DUQUESNE LIGHT COMPANY
Power Stations Department
Beaver Valley Power Station, Unit No. 1

Report

Auxiliary Feedwater Pumps
Presently Installed at Beaver Valley Power Station, Unit No. 1

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DUQUESNE LIGHT COMPANY
Nuclear Safety and Licensing Department
Beaver Valley Power Station, Unit No. 1

Report
Auxiliary Feedwater Pump Endurance Test

I. Introduction

The three auxiliary feedwater pumps are located in the east safeguards area. FW-P-2 is a 6-stage centrifugal pump connected by a Falk coupling to a Terry steam turbine rated at 710 hp at 5200 rpm. FW-P-3A and 3B are horizontal 8-stage motor driven centrigural pumps rated at 350 gpm each connected by Falk couplings to 400 hp, 4160V, 3600 rpm squirrel cage induction motors. The primary water supply for these pumps is maintained in a 152,000 gallon seismic category 1 Primary Plant Demineralized Water Storage Tank. The purpose of the tests was to verify the proper operation of the Auxiliary Feedwater Pumps in the recirculation and Steam Generator feed flow modes.

II. Summary of the Auxiliary Feedwater Pump Endurance Test

During the first phase of the test, each pump was operated in the recirculation mode for 48 hours. Following the 48-hour pump run, the pumps were shutdown until the pump temperatures were reduced to within $20^{\circ}F$ of their values at the start of the 48-hour test and at least 8 hours had elapsed. The pumps were then operated again for 1 hour in the recirculation mode, then the feedwater system was realigned to provide the normal auxiliary feed flow path to the steam generators to verify that the pumps could provide design flow at no load steam pressure.

Figure 1 illustrates a flow diagram of the test method. Data were recorded as to the pump suction and discharge pressures, pump flow, pump speed, vibration and bearing temperatures throughout the testing period. Figure 2 depicts the location of the areas on the pumps and drives where vibration and temperatures were measured. Vibration was measured using the IRD Model 308 vibration measuring instrument; the bearing temperatures were monitored using a contact pyrometer.

Figures 3a, 3b, and 3c and 4a, 4b, and 4c plot the number 3 and 4 bearing oil temperatures versus time of the respective bearings. Environmental conditions in the auxiliary feedwater pump area were also monitored to ensure temperature and humidity limits for safety related equipment were not exceeded. Figures 5a, 5b, and 5c and 6a, 6b, and 6c plot the ambient temperatures and himidity versus time during the respective pump test.

III. Design Verification

A. Motor Driven Auxiliary Feedwater Pumps FW-P-3A and 3B

The acceptance criteria for maximum lube oil temperature was 160°F; the maximum lube oil temperature recorded for any pump was 132°F for the 3B pump. The recirculation flow acceptance criteria was 135 + 65/-0 gpm, the flows on both pumps being near the upper limit of 200 gpm with FW-P-3B being recorded at 200 gpm. The acceptance criteria for the ambient room temperature was 40 to 140°F with a maximum temperature reading of 90°F which occurred during testing of FW-P-3B. The humidity acceptance criteria was 20 to 100%; a maximum recorded value of 88% occurred during testing of FW-P-3A. Acceptance criteria for Steam Generator feed flow was to verify an obstruction free path between the feedwater pumps and the Steam Generators. The feed flow of FW-P-3A was 345 gpm and the flow of FW-P-3B was 352 gpm.

FW-P-3A was operated for 10 minutes in a run-out flow test to pump water to the depressurized Steam Generator; flow to the 1A, 1B and 1C Steam Generators was respectively 245, 230 and 255 gpm. At these flows, the maximum motor current recorded was 42 amps which was less than the overcurrent trip point of 60 amps.

The vibration data obtained throughout the testing period was compared to the IAW ASME Section XI, Table IWP-3100-2 using the IRD General Machinery Vibration Severity Chart and was found to be acceptable.

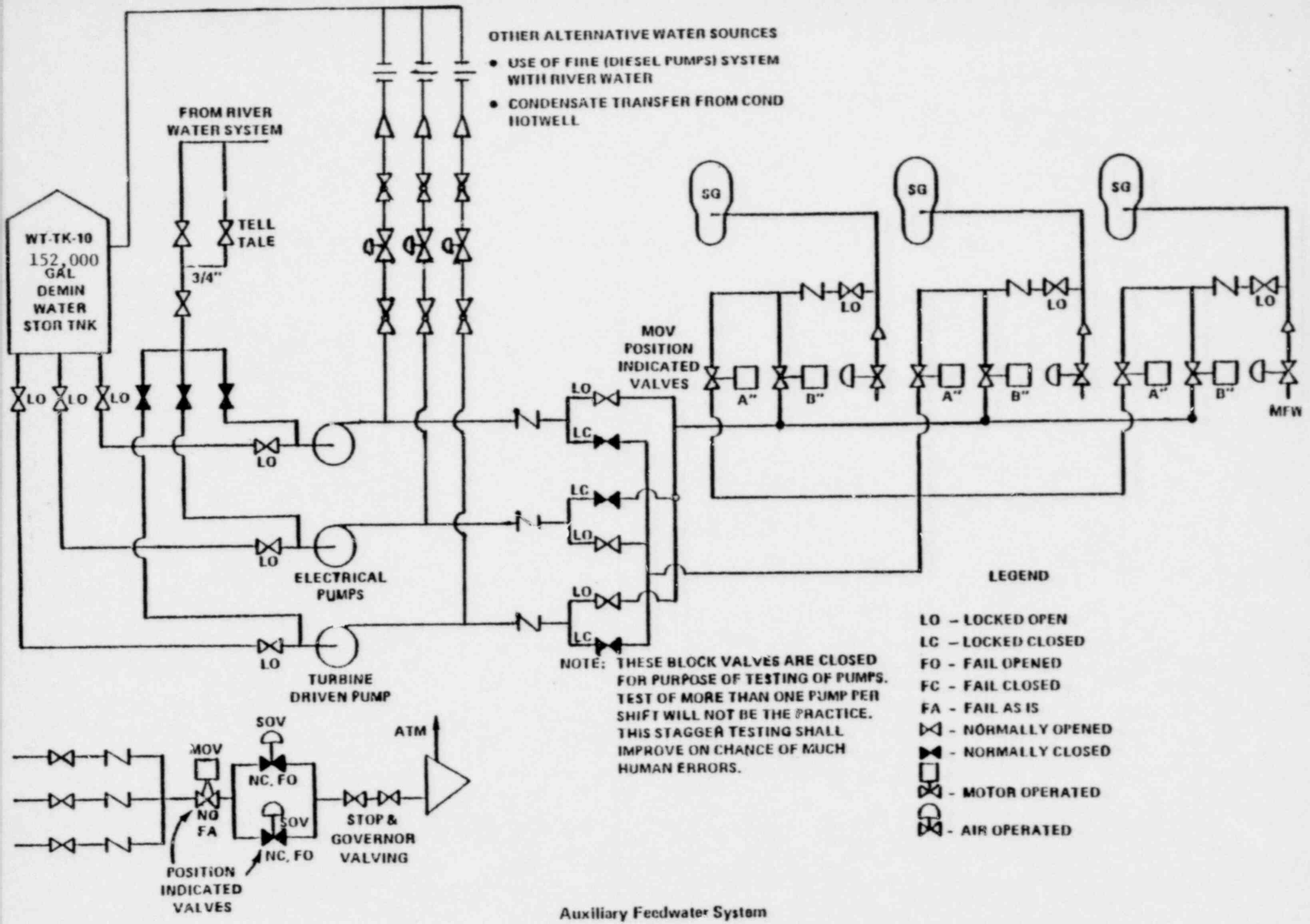
B. Turbine Driven Auxiliary Feedwater Pump FW-P-2

The acceptance criteria for maximum recorded lube oil temperature was 160°F; the maximum value recorded for bearing lube oil temperature was 138°F. The recirculation flow acceptance criteria was 250 + 75/-0 gpm; the flow on this pump being recorded as 273 gpm. The acceptance criteria for the ambient room temperature was 40 to 140°F with a maximum temperature reading of 83°F during operation of this pump. The humidity acceptance criteria was 20 to 100%; a maximum recorded value of 83% occurred during this pump test. Acceptance criteria for Steam Generator feed flow was to verify an obstruction free path between the feedwater pumps and the Steam Generators. The flow of FW-P-2 was 700 gpm.

