DOE/NASA/0124-2
NASA CR-159881

SMALL PASSENGER CAR TRANSMISSION TEST— FORD C4 TRANSMISSION

M.P. Bujold
Eaton Corporation
Engineering & Research Center

June 1980

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Lewis Research Center
Under Contract DEN 3-124

for
U.S. DEPARTMENT OF ENERGY
Conservation and Solar Energy
Office of Transporation Programs

NOTICE

DOE/NASA/0124-2
NASA CR-159881

SMALL PASSENGER CAR TRANSMISSION TEST— FORD C4 TRANSMISSION

M.P. Bujold
Eaton Corporation
Engineering & Research Center
Southfield, Michigan 48037

June 1980

Prepared for
National Aeronautics and Space Administration
Lewis Research Center
Cleveland, Ohio 44135
Under Contract DEN 3-124

for
U.S. DEPARTMENT OF ENERGY
Conservation and Solar Energy
Office of Transportation Programs
Washington, D.C. 20545
Under Interagency Agreement EC-77-A-31-1044

PREFACE

The Electric and Hybrid Vehicle Research, Development, and Demonstration Act of 1976 (Public Law 94-413) authorized a Federal program of research and development designed to promote electric and hybrid vehicle technologies. The Energy Research and Development Administration, now the Department of Energy (DOE), which was given the responsibility for implementing the Act, established the Electric and Hybrid Vehicle Research, Development, and Demonstration Project within the Division of Transportation Energy Conservation to manage the activities required by Public Law 94-413.

The National Aeronautics and Space Administration under an Interagency Agreement (Number EC-77-A-31-1044) was requested by ERDA (DOE) to undertake research and development of propulsion systems for electric and hybrid vehicles. The Lewis Research Center was made the responsible NASA Center for this project. The work presented in this report is an early part of the Lewis Research Center program for propulsion system research and development for electric vehicles.

The work described in this report was conducted under Contract DEN 3-124 with the National Aeronautics and Space Administration (NASA) and sponsored by the Department of Energy through an agreement with NASA.

TABLE OF CONTENTS

TABLE OF CONTENTS (cont'd)

SUMMARY

The small passenger car transmission test was initiated to supply electric vehicle manufacturers with technical information regarding the performance of commercially available transmissions. This information would enable EV manufacturers to design a more energy efficient vehicle. With this information the manufacturers would be able to estimate vehicle driving range as well as speed and torque requirements for specific road load performance characteristics.

This report covers the 1979 Ford C4 automatic transmission. This transmission was tested per a passenger car automatic transmission test code (SAE J651b) which required drive performance, coast performance, and no load test conditions. Under these test conditions the transmission attained maximum efficiencies in the mid-80% range for both drive performance tests and coast performance tests. The major results of this test are the torque speed and efficiency curves which are located in the data section of this report. These graphs map the complete performance characteristics for the Ford C4 transmission. This information will facilitate the vehicle manufacturer in the design of a more energy efficient vehicle.

INTRODUCTION

The Ford C4 transmission is a commercially available automatic transmission which is suited for a small passenger car installation. The transmission is equipped with three forward driving ranges, a neutral, reverse, and park. Very little technical information in the area of torque, speed and efficiency data is currently available on this transmission. This lack of available information was the principal reason for the initiation of this test.

The principal object of this test was to map torque, speed, and efficiency curves of the test transmission in each gear range and in both drive performance and coast performance conditions. The test was performed per the specifications of the Passenger Car Automatic Transmission Test Code - SAE J651b. The torque and speed limits of this test were governed by the torque and speed limits of an engine which would typically be supplied with this transmission. The test code specified that three basic tests were to be conducted which involved holding the torque constant and varying the transmission speed. The three specific tests were drive performance, coast performance, and no load losses which were conducted in first, second and third gear.

The test code required that the transmission should be held in gear over the complete range of the test. In order to accomplish this, it was necessary to block the valves. This kept the transmission locked in gear. The test code also specified an oil temperature requirement to ensure that a set viscosity level be attained throughout the tests. This temperature requirement was accomplished through the use of an immersion heater and oil cooler. The oil temperature was the main factor in limiting the amount of load that could be applied to the transmission.

The data that was obtained from the torque and speed sensors was placed directly onto tape. The tape was then fed into a computer which reduced the data and generated the necessary graphs and technical information. The main advantage to this method of data reduction is that any fluctuation that may occur due to system resonance is averaged by the computer. This method minimizes the error and allows the data to be viewed after the tests are completed.

EQUIPMENT TESTED

This report involves the tests conducted on a Ford C4 automatic transmission (Part No. D9ZP 7000 EA, Serial No. PEJ M6 M4J, D9EP AA). The transmission consists primarily of a three-element hydraulic torque converter and a planetary gear set. Two multiple-disc clutches, a one-way clutch, and a hydraulic control system which is capable of providing automatic upshifts and downshifts through the three forward ratios.

The torque converter couples the engine to the planetary gears through oil and provides hydraulic torque multiplication when required. The planetary gear set produces three forward speeds and reverse.

The three-element torque converter consists of a pump or driving member, a turbine or driven member, and a stator assembly. The stator is mounted on a one-way roller clutch which will allow the stator to turn in the clockwise direction. This is a commercially available transmission which is suited for small passenger vehicles.

TEST APPARATUS

The test apparatus used to operate the Ford C4 transmission consisted of the following basic items which are described and listed below. The apparatus was basically the same for drive and coast performance tests with the exception of the transmission which was indexed 180° for coast performance tests.

The driving dynamometer was used to power the transmission. A torque sensor was placed on the dynamometer shaft to accurately monitor the torque into the transmission. A speed pickup was placed on the dyno shaft to measure the speed into the transmission.

The output shaft of the transmission was coupled to a torque sensor which accurately measured its torque. An absorbing dynamometer was coupled to the rear torque sensor to apply load to the system. A speed pickup was mounted to the absorber shaft to measure output speed.

The transmission oil temperature was controlled through the use of a heat exchanger and circulation heater. When the transmission was operating at light load, the oil cooler was shutdown and the circulation heater was engaged so that the oil could be kept up to temperature specification. When the transmission was operating under heavy load, the oil cooler was operating and the circulation heater was disengaged so that the temperature specification was not exceeded.

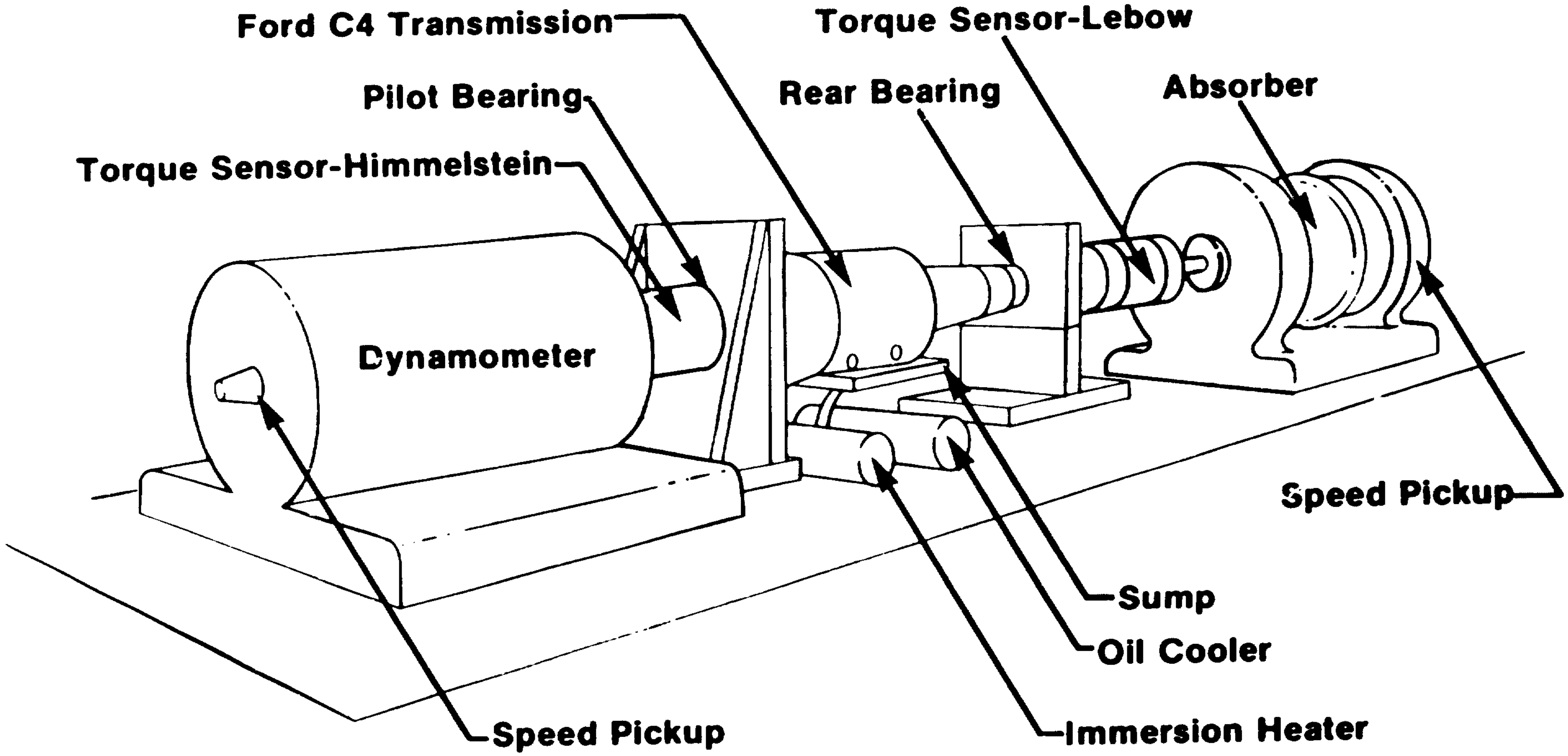
The transmission was held in first gear by placing the gear selector lever in its appropriate setting. The transmission was held in second gear by blocking the 1 to 2 shift valve in the second position. The transmission was held in third gear by placing stops in the 1 to 2 shift valve and the 2 to 3 shift valve so the valves were kept in the 2 and 3 position respectively.

The instrumentation for the setup consisted of the following basic items. The Lebow torque sensor was used in conjunction with a Daytronic signal conditioner (878). The Himmelstein torque sensor was matched with a Daytronic signal conditioner (878A). The magnetic speed pickup was used with an Airpax speed readout. These signals were then fed into a Sangamo 3500 tape recorder. The tape recorded data were then fed into a Hewlett Packard Analyzer which reduced the data.

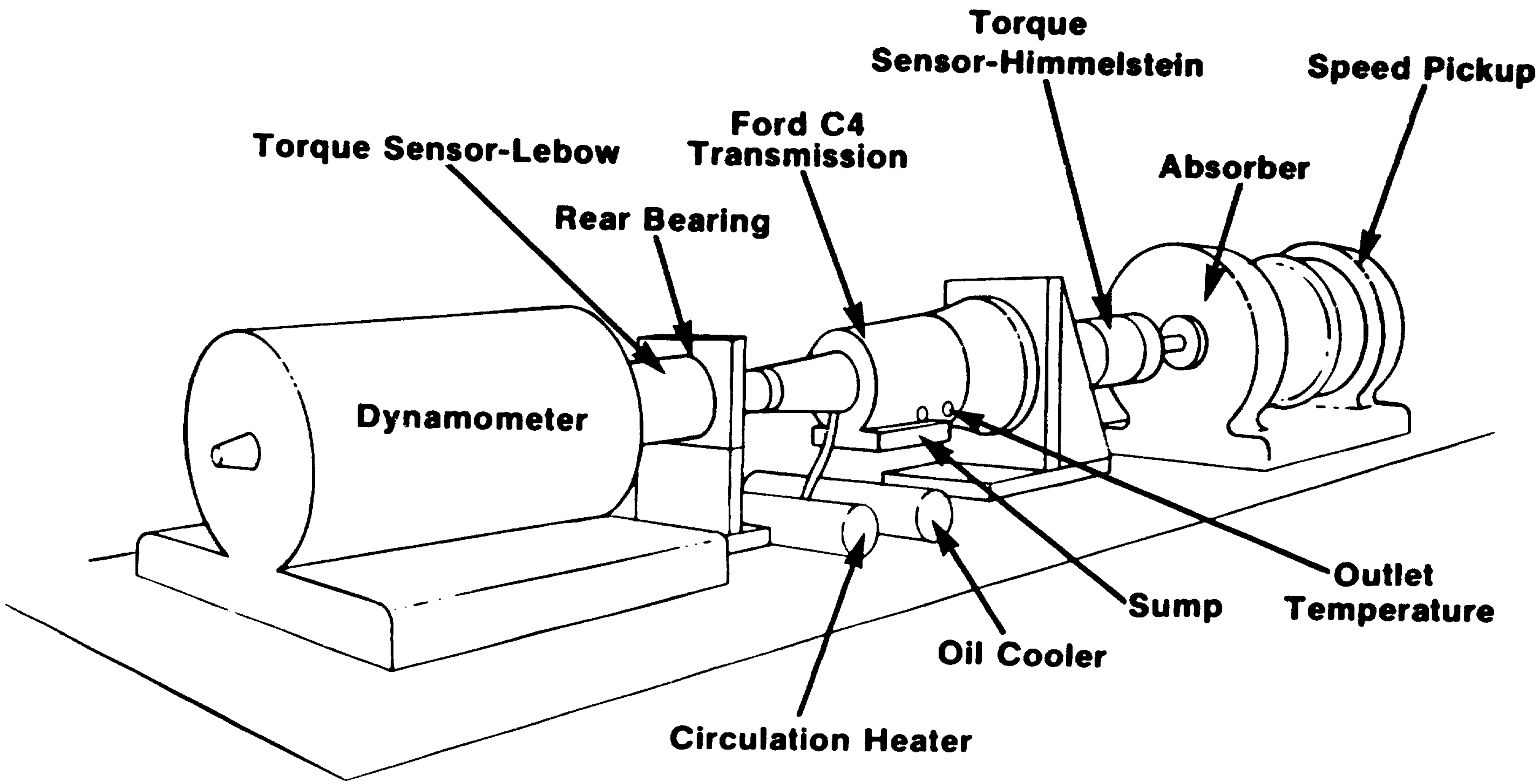
DESCRIPTION	PART NO.	MANUFACTURER
Driving Dynamometer	Model 26G308	General Electric
Flexible Coupling	226 SN	Thomas-Rexnord
Torque Sensor	MCRT6-02T(2-3)	Himmelstein
Pilot Bearing	SFT-15	Sealmaster
Transmission	C4	Ford
Rear Bearing	209-SFF	MRC
Flexible Coupling	226 SN	Thomas-Rexnord
Torque Sensor	1648-5K	Lebow
Absorber	1014DG	Dynamatic
Heat Exchanger	F-301-ER-2P	Young
Circulation Heater	NWHO-2	Chromalox
Pressure Gage	D-0252	Marsh

INSTRUMENTATION

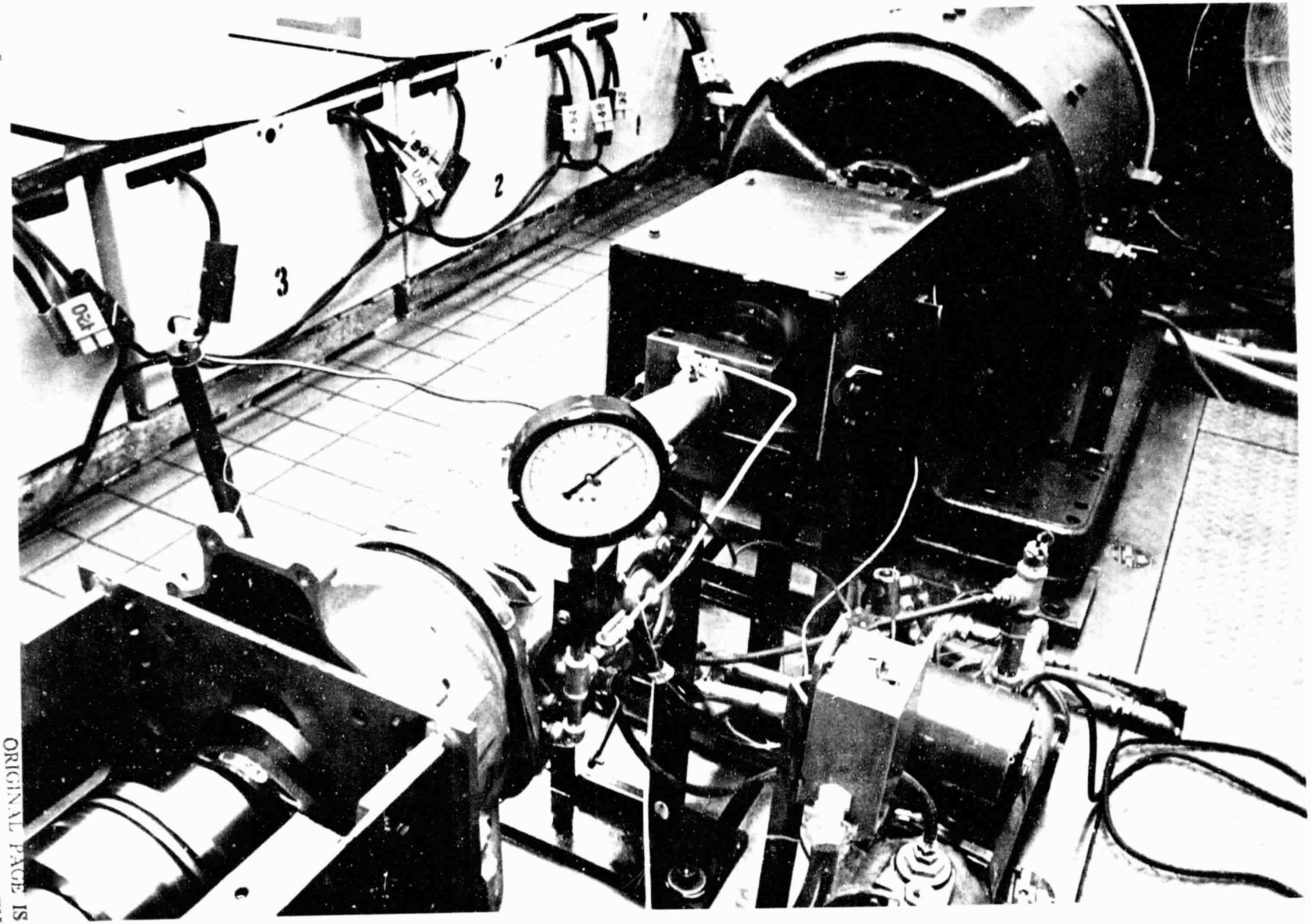
Torque Signal Conditioner	878A	Daytronic
Torque Signal Conditioner	878	Daytronic
Speed Readout	761400110	Airpax
Temperature Conditioner	810	Daytronic
Thermocouples	6610WBA2	Applied Instruments



**Drive Performance Test Setup
DEN3-124**

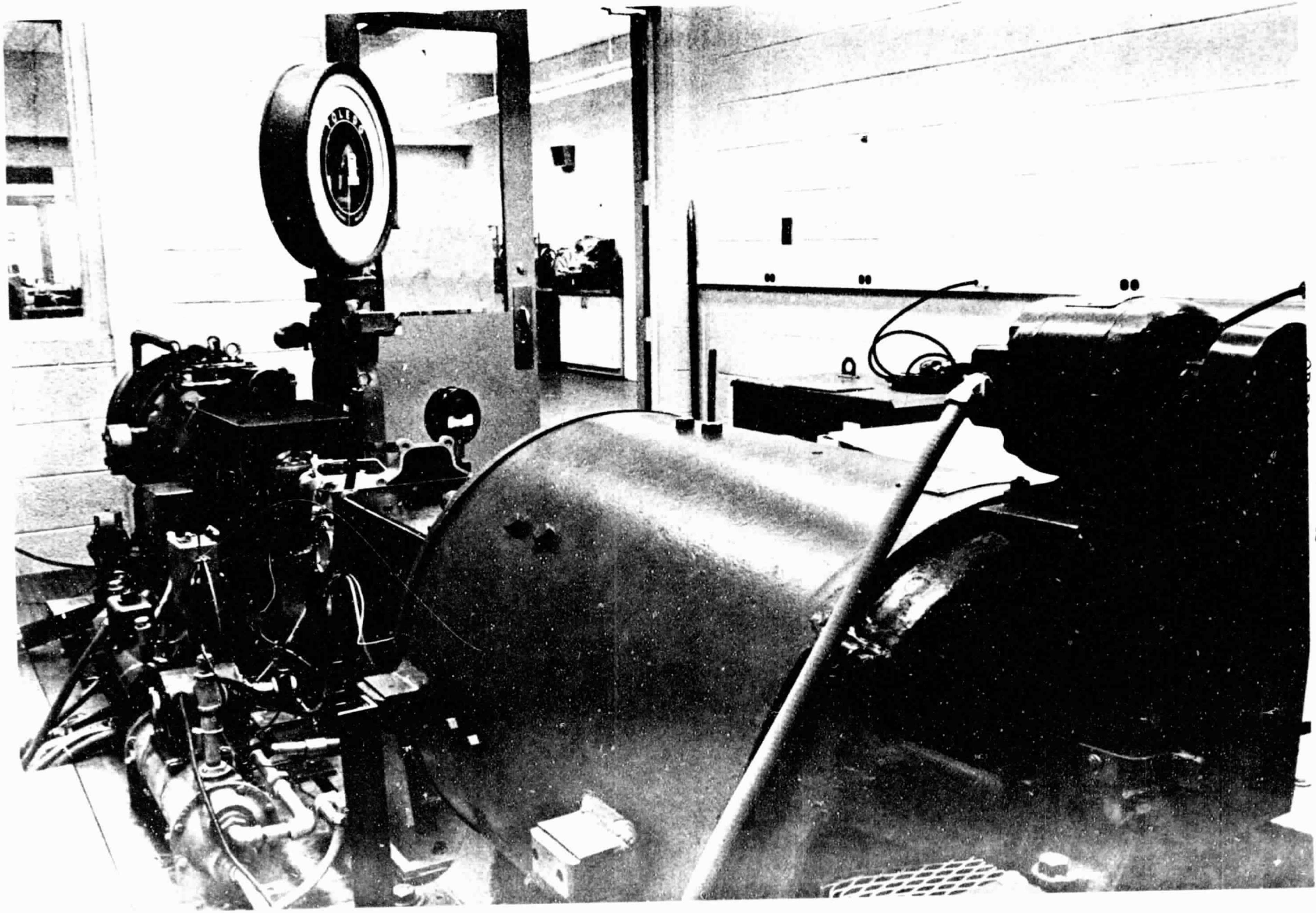


Coast Performance Test Setup
DEN3-124

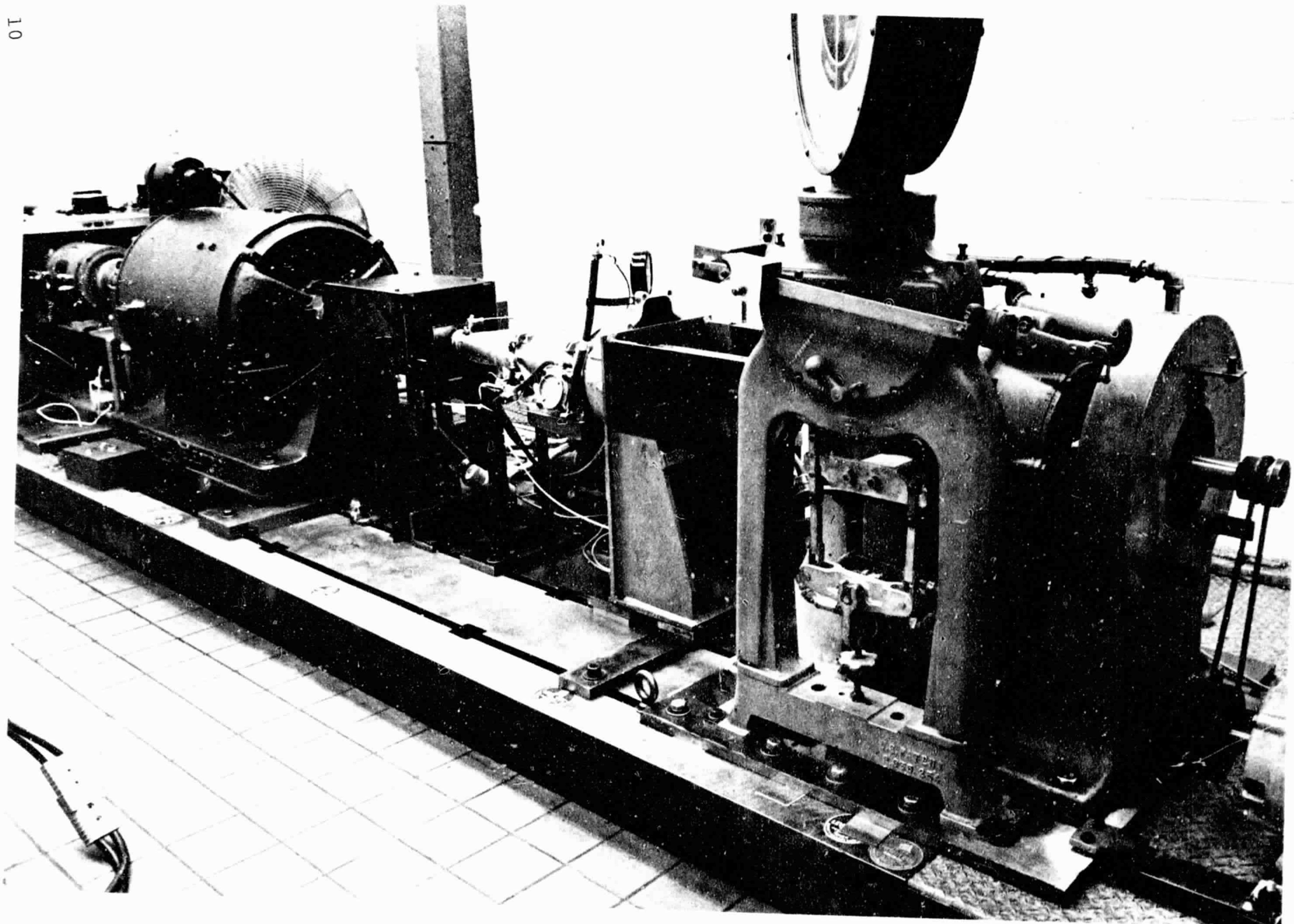


1979 Ford C4 Coast Performance (Front View)

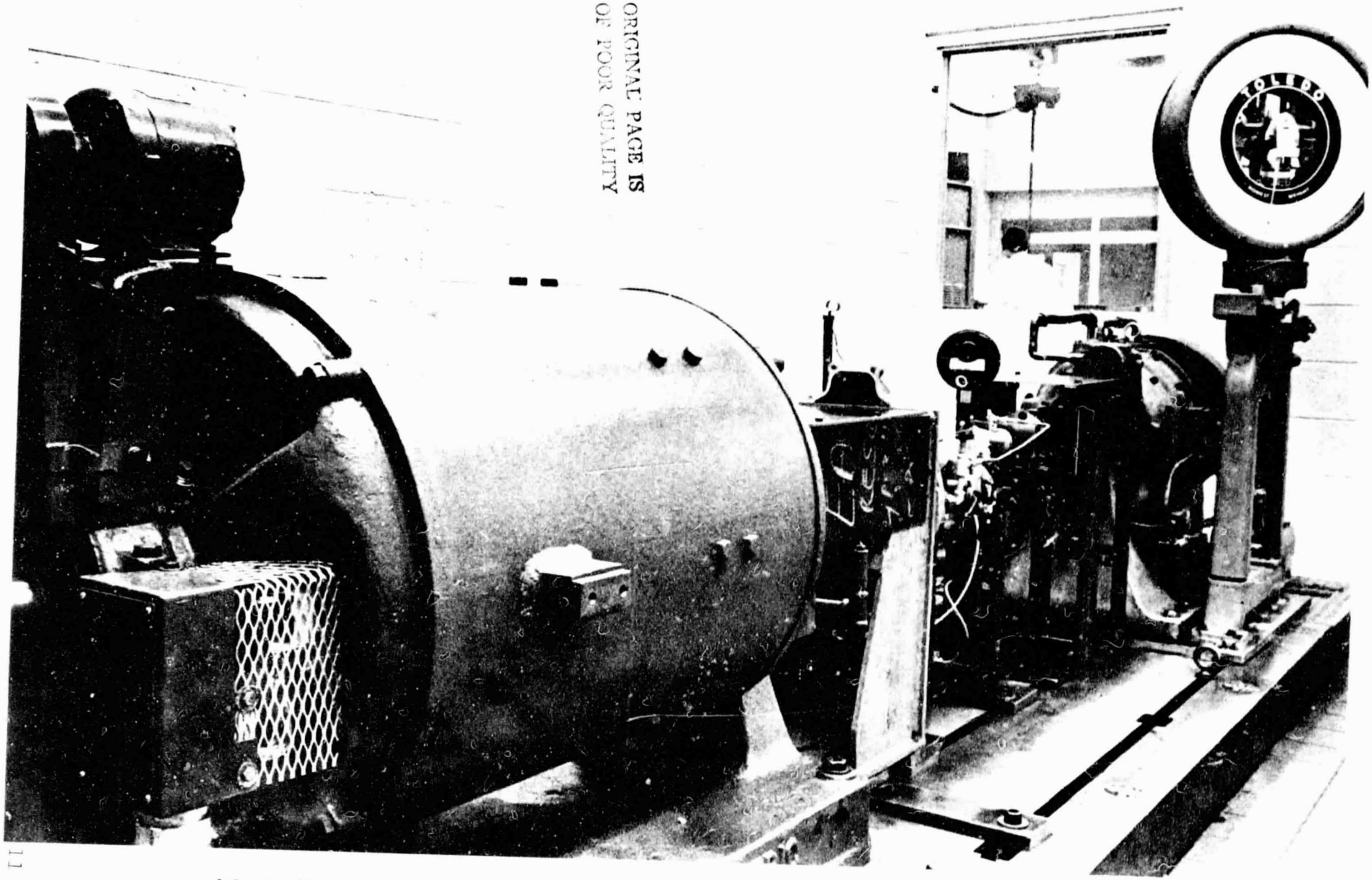
ORIGINAL PAGE IS



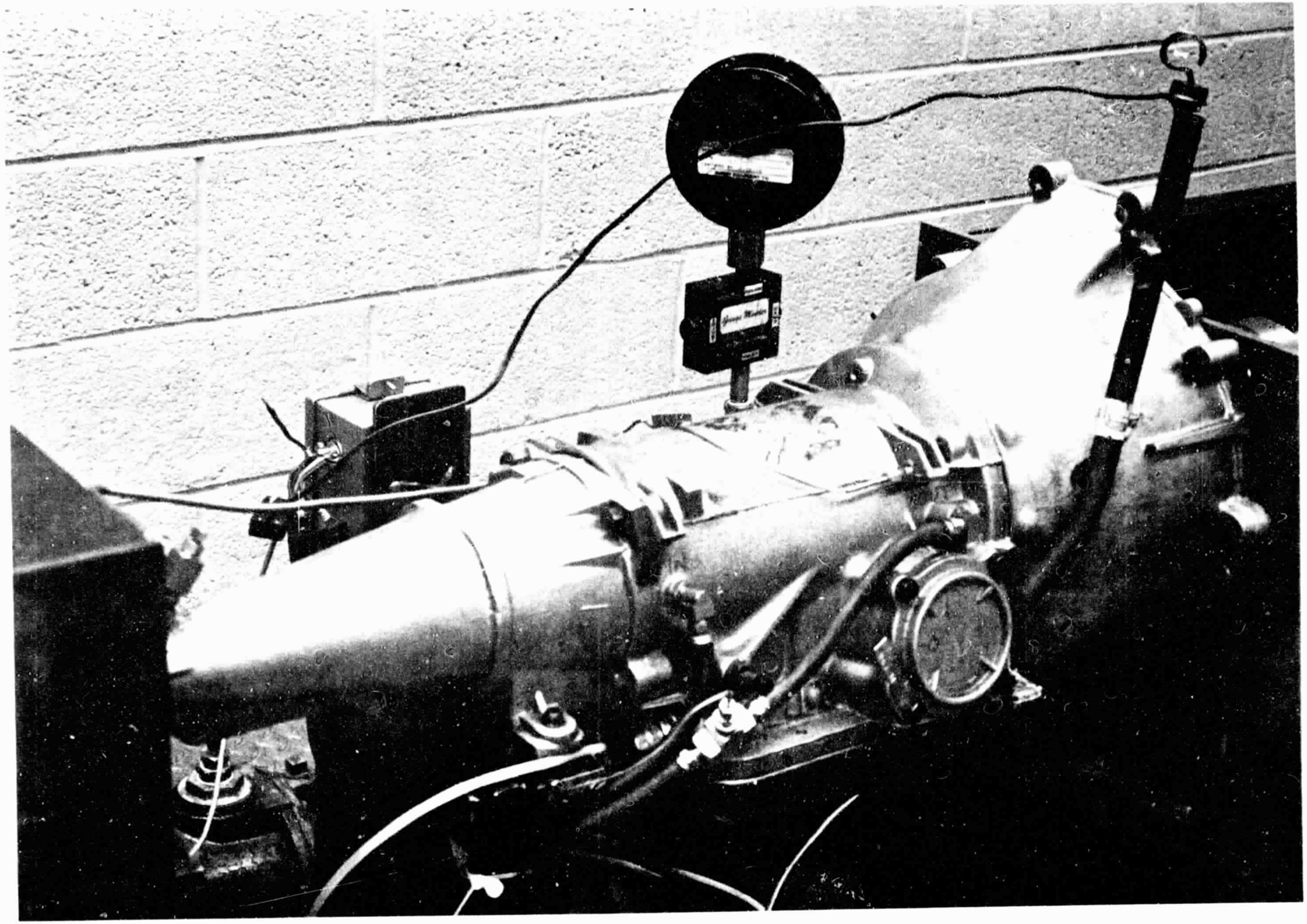
1979 Ford C4 Transmission Drive Performance (Front View)



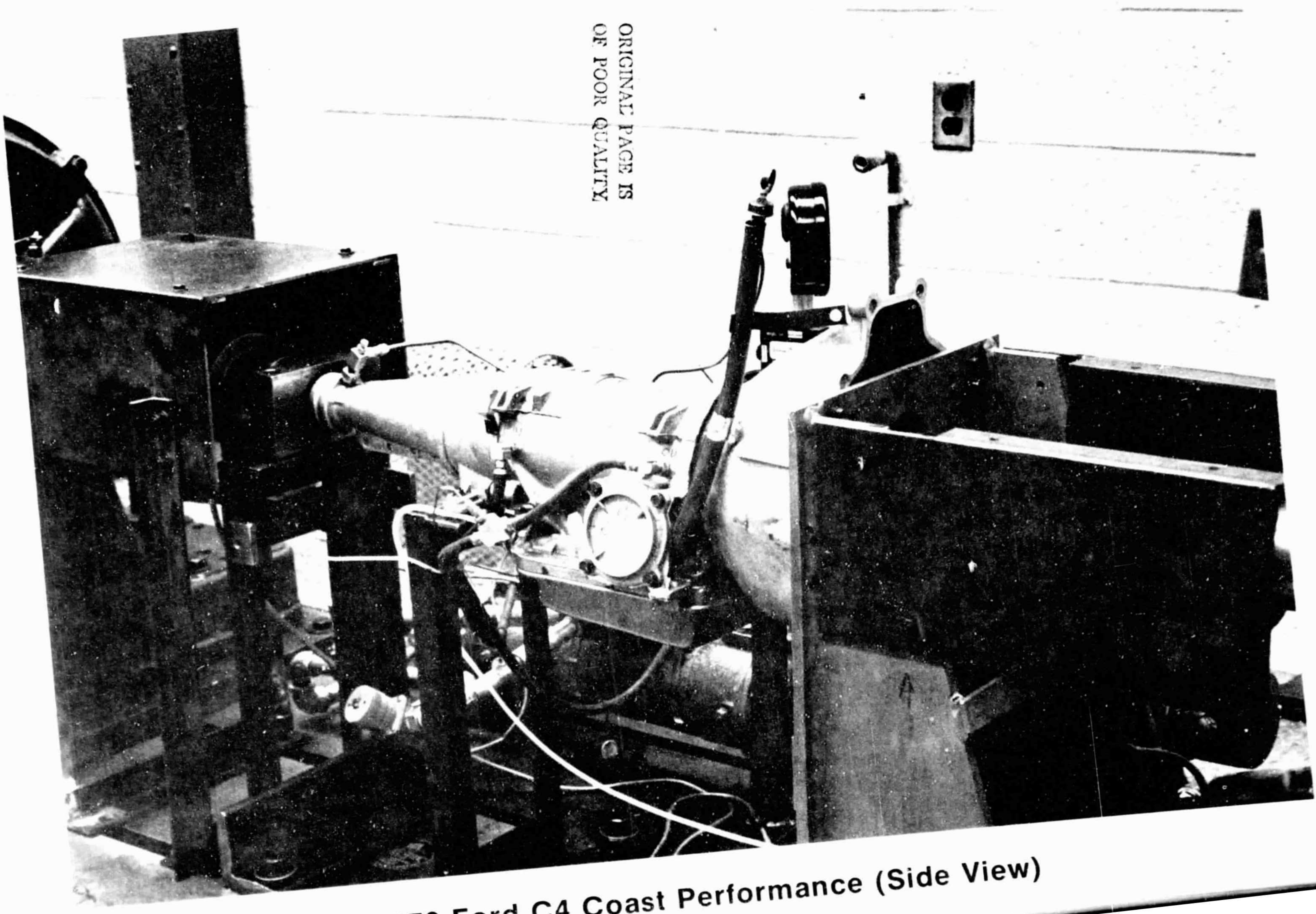
1979 Ford C4 Coast Performance (Front View)



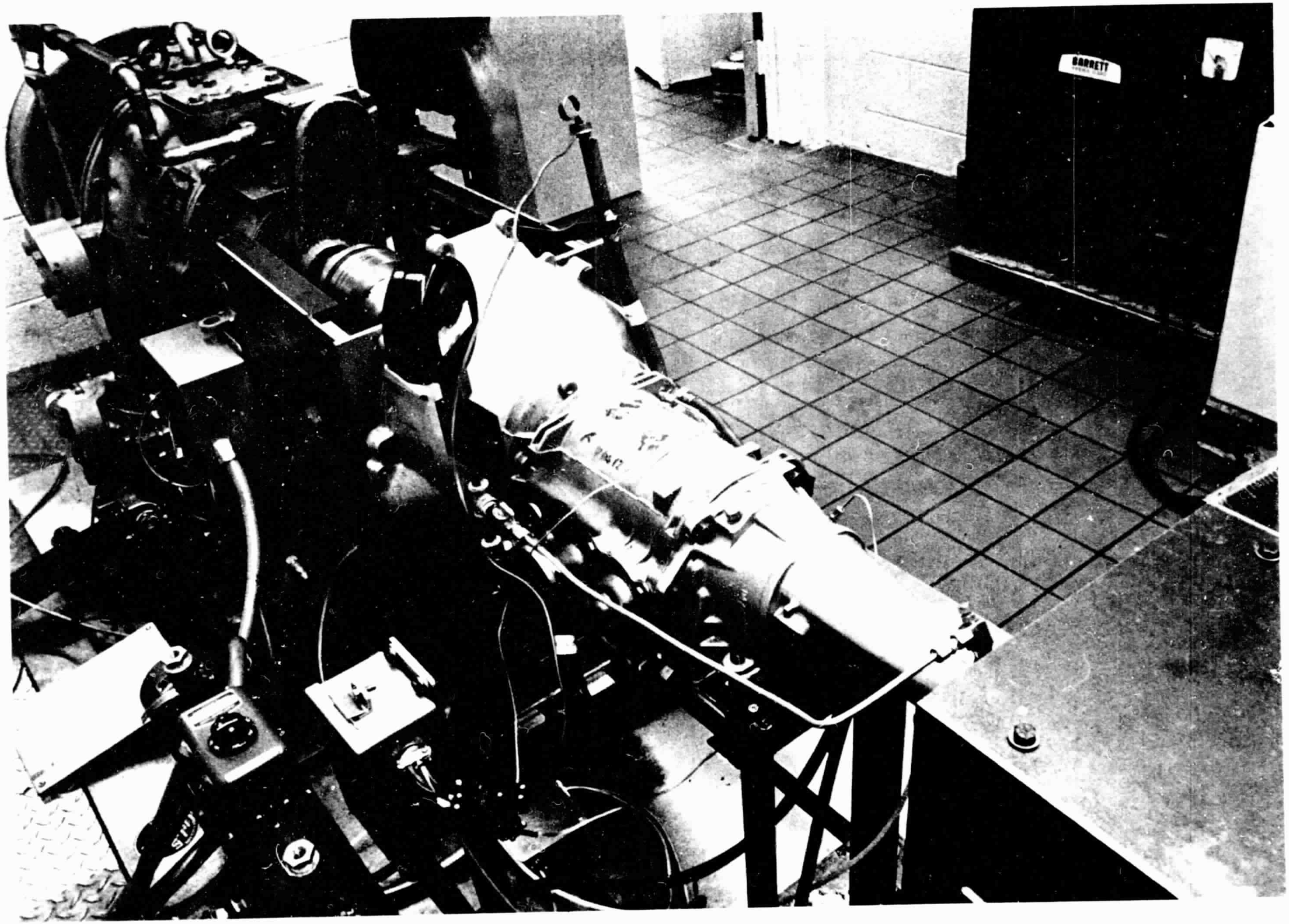
1979 Ford C4 Transmission Drive Performance (Front View)



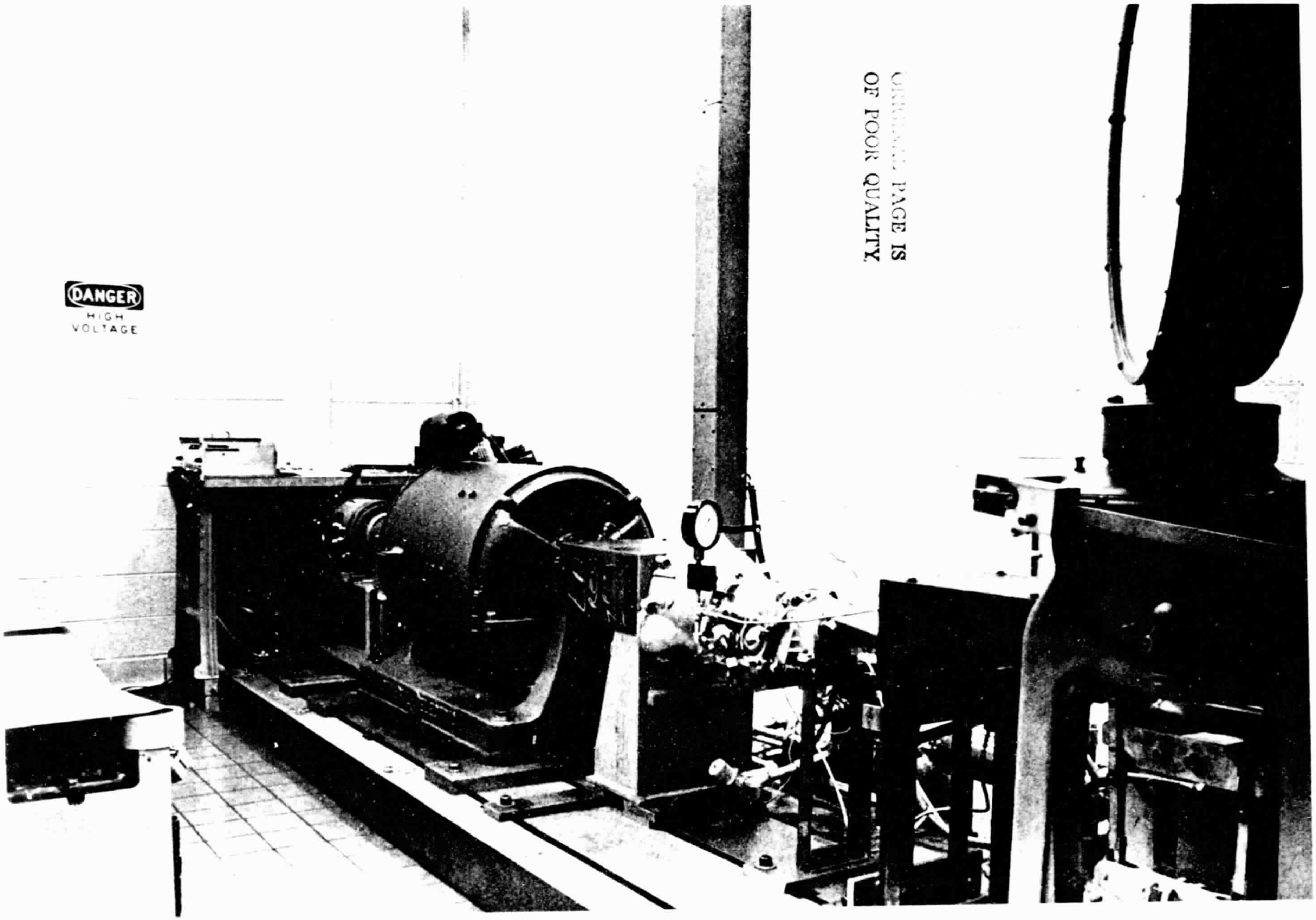
1979 Ford C4 Coast Performance (Side View)



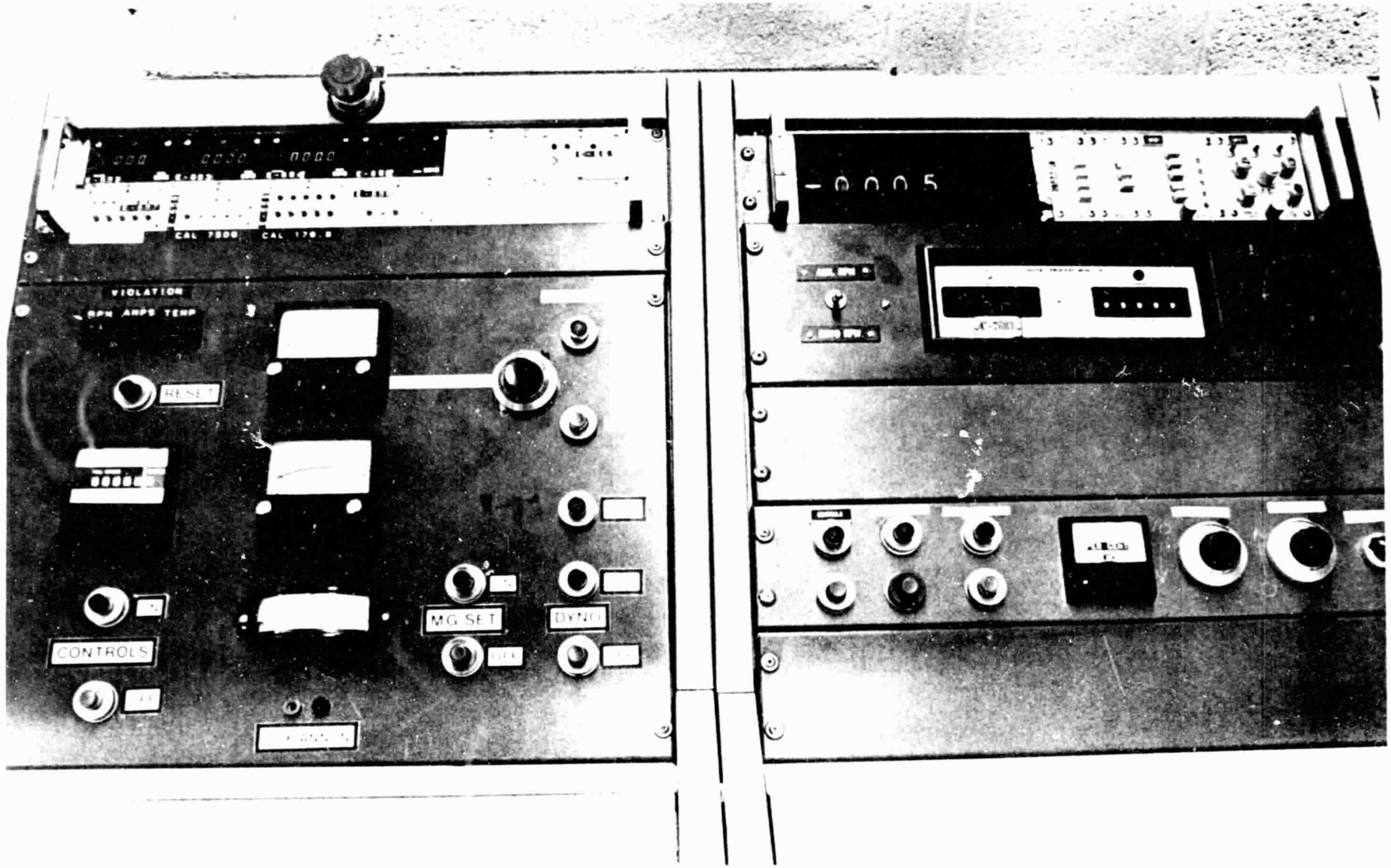
1979 Ford C4 Coast Performance (Side View)



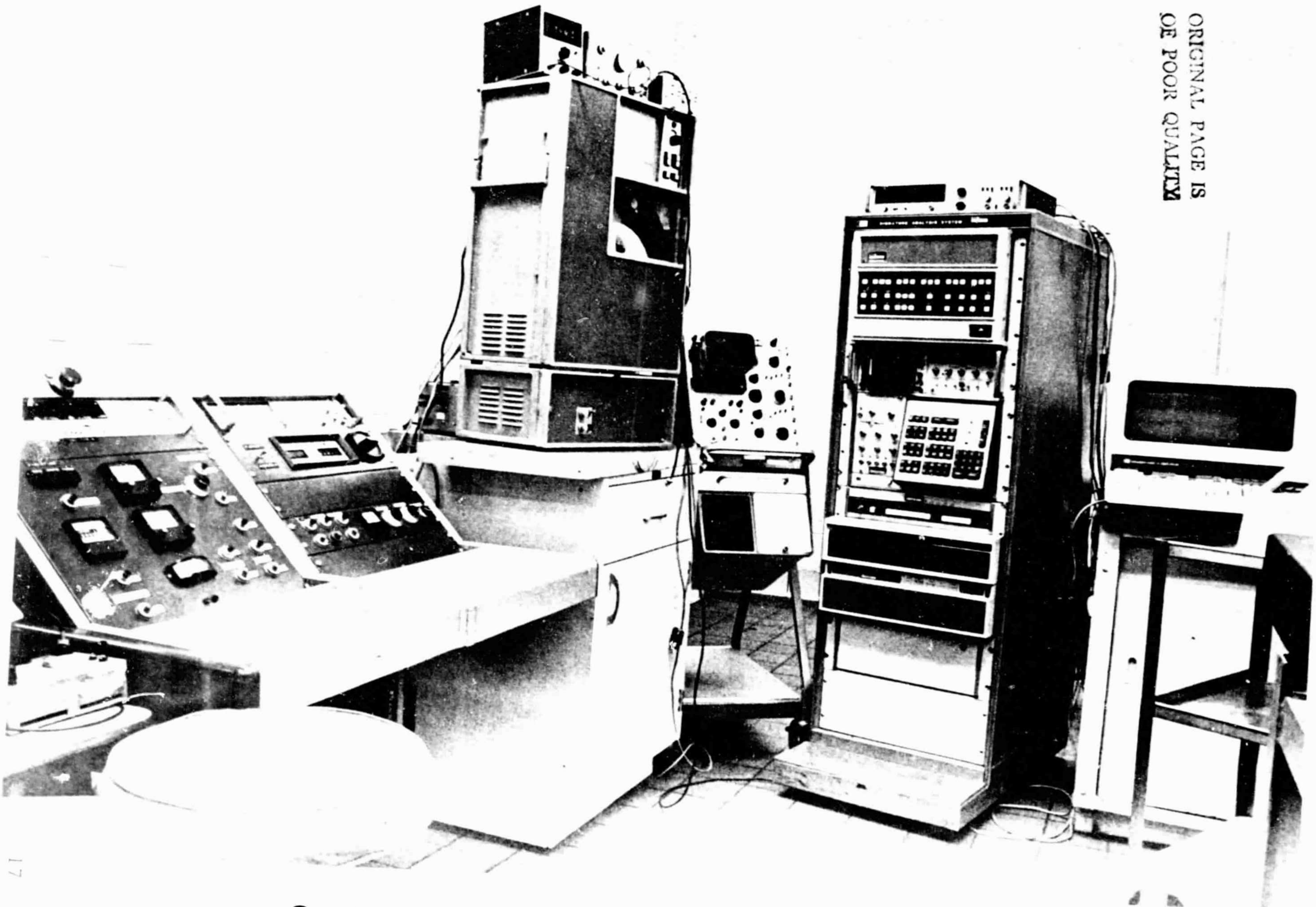
1979 Ford C4 Coast Performance (Back View)



1979 Ford C4 Transmission Drive Performance (Back View)



Control Console



Control Console with Data Reduction Equipment

TEST PROCEDURE

The test was conducted per the Passenger Car Automatic Transmission Test Code-SAE J651b. The code states that three basic tests should be performed on the transmission. These tests were drive performance, coast performance and no load losses. Each test was performed to the accuracies stated in the code. The throttle valve was modulated throughout the test to its normal operating positions. The graph on page 20 indicates the engine torque and its related vacuum setting.

The first test conducted was the drive performance test. The limits of the test were determined by the normal operating conditions of an engine typically supplied with this transmission. The torque limit was set to 100 lb-ft and the speed limit was set to 5000 rpm. The input shaft of the transmission was tested at a torque which ranged from 10-100 lb-ft on the input shaft of the transmission. The torque was incremented by 10 lb-ft for each test. The speed limits of the test ranged from 500 to 4500 rpm on the input shaft of the transmission.

Section 1 of the test code which is labeled Drive Performance - Constant Input Torque was conducted first. The input torque was held at 10 lb-ft and the speed was incremented from 500-4500 rpm. The torque was then set to 20 lb-ft and the transmission was run through the same speed range. This procedure was followed for input torques of 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100 lb-ft. The throttle valve was modulated to match the appropriate input torque for these test ranges. The starting speed was dependent on when the torque could be attained which was characteristic of the torque converter. The data recorded in this test were input and output speed, input and output torque, line pressure, sump temperature, outlet temperature, case hotspot temperature and ambient temperature.

This procedure was performed on the transmission in first, second and third gear range. The transmission was held in each gear through the entire torque and speed range per the explanation given in the test apparatus section of this report.

The next portion of the test to be conducted was the Cross Sectional Road Load Performance Test. This test was conducted in third gear and involved holding the transmission output shaft at a constant torque while varying the input speed. The output torques selected were 10, 20, 30, 40, 45, 50, 60, 70, 80 and 90 lb-ft. The speed range was from 500-4500 rpm on the input shaft. the starting speed was dependent on when the torque could be attained. The throttle valve was modulated throughout the test to match the appropriate engine torque. The data recorded in this test were input and output torque, input and output speed, line pressure, sump temperature, outlet temperature, case hotspot temperature, and ambient temperature.

The No Load Loss portion of the test was performed next. This test was run with the output shaft turning freely. The input torque and speed were recorded for an entire speed range which ran from 500 rpm to 4500 rpm. This test was performed in each gear range by disconnecting the output shaft and allowing it to turn freely.

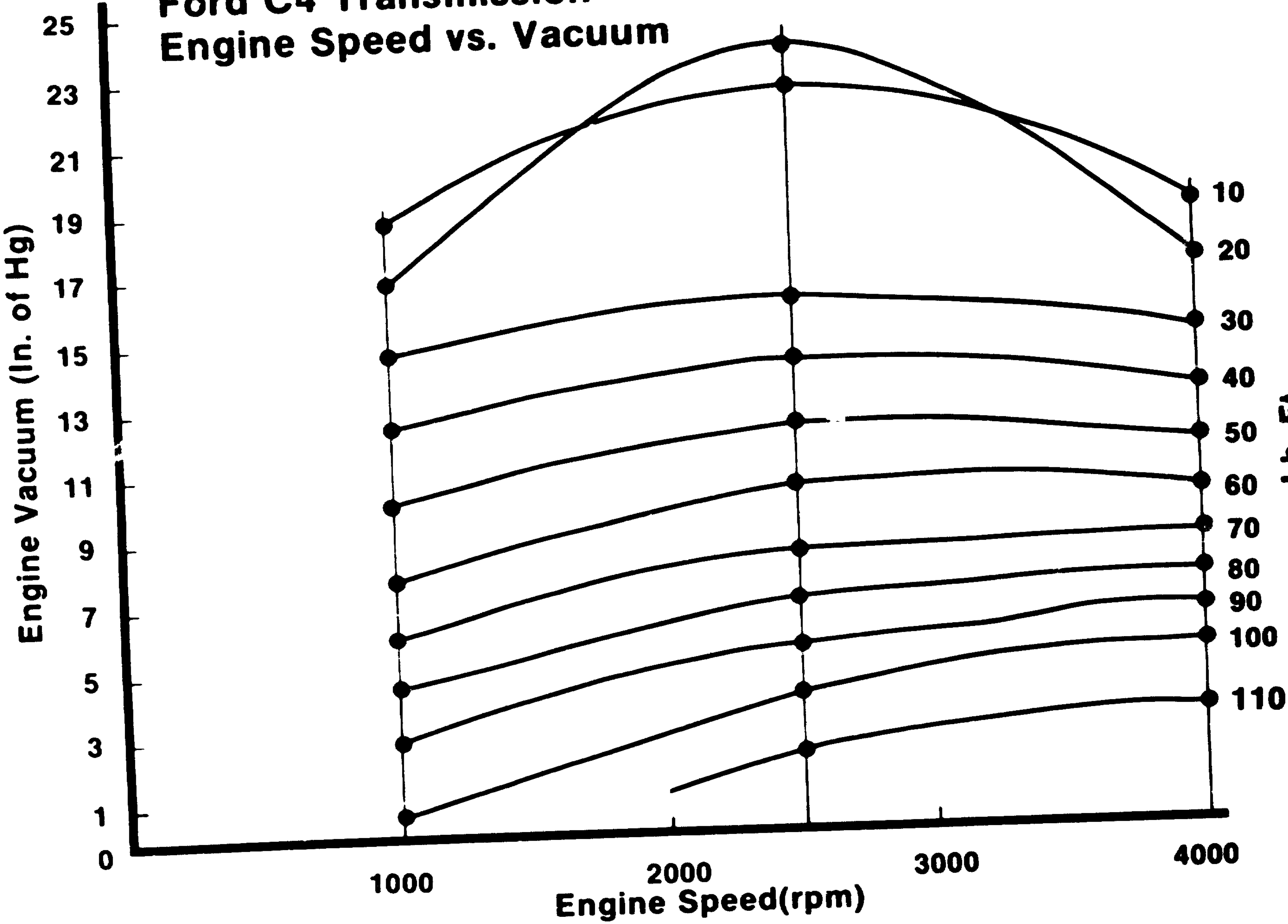
The parameters recorded in this test were input torque and speed, line pressure, sump temperature, outlet temperature, case hotspot temperature, and ambient temperature.

The final set of tests performed were the coast performance tests. For this test the transmission was oriented in the reverse direction so that the dynamometer drove through the output shaft of the transmission and the power was taken up in the absorber. The test was operated by setting the converter impeller torque at a constant level and varying its speed in the range set by the previous tests. In order to run this test, it was necessary to spin the torque converter shaft at approximately 400 rpm so that the charge pump would generate the line pressure necessary to operate the transmission. The torque and speed ranges of this test were different from the previous tests due to torque converter characteristics. The speed was limited by two conditions. These conditions were the lowest speed necessary to maintain line pressure and the lowest speed at which the torque could be attained. The amount of torque which could be applied to the system was limited by the current limits of the dynamometer controller. The 1st gear coast performance tests reached the current limit at the 70 lb-ft run. This was due to the slow output speed in first gear which was beyond the dynamometer torque speed characteristics. The data recorded during this portion of the test were input and output torque, input and output speed, line pressure, sump temperature, outlet temperature, case hotspot temperature, and ambient temperature. The throttle valve was set to the idle position during the entire test.

The transmission was filled with Ford automatic transmission fluid (C1A2-19582-A) through the entire test schedule. The physical and chemical properties of the transmission fluid were monitored throughout the test. The color of the fluid did not appreciably change during the tests.

The fluid was inspected when the transmission was locked in gear for each run. The fluid appeared slightly darker than normal after the 3rd gear coast performance tests. Through all of the other tests the color of the fluid did not change.

DEN3-124
Ford C4 Transmission
Engine Speed vs. Vacuum



CALIBRATION

The test apparatus was calibrated before and after a major test was completed. The major components calibrated were the torque sensors and the speed readouts. The torque sensors were calibrated with their respective readouts and attaching cables so that a total system accuracy was obtained. The calibration was performed by placing a set of known weights at a known distance to produce the resultant torque. The weights were weighed on a Toledo Digital Scale Model No. 1070, which is calibrated to a set of weights traceable to the National Bureau of Standards. The calibration arm was measured to a length of 24.00 inches. This length was recalculated for each weight which was placed on the calibration arm due to the deflection in the arm. The calibration sheets contained in this section show the calculated torque and the actual torque which apeared on the readout (measured torque). The torque sensors were calibrated to the limits [illegible] the range over which they were to operate.

The speed readout was an AIRPAX counter (Model No. 761400110) which was calibrated in an operating range from [illegible] to 4500 rpm. The counter was calibrated with a Hewlett Packard [illegible]ric counter (Model No. 5245L) used in conjunction with a WWVB frequency comparator (True Time, Inc. Model No. 60-TR). The accuracy of the digital readout was ± 1 count.

CALIBRATION SHEET **2-26-80**
HIMMELSTEIN TORQUE SENSOR #MCRT 6-02T (2-3) **DEN3-124**
CAL VALUE = 58.5 lb-ft
(Drive performance torque was positive. Direction of torque was clockwise.)

CALCULATED TORQUE (lb-ft)		MEASURED TORQUE (lb-ft)
(8.175) x 2 x (cos .25) =	16.35	+16.5
(13.175) x 2 x (cos .5) =	26.35	+26.0
(18.645) x 2 x (cos .5) =	37.28	+37.0
(28.195) x 2 x (cos .5) =	56.38	+56.0
(48.245) x 2 x (cos 1) =	96.47	+96.47
(58.715) x 2 x (cos 1) =	117.41	+117.50
	96.47	+96.47
	56.38	+56.0
	37.28	+37.0
	26.35	+26.0
	16.35	+16.5
	0	0

(Coast performance torque was negative. Direction of torque was counterclockwise.)

(-8.175) x 2 x (cos 0) =	16.35	-16.5
(-13.645) x 2 x (cos 0) =	27.29	-27.0
(-18.645) x 2 x (cos 0) =	37.29	-37.0
(-28.195) x 2 x (cos .25)=	56.38	-56.5
(-48.245) x 2 x (cos .5) =	96.48	-96.5
(-58.715) x 2 x (cos .5) =	117.42	-117.5
	96.48	-96.5
	56.38	-56.5
	37.29	-37.0
	27.29	-27.0
	16.35	-16.5
	0	0

CALIBRATION SHEET **2-26-80**
LEBOW TORQUE SENSOR #1648-5K **DEN3-124**
CAL VALUE = 271

(Coast performance torque was negative. Direction of torque was counterclockwise.)

CALCULATED TORQUE (lb-ft)		**MEASURED TORQUE (lb-ft)**
(-8.175) x 2 x (cos 0) =	16.35	-17.0
(-13.175) x 2 x (cos .25) =	26.35	-27.0
(-18.645) x 2 x (cos .25) =	37.29	-37.5
(-28.195) x 2 x (cos .5) =	56.39	-56.5
(-48.245) x 2 x (cos 1) =	96.49	-96.5
(-68.245) x 2 x (cos 1) =	136.46	-136.5
(-88.275) x 2 x (cos 3) =	176.30	-176.5
(-108.305) x 2 x (cos 3.5) =	216.2	-216.5
(-128.385) x 2 x (cos 4.0) =	256.14	-256.5
(-148.445) x 2 x (cos 4.0) =	296.16	-296.5
(-168.475) x 2 x (cos 5.0) =	335.66	-336.0
(-178.951) x 2 x (cos 5.0) =	356.54	-356.5
	0	0

(Drive performance torque was positive. Direction of torque was clockwise.)

(8.175) x 2 x (cos 0) =	16.35	+17.0
(13.175) x 2 x (cos .25) =	26.35	+27.0
(18.175) x 2 x (cos .25) =	37.29	+38.0
(28.195) x 2 x (cos .5) =	56.39	+56.5
(48.245) x 2 x (cos 1) =	96.49	+94.0
(68.245) x 2 x (cos 1) =	136.46	+134.5
(88.275) x 2 x (cos 3) =	176.30	+175.5
(108.305) x 2 x (cos 3.5) =	216.2	+216.5
(128.385) x 2 x (cos 4.0) =	256.16	+257.0
(148.445) x 2 x (cos 4.0) =	296.16	+297.0
(168.475) x 2 x (cos 5.0) =	335.66	+336.5
(178.951) x 2 x (cos 5.0) =	356.54	+357.0
	0	0

SYSTEM ACCURACY

The instruments used in the test setup have been calibrated to insure the accuracy of the test data. The individual components utilized in the tests contain manufacturers specifications which guarantee the accuracy of the instrumentation. These accuracies are listed and combined in the appendix section to determine the total system accuracy. The three major components involved in the system accuracy are the torque signals, speed signals, and data reduction equipment. Worst case system accuracies for the torque sensors, cabling and readouts were determined from the calibration charts and are shown below.

TAPE RECORDER: Sangamo Model #3500
ACCURACY: ±0.05% of Full Scale

TORQUE SENSOR: Lebow (1648-5K) + Daytronic (878A)
ACCURACY: ((Calculated Torque-Measured)/Full Scale Torque) x (100)
((175.79 - 176.0)/416.66) x (100) = ±0.05% of Full Scale

TORQUE SENSOR: Himmelstein (MCRT 6-62T(2-3)) + Daytronic (878)
ACCURACY: ((Calculated Torque-measured)/Full Scale Torque) x (100)
((56.26 - 55.9)/(166.66)) x (100) = ±0.21% of Full Scale

SPEED SENSOR: Speed Pickup + Airpax Counter
ACCURACY: Calibration was ±1 Count (1/4000) x (100) = ±0.025% of Full Scale

SPEED CONDITIONER (Frequency to Voltage Converter-Daytronic 840)
ACCURACY: 0.05% of Average DC Voltage ±0.10% of Full Scale

HEWLETT PACKARD ANALYZER (HP 5451B Fourier Analyzer)
ACCURACY: 12 Bits = 2^{11} = 2048 Bits = 1 Volt
(1/2048) x (100) = ±0.048% of Full Scale

COMPUTER INTER NUMBER CALCULATION (Method of Program Calculation)
= 0.5% of Full Scale

The inter number calculation error resulted from the method that the computer used to average the acquired data. This method is explained in the Appendix A.

From the instrument accuracy determined above, a system accuracy may be determined. There are two generally accepted methods for calculating a system error. These methods are the root mean square and the sum of the errors. Both methods are tabulated in the appendix and charted below for torque, speed, power and efficiency readings.

	ROOT MEAN SQUARE METHOD % OF FULL SCALE	SUM OF ERRORS METHOD % OF FULL SCALE	FULL SCALE
Torque Error (Lebow)	0.08%	0.15%	416 lb-ft
Torque Error (Himm.)	0.221%	0.31%	166 lb-ft
Speed Error	0.124%	0.223%	4000 RPM
Power Out Error	0.50%	0.70%	90 HP
Efficiency Error	0.58%	1.0%	100%

DATA REDUCTION

The signals obtained from the torque and speed transducers of the test stand were placed directly onto a Sangamo Tape Recorder Model No. 3500. The information on the tape was then fed into a computer which was used to compile the data. While in the computer, the data was reviewed to insure their accuracy and then a hard copy was printed out on a line printer.

The following procedure was used to record the input and output torque. The torque signals were placed on the tape recorder as voltage. A calibration value was determined in engineering units (lb-ft) for each torque sensor. The torques were recorded on channels one and two in the following manner:

CHANNEL 1: PRECALIBRATION ZERO CALIBRATION VOLTAGE PRERUN ZERO DATA

CHANNEL 2: PRECALIBRATION ZERO CALIBRATION VOLTAGE PRERUN ZERO DATA

This information was then fed into the computer which integrated and compiled a 2.5 second sample of data to obtain an average value in engineering units.

The frequency signals from the speed pickups were placed directly onto the tape recorder. The data on the tape was then fed into a frequency to voltage unit which turned the frequency into a dc voltage which in turn was fed into the computer. The method for recording speeds is shown below.

CHANNEL 3: ZERO FREQUENCY CALIBRATION FREQUENCY PRERUN ZERO FREQUENCY DATA

CHANNEL 4: ZERO FREQUENCY CALIBRATION FREQUENCY PRERUN ZERO FREQUENCY DATA

The data on these channels was then fed into the computer which integrated and compiled a 2.5 second sample of data to obtain an average speed value in engineering units.

The computer was programmed to take the values of torques and speeds and calculate efficiency and power from them. From the data it has generated, the computer would print out the required graphs and data per the contract specification. The main advantage to taking data in this manner was that the computer would calculate an integrated average which would minimize the error in a fluctuating signal. Any fluctuation due to system resonance or gear teeth meshing would be integrated and averaged.

TEST RESULTS

The data contained in this segment of the report has been divided into three major sections. These sections are drive performance, coast performance, and no load losses. There are five data sheets for each test condition in the drive performance and coast performance tests. The organization of this data is described and listed in the table of contents. Cover sheets for drive performance, coast performance and no load losses have been placed at the beginning of each section to describe the enclosed sheets.

DRIVE PERFORMANCE

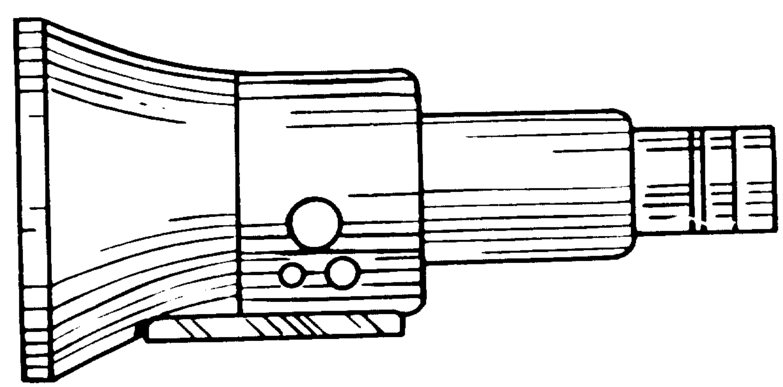
1st Gear

Graphs Contained in This Section

Torque Ratio -vs- Output Speed
Output Torque -vs- Output Speed
Input Speed -vs- Output Speed
Efficiency -vs- Output Speed
Efficiency -vs- Power Out

Torque In

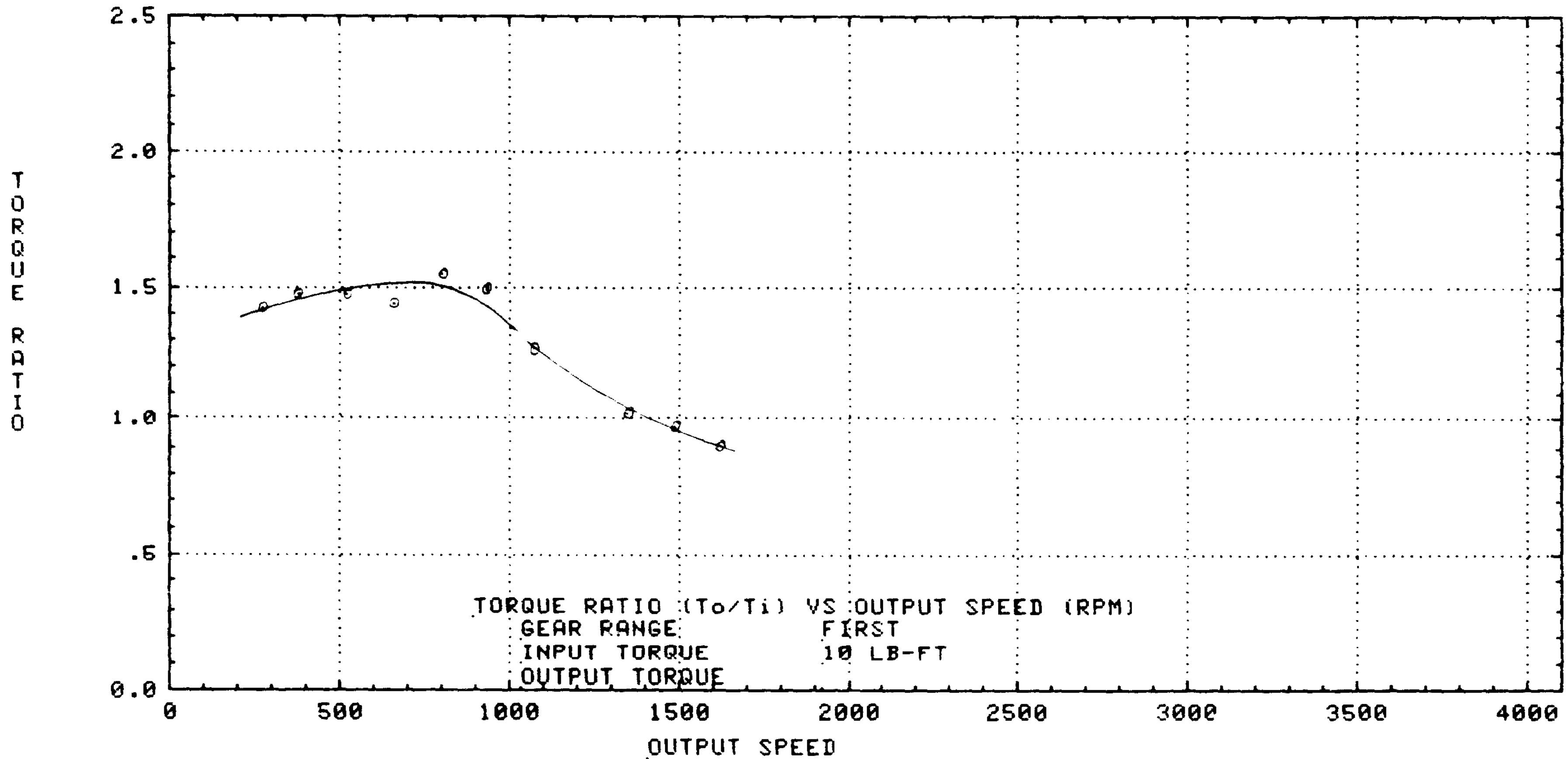
Speed In

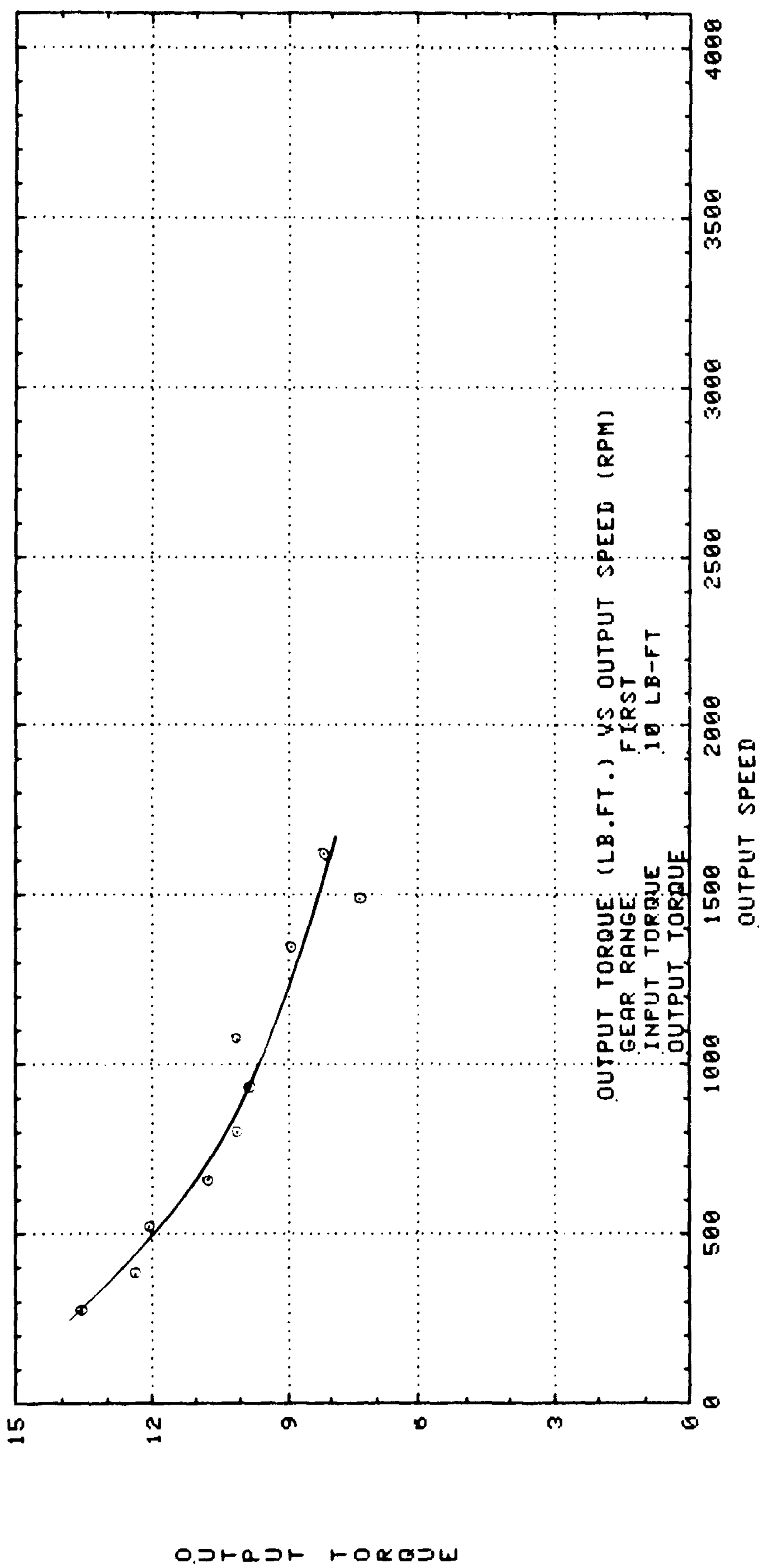


Torque Out

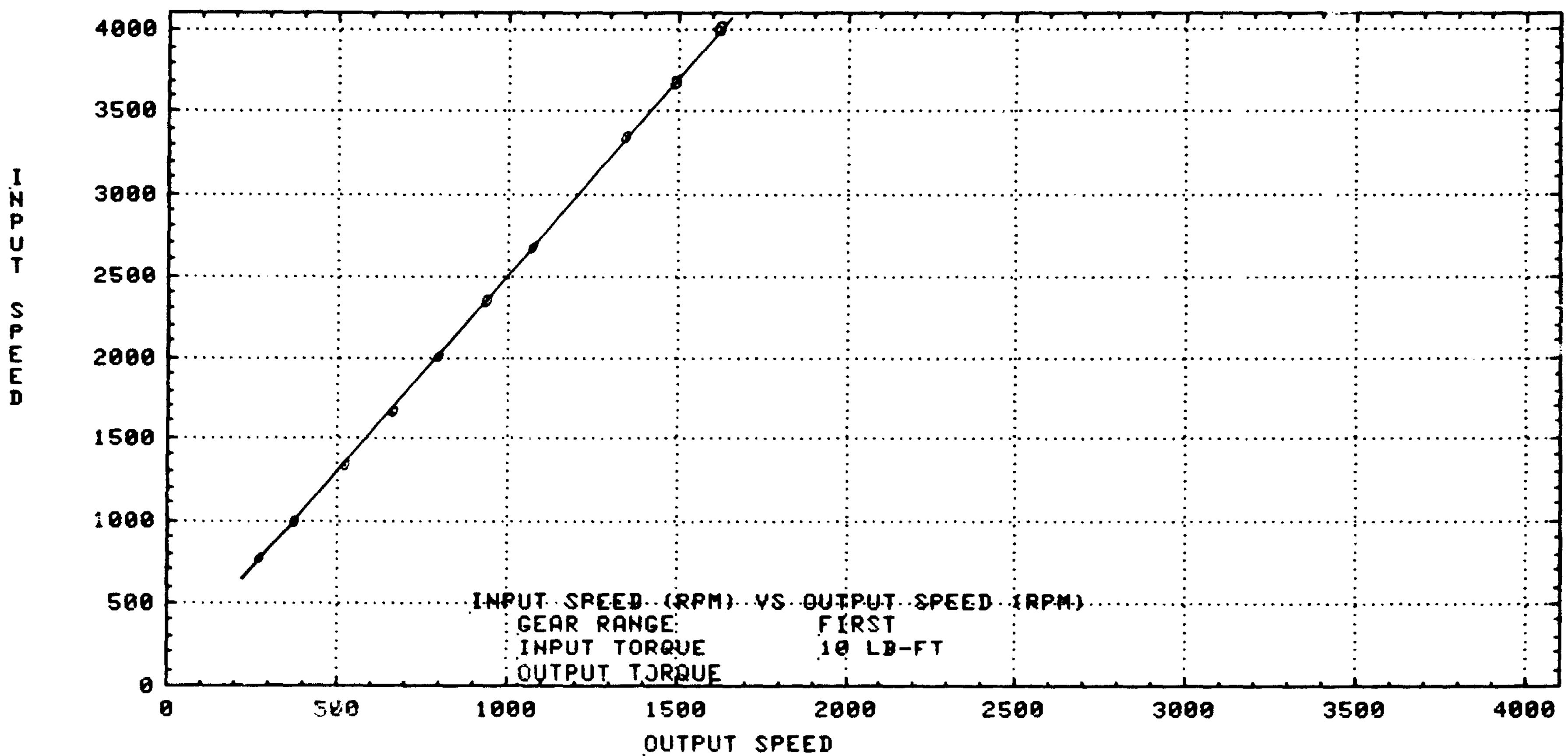
Speed Out

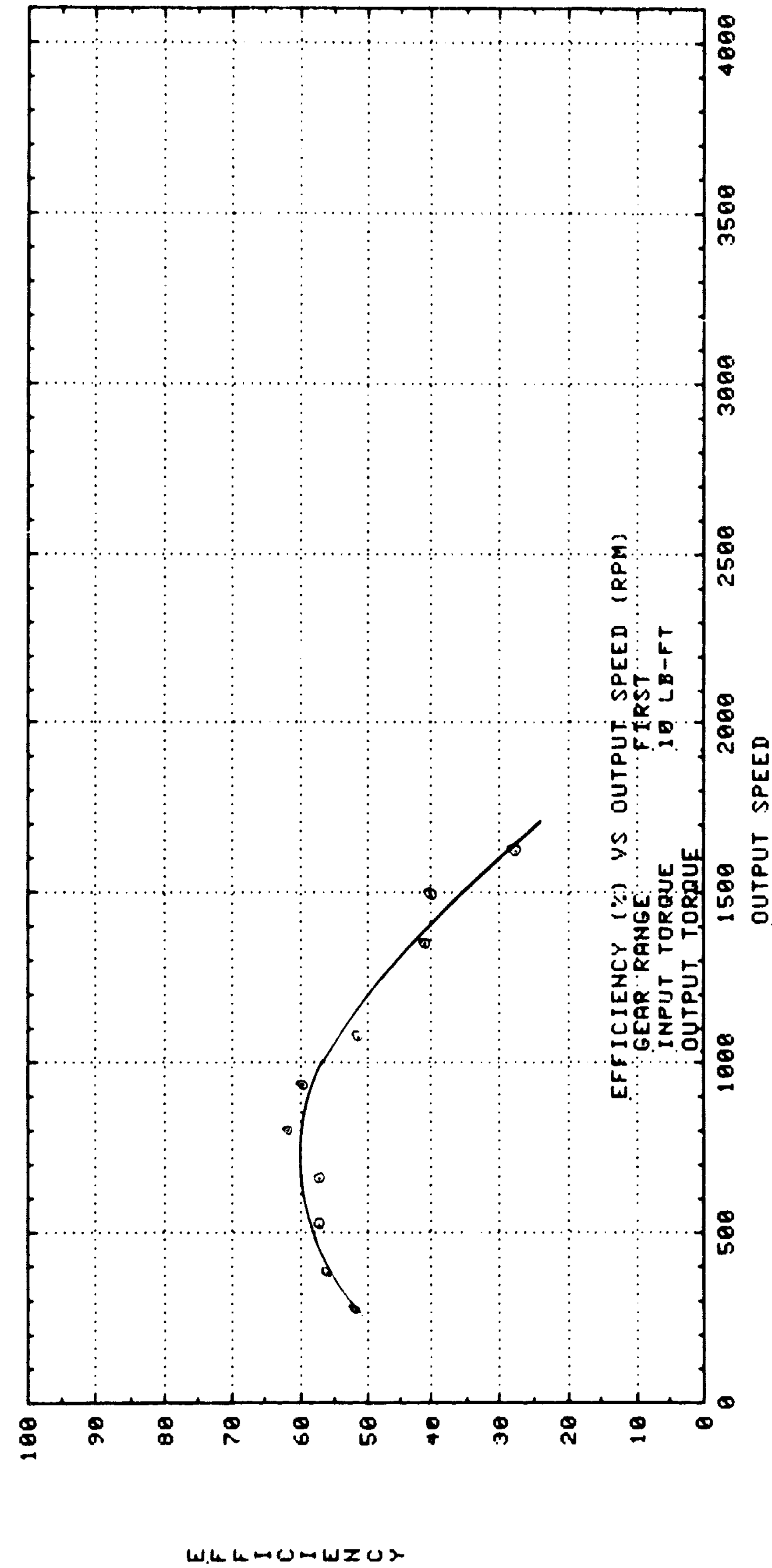
Drive Performance Tests


TORQUE RATIO
2.5
2.0
1.5
1.0
.5
0.0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 10 LB-FT
OUTPUT TORQUE

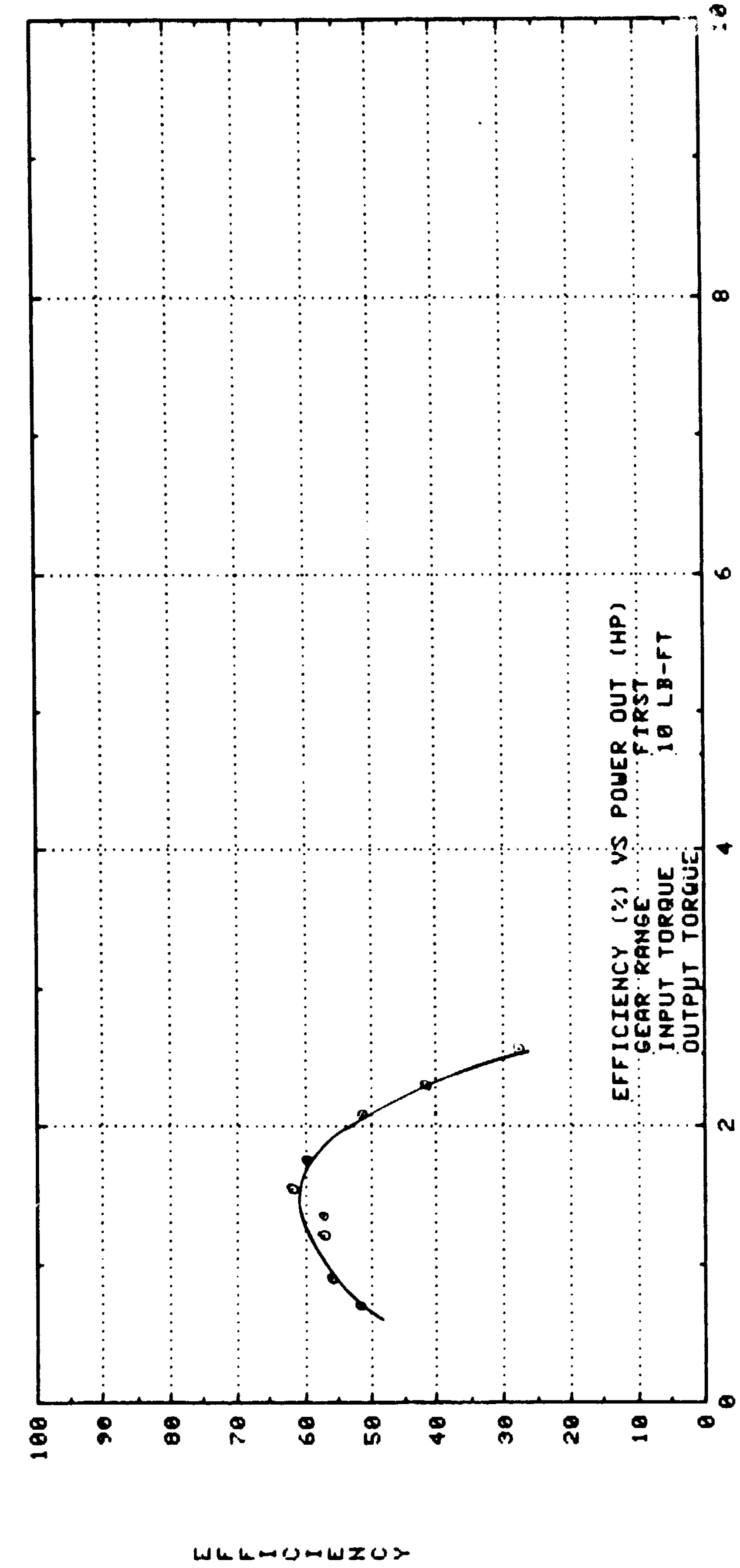


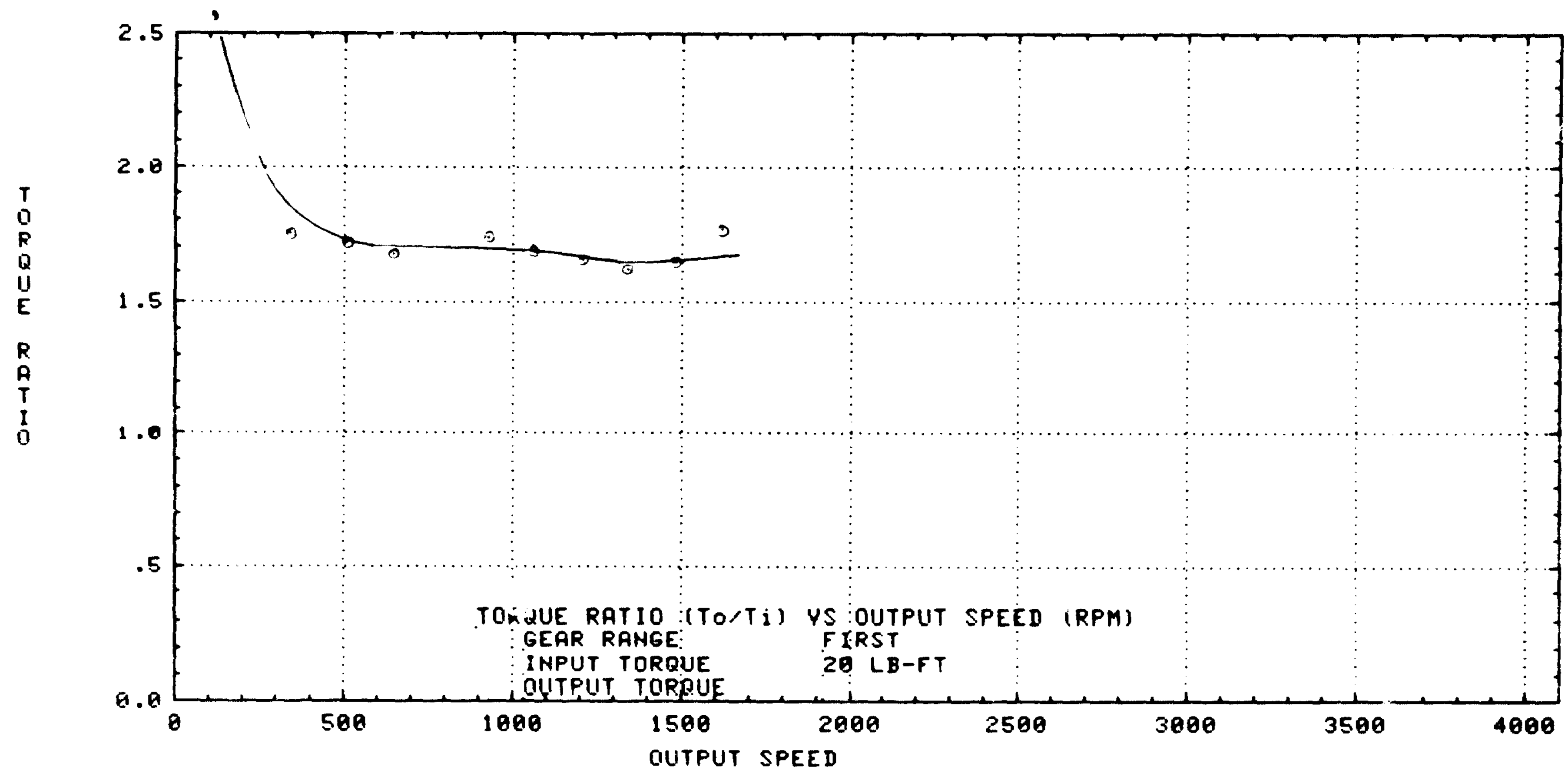
OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 10 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
OUTPUT TORQUE
0
500
1000
1500
2000
2500
3000
3500
4000
0
3
6
9
12
15

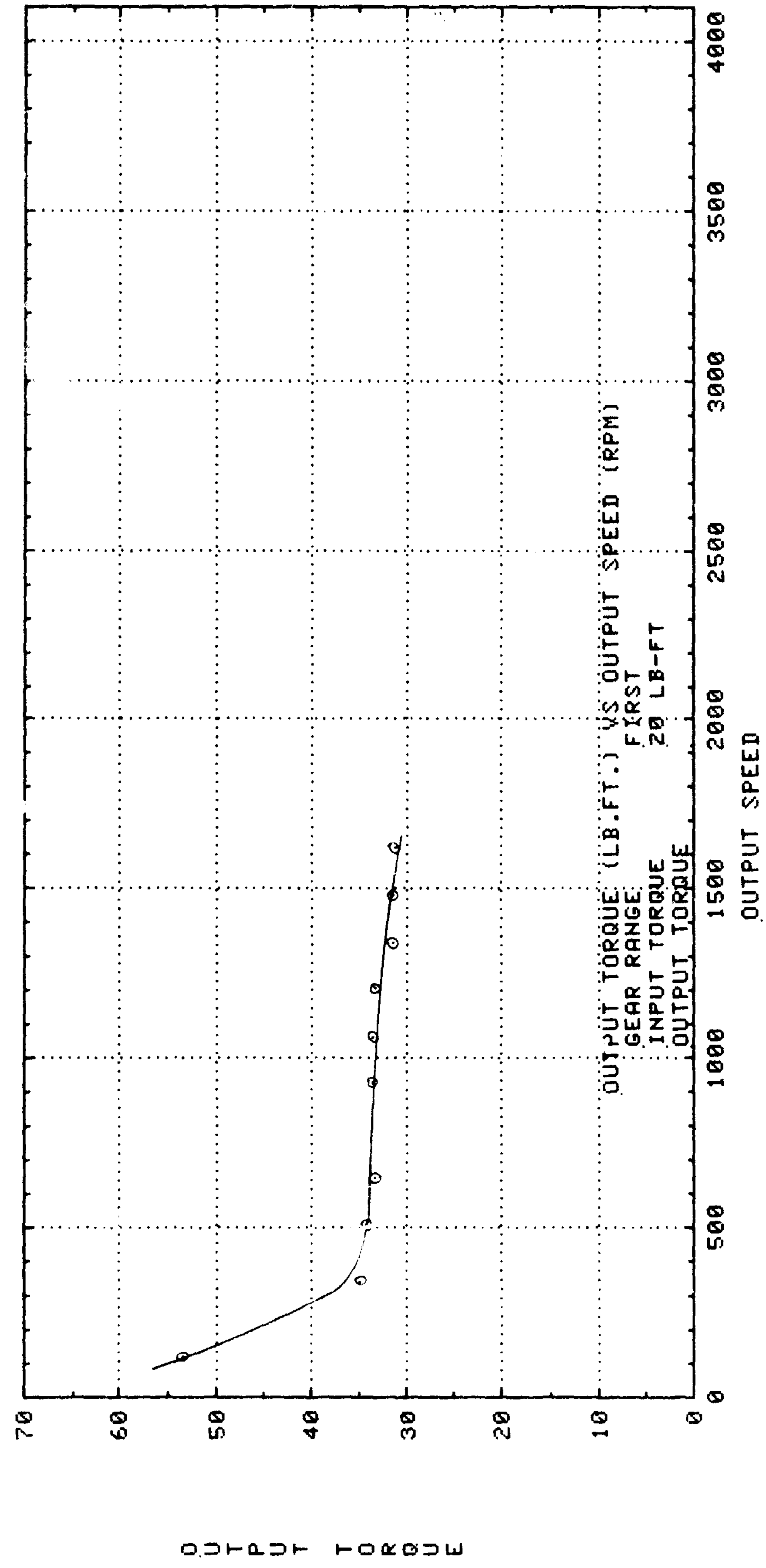

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 10 LB-FT
OUTPUT TORQUE
INPUT SPEED
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000



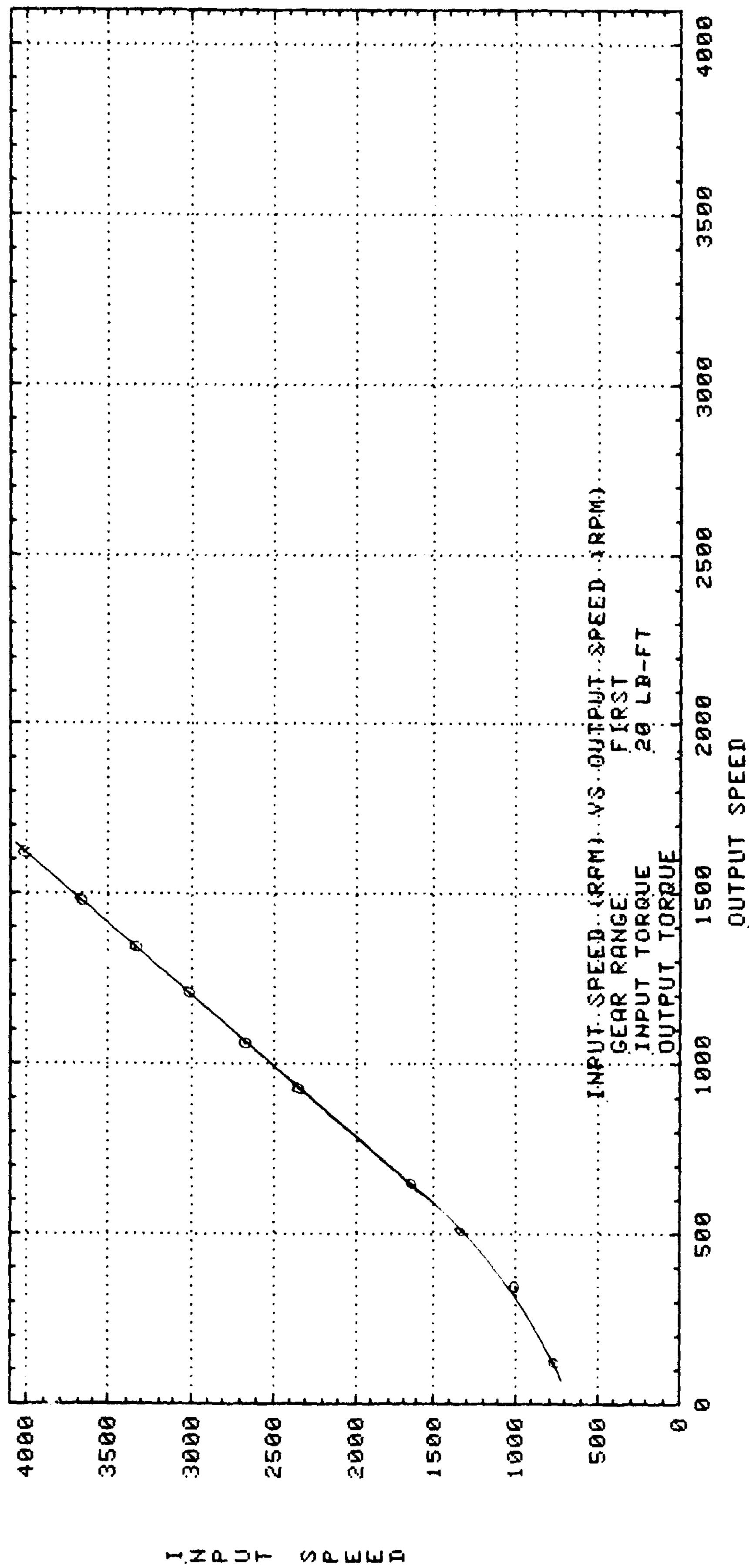
EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 10 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
EFFICIENCY
0
500
1000
1500
2000
2500
3000
3500
4000
0
10
20
30
40
50
60
70
80
90
100

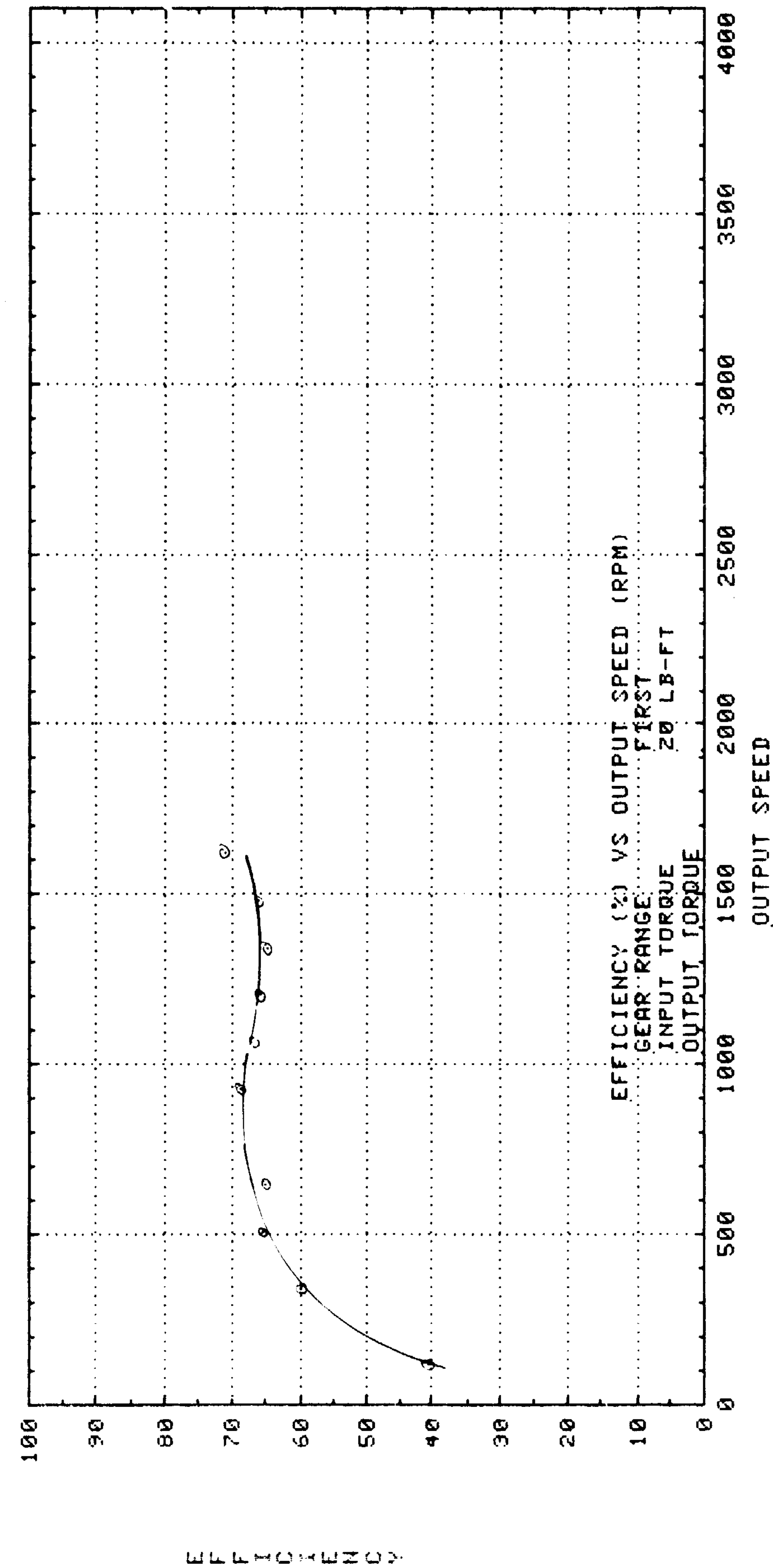

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE FIRST
INPUT TORQUE 10 LB-FT
OUTPUT TORQUE
POWER OUT
EFFICIENCY
0
2
4
6
8
10
0
10
20
30
40
50
60
70
80
90
100

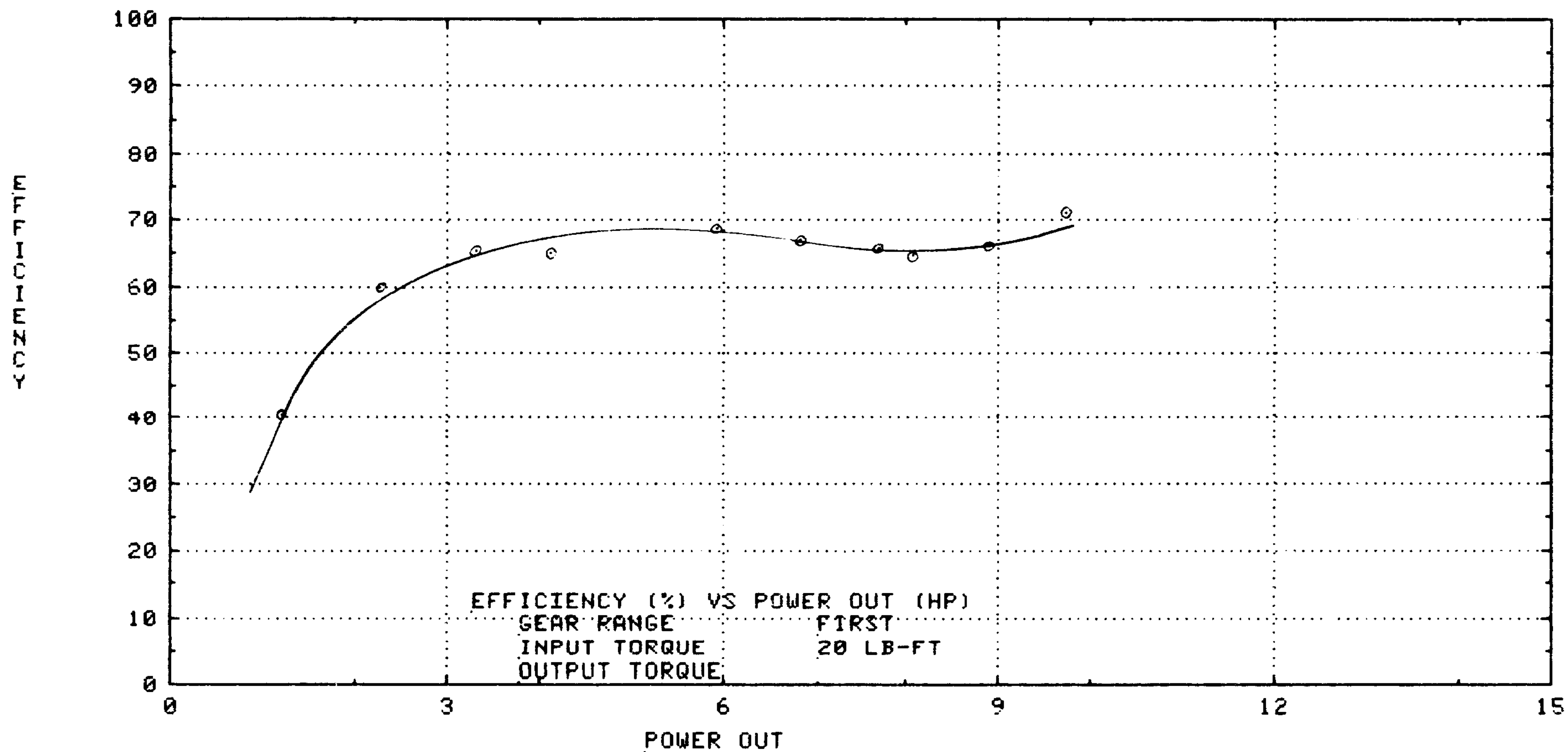

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 20 LB-FT
OUTPUT TORQUE
TORQUE RATIO
OUTPUT SPEED
2.5
2.0
1.5
1.0
.5
0.0
0
500
1000
1500
2000
2500
3000
3500
4000

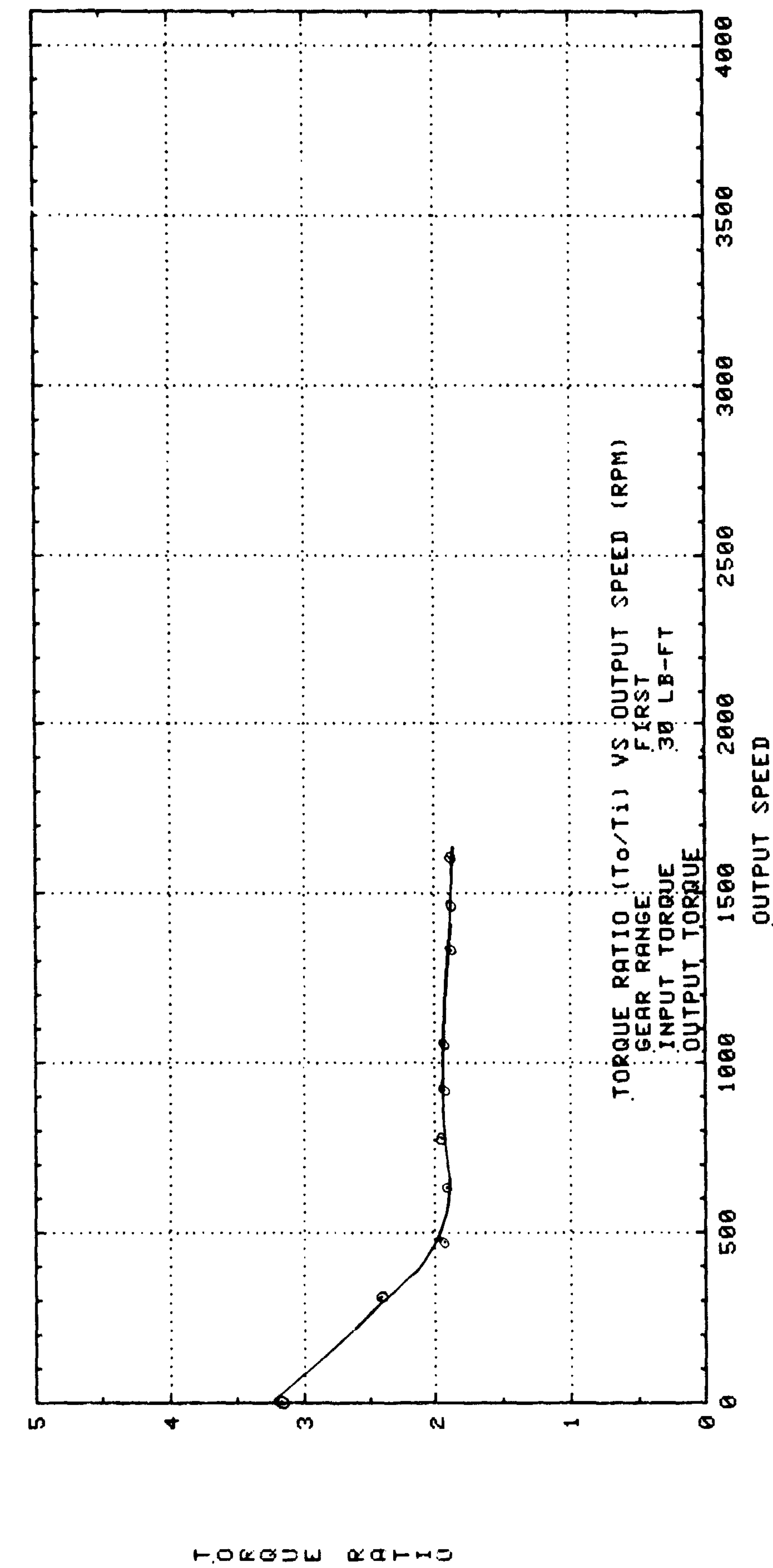


OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 20 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
OUTPUT TORQUE
0
10
20
30
40
50
60
70
0
500
1000
1500
2000
2500
3000
3500
4000

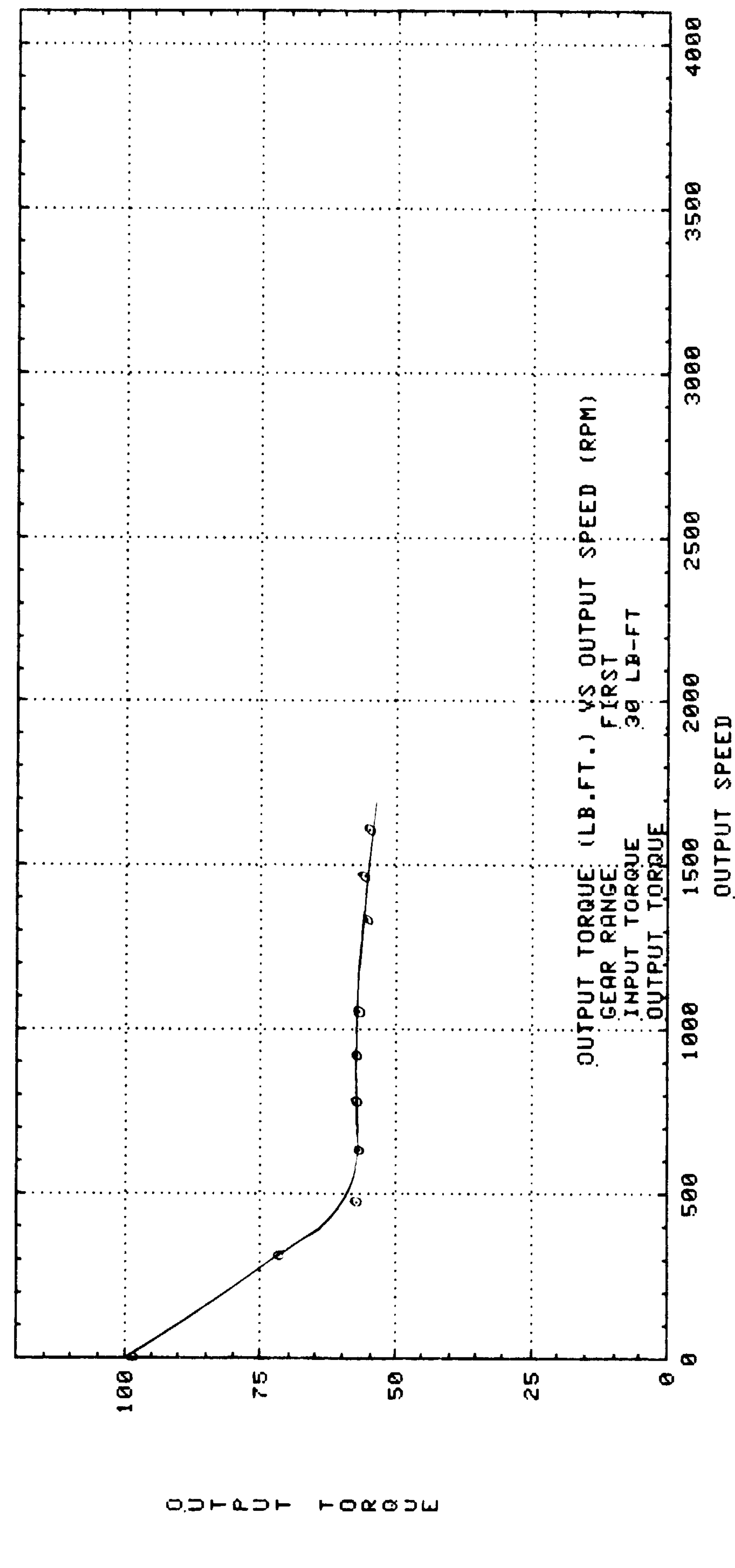

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 20 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000


EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 20 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000
100
90
80
70
60
50
40
30
20
10
0
EFFICIENCY

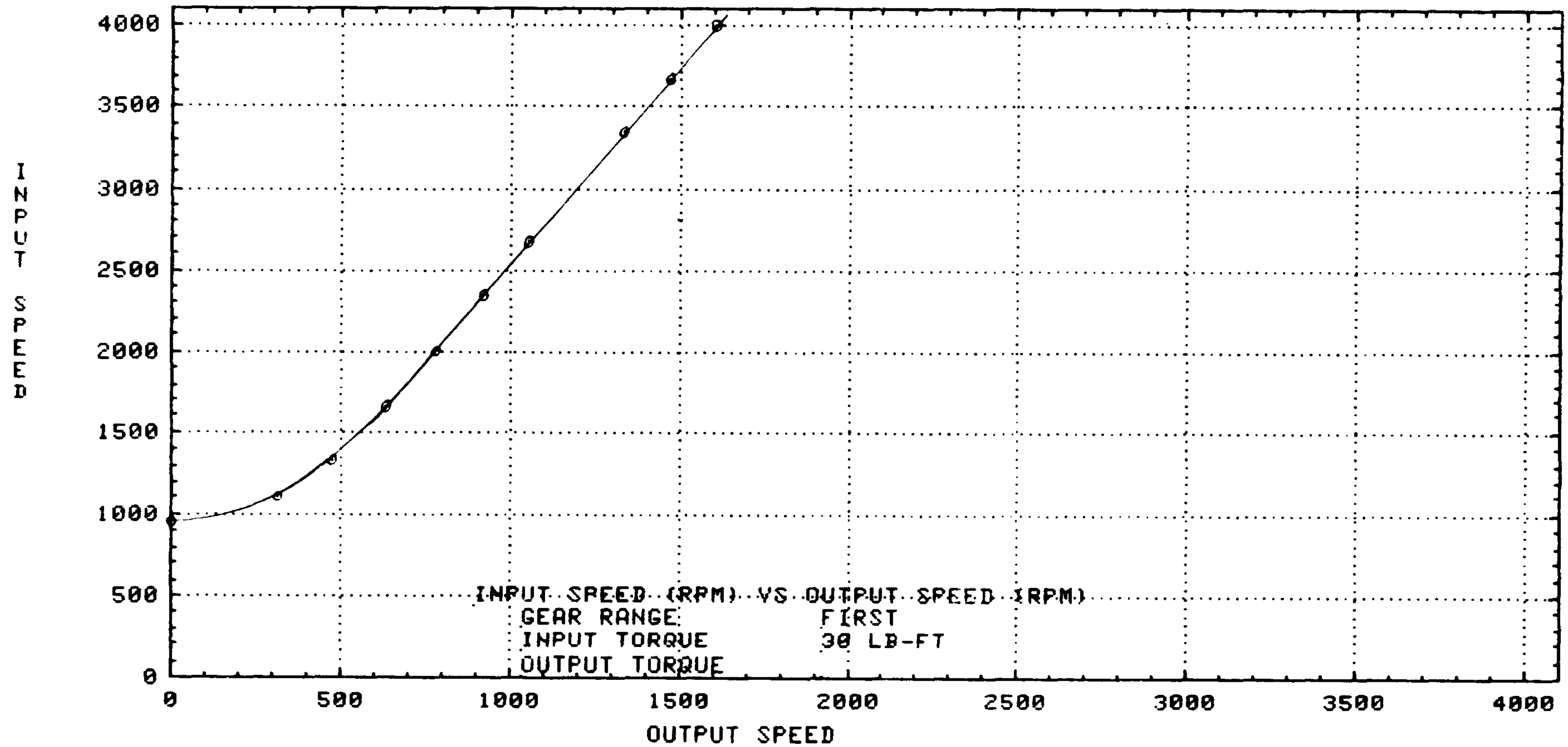

EFFICIENCY
100
90
80
70
60
50
40
30
20
10
0
0
3
6
9
12
15
POWER OUT
EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE FIRST
INPUT TORQUE 20 LB-FT
OUTPUT TORQUE

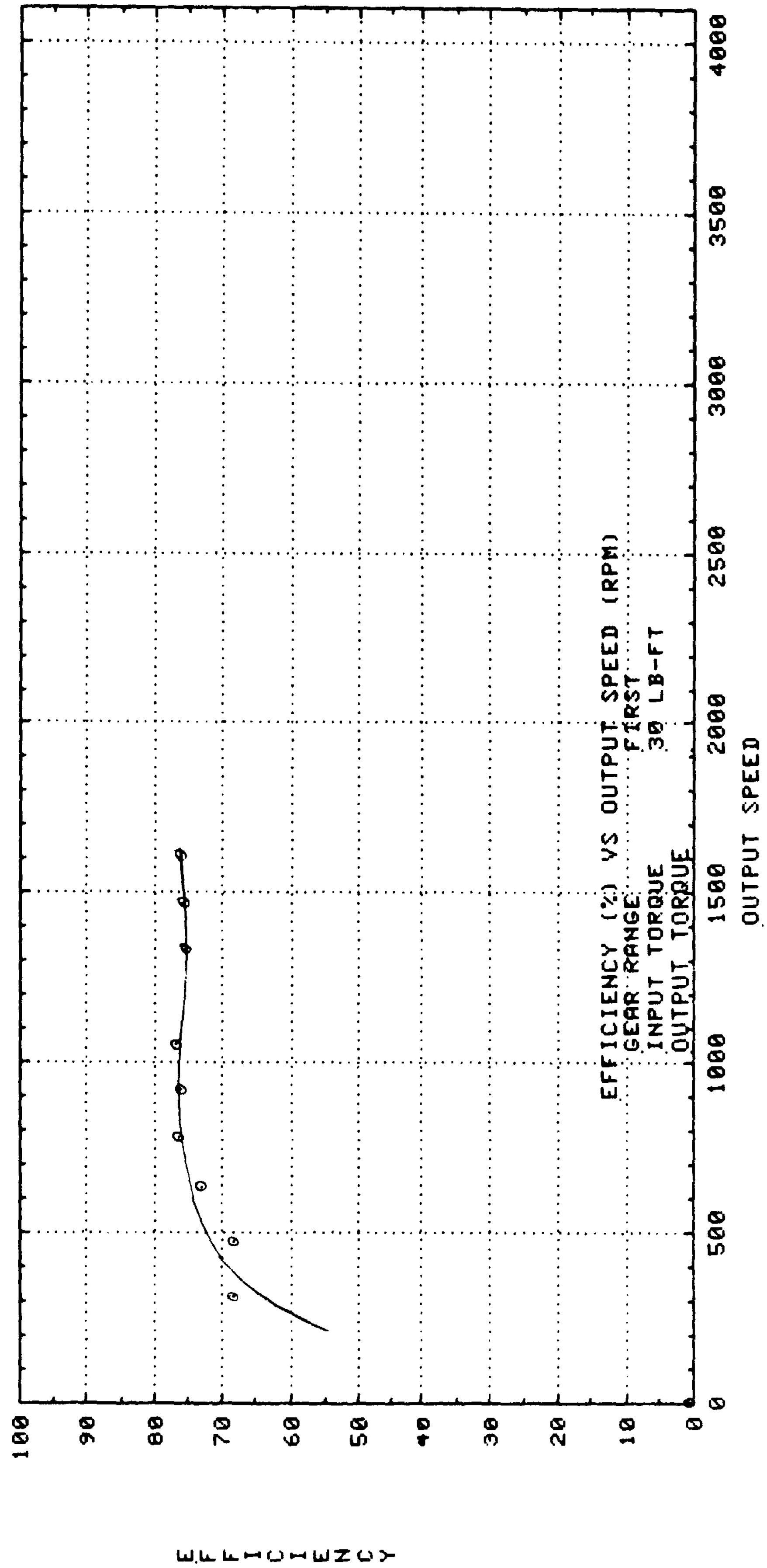


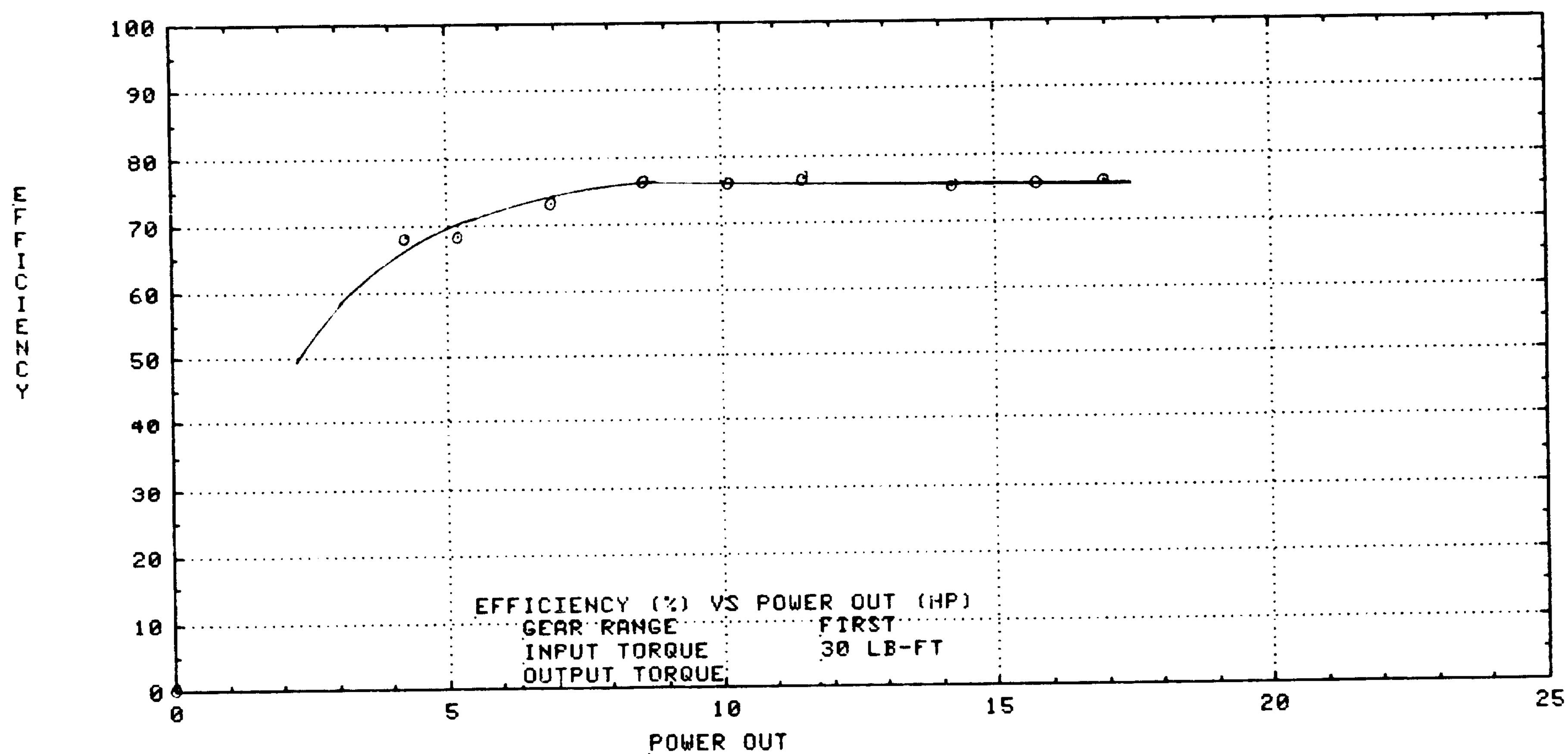
TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 30 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
TORQUE RATIO
0
500
1000
1500
2000
2500
3000
3500
4000
0
1
2
3
4
5

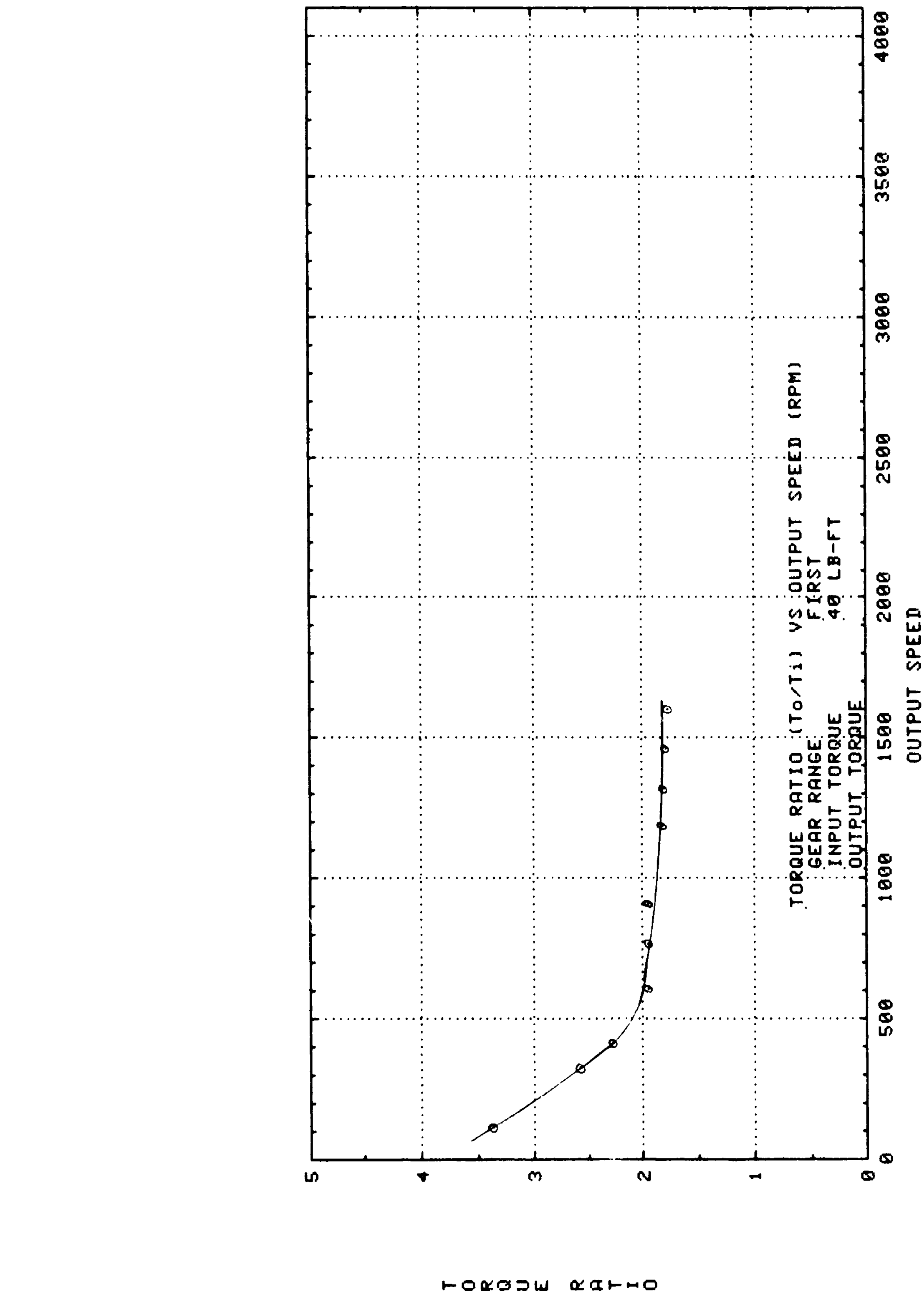


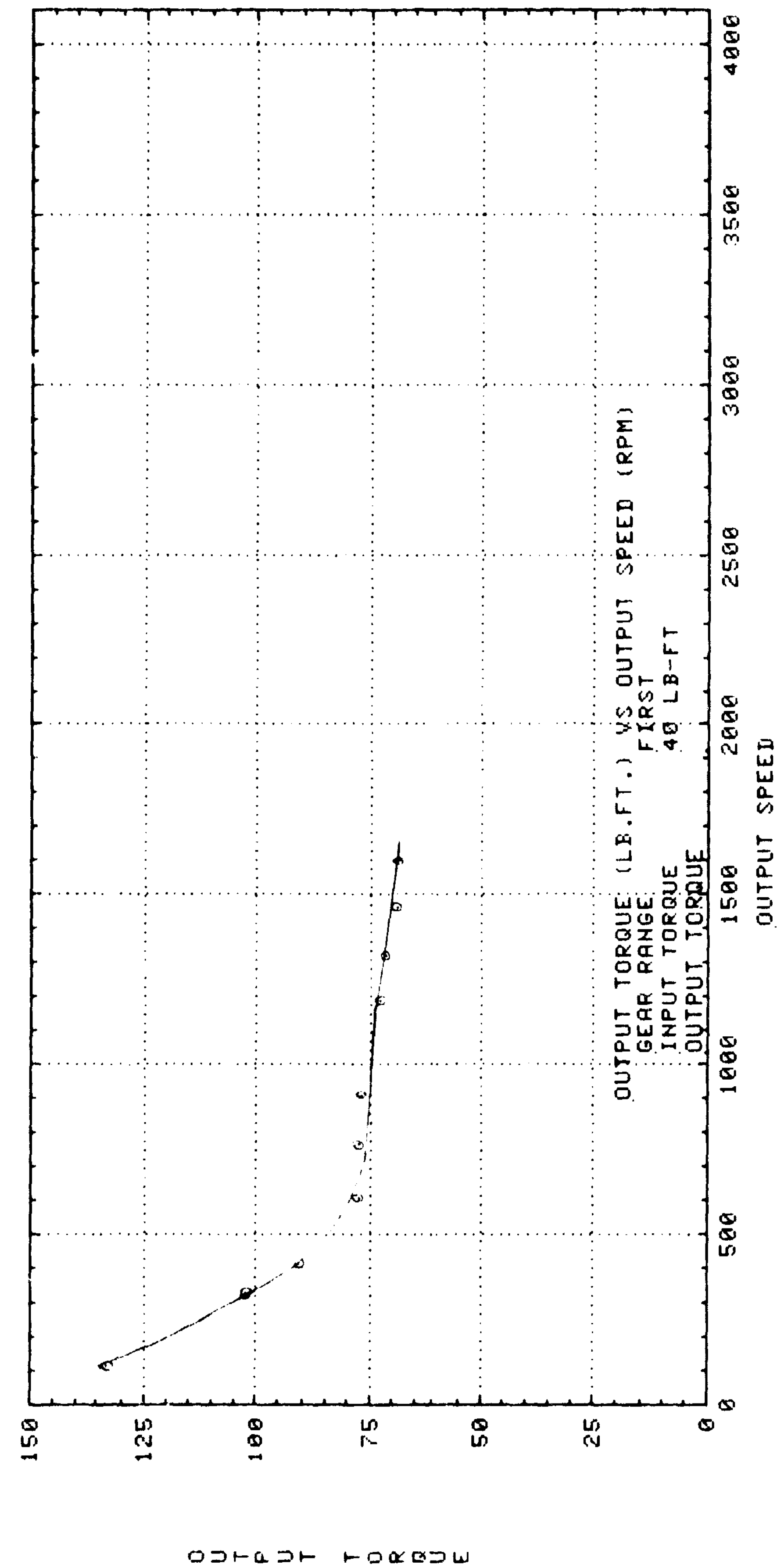
OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 30 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
OUTPUT TORQUE
0
500
1000
1500
2000
2500
3000
3500
4000
0
25
50
75
100

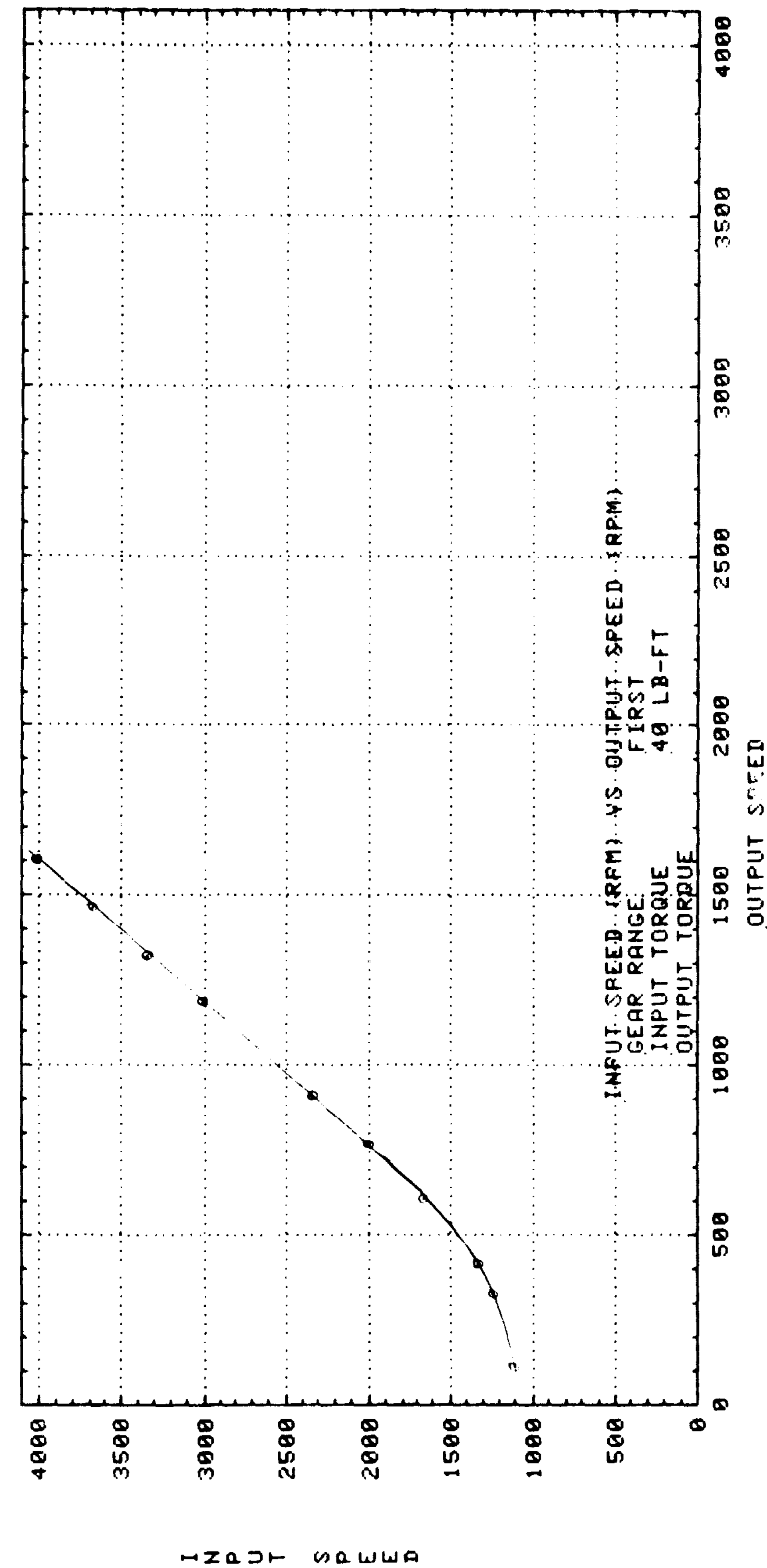

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 30 LB-FT
OUTPUT TORQUE
INPUT SPEED
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000


EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 30 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
EFFICIENCY
0
500
1000
1500
2000
2500
3000
3500
4000
0
10
20
30
40
50
60
70
80
90
100

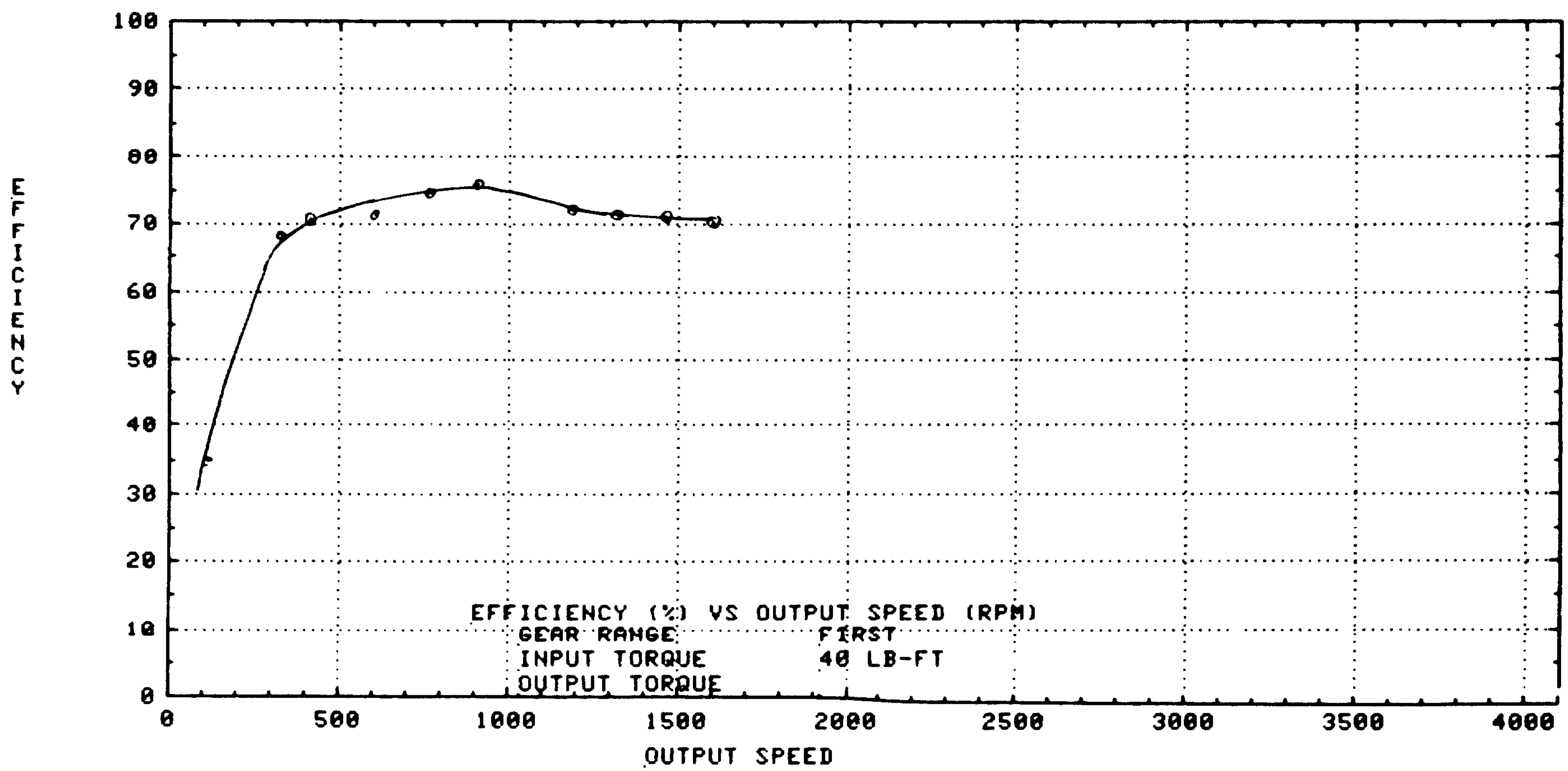

EFFICIENCY
POWER OUT
EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE FIRST
INPUT TORQUE 30 LB-FT
OUTPUT TORQUE
0
10
20
30
40
50
60
70
80
90
100
0
5
10
15
20
25

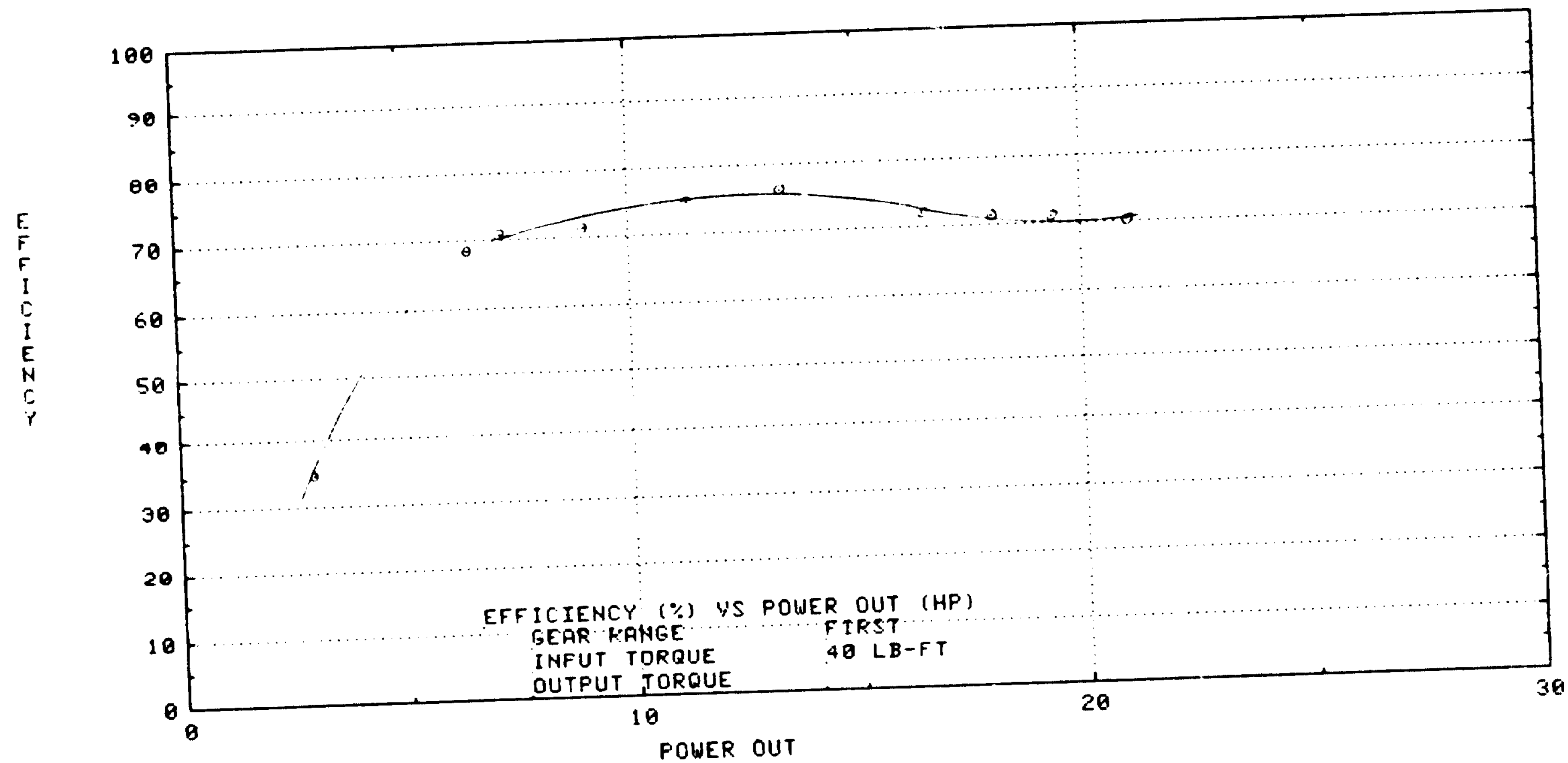

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 40 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
TORQUE RATIO
0
500
1000
1500
2000
2500
3000
3500
4000
0
1
2
3
4
5

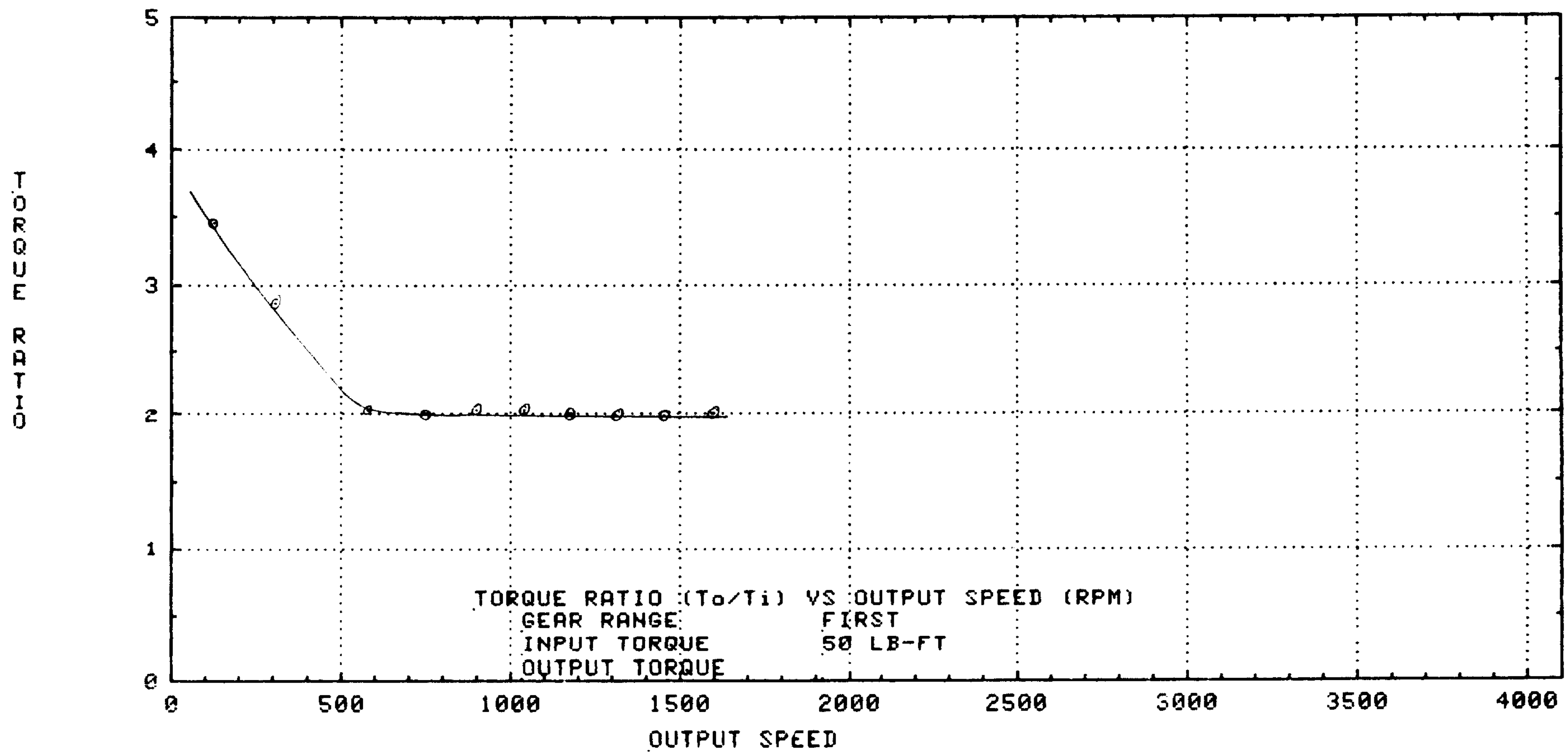

OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 40 LB-FT
OUTPUT TORQUE
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
0
25
50
75
100
125
150
OUTPUT TORQUE

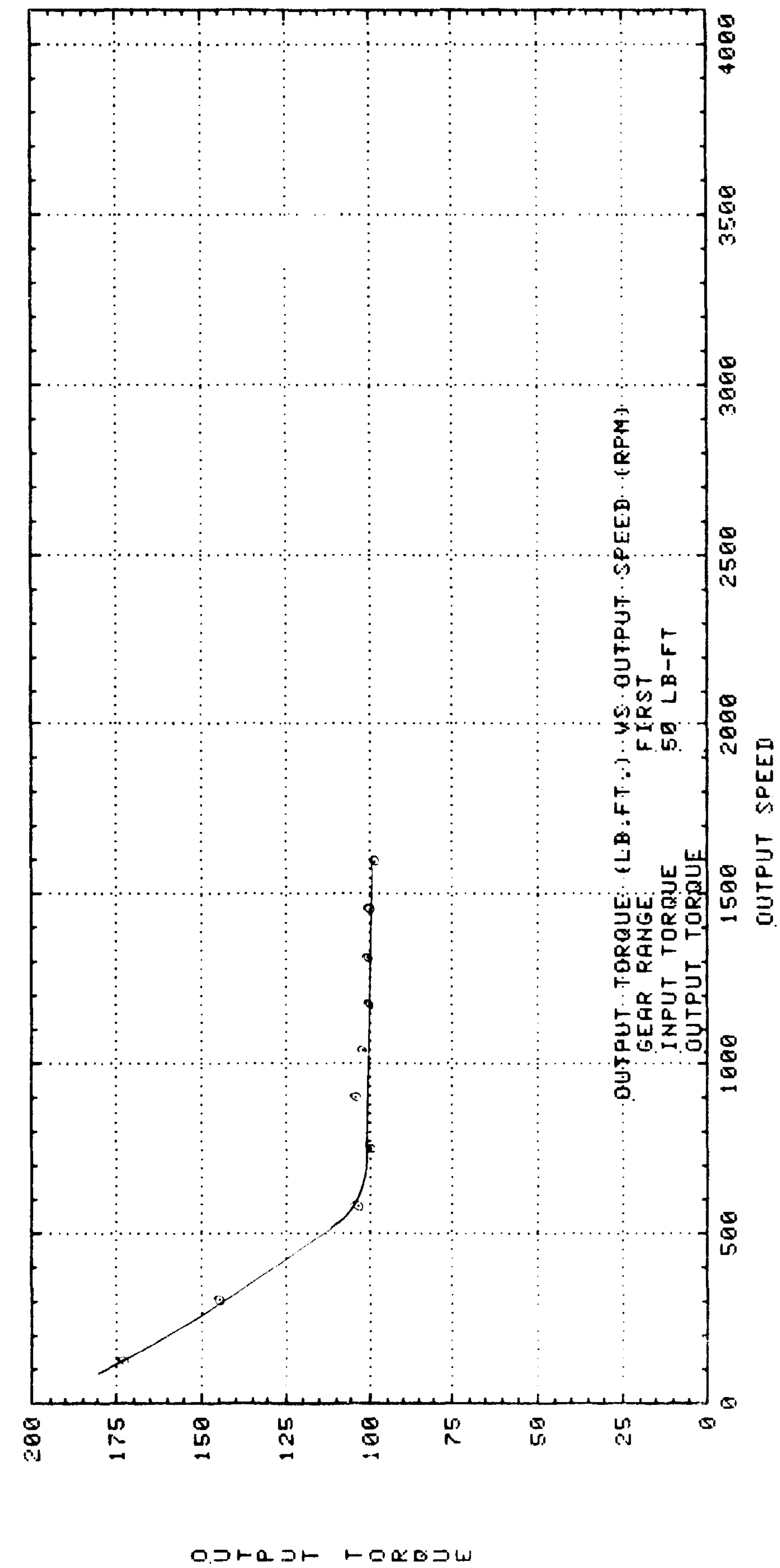


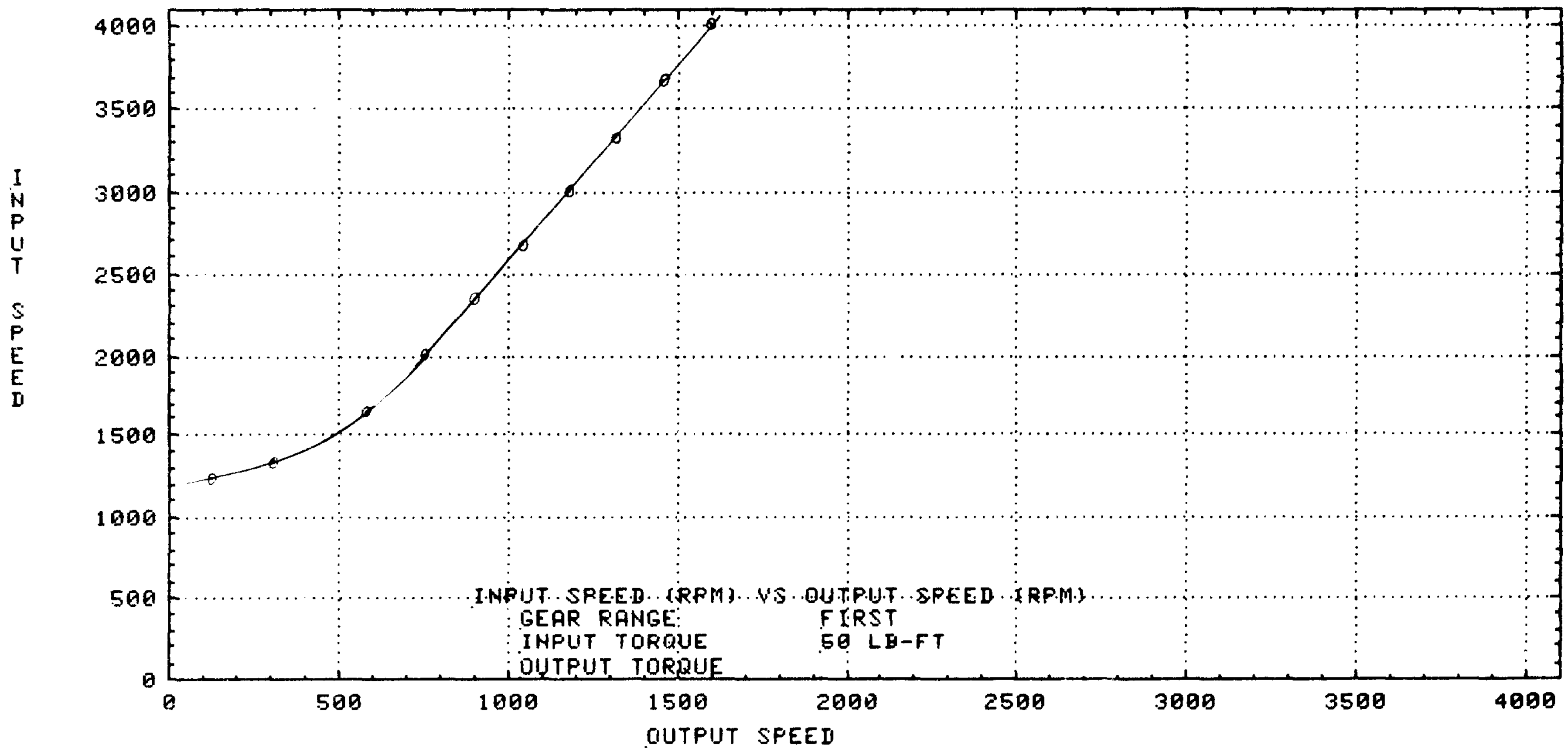
INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 40 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

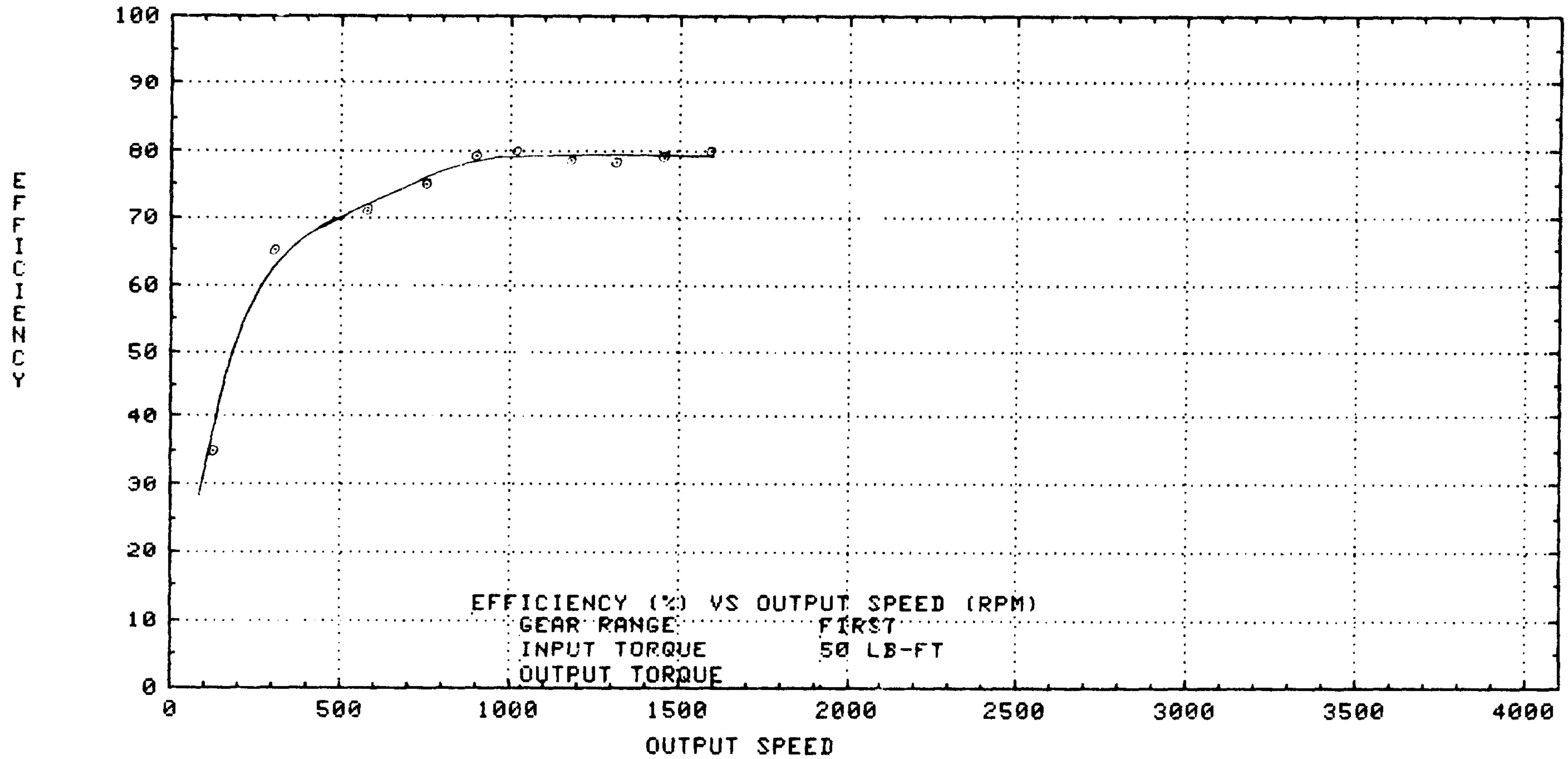

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 40 LB-FT
OUTPUT TORQUE
EFFICIENCY
OUTPUT SPEED
0
10
20
30
40
50
60
70
80
90
100
500
1000
1500
2000
2500
3000
3500
4000

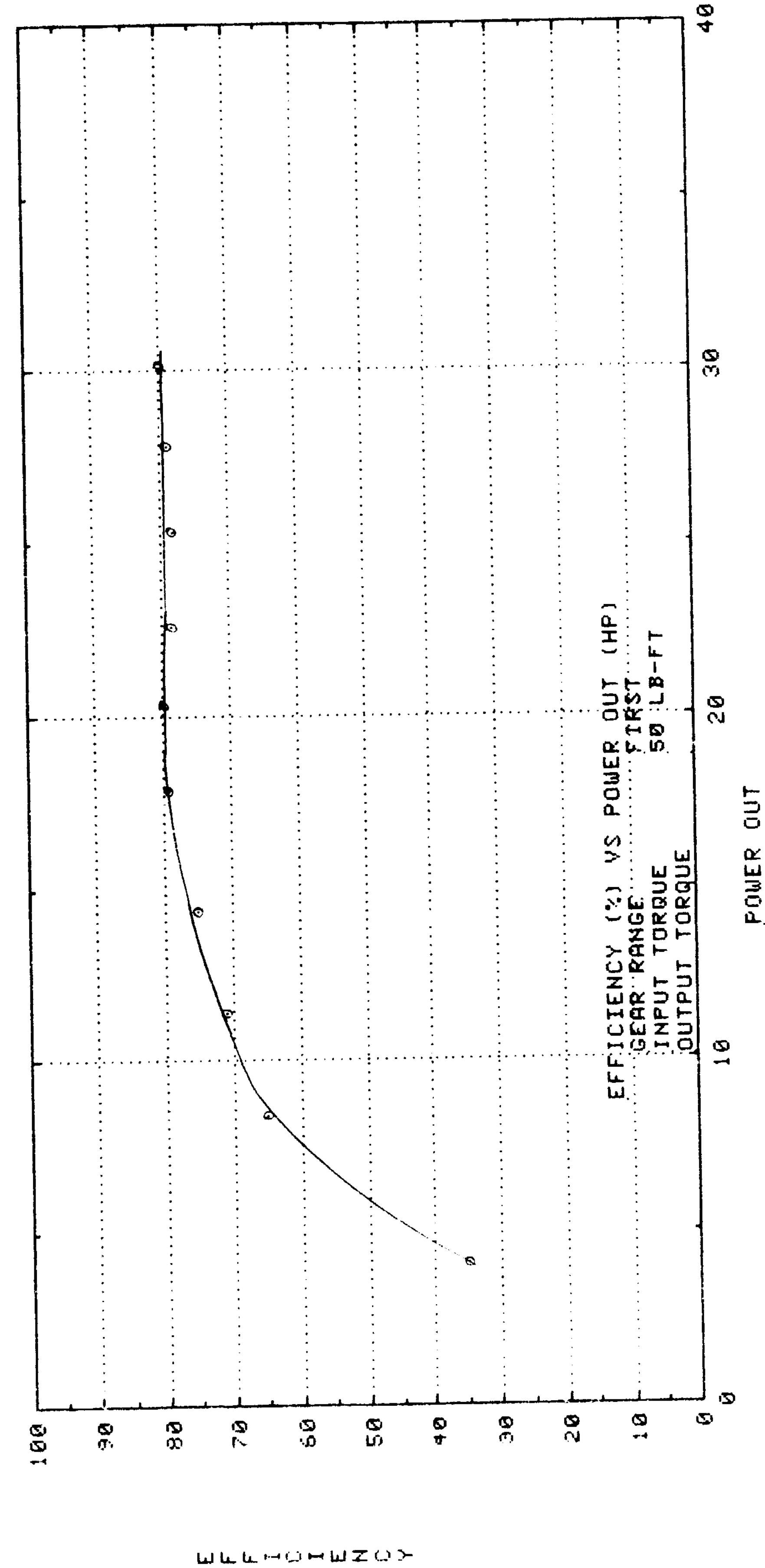

EFFICIENCY
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
POWER OUT
EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE FIRST
INPUT TORQUE 40 LB-FT
OUTPUT TORQUE

