269	170	254	236	176	.75	1.3		59.3	455	45.7	74	#1 Jets	1-26-79 AD
5	10080	4535	0.5		1.5	0.2	1.0	104	110	11997	6020	274	279	284	278	233	235	252	258	222	-	241	278	279	281	213	289	169	254	236	176	.75	1.3		58.8	460	43.9	74	#1 Jets	1-27-79 AD

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a

Notes: (Unless Otherwise Specified)

1. Cone face T/C at ~3.14 inch radius.

CONSTANT TEST SETTINGS: Shaft Speed 10,000 rpm; Thrust Load 6,000 lbs; Oil Inlet Temp 195 °F

SYMBOLS: △ Test Condition (Setting); ⟷ Reference Data Only; * Calculated Values

FRONT BEARING S/N 5 REAR BEARING S/N 1

TEST NO.	SPEED (RPM) SHAFT △	SPEED (RPM) SEPARATOR	OIL FLOW (GPM) CONE RIB △		SUPPORT I.R. ⟷	SUPPORT O.R. ⟷	JETS △	OIL PRES. SUPP BRG. ⟷	OIL PRES. TEST BRG. ⟷	BRG. LOADS THRUST △	BRG. LOADS RADIAL △	TEMPERATURE °F REAR BEARING HSG. O.B. 1	REAR BEARING OUTER RING #1 2	REAR BEARING OUTER RING #2 3	REAR BEARING OUTER RING #3 4	REAR BEARING HSG. I.B. 5	REAR BEARING I.B. FACE 6	REAR BEARING CONE FACE 7	REAR BEARING CONE BACK FACE 8	REAR BEARING SHAFT I.B. 9	REAR BEARING 10	REAR BEARING LUBE OUT 11	FRONT BEARING OUTER RING #1 12	FRONT BEARING OUTER RING #2 13	FRONT BEARING OUTER RING #3 14	FRONT BEARING SLEEVE OUT 15	FRONT BEARING LUBE OUT 16	OIL IN △ 17(1)	SLAVE BEARING FRONT ⟷ REAR 18(2) 19(3)	SLAVE BEARING IN 20(4)	SHAFT EXCURSION FRONT In x 10^{-3}	SHAFT EXCURSION REAR In x 10^{-3}	VIB LEVEL g's	MOTOR I	MOTOR V	MOTOR HP *	TEST LAB (°F)	NOTES	DATE BY
BGdRII 4.0	10070	4525	○		1.5	0.2	4.0	98	94	6037	3030	245	241	242	238	206	239	255	241	208	-	236	243	246	245	221	245	194	256	241	191	.9	1.25	<10	52.1	450	47.0	66	#6 JETS	2-7-75 JO
3.0	10070	4530	○		1.5	0.2	3.0	99	99	5963	3030	255	249	251	246	208	246	262	247	212	-	241	253	255	255	222	257	194	257	242	191	.9	1.25	<10	52.9	456	46.4	75	#5 JETS	2-7-75 JO
2.0	10095	4540	○		1.5	0.2	2.0	91	94	6000	3000	225	265	268	261	219	258	279	260	217	-	251	265	267	267	223	275	194	258	242	192	.9	1.25	<10	51.9	452	40.6	65	#5 JETS	2-7-75 JO
1.0																																							
.5																																							
BGdRII 3.0	10080	4535	2.9		1.5	0.2	1.0	101	107	5963	3000	229	258	263	256	226	206	217	238	216	-	226	256	258	259	225	246	195	252	243	194	.9	1.3	<10	53.7	458	43.5	70	#1 JETS	2-5-75 JO
2.5	10085	4535	2.5		1.5	0.2	1.0	104	109	6037	2980	231	260	265	259	229	206	218	240	218	-	229	258	261	261	230	248	195	257	243	195	.85	1.25	<10	51.7	459	41.2	76	#1 JETS	2-5-75 JO
2.0	10080	4535	2.5		1.5	0.2	1.0	108	113	6037	3000	238	261	265	259	226	211	222	242	219	-	233	262	265	265	222	253	195	255	241	193	.85	1.25	<10	51.5	452	40.1	66	#1 JETS	2-6-75 JO
1.0	10085	4540	1.0		1.5	0.2	1.0	94	109	6000	3030	255	269	273	268	231	228	238	250	224	-	248	283	286	286	225	282	195	259	244	195	.75	1.3		51.5	452	40.1	69	#1 JETS (RERUN)	1-30-75 JO
RERUN 1.0	10085	4535	1.0		1.5	0.2	1.0	94	100	5963	3010	255	269	273	268	233	228	237	249	225	-	249	275	278	278	225	271	195	256	243	195	.85	1.25	<10	49.7	455	38.5	78	#1 JETS	2-6-75 JO
.5	10095	4545	0.5		1.5	0.2	1.0	101	106	6037	3000	274	279	282	277	239	241	255	256	229	-	263	284	285	289	226	288	196	261	255	195	.85	1.25	<10	47.5	455	36.2	79	#1 JETS	2-6-75 JO

*Note: Test BGdRII 1.0 - Front Brg Separator damaged at Cone Rib. Use Rear Brg Data only - Front Brg Shaft Rear Seal for this test.

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a

Notes: (Unless Otherwise Specified)

1. Cone face T/C at ~3.14 inch radius.

CONSTANT TEST SETTINGS: Shaft Speed 10,000 rpm; Thrust Load 6000 lbs; Oil Inlet Temp 195 °F

SYMBOLS: △ Test Condition (Setting); ←→ Reference Data Only; * Calculated Values

FRONT BEARING S/N 5 REAR BEARING S/N 1

TEST NO.	SPEED (RPM)		OIL FLOW (GPM)				OIL PRES.		BRG. LOADS		TEMPERATURE OF																				SHAFT EXCURSION		VIB LEVEL	MOTOR			TEST LAB (°F)	NOTES	DATE
											REAR BEARING											FRONT BEARING																	
											HSG. O.B.	OUTER RING			HSG. I.B.	SHAFT I.B.	CONE FACE	CONE I.R.	SHAFT I.B.		LUBE OUT	OUTER RING				SLAVE BEARING		LUBE OUT	OIL IN △	SLAVE BEARING FRONT/REAR		FRONT	REAR						
	SHAFT △	SEPARATOR	CONE RIB △		SUPPORT I.R. ←	SUPPORT O.R. →	JETS △	SUPP ING. ←	TEST BRG. →	THRUST △	RADIAL △	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17(1)	18(2)	19(3)	20(4)	In × 10^{-3}	In × 10^{-3}	%	I	V	HP *			BY
B6cJII 1.0	10070	4530			1.5	0.2	4.0	98	94	6037	4540	247	242	248	240	208	242	258	242	211	-	236	244	246	246	223	245	195	258	244	191	.9	1.25	<10	58.1	453	47.2	67	#6 JETS	2-7-75 MD
3.0	10065	4530			1.5	0.2	3.0	98	98	5963	4500	256	250	251	247	215	248	264	249	215	-	244	254	255	257	226	258	195	261	246	192	.9	1.25	<10	57.0	457	46.2	76	#5 JETS	2-7-75 MD
2.0	10090	4540			1.5	0.2	2.0	91	94	6037	4500	276	266	269	263	221	259	280	261	219	-	253	266	268	268	225	275	195	261	246	193	.9	1.2	<10	51.9	494	41.0	67	#5 JETS	2-11-75 MD
1.0																																							
.5																																							
B6cRII 3.0	10085	4535	2.9		1.5	0.2	1.0	102	108	6037	4480	230	259	263	257	228	207	216	238	217	-	226	256	259	260	224	245	195	260	246	193	.9	1.3	<10	54.0	459	43.7	70	#1 JETS	2-5-75 MD
2.5	10085	4540	2.5		1.5	0.2	1.0	103	109	6037	4500	231	260	265	259	230	209	220	241	220	-	229	259	262	262	223	248	195	256	244	193	.85	1.25	<10	53.3	458	42.9	76	#1 JETS	2-5-75 MD
2.0	10085	4535	2.0		1.5	0.2	1.0	108	114	6037	4480	238	261	266	260	228	212	222	241	221	-	223	262	266	266	223	253	195	261	245	192	.9	1.25	<10	53.2	452	41.8	67	#1 JETS	2-6-75 MD
1.0	10085	4535	1.0		1.5	0.2	1.0	95	100	6037	4480	257	270	275	270	235	229	240	252	228	-	250	285	289	289	232	284	195	265	249	196	.75	1.3		52.3	453	41.2	70	#1 JETS (AFTER RERUN)	2-13-75 MD
RERUN 1.0	10085	4540	1.0		1.5	0.2	1.0	101	106	6000	4530	255	268	273	267	231	228	236	249	223	-	249	275	279	279	226	273	195	260	246	194	.9	1.25		50.2	455	39.2	76		2-11-75 MD
.5	10095	4540	0.5		1.5	0.2	1.0	101	107	6037	4540	274	279	283	278	240	243	254	256	230	-	243	285	285	289	227	288	194	264	248	194	.85	1.25	<10	45.2	459	44.0	79	#1 JETS	2-5-75 MD

*Note: Test B6cRII 1.0 - Front Brg. Accidently Damaged at Cone-Rib. Use Rear Brg Data Only. - Fr Brg S/N 4 - Rear S/N 1 FOR THIS TEST.

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Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

M. O. 7000-4 - IV a

Notes: (Unless Otherwise Specified)

1. Cone face T/C at ~3.14 inch radius.

CONSTANT TEST SETTINGS: Shaft Speed 10,000 rpm
Thrust Load 9000 lbs
Oil Inlet Temp 195 °F

SYMBOLS: △ Test Condition (Setting)
→ Reference Data Only
* Calculated Values

FRONT BEARING S/N 5 REAR BEARING S/N 1

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) CONC RIB △	SUPPORT I.R.	SUPPORT O.R.	JETS △	OIL PRES. SUPP BRG.	OIL PRES. TEST BRG.	BRG. LOAD THRUST △	BRG. LOAD RADIAL △	TEMPERATURE °F REAR BEARING ISG. O.D. 1	OUTER RING #1 2	OUTER RING #2 3	OUTER RING #3 4	ISG. I.B. 5	SHFT I.D. 6	CONE FACE 7	BRG. I.R. 8	SHAFT I.B. 9	10	LUBE OUT 11	FRONT BEARING OUTER RING #1 12	OUTER RING #2 13	OUTER RING #3 14	LUBE OUT 16	OIL IN △ 17(1)	SLAVE BEARING FRONT 18(2)	SLAVE BEARING REAR 19(3)	IN 20(4)	SHAFT EXCURSION FRONT In x 10^{-3}	SHAFT EXCURSION REAR In x 10^{-3}	VIB LEVEL %	MOTOR I	MOTOR V	MOTOR HP	TEST LAB (°F)	NOTES	DATE BY
B9dTII 4.0	10065	4525	⊖	1.5	0.2	4.0	98	95	9037	3000	251	248	249	244	211	246	241	248	211	-	241	250	251	251	223	250	195	256	241	191	.9	1.25	<10	60.7	452	54.0	70	#6 Jets	2-3-95 JO
3.0	10065	4525	⊖	1.5	0.2	3.0	98	98	9000	3030	261	255	258	252	218	250	249	254	217	-	251	260	261	262	225	264	195	258	243	192	.9	1.25	<10	58.6	456	49.4	76	#5 Jets	2-7-95 JO
2.0	10085	4540	⊖	1.5	0.2	2.0	91	94	9037	3030	282	272	275	269	234	263	258	267	221	-	256	273	272	274	234	281	194	258	244	192	.9	1.25	<10	54.8	452	43.6	70	#5 Jets	2-10-95 JO
1.0																																						
.5																																						
B9dRI 3.0	10075	4530	2.9	1.5	0.2	1.0	102	108	9000	3000	234	265	270	264	233	211	221	246	220	-	231	263	265	266	225	251	196	256	243	194	.8	1.3	<10	51.5	461	44.6	71	#1 Jets	2-23-95 JO
2.6	10080	4535	2.5	1.5	0.2	1.0	104	109	9037	2980	226	268	272	266	234	210	223	248	223	-	233	264	266	267	223	253	195	253	241	193	.85	1.25	<10	54.0	459	43.6	76	#1 Jets	2-24-95 JO
2.0	10085	4535	2.0	1.5	0.2	1.0	109	114	9000	3000	242	269	274	268	234	215	226	250	223	-	239	269	272	271	223	260	195	258	243	193	.85	1.25	<10	53.9	455	43.3	74	#1 Jets	2-27-95 JO
1.0	10080	4530	1.0	1.5	0.2	1.0	95	100	9000	3000	262	277	281	276	239	232	244	259	231	-	255	293	297	296	230	291	195	261	246	195	.75	1.3		65.0	457	44.5	71	#1 Jets (Bad)	1-2-95 JO
Rerun 1.0	10080	4535	1.0	1.5	0.2	1.0	101	106	8963	2980	262	277	282	276	239	233	245	259	230	-	255	283	287	286	233	280	197	261	246	196	.9	1.25		62.3	456	41.6	76		2-11-95 JO
.5	10095	4540	0.5	1.5	0.2	1.0	102	107	9000	3030	280	286	290	285	243	244	258	263	230	-	267	290	290	291	226	285	194	260	245	194	.85	1.25	<10	49.0	460	38.5	78	#1 Jets	2-14-95 JO

*NOTE: FRONT Brg. Surface Damaged at Cone Brg. Use Rear Brg. Data Only. Test B9dR1.0 - FrBrg S/N4 - Rear S/N1 FOR THIS TEST

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a

Notes: (Unless Otherwise Specified)

1. Cone face T/C at ~3.14 inch radius.

CONSTANT TEST SETTINGS: Shaft Speed 10,000 rpm; Thrust Load 9,000 lbs; Oil Inlet Temp 195 °F

SYMBOLS: △ Test Condition (Setting); ⟷ Reference Data Only; * Calculated Values

FRONT BEARING S/N 5 REAR BEARING S/N 1

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) ONE RIB △	SUPPORT I.R.	SUPPORT O.R.	JETS △	OIL PRES. SUPP BRG.	OIL PRES. TEST BRG.	BRG. LOADS THRUST △	BRG. LOADS RADIAL △	TEMPERATURE OF REAR BEARING ISG. O.D. 1	REAR BEARING OUTER RING #1 2	REAR BEARING OUTER RING #2 3	REAR BEARING OUTER RING #3 4	REAR BEARING ISG. I.D. 5	REAR BEARING CONE FACE 7	REAR BEARING CONE B.P. I.D. 8	REAR BEARING SHAFT I.D. 9	REAR BEARING LOCK NUT OUT 11	FRONT BEARING OUTER RING #1 12	FRONT BEARING OUTER RING #2 13	FRONT BEARING OUTER RING #3 14	FRONT BEARING ISG. O.D. 15	FRONT BEARING LOCK NUT OUT 16	OIL IN △ 17(1)	SLAVE BEARING RAD. OUT 18(2)	SLAVE BEARING RAD. IN 19(3)	SLAVE BEARING THRUST 20(1)	SHAFT EXCURSION FRONT In x 10^{-3}	SHAFT EXCURSION REAR In x 10^{-3}	VIB LEVEL %	MOTOR I	MOTOR V	MOTOR HP *	TEST LAB (°F)	NOTES	DATE / BY
B9eJII 4.0	10060	4525	⊖	1.5	0.2	4.0	98	95	8963	4540	250	247	248	244	210	244	262	247	210	-	237	249	250	250	223	249	195	259	244	192	.9	1.25	<10	61.3	454	51.0	71	#6 JETS	2-7-75 JD
3.0	10065	4525	⊖	1.5	0.2	3.0	98	98	9000	4480	261	255	258	253	218	252	269	255	217	-	250	260	261	262	226	264	195	260	246	192	.9	1.25	<10	59.7	457	49.8	76	#5 JETS	2-7-75 JD
2.0	10085	4535	⊖	1.5	0.2	2.0	91	94	9037	4520	282	272	275	269	225	264	287	266	220	-	258	272	274	275	225	281	194	260	246	193	.9	1.2	<10	55.2	452	44.2	71	#5 JETS	2-11-75 JD
1.0																																						
.5																																						
B9eRII 3.0	10075	4530	2.9	1.5	0.2	1.0	103	108	8963	4530	234	265	270	263	232	270	291	246	221	-	230	261	263	264	230	250	195	252	242	192	.9	1.3	<10	57.3	459	47.3	72	#1 JETS	2-5-75 JD
2.5	10080	4535	2.5	1.5	0.2	1.0	104	109	8963	4480	235	267	272	266	234	270	294	249	225	-	233	264	267	268	225	254	196	260	246	194	.85	1.25	<10	56.2	460	46.2	75	#1 JETS	2-5-75 JD
2.0	10075	4530	2.0	1.5	0.2	1.0	108	114	9037	4520	242	269	274	268	235	273	297	250	225	-	239	269	272	272	230	250	195	259	244	193	.85	1.25	<10	55.2	454	44.5	76	#1 JETS	2-6-75 JD
1.0	10080	4535	1.0	1.5	0.2	1.0	95	100	8963	4500	261	277	281	276	239	282	304	256	230	-	256	(293)*	297	(296)*	(226)*	(292)*	195	264	249	195	.75	1.3		(55.8 | 459 | 45.5)*	72	#1 JETS (185 GPM)	1-31-75 JD
RERUN 1.0	10075	4535	1.0	1.5	0.2	1.0	101	106	9000	4540	261	276	282	276	238	231	241	256	230	-	255	283	286	286	233	280	195	262	246	194	.9	1.25		52.8	457	42.3	75		2-10-75 JD
.5	10095	4540	0.5	1.5	0.2	1.0	102	107	8963	4540	280	286	290	285	244	215	261	265	233	-	270	290	290	292	231	282	194	262	248	195	.85	1.25	<10	47.6	460	36.7	76	#1 JETS	2-6-75 JD

*NOTE: TEST B9eRII 1.0 - FRONT BRG SLIGHTLY DAMAGED AT CONE RIB. USE REMK BEARING DATA ONLY - FR BRG S/N 4 REMK S/N 1 FOR THIS TEST.