The vibration data obtained throughout the testing period was compared to the IAW ASME Section XI, Table IWP-3100-2 using the IRD General Machinery Vibration Severity Chart and was found to be acceptable.

IV. Conclusion

The testing which has been successfully performed has demonstrated that the Auxiliary Feedwater Pumps at the Beaver Valley Power Station are fully capable of performing their design function and will provide long term reliable operation if and when required.

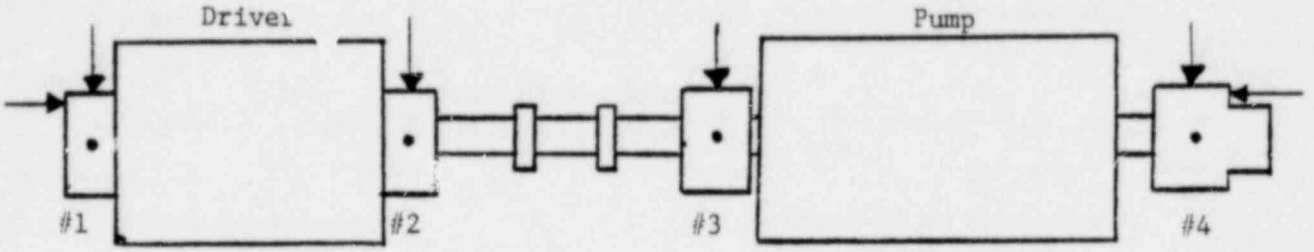


Auxiliary Feedwater System
Beaver Valley, Unit-1

Figure 1.

BEARING IDENTIFICATION

(Top View)



↓ Horizontal Vibration

· Vertical Vibration and Temperature Measurement

⇆ Axial Vibration

Test Equipment Used		Measurement
1.	IRD Model 308	vibration (in/sec) and (in)
2.	Contact Pyrometer	temperature (^{o}F)
3.	General Radio Strobotac (model 1531)	speed (RPM)
4.	Sling Psychrometer	humidity (%)
5.	Test Gauges	pressure (psi)