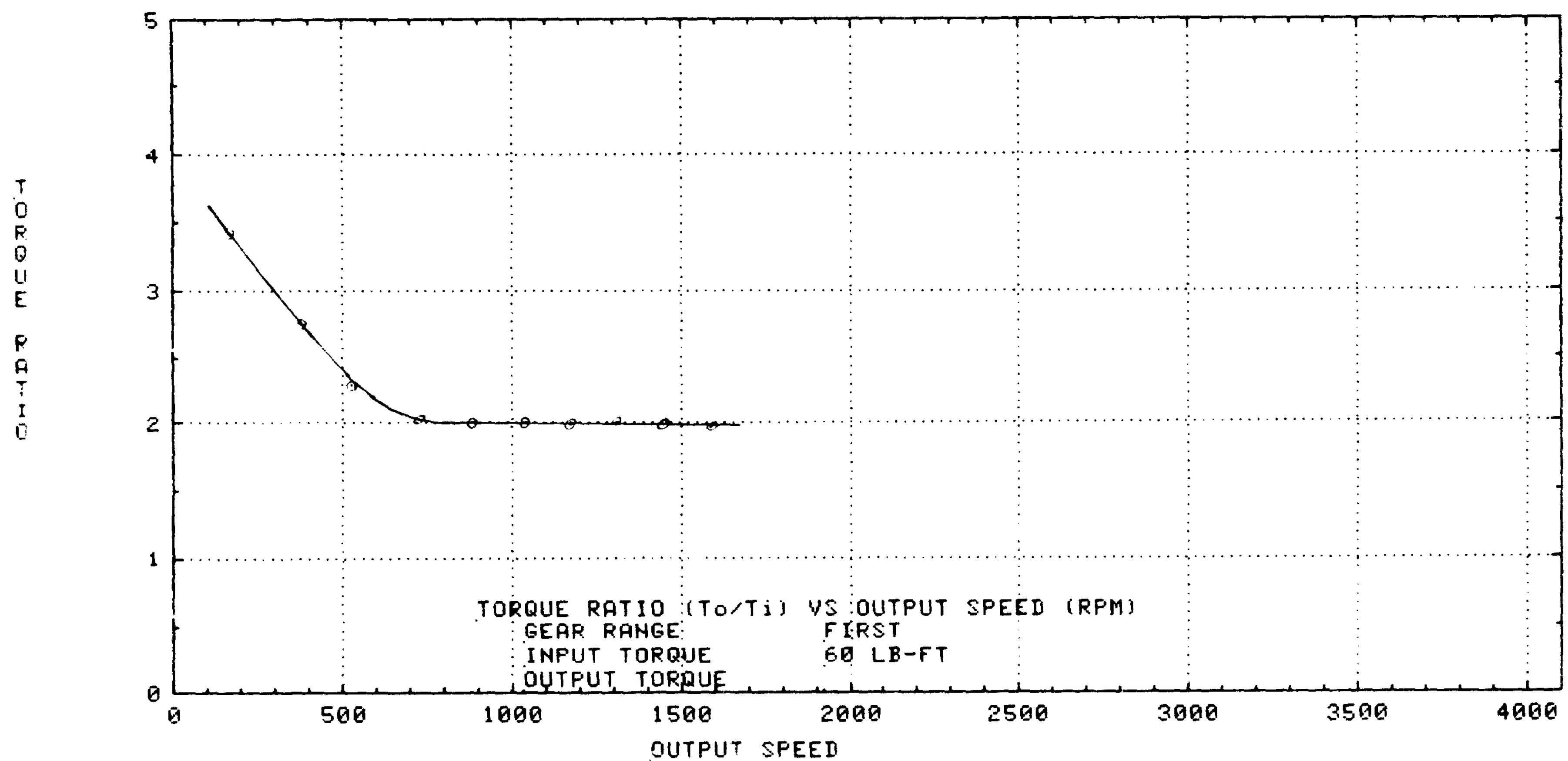

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 50 LB-FT
OUTPUT TORQUE
TORQUE RATIO
OUTPUT SPEED
0
1
2
3
4
5
500
1000
1500
2000
2500
3000
3500
4000

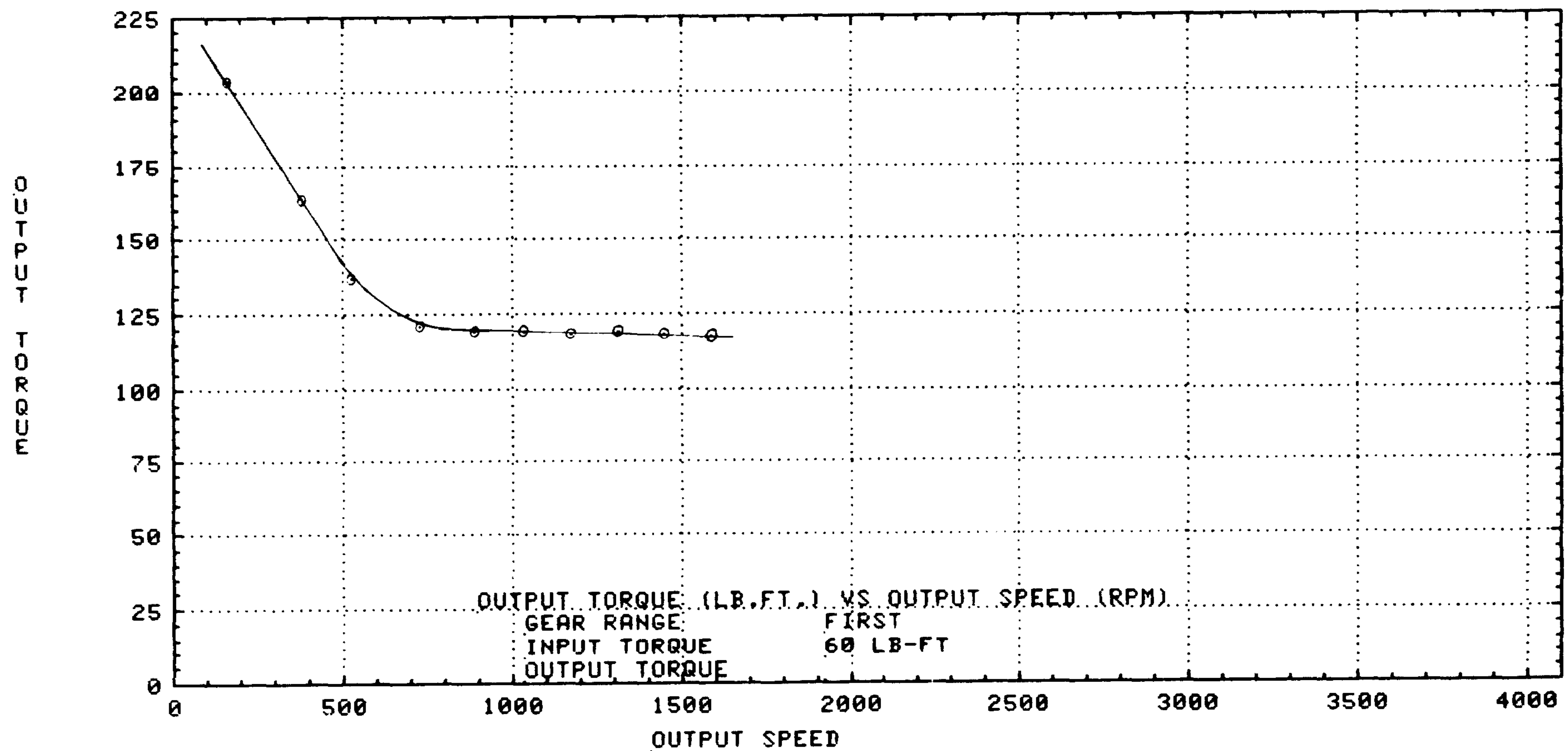

OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 50 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
OUTPUT TORQUE
0
500
1000
1500
2000
2500
3000
3500
4000
0
25
50
75
100
125
150
175
200

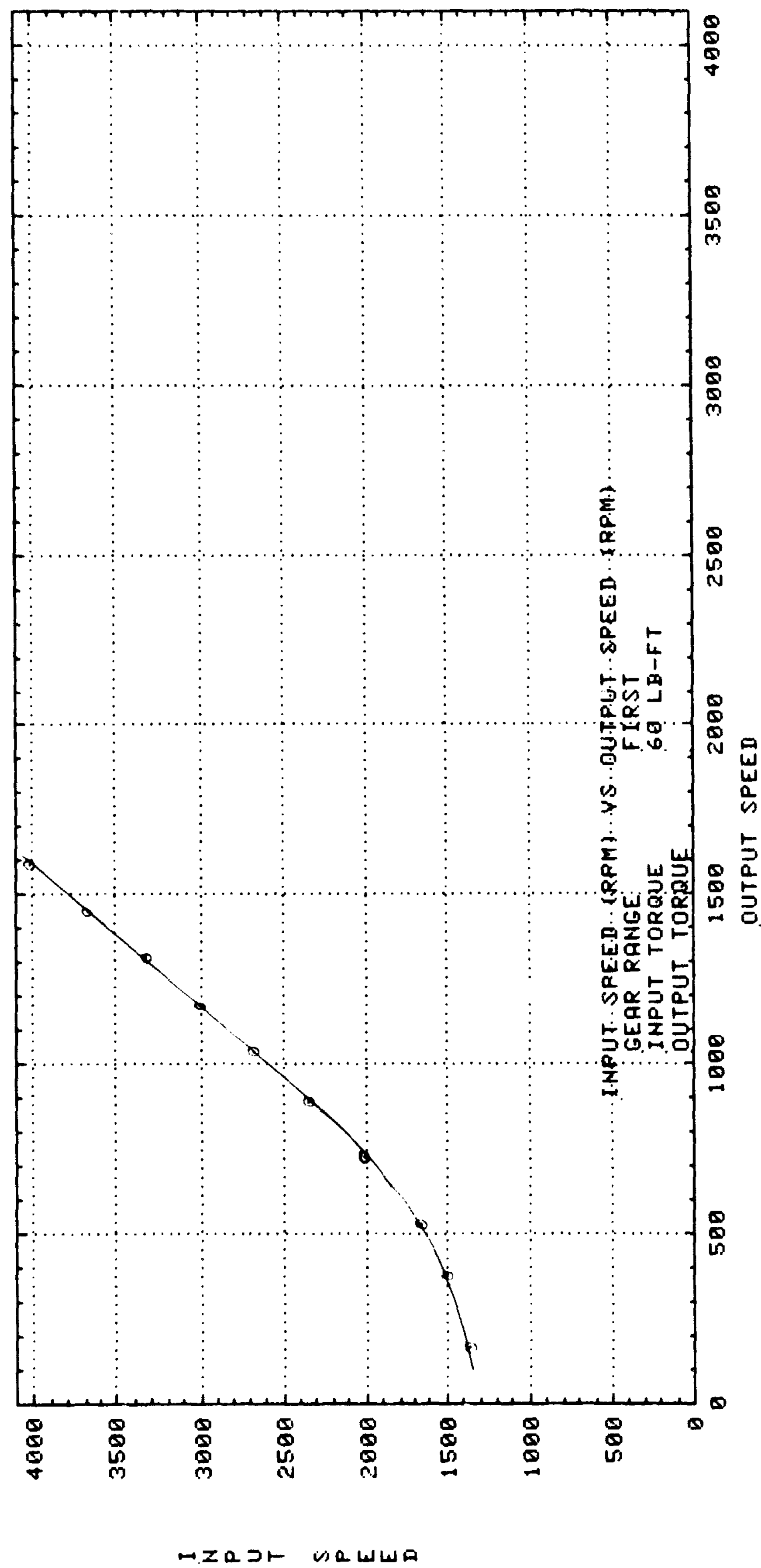

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 50 LB-FT
OUTPUT TORQUE
INPUT SPEED
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000


EFFICIENCY
100
90
80
70
60
50
40
30
20
10
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 50 LB-FT
OUTPUT TORQUE

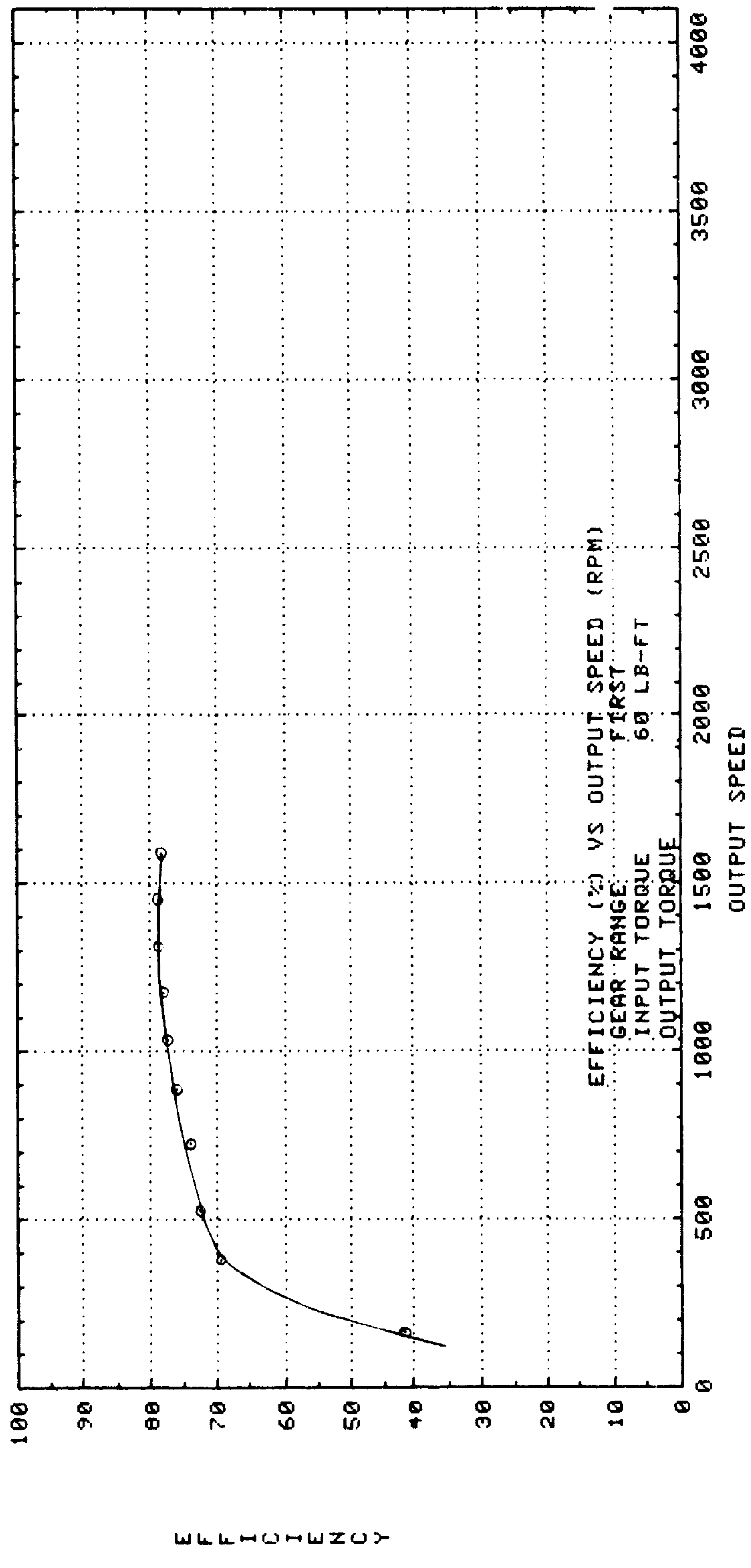

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE FIRST
INPUT TORQUE 50 LB-FT
OUTPUT TORQUE
POWER OUT
EFFICIENCY
0 10 20 30 40
0 10 20 30 40 50 60 70 80 90 100

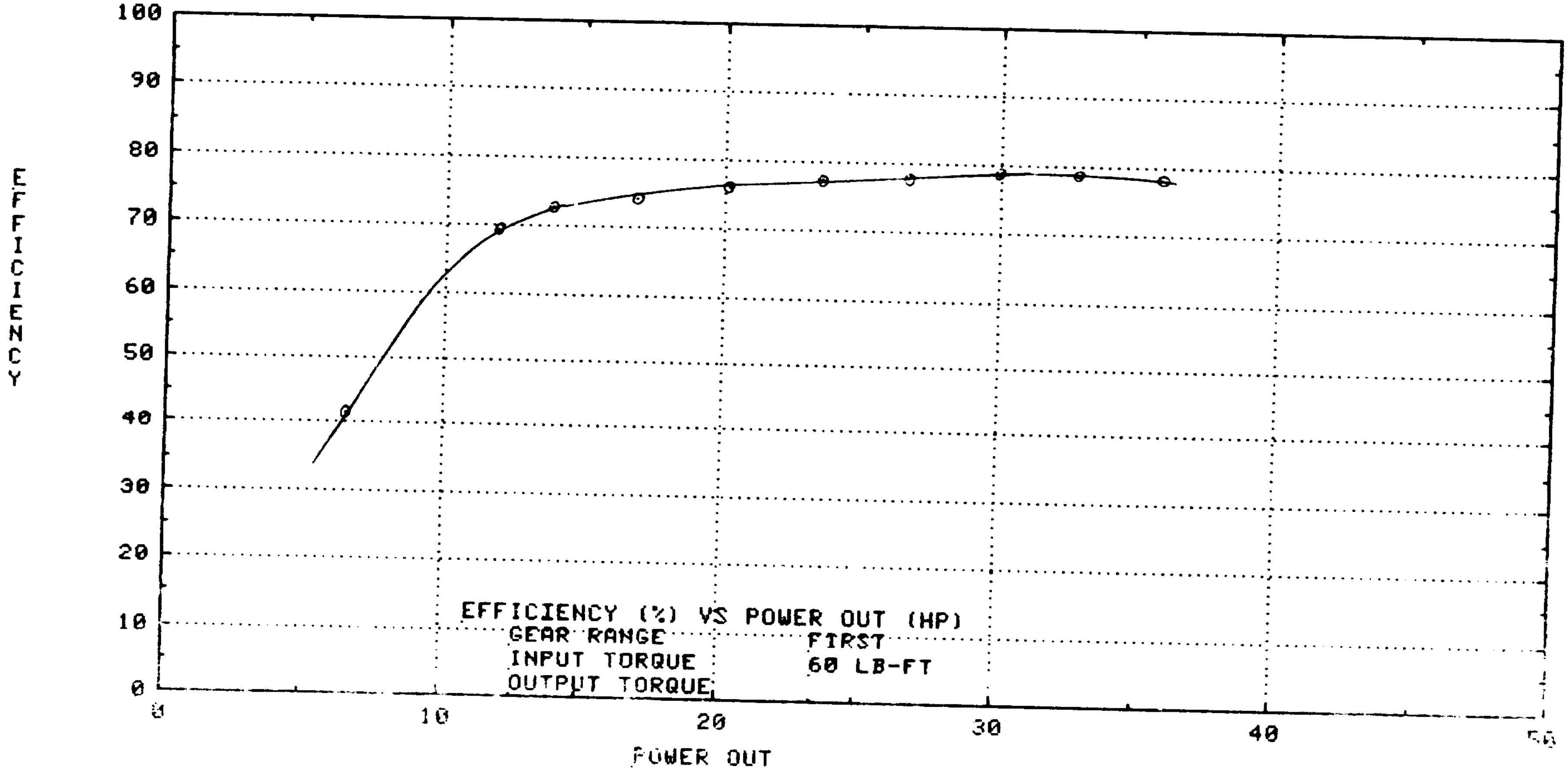

TORQUE RATIO
5
4
3
2
1
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 60 LB-FT
OUTPUT TORQUE

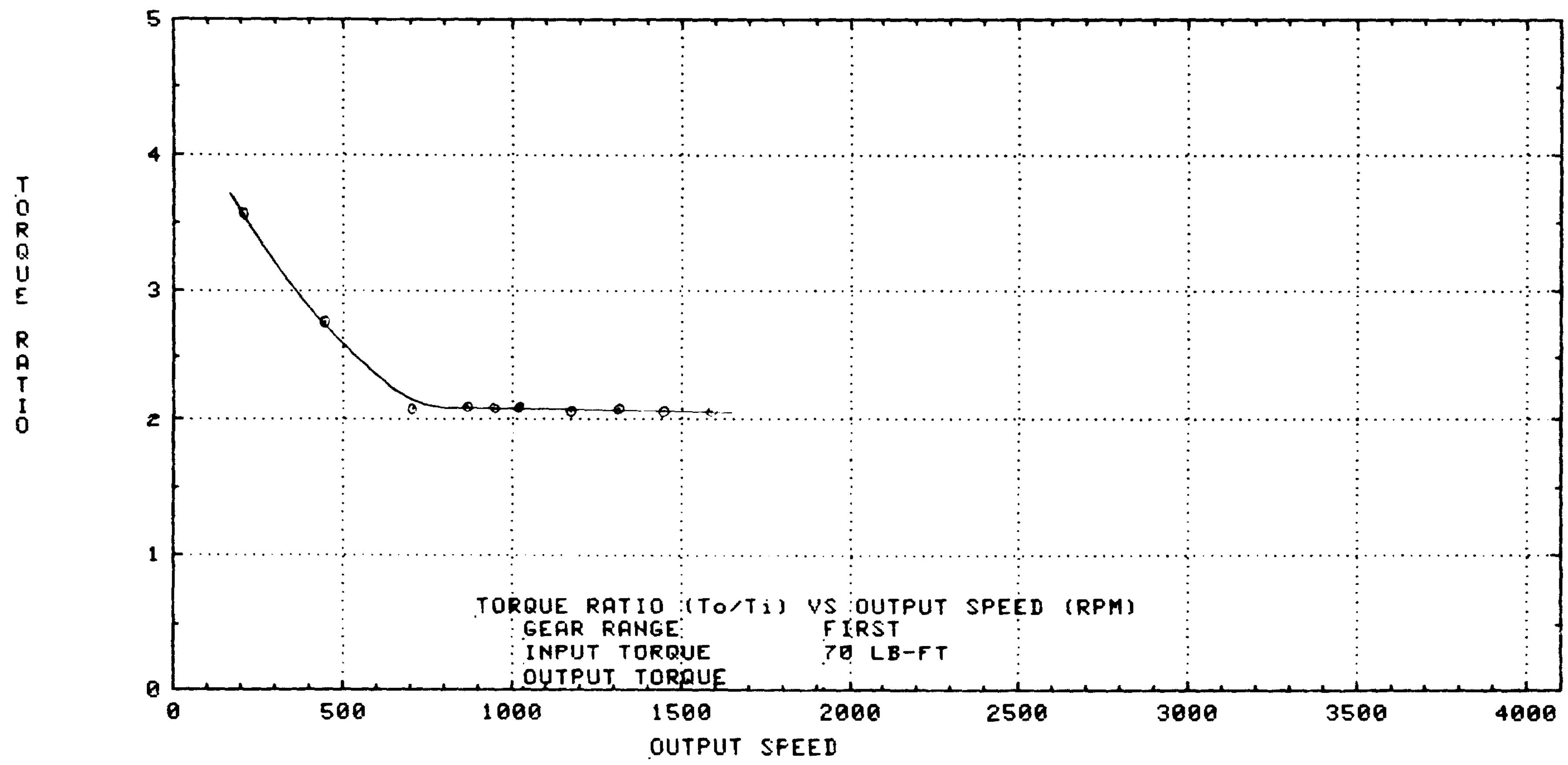

OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 60 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
OUTPUT TORQUE
225
200
175
150
125
100
75
50
25
0
500
1000
1500
2000
2500
3000
3500
4000

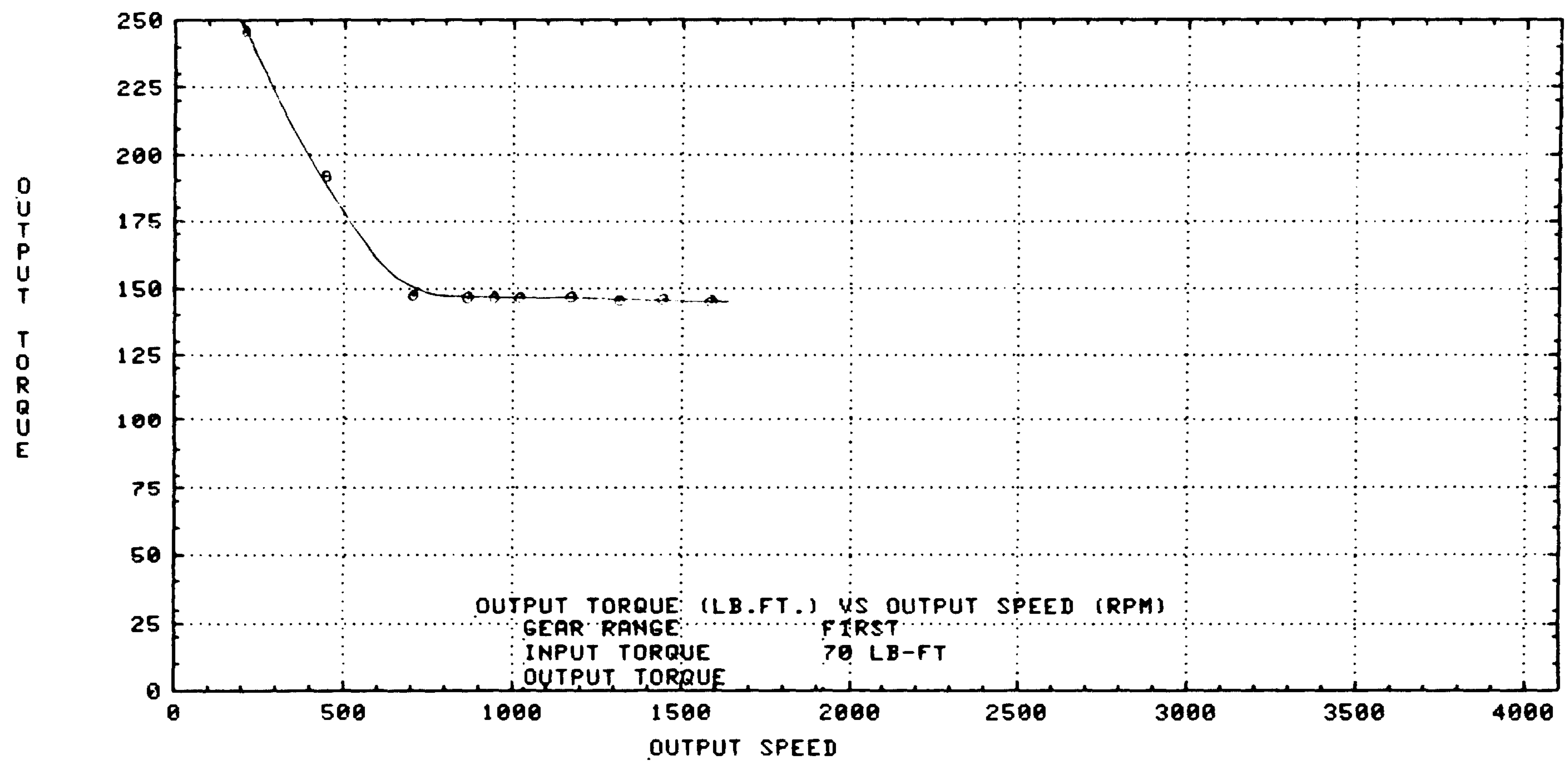


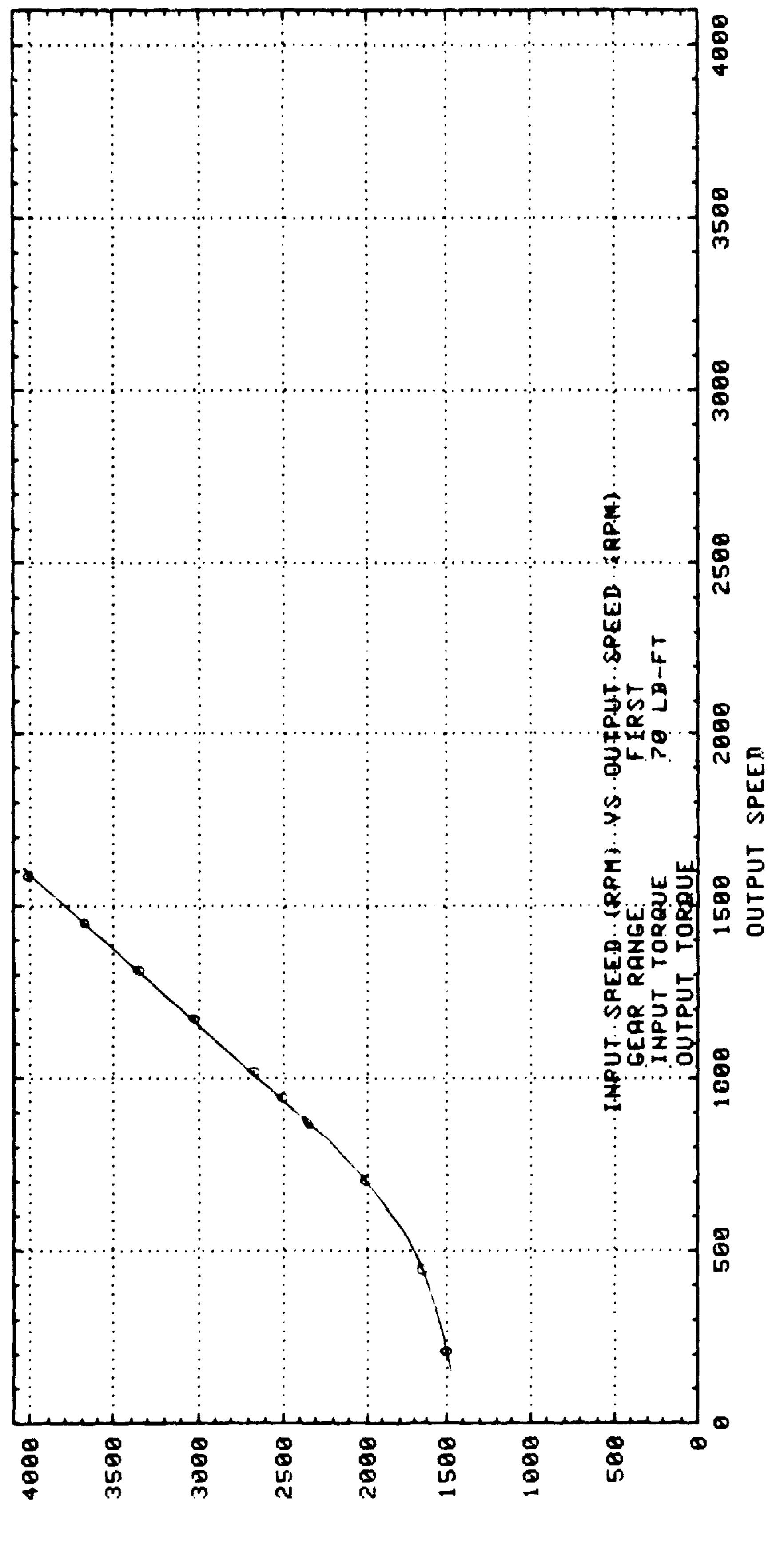
INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 60 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

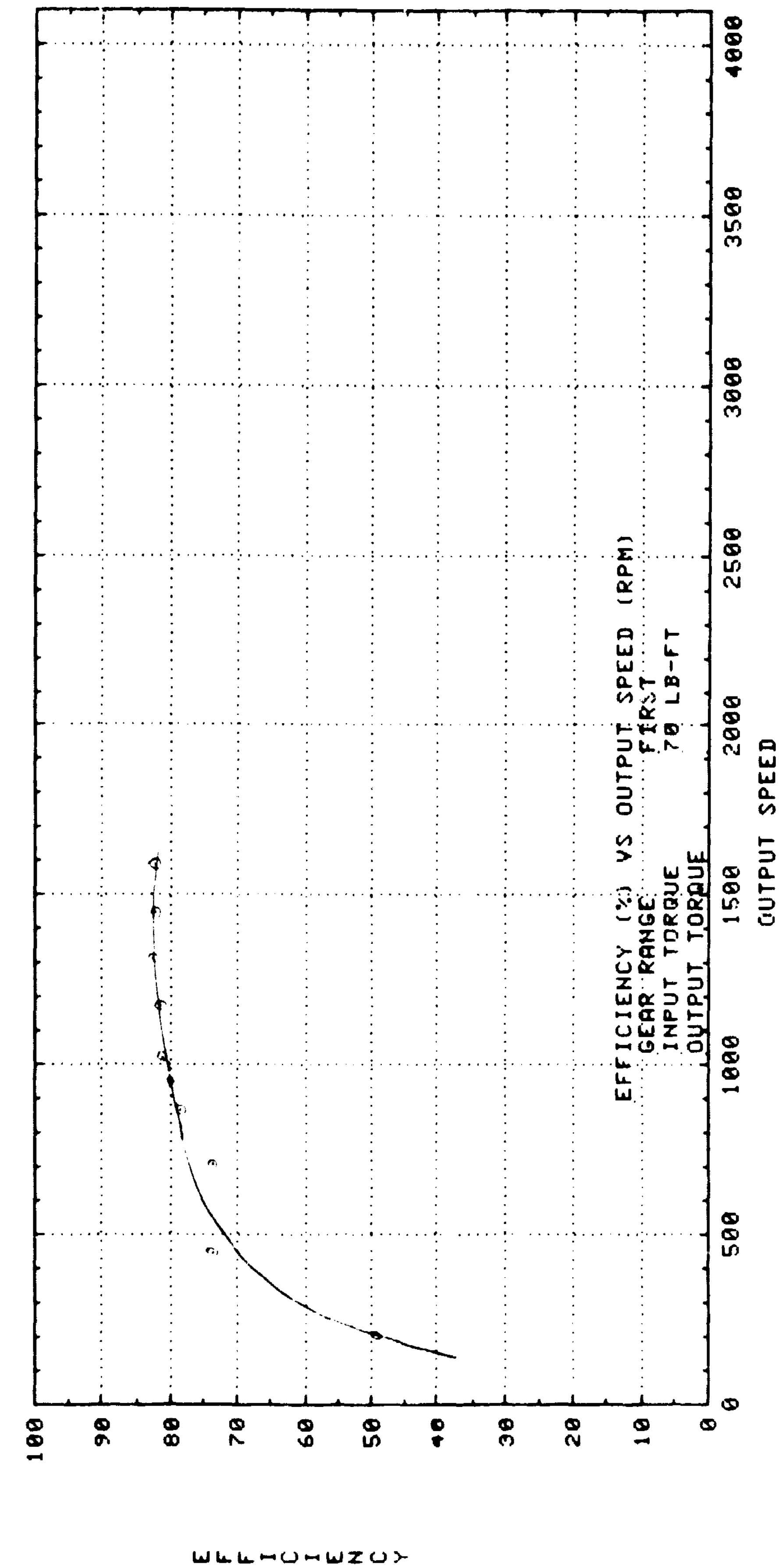

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 60 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
EFFICIENCY
0 500 1000 1500 2000 2500 3000 3500 4000
0 10 20 30 40 50 60 70 80 90 100


EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE
FIRST
INPUT TORQUE
60 LB-FT
OUTPUT TORQUE
EFFICIENCY
POWER OUT
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50

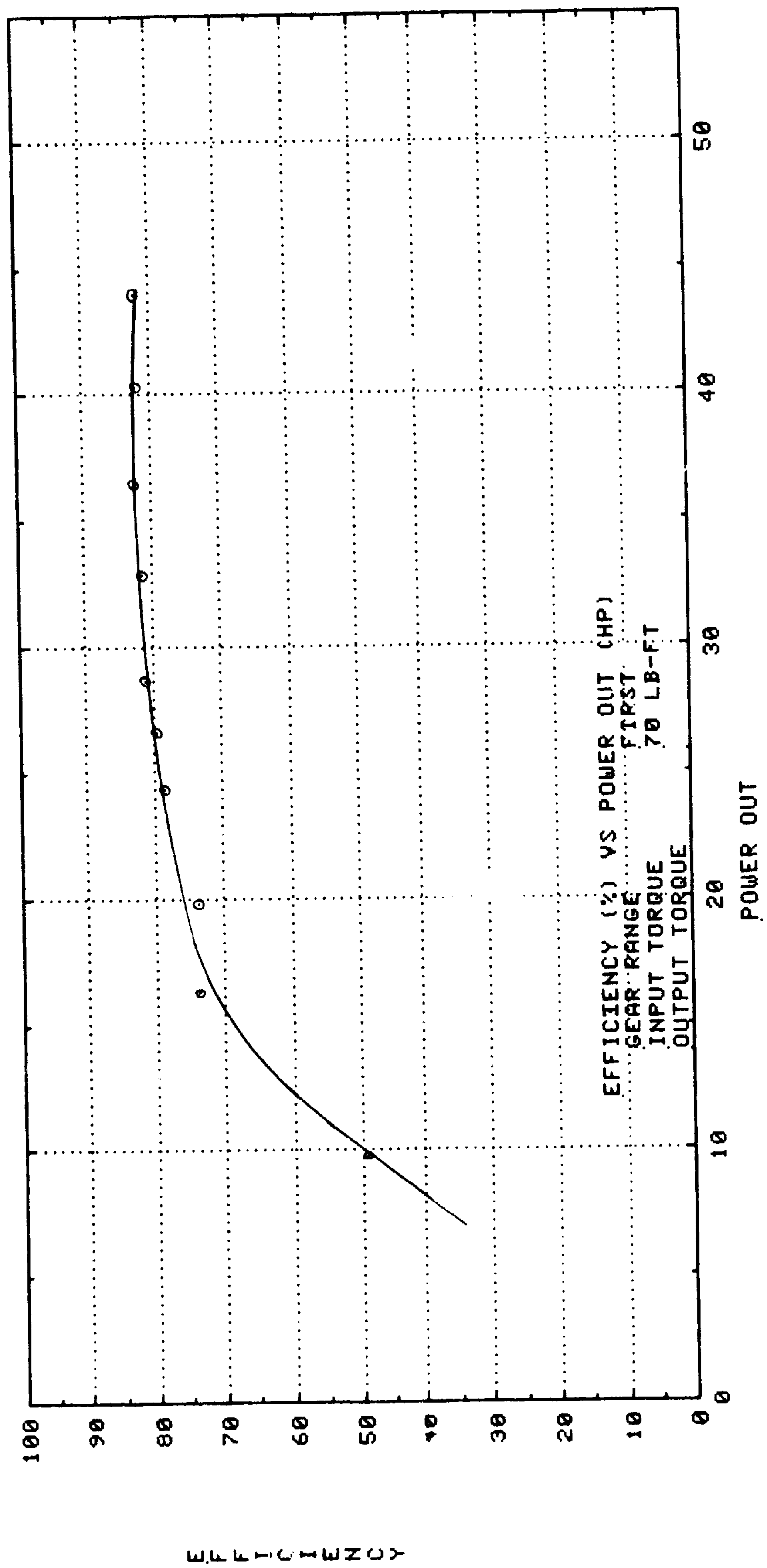

TORQUE RATIO
5
4
3
2
1
0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 70 LB-FT
OUTPUT TORQUE

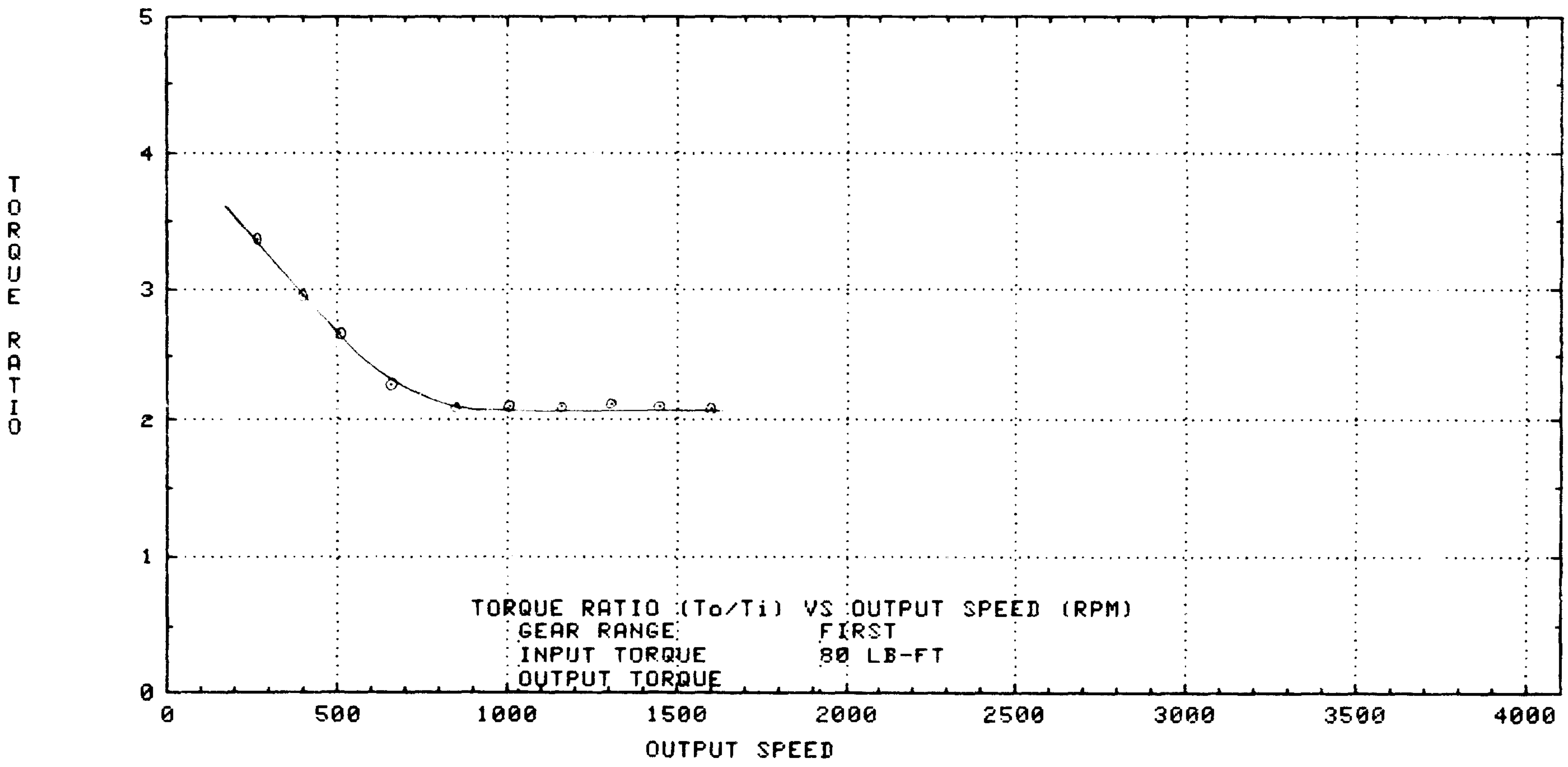

OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 70 LB-FT
OUTPUT TORQUE
OUTPUT TORQUE
OUTPUT SPEED
250
225
200
175
150
125
100
75
50
25
0
0
500
1000
1500
2000
2500
3000
3500
4000


INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 70 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

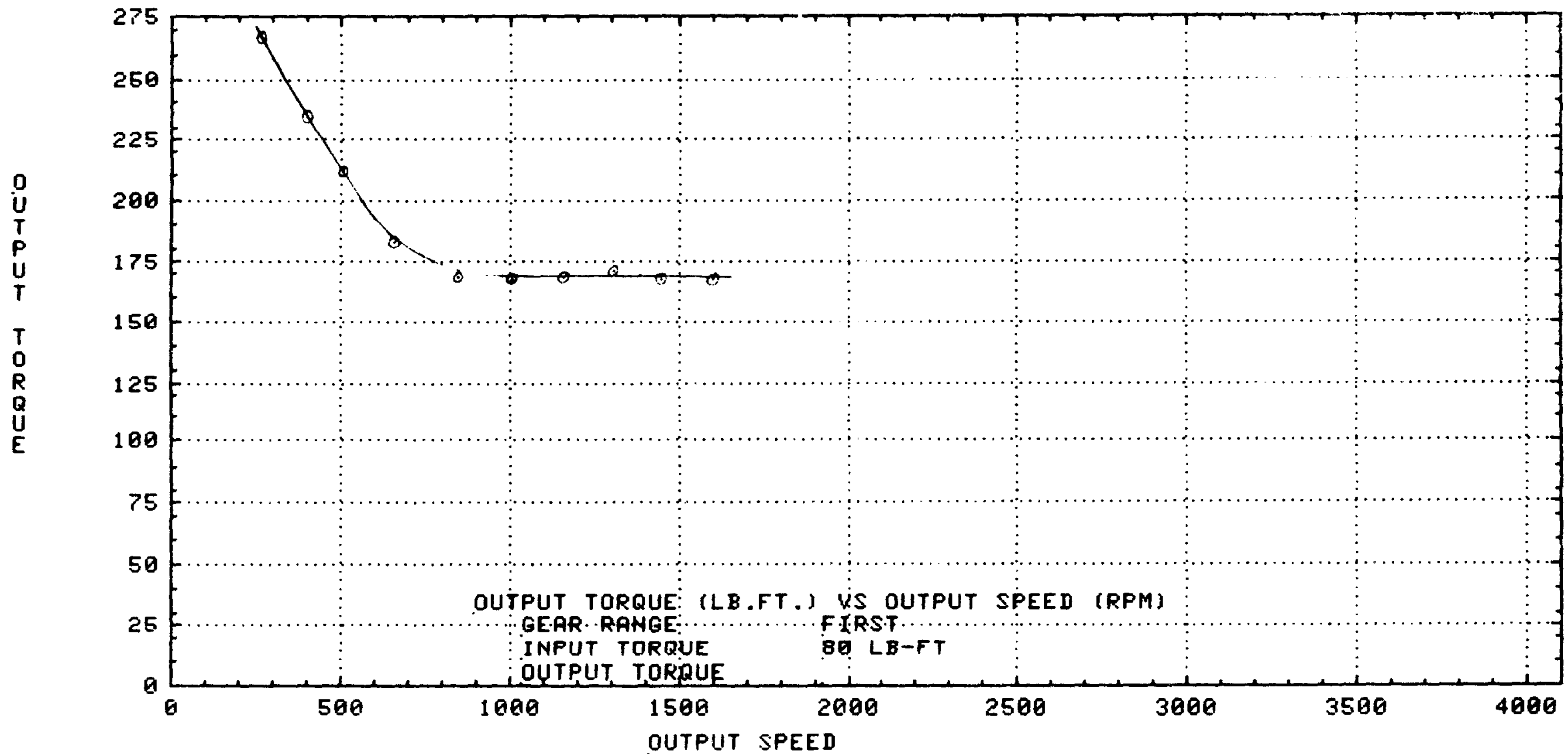


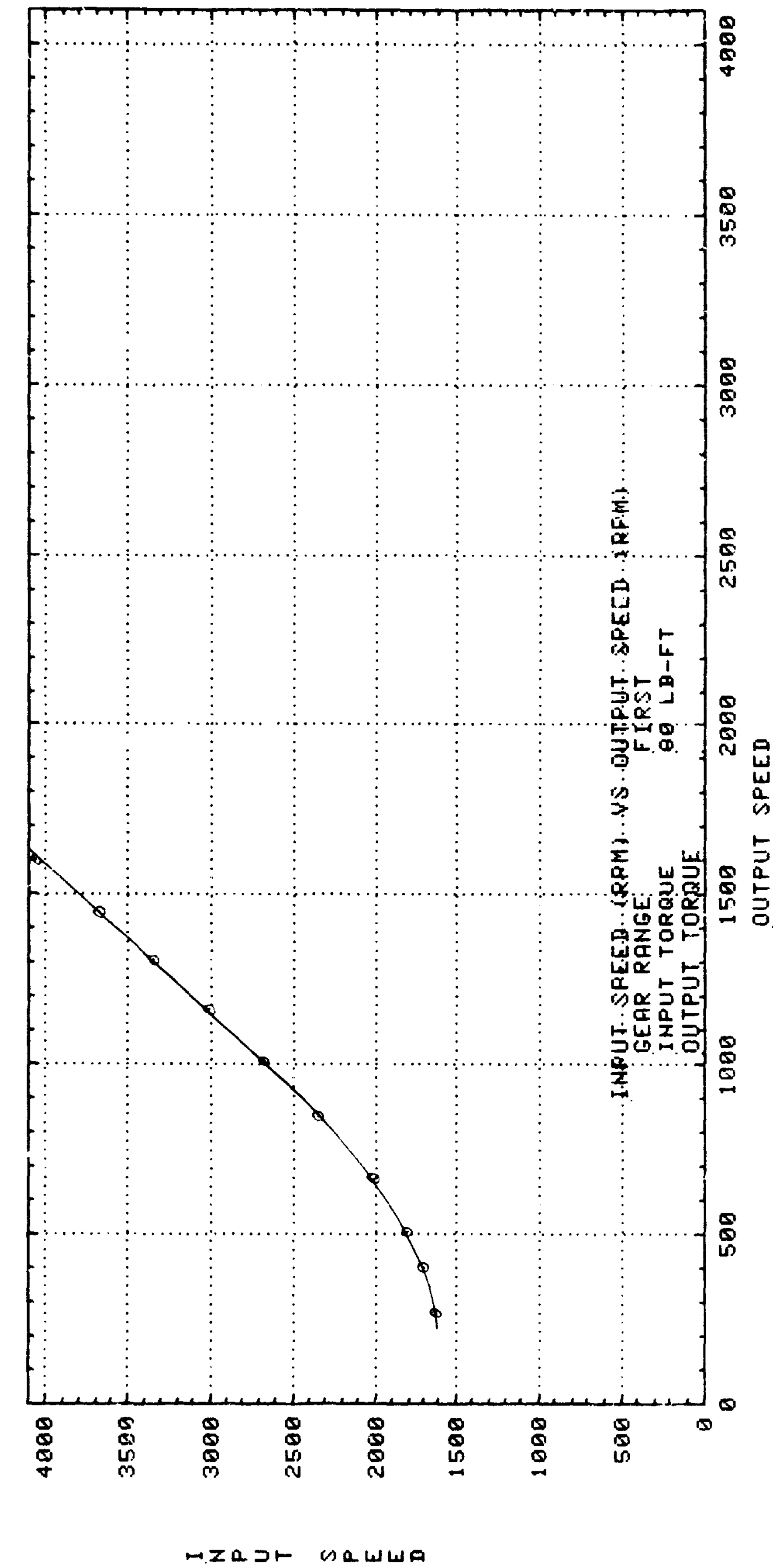
EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 70 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
EFFICIENCY
0 500 1000 1500 2000 2500 3000 3500 4000
0 10 20 30 40 50 60 70 80 90 100

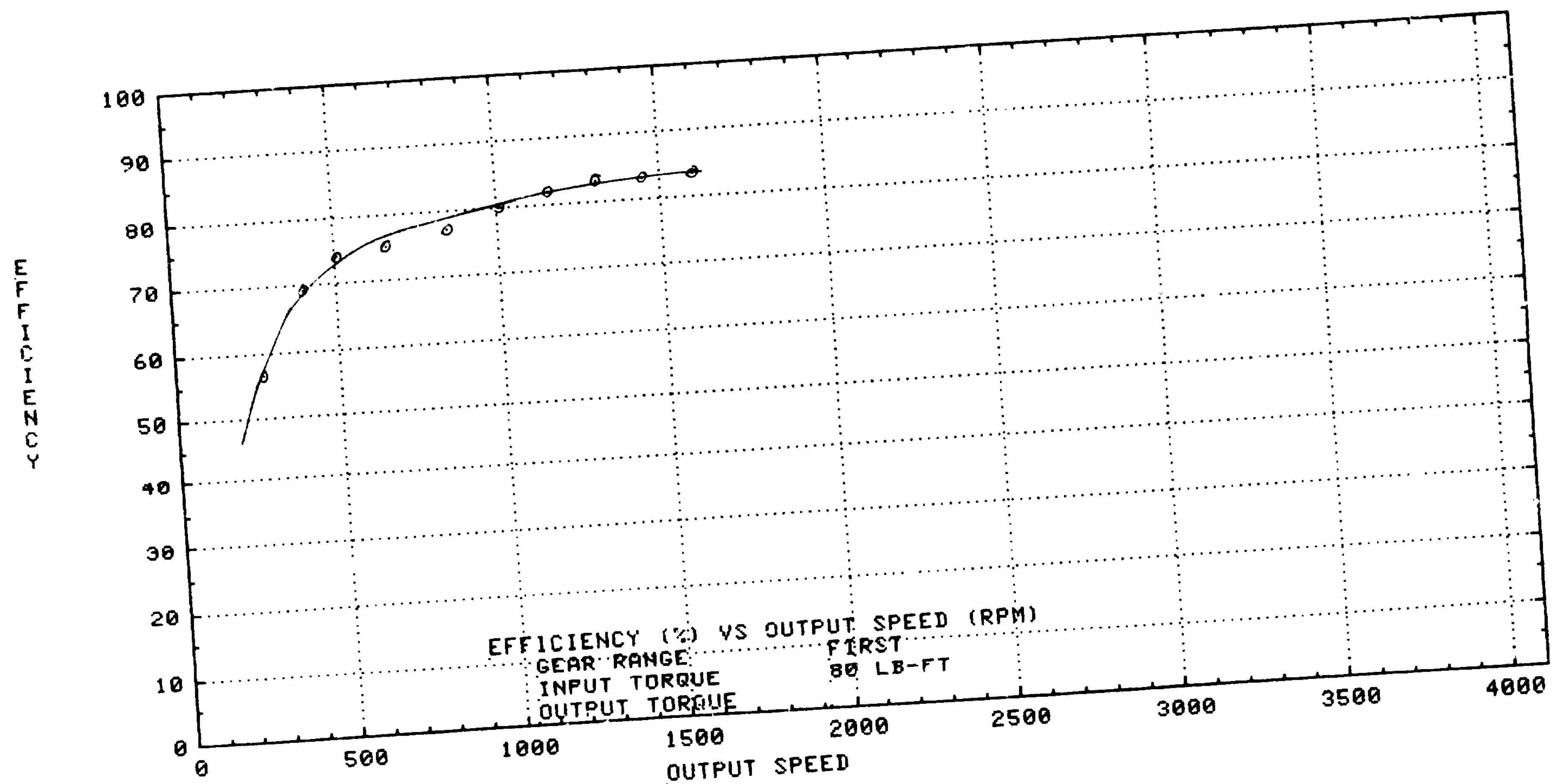

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE FIRST
INPUT TORQUE 70 LB-FT
OUTPUT TORQUE
POWER OUT
EFFICIENCY
0
10
20
30
40
50
60
70
80
90
100

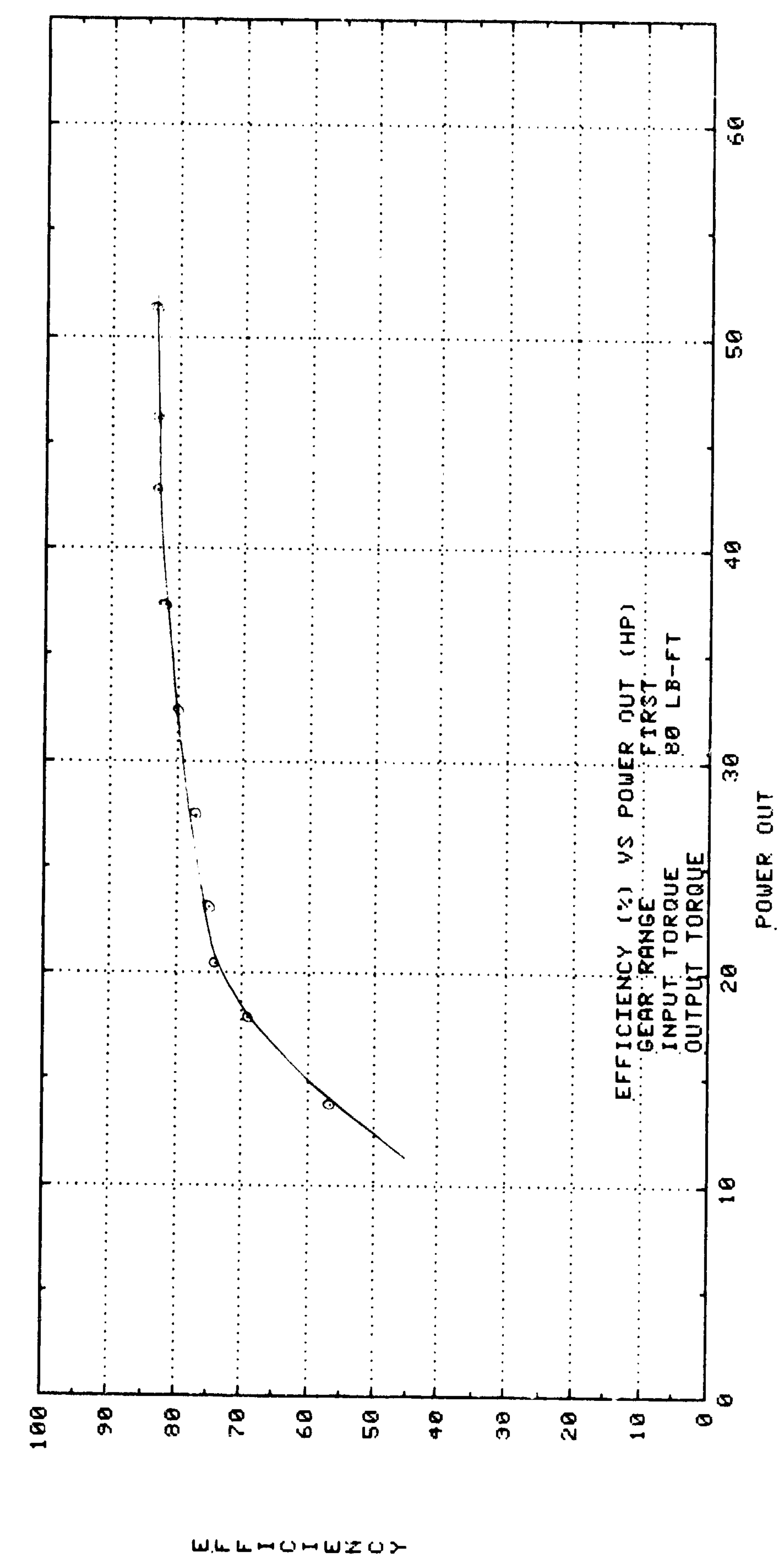


TORQUE RATIO
5
4
3
2
1
0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 80 LB-FT
OUTPUT TORQUE

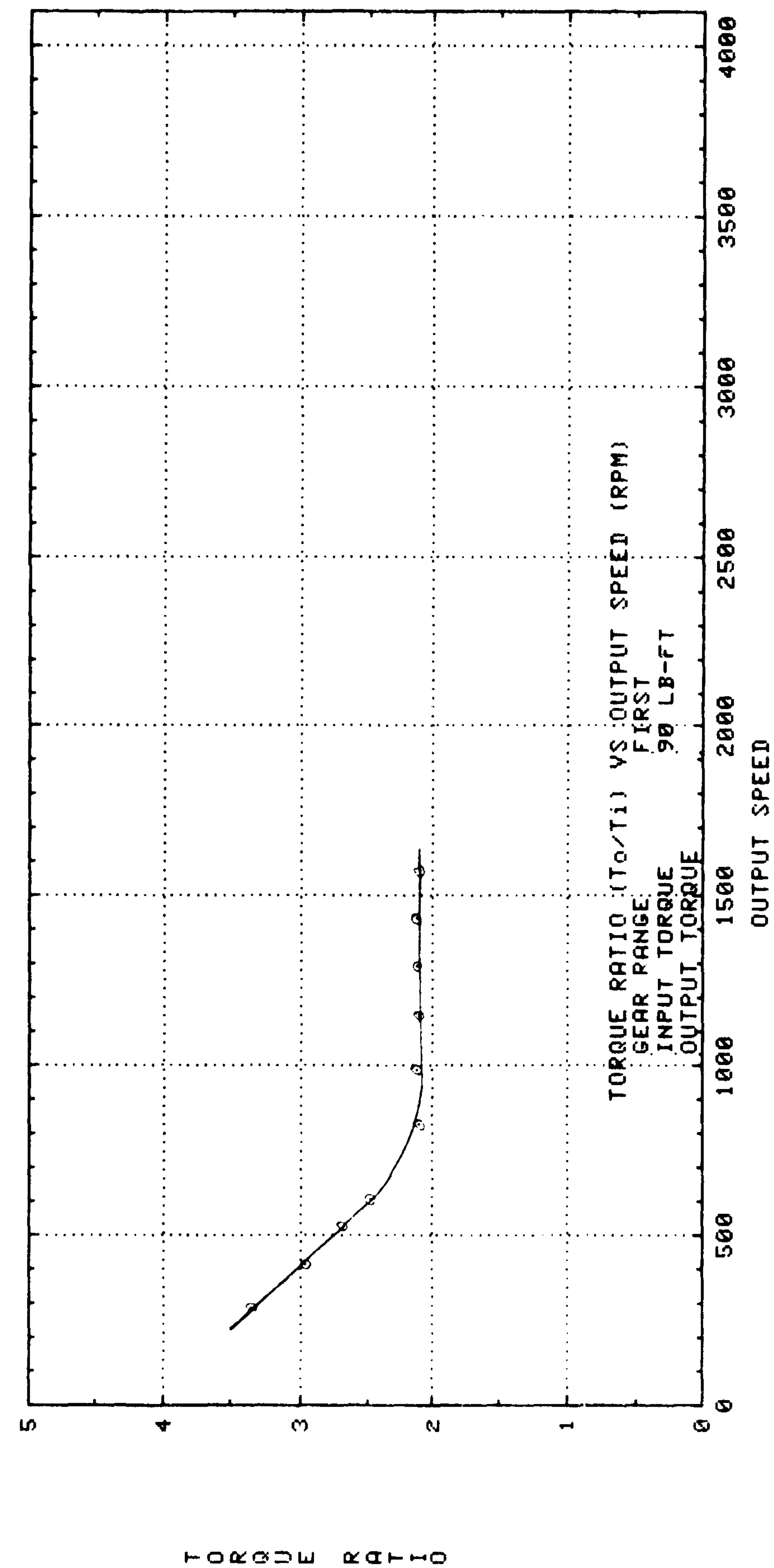

OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 80 LB-FT
OUTPUT TORQUE
OUTPUT TORQUE
OUTPUT SPEED
275
250
225
200
175
150
125
100
75
50
25
0
0
500
1000
1500
2000
2500
3000
3500
4000

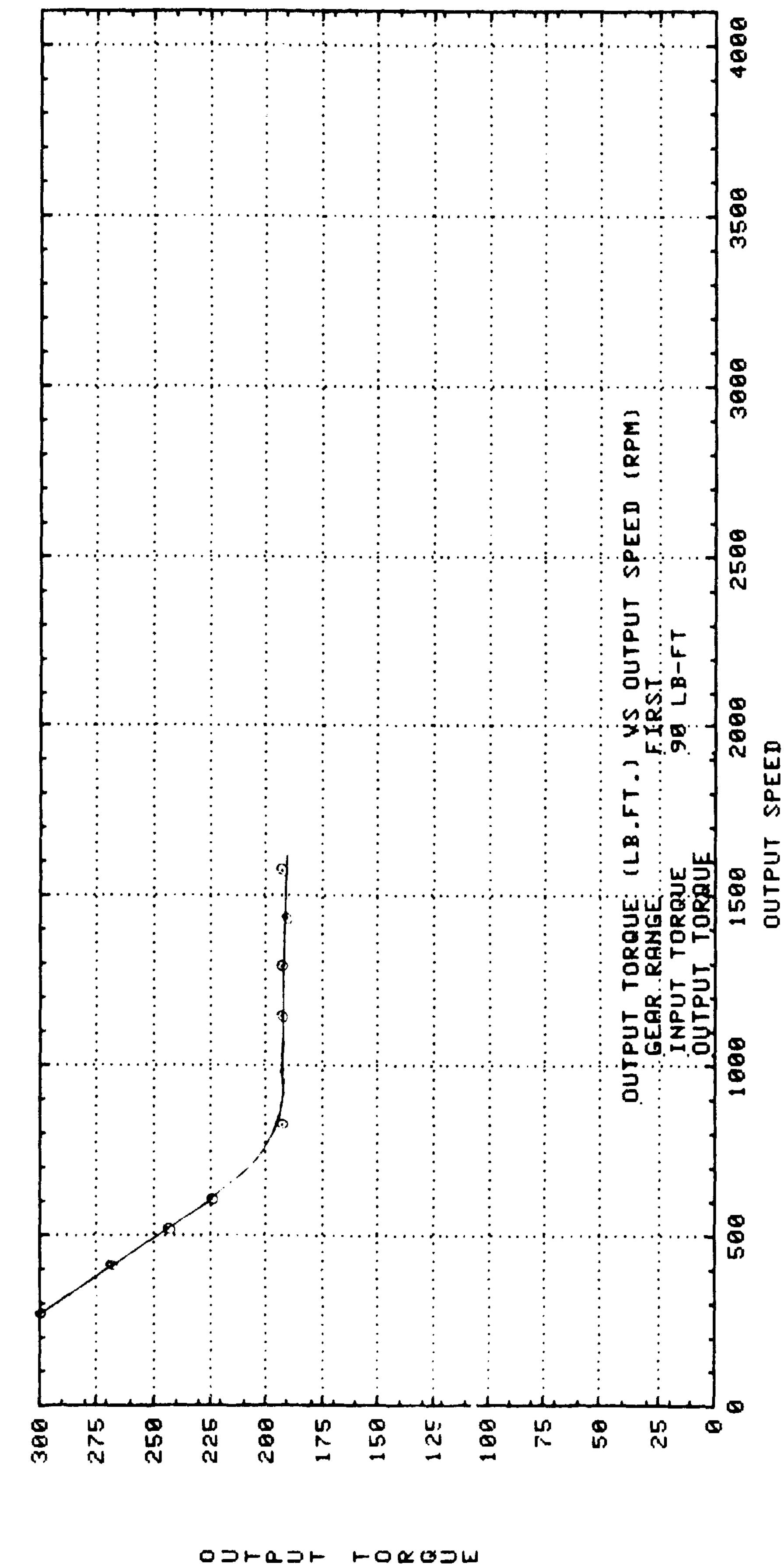

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 80 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

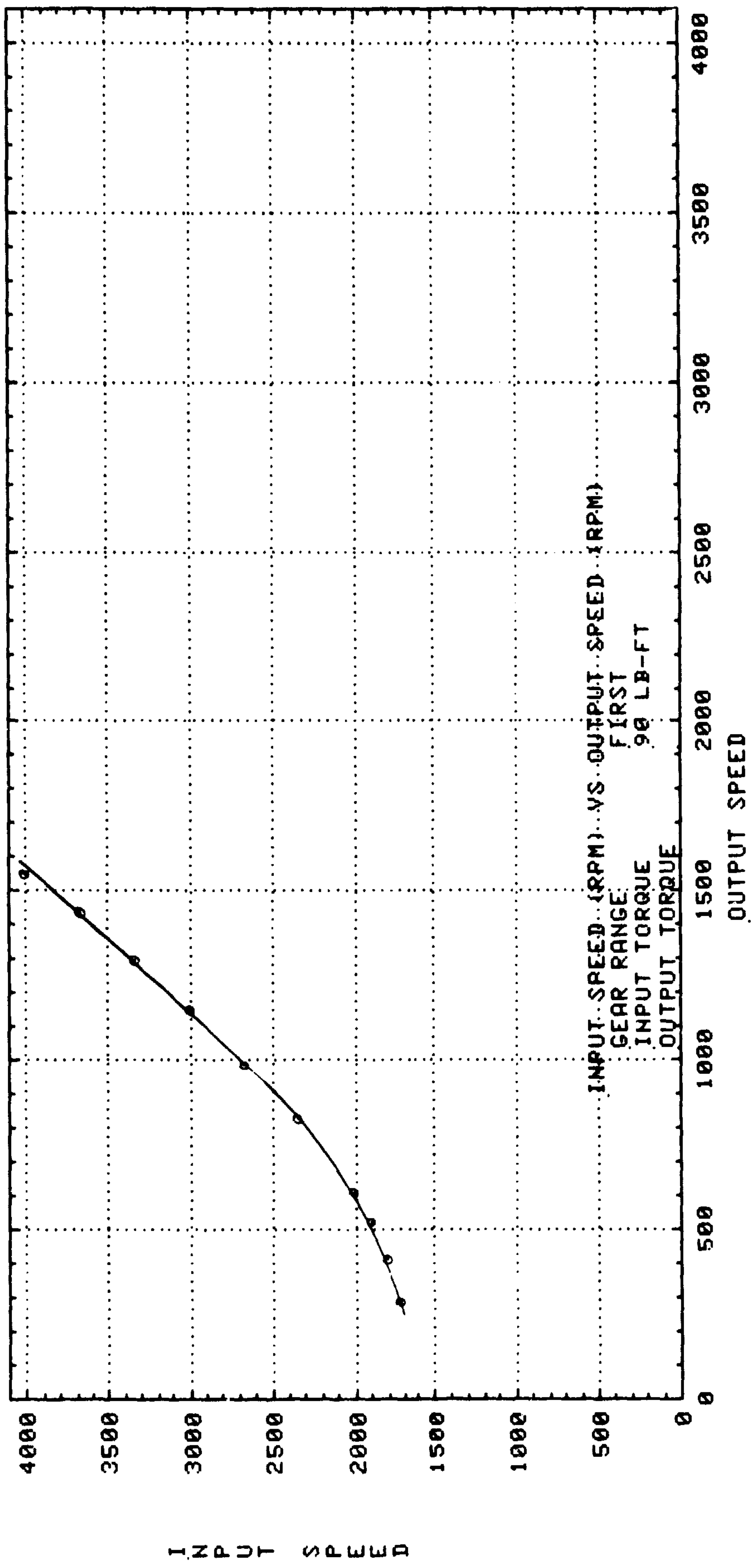

EFFICIENCY
OUTPUT SPEED
EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 80 LB-FT
OUTPUT TORQUE
0
10
20
30
40
50
60
70
80
90
100
0
500
1000
1500
2000
2500
3000
3500
4000

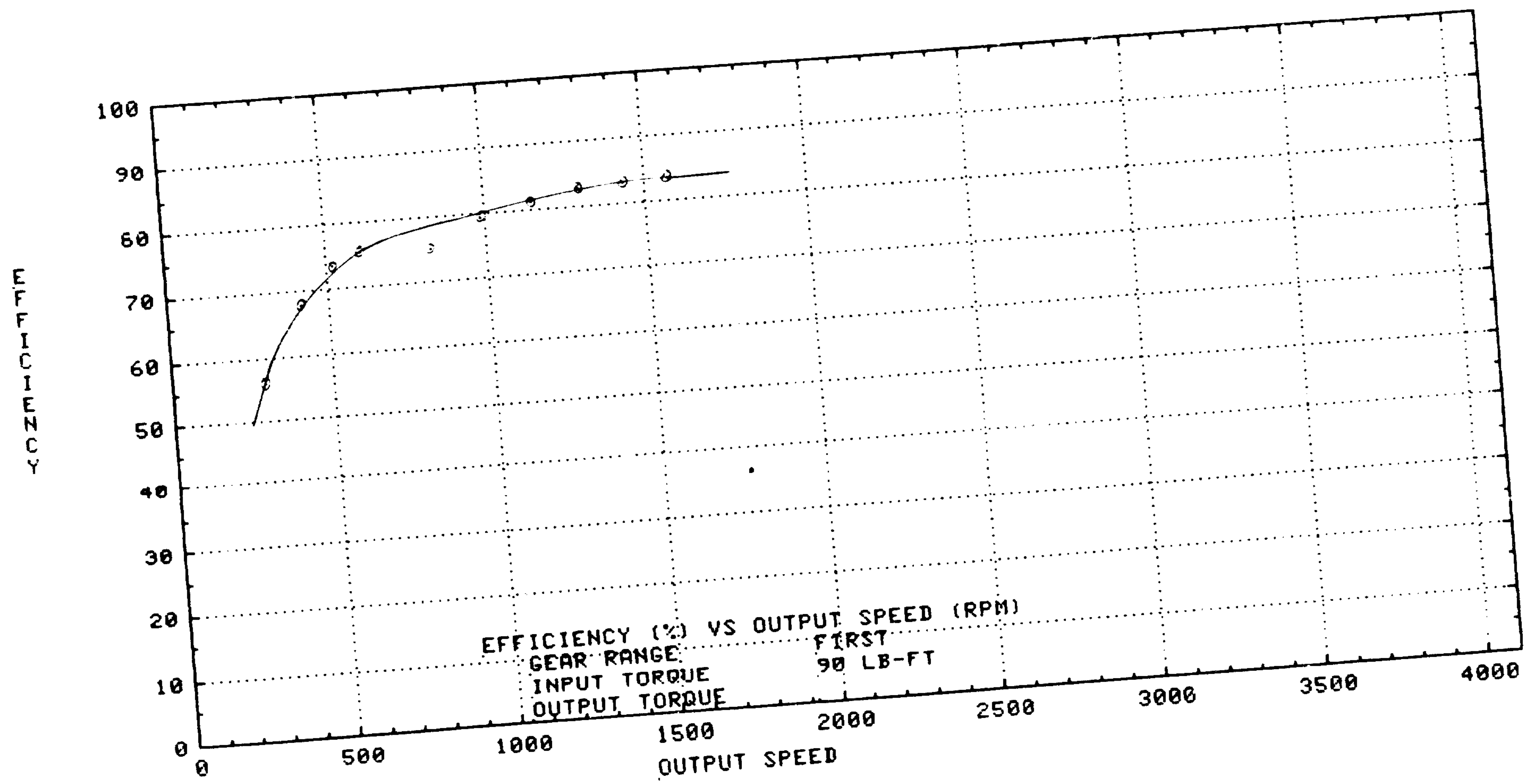


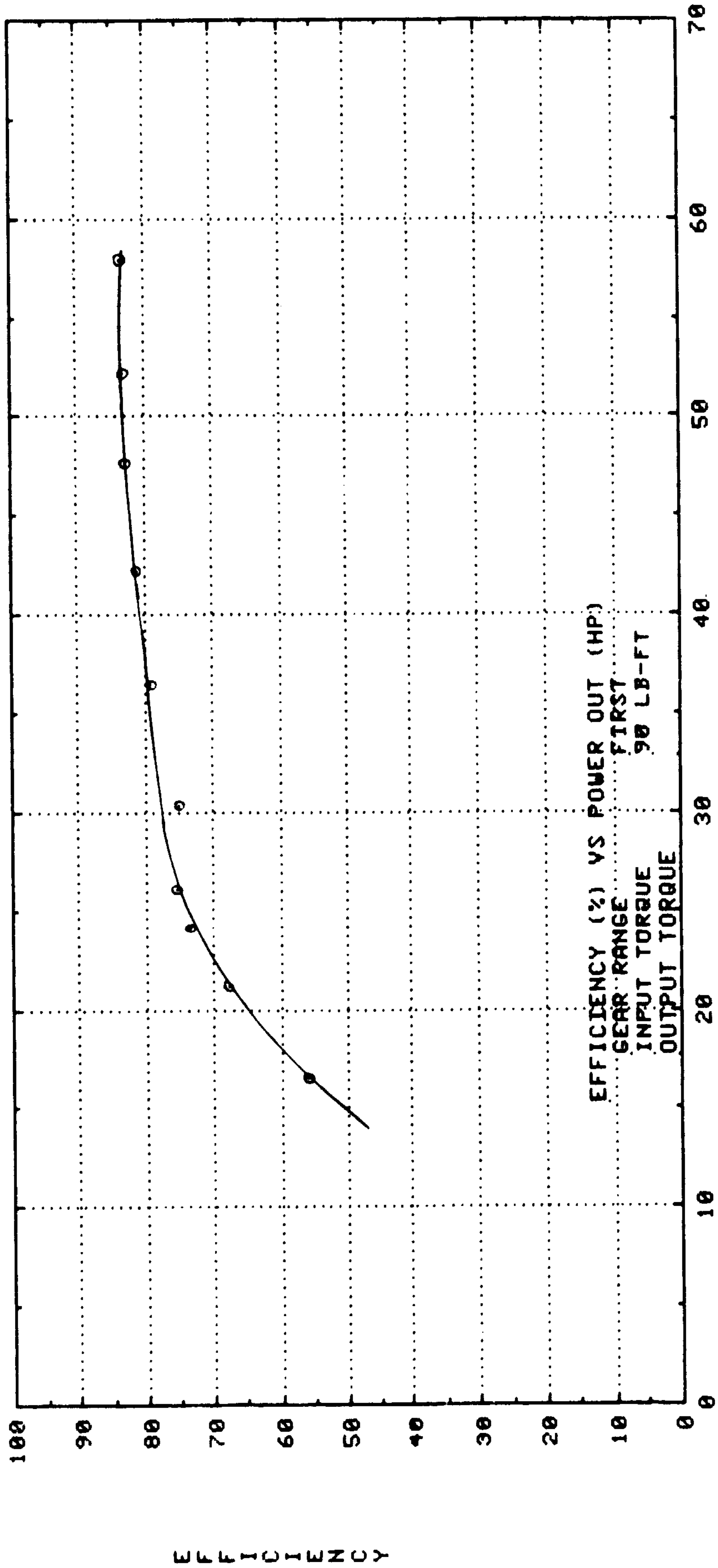
EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE FIRST
INPUT TORQUE 80 LB-FT
OUTPUT TORQUE
POWER OUT
EFFICIENCY
0
10
20
30
40
50
60
70
80
90
100

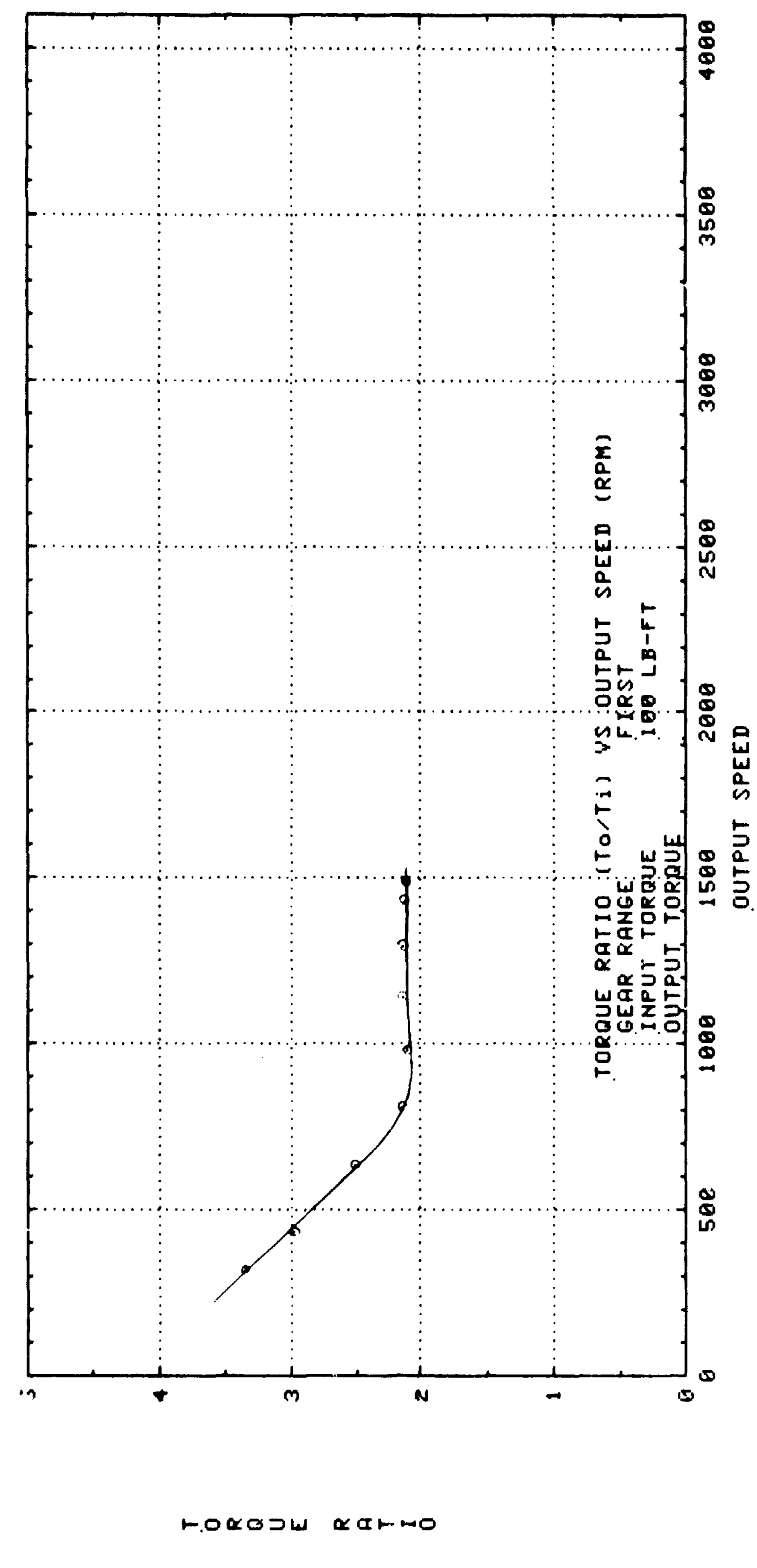

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 90 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
TORQUE RATIO
0
500
1000
1500
2000
2500
3000
3500
4000
0
1
2
3
4
5


OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 90 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT TORQUE
0
25
50
75
100
125
150
175
200
225
250
275
300

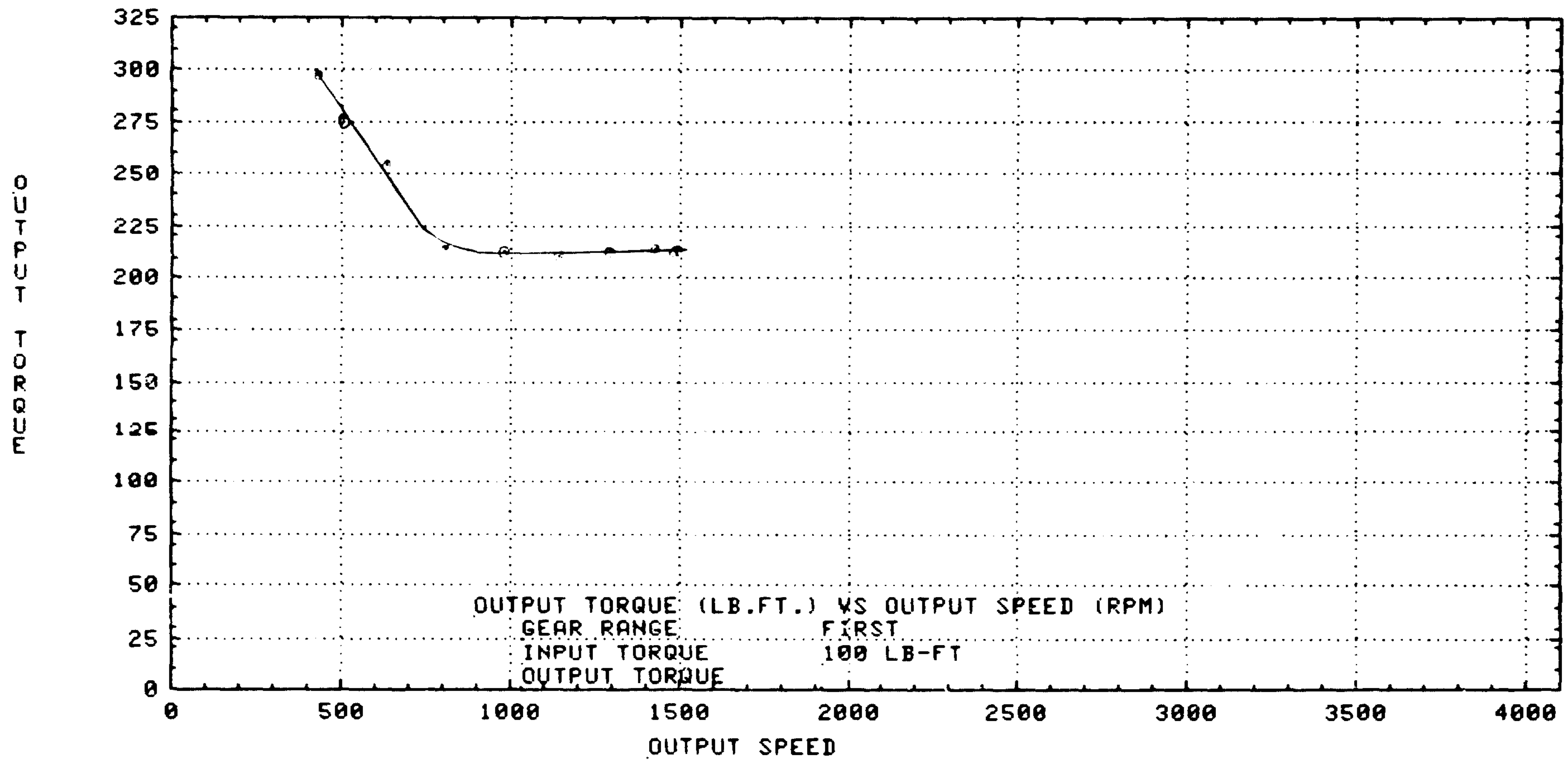

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 90 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

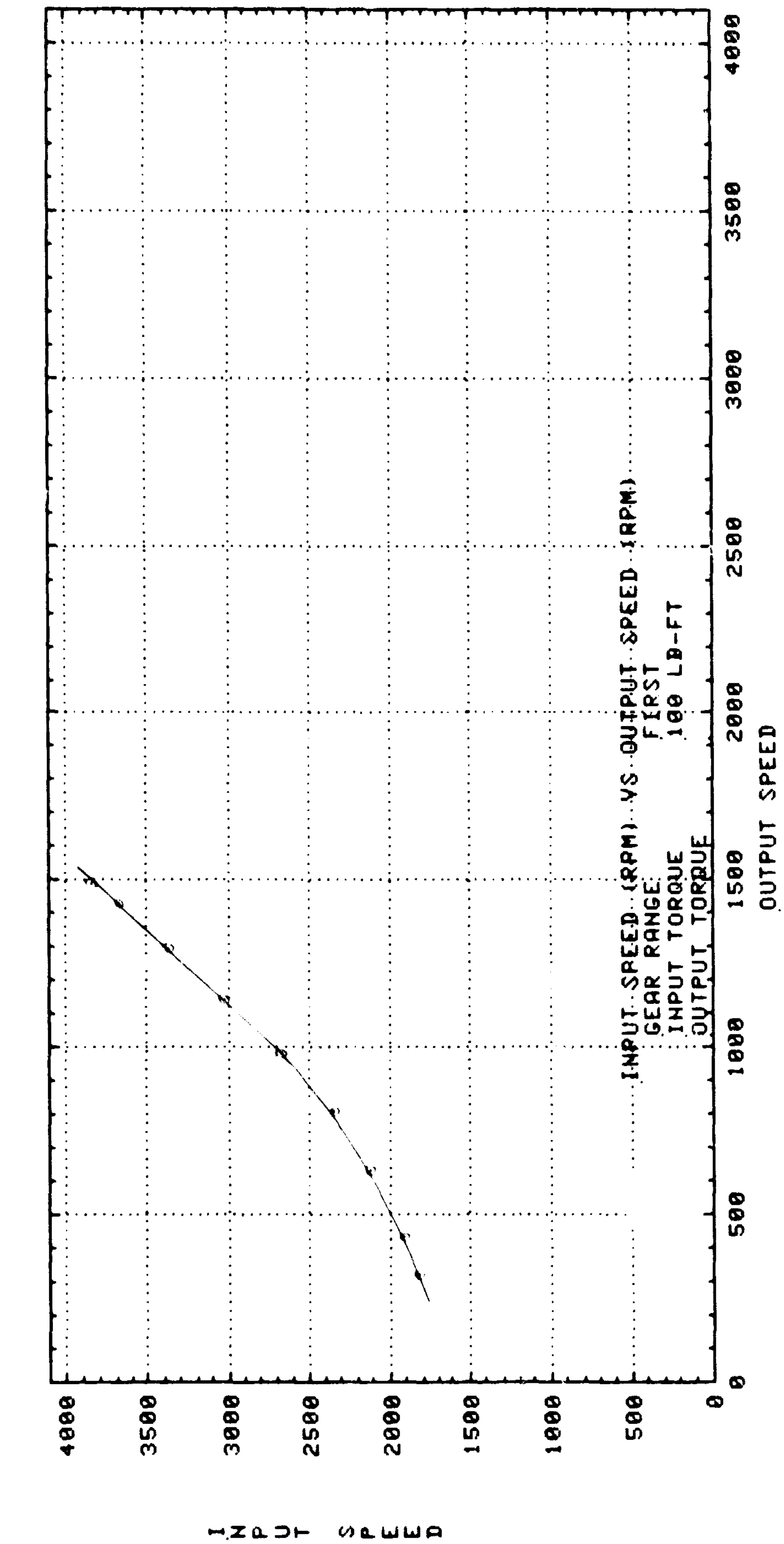

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 90 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
EFFICIENCY
0
10
20
30
40
50
60
70
80
90
100
0
500
1000
1500
2000
2500
3000
3500
4000

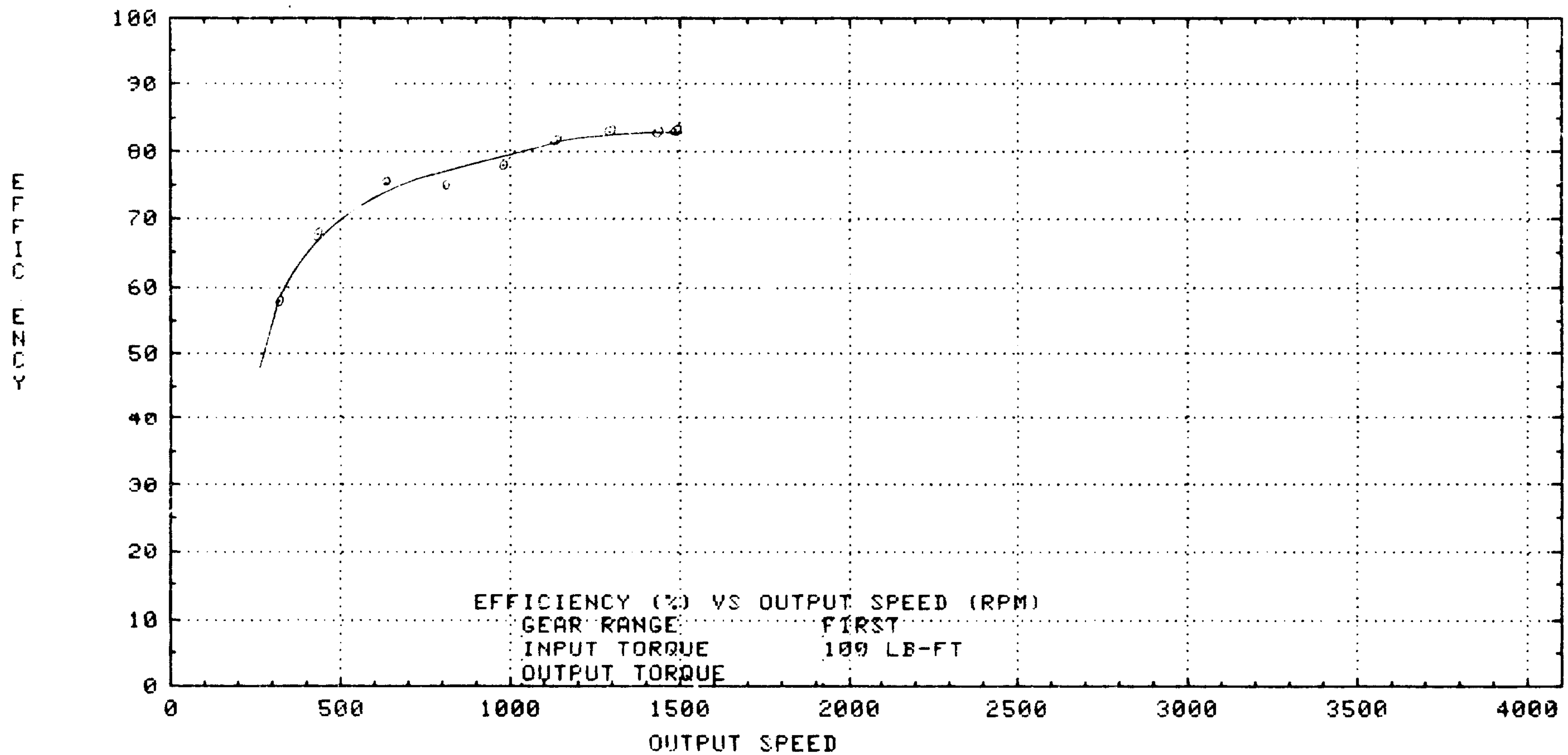

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE FIRST
INPUT TORQUE 90 LB-FT
OUTPUT TORQUE
POWER OUT
EFFICIENCY
0 10 20 30 40 50 60 70 80 90 100
0 10 20 30 40 50 60 70



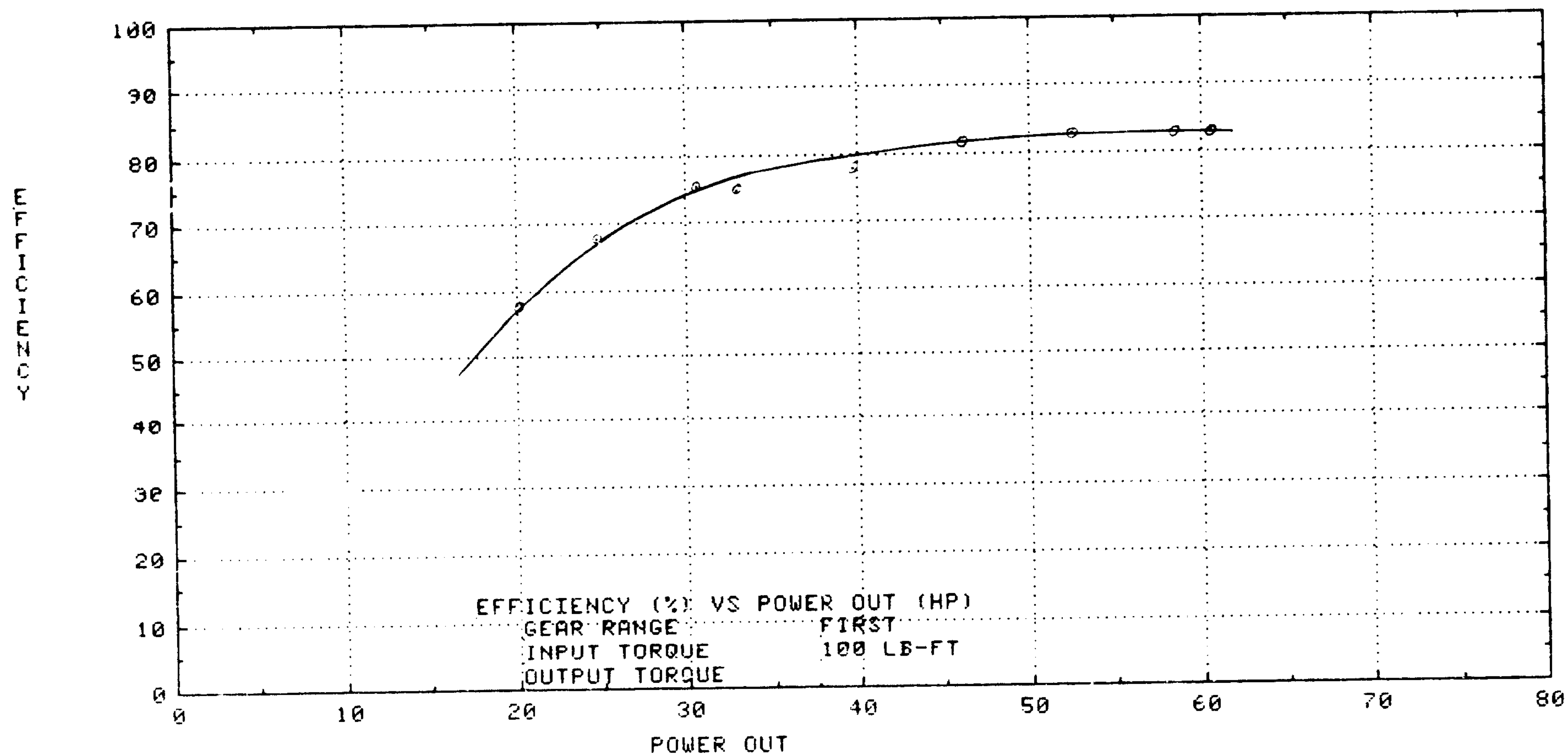
TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 100 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
TORQUE RATIO
0
500
1000
1500
2000
2500
3000
3500
4000
0
1
2
3
4
5


OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 100 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
OUTPUT TORQUE
0 500 1000 1500 2000 2500 3000 3500 4000
0 25 50 75 100 125 150 175 200 225 250 275 300 325


INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 100 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000



EFFICIENCY
100
90
80
70
60
50
40
30
20
10
0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 109 LB-FT
OUTPUT TORQUE

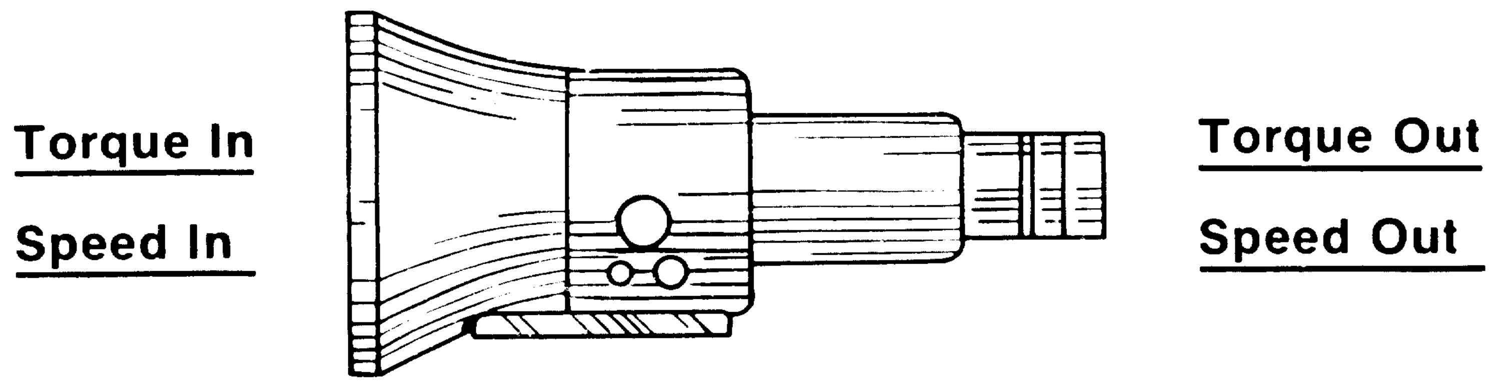

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE FIRST
INPUT TORQUE 100 LB-FT
OUTPUT TORQUE
EFFICIENCY
POWER OUT
0
10
20
30
40
50
60
70
80
90
100

DRIVE PERFORMANCE

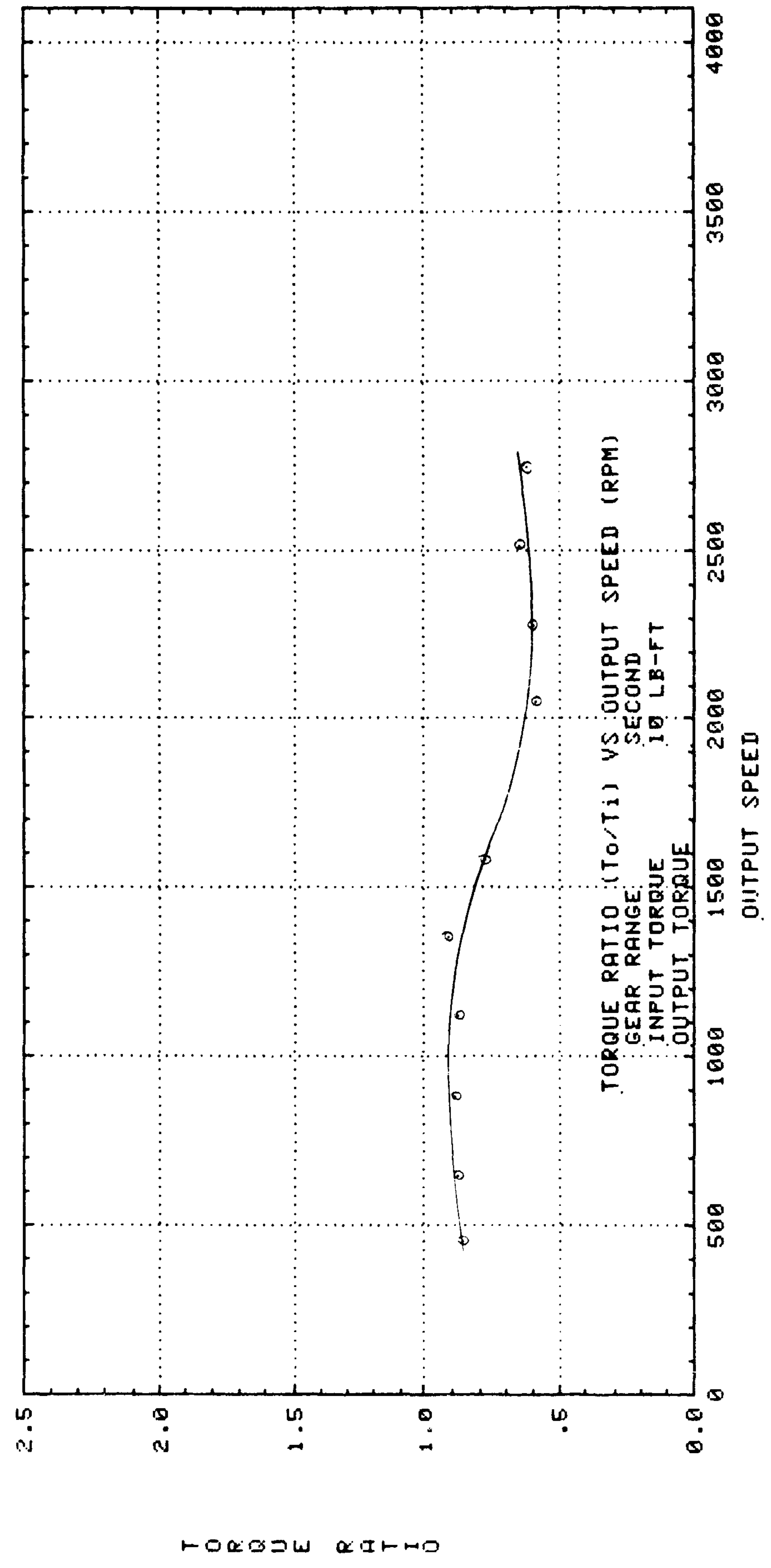
2nd Gear

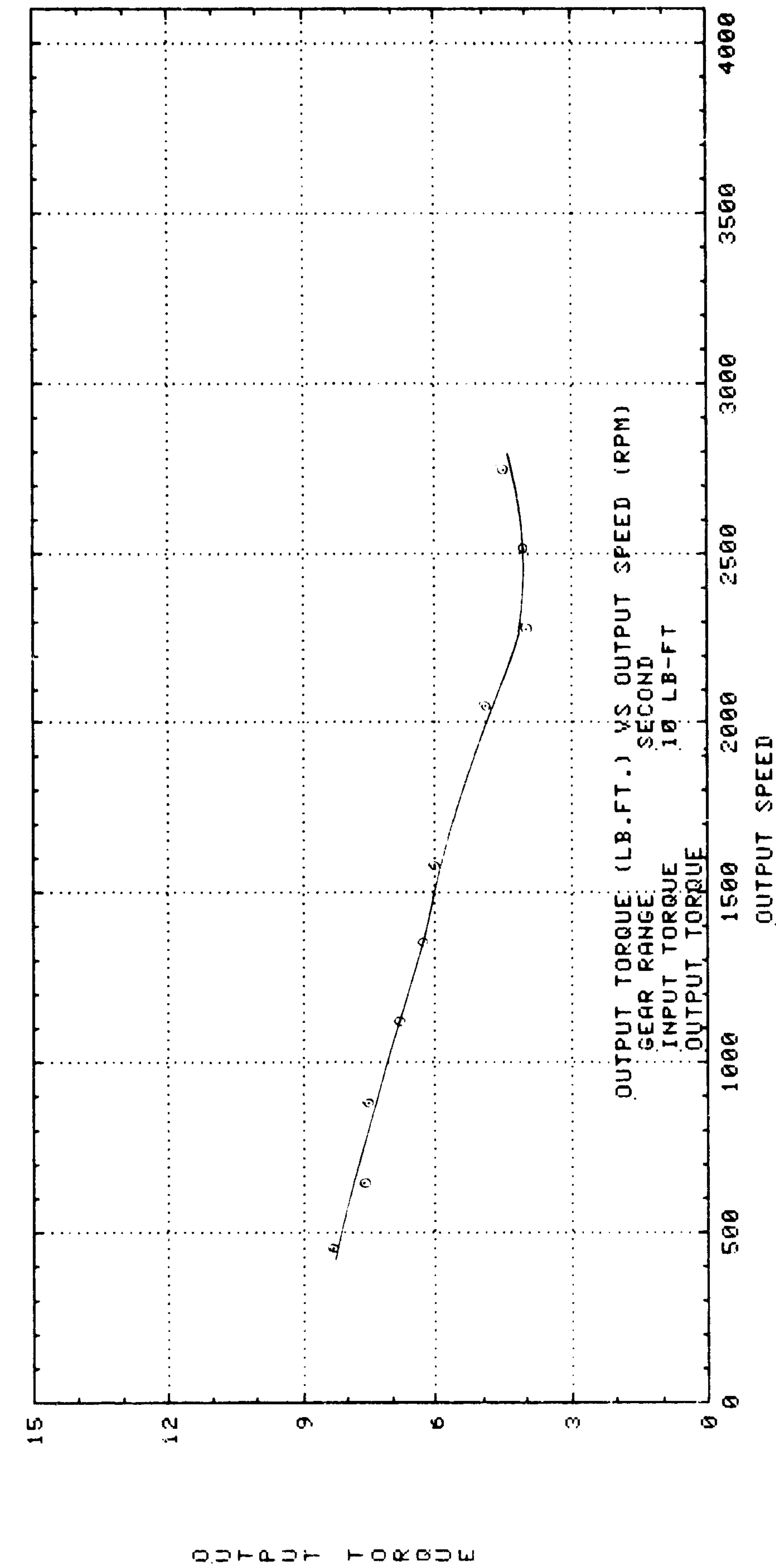
Graphs Contained in This Section

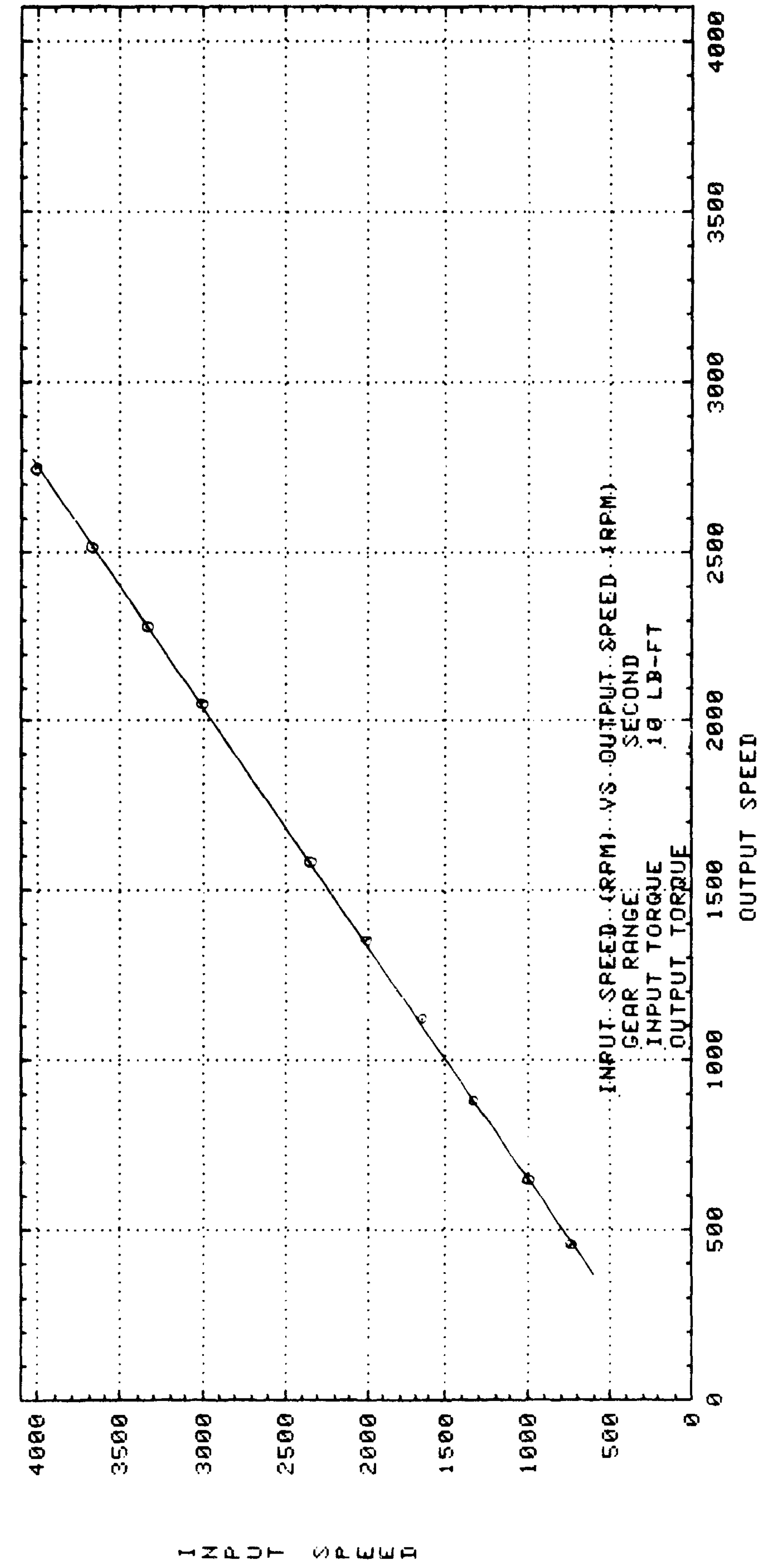
Torque Ratio -vs- Output Speed
Output Torque -vs- Output Speed
Input Speed -vs- Output Speed
Efficiency -vs- Output Speed
Efficiency -vs- Power Out

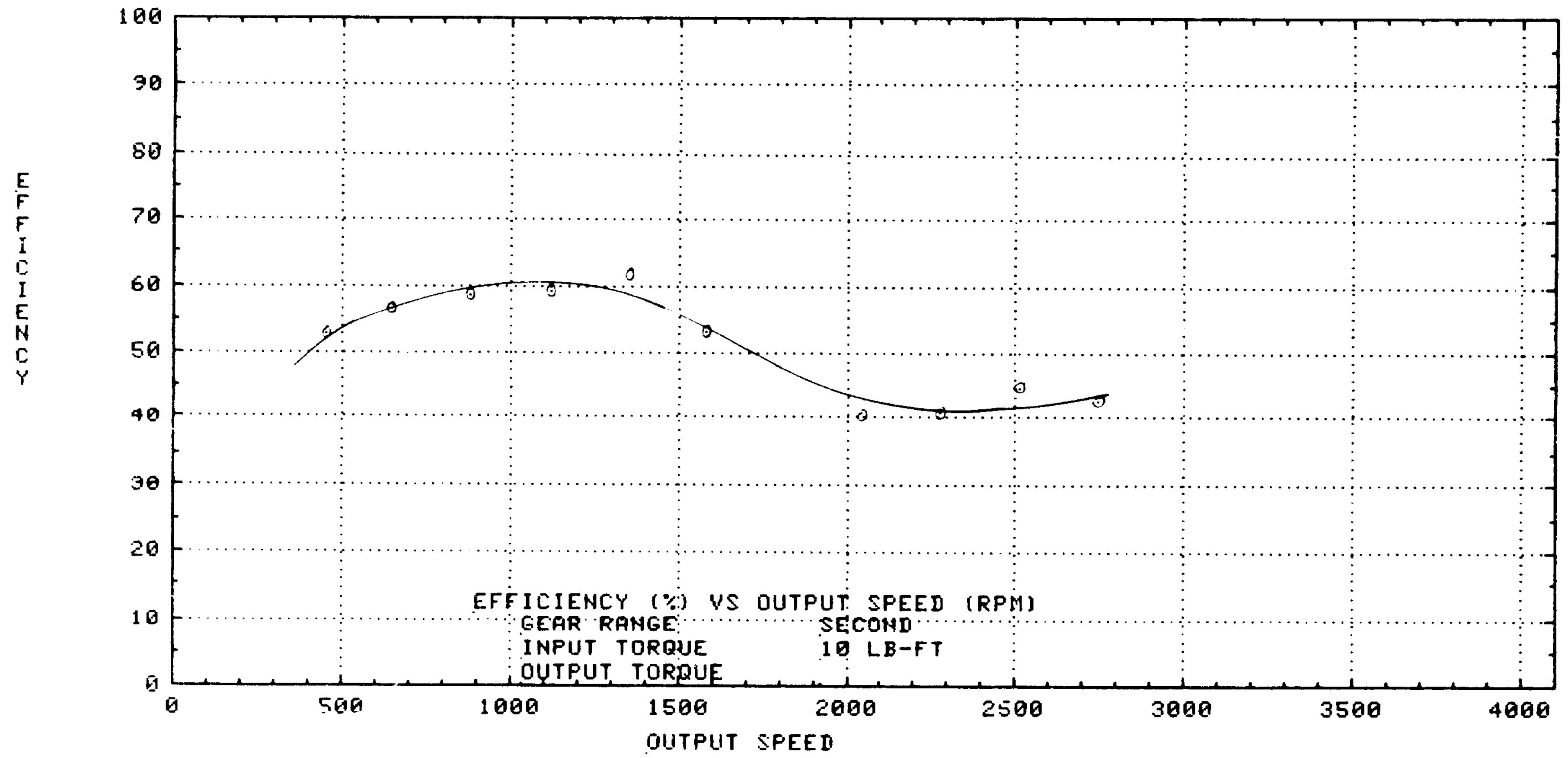


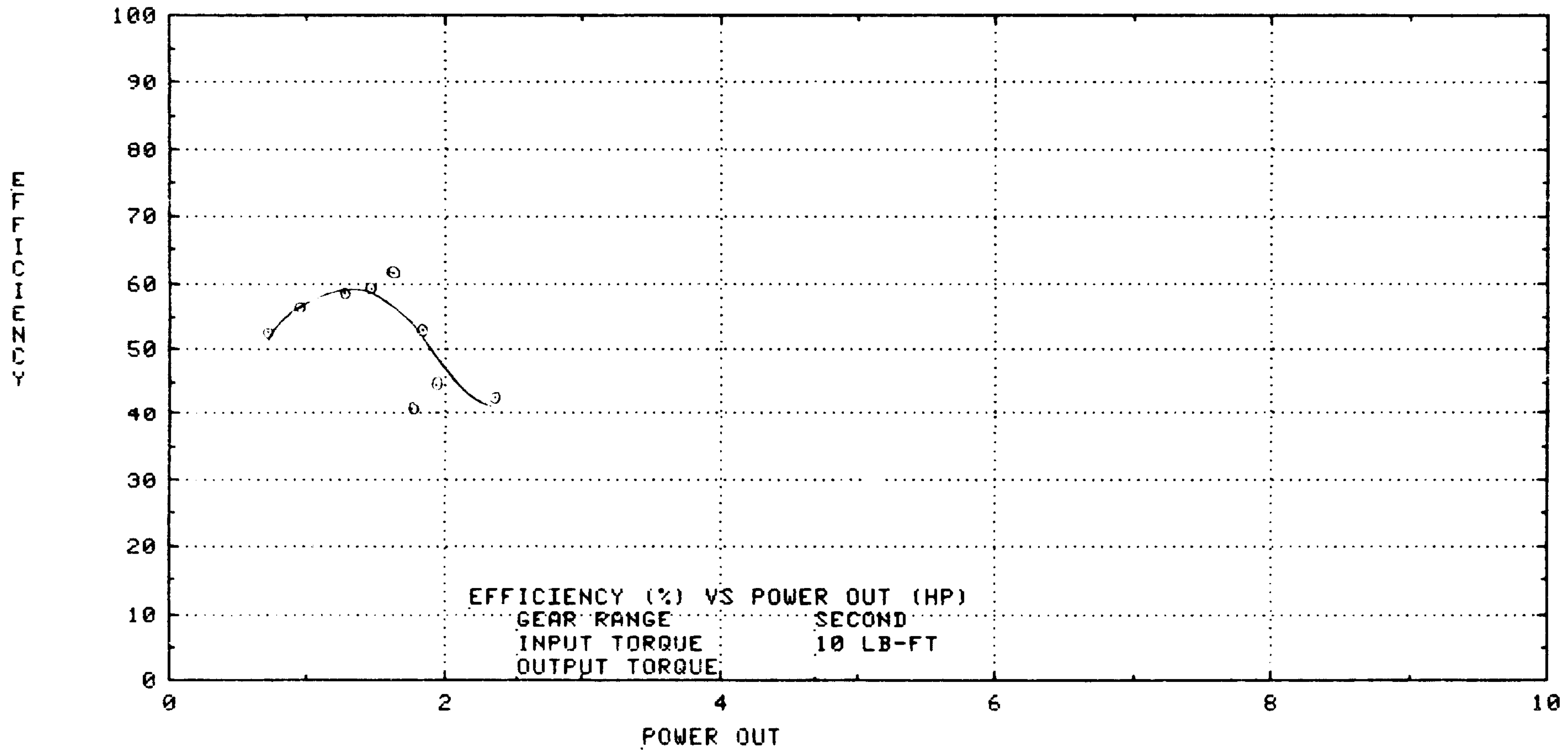
Drive Performance Tests

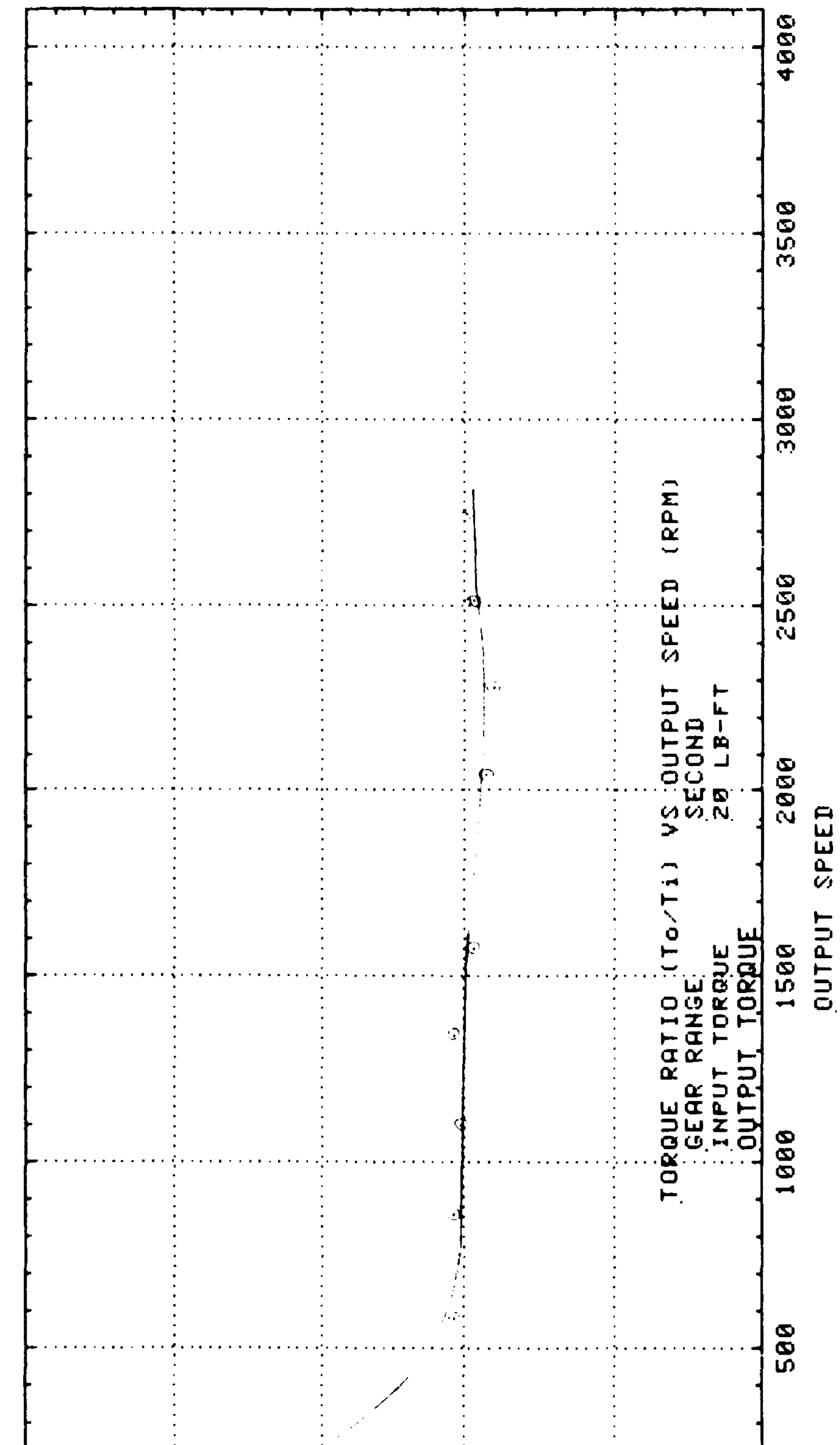

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 10 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
TORQUE RATIO
0 500 1000 1500 2000 2500 3000 3500 4000
0.0 .5 1.0 1.5 2.0 2.5


OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 10 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
OUTPUT TORQUE
0
500
1000
1500
2000
2500
3000
3500
4000
0
3
6
9
12
15

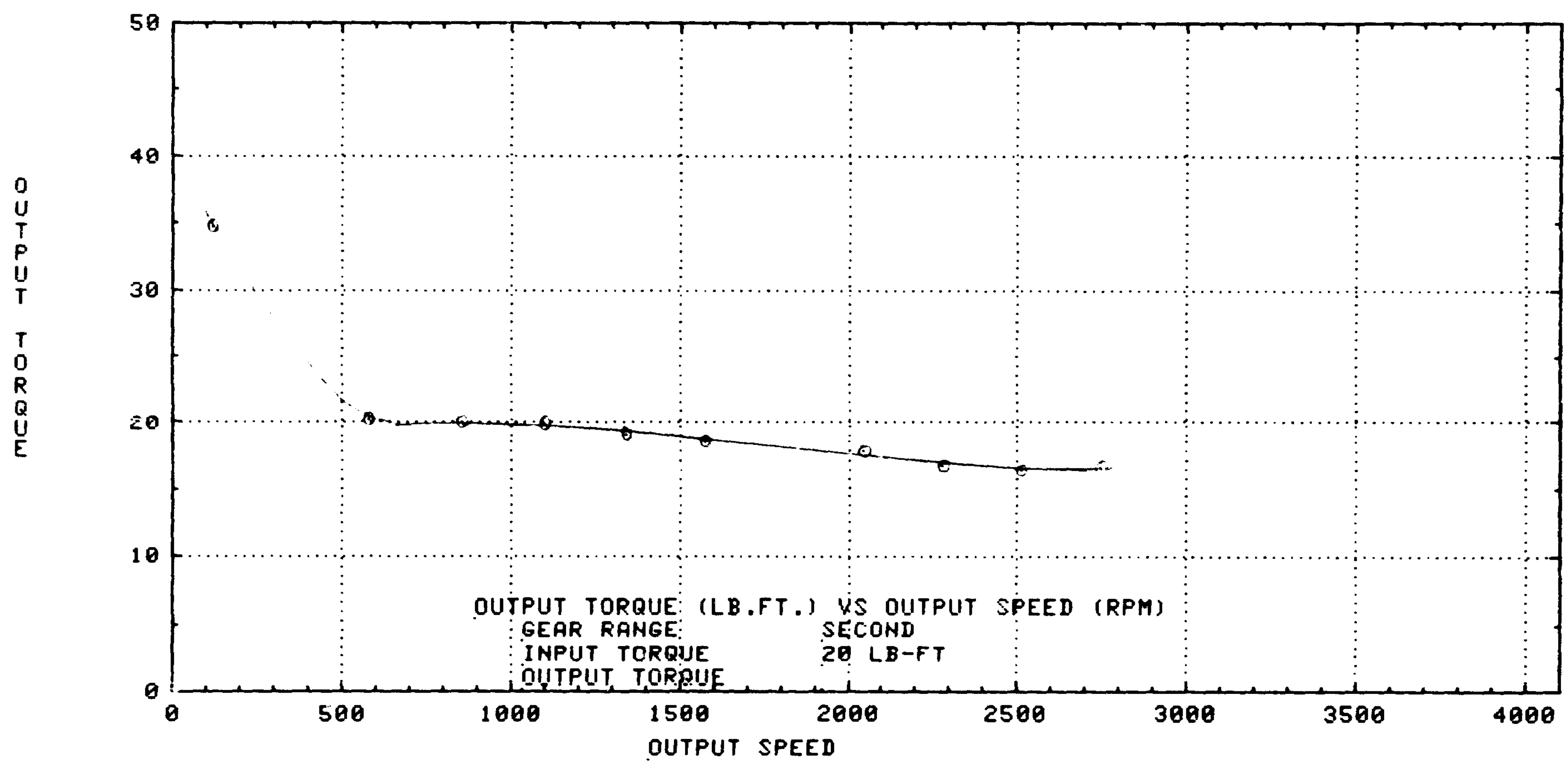

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 10 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

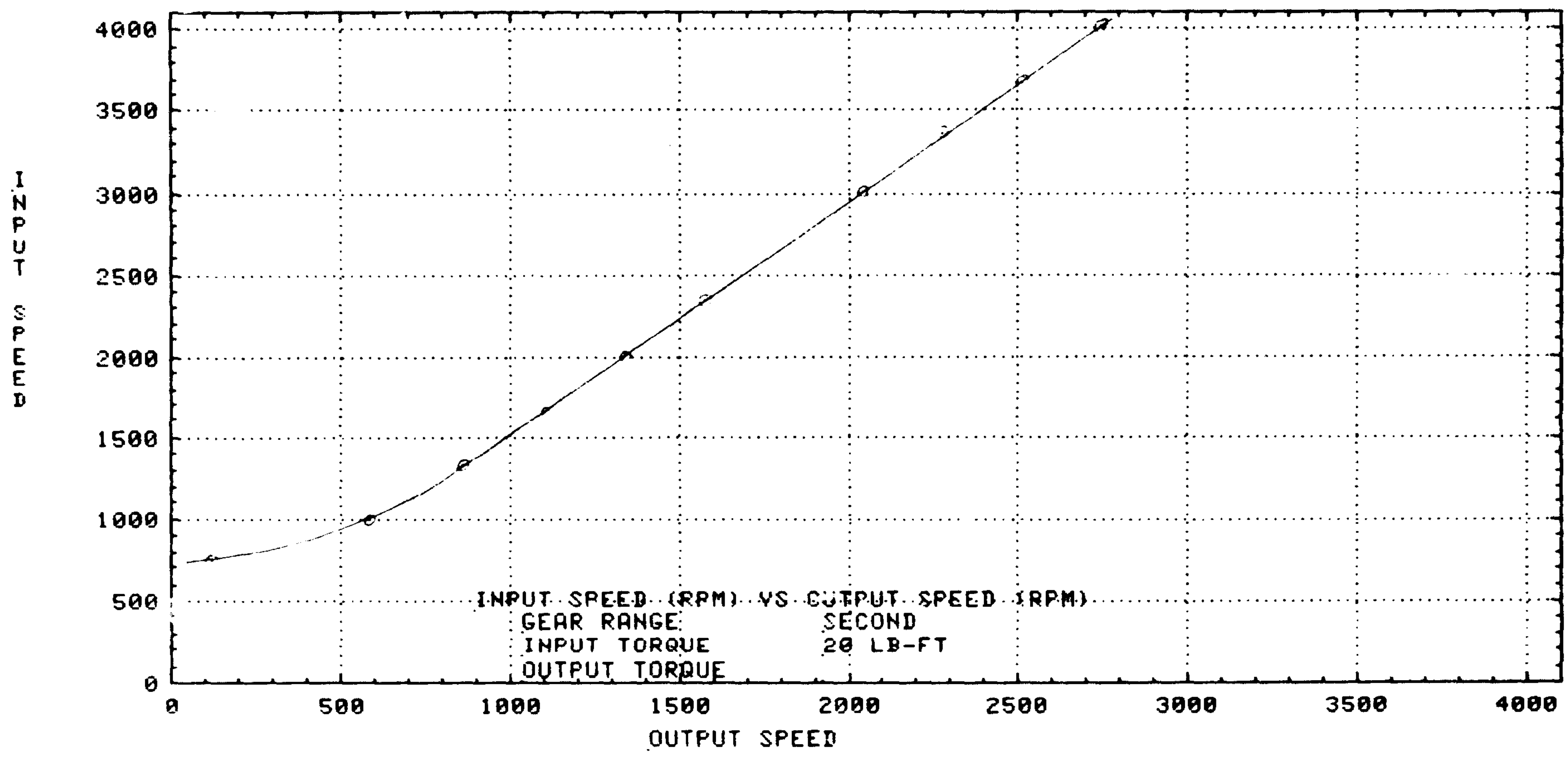

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 10 LB-FT
OUTPUT TORQUE
EFFICIENCY
OUTPUT SPEED
0
10
20
30
40
50
60
70
80
90
100
500
1000
1500
2000
2500
3000
3500
4000


EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE SECOND
INPUT TORQUE 10 LB-FT
OUTPUT TORQUE
EFFICIENCY
POWER OUT
0
10
20
30
40
50
60
70
80
90
100
0
2
4
6
8
10

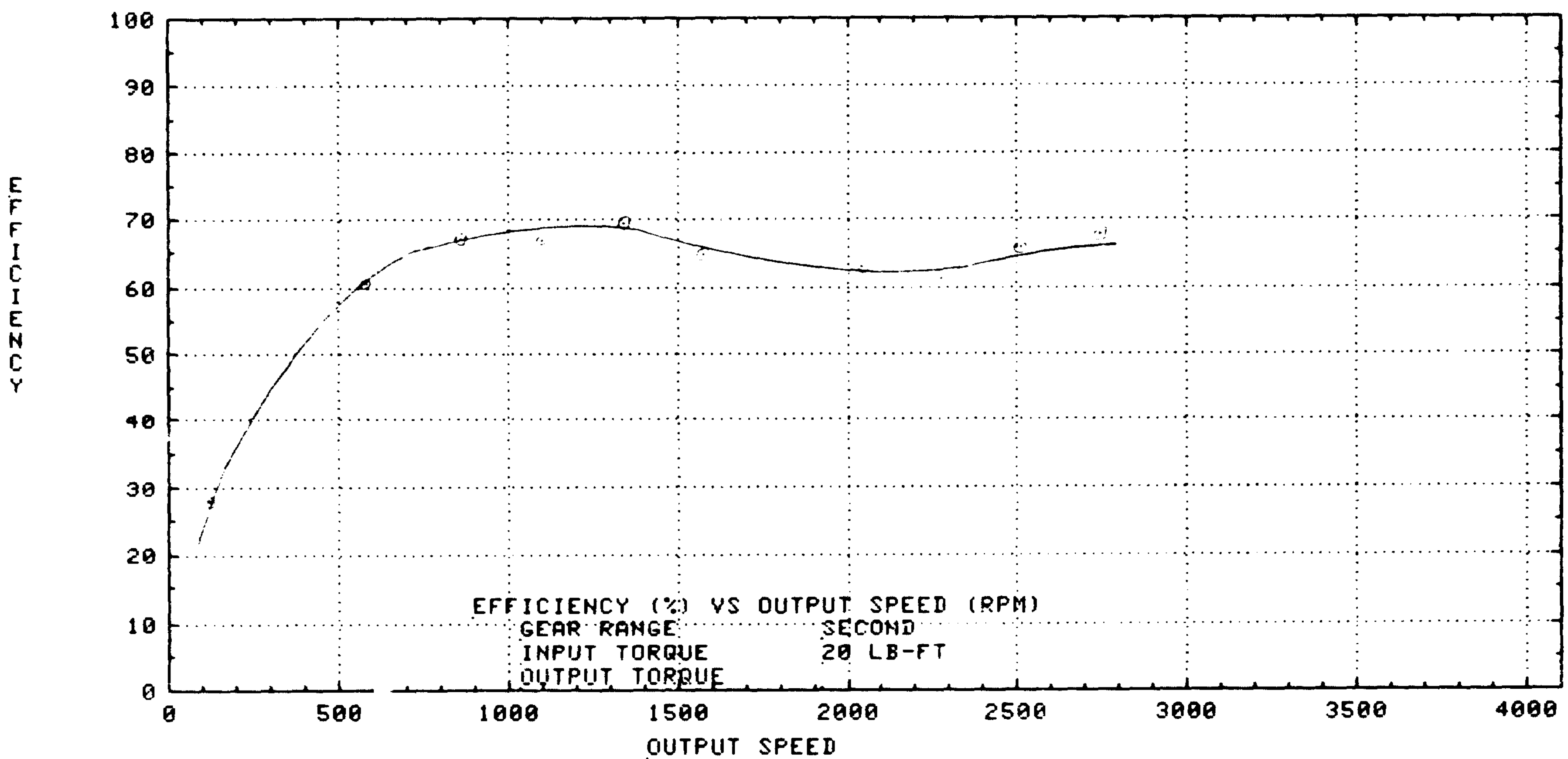


TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 20 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
TORQUE RATIO
0 500 1000 1500 2000 2500 3000 3500 4000
0.0 .5 1.0 1.5 2.0 2.5

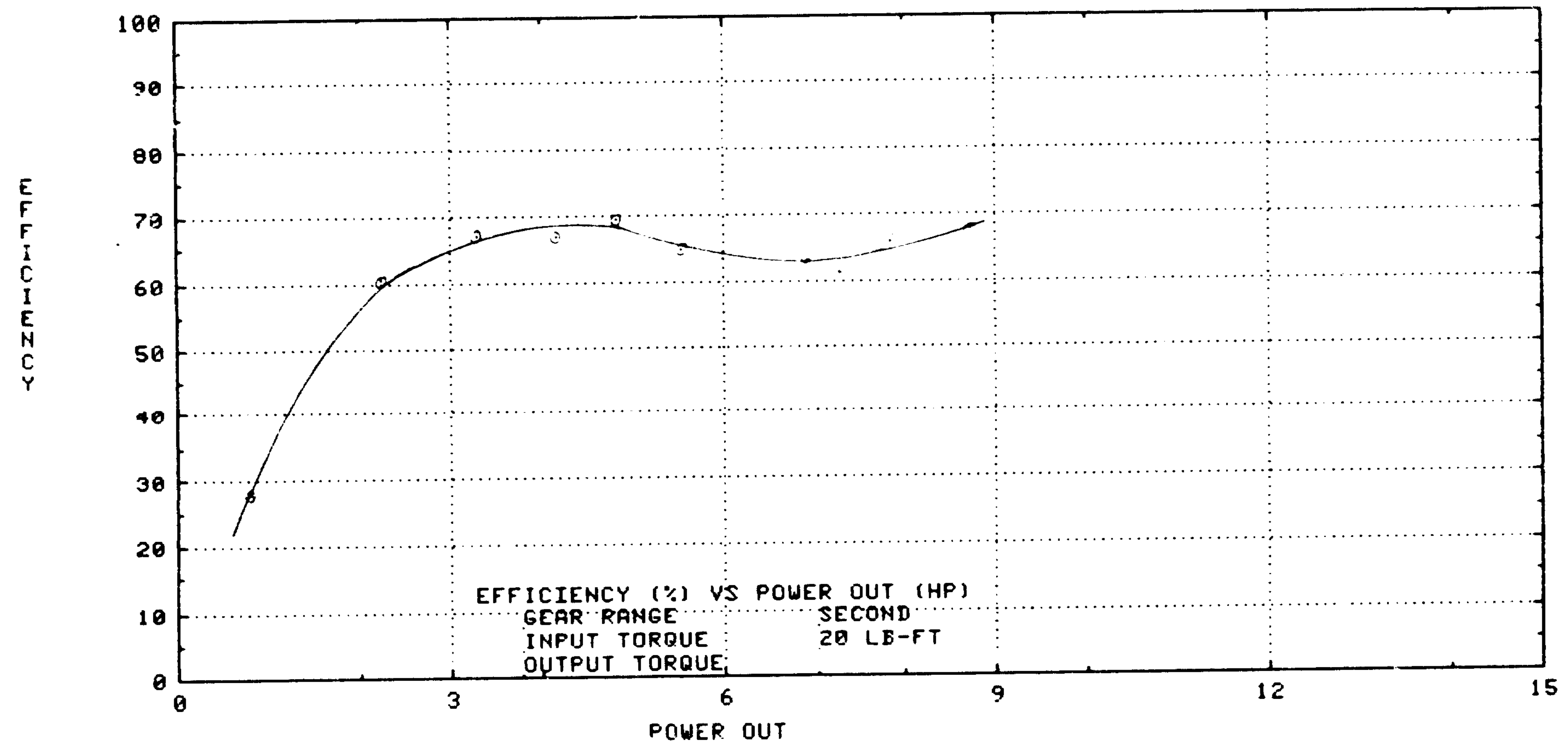

OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 20 LB-FT
OUTPUT TORQUE
OUTPUT TORQUE
OUTPUT SPEED
0
10
20
30
40
50
0
500
1000
1500
2000
2500
3000
3500
4000

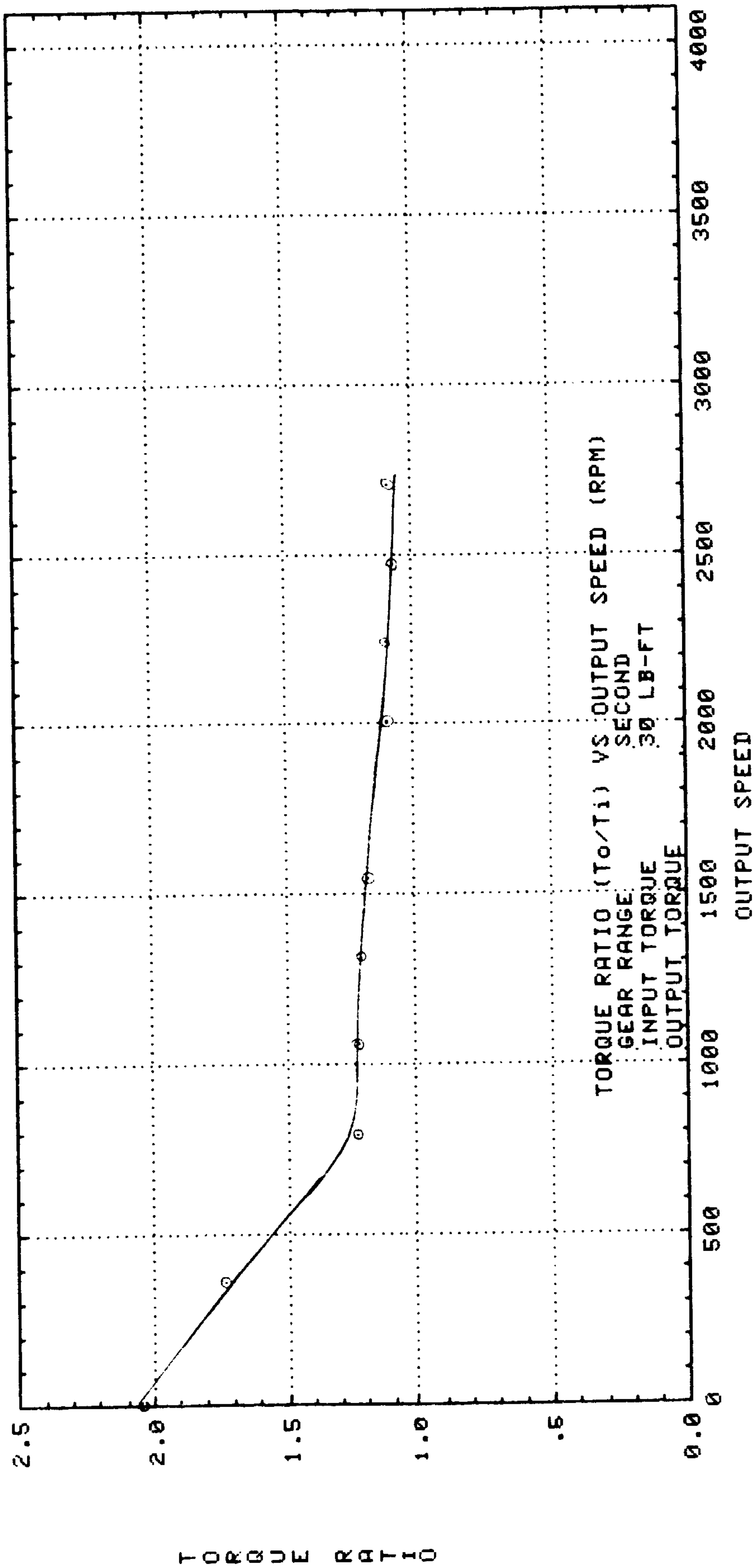


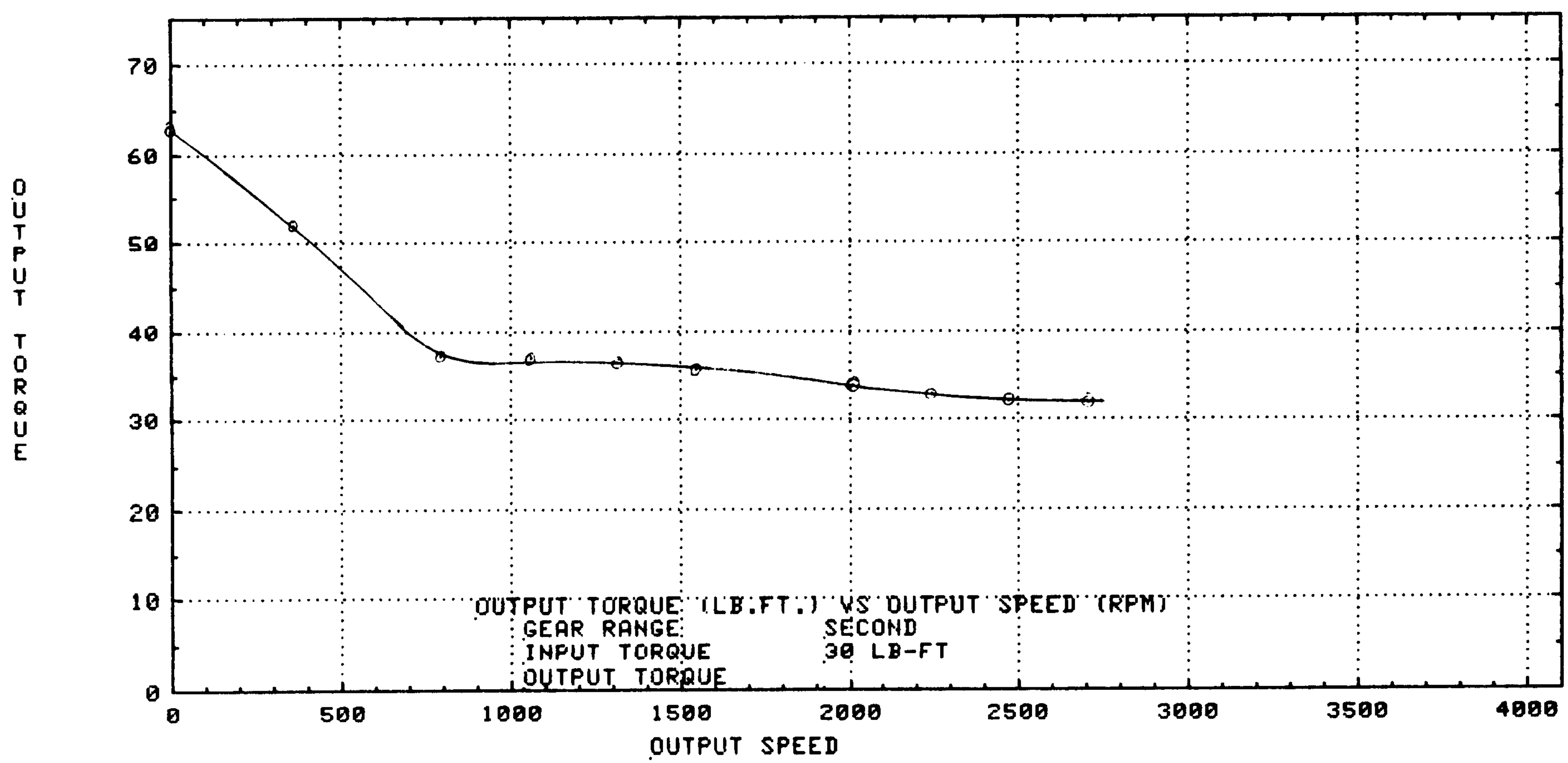
INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 20 LB-FT
OUTPUT TORQUE
INPUT SPEED
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

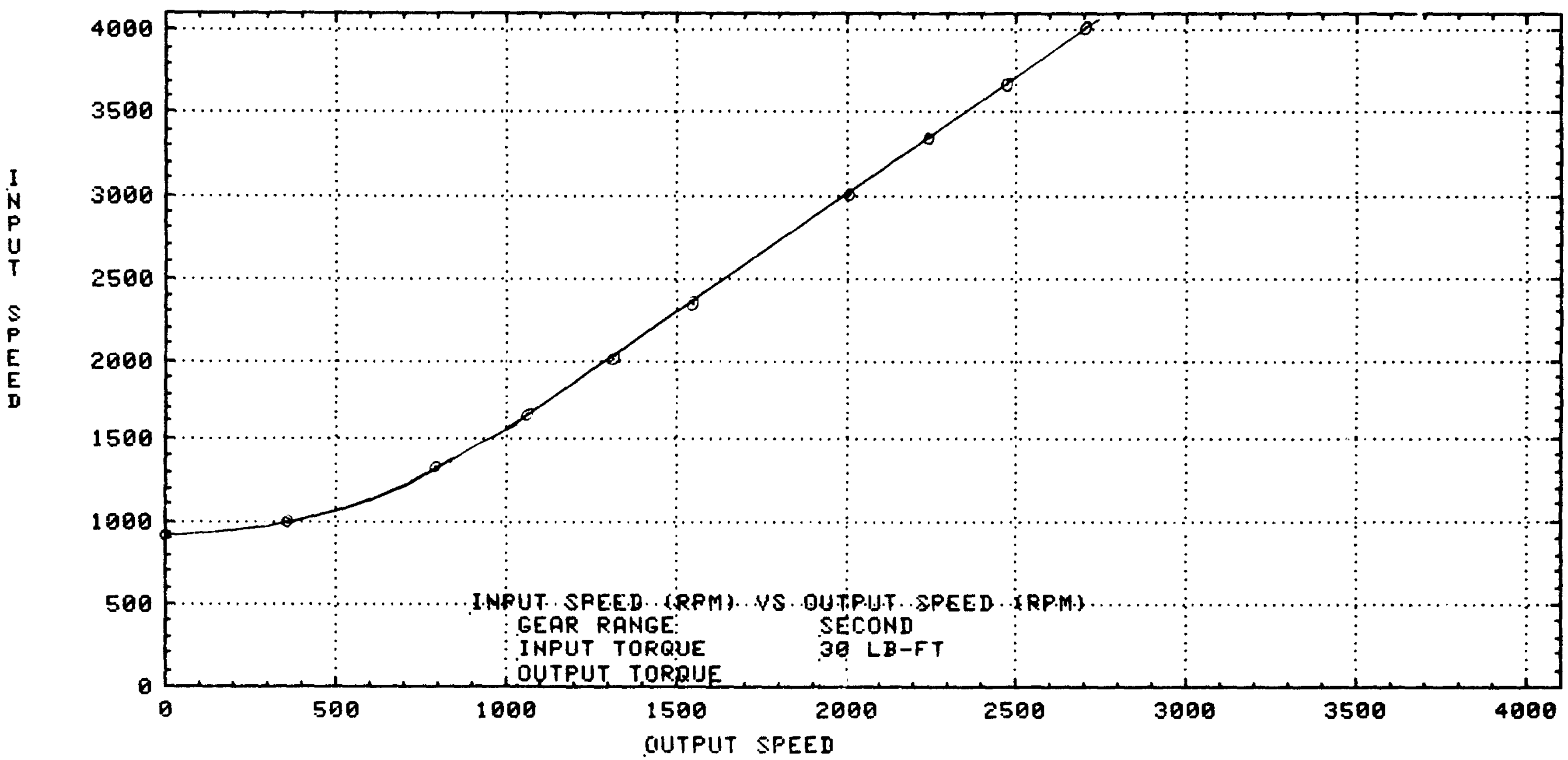


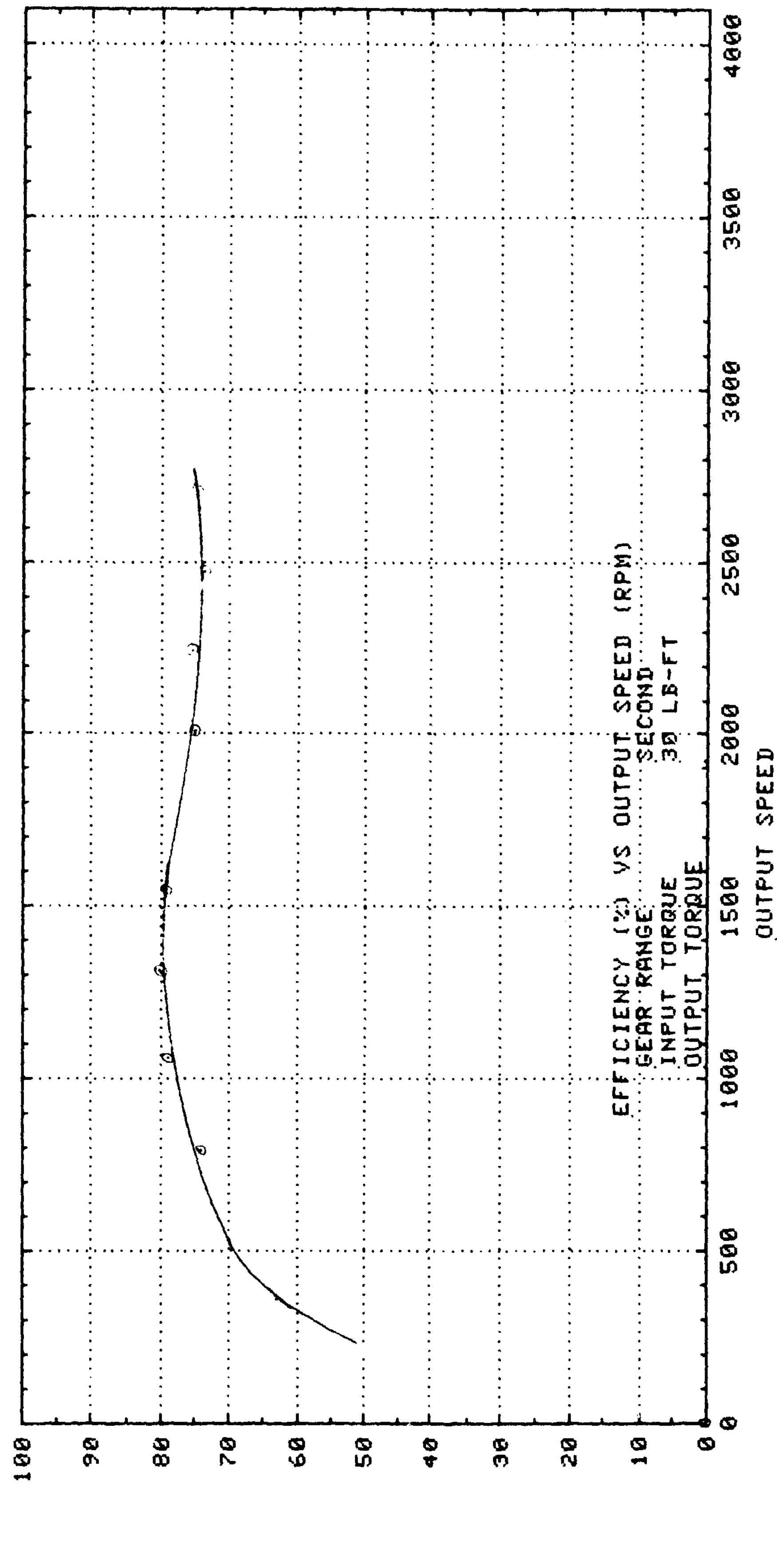
EFFICIENCY
100
90
80
70
60
50
40
30
20
10
0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 20 LB-FT
OUTPUT TORQUE

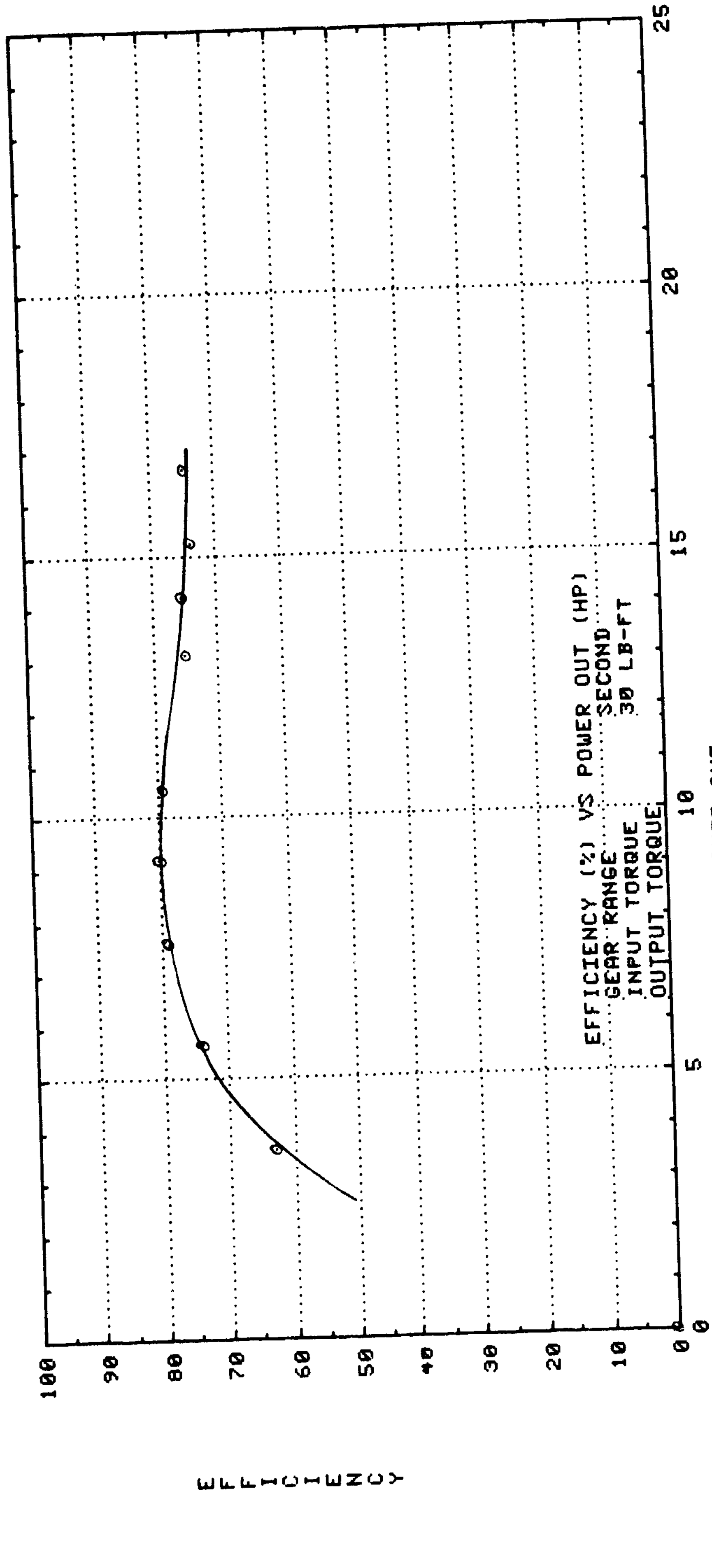

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE SECOND
INPUT TORQUE 20 LB-FT
OUTPUT TORQUE
EFFICIENCY
POWER OUT
100
90
80
70
60
50
40
30
20
10
0
3
6
9
12
15

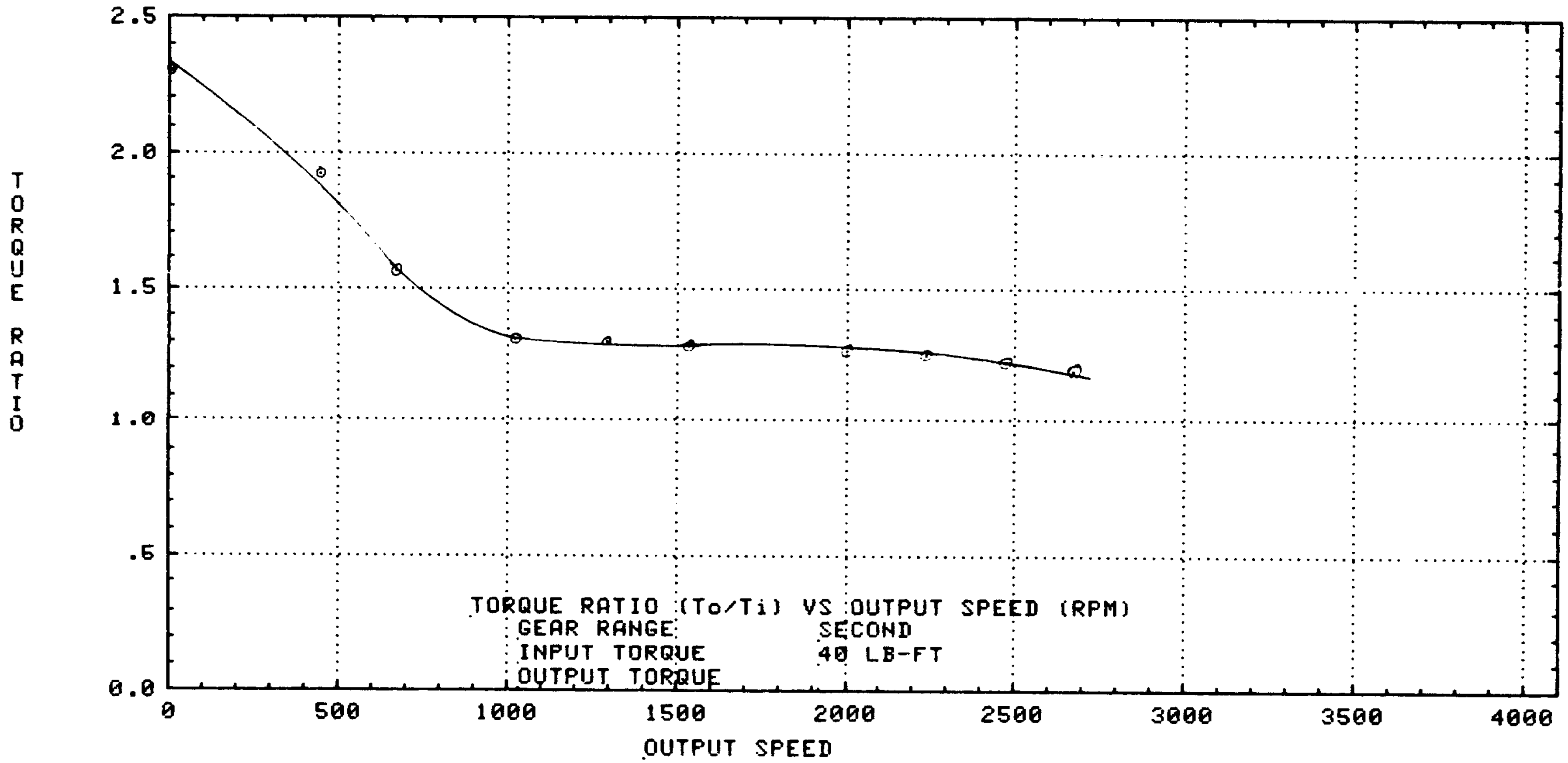

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 30 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
TORQUE RATIO
0 500 1000 1500 2000 2500 3000 3500 4000
0.0 .5 1.0 1.5 2.0 2.5

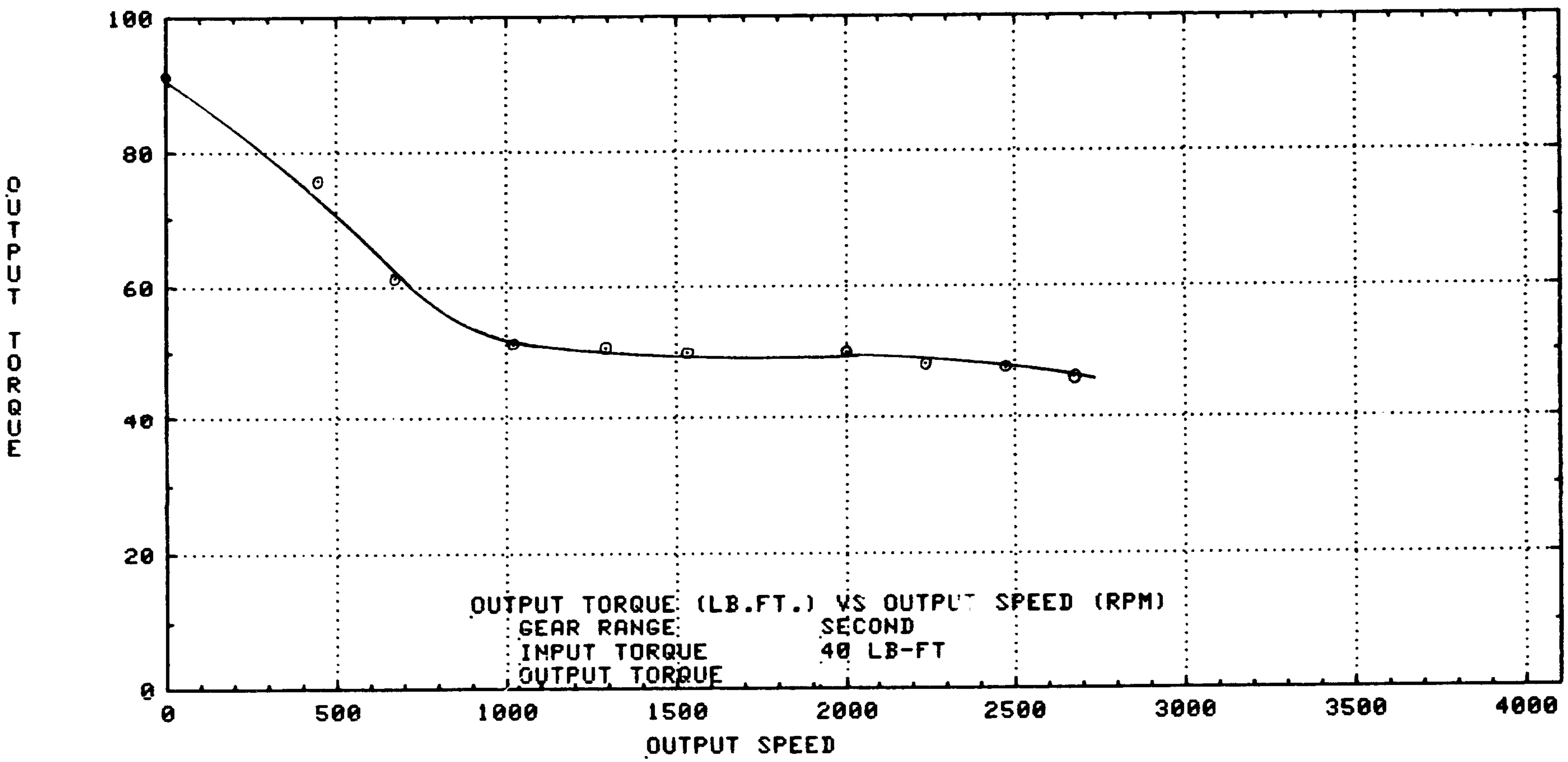

OUTPUT TORQUE
70
60
50
40
30
20
10
0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 30 LB-FT
OUTPUT TORQUE

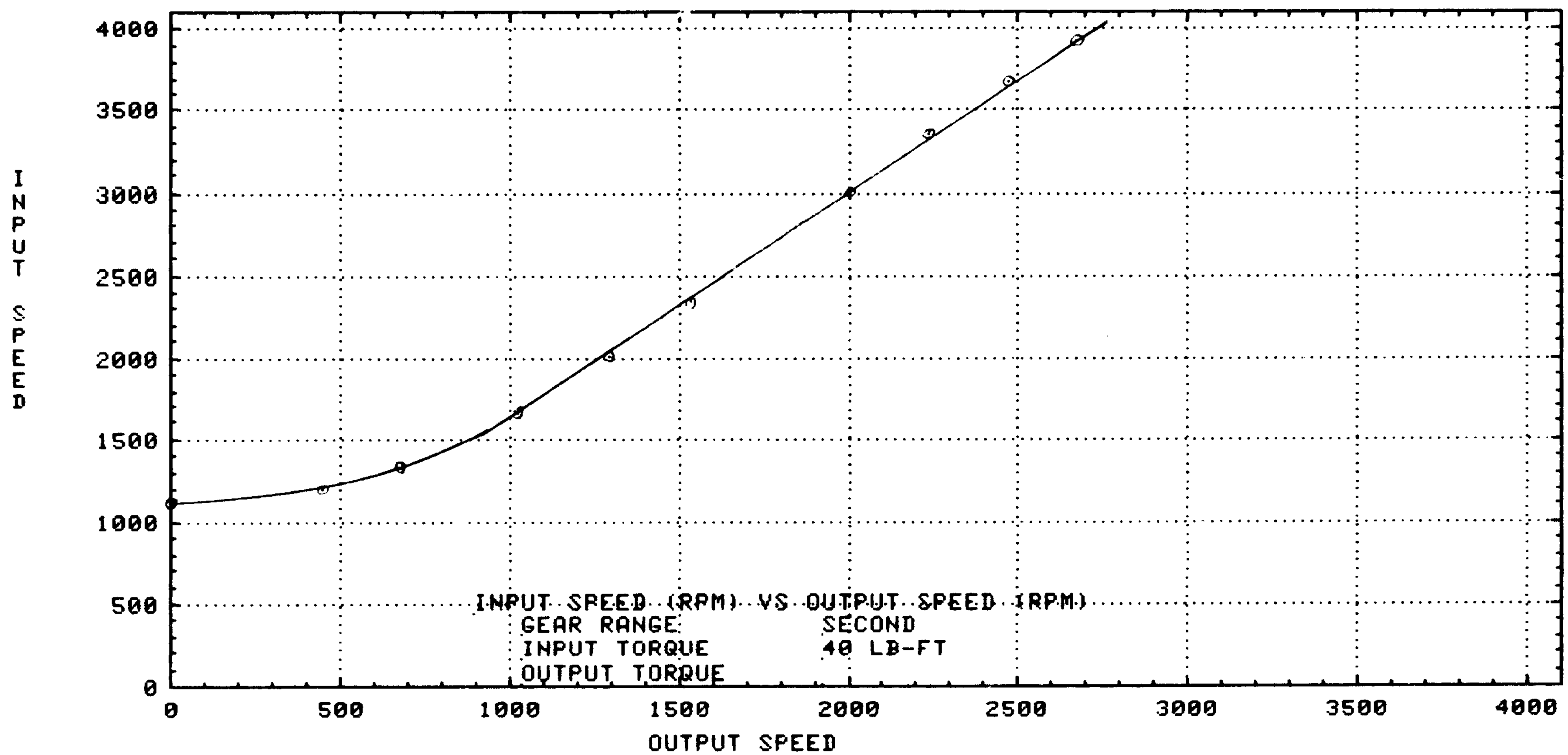

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 30 LB-FT
OUTPUT TORQUE
INPUT SPEED
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