Table VIII - Continued

Notes: (Unless Otherwise Specified)

1. Cone face T/C at ~3.14 inch radius.

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a

CONSTANT TEST SETTINGS: Shaft Speed 10,000 rpm; Thrust Load 9000 lbs; Oil Inlet Temp 195 °F

SYMBOLS: △ Test Condition (Setting); ←→ Reference Data Only; * Calculated Values

FRONT BEARING S/N 5 REAR BEARING S/N 1

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) CONE RIB △		SUPPORT I.R.	SUPPORT O.R.	JETS △	OIL PRES. SUPP BRG.	TEST BRG.	BRG. LOADS THRUST △	RADIAL △	TEMPERATURE °F REAR BEARING HSG. O.D. 1	OUTER RING #1 2	#2 3	#3 4	HSG. I.D. 5	SHAFT C.B. 6	CONE FACE 7	BRG. I.R. 8	SHAFT I.D. 9	10	LUBE OUT 11
B9FJ II 4.0	10065	4525	⊖		1.5	0.2	4.0	98	95	9037	6080	250	247	249	244	210	213	263	249	211	-	239
3.0	10065	4530	⊖		1.5	0.2	3.0	98	98	9000	6030	261	255	258	253	218	251	270	265	217	-	250
2.0	10090	4535	⊖		1.5	0.2	2.0	91	94	9037	5970	282	272	275	270	225	265	289	267	220	-	258
1.0																						
.5																						
B9FB II 3.0	10075	4530	2.9		1.5	0.2	1.0	103	108	9037	6020	234	265	270	263	232	210	220	246	222	-	230
2.5	10085	4535	2.5		1.5	0.2	1.0	105	110	8963	6030	236	266	271	266	234	211	223	248	225	-	232
2.0	10080	4530	2.0		1.5	0.2	1.0	110	115	9037	6040	242	269	274	268	235	215	227	249	226	-	238
1.0	10080	4535	1.0		1.5	0.2	1.0	95	100	9000	6000	262	276	281	276	239	233	245	259	232	-	255
RERUN 1.0	10080	4530	1.0		1.5	0.2	1.0	101	106	9037	6000	261	276	281	276	239	232	241	257	229	-	255
.5	10090	4540	0.5		1.5	0.2	1.0	102	107	9000	3030	280	285	290	285	244	245	261	265	236	-	259

TEST NO.	FRONT BEARING OUTER RING #1 12	#2 13	#3 14	15	LUBE OUT 16	OIL IN △ 17(1)	SLAVE BEARING FRONT 18(2)	REAR 19(3)	IN 20(4)	SHAFT EXCURSION FRONT In x 10^{-3}	REAR In x 10^{-3}	VIB LEVEL %	MOTOR I	V	HP *	TEST LAB (°F)	NOTES	DATE BY
B9FJ II 4.0	249	250	251	-	250	195	261	247	192	.9	1.25	<10	620	455	51.8	72	#6 JETS	2-7-75 [illegible]
3.0	259	260	262	-	264	195	263	248	192	.9	1.25	≤10	582	458	48.0	76	#5 JETS	2-7-75 [illegible]
2.0	275	273	275	226	280	195	264	249	193	.9	1.25	<10	546	452	43.4	73	#5 JETS	2-11-75 [illegible]
1.0																		
.5																		
B9FB II 3.0	262	264	264	225	250	195	261	246	193	.9	1.25	<10	575	456	47.2	73	#1 JETS	2-5-75 [illegible]
2.5	264	266	267	230	254	195	260	246	192	.85	1.25	<10	555	461	45.5	75	#1 JETS	2-5-75 [illegible]
2.0	269	272	272	228	260	195	260	246	193	.85	1.25	<10	546	456	44.1	79	#1 JETS	2-5-75 [illegible]
1.0	(292	295	296)*	233	(292)*	195	265	250	196	.75	1.3		(550	460	45.0)*	72	#1 JETS [illegible]	2-5-75 [illegible]
RERUN 1.0	282	285	286	228	280	195	266	250	195	.9	1.25		530	458	42.6	75		2-4-75
.5	290	289	291	229	284	194	265	249	194	.85	1.2	<10	479	461	37.4	76	#1 JETS	2-6-75 [illegible]

*NOTES: TEST B9FB II 1.0 - FRONT BRG SEVERELY DAMAGED AT CONE RIB. USE REAR BRG DATA ONLY. FR BRG S/N 4 - REAR S/N 1 FOR THIS TEST.

REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a

Notes: (Unless Otherwise Specified)

1. Cone face T/C at ~3.14 inch radius.

CONSTANT TEST SETTINGS: Shaft Speed 10,000 rpm; Thrust Load 12,000 lbs; Oil Inlet Temp 195 °F

SYMBOLS: △ Test Condition (Setting); ←→ Reference Data Only; * Calculated Values

FRONT BEARING S/N 5 REAR BEARING S/N 1

TEST NO.	SPEED (RPM) SHAFT △	SPEED (RPM) SEPARATOR	OIL FLOW (GPM) CONE RIB △	OIL FLOW (GPM) SUPPORT I.R. ←→	OIL FLOW (GPM) SUPPORT O.R. ←→	OIL FLOW (GPM) JETS △	OIL PRES. SUPP BRG. ←→	OIL PRES. TEST BRG. ←→	BRG. LOADS THRUST △	BRG. LOADS RADIAL △	TEMPERATURE °F REAR BEARING ISG. O.B. 1	REAR BEARING OUTER RING #1 2	REAR BEARING OUTER RING #2 3	REAR BEARING OUTER RING #3 4	REAR BEARING ISG. I.B. 5	REAR BEARING SHAFT I.B. 6	REAR BEARING CONE FACE 7	REAR BEARING CONE BRG. I.R. 8	REAR BEARING SHAFT I.B. 9	REAR BEARING 10	REAR BEARING LUBE OUT 11	FRONT BEARING OUTER RING #1 12	FRONT BEARING OUTER RING #2 13	FRONT BEARING OUTER RING #3 14	FRONT BEARING OUTER RING OUT 15	FRONT BEARING LUBE OUT 16	OIL IN △ 17(1)	SLAVE BEARING FRONT 18(2)	SLAVE BEARING REAR 19(3)	SLAVE BEARING IN 20(4)	SHAFT EXCURSION FRONT In x 10^{-3}	SHAFT EXCURSION REAR In x 10^{-3}	VIB LEVEL	MOTOR I	MOTOR V	MOTOR HP *	TEST LAB (°F)	NOTES	DATE BY
B12dJII 4.0	10060	4525	0	1.5	0.2	4.0	98	95	12000	3000	234	251	253	248	213	248	267	251	212	-	242	254	255	254	223	253	196	256	242	193	.9	1.25	<10	608	457	608	74	#6 Jets	2-27-75 DO
3.0	10075	4535	0	1.5	0.2	3.0	100	100	11963	3030	262	258	261	255	218	254	274	257	216	-	253	263	263	264	223	266	195	258	243	192	.9	1.25	<10	600	460	503	76	#5 Jets	2-27-75 DO
2.0	10075	4535	0	1.5	0.2	2.0	91	94	12037	2990	287	277	280	274	228	268	292	270	222	-	261	277	278	279	225	286	195	259	245	193	.9	1.25	<10	550	453	440	78	#5 Jets	2-11-75 DO
1.0																																							
.5																																							
B12dRII 3.0	10075	4535	2.9	1.5	0.2	1.0	102	108	12000	3030	236	269	274	268	235	211	221	249	222	-	232	265	265	267	226	252	195	252	241	193	.85	1.3	<10	518	458	427	73	#1 Jets	2-5-75 DO
2.5	10075	4535	2.5	1.5	0.2	1.0	105	110	11963	3020	239	271	277	271	237	213	226	251	226	-	226	268	270	271	230	257	196	255	243	194	.85	1.25	<10	560	461	463	76	#1 Jets	2-5-75 DO
2.0	10075	4530	2.0	1.5	0.2	1.0	111	116	12037	3000	246	275	279	273	239	218	231	255	228	-	241	274	275	276	227	264	195	258	243	193	.85	1.25	<10	559	458	455	78	#1 Jets	2-6-75 DO
1.0	10080	4535	1.0	1.5	0.2	1.0	95	100	12000	3020	262	283	288	282	243	236	250	264	233	-	240	(303	306	306	230	(303	196	263	247	198	.75	1.3		(566	459	455	73	#1 Jets (Rear Brg)	1-30-75 DO
Rerun 1.0	10070	4530	1.0	1.5	0.2	1.0	101	106	12000	3000	266	282	287	281	242	225	248	262	230	-	259	288	291	291	227	264	195	263	246	195	.9	1.25		634	459	437	73		2-4-75 DO
.5	10090	4540	0.5	1.5	0.2	1.0	102	107	12000	2970	285	291	296	290	247	250	266	270	234	-	272	296	296	297	226	290	195	261	246	195	.85	1.25	<10	490	460	385	75	#1 Jets	2-6-75 DO

*Note: Test B12dRII 1.0 - Front Brg Slightly Damaged. At Cone Rib. Use Rear Brg Data Only. For Brg. S/N 4 - Rear S/N 1 For This Test.

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a

FRONT BEARING S/N 5   REAR BEARING S/N 1

Notes: (Unless Otherwise Specified)

1. Cone face T/C at ~3.14 inch radius.

CONSTANT TEST SETTINGS: Shaft Speed 10,000 rpm; Thrust Load 12,000 lbs; Oil Inlet Temp 195 °F

SYMBOLS: △ Test Condition (Setting); ←→ Reference Data Only; * Calculated Values

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) CONE RIB △		SUPPORT I.R.	SUPPORT O.R.	JETS △	OIL PRES. SUPP BRG.	OIL PRES. TEST BRG.	BRG. LOADS THRUST △	BRG. LOADS RADIAL △	REAR BEARING HSG. O.D. 1	OUTER RING #1 2	OUTER RING #2 3	OUTER RING #3 4	HSG I.D. 5	SHAFT C.B. 6	CONE FACE 7	BRG. I.R. 8	SHAFT I.B. 9	10	LUBE OUT 11	FRONT BEARING OUTER RING #1 12	#2 13	#3 14	15	LUBE OUT 16	OIL IN △ 17(1)	SLAVE BEARING FRONT 18(2)	REAR 19(3)	IN 20(4)	SHAFT EXCURSION FRONT In x 10^{-3}	REAR In x 10^{-3}	VIB LEVEL *	MOTOR I	V	HP *	TEST LAB (°F)	NOTES	DATE BY
12cJII 4.0	10050	4520	⊖		1.5	0.2	4.0	98	95	12000	4530	255	251	254	248	214	247	267	250	212	-	245	254	255	254	226	253	196	260	246	193	.9	1.2	<10	62.8	458	53.0	76	#6 Jets	2-7-75 AO
3.0	10070	4530	⊖		1.5	0.2	3.0	100	100	12000	4520	264	258	261	256	220	255	274	258	217	-	255	262	263	265	225	265	195	261	246	192	.9	1.25	<10	61.2	460	51.6	76	#5 Jets	2-7-75 AO
2.0	10075	4535	⊖		1.5	0.2	2.0	91	94	12000	4540	288	278	281	275	229	270	292	270	224	-	262	278	280	280	227	288	196	263	248	195	.9	1.2	<10	55.2	453	44.3	80	#5 Jets	2-11-75 AO
1.0																																								
.5																																								
12cRII 3.0	10070	4530	2.9		1.5	0.2	1.0	103	109	12000	4480	236	269	274	268	235	213	223	250	224	-	233	265	267	268	224	253	194	260	245	192	.85	1.25	<10	57.9	458	47.5	74	#1 Jets	2-5-75 AO
2.5	10080	4535	2.5		1.5	0.2	1.0	105	110	1963	4540	239	271	277	270	237	211	226	253	226	-	236	268	269	271	229	257	195	257	244	193	.85	1.25	<10	56.7	461	46.9	76	#1 Jets	2-5-75 AO
2.0	10075	4530	2.0		1.5	0.2	1.0	102	107	12000	4522	247	276	280	274	239	217	232	256	230	-	242	274	278	278	228	264	195	257	245	195	.85	1.25	<10	57.0	460	47.2	78	#1 Jets	2-6-75 [illegible]
1.0	10070	4530	1.0		1.5	0.2	1.0	95	100	12037	4500	267	282	286	282	244	237	250	264	234	-	260	(302	304	305)*	234	(302)*	195	261	249	196	.75	1.3		(51.5	460	47.7)*	73	#1 Jets ([illegible])*	1-16-75 AO
Rerun 1.0	10070	4530	1.0		1.5	0.2	1.0	101	106	12000	4530	266	282	288	281	242	233	246	261	231	-	259	288	291	291	229	286	195	265	249	196	.9	1.25		54.3	460	49.1	72		2-11-75 AO
.5	10090	4535	0.5		1.5	0.2	1.0	101	107	12000	4520	285	291	296	291	248	250	265	270	237	-	275	294	295	297	230	290	196	263	248	196	.9	1.25	<10	52.7	463	43.0	74	#1 Jets	2-6-75 AO

*NOTE: TEST B 12cRII 1.0 - FRONT BRG SLIGHTLY DAMAGED AT CONE RIB - USE REAR BRG DATA ONLY. FR BRG S/N 4 - REAR S/N 1 FOR THIS TEST.

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a

Notes: (Unless Otherwise Specified)

1. Cone face T/C at ~3.14 inch radius.

CONSTANT TEST SETTINGS: Shaft Speed 10,000 rpm; Thrust Load 12,000 lbs; Oil Inlet Temp 195 °F

SYMBOLS: △ Test Condition (Setting); ←→ Reference Data Only; * Calculated Values

FRONT BEARING S/N 5 REAR BEARING S/N 1

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) CONE RIB △	SUPPORT I.R.	SUPPORT O.R.	JETS △	OIL PRES. SUPP BRG.	OIL PRES. TEST BRG.	BRG. LOADS THRUST △	BRG. LOADS RADIAL △	TEMPERATURE OF REAR BEARING HSG. O.B. 1	REAR BEARING OUTER RING #1 2	REAR BEARING OUTER RING #2 3	REAR BEARING OUTER RING #3 4	REAR BEARING HSG. I.B. 5	REAR BEARING SHAFT C.B. 6	REAR BEARING CONE FACE 7	REAR BEARING CONE B.R. 8	REAR BEARING SHAFT I.B. 9	10	LUBE OUT 11	FRONT BEARING OUTER RING #1 12	FRONT BEARING OUTER RING #2 13	FRONT BEARING OUTER RING #3 14	FRONT BEARING SLAVE 15	FRONT BEARING LUBE OUT 16	OIL IN △ 17(1)	SLAVE BEARING FRONT 18(2)	SLAVE BEARING REAR 19(3)	SLAVE BEARING IN 20(4)	SHAFT EXCURSION FRONT In x 10^{-3}	SHAFT EXCURSION REAR In x 10^{-3}	VIB LEVEL	MOTOR I	MOTOR V	MOTOR HP *	TEST LAB (°F)	NOTES	DATE BY
B12FJII 4.0	10055	4525	⊖	1.5	0.2	4.0	98	94	11963	5970	254	251	253	248	213	247	267	251	213	-	241	253	255	255	226	252	195	242	248	192	.9	1.2	<10	638	456	537	76	#6 JETS	2-7-75 MO
3.0	10070	4530	⊖	1.5	0.2	3.0	100	100	11963	6000	264	258	261	256	220	254	274	258	218	-	252	263	263	265	226	267	195	263	248	192	.9	1.25	<10	612	460	496	76	#5 JETS	2-7-75 MO
2.0	10075	4530	⊖	1.5	0.2	2.0	91	94	12037	6000	288	277	281	274	238	269	292	271	224	-	264	278	279	280	226	287	195	265	249	194	.9	1.2	<10	553	455	442	80	#5 JETS	2-7-75 MO
1.0																																							
.5																																							
B12FRII 3.0	10075	4530	2.9	1.5	0.2	1.0	102	108	11963	5970	235	268	274	267	235	272	272	249	224	-	251	264	265	267	226	253	194	241	247	192	.85	1.25	<10	583	459	485	75	#1 JETS	2-7-75 MO
2.5	10075	4530	2.5	1.5	0.2	1.0	104	110	12000	6020	238	271	276	270	237	272	276	252	226	-	236	268	270	271	231	257	195	259	247	194	.85	1.25	<10	573	461	475	76	#1 JETS	2-7-75 MO
2.0	10075	4530	2.0	1.5	0.2	1.0	103	108	12037	6000	246	274	279	272	238	276	280	256	229	-	241	273	277	276	227	264	195	263	248	195	.85	1.25	<10	568	454	461	78	#1 JETS	2-7-75 MO
1.0	10075	4530	1.0	1.5	0.2	1.0	95	100	12000	6030	266	282	287	281	243	285	299	263	234	-	210	303	306	306	235	303	195	284	250	196	.75	1.3		678	460	483	73	#1 JETS (555 RPMS)	2-7-75 MO
RERUN 1.0	10065	4530	1.0	1.5	0.2	1.0	101	106	12000	6000	266	282	287	281	242	285	296	263	232	-	259	288	290	291	235	285	195	264	251	196	.9	1.2		594	460	448	72		2-7-75 MO
.5	10085	4540	0.5	1.5	0.2	1.0	102	107	11963	6030	286	291	296	290	248	250	267	271	240	-	273	296	296	298	229	291	195	266	250	195	.9	1.2	<10	604	462	401	73	#1 JETS	2-7-75 MO

*NOTE: TEST B12 F R II 1.0 — FOUR BEG SOLIDITY DAMAGED OR CAGE RIB USE REMS BRG DATA ONLY FC BRG S/N 4 - REAR S/N 1 - FOR THIS TEST.

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a

Notes: (Unless Otherwise Specified)

1. Cone face T/C at ~3.14 inch radius.
2. Shaft I.D seal at front end of shaft.
3. 5 psig seal pressure at belt end shaft seal.
4. T/C's 6,7,8,9 measured with Acurex telemetry system.

CONSTANT TEST SETTINGS: Shaft Speed 15,000 rpm; Thrust Load 9,000 lbs; Oil Inlet Temp 170 °F

SYMBOLS: △ Test Condition (Setting); ⟶ Reference Data Only; * Calculated Values.

FRONT BEARING S/N 6 REAR BEARING S/N 1

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) CONC RIB △	SUPPORT I.R.	SUPPORT O.R.	JETS △	OIL PRES. SUPP BRG.	OIL PRES. TEST BRG.	BRG. LOADS THRUST △	BRG. LOADS RADIAL △	TEMPERATURE OF REAR BEARING ISG. O.D. 1	REAR BEARING OUTER RING #1 2	#2 3	#3 4	REAR BEARING ISG. I.D. 5	REAR BEARING SHAFT I.R.	REAR BEARING CONE FACE 7	REAR BEARING BRG. I.R. 8	REAR BEARING SHAFT I.D. 9	REAR BEARING T/C (IN CAGE) 10	REAR BEARING LUBE OUT 11	FRONT BEARING OUTER RING #1 12	FRONT BEARING OUTER RING #2 13	FRONT BEARING OUTER RING #3 14	FRONT BEARING T/C (IN CAGE) 15	FRONT BEARING LUBE OUT 16	OIL IN △ 17(1)	SLAVE BEARING FRONT 18(2)	SLAVE BEARING REAR 19(3)	SLAVE BEARING IN 20(4)	SHAFT EXCURSION FRONT In x 10^{-3}	SHAFT EXCURSION REAR In x 10^{-3}	VIB LEVEL *	MOTOR I	MOTOR V	MOTOR HP *	TEST LOG (°F)	NOTES	DATE BY
C96BI 4.0	15080		0	1.5	0.2	4.0	104	98	9000	1044	246	256	254	250	198	1/4	299	236	189	—	257	259	262	259	223	262	171	293	252	170	1.1	1.7	—	92	452	80.5	78	#6 Jets	9-23-96
3.0																																							
2.0																																							
1.0																																							
.5																																							
C96BI 3.0	15190	—	2.9	1.5	0.2	1.0	109	113	9037	1066	241	280	283	279	228	1/4	230	250	230	175	244	249	289	287	230	260	169	275	253	172	.8	1.8	—	84	458	73.8	81	#1 Jets	9-23-96
2.5	15190		2.5	1.5	0.2	1.0	108	112	9110	1045	250	282	284	282	231	1/4	235	253	233	175	252	289	293	292	228	266	170	277	255	174	.75	1.8		83	457	72.8	82	Note	MAB
2.0	15175	—	2.0	1.5	0.2	1.0	111	116	8900	1110	257	285	287	285	234	1/4	239	256	235	175	260	293	298	297	230	274	170	277	256	174	1.0	1.8	—	81	460	71.4	80	Note	9-23-96 MAB
1.0	15180	—	1.0	1.5	0.2	1.0	106	110	8937	1000	285	295	297	294	243	1/4	260	264	241	171	287	299	304	307	226	303	170	279	247	170	1.4	1.8	—	78	458	68.0	86	#1 Jets	9-23-96
.5	15230	—	0.5	1.5	0.2	1.0	110	114	9000	1022	316	316	316	314	258	1/4	284	270	241	174	319	312	317	319	229	324	170	281	255	175	1.3	1.8	—	72	457	62.1	82	#1 Jets	9-23-96 MAB

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a

NOTES: (UNLESS OTHERWISE SPECIFIED

1. Cone face T/C at ~ 3.14 inch radius.
2. Shaft I.D. seal at front end of shaft.
3. 5 psig seal pressure at belt end shaft seal.
4. T/C's 6,7,8,9 measured with Acurex telemetry system.