Figure 2

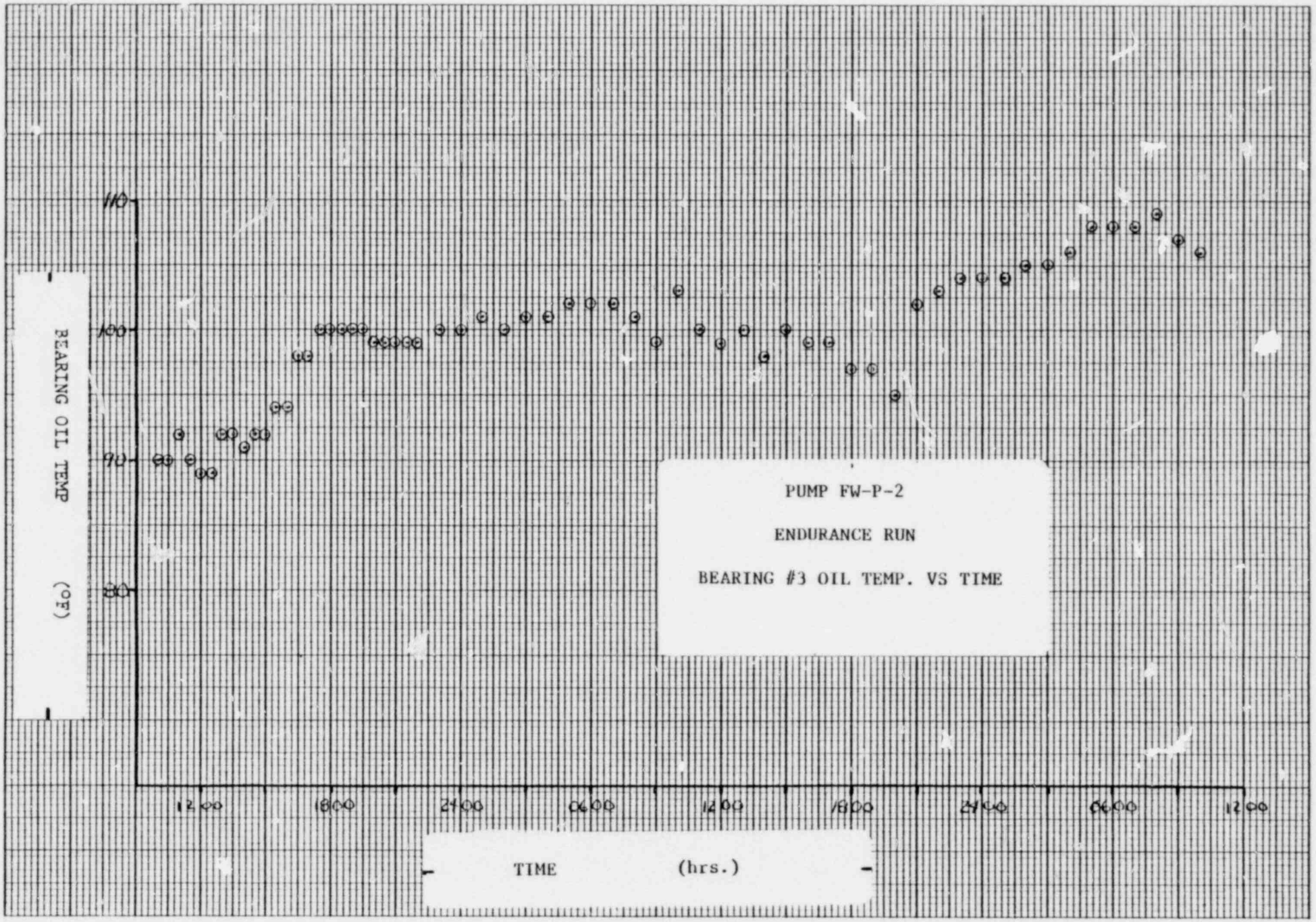


Figure 3a

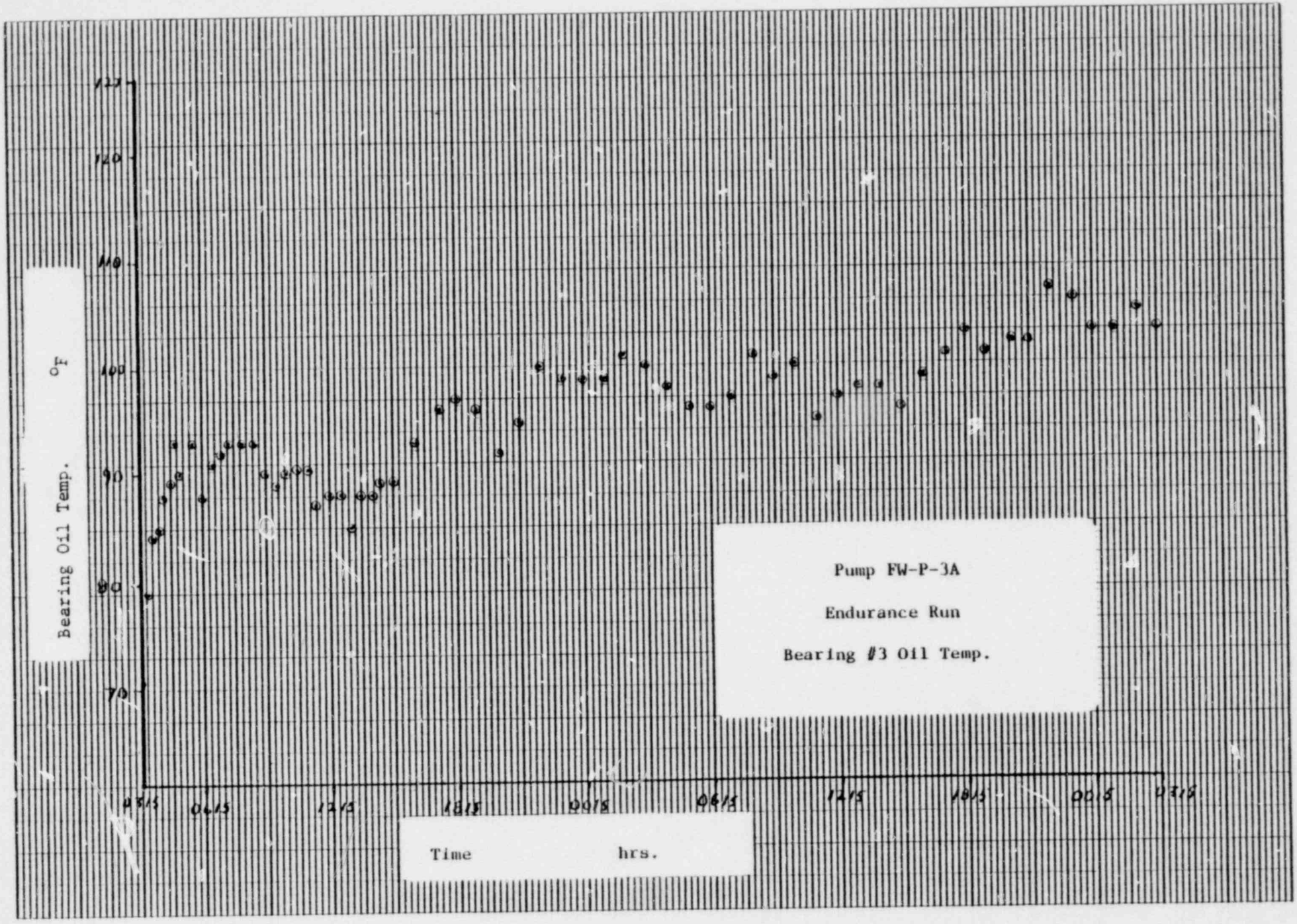

Bearing Oil Temp.
°F
120
110
100
90
80
70
0615
1215
1815
0018
0615
1215
1815
0018
0615
Time
hrs.
Pump FW-P-3A
Endurance Run
Bearing #3 Oil Temp.

Figure 3b

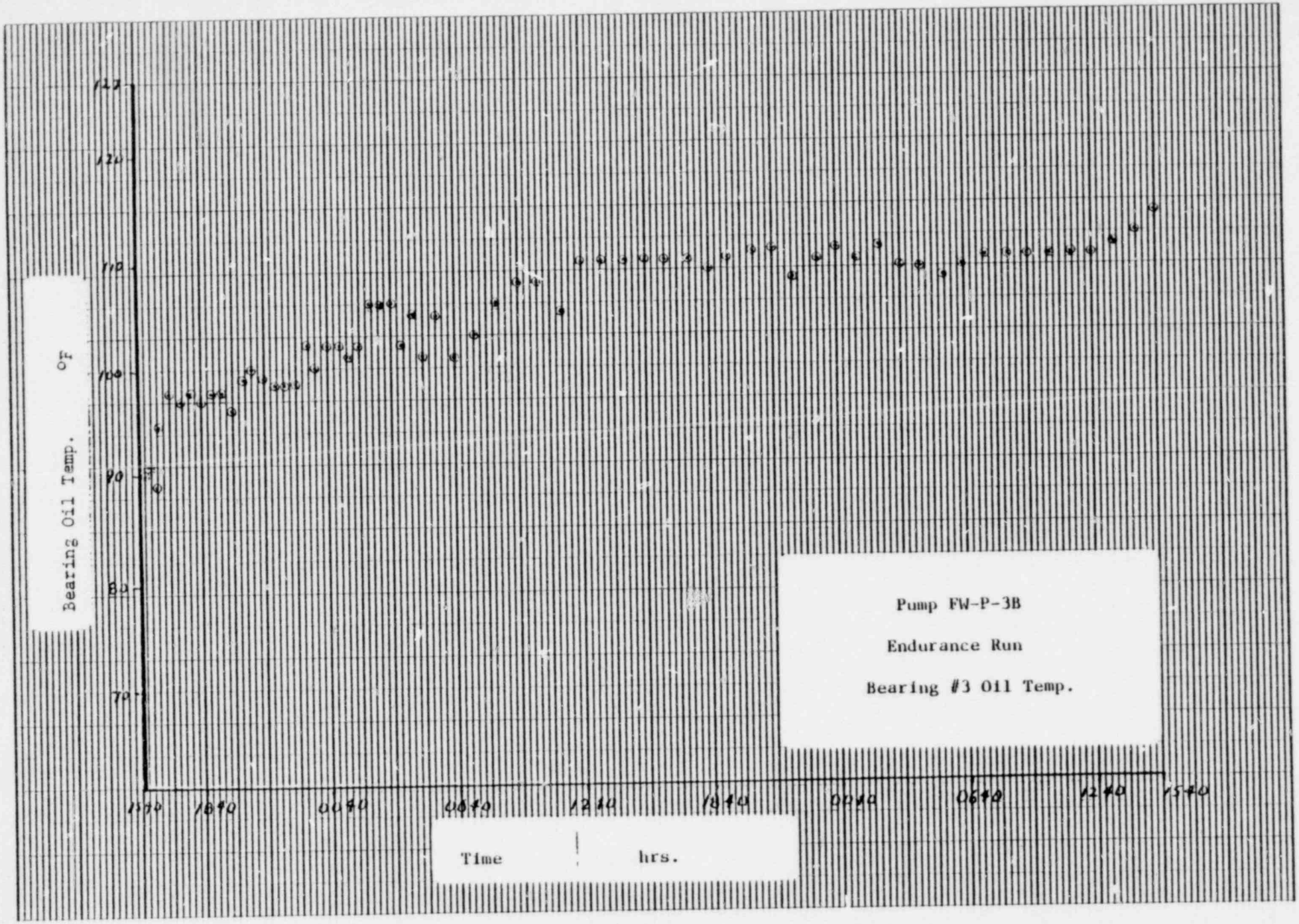

Bearing Oil Temp. °F
130
120
110
100
90
80
70
1540
1840
0040
0640
1240
1840
0040
0640
1240
1540
Time hrs.
Pump FW-P-3B
Endurance Run
Bearing #3 Oil Temp.