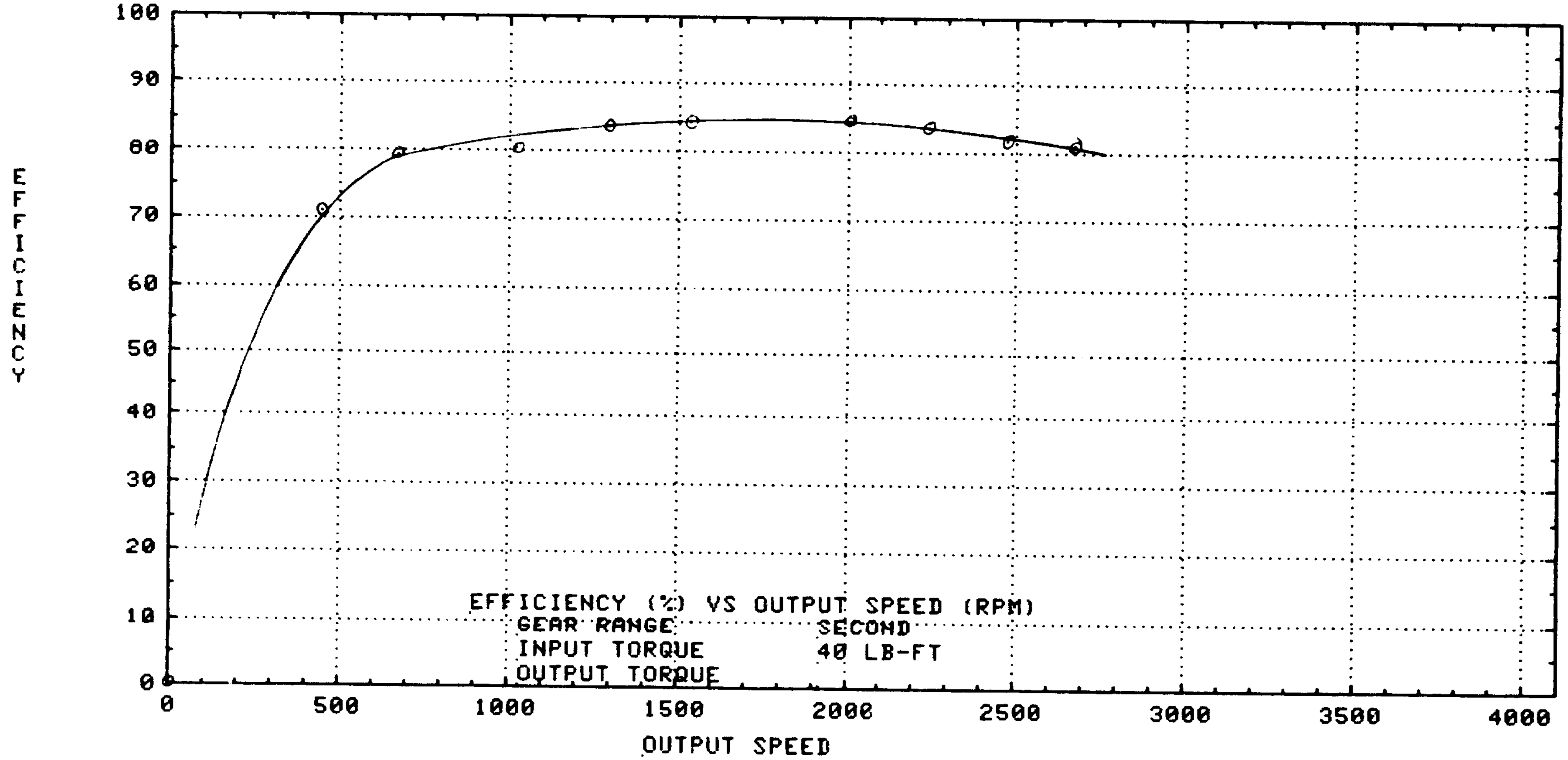

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 30 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
EFFICIENCY
0
500
1000
1500
2000
2500
3000
3500
4000
0
10
20
30
40
50
60
70
80
90
100

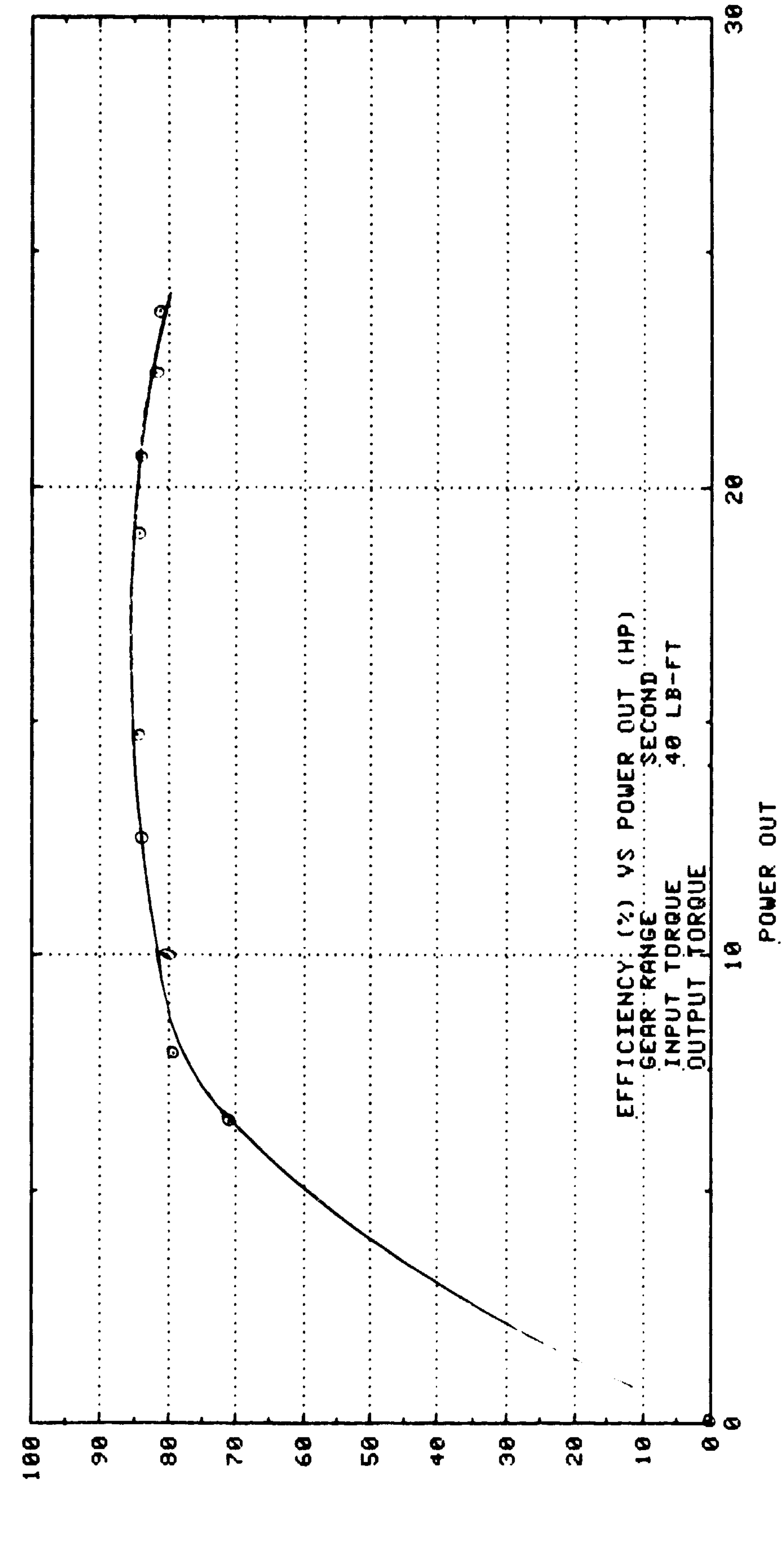

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE SECOND
INPUT TORQUE 30 LB-FT
OUTPUT TORQUE
POWER OUT
0
5
10
15
20
25
EFFICIENCY
0
10
20
30
40
50
60
70
80
90
100

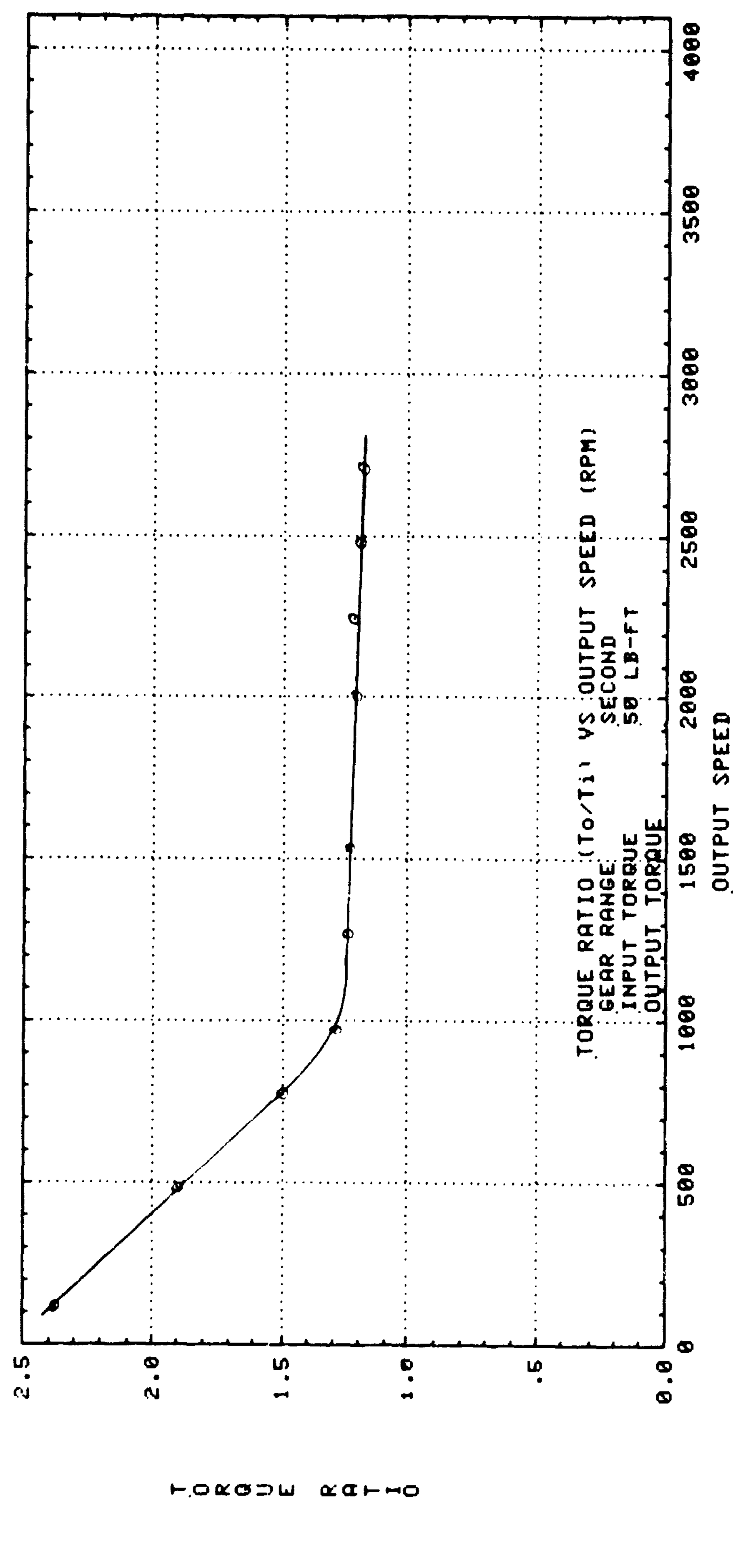

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 40 LB-FT
OUTPUT TORQUE
TORQUE RATIO
OUTPUT SPEED
2.5
2.0
1.5
1.0
.5
0.0
0
500
1000
1500
2000
2500
3000
3500
4000

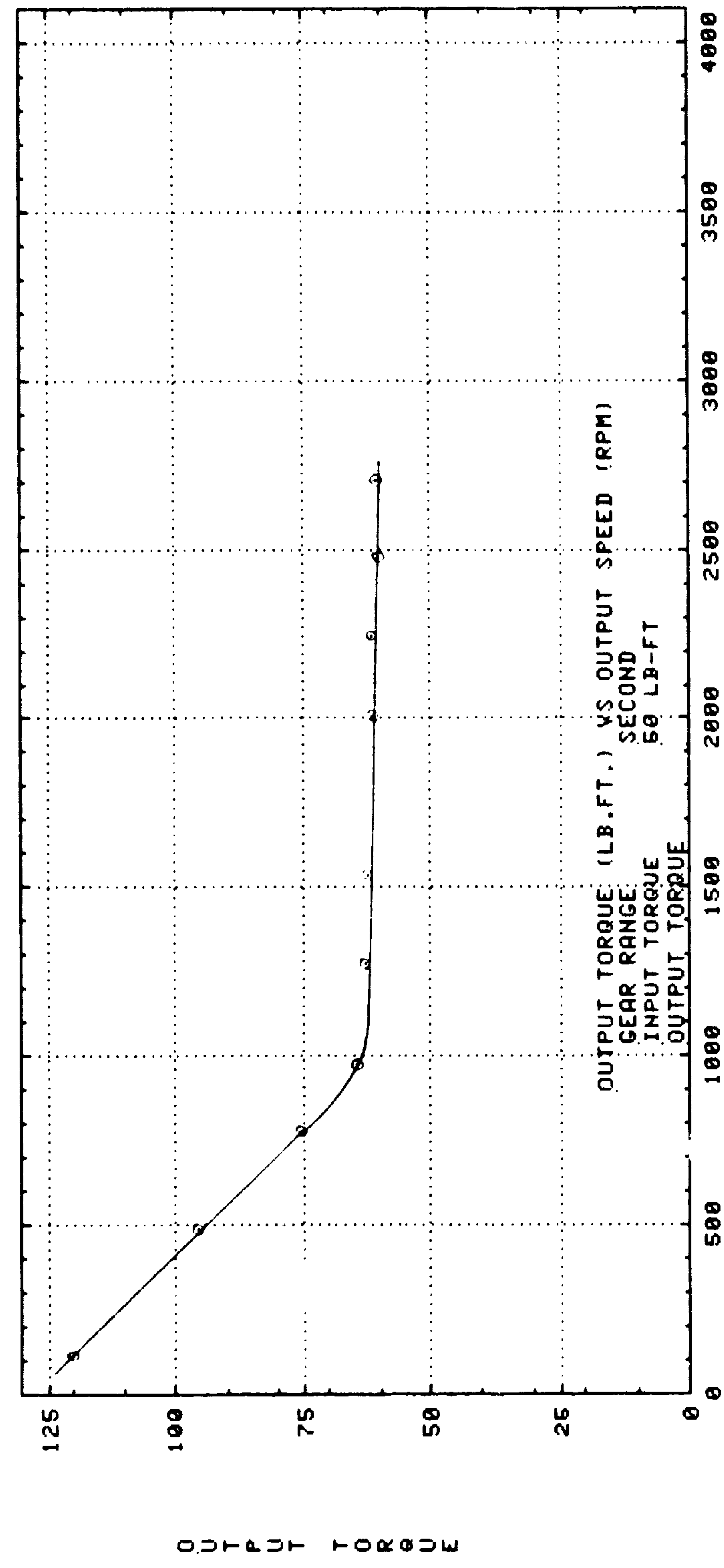

OUTPUT TORQUE
OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 40 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
100
80
60
40
20
0
0
500
1000
1500
2000
2500
3000
3500
4000

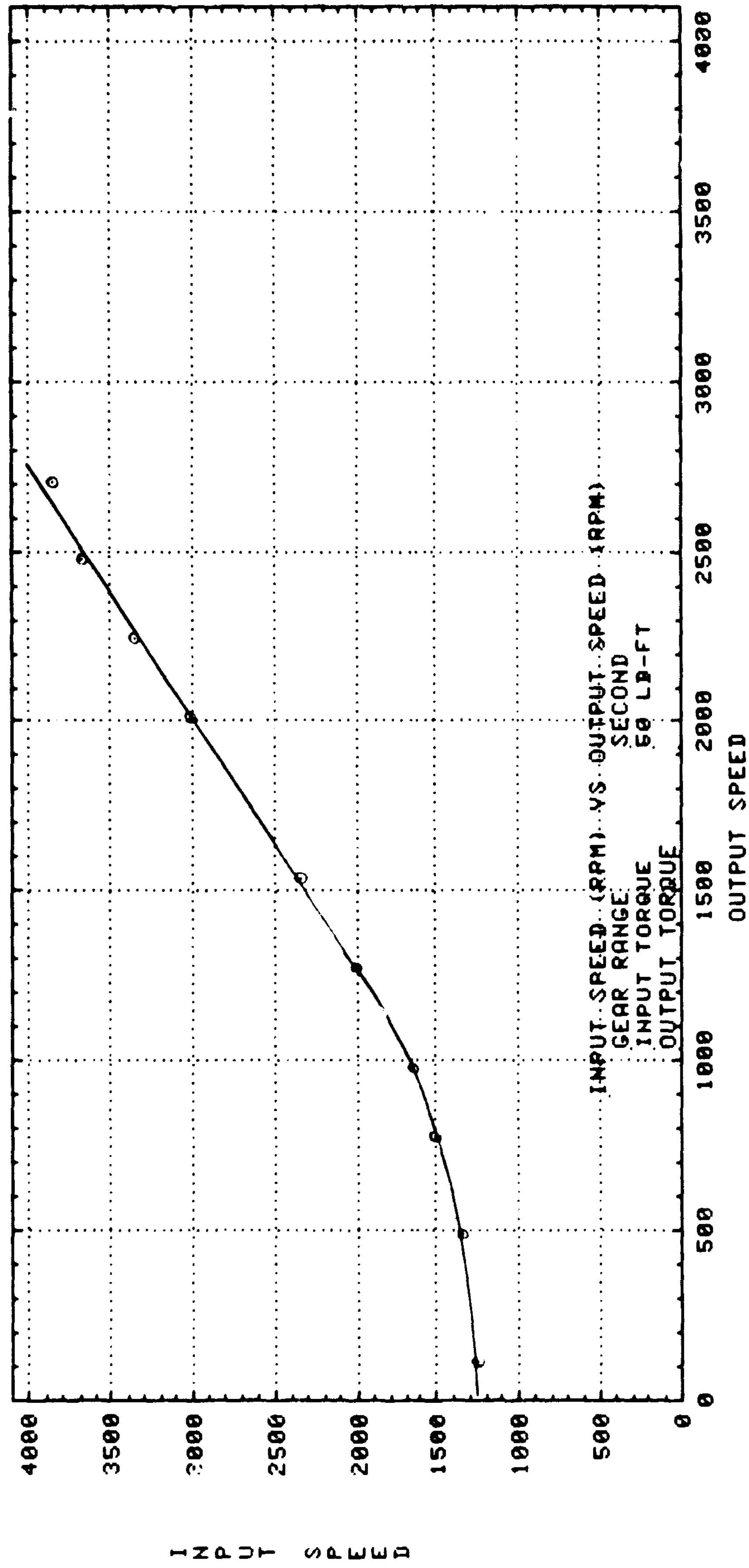

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 40 LB-FT
OUTPUT TORQUE
INPUT SPEED
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

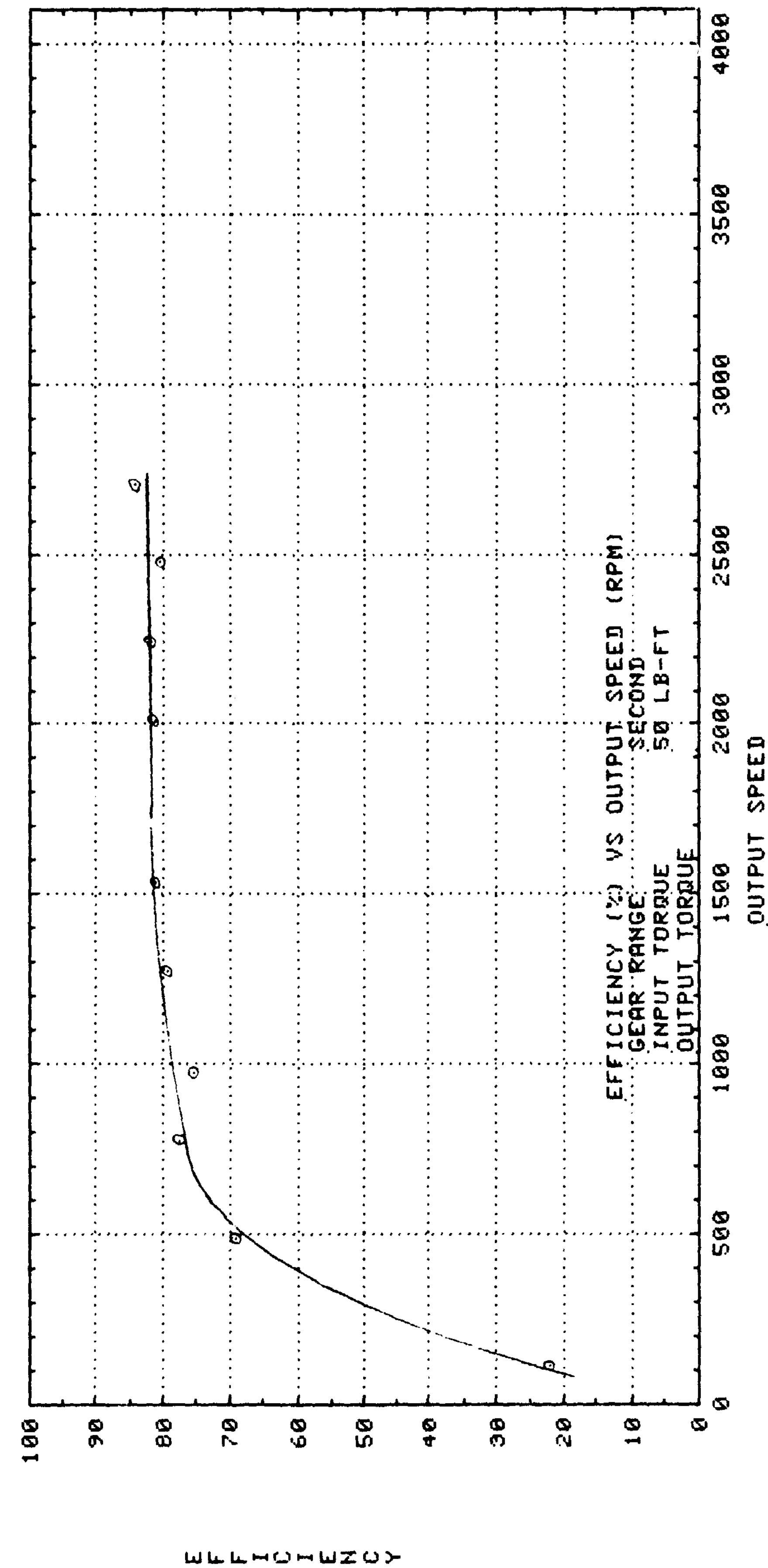

EFFICIENCY
OUTPUT SPEED
EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 40 LB-FT
OUTPUT TORQUE
0
10
20
30
40
50
60
70
80
90
100
500
1000
1500
2000
2500
3000
3500
4000

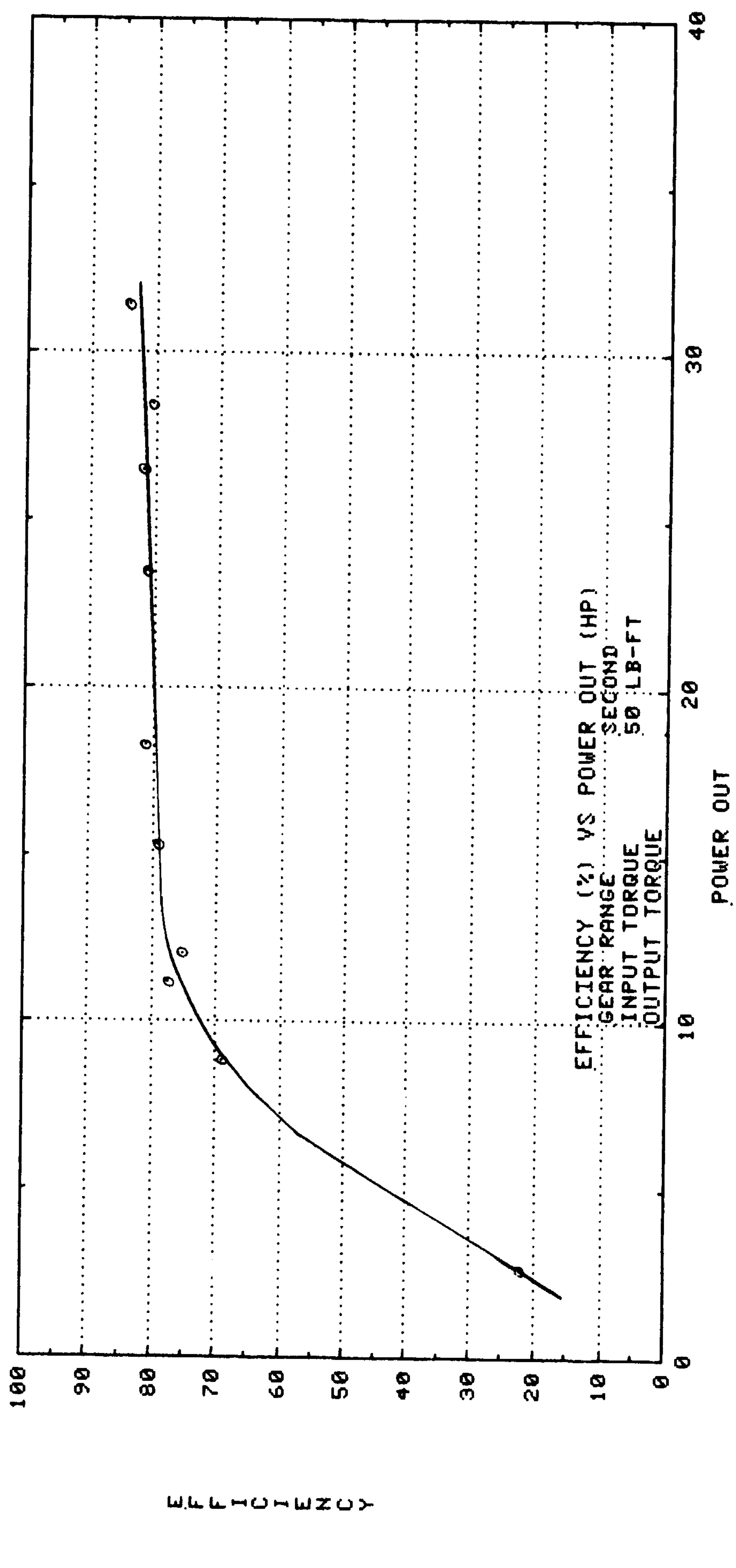

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE SECOND
INPUT TORQUE 40 LB-FT
OUTPUT TORQUE
POWER OUT
EFFICIENCY
0
10
20
30
40
50
60
70
80
90
100

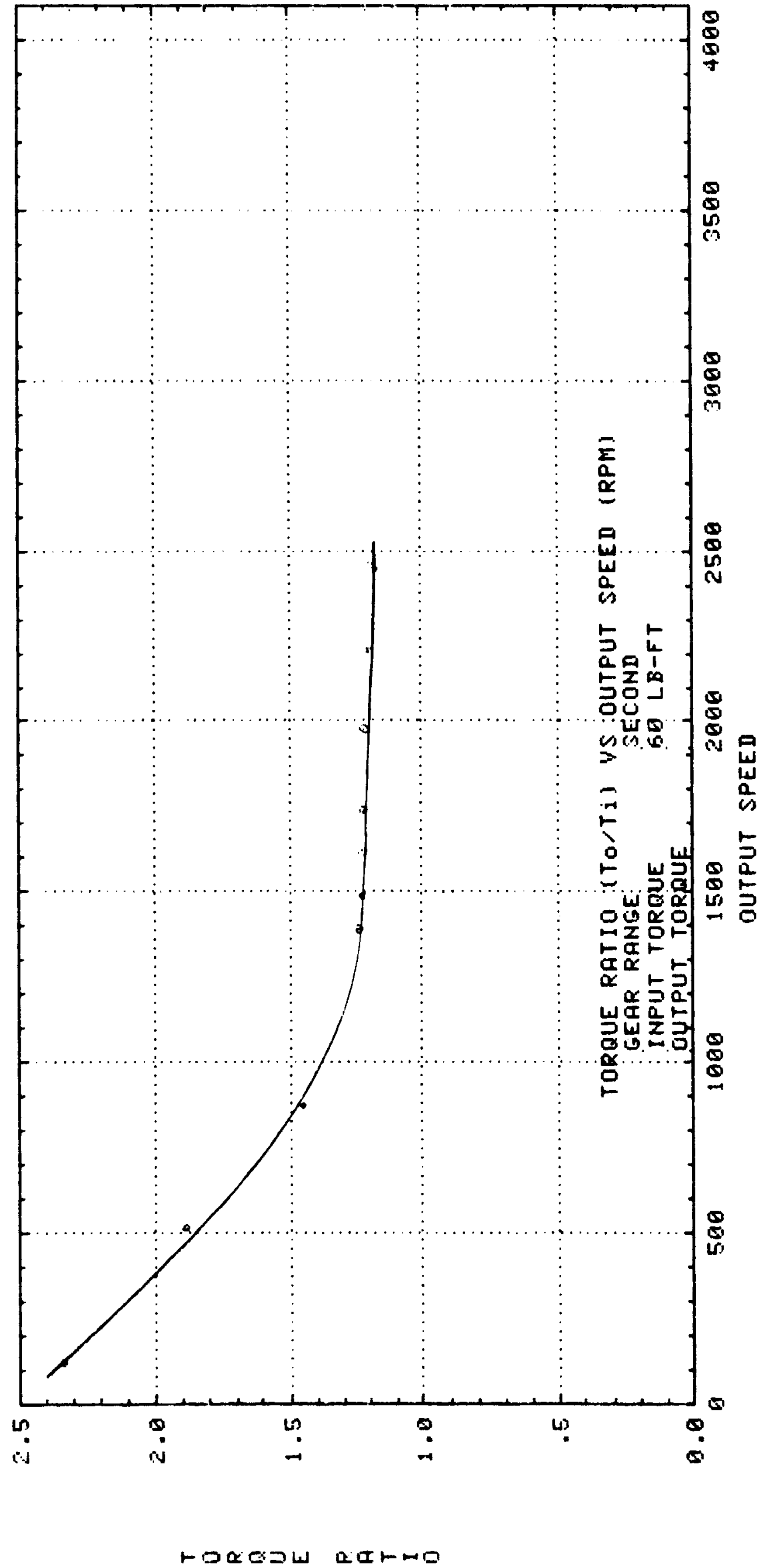

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 50 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
TORQUE RATIO
0.0
.5
1.0
1.5
2.0
2.5
0
500
1000
1500
2000
2500
3000
3500
4000

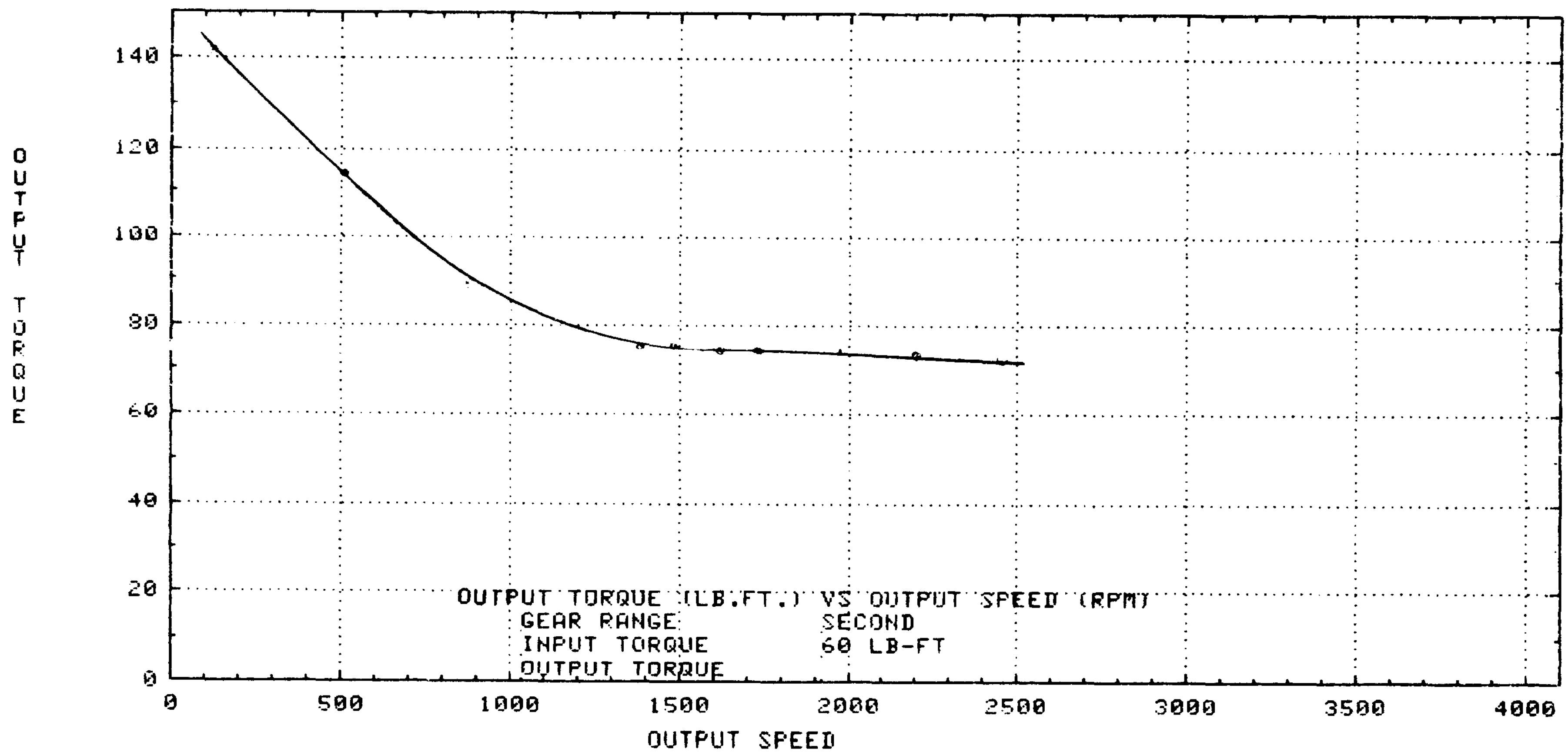

OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 50 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
OUTPUT TORQUE
0
25
50
75
100
125
0
500
1000
1500
2000
2500
3000
3500
4000


INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 50 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

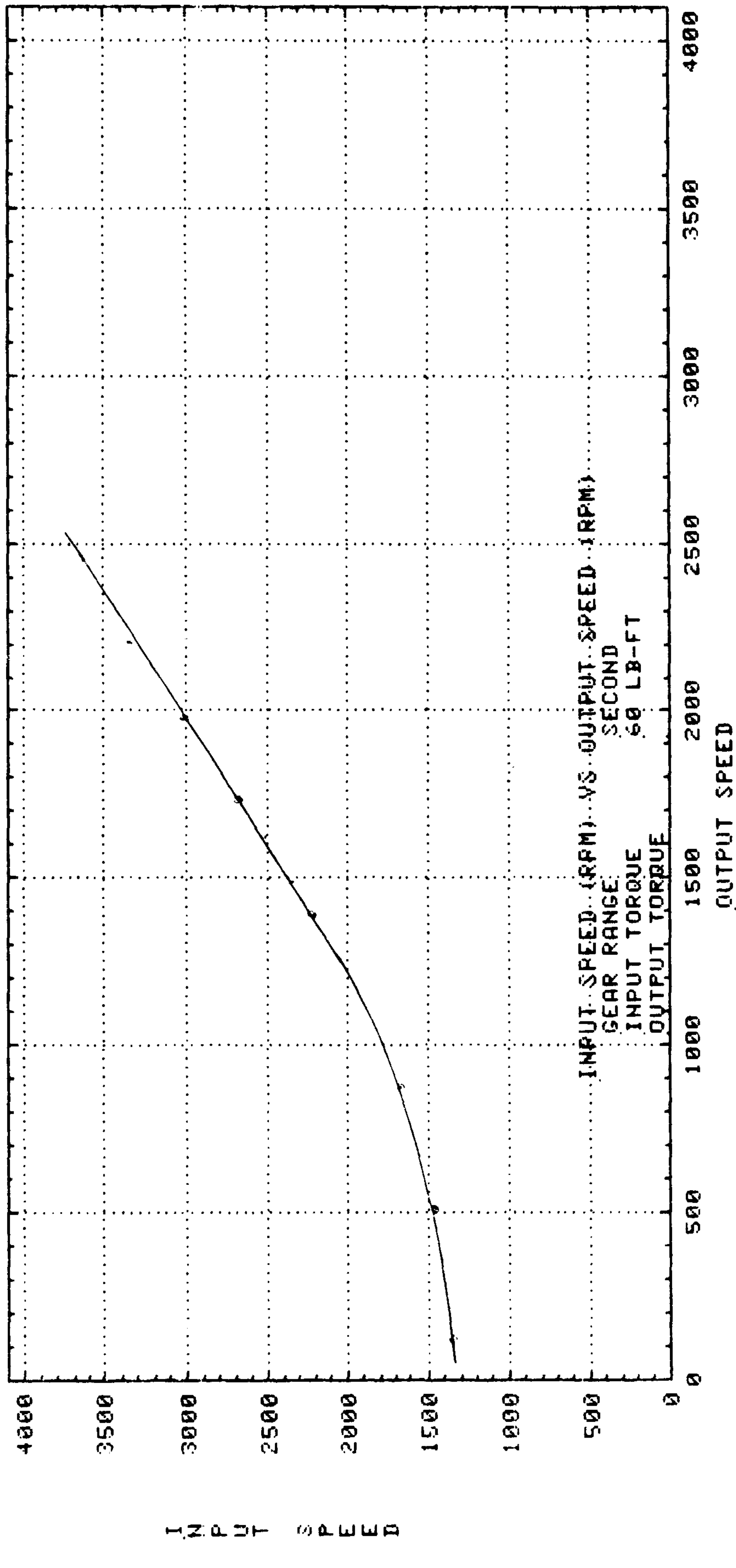

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 50 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
EFFICIENCY
0 500 1000 1500 2000 2500 3000 3500 4000
0 10 20 30 40 50 60 70 80 90 100

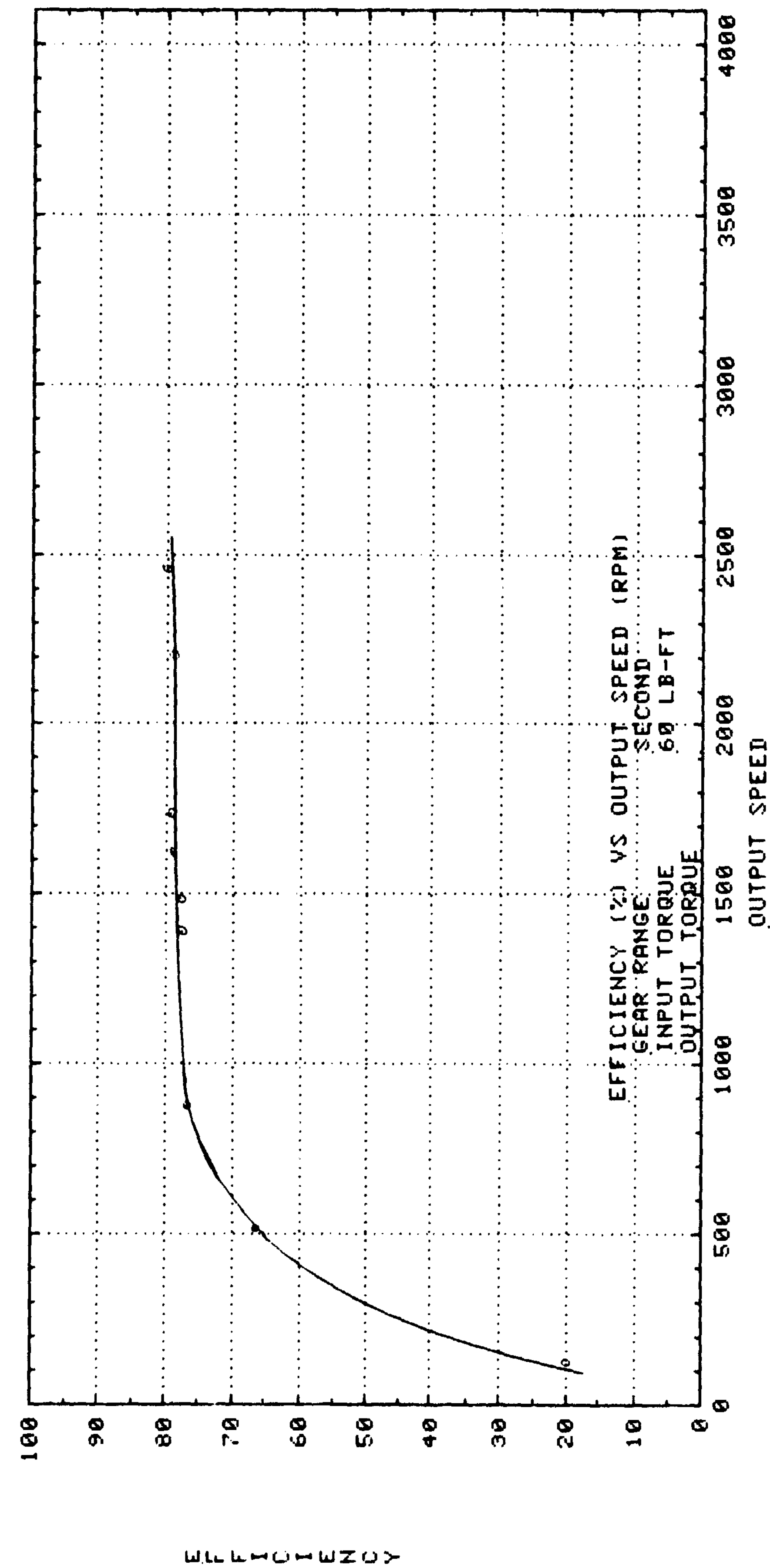

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE SECOND
INPUT TORQUE 50 LB-FT
OUTPUT TORQUE
POWER OUT
0
10
20
30
40
0
10
20
30
40
50
60
70
80
90
100
EFFICIENCY

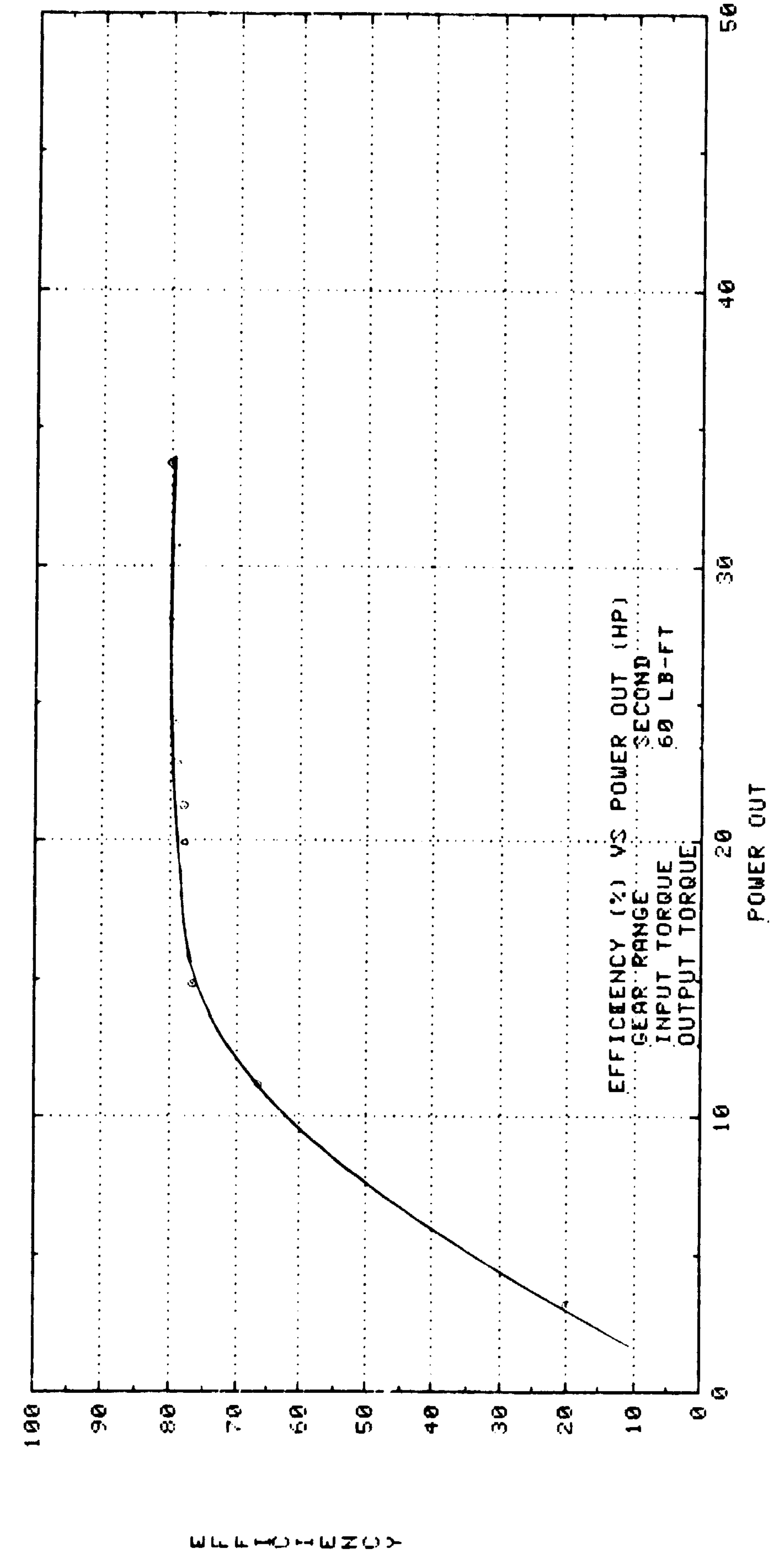

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 60 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
TORQUE RATIO
0.0
.5
1.0
1.5
2.0
2.5
0
500
1000
1500
2000
2500
3000
3500
4000

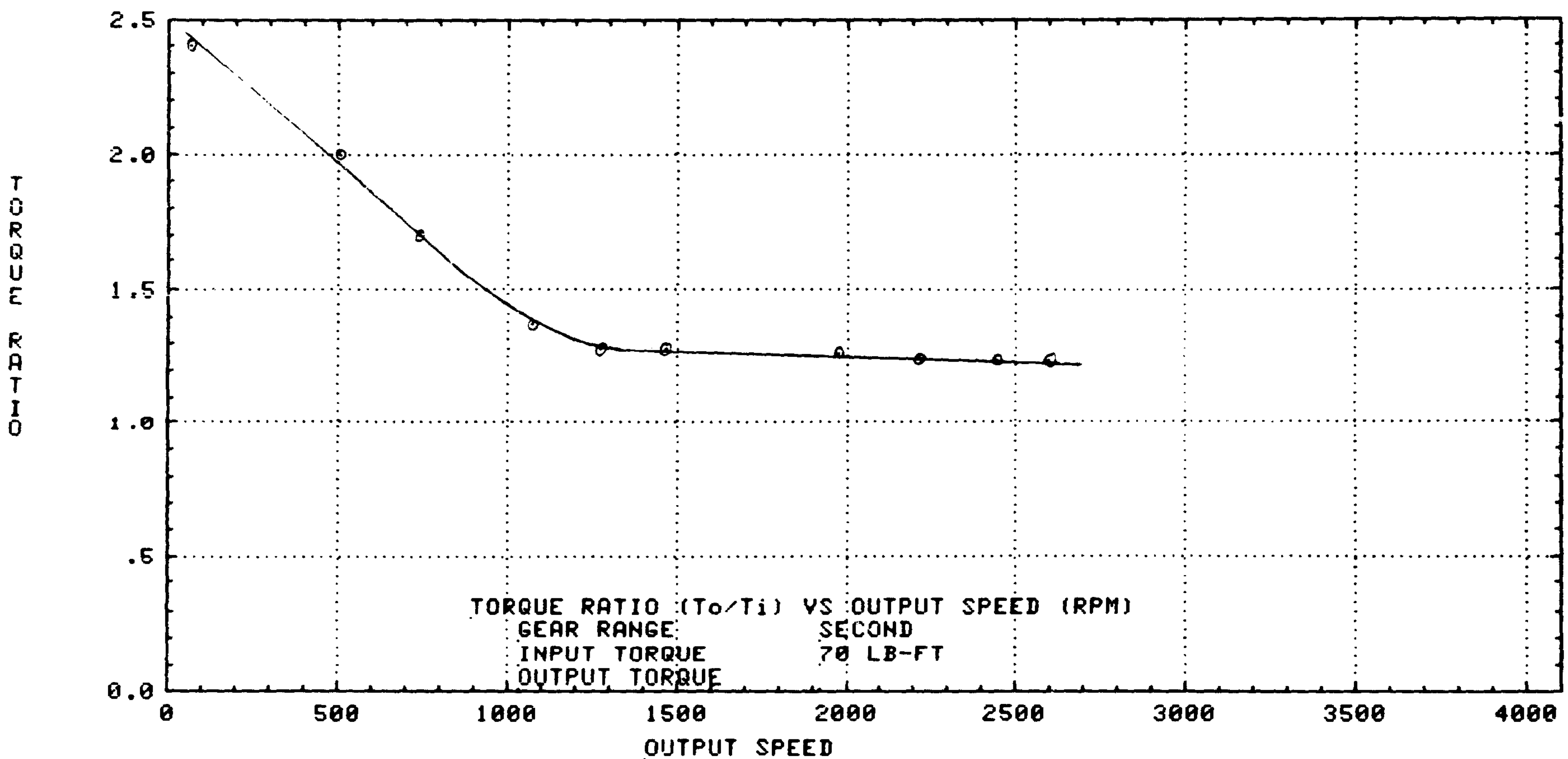


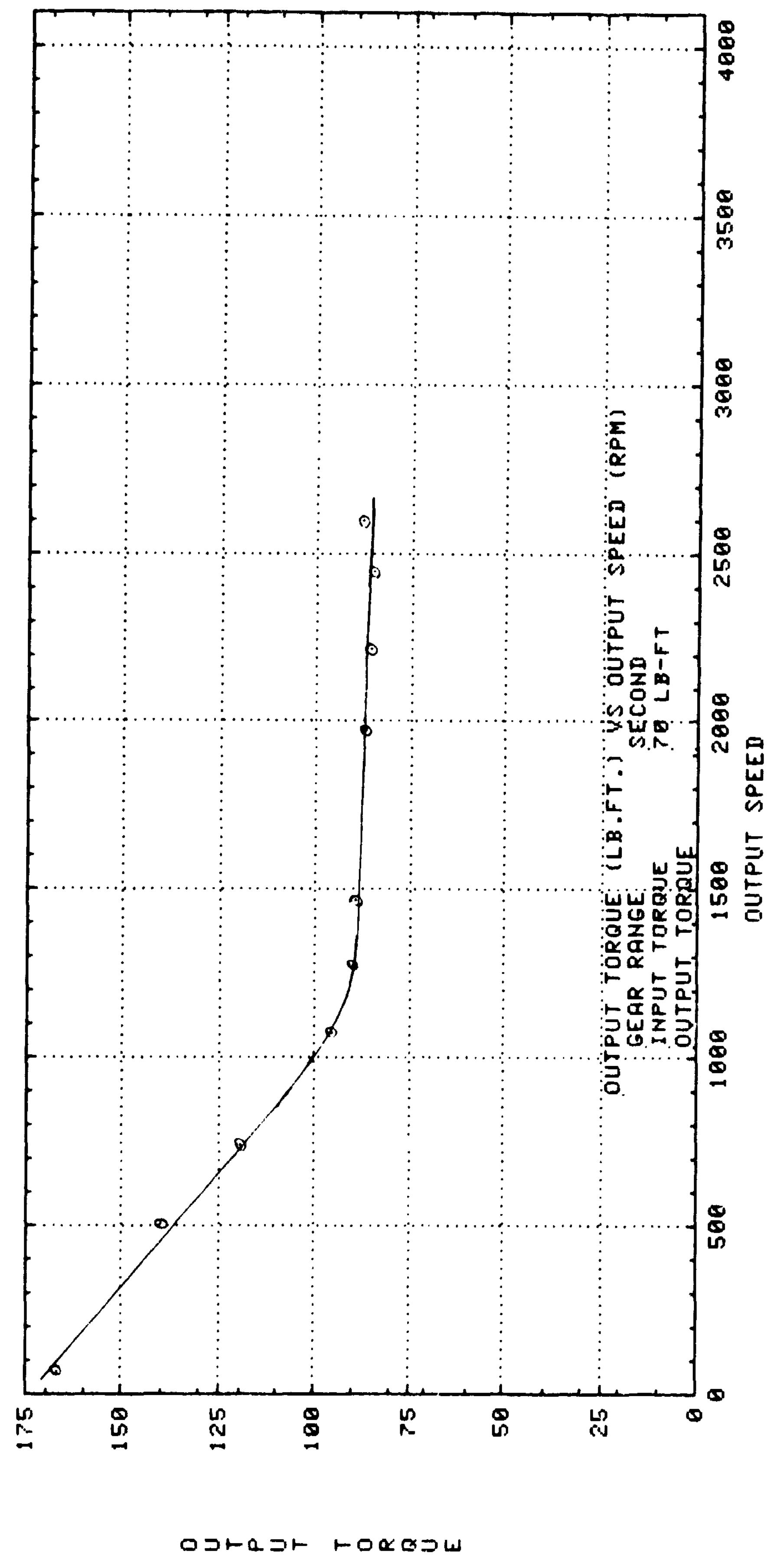
OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 60 LB-FT
OUTPUT TORQUE
OUTPUT TORQUE
OUTPUT SPEED
0
20
40
60
80
100
120
140
0
500
1000
1500
2000
2500
3000
3500
4000


INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 60 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

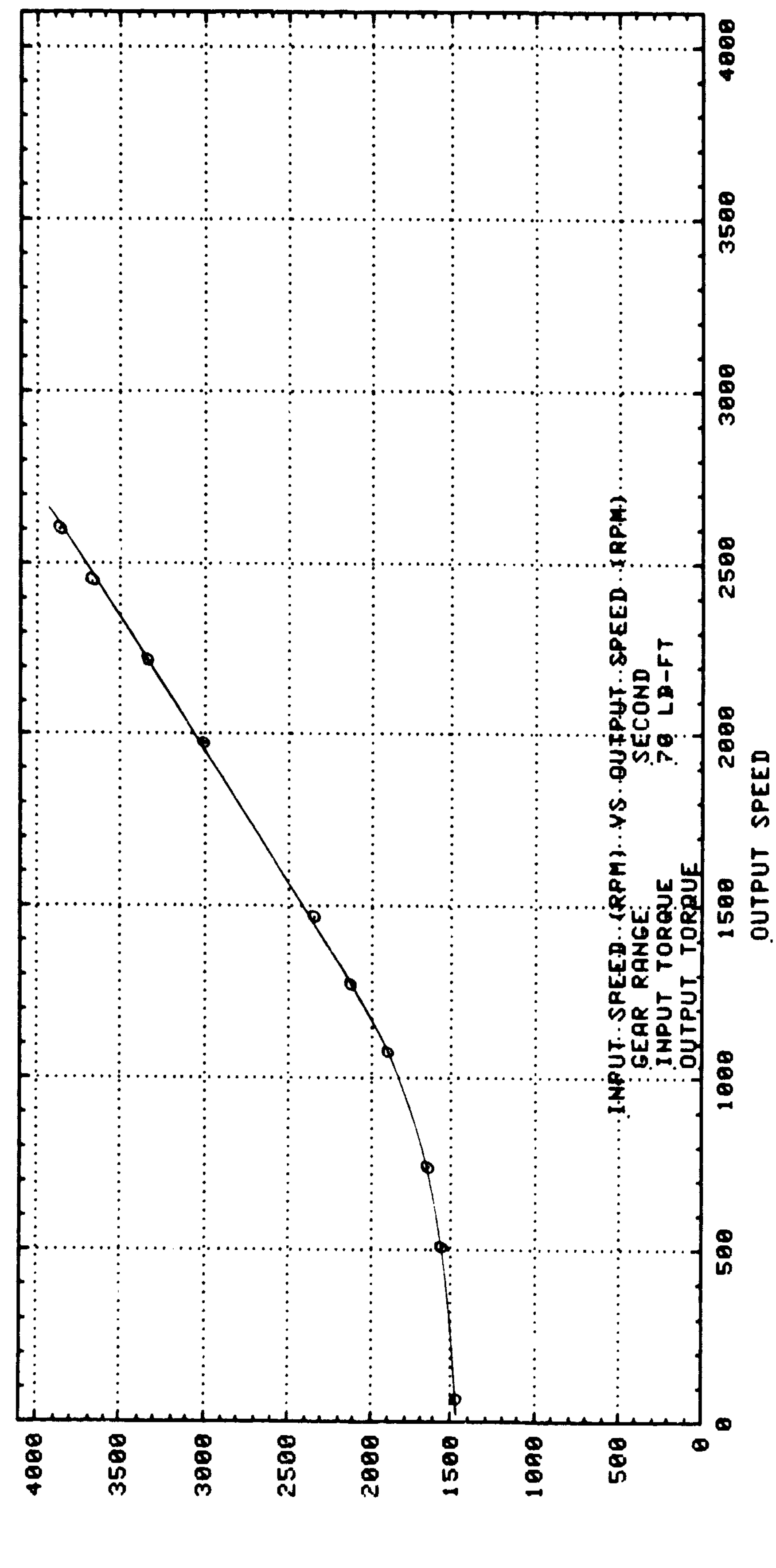

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 60 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
EFFICIENCY
0 500 1000 1500 2000 2500 3000 3500 4000
0 10 20 30 40 50 60 70 80 90 100

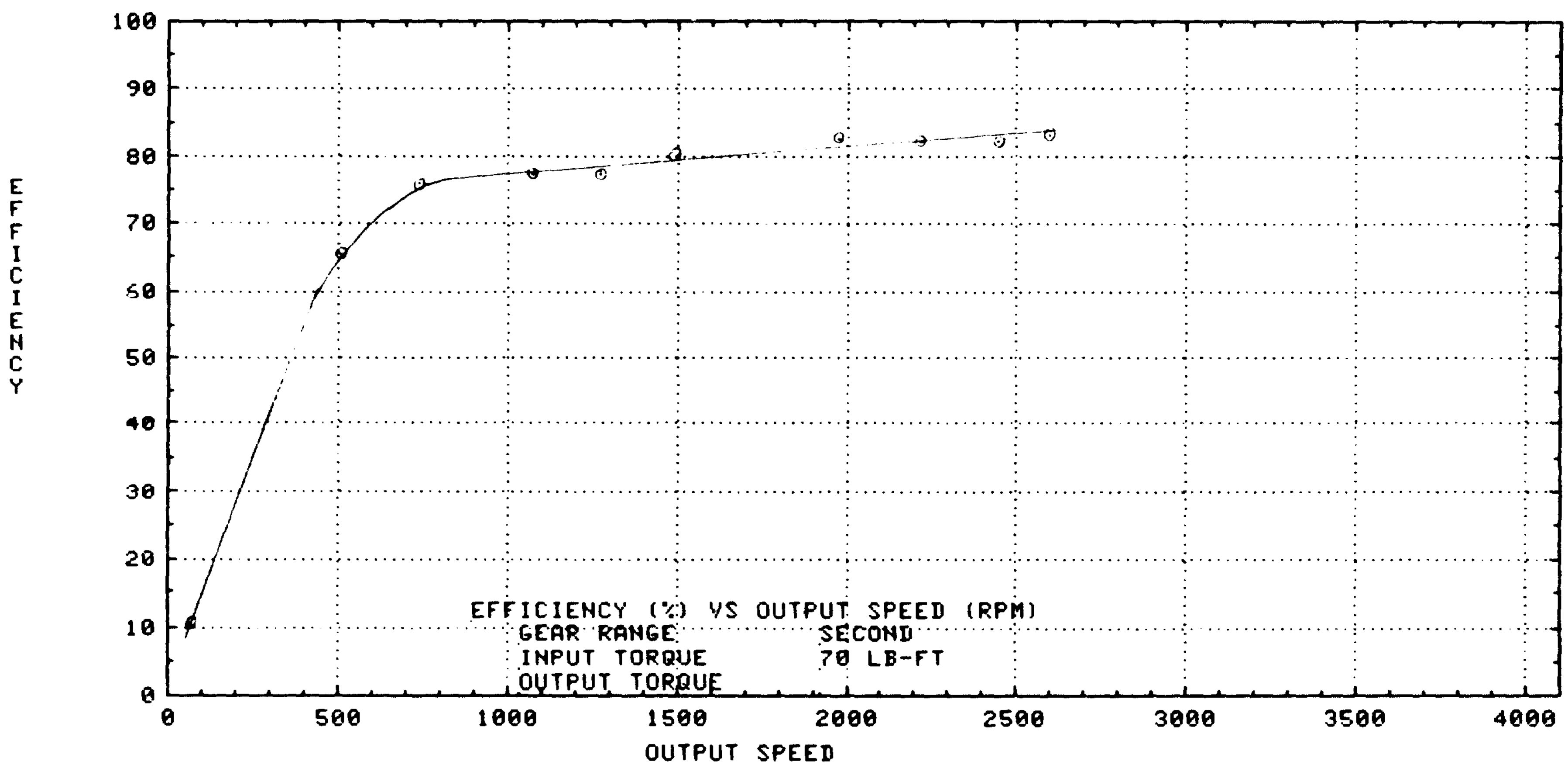

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE SECOND
INPUT TORQUE 60 LB-FT
OUTPUT TORQUE
POWER OUT
EFFICIENCY
0 10 20 30 40 50
0 10 20 30 40 50 60 70 80 90 100

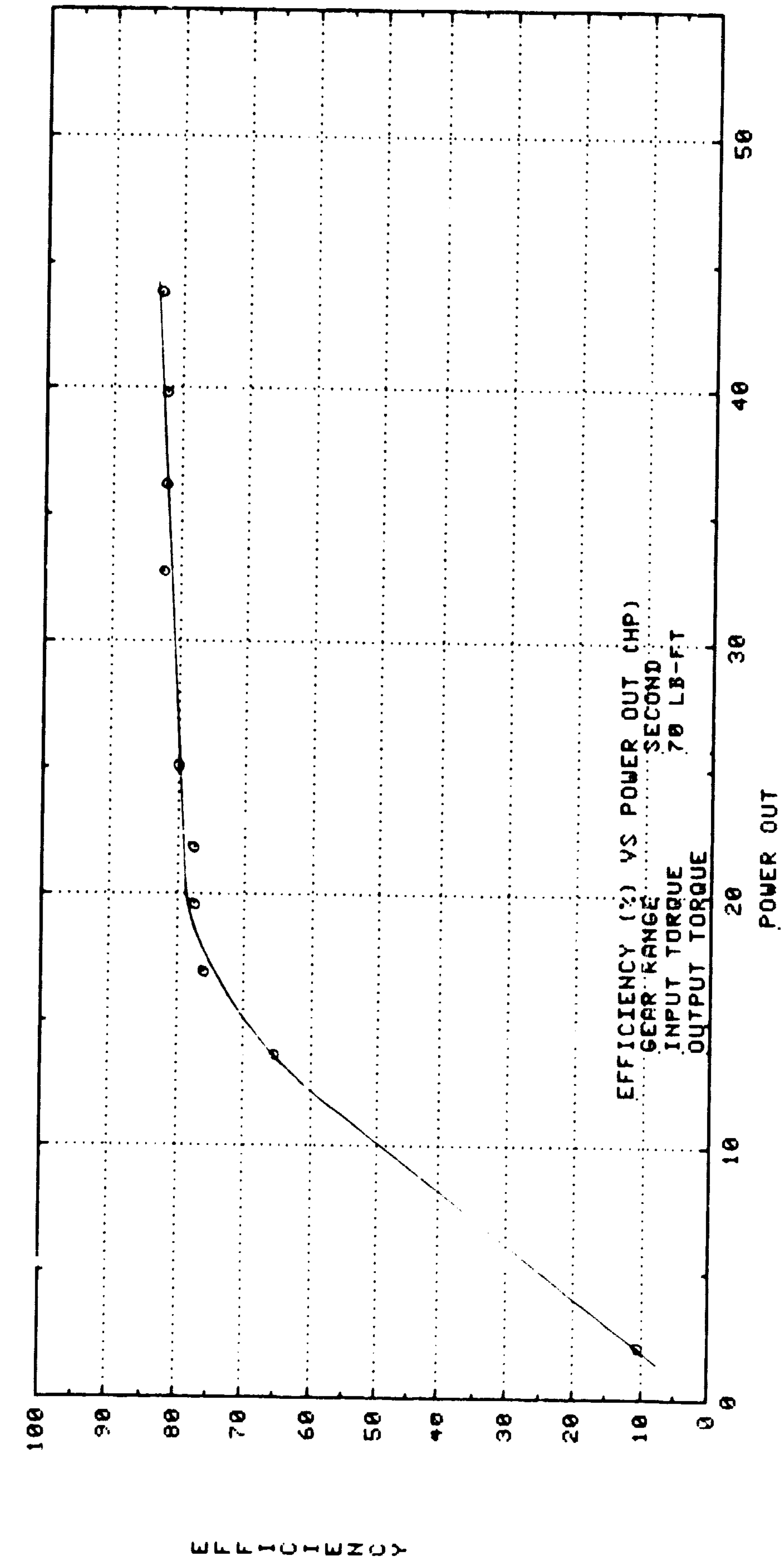

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 70 LB-FT
OUTPUT TORQUE
TORQUE RATIO
OUTPUT SPEED
2.5
2.0
1.5
1.0
.5
0.0
0
500
1000
1500
2000
2500
3000
3500
4000

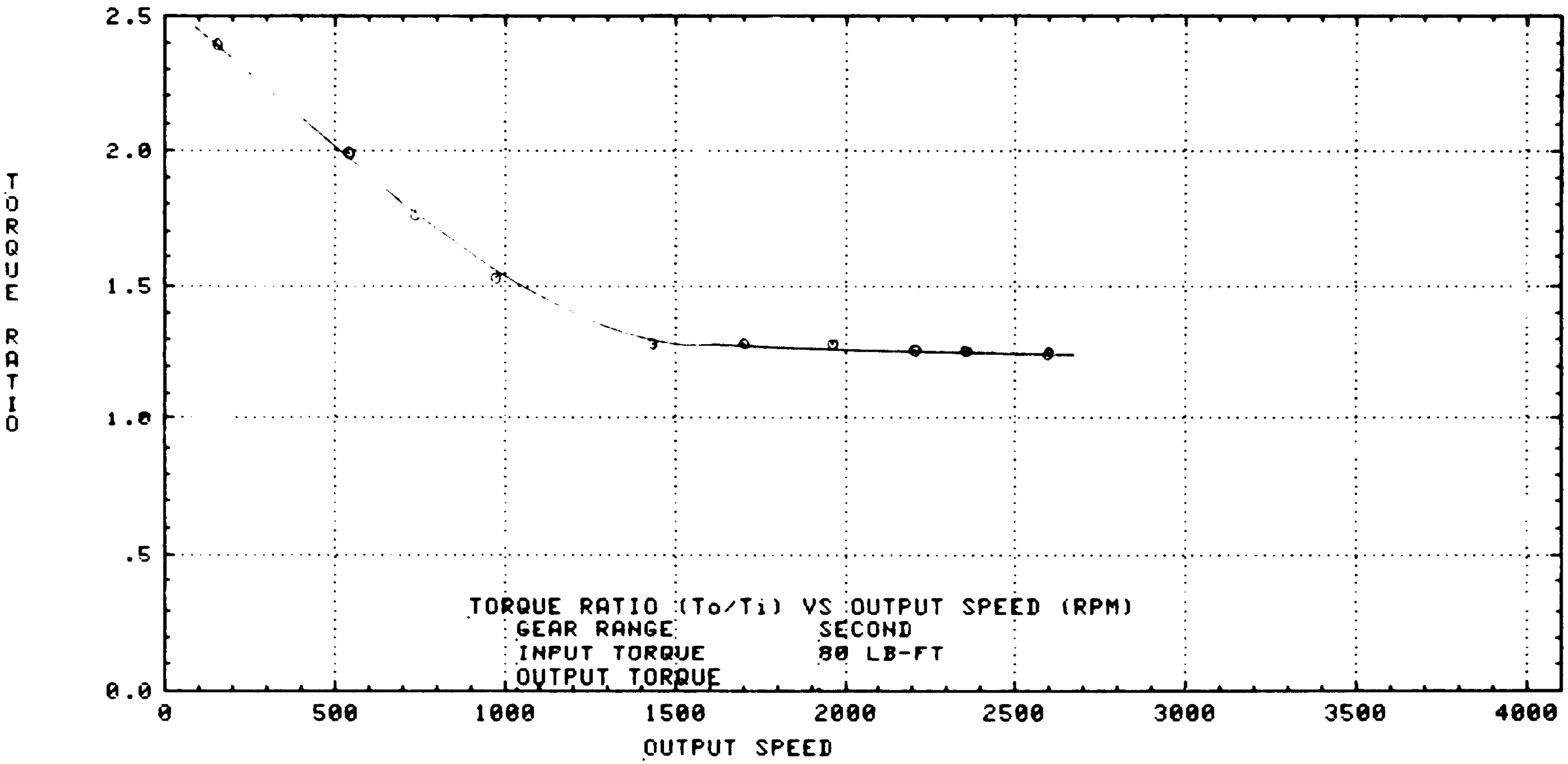


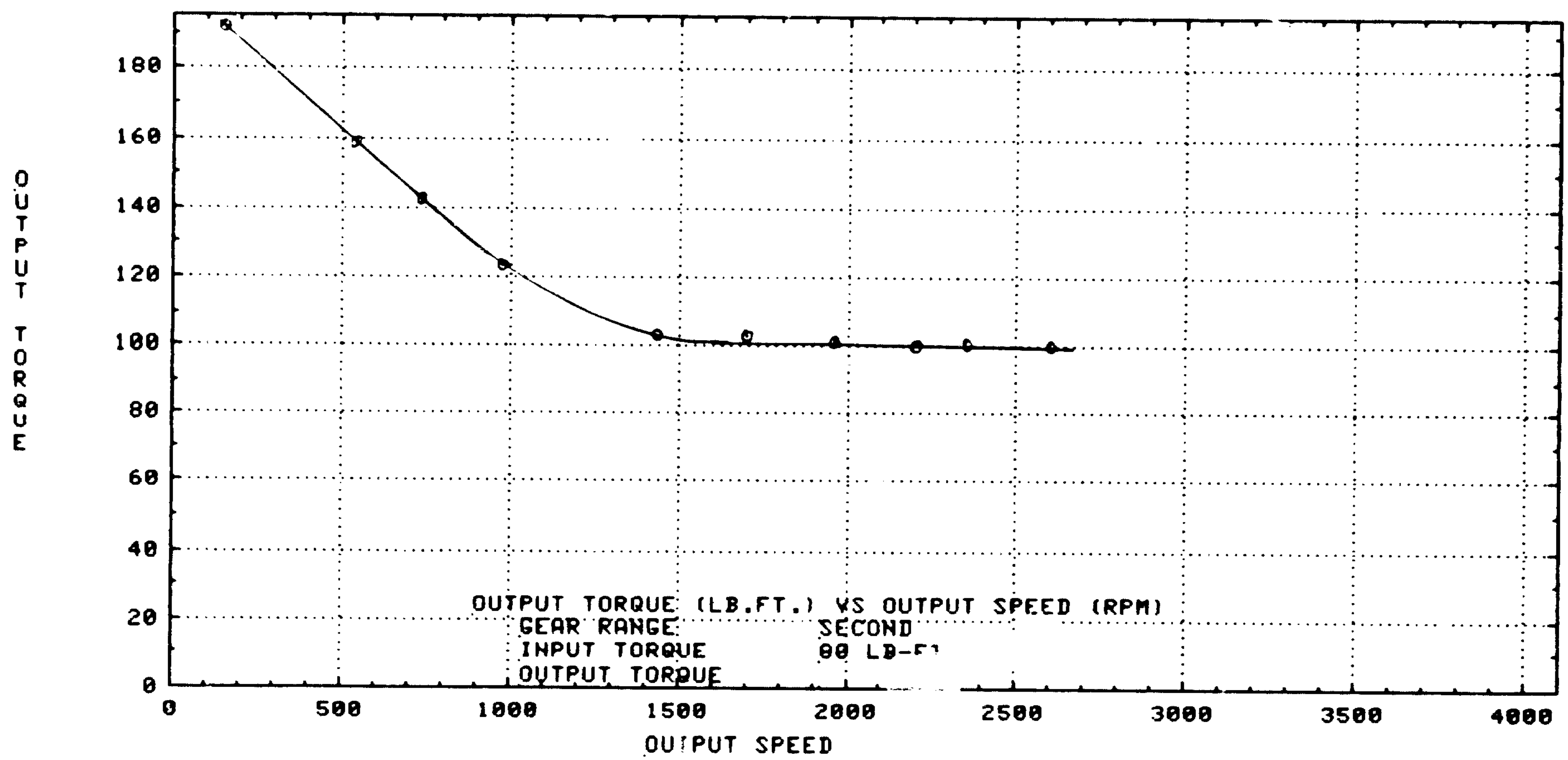
OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 70 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
OUTPUT TORQUE
0
500
1000
1500
2000
2500
3000
3500
4000
0
25
50
75
100
125
150
175

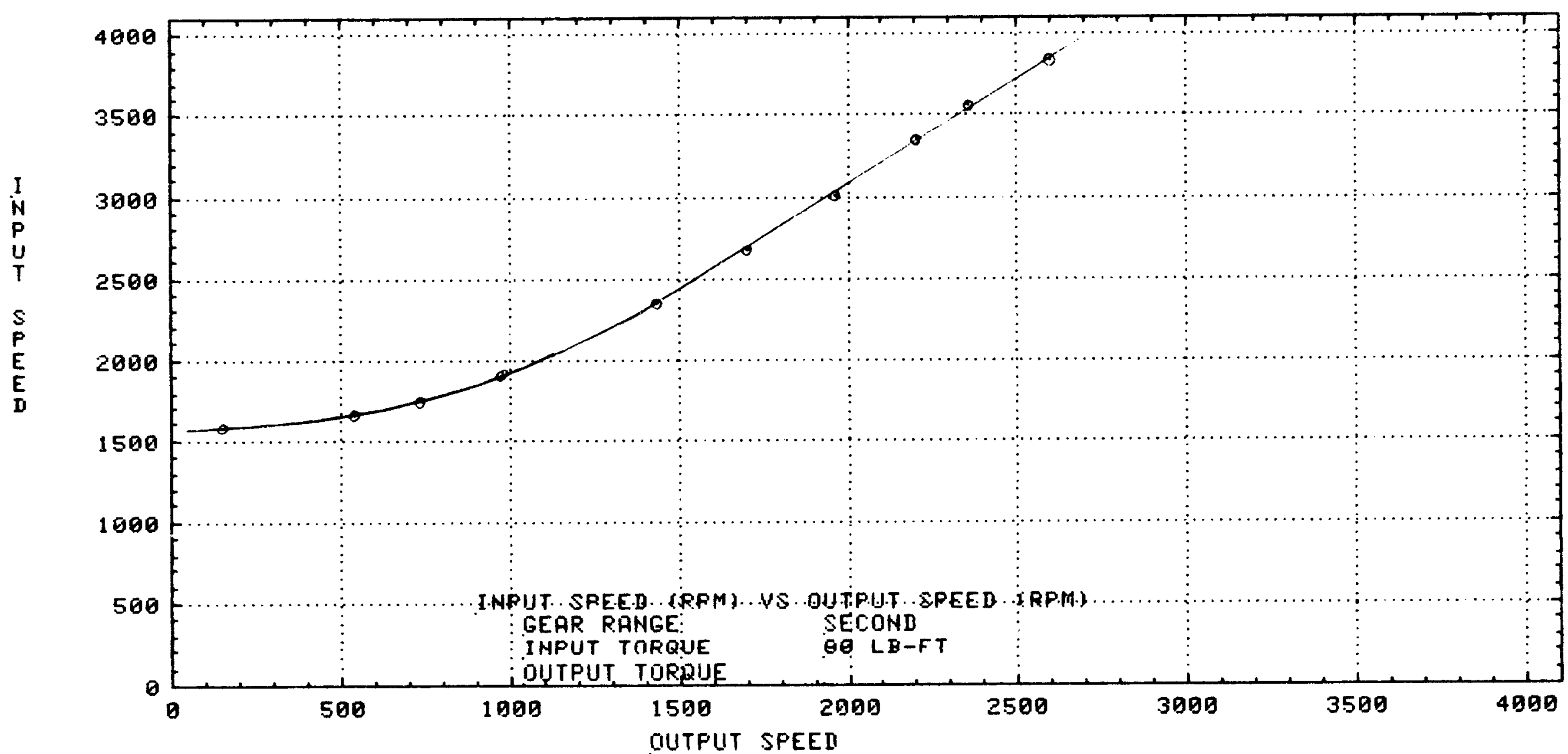

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 70 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

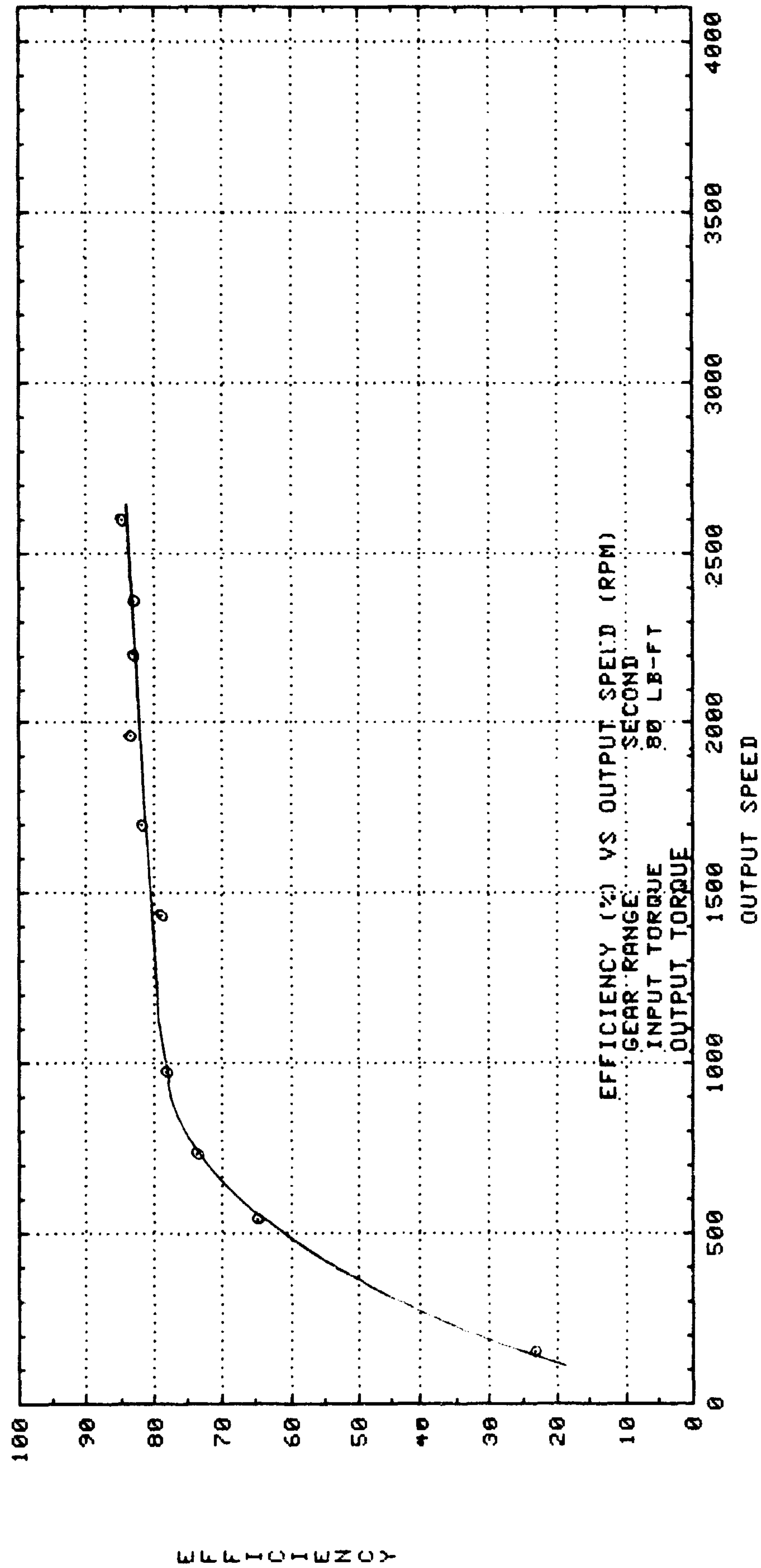

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 70 LB-FT
OUTPUT TORQUE
EFFICIENCY
OUTPUT SPEED
0
10
20
30
40
50
60
70
80
90
100
0
500
1000
1500
2000
2500
3000
3500
4000

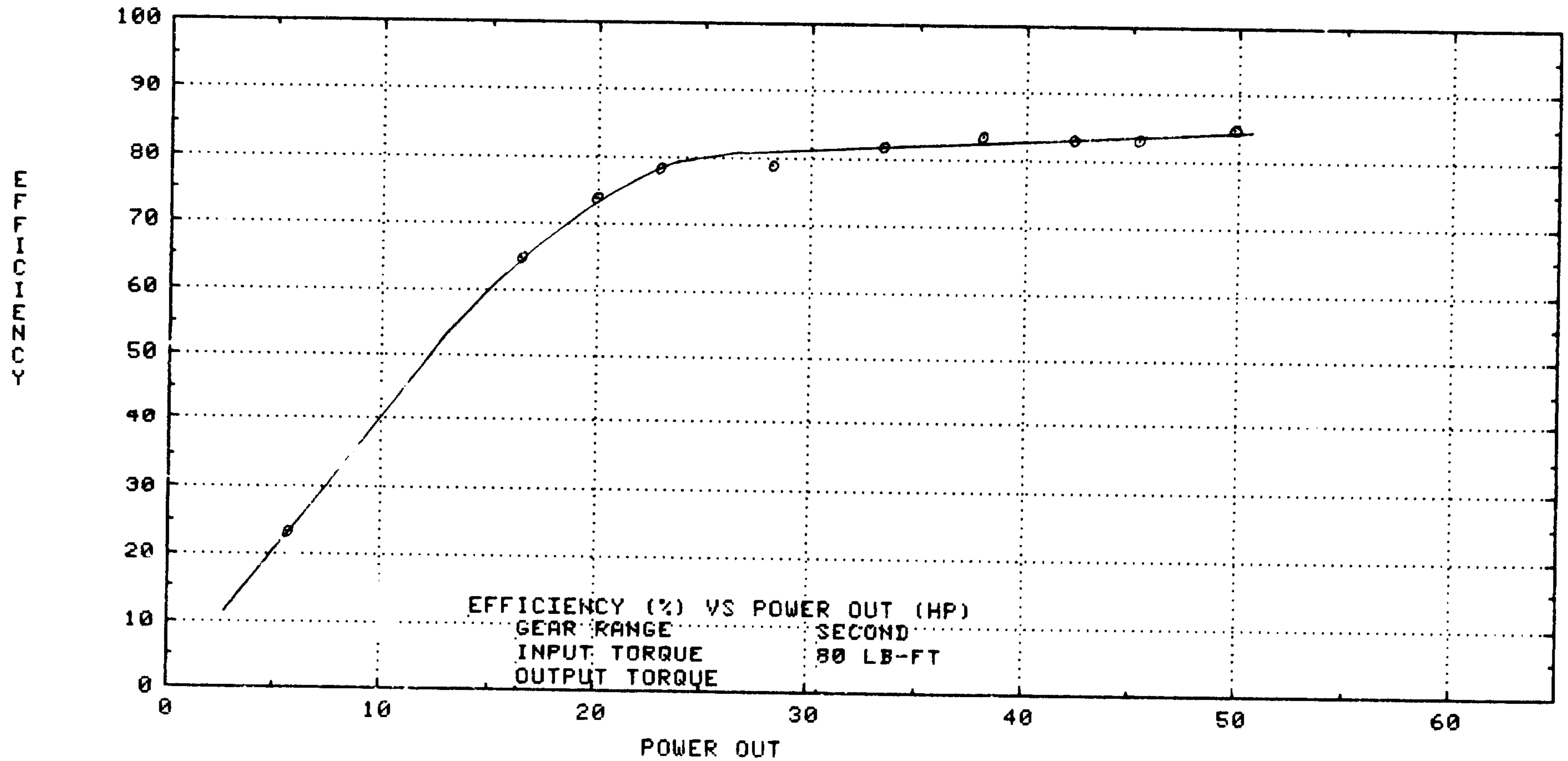

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE SECOND
INPUT TORQUE 70 LB-FT
OUTPUT TORQUE
POWER OUT
EFFICIENCY
0 10 20 30 40 50
0 10 20 30 40 50 60 70 80 90 100


TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 80 LB-FT
OUTPUT TORQUE
TORQUE RATIO
OUTPUT SPEED
2.5
2.0
1.5
1.0
.5
0.0
0
500
1000
1500
2000
2500
3000
3500
4000

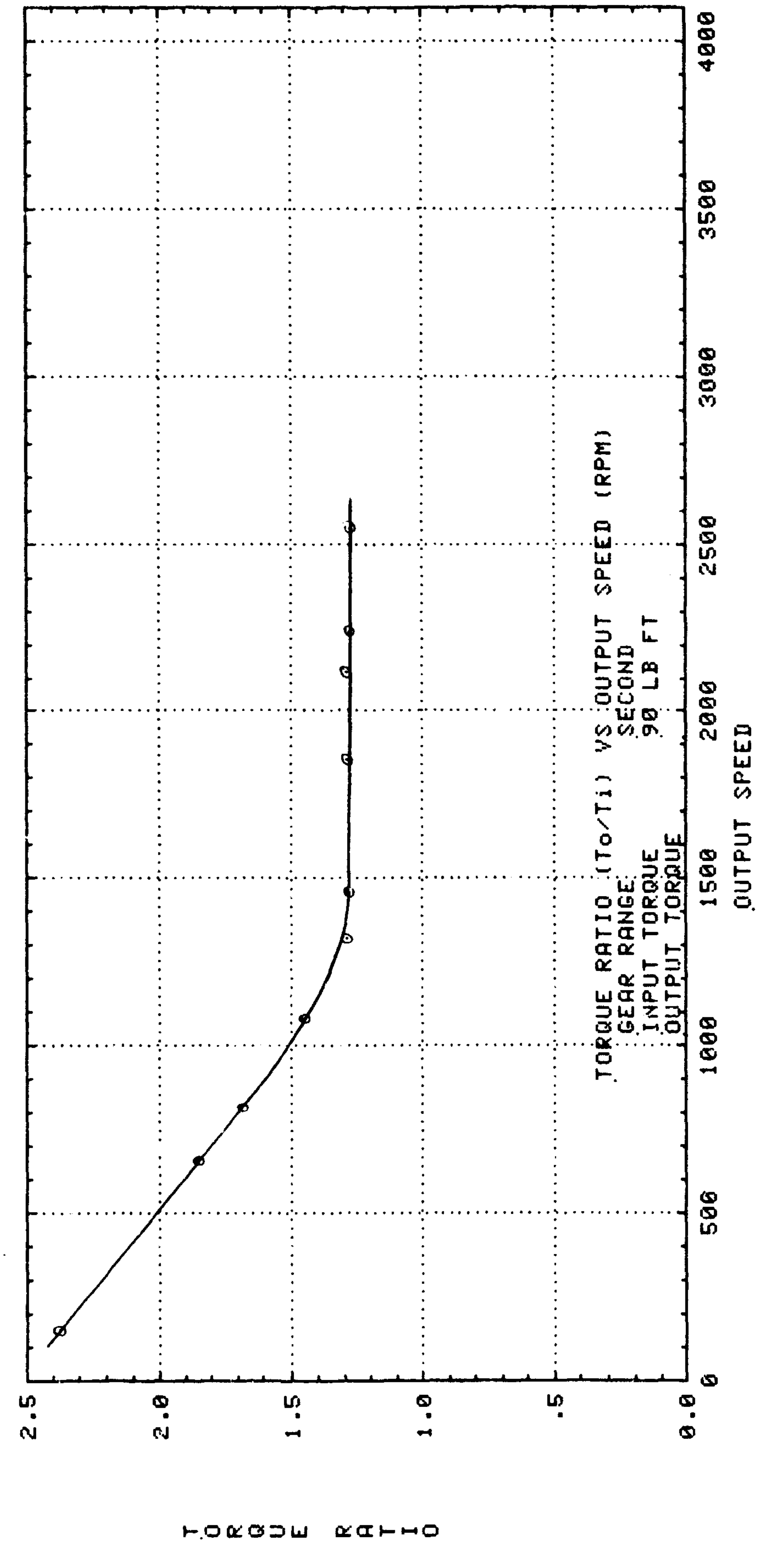

OUTPUT TORQUE
OUTPUT SPEED
0
20
40
60
80
100
120
140
160
180
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 80 LB-F
OUTPUT TORQUE


INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 00 LB-FT
OUTPUT TORQUE
INPUT SPEED
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

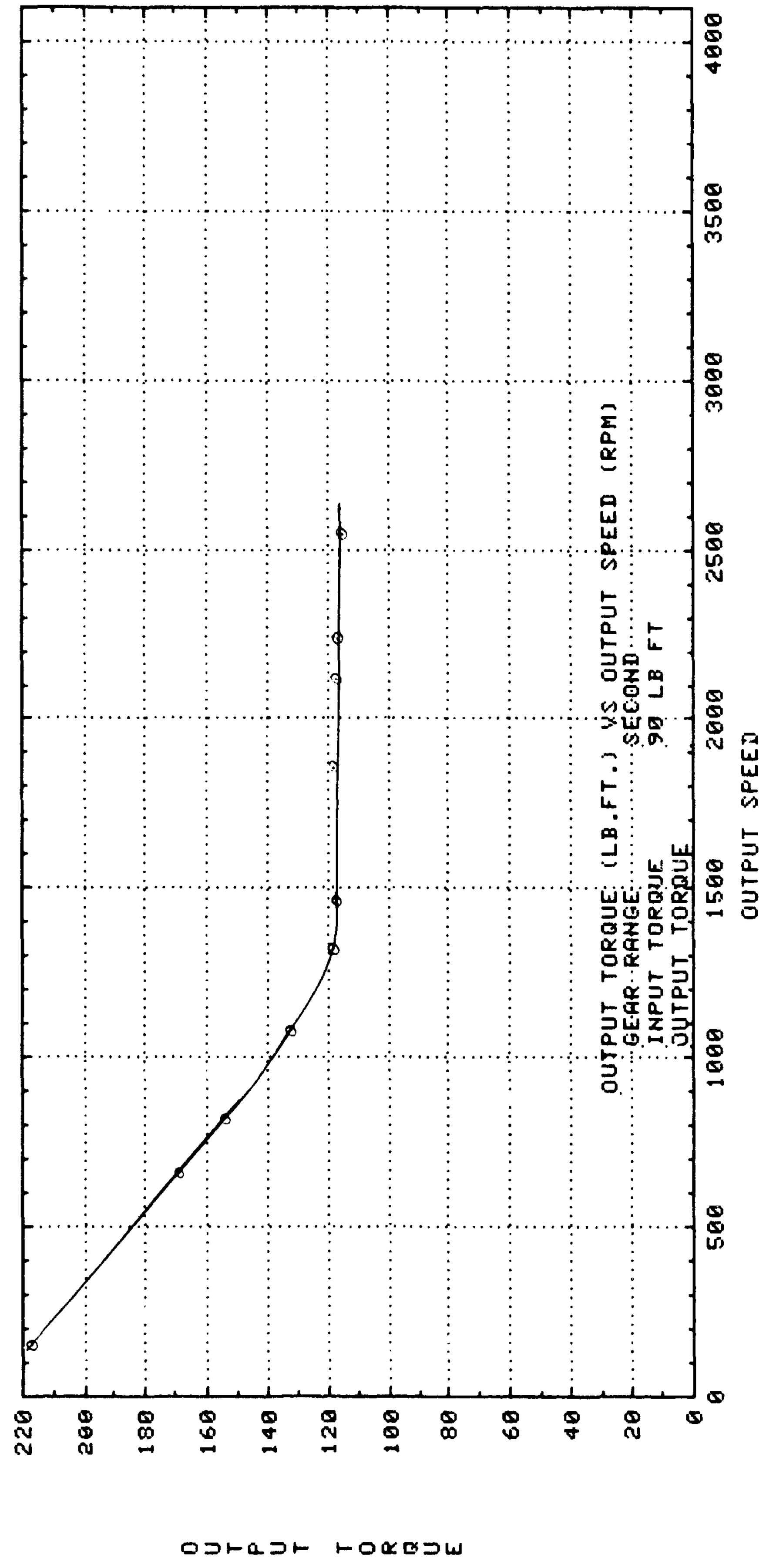

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 80 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
EFFICIENCY
0 500 1000 1500 2000 2500 3000 3500 4000
0 10 20 30 40 50 60 70 80 90 100

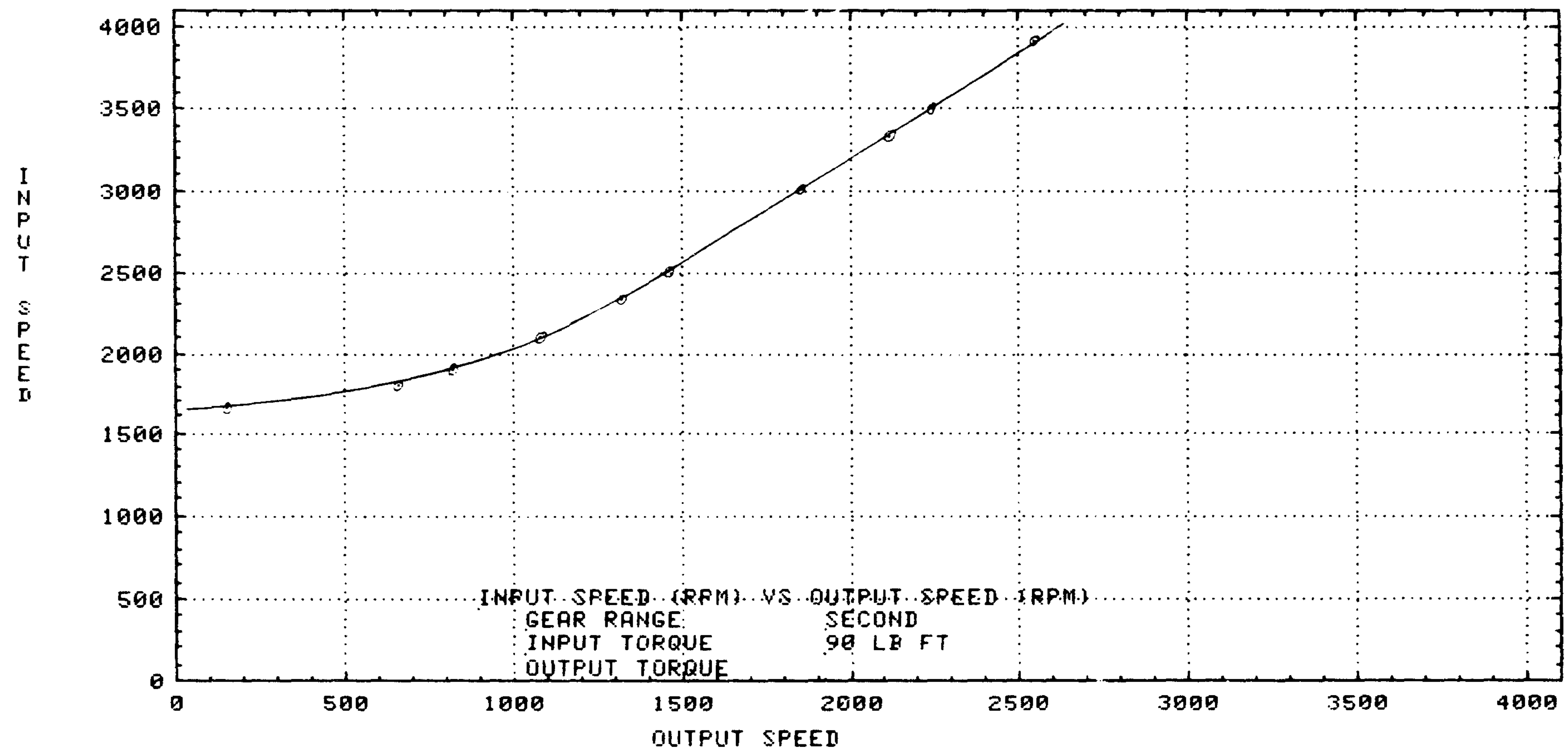


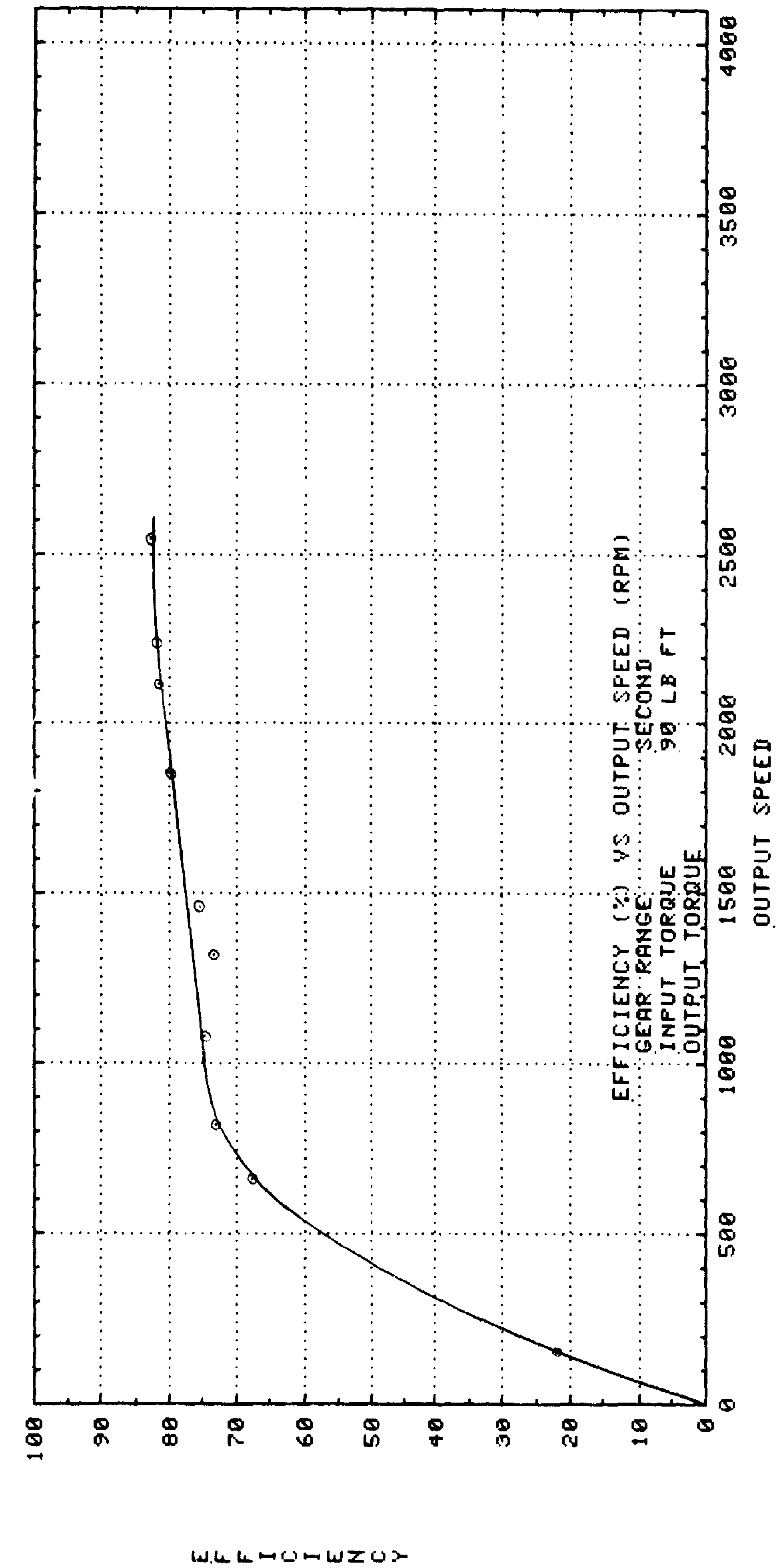
EFFICIENCY
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
POWER OUT
EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE
SECOND
INPUT TORQUE
80 LB-FT
OUTPUT TORQUE

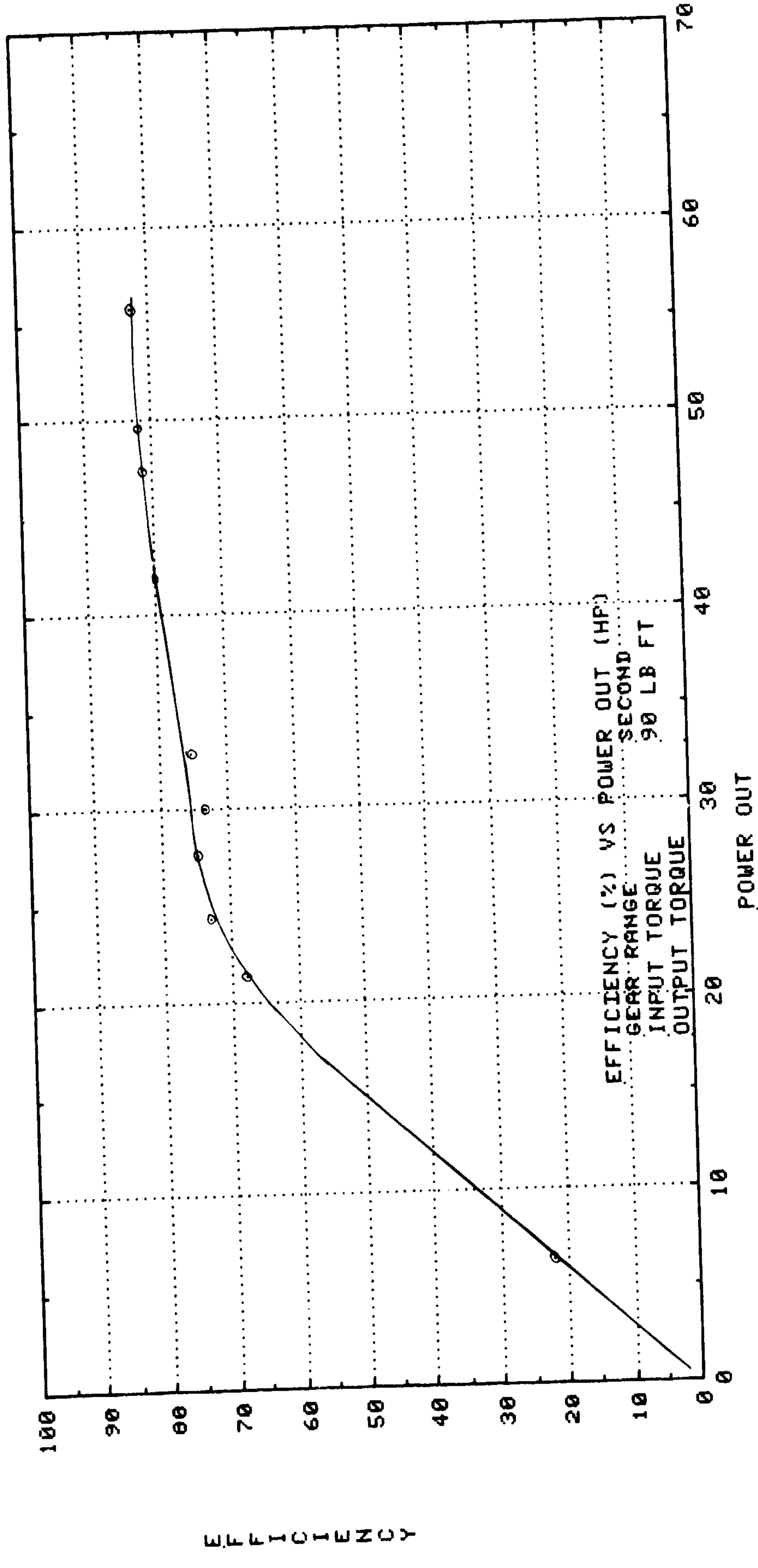


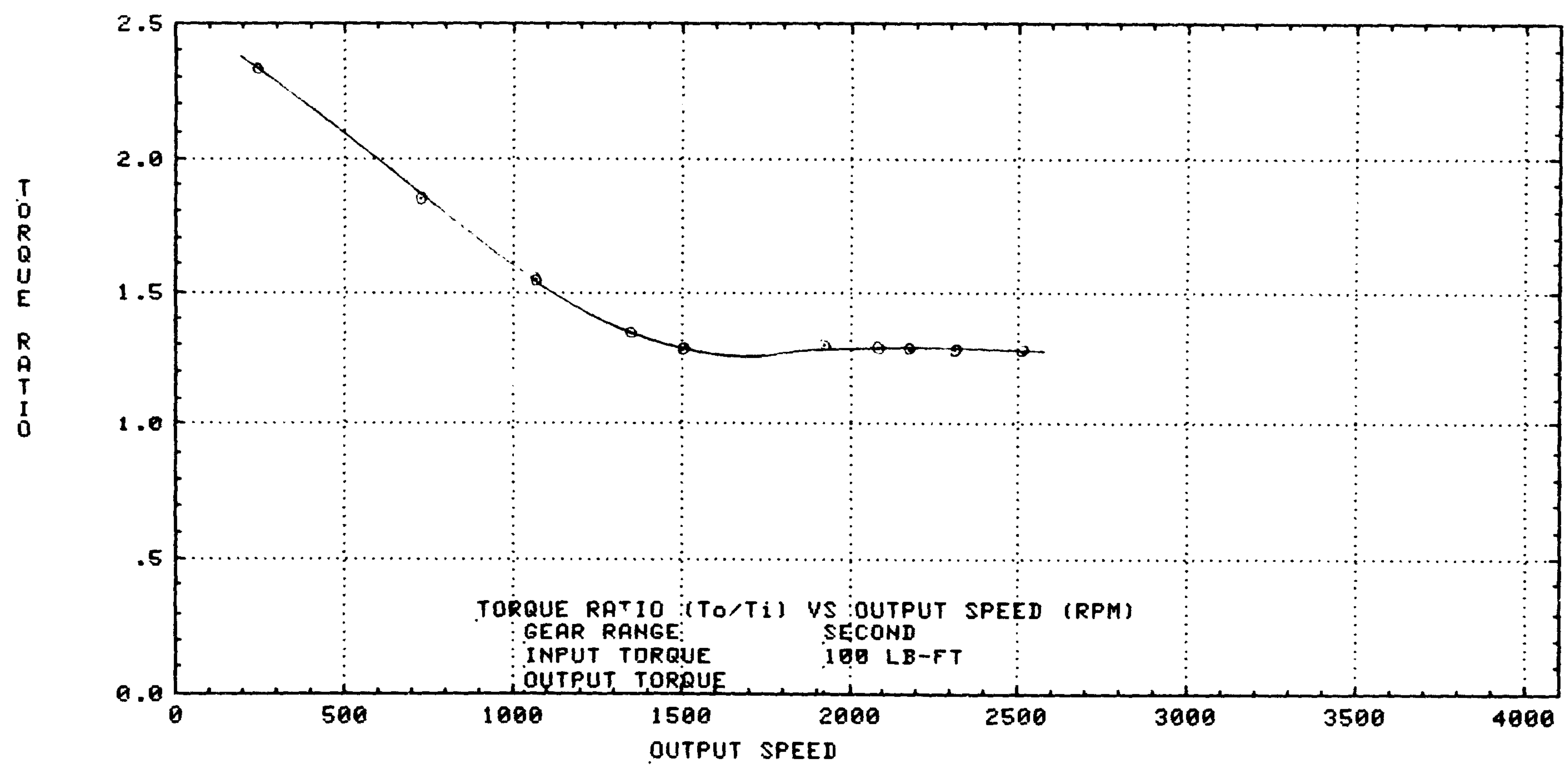
TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 90 LB FT
OUTPUT TORQUE
OUTPUT SPEED
TORQUE RATIO
0 500 1000 1500 2000 2500 3000 3500 4000
0.0 .5 1.0 1.5 2.0 2.5


OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 90 LB FT
OUTPUT TORQUE
OUTPUT SPEED
OUTPUT TORQUE
0 500 1000 1500 2000 2500 3000 3500 4000
0 20 40 60 80 100 120 140 160 180 200 220

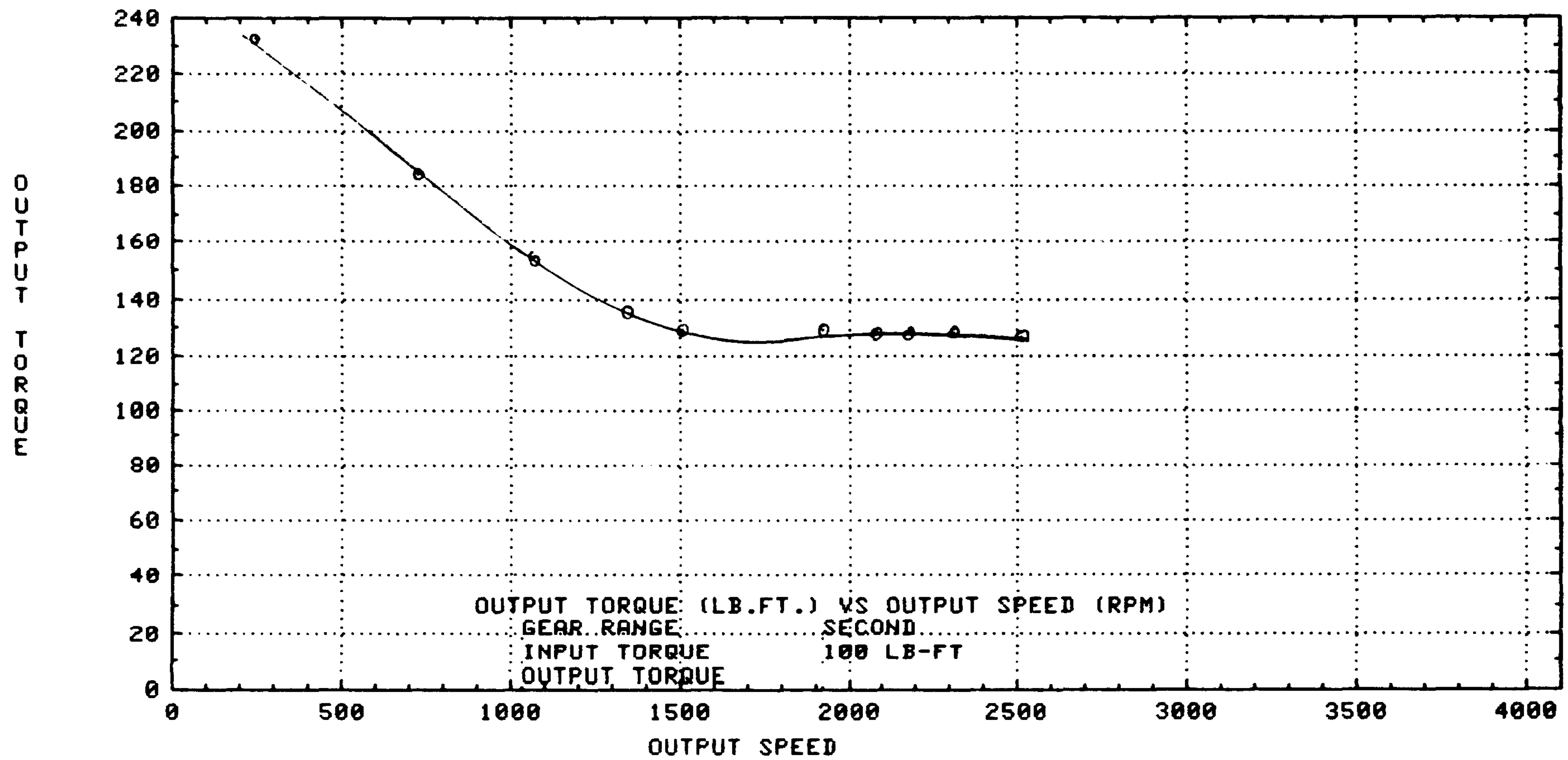

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 90 LB FT
OUTPUT TORQUE
INPUT SPEED
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

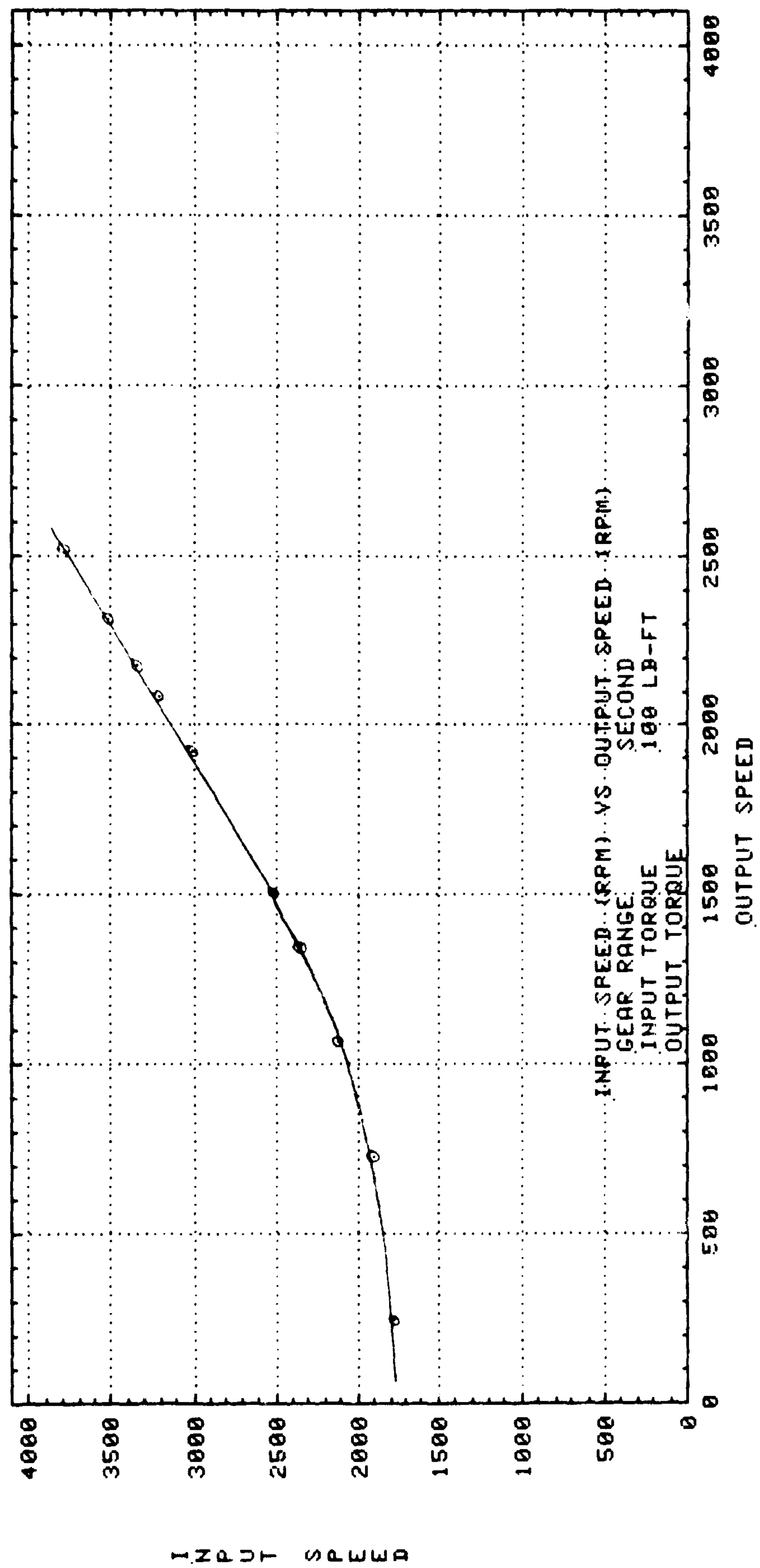

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 90 LB FT
OUTPUT TORQUE
OUTPUT SPEED
EFFICIENCY
0
500
1000
1500
2000
2500
3000
3500
4000
0
10
20
30
40
50
60
70
80
90
100

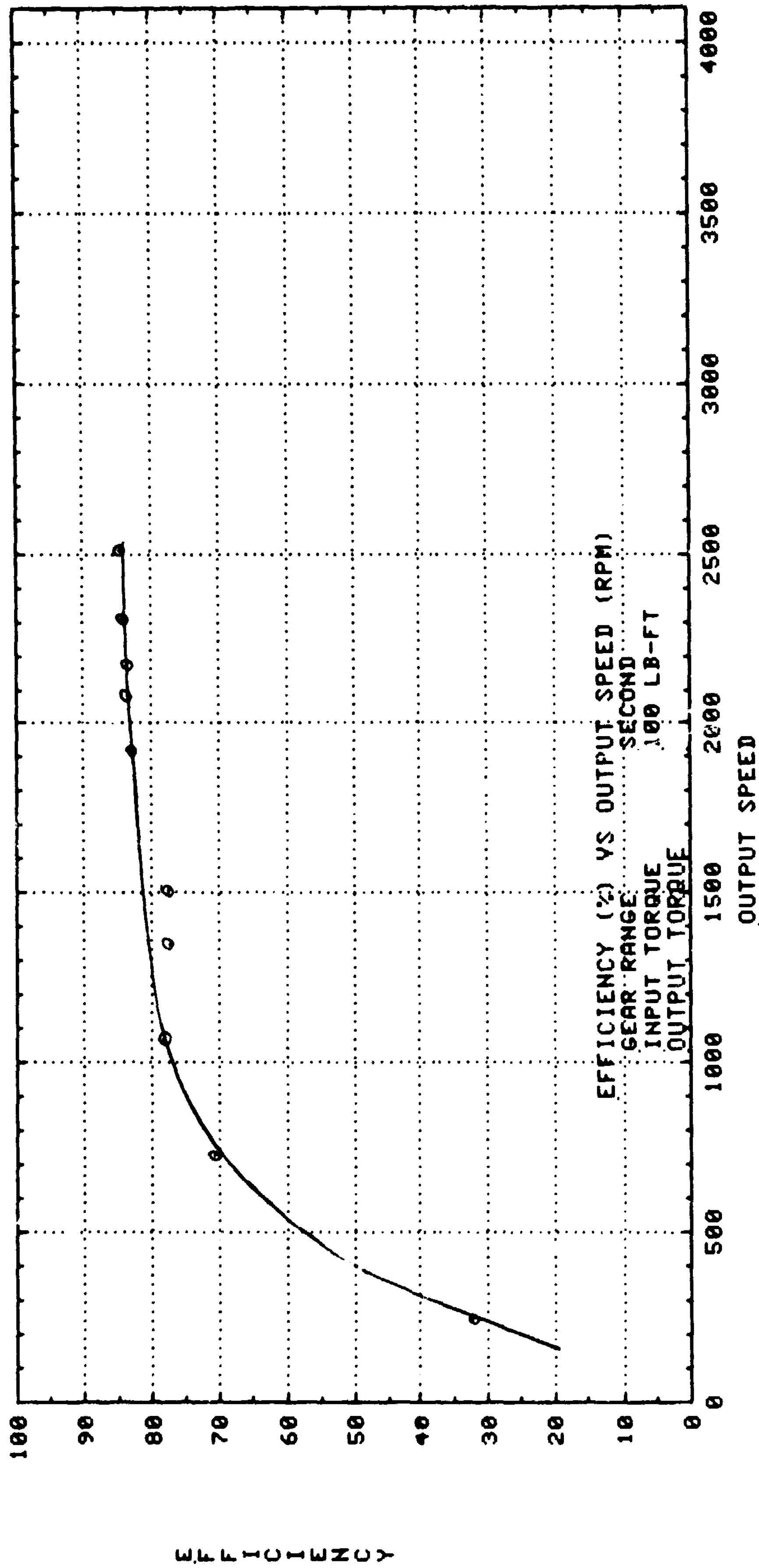

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE SECOND
INPUT TORQUE 90 LB FT
OUTPUT TORQUE
POWER OUT
EFFICIENCY
0 10 20 30 40 50 60 70
0 10 20 30 40 50 60 70 80 90 100

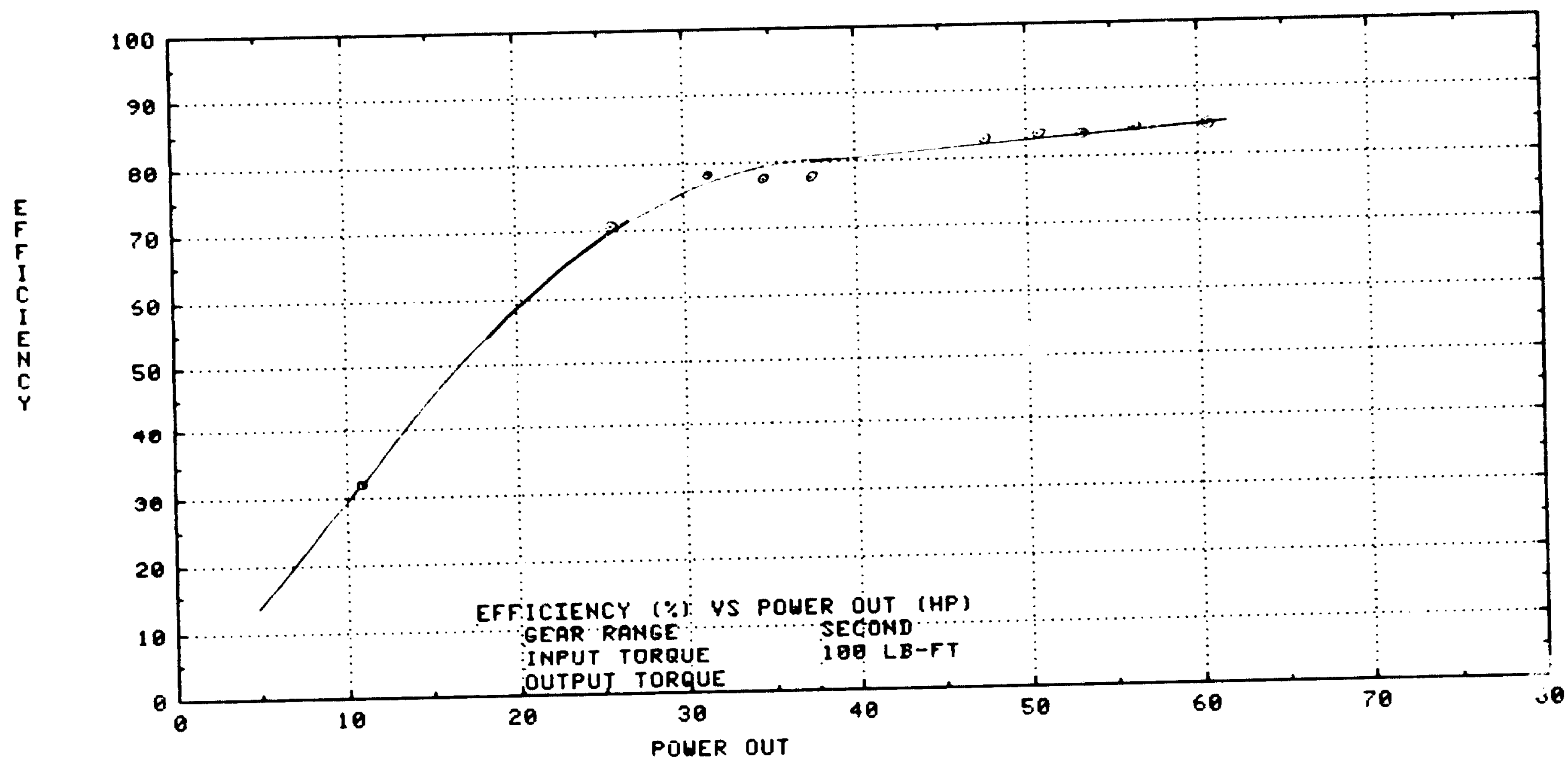


TORQUE RATIO
2.5
2.0
1.5
1.0
.5
0.0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 100 LB-FT
OUTPUT TORQUE


OUTPUT TORQUE
240
220
200
180
160
140
120
100
80
60
40
20
0
OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 100 LB-FT
OUTPUT TORQUE
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED


INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 100 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000


EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 100 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
EFFICIENCY
0
500
1000
1500
2000
2500
3000
3500
4000
100
90
80
70
60
50
40
30
20
10
0



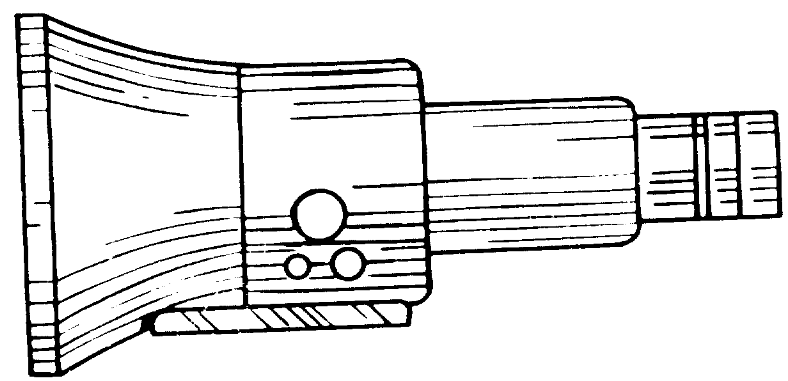
EFFICIENCY
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
POWER OUT
EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE SECOND
INPUT TORQUE 100 LB-FT
OUTPUT TORQUE

DRIVE PERFORMANCE

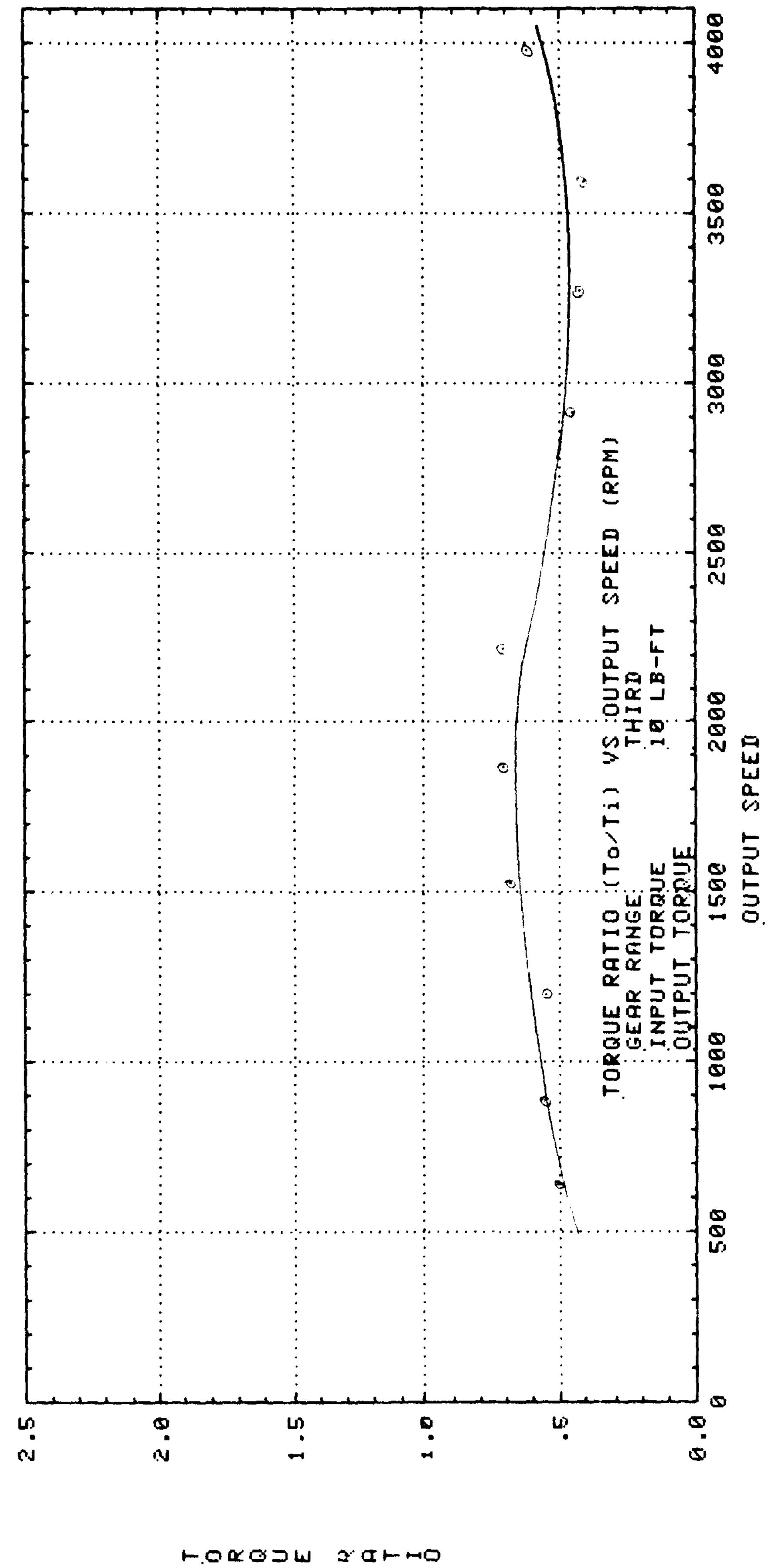
3rd Gear

Graphs Contained in This Section

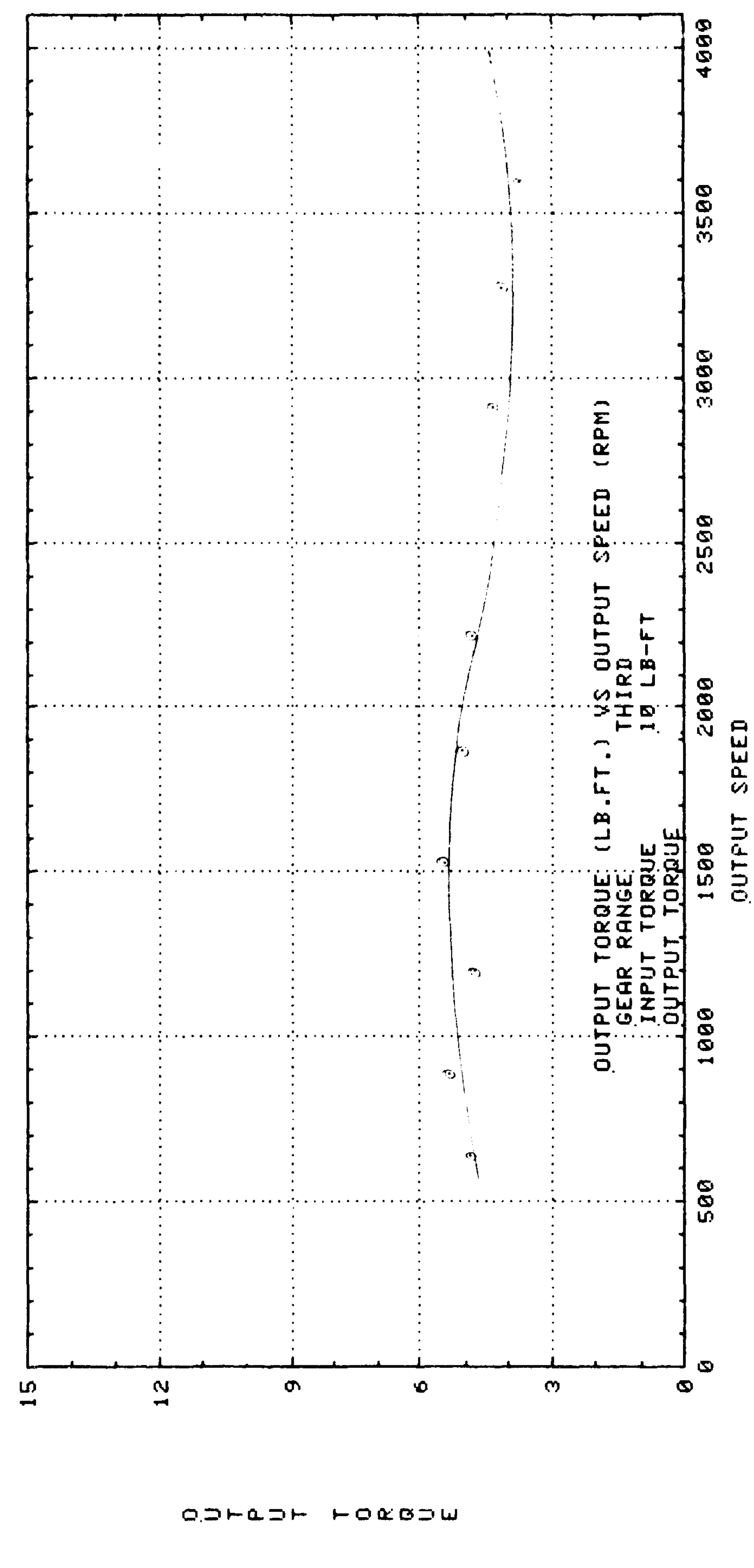
Torque Ratio -vs- Output Speed
Output Torque -vs- Output Speed
Input Speed -vs- Output Speed
Efficiency -vs- Output Speed
Efficiency -vs- Power Out

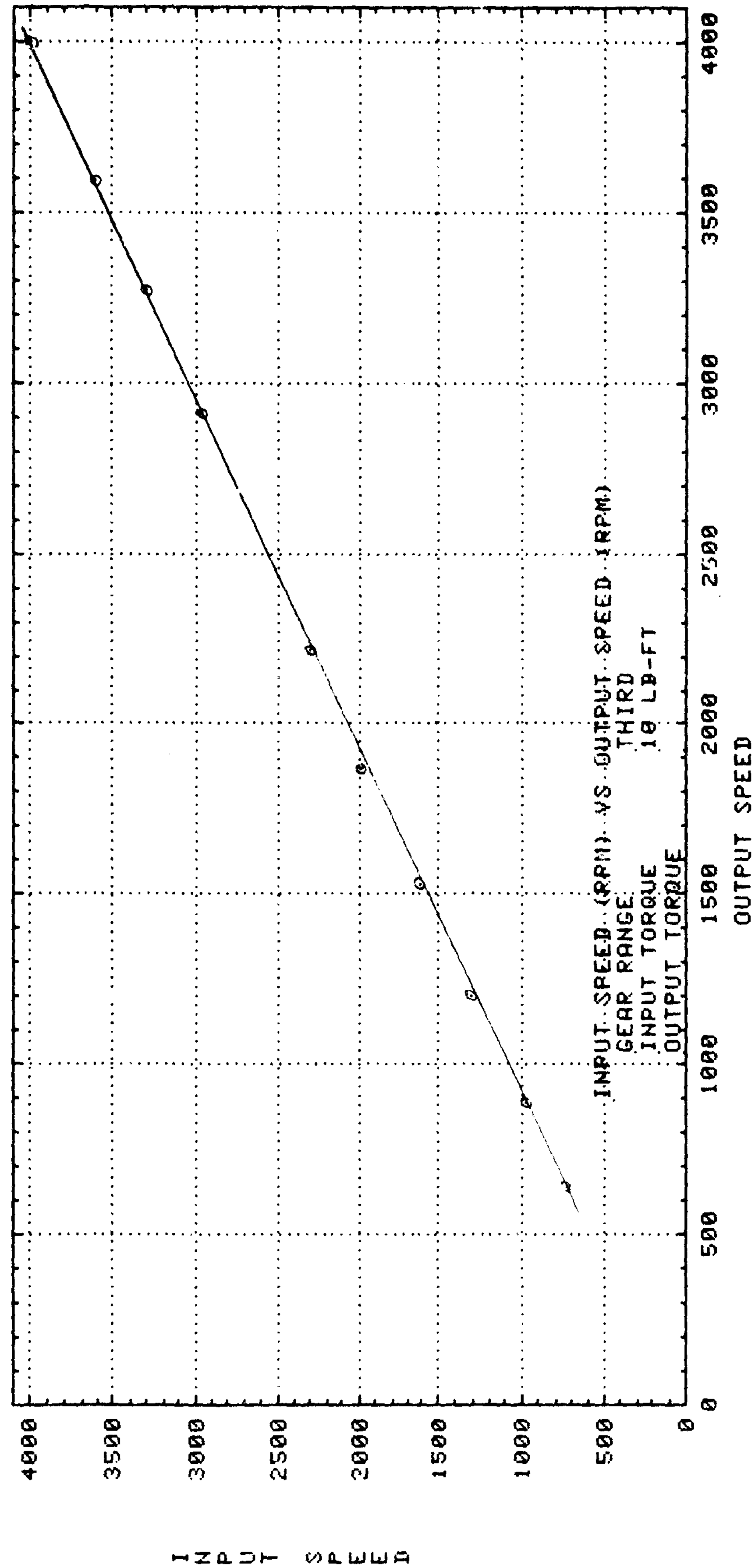


Drive Performance Tests

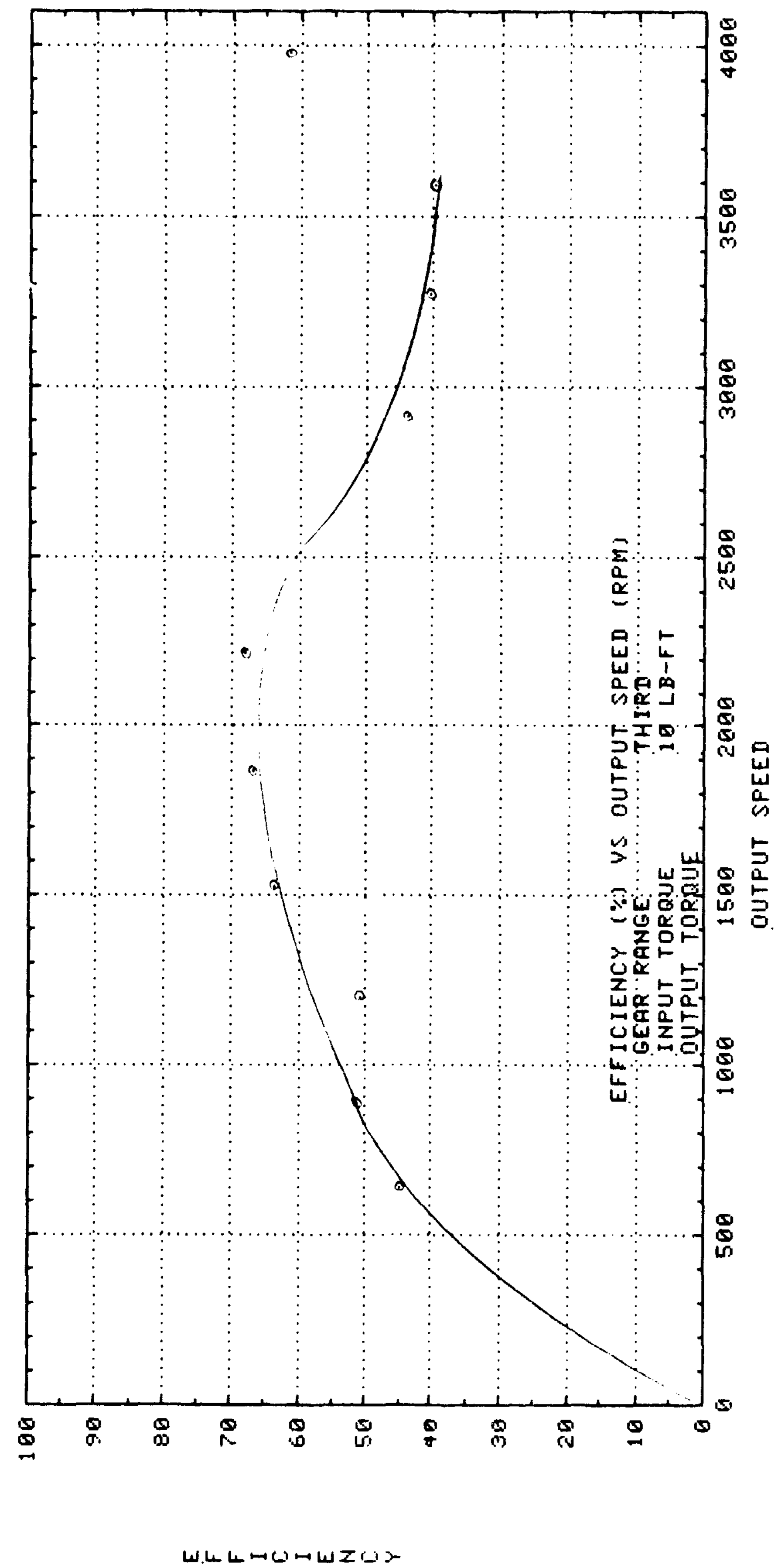


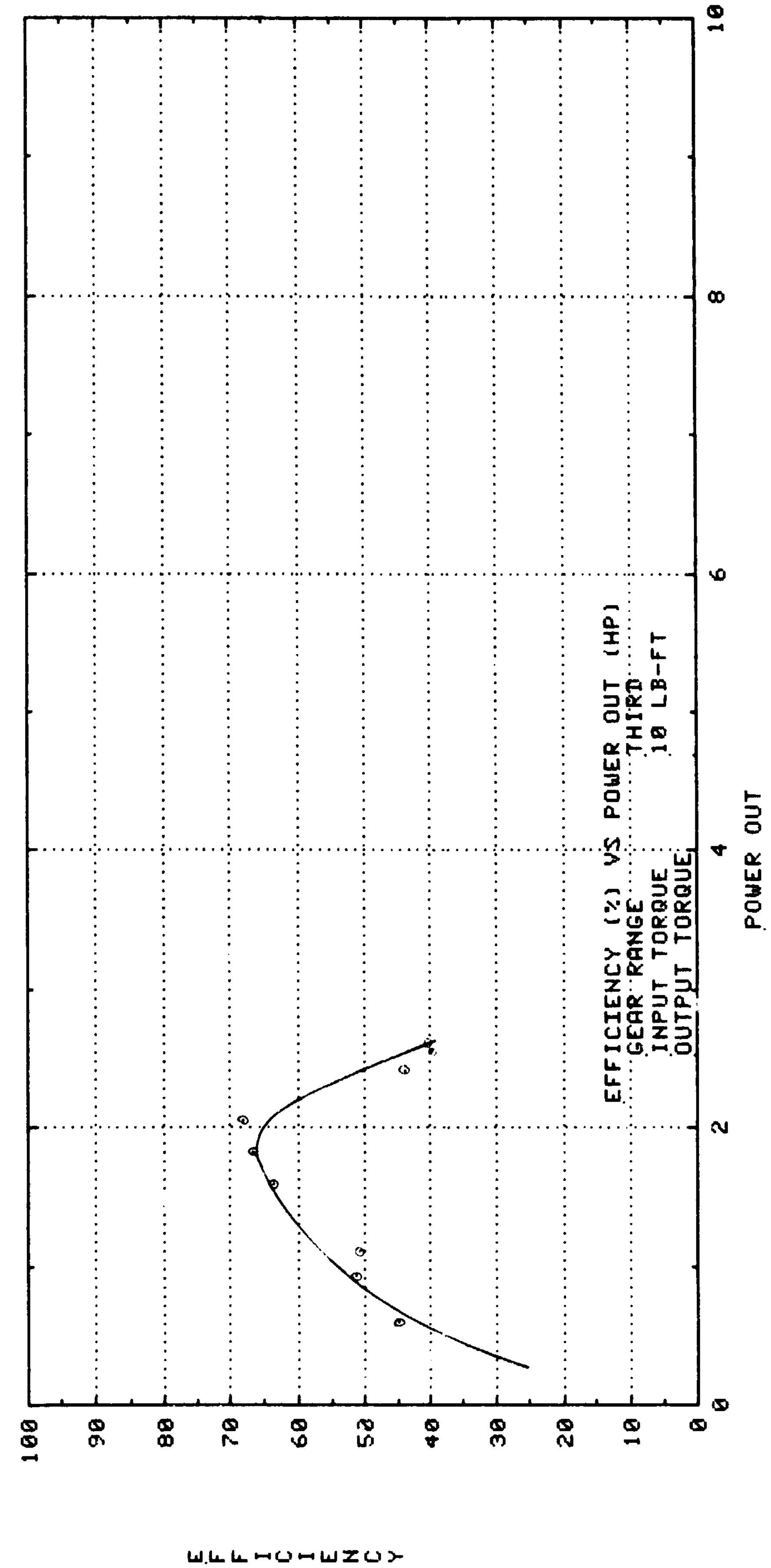
TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 10 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
TORQUE RATIO
0.0
.5
1.0
1.5
2.0
2.5
0
500
1000
1500
2000
2500
3000
3500
4000

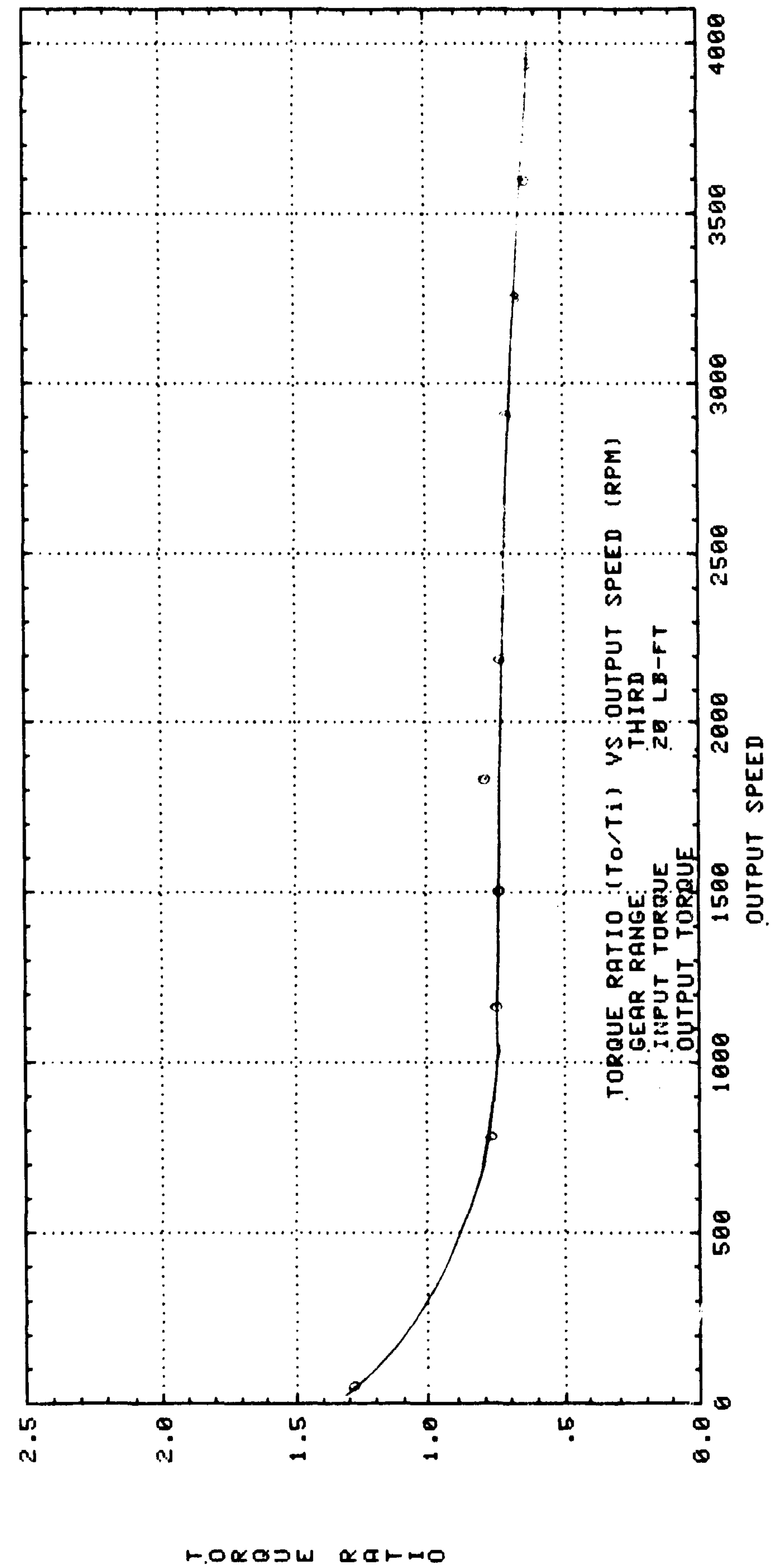

OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 10 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
OUTPUT TORQUE
0
500
1000
1500
2000
2500
3000
3500
4000
0
3
6
9
12
15

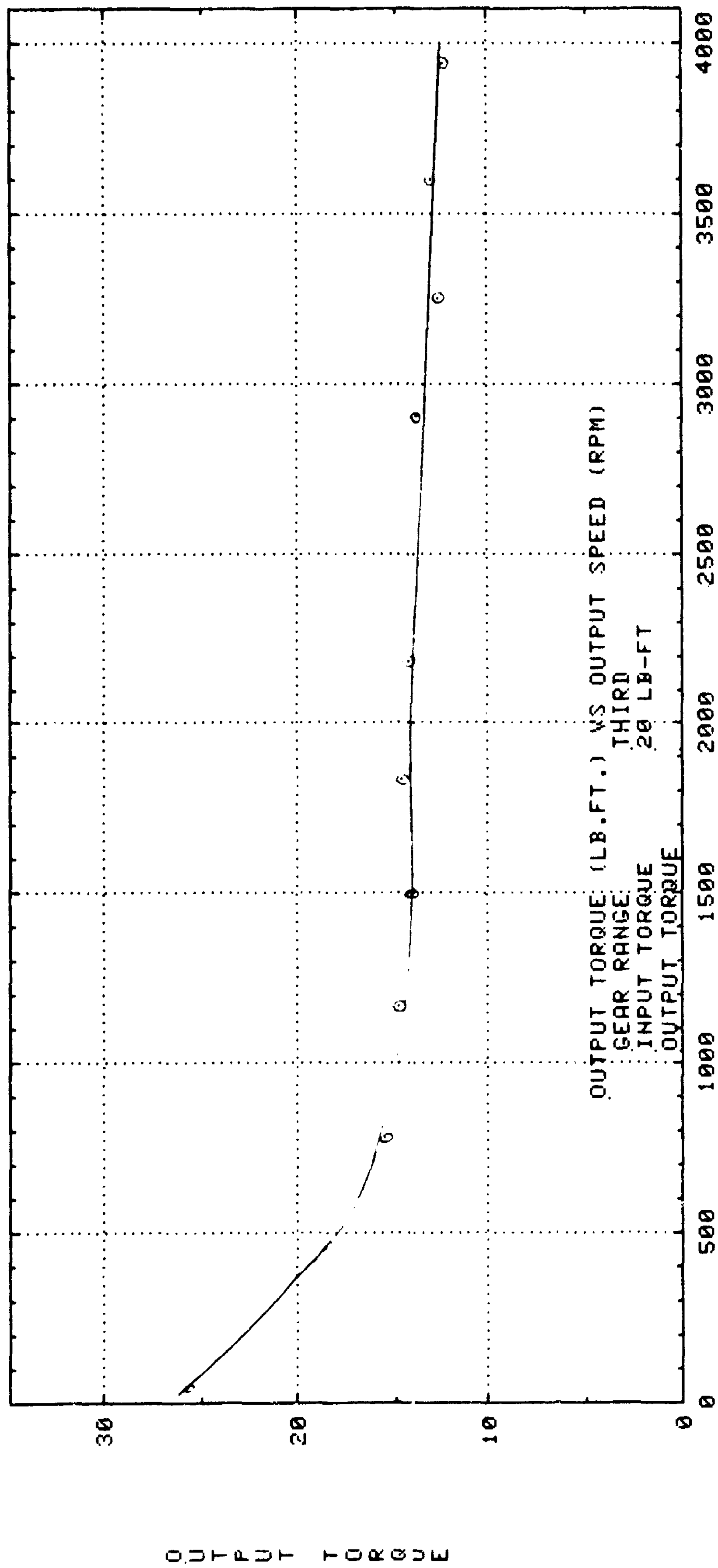


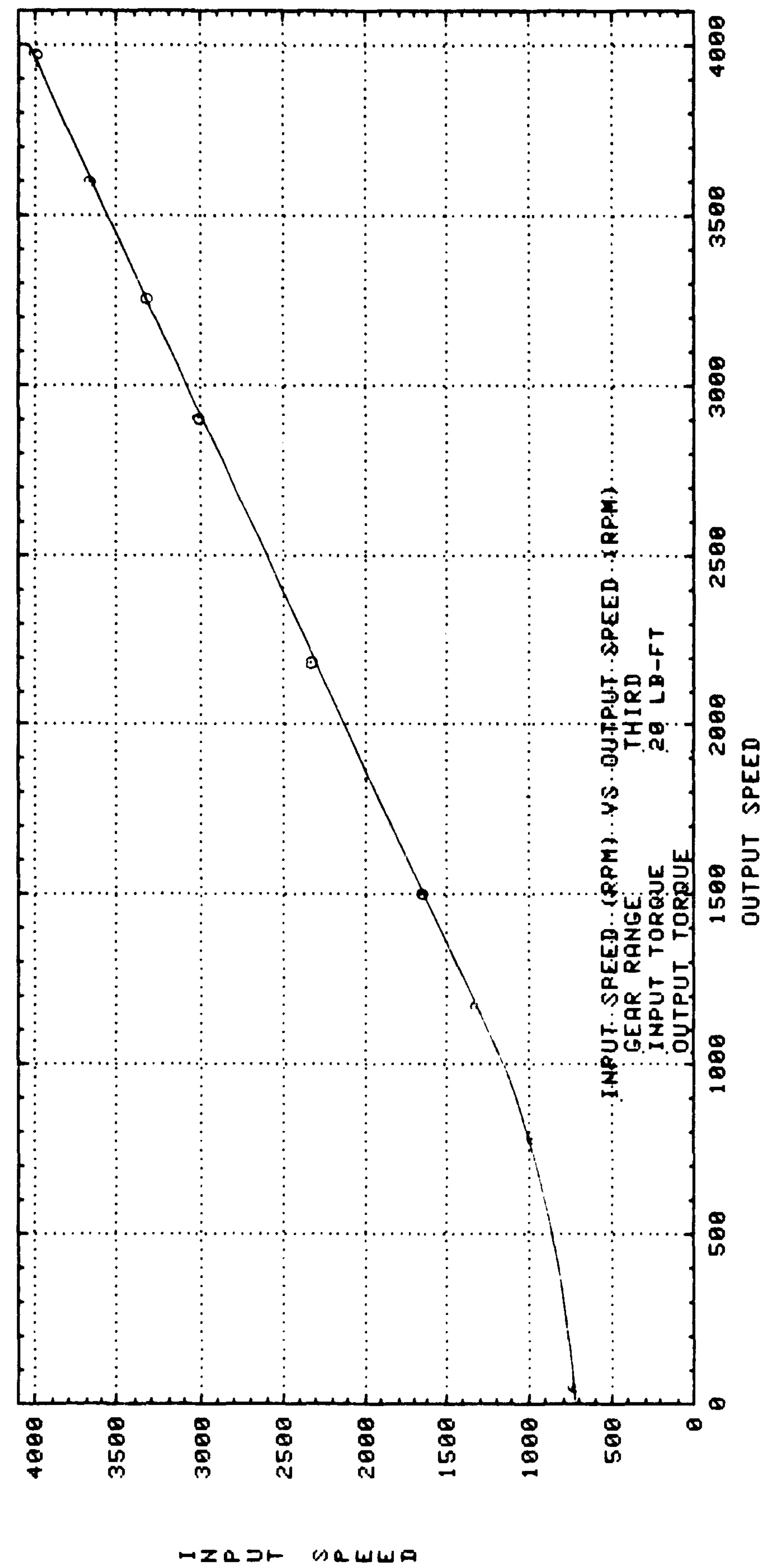
INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 10 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
INPUT SPEED
0 500 1000 1500 2000 2500 3000 3500 4000

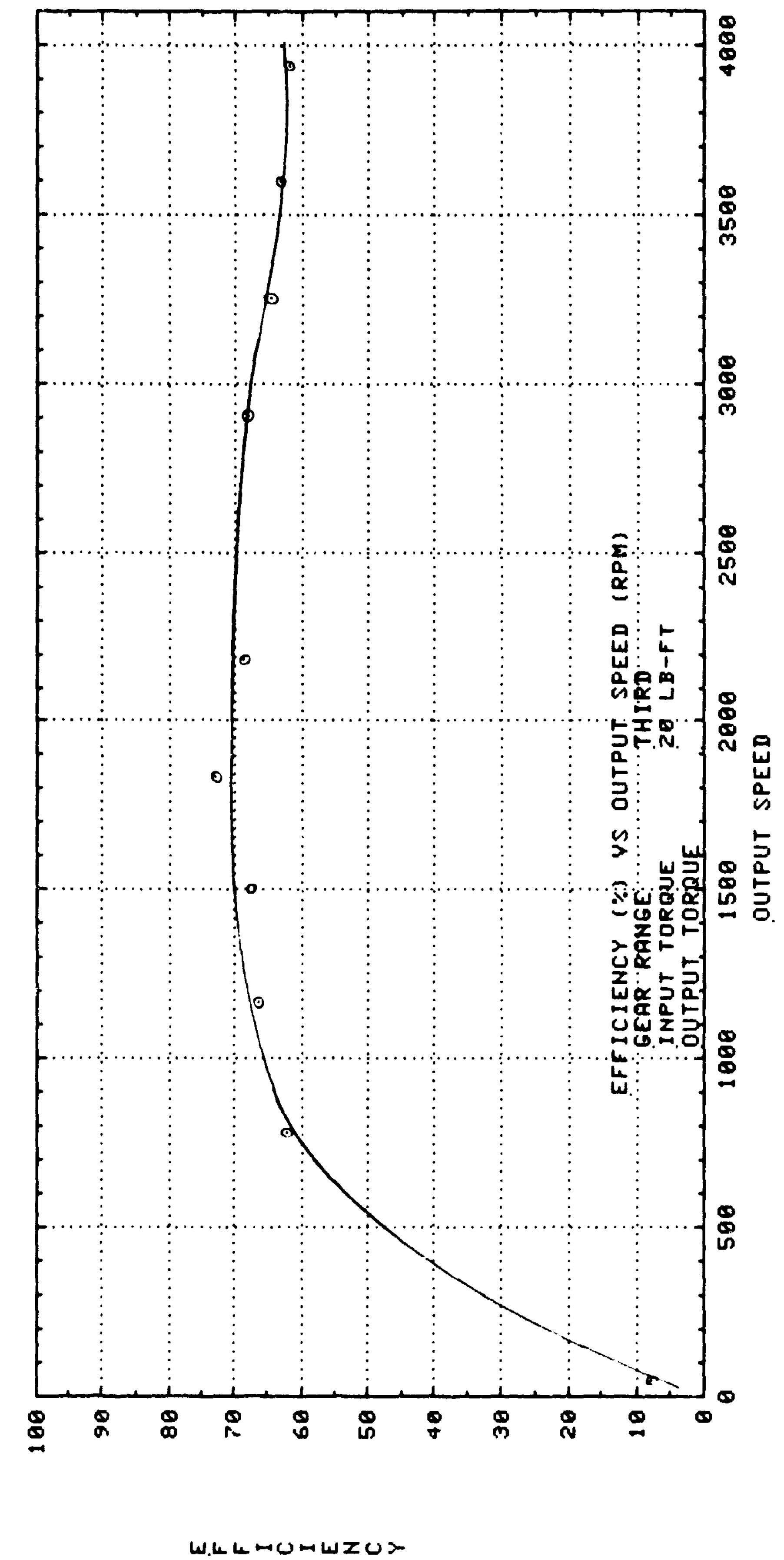

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 10 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
EFFICIENCY
0
500
1000
1500
2000
2500
3000
3500
4000
0
10
20
30
40
50
60
70
80
90
100

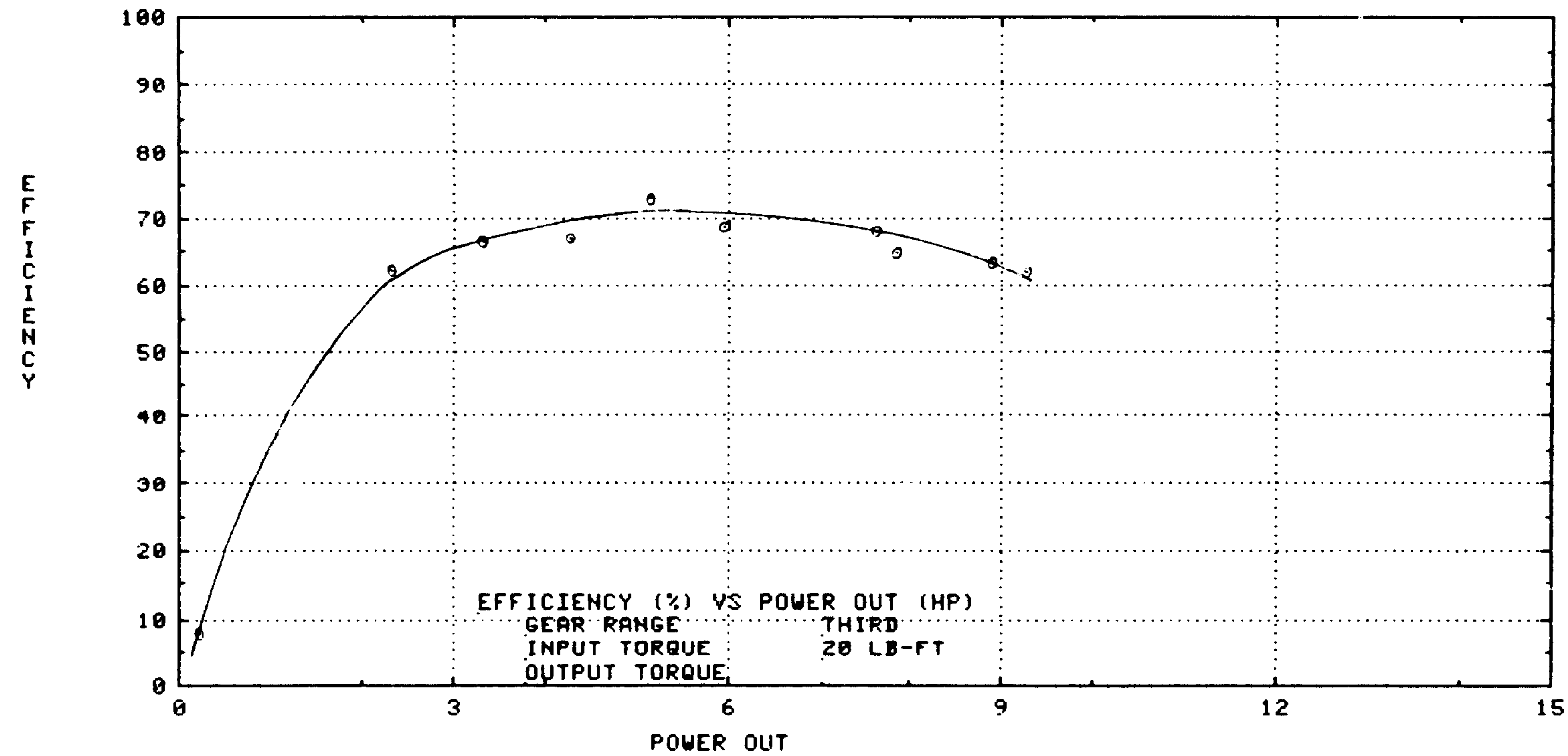

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE 10 LB-FT
OUTPUT TORQUE
POWER OUT
EFFICIENCY
0
10
20
30
40
50
60
70
80
90
100
0
2
4
6
8
10

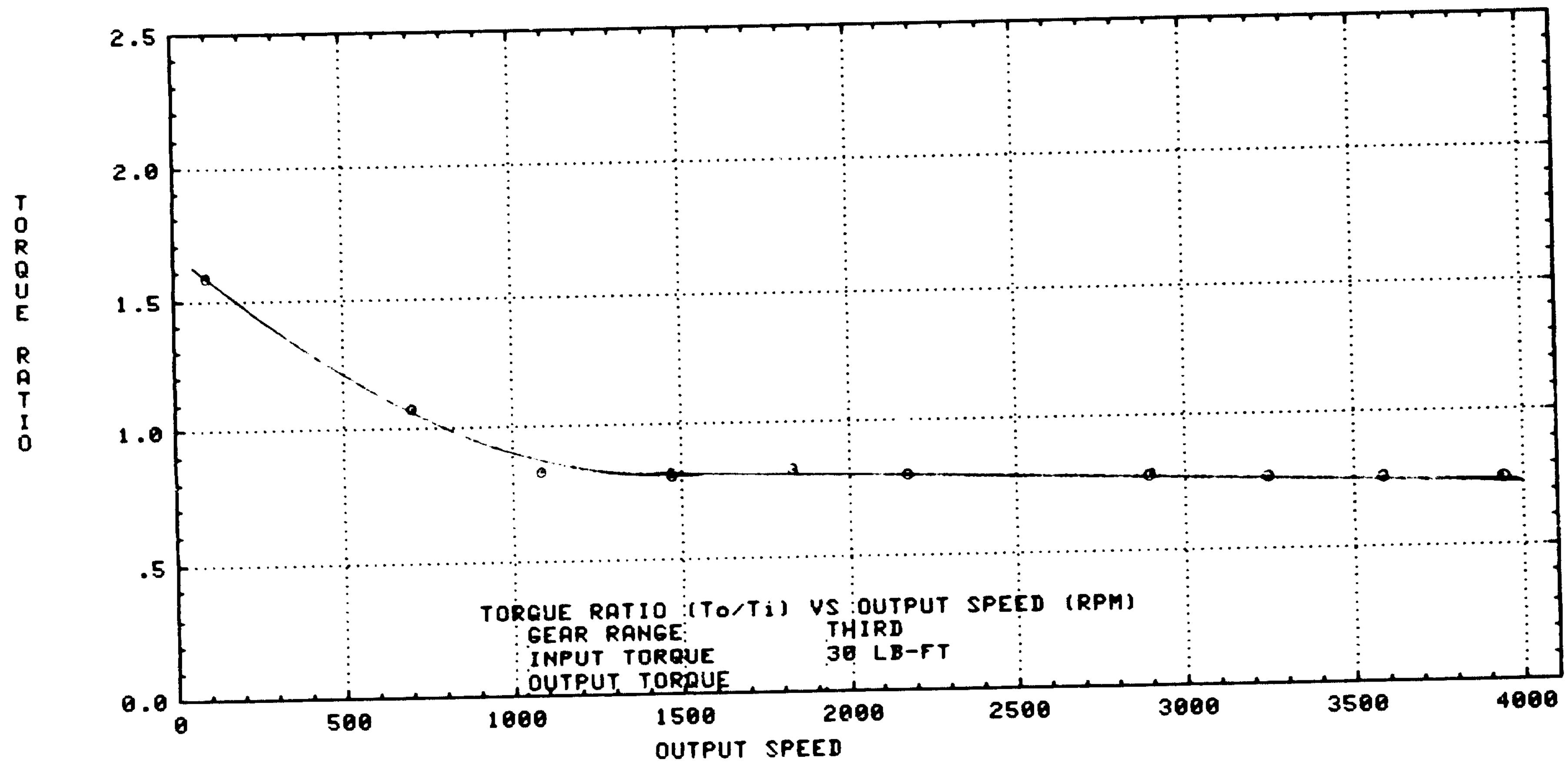

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 20 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
TORQUE RATIO
0 500 1000 1500 2000 2500 3000 3500 4000
0.0 .5 1.0 1.5 2.0 2.5