CONSTANT TEST SETTINGS: Shaft Speed 15,000 rpm
Thrust Load 9,000 lbs
Oil Inlet Temp 170 °F

SYMBOLS: △ Test Condition (Setting)
←→ Reference Data Only
* Calculated Values

FRONT BEARING S/N 6 REAR BEARING S/N 1

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) CONE RIB △	SUPPORT I.R. ←→	SUPPORT O.R. ←→	JETS △	OIL PRES. SUPP BRG. ←→	OIL PRES. TEST BRG. ←→	BRG. LOADS THRUST △	BRG. LOADS RADIAL △	TEMPERATURE °F REAR BEARING HSG. O.B. 1	REAR BEARING OUTER RING #1 2	REAR BEARING OUTER RING #2 3	REAR BEARING OUTER RING #3 4	REAR BEARING HSG. I.B. 5	REAR BEARING SHAFT I.B.	REAR BEARING CONE FACE 7	REAR BEARING BRG. I.R. 8	REAR BEARING SHAFT I.B. 9	REAR BEARING SHAFT O.B. 10	REAR BEARING LUBE OUT 11	FRONT BEARING OUTER RING #1 12	FRONT BEARING OUTER RING #2 13	FRONT BEARING OUTER RING #3 14	FRONT BEARING SLAVE BRG. LUBE OUT 15	FRONT BEARING LUBE OUT 16	OIL IN △ 17(1)	SLAVE BEARING FRONT 18(2)	SLAVE BEARING REAR 19(3)	SLAVE BEARING IN 20(4)	SHAFT EXCURSION FRONT In x 10^{-3}	SHAFT EXCURSION REAR In x 10^{-3}	VIB LEVEL	MOTOR I	MOTOR V	MOTOR HP *	TEST LAB (°F)	NOTES	DATE BY
9cJI 4.0	15140		Ø	1.4	0.2	3.9	108	104	9000	2011	269	255	254	250	196	188	300	238	191	—	253	258	261	259	225	269	169	279	264	169	1.1	1.7	—	95	451	83.0	76	#6 Jets	9-23-75 JJ
RERUN 4.0	15100		Ø	1.5	0.2	4.0	104	98	9110	2000	265	255	254	250	197	188	298	236	191	—	255	259	261	259	226	261	170	278	264	170	1.1	1.7	—	95	457	83.0	76	#6 Jets	9-23-75 JJM
3.0																																								
2.0																																								
1.0																																								
.5																																								
9cRI 3.0	15105		2.9	1.5	0.2	1.0	114	118	9074	1978	240	280	283	280	227	211	225	250	226	174	242	283	288	287	231	260	169	282	261	171	1.1	1.6	—	88	453	76.6	80	#1 Jets	9-18-75 JJM
2.5	15165		2.5	1.5	0.2	1.0	112	116	8960	1965	248	282	285	283	232	161	232	254	232	175	252	289	293	292	235	267	170	283	267	174	1.0	1.8	—	84	455	23.5	84	#1 Jets	9-19-75 JJM
2.0	15170		2.0	1.5	0.2	1.0	110	115	8960	1900	258	285	287	285	235	217	241	255	235	175	256	293	298	297	232	276	171	285	269	175	1.1	1.8	—	82	460	72.4	81	#1 Jets	9-17-75 JJM
1.0	15180		1.0	1.5	0.2	1.0	106	111	9000	2000	285	296	297	295	247	234	260	264	244	174	258	300	306	309	229	305	172	285	261	172	1.4	1.8	—	80	459	70.3	85	#1 Jets	9-15-75 JJM
.5	15225		0.5	1.5	0.2	1.0	110	114	8981	2022	316	315	316	314	258	161	286	273	252	174	319	312	317	319	232	323	170	287	266	175	1.3	1.8	—	73	455	62.7	82	#1 Jets	9-20-75 JJM

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a'

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. Cone face T/C at ~3.14 inch radius.
2. Shaft I.D. seal at front end of shaft.
3. 5 psig seal pressure at belt end shaft seal.
4. T/C's 6,7,8,9 measured with Acurex telemetry system.

CONSTANT TEST SETTINGS: Shaft Speed 15,000 rpm
Thrust Load 12,000 lbs
Oil Inlet Temp 170 °F

SYMBOLS: △ Test Condition (Setting)
→ Reference Data Only
* Calculated Values

FRONT BEARING S/N 6 REAR BEARING S/N 1

TEST NO.	SPEED (RPM)		OIL FLOW (GPM)				OIL PRES.		BRG. LOADS		TEMPERATURE OF																			SHAFT EXCURSION		VIB LEVEL	MOTOR			TEST TANK (°F)	NOTES	DATE BY
											REAR BEARING												FRONT BEARING						OIL IN	SLEEVE BEARING TEMPERATURE										
	SHAFT △	SEPARATOR	CONE RIB △	SUPPORT I.R.	SUPPORT O.R.	JETS △	SUPP BRG.	TEST BRG.	THRUST △	RADIAL △	HSG. O.B. 1	OUTER RING #1 2	OUTER RING #2 3	OUTER RING #3 4	HSG. I.B. 5	CAGE I.B. 6	CAGE FACE 7	R.C. I.R. 8	SHAFT I.B. 9	CAGE BACK FACE 10	CAGE OUT 11	OUTER RING #1 12	OUTER RING #2 13	OUTER RING #3 14	HSG. O.B. 15	CAGE OUT 16	△	FRONT IN	FRONT OUT	REAR IN	REAR OUT	FRONT In x 10^{-3}	REAR In x 10^{-3}		I	V	HP *			
C12dJI4.0	14960		80	1.5	0.2	4.0	103	97	12000	2956	270	258	258	254	199	110	297	234	187	257	263	265	264	227	264	170	280	268	170	1.0	1.7	—	97	453	85.0	80	#6 Jets	
3.0																																						
2.0																																						
1.0																																						
.5																																						
C12dRI3.0	15150		2.9	1.5	.2	1.0	115	119	12050	3100	246	286	290	286	232	165	233	260	235	175	248	270	295	294	234	267	170	287	220	174	1.0	1.6	—	92	452	80.2	85	#6 Jets	
2.5	15155		2.5	1.5	.2	1.0	112	116	11930	2700	253	289	291	288	235	162	238	263	235	175	256	295	300	299	237	273	170	286	271	174	1.0	1.8	—	88	455	77.3	84	#6 Jets	
2.0	15170		2.0	1.5	0.2	1.0	112	116	12071	3011	264	289	291	290	236	164	242	264	234	176	266	297	302	302	234	280	171	288	271	176	1.0	1.8	—	86	453	74.8	79	#1 Jets	
1.0	15195		1.0	1.5	0.2	1.0	111	115	12000	2967	294	305	306	305	254	168	266	273	252	174	298	307	314	317	235	311	170	287	274	174	1.1	1.8	—	82	458	71.7	80	#1 Jets	
.5	15220		0.5	1.5	0.2	1.0	110	114	11925	2978	323	322	323	321	262	168	291	278	252	175	325	319	324	326	234	330	171	290	275	176	1.3	1.7	—	75	497	65.1	82	#1 Jets	

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. Cone face T/C at ~3.14 inch radius.
2. Shaft I.D. seal at front end of shaft.
3. 5 psig seal pressure at bolt end shaft seal.
4. T/C's 6,7,8,9 measured with Acurex telemetry system.

CONSTANT TEST SETTINGS: Shaft Speed 15,000 rpm
Thrust Load 12,000 lbs
Oil Inlet Temp 170 °F

SYMBOLS: △ Test Condition (Setting)
→ Reference Data Only
* Calculated Values

FRONT BEARING S/N 6 ; REAR BEARING S/N 1

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) CONE RIB △	SUPPORT I.R. →	SUPPORT O.R. →	JETS △	OIL PRES. SUPP BRG. →	OIL PRES. TEST BRG. →	BRG. LOADS THRUST △	BRG. LOADS RADIAL △	TEMPERATURE OF REAR BEARING HSG. O.D. 1	REAR BEARING OUTER RING #1 2	REAR BEARING OUTER RING #2 3	REAR BEARING OUTER RING #3 4	REAR BEARING HSG. I.D. 5	REAR BEARING SHAFT (C.P. 1/16")	REAR BEARING CONE FACE 7	REAR BEARING INN. I.R. 8	REAR BEARING SHAFT I.D. 9	REAR BEARING CONE BACK FACE 10	REAR BEARING LUBE OUT 11	TEMPERATURE OF FRONT BEARING OUTER RING #1 12	FRONT BEARING OUTER RING #2 13	FRONT BEARING OUTER RING #3 14	FRONT BEARING SLAVE CONE OUT 15	FRONT BEARING LUBE OUT 16	OIL IN △ 17(1)	ISLAND BEARING FRONT FAR 18(2)	ISLAND BEARING FRONT NEAR 19(3)	ISLAND BEARING IN 20(4)	SHAFT EXCURSION FRONT In x 10^{-3}	SHAFT EXCURSION REAR In x 10^{-3}	VIB LEVEL %	MOTOR I	MOTOR V	MOTOR HP *	TEST LAB (°F)	NOTES	DATE BY
C12eJI4.0	14890		0	1.5	0.2	4.0	109	105	12110	4500	219	257	256	253	198	117	293	231	185	—	256	260	263	242	227	263	170	275	270	169	1.0	1.7	—	101	460	883	81	#6 Jets	8-27-75 JD
3.0				1																																			
2.0																																							
1.0																																							
.5																																							
C12eRI3.0	15120		2.9	1.5	0.2	1.0	114	118	12070	4610	246	285	289	287	233	133	233	260	234	175	248	291	295	295	234	267	170	290	285	174	—	—	—	90	455	891	85	#1 Jets	8-17-75 JHB
2.5	15155		2.5	1.5	0.2	1.0	112	116	11925	4575	252	288	290	289	235	100	238	263	237	175	255	295	300	299	236	272	170	290	276	174	.9	1.8	—	87	446	772	83	#1 Jets	8-27-75 JHB
2.0	15120		2.0	1.5	0.2	1.0	108	113	11925	4500	263	291	293	291	238	105	242	267	235	175	245	299	303	303	238	279	170	292	276	174	1.0	1.8	—	88	454	796	81	#1 Jets	8-20-75 JHB
1.0	15190		2.0	1.5	0.2	1.0	111	115	12000	4566	293	309	306	305	254	101	267	274	251	175	297	308	314	317	235	312	170	292	278	174	1.1	1.8	—	82	457	719	80	#1 Jets	8-13-75 JHB
.5	15215		0.5	1.5	0.2	1.0	110	114	11863	4478	323	322	323	321	263	101	290	277	255	175	324	319	324	326	236	331	170	295	281	175	1.4	1.8	—	97	459	683	82	#1 Jets	8-13-75 JHB

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. Cone face T/C at ~3.14 inch radius.
2. Shaft I.D. seal at front end of shaft.
3. 5 psig seal pressure at belt end shaft seal.
4. T/C's 6,7,8,9 measured with Acurex telemetry system

CONSTANT TEST SETTINGS: Shaft Speed 15,000 rpm; Thrust Load 12,000 lbs; Oil Inlet Temp 170 °F

SYMBOLS: △ Test Condition (Settin; ⟶ Reference Data Only; * Calculated Values

FRONT BEARING S/N 6 — R BEARING S/N /

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) CONE RIB △	SUPPORT I.R. ⟶	SUPPORT O.R. ⟶	JETS △	OIL PRES. SUPP BRG. ⟶	OIL PRES. TEST BRG. ⟶	BRG. LOADS THRUST △	BRG. LOADS RADIAL △	TEMPERATURE OF REAR BEARING HSG. O.B. 1	REAR BEARING OUTER RING #1 2	REAR BEARING OUTER RING #2 3	REAR BEARING OUTER RING #3 4	REAR BEARING HSG. I.D. 5	SHAFT C.D. 6	CONE FACE 7	BRG. I.R. 8	SHAFT I.D. 9	LUBE OUT (End Housing) 10	LUBE OUT 11	FRONT BEARING OUTER RING #1 12	FRONT BEARING OUTER RING #2 13	FRONT BEARING OUTER RING #3 14	LUBE OUT (Side Cover) 15	LUBE OUT 16	OIL IN △ 17(1)	SLAVE BEARING FRONT ⟶ 18(2)	SLAVE BEARING REAR ⟶ 19(3)	OIL IN 20(4)	SHAFT EXCURSION FRONT In x 10^{-3}	SHAFT EXCURSION REAR In x 10^{-3}	VIB LEVEL	MOTOR I	MOTOR V	MOTOR HP *	TEST LAB (°F)	NOTES	DATE BY
C12FTI 4.0	14940		0	1.5	0.2	4.0	108	104	11925	6066	270	258	258	254	199	216	297	287	190	—	259	261	264	264	229	265	170	284	274	169	1.0	1.7	—	100	449	87.1	81	#6 Jets	9-22-77 WM
3.0																																							
2.0																																							
1.0																																							
.5																																							
C12FRI 3.0	15130		2.9	1.5	0.2	1.0	114	118	12075	6000	246	285	289	287	235	205	235	263	231	175	249	292	297	296	237	267	170	292	277	173	—	—	—	92	454	80.8	85	#1 Jets	9-19-77 WM
2.5	15150		2.5	1.5	0.2	1.0	112	116	11950	6036	251	288	291	288	236	209	237	264	238	175	255	295	300	300	234	272	170	293	278	173	.75	1.8	—	89	460	79.0	82	#1 Jets	9-19-77 WM
2.0	15175		2.0	1.5	0.2	1.0	110	114	12125	5926	263	290	293	292	239	201	241	267	236	175	266	299	304	304	239	280	170	295	279	174	.9	1.8	—	88	455	77.9	80	#1 Jets	9-19-77 WM
1.0	15170		1.0	1.5	0.2	1.0	110	114	12037	6000	293	305	306	305	254	250 101	267	277	252	176	297	309	315	317	237	312	170	296	281	175	1.2	1.8	—	83	456	72.4	80	#1 Jets	9-20-77 WM
.5	15210		0.5	1.5	0.2	1.0	110	114	11925	6033	323	322	322	321	313	101	290	280	254	175	304	320	324	327	237	331	170	300	285	175	1.2	1.8	—	76	460	66.6	81	#1 Jets	9-20-77 WM

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a

FRONT BEARING S/N 6   REAR BEARING S/N 1

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. Cone face T/C at ~3.14 inch radius.
2. Shaft I.D. seal at front end of shaft.
3. 5 psig seal pressure at belt end shaft seal.
4. T/C's 6,7,8,9 measured with Acurex telemetry system.

CONSTANT TEST SETTINGS: Shaft Speed 15,000 rpm
Thrust Load 9,000 lbs
Oil Inlet Temp 195 °F

SYMBOLS: △ Test Condition (Setting)
←→ Reference Data Only
* Calculated Values

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) CONE RIB △		SUPPORT I.R.	SUPPORT O.R.	JETS △	OIL PRES. SUPP BRG.	TEST BRG.	BRG. LOADS THRUST △	RADIAL △	TEMPERATURE °F REAR BEARING HSG. O.B. 1	OUTER RING #1 2	#2 3	#3 4	HSG. I.B. 5	SHAFT C.R. 6	CONE FACE 7	BRG. I.R. 8	SHAFT I.B. 9	CONE RIB LUBE IN 10	LUBE OUT 11	FRONT BEARING OUTER RING #1 12	#2 13	#3 14	CONE RIB LUBE IN 15	LUBE OUT 16	OIL IN △ 17	SLAVE BEARING FRONT 18	REAR 19	IN 20	SHAFT EXCURSION FRONT In x 10⁻³	REAR In x 10⁻³	VIB LEVEL *	MOTOR I	V	HP *	TEST LAB (°F)	NOTES	DATE BY
C9bJII 4.0																																							
3.0																																							
2.0																																							
1.0																																							
.5																																							
C9bRII 3.0	15210	-	2.9		1.5	0.2	1.0	105	110	9075	1022	258	294	297	295	244	~~60~~	245	265	339	195	261	301	305	303	245	278	194	292	271	191	.8	2.0	—	82	455	71.4	72	#1 Jets	[illegible]
2.5	15230		2.5		1.5	0.2	1.0	101	105	9057	1022	263	295	298	296	246	~~45~~	250	265	245	196	268	303	308	306	244	283	195	292	272	193	.9	1.9	—	81	456	70.4	74	#1 Jets	[illegible]
2.0	15235		2.0		1.5	0.2	1.0	105	110	9037	1044	274	298	301	299	251	~~60~~	256	269	249	196	279	308	313	311	245	292	194	295	272	194	.7	1.8	—	78	457	78.0	77	#1 Jets	[illegible]
1.0	15250	--	1.0		1.5	0.2	1.0	110	115	9075	1044	300	310	311	310	264	~~99~~	271	272	257	196	305	315	321	322	249	319	194	297	276	197	1.2	1.8	—	74	462	64.9	79	#1 Jets	[illegible]
.5																																							

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

N. O. 7000-4 - IV a

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. Cone face T/C at ~3.14 inch radius.
2. Shaft I.D. seal at front end of shaft.
3. 5 psig seal pressure at belt end shaft seal.
4. T/C's 6,7,8,9 measured with Acurex telemetry system.