Figure 3c

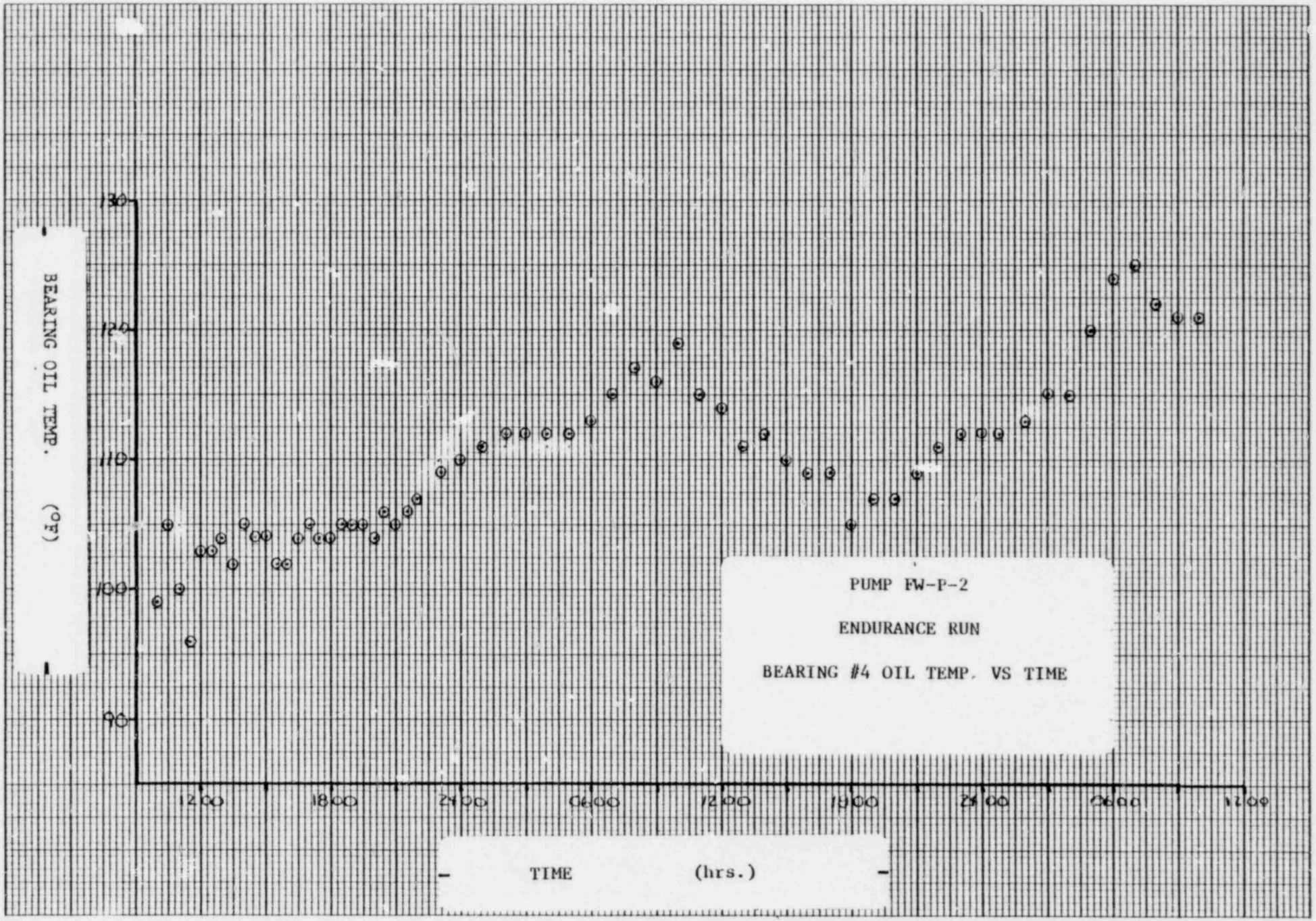


Figure 4a

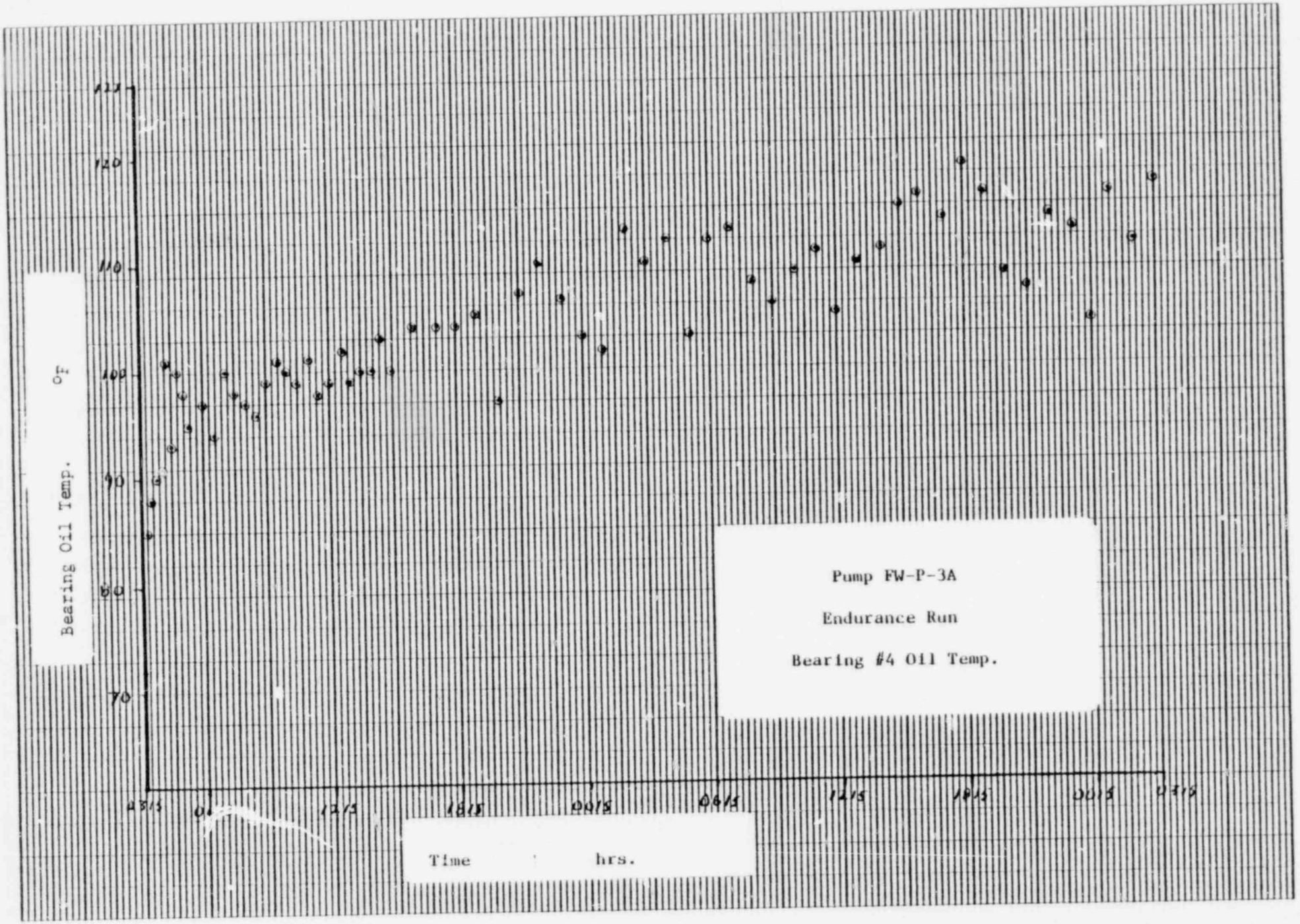

Bearing Oil Temp. °F
120
110
100
90
80
70
Time hrs.
Pump FW-P-3A
Endurance Run
Bearing #4 Oil Temp.