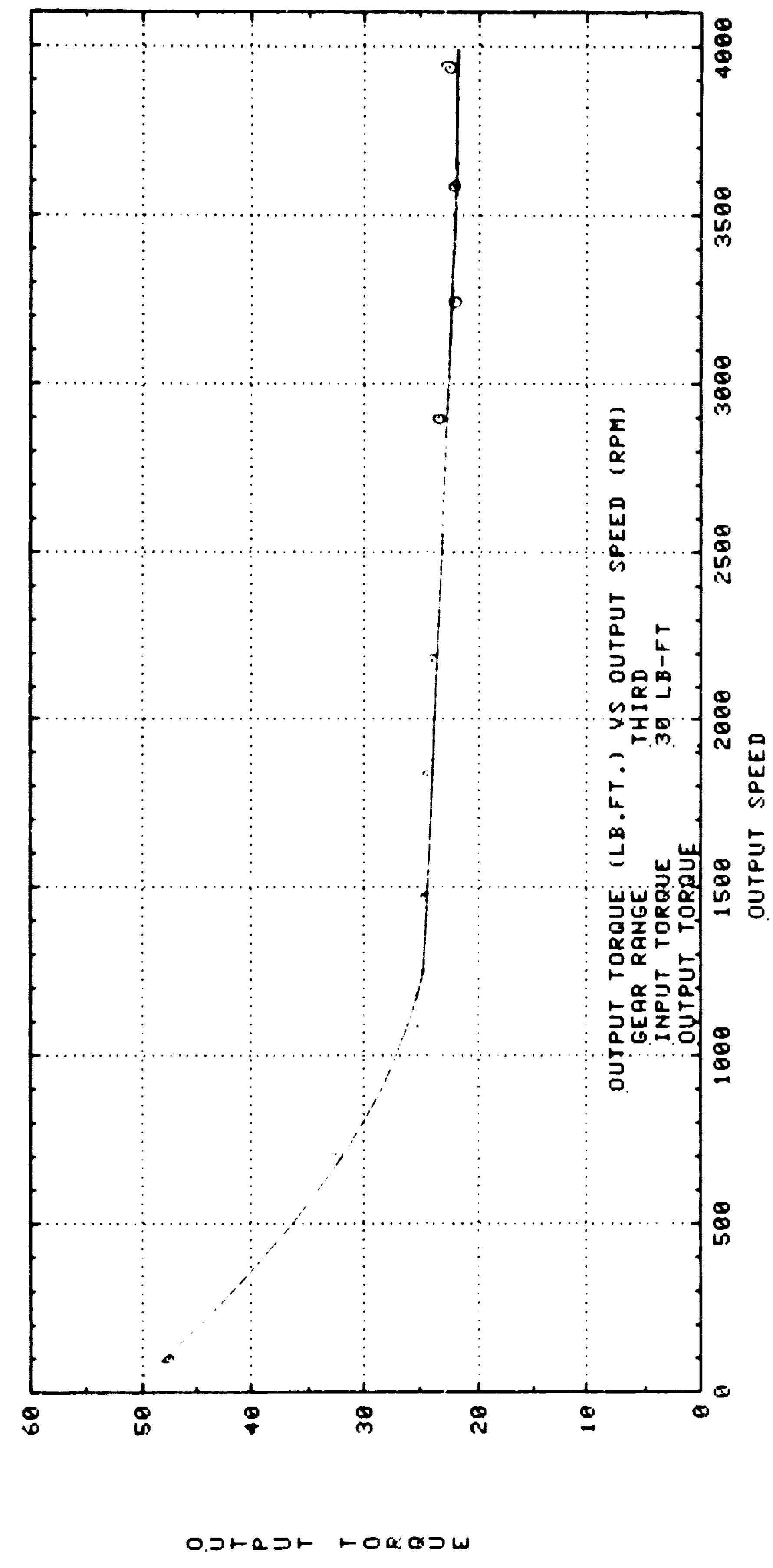

OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 20 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
OUTPUT TORQUE
0
500
1000
1500
2000
2500
3000
3500
4000
0
10
20
30

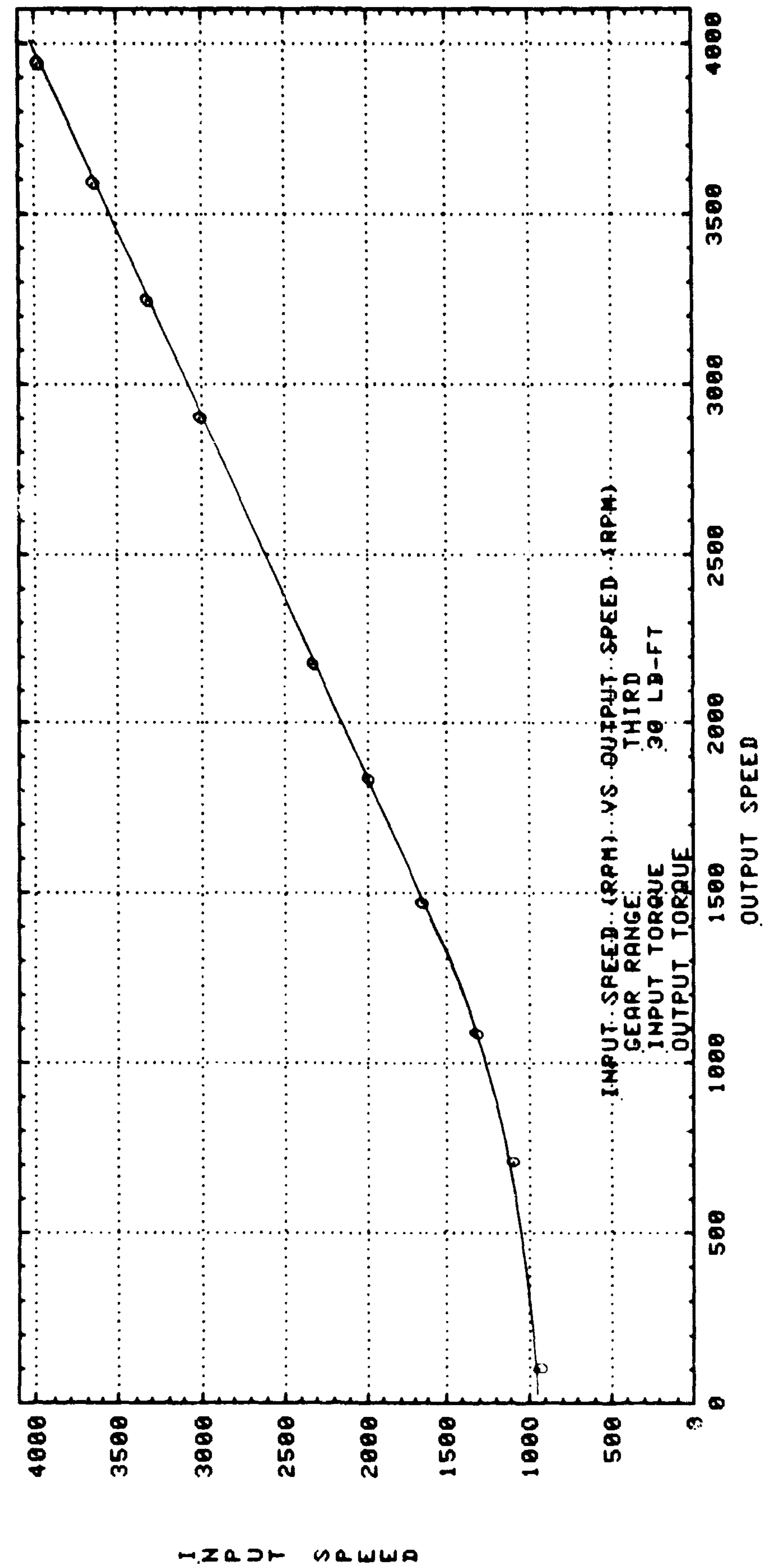

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 20 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

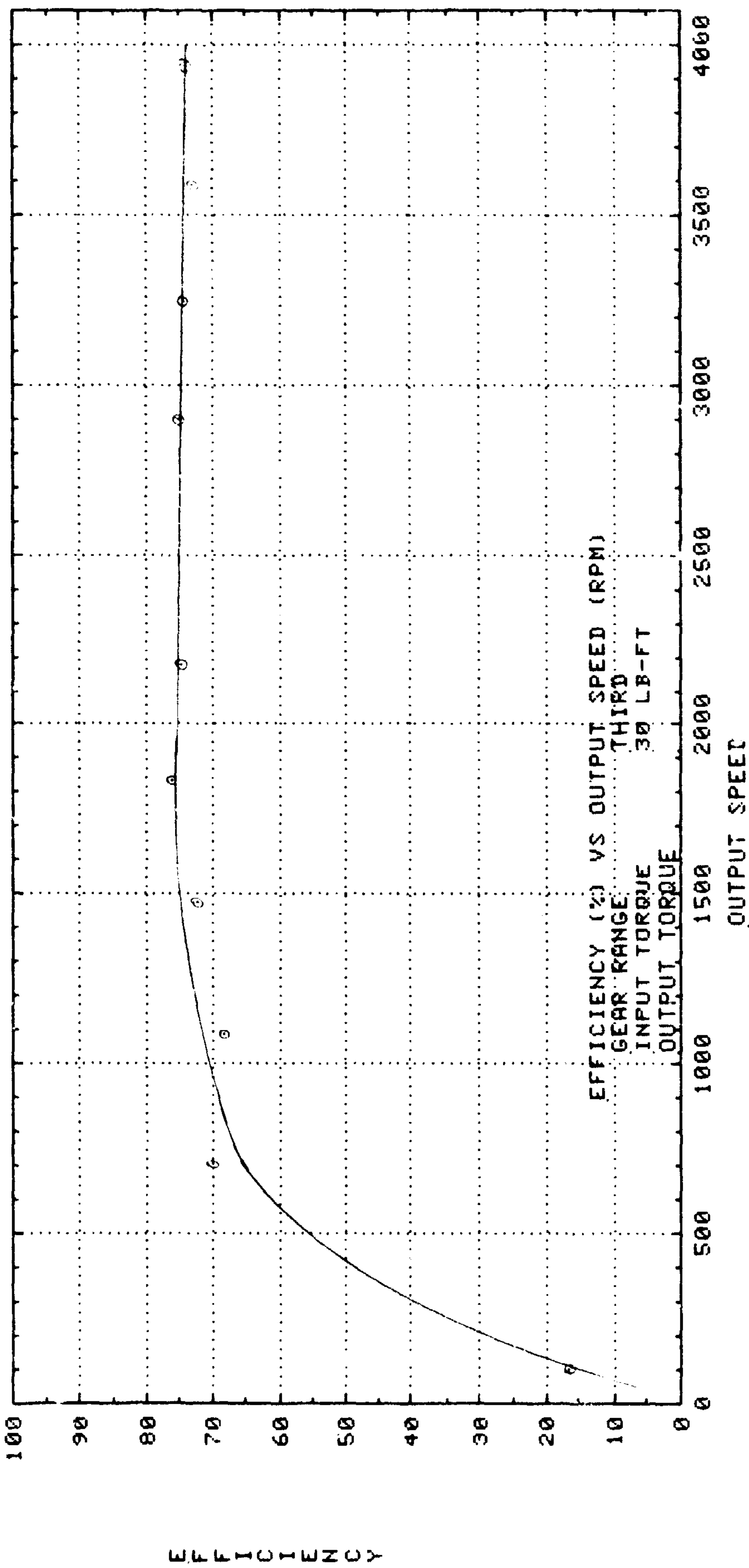

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 20 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
0 500 1000 1500 2000 2500 3000 3500 4000
EFFICIENCY
0 10 20 30 40 50 60 70 80 90 100

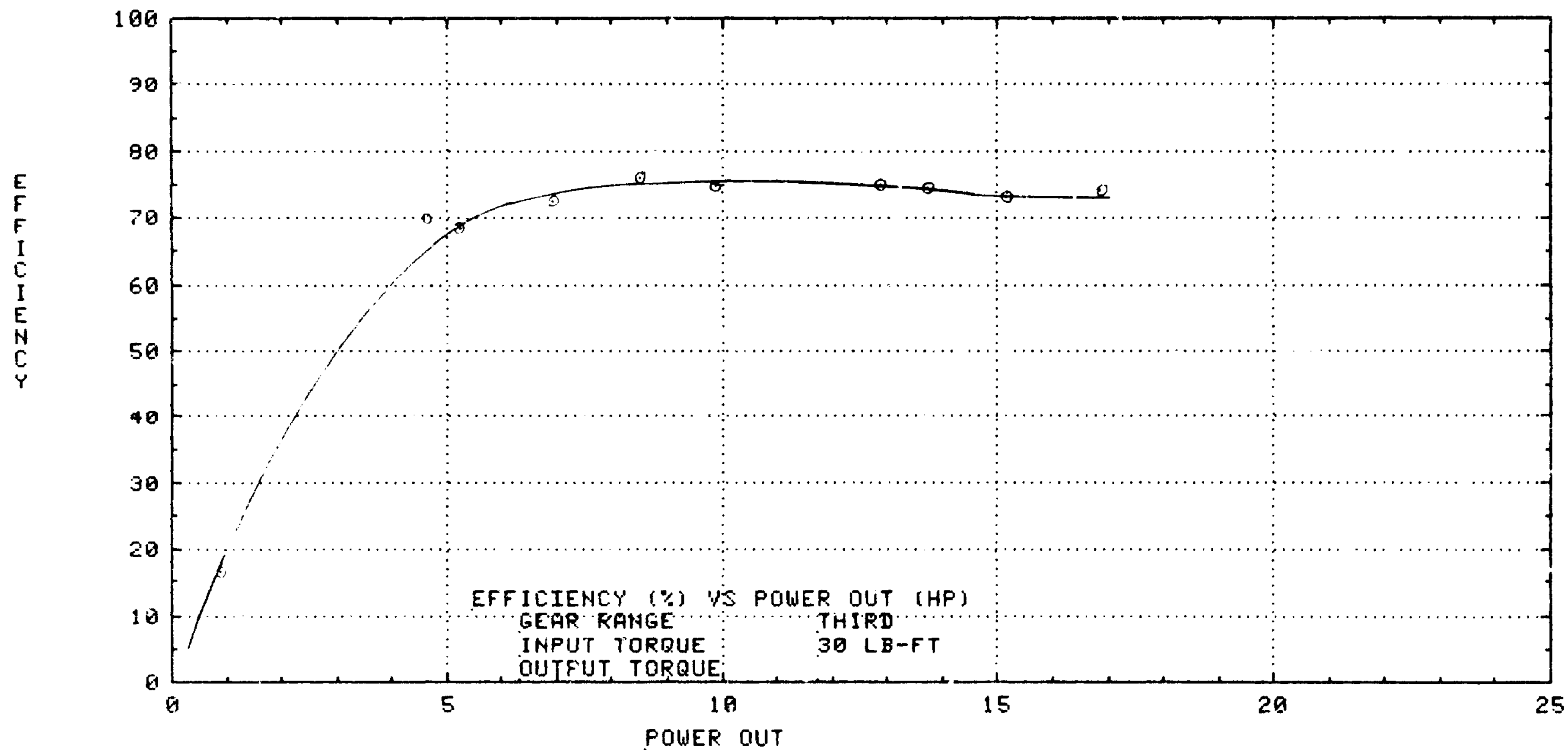

EFFICIENCY
100
90
80
70
60
50
40
30
20
10
0
0
3
6
9
12
15
POWER OUT
EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE 20 LB-FT
OUTPUT TORQUE

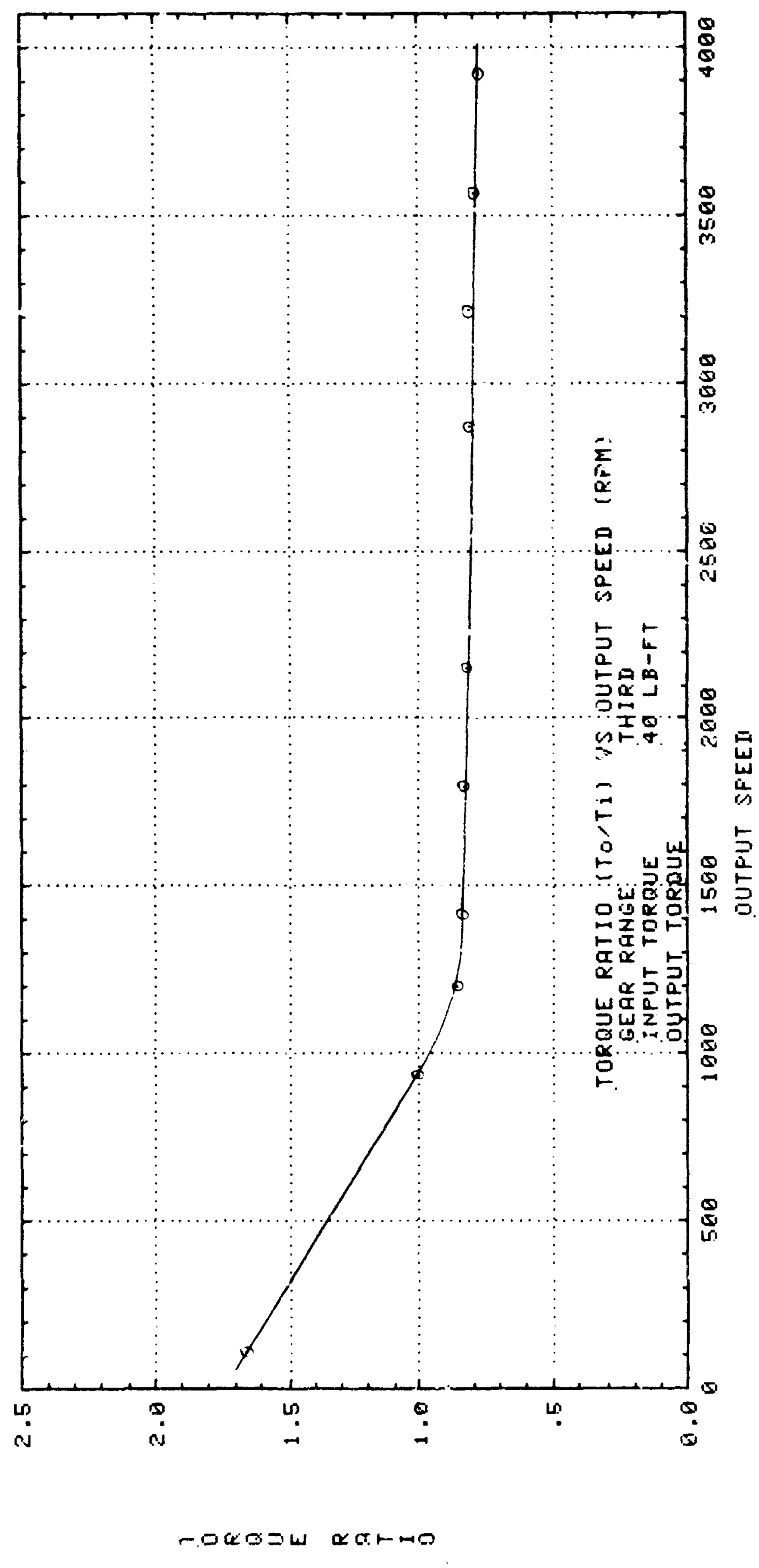

TORQUE RATIO
2.5
2.0
1.5
1.0
.5
0.0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 30 LB-FT
OUTPUT TORQUE

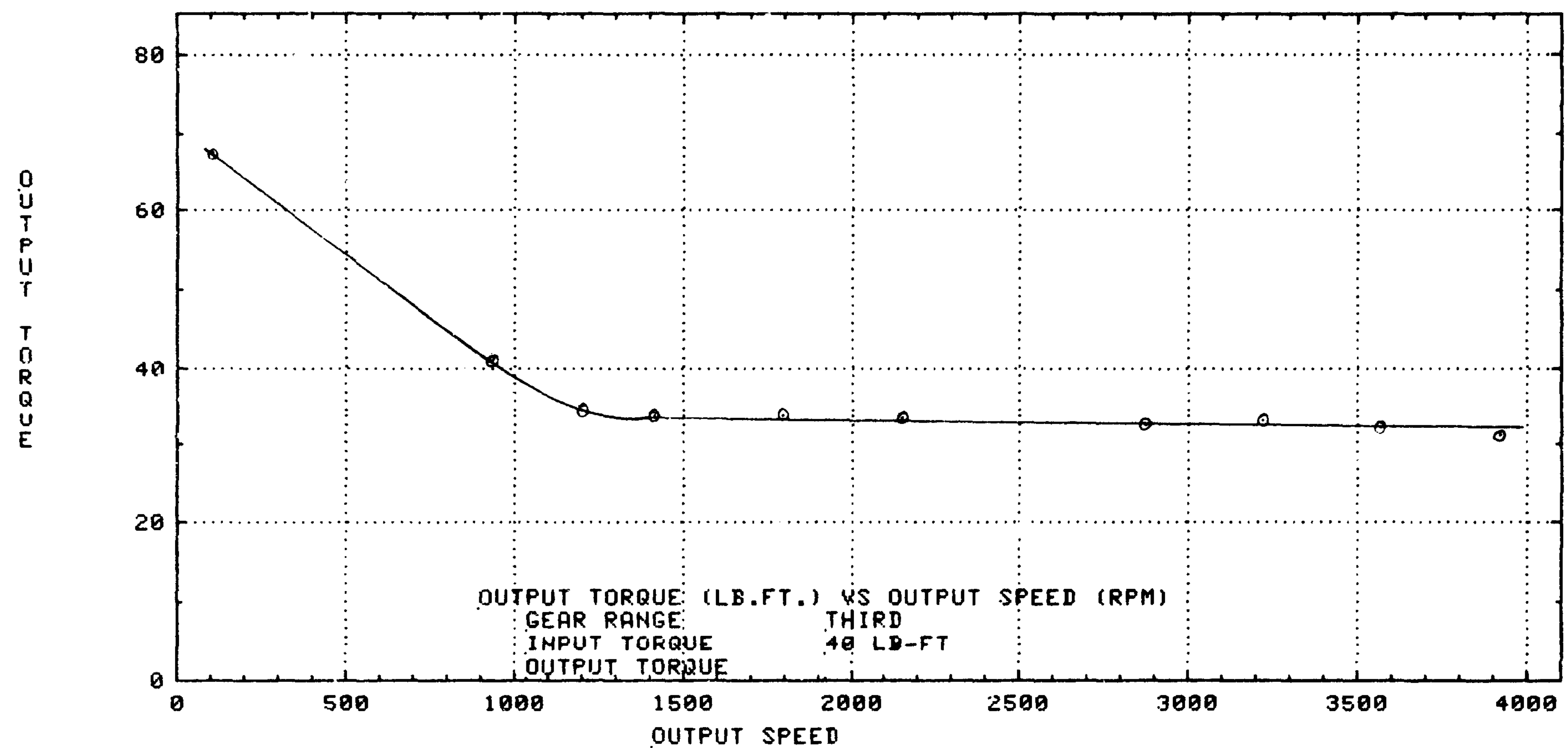

OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 30 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
OUTPUT TORQUE
0
500
1000
1500
2000
2500
3000
3500
4000
0
10
20
30
40
50
60

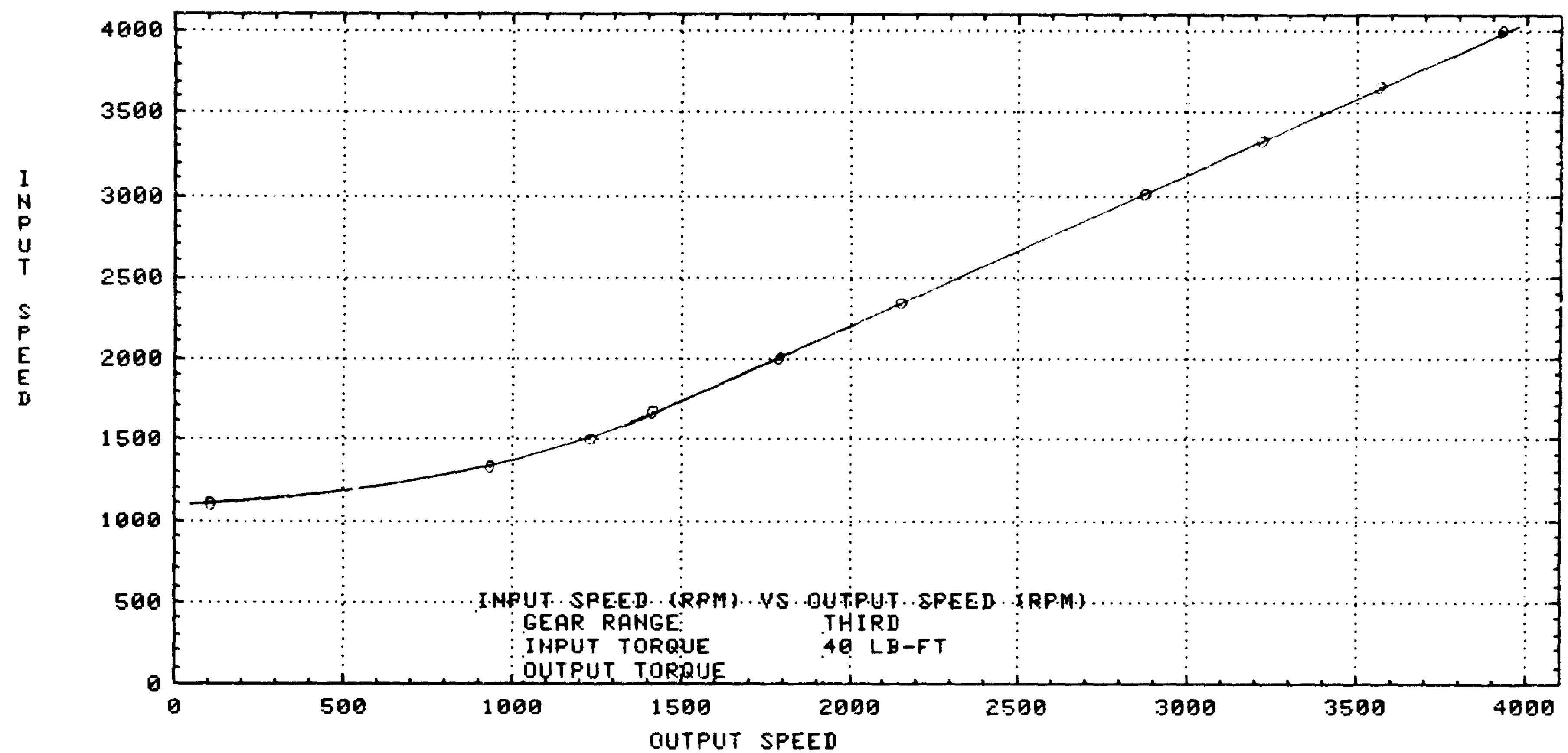

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 30 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000


EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 30 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
EFFICIENCY
0 500 1000 1500 2000 2500 3000 3500 4000
0 10 20 30 40 50 60 70 80 90 100

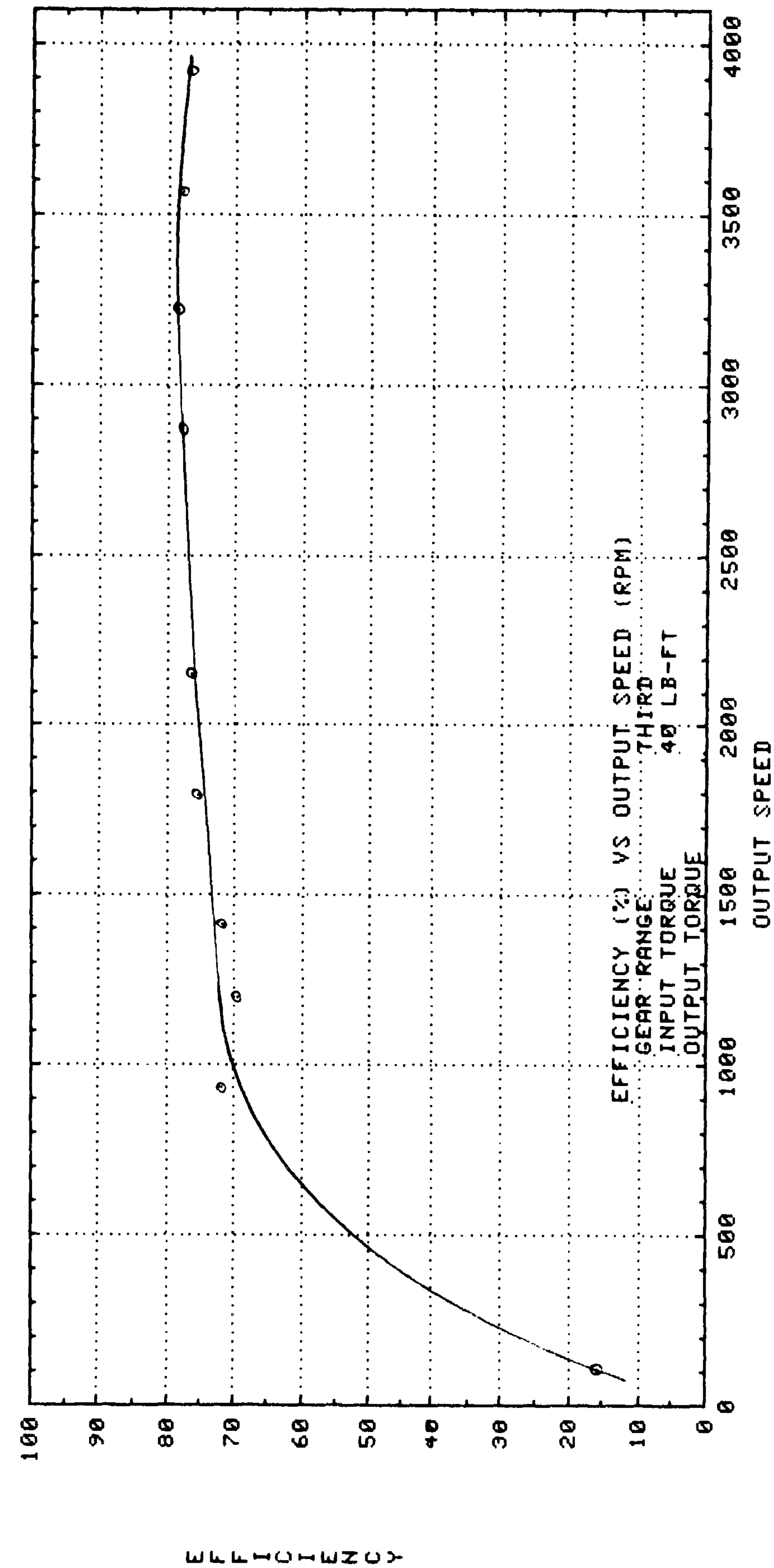

EFFICIENCY
100
90
80
70
60
50
40
30
20
10
0
EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE 30 LB-FT
OUTPUT TORQUE
0
5
10
15
20
25
POWER OUT

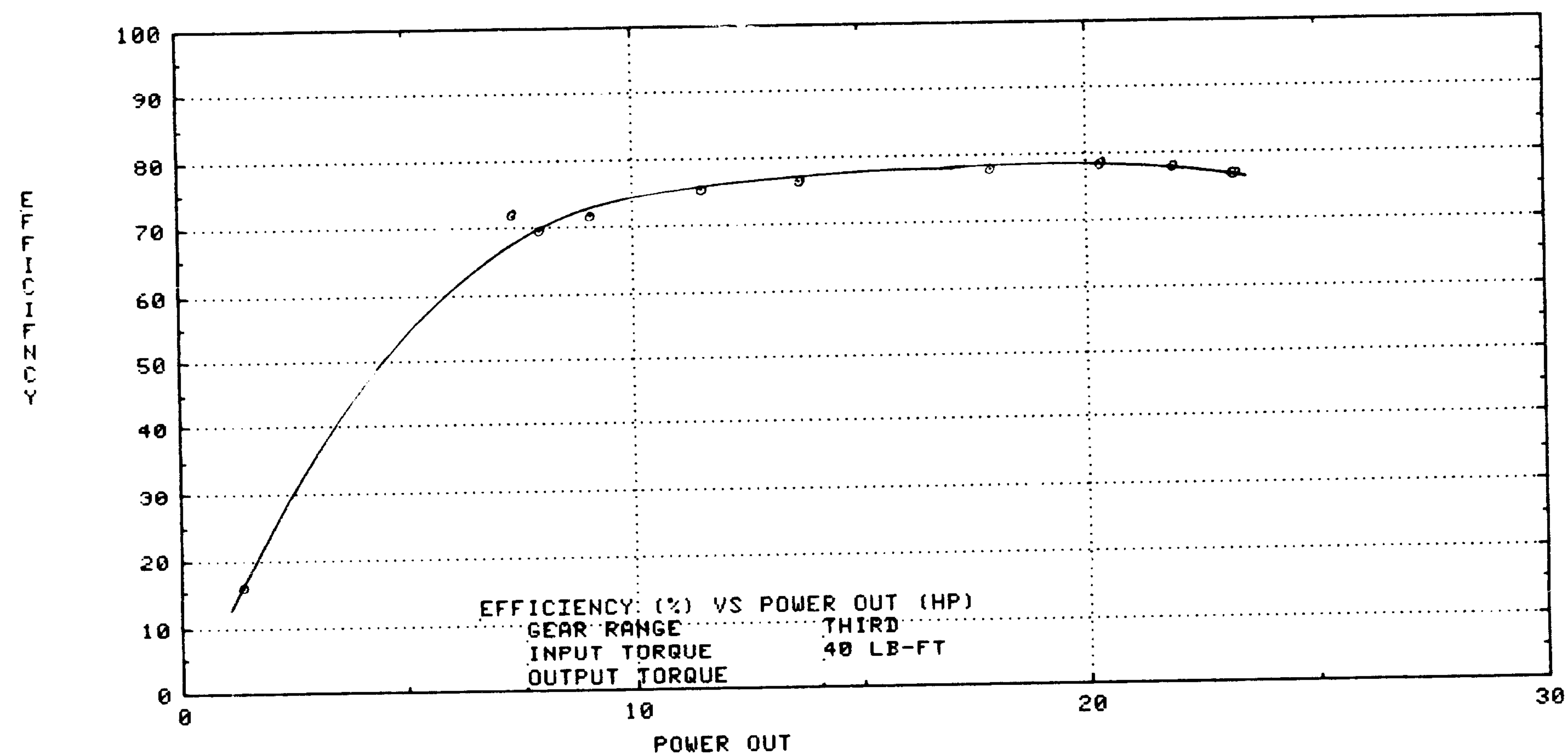

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 40 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
TORQUE RATIO
0.0 .5 1.0 1.5 2.0 2.5
0 500 1000 1500 2000 2500 3000 3500 4000

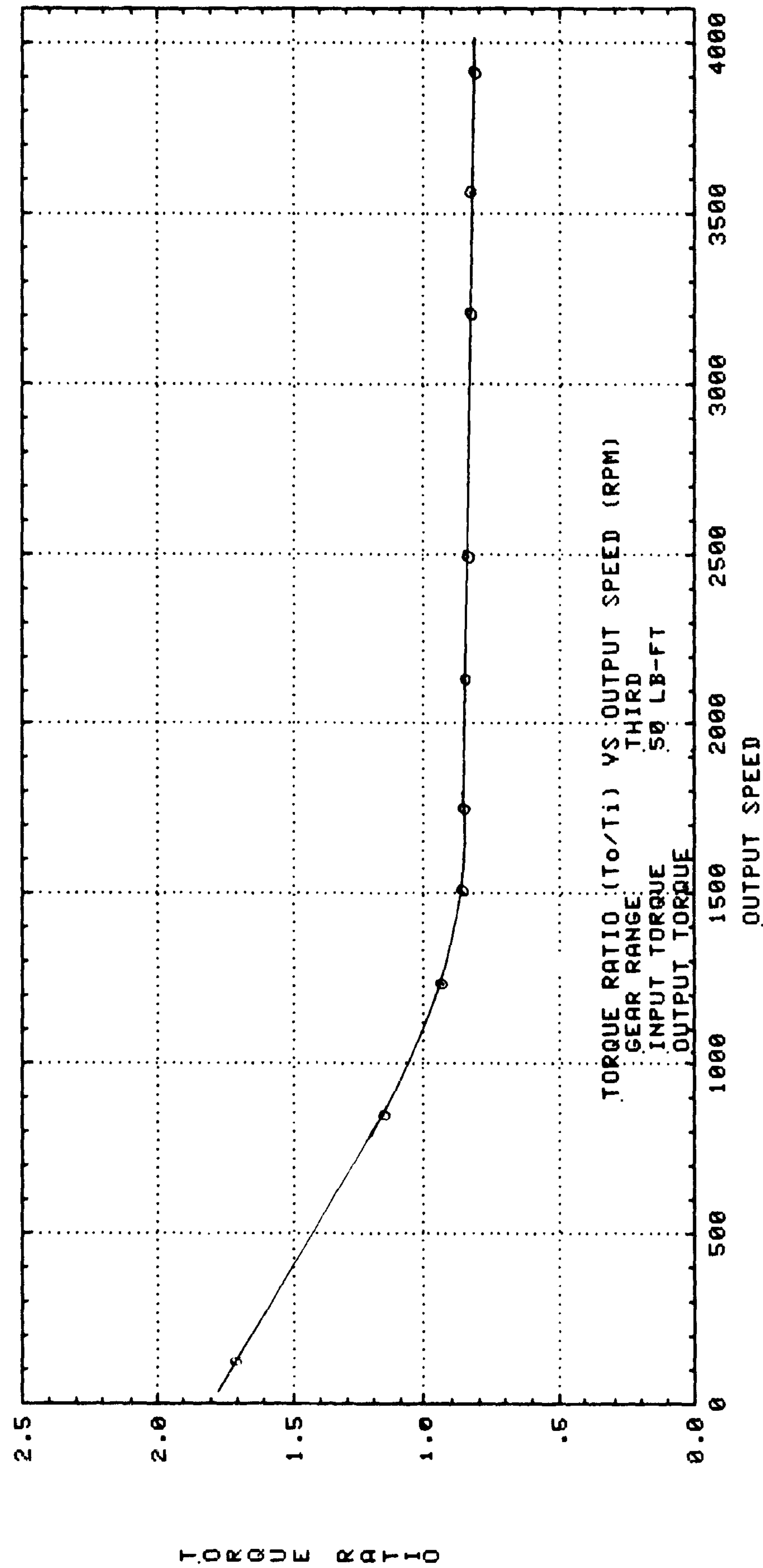

OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 40 LB-FT
OUTPUT TORQUE
OUTPUT TORQUE
OUTPUT SPEED
0
20
40
60
80
0
500
1000
1500
2000
2500
3000
3500
4000

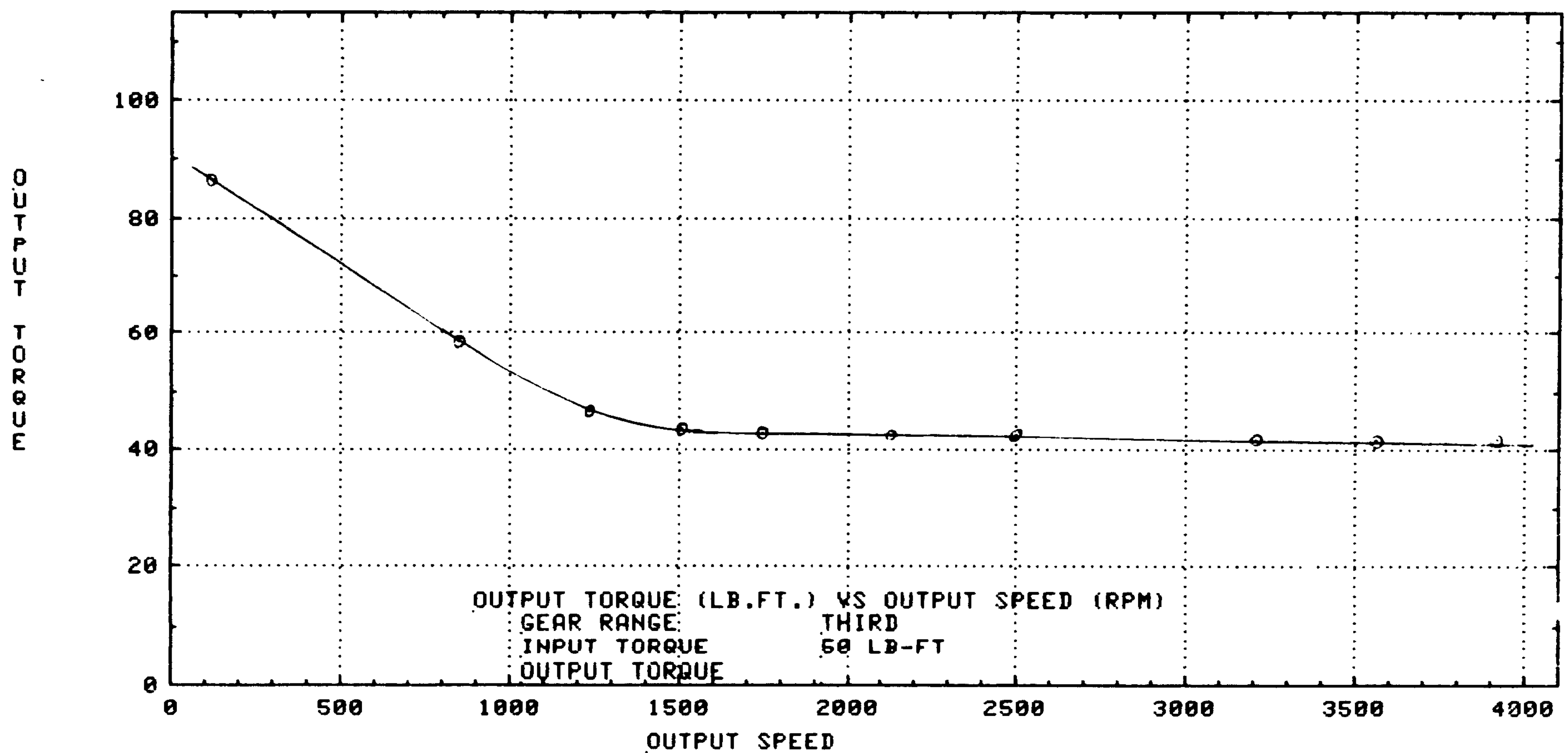


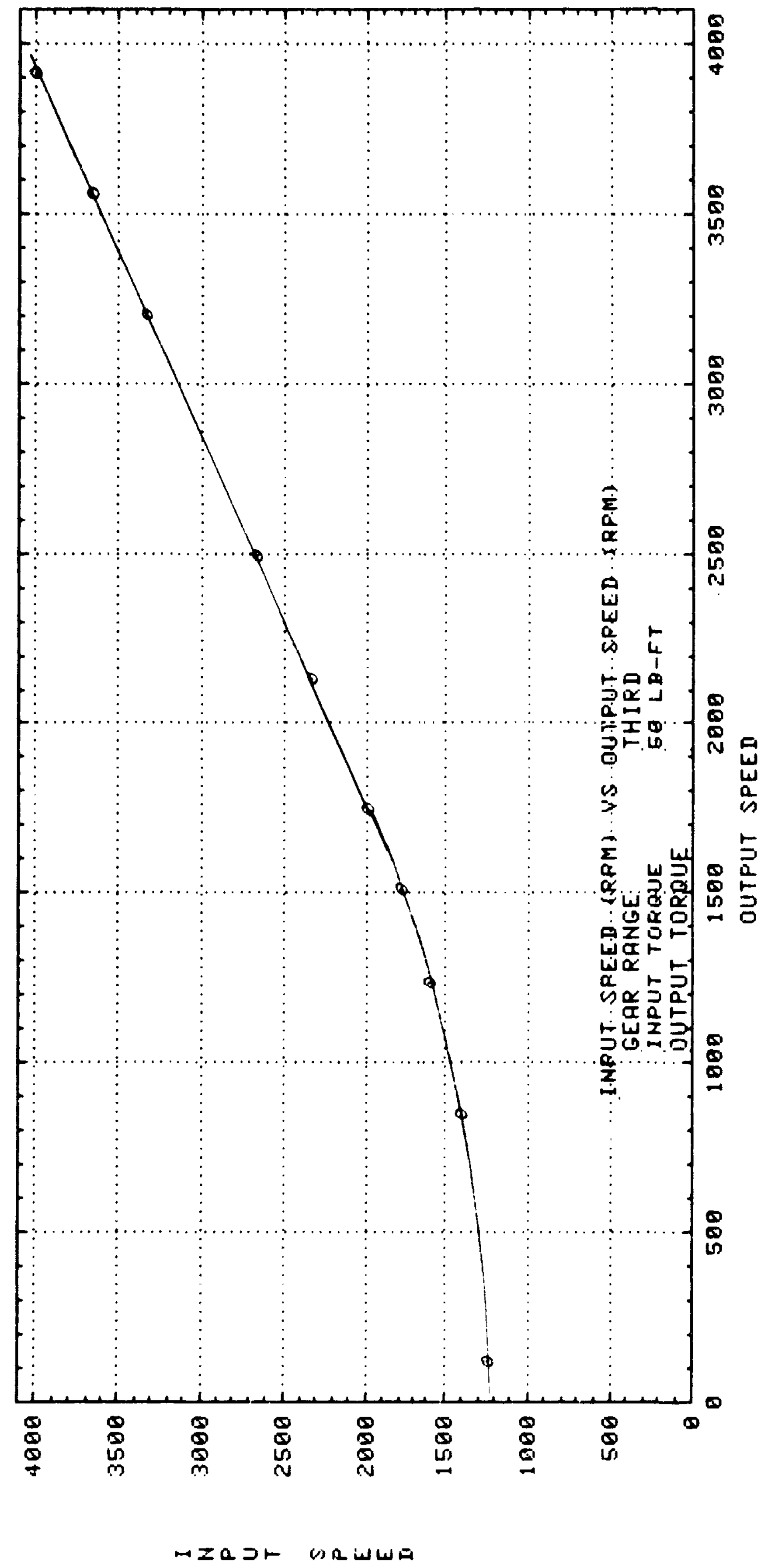
INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 40 LB-FT
OUTPUT TORQUE
INPUT SPEED
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000


EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 40 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
EFFICIENCY
0 500 1000 1500 2000 2500 3000 3500 4000
0 10 20 30 40 50 60 70 80 90 100

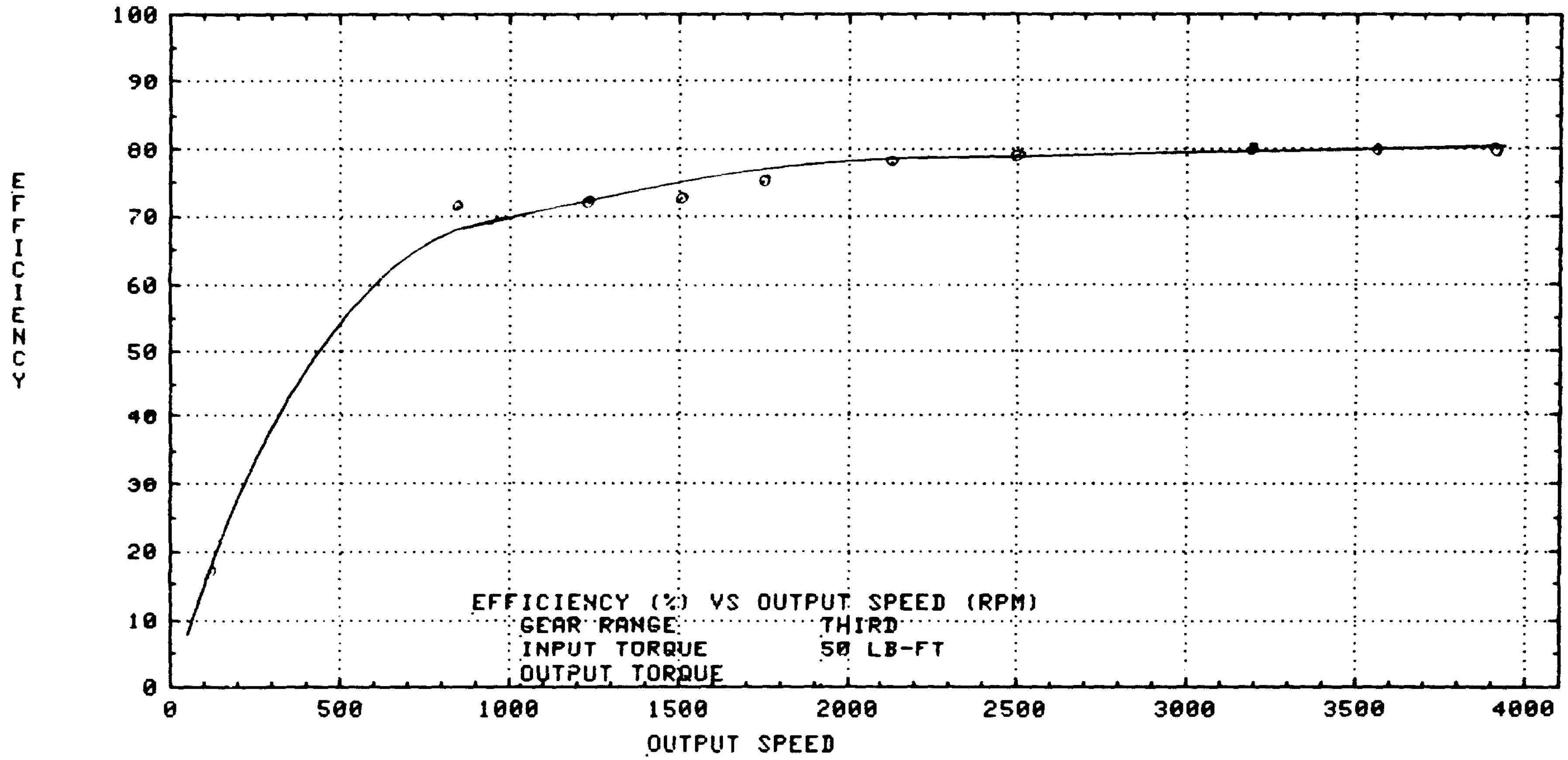

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE 40 LB-FT
OUTPUT TORQUE
EFFICIENCY
POWER OUT
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30

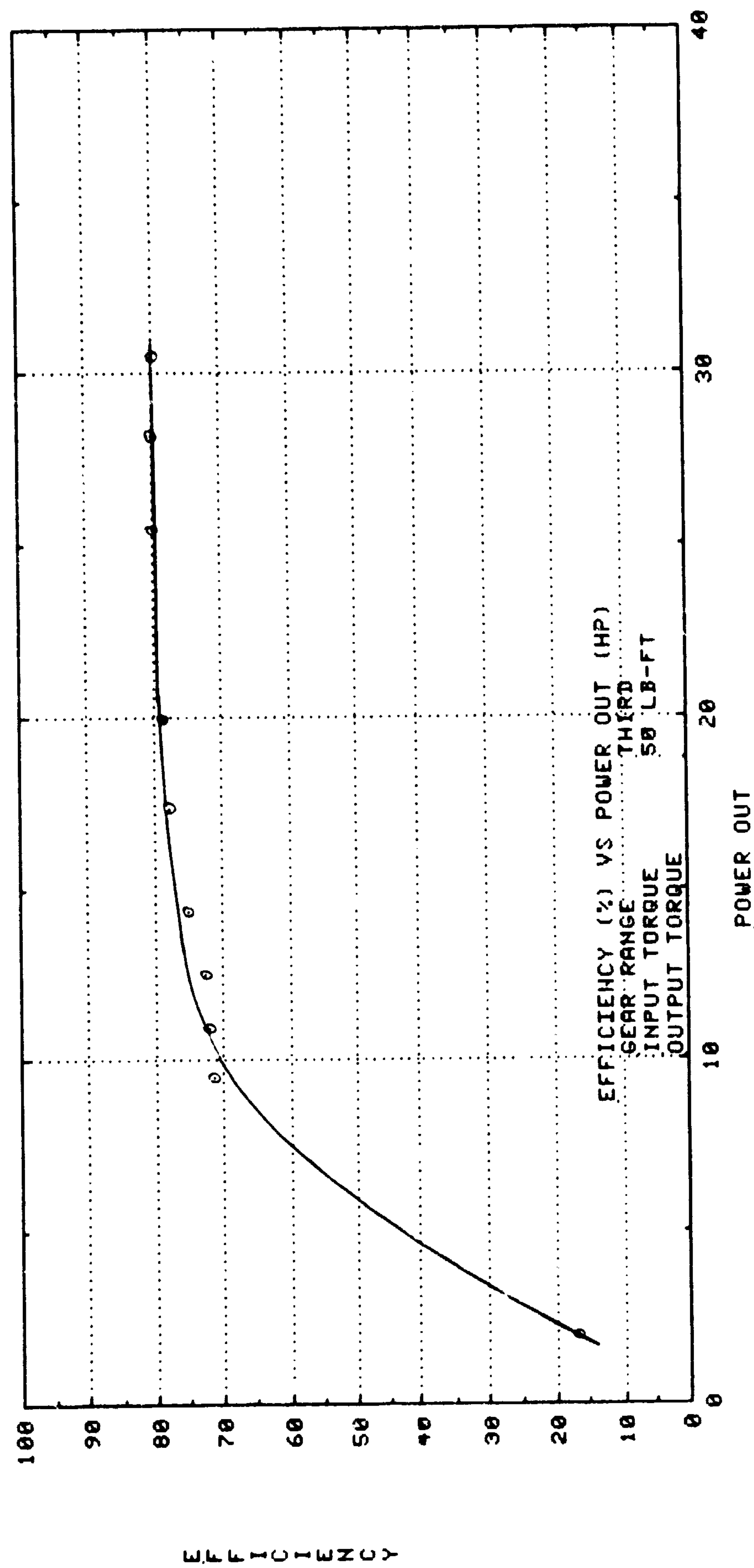

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 50 LB-FT
OUTPUT TORQUE
TORQUE RATIO
OUTPUT SPEED
0.0
.5
1.0
1.5
2.0
2.5
0
500
1000
1500
2000
2500
3000
3500
4000


OUTPUT TORQUE
100
80
60
40
20
0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 50 LB-FT
OUTPUT TORQUE

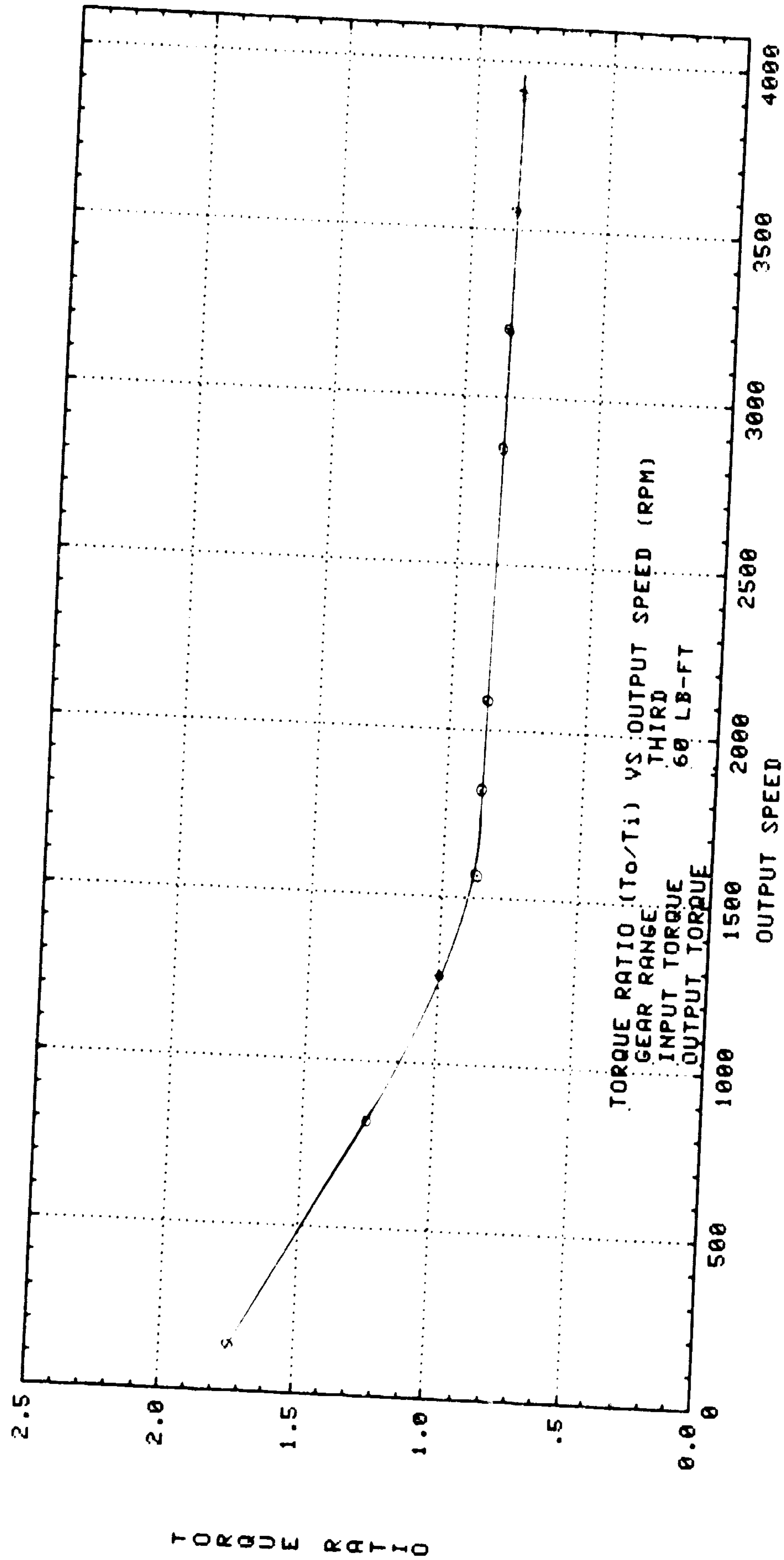


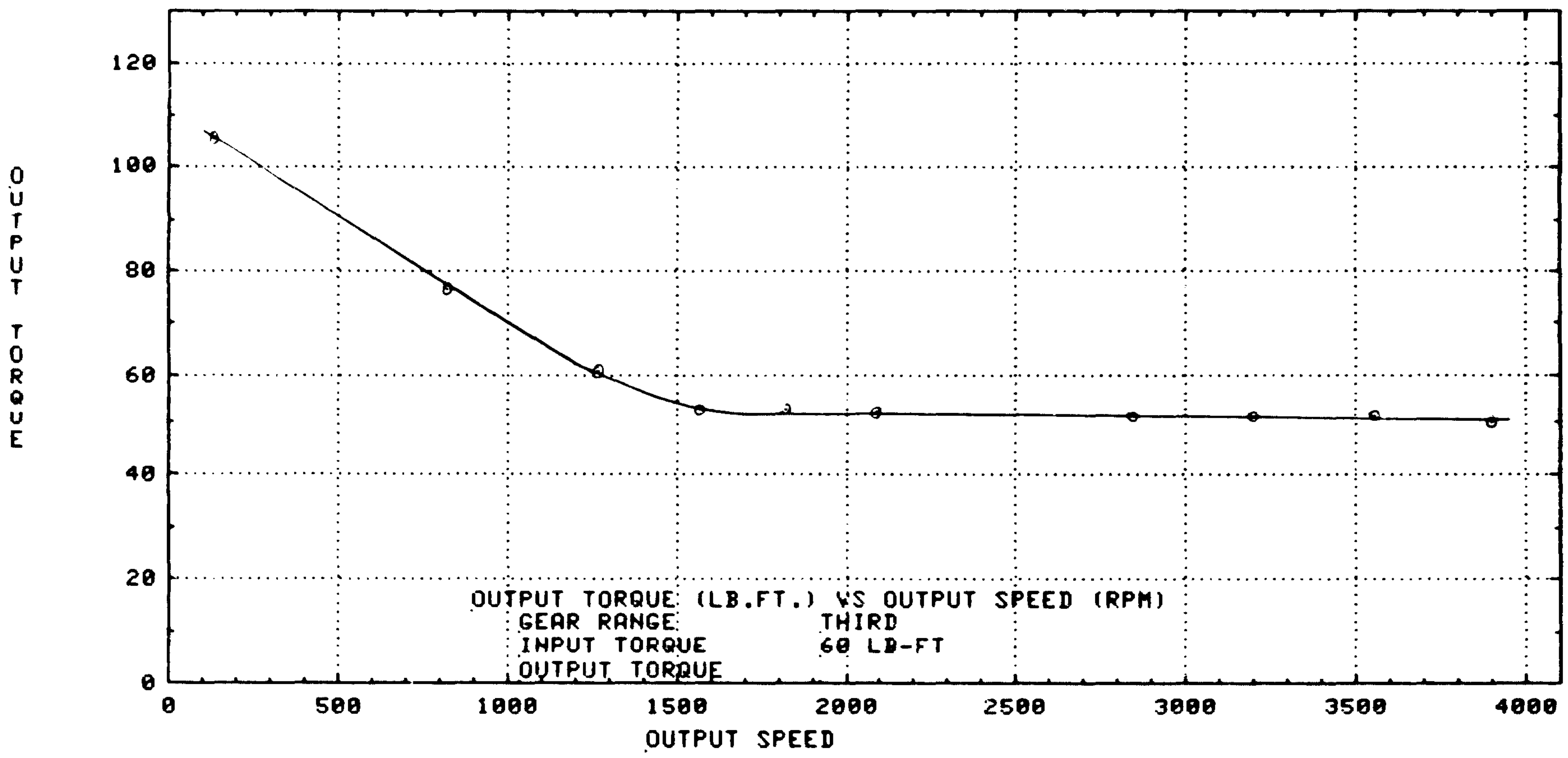
INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 50 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

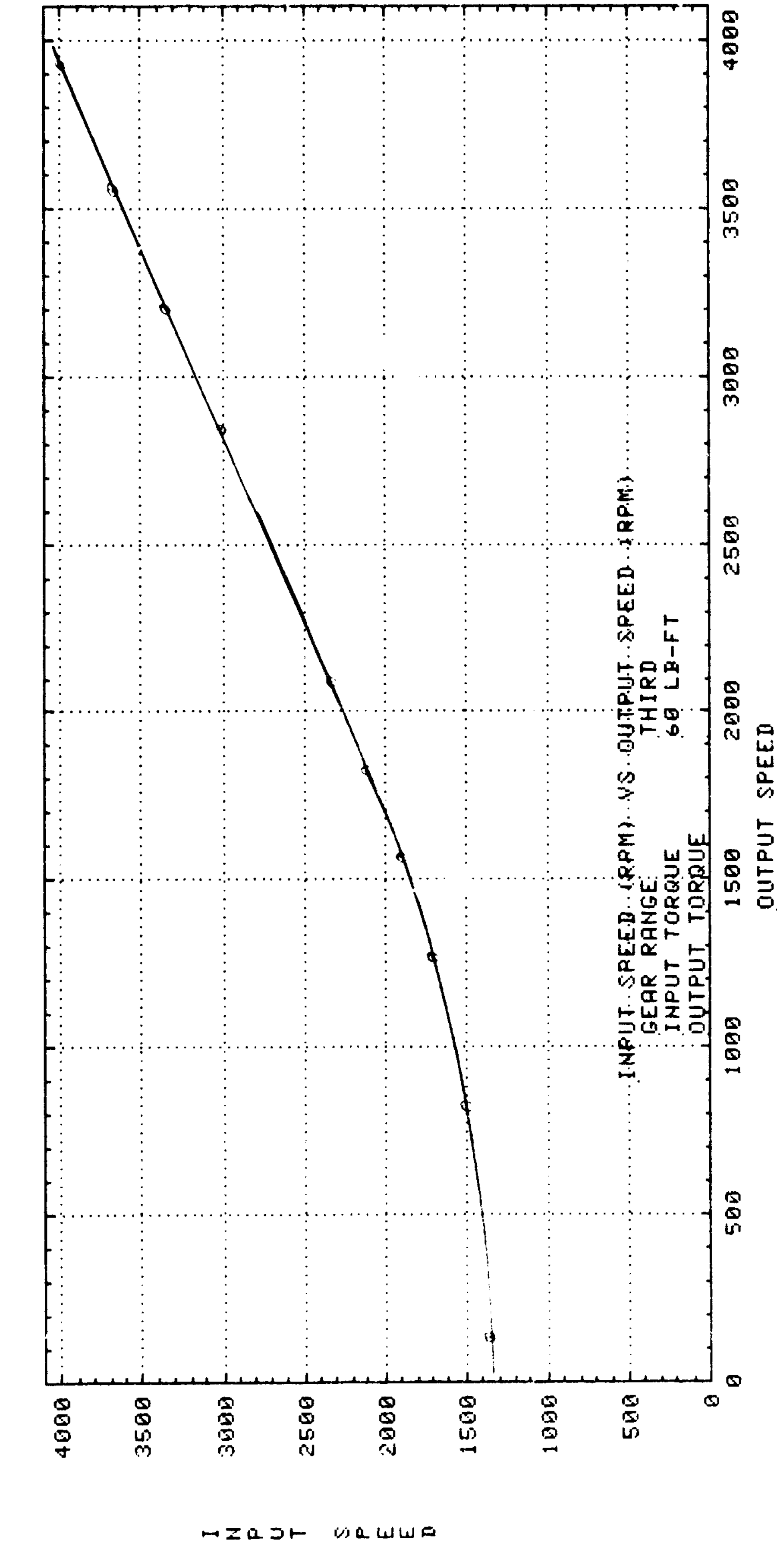

EFFICIENCY
100
90
80
70
60
50
40
30
20
10
0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 50 LB-FT
OUTPUT TORQUE

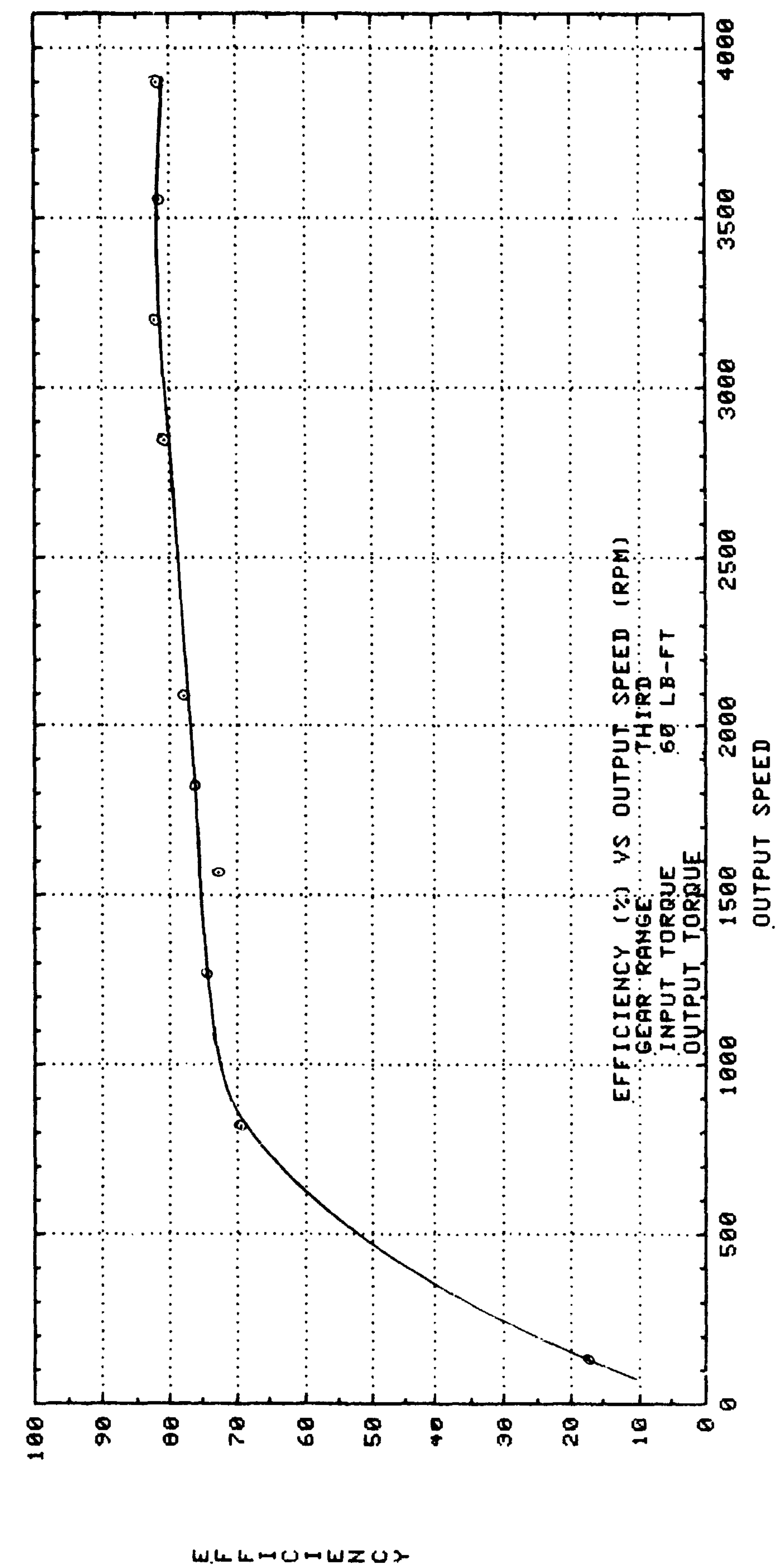


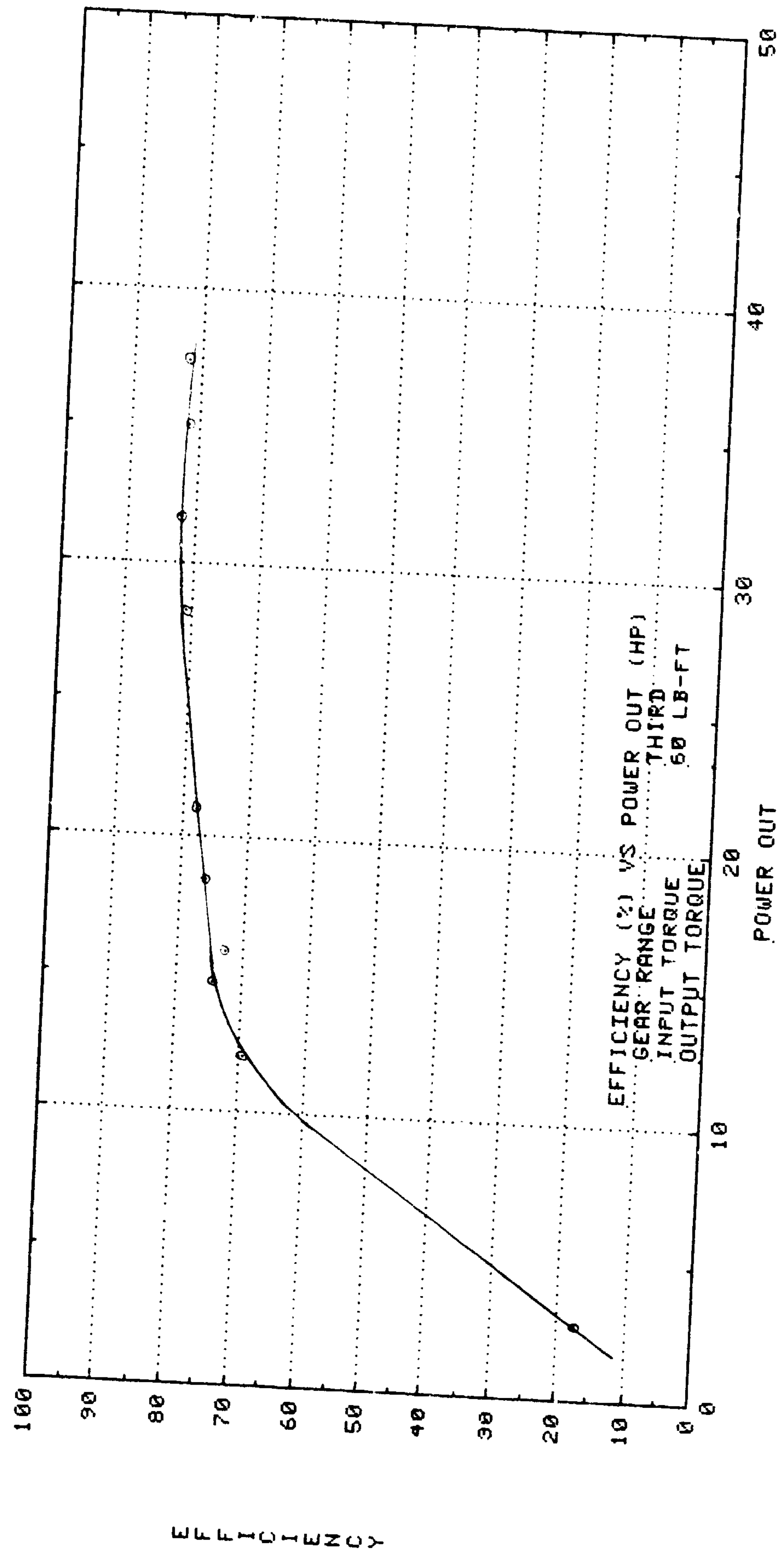
EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE 50 LB-FT
OUTPUT TORQUE
POWER OUT
EFFICIENCY
0 10 20 30 40
0 10 20 30 40 50 60 70 80 90 100

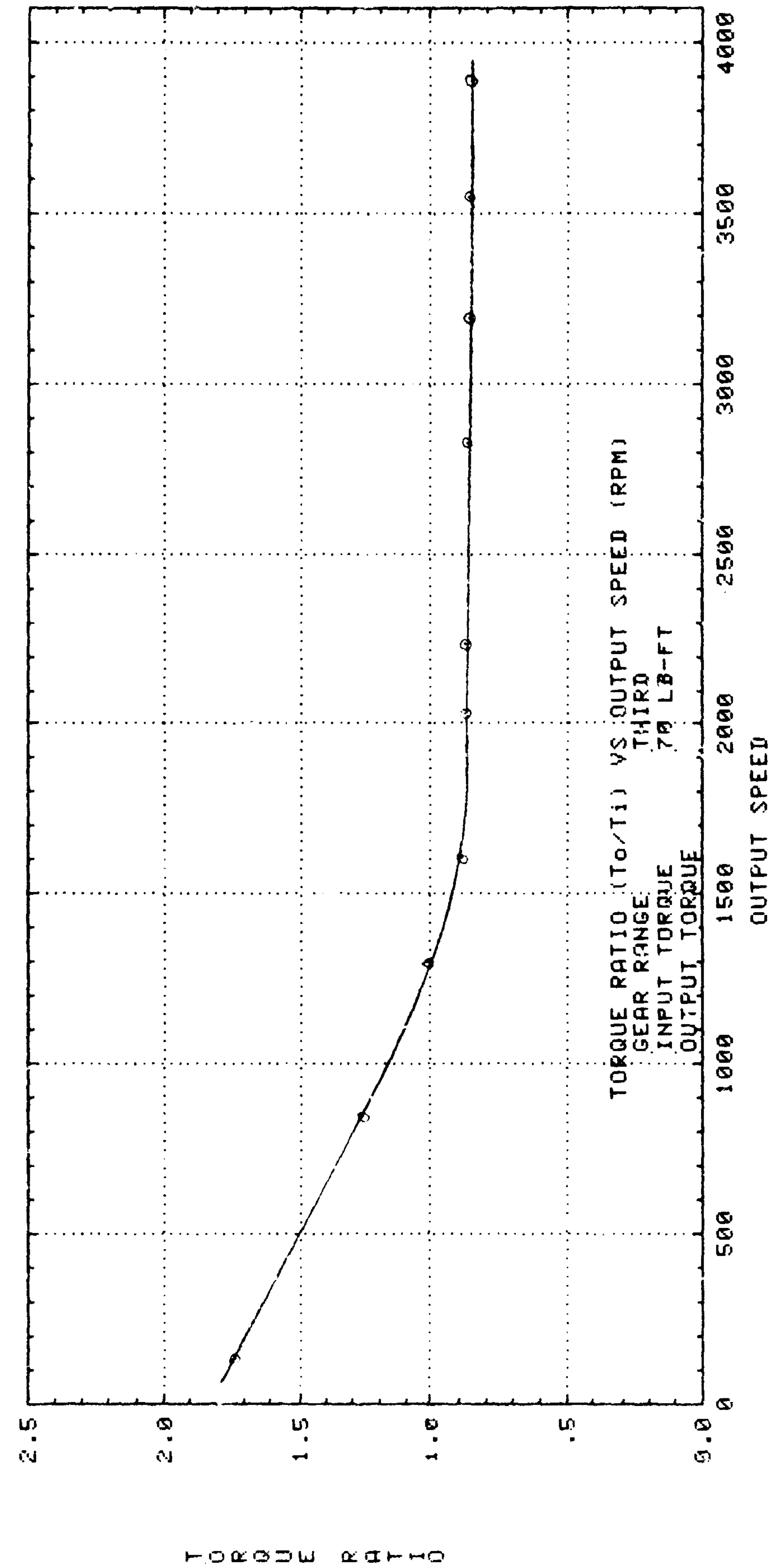

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 60 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000
TORQUE RATIO
0.0
.5
1.0
1.5
2.0
2.5

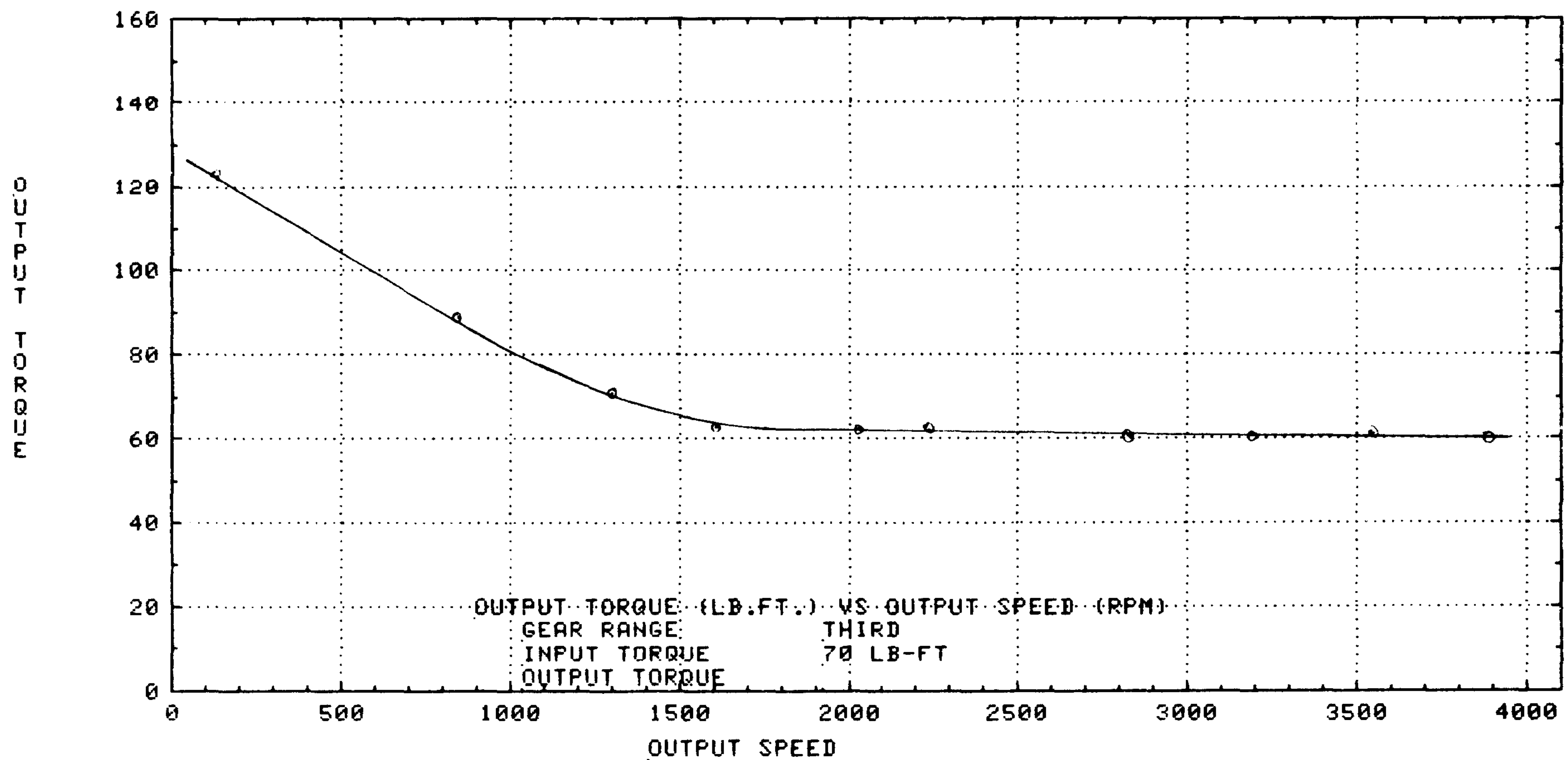

OUTPUT TORQUE
OUTPUT SPEED
OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 60 LB-FT
OUTPUT TORQUE
0
20
40
60
80
100
120
0
500
1000
1500
2000
2500
3000
3500
4000


INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 60 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

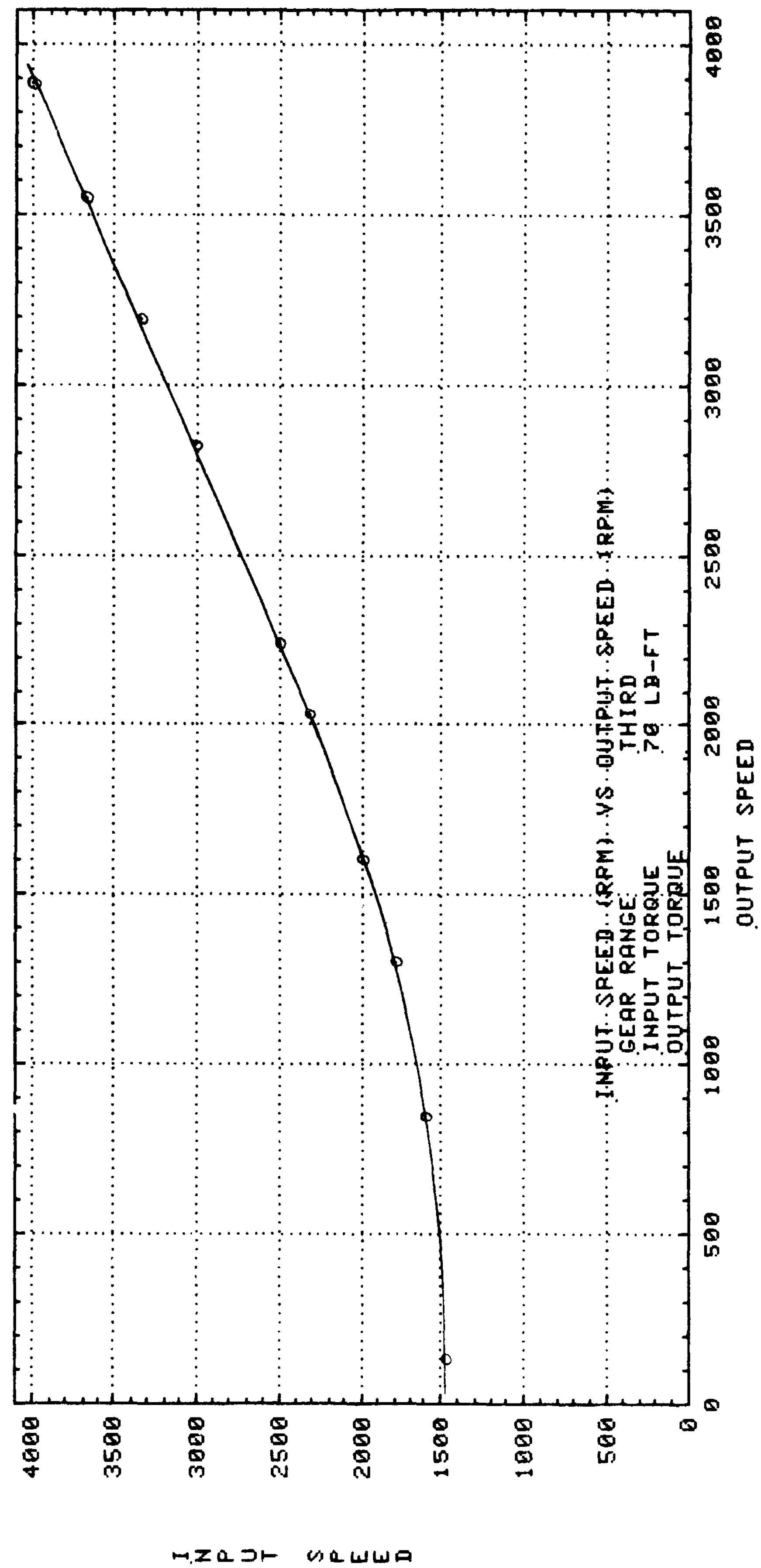

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 60 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
EFFICIENCY
0
500
1000
1500
2000
2500
3000
3500
4000
0
10
20
30
40
50
60
70
80
90
100

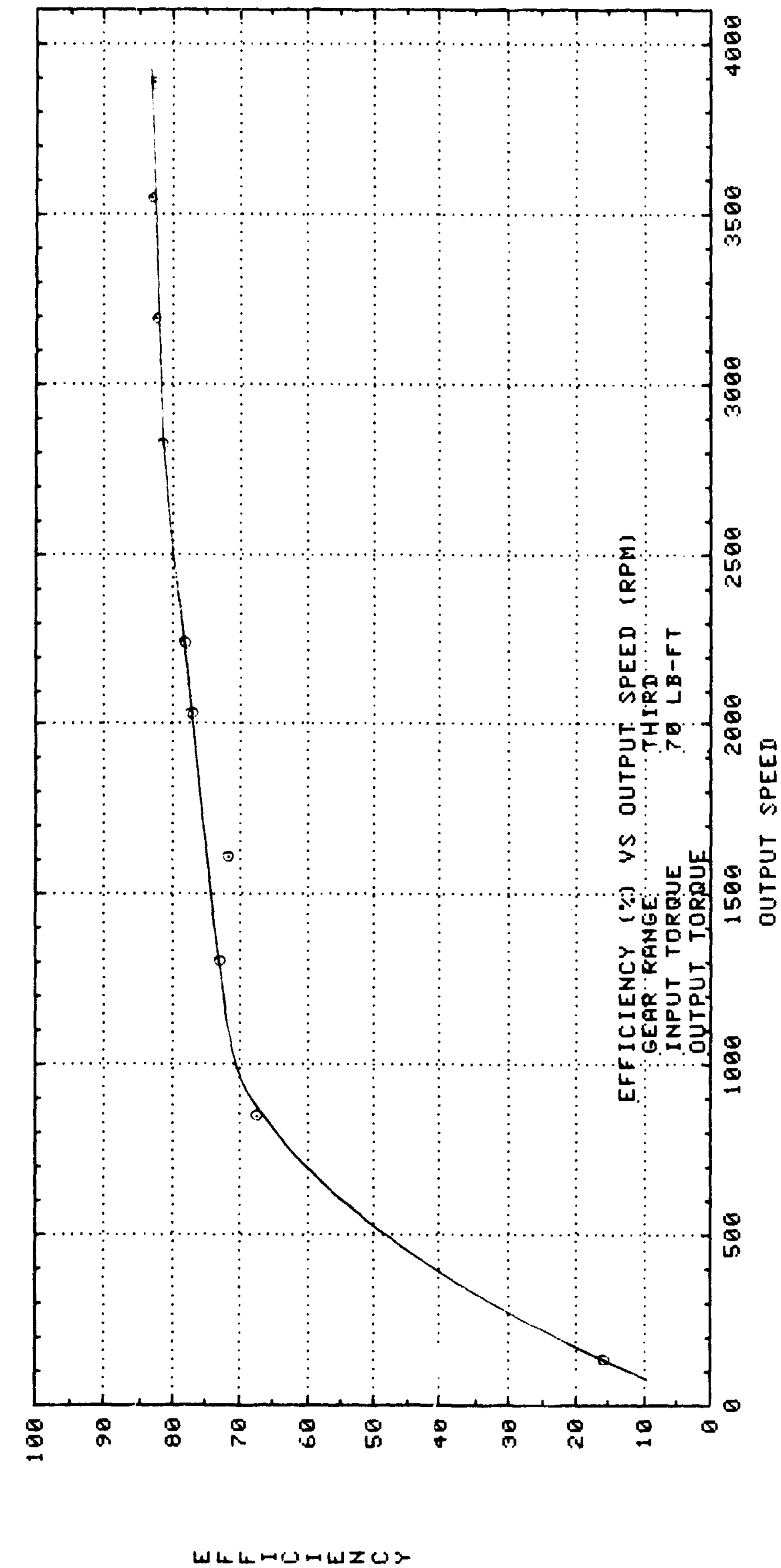

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE 60 LB-FT
OUTPUT TORQUE
POWER OUT
EFFICIENCY
0
10
20
30
40
50
60
70
80
90
100
0
10
20
30
40
50

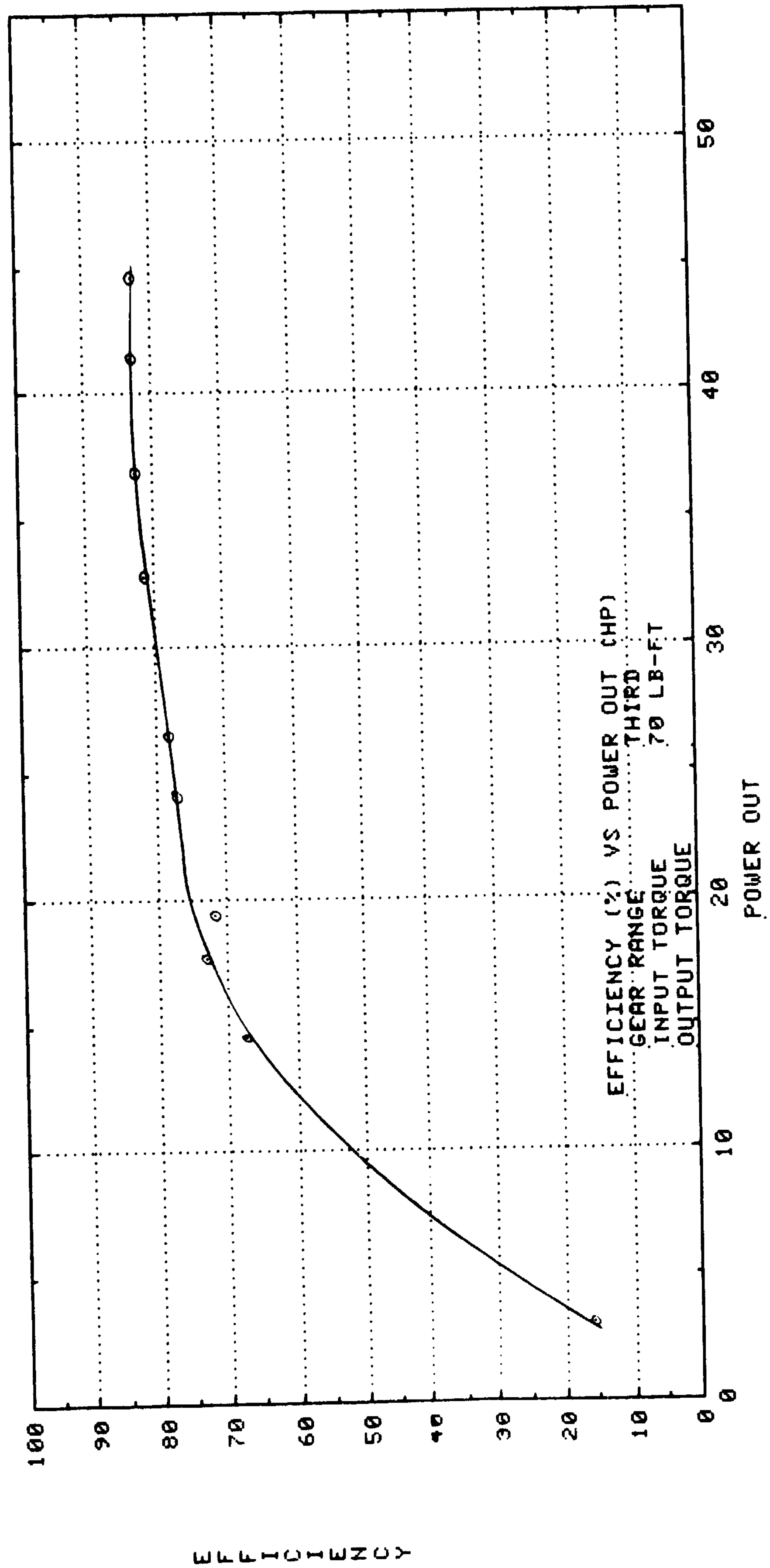

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 70 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
TORQUE RATIO
0
500
1000
1500
2000
2500
3000
3500
4000
0.0
.5
1.0
1.5
2.0
2.5

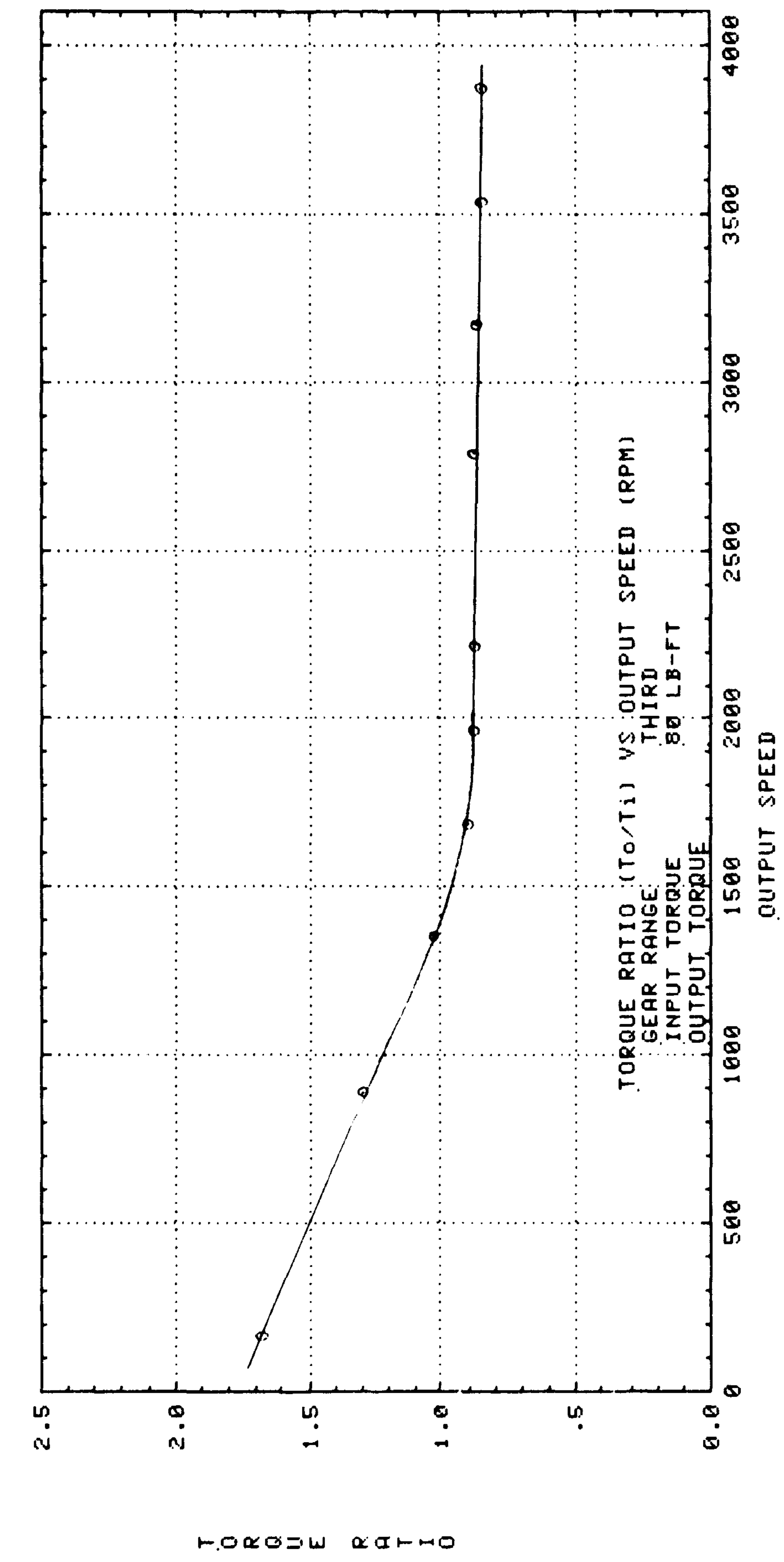


OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 70 LB-FT
OUTPUT TORQUE
OUTPUT TORQUE
OUTPUT SPEED
0
20
40
60
80
100
120
140
160
500
1000
1500
2000
2500
3000
3500
4000

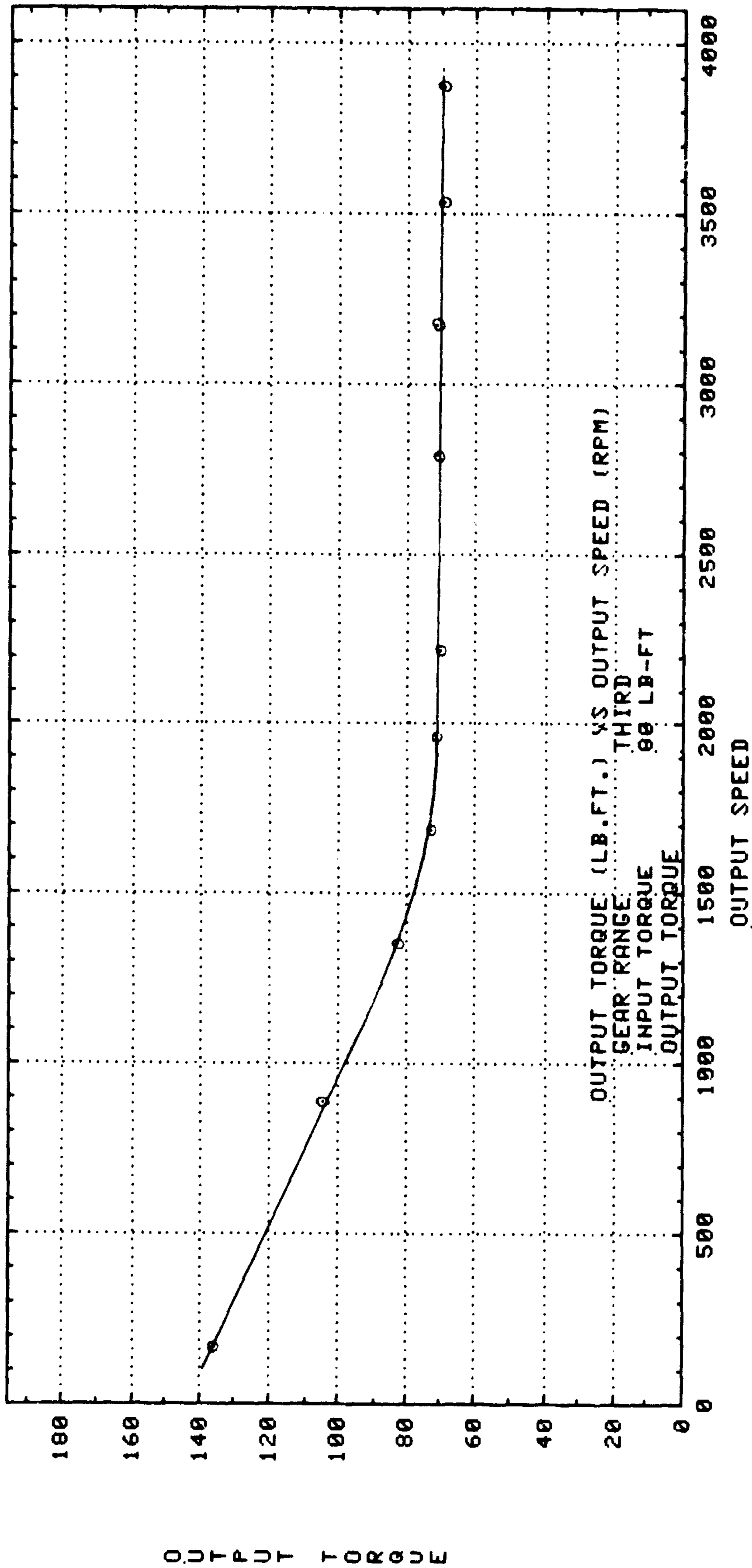

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 70 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

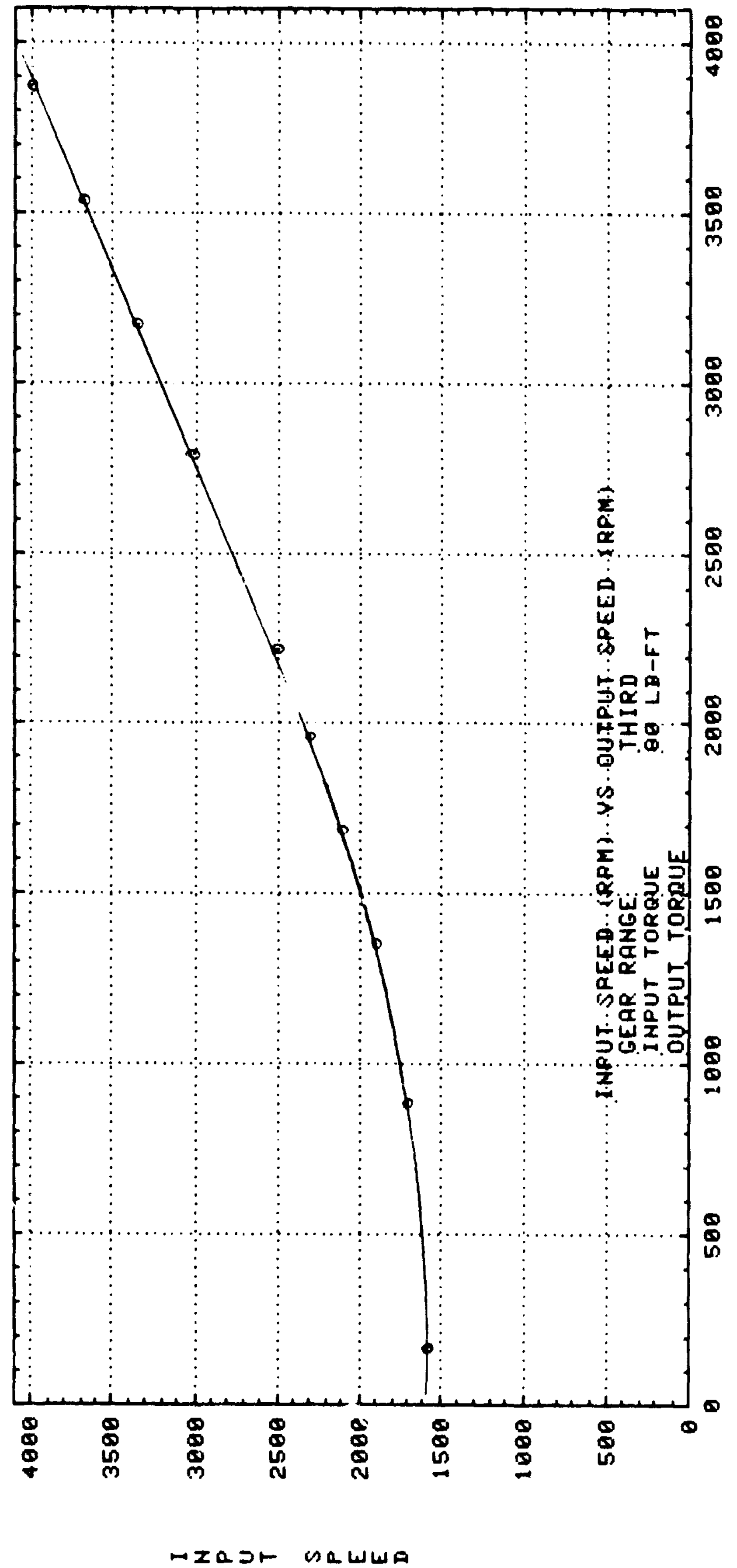

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 70 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
EFFICIENCY
0 500 1000 1500 2000 2500 3000 3500 4000
0 10 20 30 40 50 60 70 80 90 100

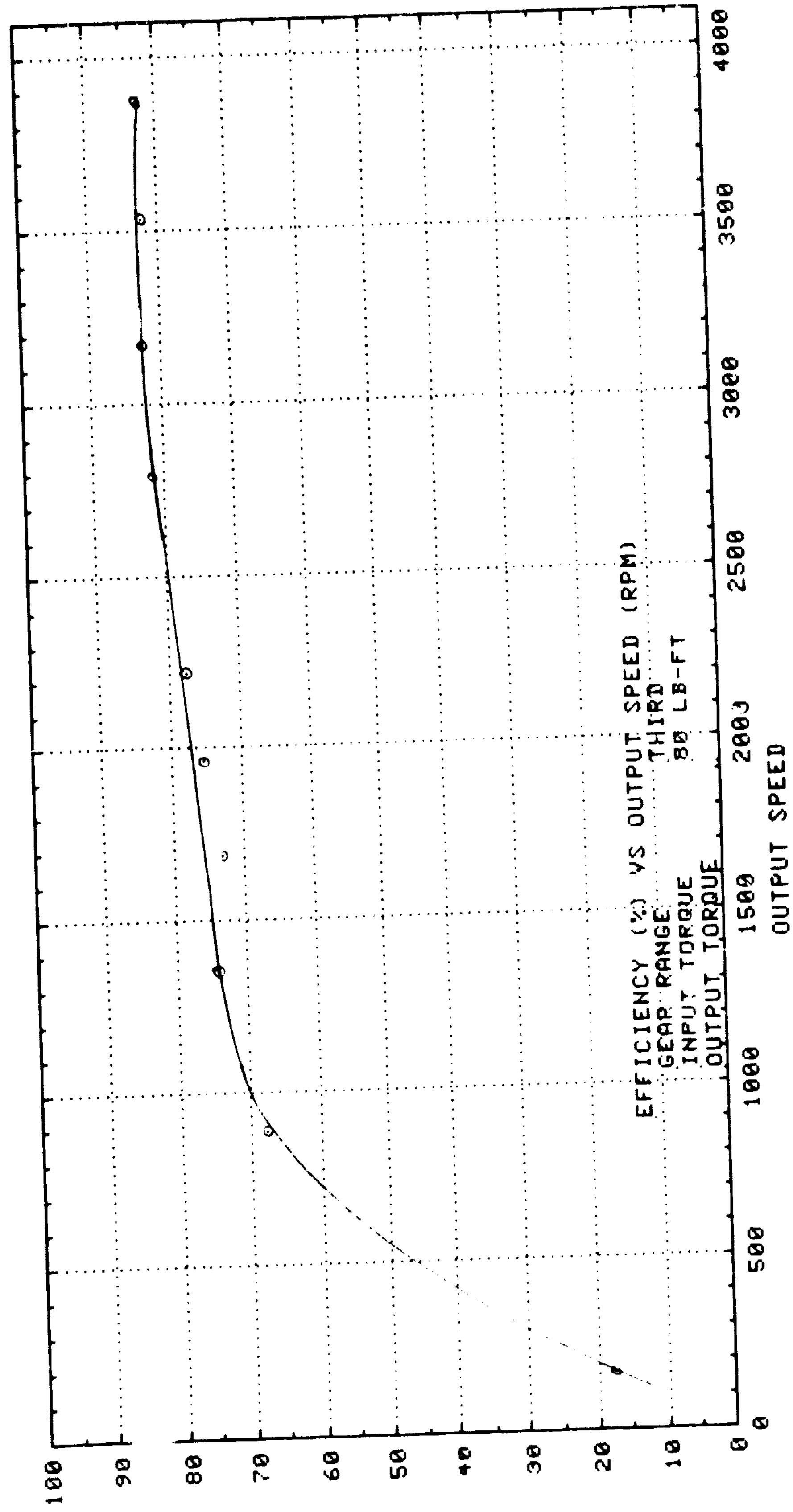

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE 70 LB-FT
OUTPUT TORQUE
POWER OUT
EFFICIENCY
0
10
20
30
40
50
60
70
80
90
100

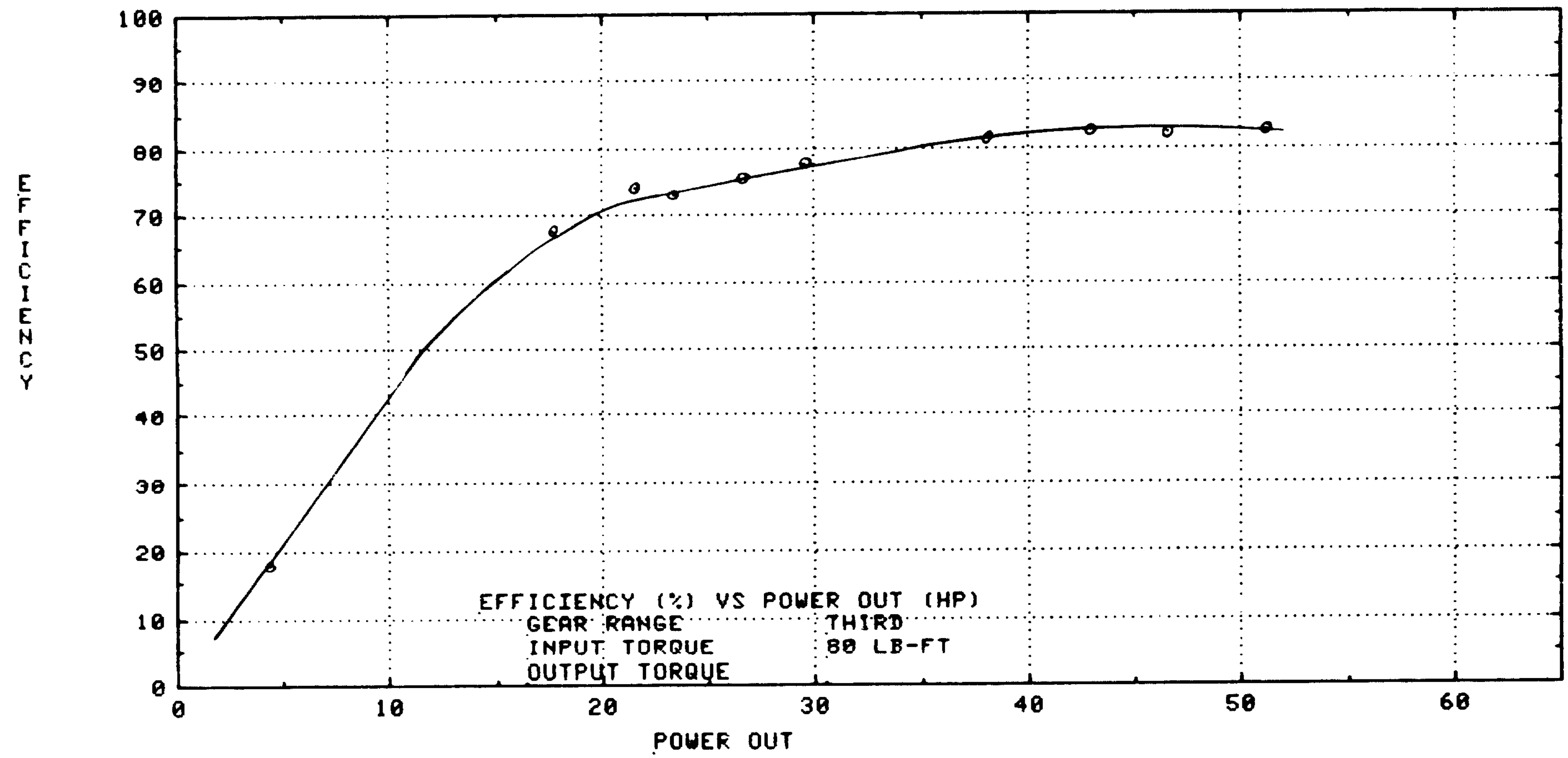


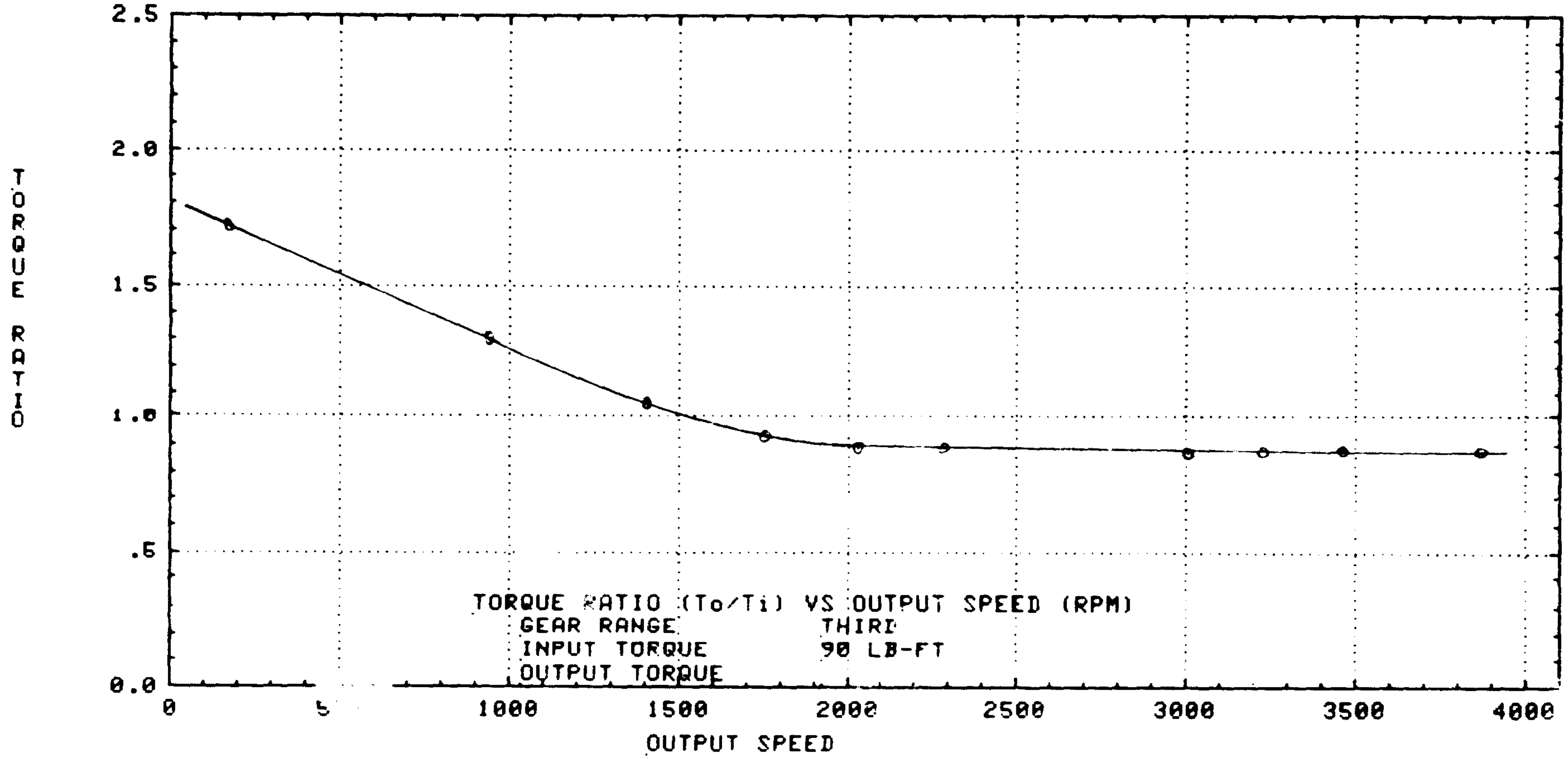
TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 80 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
TORQUE RATIO
0
500
1000
1500
2000
2500
3000
3500
4000
0.0
.5
1.0
1.5
2.0
2.5

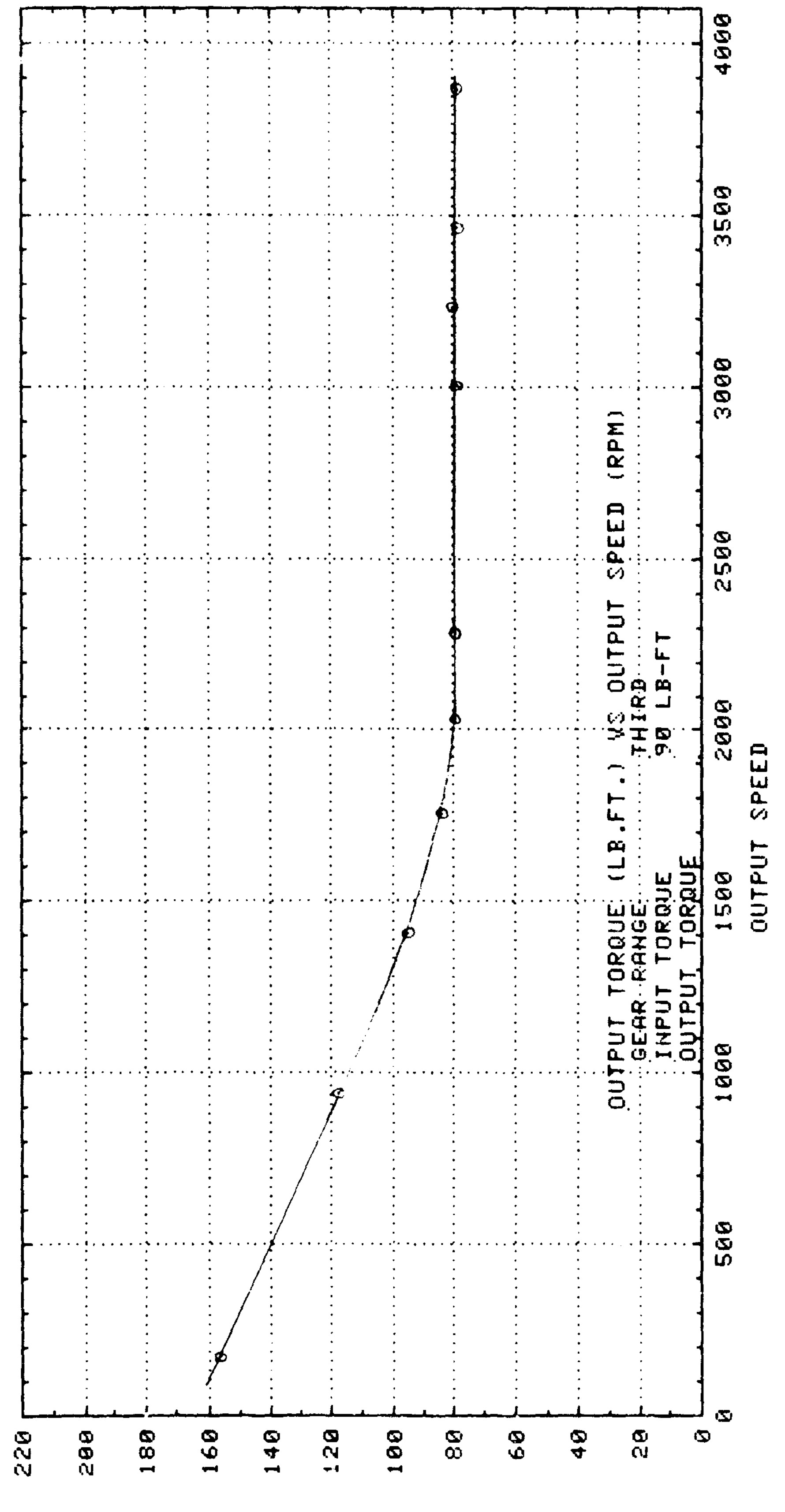

OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 80 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
OUTPUT TORQUE
0
500
1000
1500
2000
2500
3000
3500
4000
20
40
60
80
100
120
140
160
180


INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 90 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

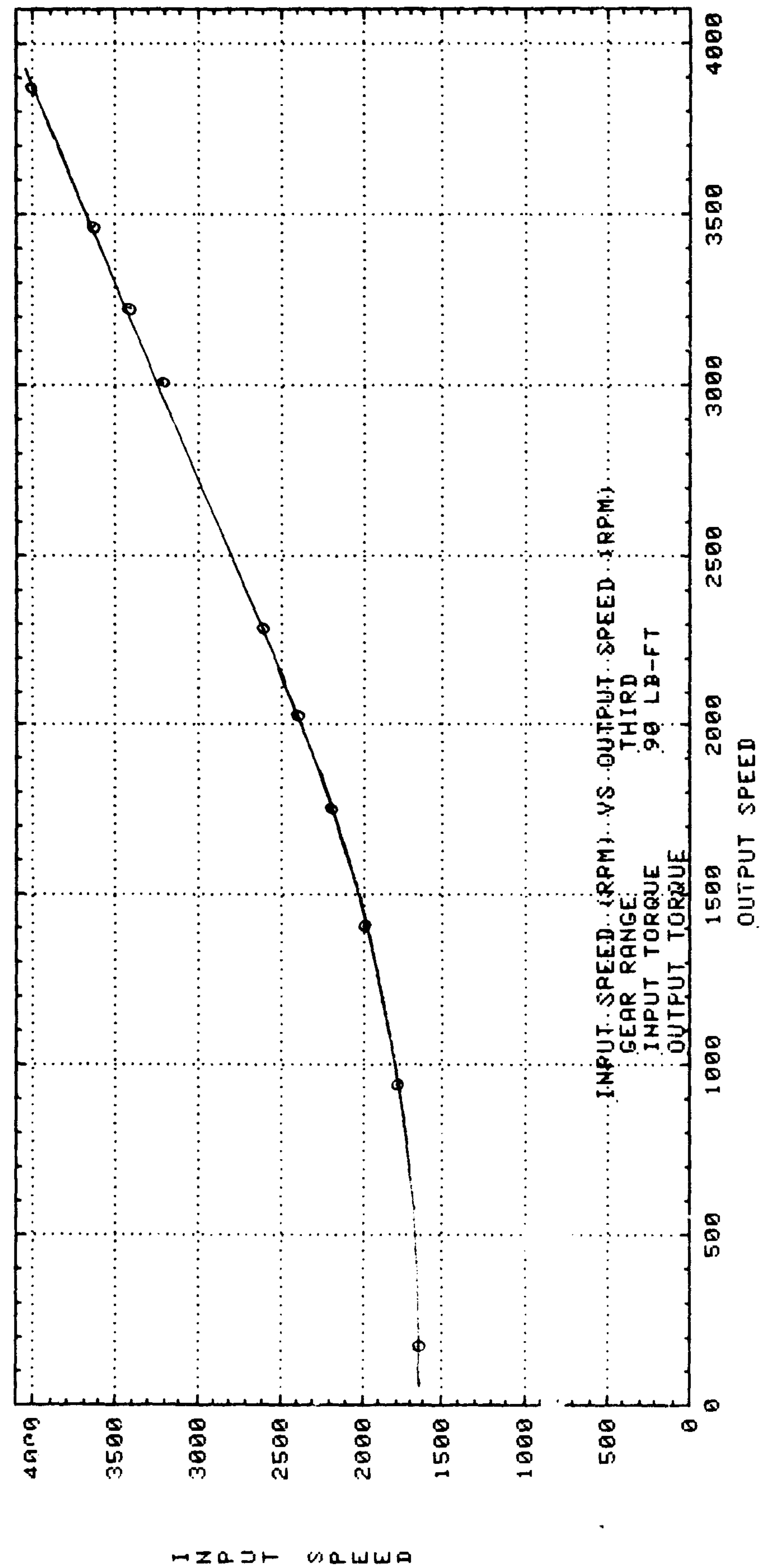

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 80 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000
0
10
20
30
40
50
60
70
80
90
100

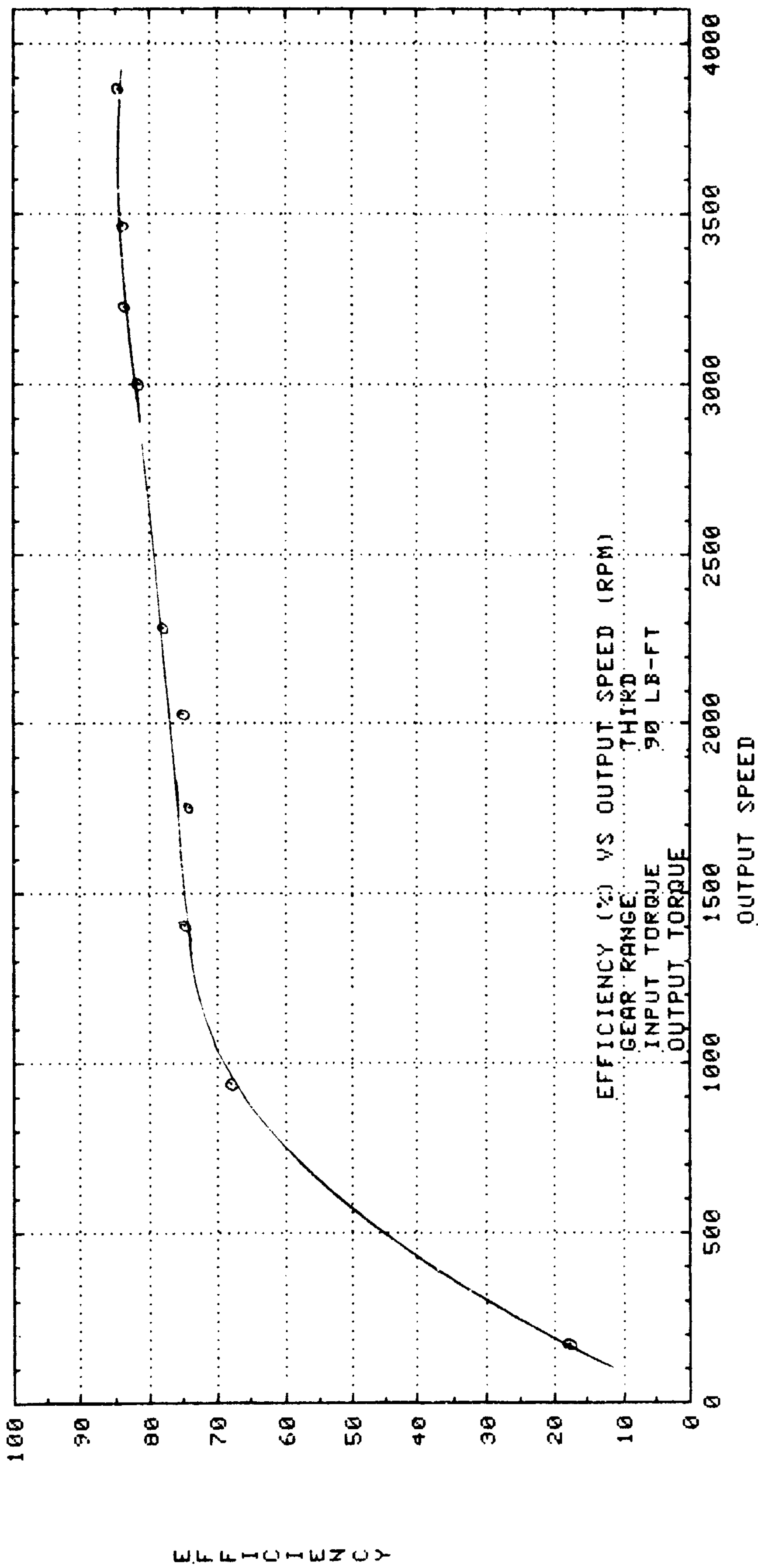

EFFICIENCY
EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE 80 LB-FT
OUTPUT TORQUE
POWER OUT
0
10
20
30
40
50
60
70
80
90
100

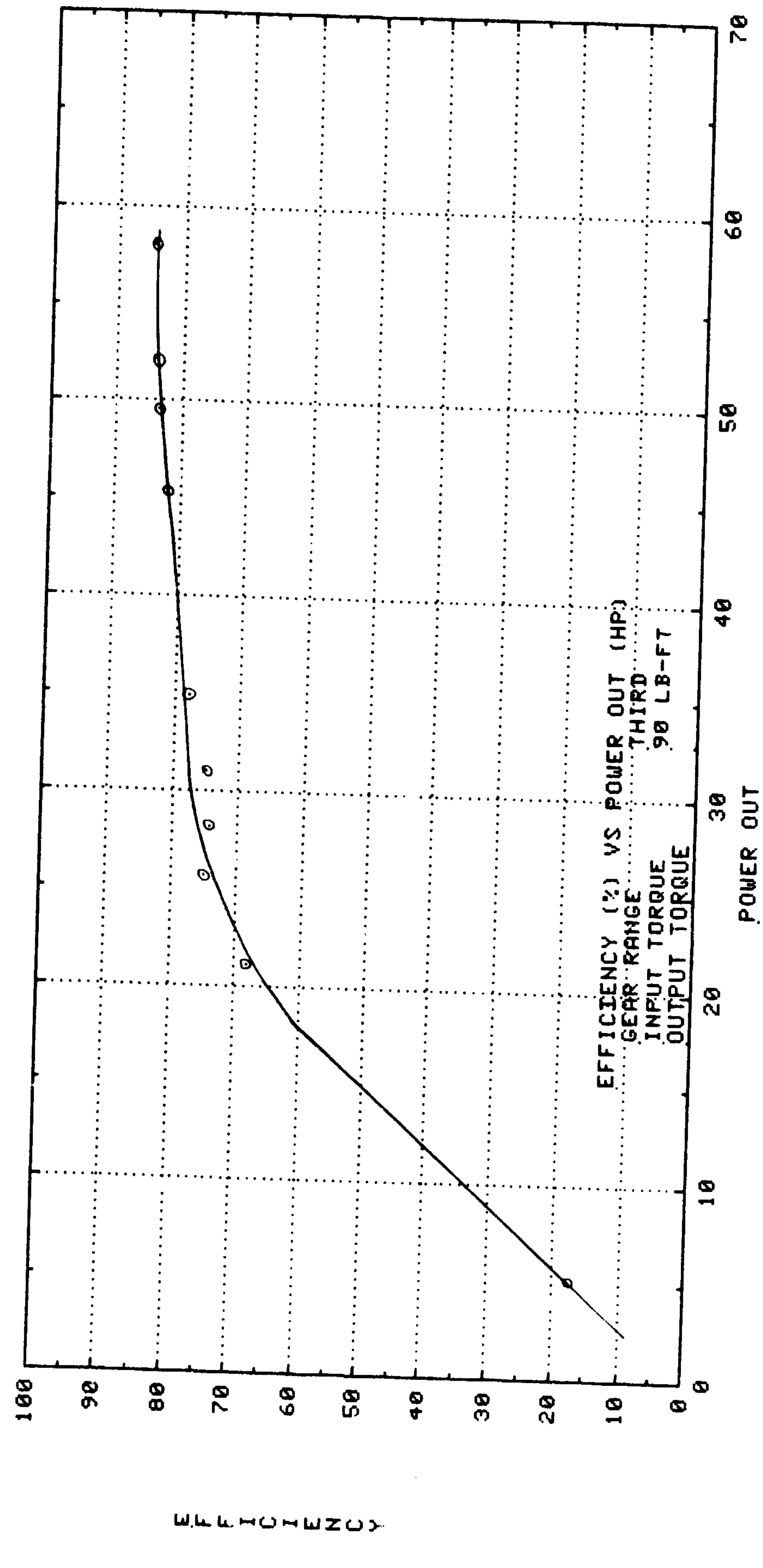

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 90 LB-FT
OUTPUT TORQUE
TORQUE RATIO
OUTPUT SPEED
2.5
2.0
1.5
1.0
.5
0.0
0
1000
1500
2000
2500
3000
3500
4000



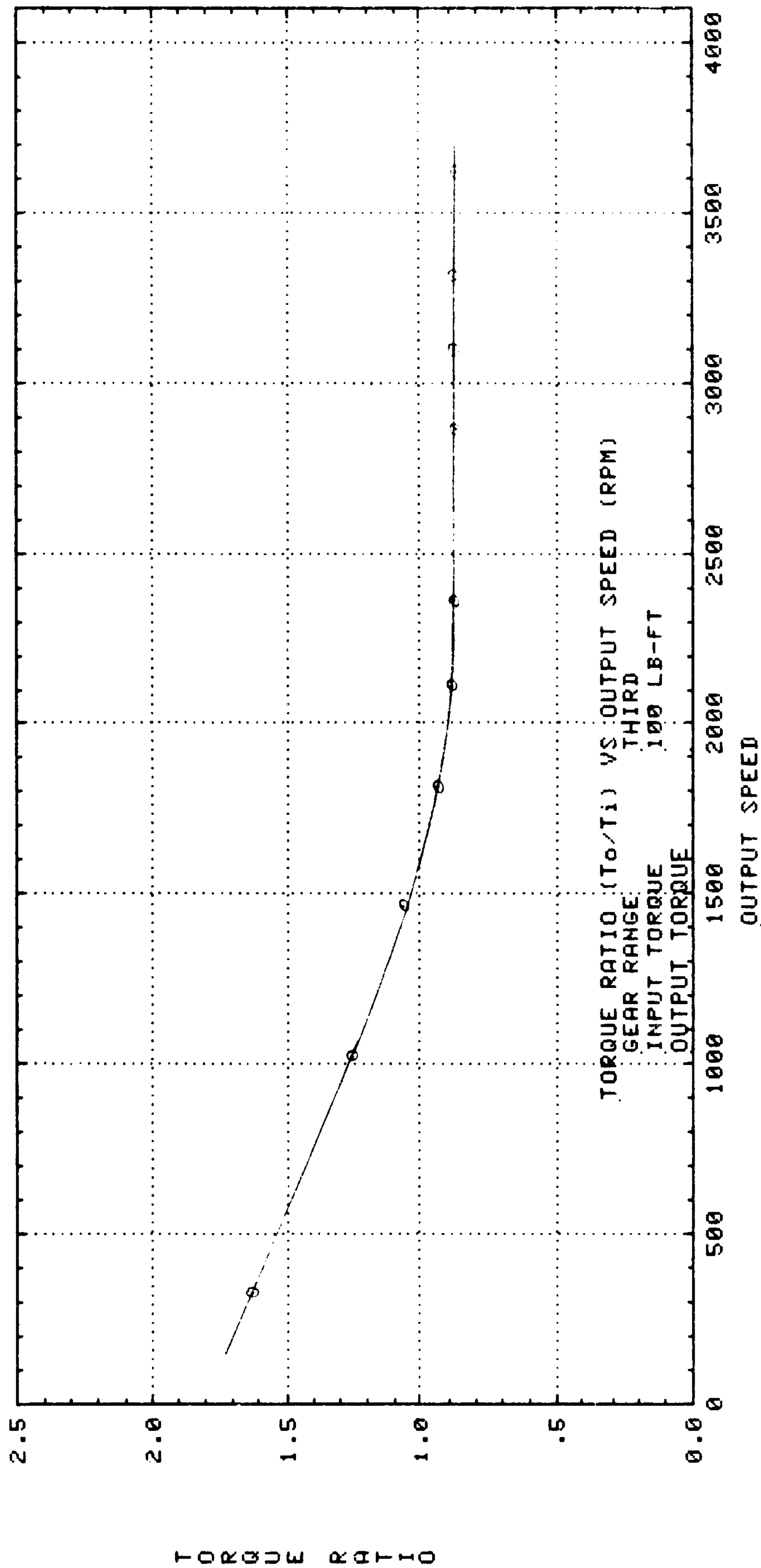
OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 90 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000
0
20
40
60
80
100
120
140
160
180
200
220

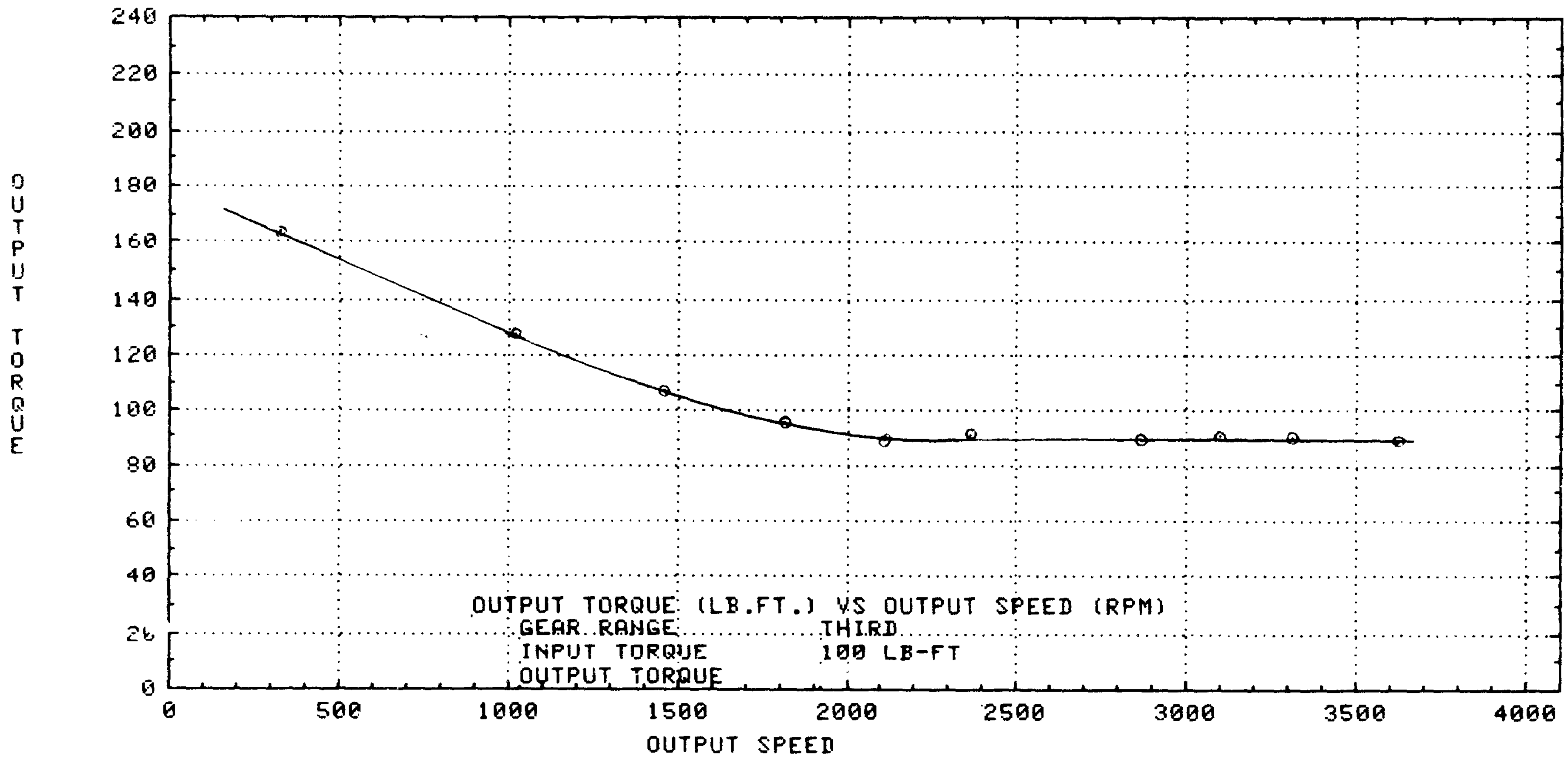

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 90 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

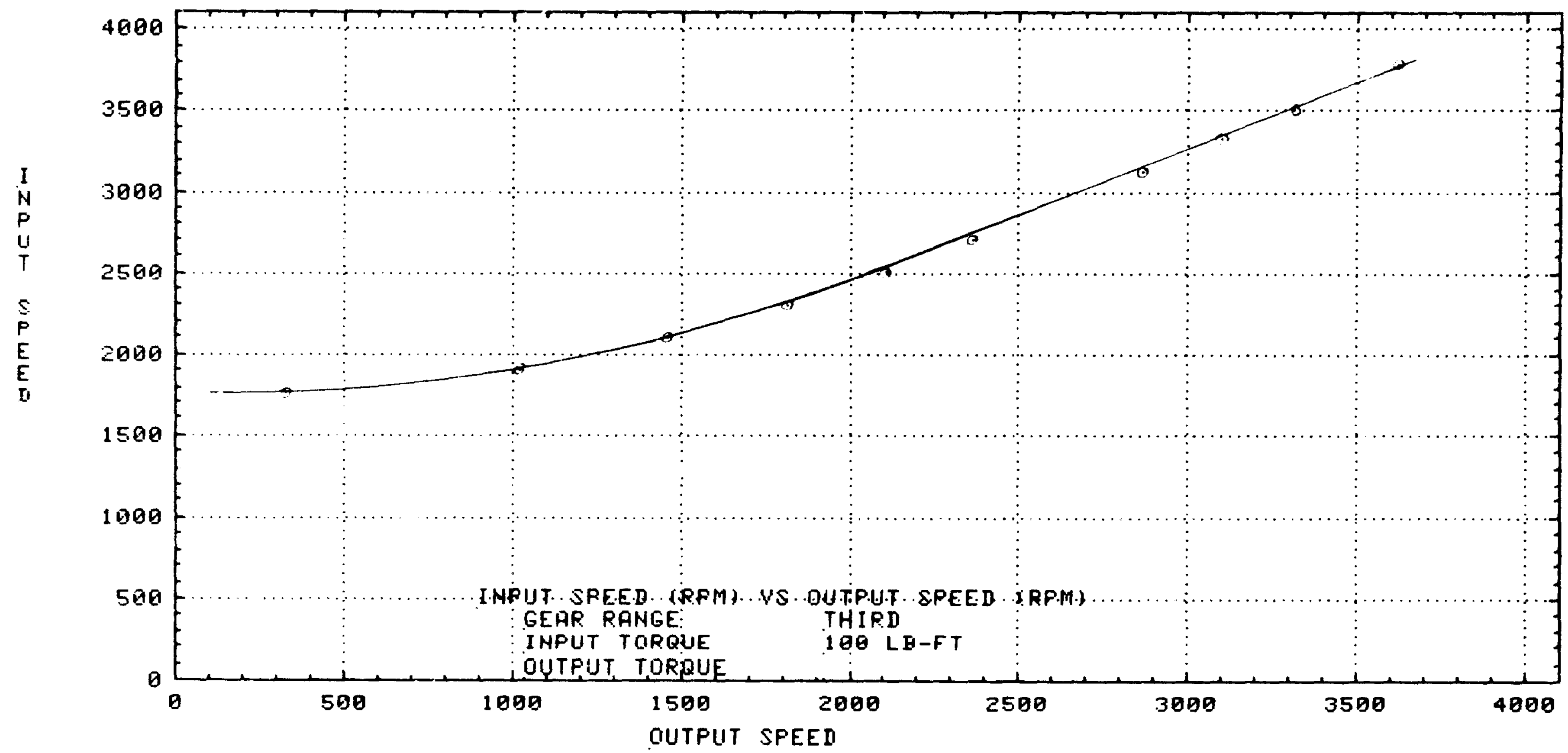

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 90 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
EFFICIENCY
0
500
1000
1500
2000
2500
3000
3500
4000
0
10
20
30
40
50
60
70
80
90
100

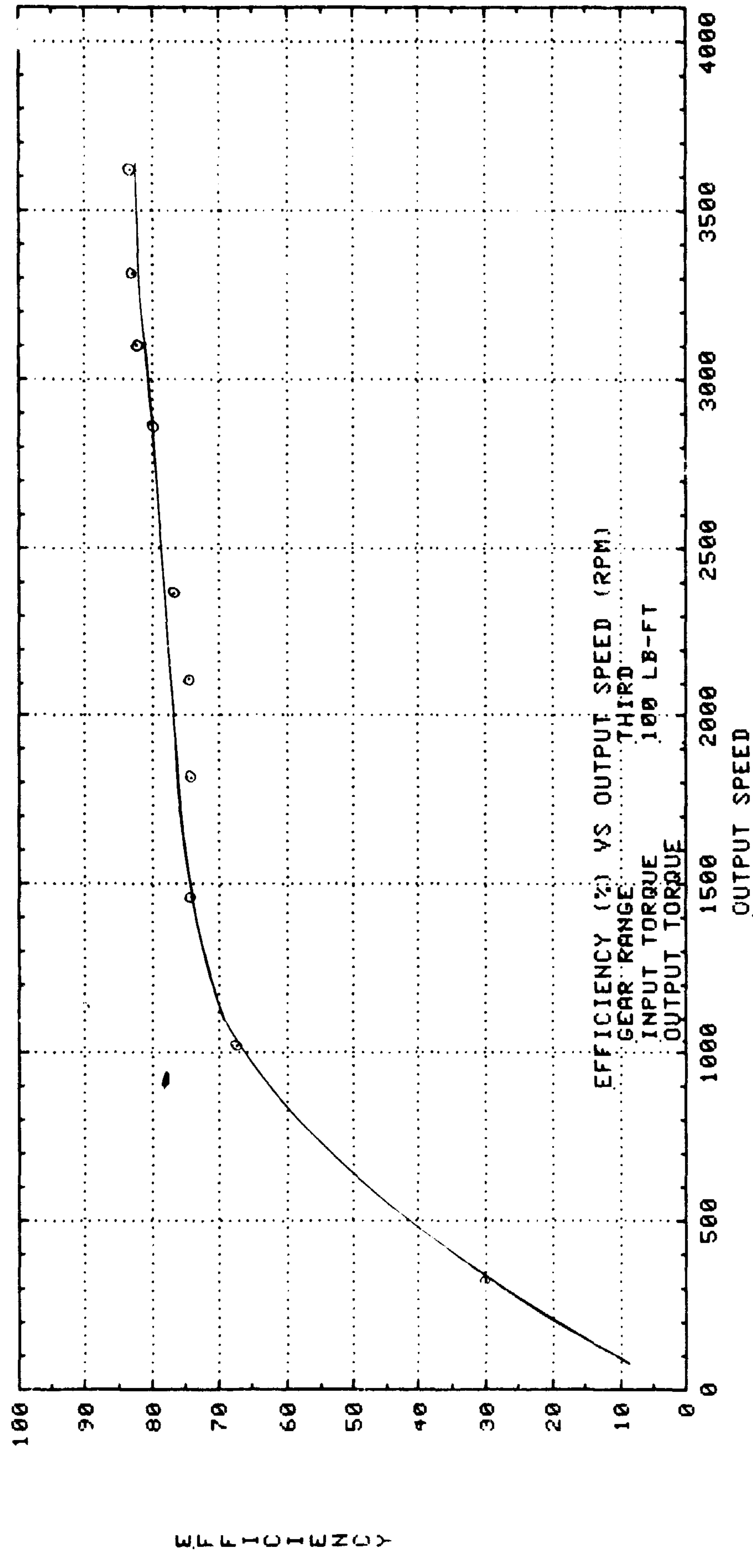


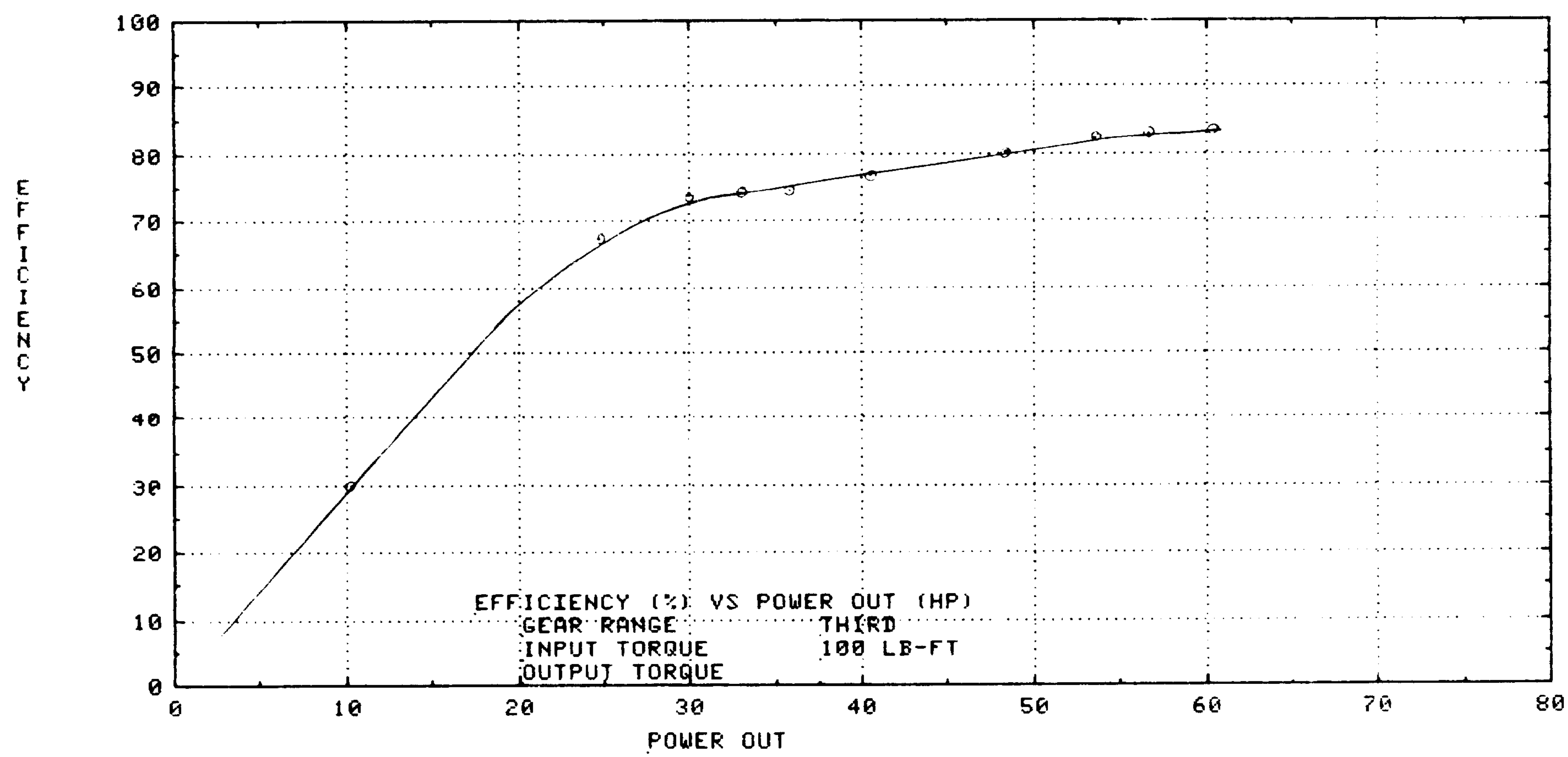
EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE 90 LB-FT
OUTPUT TORQUE
POWER OUT
0
10
20
30
40
50
60
70
80
90
100


TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 100 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
TORQUE RATIO
0 500 1000 1500 2000 2500 3000 3500 4000
0.0 .5 1.0 1.5 2.0 2.5


OUTPUT TORQUE
240
220
200
180
160
140
120
100
80
60
40
20
0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
OUTPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 100 LB-FT
OUTPUT TORQUE


INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 100 LB-FT
OUTPUT TORQUE
INPUT SPEED
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000


EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 100 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000
0
10
20
30
40
50
60
70
80
90
100
EFFICIENCY

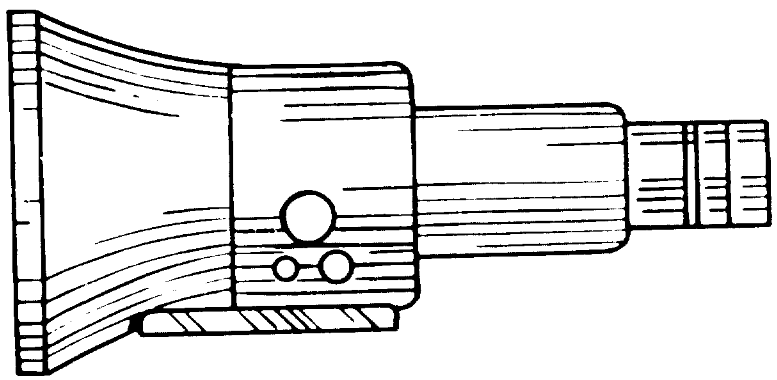

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE 100 LB-FT
OUTPUT TORQUE
EFFICIENCY
POWER OUT
0
10
20
30
40
50
60
70
80
90
100

CROSS SECTIONAL ROAD LOAD PERFORMANCE

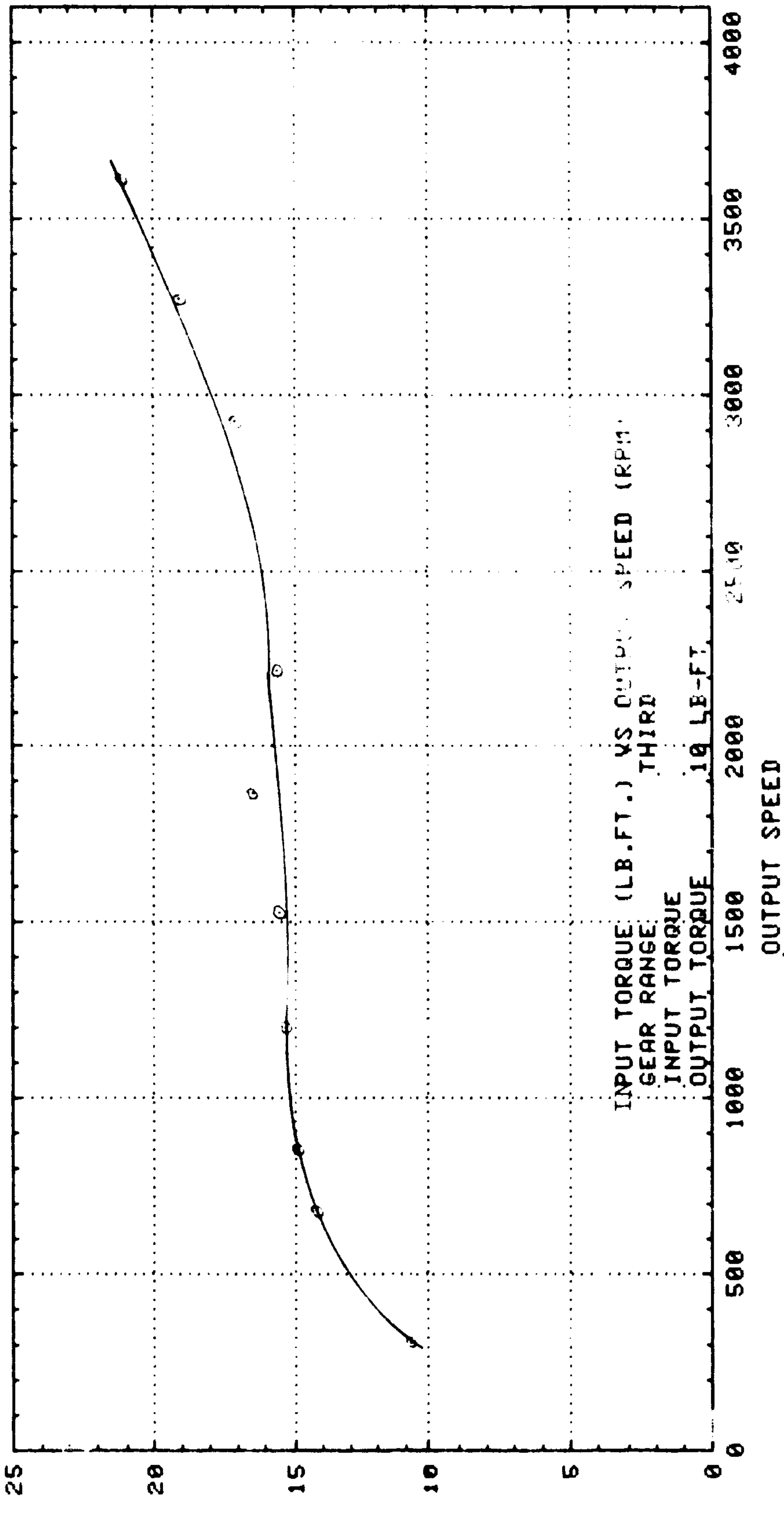
3rd Gear

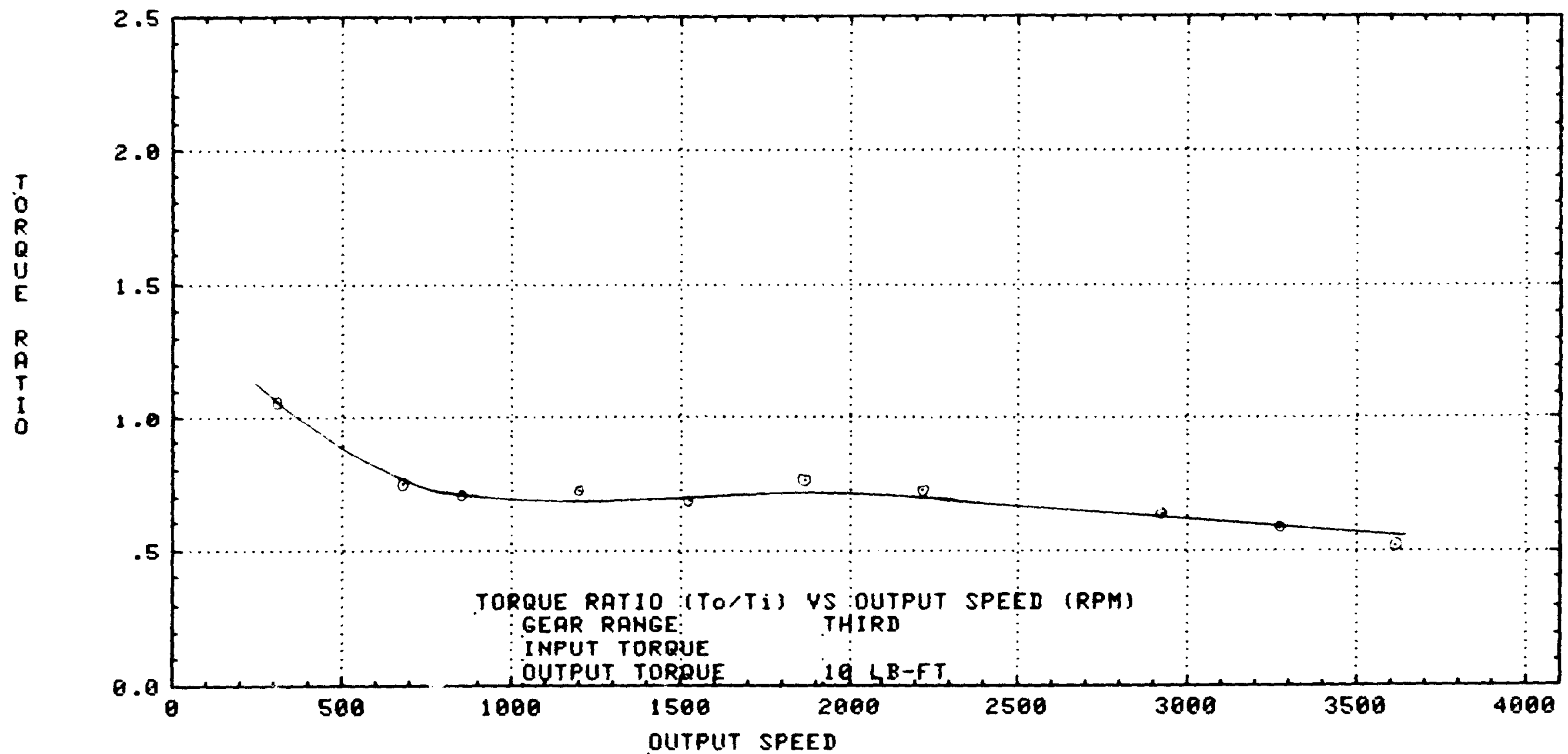
Graphs Contained in This Section

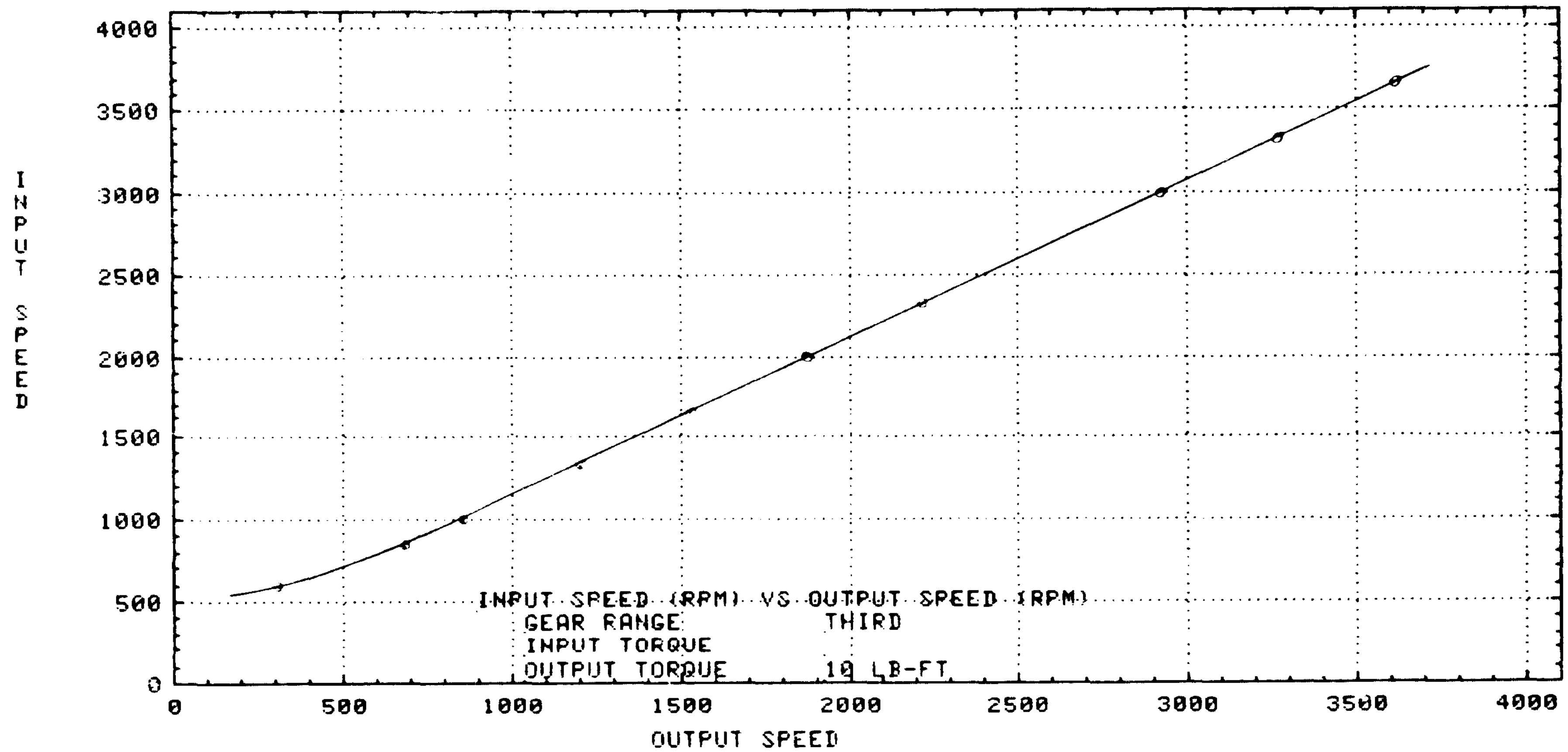
Torque Ratio -vs- Output Speed
Output Torque -vs- Output Speed
Input Speed -vs- Output Speed
Efficiency -vs- Output Speed
Efficiency -vs- Power Out

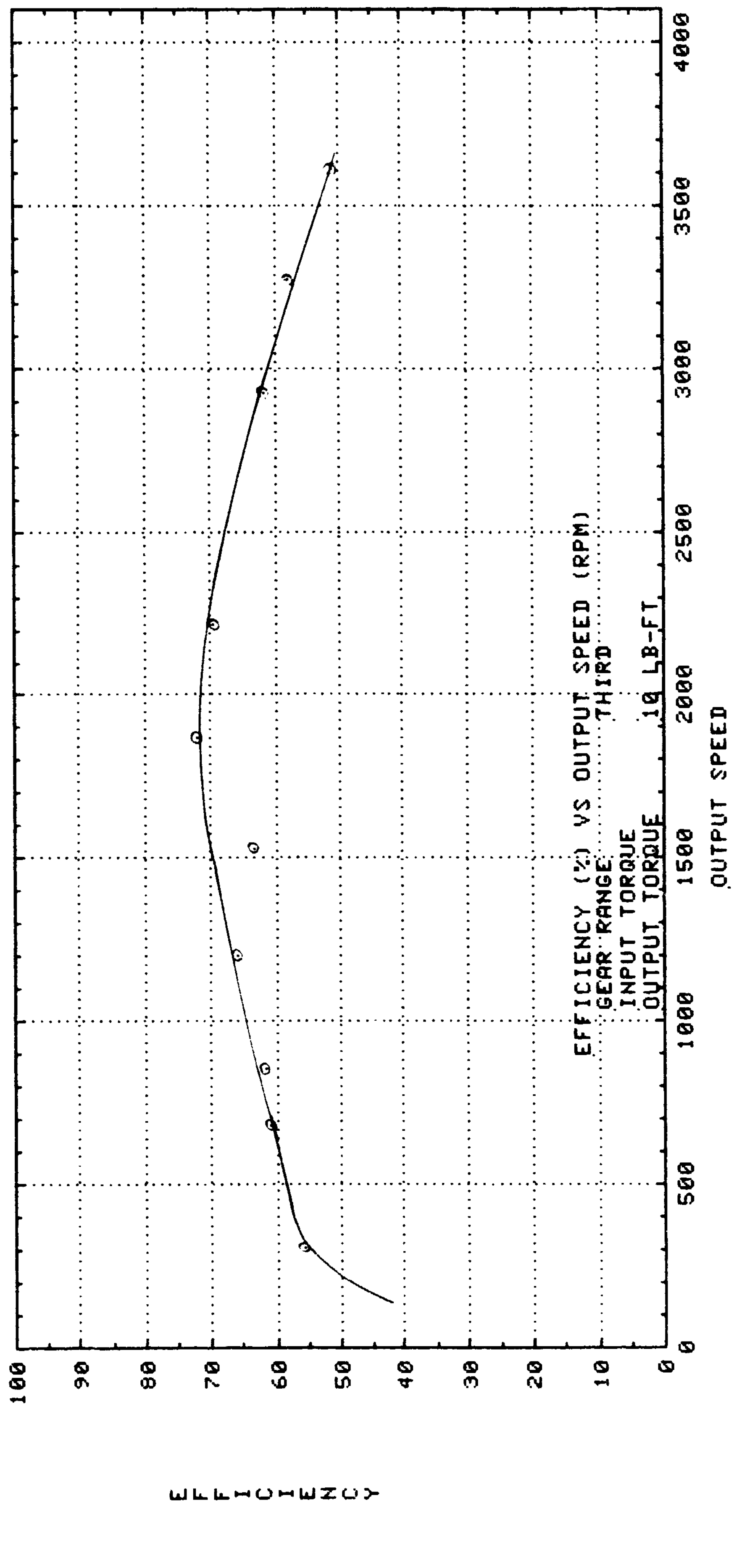


Drive Performance Tests


INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 10 LB-FT
OUTPUT SPEED
0
500
1000
1500
2000
3000
3500
4000
0
5
10
15
20
25
INPUT TORQUE