CONSTANT TEST SETTINGS: Shaft Speed 15,000 rpm; Thrust Load 9000 lbs; Oil Inlet Temp 195 °F

SYMBOLS: △ Test Condition (Setting); ←→ Reference Data Only; * Calculated Values

FRONT BEARING S/N 6 REAR BEARING S/N 1

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) CONE RIB △	SUPPORT I.R. ←→	SUPPORT O.R. ←→	JETS △	OIL PRES. SUPP BRG. ←→	OIL PRES. TEST BRG. ←→	BRG. LOADS THRUST △	BRG. LOADS RADIAL △	TEMPERATURE OF REAR BEARING HSG. O.D. 1	REAR BEARING OUTER RING #1 2	REAR BEARING OUTER RING #2 3	REAR BEARING OUTER RING #3 4	REAR BEARING HSG. I.D. 5	REAR BEARING SHAFT I.D. 6	REAR BEARING CONE FACE 7	REAR BRG. I.R. 8	REAR BEARING SHAFT I.D. 9	REAR BEARING SLAVE LAND 10	REAR BEARING LUBE OUT 11	FRONT BEARING OUTER RING #1 12	FRONT BEARING OUTER RING #2 13	FRONT BEARING OUTER RING #3 14	FRONT BEARING SLAVE LAND 15	FRONT BEARING LUBE OUT 16	OIL IN △ 17(1)	SLAVE BEARING FRONT 18(2)	SLAVE BEARING REAR 19(3)	SLAVE BEARING IN 20(4)	SHAFT EXCURSION FRONT In x 10^{-3}	SHAFT EXCURSION REAR In x 10^{-3}	VIB LEVEL %	MOTOR I	MOTOR V	MOTOR HP *	TEST LAB (°F)	NOTES	DATE BY
C9cII4.0																																							
3.0																																							
2.0																																							
1.0																																							
.5																																							
C9cRII3.0	15210		2.9		1.5	0.2	1.0	105	110	9037	1878	258	294	296	295	244	244	243	264	239	196	262	304	305	304	246	279	195	297	281	193	.7	1.9	—	83	462	72.3	73	#1 Jets	
2.5	15225		2.5		1.5	0.2	1.0	102	106	9037	2000	264	296	299	297	247	250	250	265	247	196	269	304	309	307	249	284	195	299	289	194	.8	1.9	—	81	460	71.9	73	#1 Jets	
2.0	15235		2.0		1.5	0.2	1.0	105	110	9087	2044	274	299	301	300	251	257	257	268	250	196	279	308	313	312	249	292	194	301	287	195	1.1	1.8	—	81	454	70.2	79	#1 Jets	
1.0	15250		1.0		1.5	0.2	1.0	110	114	9112	2000	300	310	311	311	264	271	271	272	259	197	306	316	321	322	251	319	195	304	289	198	1.2	1.8	—	74	461	64.2	80	#1 Jets	
.5																																							

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. Cone face T/C at ~3.14 inch radius.
2. Shaft I.D. seal at front end of shaft.
3. 5 psig seal pressure at belt end shaft seal.
4. T/C's 6,7,8,9 measured with Acurex telemetry system.

CONSTANT TEST SETTINGS: Shaft Speed 15,000 rpm; Thrust Load 12,000 lbs; Oil Inlet Temp 195 °F

SYMBOLS: △ Test Condition (Setting); ⟶ Reference Data Only; * Calculated Value

FRONT BEARING S/N 6 REAR BEARING S/N 1

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) CONE RIB △	SUPPORT I.R. ⟶	SUPPORT O.R. ⟶	JETS △	OIL PRES. SUPP BRG. ⟶	OIL PRES. TEST BRG. ⟶	BRG. LOADS THRUST △	BRG. LOADS RADIAL △	TEMPERATURE OF REAR BEARING HSG. O.D. 1	REAR BEARING OUTER RING #1 2	REAR BEARING OUTER RING #2 3	REAR BEARING OUTER RING #3 4	REAR BEARING HSG. I.D. 5	REAR BEARING (AIR) I.D. 6	REAR BEARING CONE FACE 7	REAR BEARING I.R. 8	REAR BEARING SHAFT I.D. 9	REAR BEARING SHAFT AXIAL 10	REAR BEARING LUBE OUT 11	FRONT BEARING OUTER RING #1 12	FRONT BEARING OUTER RING #2 13	FRONT BEARING OUTER RING #3 14	FRONT BEARING CAGE/CAGE SPOT 15	FRONT BEARING LUBE OUT 16	OIL IN △ 17(1)	SHAFT BEARING FRONT 18(2)	SHAFT BEARING REAR 19(3)	SHAFT BEARING IN 20(4)	SHAFT EXCURSION FRONT In x 10^{-3}	SHAFT EXCURSION REAR In x 10^{-3}	VIB LEVEL %	MOTOR I	MOTOR V	MOTOR HP *	TEST TAB (°F)	NOTES	DATE BY
C12dTII4.0																																								
3.0																																								
2.0																																								
1.0																																								
.5																																								
C12dRII3.0	15200	- -	2.9	1.5	0.2	1.0	105	110	12080	3011	263	300	304	302	249	42	249	274	246	197	257	307	311	310	247	284	196	302	288	195	.7	1.9	—	85	457	74.7	73	#1 Jets	3-31-75 WM
2.5	15210	- -	2.5	1.5	0.2	1.0	101	105	11978	3033	269	302	305	303	251	44	254	273	249	197	274	310	315	313	250	289	195	301	289	195	.8	1.9	—	85	455	74.3	74	#1 Jets	4-1-75 WM
2.0	15225	- -	2.0	1.5	0.2	1.0	105	110	12037	2956	280	305	307	306	255	46	260	275	254	197	235	315	319	318	252	298	195	305	291	197	1.1	1.8	—	83	457	72.7	80	#1 Jet.	3-31-75 WM
1.0	15240	- -	1.0	1.5	0.2	1.0	110	115	11925	2979	307	317	319	318	268	48	278	292	262	199	313	322	328	330	252	325	195	307	294	200	1.1	1.8	—	78	460	68.5	79	#1 Jets	3-31-75 WM
.5																																								

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

M. O. 7000-4 - IV a

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. Cone face T/C at ~3.14 inch radius.
2. Shaft I.D. seal at front end of shaft.
3. 5 psig seal pressure at belt end shaft seal.
4. T/C's 6,7,8,9 measured with Acurex telemetry system.

CONSTANT TEST SETTINGS: Shaft Speed 15,000 rpm
Thrust Load 12,000 lbs
Oil Inlet Temp 195 °F

SYMBOLS: △ Test Condition (Setting)
←→ Reference Data Only
* Calculated Values

FRONT BEARING S/N 6 REAR BEARING S/N 1

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) CONE RIB △	SUPPORT I.R. ←→	SUPPORT O.R. ←→	JETS △	OIL PRES. SUPP BRG. ←→	OIL PRES. TEST BRG. ←→	BRG. LOADS THRUST △	BRG. LOADS RADIAL △	TEMPERATURE °F REAR BEARING HSG. O.B. 1	OUTER RING #1 2	OUTER RING #2 3	OUTER RING #3 4	HSG. I.B. 5	SHAFT C.B. 6	CONE FACE 7	BRG. I.R. 8	SHAFT I.B. 9	LUBE CAGE INLET 10	LUBE OUT 11	TEMPERATURE °F FRONT BEARING OUTER RING #1 12	OUTER RING #2 13	OUTER RING #3 14	LUBE CAGE OUTLET 15	LUBE OUT 16	OIL IN △ 17(1)	SLAVE BEARING FRONT 18(2)	SLAVE BEARING REAR 19(3)	SLAVE BEARING IN 20(4)	SHAFT EXCURSION FRONT In x 10^{-3}	SHAFT EXCURSION REAR In x 10^{-3}	VIB LEVEL *	MOTOR I	MOTOR V	MOTOR HP *	TEST LAB (°F)	NOTES	DATE BY
C12eJII40																																								
30																																								
20																																								
10																																								
.5																																								
C12eRII30	15195		2.9		1.5	0.2	1.0	104	108	12000	4478	262	300	304	302	249	242	249	273	245	196	265	307	312	310	251	283	195	304	292	199	.8	1.9	—	88	458	77.5	73	#1 Jets	
25	15215		2.5		1.5	0.2	1.0	100	104	12000	4522	269	301	305	302	251	246	254	273	249	196	213	310	315	314	255	289	194	309	291	175	.7	1.9	—	87	453	75.7	76	#1 Jets	
20	15220		2.0		1.5	0.2	1.0	104	109	12037	4434	279	304	307	306	255	250	261	275	254	198	224	314	320	319	255	297	196	309	295	199	1.0	1.8	—	83	458	72.9	77	#1 Jets	
10	15240		1.0		1.5	0.2	1.0	110	115	12000	4545	307	317	319	319	268	262	277	281	261	197	214	322	328	330	255	325	194	310	297	199	1.1	1.7	—	80	461	70.6	78	#1 Jets	
.5																																								

Table VIII - Continued

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV a

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. Cone face T/C at ~3.14 inch radius.
2. Shaft I.D. seal at front end of shaft.
3. 5 psig seal pressure at belt end shaft seal.
4. T/C's 6,7,8,9 measured with Acurex telemetry system.

CONSTANT TEST SETTINGS: Shaft Speed 15,000 rpm; Thrust Load 12,000 lbs; Oil Inlet Temp 195 °F

SYMBOLS: △ Test Condition (Setting); ←→ Reference Data Only; * Calculated Values

FRONT BEARING S/N 6 REAR BEARING S/N 1

TEST NO.	SPEED (RPM) SHAFT △	SPEED (RPM) SEPARATOR	OIL FLOW (GPM) CONE RIB △	OIL FLOW (GPM)	OIL FLOW (GPM) SUPPORT I.R. ←→	OIL FLOW (GPM) SUPPORT O.R. ←→	OIL FLOW (GPM) JETS △	OIL PRES. SUPP BRG. ←→	OIL PRES. TEST BRG. ←→	BRG. LOADS THRUST △	BRG. LOADS RADIAL △	TEMPERATURE °F REAR BEARING HSG. O.D. 1	REAR BEARING OUTER RING #1 2	REAR BEARING OUTER RING #2 3	REAR BEARING OUTER RING #3 4	REAR BEARING HSG. I.D. 5	REAR BEARING SHAFT O.D. 6	REAR BEARING CONE FACE 7	REAR BEARING BRG. I.R. 8	REAR BEARING SHAFT I.D. 9	REAR BEARING CONE RIB 10	REAR BEARING LUBE OUT 11	FRONT BEARING OUTER RING #1 12	FRONT BEARING OUTER RING #2 13	FRONT BEARING OUTER RING #3 14	FRONT BEARING SLAVE LUBE OUT 15	FRONT BEARING LUBE OUT 16	OIL IN △ 17(1)	SLAVE BEARING FRONT 18(2)	SLAVE BEARING REAR 19(3)	SLAVE BEARING IN 20(4)	SHAFT EXCURSION FRONT In x 10^{-3}	SHAFT EXCURSION REAR In x 10^{-3}	VIB LEVEL	MOTOR I	MOTOR V	MOTOR HP *	TEST LAB (°F)	NOTES	DATE BY
C12FJII4.0																																								
3.0																																								
2.0																																								
1.0																																								
.5																																								
C12FRII3.0	15200		2.9		1.5	0.2	1.0	104	108	12000	5978	263	300	304	302	250	94	250	274	250	197	226	307	312	311	259	285	196	309	296	195	.9	1.9	—	87	459	76.8	73	#1 Jets	8-21-75 P.M.
2.5	15210		2.5		1.5	0.2	1.0	102	106	12110	5956	270	302	305	303	251	99	255	276	254	197	275	310	315	314	252	290	195	309	294	196	.7	1.8	—	86	455	75.3	77	#1 Jets	8-21-75 P.M.
2.0	15220		2.0		1.5	0.2	1.0	105	110	12037	5978	280	305	308	307	255	100	260	277	255	198	285	316	320	319	256	298	195	311	298	198	1.0	1.8	—	83	459	73.1	80	#1 Jets	8-21-75 A.M.
1.0																																								
.5																																								

Table IX

Test Results - Parametric Study - Phase B

PERFORMANCE TESTS WITH HIGH SPEED TAPERED ROLLER BEARINGS

W. O. 7000-4 - IV b

FRONT BEARING S/N 6

REAR BEARING S/N 1

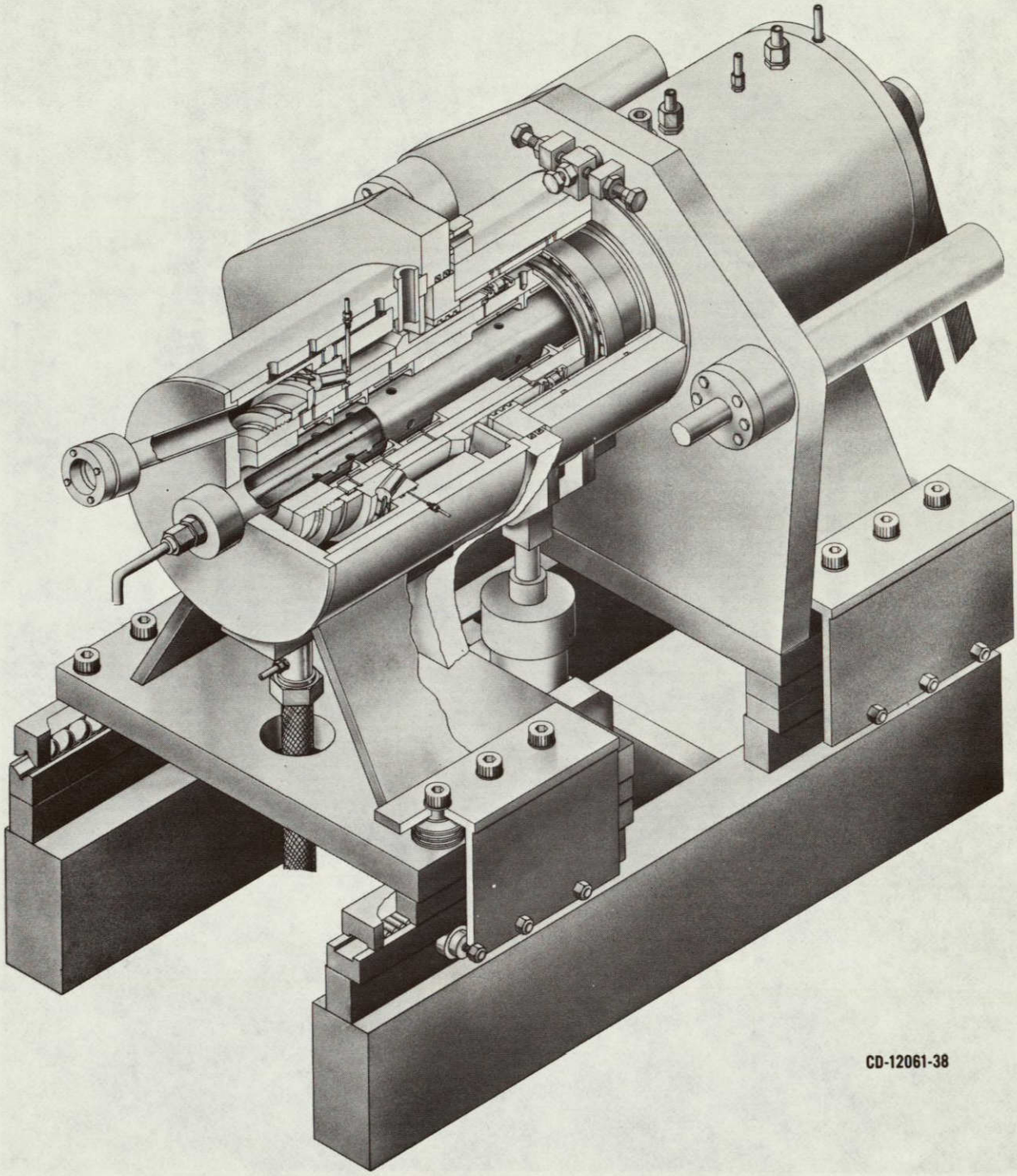
NOTES: (UNLESS OTHERWISE SPECIFIED)

1. Cone face T/C at ~ 3.14 inch radius.
2. Shaft I.D. seal at front end of shaft.
3. 5 psig seal pressure at belt end shaft seal.
4. T/C's 6,7,8,9 measured with Acurex telemetry system.

CONSTANT TEST SETTINGS. Shaft Speed 12,500 rpm; Thrust Load 12,000 lbs; Oil Inlet Temp 195 °F, 170 °F

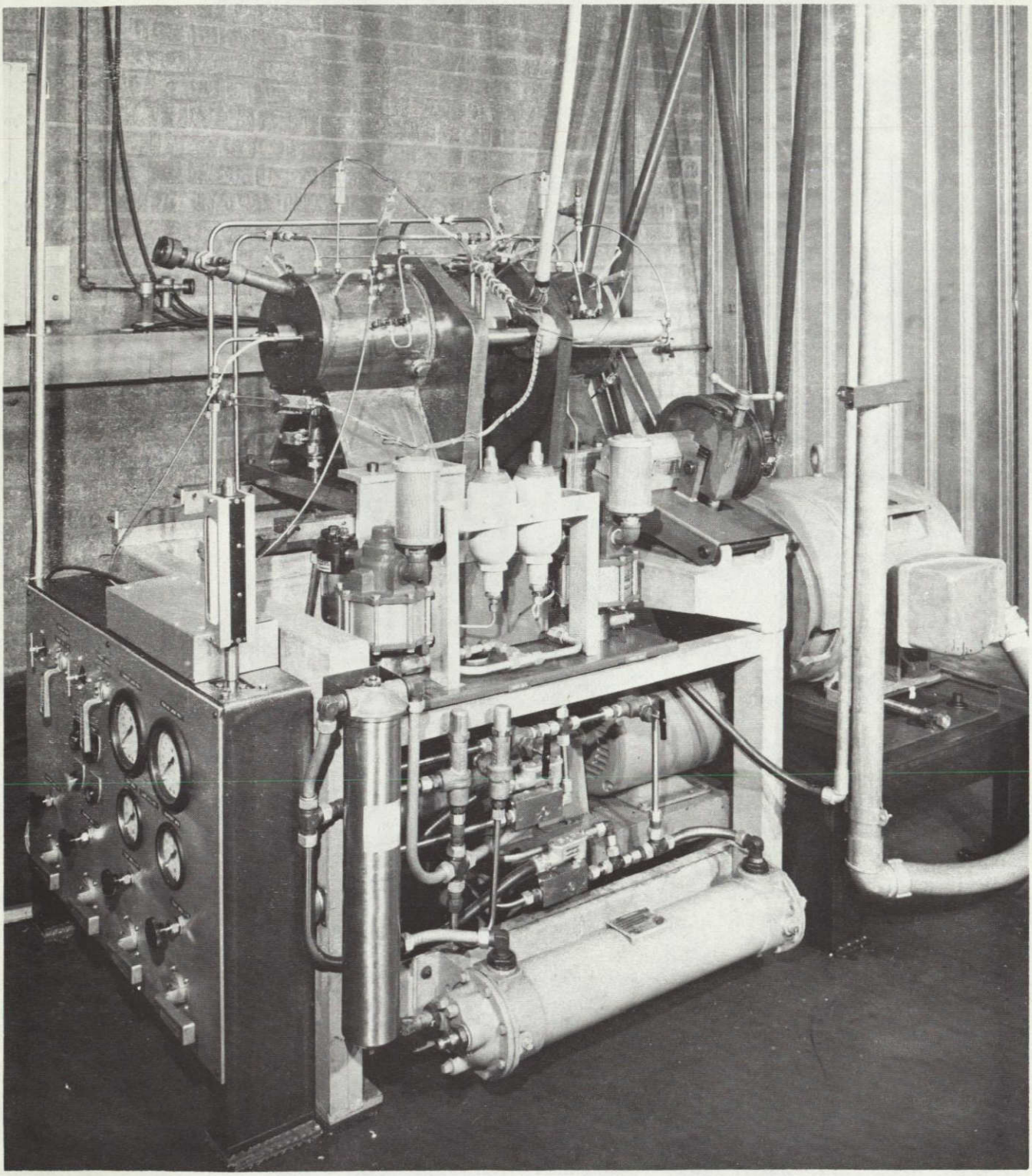
SYMBOLS: △ Test Condition (Setting); ⟷ Reference Data Only; * Calculated Values