Figure 4b

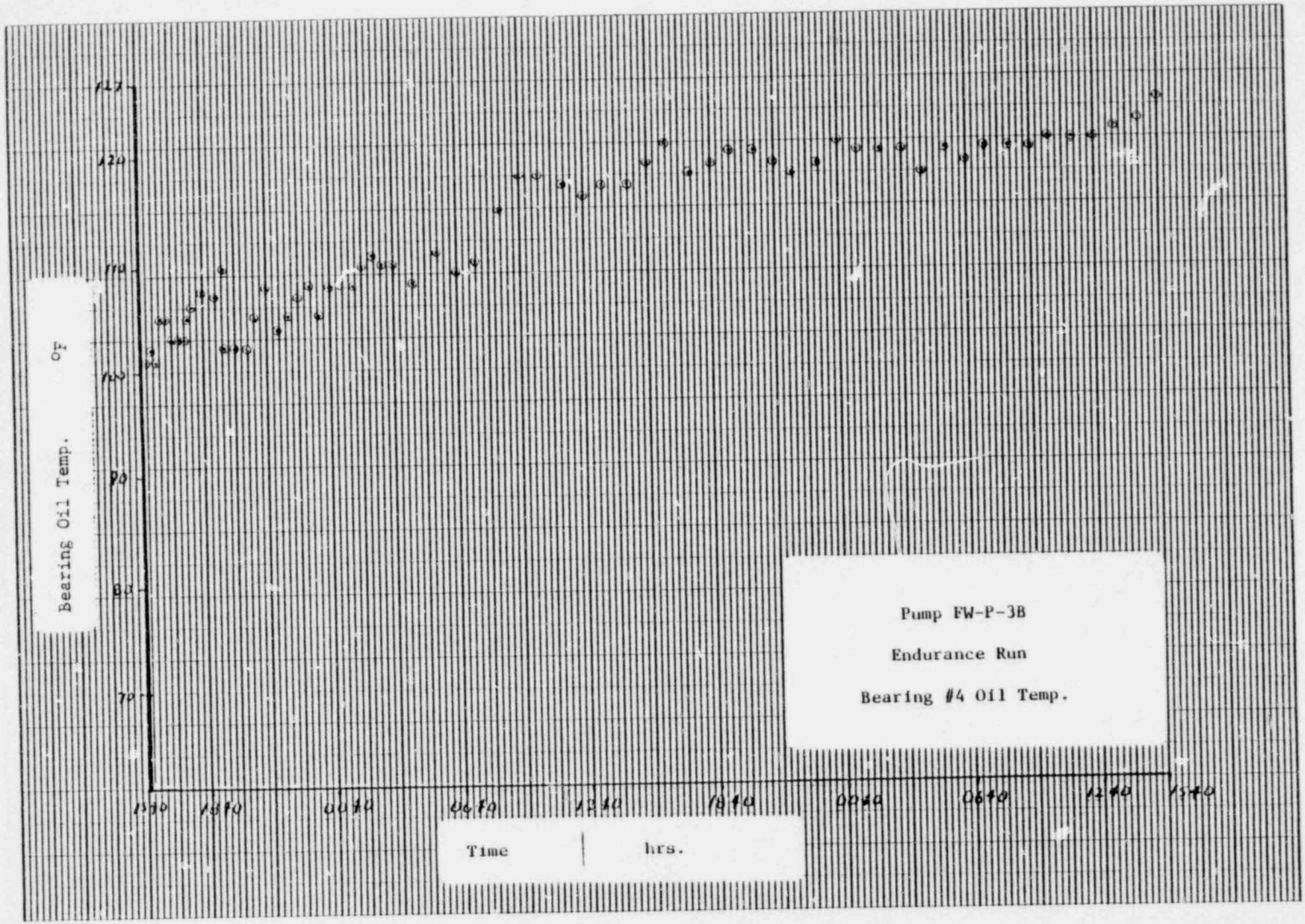

Bearing Oil Temp. °F
120
110
100
90
80
70
1540
1840
0040
0640
1240
1840
0040
0640
1240
1540
Time | hrs.
Pump FW-P-3B
Endurance Run
Bearing #4 Oil Temp.