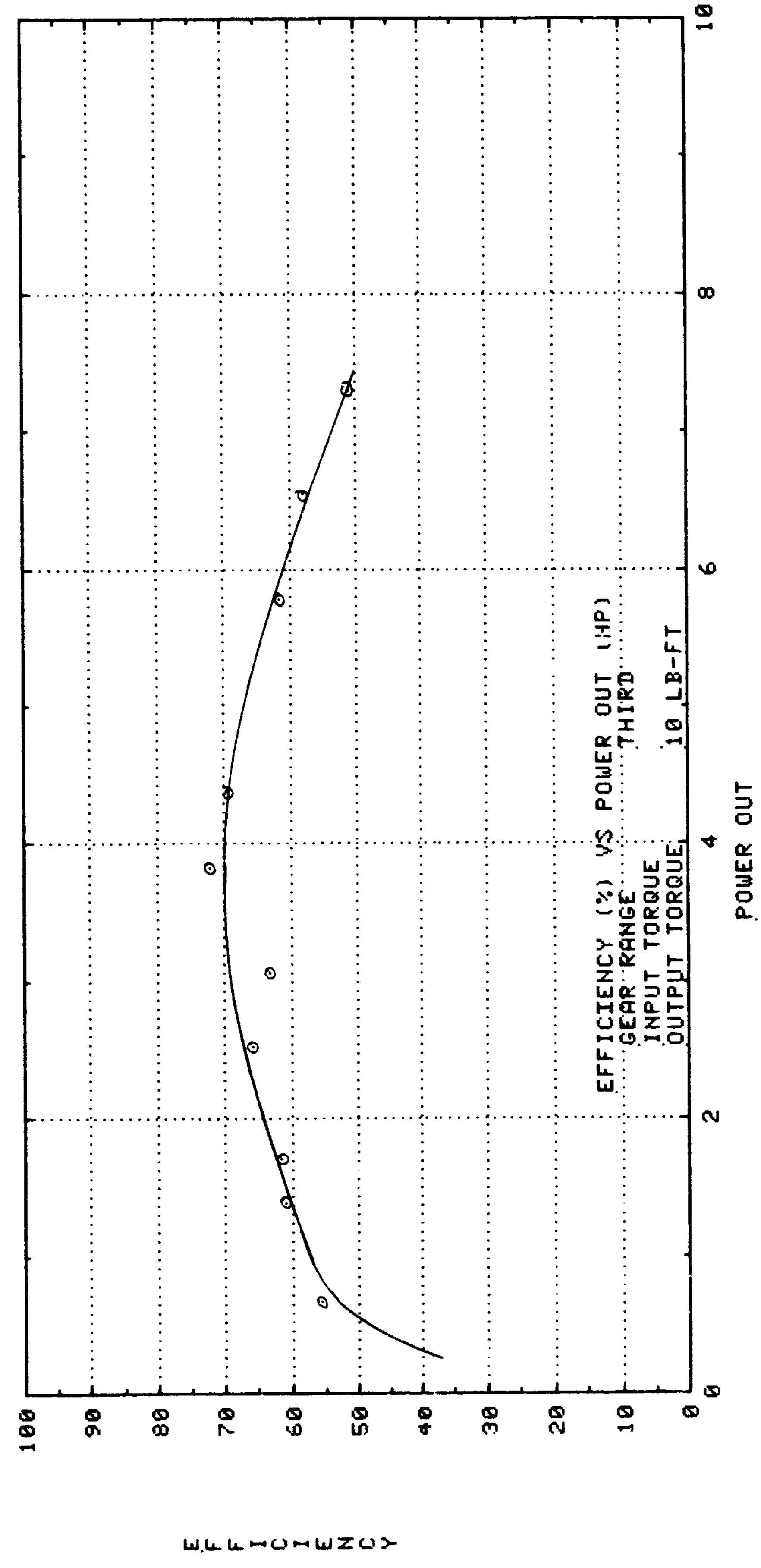

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 10 LB-FT
TORQUE RATIO
2.5
2.0
1.5
1.0
.5
0.0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED


INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 10 LB-FT
INPUT SPEED
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

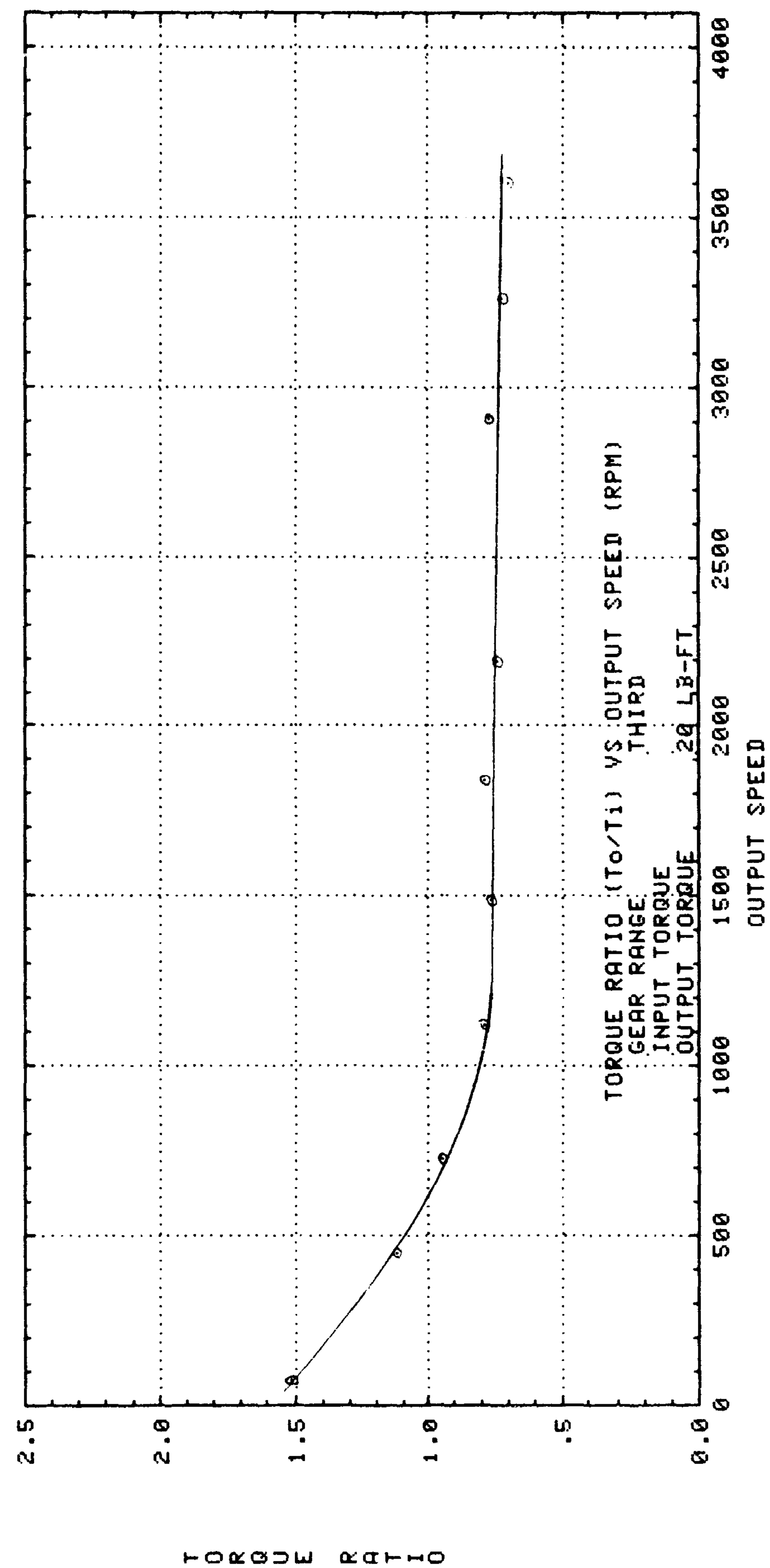


EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 10 LB-FT
OUTPUT SPEED
EFFICIENCY
0 500 1000 1500 2000 2500 3000 3500 4000
0 10 20 30 40 50 60 70 80 90 100

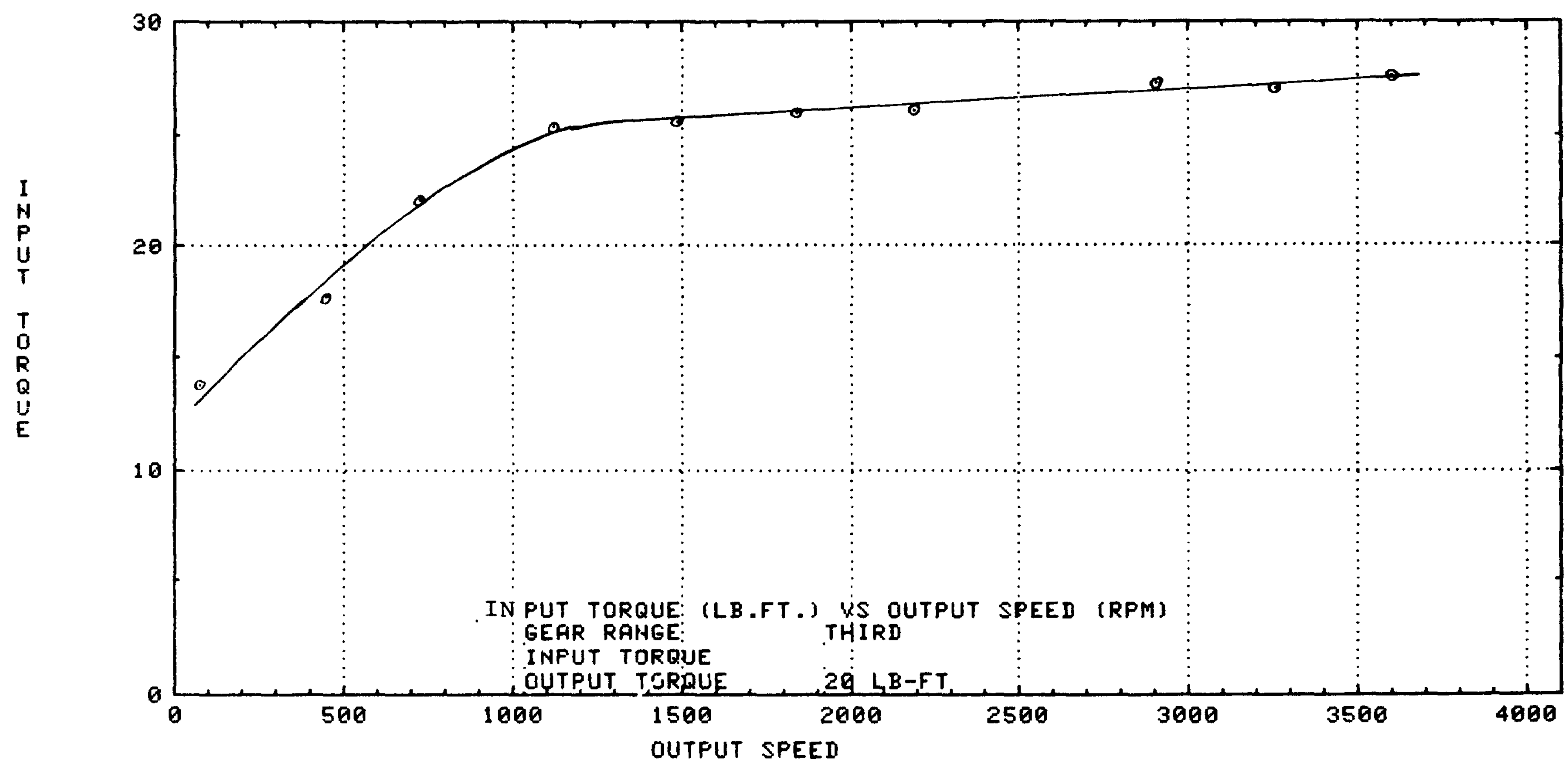
C-3

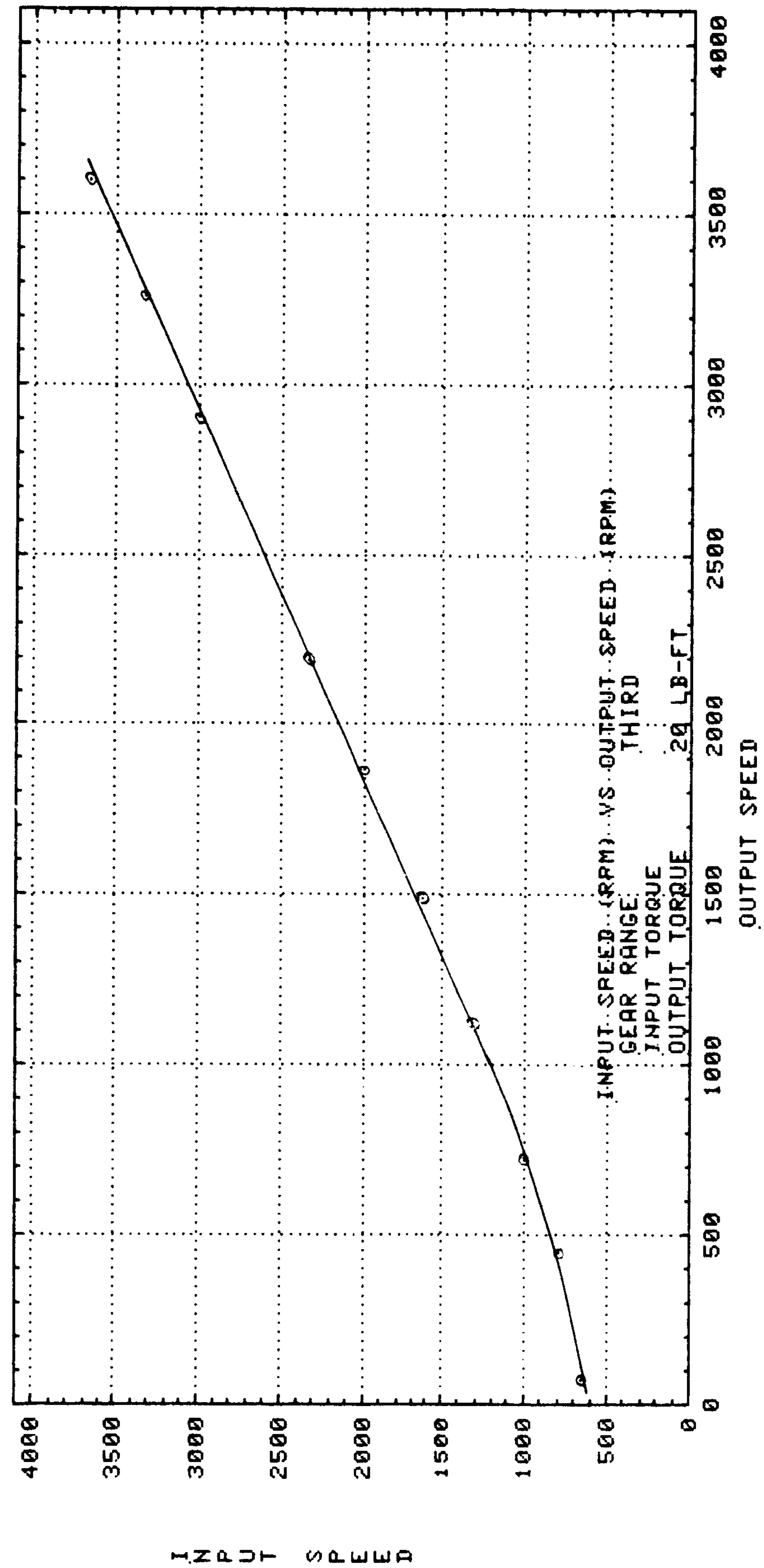


EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 10 LB-FT
POWER OUT
EFFICIENCY
0 2 4 6 8 10
0 10 20 30 40 50 60 70 80 90 100

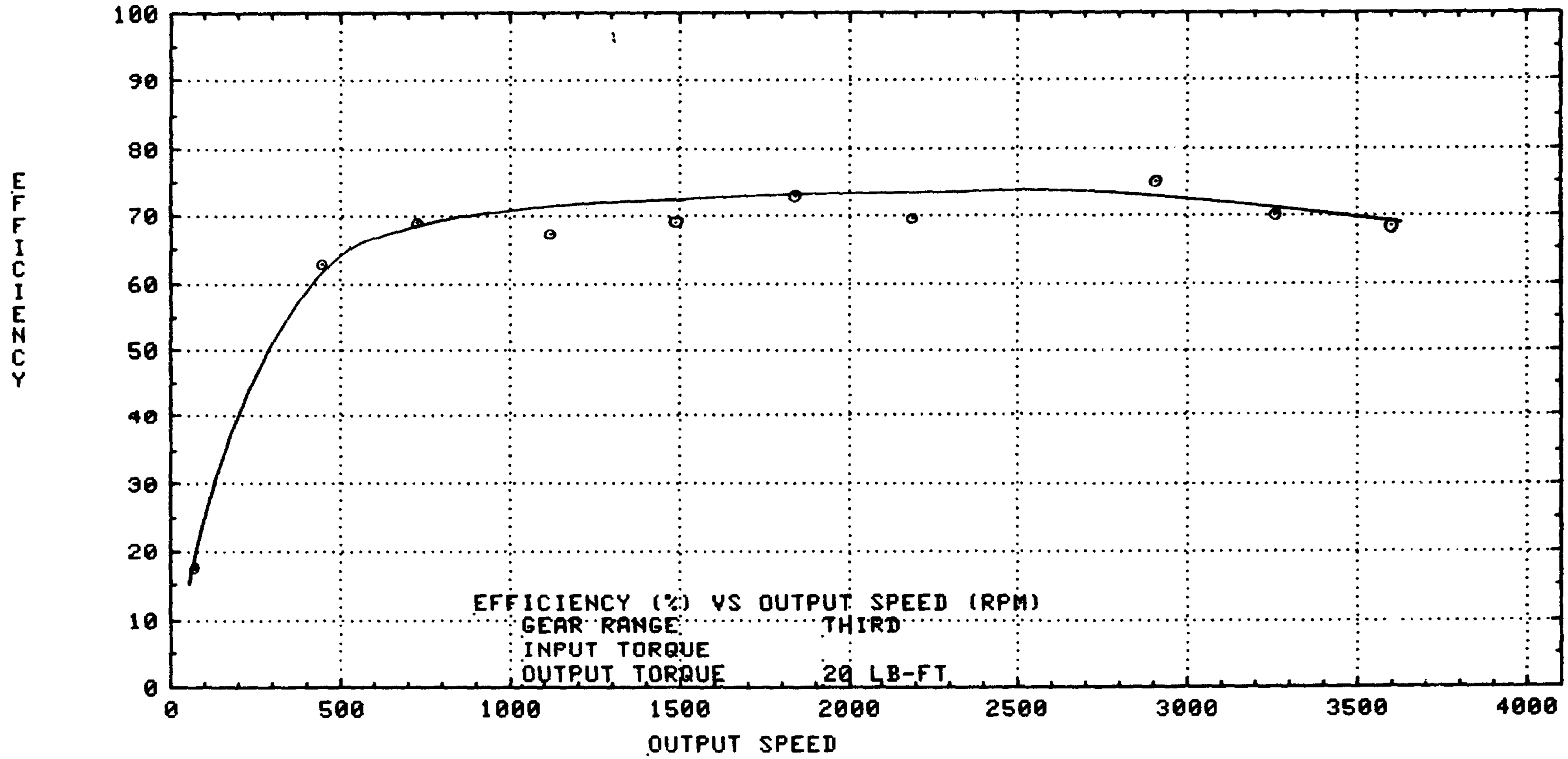


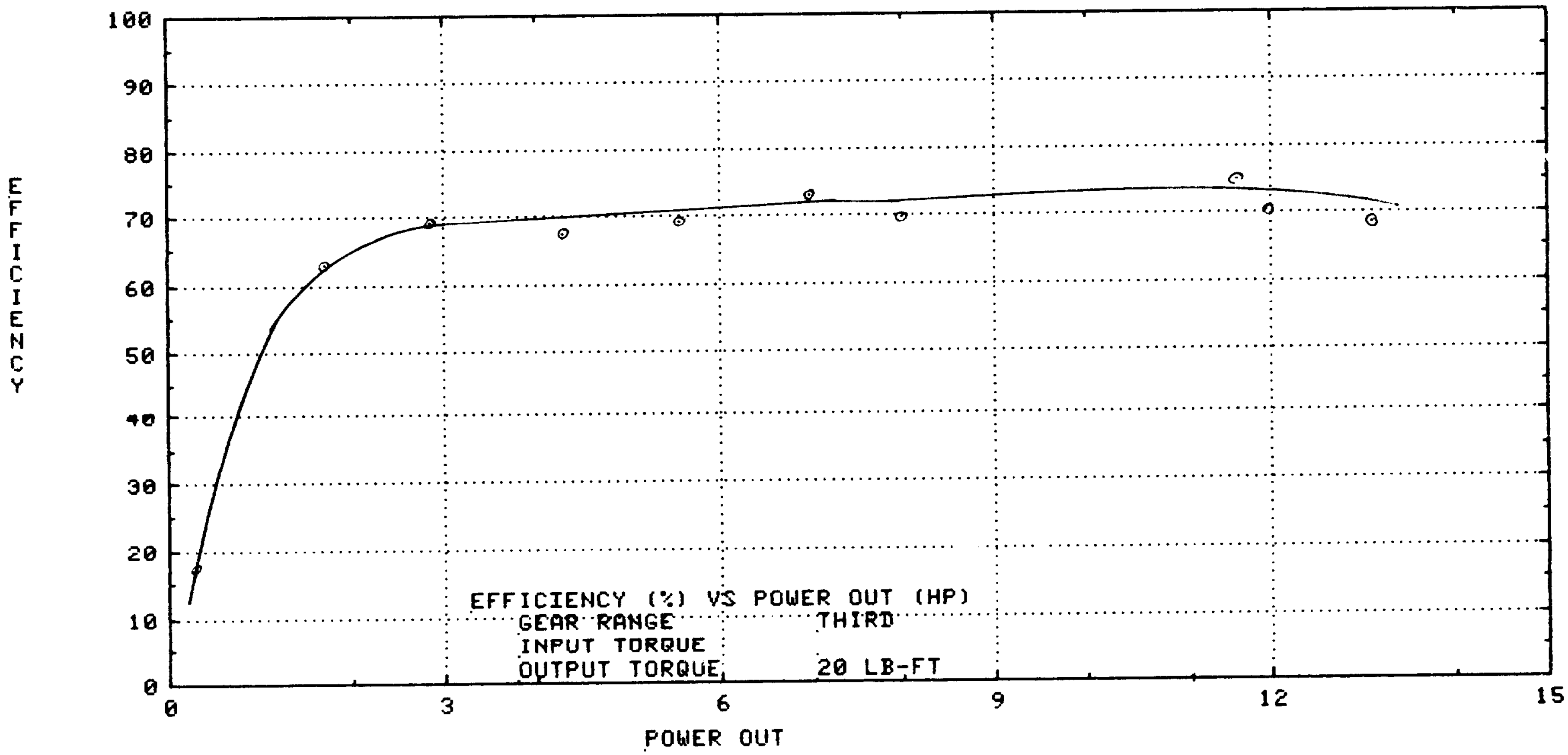
TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 20 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
TORQUE RATIO
0 500 1000 1500 2000 2500 3000 3500 4000
0.0 .5 1.0 1.5 2.0 2.5


INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 20 LB-FT
INPUT TORQUE
OUTPUT SPEED
0
10
20
30
0
500
1000
1500
2000
2500
3000
3500
4000

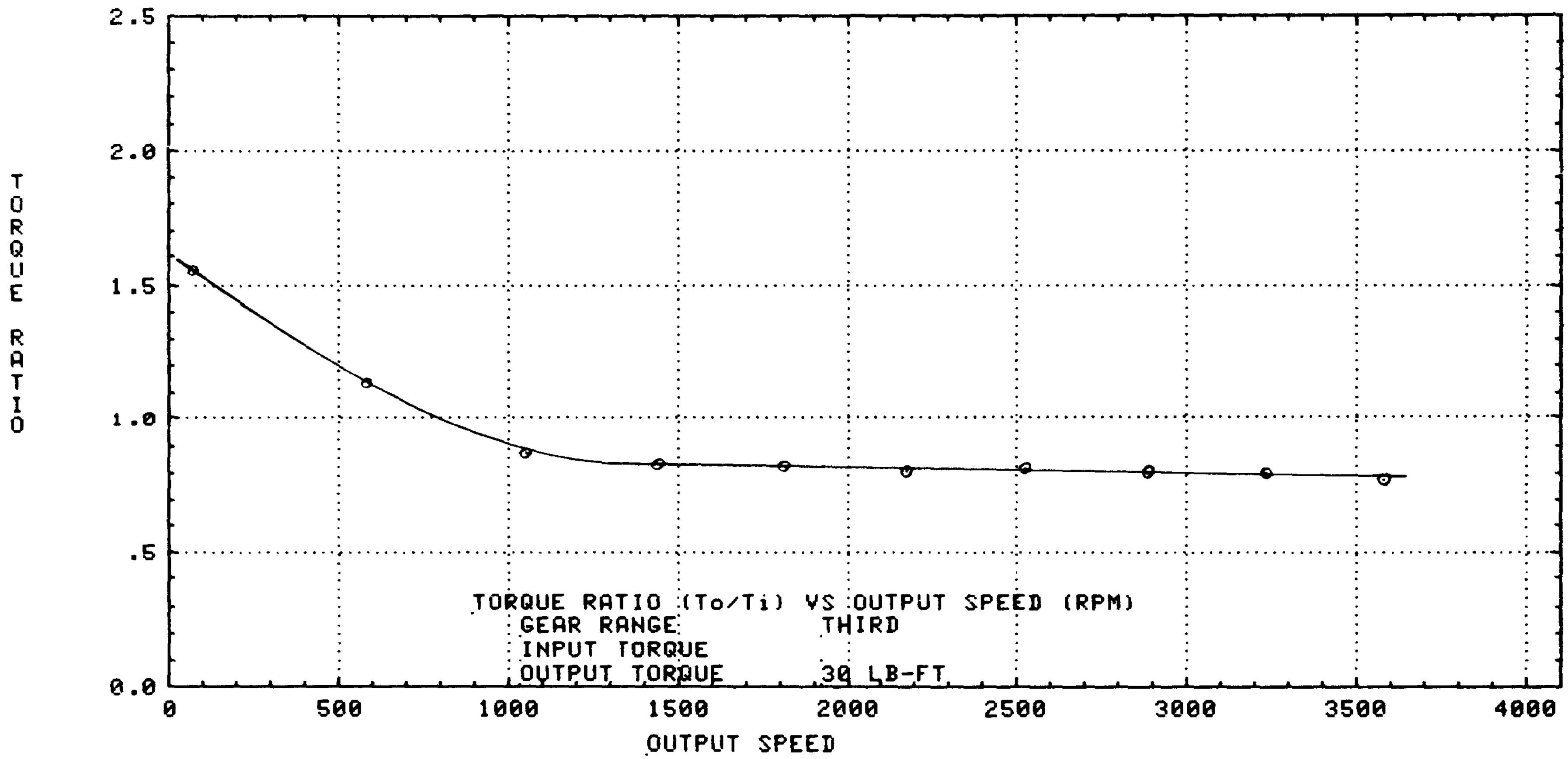


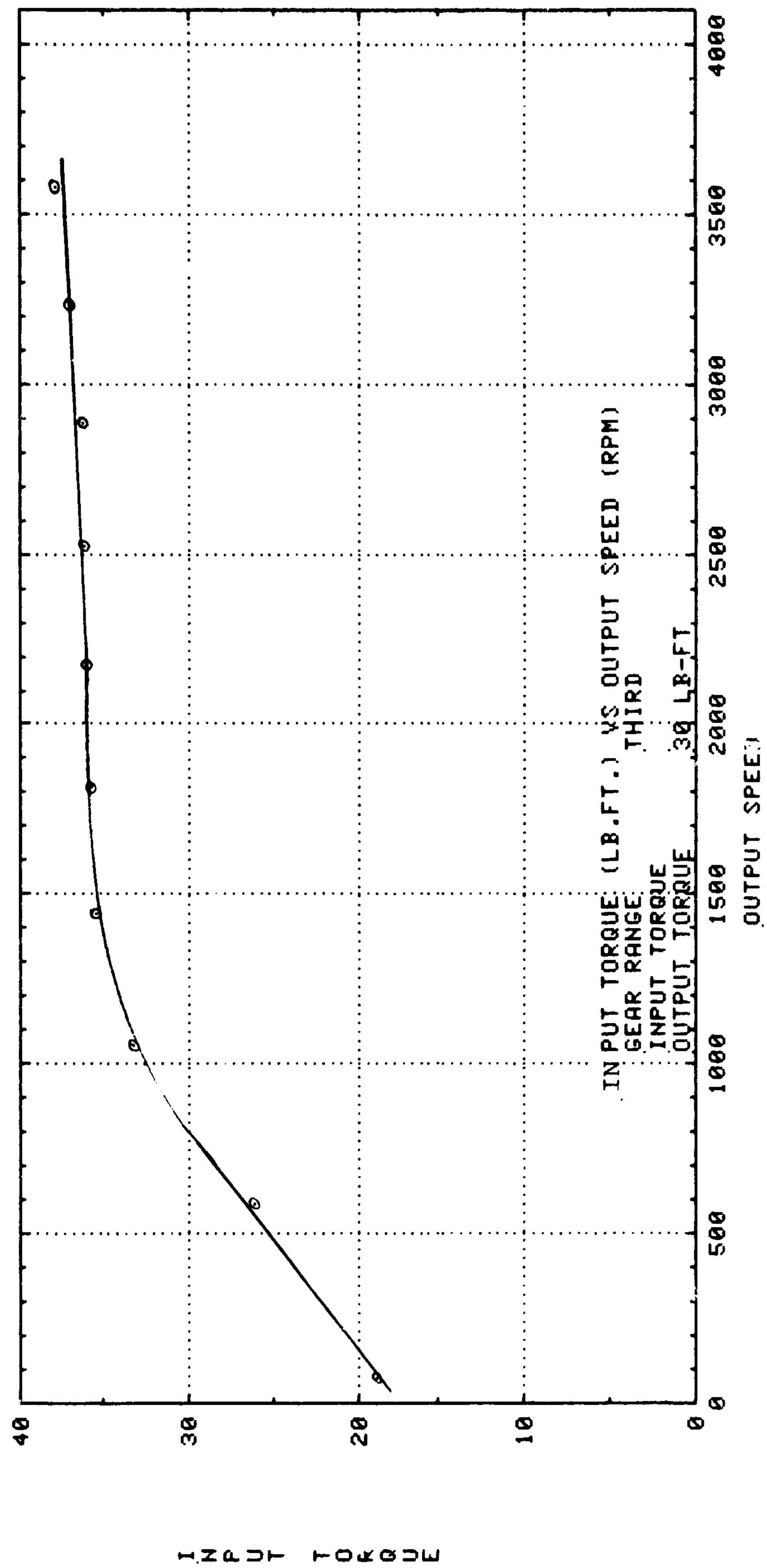
INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 20 LB-FT
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

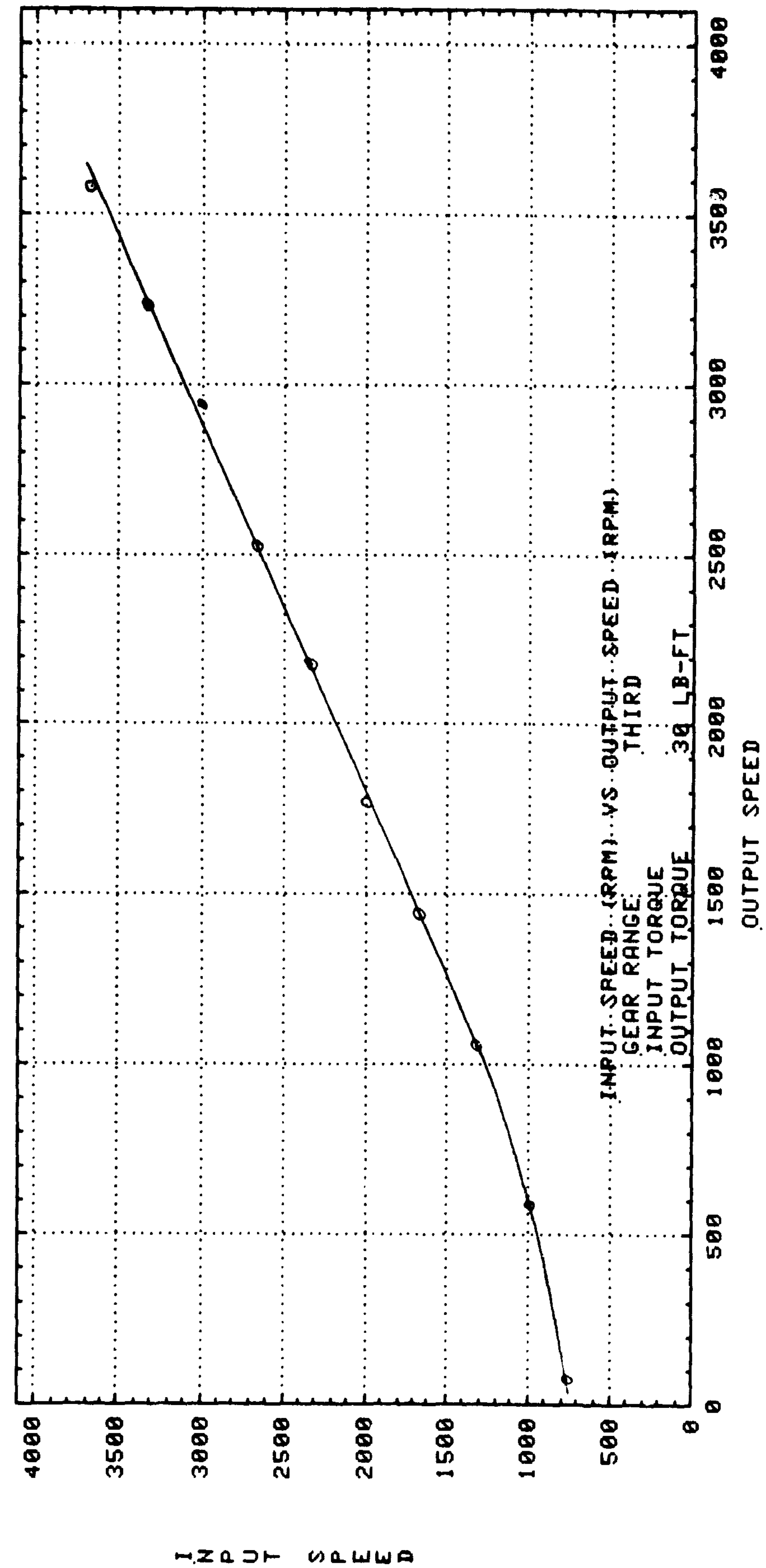

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 20 LB-FT
EFFICIENCY
OUTPUT SPEED
0
10
20
30
40
50
60
70
80
90
100
0
500
1000
1500
2000
2500
3000
3500
4000

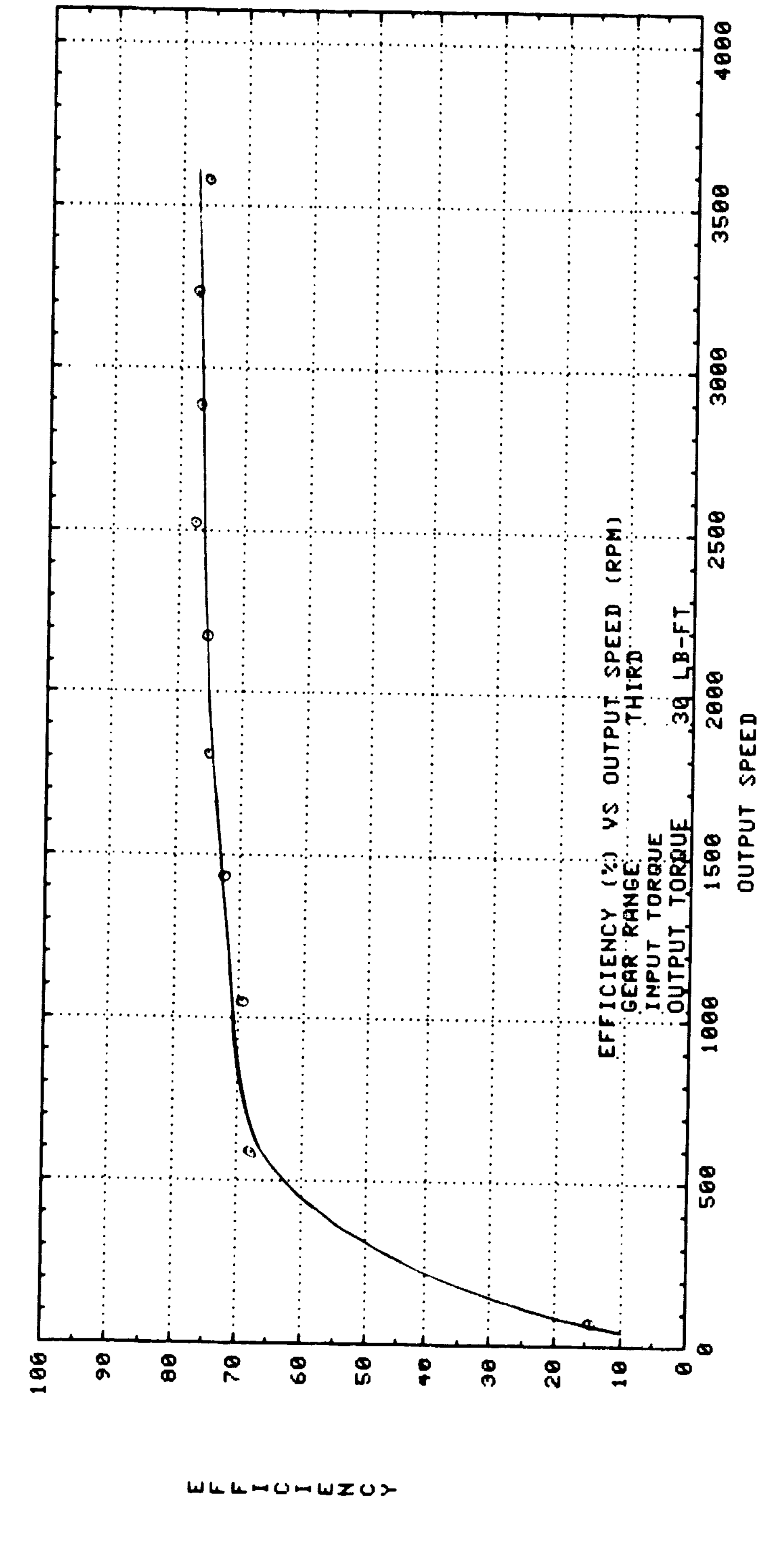


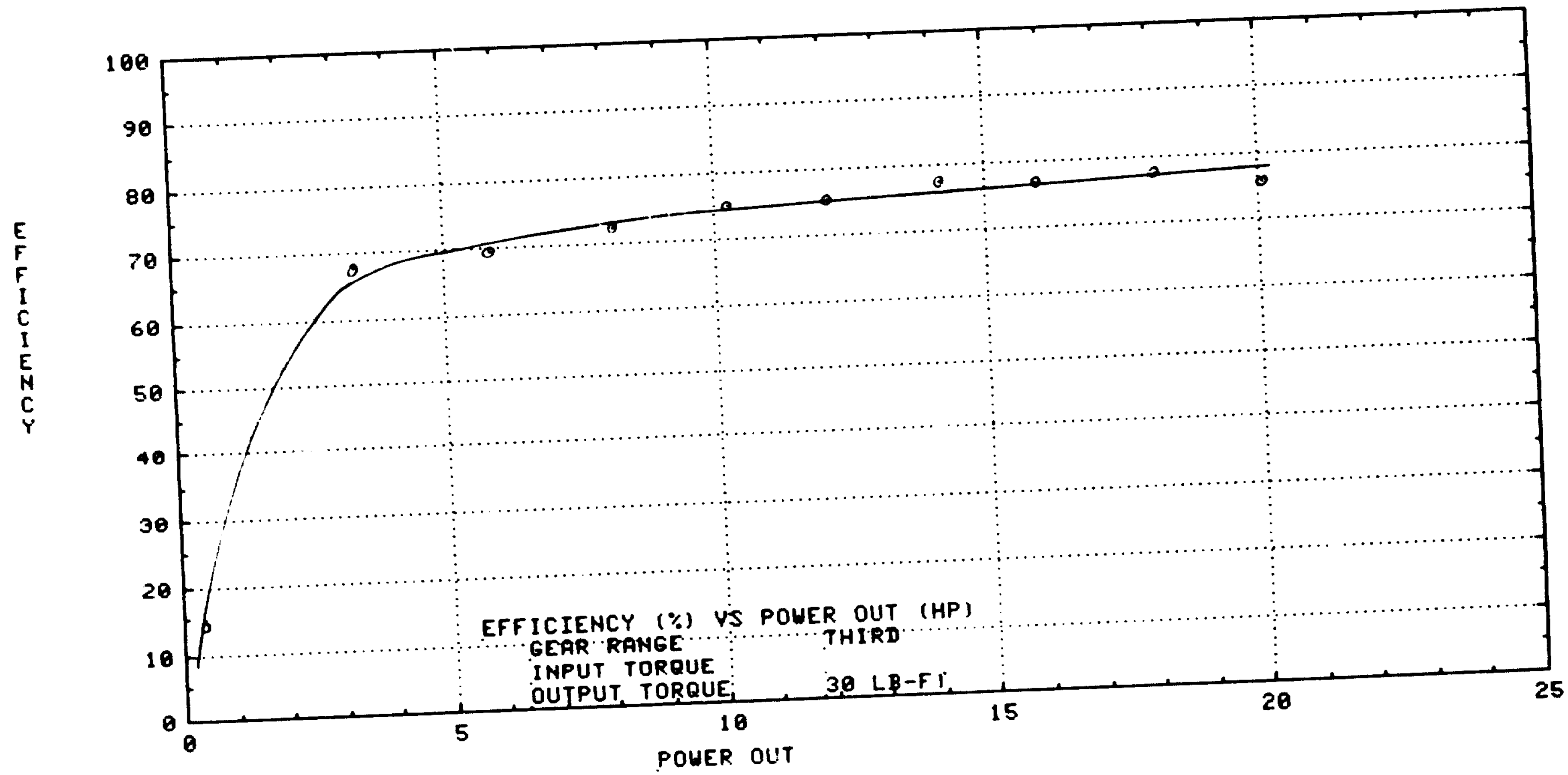
EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 20 LB-FT
EFFICIENCY
POWER OUT
100
90
80
70
60
50
40
30
20
10
0
3
6
9
12
15

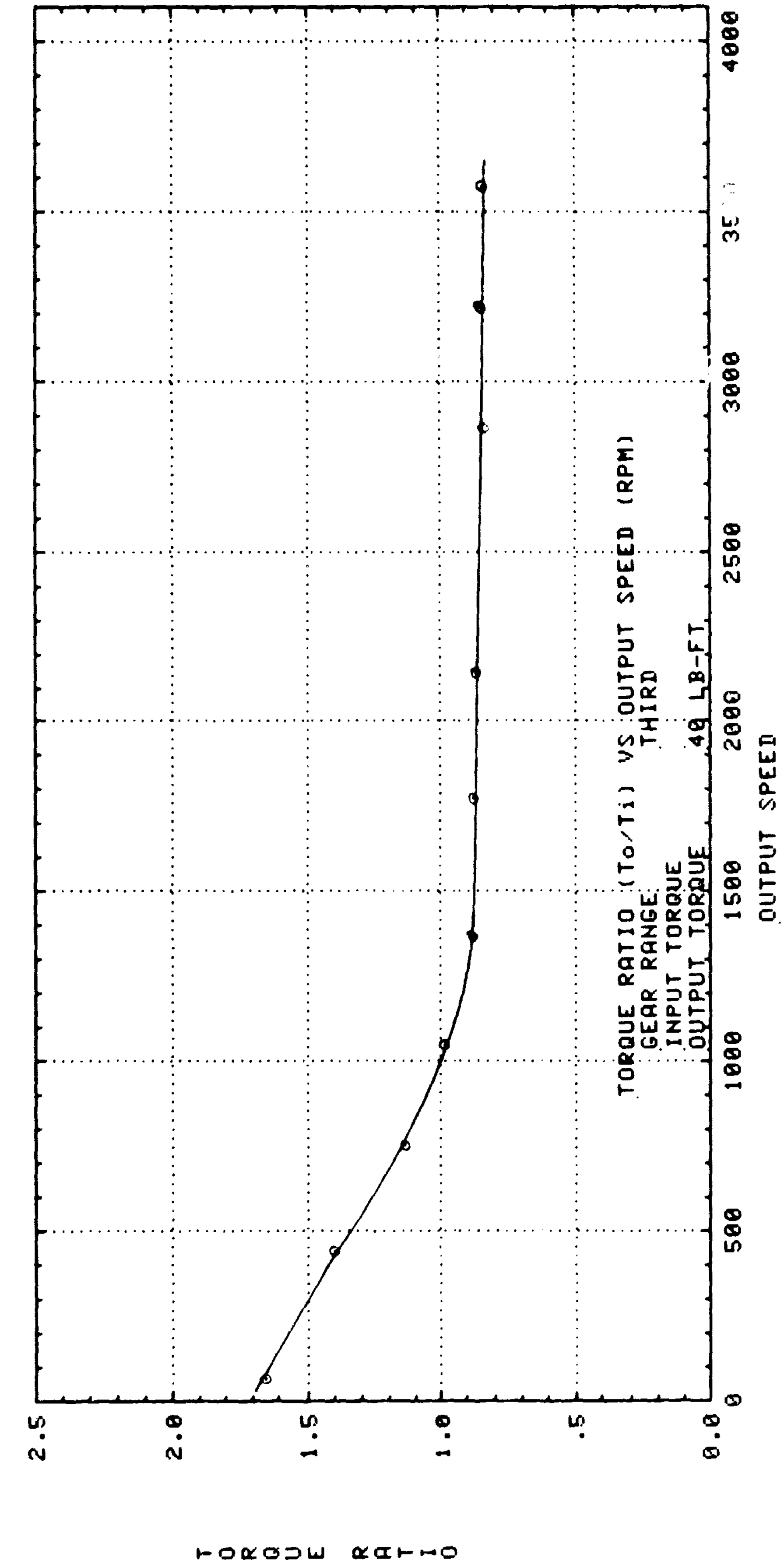

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 30 LB-FT
TORQUE RATIO
OUTPUT SPEED
0.0
.5
1.0
1.5
2.0
2.5
0
500
1000
1500
2000
2500
3000
3500
4000

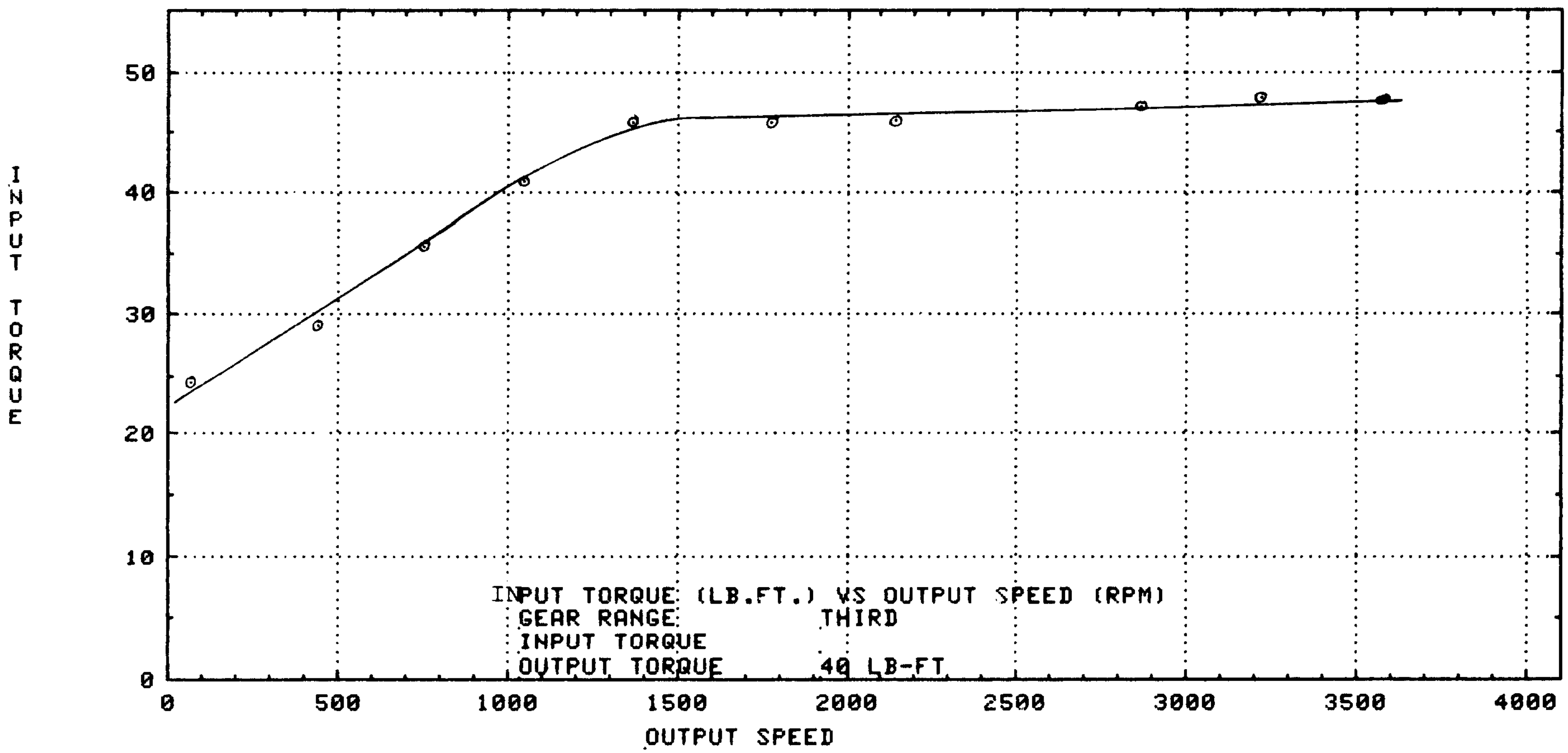

INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 30 LB-FT
OUTPUT SPEED
INPUT TORQUE
0
500
1000
1500
2000
2500
3000
3500
4000
0
10
20
30
40


INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 30 LB-FT
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

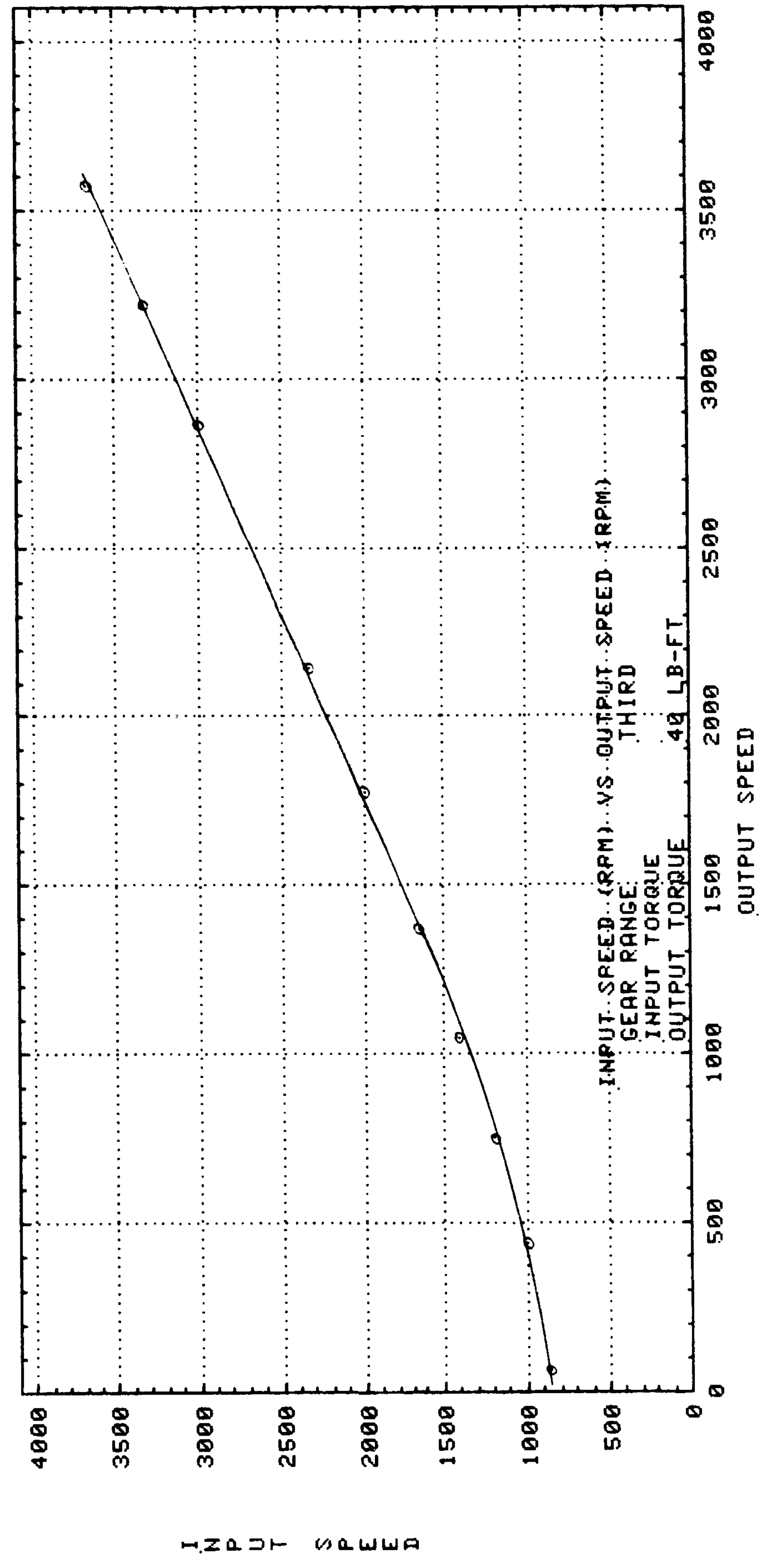

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 30 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
EFFICIENCY
0 500 1000 1500 2000 2500 3000 3500 4000
0 10 20 30 40 50 60 70 80 90 100


EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 30 LB-FT
EFFICIENCY
POWER OUT
100
90
80
70
60
50
40
30
20
10
0
0
5
10
15
20
25

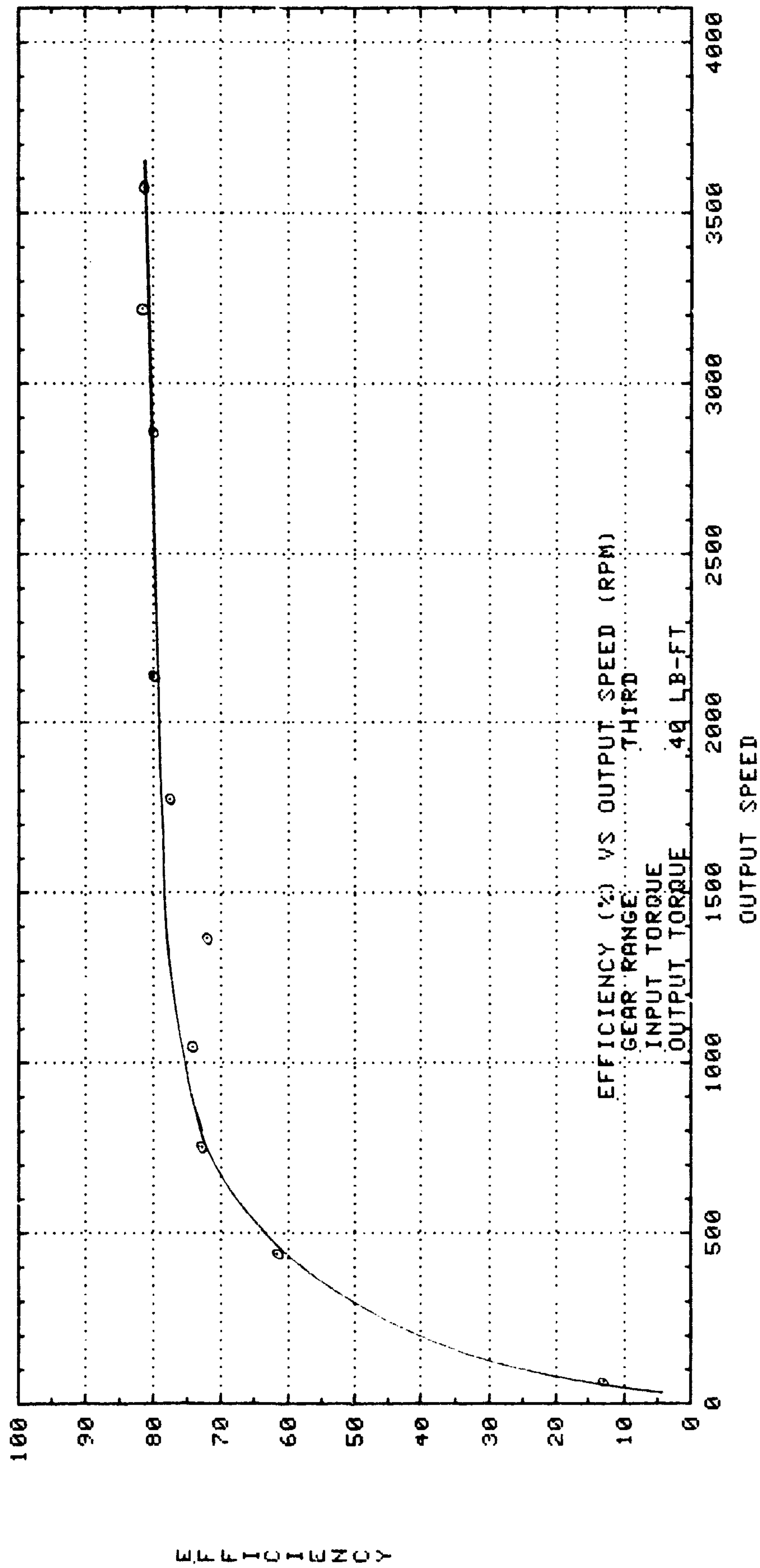

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 40 LB-FT
OUTPUT SPEED
TORQUE RATIO
0.0
.5
1.0
1.5
2.0
2.5
0
500
1000
1500
2000
2500
3000
3500
4000

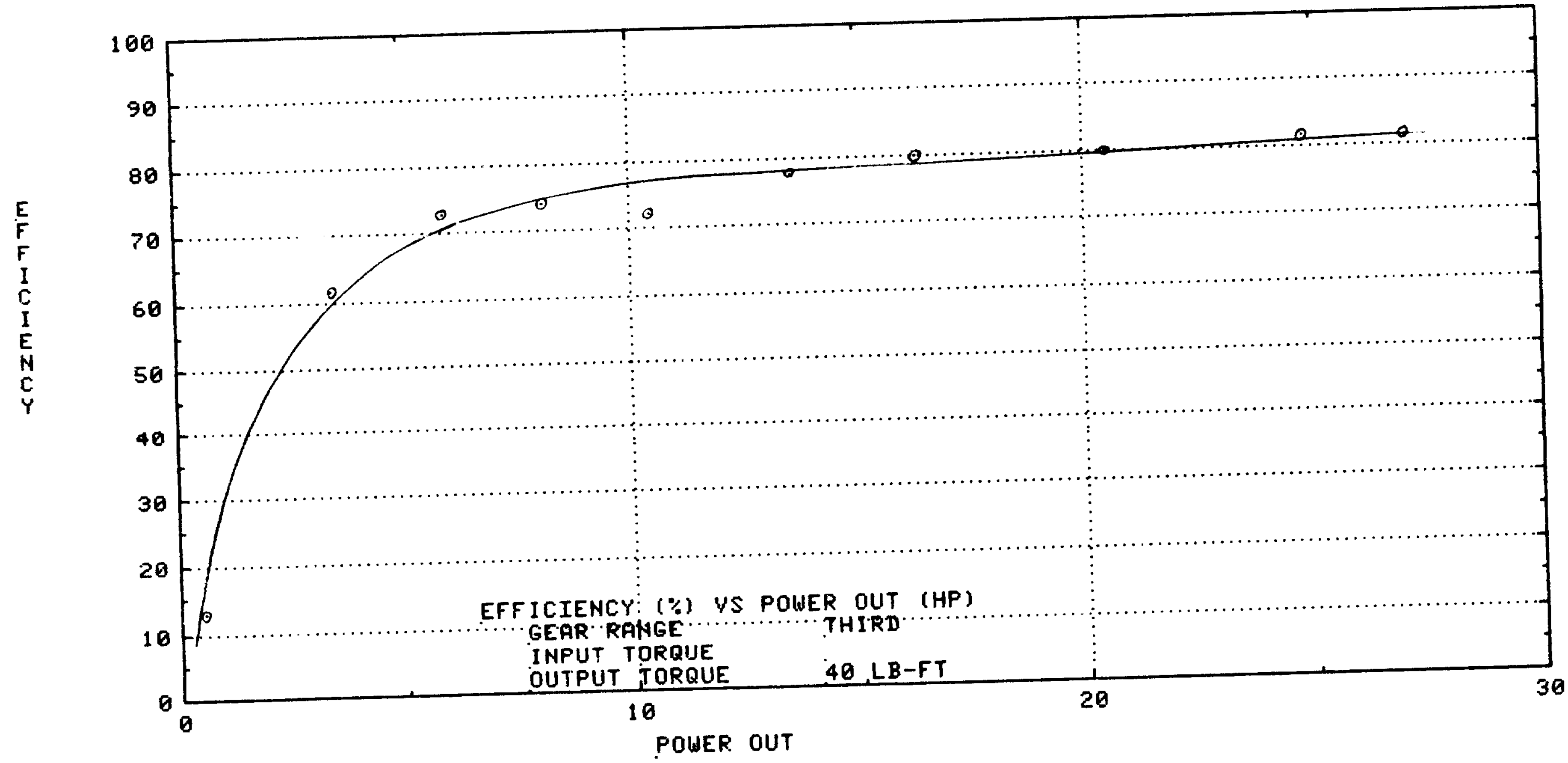


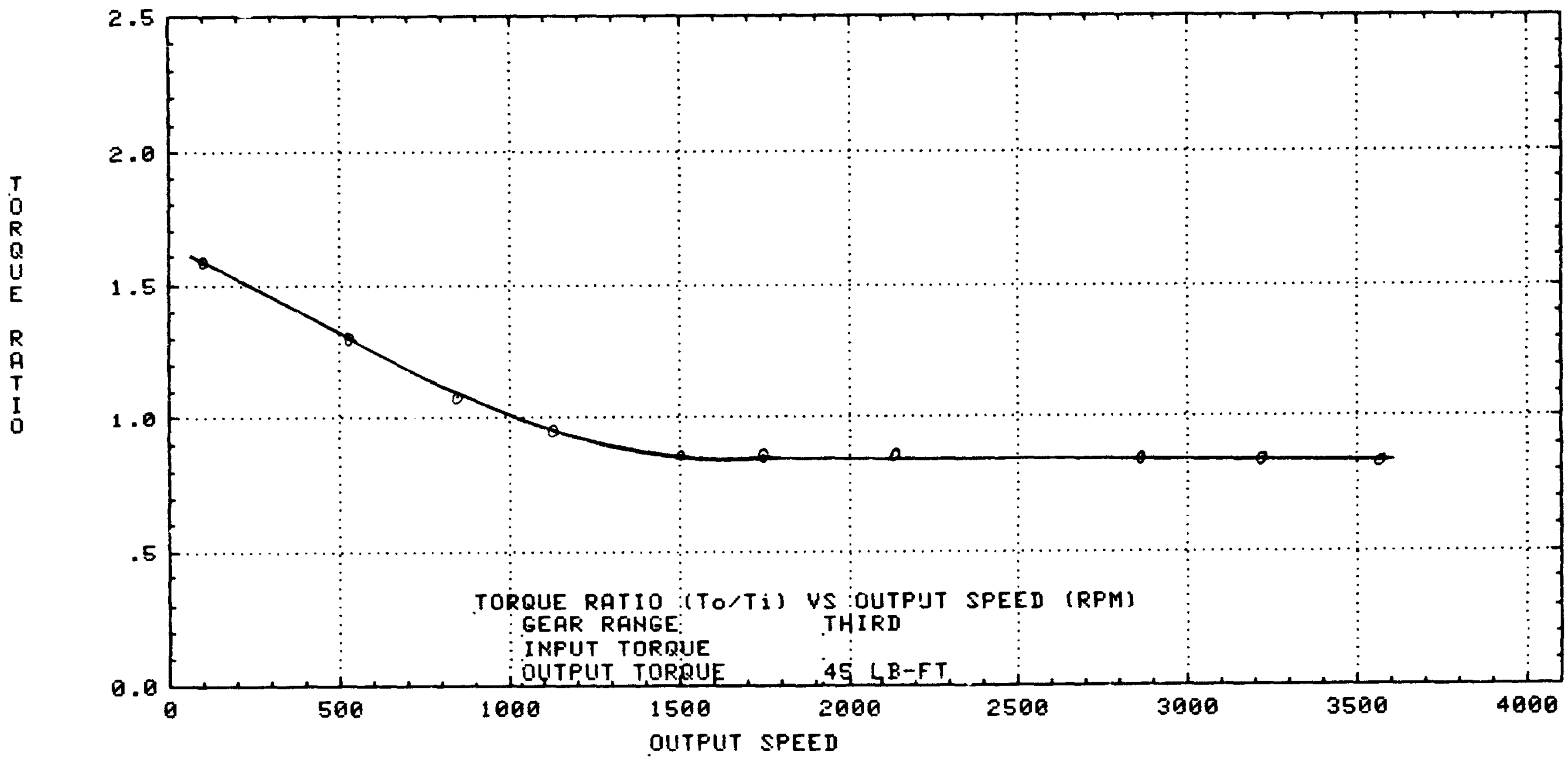
INPUT TORQUE
OUTPUT SPEED
0
10
20
30
40
50
0
500
1000
1500
2000
2500
3000
3500
4000
INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 40 LB-FT

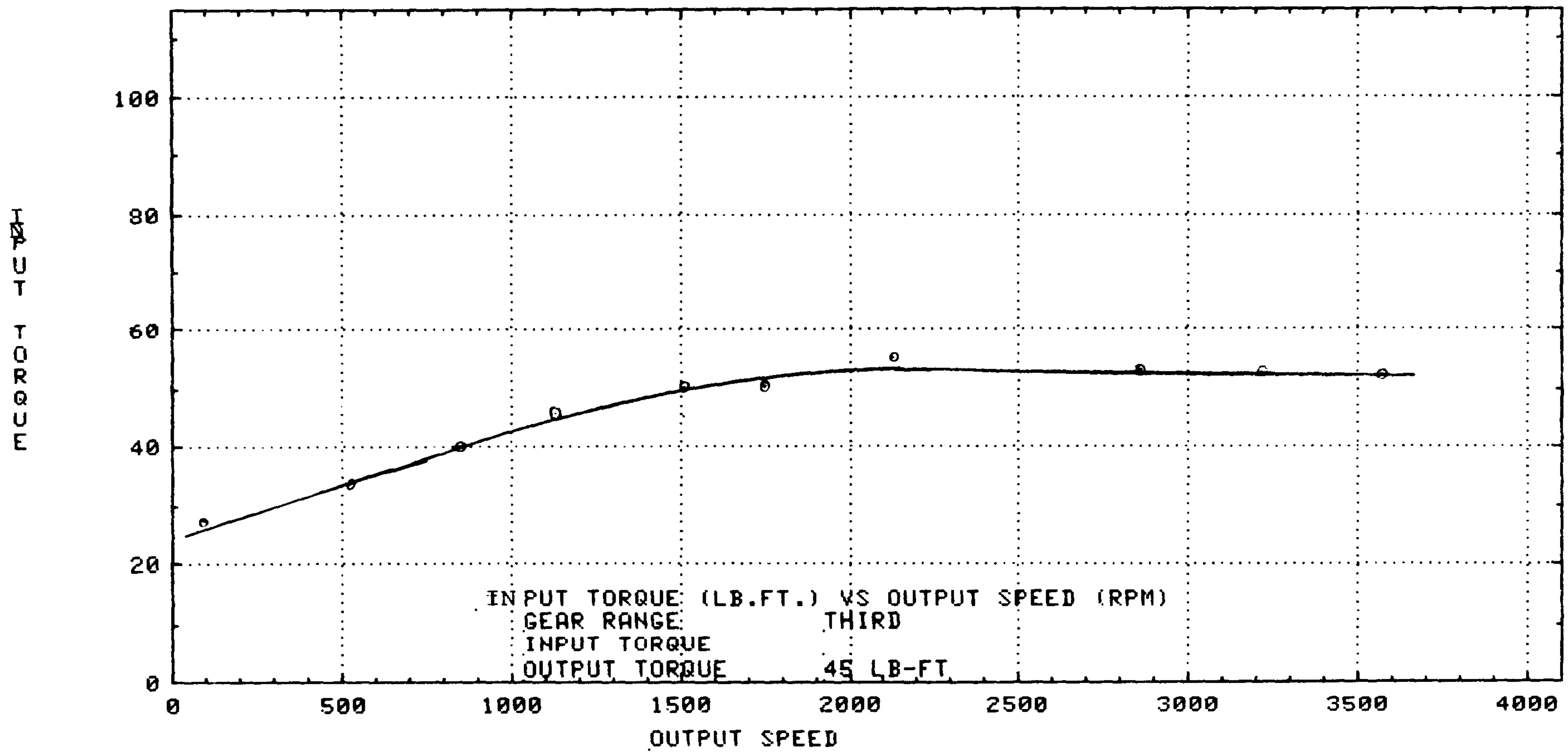


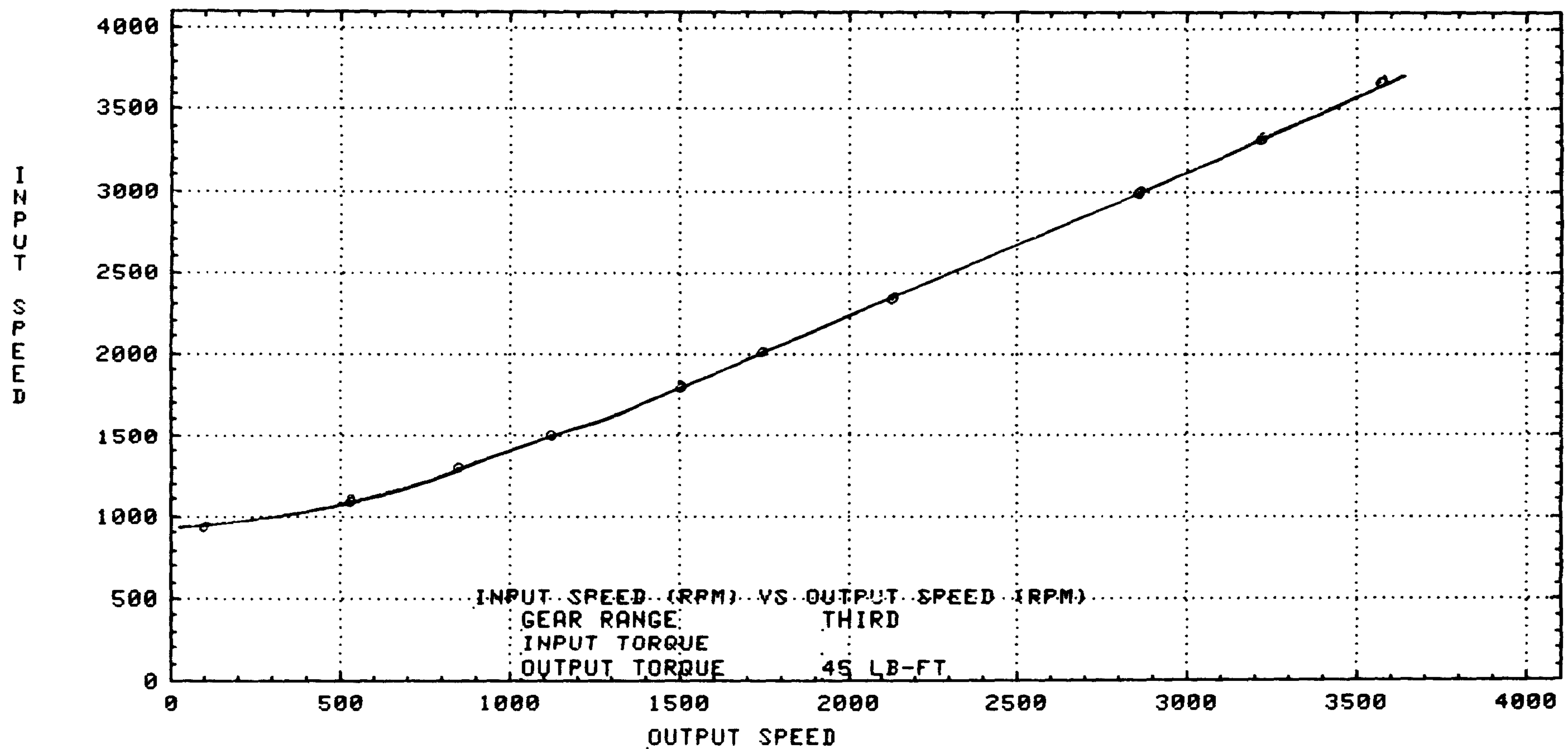
INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 40 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

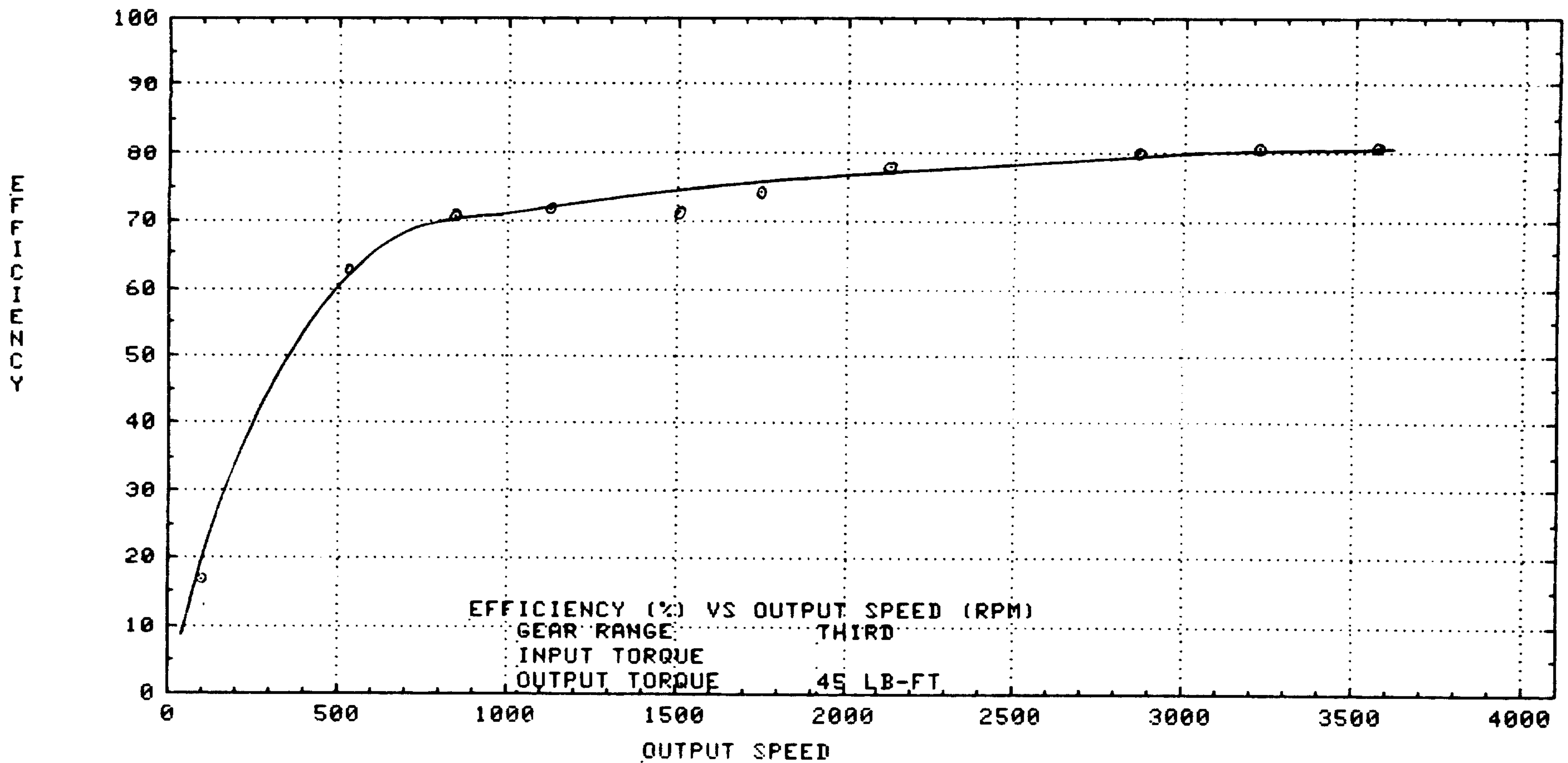

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 40 LB-FT
OUTPUT SPEED
EFFICIENCY
0
500
1000
1500
2000
2500
3000
3500
4000
0
10
20
30
40
50
60
70
80
90
100

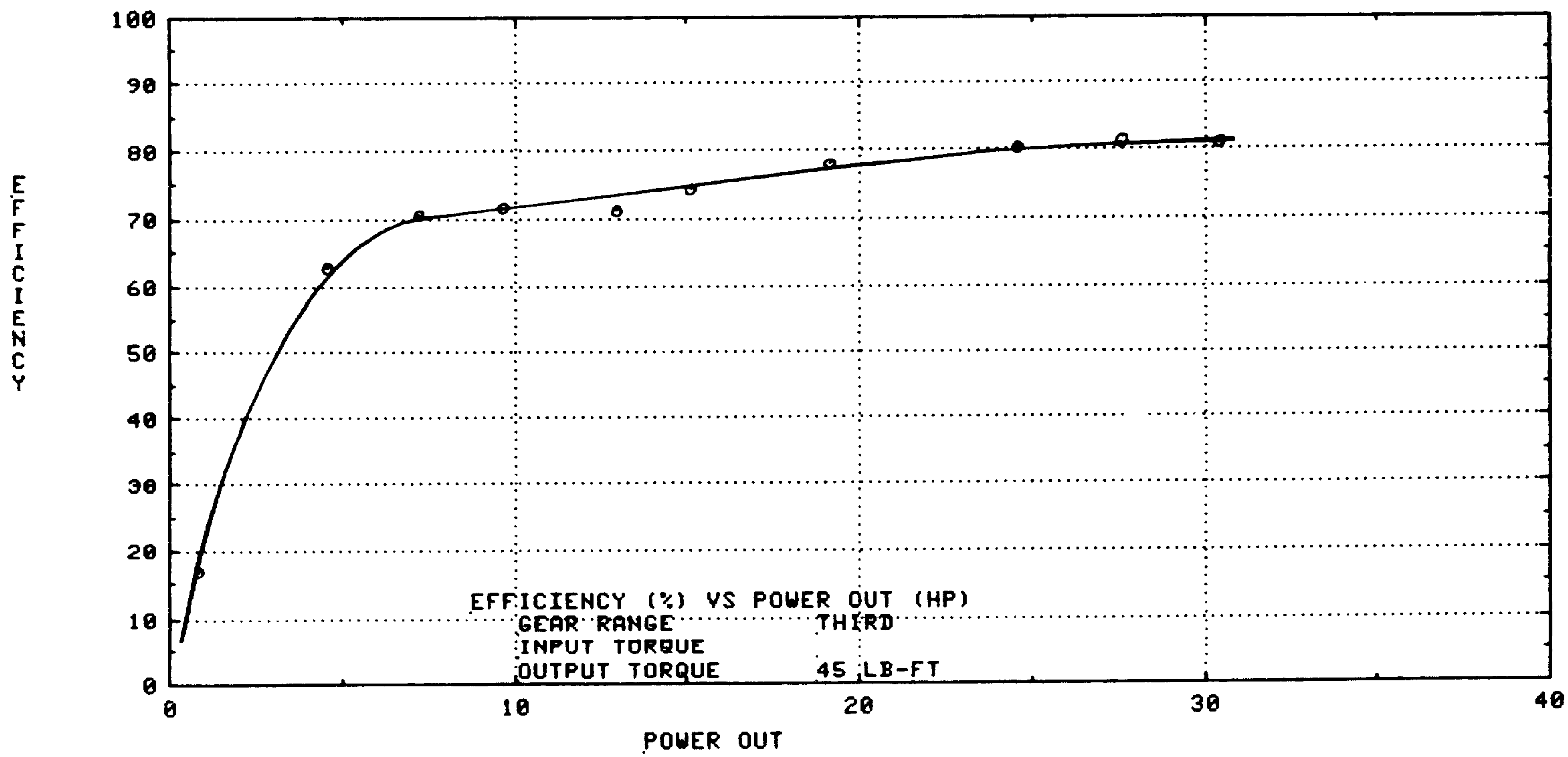

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 40 LB-FT
EFFICIENCY
POWER OUT
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30

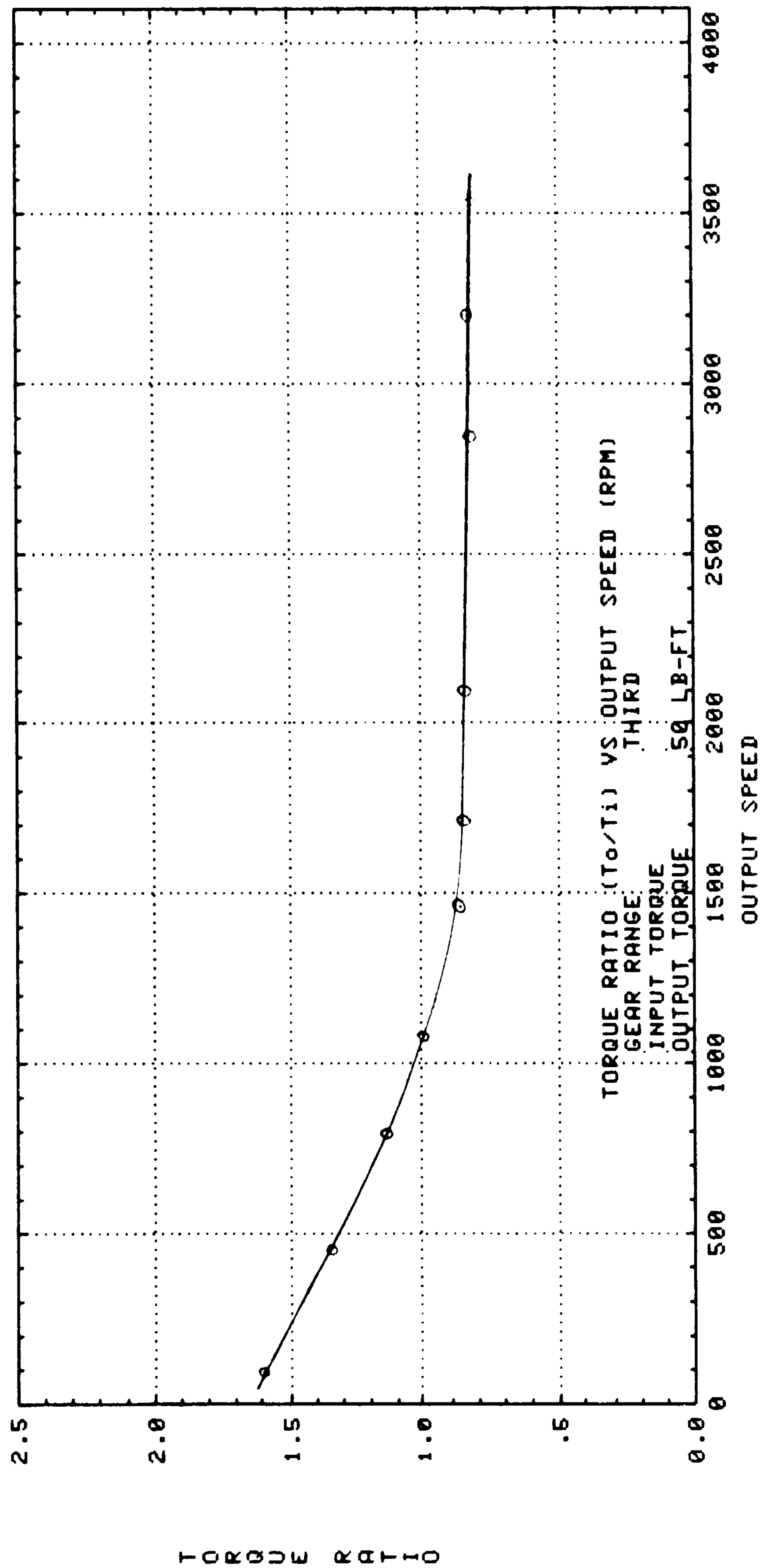

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 45 LB-FT
TORQUE RATIO
OUTPUT SPEED
2.5
2.0
1.5
1.0
.5
0.0
0
500
1000
1500
2000
2500
3000
3500
4000


INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 45 LB-FT
INPUT TORQUE
OUTPUT SPEED
0
20
40
60
80
100
500
1000
1500
2000
2500
3000
3500
4000

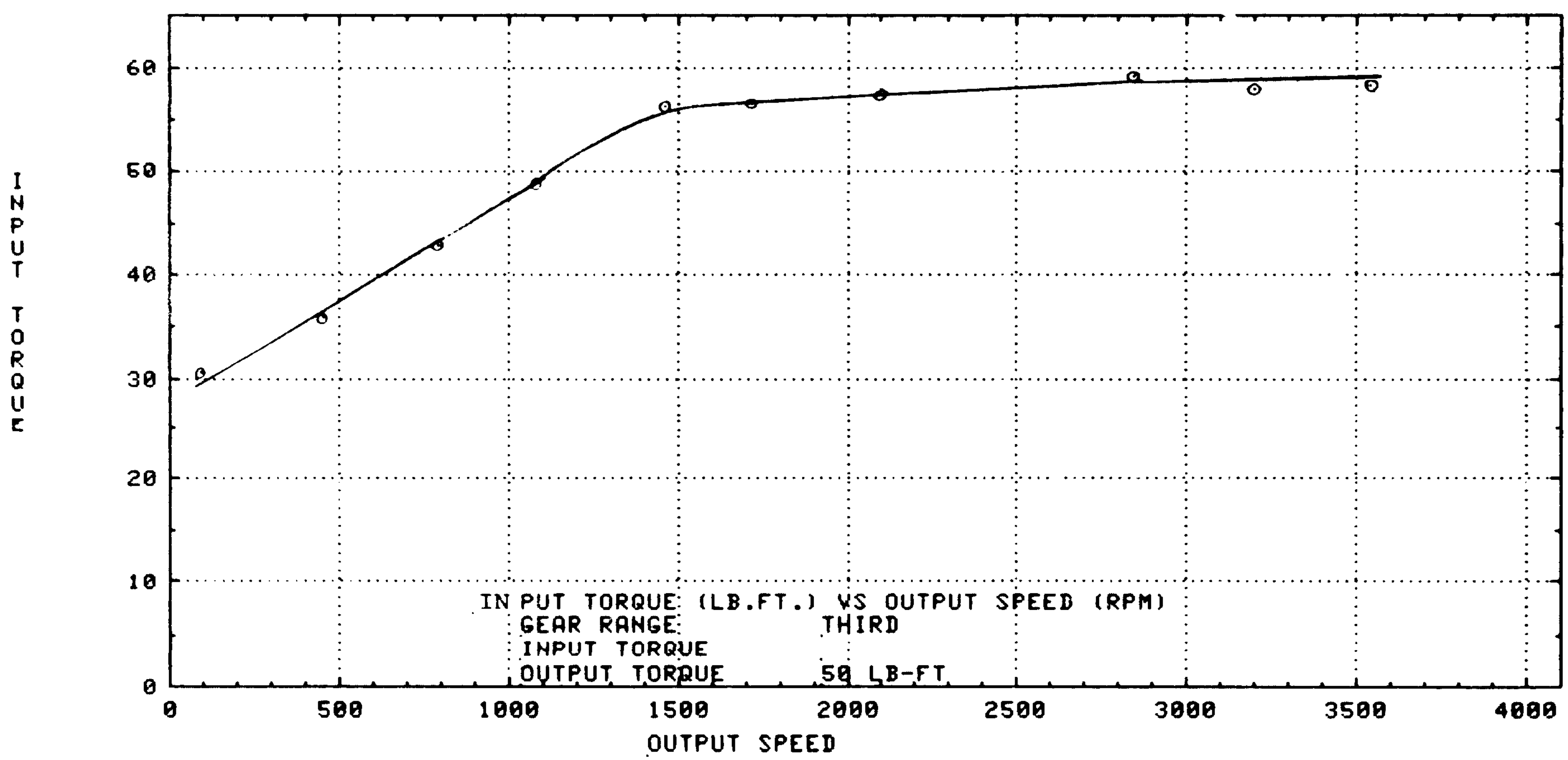

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 45 LB-FT
INPUT SPEED
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

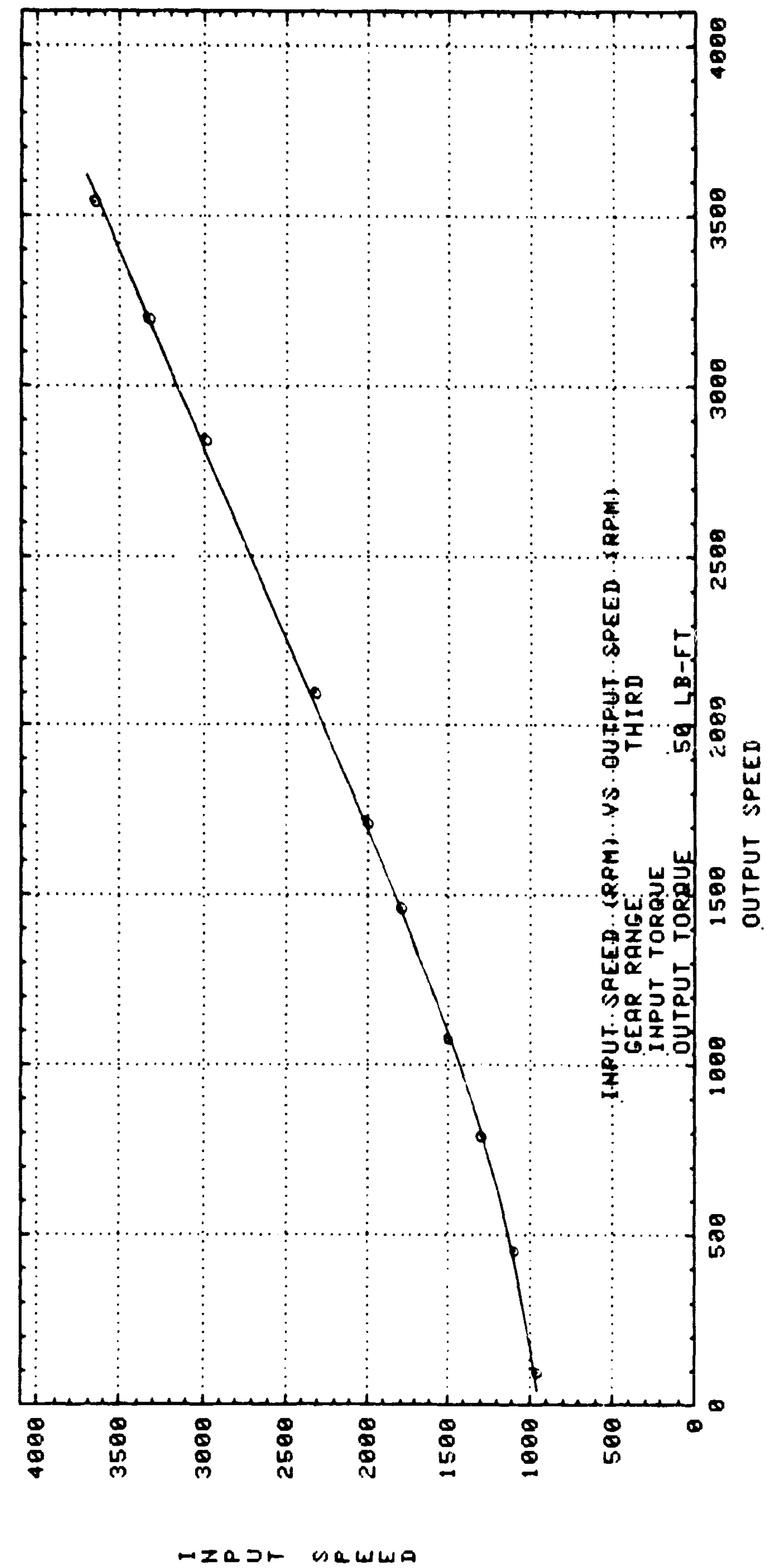

EFFICIENCY
100
90
80
70
60
50
40
30
20
10
0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 45 LB-FT

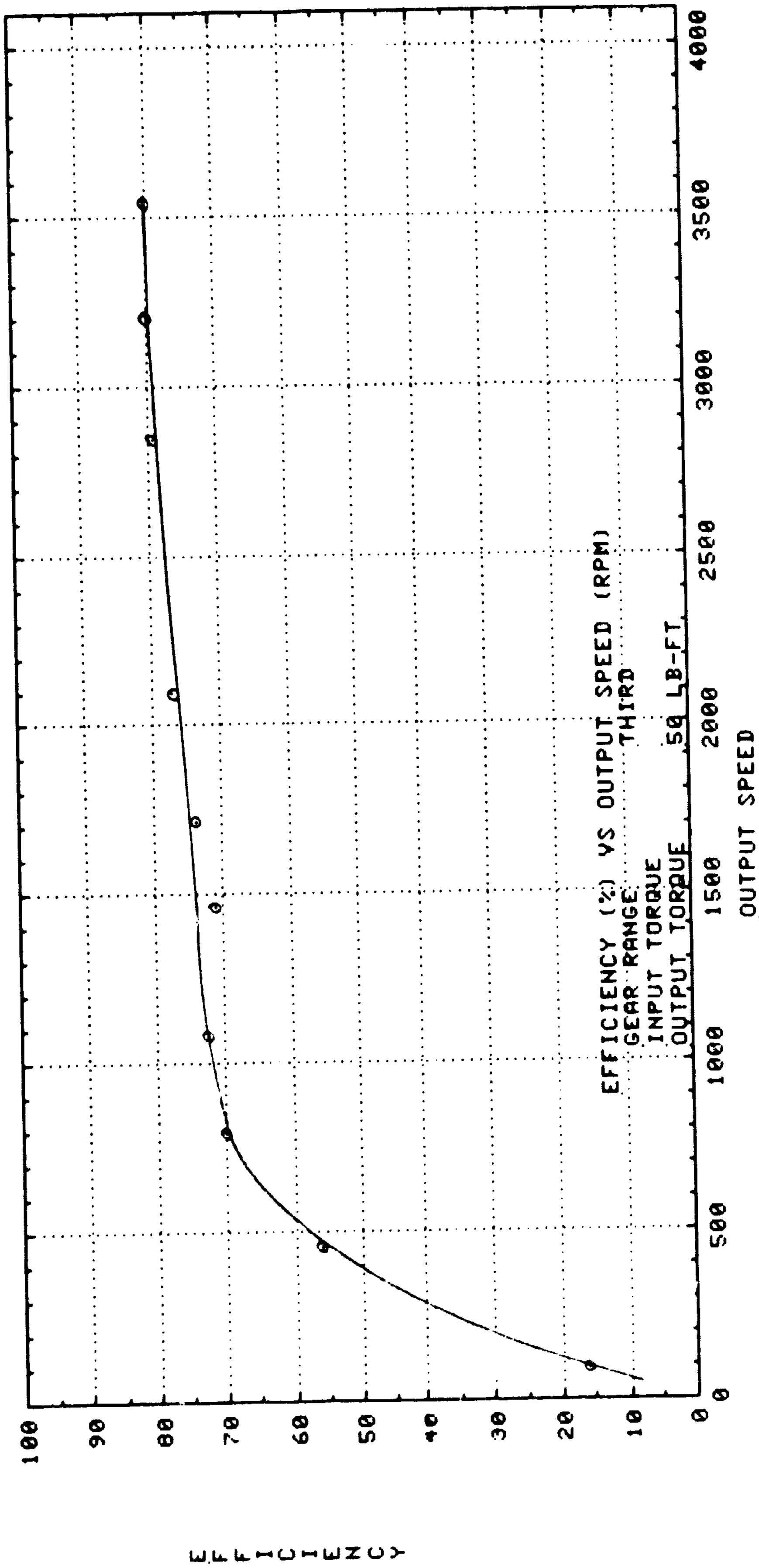

EFFICIENCY
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
POWER OUT
EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 45 LB-FT

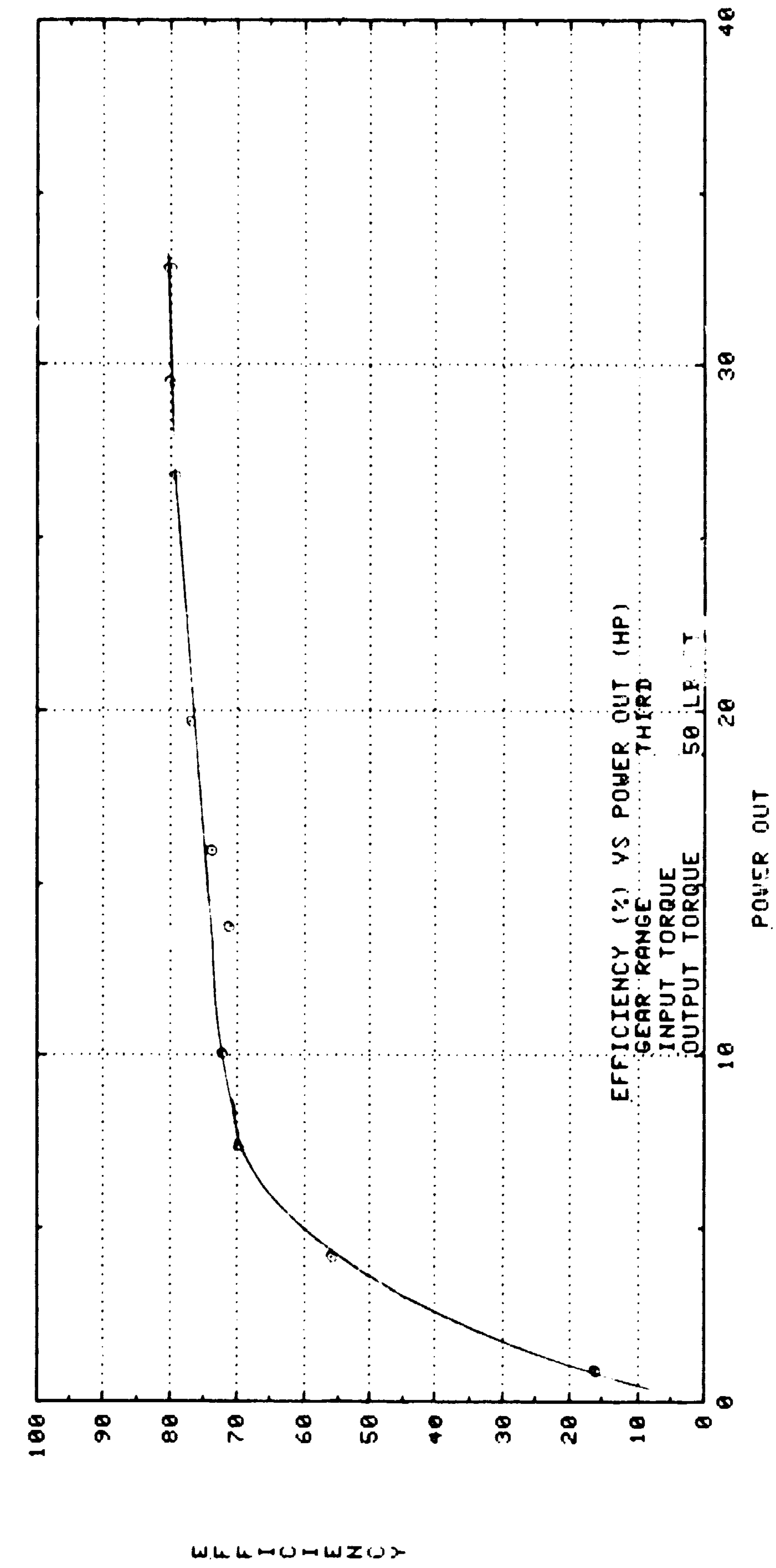


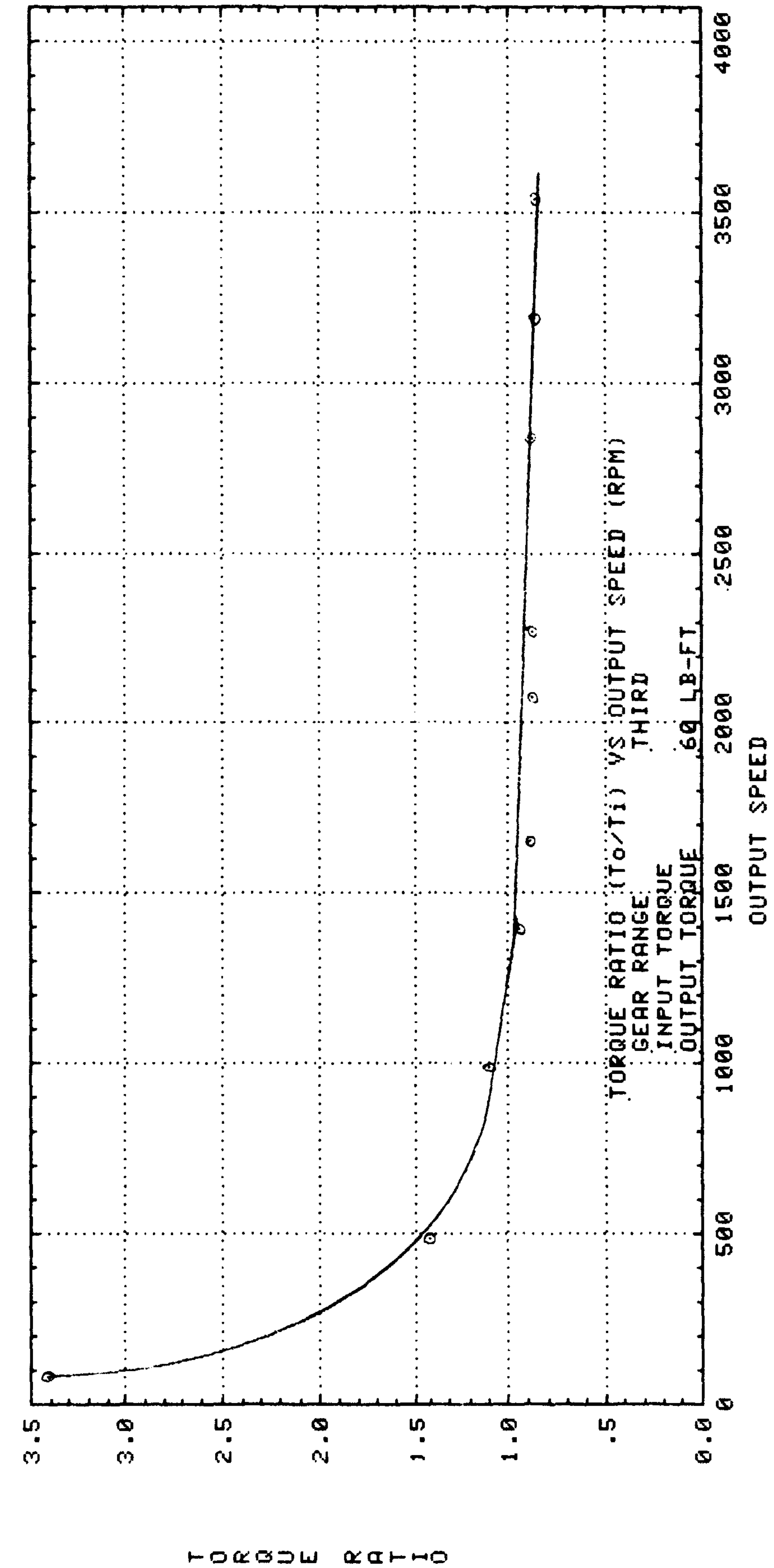
TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 50 LB-FT
OUTPUT SPEED
TORQUE RATIO
0
500
1000
1500
2000
2500
3000
3500
4000
0.0
.5
1.0
1.5
2.0
2.5


INPUT TORQUE
60
50
40
30
20
10
0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 50 LB-FT

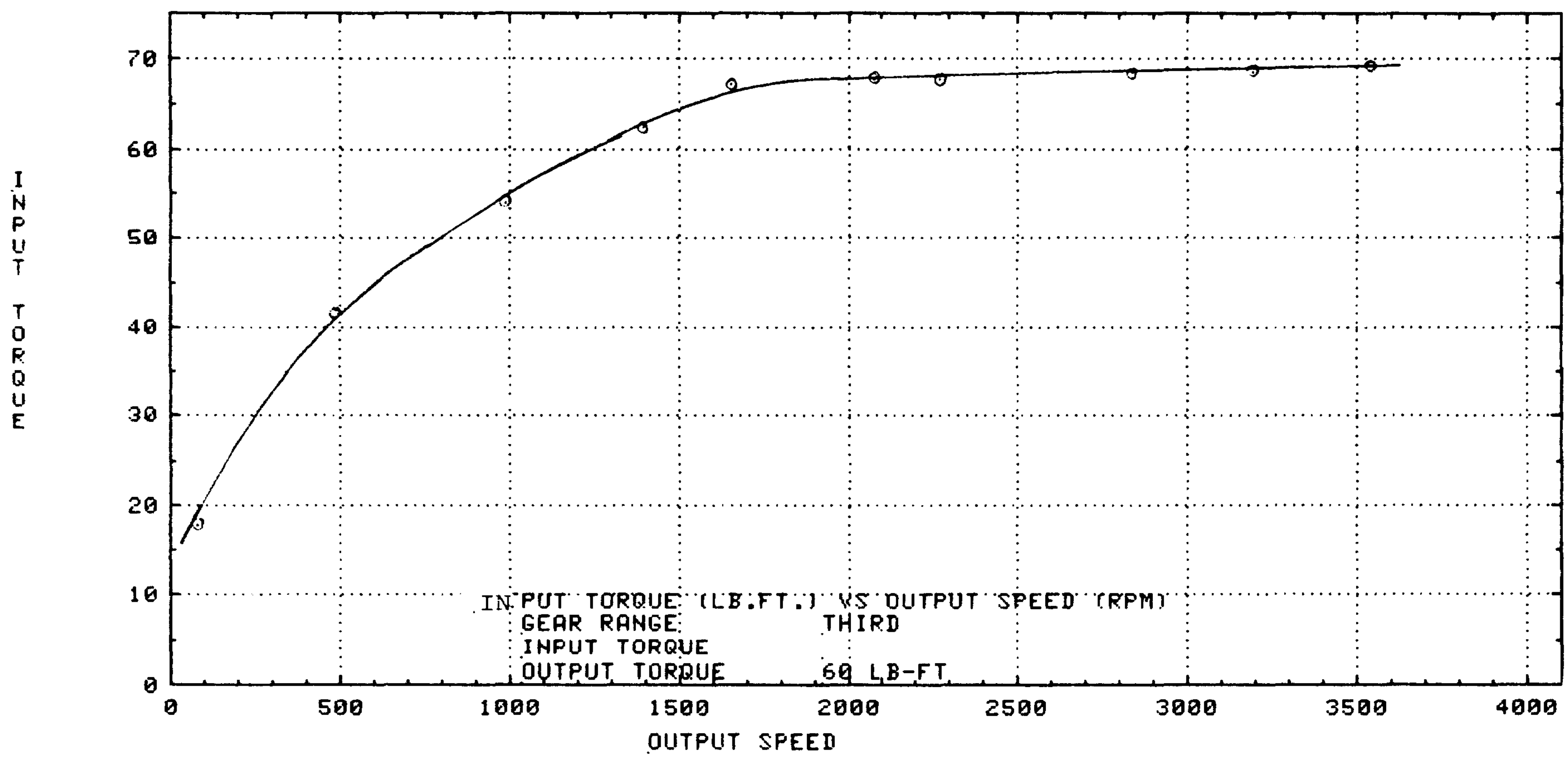

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 50 LB-FT
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

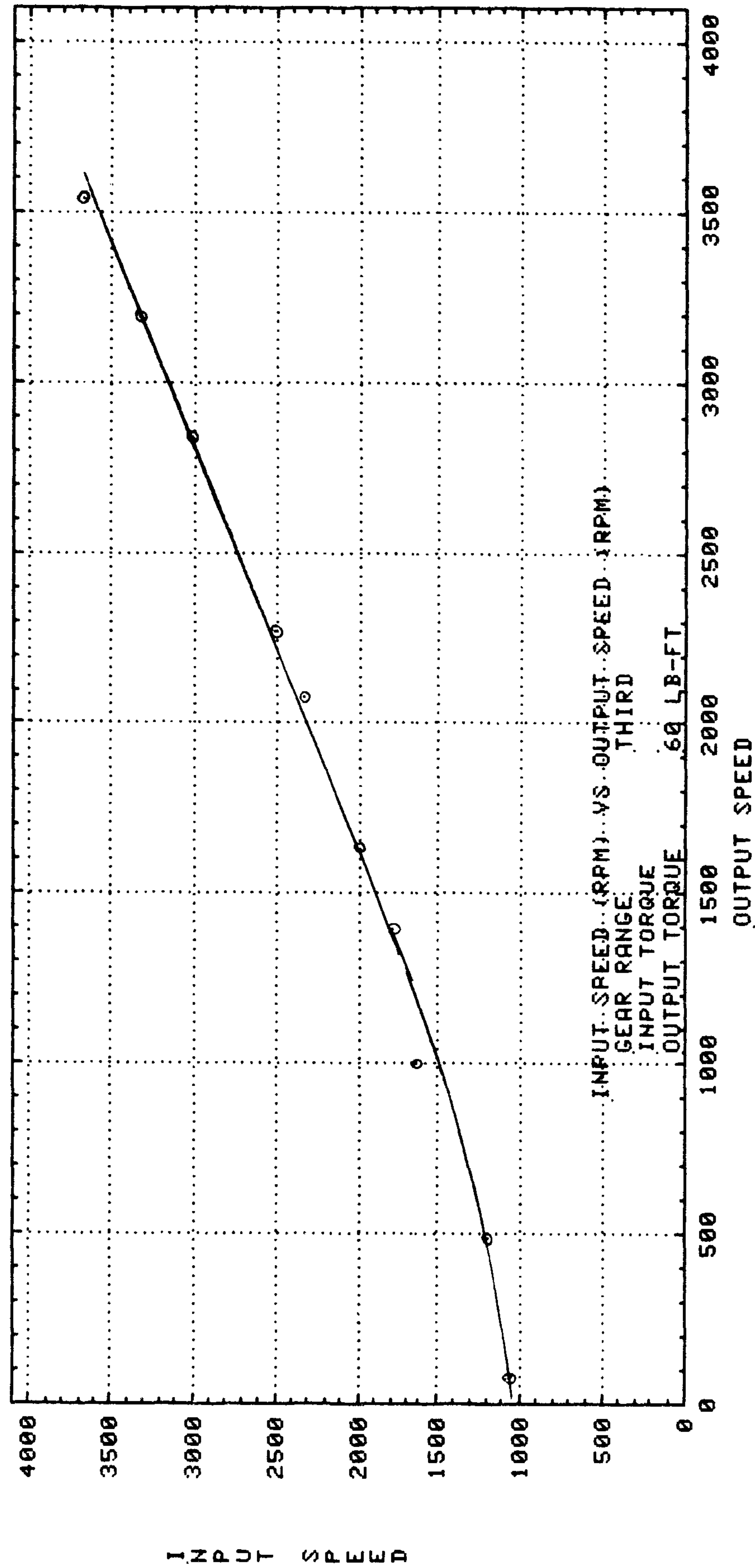

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 50 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
0 500 1000 1500 2000 2500 3000 3500 4000
EFFICIENCY
0 10 20 30 40 50 60 70 80 90 100

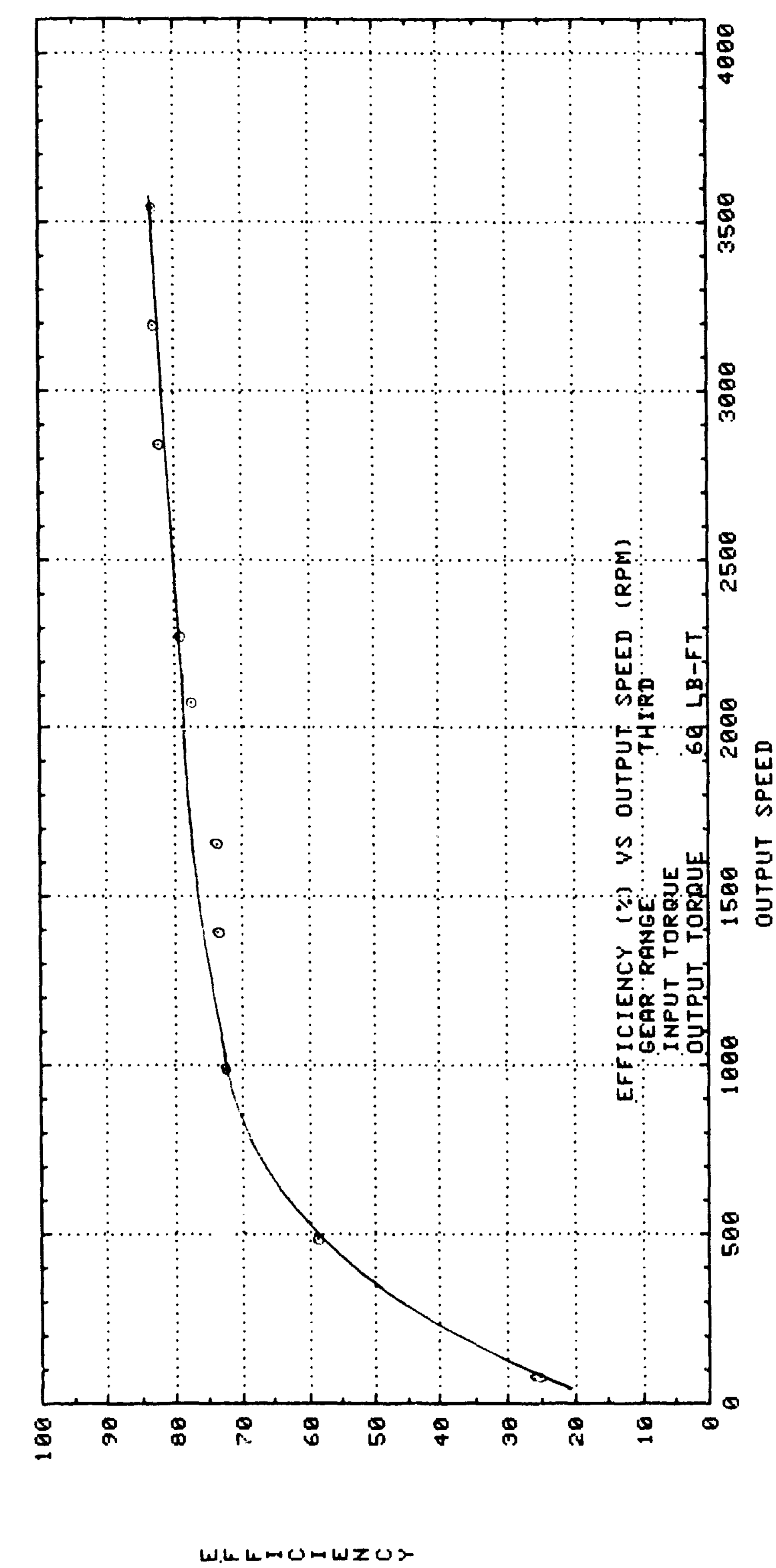

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 50 LB
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
POWER OUT
EFFICIENCY

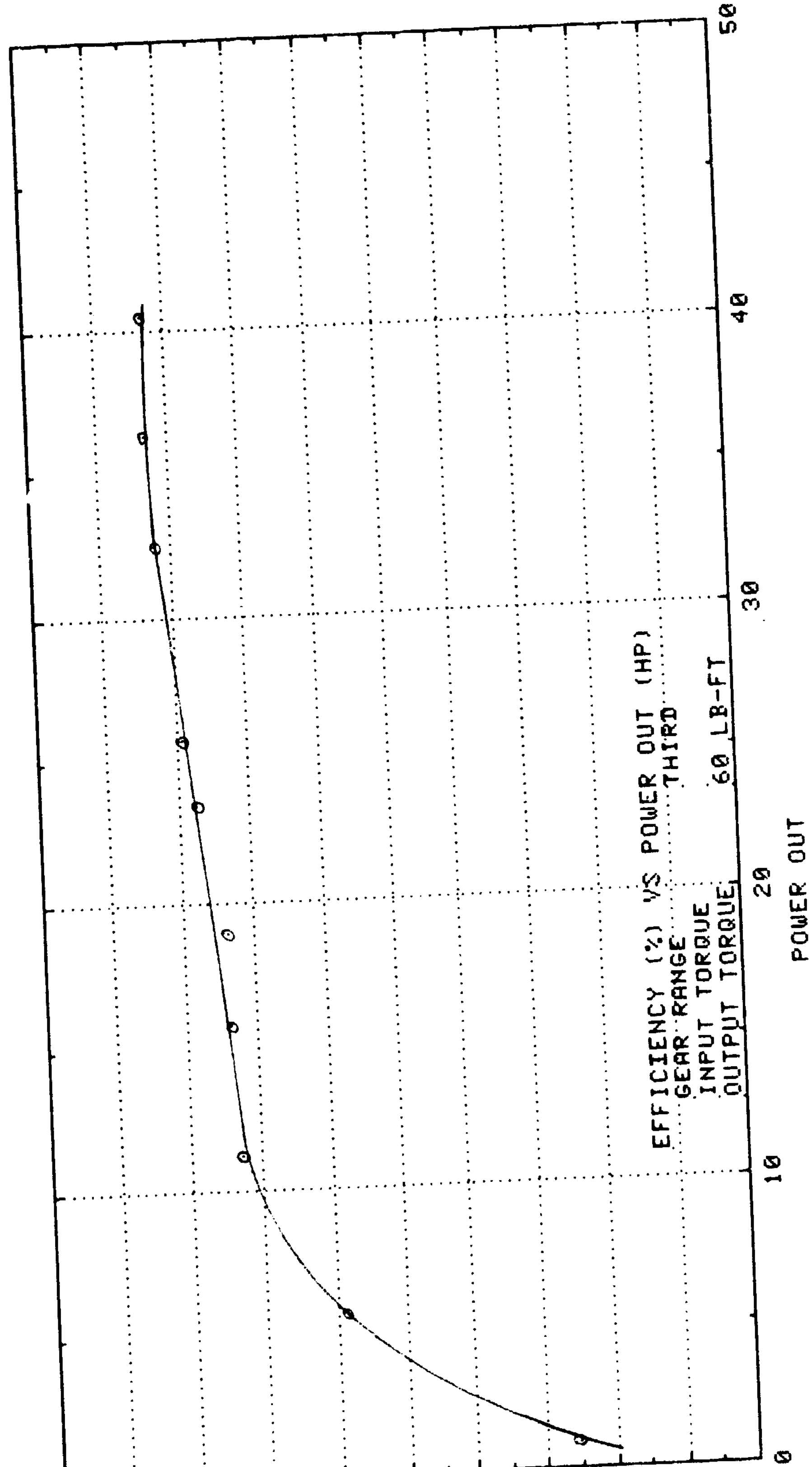


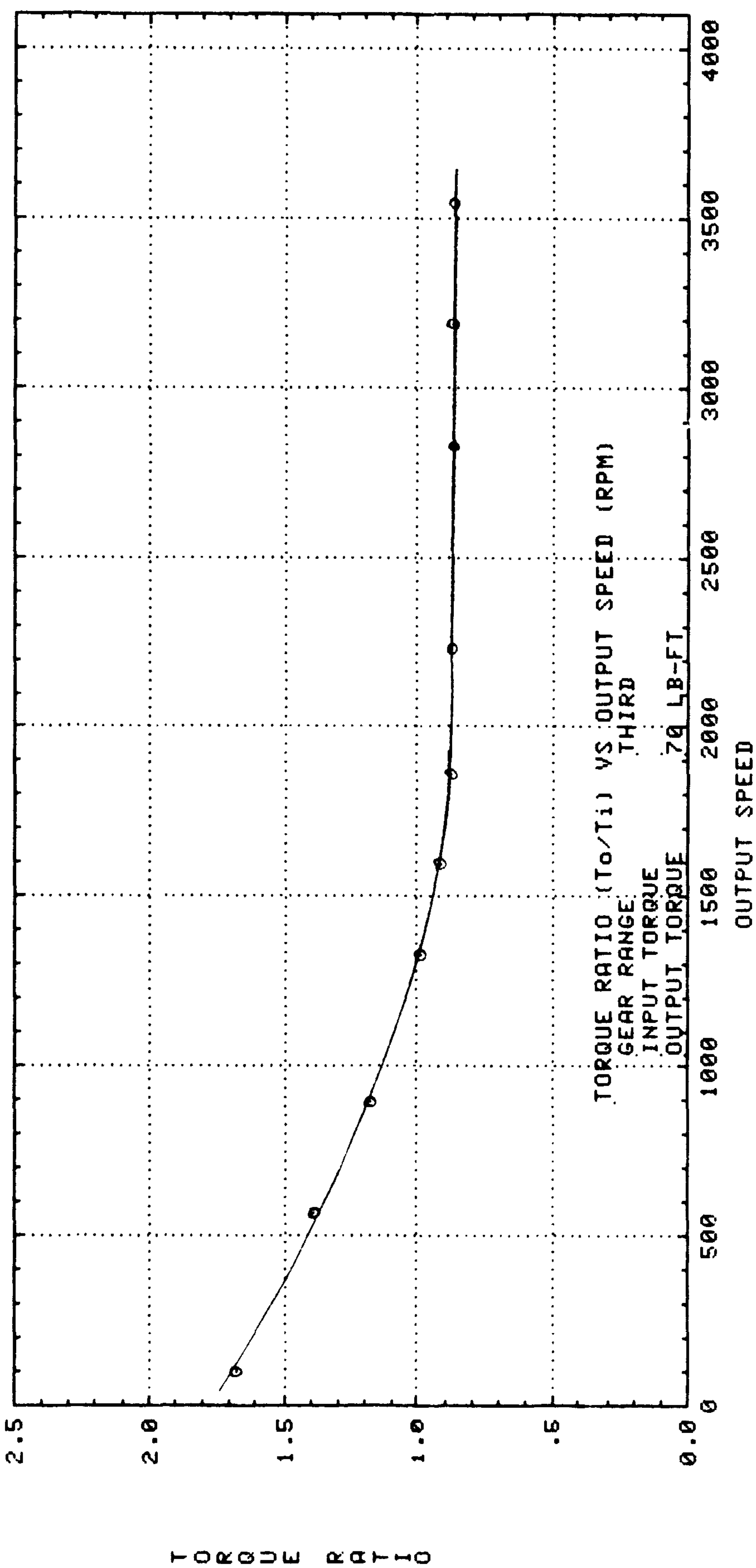
TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 60 LB-FT
OUTPUT SPEED
TORQUE RATIO
0 500 1000 1500 2000 2500 3000 3500 4000
0.0 .5 1.0 1.5 2.0 2.5 3.0 3.5

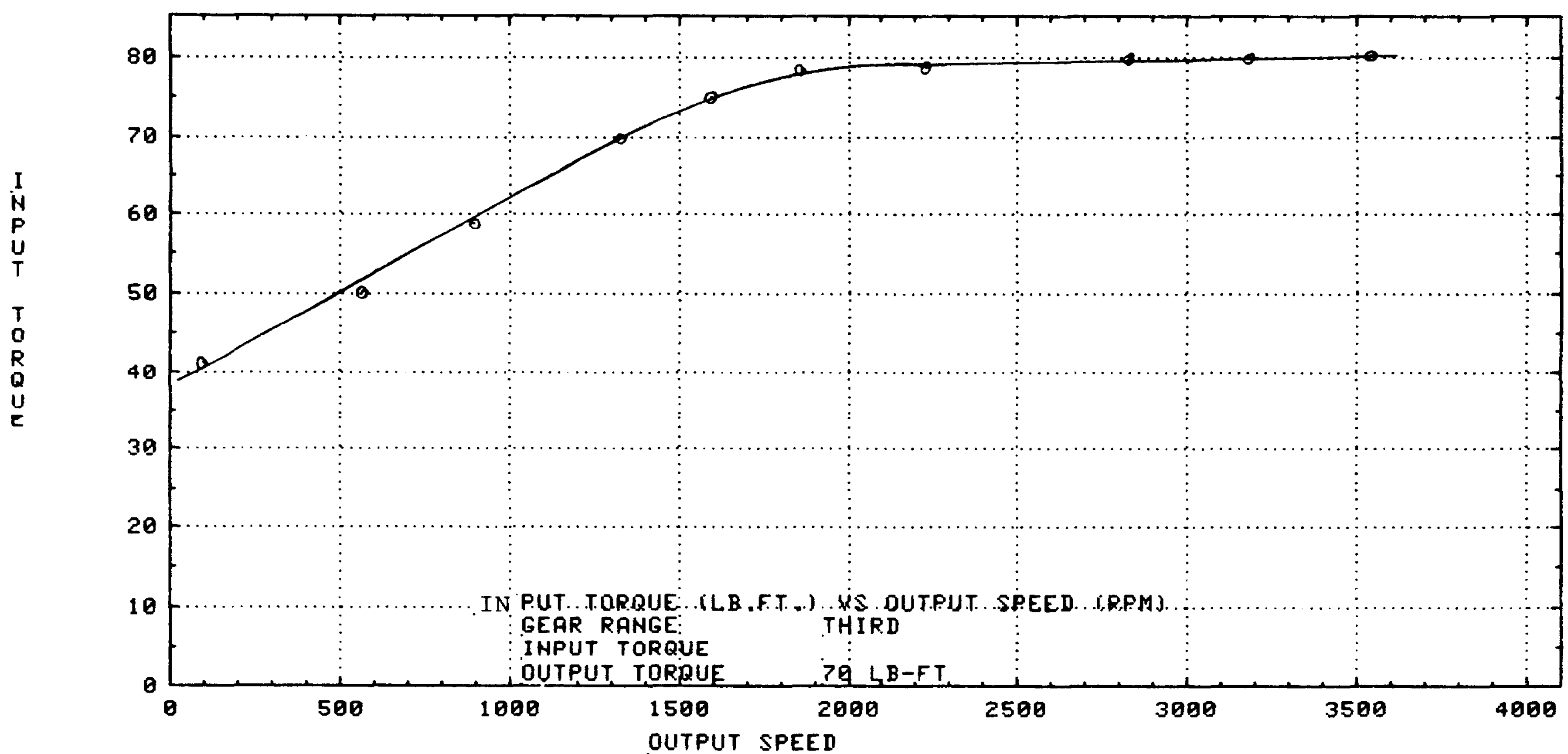

INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 60 LB-FT
INPUT TORQUE
OUTPUT SPEED
0
10
20
30
40
50
60
70
0
500
1000
1500
2000
2500
3000
3500
4000

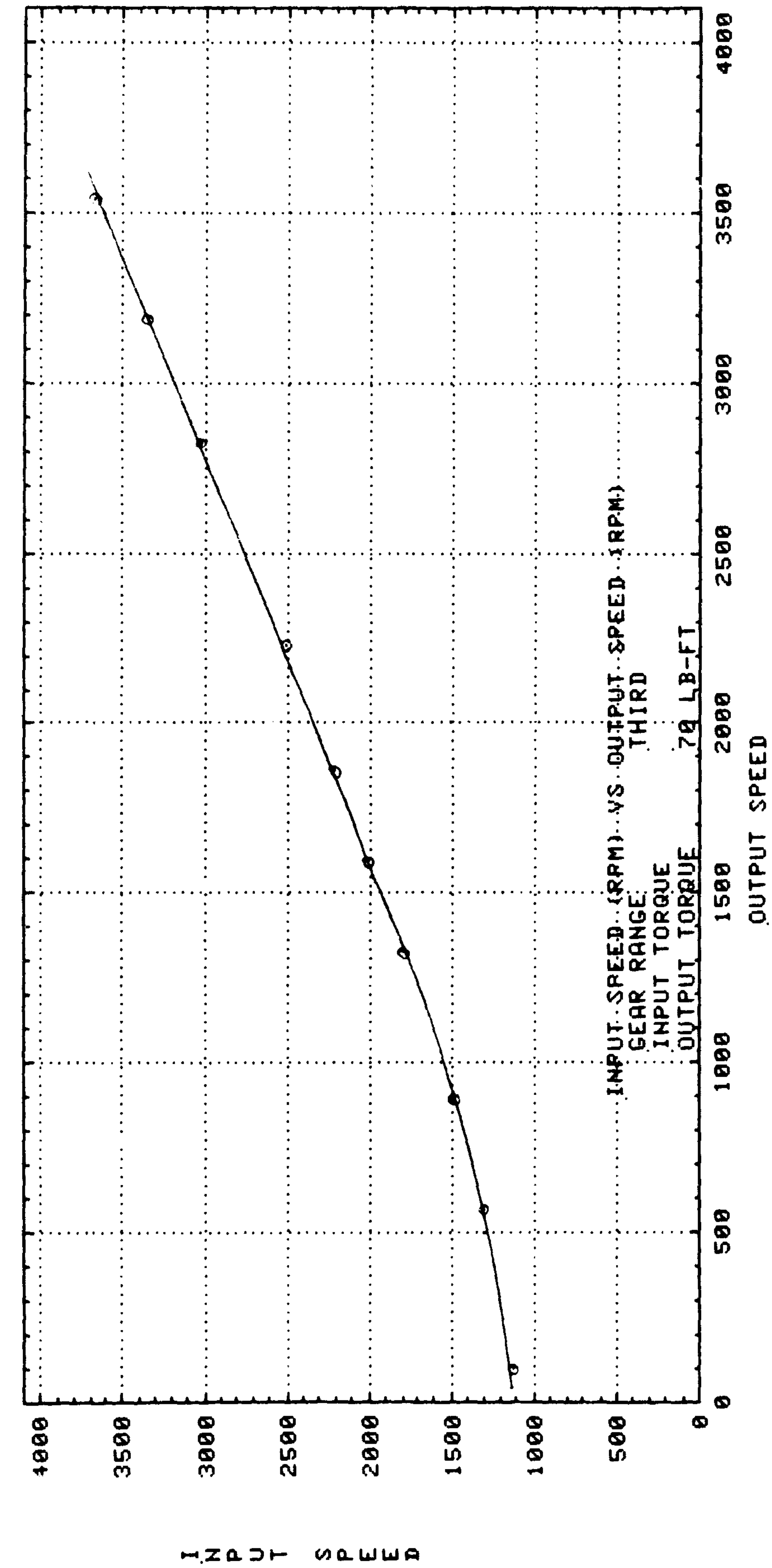

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 60 LB-FT
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

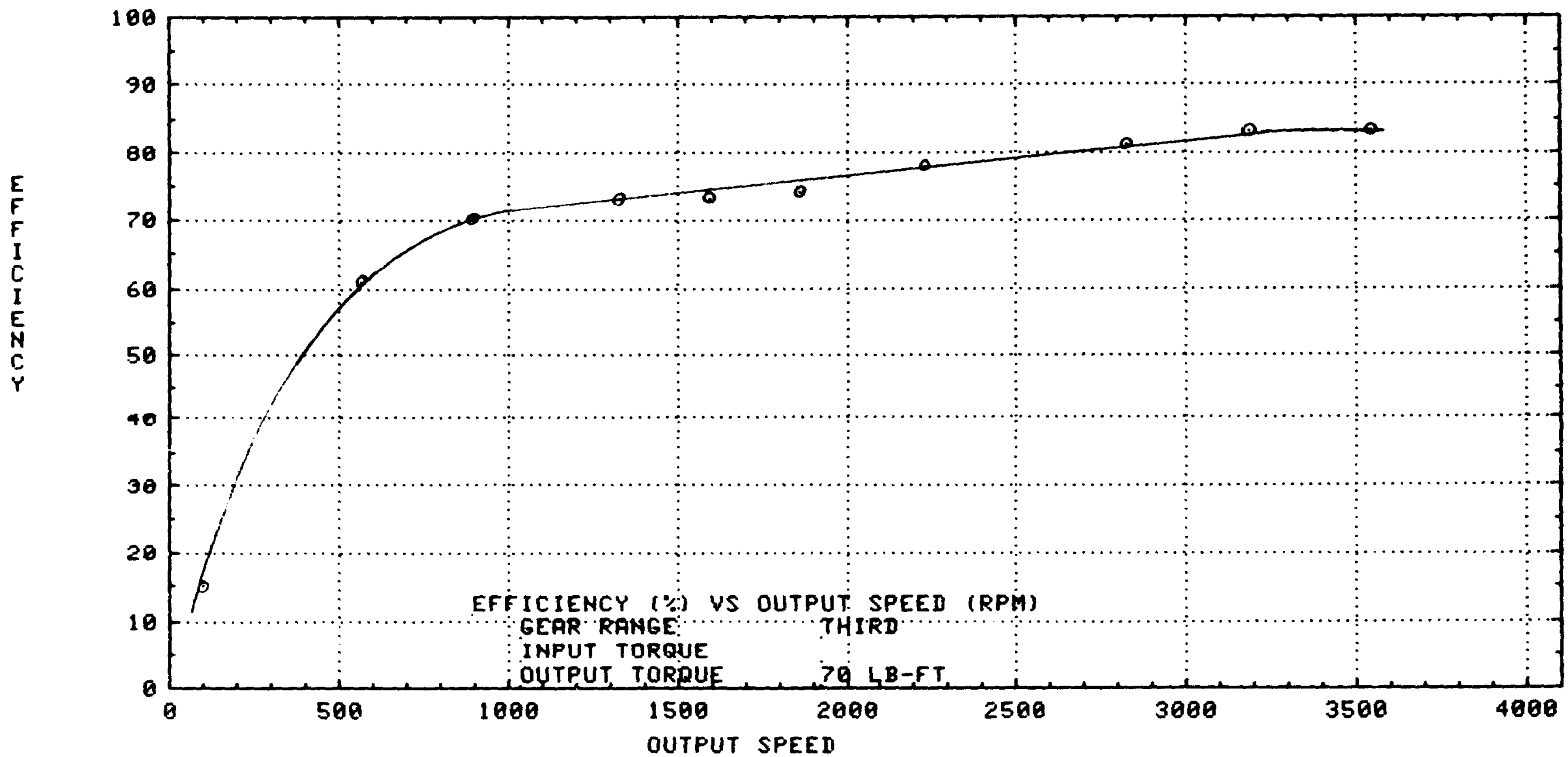

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 60 LB-FT
OUTPUT SPEED
EFFICIENCY
0
500
1000
1500
2000
2500
3000
3500
4000
0
10
20
30
40
50
60
70
80
90
100

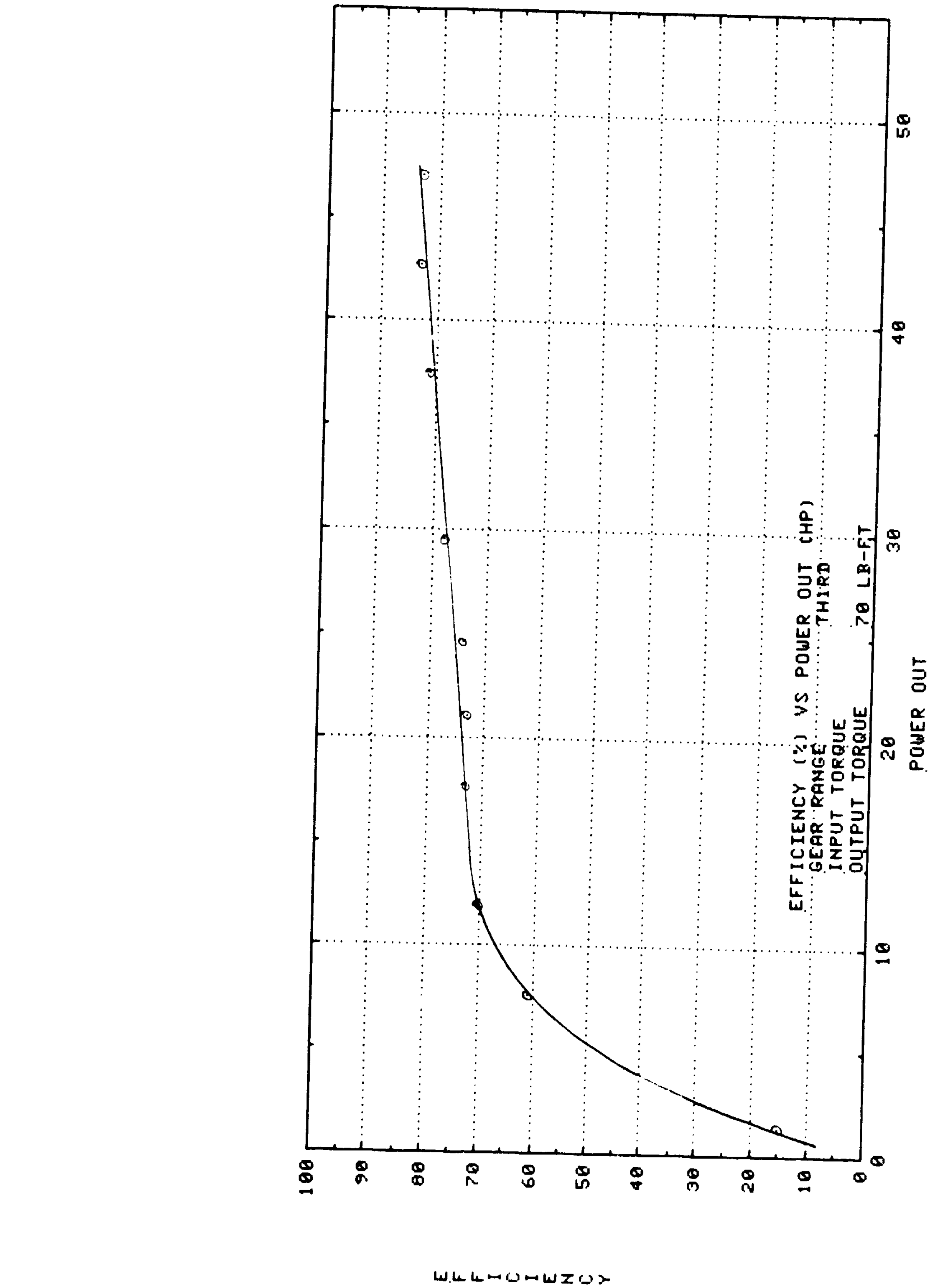

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE 60 LB-FT
OUTPUT TORQUE
POWER OUT
EFFICIENCY
0
10
20
30
40
50
60
70
80
90
100

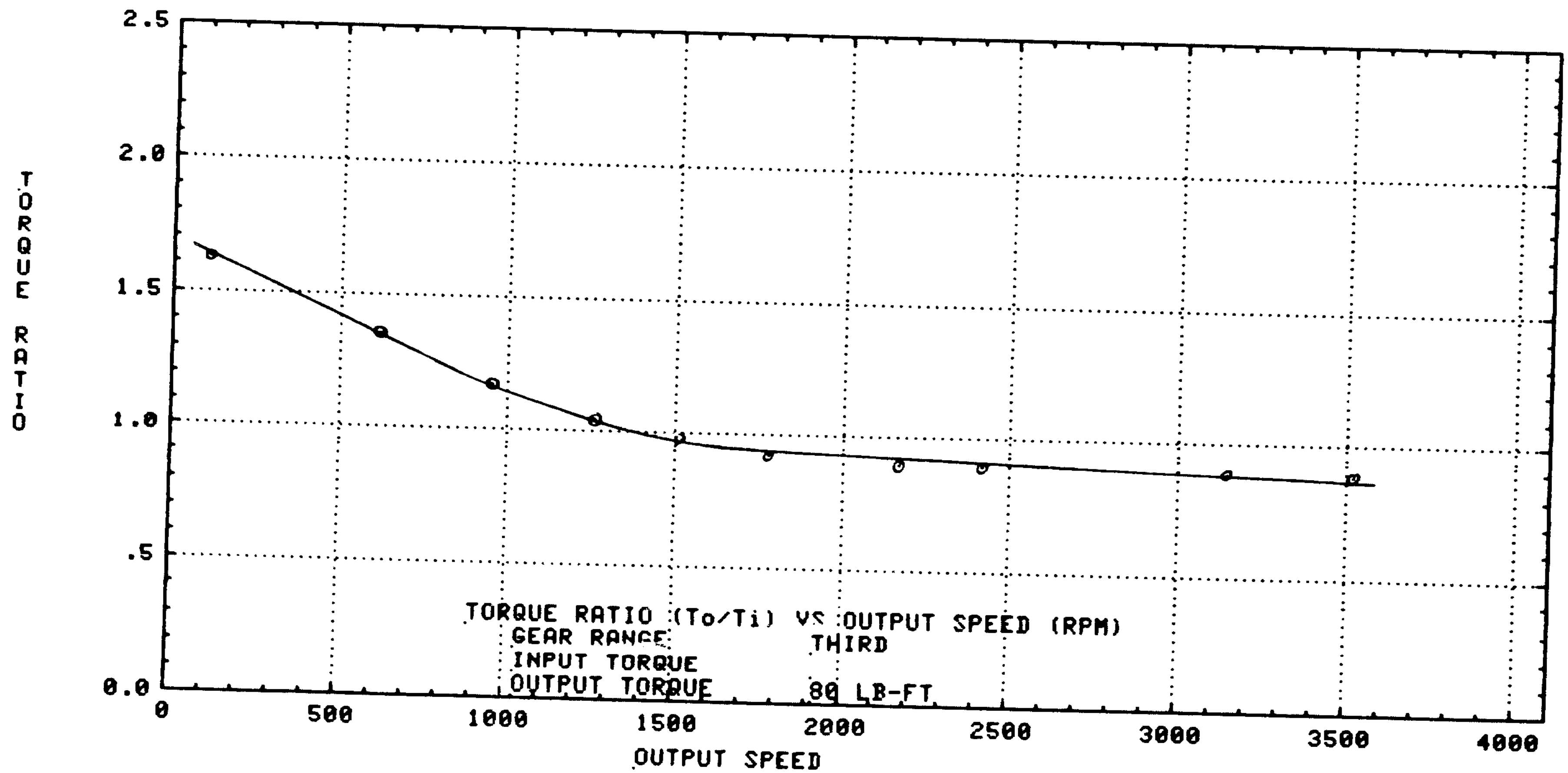

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 70 LB-FT
OUTPUT SPEED
TORQUE RATIO
0
500
1000
1500
2000
2500
3000
3500
4000
0.0
.5
1.0
1.5
2.0
2.5


INPUT TORQUE
80
70
60
50
40
30
20
10
0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 70 LB-FT

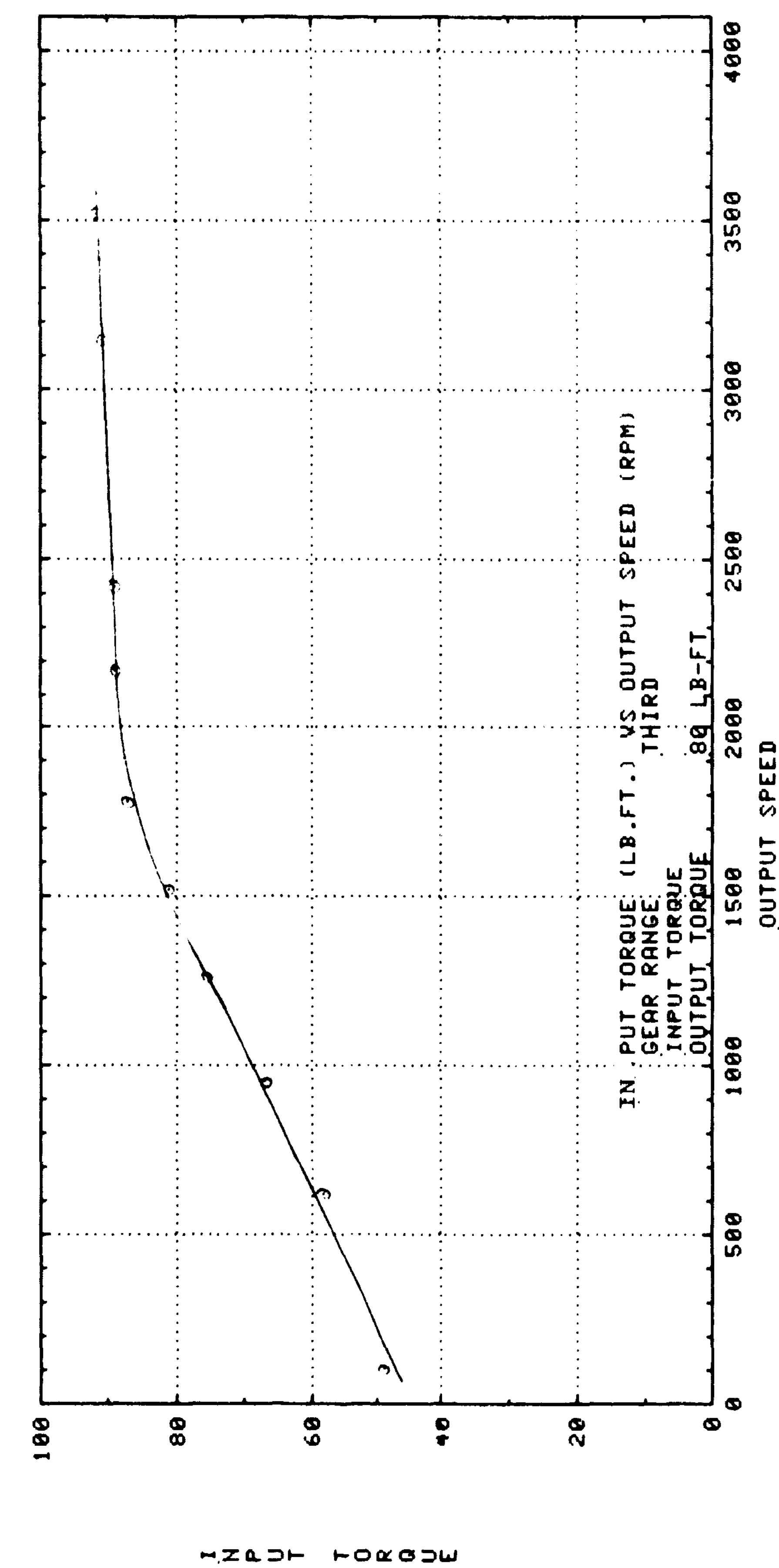

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 70 LB-FT
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000


EFFICIENCY
100
90
80
70
60
50
40
30
20
10
0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 70 LB-FT

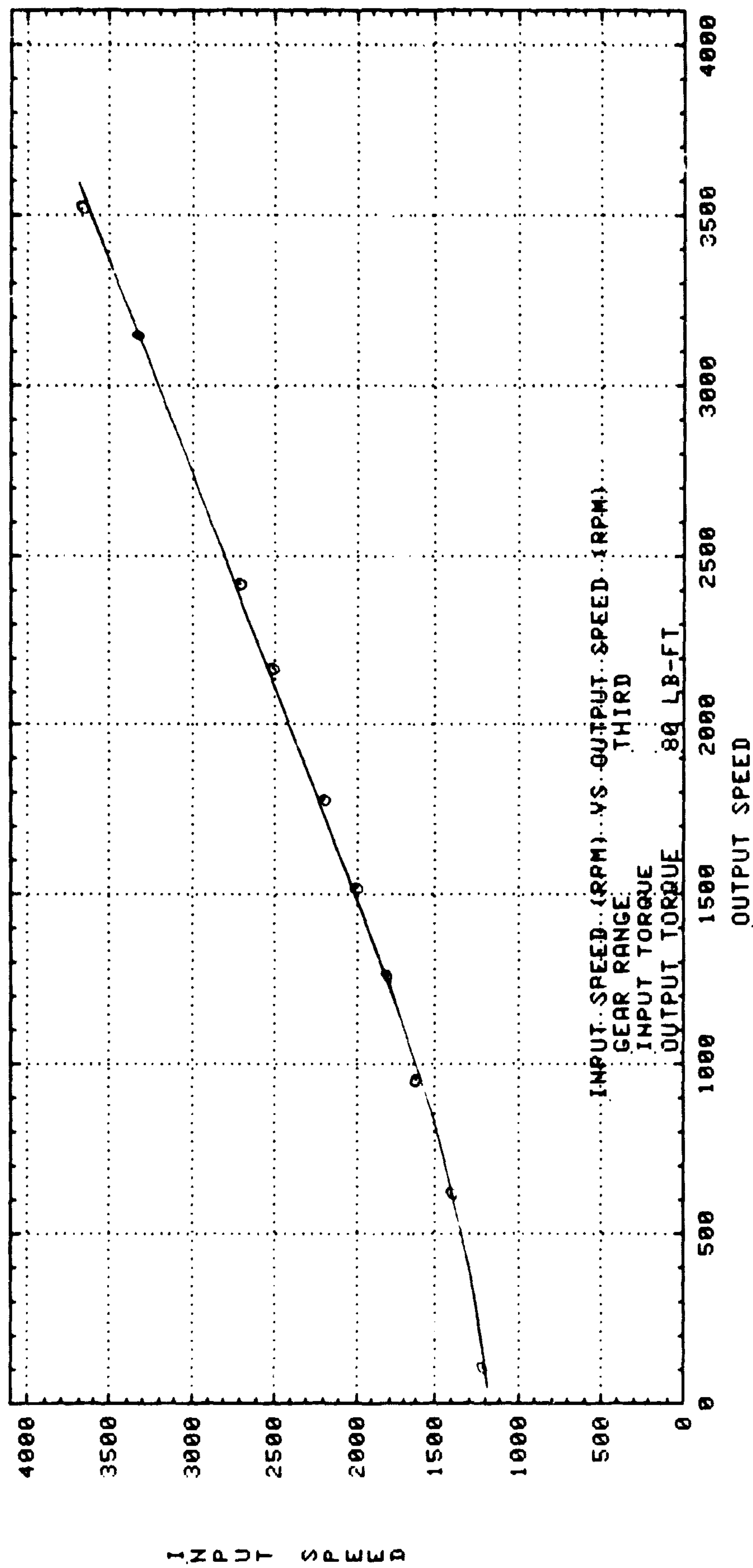

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 70 LB-FT
POWER OUT
EFFICIENCY
0 10 20 30 40 50
0 10 20 30 40 50 60 70 80 90 100

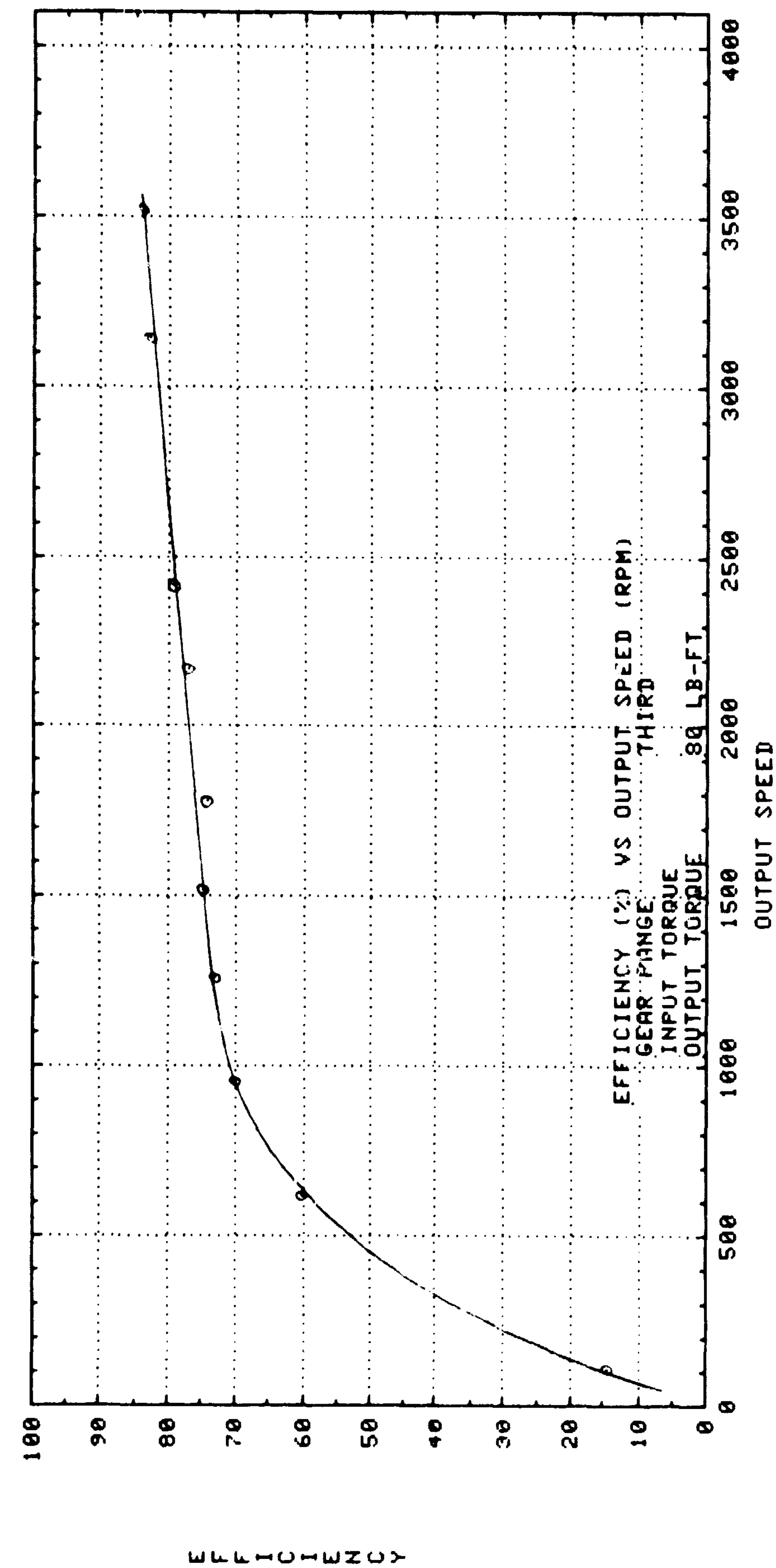


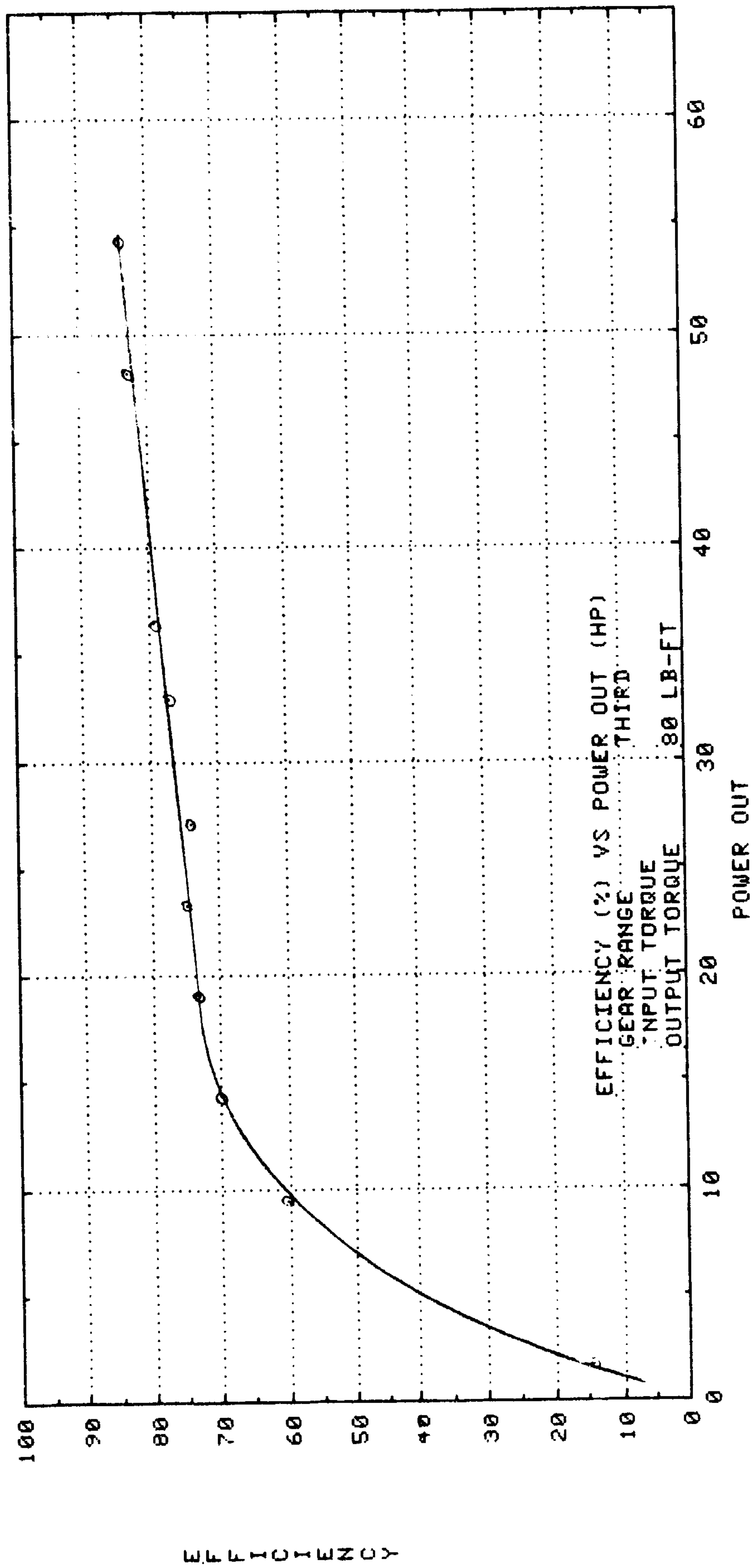
TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 80 LB-FT
TORQUE RATIO
OUTPUT SPEED
2.5
2.0
1.5
1.0
.5
0.0
0
500
1000
1500
2000
2500
3000
3500
4000

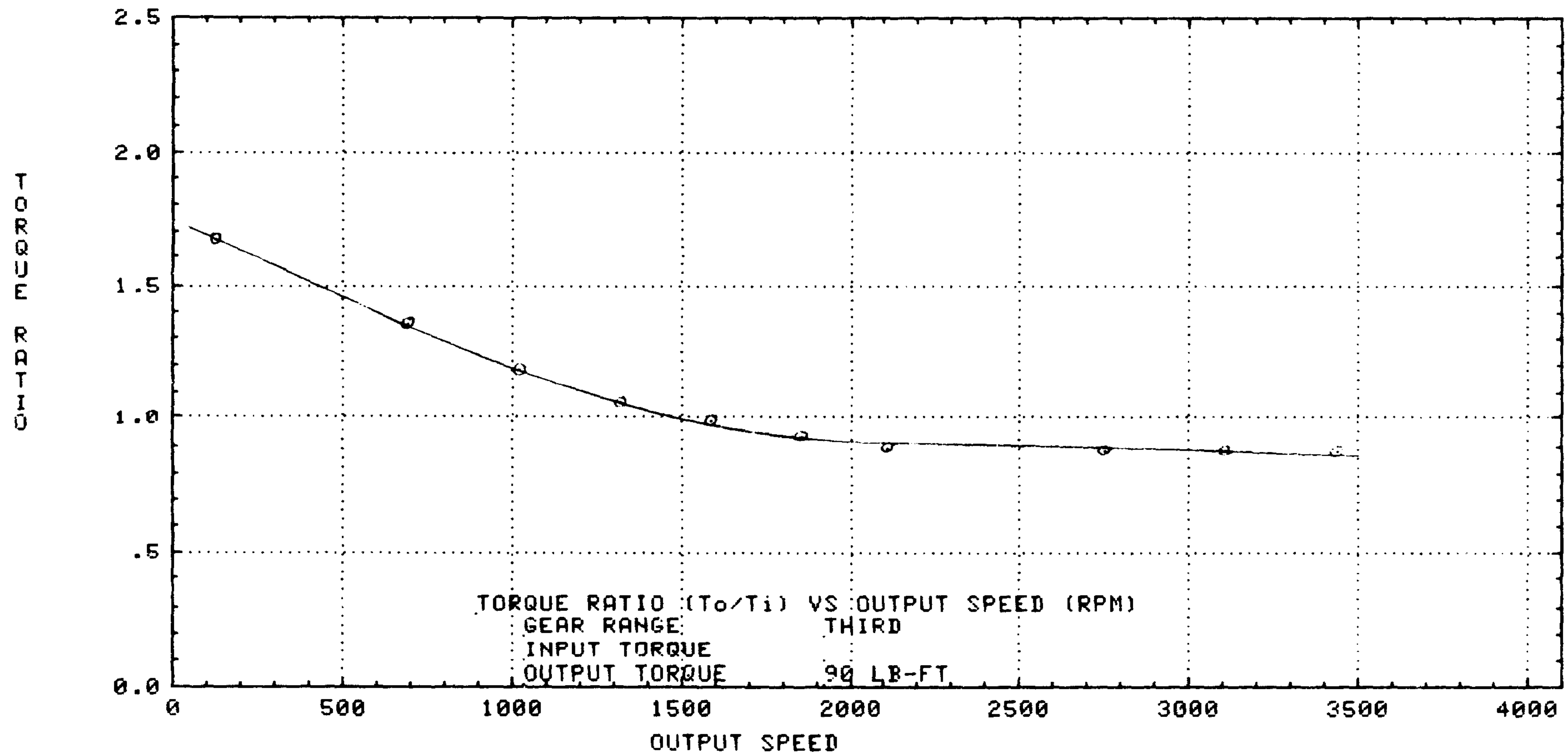


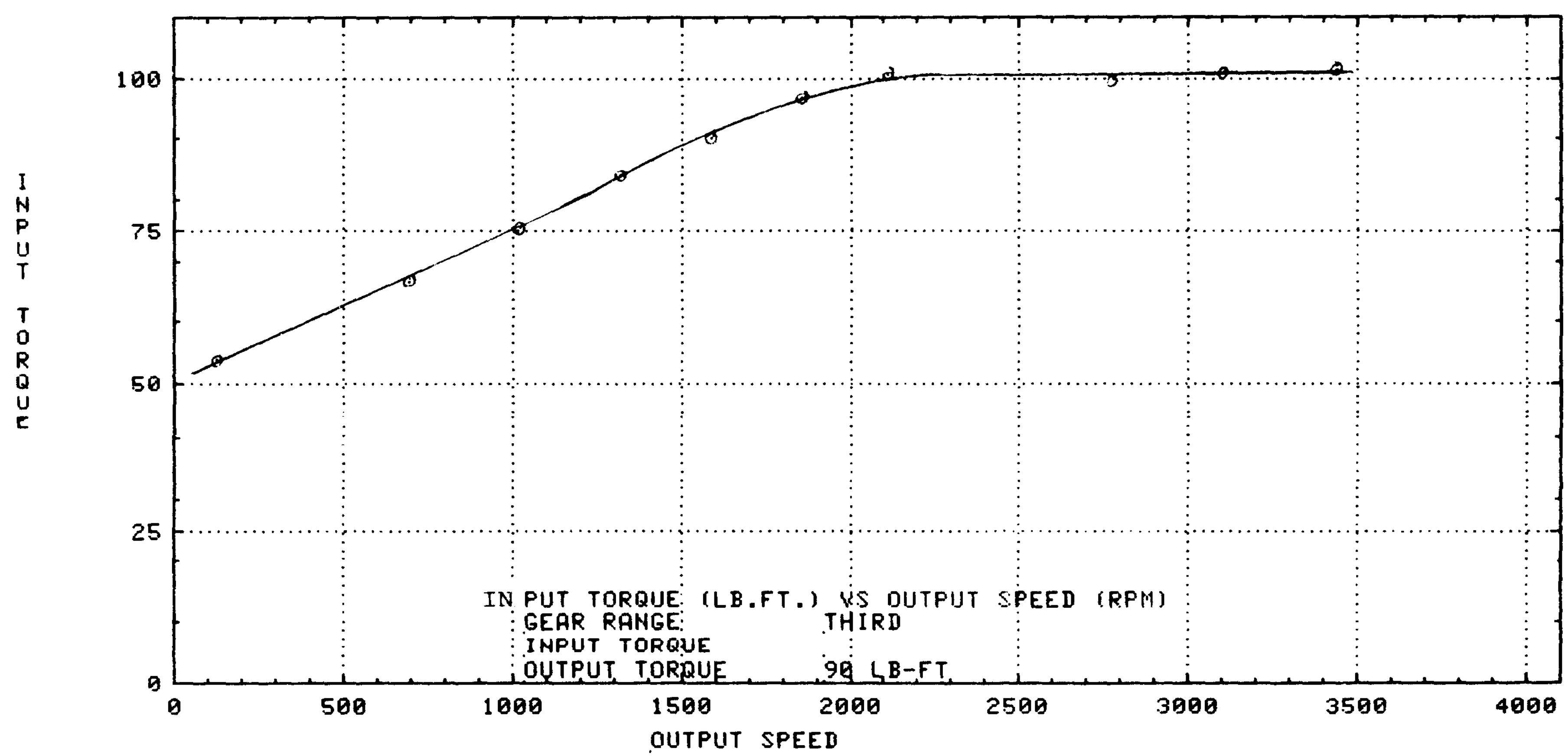
INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 80 LB-FT
OUTPUT SPEED
INPUT TORQUE
0
500
1000
1500
2000
2500
3000
3500
4000
0
20
40
60
80
100

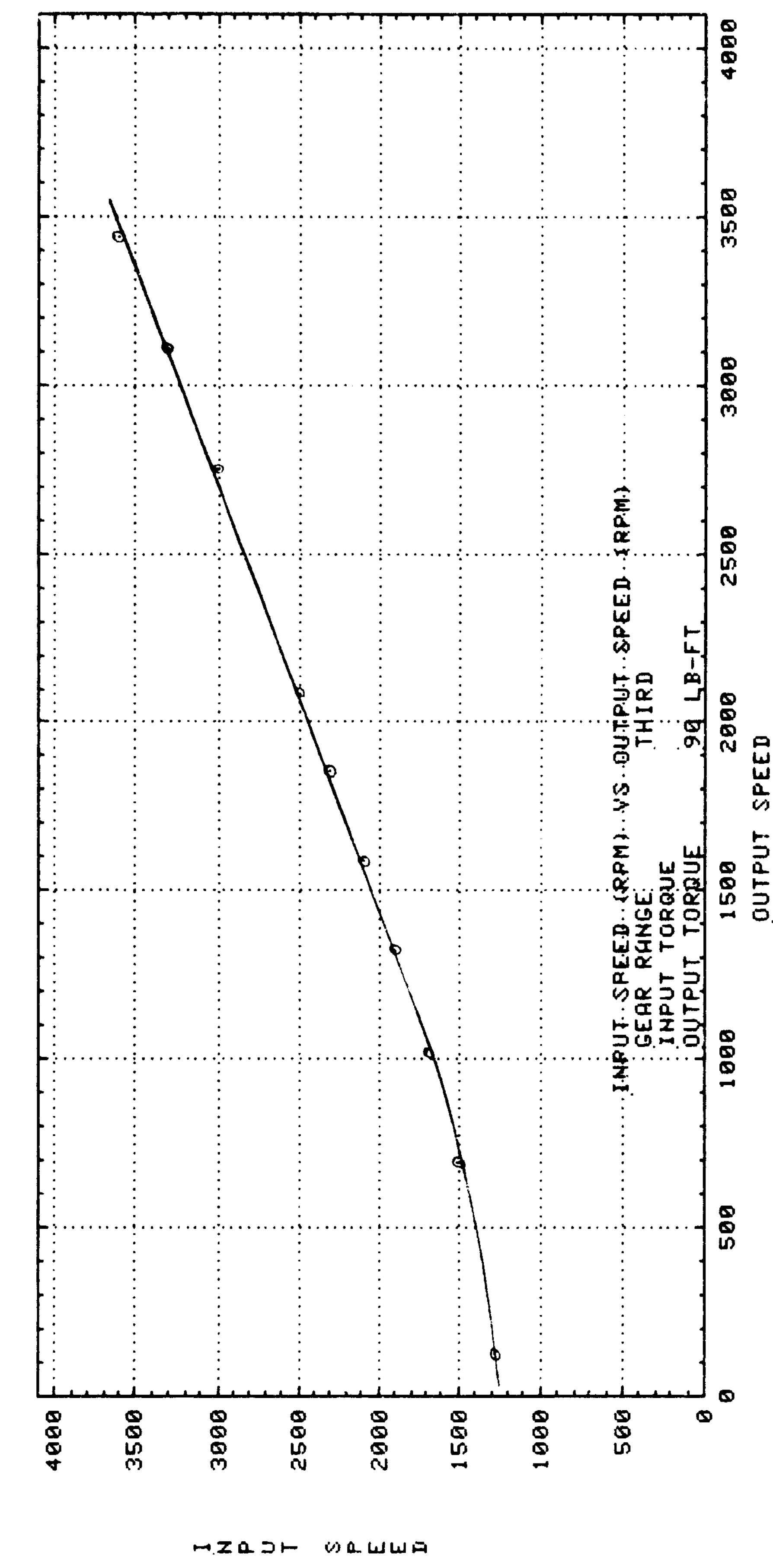

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 80 LB-FT
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000


EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 80 LB-FT
OUTPUT SPEED
EFFICIENCY
0
500
1000
1500
2000
2500
3000
3500
4000
0
10
20
30
40
50
60
70
80
90
100

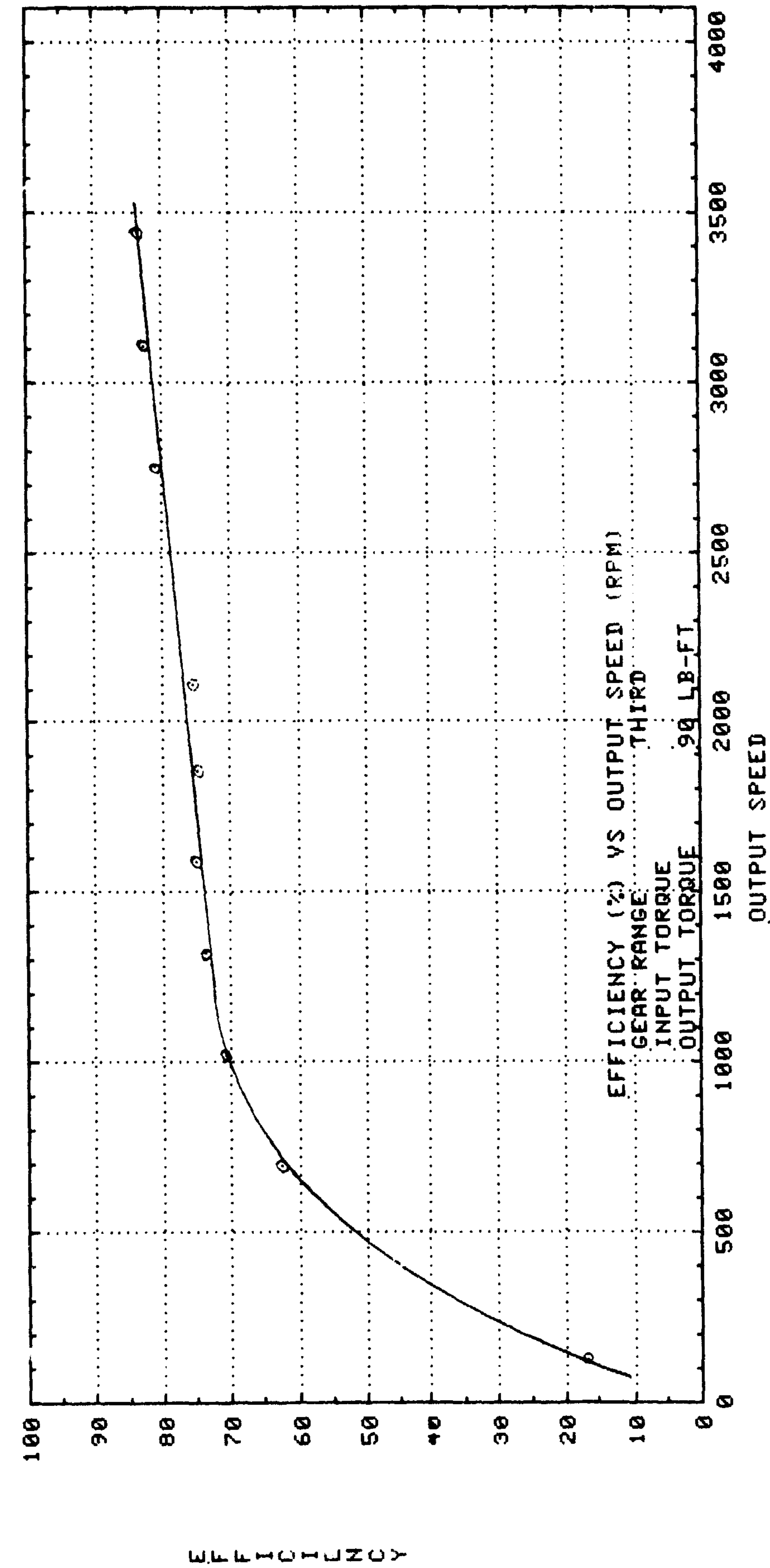

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 80 LB-FT
POWER OUT
EFFICIENCY
0 10 20 30 40 50 60
0 10 20 30 40 50 60 70 80 90 100

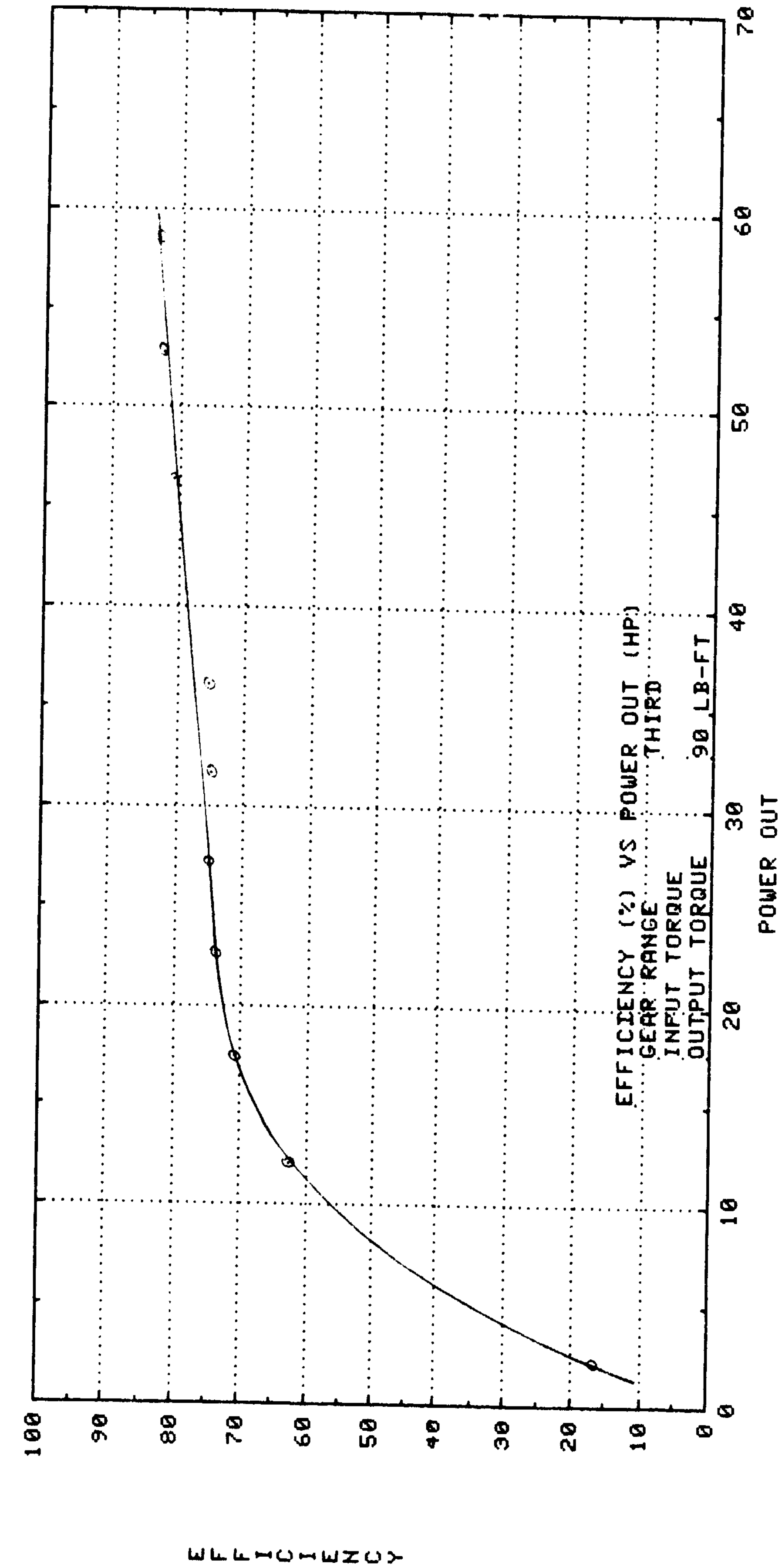

TORQUE RATIO
TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 90 LB-FT
OUTPUT SPEED
2.5
2.0
1.5
1.0
.5
0.0
0
500
1000
1500
2000
2500
3000
3500
4000


INPUT TORQUE
100
75
50
25
0
0
500
1000
1500
2000
2500
3000
3500
4000
IN PUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 90 LB-FT
OUTPUT SPEED



INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 90 LB-FT
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000


EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 90 LB-FT
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000
EFFICIENCY
0
10
20
30
40
50
60
70
80
90
100

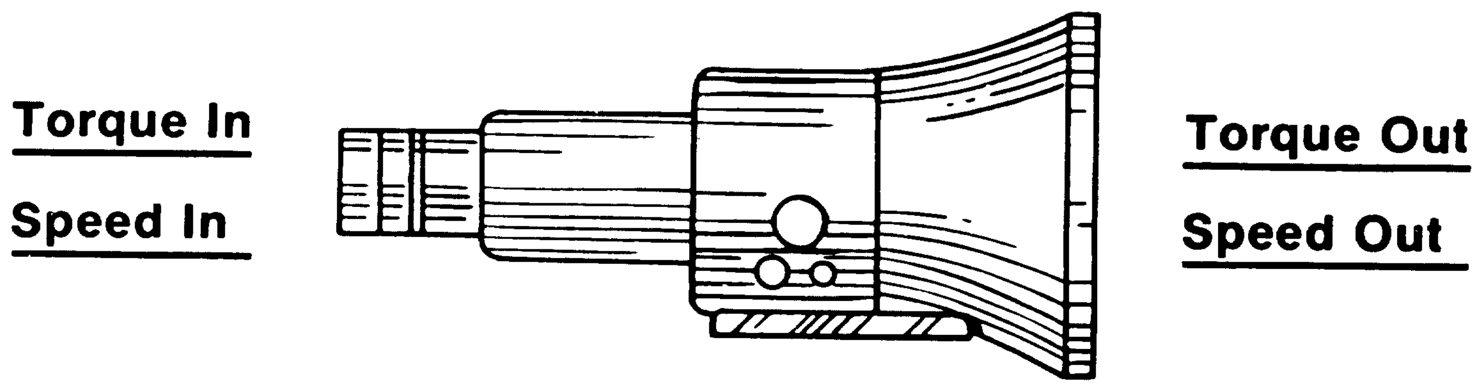

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 90 LB-FT
POWER OUT
EFFICIENCY

COAST PERFORMANCE

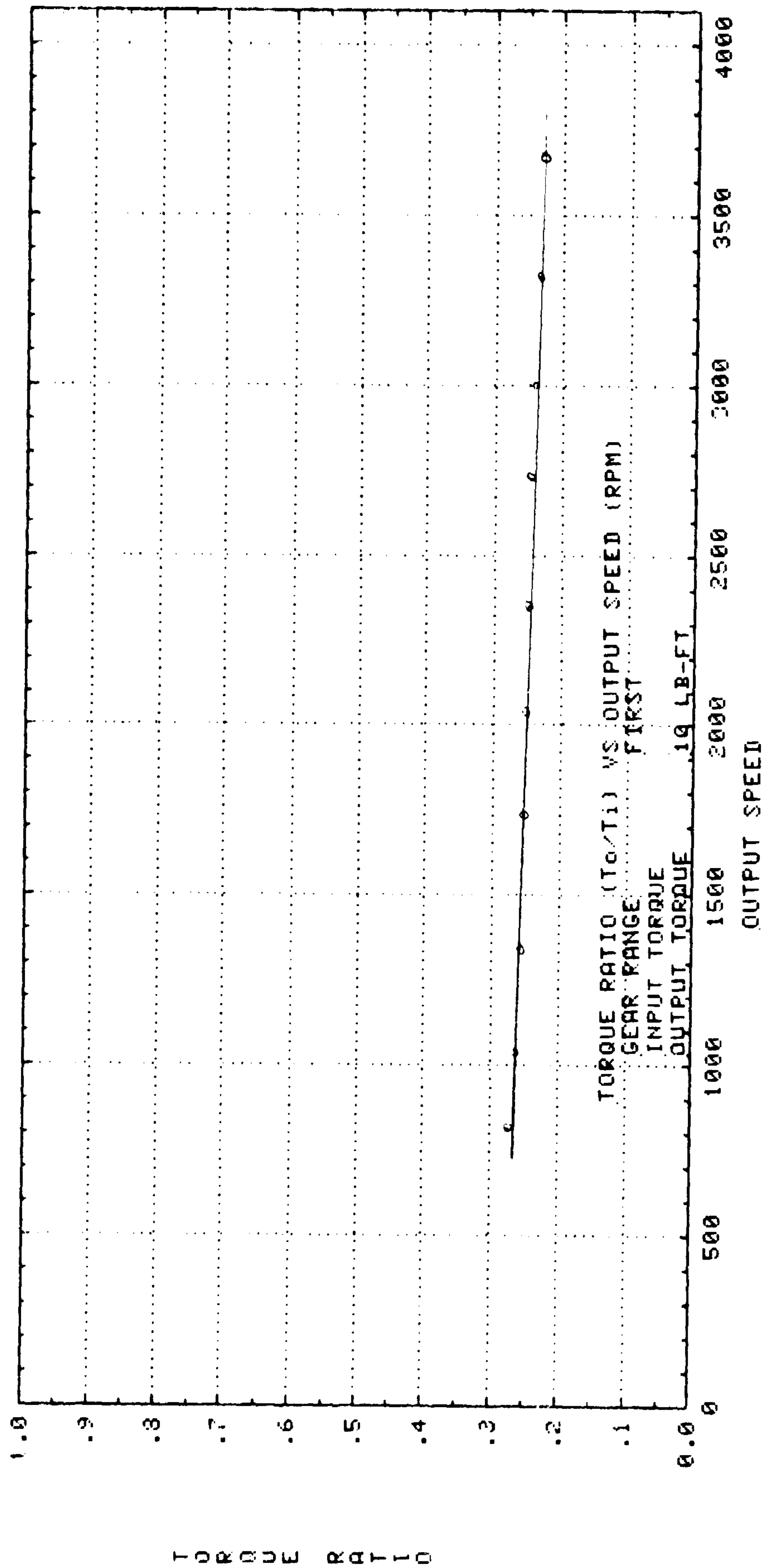
1st Gear

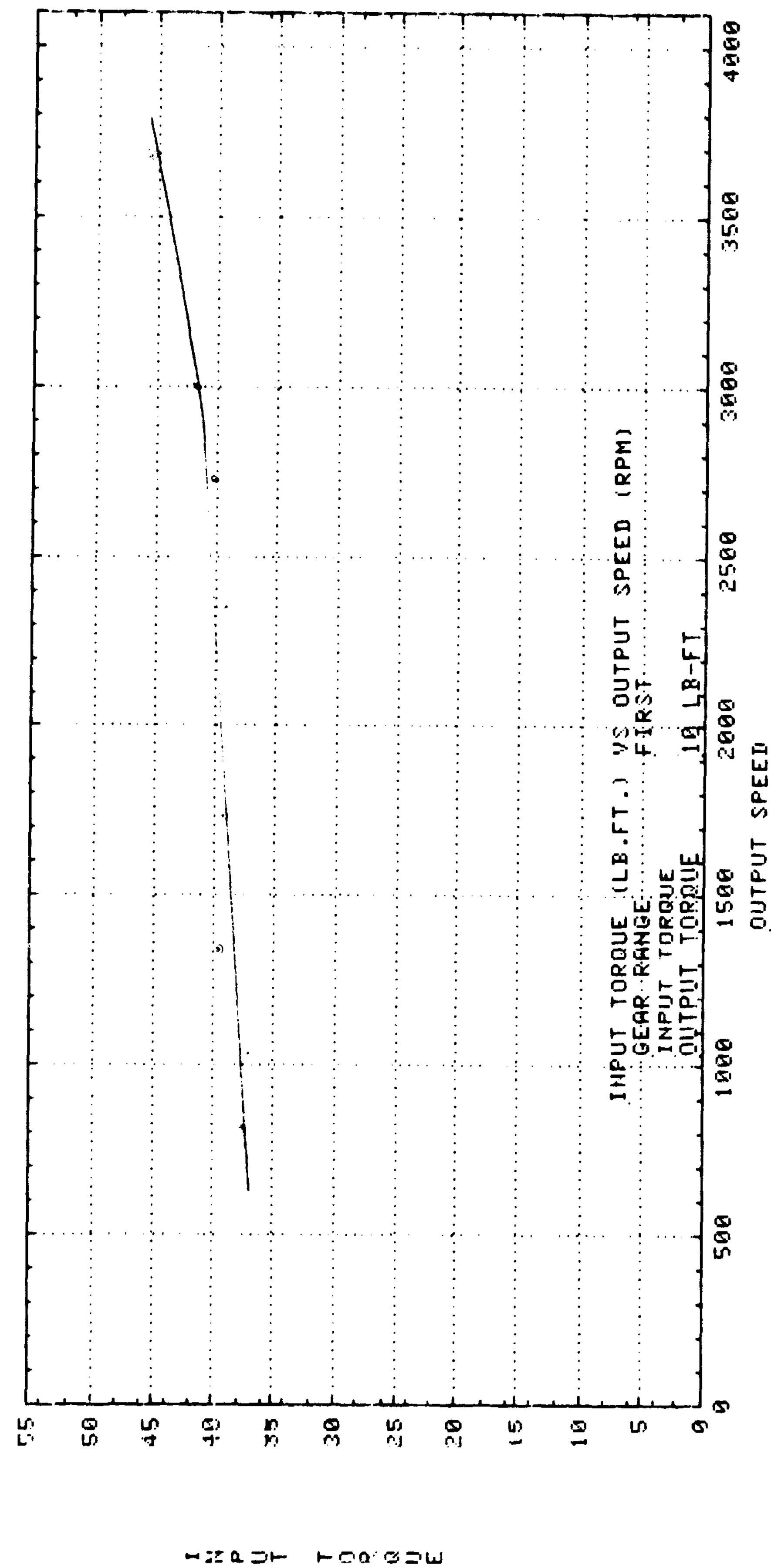
Graphs Contained in This Section

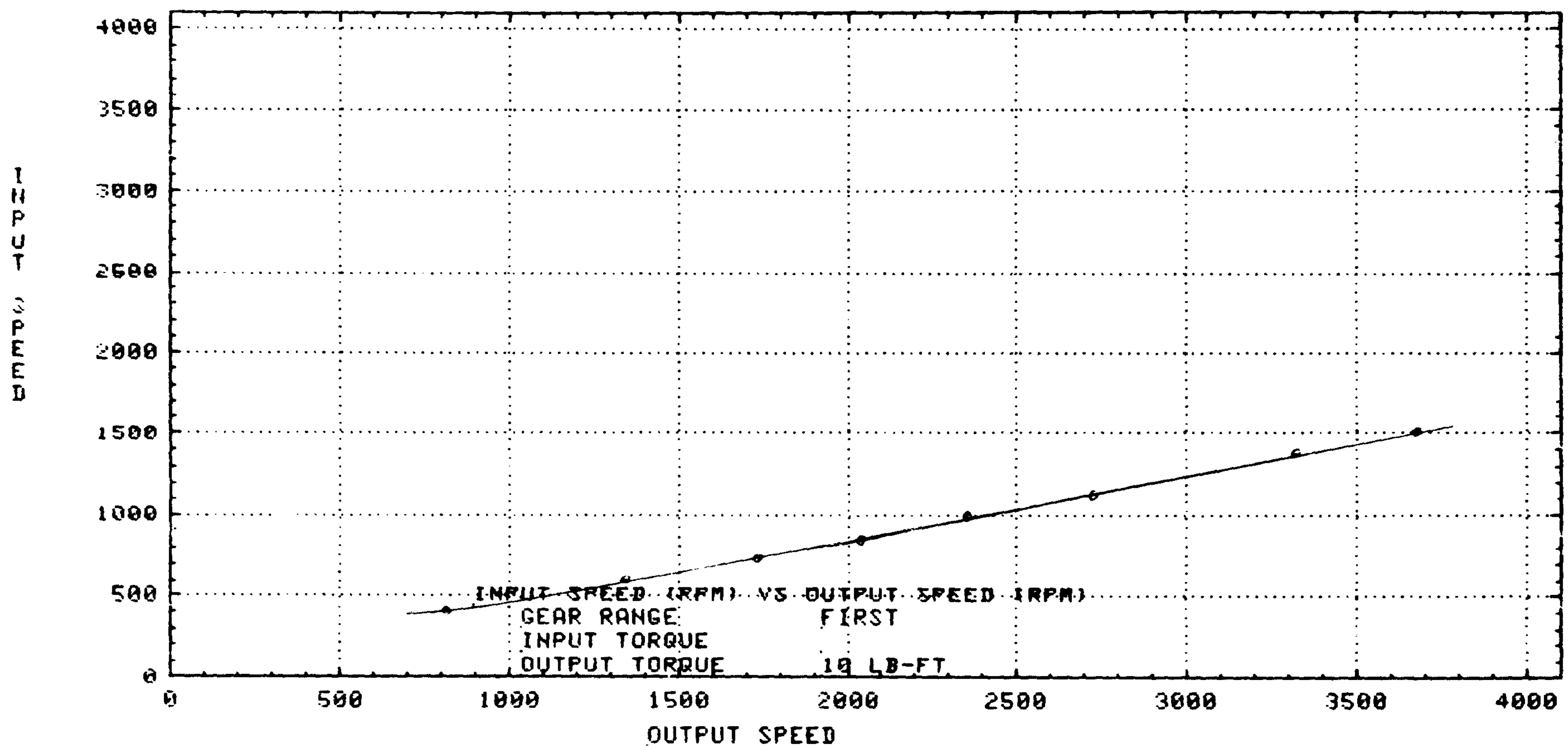
Torque Ratio -vs- Output Speed
Output Torque -vs- Output Speed
Input Speed -vs- Output Speed
Efficiency -vs- Output Speed
Efficiency -vs- Power Out

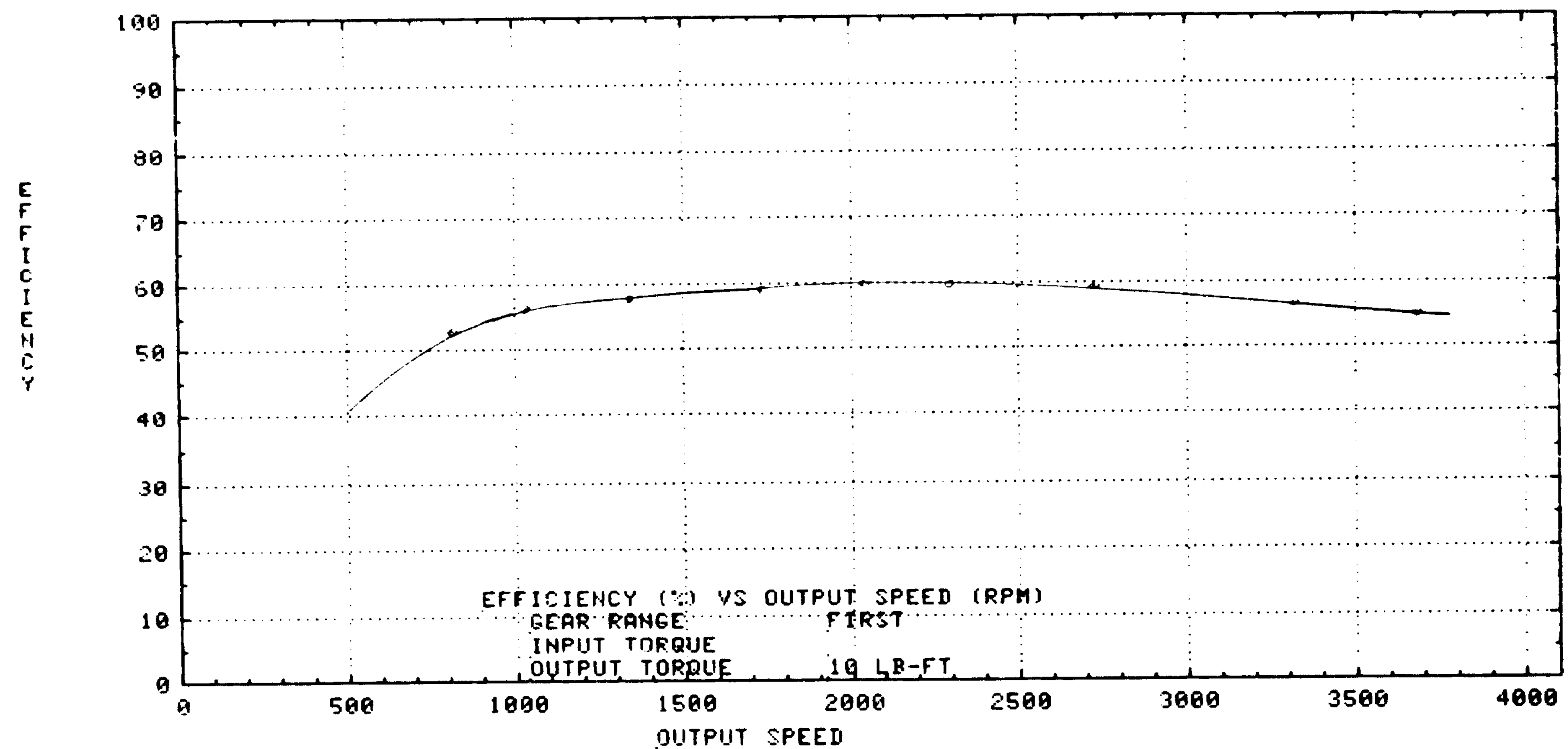


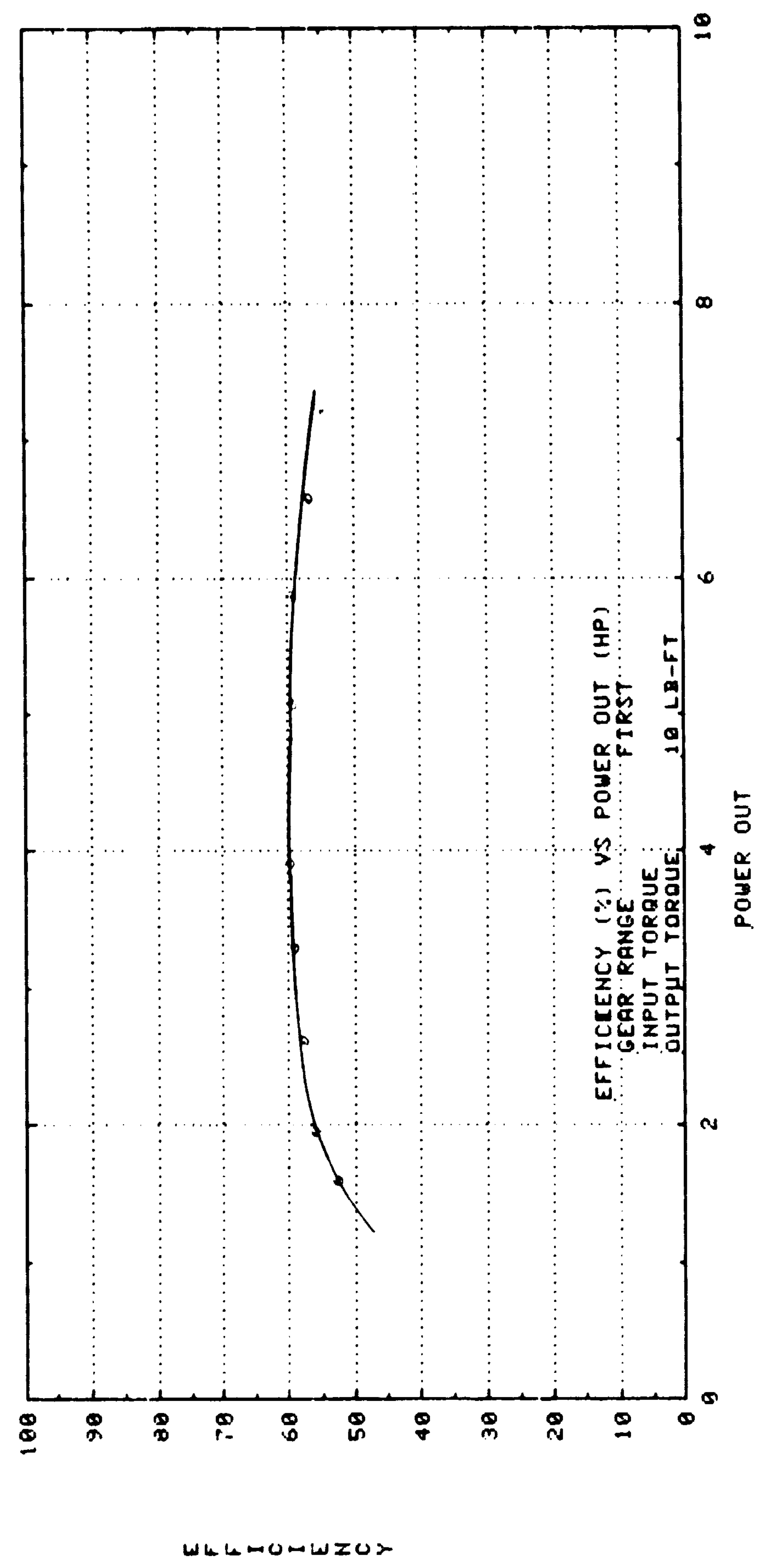
Coast Performance Tests

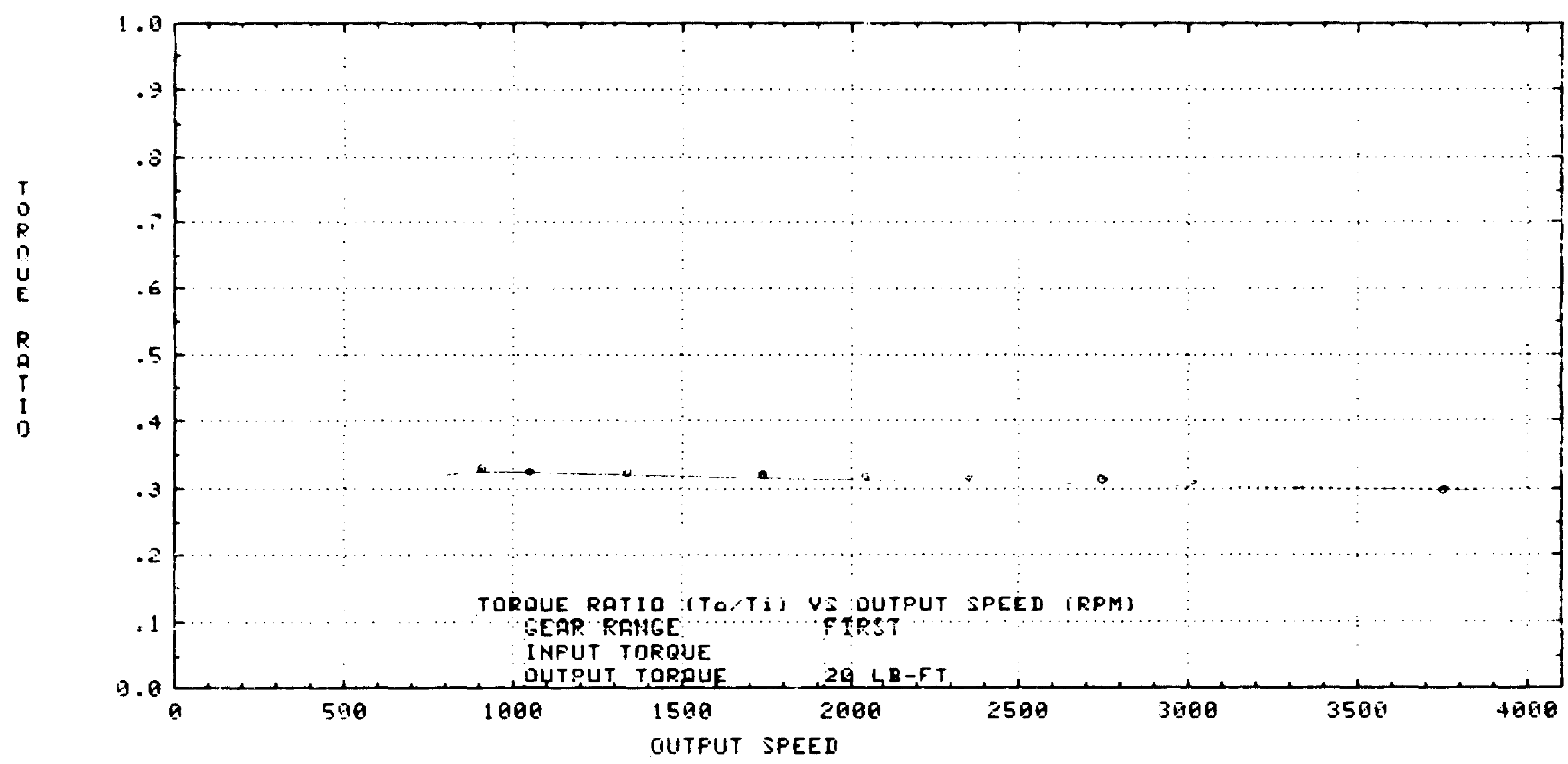

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE
OUTPUT TORQUE 10 LB-FT
OUTPUT SPEED
TORQUE RATIO
0 500 1000 1500 2000 2500 3000 3500 4000
0.0 .1 .2 .3 .4 .5 .6 .7 .8 .9 1.0

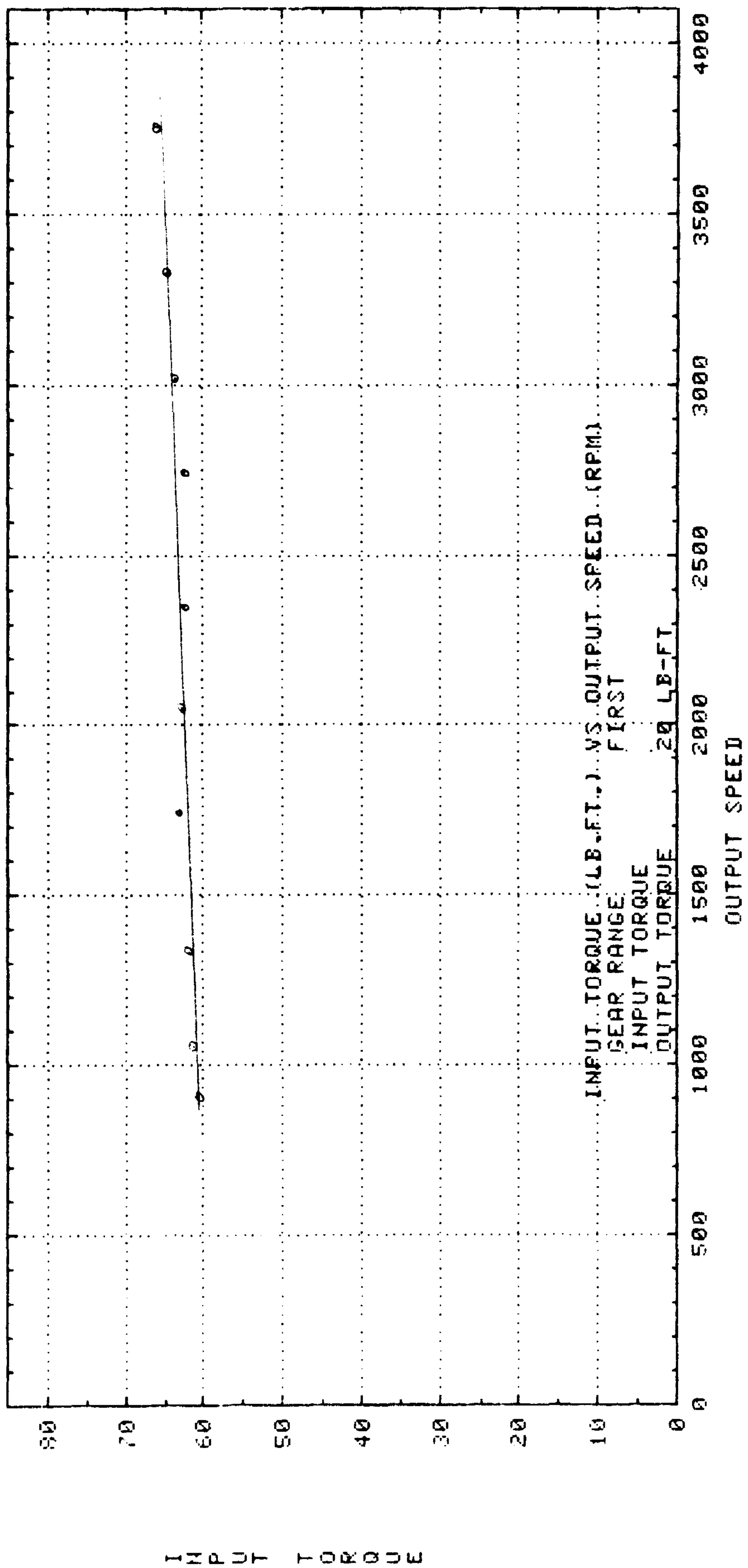

INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE
OUTPUT TORQUE 10 LB-FT
OUTPUT SPEED
INPUT TORQUE
0 500 1000 1500 2000 2500 3000 3500 4000
0 5 10 15 20 25 30 35 40 45 50 55

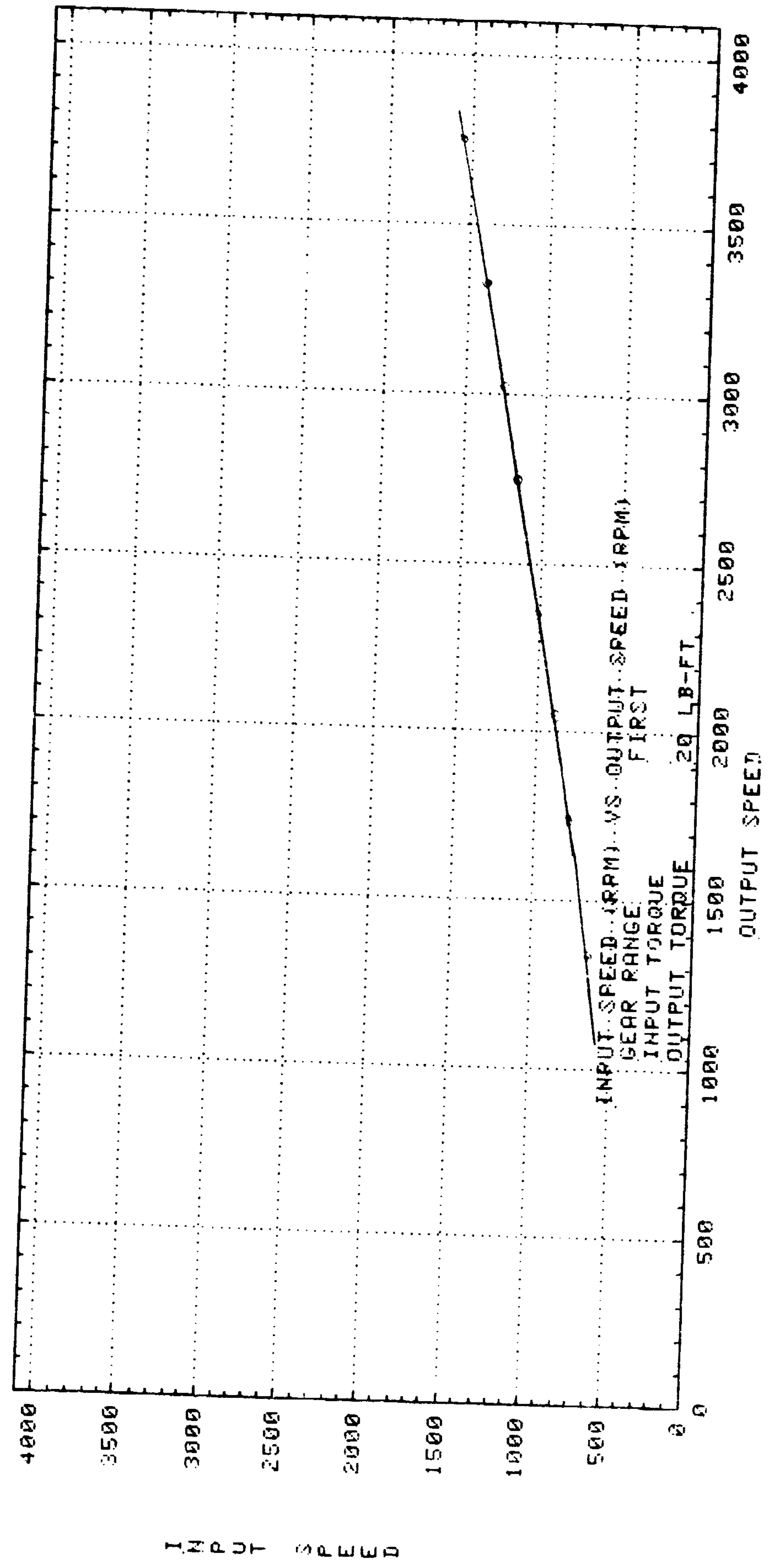

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE
OUTPUT TORQUE 10 LB-FT
INPUT SPEED
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

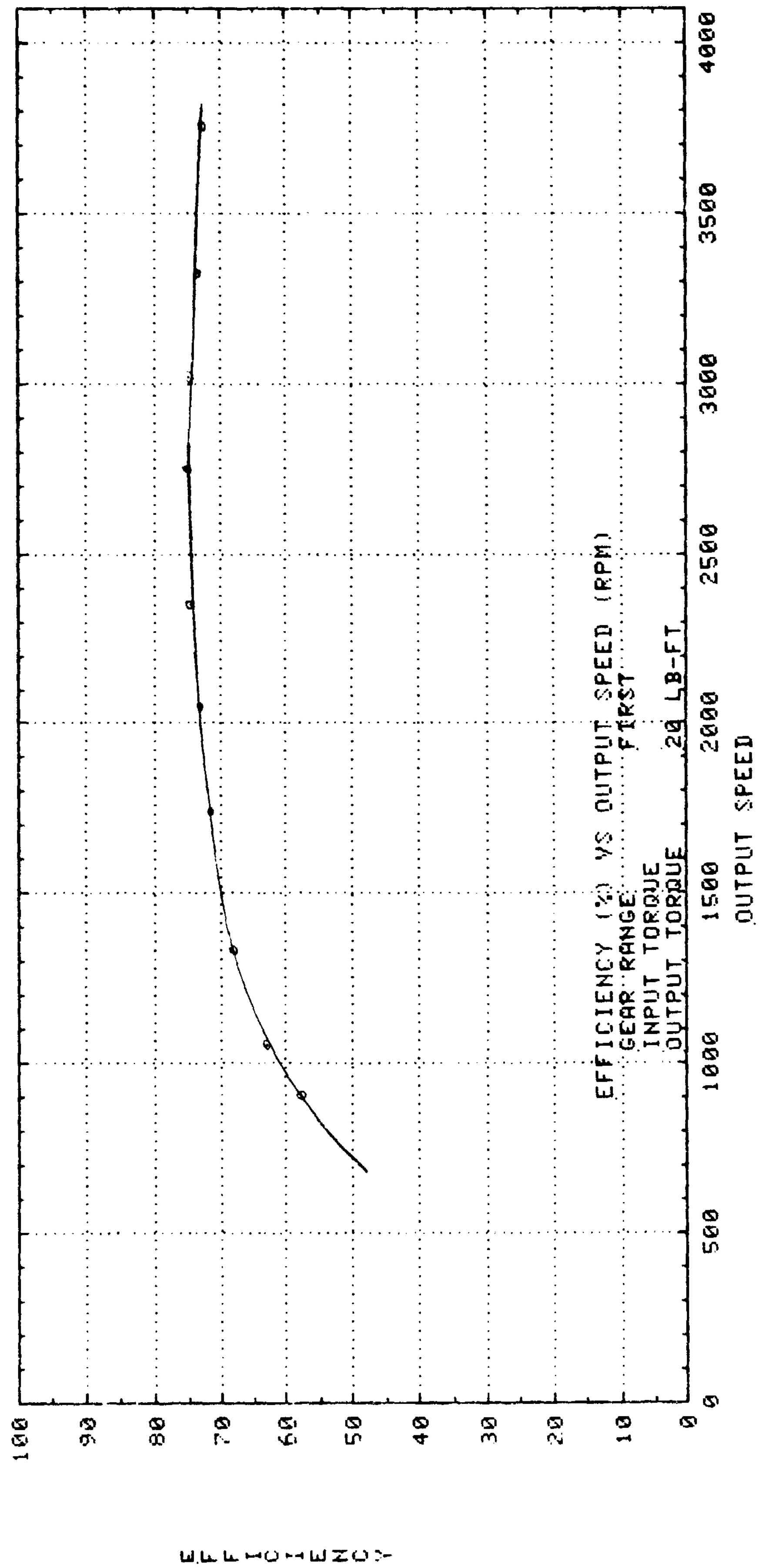

EFFICIENCY
100
90
80
70
60
50
40
30
20
10
0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE
OUTPUT TORQUE 10 LB-FT

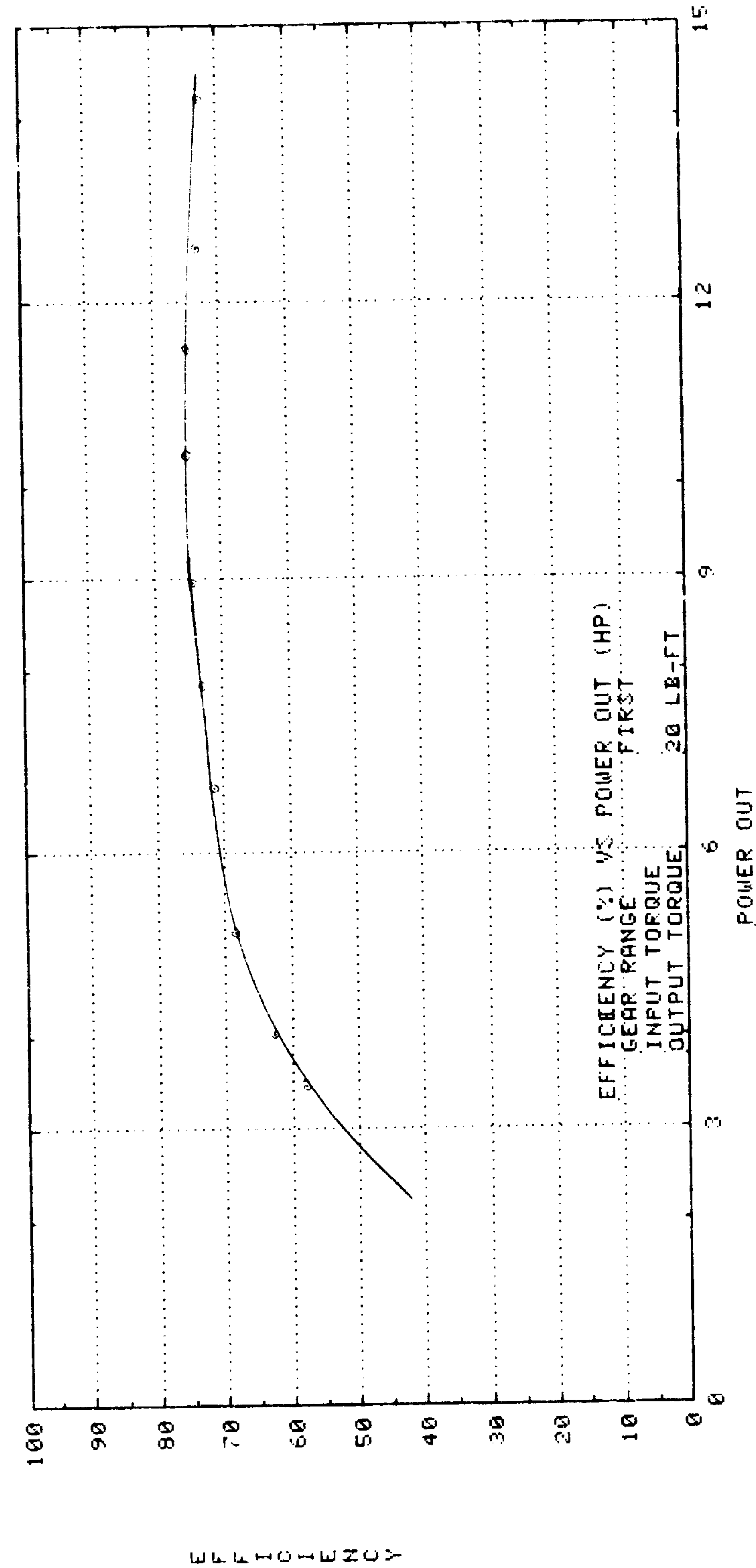

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE FIRST
INPUT TORQUE 10 LB-FT
OUTPUT TORQUE
POWER OUT
EFFICIENCY
0 2 4 6 8 10
0 10 20 30 40 50 60 70 80 90 100


TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE
OUTPUT TORQUE 20 LB-FT
TORQUE RATIO
OUTPUT SPEED
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
0.0
0
500
1000
1500
2000
2500
3000
3500
4000

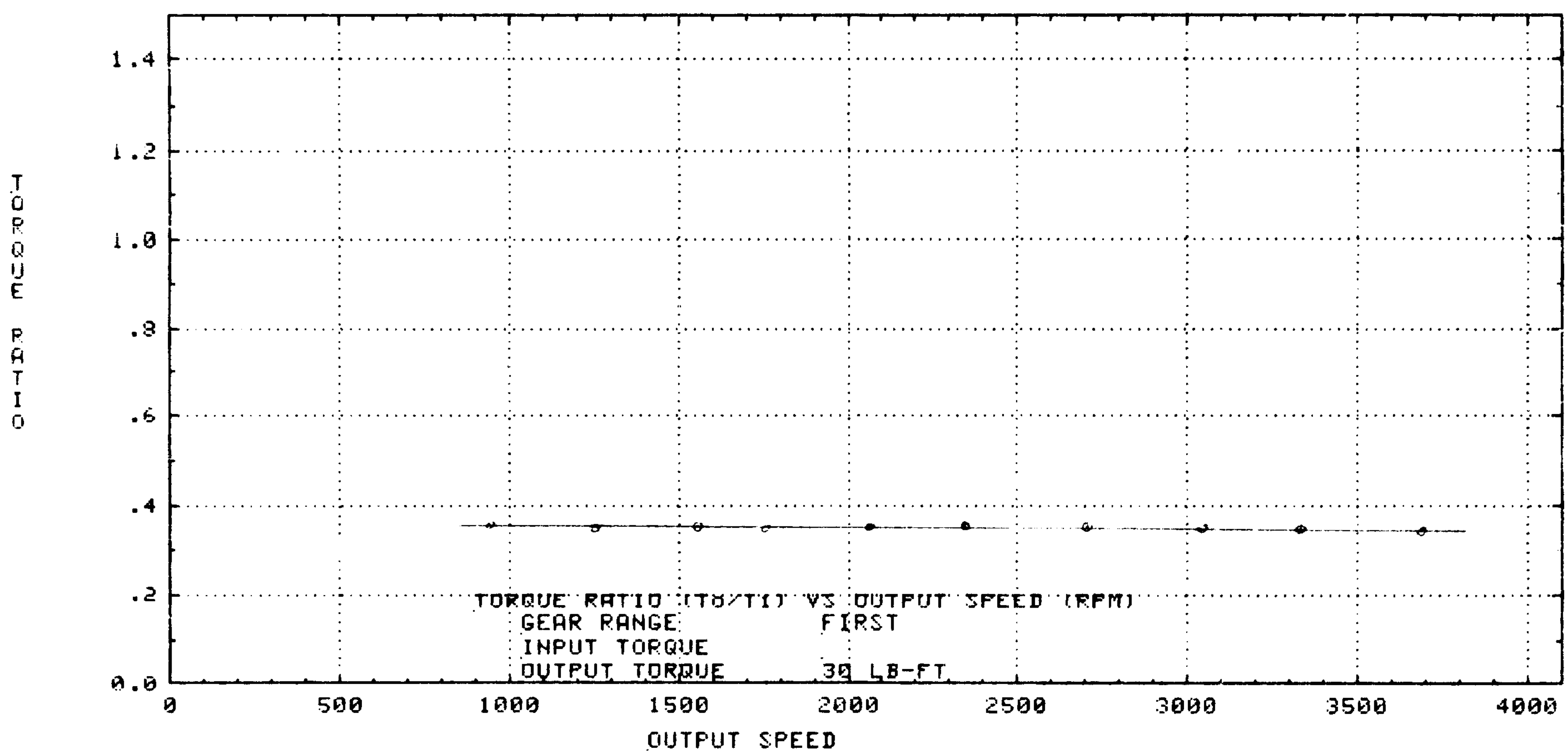

INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE
OUTPUT TORQUE 20 LB-FT
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
0
10
20
30
40
50
60
70
80
INPUT TORQUE

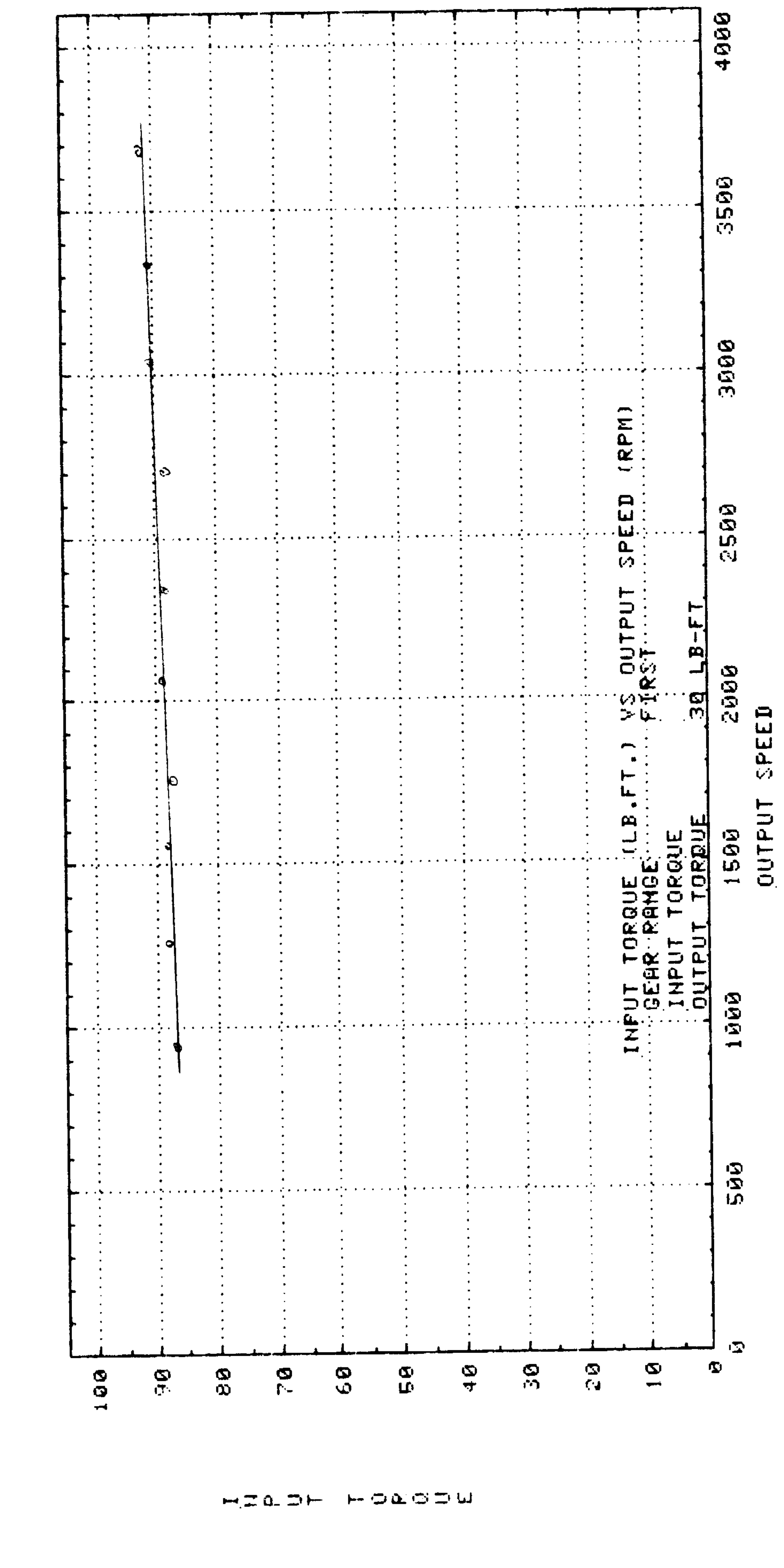

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE : FIRST
INPUT TORQUE :
OUTPUT TORQUE : 20 LB-FT
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

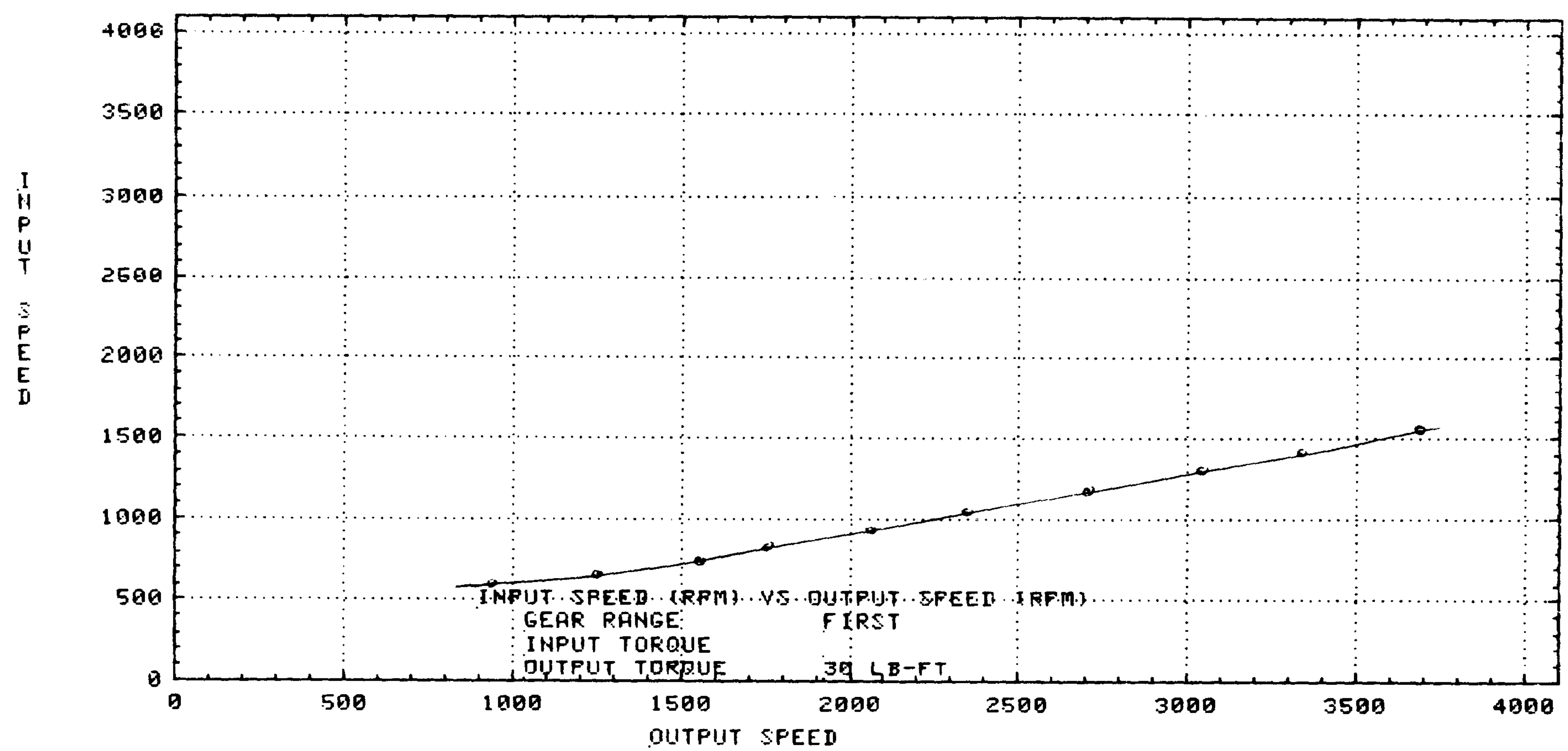

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE
OUTPUT TORQUE 20 LB-FT
OUTPUT SPEED
0 500 1000 1500 2000 2500 3000 3500 4000
0 10 20 30 40 50 60 70 80 90 100
EFFICIENCY

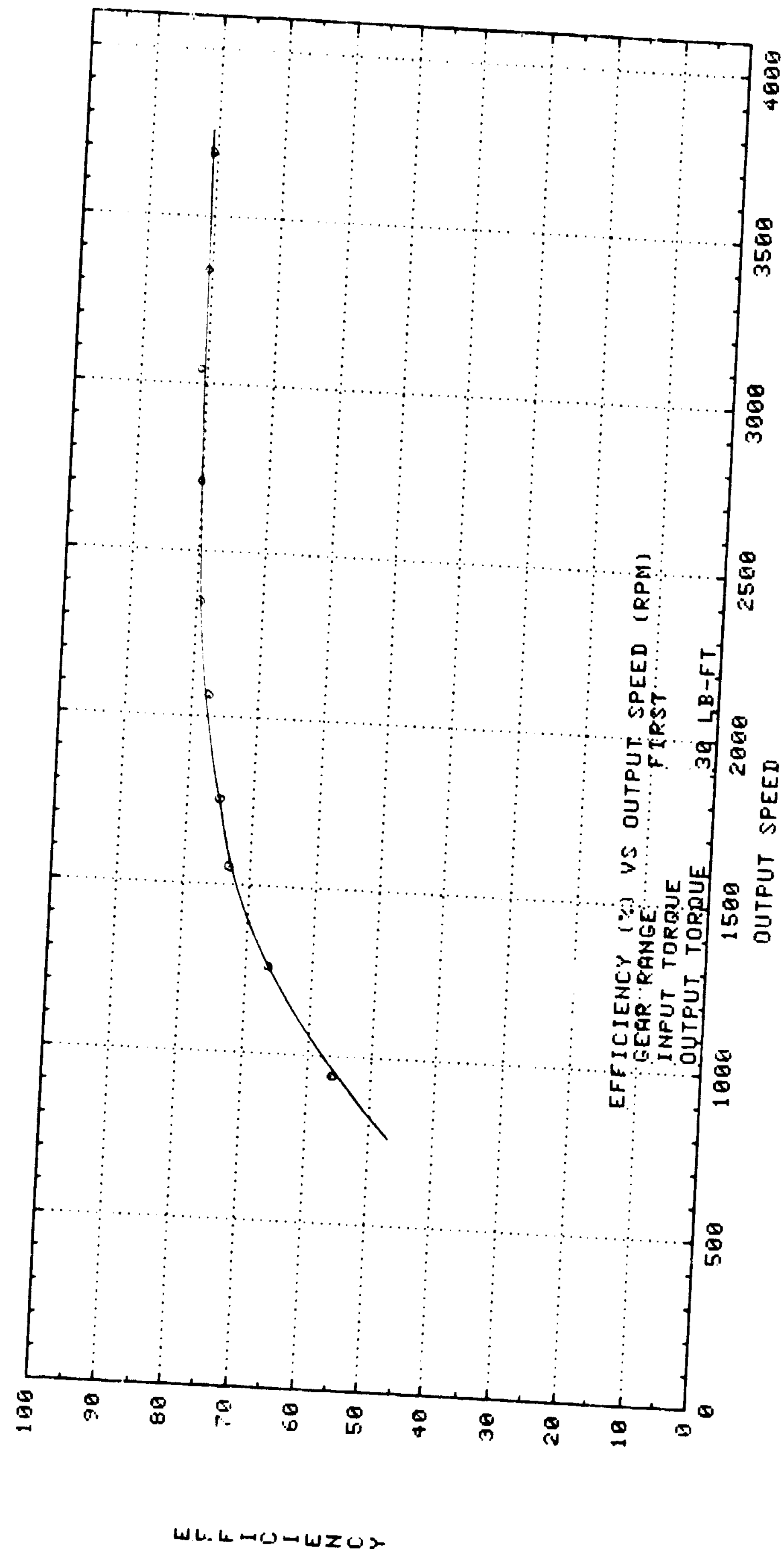


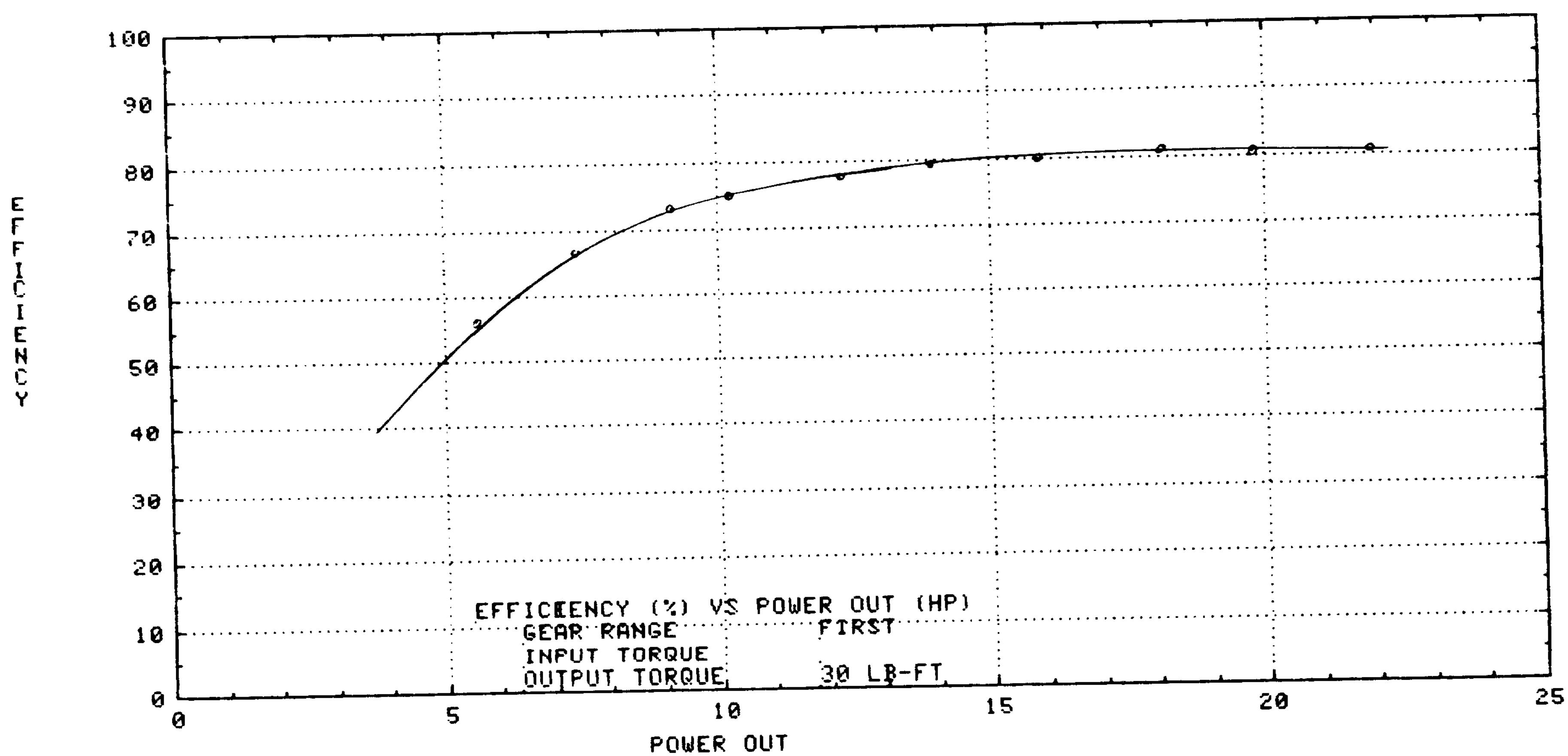
EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE FIRST
INPUT TORQUE
OUTPUT TORQUE 20 LB-FT
POWER OUT
EFFICIENCY
0
3
6
9
12
15
0
10
20
30
40
50
60
70
80
90
100

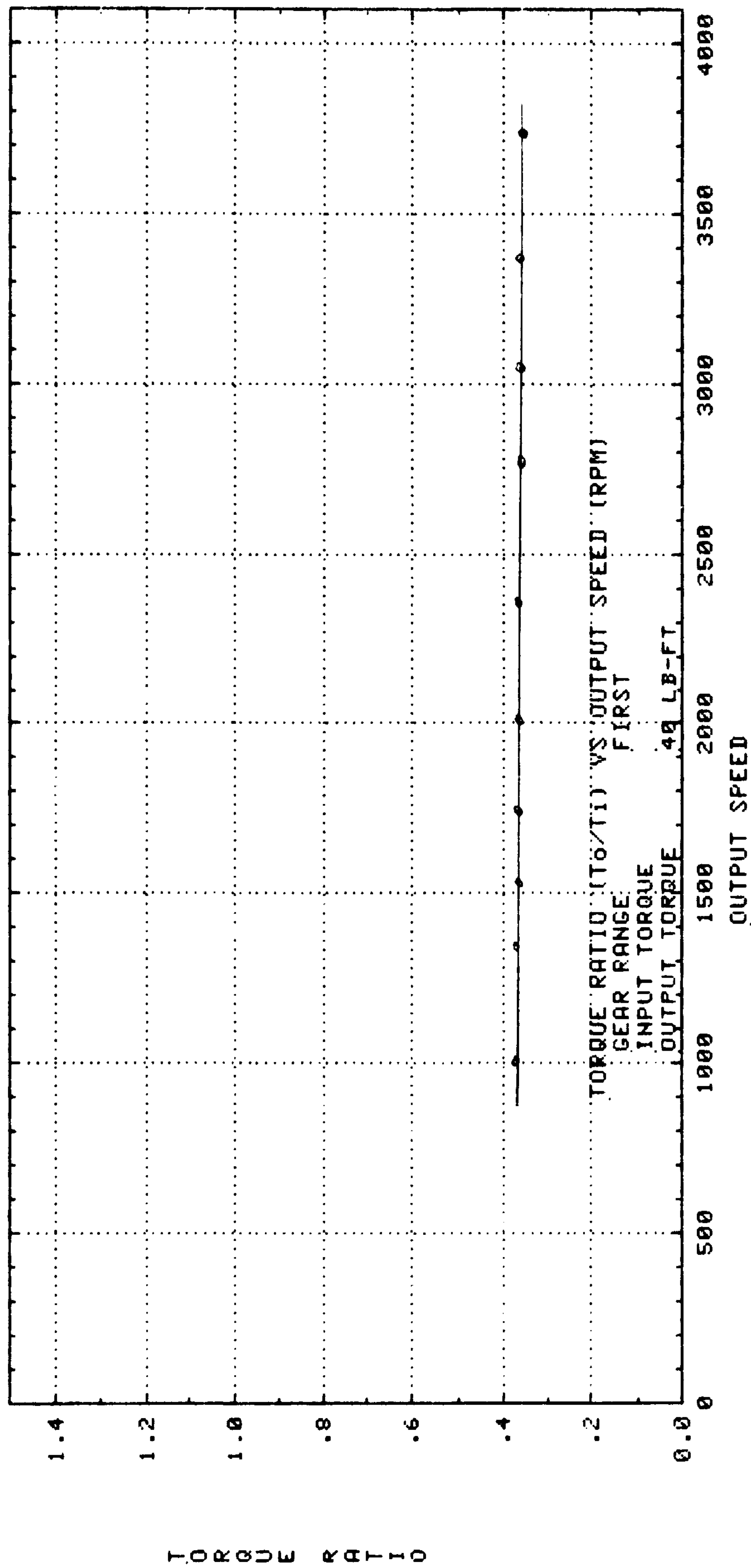

TORQUE RATIO (T0/TI) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE
OUTPUT TORQUE 30 LB-FT
TORQUE RATIO
OUTPUT SPEED
0.0
.2
.4
.6
.8
1.0
1.2
1.4
0
500
1000
1500
2000
2500
3000
3500
4000


INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE
OUTPUT TORQUE 30 LB-FT
OUTPUT SPEED
INPUT TORQUE
0
500
1000
1500
2000
2500
3000
3500
4000
0
10
20
30
40
50
60
70
80
90
100

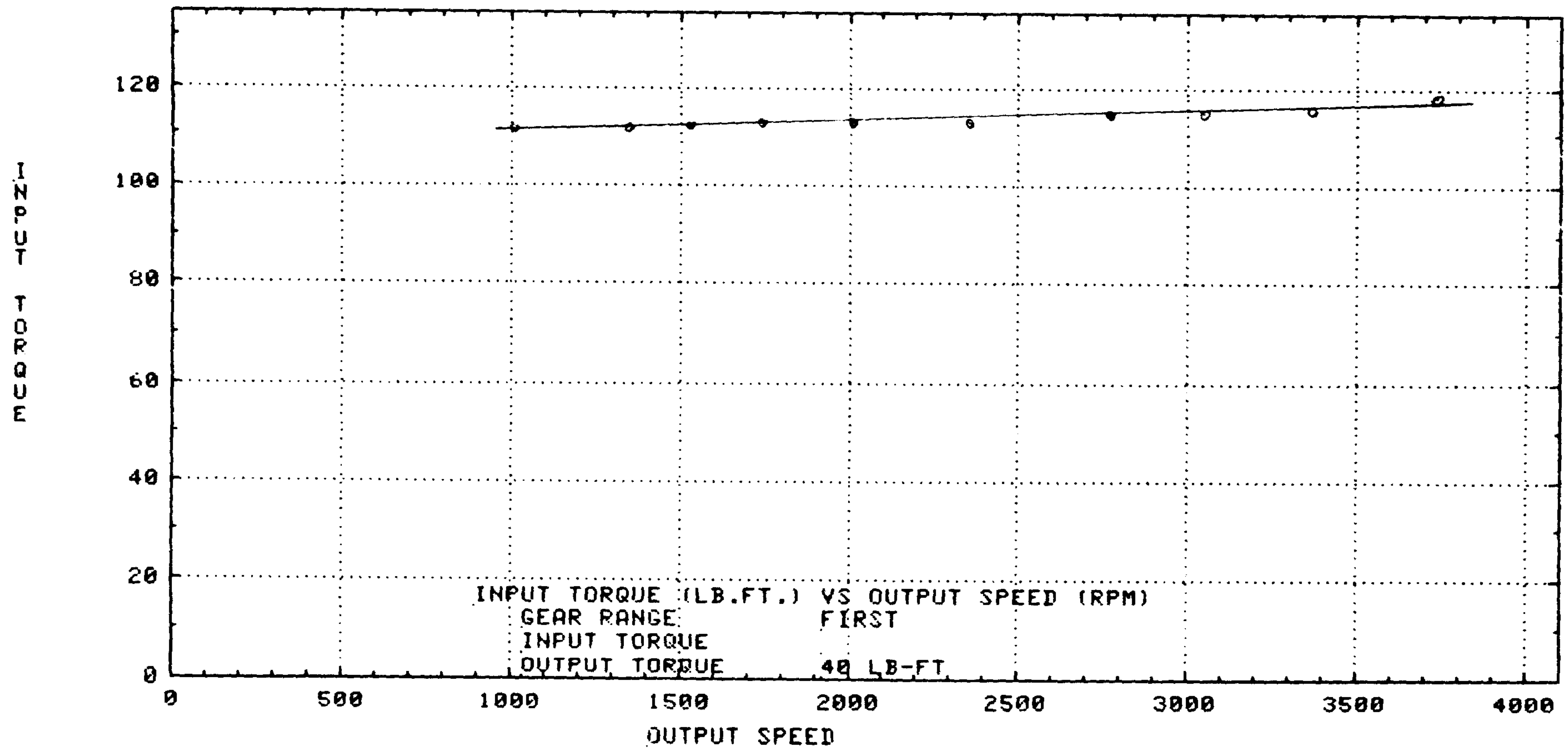

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE
OUTPUT TORQUE 30 LB-FT
INPUT SPEED
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000


EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE
OUTPUT TORQUE 30 LB-FT
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000
0
10
20
30
40
50
60
70
80
90
100
EFFICIENCY

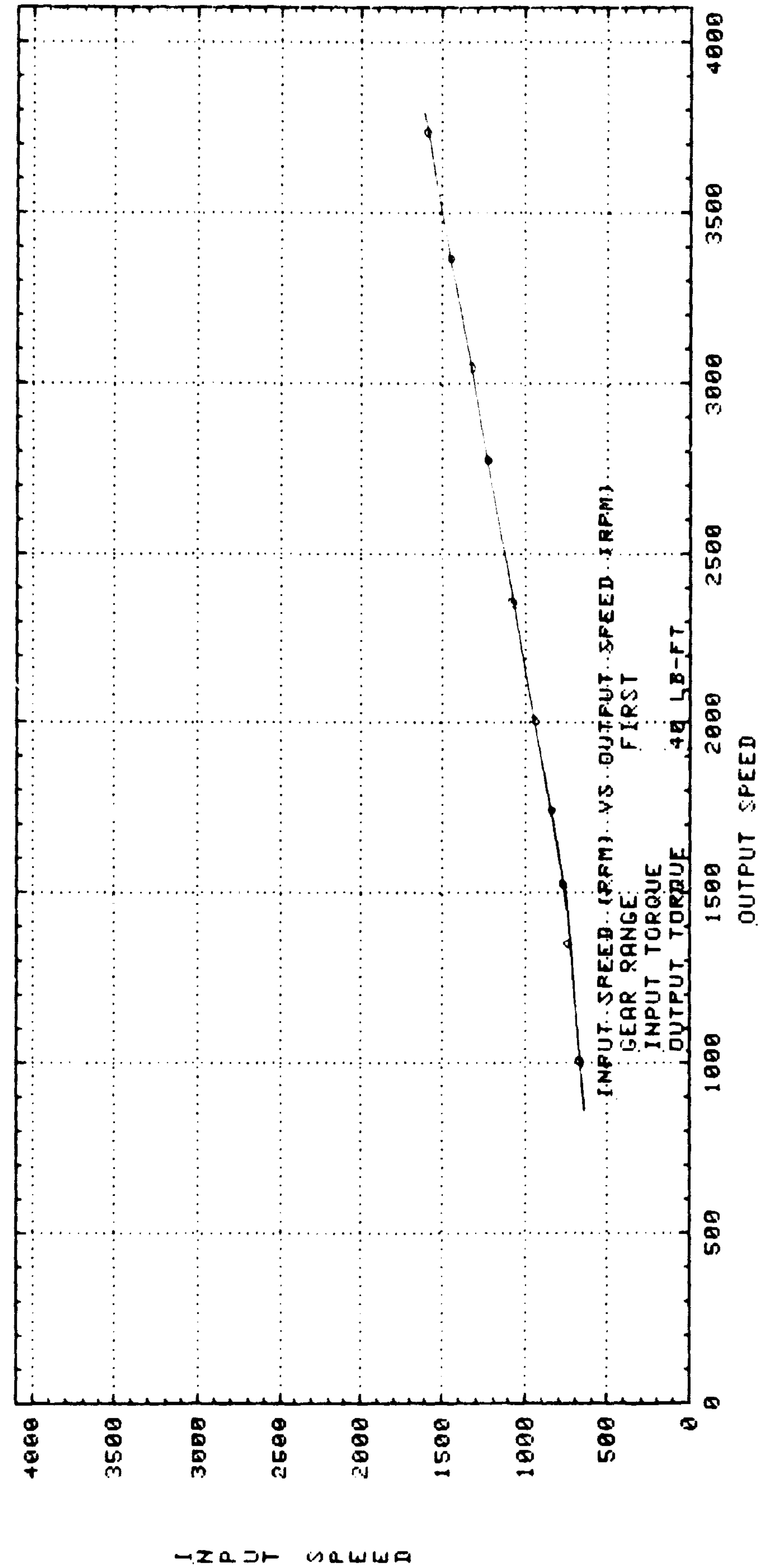

EFFICIENCY
POWER OUT
EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE FIRST
INPUT TORQUE
OUTPUT TORQUE 30 LB-FT
0 5 10 15 20 25
0 10 20 30 40 50 60 70 80 90 100



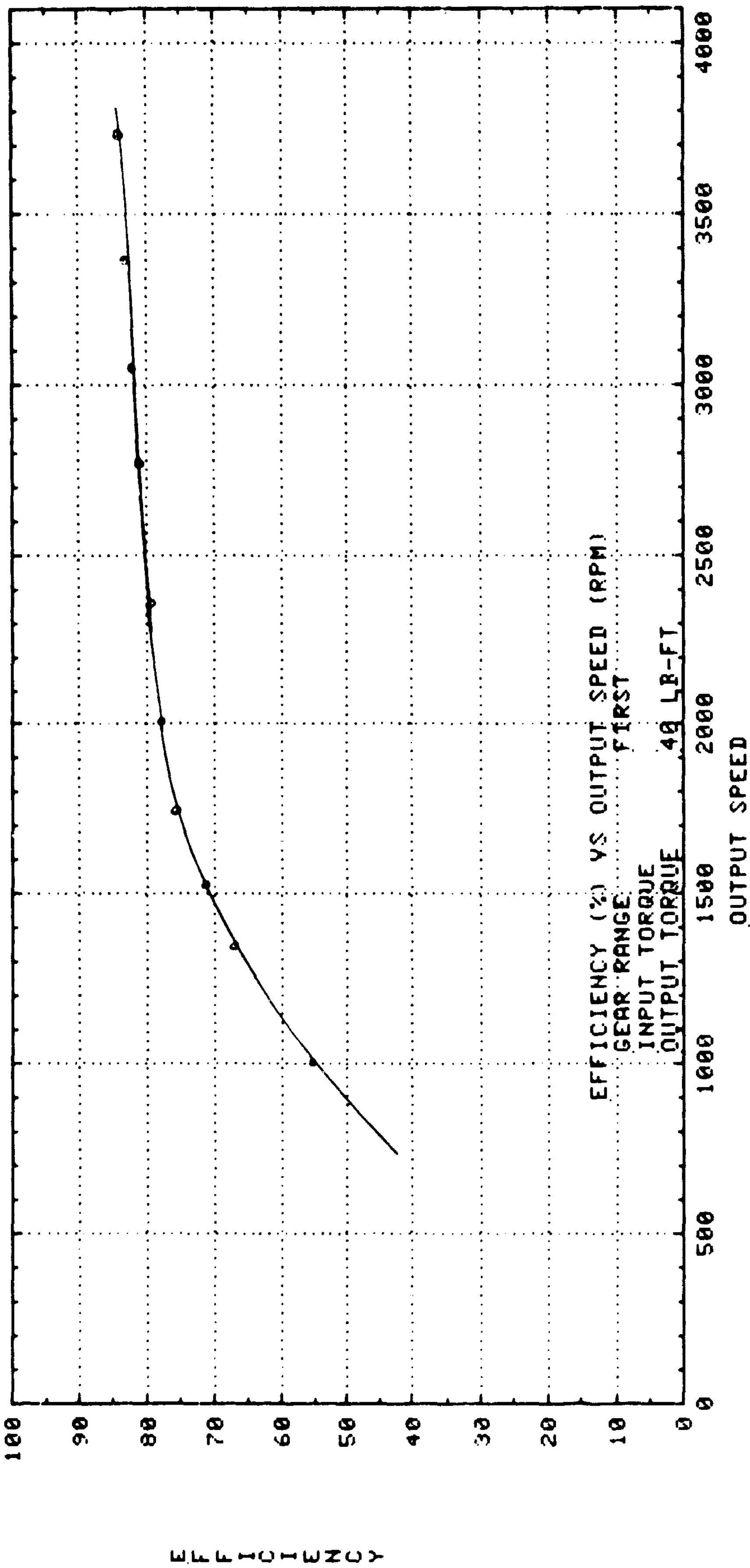
TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE
OUTPUT TORQUE 40 LB-FT
OUTPUT SPEED
TORQUE RATIO
0 500 1000 1500 2000 2500 3000 3500 4000
0.0 .2 .4 .6 .8 1.0 1.2 1.4

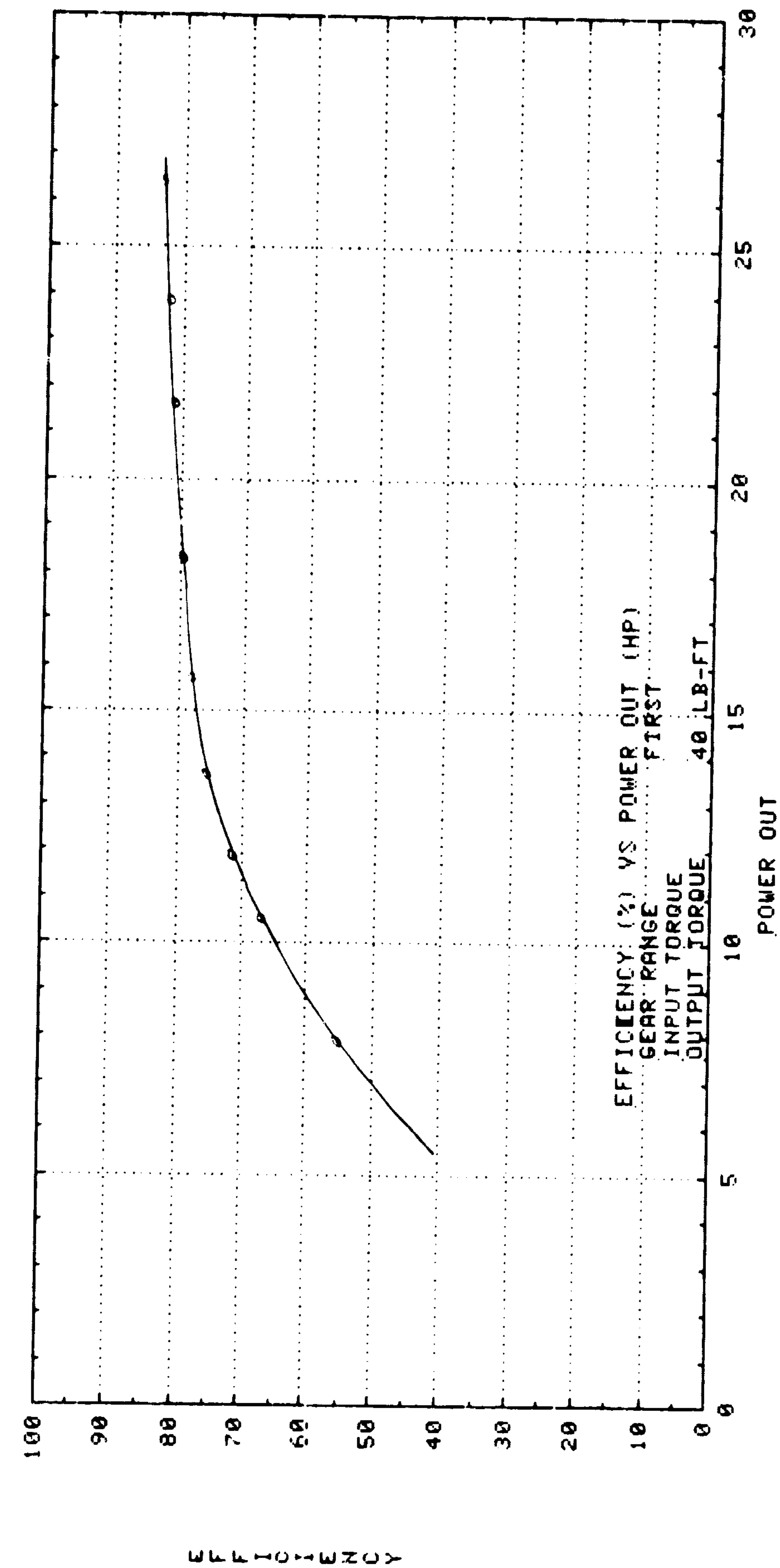


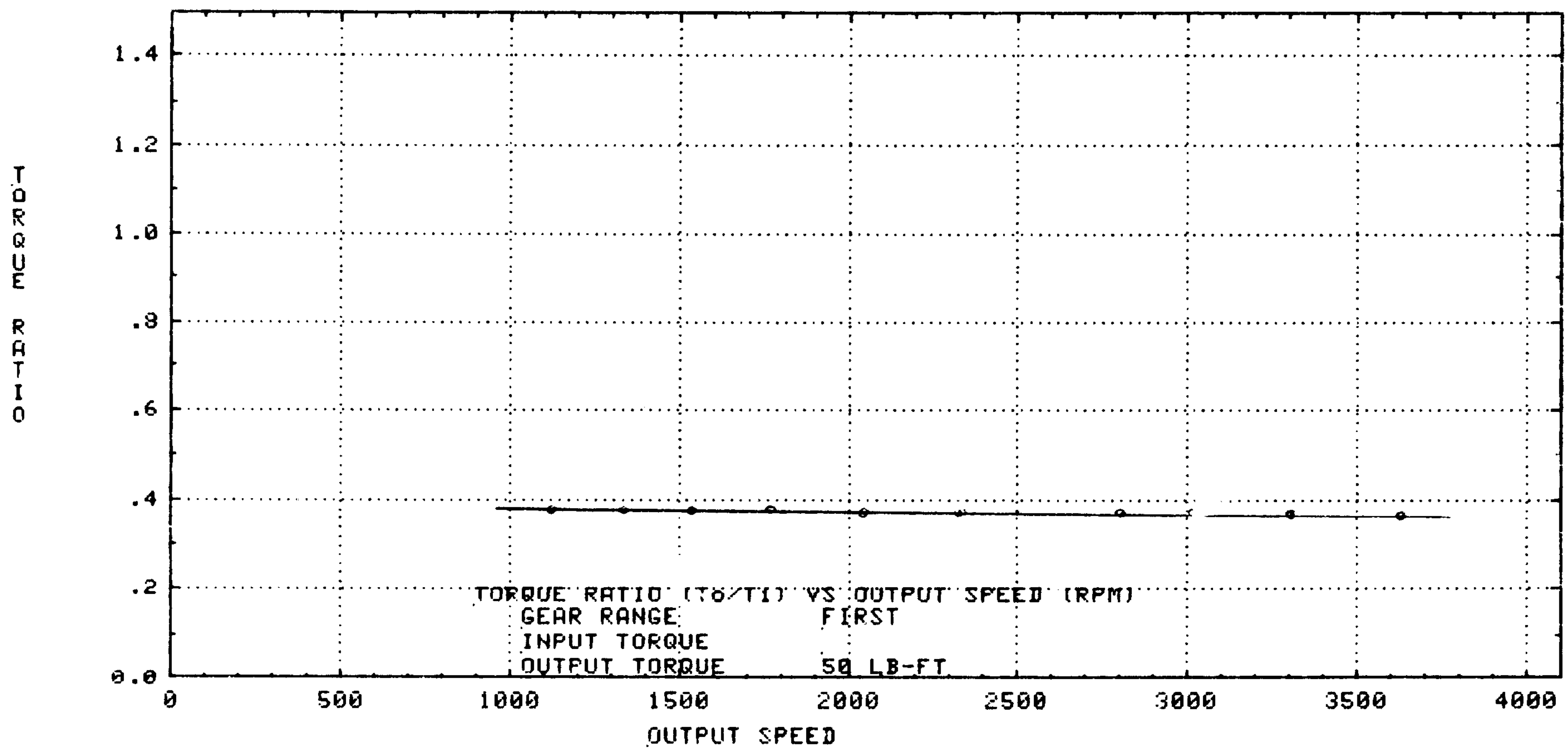
INPUT TORQUE
120
100
80
60
40
20
0
INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE
OUTPUT TORQUE 40 LB-FT
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED



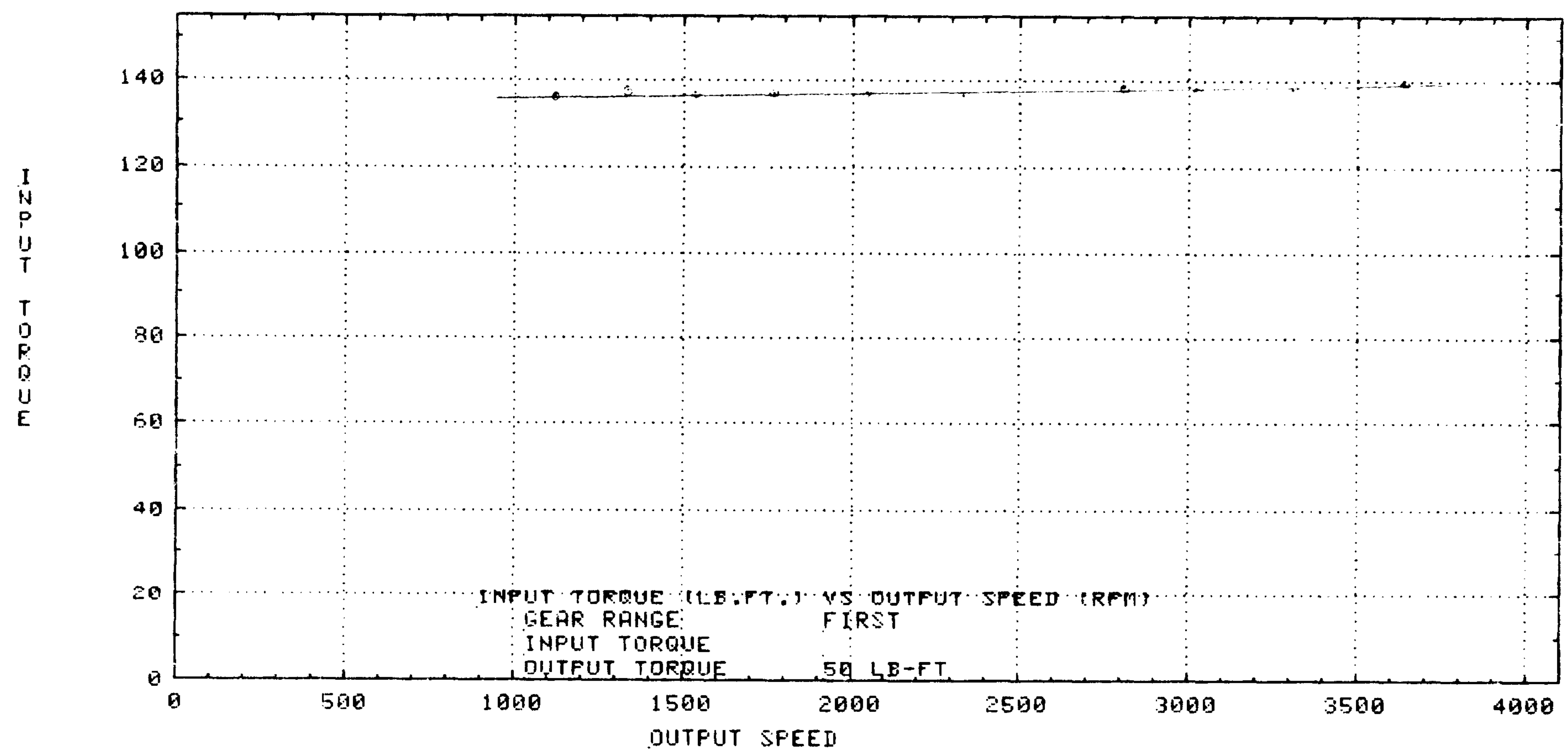
INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE
OUTPUT TORQUE 40 LB-FT
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

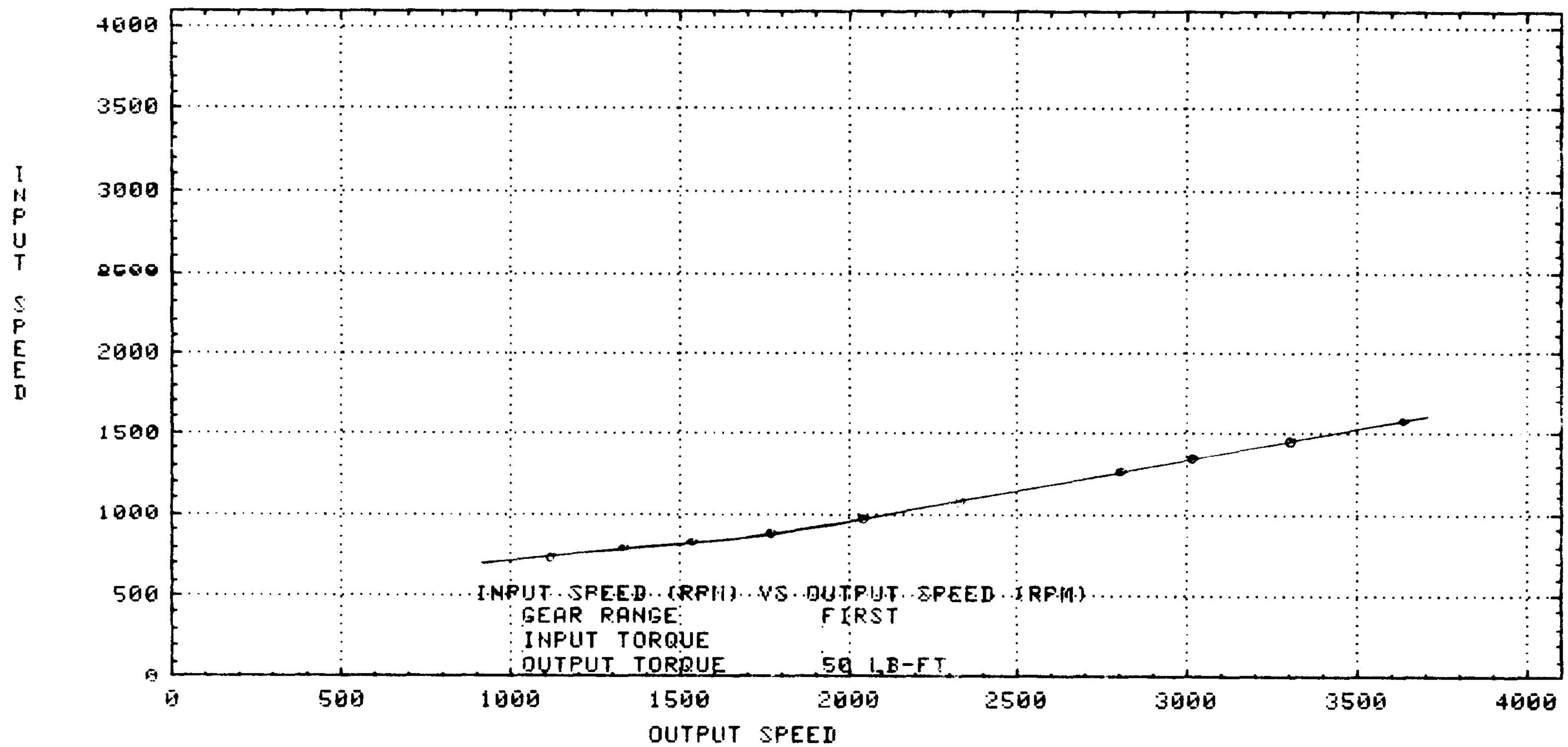

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE 40 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
EFFICIENCY
0
500
1000
1500
2000
2500
3000
3500
4000
10
20
30
40
50
60
70
80
90
100

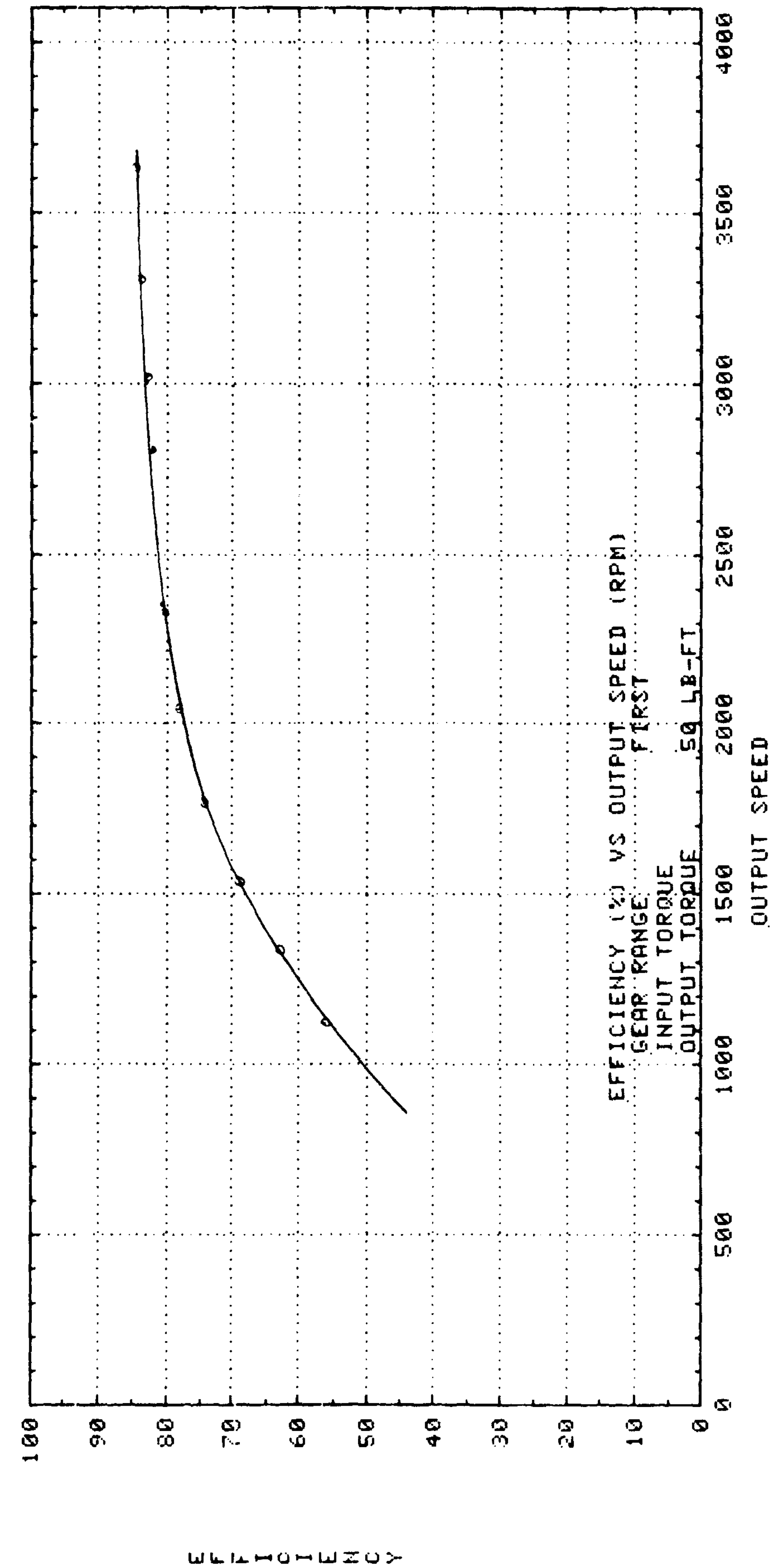

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE FIRST
INPUT TORQUE 40 LB-FT
OUTPUT TORQUE
POWER OUT
EFFICIENCY
0
5
10
15
20
25
30
0
10
20
30
40
50
60
70
80
90
100

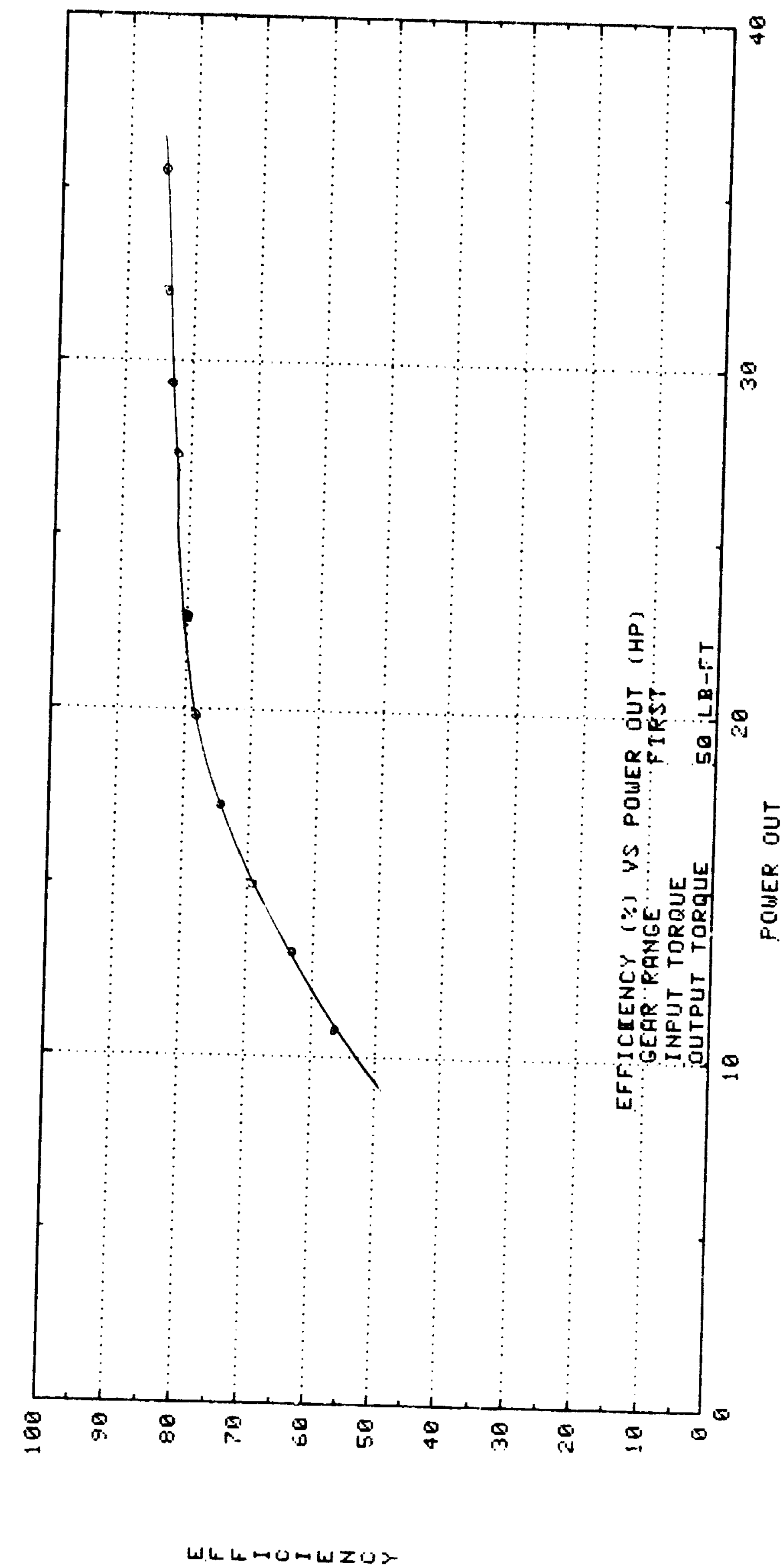


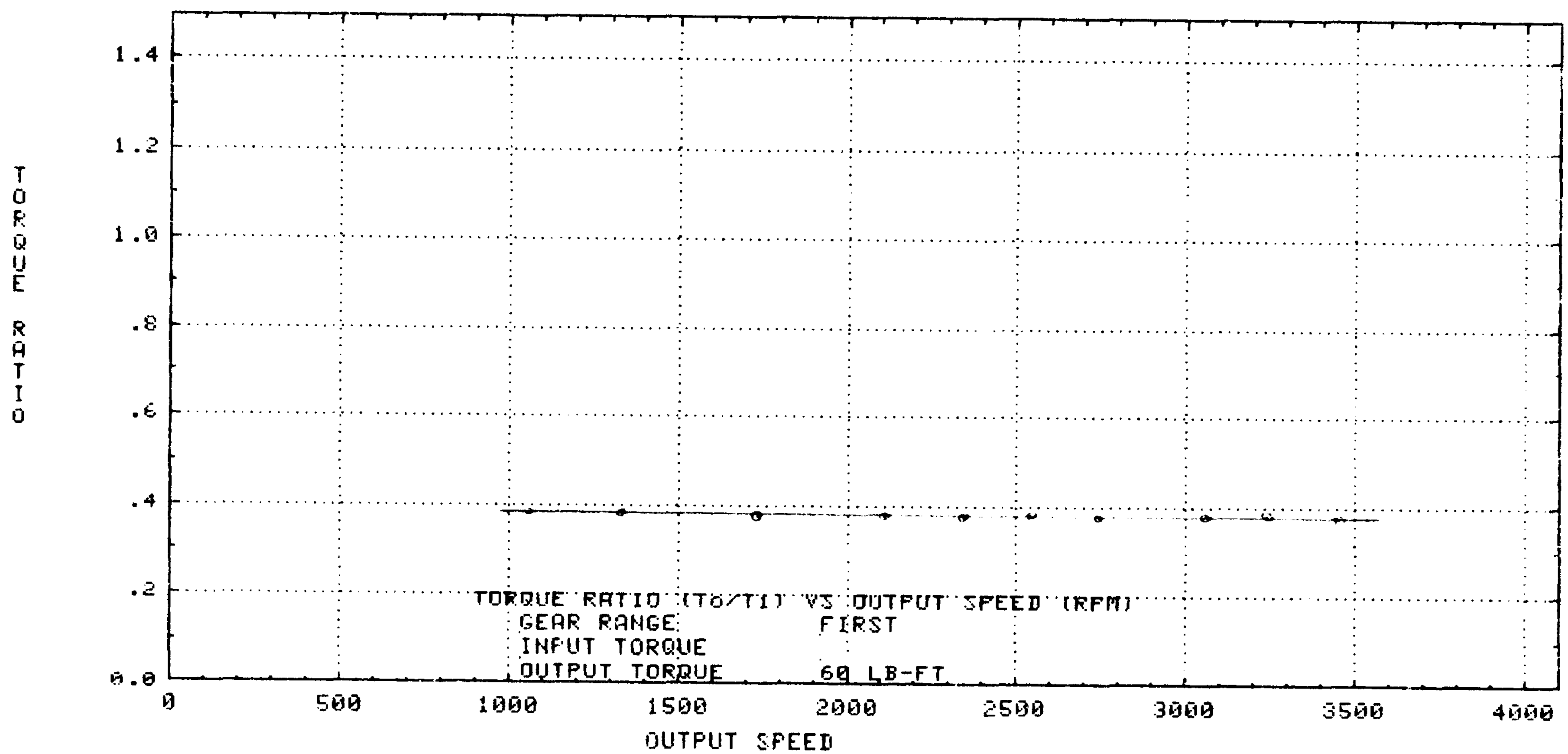
TORQUE RATIO
1.4
1.2
1.0
.8
.6
.4
.2
0.0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
TORQUE RATIO (TO/TI) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE
OUTPUT TORQUE 50 LB-FT

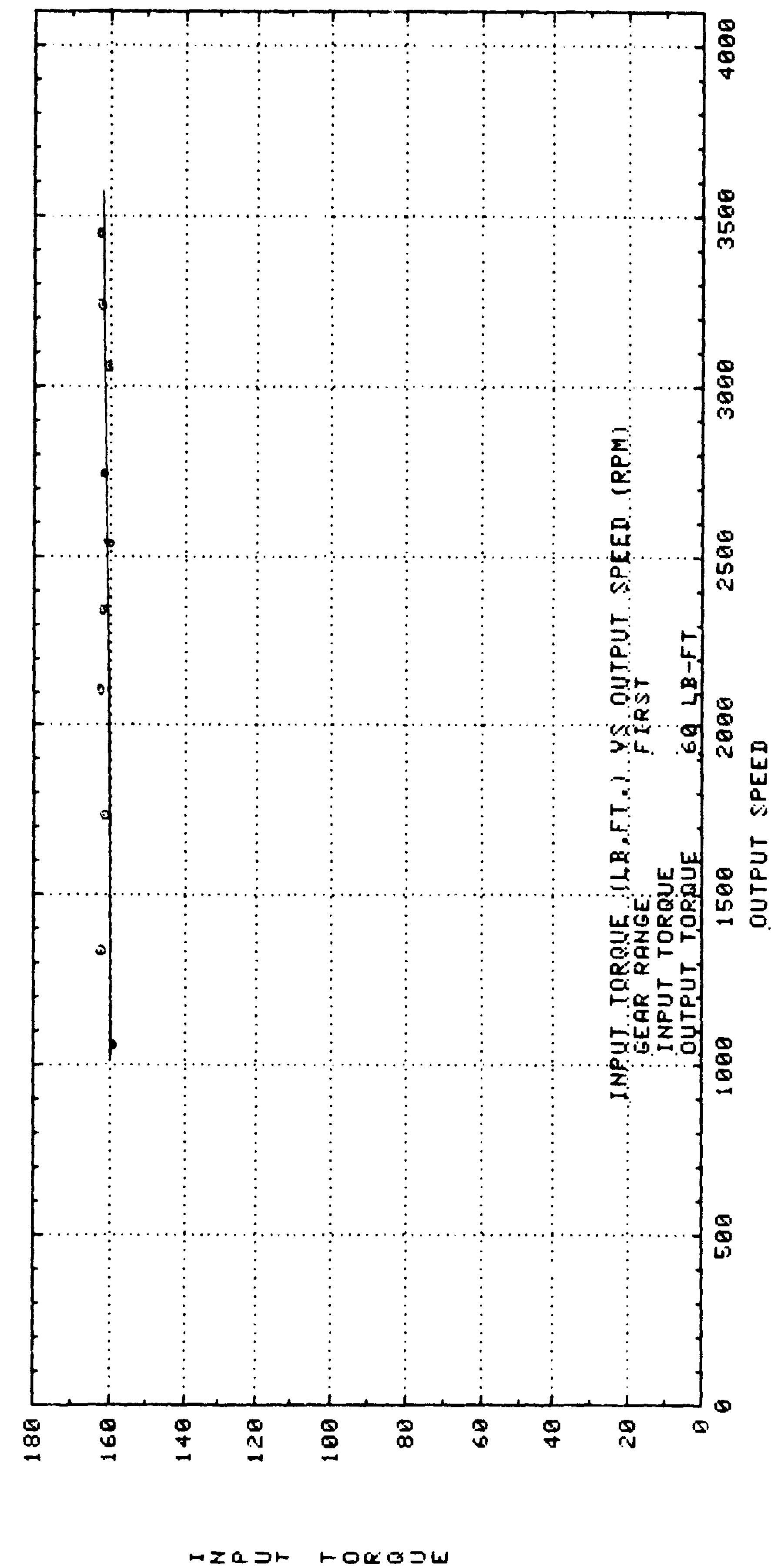

INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE
OUTPUT TORQUE 50 LB-FT
INPUT TORQUE
OUTPUT SPEED
0
20
40
60
80
100
120
140
0
500
1000
1500
2000
2500
3000
3500
4000


INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE
OUTPUT TORQUE 50 LB-FT
INPUT SPEED
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

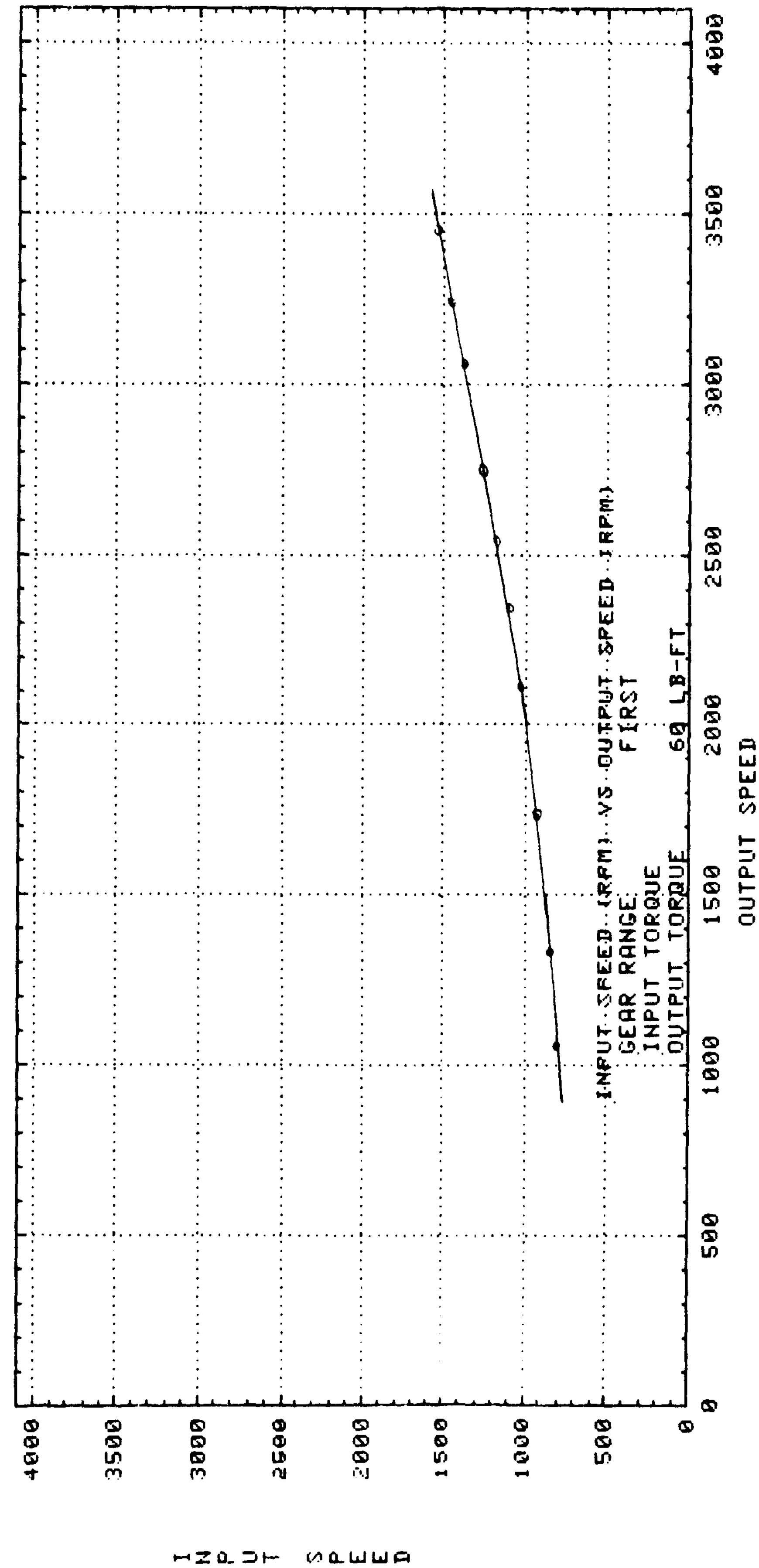

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE
OUTPUT TORQUE 50 LB-FT
OUTPUT SPEED
EFFICIENCY
0
500
1000
1500
2000
2500
3000
3500
4000
0
10
20
30
40
50
60
70
80
90
100

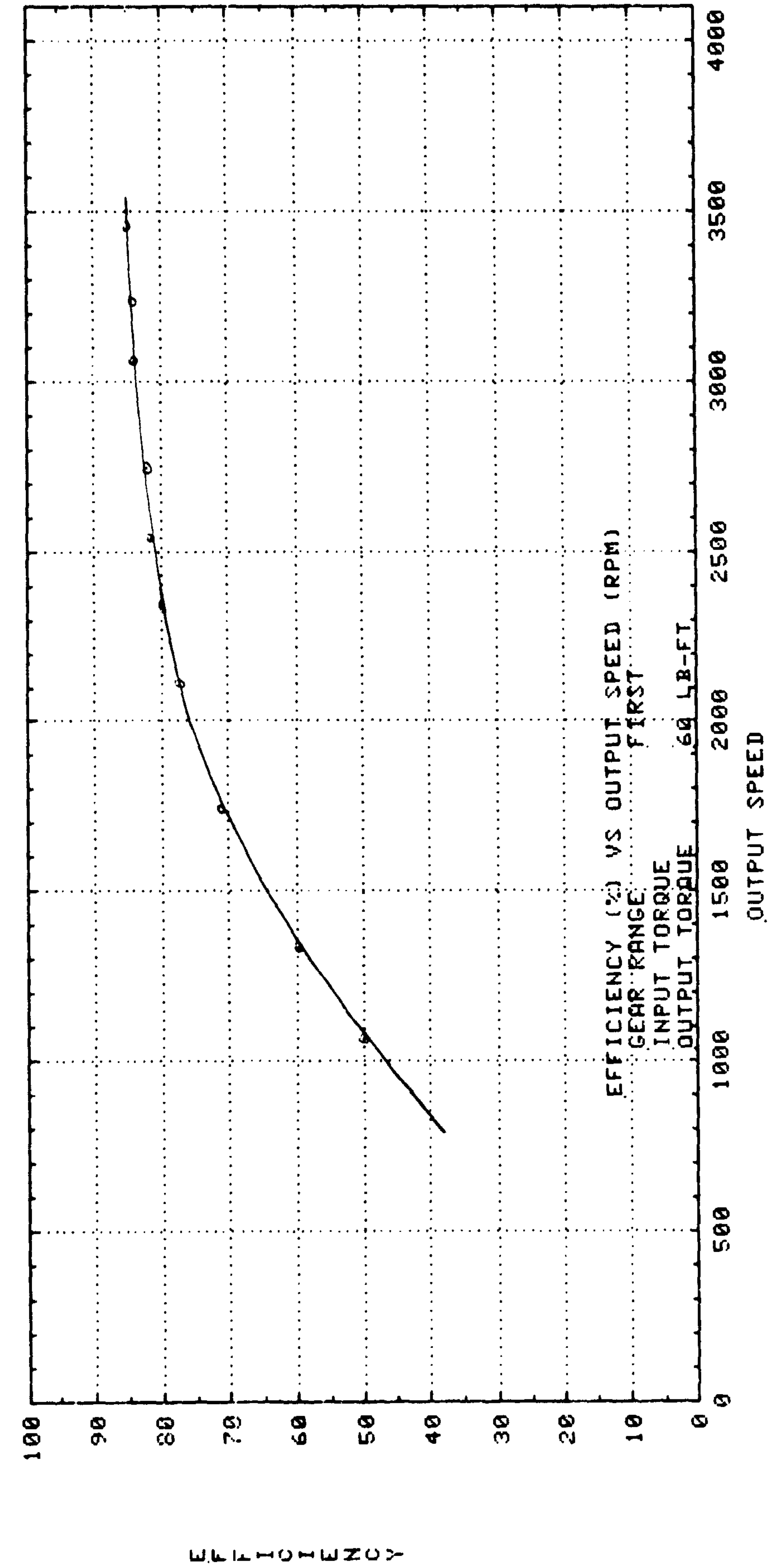

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE FIRST
INPUT TORQUE
OUTPUT TORQUE 50 LB-FT
POWER OUT
EFFICIENCY
0
10
20
30
40
50
60
70
80
90
100

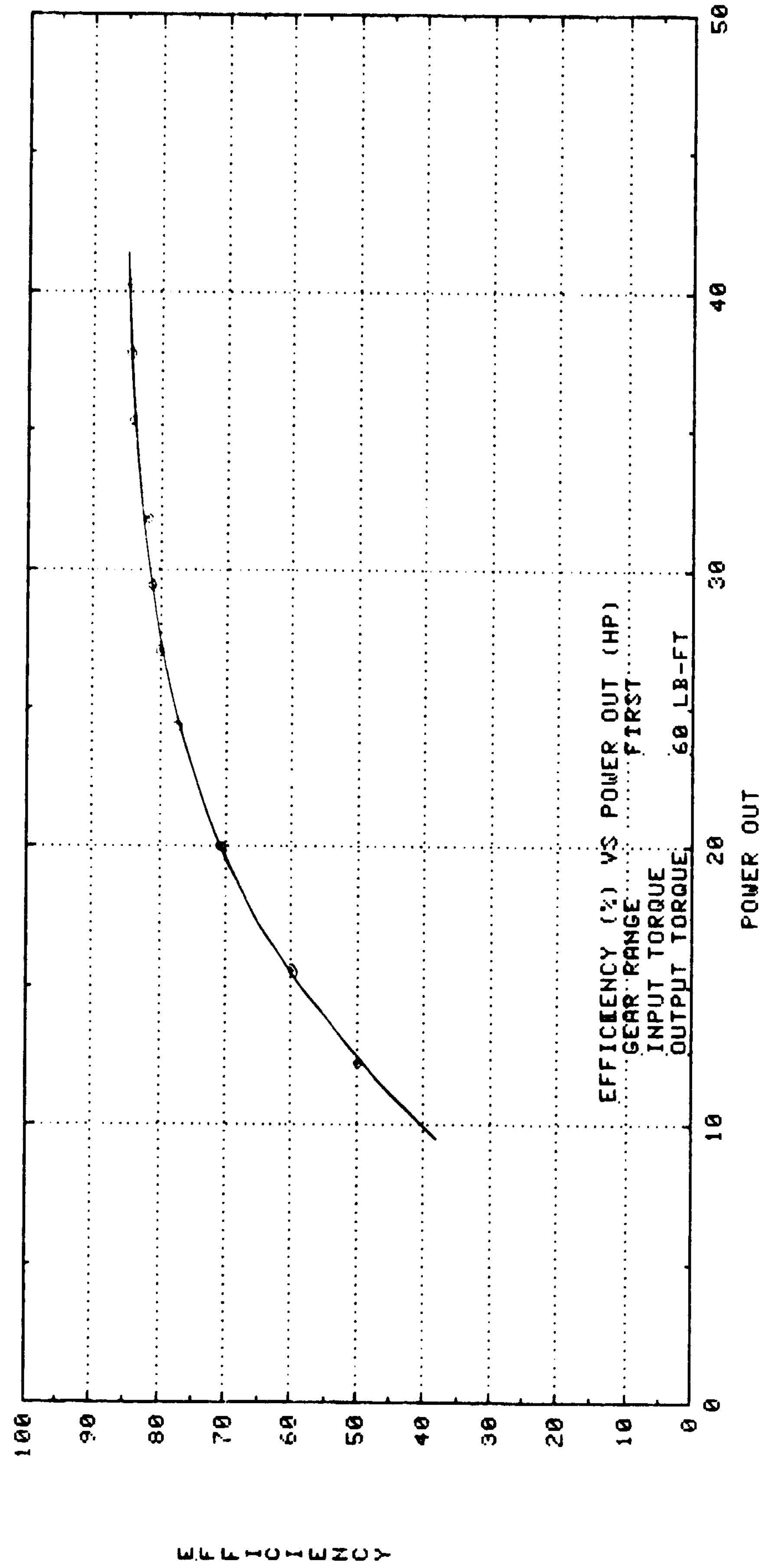

TORQUE RATIO (TO/TI) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE
OUTPUT TORQUE 60 LB-FT
TORQUE RATIO
OUTPUT SPEED
0.0
.2
.4
.6
.8
1.0
1.2
1.4
0
500
1000
1500
2000
2500
3000
3500
4000



INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE
OUTPUT TORQUE 60 LB-FT
OUTPUT SPEED
INPUT TORQUE
0 500 1000 1500 2000 2500 3000 3500 4000
0 20 40 60 80 100 120 140 160 180


INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE
OUTPUT TORQUE 60 LB-FT
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000


EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE FIRST
INPUT TORQUE
OUTPUT TORQUE 60 LB-FT
OUTPUT SPEED
EFFICIENCY
0
500
1000
1500
2000
2500
3000
3500
4000
0
10
20
30
40
50
60
70
80
90
100

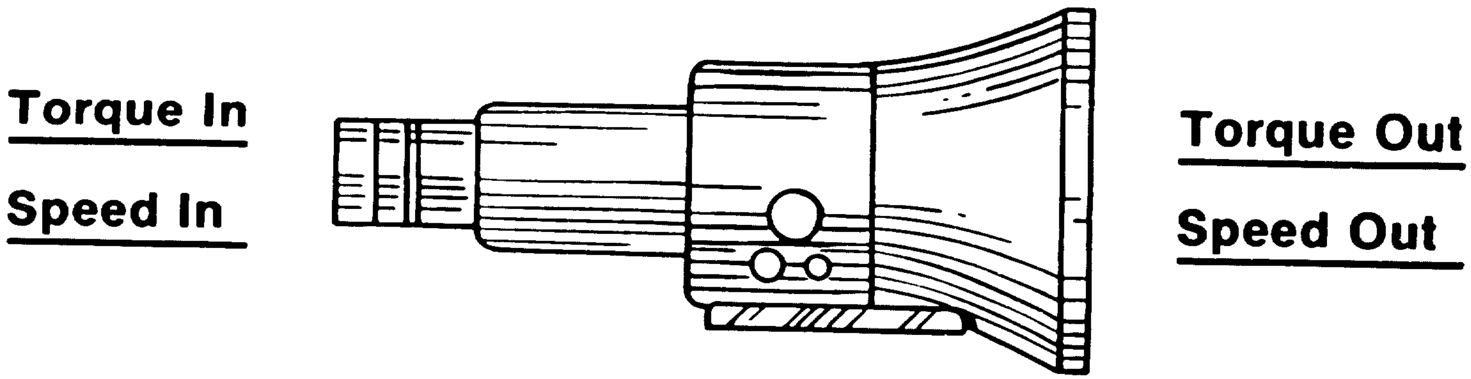

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE FIRST
INPUT TORQUE
OUTPUT TORQUE 60 LB-FT
POWER OUT
EFFICIENCY
0
10
20
30
40
50
60
70
80
90
100

COAST PERFORMANCE

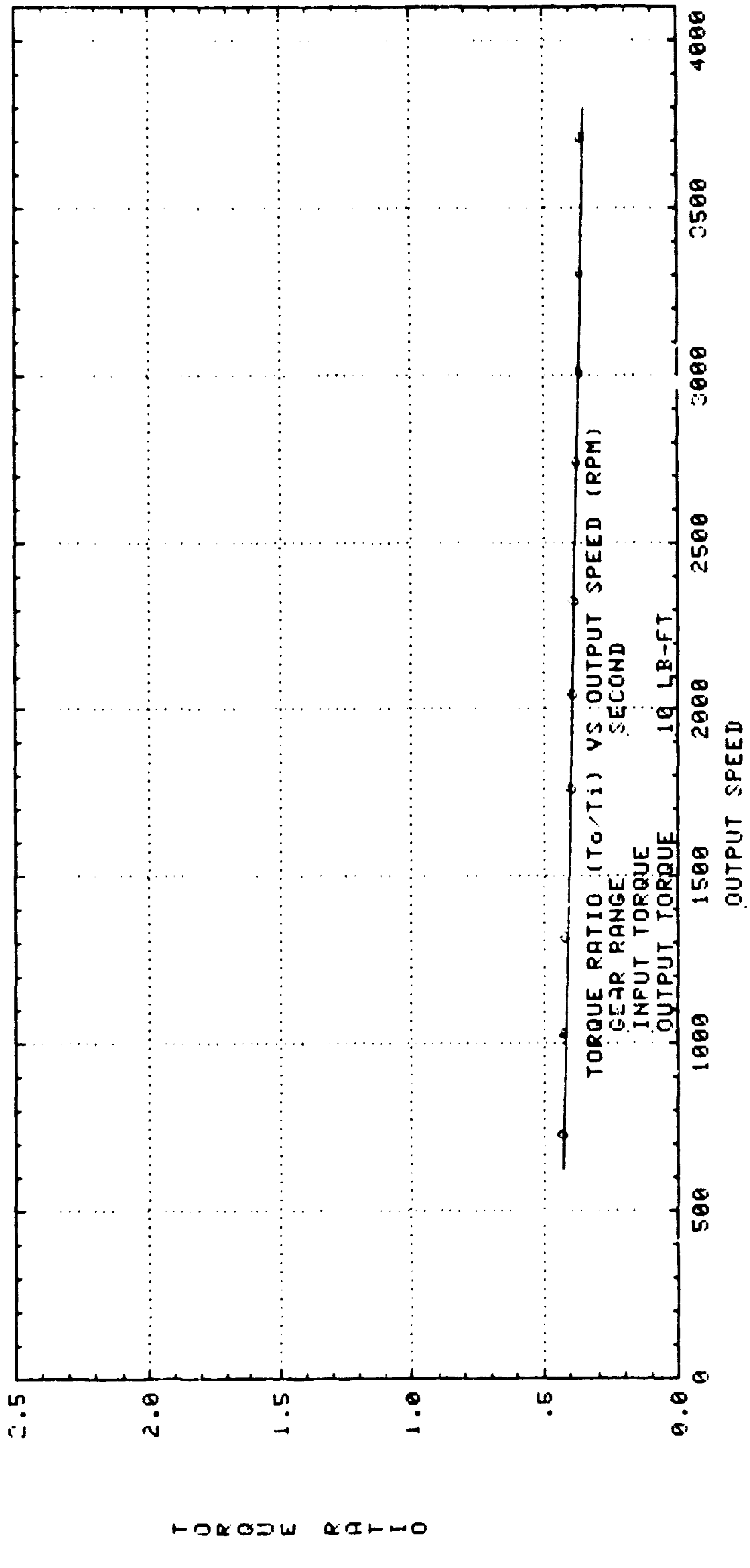
2nd Gear

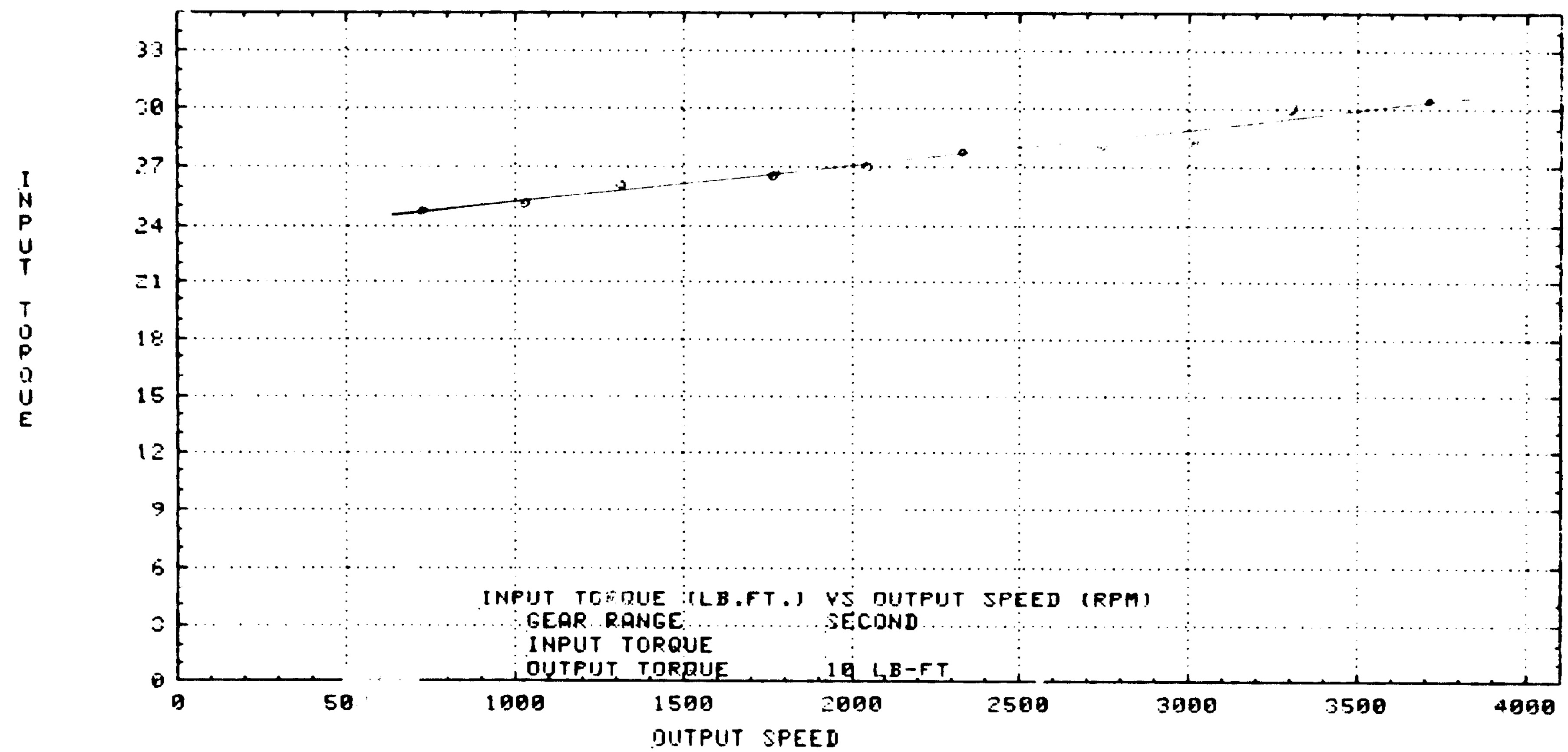
Graphs Contained in This Section

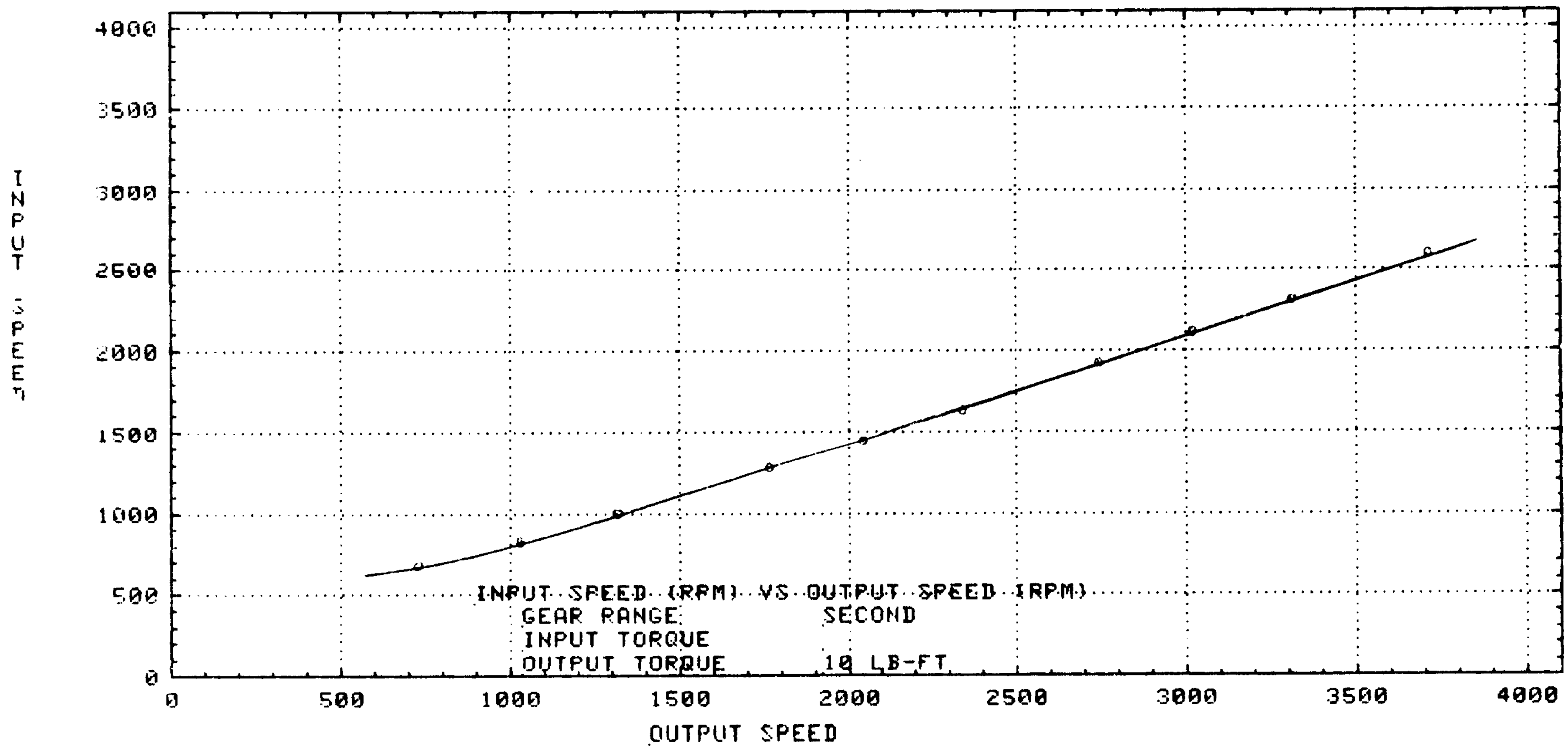
Torque Ratio -vs- Output Speed
Output Torque -vs- Output Speed
Input Speed -vs- Output Speed
Efficiency -vs- Output Speed
Efficiency -vs- Power Out

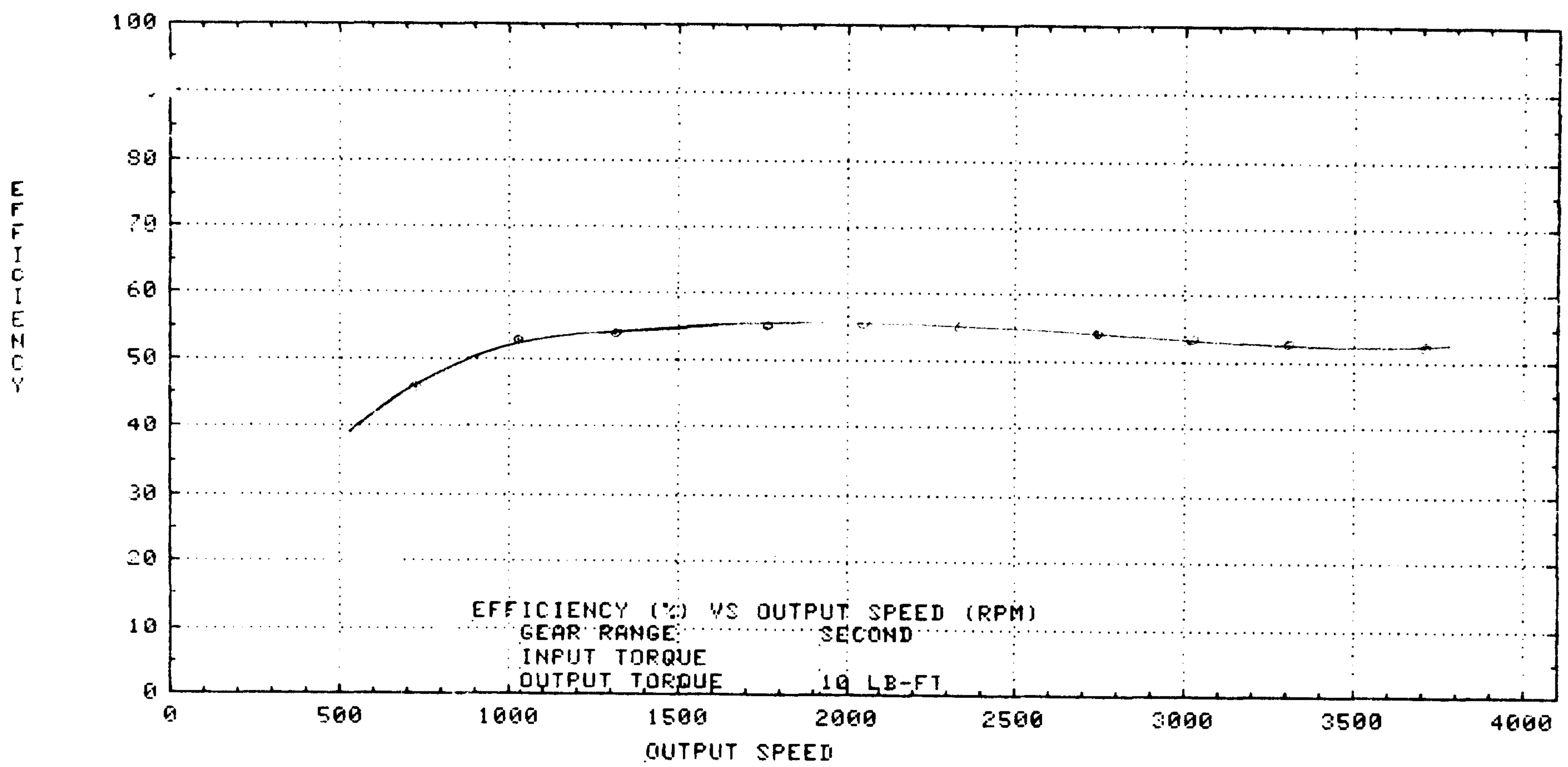


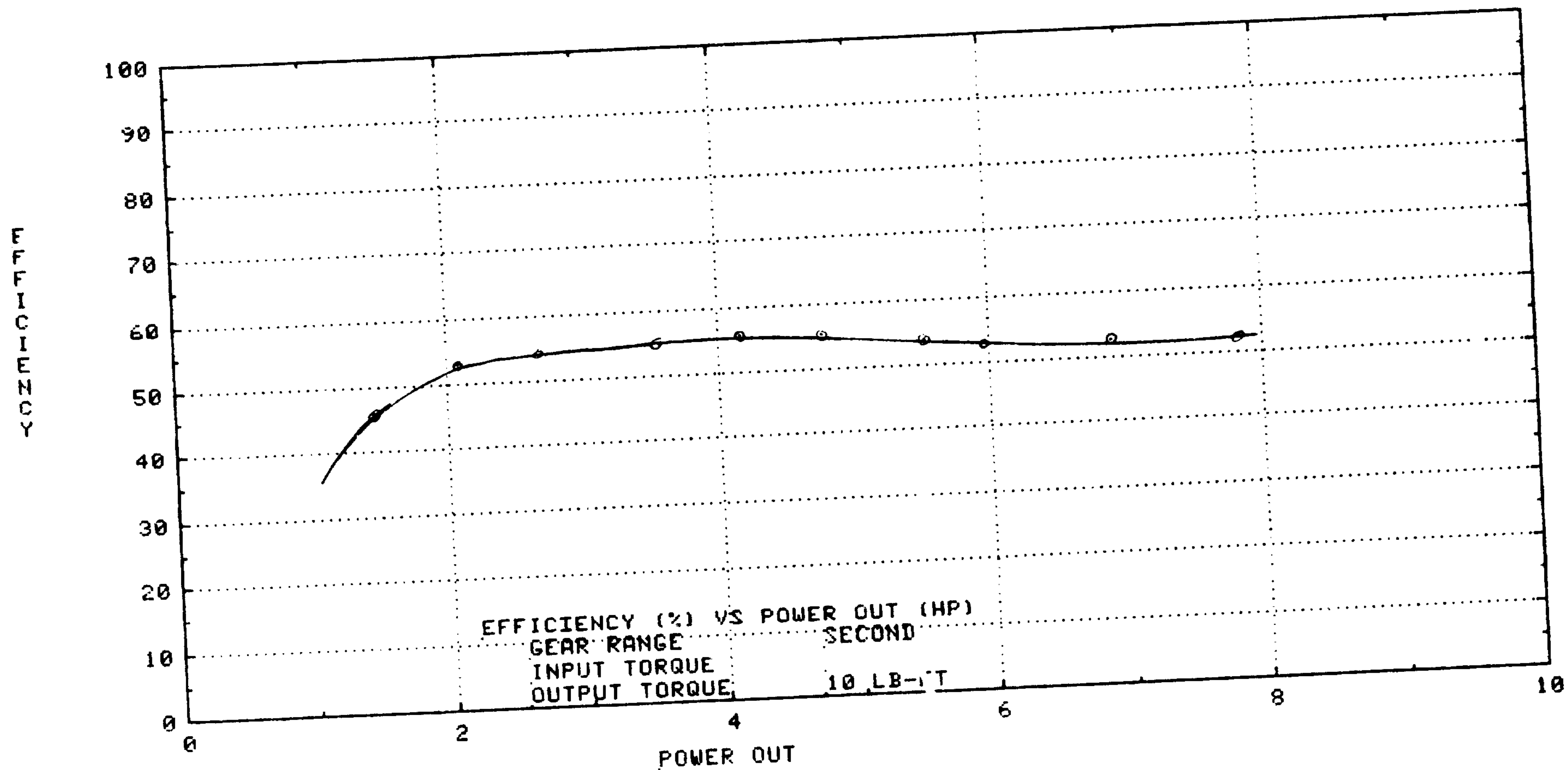
Coast Performance Tests

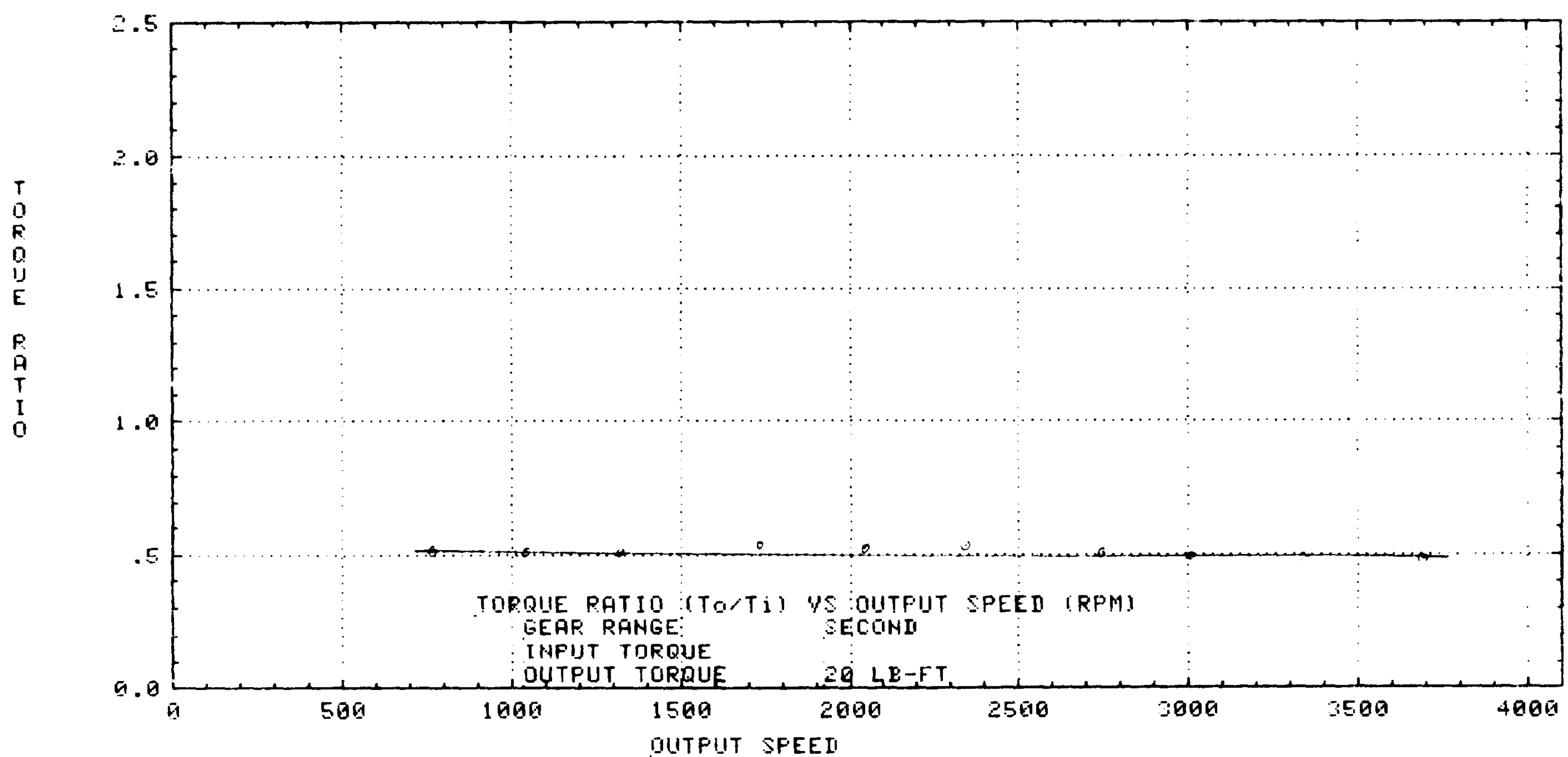

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 10 LB-FT
OUTPUT SPEED
TORQUE RATIO
0
500
1000
1500
2000
2500
3000
3500
4000
0.0
.5
1.0
1.5
2.0
2.5


INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 10 LB-FT
INPUT TORQUE
OUTPUT SPEED
0
3
6
9
12
15
18
21
24
27
30
33
0
50
1000
1500
2000
2500
3000
3500
4000

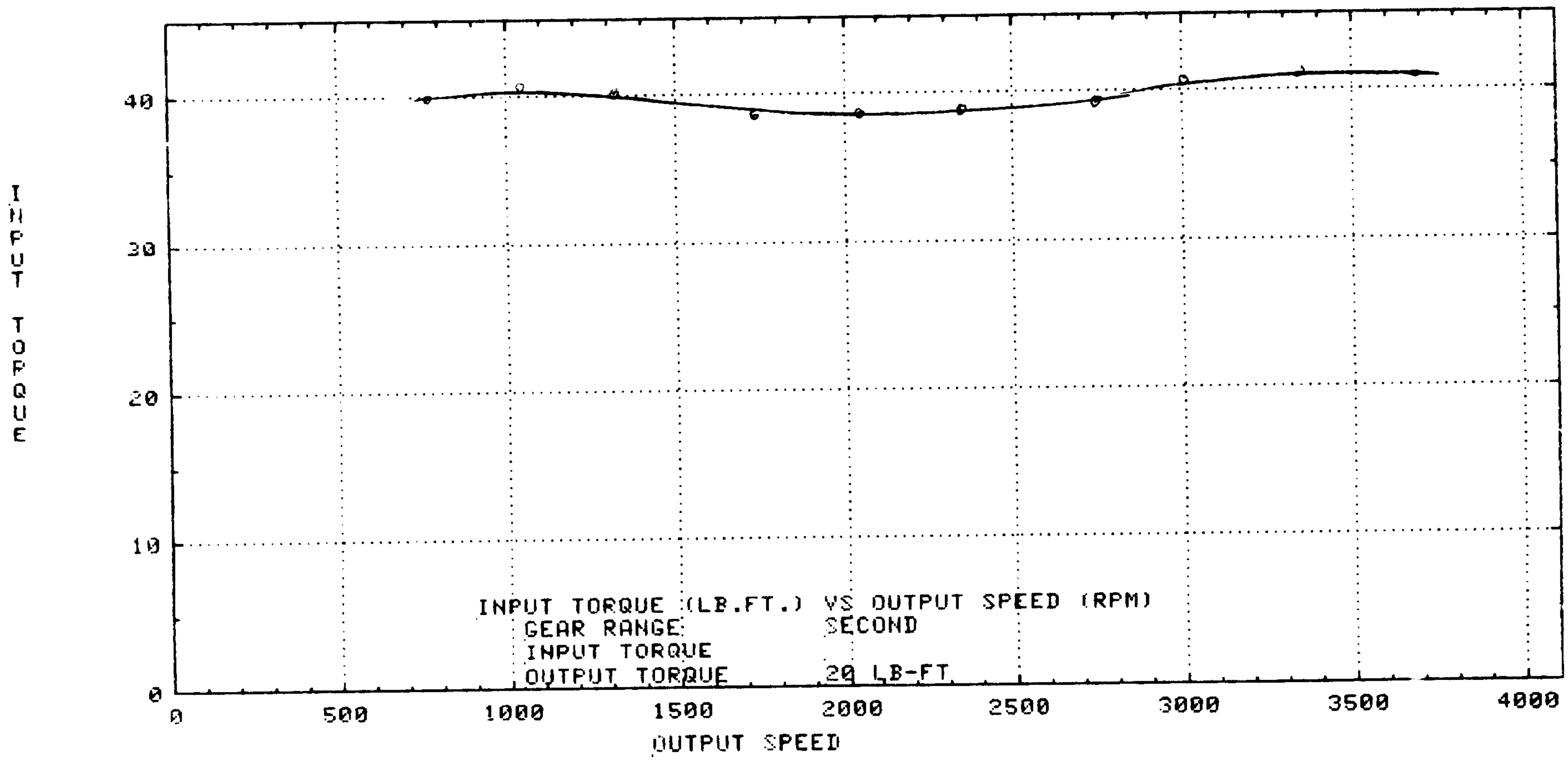

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 10 LB-FT
INPUT SPEED
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000


EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 10 LB-FT
EFFICIENCY
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000
10
20
30
40
50
60
70
80
100

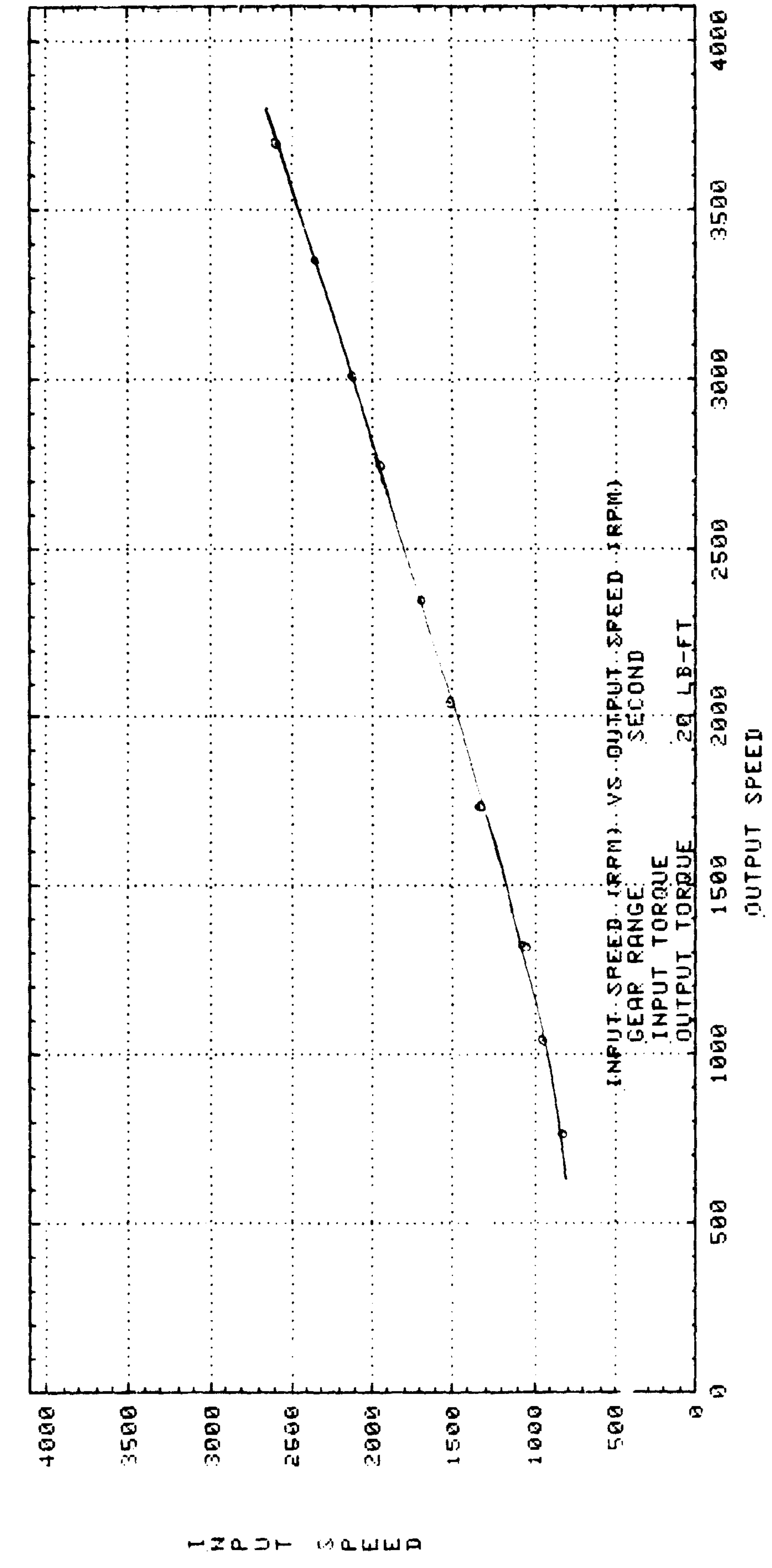

EFFICIENCY
100
90
80
70
60
50
40
30
20
10
0
0
2
4
6
8
10
POWER OUT
EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 10 LB-FT

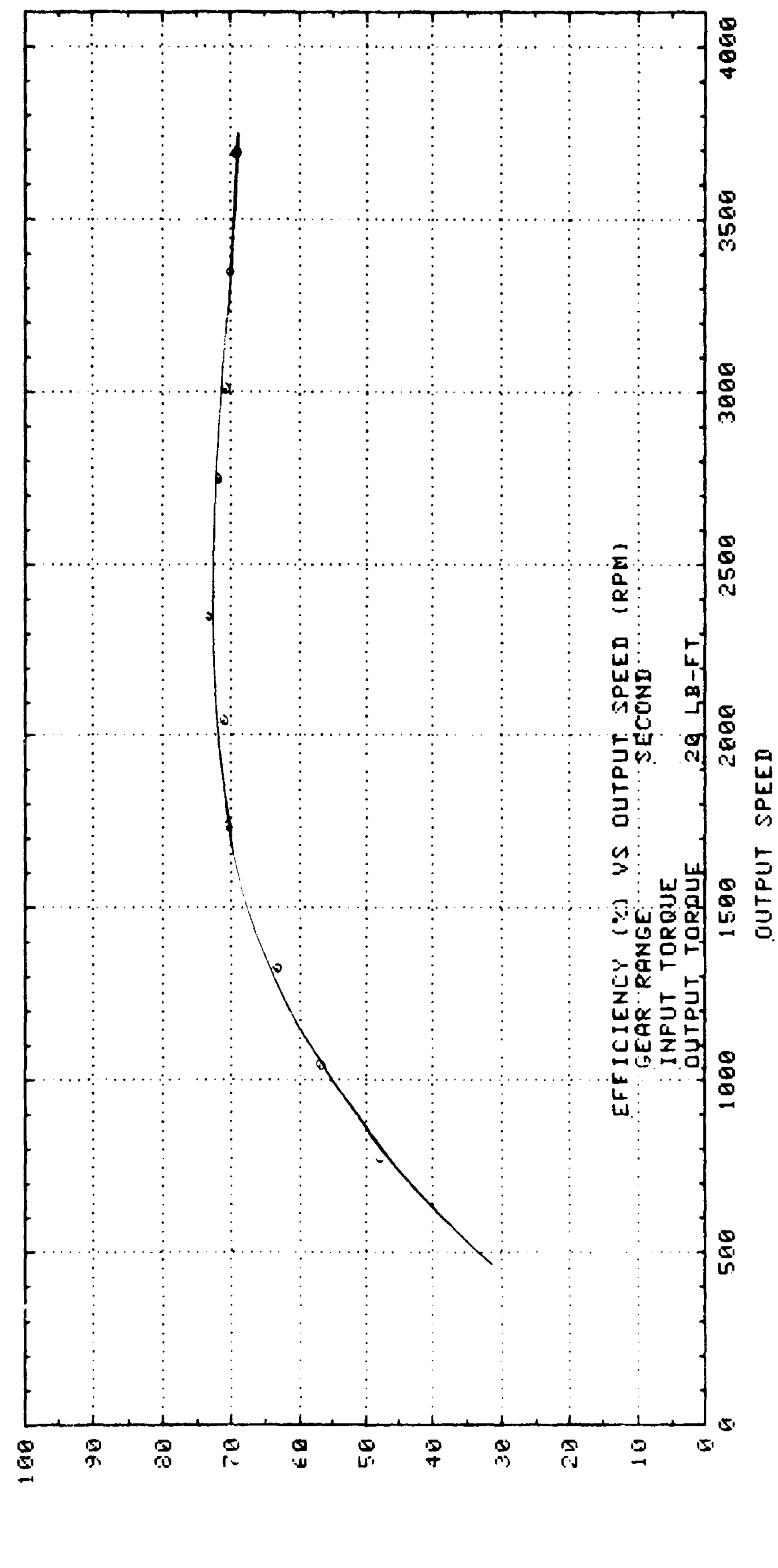


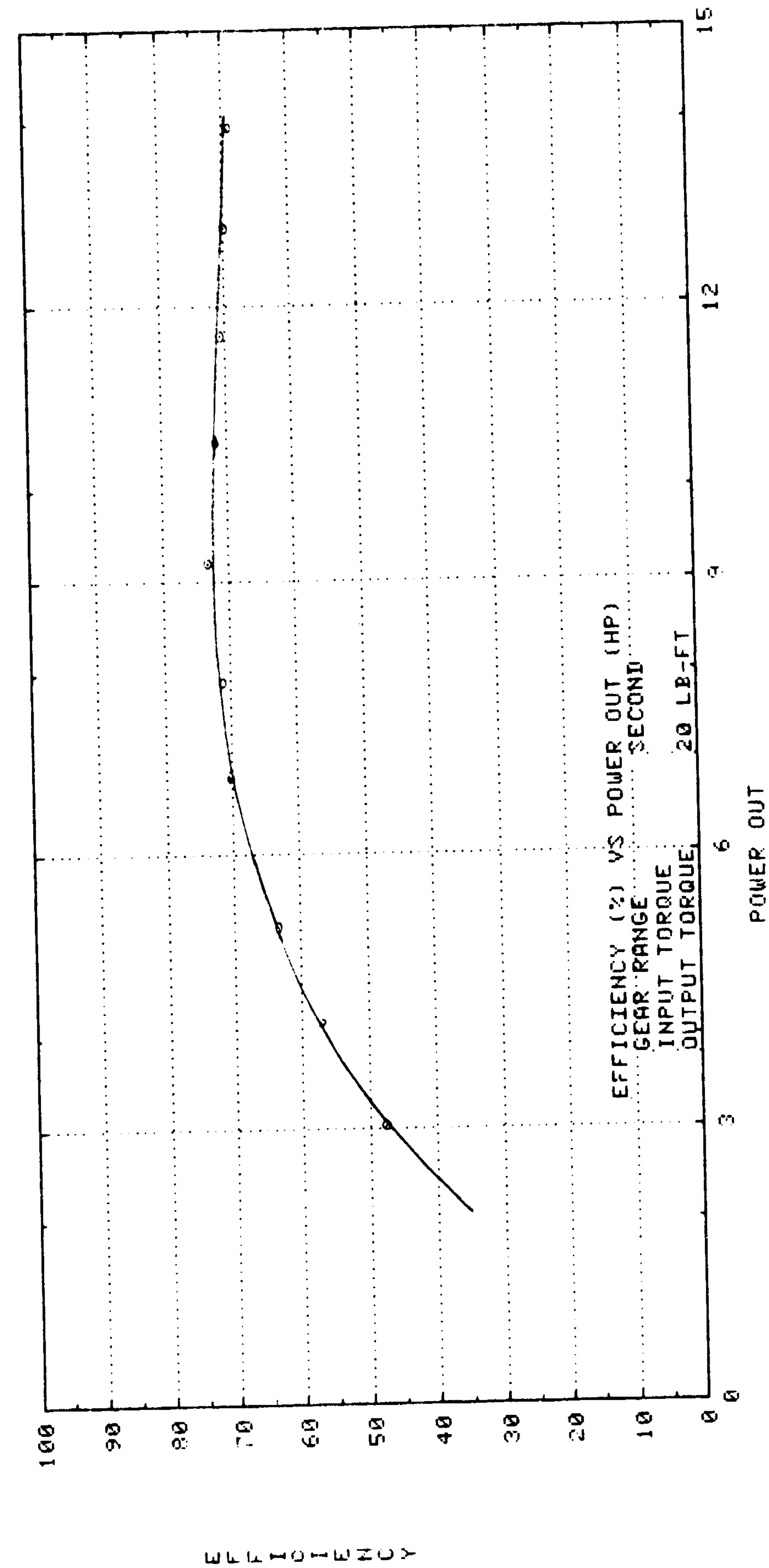
TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 20 LB-FT
TORQUE RATIO
OUTPUT SPEED
0.0
.5
1.0
1.5
2.0
2.5
0
500
1000
1500
2000
2500
3000
3500
4000