TEST NO.	SPEED (RPM) SHAFT △	SEPARATOR	OIL FLOW (GPM) per Brg. CONE RIB	Front O.R.	SUPPORT I.R. ⟷	SUPPORT O.R. ⟷	JETS △	OIL PRES. SUPP BRG. ⟷	TEST BRG. ⟷	BRG. LOAD, THRUST △	RADIAL △	TEMPERATURE OF REAR BEARING (°F) OUTER RING #1 O.D.	#2	#3	#4	INNER RING #5 I.D.	STAMP	CONE FACE #7	CONE B.R. #8	SHAFT I.D. #9	Cool. Oil Out #10	CAGE #11	FRONT BEARING OUTER RING #12	#13	#14	Cool. Oil Out #15	LINER OUT #16	OIL IN △ #17(1)	STAGE BEARING TEMPERATURE RISE #18(2)	#19(3)	#20(4)	SHAFT EXCUR. IN FRONT In x 10^{-3}	REAR In x 10^{-3}	VIB LEVEL *	MOTOR I	V	HP *	TEST LAB (°F)	Stand BL OUT (°F)	NOTES	DATE BY
IVb1a	12535	—	.65	.8	1.5	0.2	1.0	108	110	12000	6033	290	281	281	284	241	25/101	281	285	252	220	288	281	277	286	222	296	194	287	272	197	1.4	1.7	←	62	461	52.6	89	295		
IVb2a	12535	—	.65	.7	1.5	0.2	1.0	109	112	12035	6022	291	284	284	287	244	25/112	282	285	252	224	291	285	282	289	226	299	195	287	274	199	1.4	1.7	—	61	451	50.0	92	241		
IVb1b	12530	—	.5	.7	1.5	0.2	1.0	113	116	11963	6000	298	287	287	289	245	26/109	287	284	251	225	293	287	284	292	226	304	195	287	273	199	1.4	1.7	—	61	457	50.0		248		
IVb1c #3a	12530	—	.5	.7	1.5	0.2	1.0	114	117	11963	5970	301	291	291	294	249	26/105	290	288	255	232	297	292	289	286	233	305	205	293	279	204	1.4	1.7	—	61	449	49.7	88	256		
IVb 2.	12535	—	.5	Ø	1.5	0.2	1.0	111	115	11906	5922	307	310	316	312	255	28/103	290	286	255	—	304	313	313	317	—	310	195	289	275	199	1.4	1.7	—	61	450	49.9	86	253		
IVb3b	12535	—	1.0	1.0	1.5	0.2	1.0	103	106	11963	5956	286	288	287	290	253	25/102	296	289	258	235	286	287	284	291	236	297	214	297	283	210	1.4	1.7	—	62	451	51.1	85	262		
IVb1d	12548	—	.5	.9	1.5	0.2	1.0	104	106	12039	6023	300	301	300	303	262	29/101	300	300	269	246	308	301	297	306	247	319	222	306	291	220	1.4	1.7	—	58	455	51.6	83	270		
IVb1e	12545	—	1.0	.95	1.5	0.2	1.0	92	94	12056	6000	298	300	300	302	265	28/101	289	301	272	250	297	299	296	305	251	309	229	312	296	228	1.4	1.7	—	60	461	50.5	89	275		
IVb4a	12535	—	0.5	Ø	1.5	0.2	1.0	103	108	11963	6033	290	297	303	297	237	30/44	271	270	229	—	285	298	299	301	—	294	170	269	256	171	1.4	1.7	—	63	445	52.0	77	225		
IVb4b	12525	—	1.0	Ø	1.5	0.2	1.0	87	91	12037	6000	269	284	290	285	231	29/95	248	265	227	—	264	284	286	289	—	275	170	266	255	169	1.4	1.7	—	66	449	550	79	227		



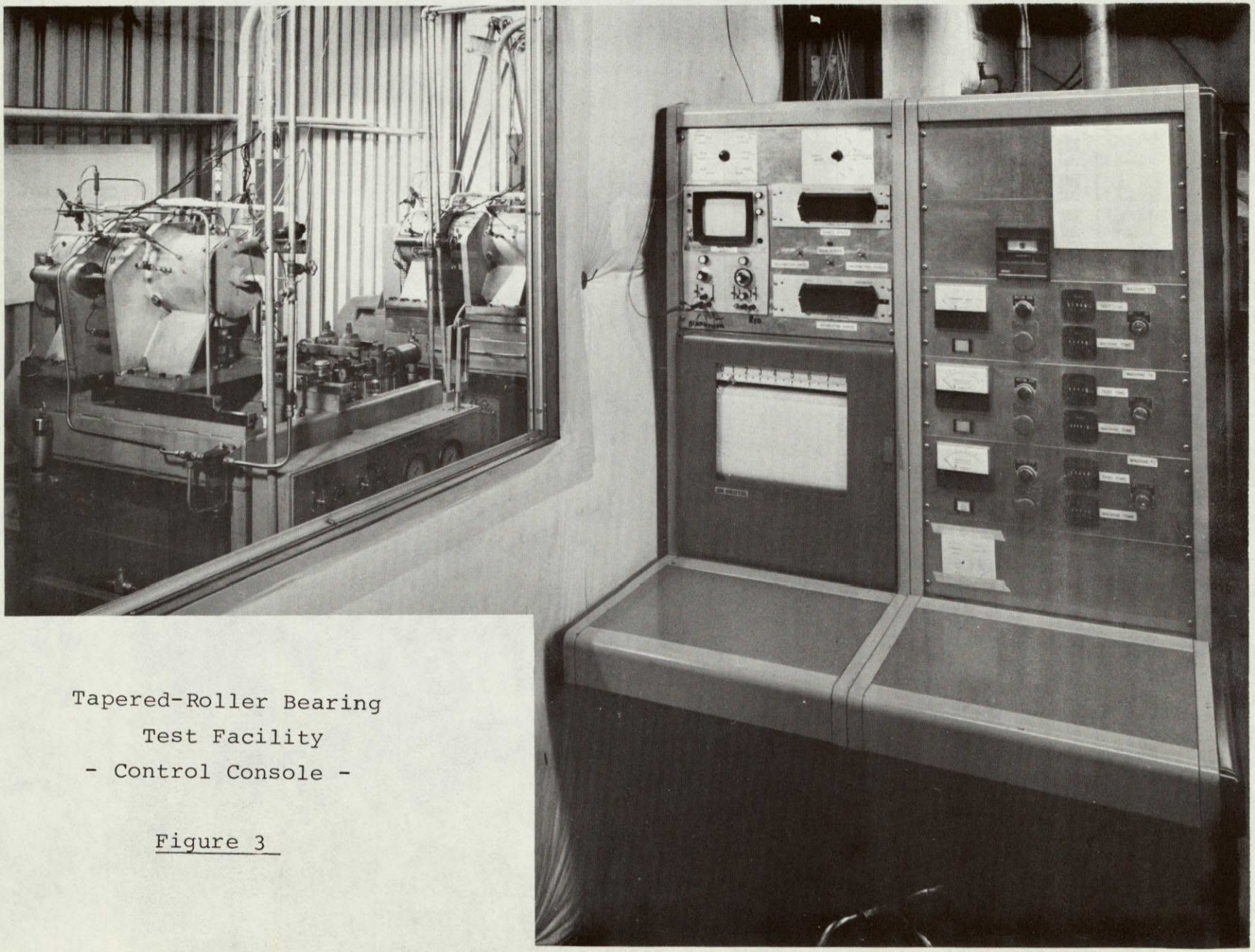
High-Speed Tapered-Roller Bearing Test Machine

Figure 1



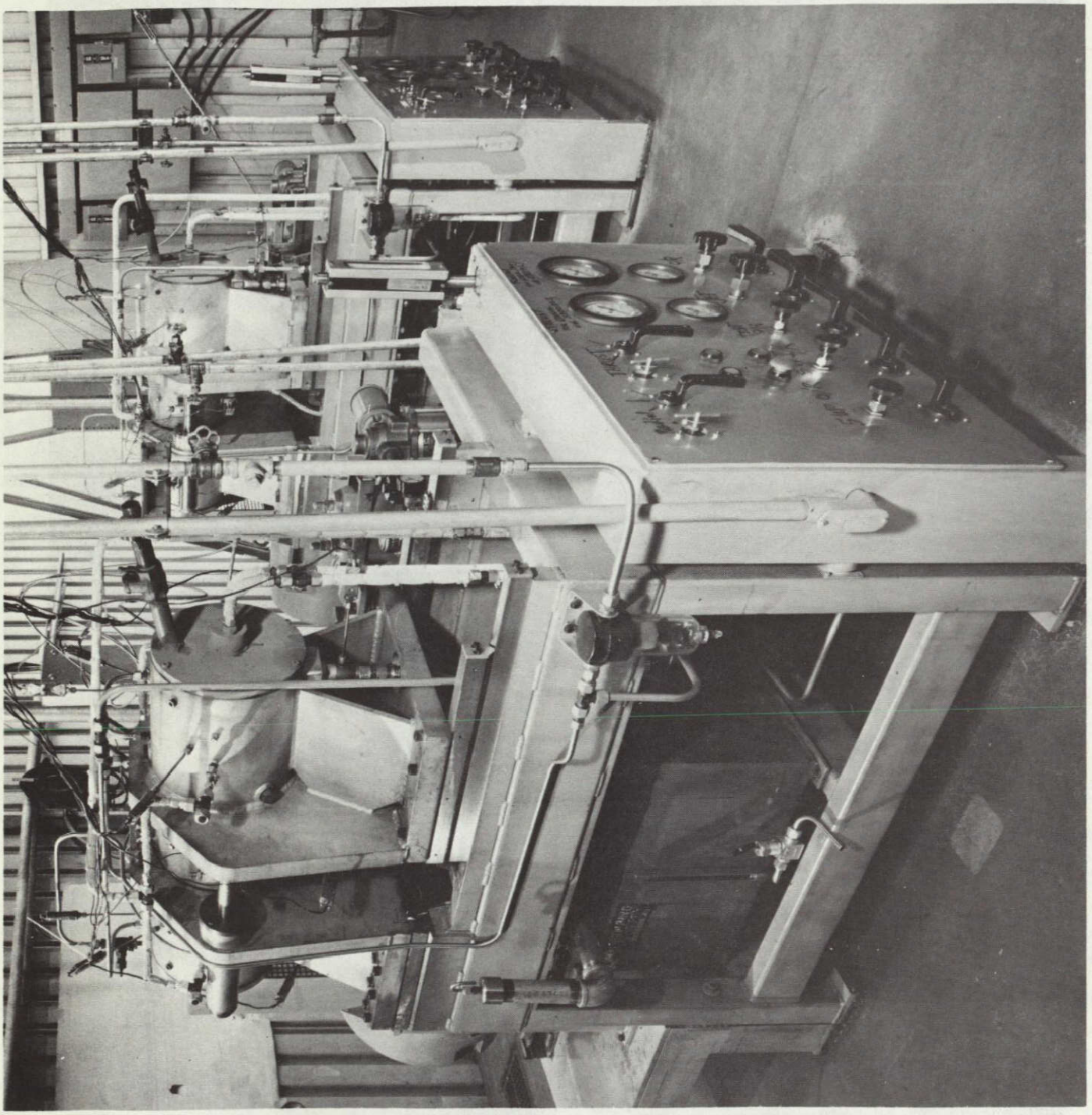
Tapered-Roller Bearing
Test Machine

Figure 2



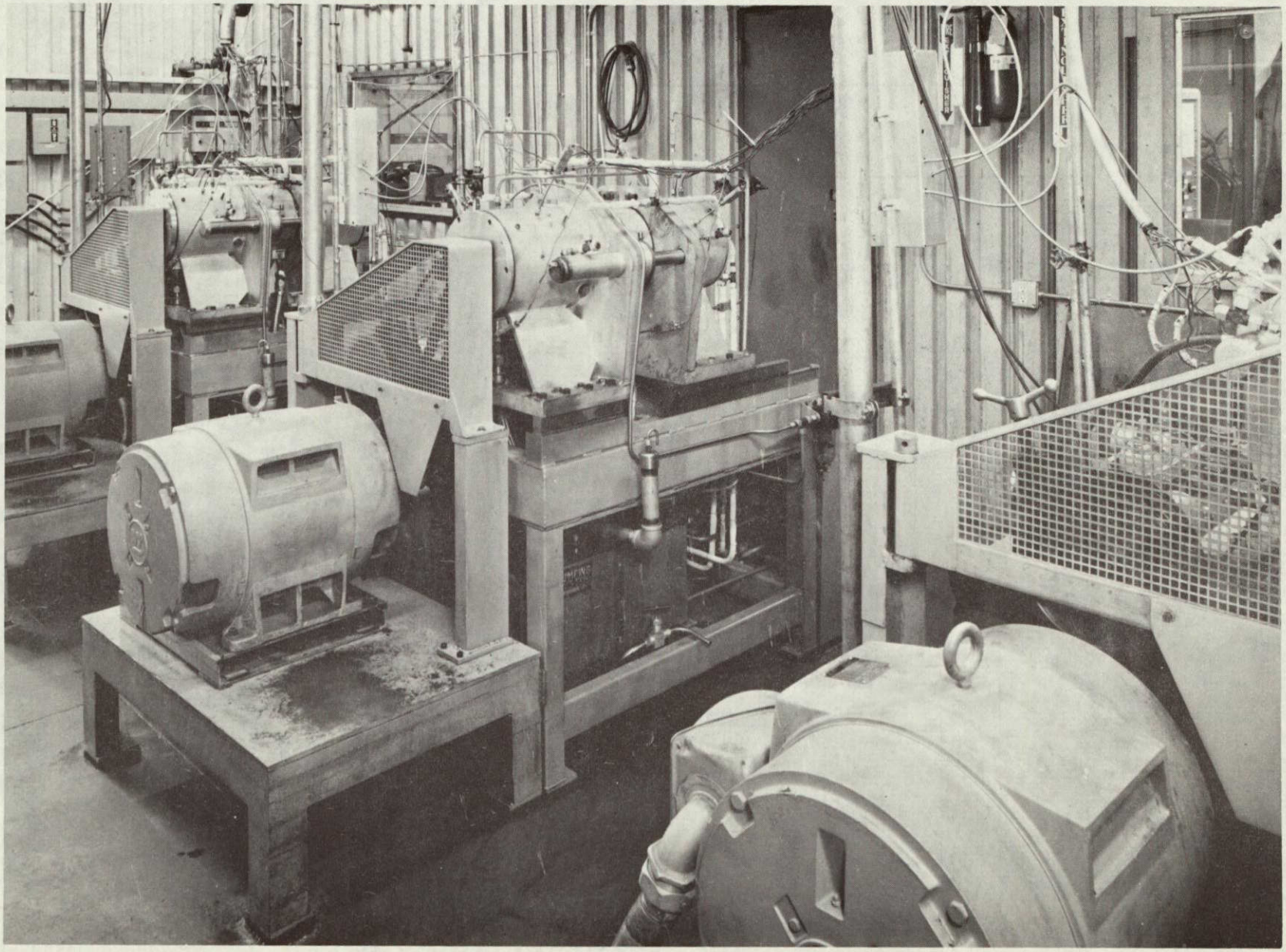
Tapered-Roller Bearing
Test Facility
- Control Console -

Figure 3



Tapered-Roller Bearing
Test Machines S/N 2 and S/N 3

Figure 4



Tapered-Roller Bearing
Test Facility

Figure 5

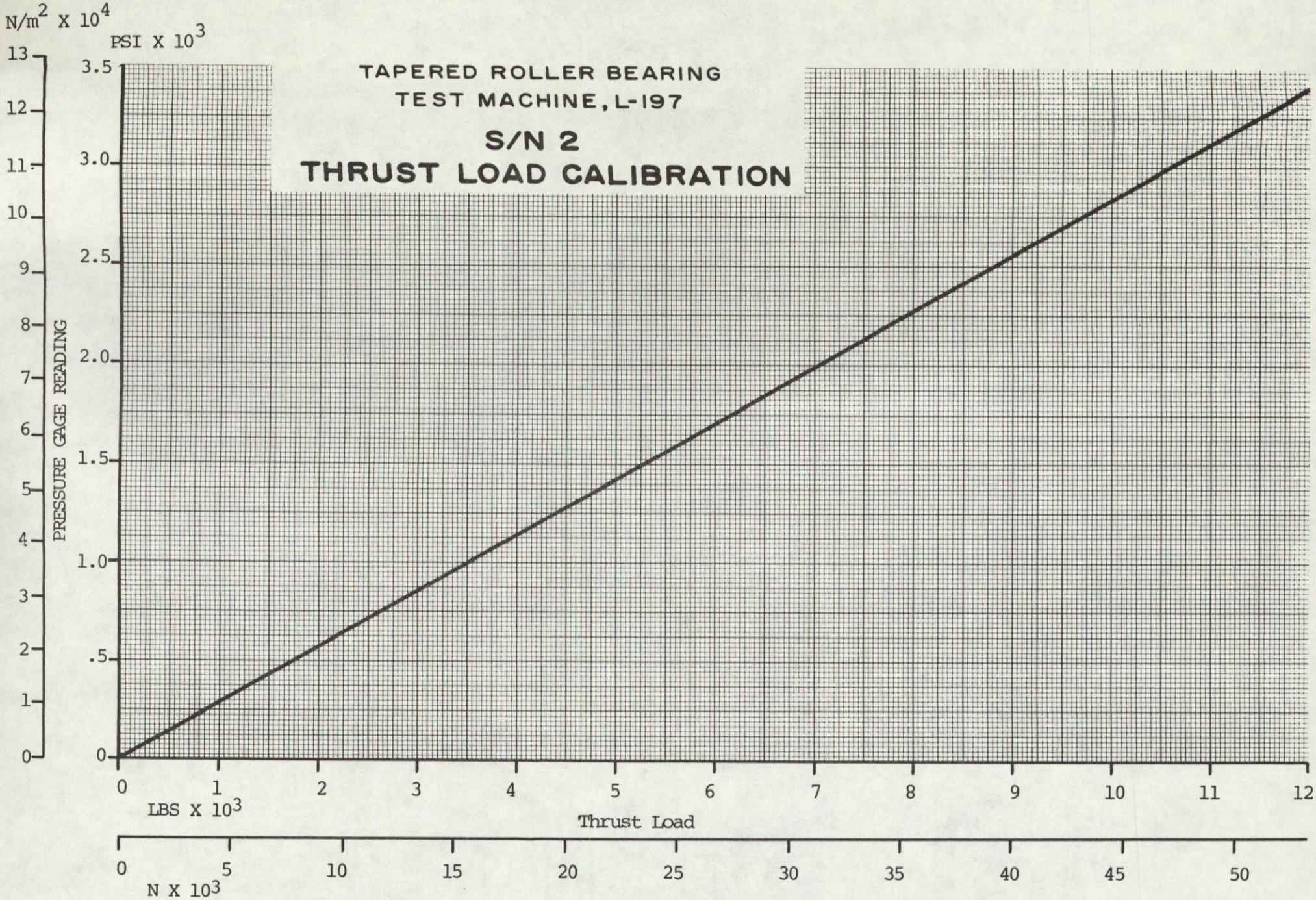

TAPERED ROLLER BEARING
TEST MACHINE, L-197
S/N 2
THRUST LOAD CALIBRATION
N/m² X 10⁴
PSI X 10³
PRESSURE GAGE READING
LBS X 10³
Thrust Load
N X 10³