Figure 4c

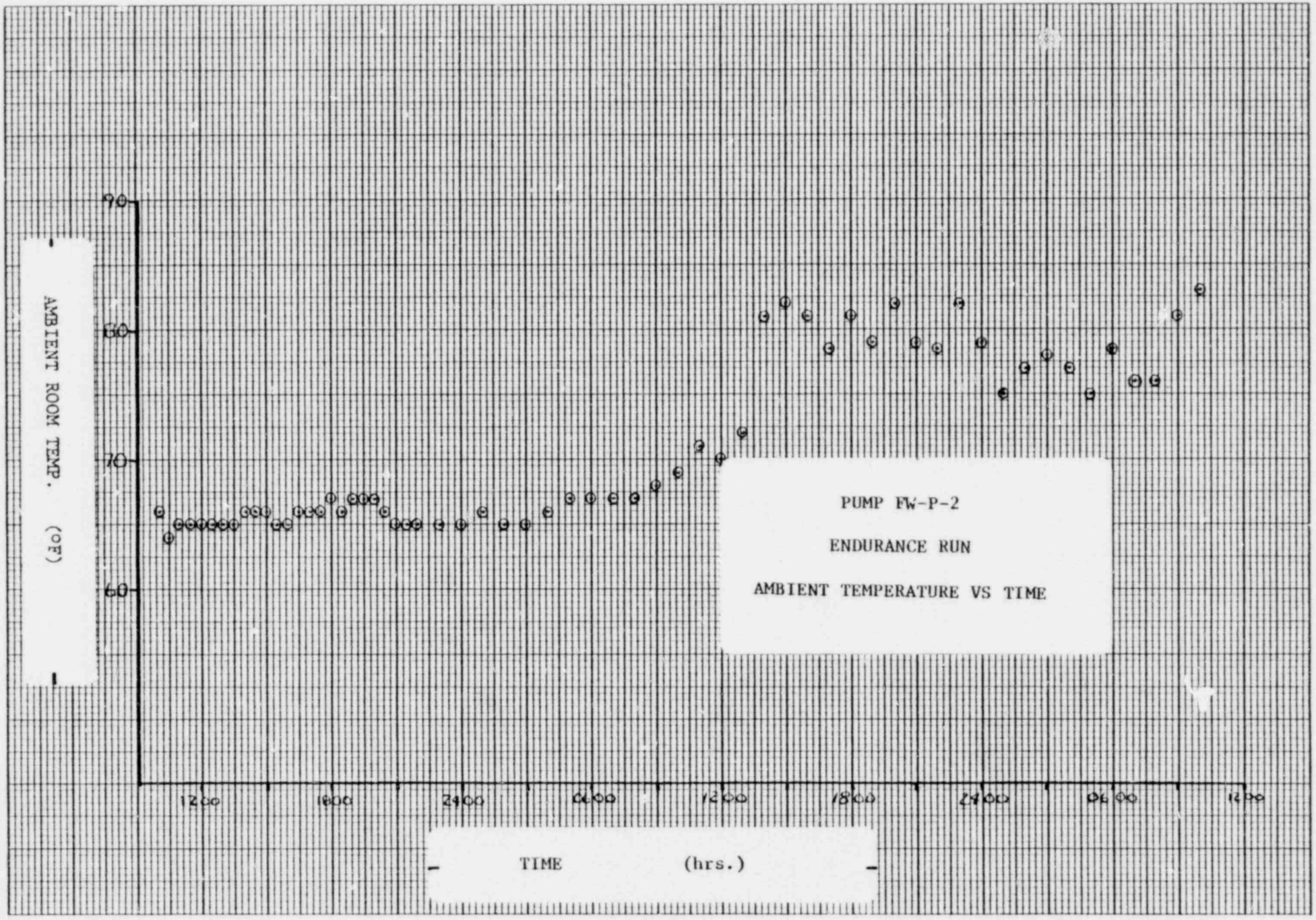

AMBIENT ROOM TEMP. (°F)
90
80
70
60
PUMP FW-P-2
ENDURANCE RUN
AMBIENT TEMPERATURE VS TIME
1200
1800
2400
0600
1200
1800
2400
0600
1200
TIME (hrs.)

Figure 5a

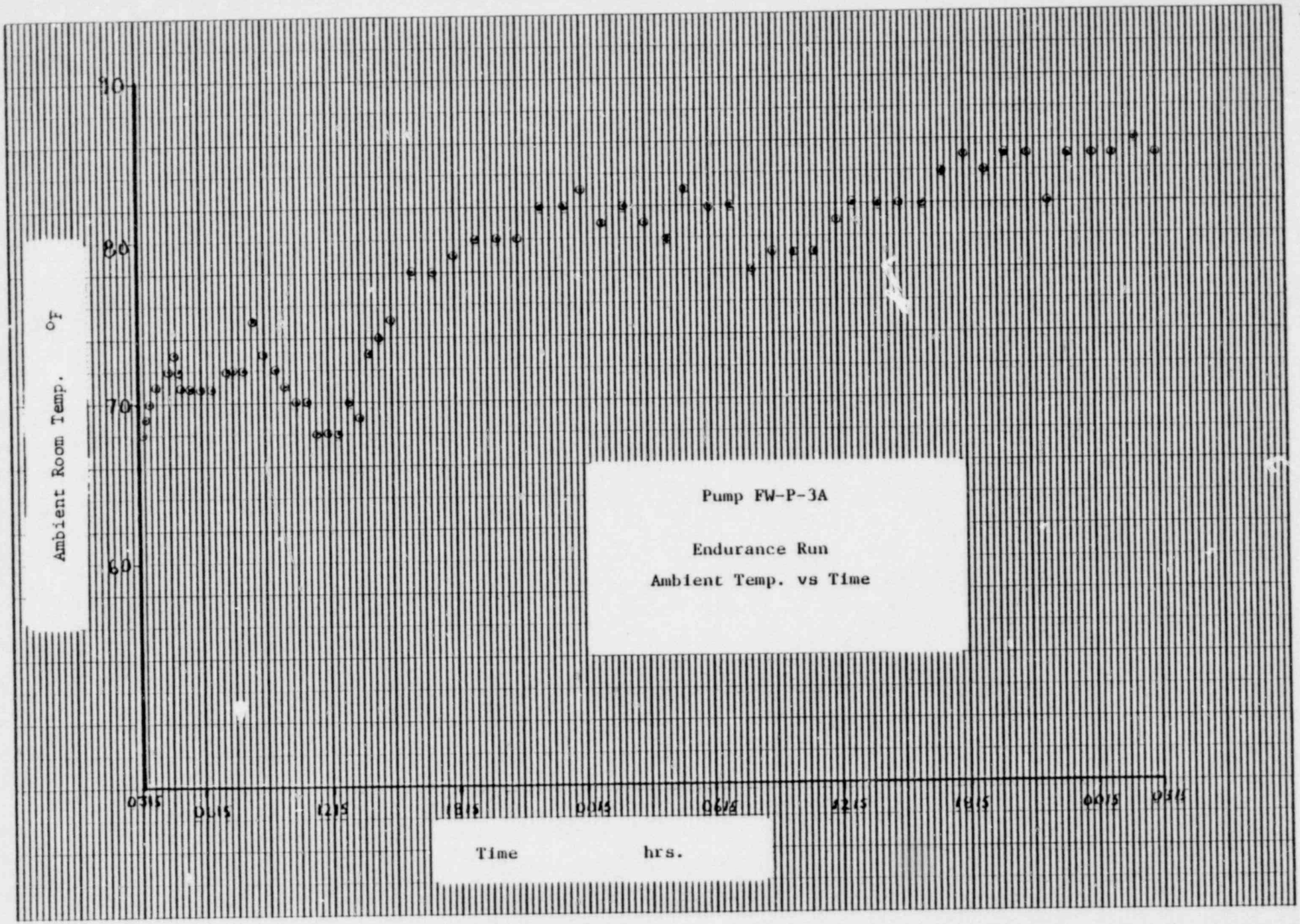

Ambient Room Temp. °F
90
80
70
60
Pump FW-P-3A
Endurance Run
Ambient Temp. vs Time
Time hrs.