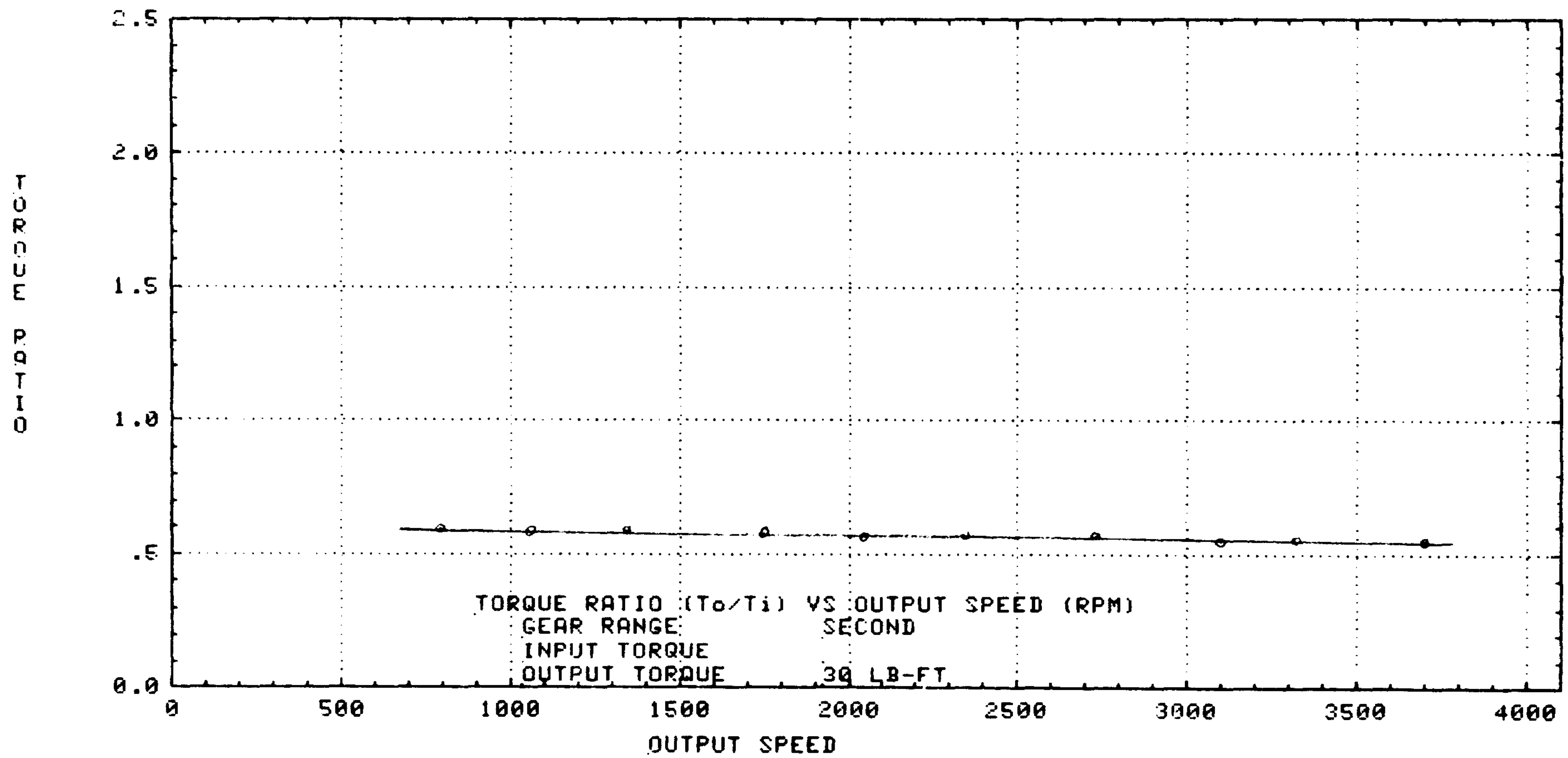
INPUT TORQUE
40
30
20
10
0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 20 LB-FT


INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 20 LB-FT
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

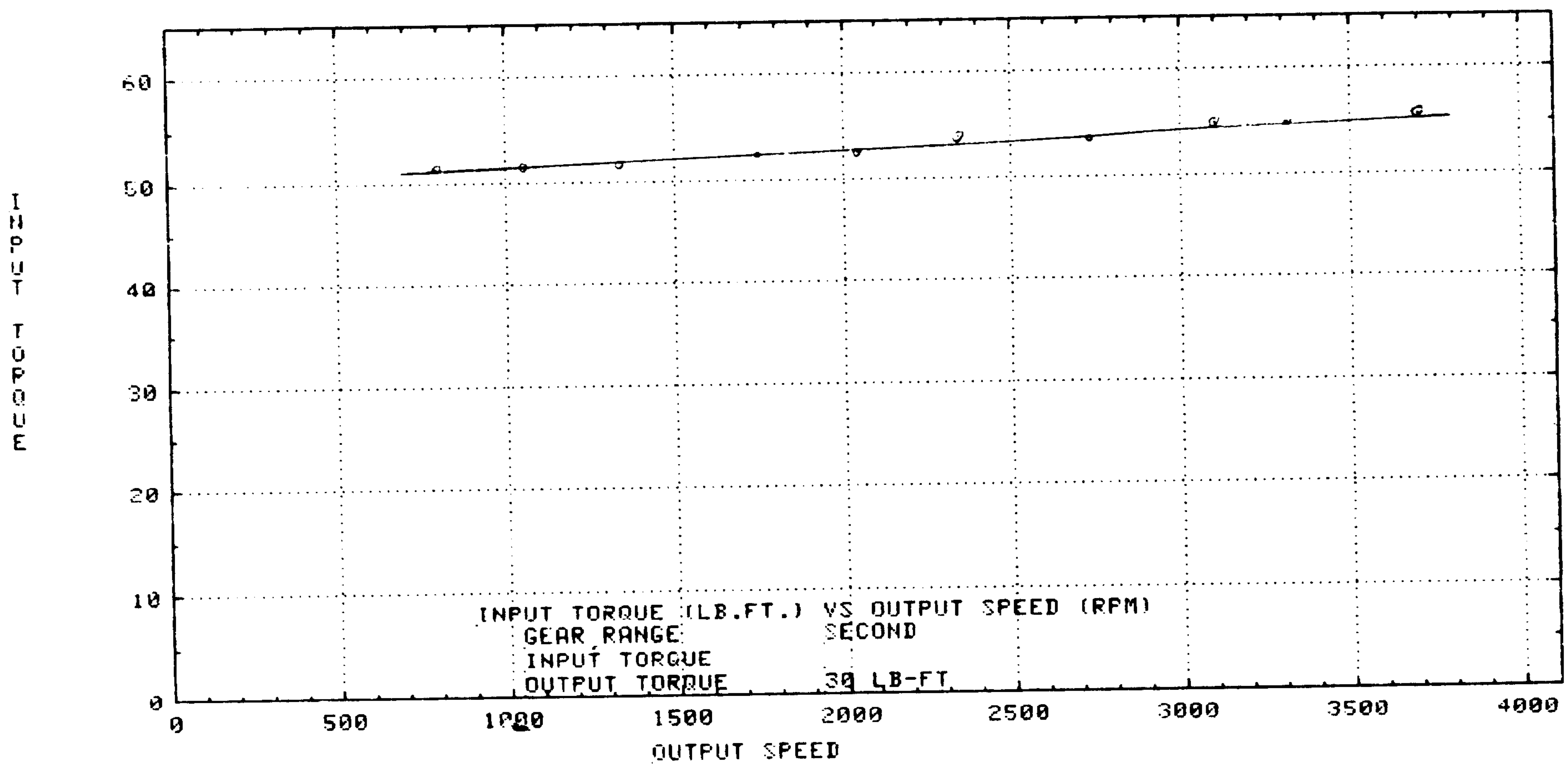

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 20 LB-FT
OUTPUT SPEED
0 500 1000 1500 2000 2500 3000 3500 4000
EFFICIENCY
0 10 20 30 40 50 60 70 80 90 100

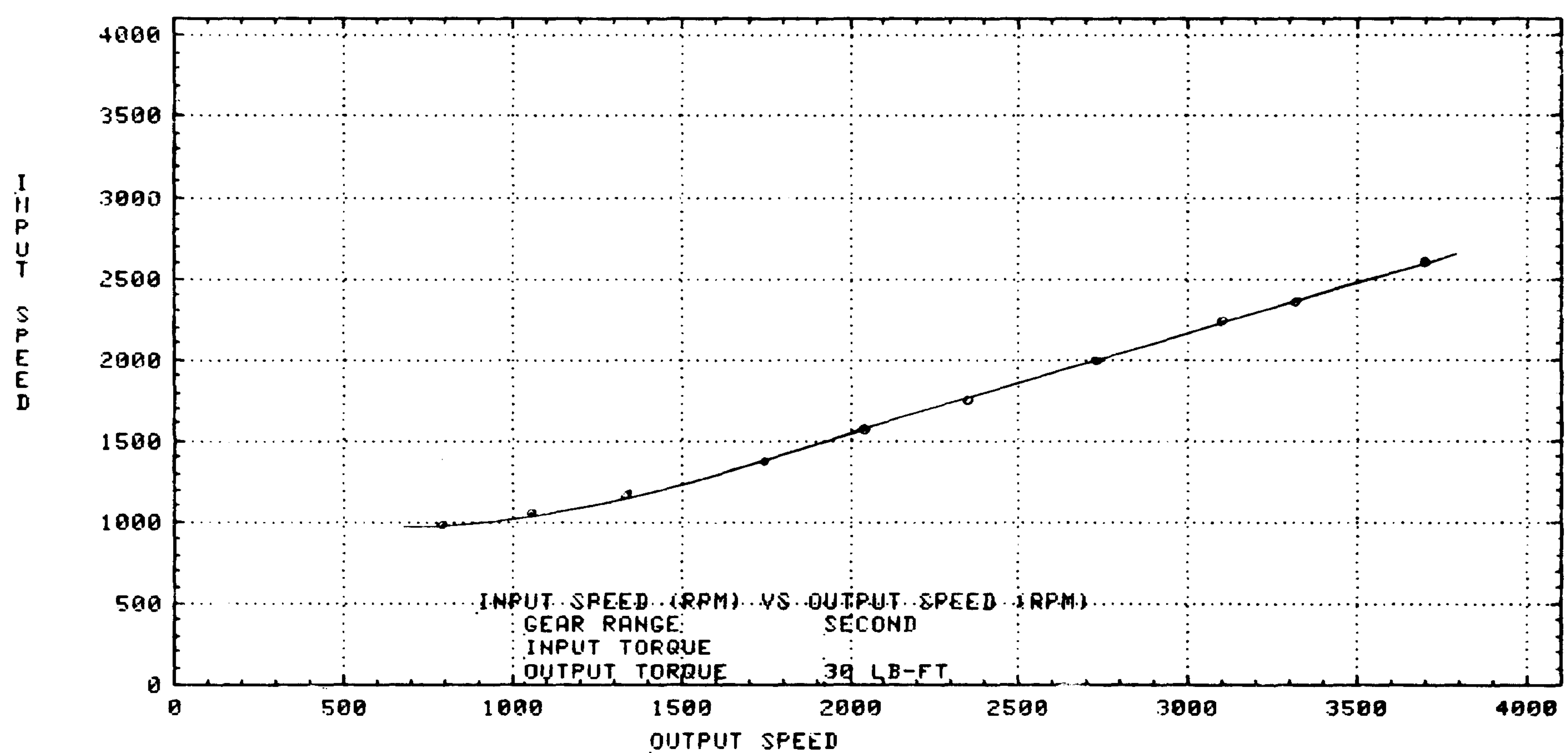


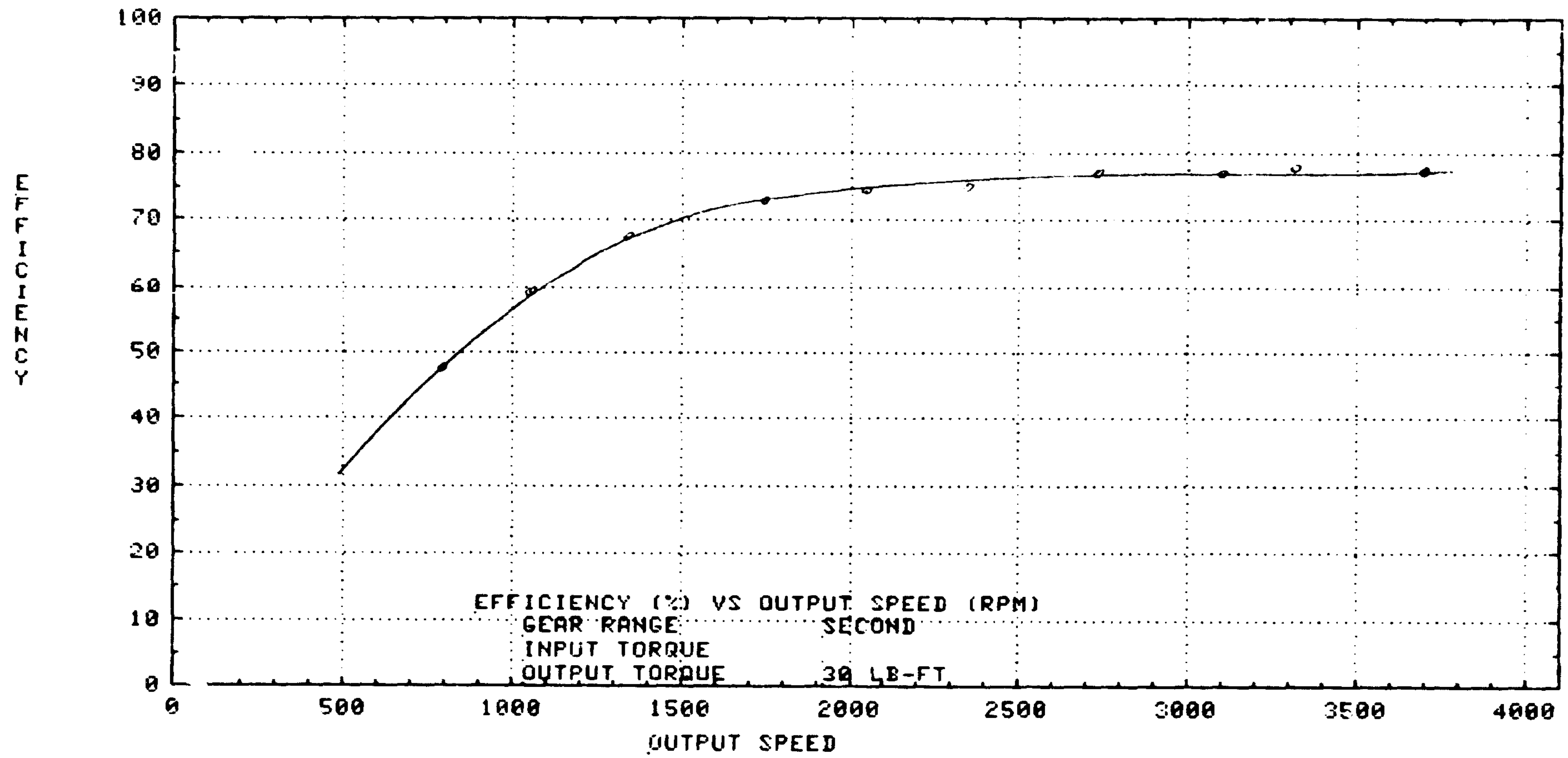
EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 20 LB-FT
POWER OUT
EFFICIENCY
0
3
6
9
12
15
0
10
20
30
40
50
60
70
80
90
100

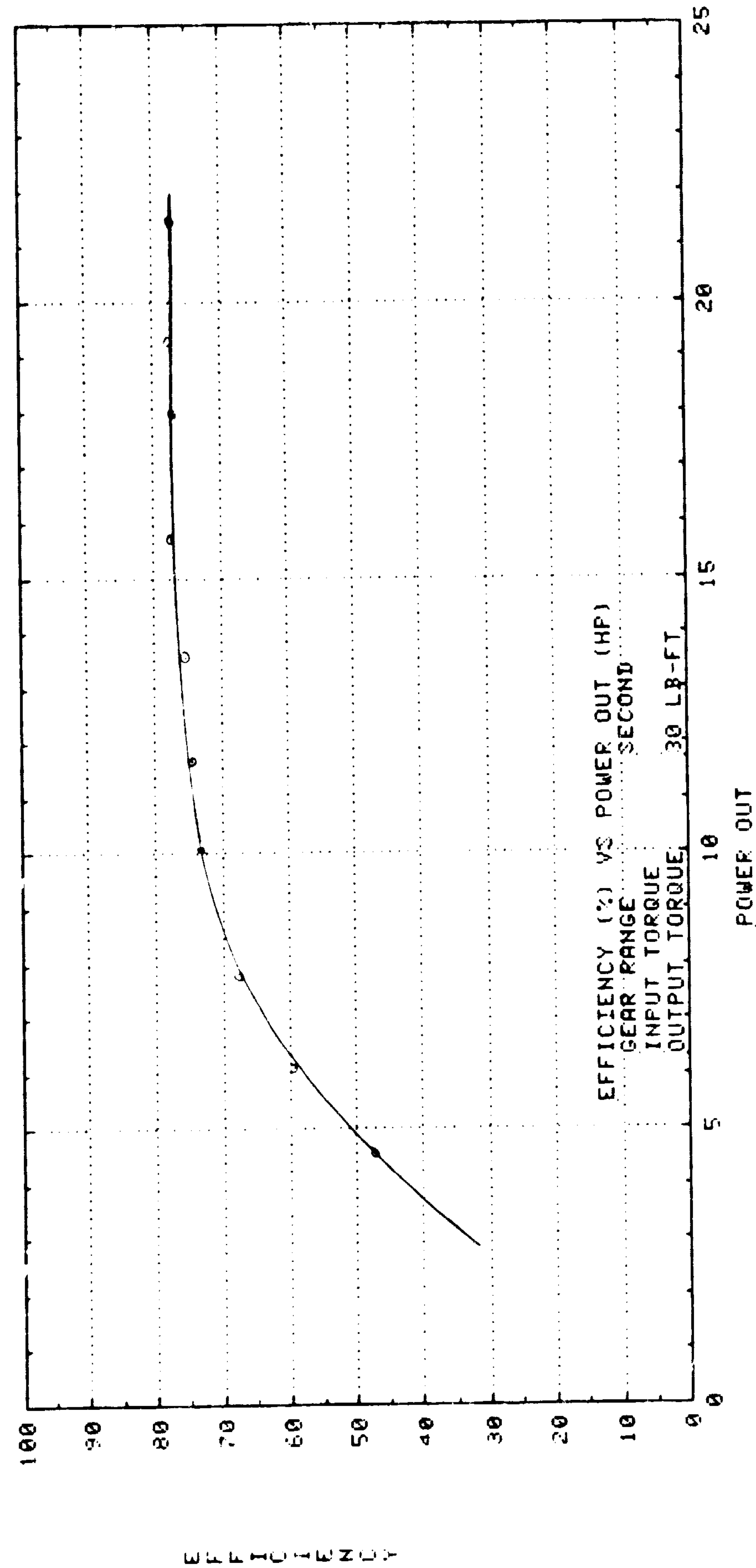


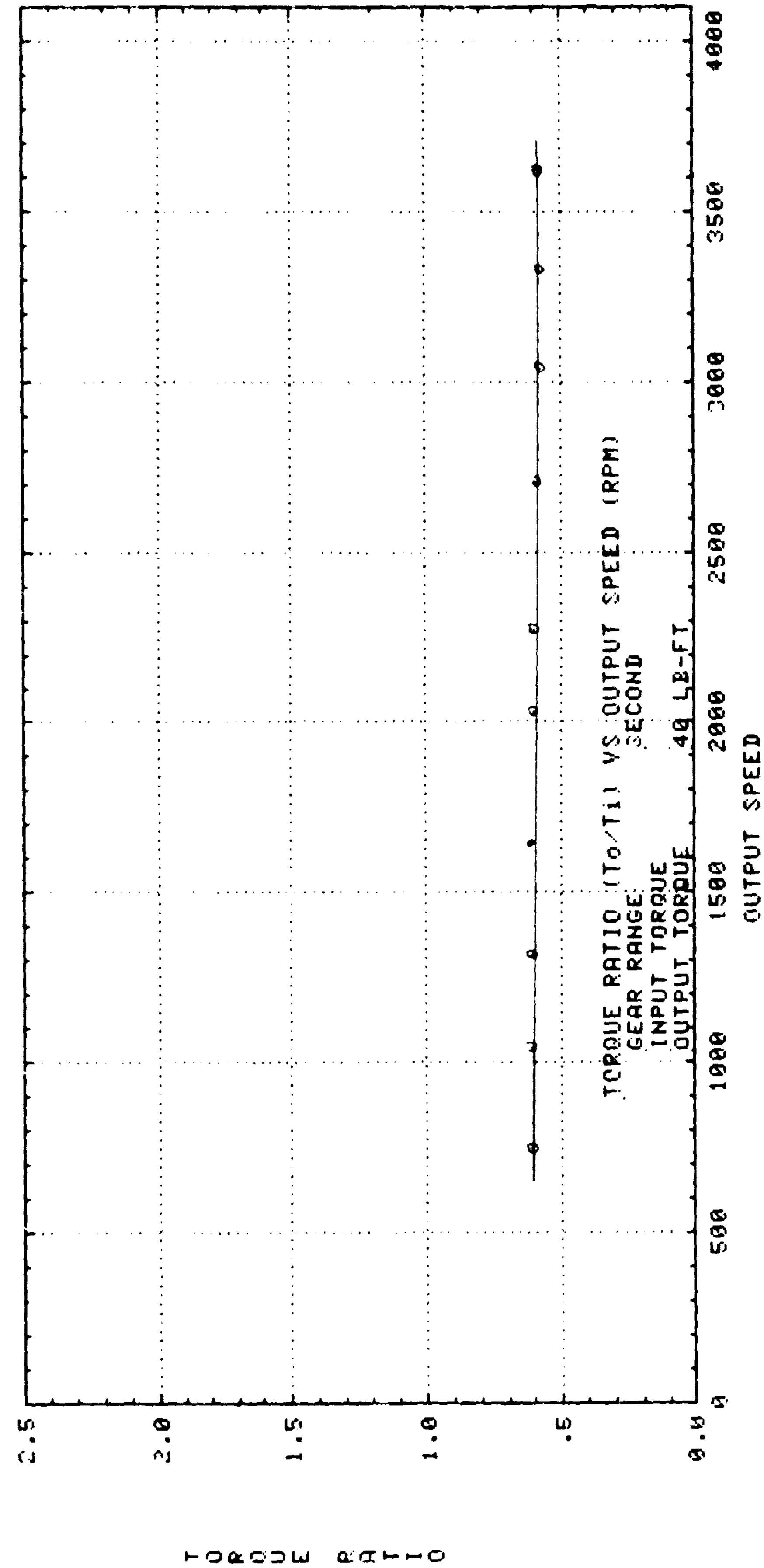
TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 30 LB-FT
TORQUE RATIO
OUTPUT SPEED
0.0
.5
1.0
1.5
2.0
2.5
0
500
1000
1500
2000
2500
3000
3500
4000

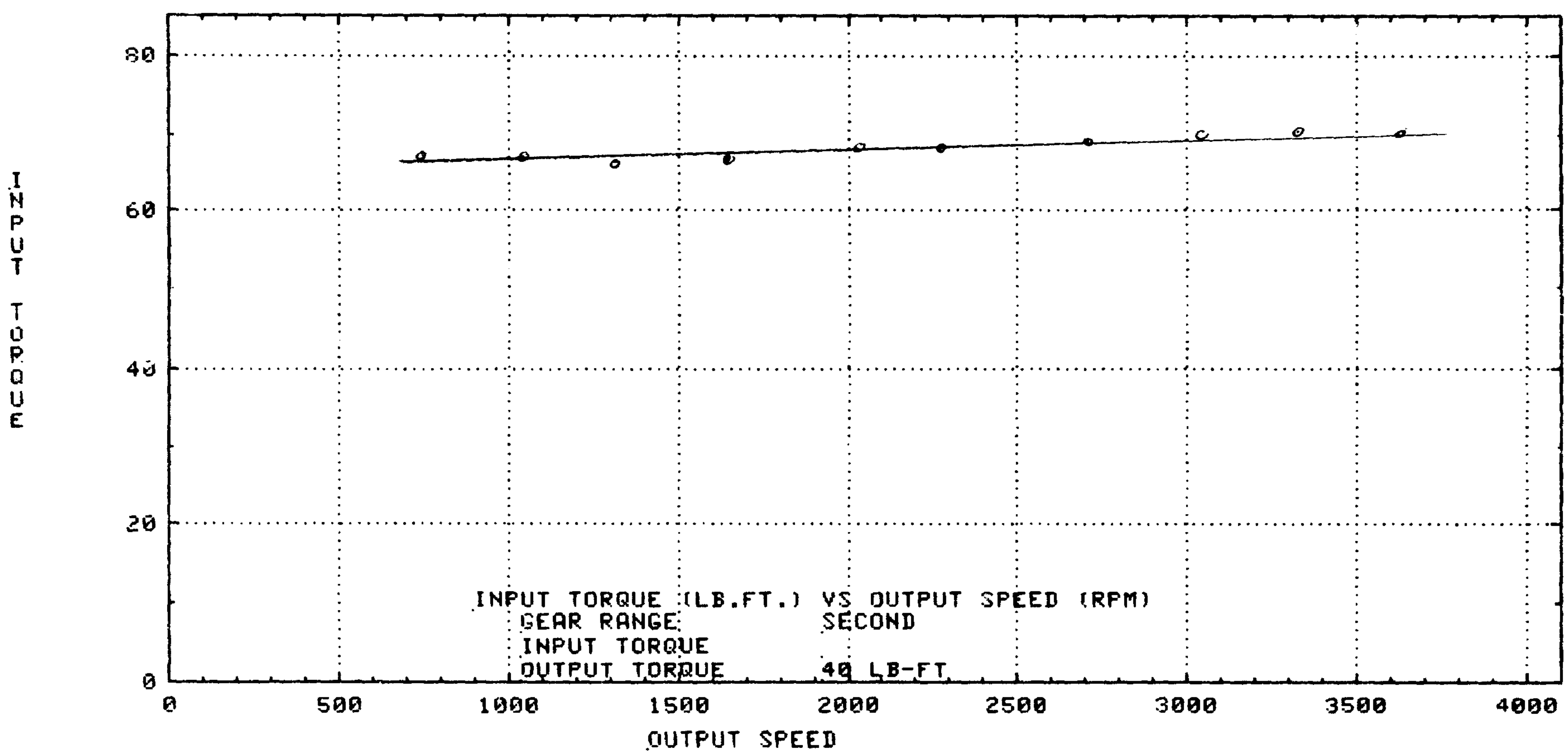

INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 30 LB-FT
INPUT TORQUE
OUTPUT SPEED
0
10
20
30
40
50
60
0
500
1000
1500
2000
2500
3000
3500
4000


INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 30 LB-FT
INPUT SPEED
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

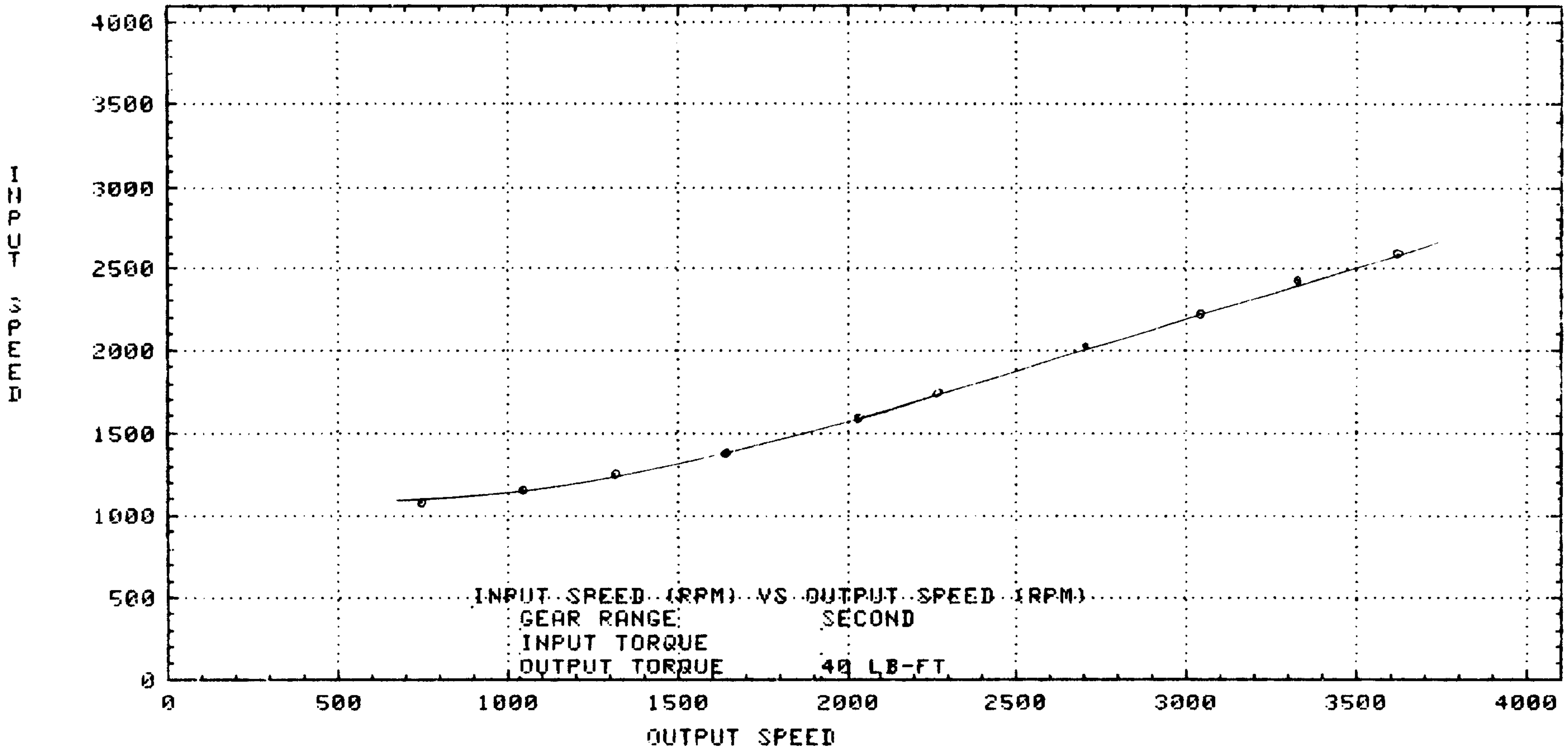

EFFICIENCY
100
90
80
70
60
50
40
30
20
10
0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 30 LB-FT

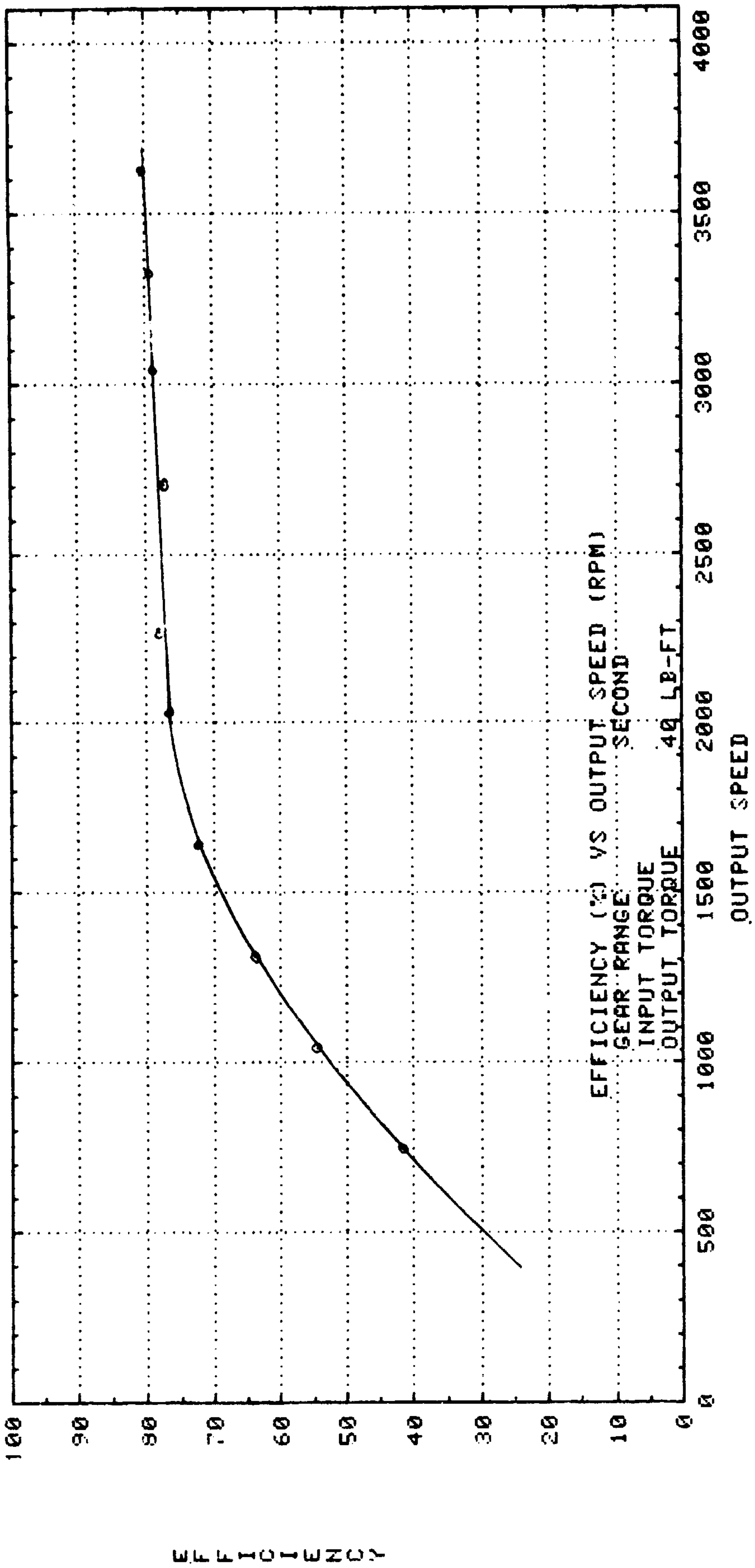

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE SECOND
INPUT TORQUE 30 LB-FT
OUTPUT TORQUE
POWER OUT
EFFICIENCY
0
5
10
15
20
25
0
10
20
30
40
50
60
70
80
90
100

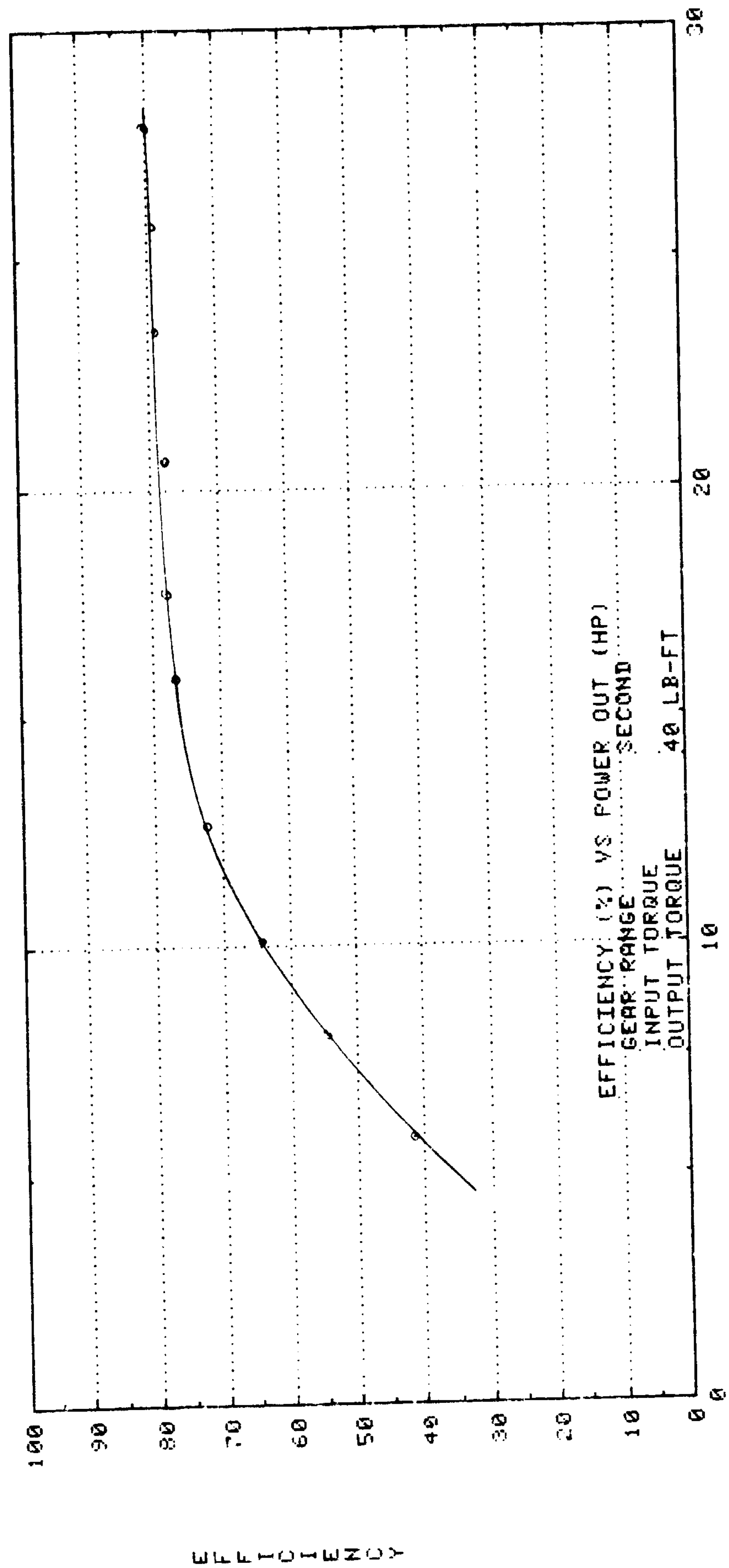

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 40 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
0 500 1000 1500 2000 2500 3000 3500 4000
TORQUE RATIO
0.0 .5 1.0 1.5 2.0 2.5

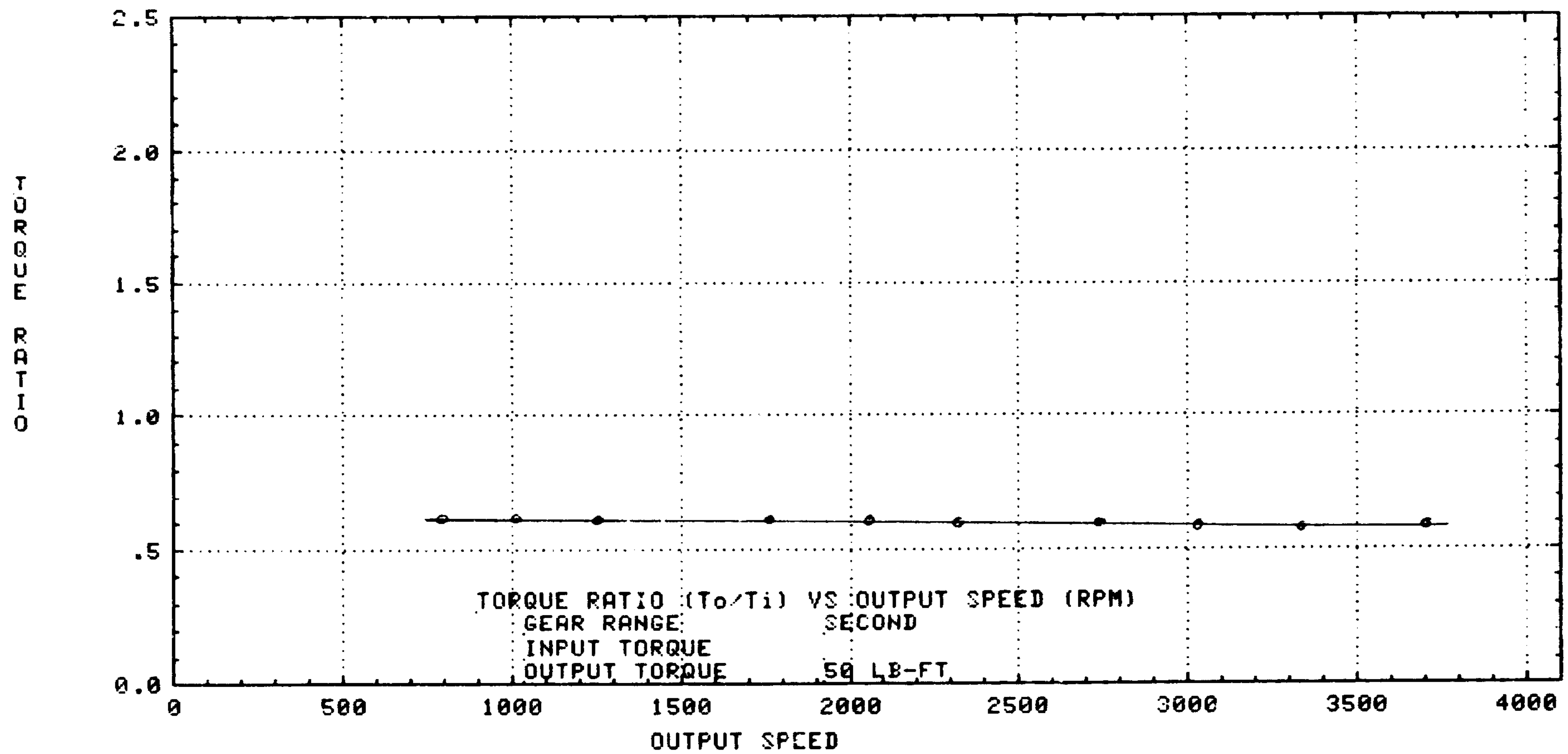

INPUT TORQUE
80
60
40
20
0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 40 LB-FT

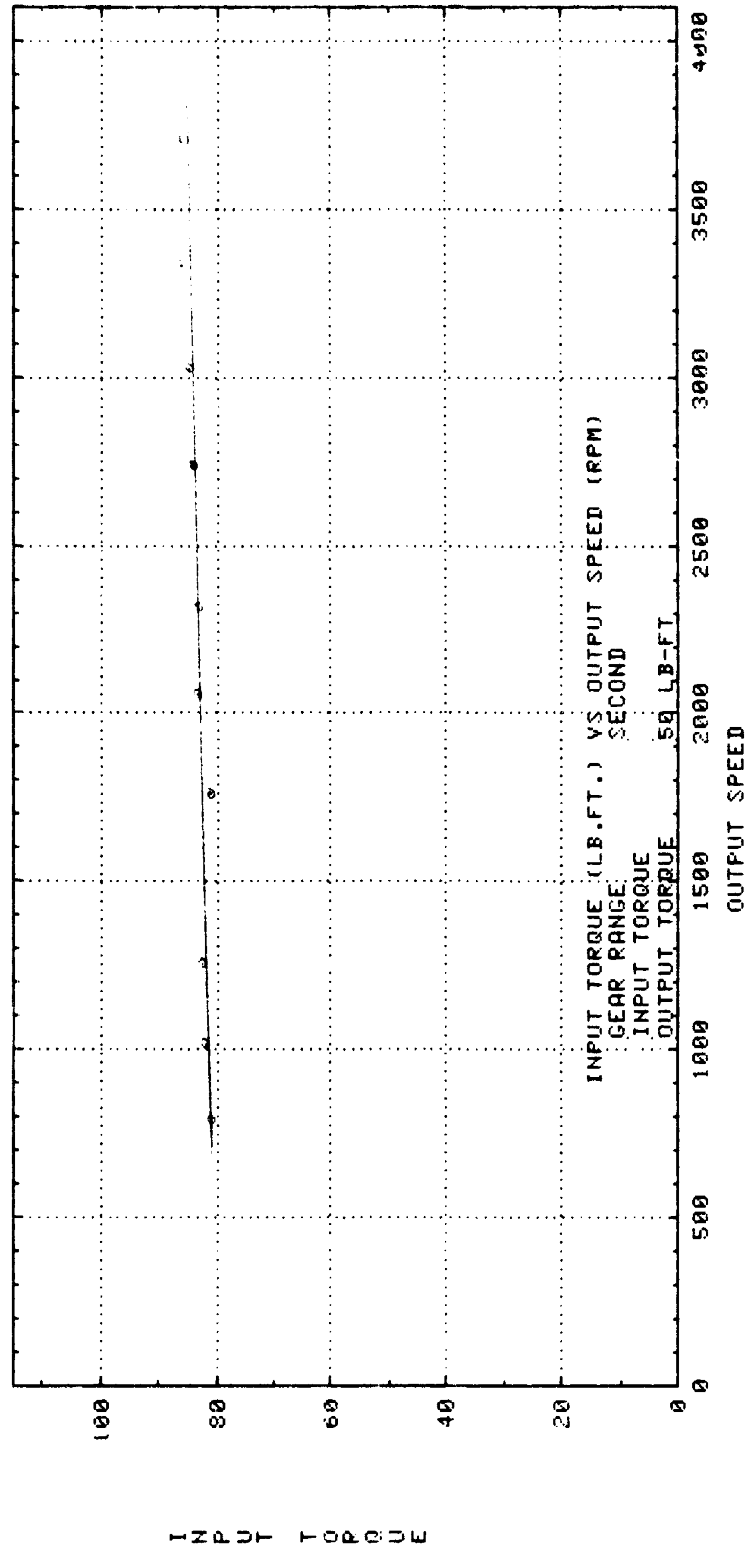
C-4

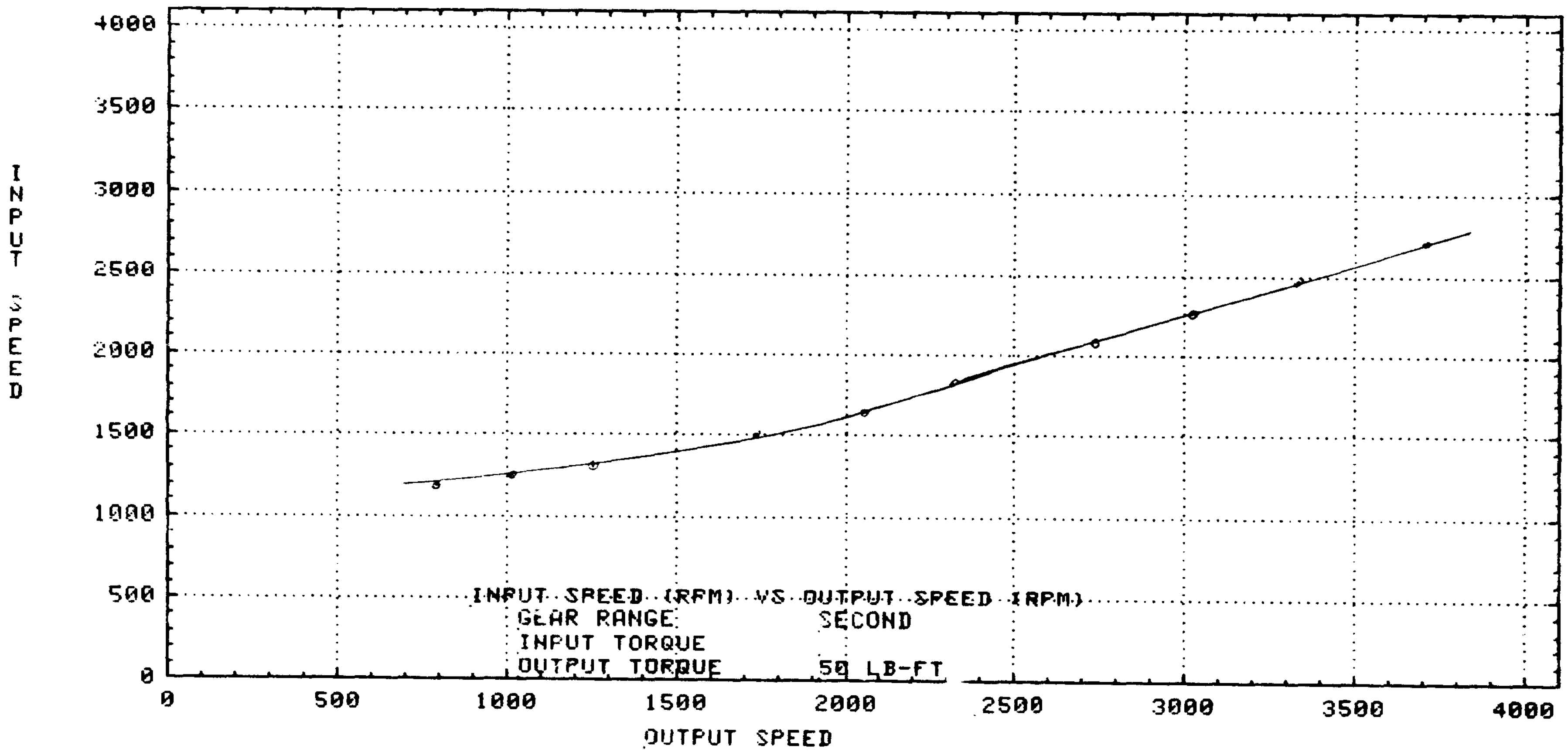

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 40 LB-FT
INPUT SPEED
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

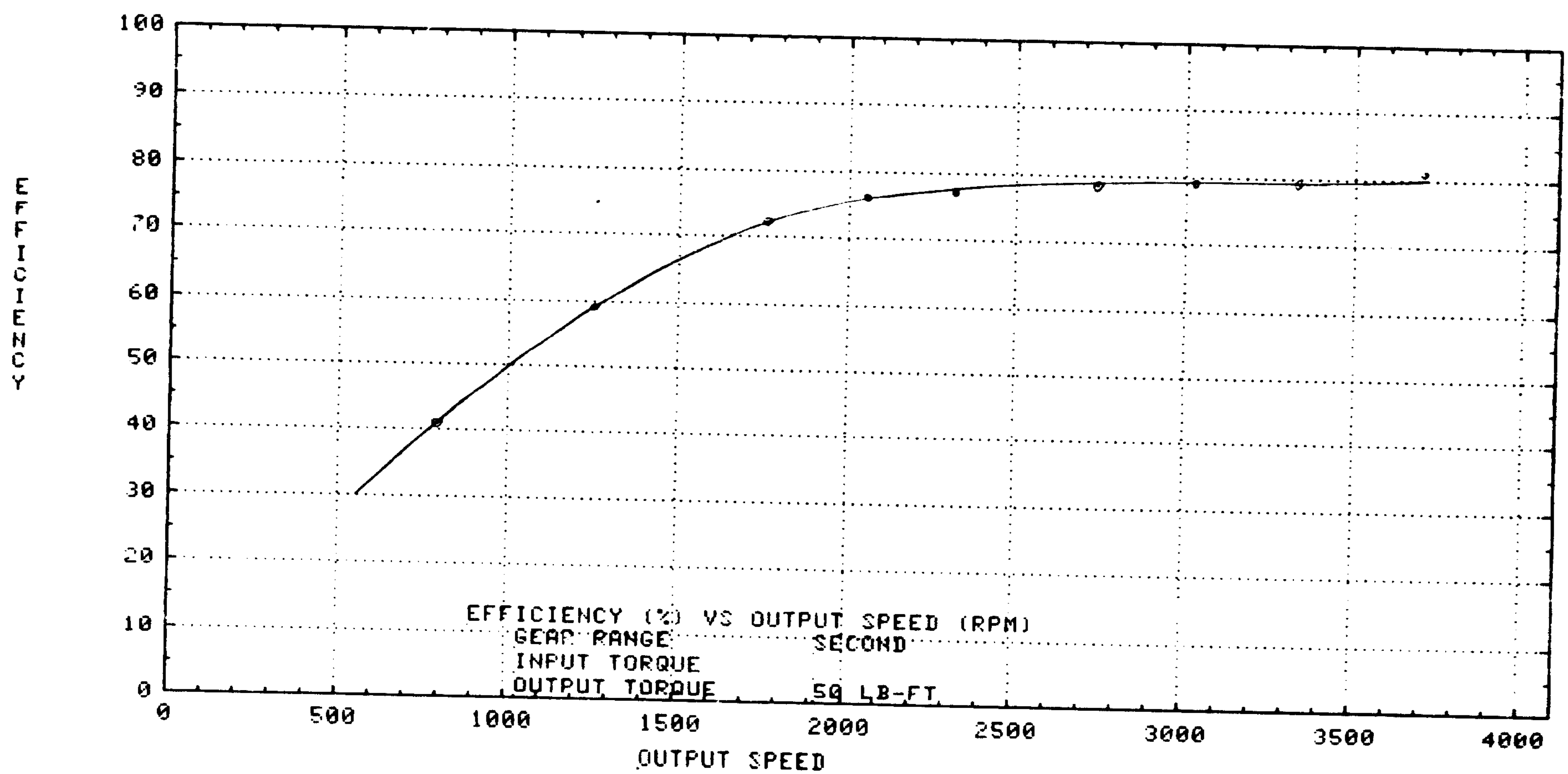

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 40 LB-FT
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000
0
10
20
30
40
50
60
70
80
90
100
EFFICIENCY

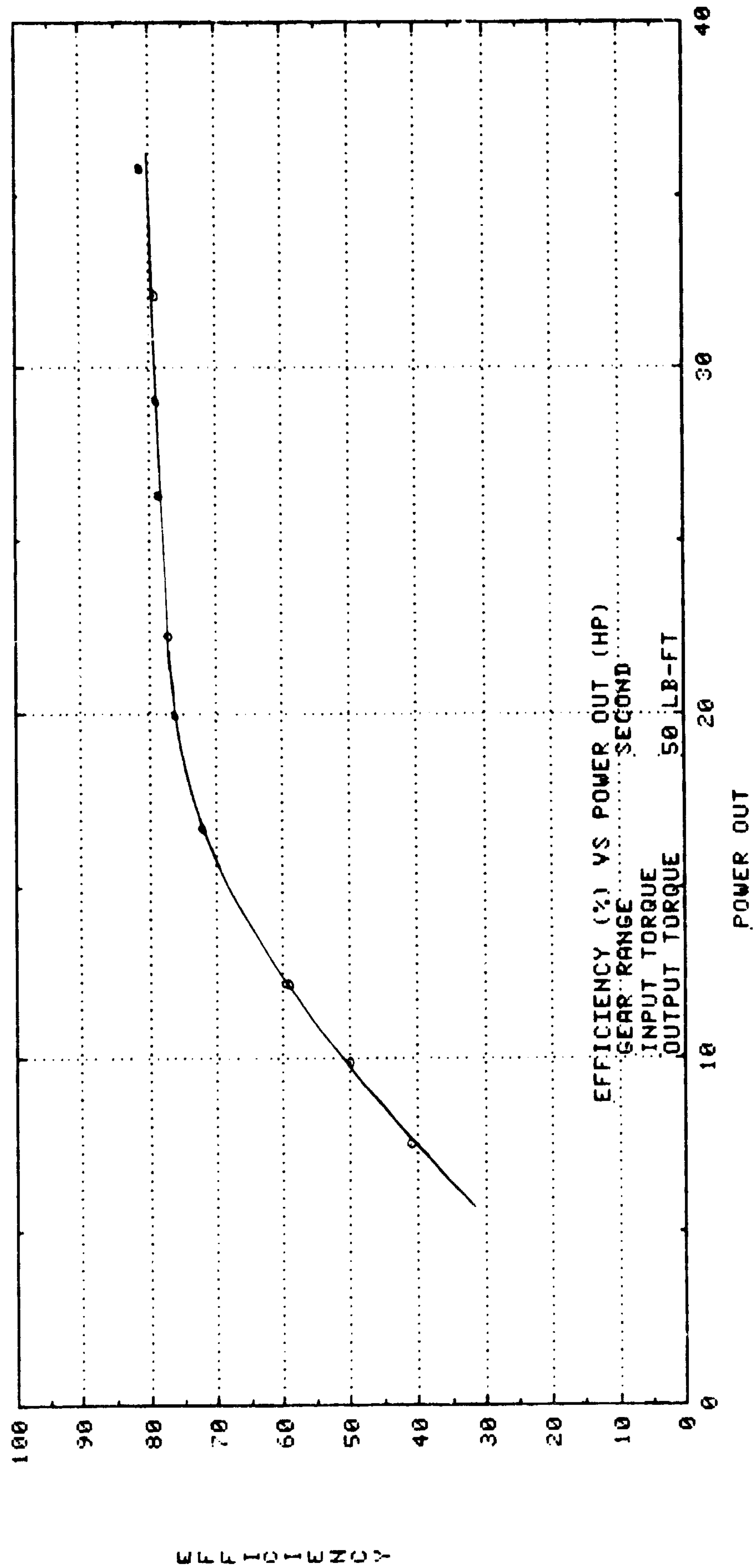

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 40 LB-FT
POWER OUT
EFFICIENCY
0
10
20
30
40
50
60
70
80
90
100

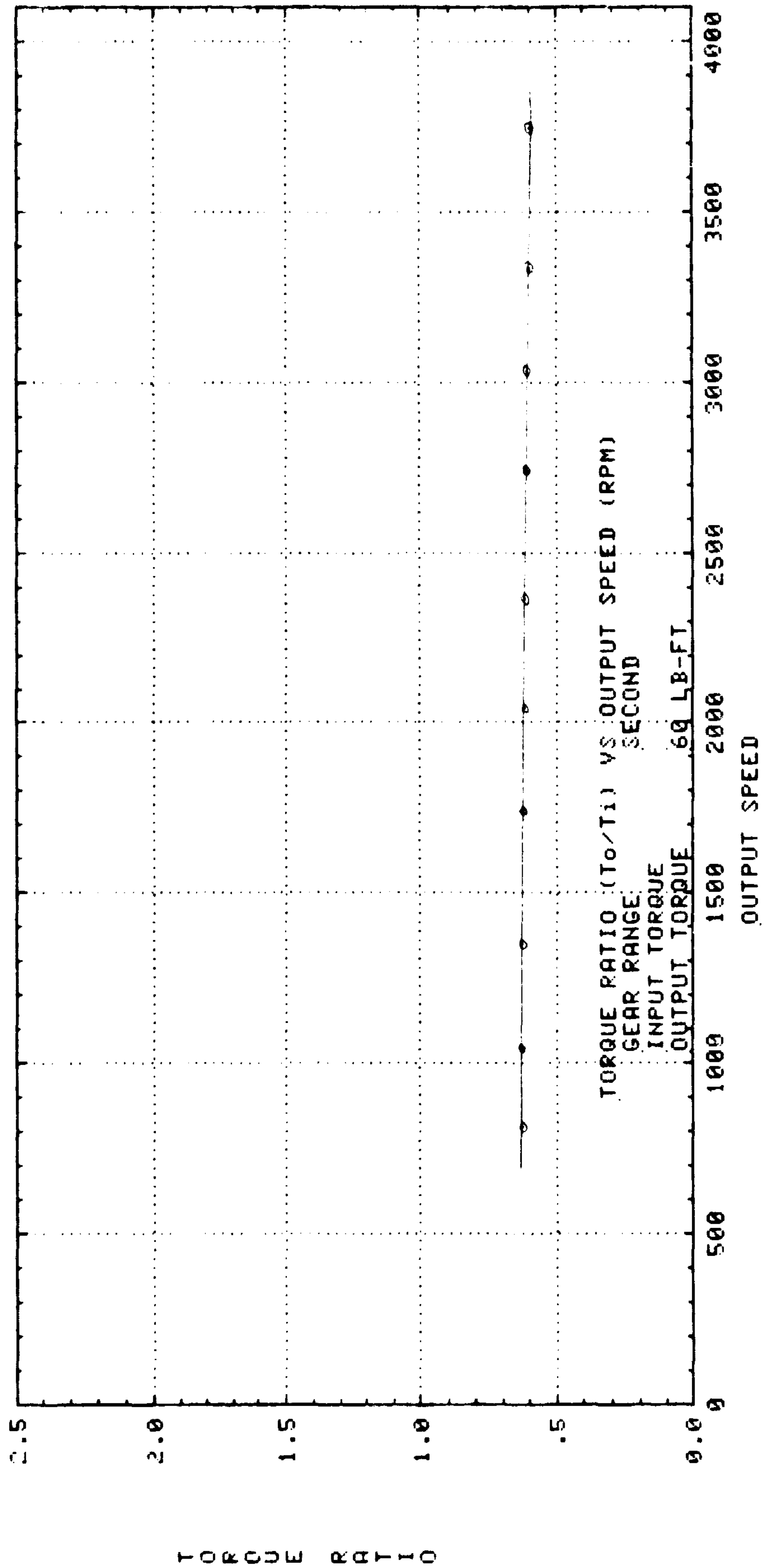

TORQUE RATIO
2.5
2.0
1.5
1.0
.5
0.0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 50 LB-FT

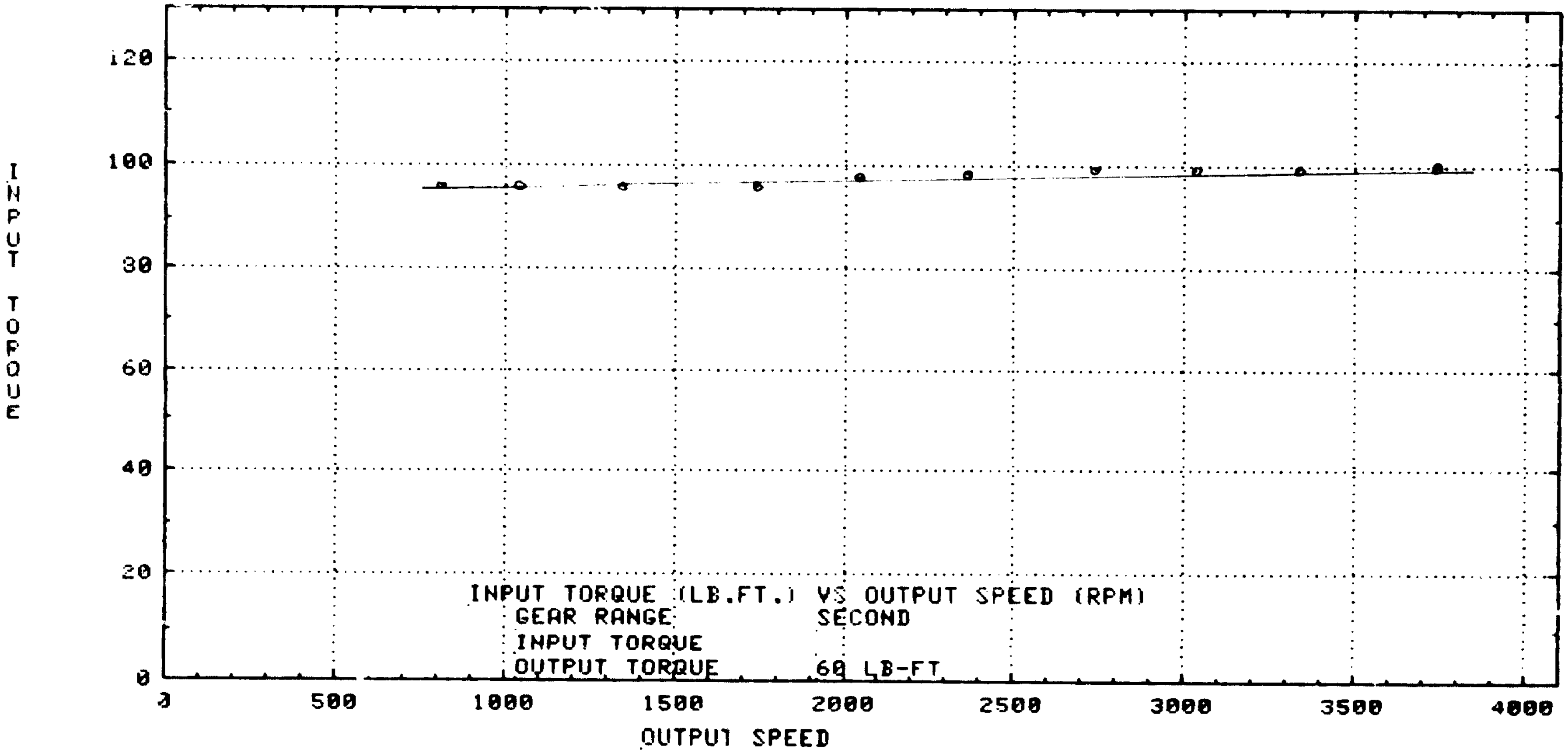

INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 50 LB-FT
OUTPUT SPEED
INPUT TORQUE
0
500
1000
1500
2000
2500
3000
3500
4000
20
40
60
80
100

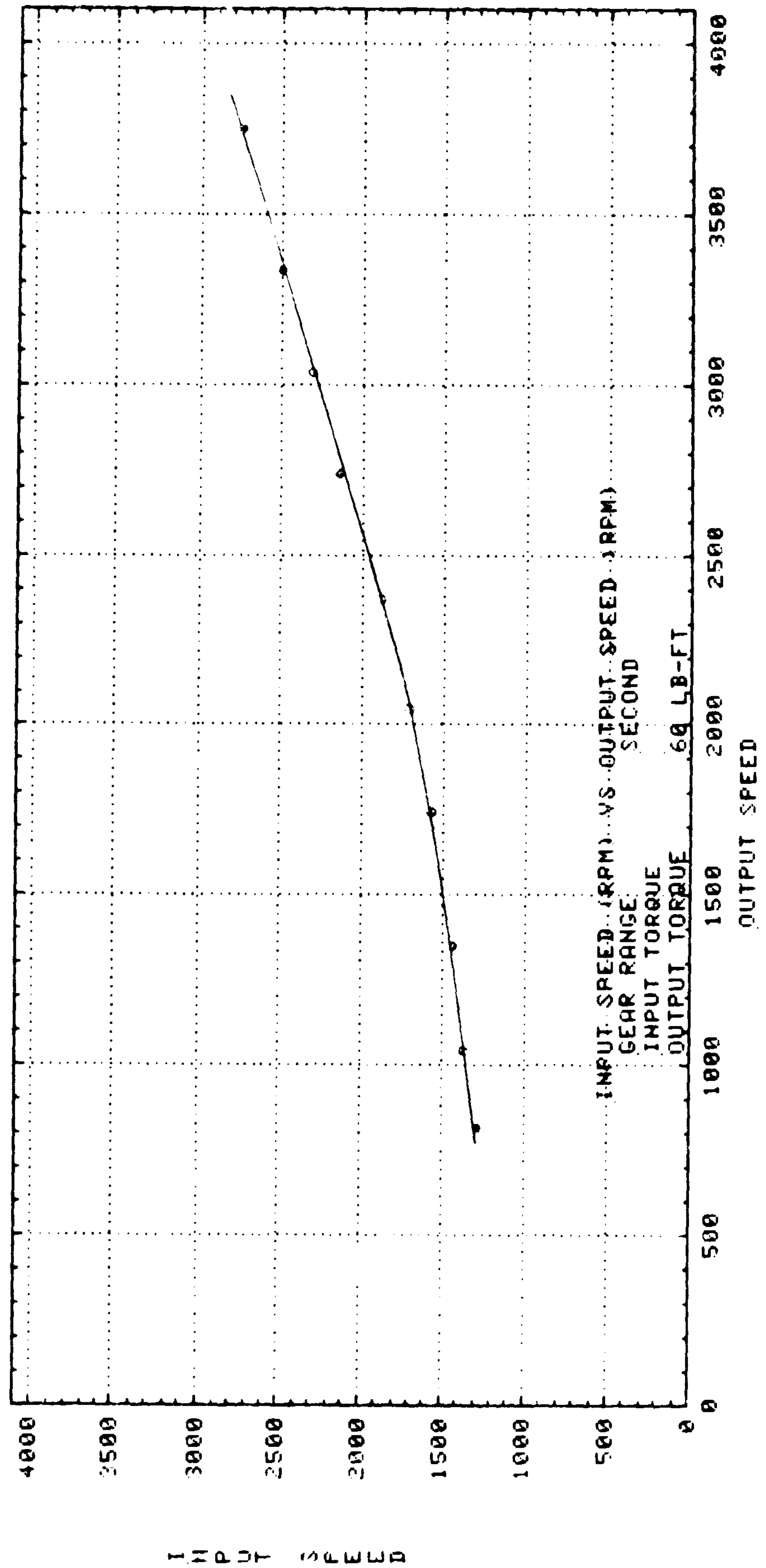

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 50 LB-FT
INPUT SPEED
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

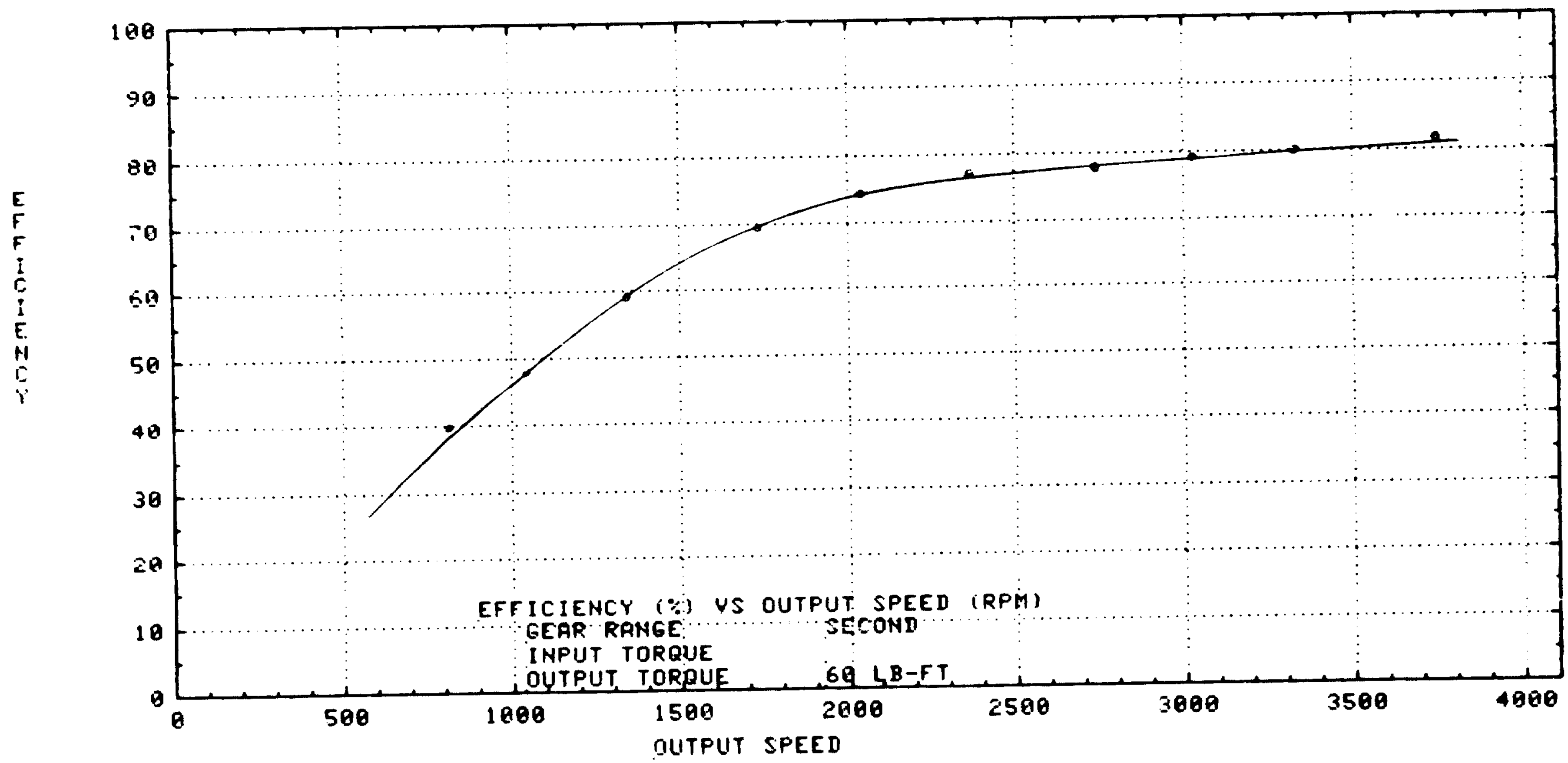

EFFICIENCY
OUTPUT SPEED
EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 50 LB-FT
0
500
1000
1500
2000
2500
3000
3500
4000
10
20
30
40
50
60
70
80
90
100


EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 50 LB-FT
POWER OUT
EFFICIENCY
0
10
20
30
40
50
60
70
80
90
100
0
10
20
30
40

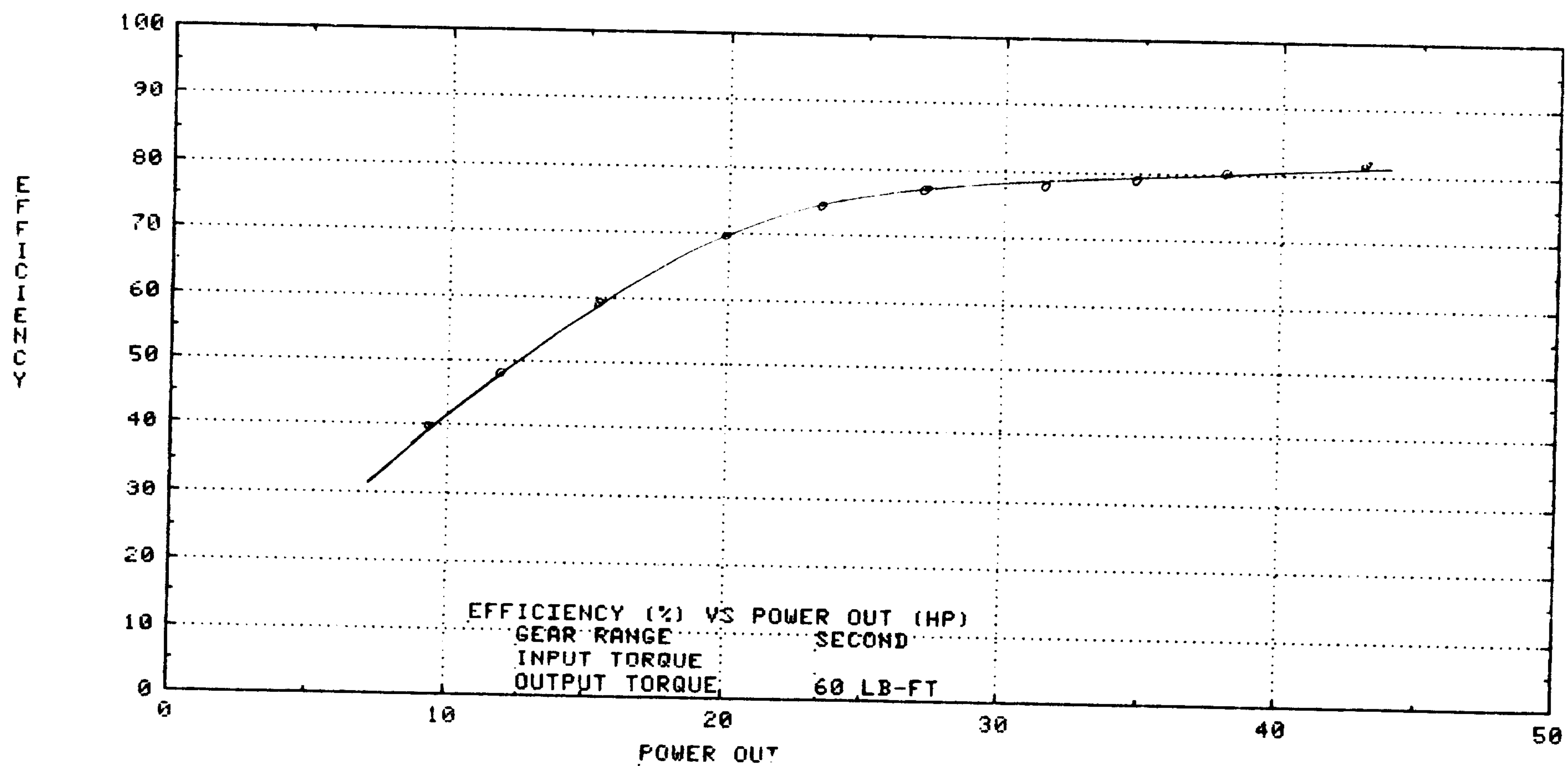

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 60 LB-FT
OUTPUT SPEED
TORQUE RATIO
0.0
.5
1.0
1.5
2.0
2.5
0
500
1000
1500
2000
2500
3000
3500
4000

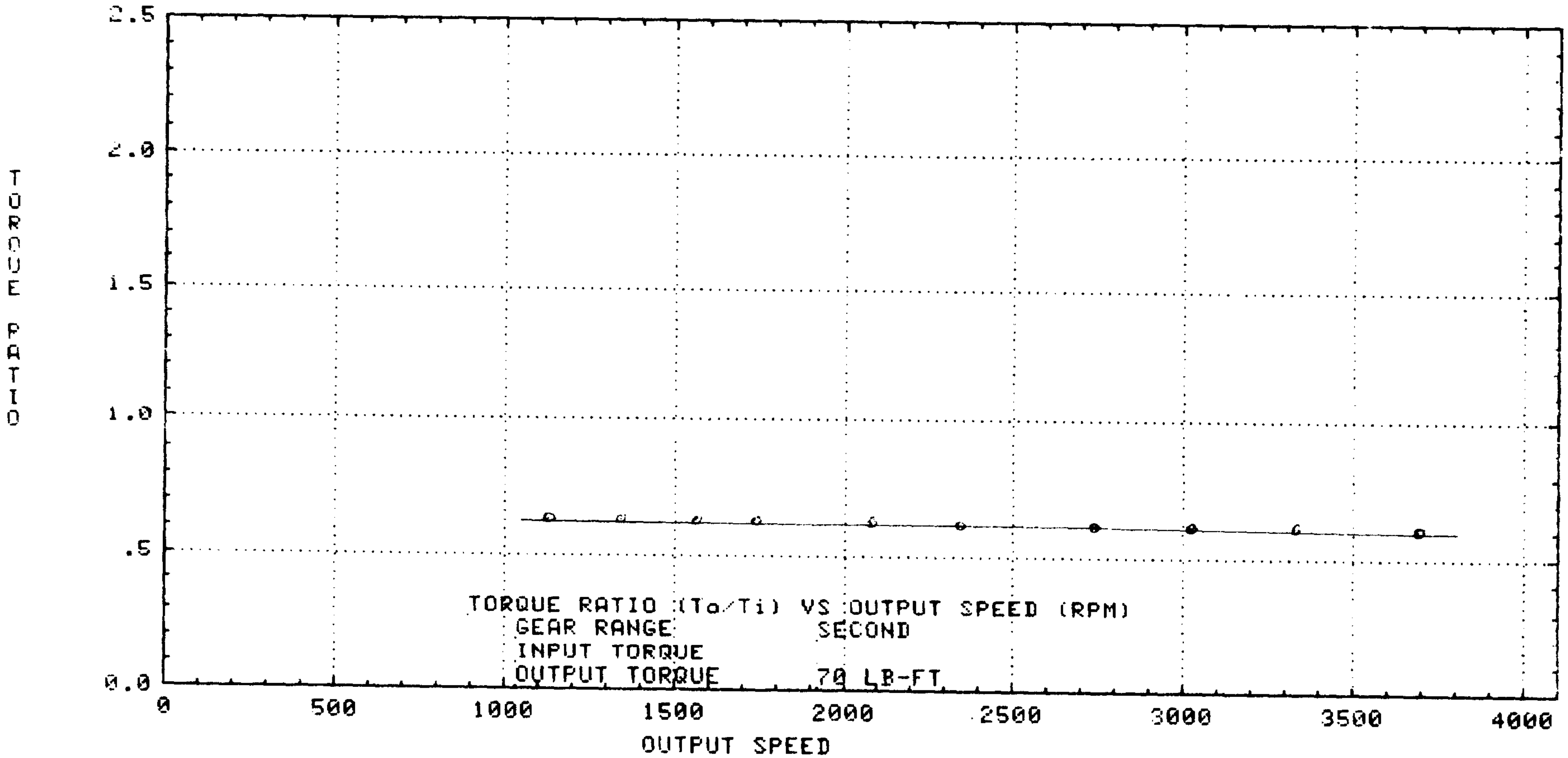

INPUT TORQUE
120
100
80
60
40
20
0
INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 60 LB-FT
0 500 1000 1500 2000 2500 3000 3500 4000
OUTPUT SPEED

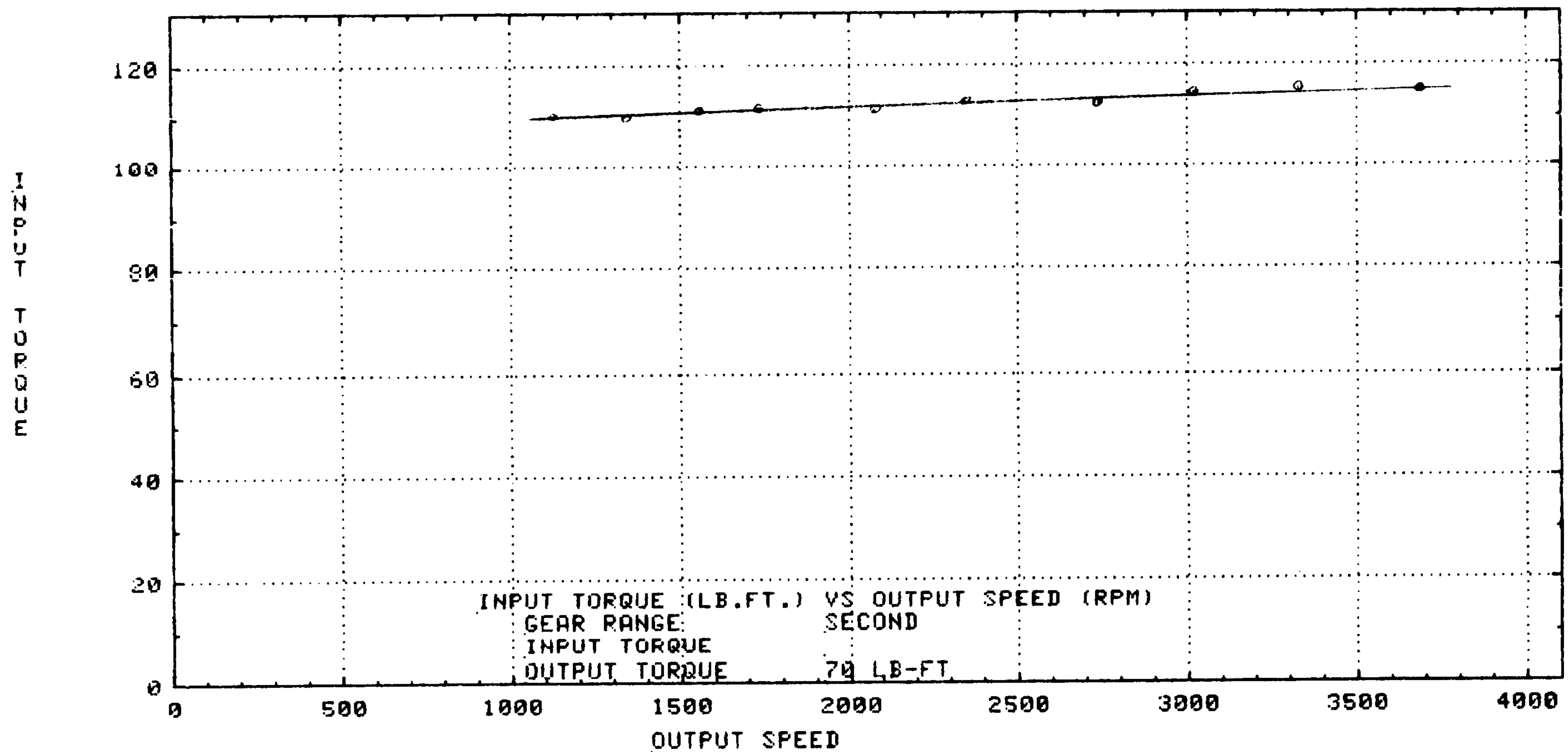

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 60 LB-FT
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000



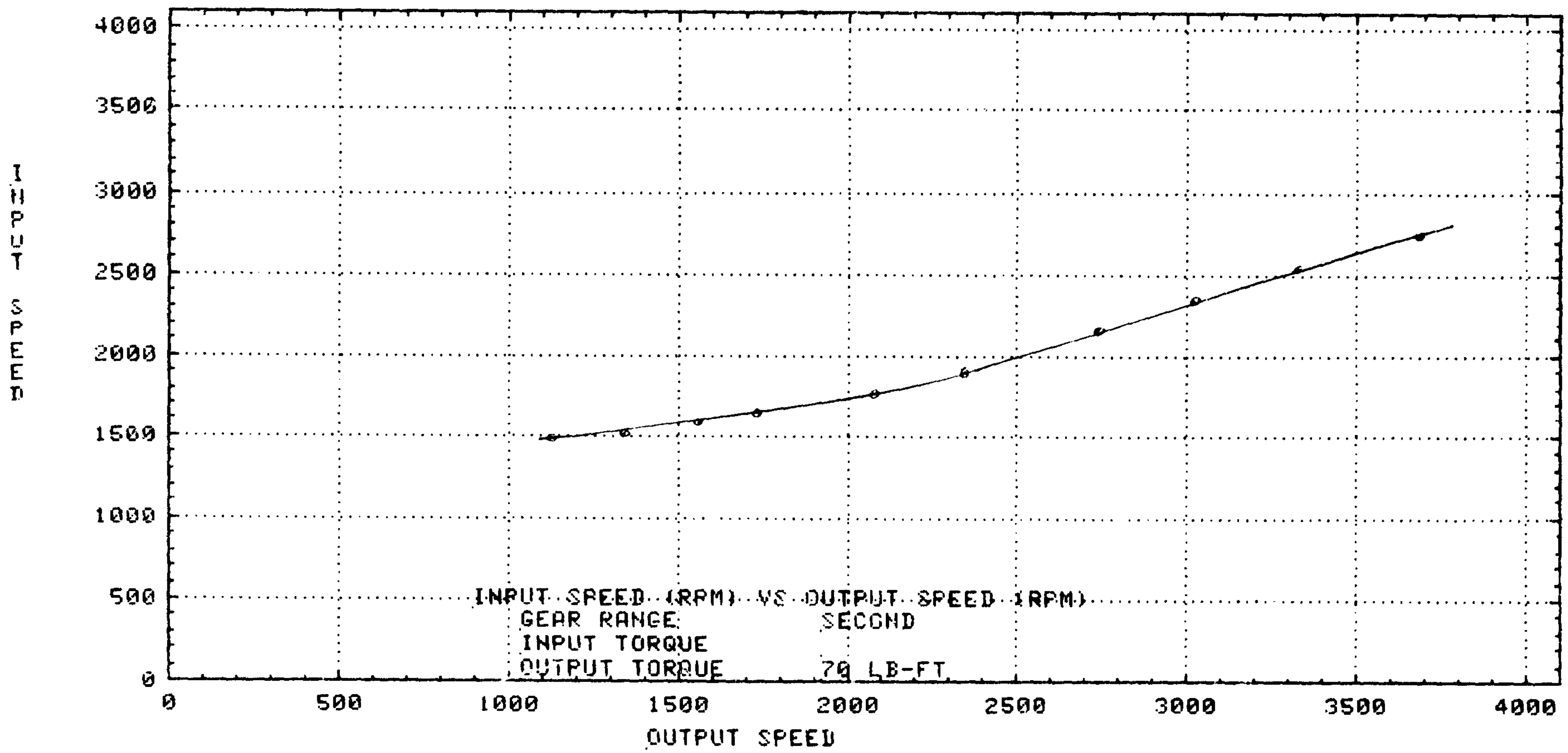
EFFICIENCY
100
90
80
70
60
50
40
30
20
10
0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 60 LB-FT

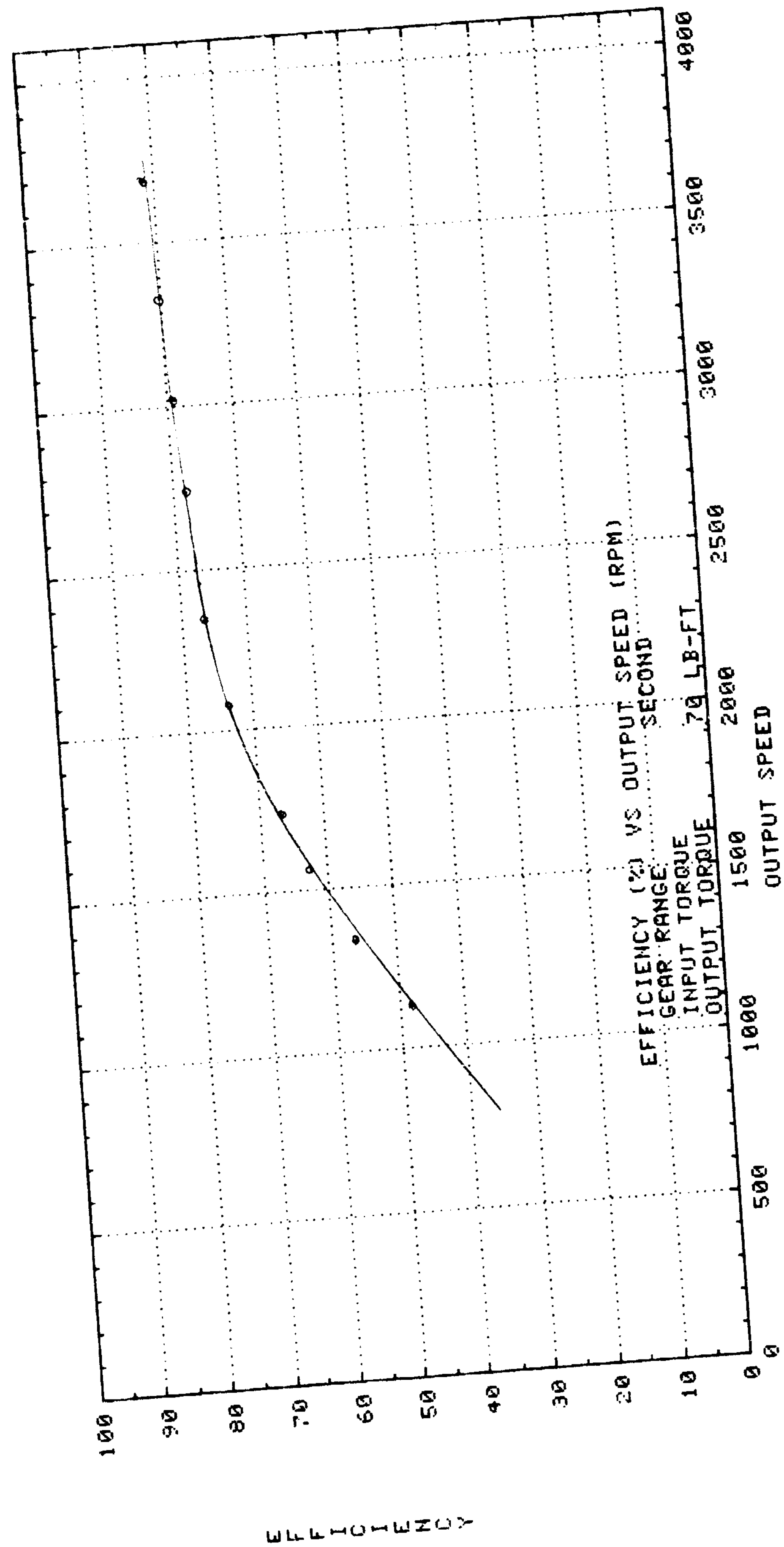

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 60 LB-FT
EFFICIENCY
POWER OUT
0
10
20
30
40
50
60
70
80
90
100

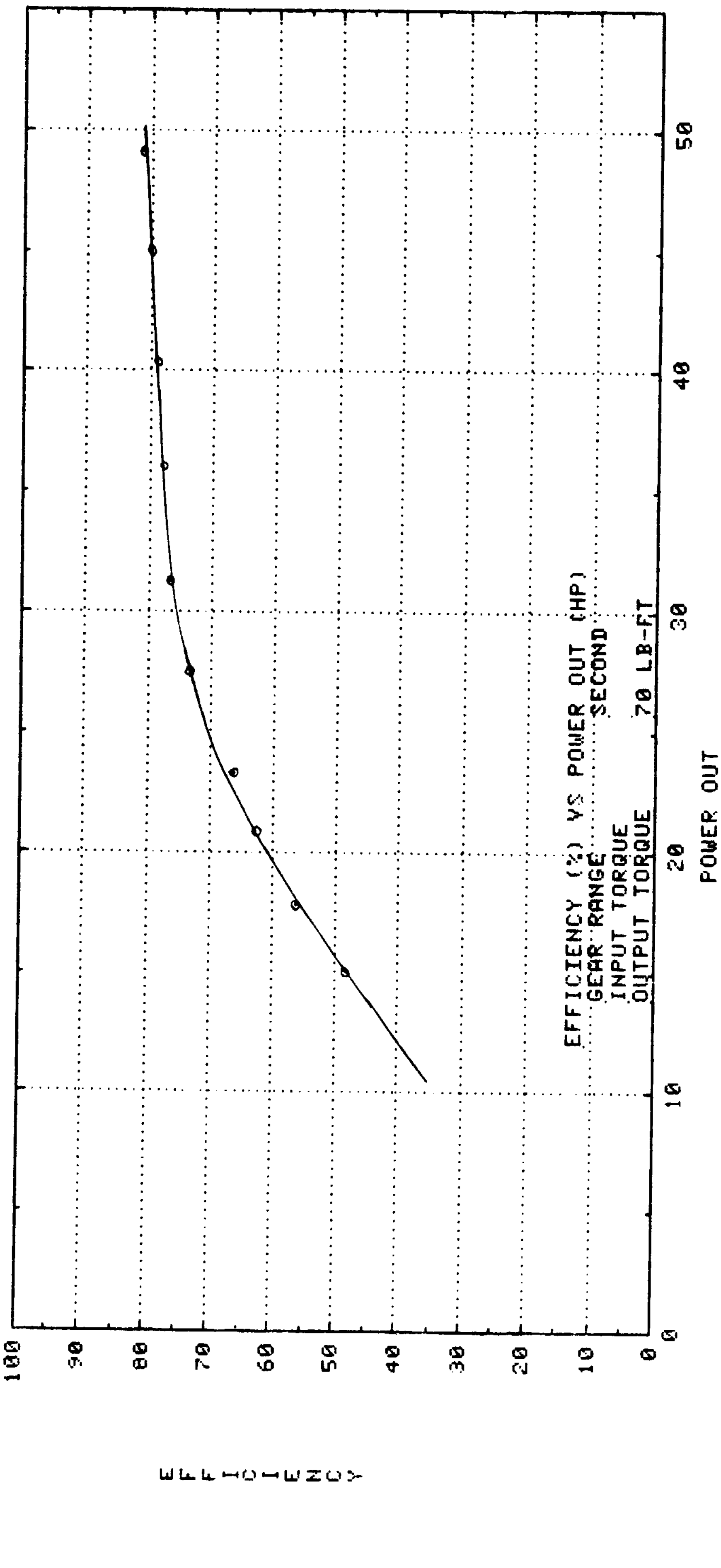

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 70 LB-FT
TORQUE RATIO
OUTPUT SPEED
0.0
.5
1.0
1.5
2.0
2.5
0
500
1000
1500
2000
2500
3000
3500
4000

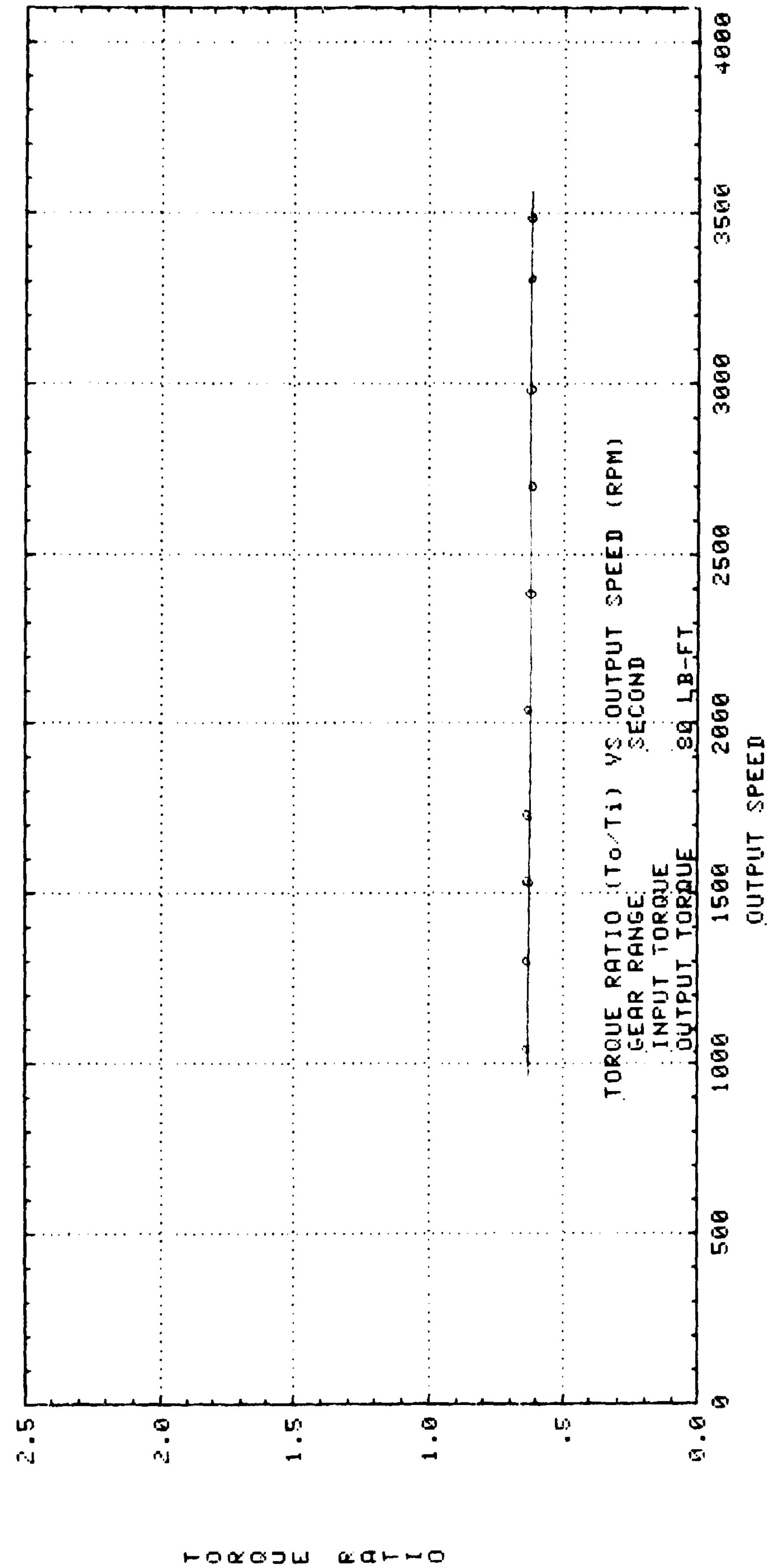


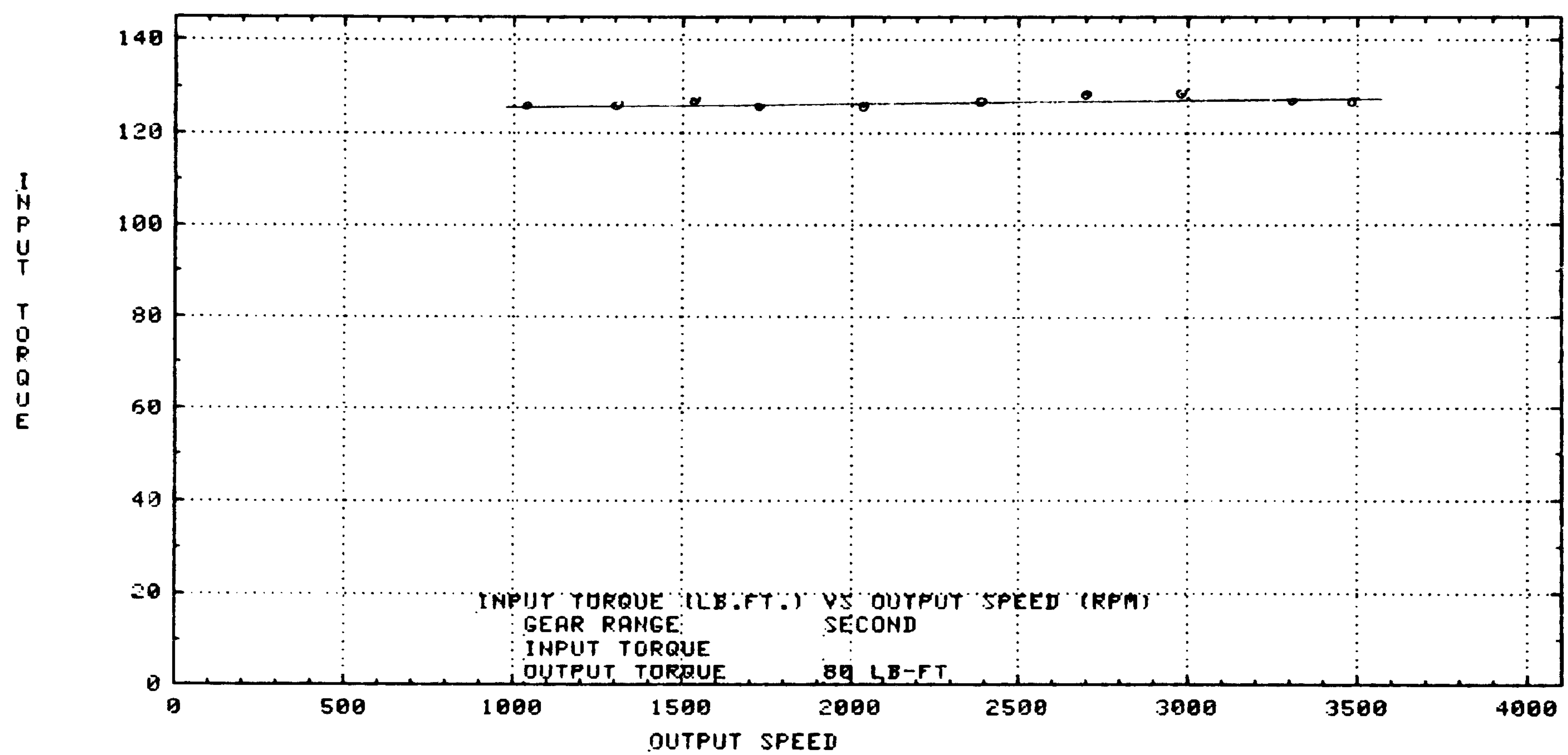
INPUT TORQUE
120
100
80
60
40
20
0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 70 LB-FT

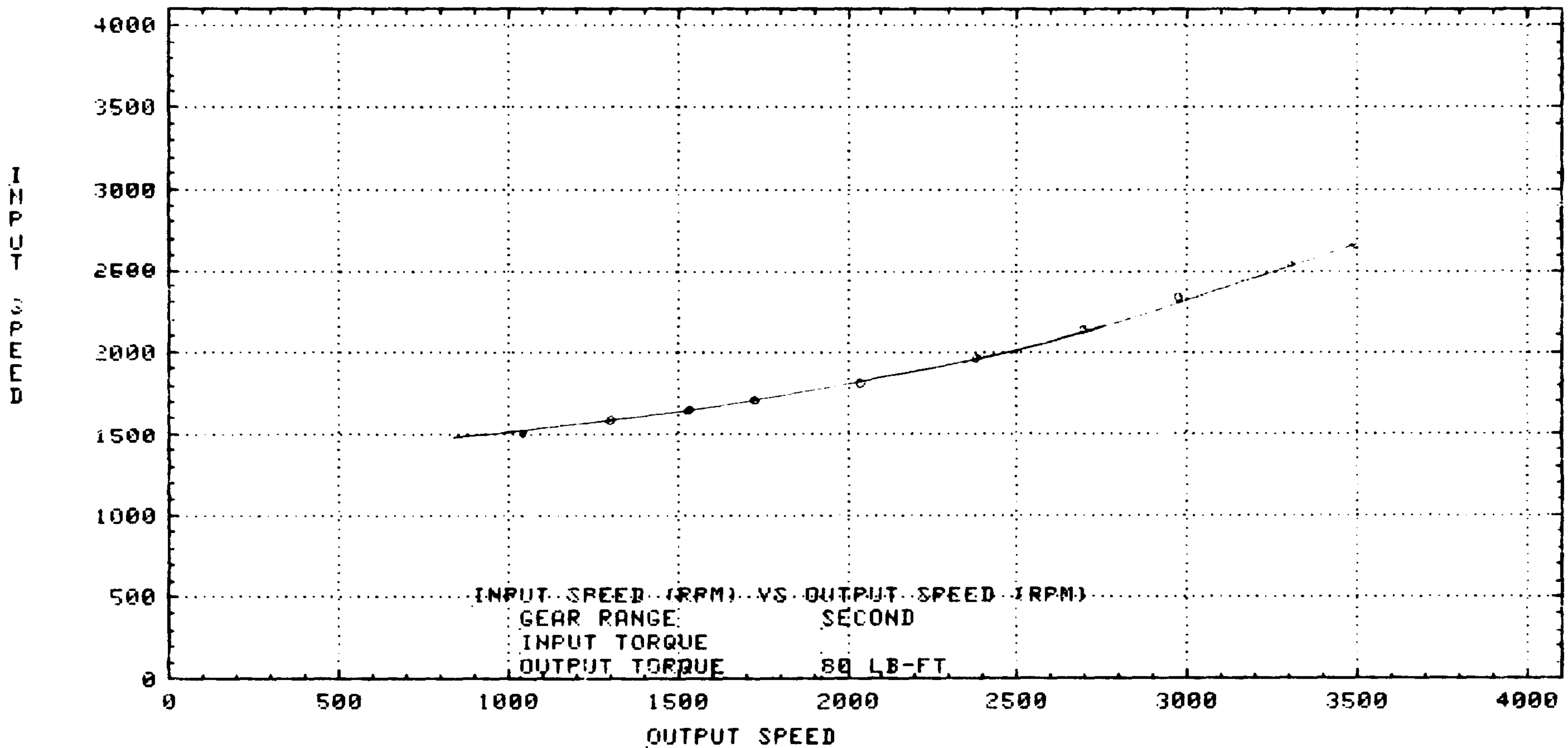

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 70 LB-FT
INPUT SPEED
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

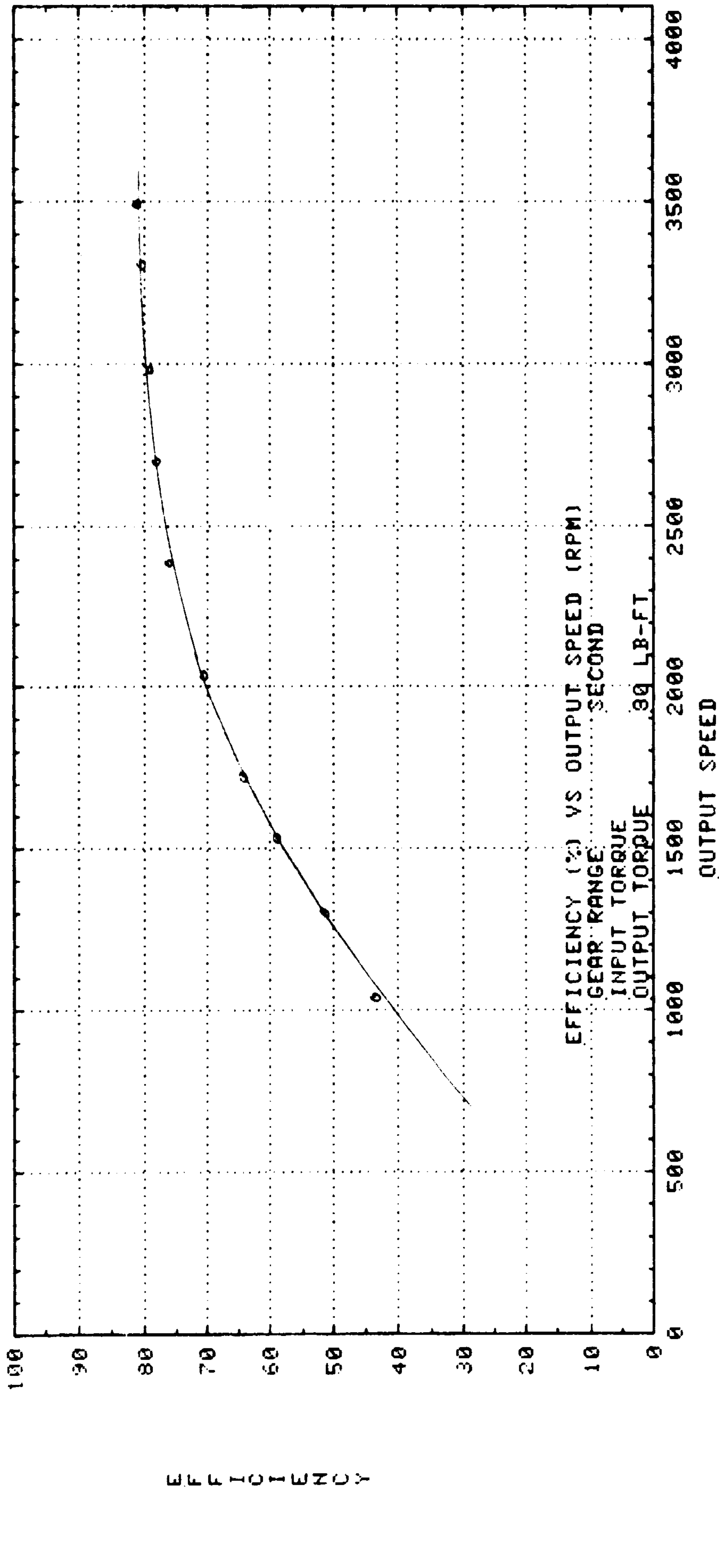

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 70 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
EFFICIENCY
0
500
1000
1500
2000
2500
3000
3500
4000
10
20
30
40
50
60
70
80
90
100


EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 70 LB-FT
POWER OUT
EFFICIENCY
0
10
20
30
40
50
60
70
80
90
100

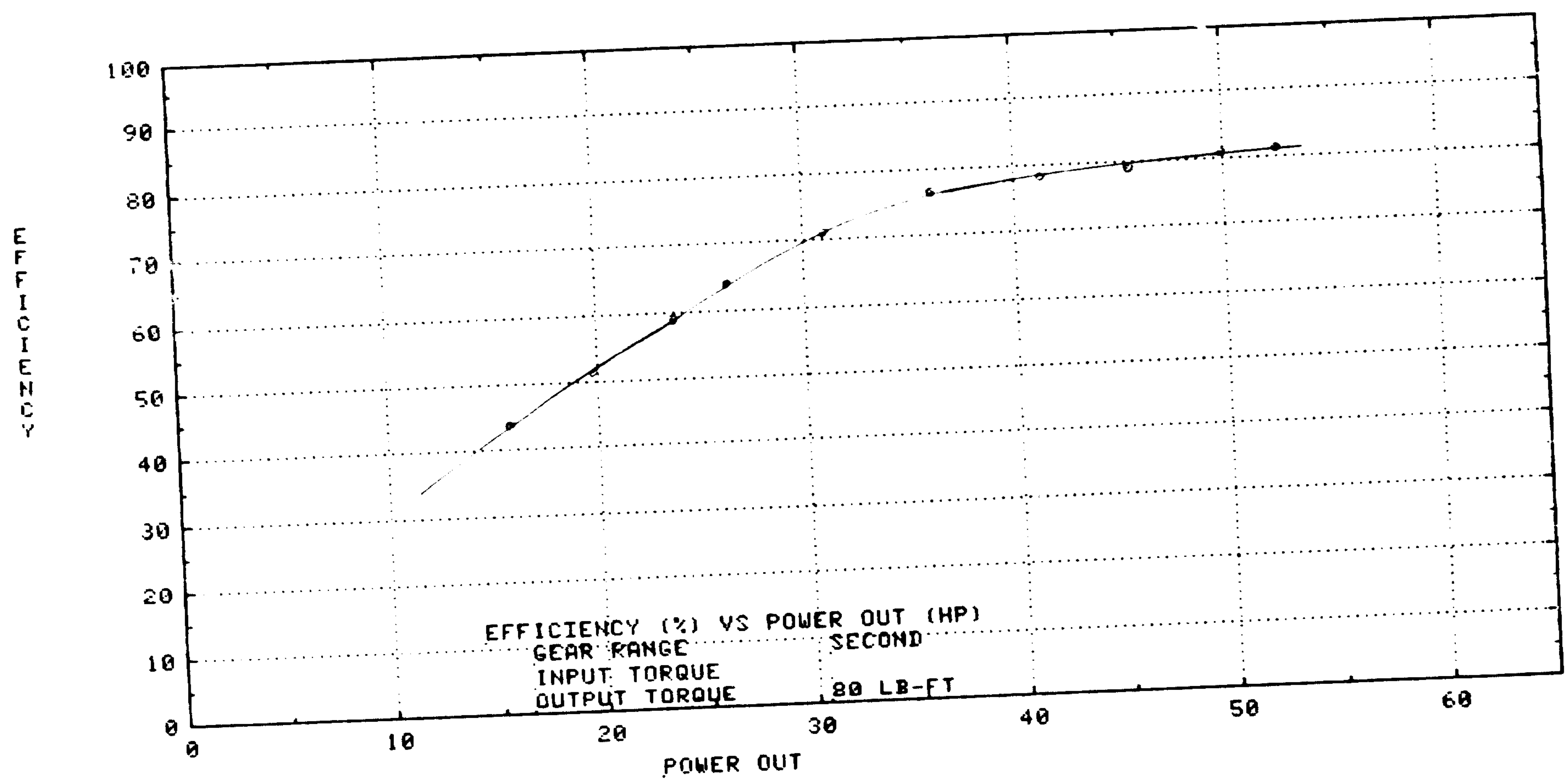

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE 80 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
TORQUE RATIO
0
500
1000
1500
2000
2500
3000
3500
4000
0.0
.5
1.0
1.5
2.0
2.5


INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 80 LB-FT
INPUT TORQUE
OUTPUT SPEED
0
20
40
60
80
100
120
140
0
500
1000
1500
2000
2500
3000
3500
4000


INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 80 LB-FT
INPUT SPEED
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000



EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 30 LB-FT
OUTPUT SPEED
EFFICIENCY
0 500 1000 1500 2000 2500 3000 3500 4000
0 10 20 30 40 50 60 70 80 90 100


EFFICIENCY
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
POWER OUT
EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE SECOND
INPUT TORQUE
OUTPUT TORQUE 80 LB-FT

COAST PERFORMANCE

3rd Gear

Graphs Contained in This Section

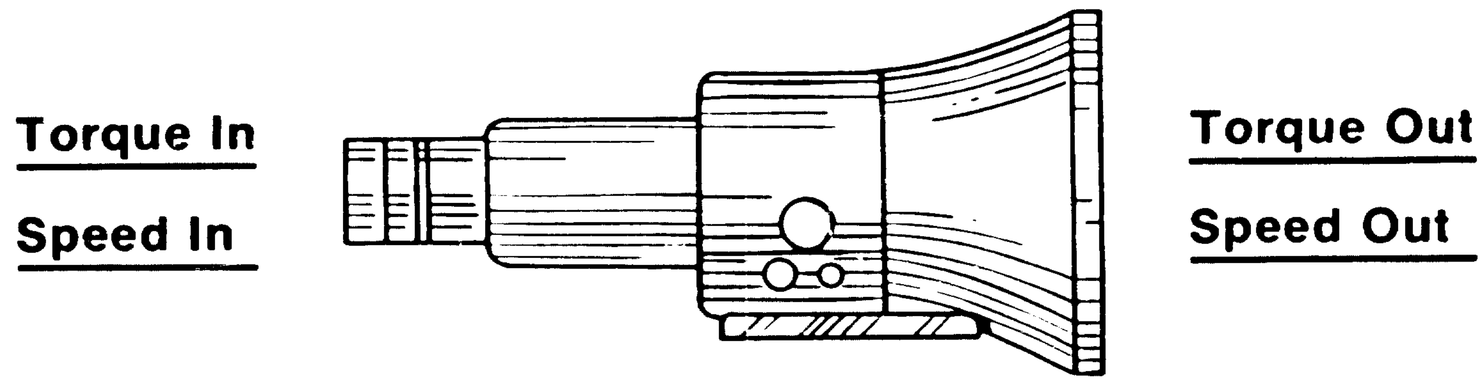
Torque Ratio -vs- Output Speed

Output Torque -vs- Output Speed

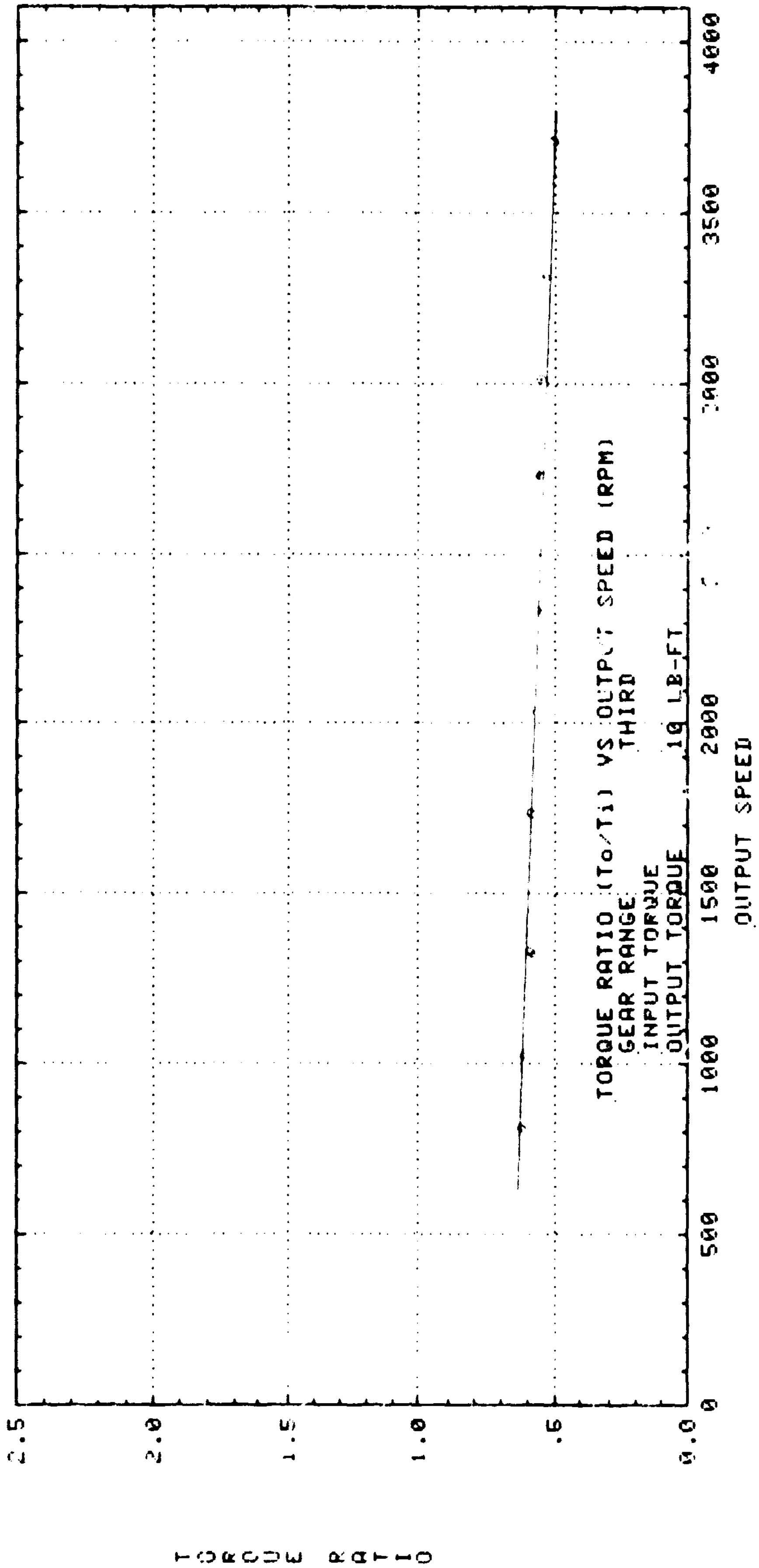
Input Speed -vs- Output Speed

Efficiency -vs- Output Speed

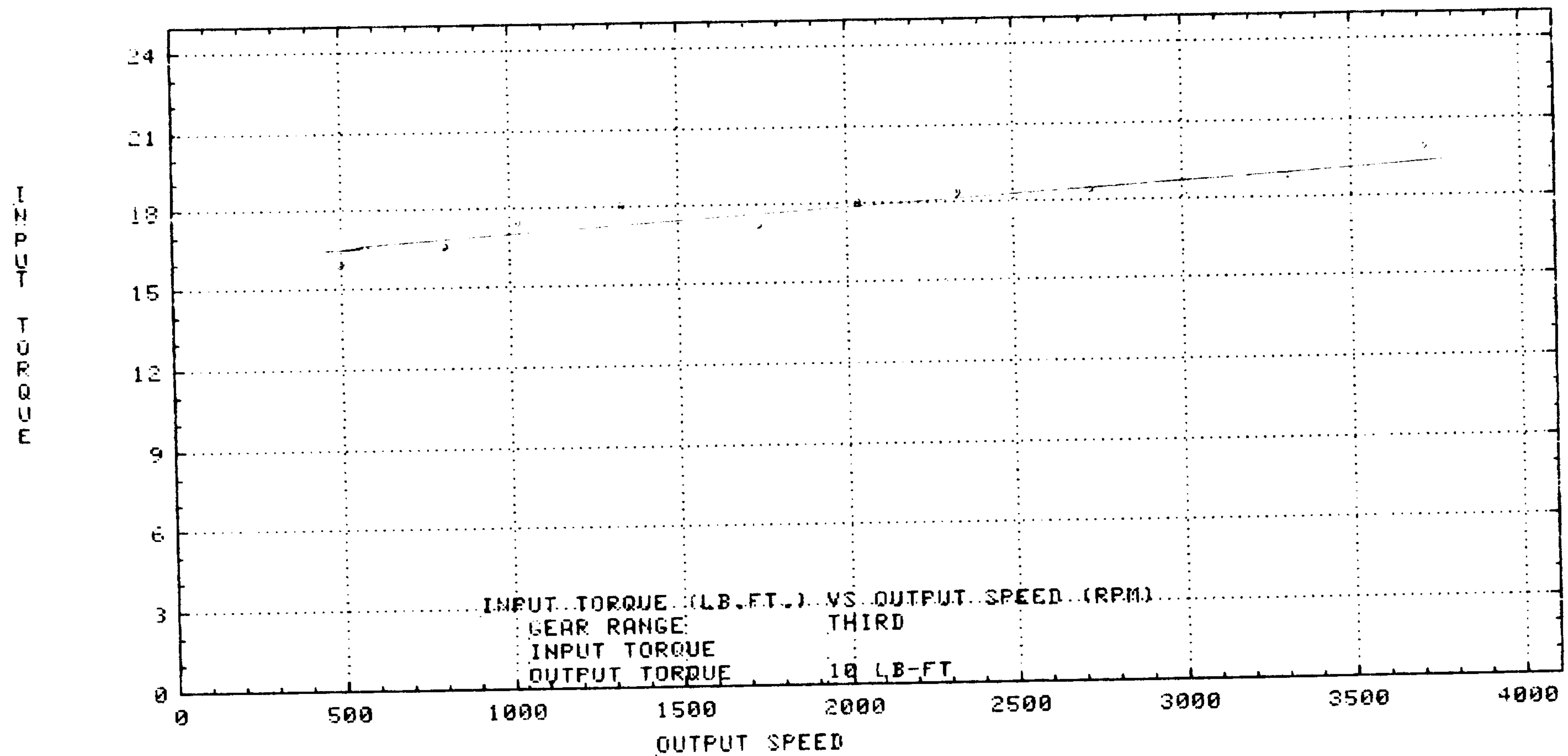
Efficiency -vs- Power Out

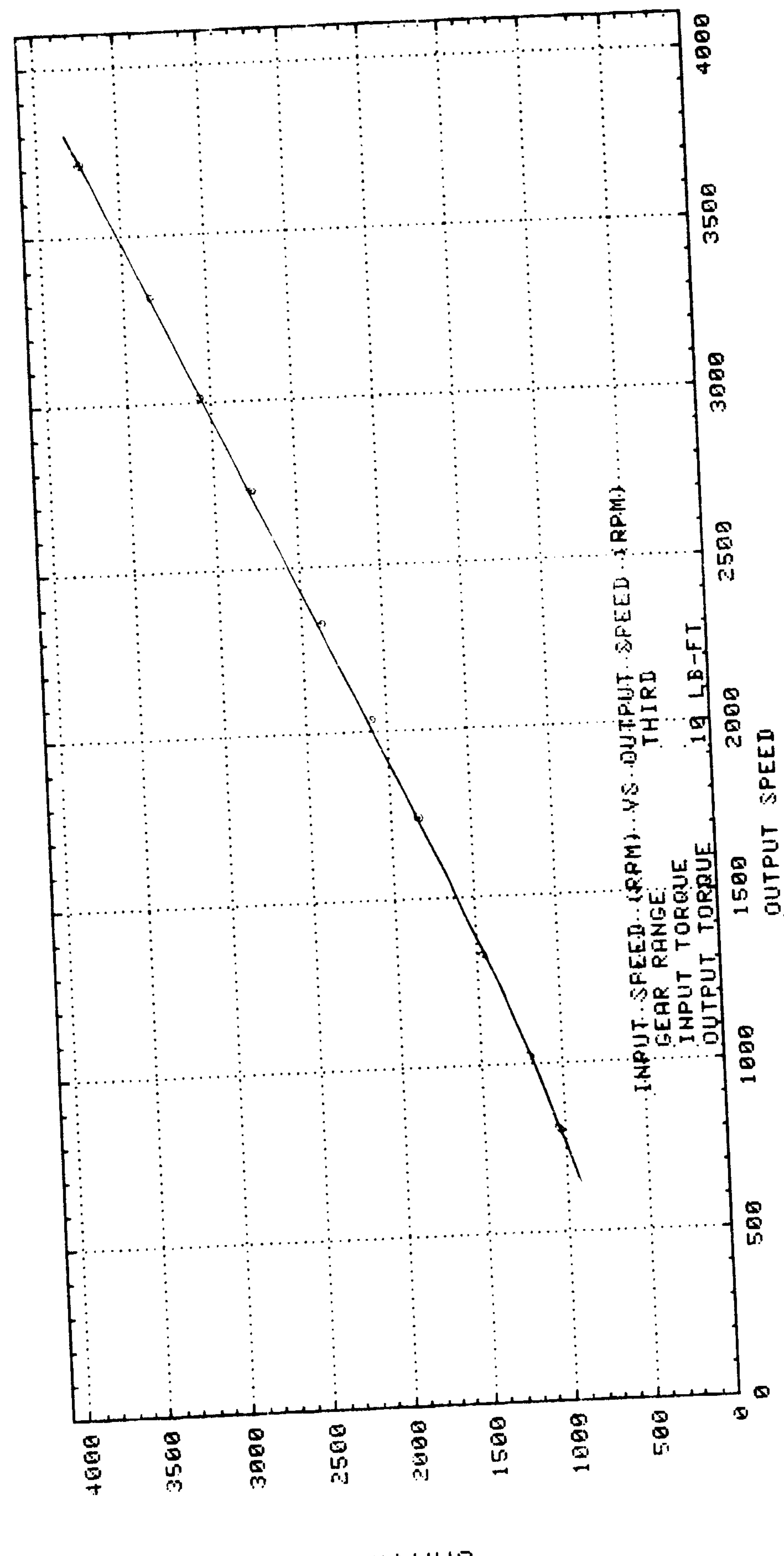


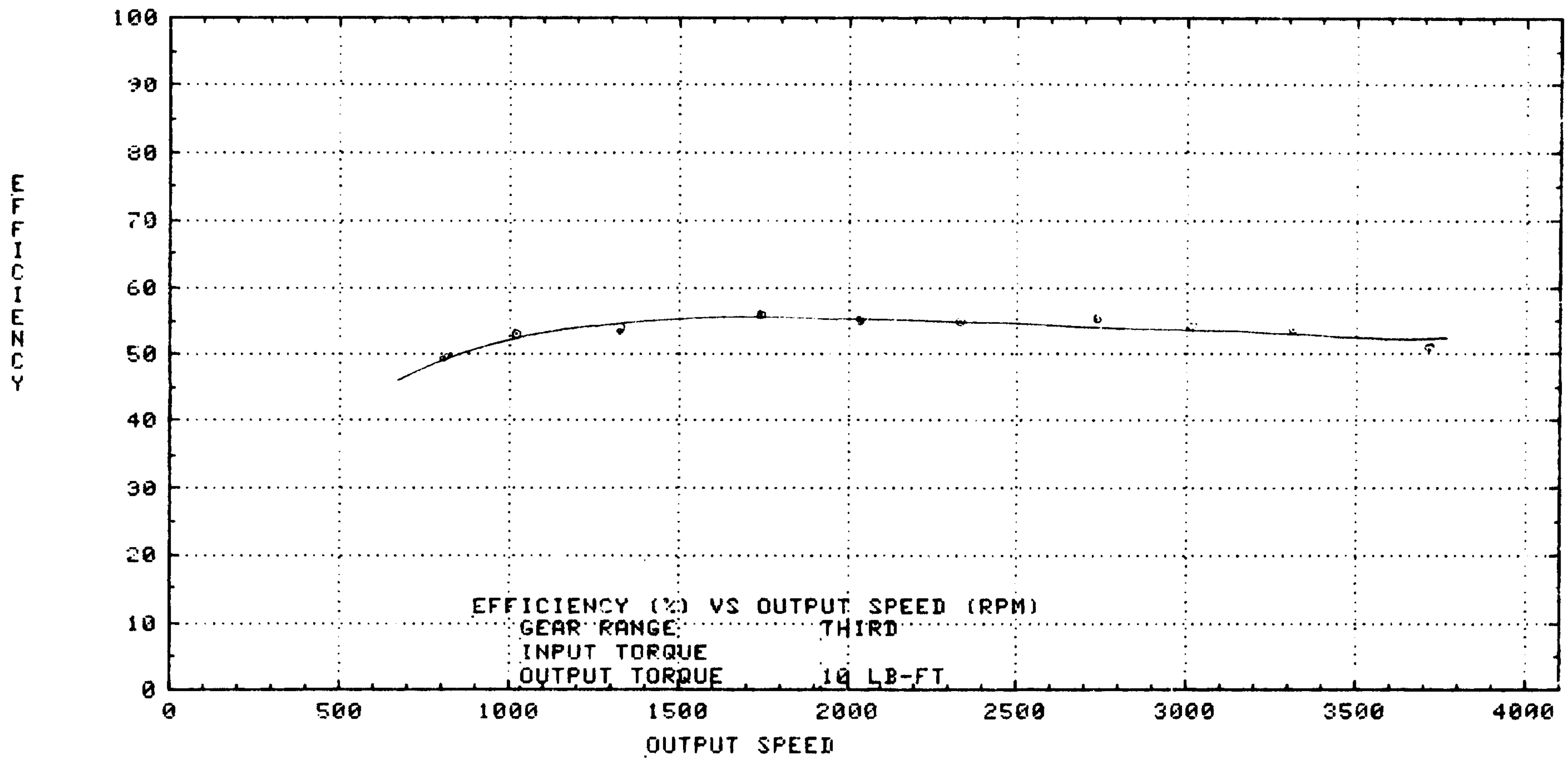
Coast Performance Tests



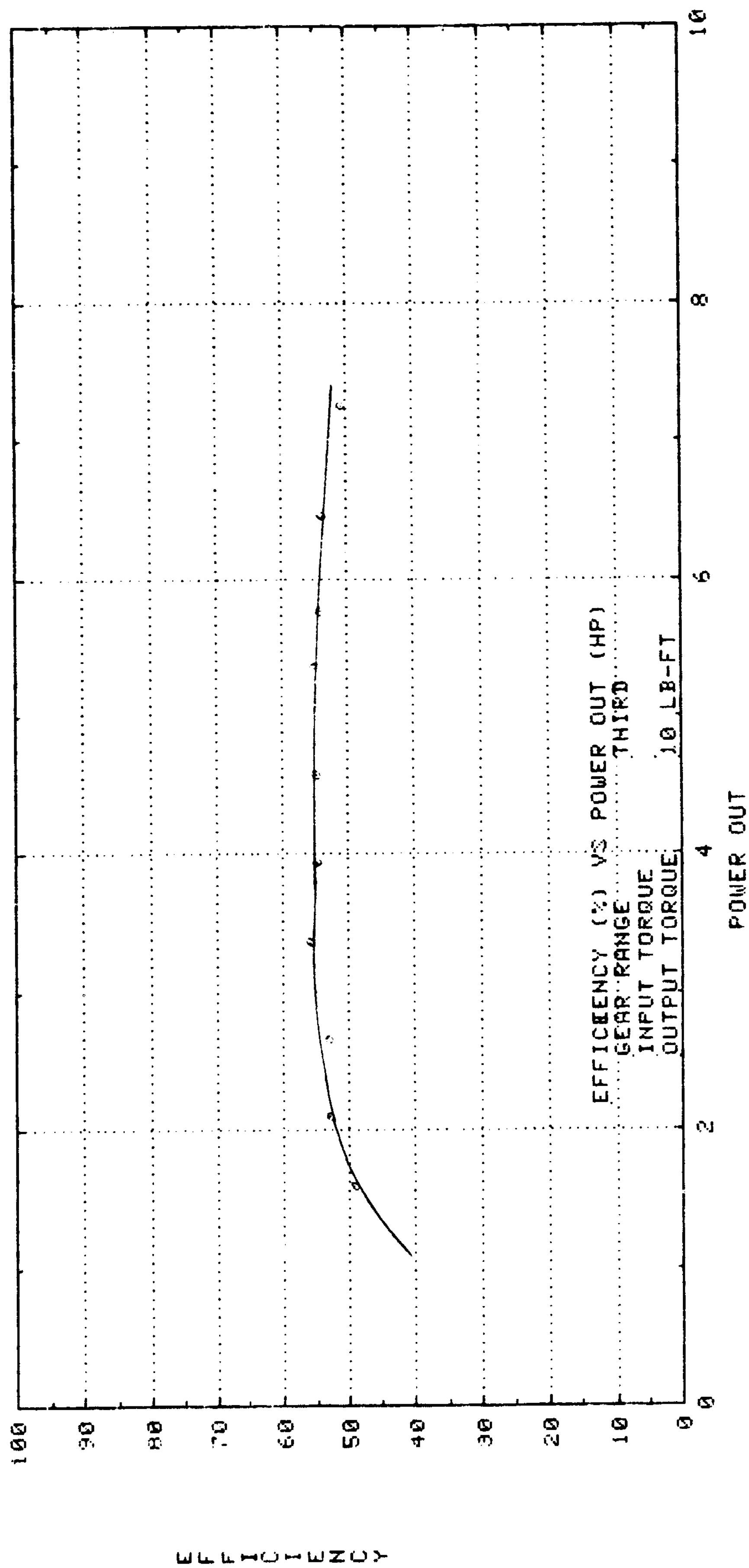
TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 10 LB-FT
OUTPUT SPEED
TORQUE RATIO
0 500 1000 1500 2000 3500 4000
0.0 .5 1.0 1.5 2.0

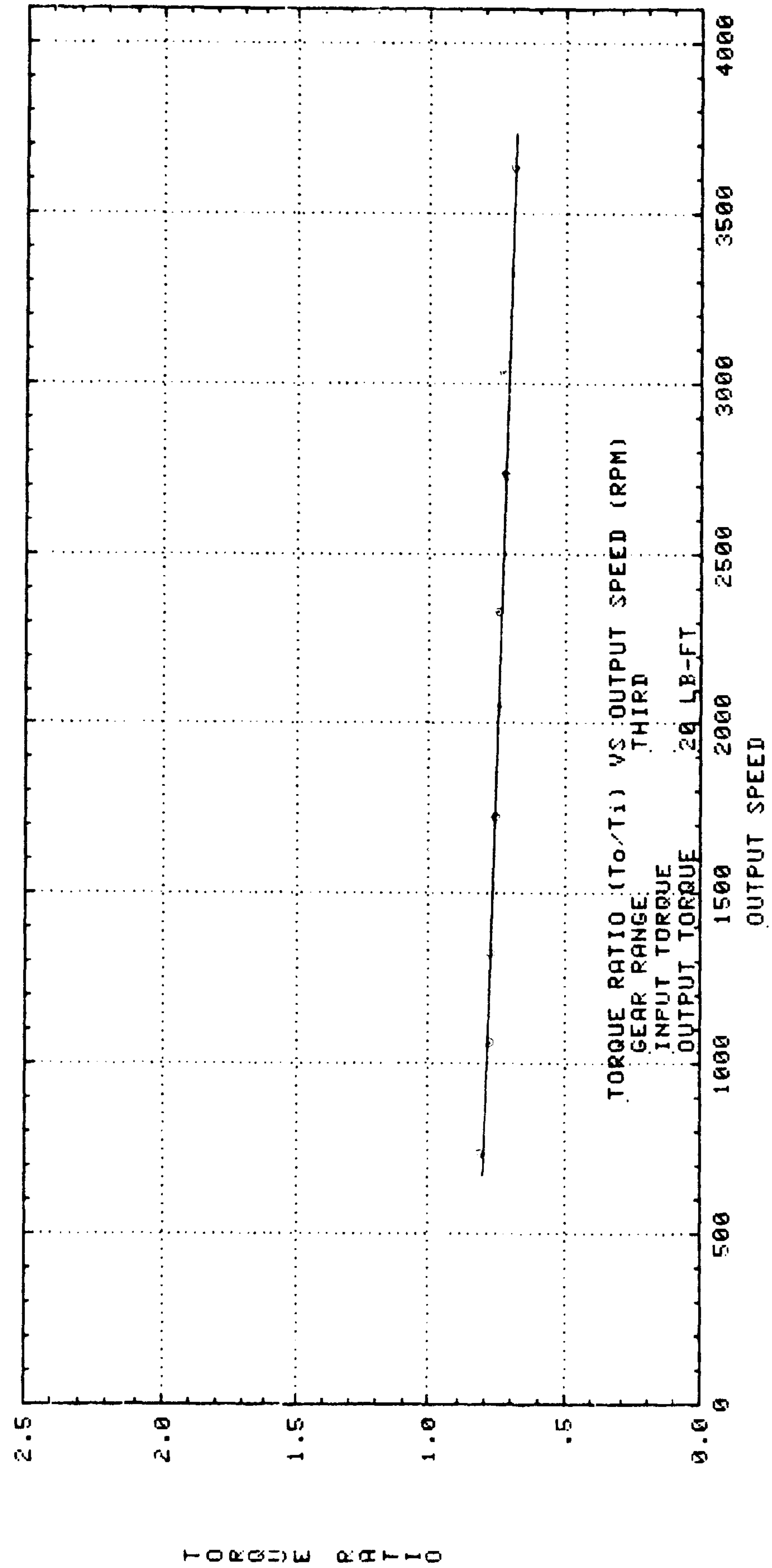

INPUT TORQUE
24
21
18
15
12
9
6
3
0
INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 10 LB-FT
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED

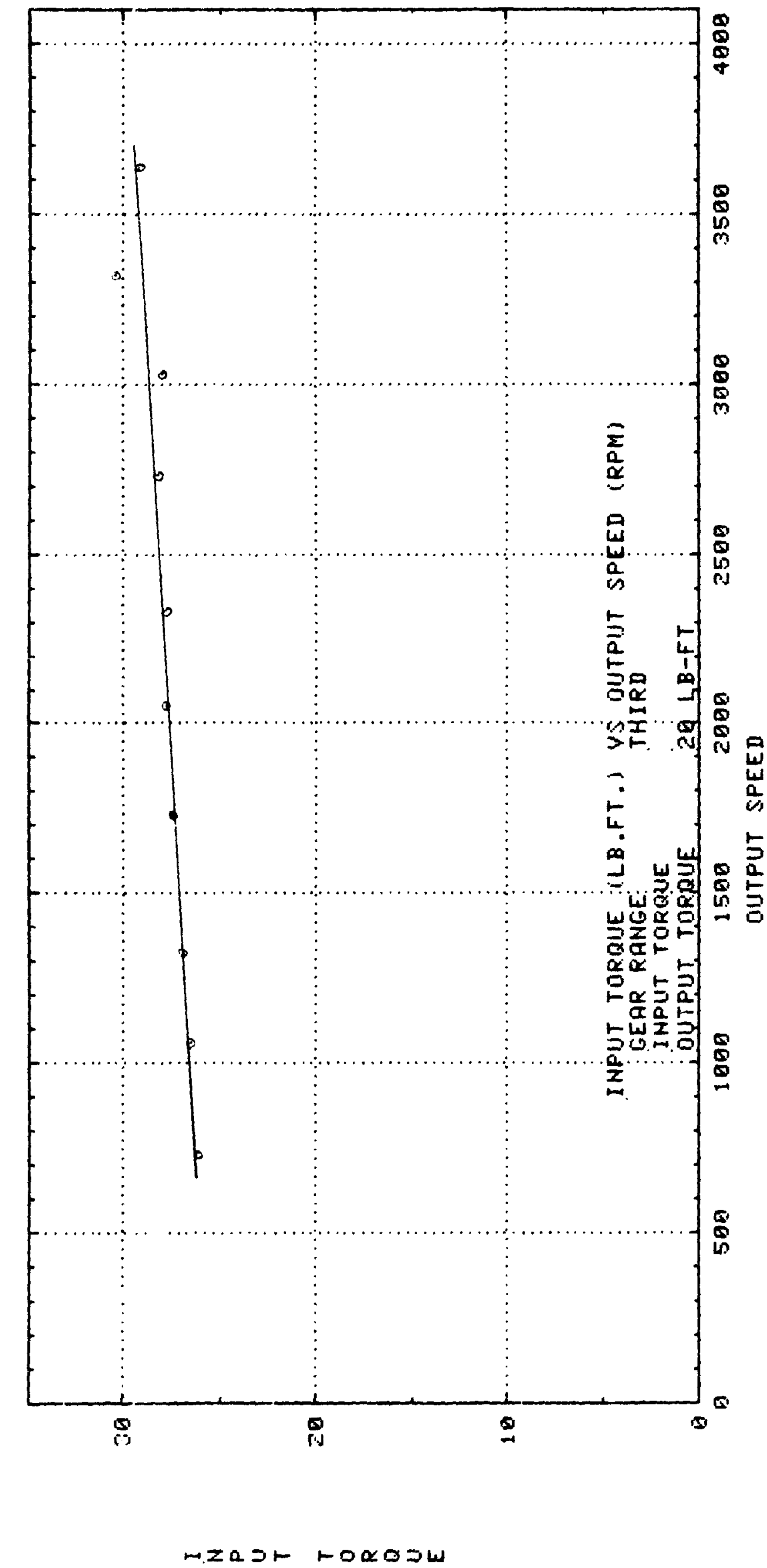

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 10 LB-FT
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

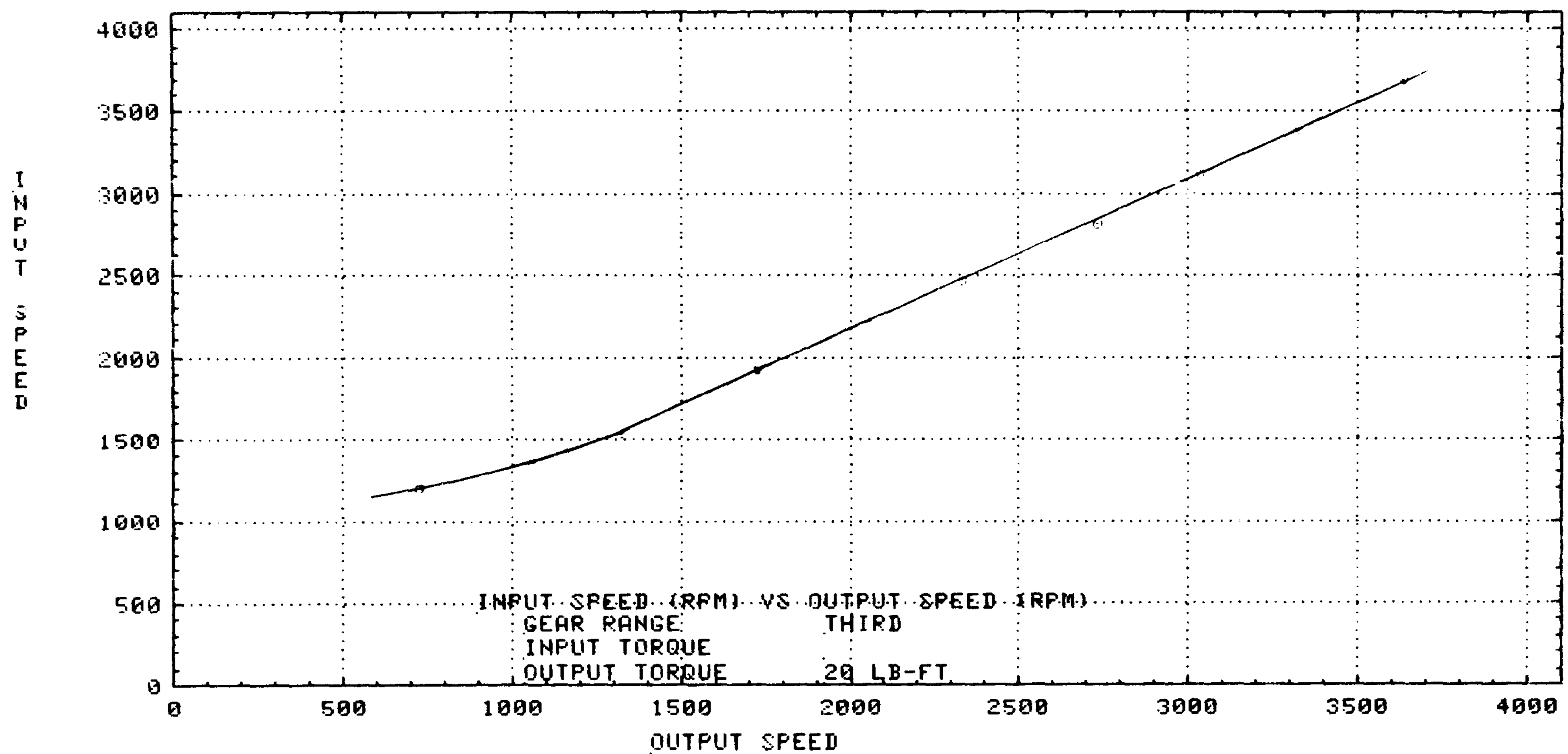


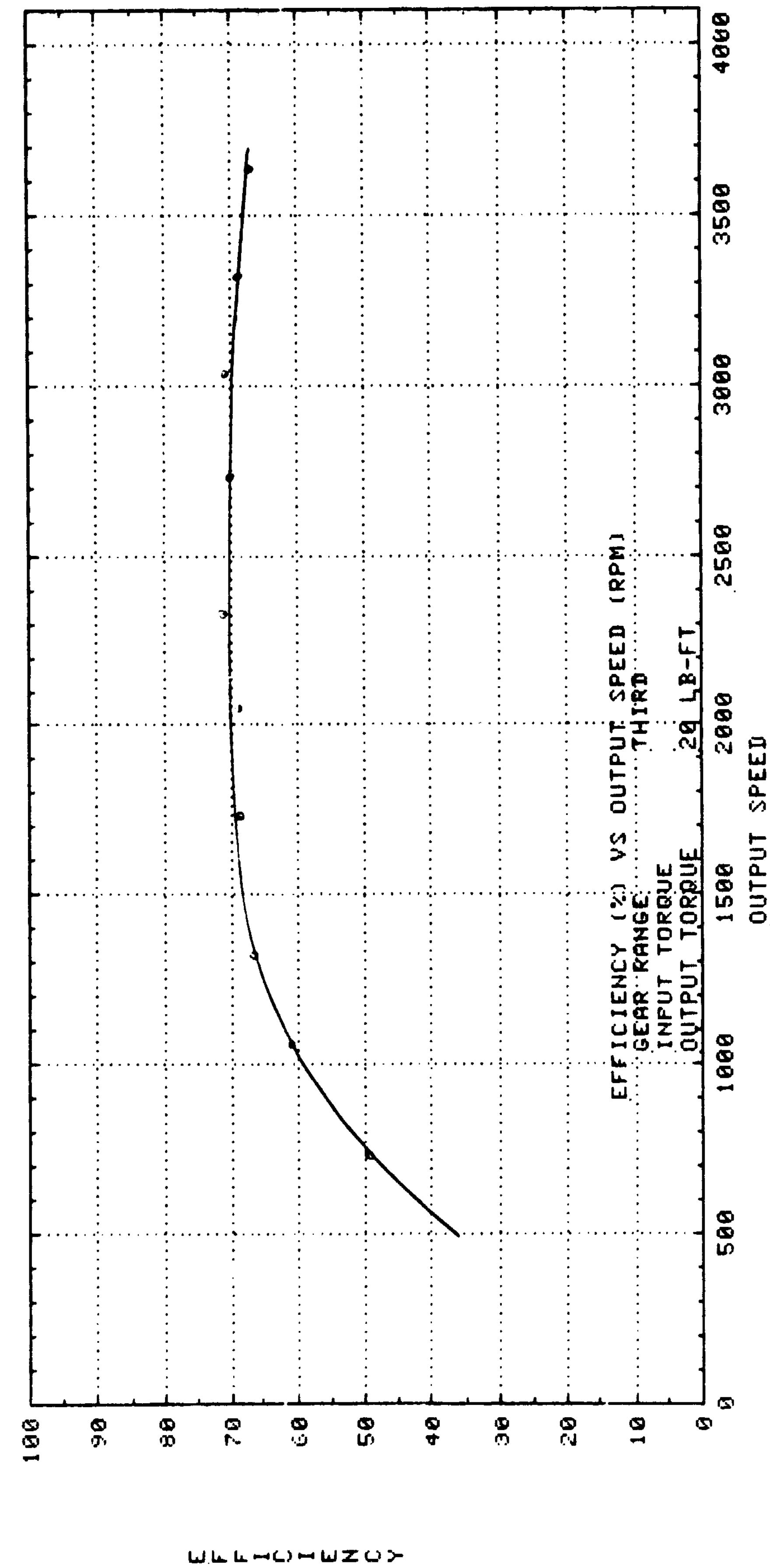
EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 10 LB-FT
EFFICIENCY
OUTPUT SPEED
100
90
80
70
60
50
40
30
20
10
0
0
500
1000
1500
2000
2500
3000
3500
4000

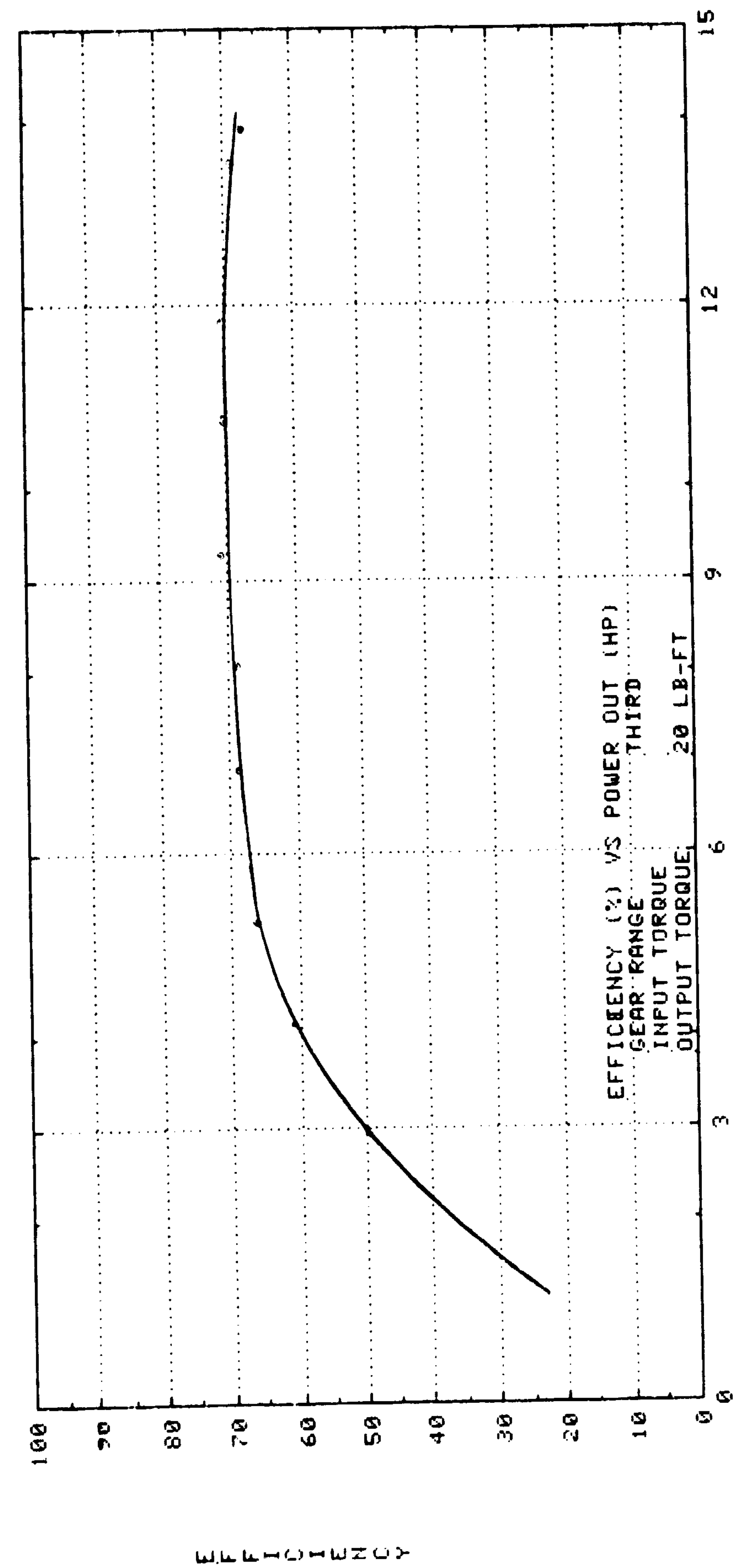

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 10 LB-FT
POWER OUT
EFFICIENCY
0
2
4
6
8
10
100
90
80
70
60
50
40
30
20
10
0

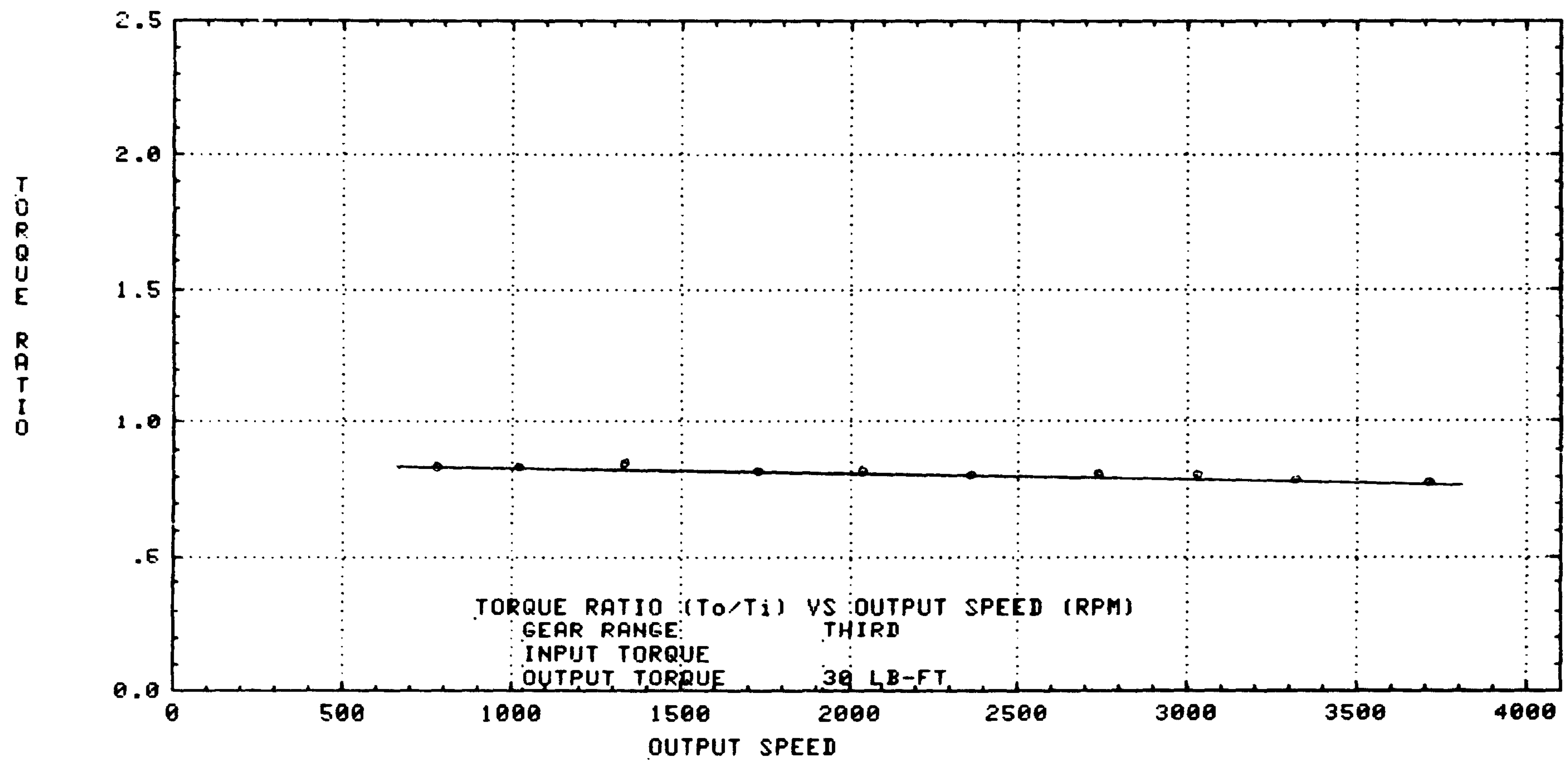

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 20 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
TORQUE RATIO
0
500
1000
1500
2000
2500
3000
3500
4000
0.0
.5
1.0
1.5
2.0
2.5


INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 20 LB-FT
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
0
10
20
30
INPUT TORQUE

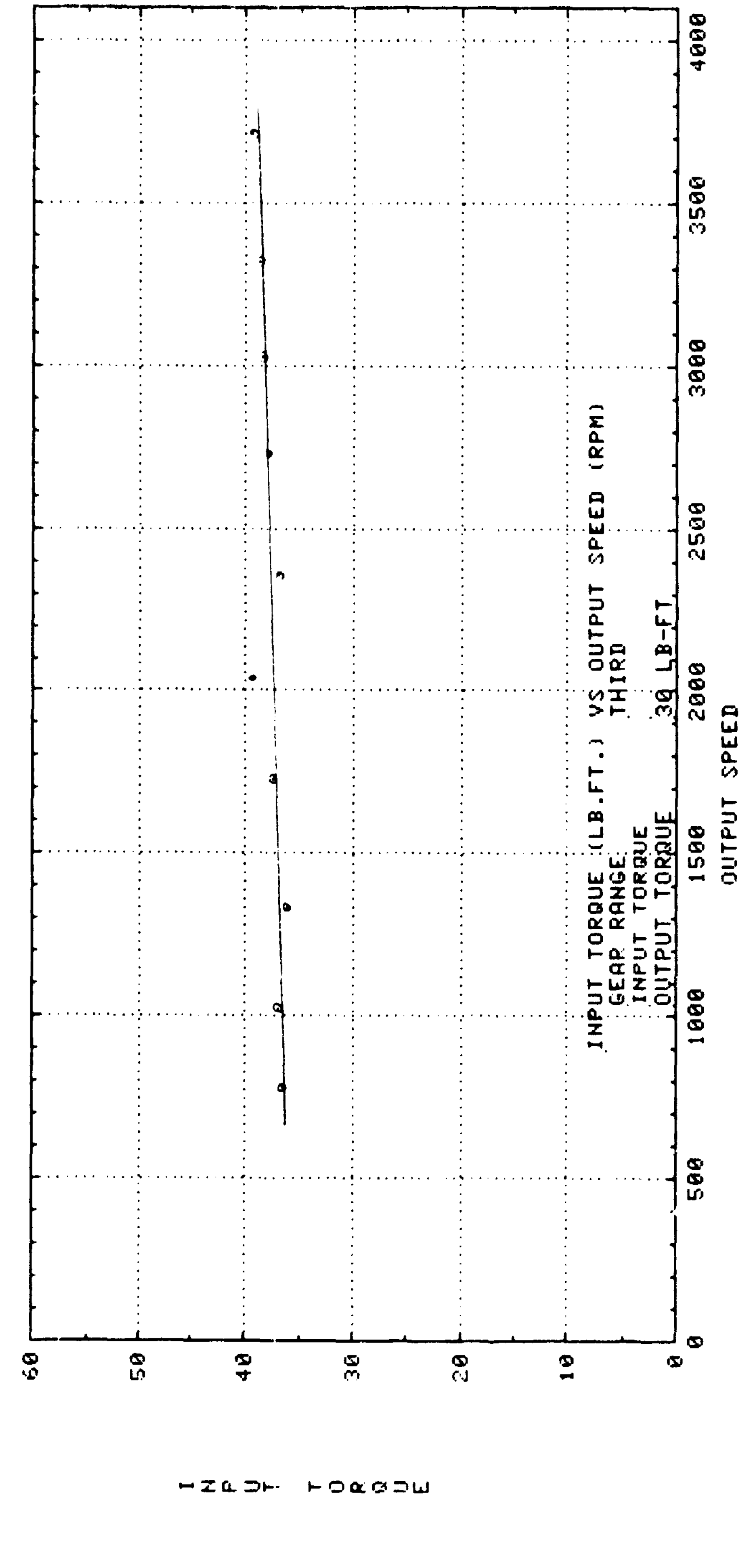

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 20 LB-FT
INPUT SPEED
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

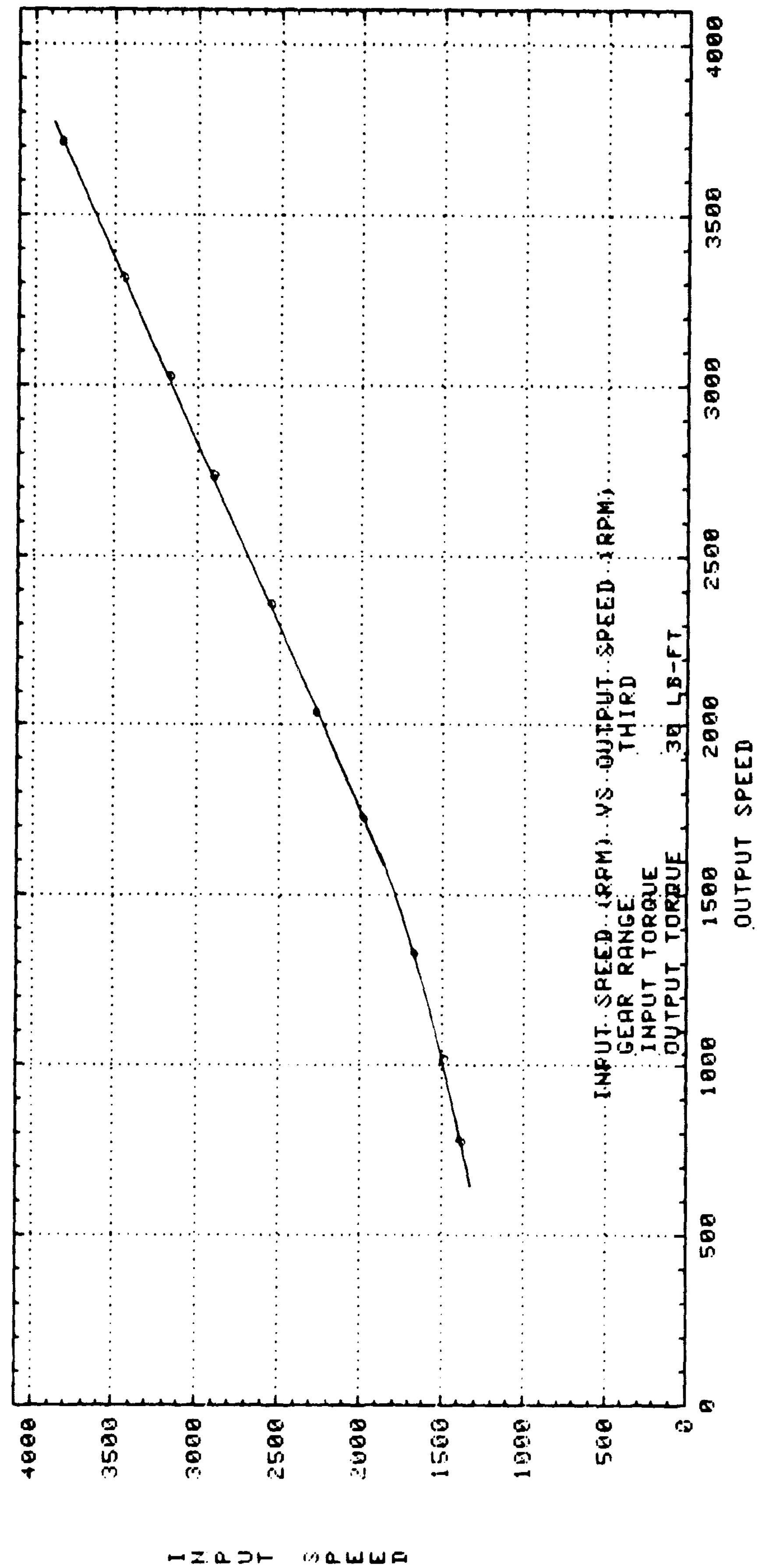

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 20 LB-FT
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000
EFFICIENCY
0
10
20
30
40
50
60
70
80
90
100