Figure 6

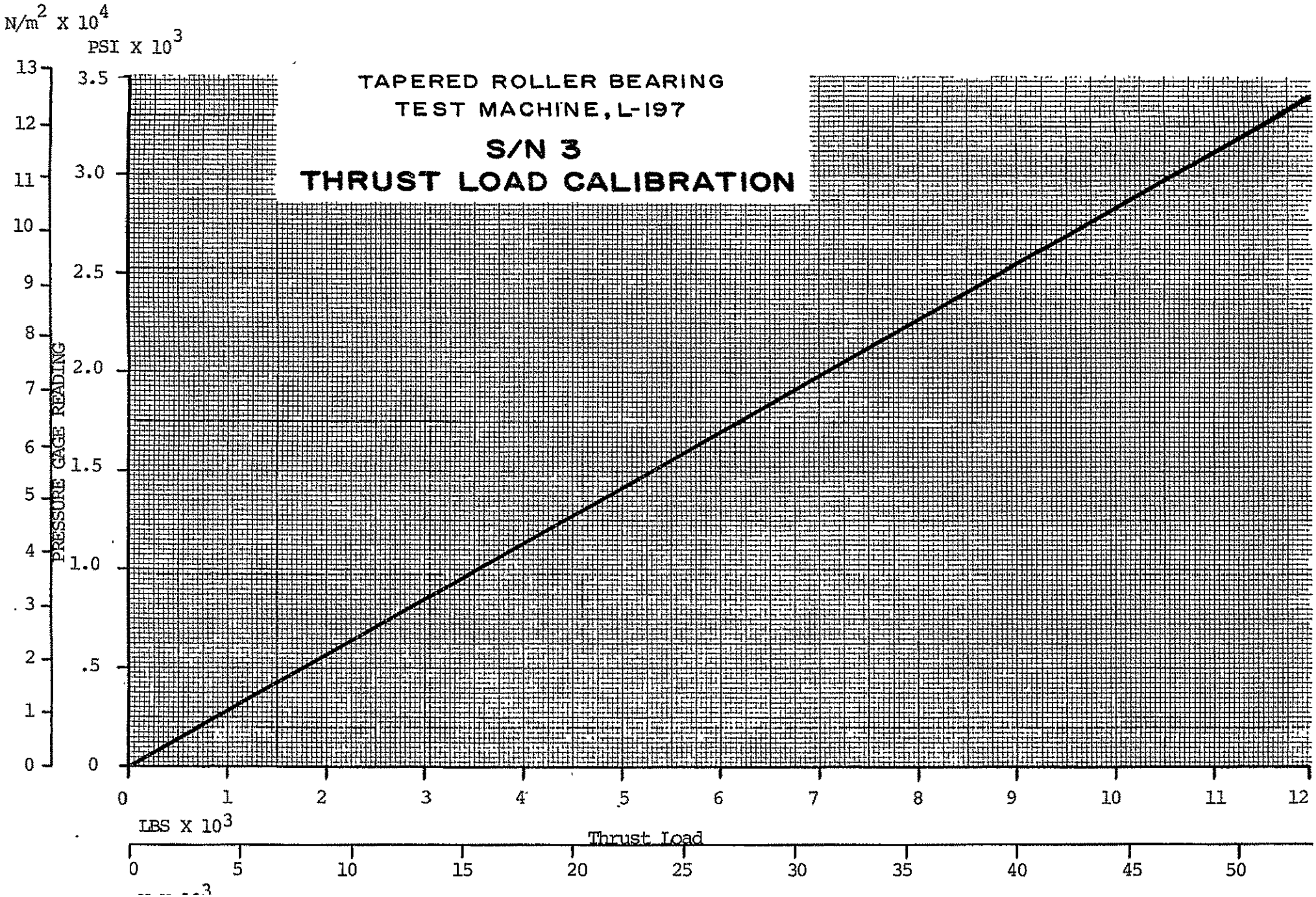

TAPERED ROLLER BEARING
TEST MACHINE, L-197
S/N 3
THRUST LOAD CALIBRATION
N/m² X 10⁴
PSI X 10³
PRESSURE GAGE READING
13
12
11
10
9
8
7
6
5
4
3
2
1
0
3.5
3.0
2.5
2.0
1.5
1.0
.5
0
0 1 2 3 4 5 6 7 8 9 10 11 12
LBS X 10³
Thrust Load
0 5 10 15 20 25 30 35 40 45 50

Figure 8

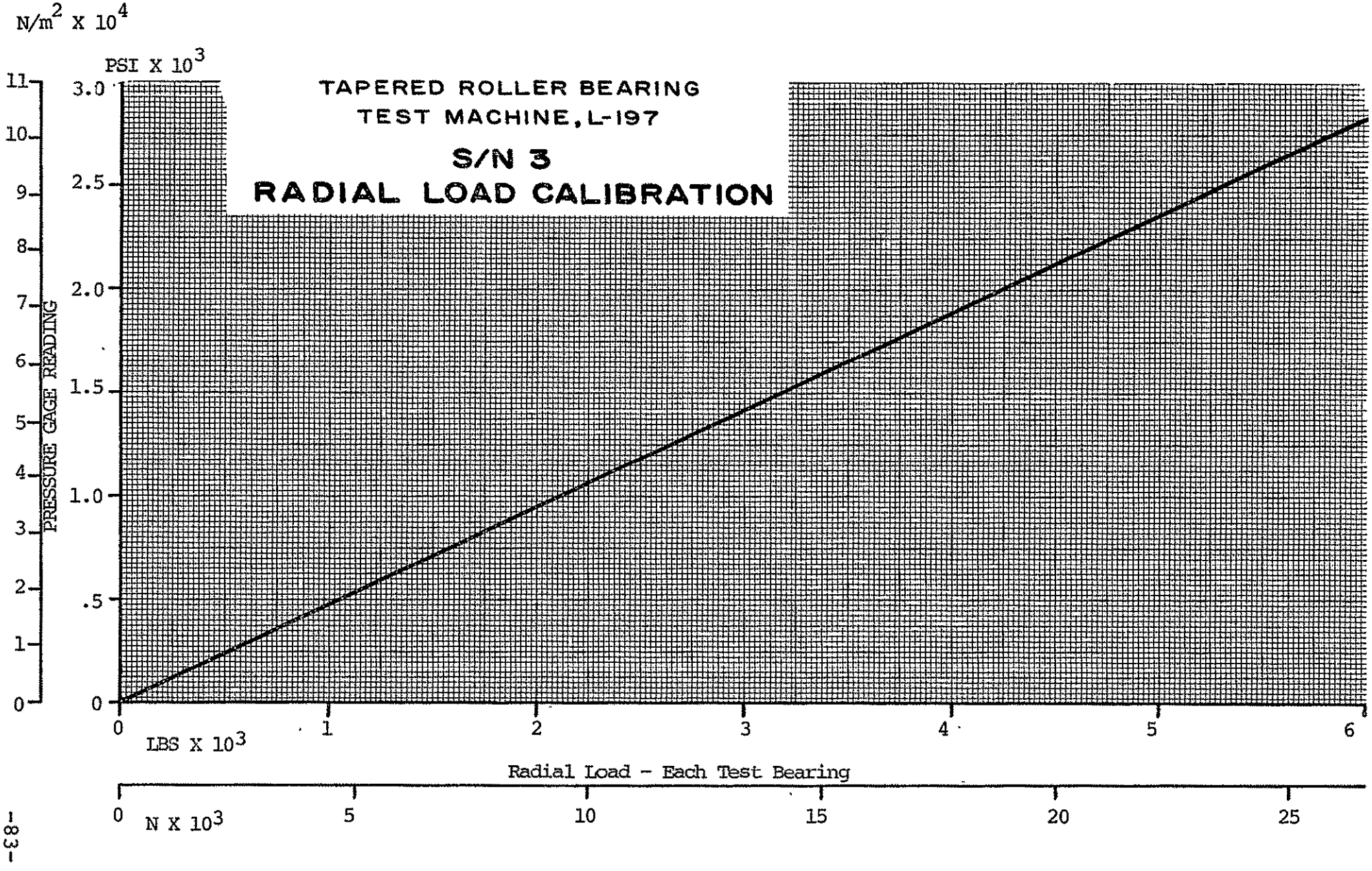

N/m² X 10⁴
PSI X 10³
TAPERED ROLLER BEARING
TEST MACHINE, L-197
S/N 3
RADIAL LOAD CALIBRATION
PRESSURE GAGE READING
LBS X 10³
Radial Load - Each Test Bearing
N X 10³

Figure 9

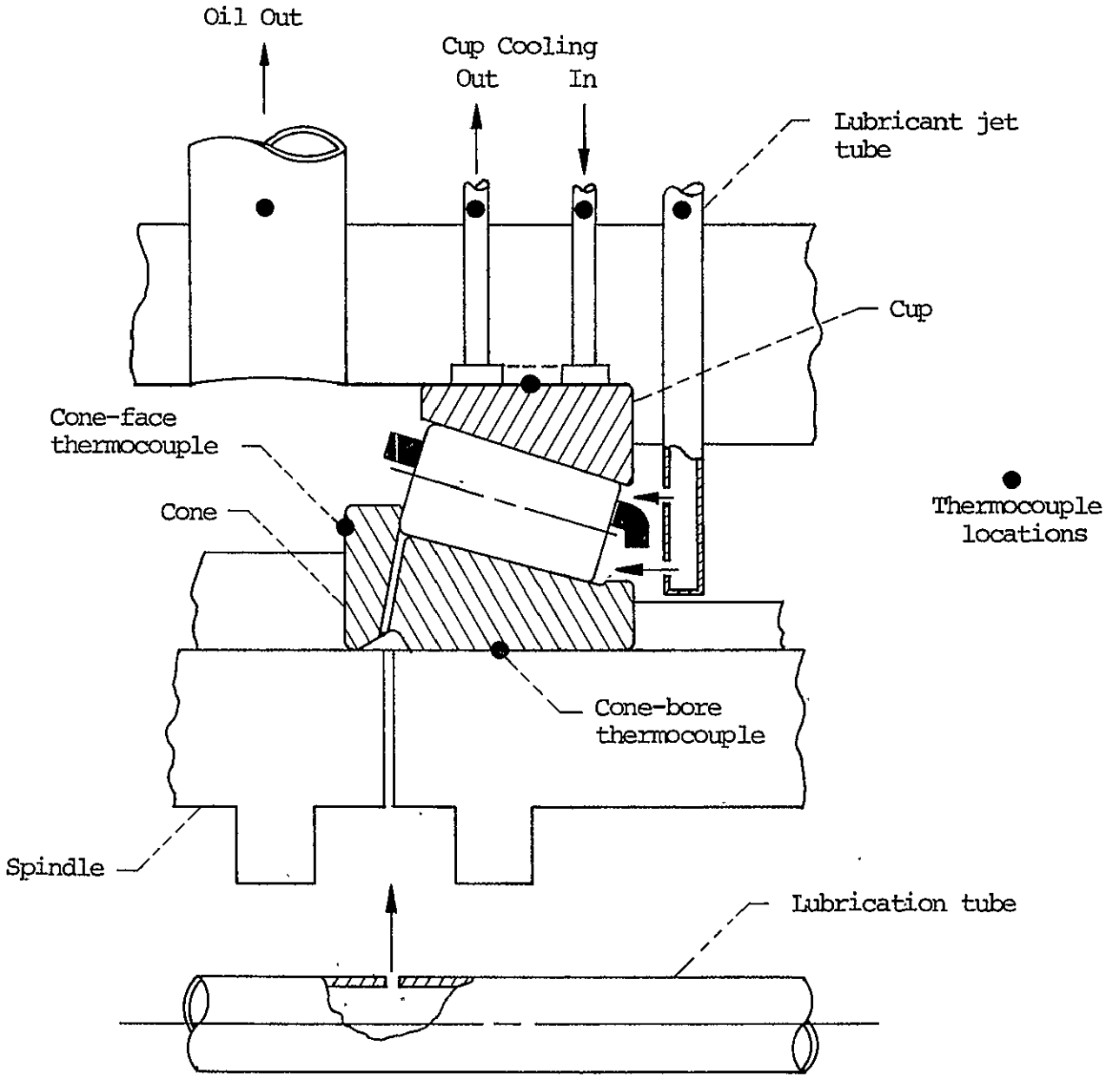
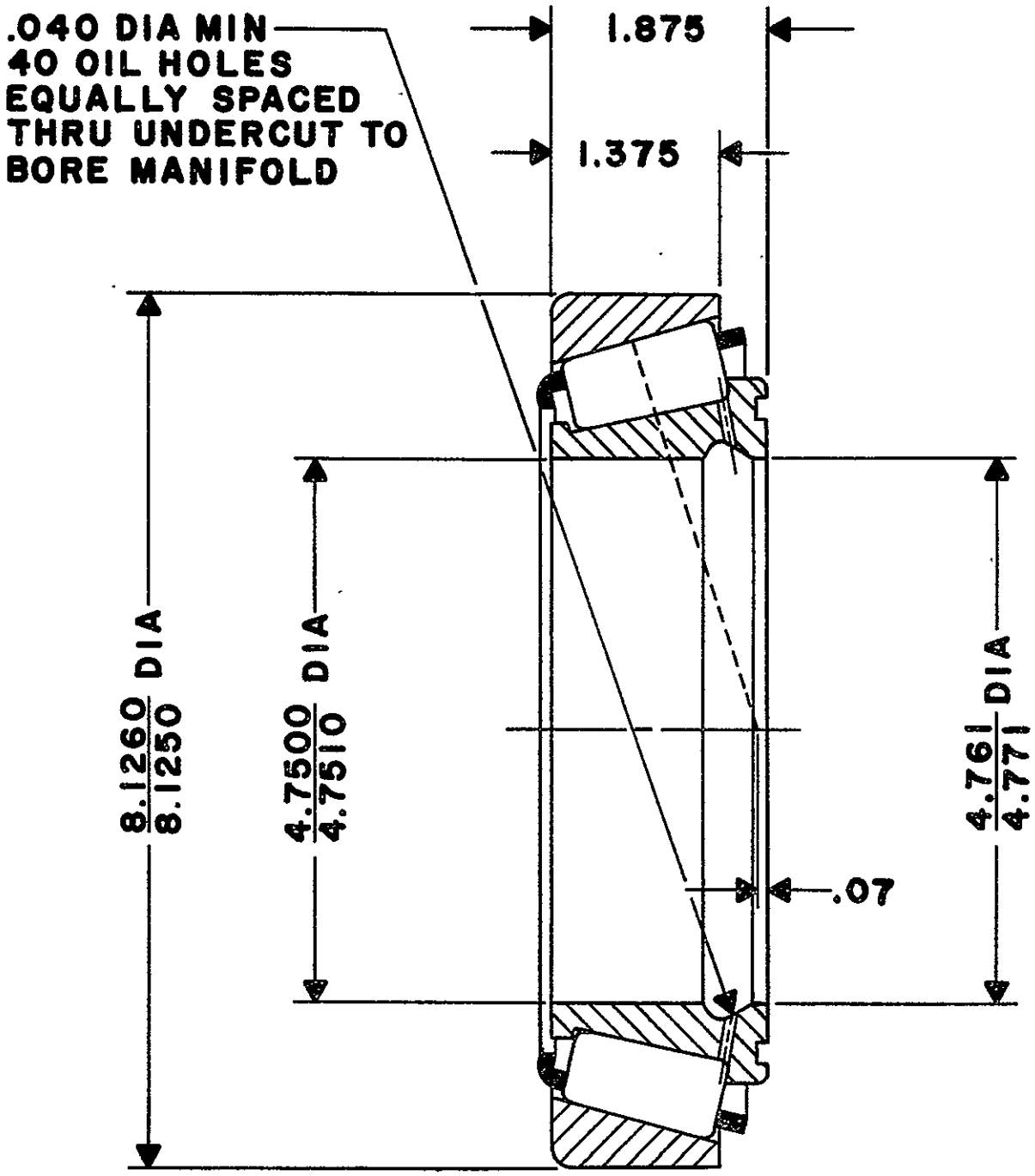
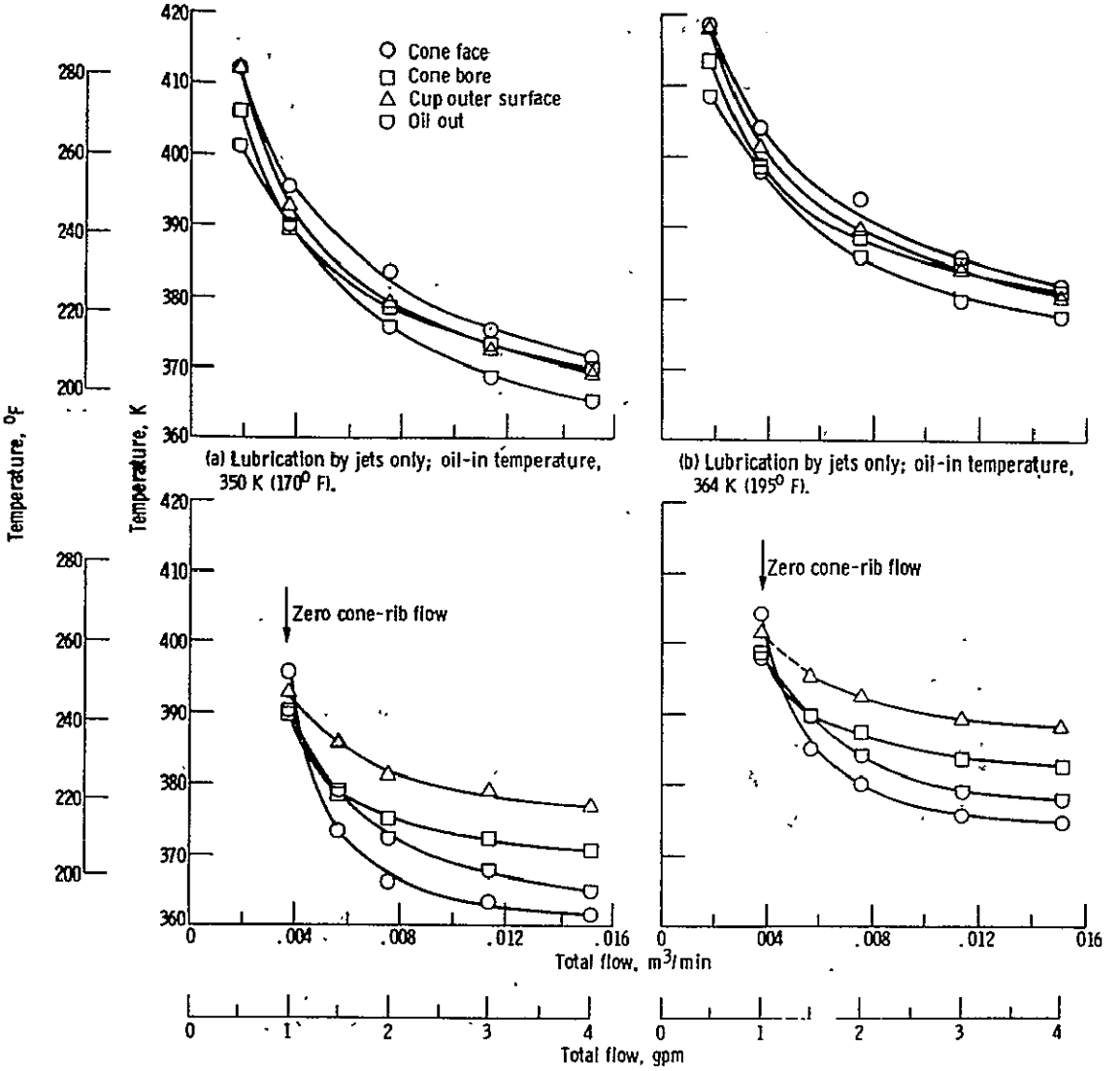


Figure 10 - Test Bearing lubrication and thermocouple locations.