Figure 5b

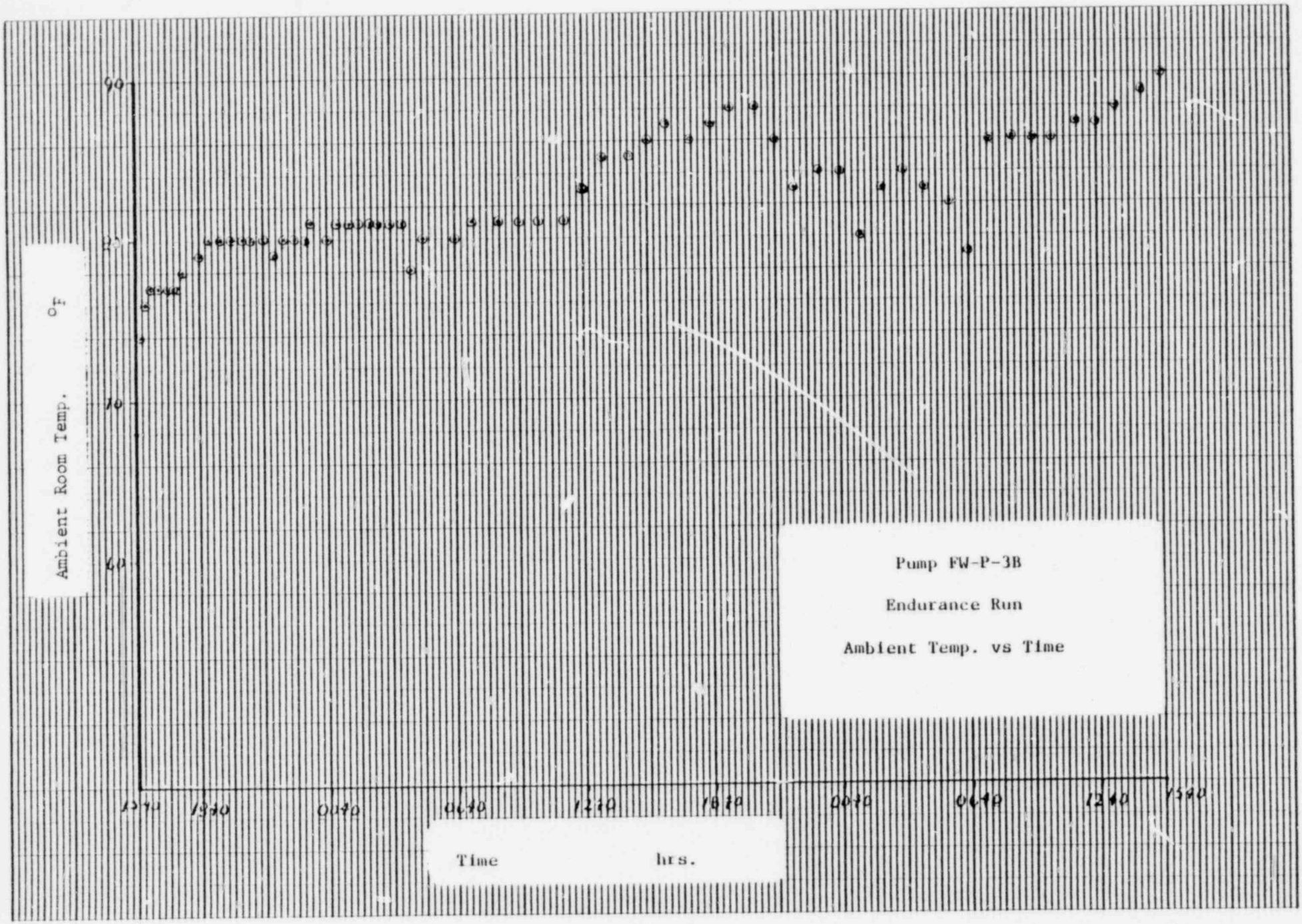

Ambient Room Temp. °F
90
80
70
60
1370
1920
0040
0640
1240
1840
0040
0640
1240
1540
Time hrs.
Pump FW-P-3B
Endurance Run
Ambient Temp. vs Time

Figure 5c

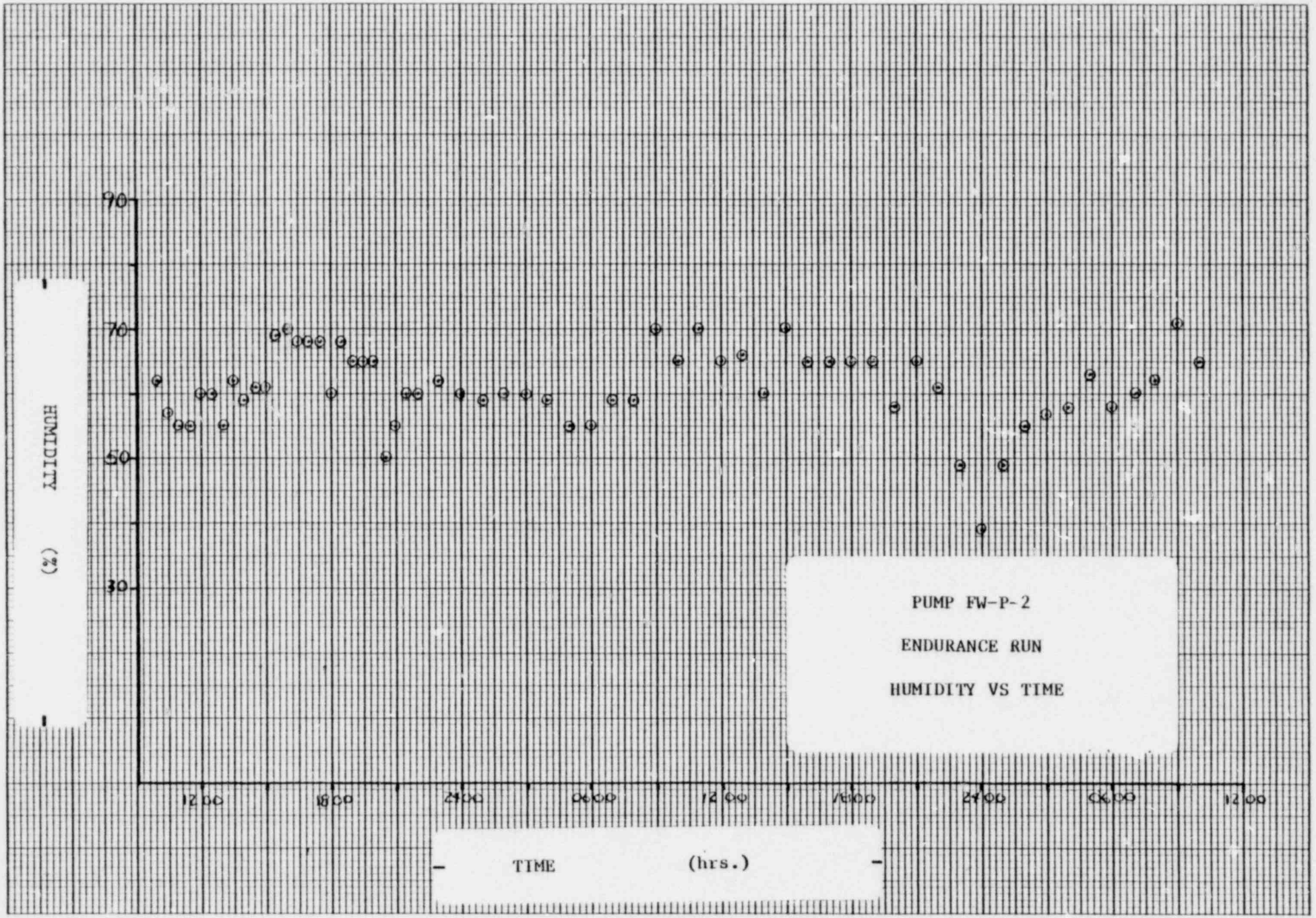

HUMIDITY (%)
90
70
50
30
12 00
18 00
24 00
06 00
12 00
18 00
24 00
06 00
12 00
TIME (hrs.)
PUMP FW-P-2
ENDURANCE RUN
HUMIDITY VS TIME