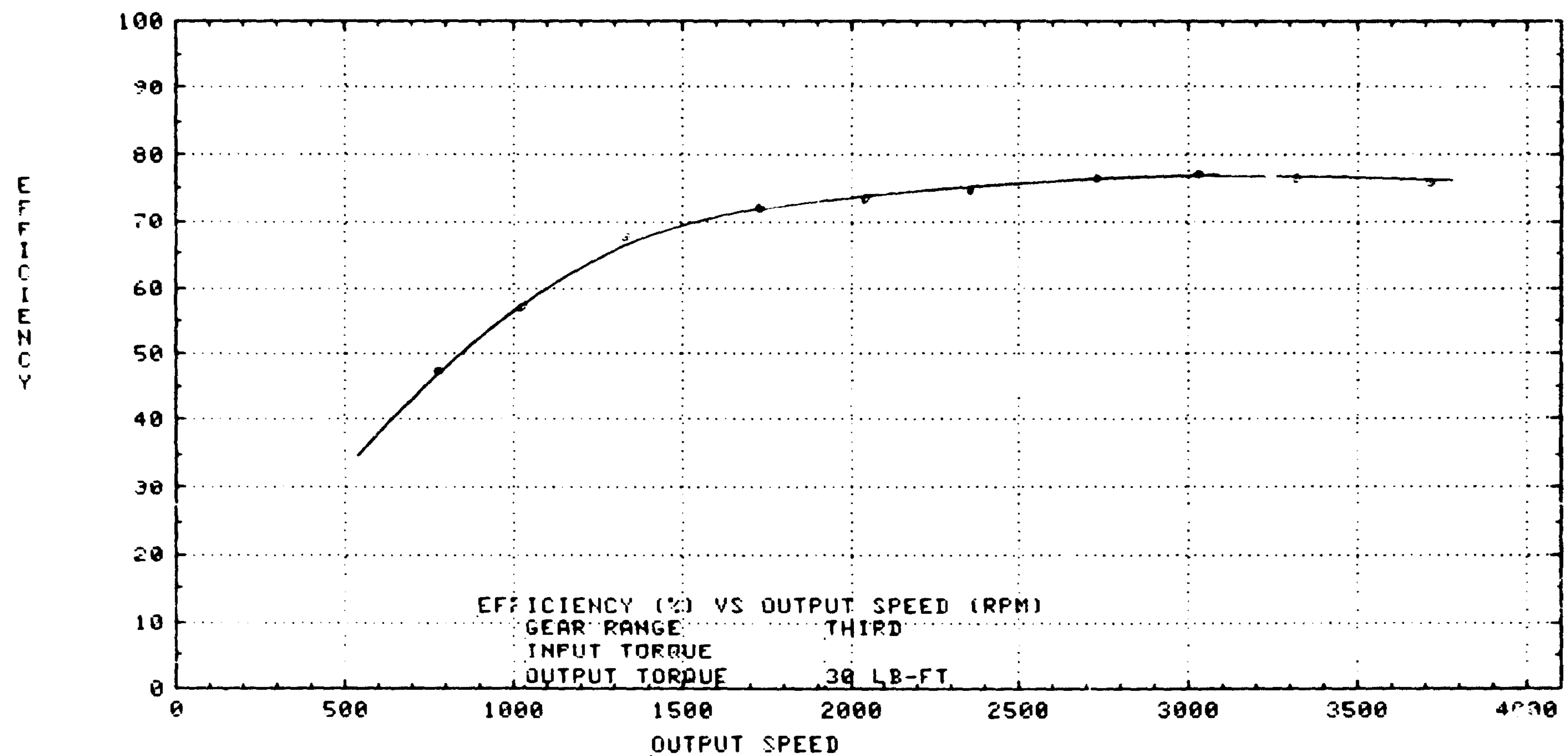

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE 20 LB-FT
OUTPUT TORQUE
POWER OUT
EFFICIENCY
0
3
6
9
12
15
0
10
20
30
40
50
60
70
80
90
100

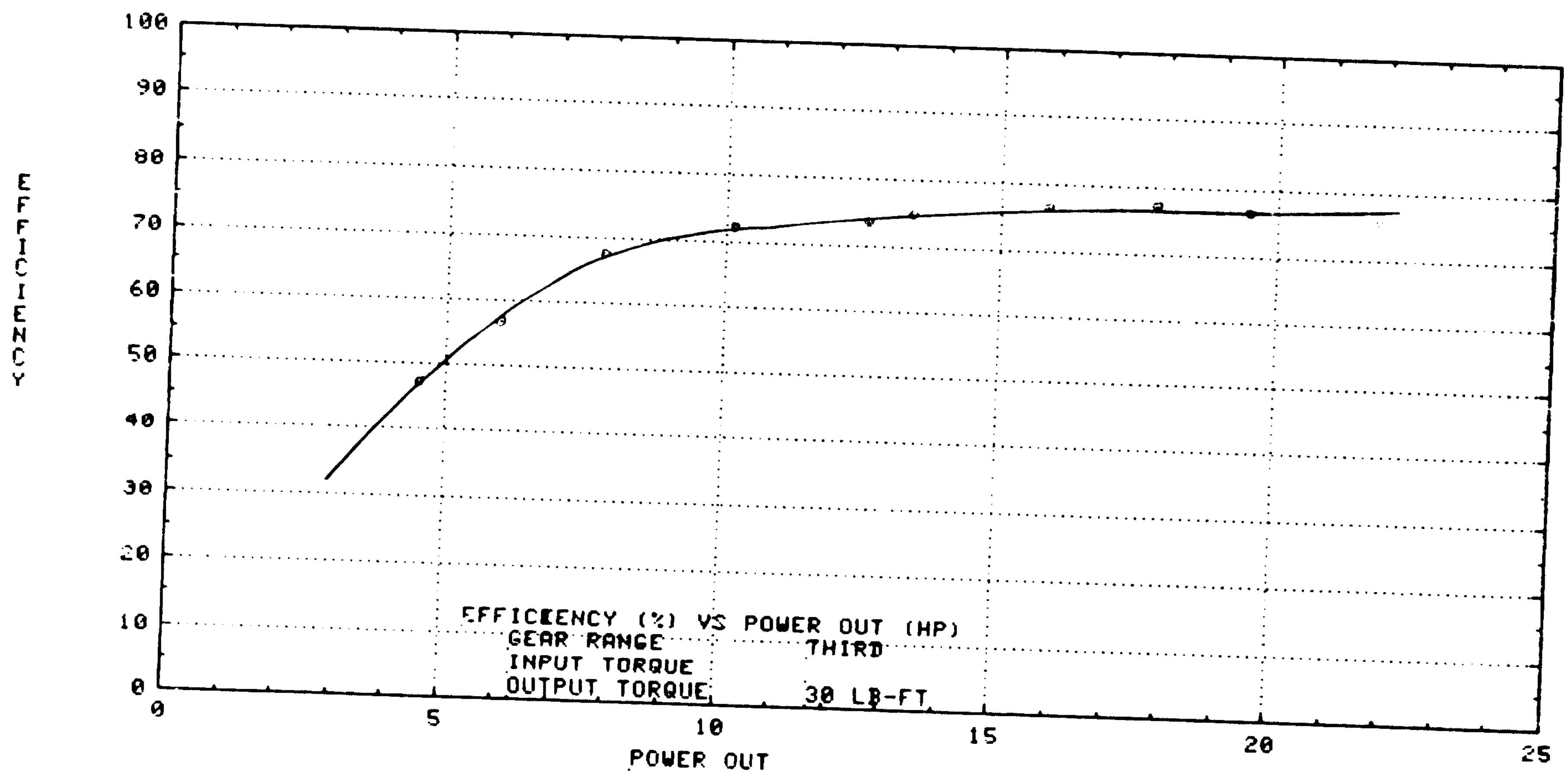


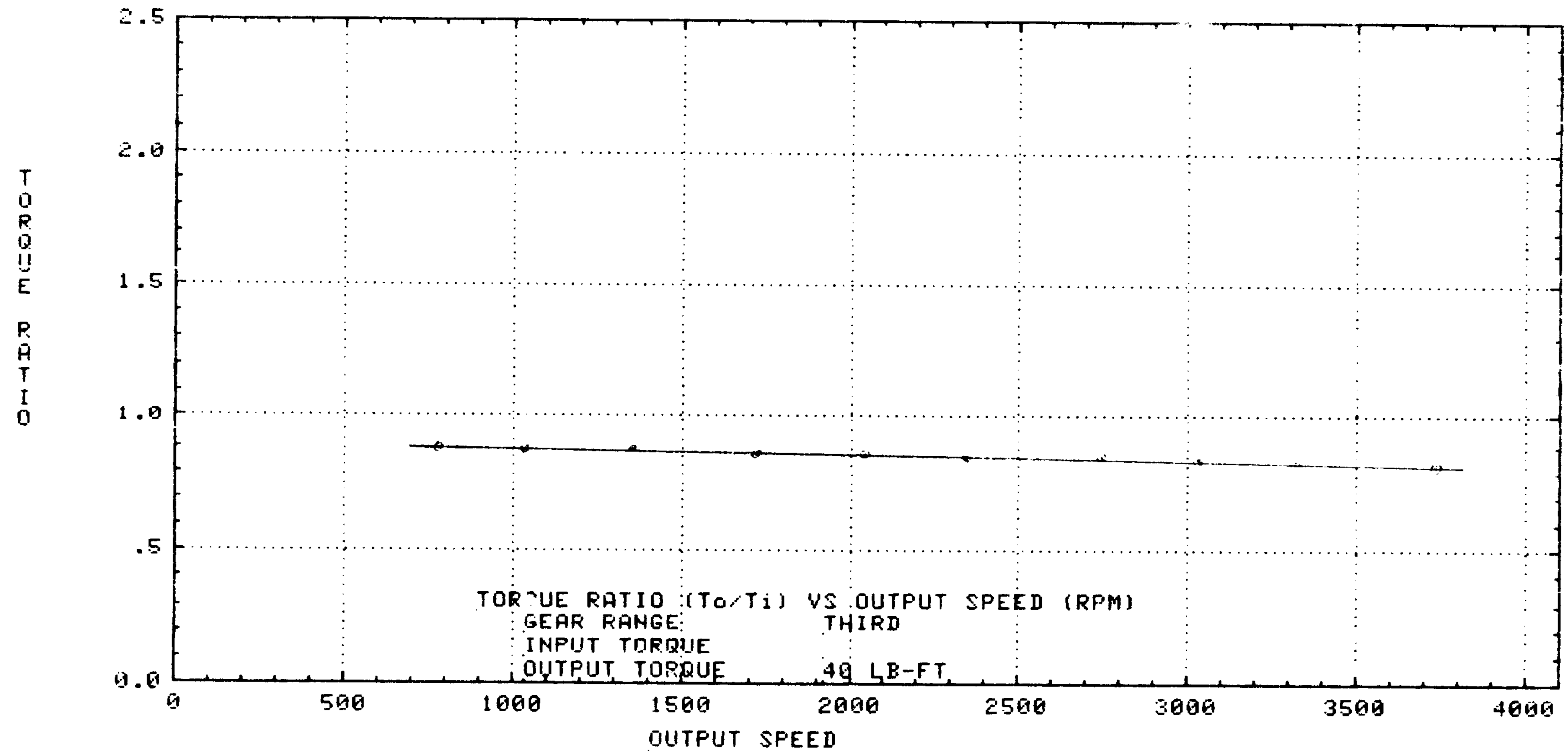
2.5
2.0
1.5
1.0
.5
0.0
TORQUE RATIO
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 30 LB-FT


INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 30 LB-FT
OUTPUT SPEED
INPUT TORQUE
0
500
1000
1500
2000
2500
3000
3500
4000
0
10
20
30
40
50
60

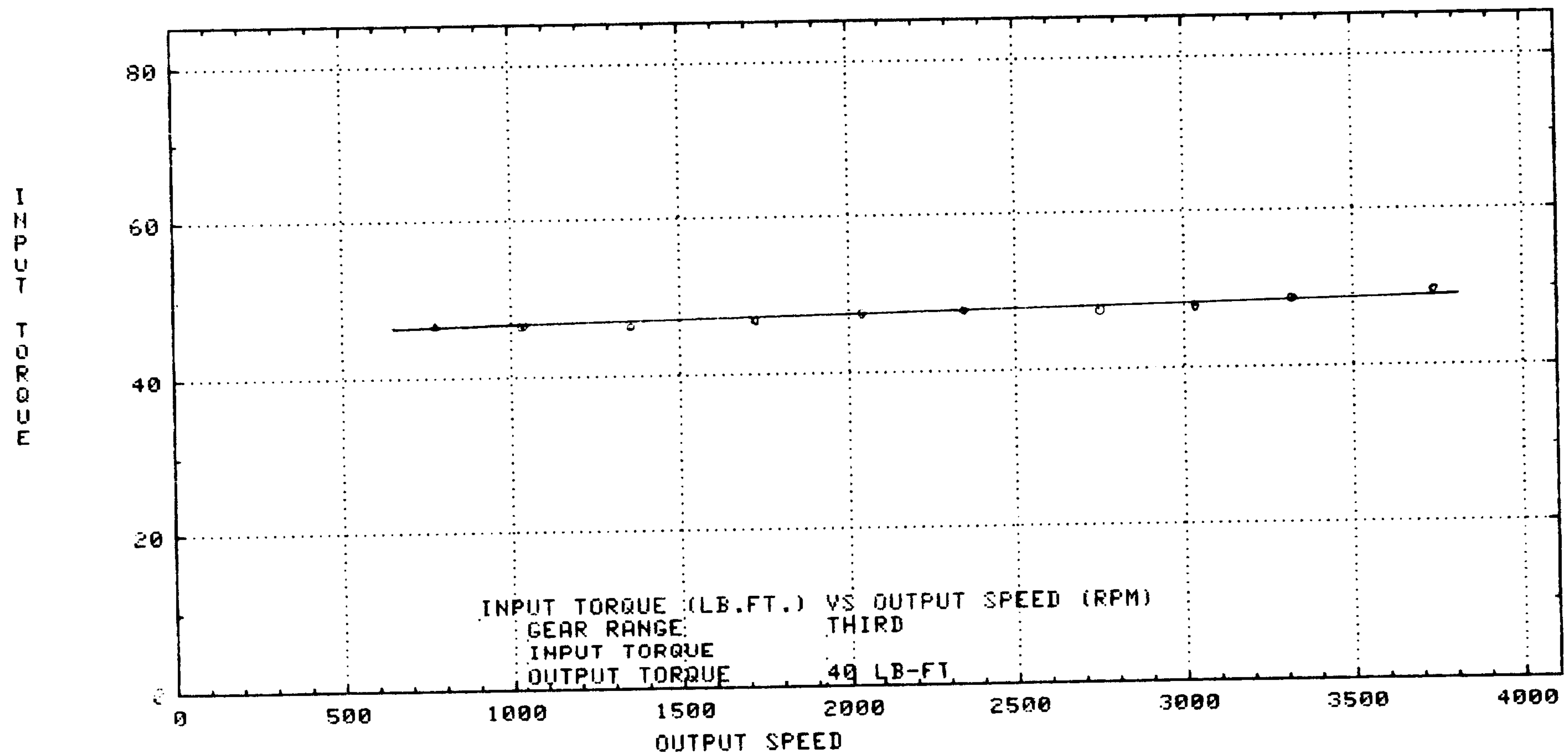

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 30 LB-FT
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

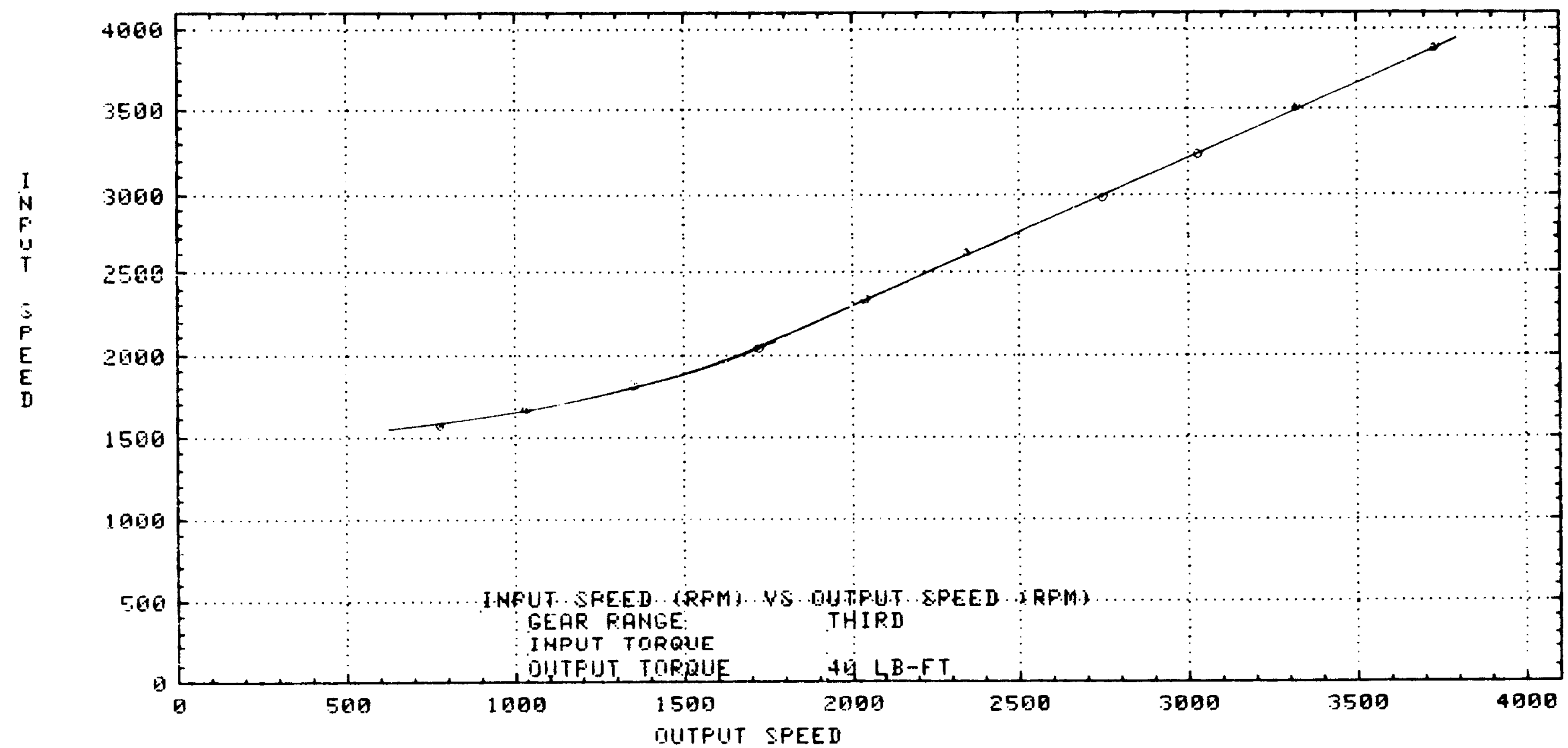

100
90
80
70
60
50
40
30
20
10
0
EFFICIENCY
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 30 LB-FT

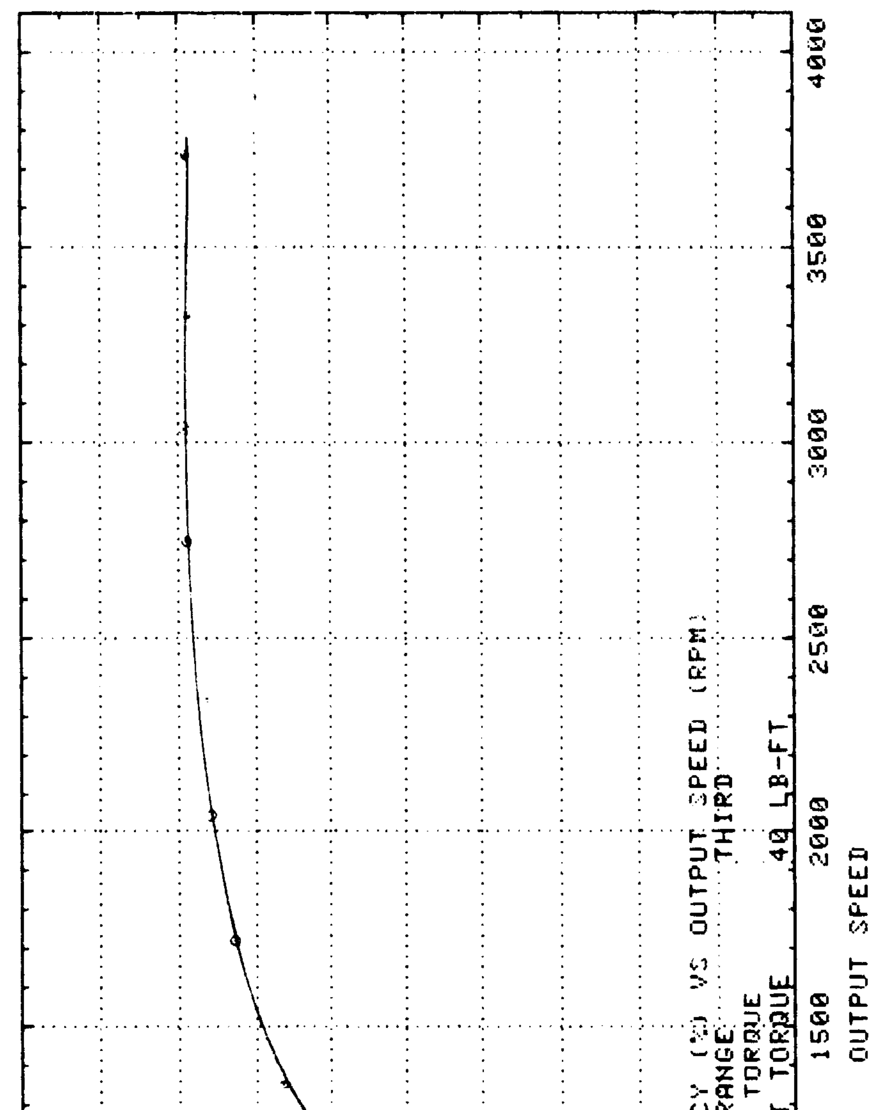

EFFICEENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 30 LB-FT
EFFICIENCY
POWER OUT
0
10
20
30
40
50
60
70
80
90
100
5
15
25

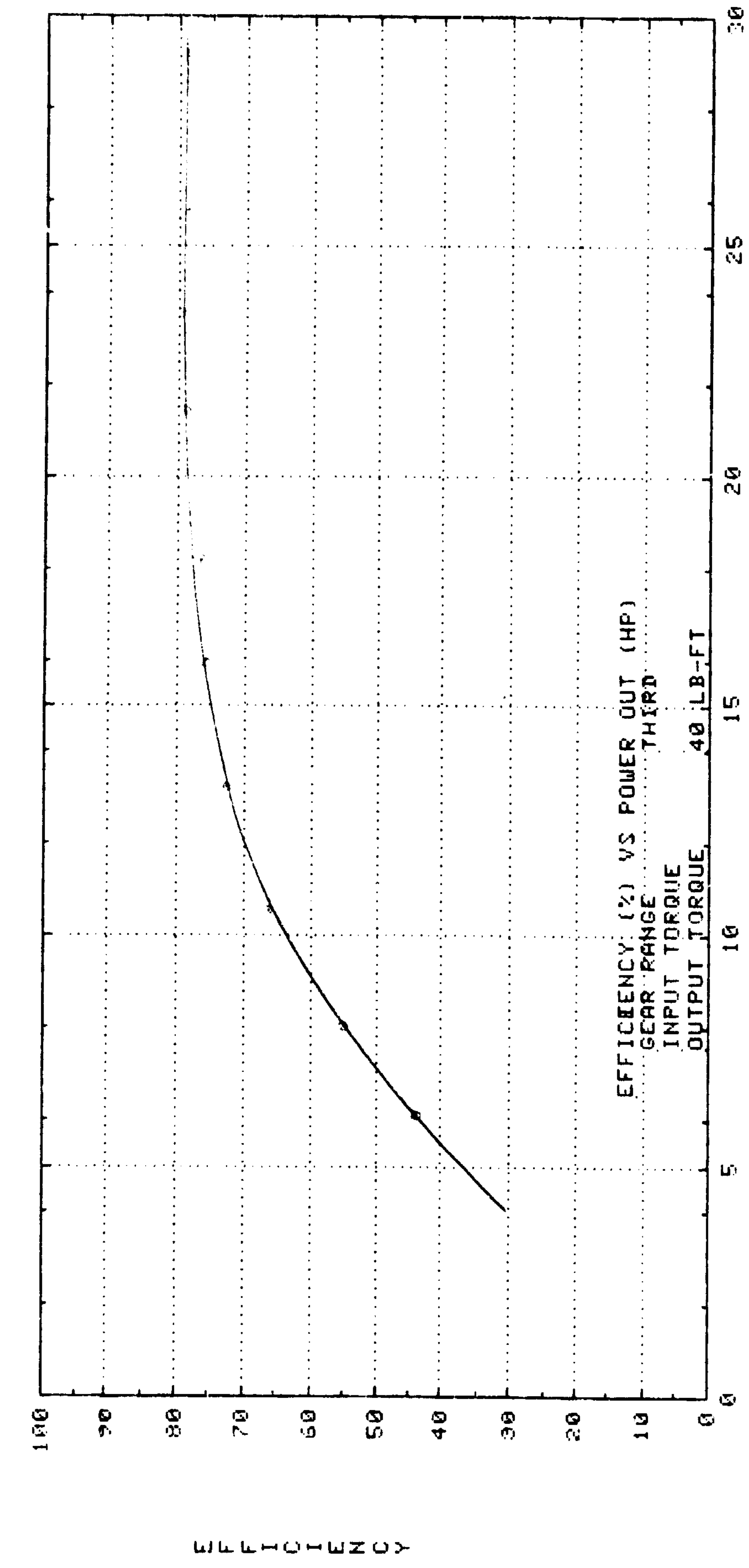


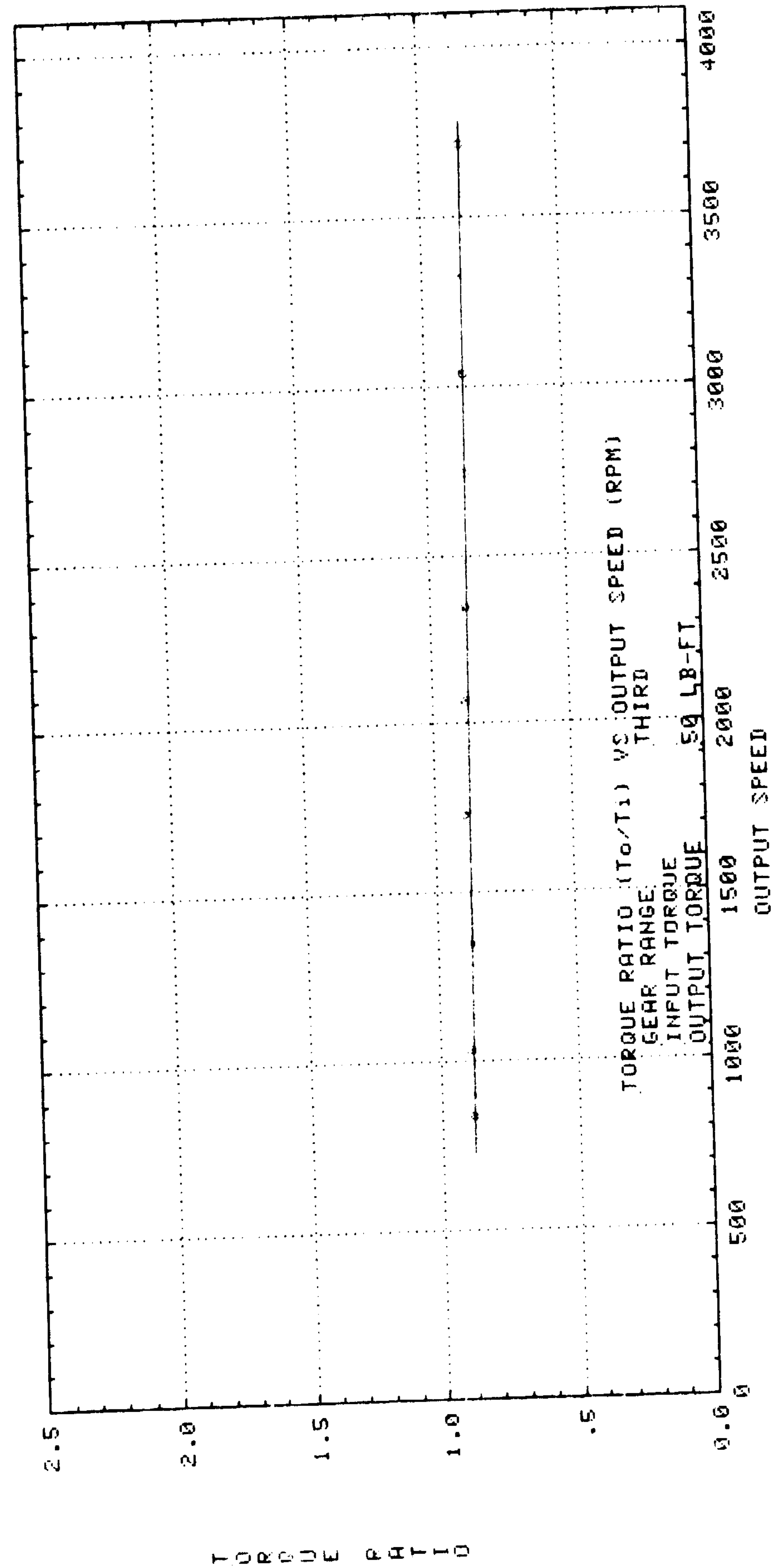
TORQUE RATIO
2.5
2.0
1.5
1.0
.5
0.0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
TOR^UE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 40 LB-FT

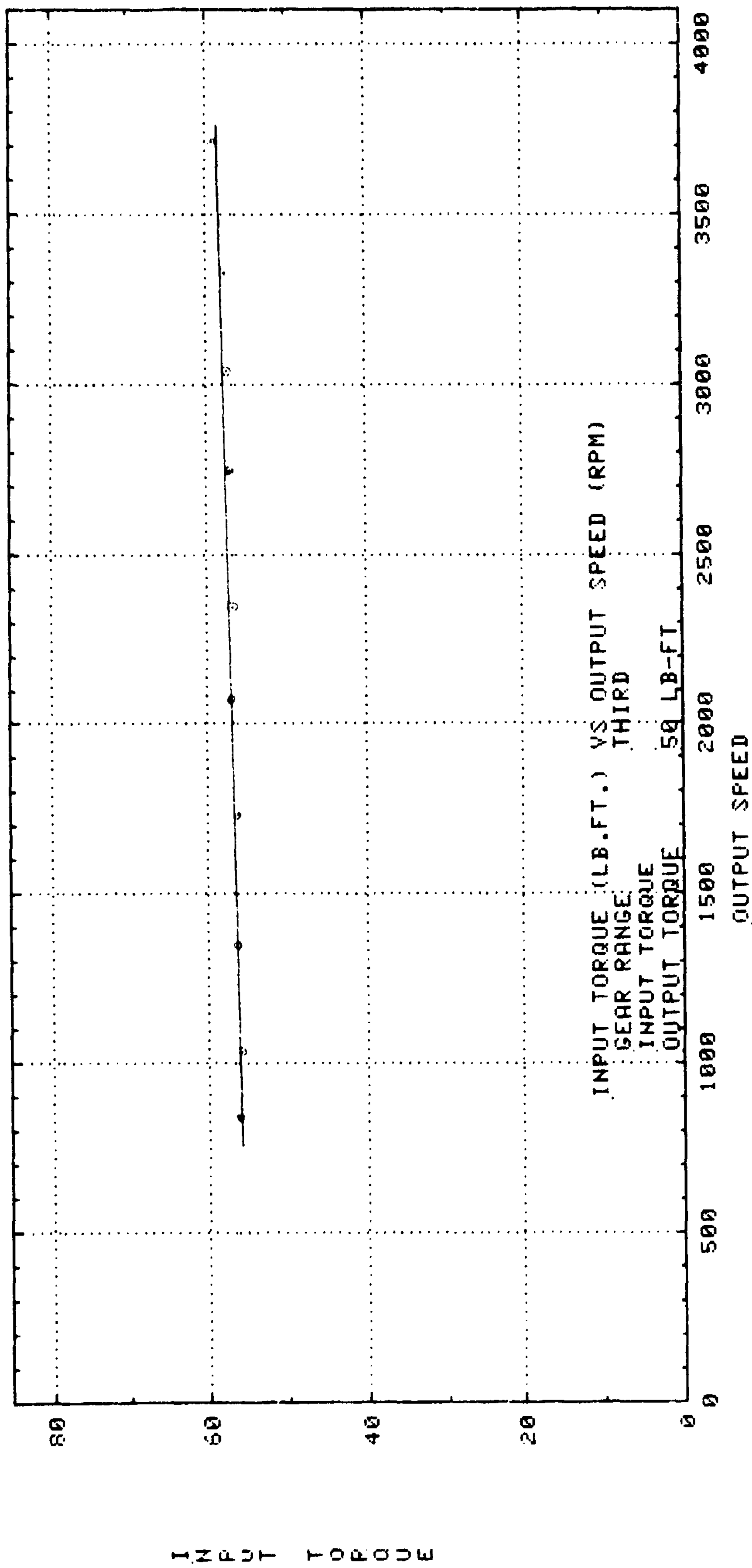

INPUT TORQUE
80
60
40
20
0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 40 LB-FT


INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 40 LB-FT
INPUT SPEED
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

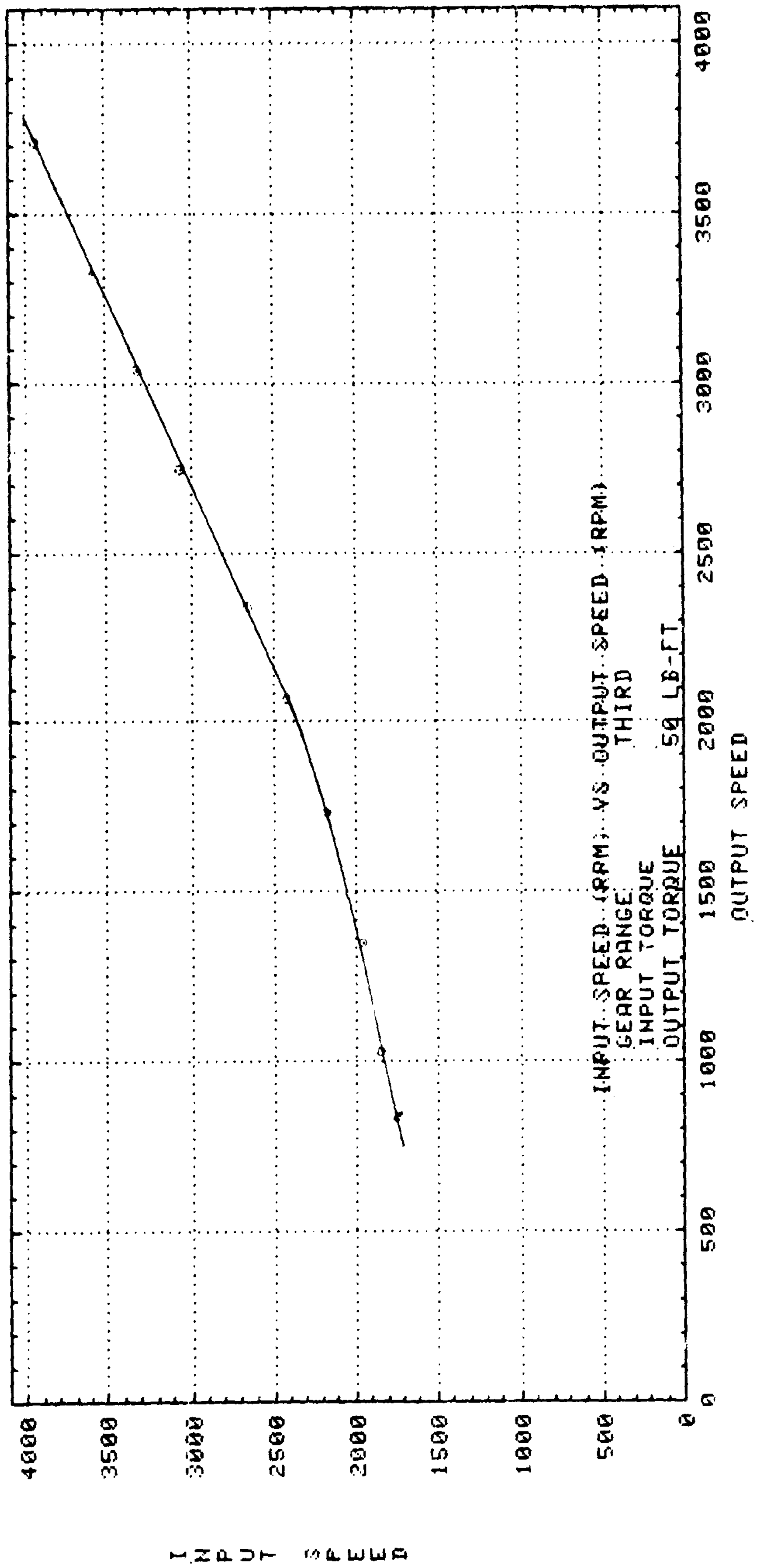

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 40 LB-FT
OUTPUT SPEED
EFFICIENCY
0
500
1000
1500
2000
2500
3000
3500
4000
0
10
20
30
40
50
60
70
80
90
100


EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 40 LB-FT
POWER OUT
EFFICIENCY
0
5
10
15
20
25
30
10
20
30
40
50
60
70
80
90
100

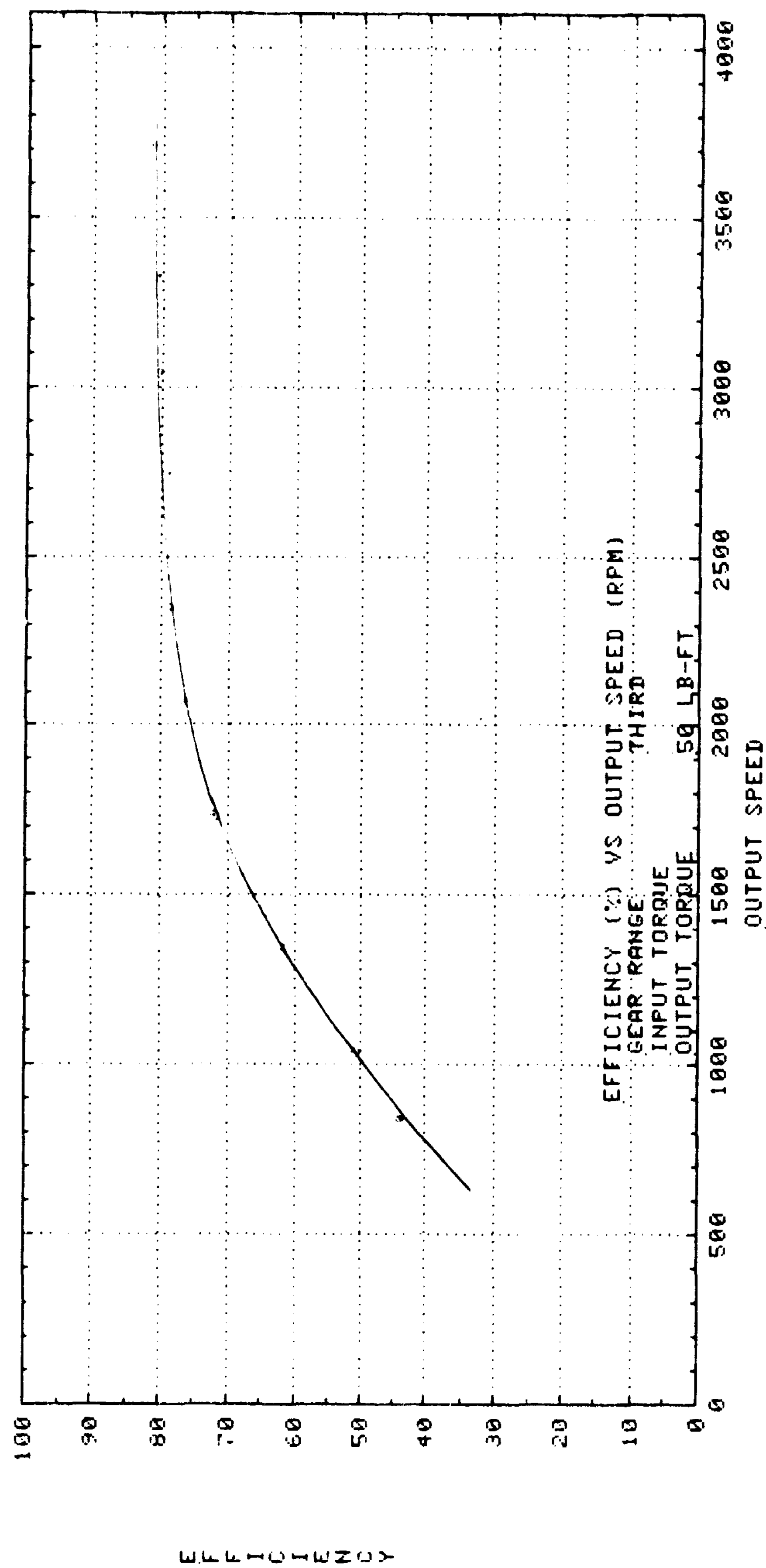

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE 50 LB-FT
OUTPUT TORQUE
OUTPUT SPEED
TORQUE RATIO
0
500
1000
1500
2000
2500
3000
3500
4000
0.0
.5
1.0
1.5
2.0
2.5

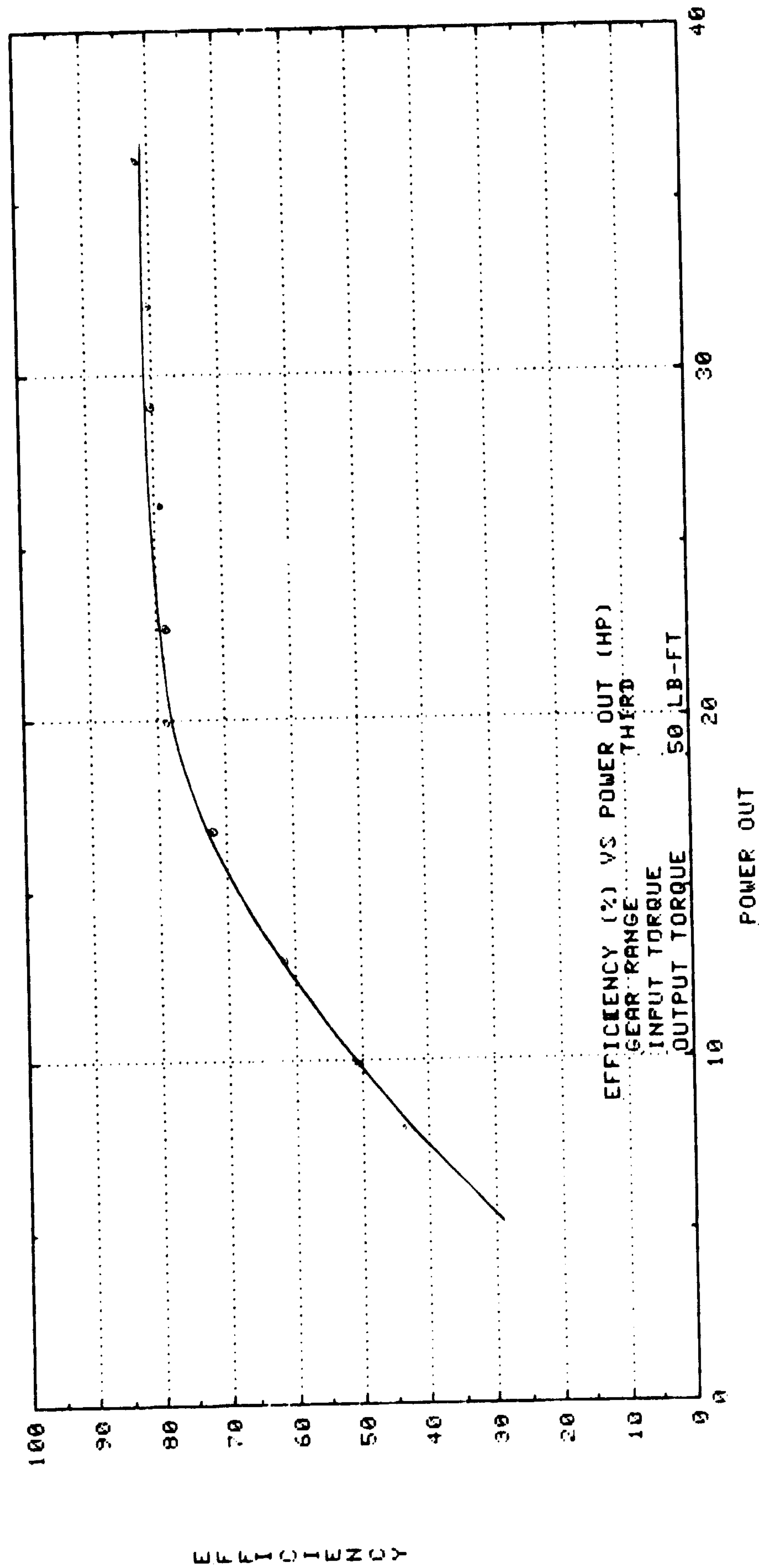


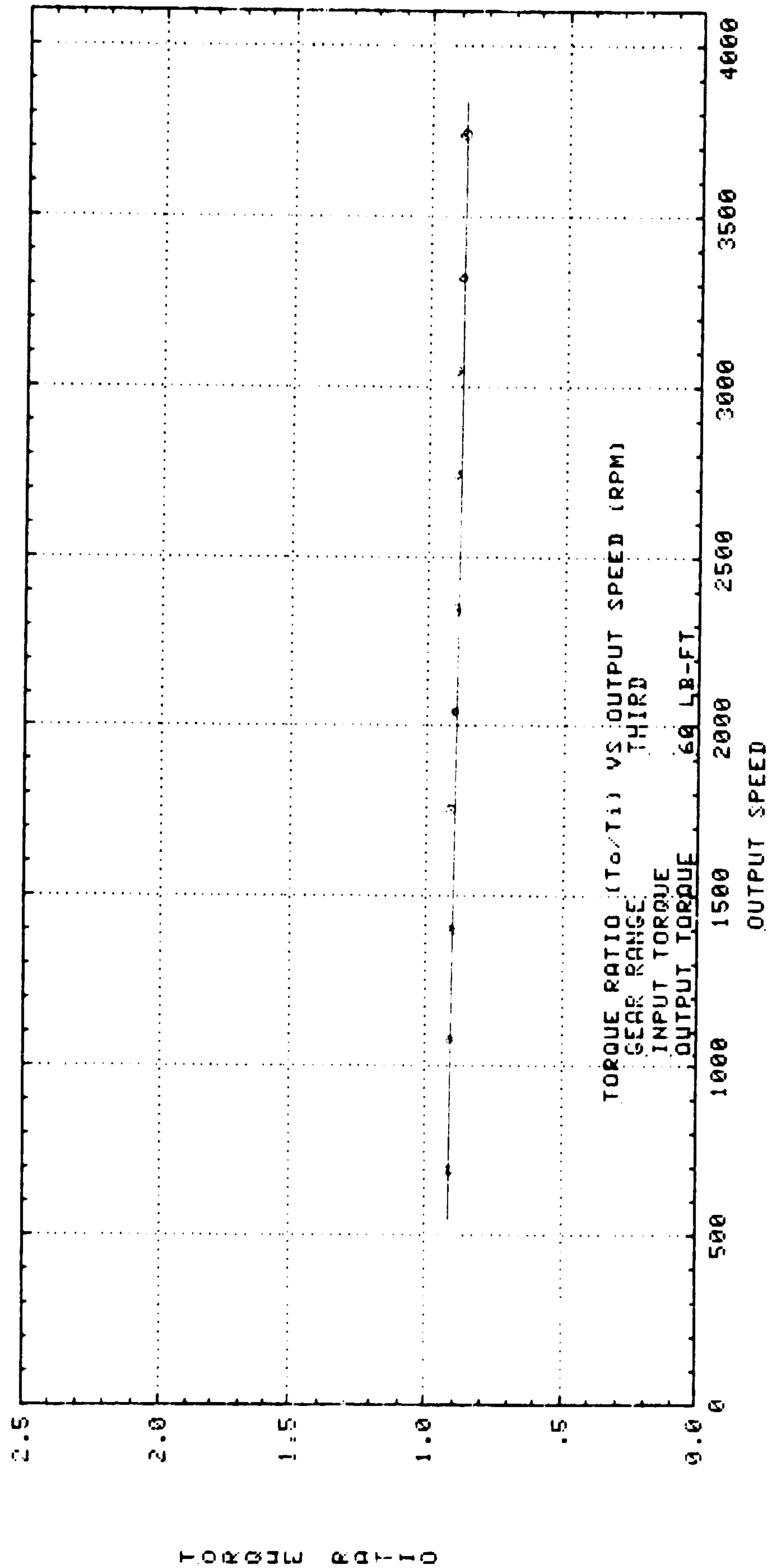
INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 50 LB-FT
OUTPUT SPEED
INPUT TORQUE
0
500
1000
1500
2000
2500
3000
3500
4000
0
20
40
60
80

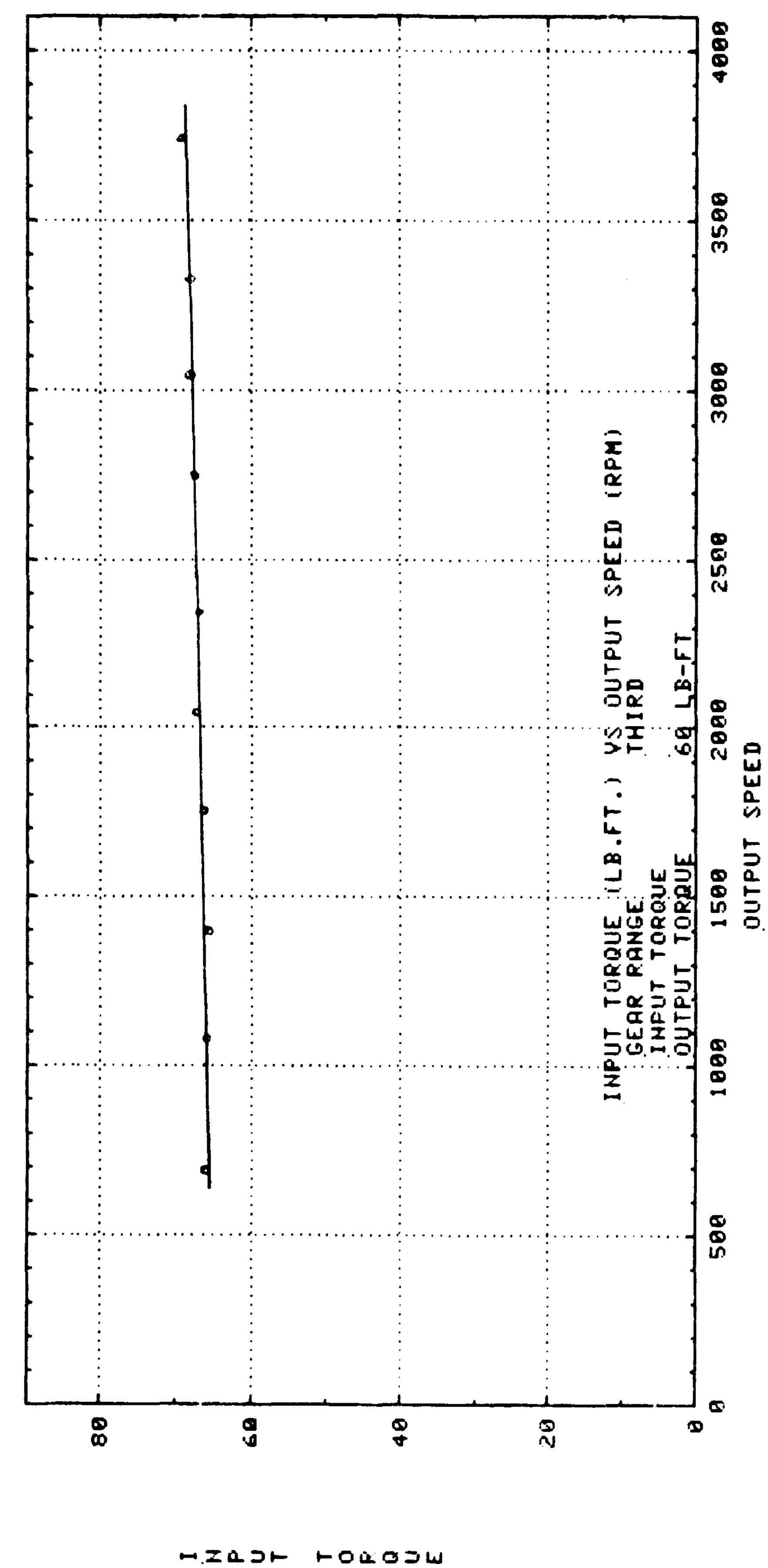


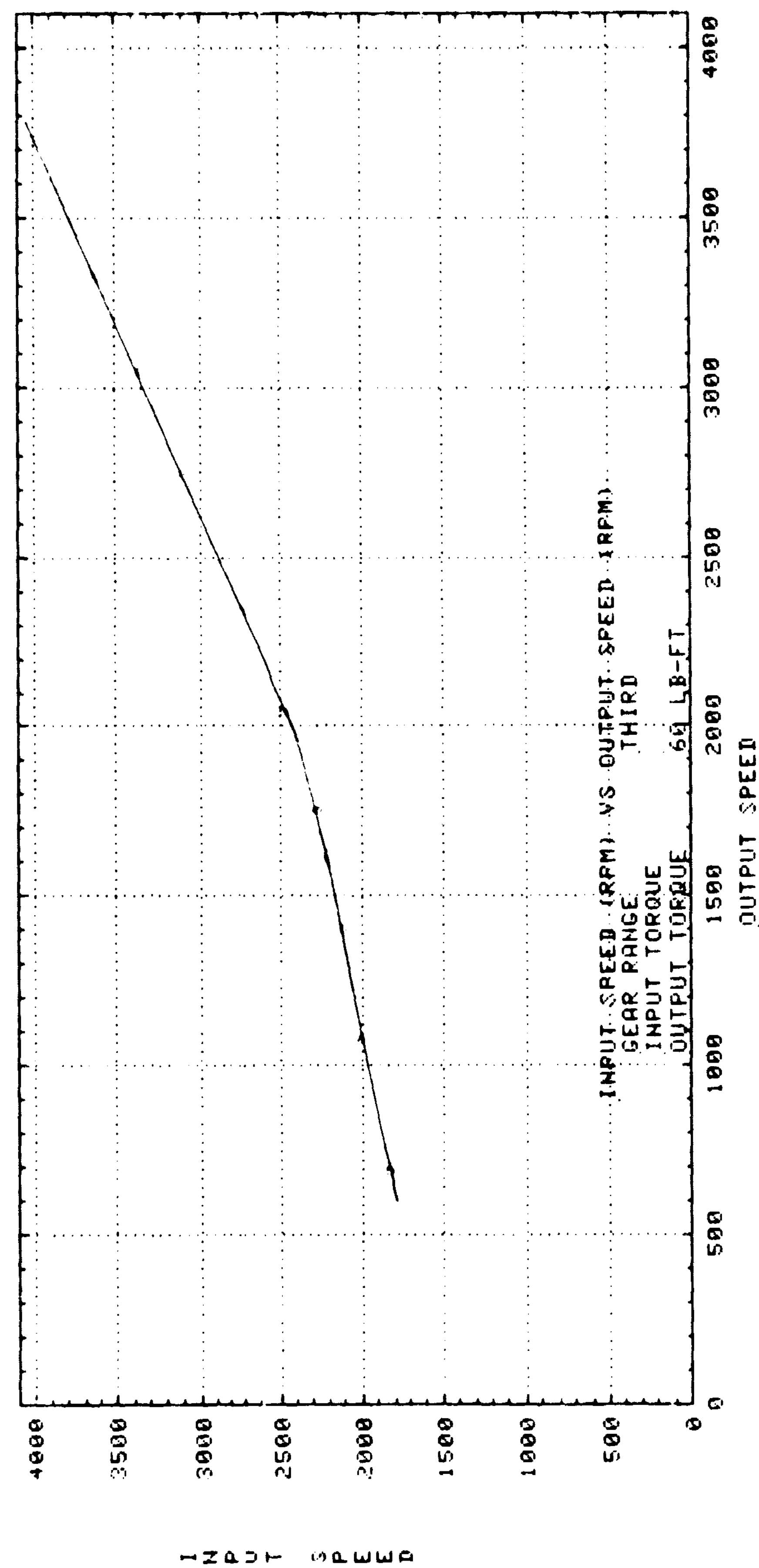
INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 50 LB-FT
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

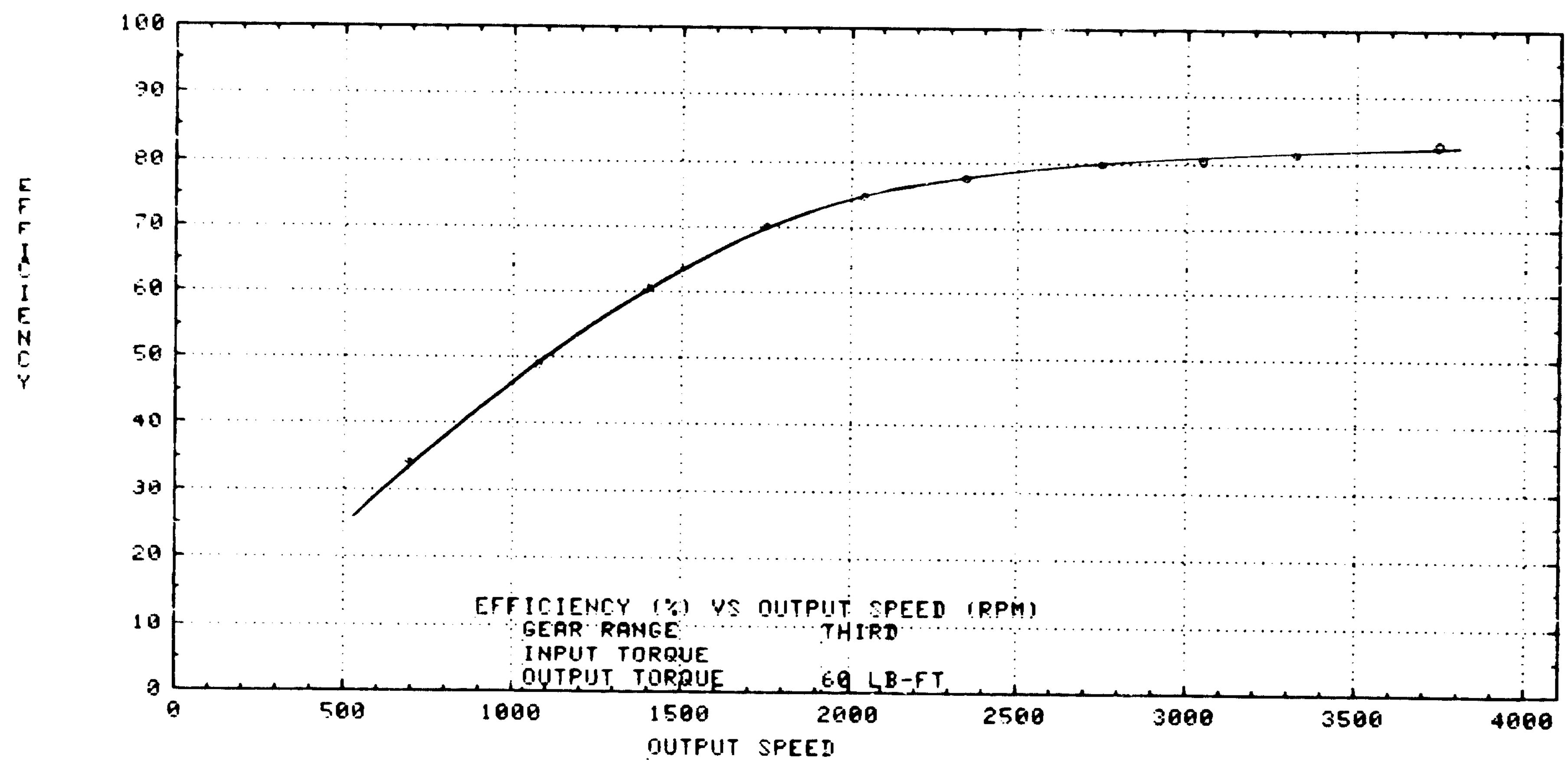

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 50 LB-FT
OUTPUT SPEED
0 500 1000 1500 2000 2500 3000 3500 4000
0 10 20 30 40 50 60 70 80 90 100
EFFICIENCY

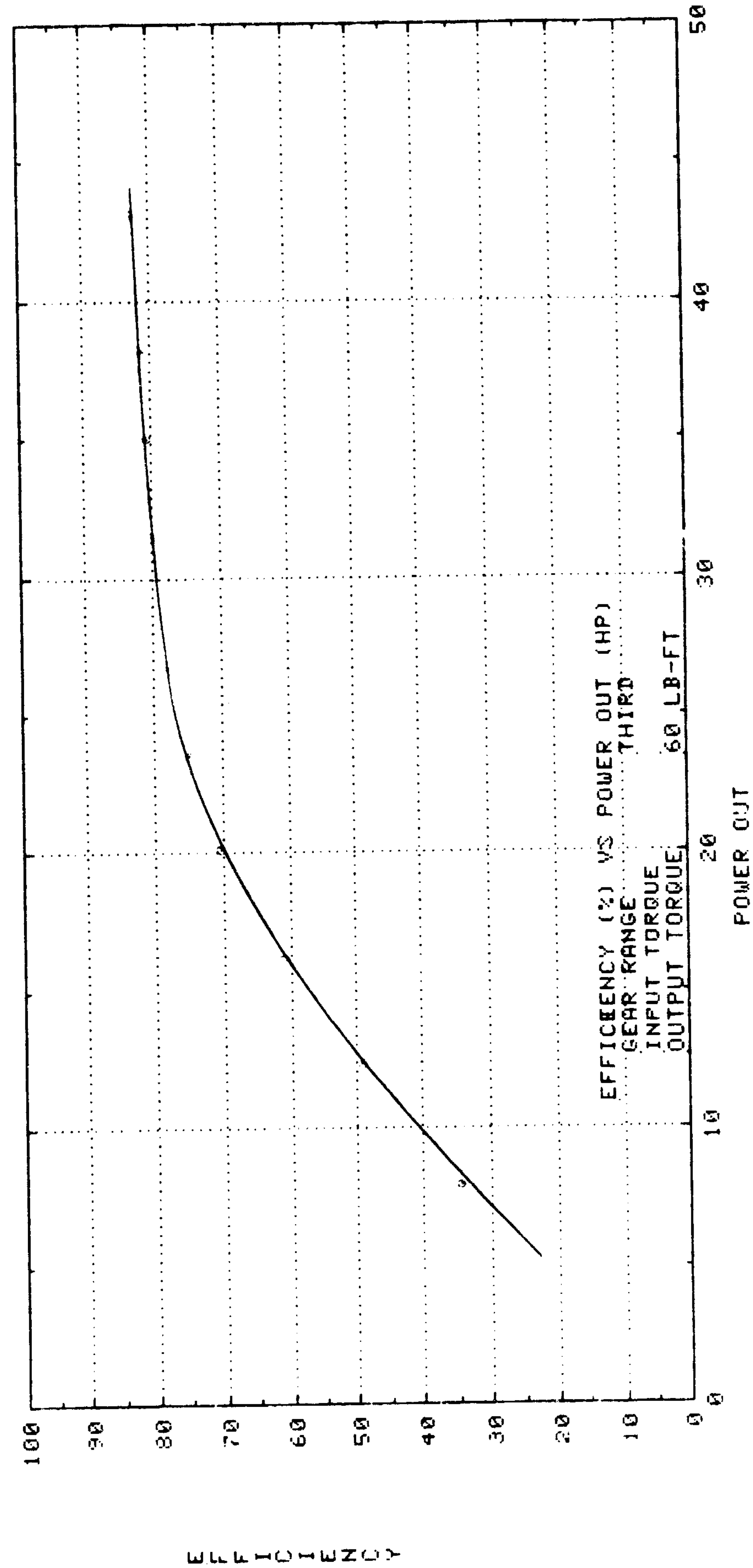

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 50 LB-FT
POWER OUT
EFFICIENCY
0
10
20
30
40
50
60
70
80
90
100
0
10
20
30
40

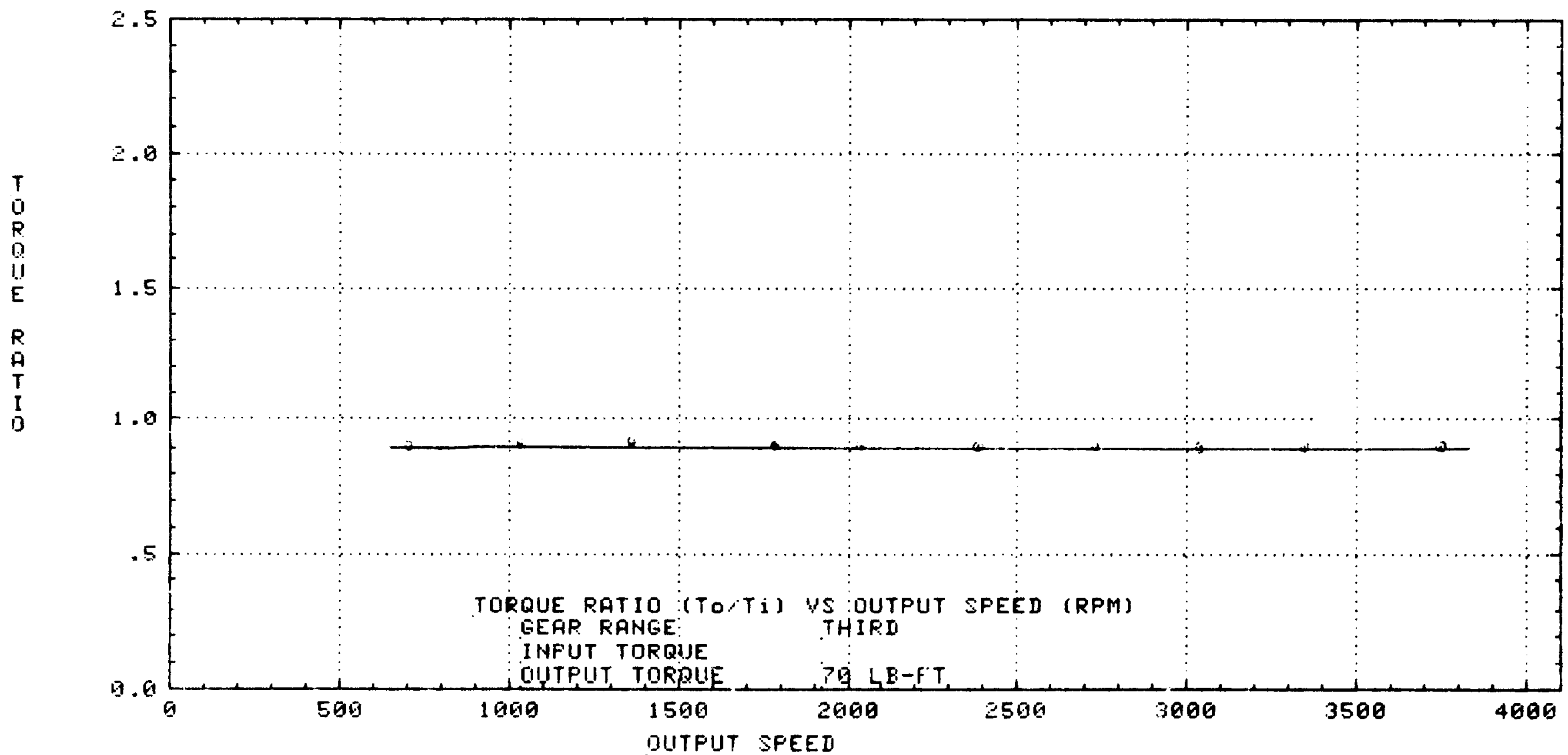

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE
THIRD
INPUT TORQUE
OUTPUT TORQUE
60 LB-FT
OUTPUT SPEED
TORQUE RATIO
0
500
1000
1500
2000
2500
3000
3500
4000
0.0
.5
1.0
1.5
2.0
2.5

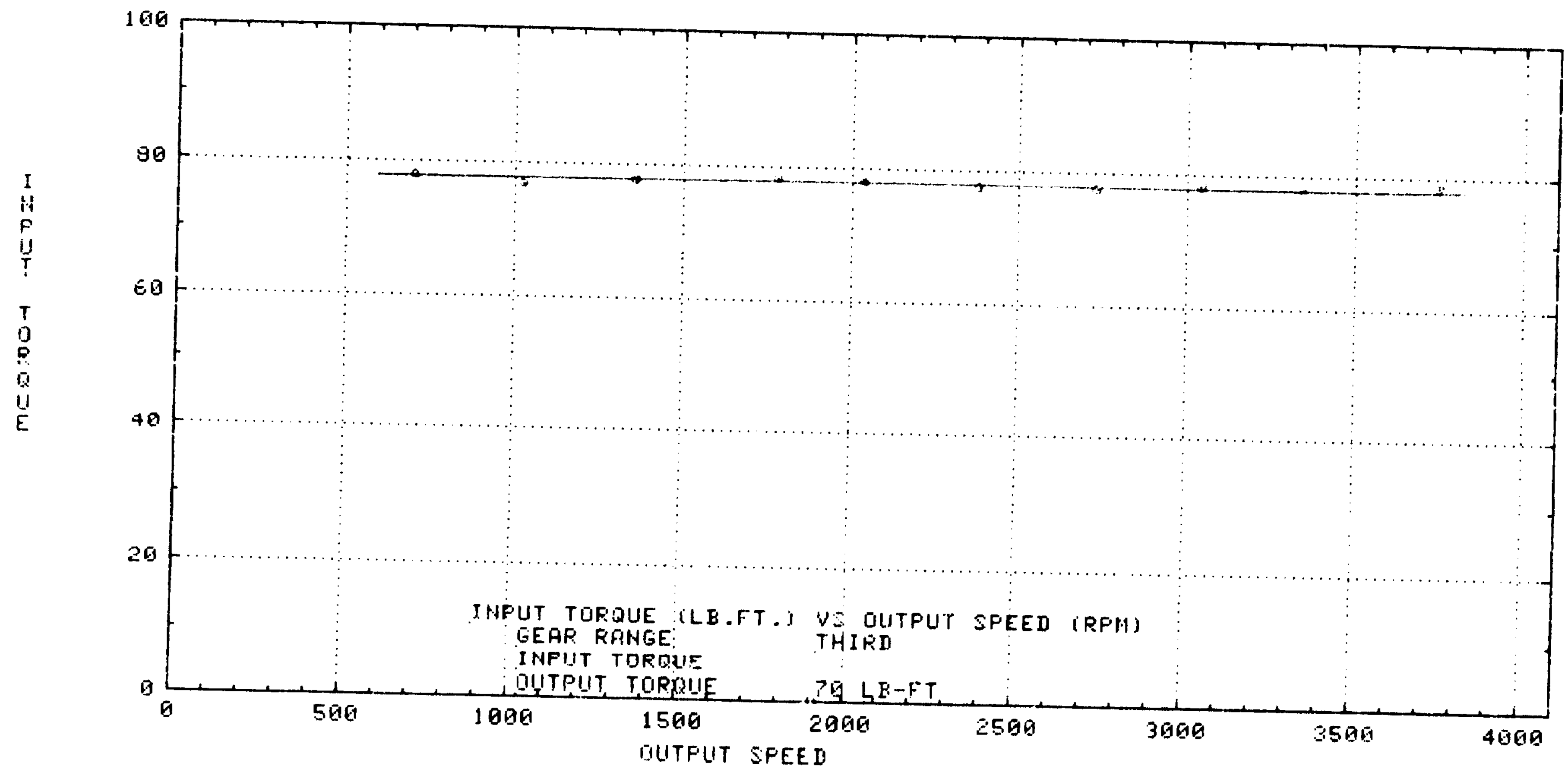

INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 60 LB-FT
OUTPUT SPEED
INPUT TORQUE
0
500
1000
1500
2000
2500
3000
3500
4000
0
20
40
60
80

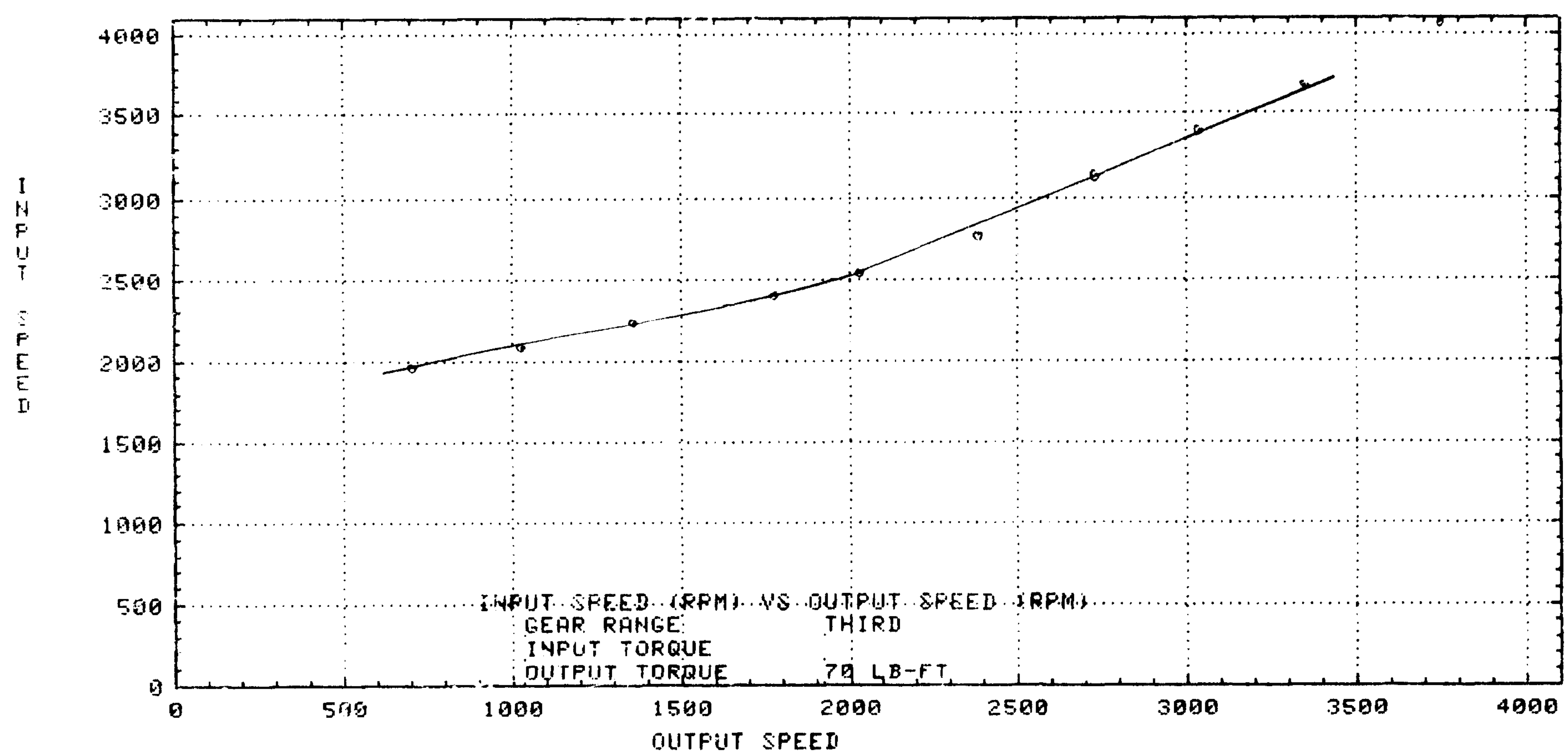

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 60 LB-FT
OUTPUT SPEED
INPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

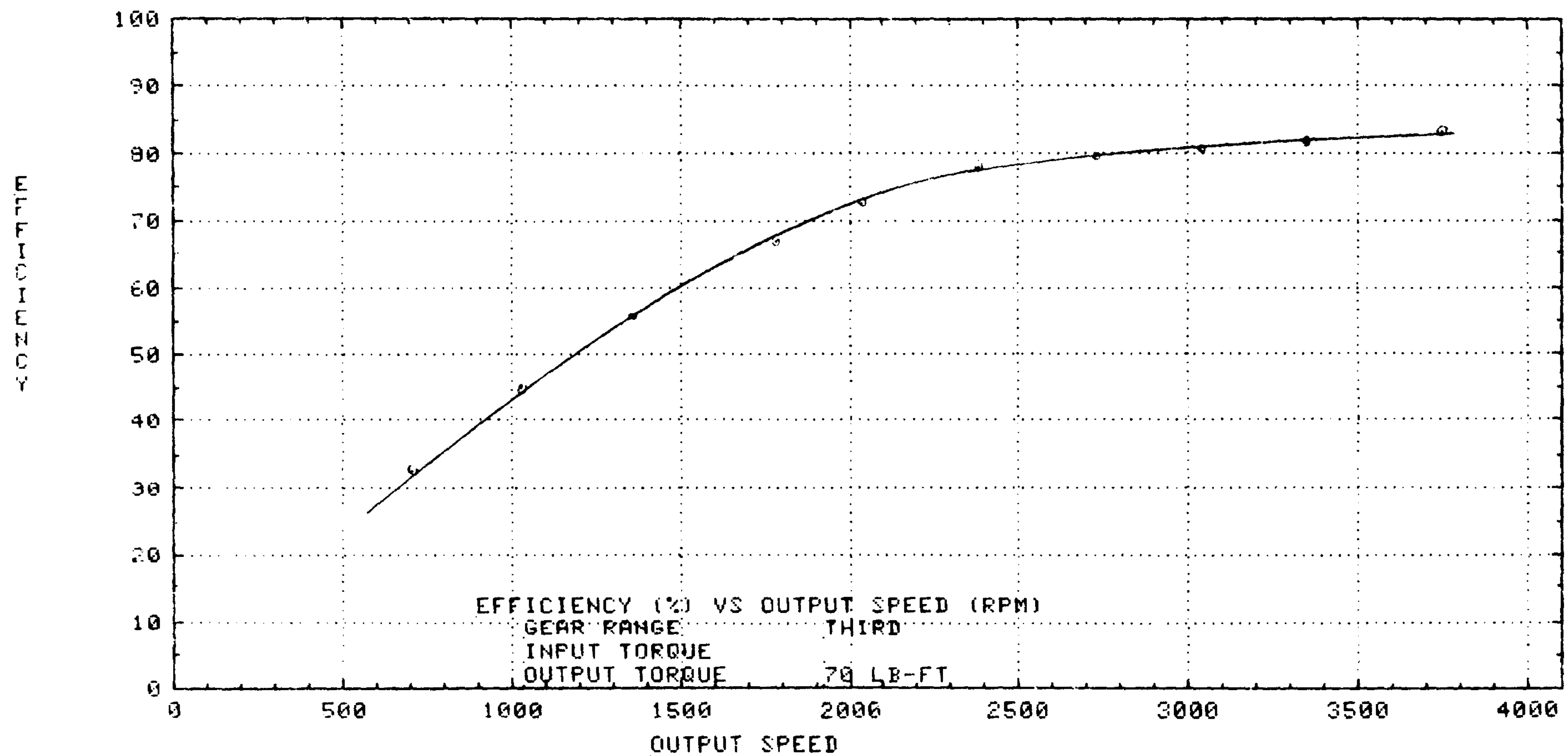

EFFICIENCY
100
90
80
70
60
50
40
30
20
10
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 60 LB-FT


EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 60 LB-FT
POWER OUT
EFFICIENCY
0
10
20
30
40
50
60
70
80
90
100

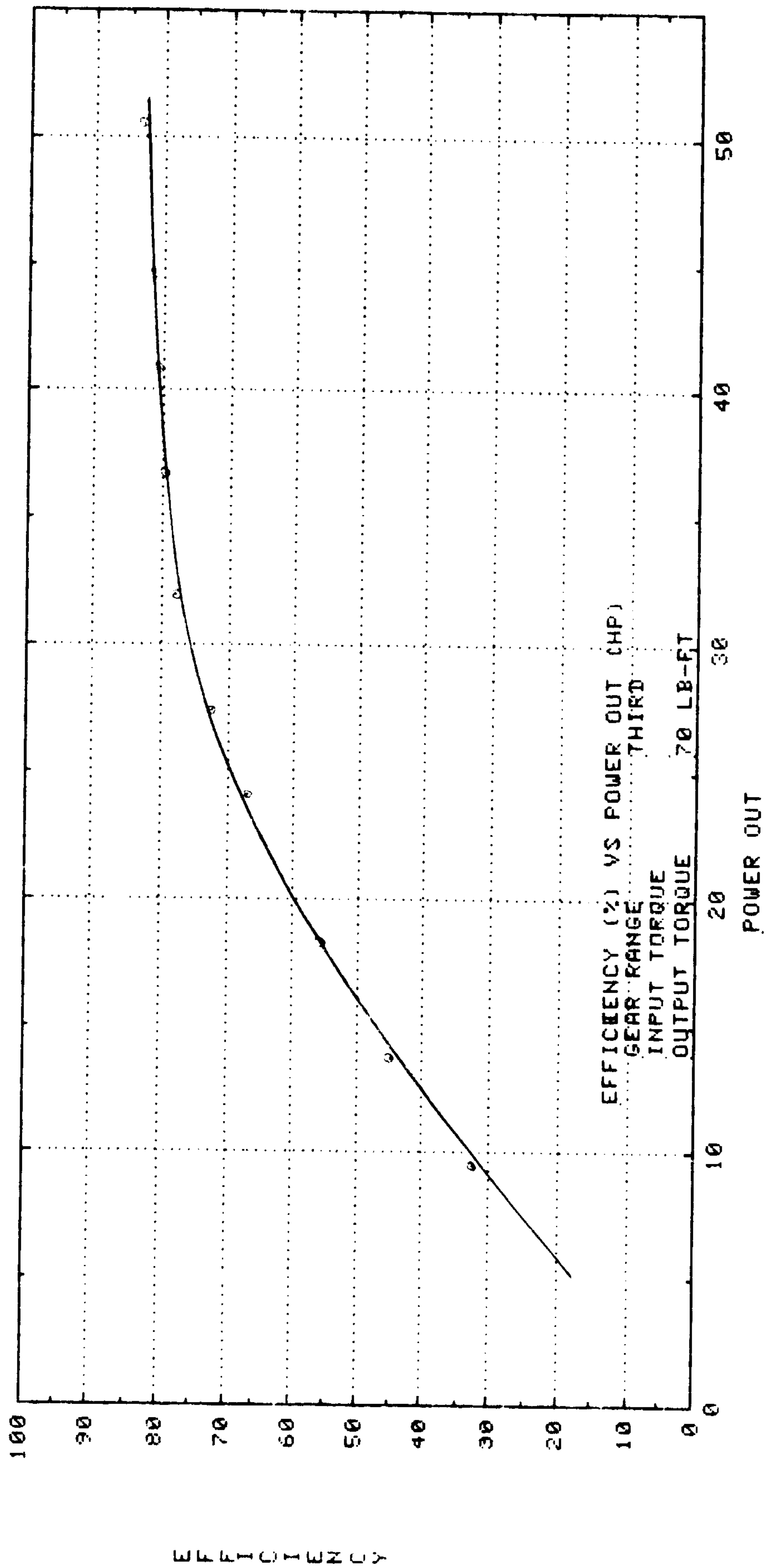

TORQUE RATIO
TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 70 LB-FT
2.5
2.0
1.5
1.0
.5
0.0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED

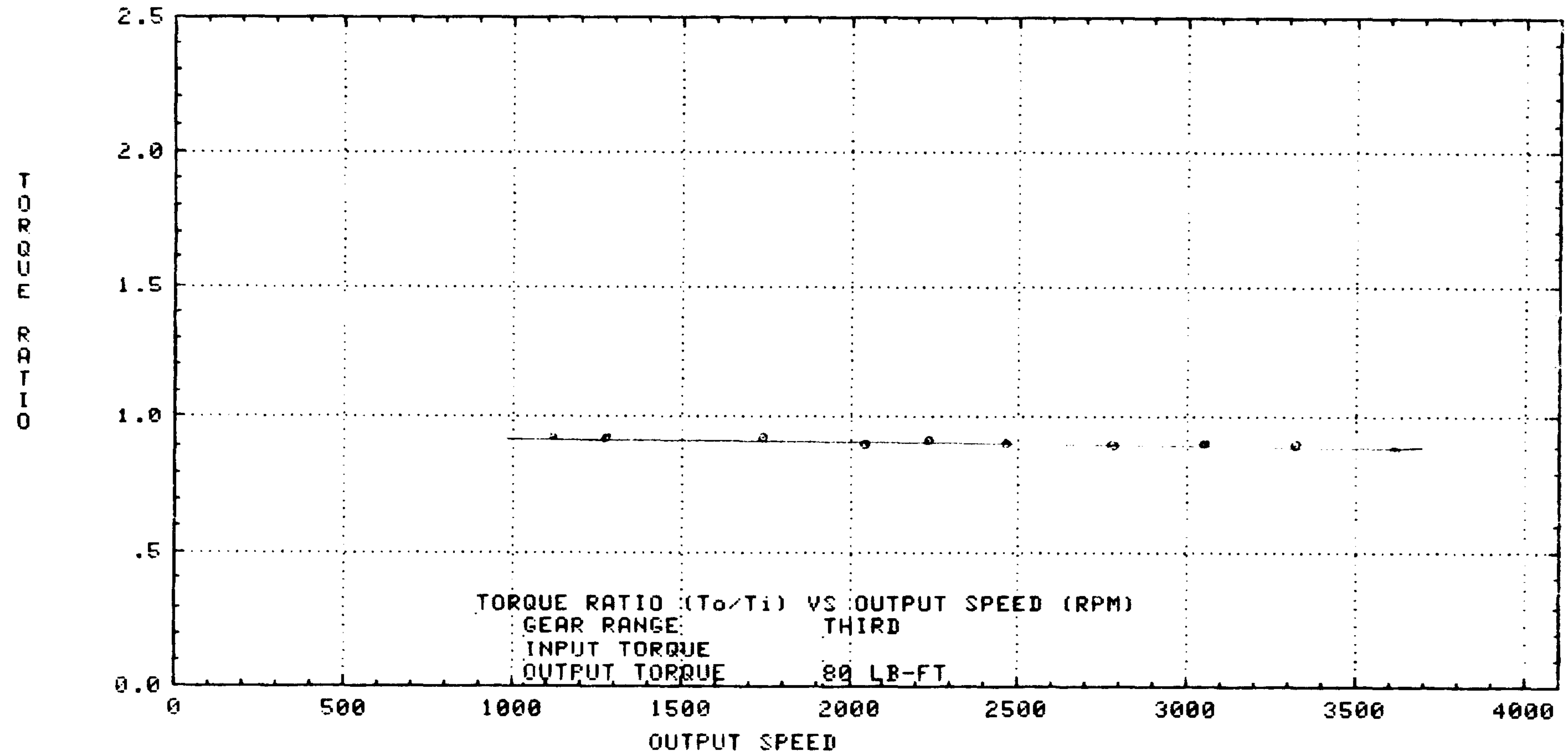

INPUT TORQUE
0
20
40
60
80
100
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 70 LB-FT

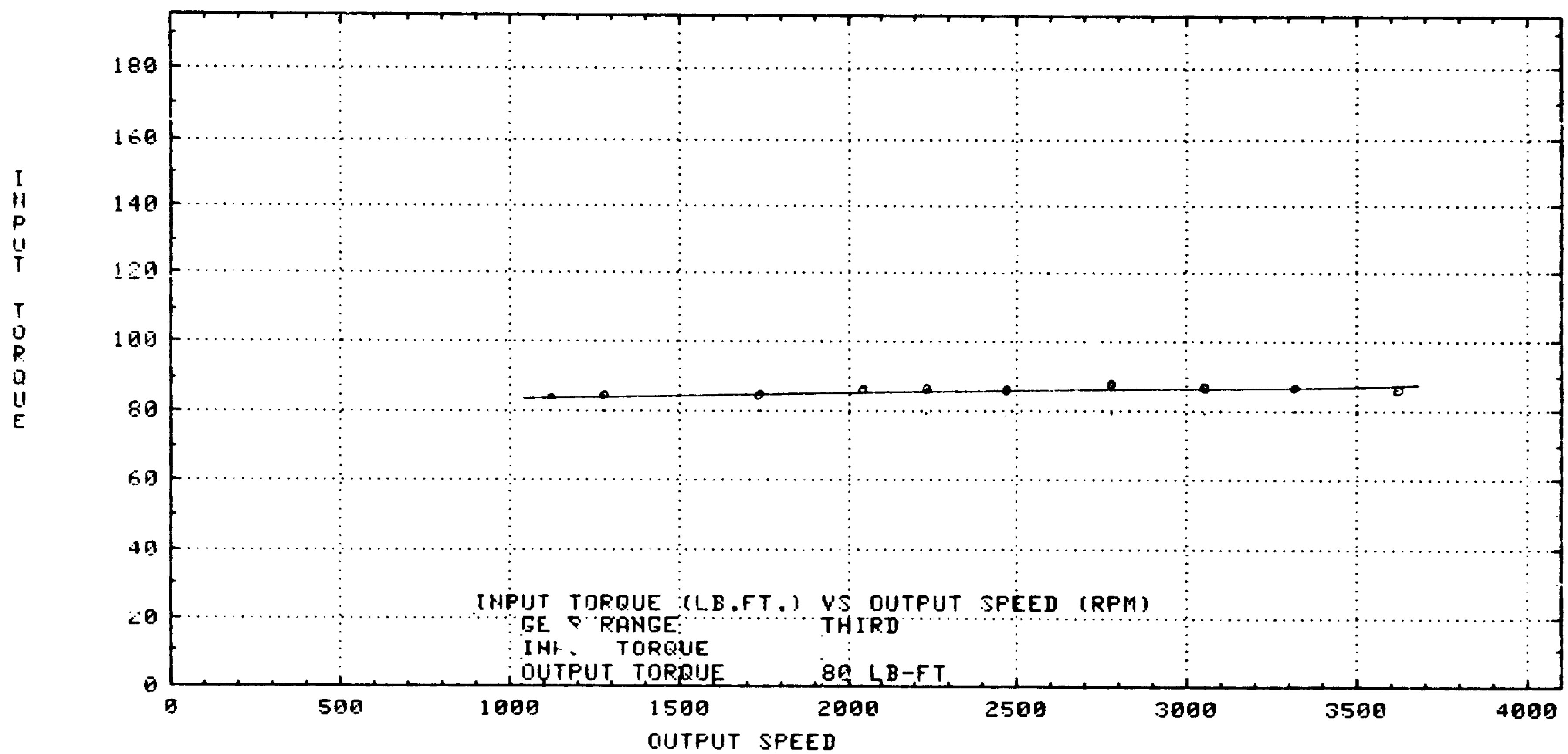

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 70 LB-FT
INPUT SPEED
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000



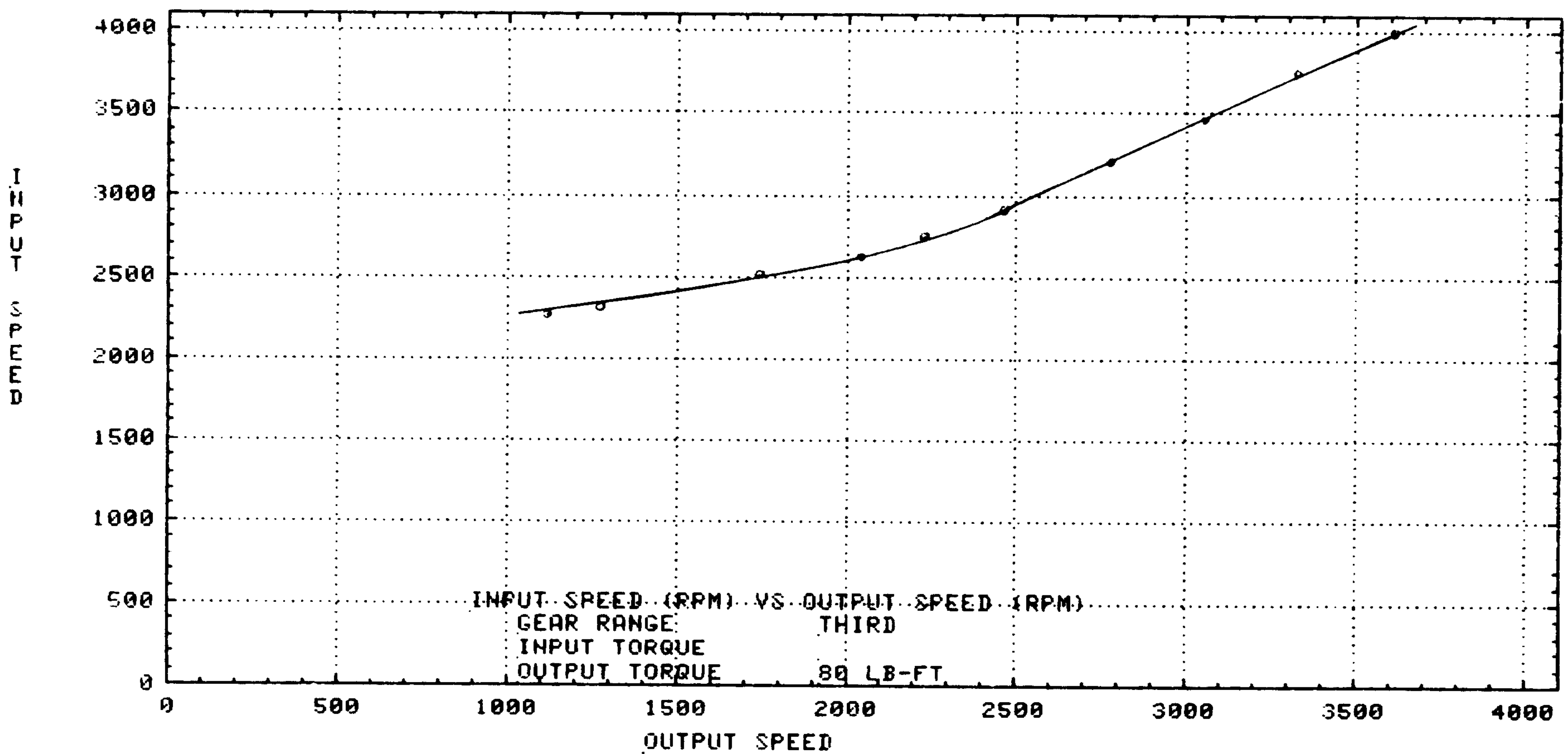
EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 70 LB-FT
EFFICIENCY
OUTPUT SPEED
0
10
20
30
40
50
60
70
80
90
100
500
1000
1500
2000
2500
3000
3500
4000

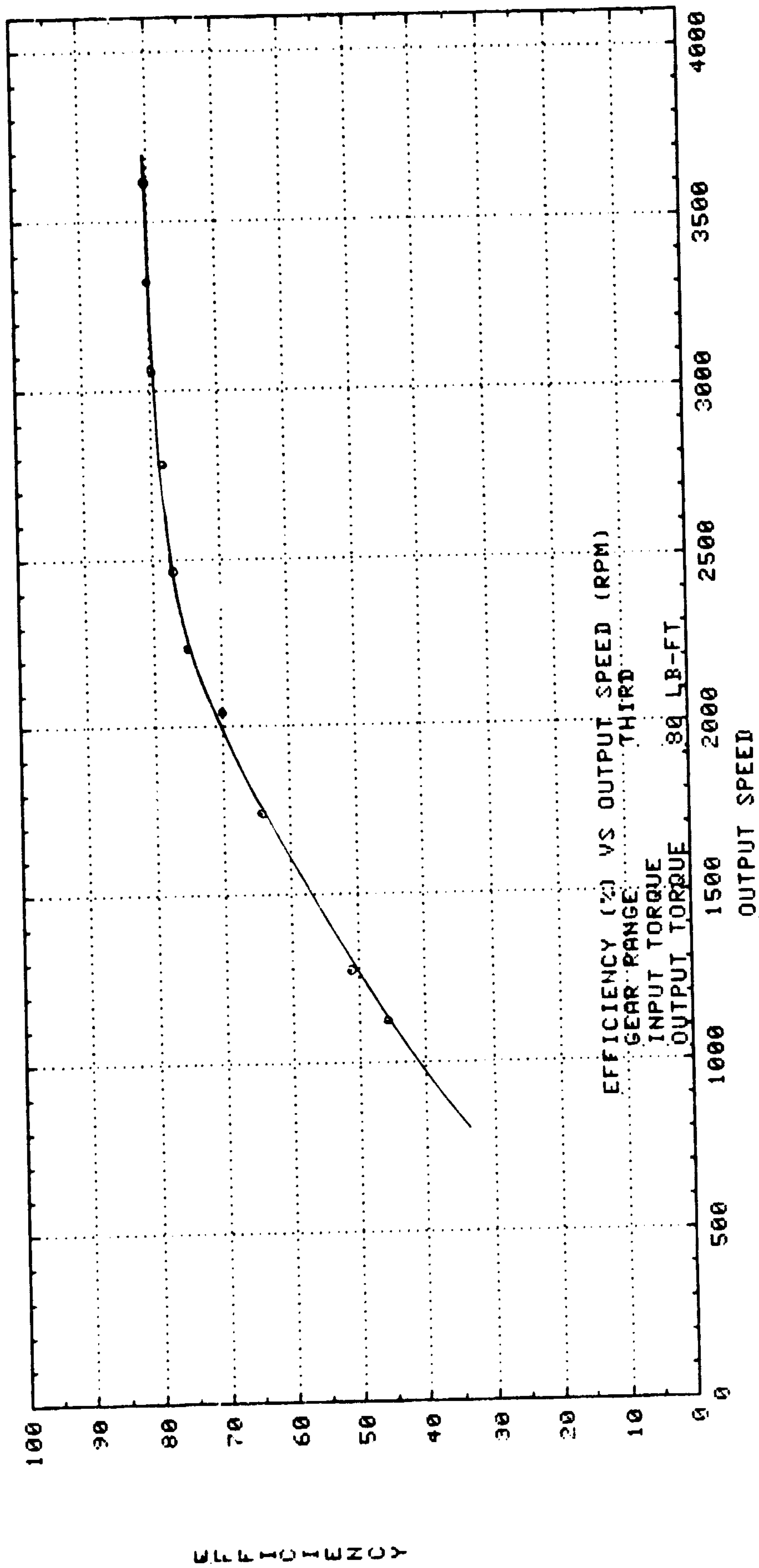

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 70 LB-FT
POWER OUT
EFFICIENCY
0
10
20
30
40
50
60
70
80
90
100

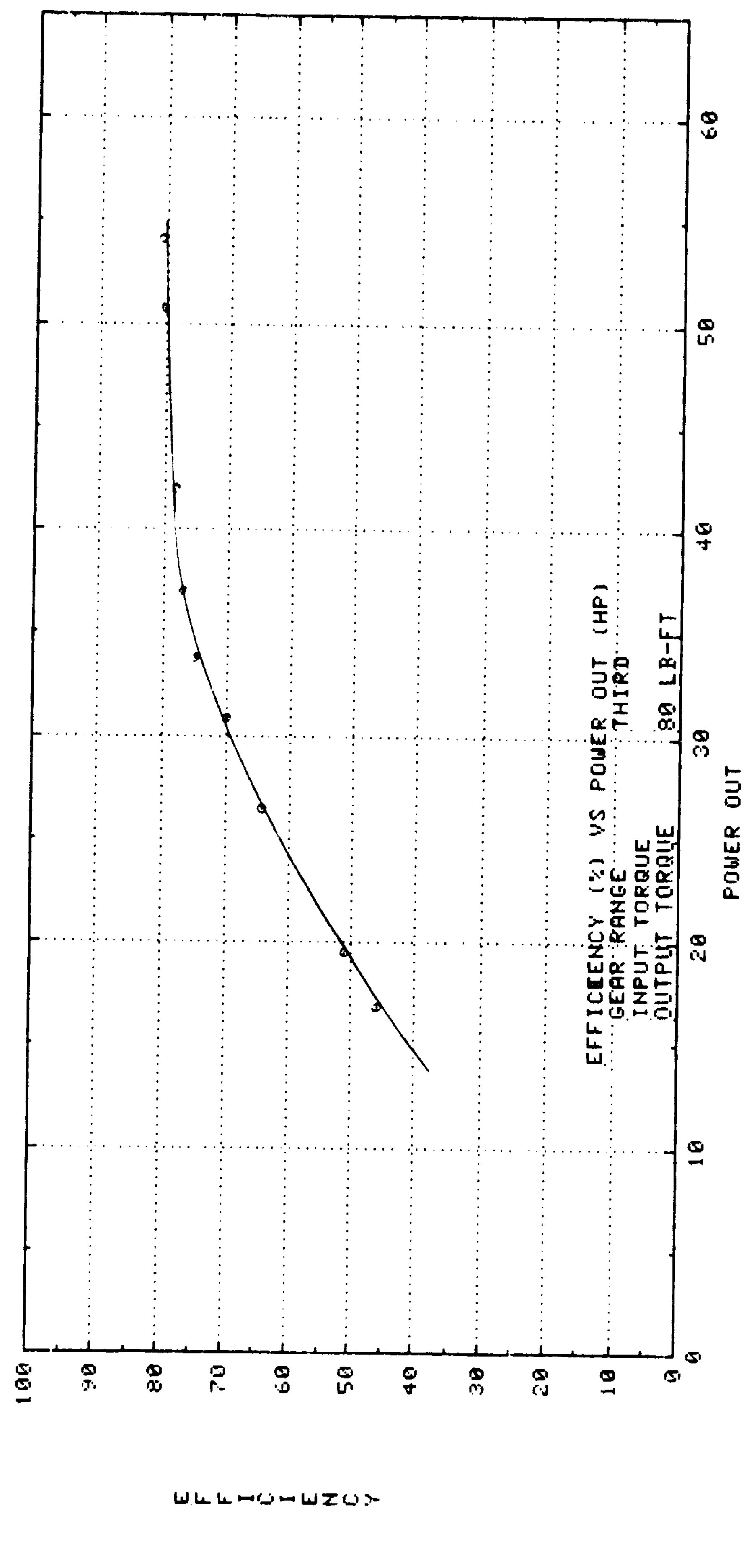

TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 80 LB-FT
TORQUE RATIO
OUTPUT SPEED
2.5
2.0
1.5
1.0
.5
0.0
0
500
1000
1500
2000
2500
3000
3500
4000

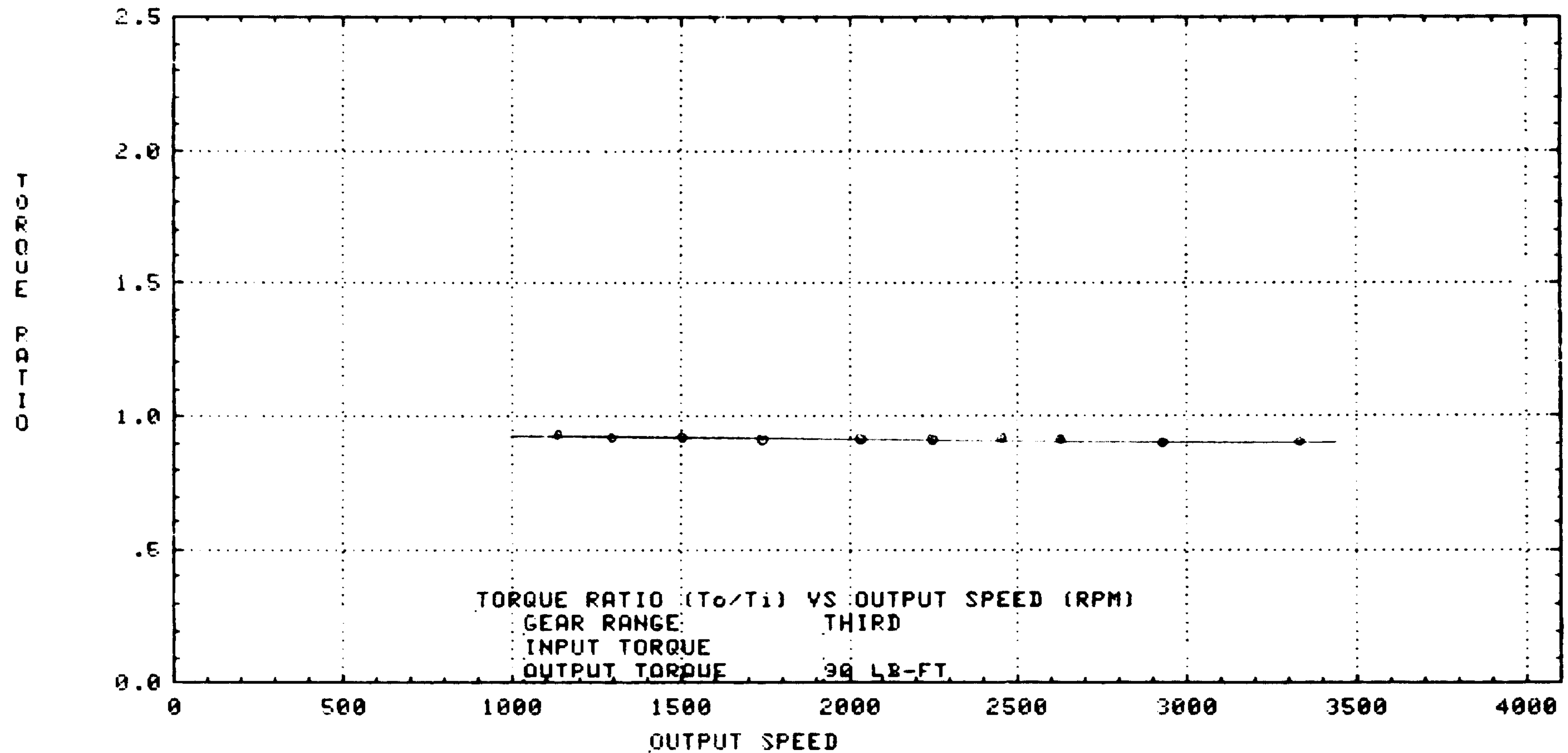


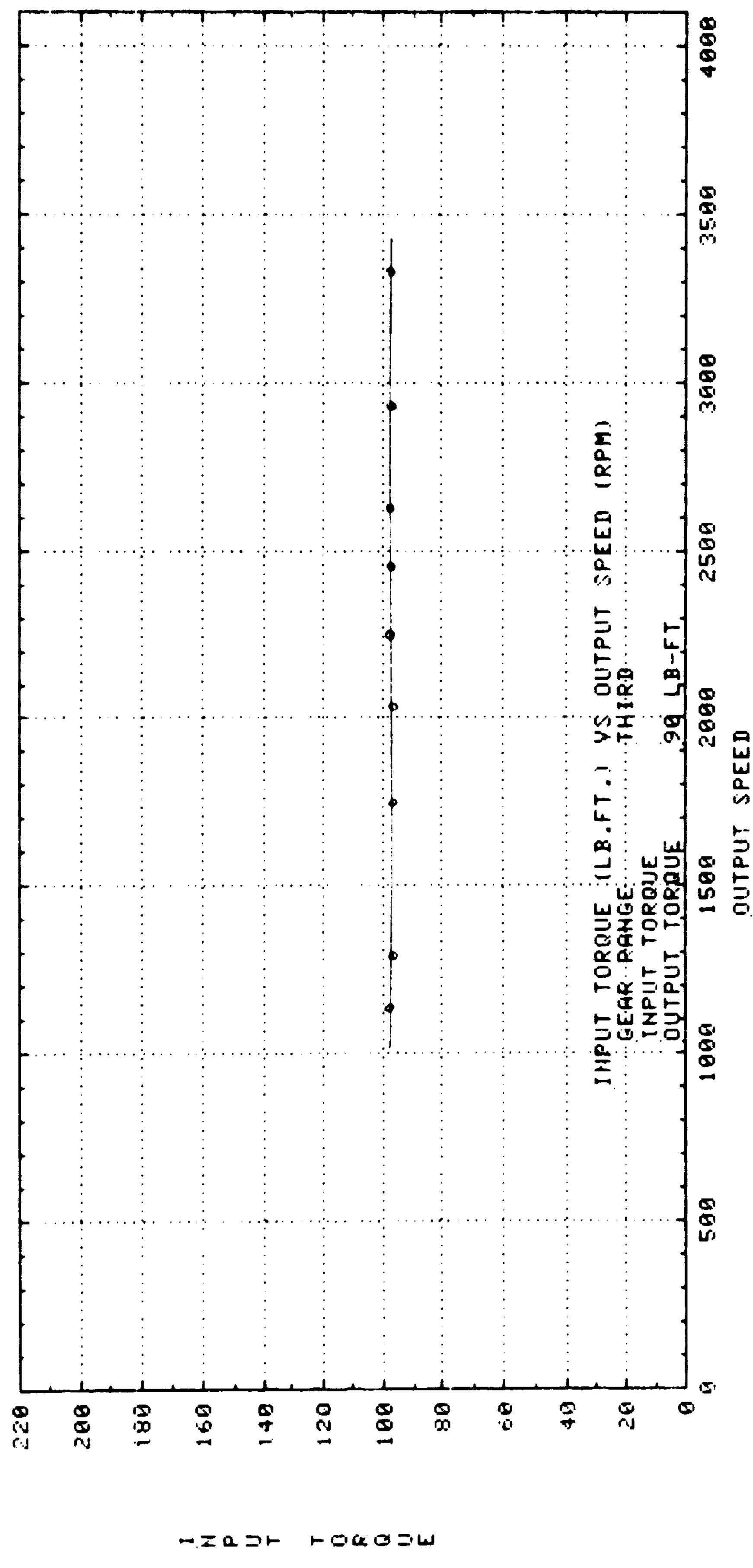
INPUT TORQUE
180
160
140
120
100
80
60
40
20
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 80 LB-FT

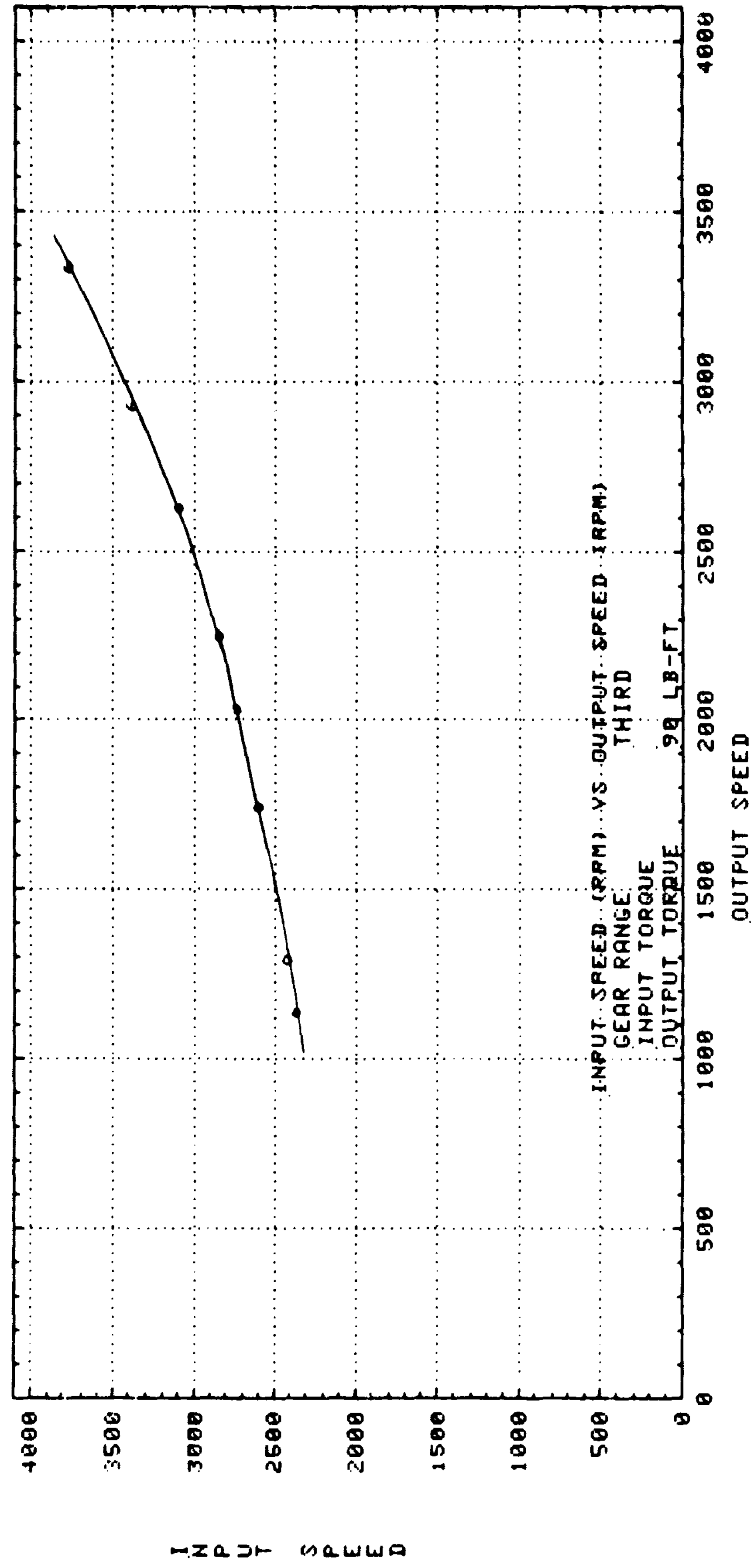

INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 80 LB-FT
INPUT SPEED
OUTPUT SPEED
0
500
1000
1500
2000
2500
3000
3500
4000

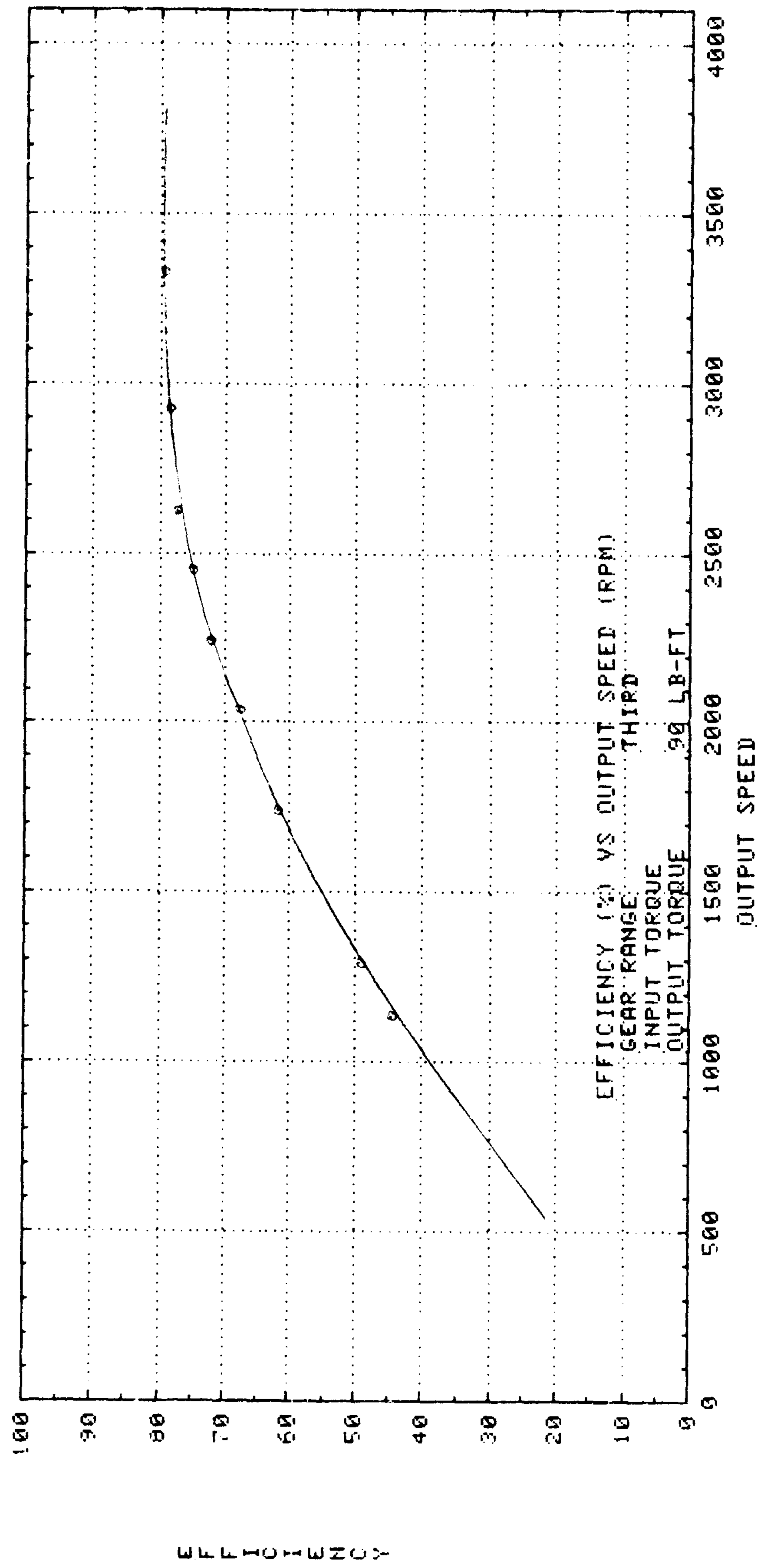

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 80 LB-FT
OUTPUT SPEED
EFFICIENCY

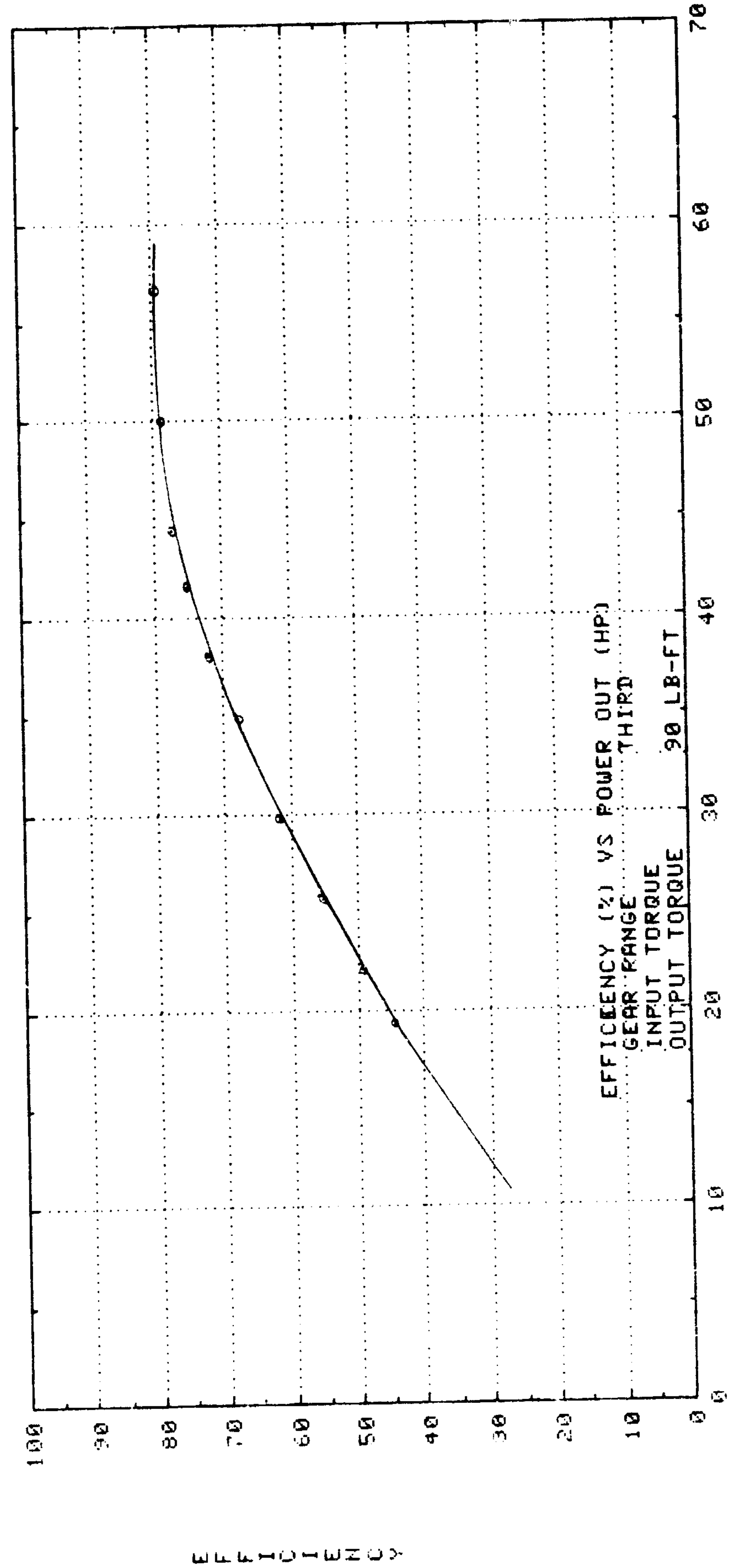

EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 80 LB-FT
POWER OUT
EFFICIENCY
0 10 20 30 40 50 60
0 10 20 30 40 50 60 70 80 90 100


TORQUE RATIO
2.5
2.0
1.5
1.0
.5
0.0
0
500
1000
1500
2000
2500
3000
3500
4000
OUTPUT SPEED
TORQUE RATIO (To/Ti) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 90 LB-FT


INPUT TORQUE (LB.FT.) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 90 LB-FT
OUTPUT SPEED
INPUT TORQUE
0
500
1000
1500
2000
2500
3000
3500
4000
0
20
40
60
80
100
120
140
160
180
200
220


INPUT SPEED (RPM) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 90 LB-FT
OUTPUT SPEED
INPUT SPEED
0 500 1000 1500 2000 2500 3000 3500 4000

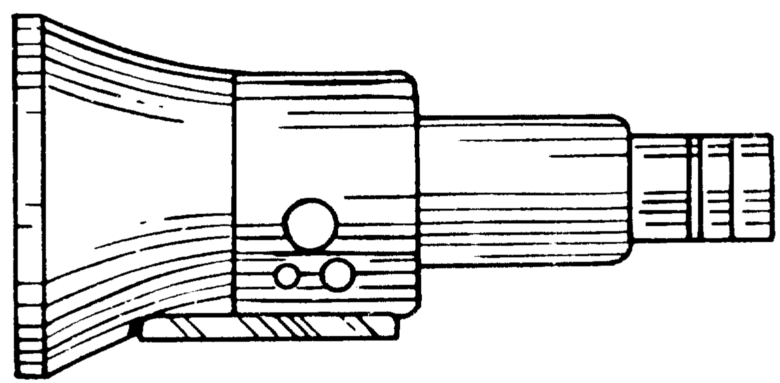

EFFICIENCY (%) VS OUTPUT SPEED (RPM)
GEAR RANGE THIRD
INPUT TORQUE
OUTPUT TORQUE 90 LB-FT
OUTPUT SPEED
EFFICIENCY
0
500
1000
1500
2000
2500
3000
3500
4000
0
10
20
30
40
50
60
70
80
90
100



EFFICIENCY (%) VS POWER OUT (HP)
GEAR RANGE THIRD
INPUT TORQUE 90 LB-FT
OUTPUT TORQUE
POWER OUT
EFFICIENCY

Graphs Contained in This Section

Torque Loss -vs- Input Speed



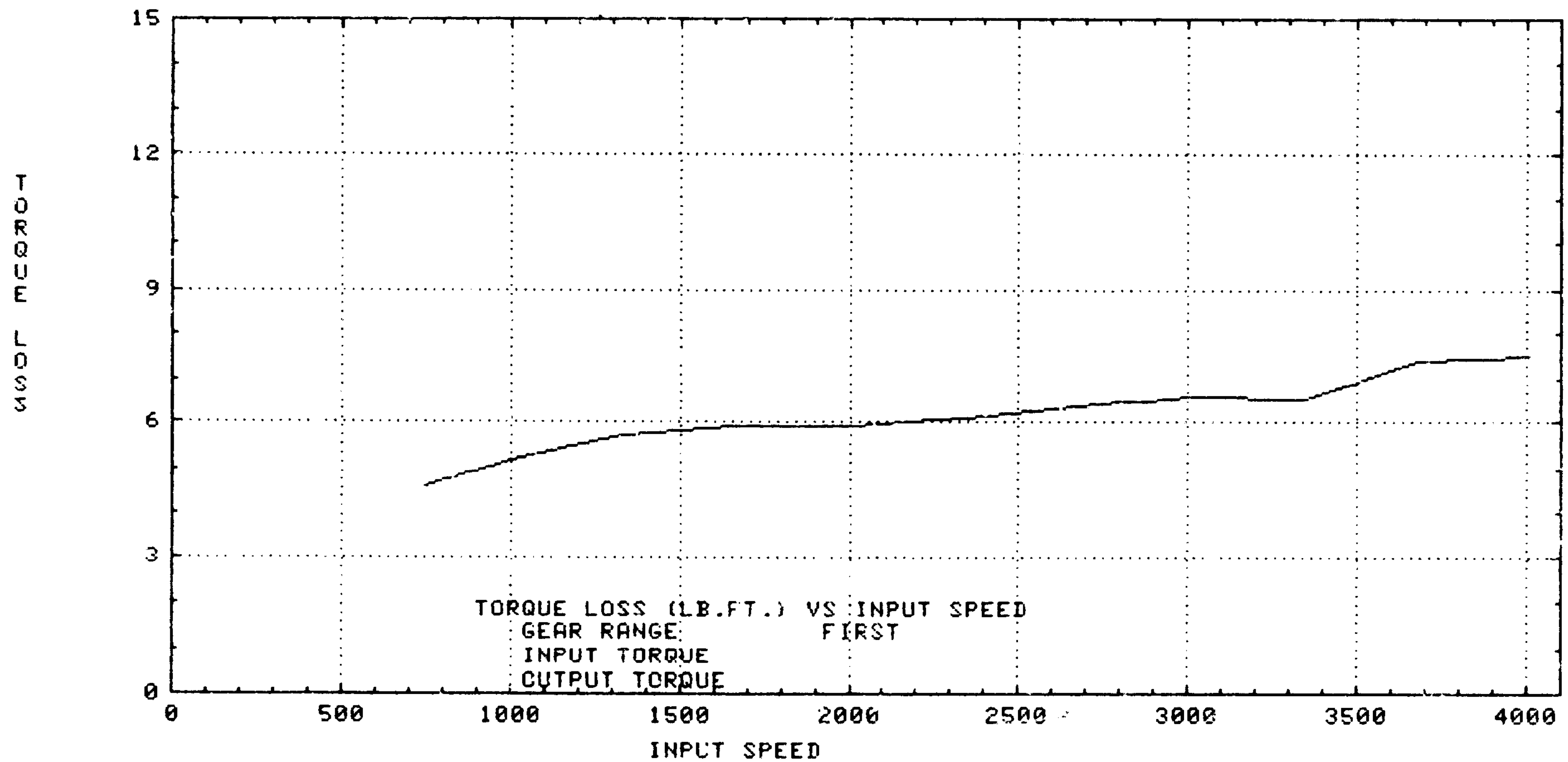
Torque In

Speed In

No Load Losses

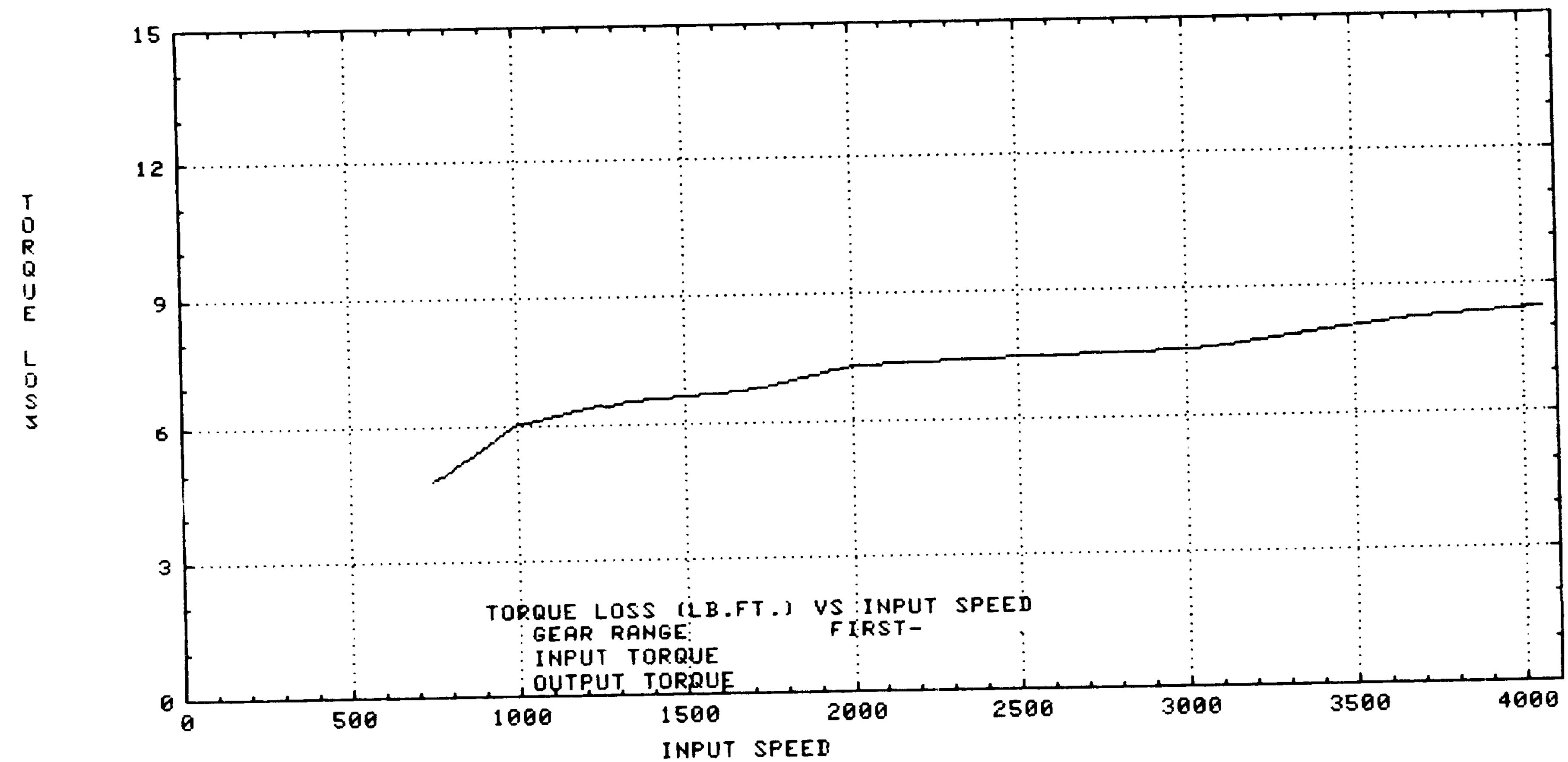
NO LOAD LOSSES

1st Gear (Closed Throttle)


TORQUE LOSS
15
12
9
6
3
0
0
500
1000
1500
2000
2500
3000
3500
4000
INPUT SPEED
TORQUE LOSS (LB.FT.) VS INPUT SPEED
GEAR RANGE FIRST
INPUT TORQUE
OUTPUT TORQUE

NO LOAD LOSSES

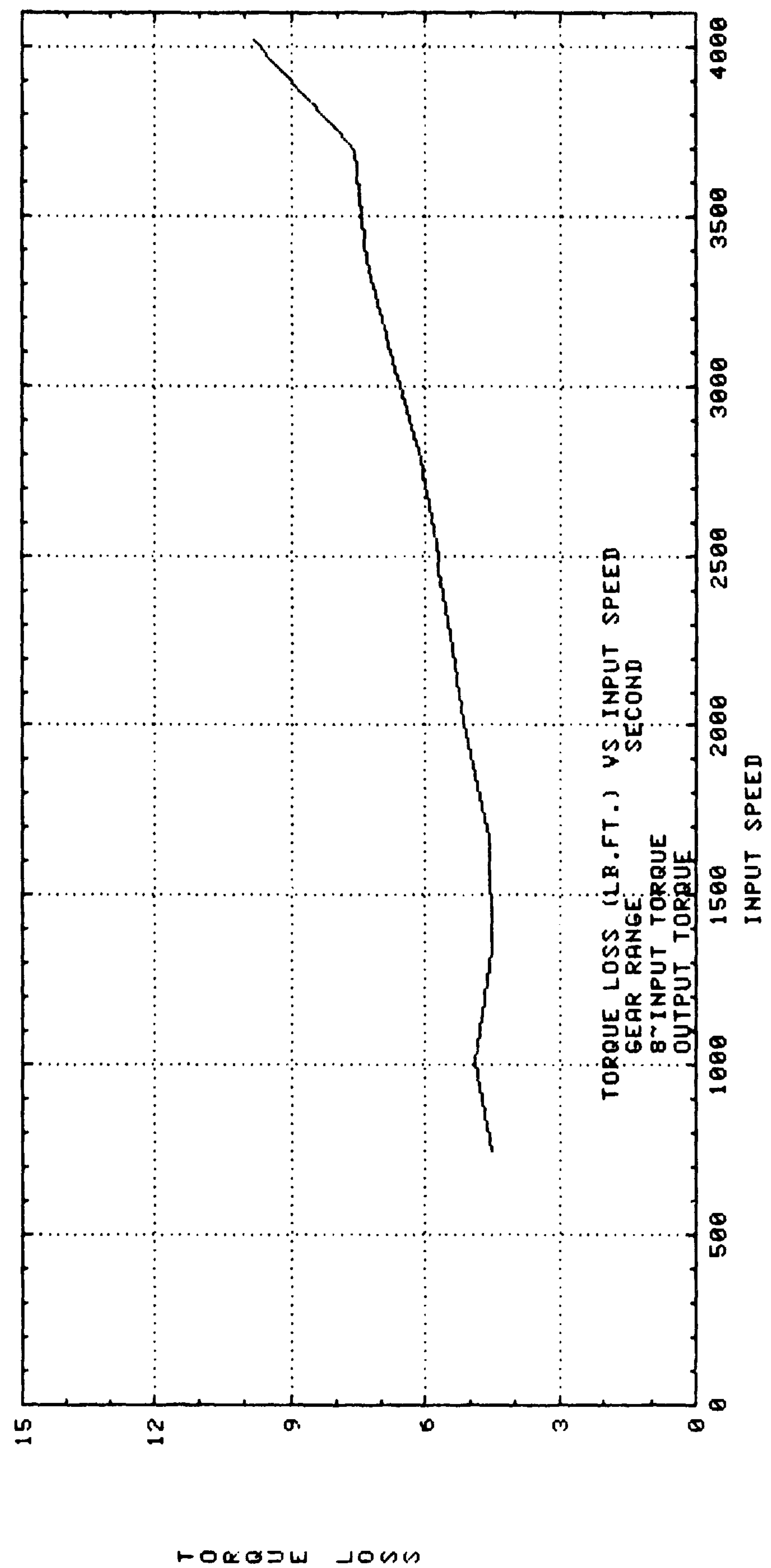
1st Gear (Open Throttle)



TORQUE LOSS (LB.FT.) VS INPUT SPEED
GEAR RANGE FIRST-
INPUT TORQUE
OUTPUT TORQUE
TORQUE LOSS
INPUT SPEED
15
12
9
6
3
0
500
1000
1500
2000
2500
3000
3500
4000

NO LOAD LOSSES

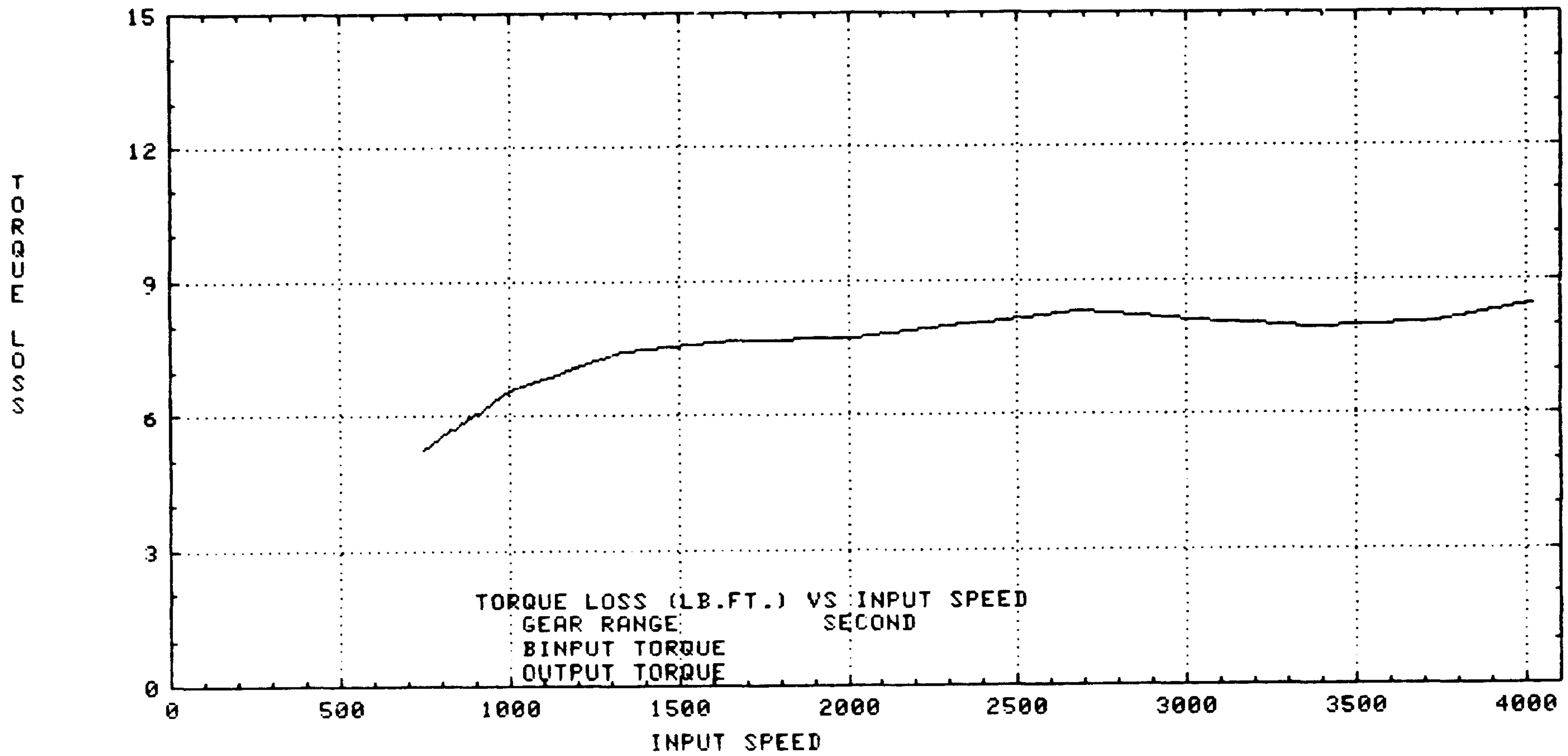
2nd Gear (Closed Throttle)



TORQUE LOSS (LB.FT.) VS INPUT SPEED
GEAR RANGE SECOND
8" INPUT TORQUE
OUTPUT TORQUE
INPUT SPEED
TORQUE LOSS
0
500
1000
1500
2000
2500
3000
3500
4000
0
3
6
9
12
15

NO LOAD LOSSES

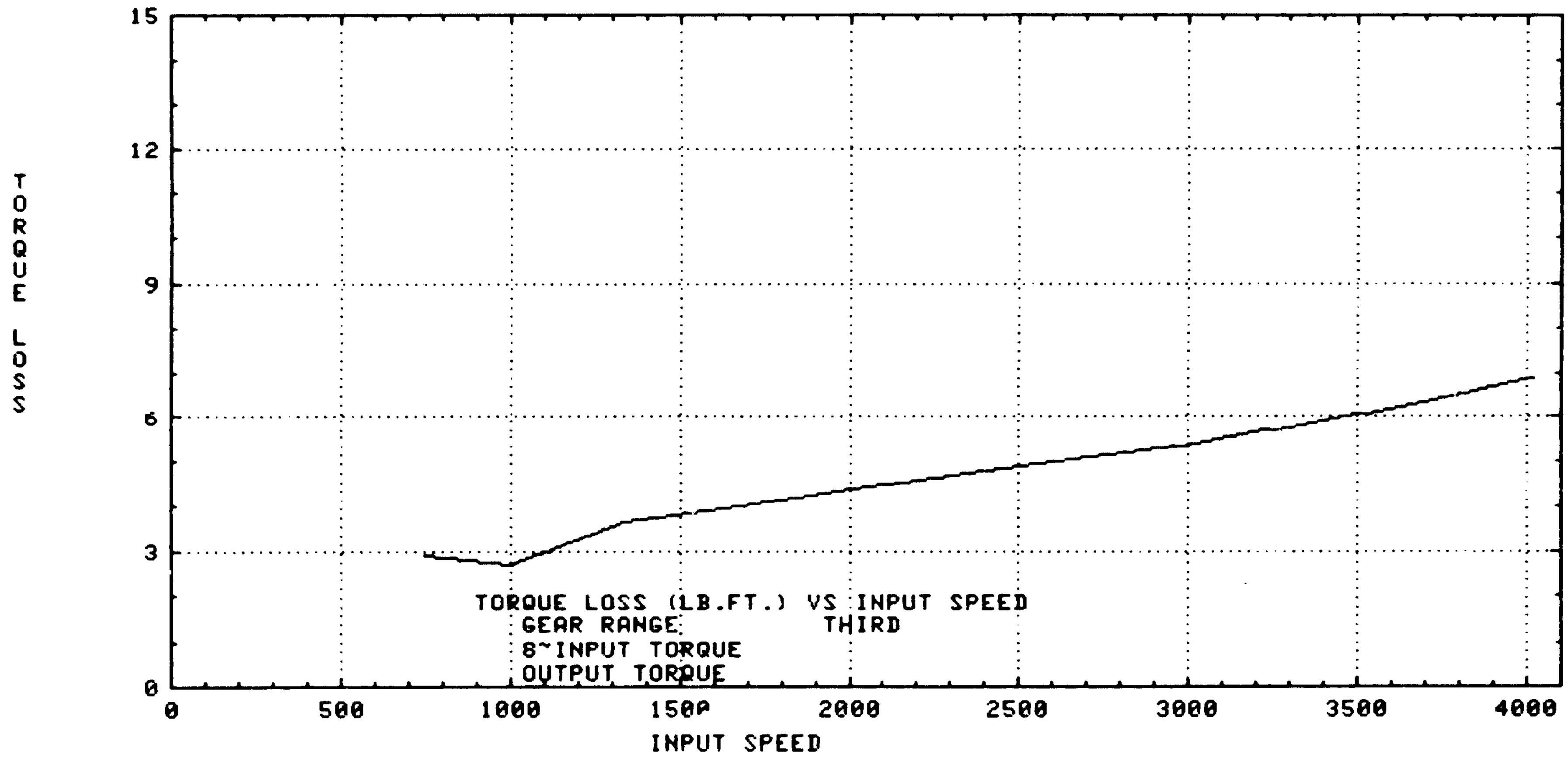
2nd Gear (Open Throttle)



TORQUE LOSS
15
12
9
6
3
0
0
500
1000
1500
2000
2500
3000
3500
4000
INPUT SPEED
TORQUE LOSS (LB.FT.) VS INPUT SPEED
GEAR RANGE SECOND
BINPUT TORQUE
OUTPUT TORQUE

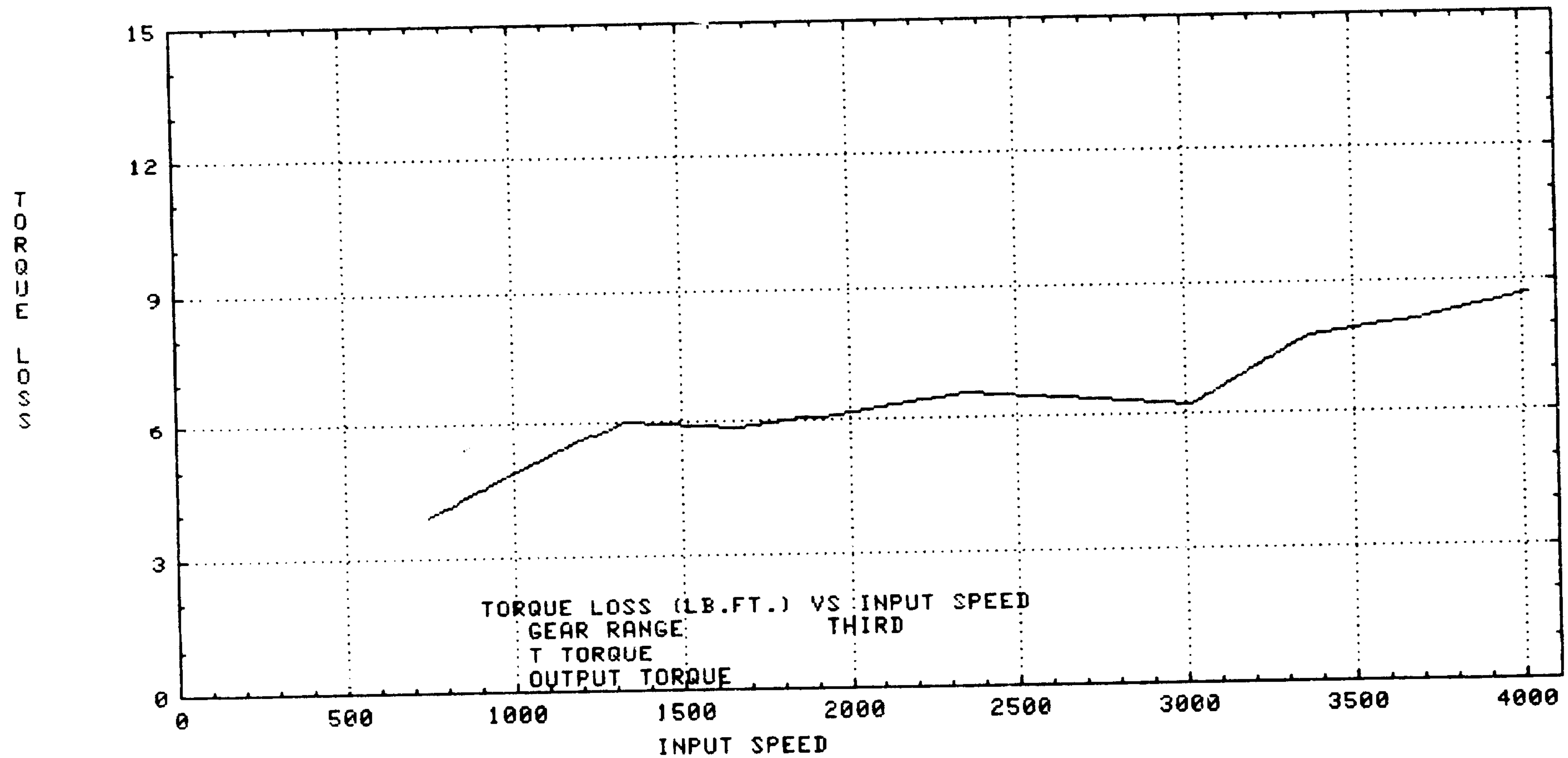
NO LOAD LOSSES

3rd Gear (Closed Throttle)


TORQUE LOSS (LB.FT.) VS INPUT SPEED
GEAR RANGE THIRD
8~INPUT TORQUE
OUTPUT TORQUE
TORQUE LOSS
INPUT SPEED
0
3
6
9
12
15
0
500
1000
1500
2000
2500
3000
3500
4000

NO LOAD LOSSES

3rd Gear (Open Throttle)


TORQUE LOSS (LB.FT.) VS INPUT SPEED
GEAR RANGE THIRD
T TORQUE
OUTPUT TORQUE
TORQUE LOSS
INPUT SPEED
15
12
9
6
3
0
0
500
1000
1500
2000
2500
3000
3500
4000

APPENDIX A
CALCULATION OF ERROR

ROOT MEAN SQUARE METHOD

$$\text{TORQUE ERROR (HIMMELSTEIN)} = \sqrt{(\text{TORQUE TRANS. ERROR})^2 + (\text{TAPE RECORDER ERROR})^2 + (\text{ANALYZER ERROR})^2}$$
$$= \sqrt{(0.21)^2 + (0.05)^2 + (0.048)^2} = \pm 0.221\% \text{ of Full Scale}$$

$$\text{TORQUE ERROR (LEBOW)} = \sqrt{(\text{TORQUE TRANS. ERROR})^2 + (\text{TAPE RECORDER ERROR})^2 + (\text{ANALYZER ERROR})^2}$$
$$= \sqrt{(0.05)^2 + (0.05)^2 + (0.048)^2} = \pm 0.08\% \text{ of Full Scale}$$

$$\text{SPEED ERROR} = \sqrt{(\text{SPEED SENSOR})^2 + (\text{SPEED CONDITIONER})^2 + (\text{TAPE RECORDER ERROR})^2 + (\text{ANALYZER ERROR})^2}$$
$$= \sqrt{(0.025)^2 + (0.10)^2 + (0.05)^2 + (0.048)^2} = \pm 0.124\% \text{ of Full Scale}$$

$$\text{POWER OUT ERROR} = \sqrt{(\text{TORQUE ERROR (LEBOW)})^2 + \text{SPEED ERROR})^2 + (\text{COMPUTER CALCULATION ERROR})^2}$$
$$= \sqrt{(0.08)^2 + (0.124)^2 + (0.5)^2} = \pm 0.5\% \text{ of Full Scale}$$

$$\text{EFFICIENCY ERROR} = \sqrt{(\text{TORQUE ERROR (LEBOW)})^2 + (\text{SPEED ERROR})^2 + (\text{TORQUE ERROR (HIMM)})^2 + (\text{SPEED ERROR})^2 + (\text{COMPUTER CALCULATION ERROR})^2}$$
$$= \sqrt{(0.08)^2 + (0.124)^2 + (0.221)^2 + (0.124)^2 + (0.5)^2} = \pm 0.579\% \text{ of Full Scale}$$

SUM OF ERROR METHOD

TORQUE ERROR HIMMELSTEIN = (TORQUE TRANSDUCER ERROR) + (TAPE RECORDER ERROR) + (ANALYZER ERROR)
= (0.21) + (0.05) + (0.048) = ±0.308% of Full Scale

TORQUE ERROR (LEBOW) = (TORQUE TRANS. ERROR) + (TAPE RECORDER ERROR) + (ANALYZER ERROR)
= (0.05) + (0.05) + (0.048) = ±0.148% of Full Scale

SPEED ERROR = (SPEED SENSOR) + (SPEED CONDITIONER) + (TAPE RECORDER ERROR) + (ANALYZER ERROR)
= (0.025) + (0.1) + (0.05) + (0.048) = ±0.223% of Full Scale (1 Volt = 4000 RPM)

POWER OUT ERROR = (TORQUE ERROR (LEBOW)) + (SPEED ERROR) + (COMPUTER CALCULATION ERROR)
= (0.08) + (0.124) + (0.5) = ±0.704% of Full Scale

EFFICIENCY ERROR = (TORQUE ERROR (LEBOW)) + (SPEED ERROR) + (TORQUE ERROR HIMM.) + (SPEED ERROR)
+ (COMPUTER CALCULATION ERROR)
= (0.08) + (0.124) + (0.221) + (0.124) + (0.5) = ±0.1049% of Full Scale

The inter number computer calculation error was determined by taking a set of sample calculations and comparing the accurate multiplication to the computer multiplication. A sample comparison is given below.

DATA DRIVE
PERFORMANCE
2ND GEAR

T_i=40 lb/ft	ACCURATE CALCULATION	COMPUTER CALCULATION
T_i=39.500, T_o=116.3369	T_o/T_i=2.9452	T_o/T_i=2.9367

Comparison = (2.9452 - 2.9367)/2.9452 x 100 = 0.288%

Since every calculation was not checked in this manner, a factor of safety was added to 0.288%, and 0.5% was used as the inter number computer calculation error.

OTHER MANUALS

To locate specific manuals in the documentation shipped with the system, refer to the System Configuration Notice for the contents of each binder.

SYSTEM SPECIFICATIONS & CHARACTERISTICS

The specifications in Table 1-1 describe the system's warranted performance. Those items under the heading of "Characteristics" go beyond the guaranteed specifications and give typical performance for some additional parameters and operations. These are included only to give you information which may be useful in applying the system.

Table 1-1. System Specifications and Characteristics

SPECIFICATIONS
(Specifications describe the standard system's warranted performance.)

ANALOG-TO-DIGITAL CONVERTER

Input Voltage Range: ±0.125V to ±8V peak in steps of 2.

Input Coupling: dc or ac.

Input Channels: 2 channels wired for 4 standard (4 channels optional with plug-in cards).

Resolution: 12 bits including sign.

Input Frequency Range: dc to 50 kHz, 5 Hz to 50 kHz, ac coupled (100 kHz optional).

Sample Rate:

Internal: 100 kHz max (1, 2, 3, or 4 channels simultaneously) (200 kHz optional on 1, 2, 3, or 4 channels.) (50 kHz max. 3 or 4 channels simultaneously †)

External: An external time base may be used to allow external control of the sampling rate up to 100 kHz (200 kHz optional). One sample can be taken for each clock pulse (TTL level).

Internal Clock Accuracy: ±0.01%.

DISPLAY UNIT

Vertical Scale Calibration: Data in memory is automatically scaled to give a maximum on-screen calibrated display. The scale factor is given in volts/division, volts²/division, or in dB offset.

Log Display Range: 80 dB with a scale factor ranging from 0 to +998 dB. Offset selectable in 4 dB steps.

Linear Display Range: ±4 divisions with scale factor ranging from 1 × 10⁻⁵¹² to 5 × 10⁵¹² in steps of 1, 2, and 5.

Digital UP/DOWN Scale: Allows 8 up-scale and 2 down-scale steps (calibrated continuous scale factor).

Horizontal Scale Calibration:

Linear Sweep Length: 10, 10.24 or 12.8 divisions.

Log Horizontal: 0.5 decades/division

Markers: Intensity markers every 8th or every 32nd point

BASE SOFTWARE

Transform Accuracy: The expected rms value of computational error introduced in either the forward or inverse FFT will not exceed 0.1% of the rms value of the transform result.

Dynamic Range: >75 dB for a minimum detectable spectral component in the presence of one full scale spectral component after twenty ensemble averages for a block size of 1024.

EXECUTION TIMES*

Fourier Transform: < 55 ms

Stable Power Spectrum Average: < 80 ms

Stable Tri-Spectrum Average: < 220 ms

REAL TIME BANDWIDTHS*

Fourier Transform: >7.5 kHz

Stable Power Spectrum Average: 5.4 kHz

Stable Tri-Spectrum Average: 1.9 kHz

MASS STORAGE SOFTWARE

MAXIMUM REAL TIME DATA ACQUISITION RATE (Single Channel):

BS 256: 10 kHz

BS 1024: 39 kHz (25 kHz†)

BS 4096: 80 kHz (30 kHz†)

OFF-LINE BSFA SOFTWARE

Center Frequency Range: dc to one-half the Real Time Data Acquisition Rate.

Center Frequency Resolution: Continuous resolution to the limit of the frequency accuracy for center frequencies >0.02% of the sampling frequency.

Frequency Accuracy: ±0.01%.

Bandwidth Selection: In steps of f/5n where n = 2, 3, 4, etc

Max. Resolution Enhancement: >400

Dynamic Range:** 90 dB from peak out-of-band spectral component to the peak level of the passband noise.
80 dB from peak in-band spectral component to the peak level of the passband noise.

Out-of-Band Rejection: >90 dB

Passband Flatness of the Digital Filter: ±0.01 dB

ENVIRONMENTAL CONDITIONS

Temperature Range: 0°C to 40°C (104°F)

*For band limited random noise type signals at block size 1024 [illegible]

**After eight ensemble averages of a power spectrum at block size 1024. Reduced to 10 dB at the exact center of the band.

†These rates apply to systems with modules 5466B and 5445A/B having a serial prefix lower than 1842.

FM RECORD/REPRODUCE SPECIFICATIONS

Input Sensitivity:	0.1 to 2.5 volts rms; adjustable with input attenuator for ±40% deviation. Can be extended to 10 volts.
Nominal Input Level:	±1.4 volts peak.
Nominal Input Impedance:	100 K ohms resistive, shunted by less than 100 pf, unbalanced to ground.
Frequency Response:	
Flat Amplitude Filter	DC to 20 KHz, at 60 ips, ±0.5 db; ±40 deviation.
Linear Phase Filter	DC to 12 KHz, at 60 ips, ±0.5 db; ±40% deviation.
	DC to 20 KHz at 60 ips, ±0.5, -3 db; ±40% deviation.
Frequency Responses (Optional):	DC to 80 KHz at 120 ips using ±40% deviation with IRIG intermediate band center frequency of 432 KHz. Upper frequency limit and center frequencies are proportionately lower at lower speeds, to 3-3/4 ips. DC to 10 KHz at 60 ips using ±40% deviation with IRIG low band frequency of 54 KHz for improved S/N ratios. Upper frequency limit and center frequencies are proportionately lower at lower speeds.
DC Drift (Oscillator and Discriminator):	Less than ±0.5% of peak-to-peak deviation per 10°F after 20 minute warm-up.
Signal/Noise Ratio	46 db at 60 ips.

DC Linearity:	Less than ±0.5% of peak-to-peak deviation reference to best straight line through zero.
AC Distortion:	Less than 1.5% total harmonic distortion at all speeds.
Transient Response (60 ips):	
Flat Amplitude Filter (±1/2db)	Rise Time (10% to 90% points) - 22 microseconds. Overshoot - less than 15%.
Linear Phase Filter (+1/2, -3 db)	Rise Time (10% to 90% points) - 18 microseconds. Overshoot - less than 2.5%.
Output Level (±40% deviation):	±1.4 volts peak, into 1000 ohms, with short circuit protection (SCP).
Output Current (±40% deviation):	±3 milliamperes peak with SCP.
Output Impedance:	Less than 50 ohms, unbalanced to ground, with SCP.

GENERAL

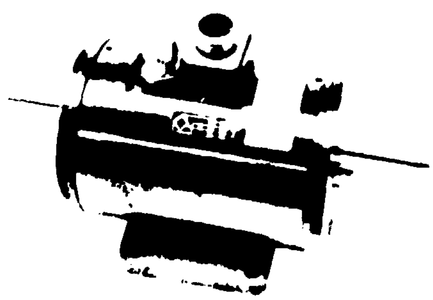
Configuration:	One standard 19 inch wide equipment enclosure for 14 channel FM or Direct Record/Reproduce System. For 28-32 vdc operation. Additional enclosure furnished for operation from other power supplies. Optional Rack Mounting Kit available.
Recorder Size (28-32 v):	26-1/8 inches high by 19 inches wide by 12 inches deep for a 7 channel-6 speed record/reproduce system or a 14 channel-6 speed record, 2 speed reproduce system. Additional enclosure (7-1/2 inches height) which attaches to portable

Rotating Shaft Torque Sensors

Model 1602
Low capacity torque sensors.

Capacity (Oz. In.)	Max. Speed (RPM)	Model	Protected for Overloads to (Oz. In.)	Torsional Stiffness (Lb. In./Rad.)	Rotating Inertia (Lb.-In.²)	Weight (Lbs.)
50	20,000	1602-50	150	400	.35	3⅛
100	20,000	-100	300	1,000	.35	3⅛
200	20,000	-200	600	2,500	.35	3⅛
500	20,000	-500	1,500	5,500	.35	3⅛
1,000	20,000	-1K	1,500	8,000	.35	[illegible]⅛

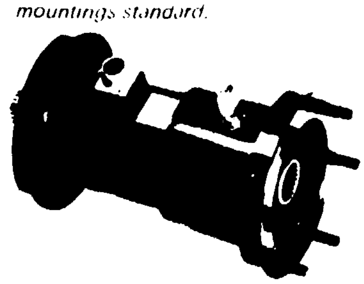
Models 1604, 1605 & 1607
Utility rotating shaft torque sensor recommended for general application.



Capacity (Lb. In.)	Max. Speed (RPM)	Model	Protected for Overloads to (Lb. In.)	Torsional Stiffness (Lb. In./Rad.)	Rotating Inertia (Lb.-In.²)	Weight (Lbs.)
50	15,000	1604-50	150	5,000	1.0	18
100	15,000	-100	300	13,500	1.0	18
200	15,000	-200	600	33,000	1.0	18
500	15,000	-500	1,500	85,000	1.0	18
1,000	15,000	-1K	3,000	150,000	1.0	18
2,000	15,000	-2K	6,000	225,000	1.0	18
2,000	15,000	1605-2K	6,000	700,000	3.25	28
5,000	15,000	-5K	15,000	950,000	3.25	28
10,000	15,000	-10K	20,000	1,000,000	3.25	28
20,000	4,000	1607-20K	60,000	6,800,000	52.0	75
50,000	4,000	-50K	150,000	11,800,000	57.0	75
100,000	4,000	-100K	150,000	19,950,000	180.0	75

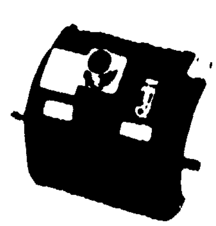
ORIGINAL PAGE IS
OF POOR QUALITY

Model 1615
Standard flange housing mount with AND pads to match Army-Navy mountings standard.



Capacity (Lb. In.)	Max. Speed (RPM)	Model	Protected for Overloads to (Lb. In.)	Torsional Stiffness (Lb. In./Rad.)	Rotating Inertia (Lb.-In.²)	Weight (Lbs.)
50	15,000	1615A-50	150	1,500	1.0	24
100	15,000	-100	300	4,000	1.1	24
200	15,000	-200	600	10,000	1.2	24
500	15,000	-500	1,500	20,000	1.3	24
1K	15,000	-1K	1,500	25,000	1.4	24
50	15,000	1615K-50	75	1,620	1.04	25
100	15,000	-100	150	4,570	1.05	25
200	15,000	-200	300	12,900	1.06	25
500	15,000	-500	750	940,000	1.97	25
1,000	15,000	-1K	1,500	204,000	2.00	25
2,000	15,000	-2K	3,000	347,000	2.08	26
5,000	15,000	-5K	7,500	500,000	2.38	26
10,000	15,000	-10K	15,000	574,000	2.76	26

Model 1648
Flange drive units recommended for use when short length is mandatory.



Capacity (Lb. In.)	Max. Speed (RPM)	Model	Protected for Overloads to (Lb. In.)	Torsional Stiffness (Lb. In./Rad.)	Rotating Inertia (Lb.-In.²)	Weight (Lbs.)
2,000	5,000	1648-2K	3,000	742,000	23.0	23
5,000	5,000	-5K	7,500	1,811,000	23.0	23
10,000	5,000	-10K	15,000	2,248,000	23.0	23
20,000	5,000	-20K	30,000	3,507,000	23.5	23

GENERAL SPECIFICATIONS: (All Models)

SENSOR: Four arm bonded foil strain gage bridge
BRIDGE RESISTANCE: 350 ohms nominal
BRIDGE VOLTAGE: 20 volts maximum, 3 KHz
OUTPUT: 2 to 2.5 millivolt/volt nominal
LINEARITY: 0.1% of full scale
COMPENSATED TEMPERATURE RANGE: 30°F to 150°F
USEABLE TEMPERATURE RANGE: 0°F to 200°F
EFFECT OF TEMPERATURE ON ZERO: .002% of full scale/°F
EFFECT OF TEMPERATURE ON OUTPUT: .002% of reading/°F

TECHNICAL SPECIFICATION

MCRT®6-02T Non-Contact Torquemeter

MAX. TORQUE – 15,000 lb.-in.
SPEED – 0 - 7,500 rpm

GENERAL DESCRIPTION

The MCRT®6-02T is a compact, high accuracy, flanged torquemeter well adapted for vehicle drive-line measurements and continuous monitoring and feedback applications. It uses a rotating strain gage torque bridge, temperature compensated for drift and modulus. The bridge is connected to a stationary electronic readout via integral, non-contact rotary transformers.

The torquemeter is immune to water, lubricants, coolants, vibration, etc. The elimination of slip-rings permits high accuracy low level measurements with long, maintenance-free life. Thrust and bending loads are inherently cancelled by the transducer design. An optional, integral non-contact speed pickup may be specified when ordering.

Linearity: 0.1%

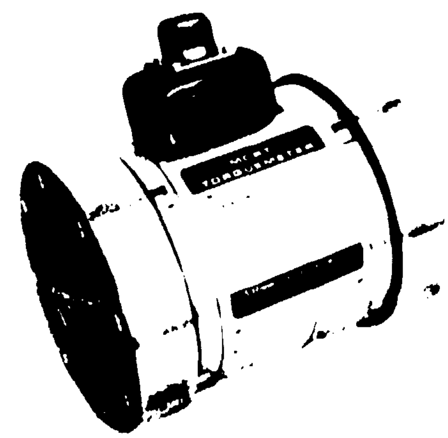
Temperature Effects: From 75 to 175° F maximum drift is 0.2% of full scale and maximum error due to modulus change is 0.2% of reading.

Maximum Operating Temperature: 220° F, assuming permanent lubrication. Above 175° F, the maximum shaft speed may have to be de-rated.

Readout: Any carrier amplifier suitable for strain gage service may be used.

Excitation Voltage: 10 volts rms, maximum.

Nominal Output: 0.75 millivolts/volt (open circuit)



Standard Ratings:

MODEL	FULL SCALE TORQUE	TORSIONAL STIFFNESS	MAXIMUM BENDING MOMENT	MAXIMUM ROTATING INERTIA	MAXIMUM WEIGHT
MCRT 6-02T	(lb. in.)	(lb. in./rad.)	(lb. in.)	(in. oz. sec.^{2})	(lbs.)
(1-3)	1,000	602,000	500	0.60	13 8
(2-3)	2,000	1,375,000	1,000	0.60	13 8
(4-3)	4,000	2,640,000	2,000	0 60	13 8
(6-3)	6,000	2,430,000	3,000	0 90	17 0
(10-3)	10,000	2,930,000	5,000	0 90	17 0
(15-3)	15,000	3,530,000	5,500	0 90	17 0

Overload Capacity: 2 times full scale rating

Shaft Speed: 0 to 7,500 rpm, bi-directional. Optional speed pickup produces 60 pulses per shaft revolution.

Construction: Load carrying members (flanges, shaft) are 17-4 PH high strength stainless steel.

NOTES

(1) Maximum speed rating assumes permanent lubrication. Consult factory for higher speed operation.
(2) When combined axial and bending loads are present, the bending capacity must be derated. Consult factory.
(3) Stator should be compliantly restrained from rotating.

S. Himmelstein and Company

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NASA CR-159881		

4. Title and Subtitle	5. Report Date
SMALL PASSENGER CAR TRANSMISSION TEST - FORD C4 TRANSMISSION	June 1980
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
M. P. Bujold	ERC LIB. 8060
	10. Work Unit No.

9. Performing Organization Name and Address	11. Contract or Grant No.
Eaton Corporation Engineering & Research Center 26201 Northwestern Highway Southfield, MI 48037	DEN 3-124

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
U.S. Department of Energy Office of Transportation Programs Washington, DC 20585	Contractor Report
	14. Sponsoring Agency ~~Code~~ Report No. DOE/NASA/0124-2

15. Supplementary Notes

Final Report. Prepared under Interagency Agreement EC-77-A-31-1044. Project Manager, Henry B. Tryon, Transportation Propulsion Division, NASA Lewis Research Center, Cleveland, Ohio 44135.

16. Abstract

The small passenger car transmission test was initiated to supply electric vehicle manufacturers with technical information regarding the performance of commercially available transmissions. This information would enable EV manufacturers to design a more energy efficient vehicle. With this information the manufacturers would be able to estimate vehicle driving range as well as speed and torque requirements for specific road load performance characteristics. This report covers the testing of a 1979 Ford C4 automatic transmission. This transmission was tested per a passenger car automatic transmission test code (SAE J651b) which required drive performance, coast performance, and no load test conditions. Under these test conditions, the transmission attained maximum efficiencies in the mid-eighty percent range for both drive performance tests and coast performance tests. The major results of this test are the torque, speed and efficiency curves which are located in the data section of this report. These graphs map the complete performance characteristics for the Ford C4 transmission.

17. Key Words (Suggested by Author(s))	18. Distribution Statement
Electric vehicles; Transmissions; Torque converters	Unclassified - unlimited STAR Category 37 DOE Category UC-96

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
Unclassified	Unclassified	377	A17

* For sale by the National Technical Information Service, Springfield, Virginia 22161

USGPO 1980 657-145/402