Test Bearing
Tapered-Roller Bearing Test Program

Figure 11



(a) Lubrication by jets only; oil-in temperature, 350 K (170° F).

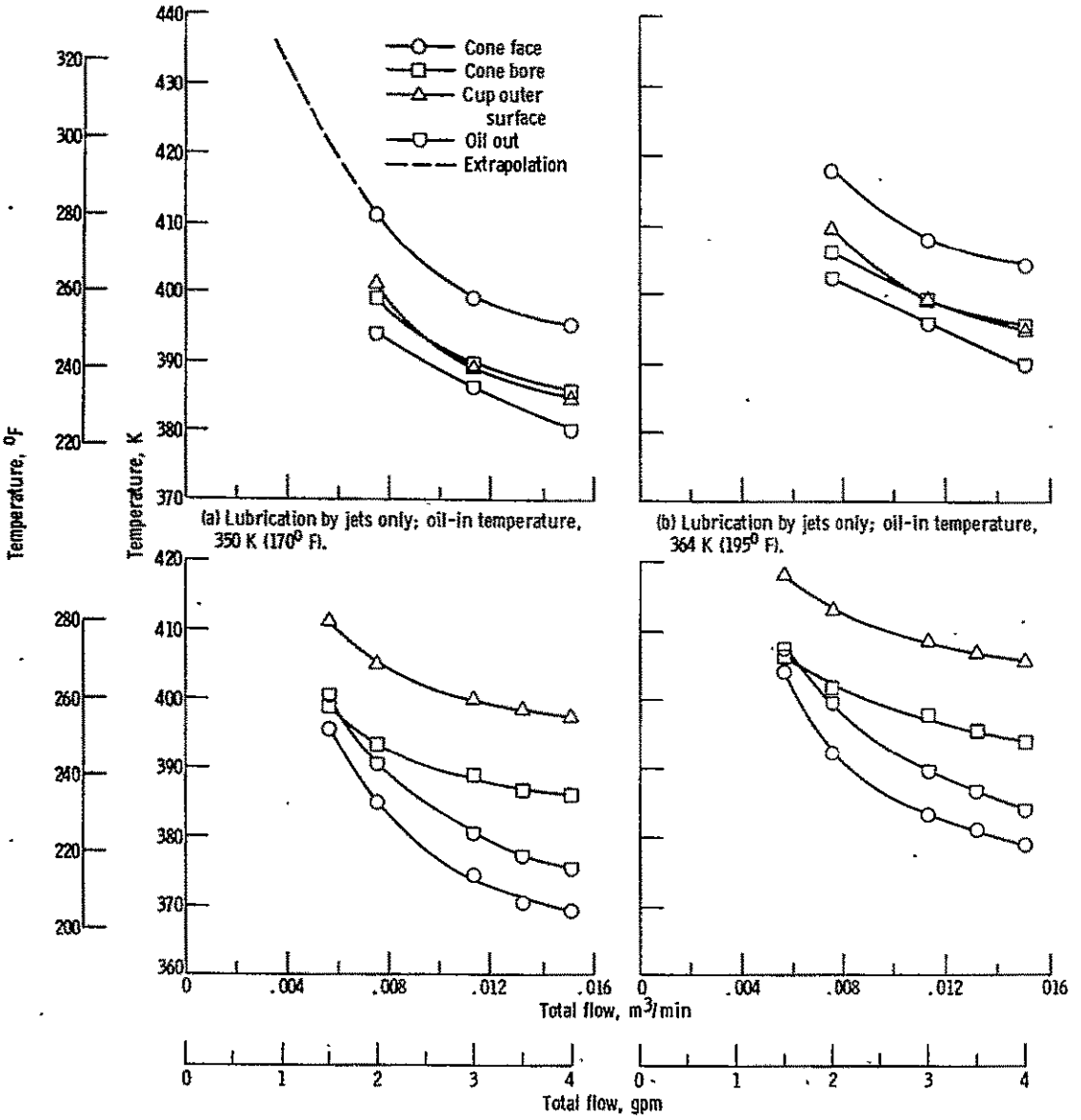
(b) Lubrication by jets only; oil-in temperature, 364 K (195° F).

(c) Lubrication through cone rib with 0.0038 m^3/min (1.0 gpm) by jets; oil-in temperature, 350 K (170° F).

(d) Lubrication through cone rib with 0.0038 m^3/min (1.0 gpm) by jets, oil-in temperature, 364 K (195° F)

- Temperature as a function of flow rate at shaft speed of 6000 rpm. Thrust load, 53 400 N (12 000 lb); radial load, 26 700 N (6000 lb).

Figure 12



(a) Lubrication by jets only; oil-in temperature, 350 K (170° F).

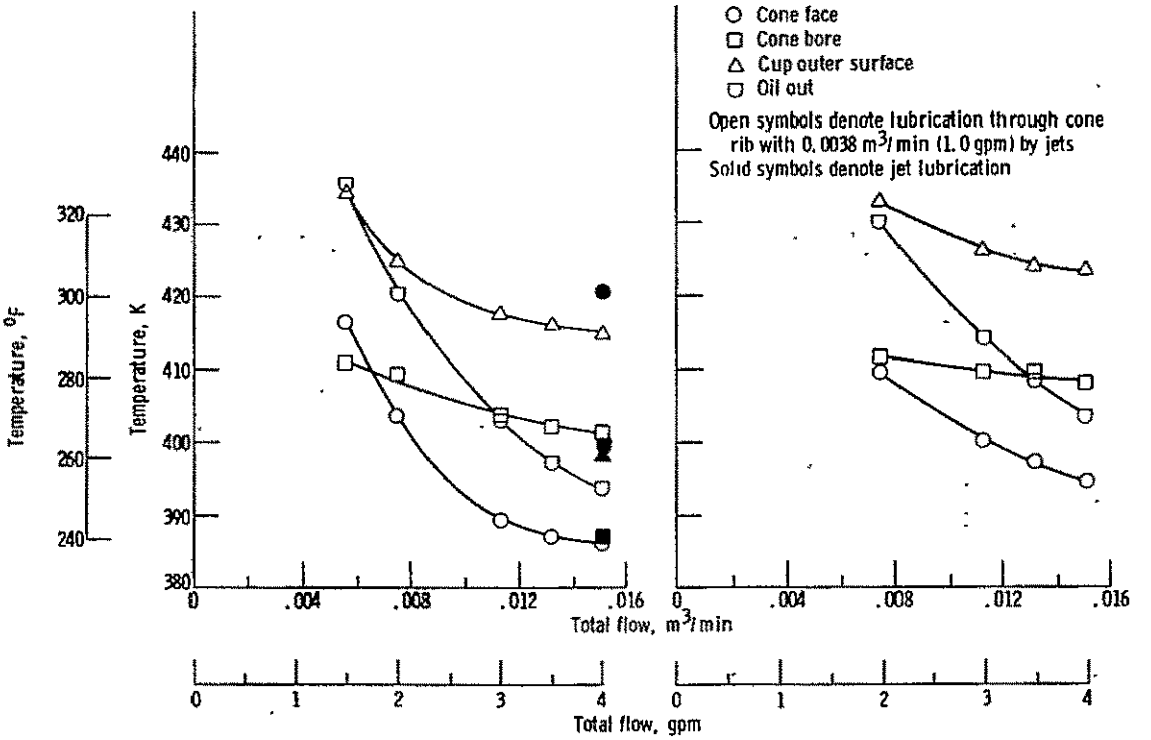
(b) Lubrication by jets only; oil-in temperature, 364 K (195° F).

(c) Lubrication through cone rib with 0.0038 m^3/min (1.0 gpm) by jets; oil-in temperature, 350 K (170° F).

(d) Lubrication through cone rib with 0.0038 m^3/min (1.0 gpm) by jets; oil-in temperature, 364 K (195° F).

Temperature as a function of flow rate at a shaft speed of 10 000 rpm. Thrust load, 53 400 N (12 000 lb), radial load, 26 700 N (6000 lb).

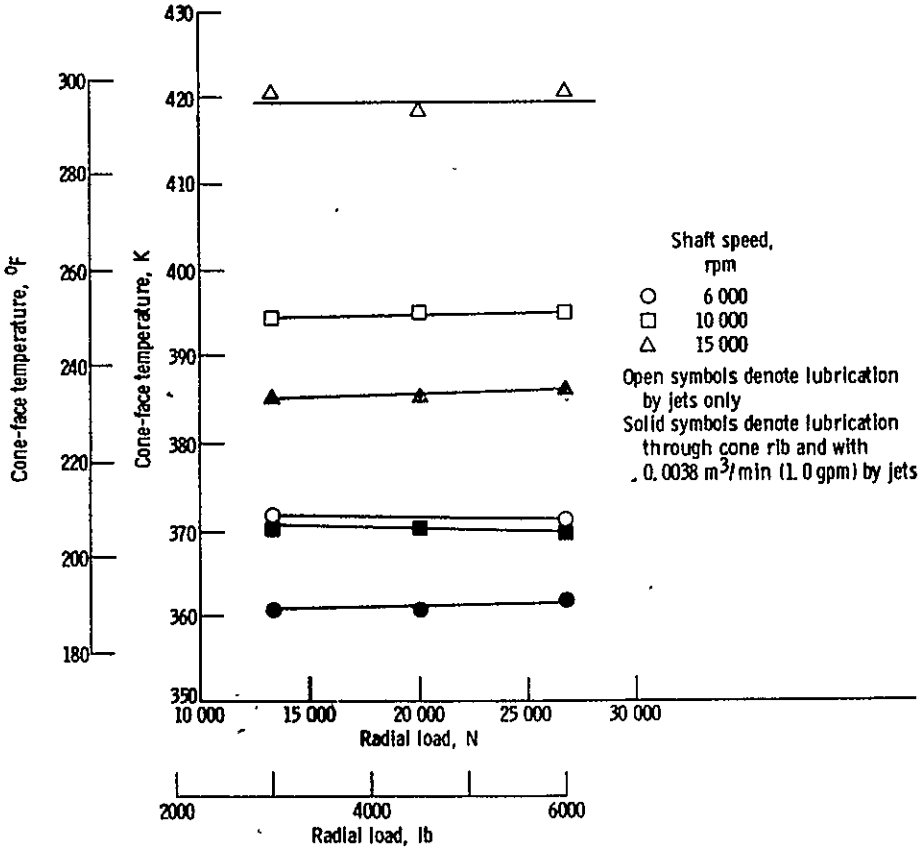
Figure 13



(a) Oil-in temperature, 350 K (170° F). (b) Oil-in temperature, 364 K (195° F).

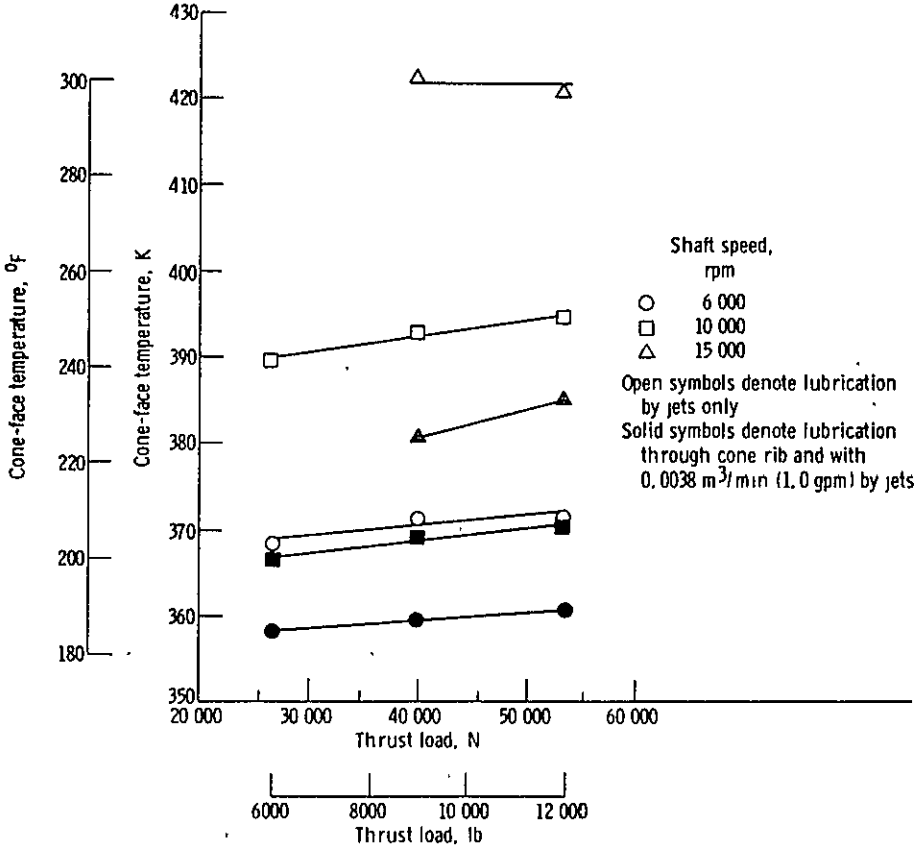
- Temperature as function of flow rate at shaft speed of 15 000 rpm. Thrust load, 53 400 N (12 000 lb); radial load, 26 700 N (6000 lb).

Figure 14



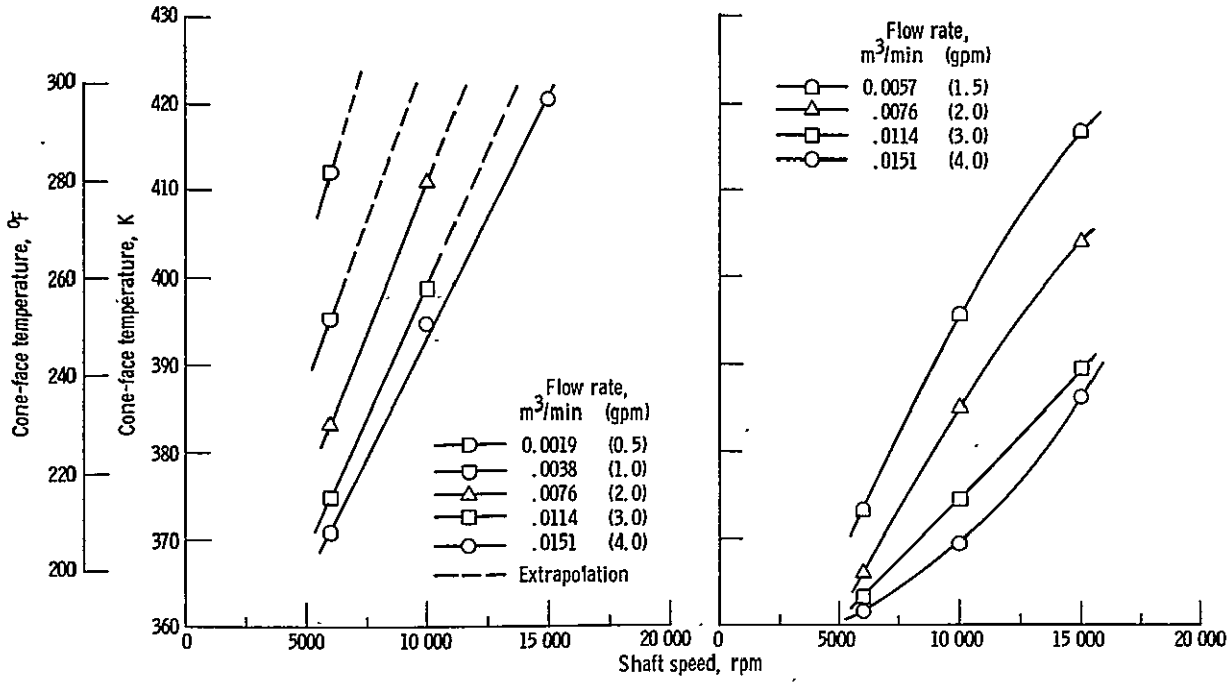
- Effect of radial load on cone-face temperature. Thrust load, 53 400 N (12 000 lb); oil-in temperature, 350 K (170° F); total oil flow, 0.0151 m³/min (4.0 gpm).

Figure 15



- Effect of thrust load on cone-face temperature. Radial load, 13 400 N (3000 lb); oil-in temperature, 350 K (170° F); total oil flow, 0.0151 m³/min (4.0 gpm).

Figure 16

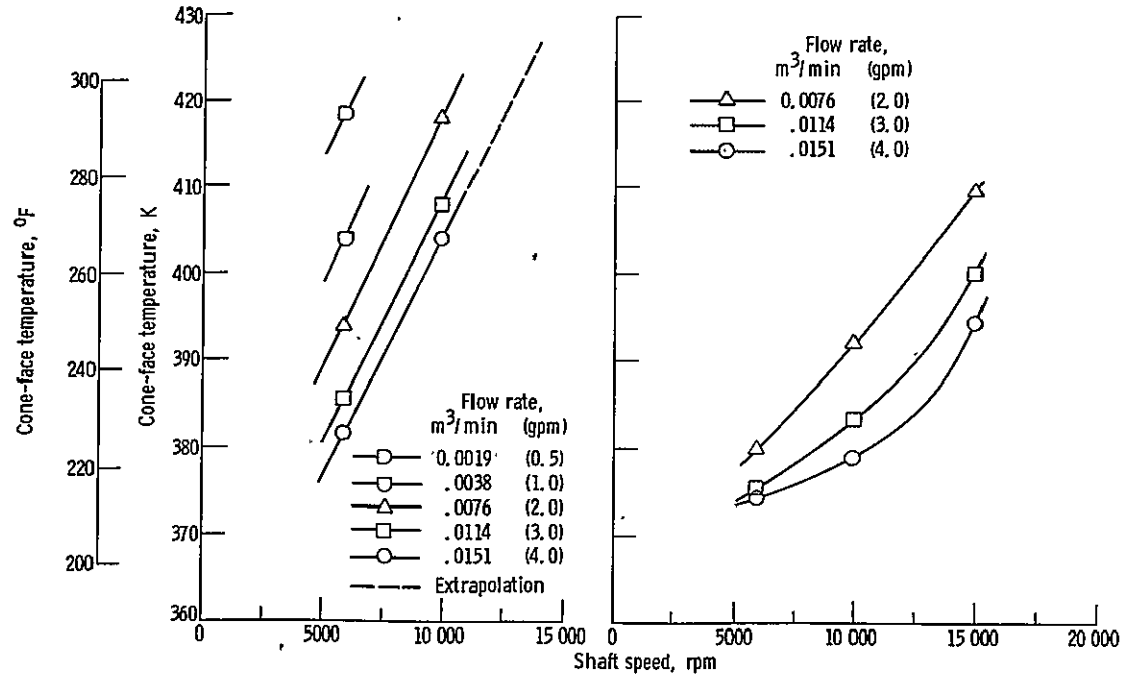


(a) Lubrication by jets only.

(b) Lubrication through cone rib with 0.0038 m^3/min (1.0 gpm) by jets.