Figure 6a

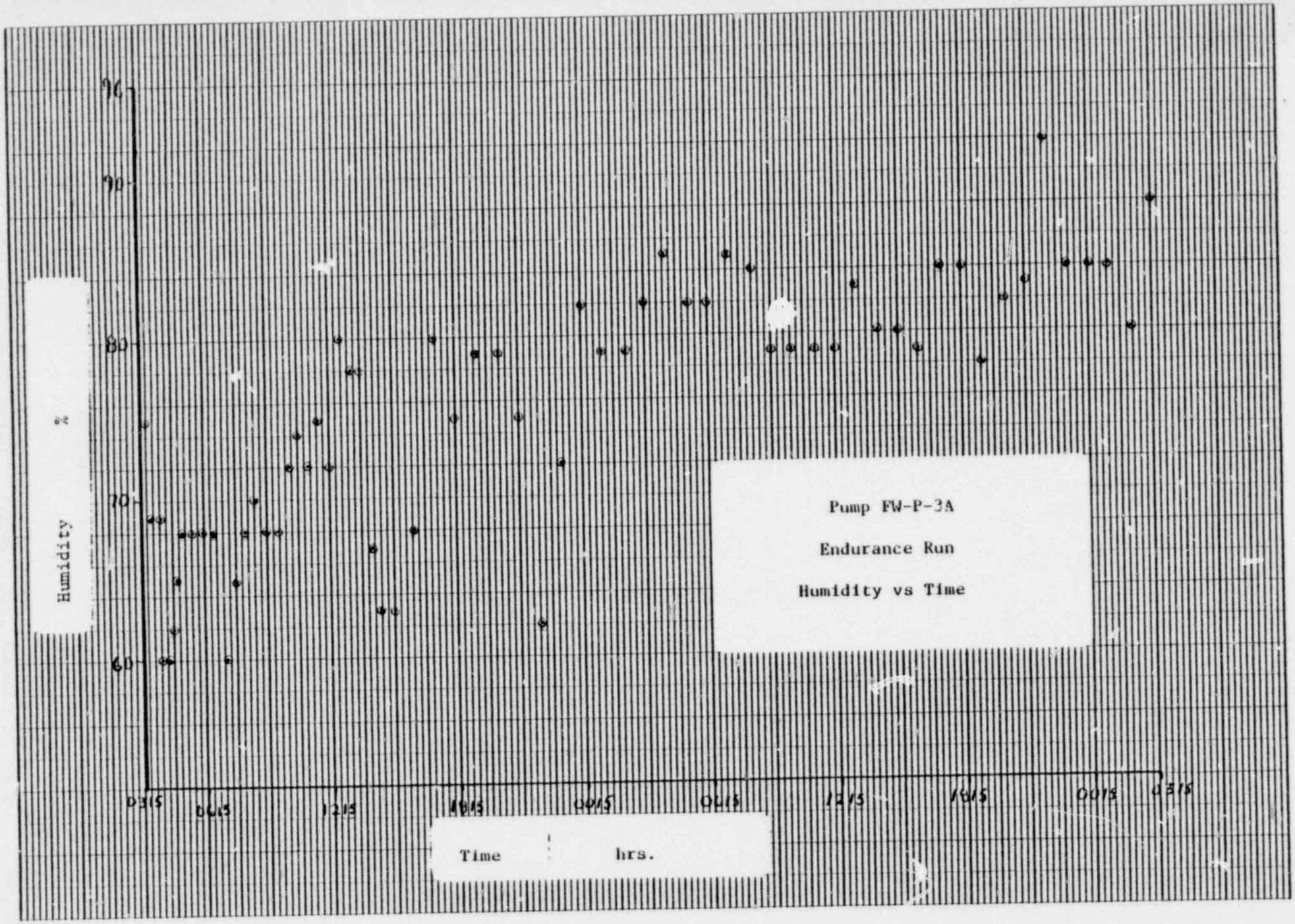

Humidity %
90
80
70
60
0315
0615
1215
1815
0015
0615
1215
1815
0015
0315
Time hrs.
Pump FW-P-3A
Endurance Run
Humidity vs Time

Figure 6b

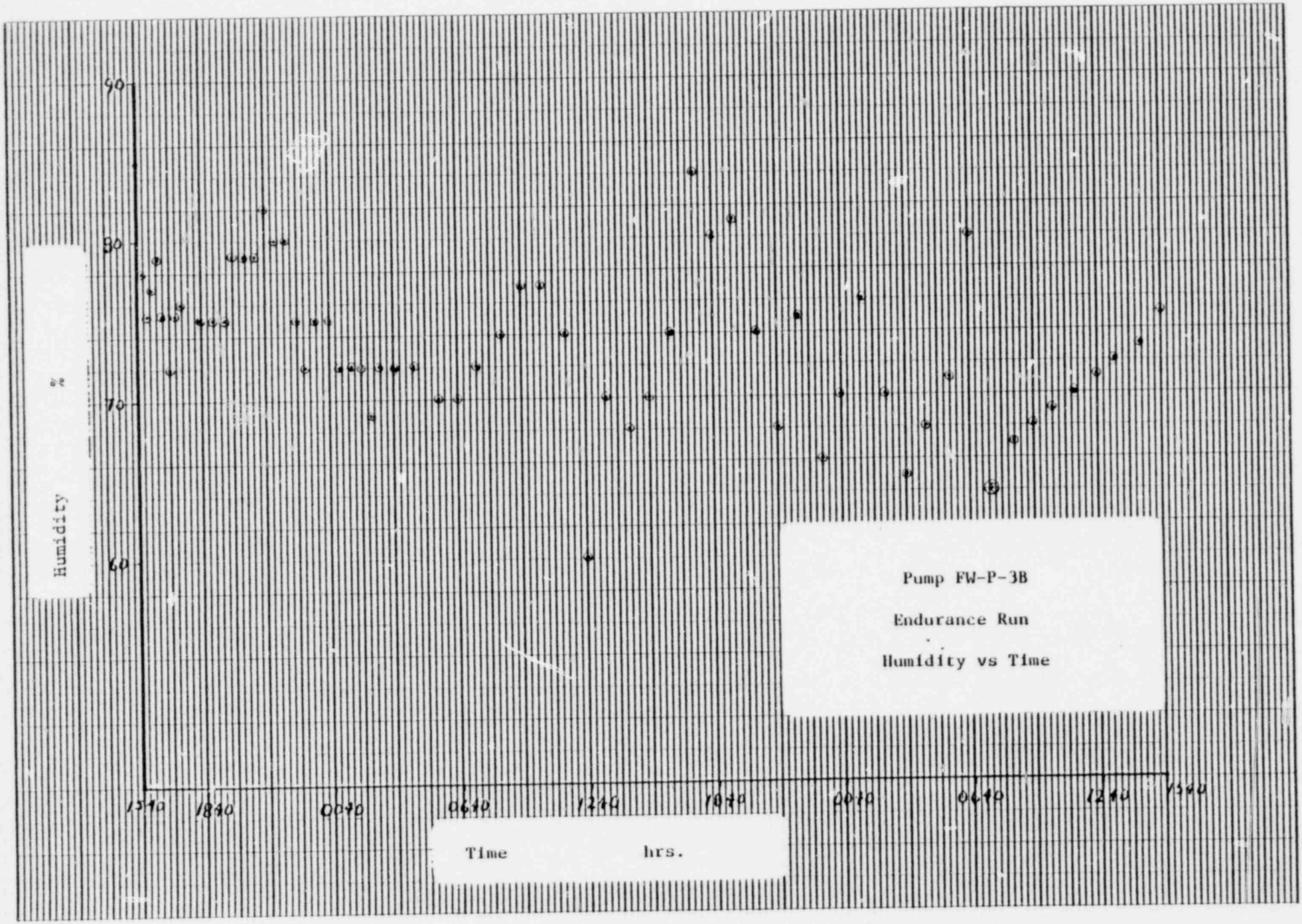

90
80
70
60
Humidity %
1540
1840
0040
0640
1240
1840
0040
0640
1240
1540
Time hrs.
Pump FW-P-3B
Endurance Run
Humidity vs Time

Figure 6c