- Effect of shaft speed and flow rate on cone-face temperature for oil-in temperature of 350 K (170° F). Thrust load, 53 400 N (12 000 lb); radial load, 26 700 N (6000 lb).

Figure 17

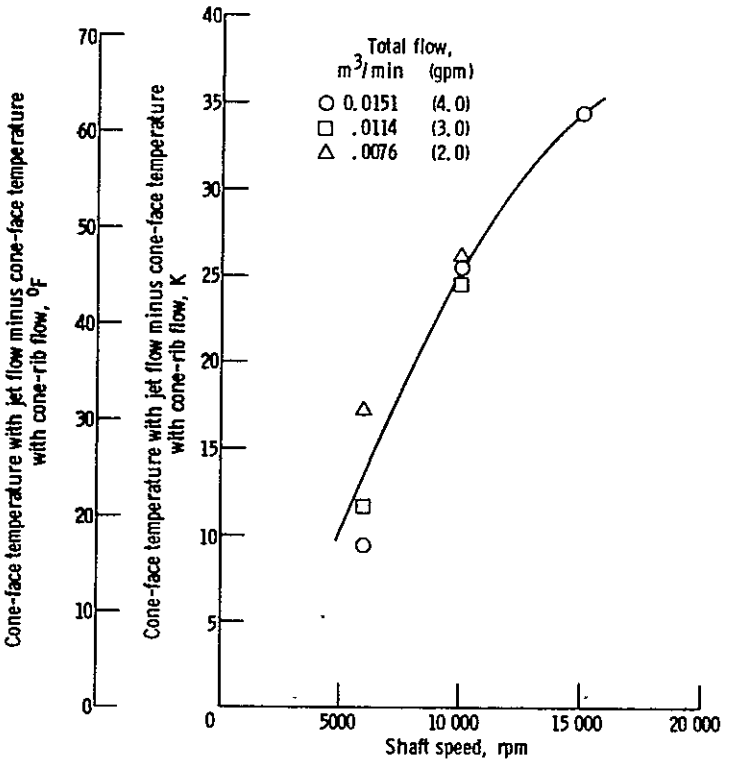


(a) Lubrication by jets only.

(b) Lubrication through cone rib with 0.0038 m^3/min (1.0 gpm) by jets.

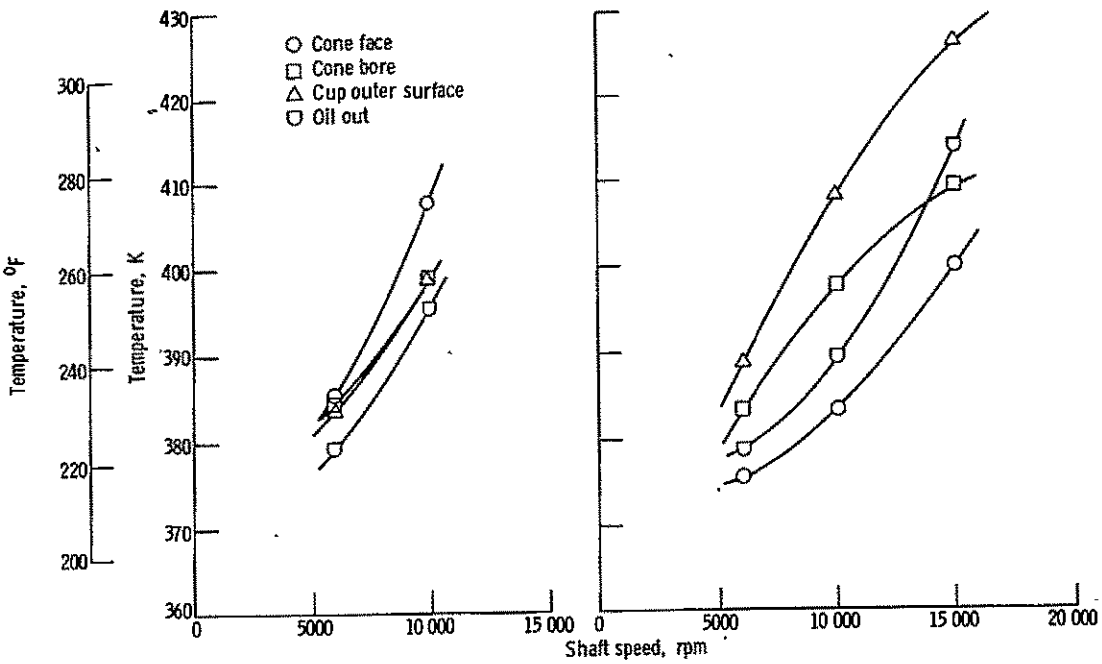
- Effect of shaft speed and flow rate on cone-face temperature for oil-in temperature of 364 K (195° F). Thrust load, 53 400 N (12 000 lb); radial load, 26 700 N (6000 lb).

Figure 18



- Effect of shaft speed on cone-face temperature with jet lubrication minus that with cone-rib lubrication. Oil-in temperature, 350 K (170° F); thrust load, 53 400 N (12 000 lb); radial load, 26 700 N (6000 lb).

Figure 19

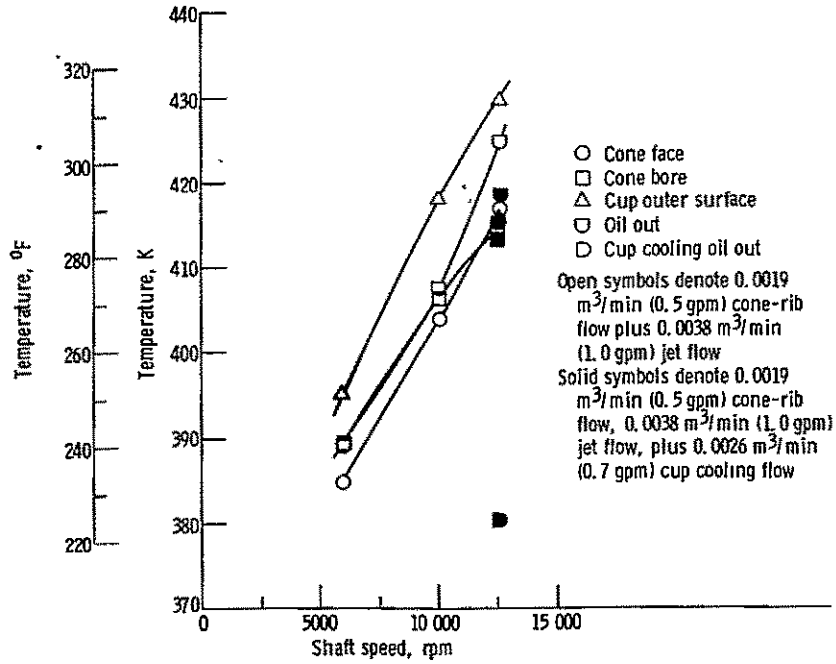


(a) Lubrication by jets only.

(b) Lubrication through cone rib with 0.0038 m^3/min (1.0 gpm) by jets.

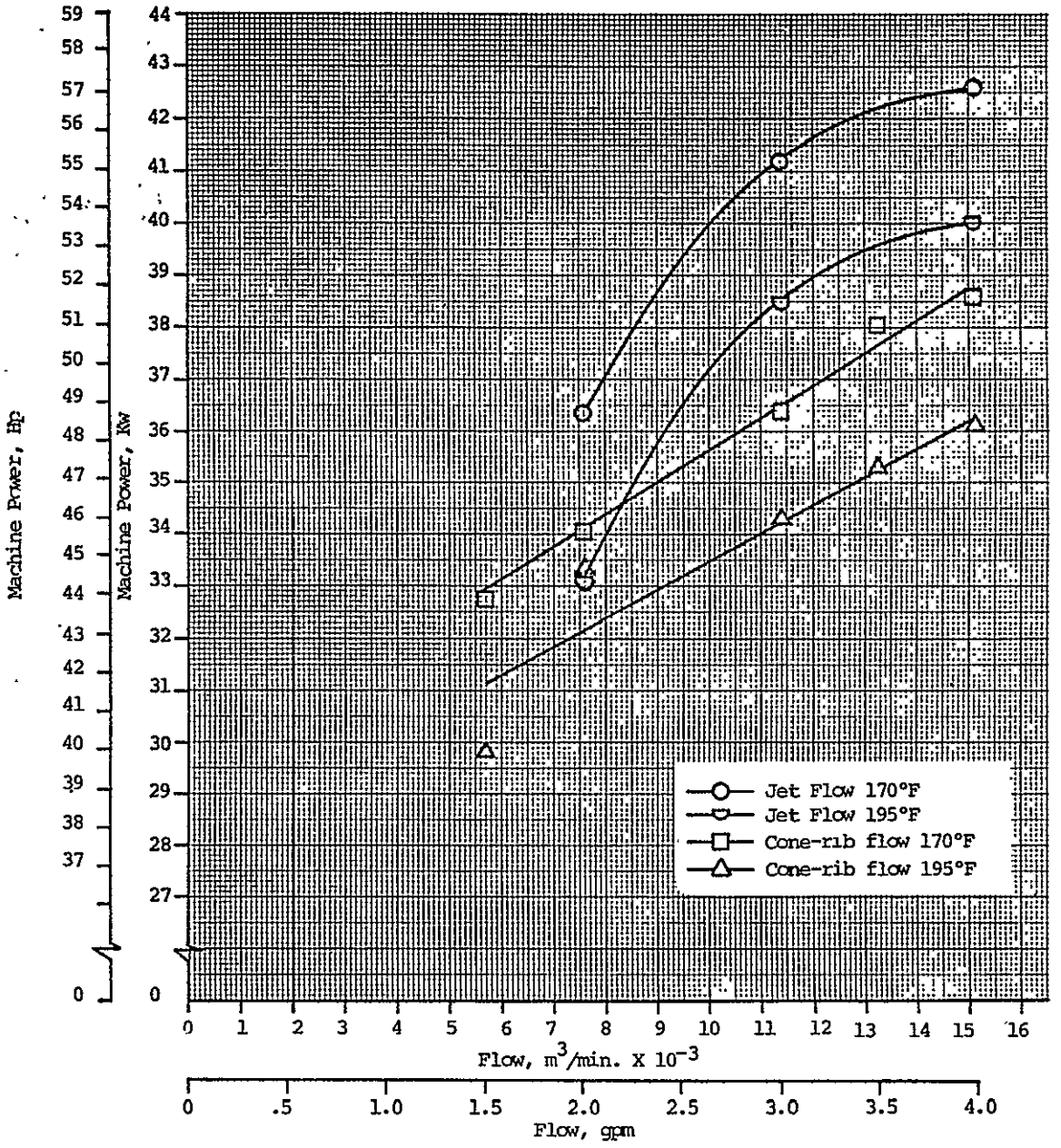
- Effect of jet lubrication and cone-rib lubrication on bearing and oil-out temperatures. Thrust load, 53 400 N (12 000 lb); radial load, 26 700 N (6000 lb); oil-in temperature, 364 K (195° F); total oil flow rate, 0.0114 m^3/min (3.0 gpm).

Figure 20



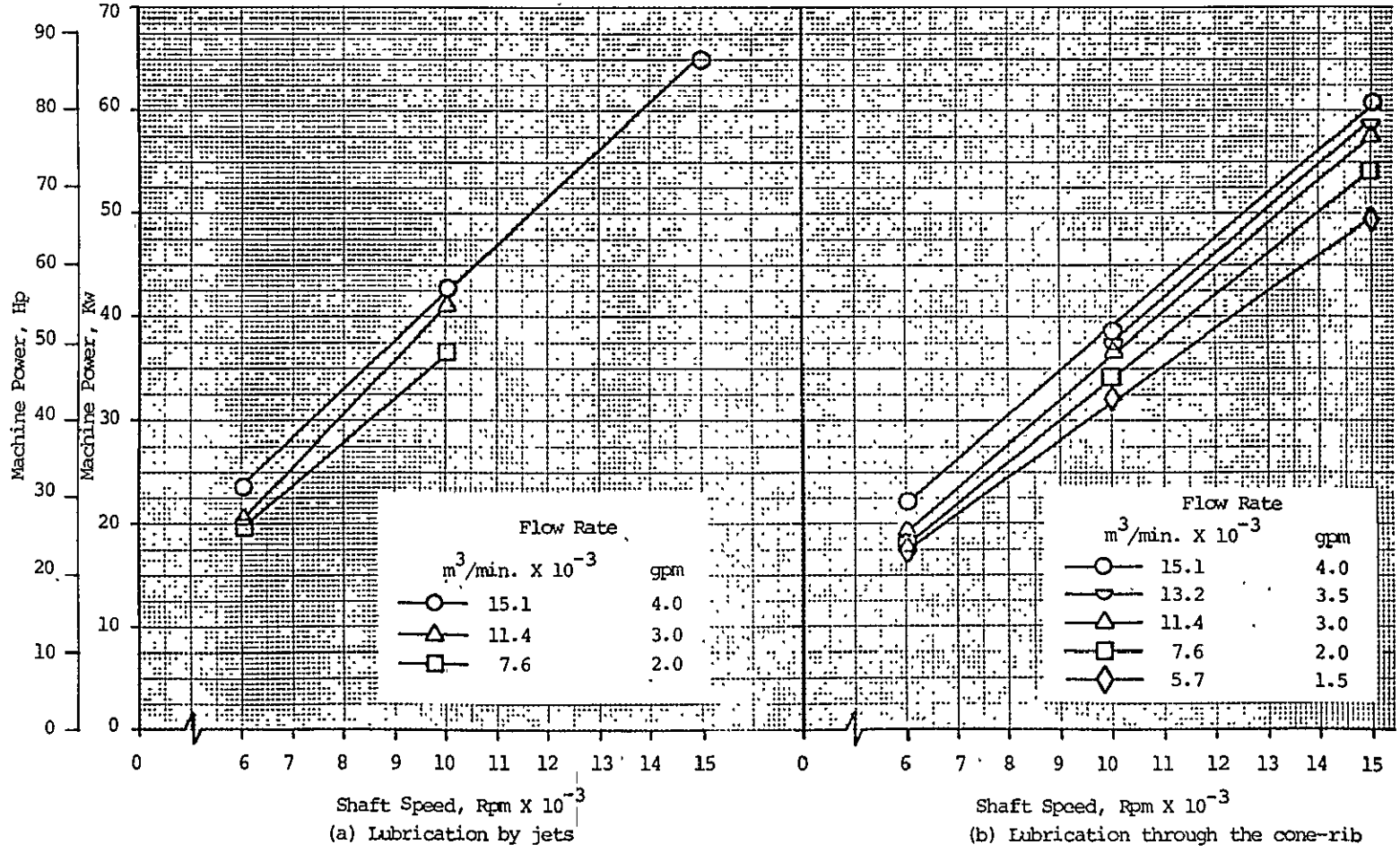
- Effect of cup cooling on bearing and oil-out temperatures. Thrust load, 53 400 N (12 000 lb); radial load, 26 700 N (6000 lb); oil-in temperature, 364 K (195° F).

Figure 21



Test machine power demand as a function of flow rate at 10,000 rpm shaft speed, 53,400 N (12,000 lbs) thrust load, 26,700 N (6,000 lbs) radial load.

Figure 22

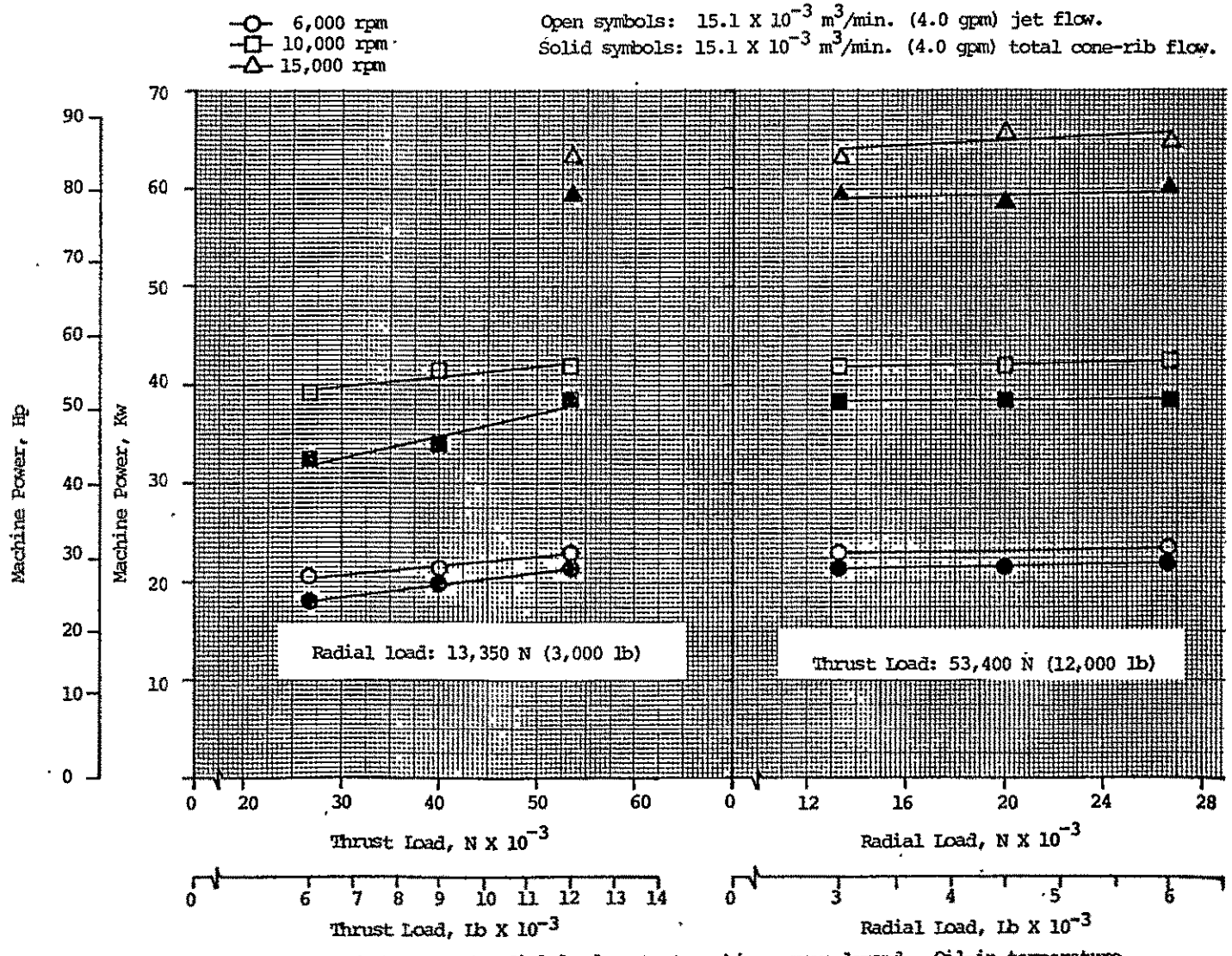


(a) Lubrication by jets

(b) Lubrication through the cone-rib

Effect of shaft speed and flow rate on test machine power demand for an oil-in temperature of 350°K (170°F). Thrust load 53,400 N (12,000 lb), radial load 28,700 N (6,000 lb).

Figure 23



Effect of thrust and radial load on test machine power demand. Oil-in temperature 350°K (170°F), total oil flow 15.1 X 10^{-3} m^3/min. (4.0 gpm).

Figure 24

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