

**INDUCTION MOTOR  
INSTRUCTION MANUAL**

**AEP PRO SERV  
Amos Plant SCR Construction Project  
Big Sandy Plant SCR Construction Project**

**EM SALE 01-1103-11  
PO PX71-103/PX71-118**

**ELECTRIC MACHINERY COMPANY  
800 CENTRAL AVENUE  
MINNEAPOLIS, MINNESOTA 55413  
PHONE: 612-378-8000      FAX: 612-378-8054**



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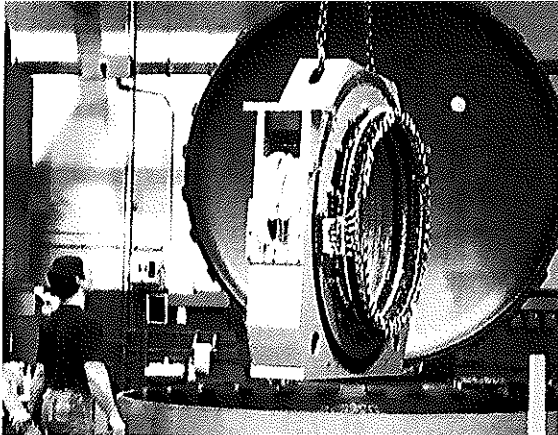
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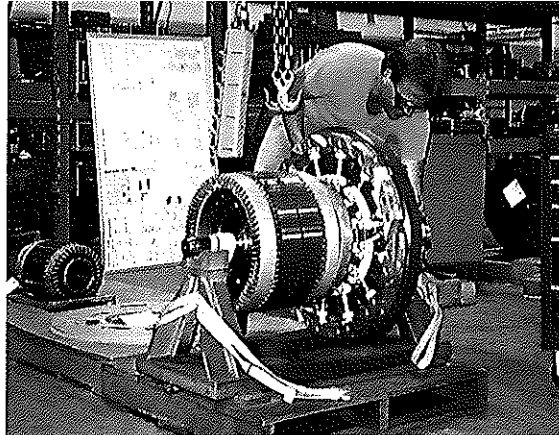
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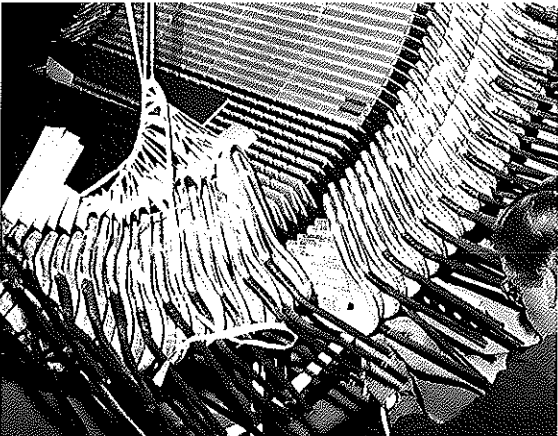
## Customer Service & Support



*Vacuum Pressure Impregnation Tank*



*Turbo Exciter Upgrades*



*Stator Rewinds*



*OEM Knowledge, Expertise.*

Protecting your investment - it means more than insuring the plant. It also means keeping your equipment in top condition to maximize service life and upgrading them to keep in step with changing technology. That's why you can count on EM - the responsive company with comprehensive rotating equipment service and support.

We have earned a reputation for quality by supporting our customers with specialized technical product support and our ability to respond promptly to customer demands. Excellent service is assured by people who understand your equipment and process needs. Our experienced staff of service engineers can spot potential performance problems and recommend corrective action. Continue to enjoy the benefits of first-hand product knowledge and problem solving capabilities by having us instruct your on-site staff. We can recommend ways to improve your equipment efficiency and reduce operation costs with improvements such as overhauls and upgrades. Our extensive experience gives us a strong base to help customers develop effective stocking programs. Rely on us to maximize your equipment availability.

EM experience...responding with solutions for over 100 years.

### ELECTRIC MACHINERY COMPANY

800 Central Avenue  
Minneapolis, MN 55413  
(612) 378-8000 Fax: (612) 378-8051  
[www.electrimachinery.com](http://www.electrimachinery.com)

Service: 612-378-8920 612-378-8916 612-378-8912

Parts: 612-378-8028 612-378-8170

After Hours: 612-247-9232

PARTS SERVICE REPAIRS



**FACTORY SERVICE CONTACT INFORMATION**

Electric Machinery maintains a complete staff of Engineering, Parts and Service Personnel to assist your needs 24 hours a day. During normal office hours, contact:

Automated General Office: 612-378-8000

Parts and Service Office Fax: 612-378-8051

**Parts Administrators:**

Terry Trombley 612-378-8028  
Russ Bakke 612-378-8170

**Service Engineers:**

Jim Heil 612-378-8916  
Roman Jurewicz 612-378-8952  
Oleg Pisarenko 612-378-8912

**Aftermarket Manager:**

Roman Jurewicz 612-378-8952

**Emergency contact for after-hours, weekends, or holidays:**

**For technical assistance or services**  
**please contact our emergency cell. #: 612-247-9232**

**For replacement spare parts**  
**please contact our emergency pager: 612-648-3692**

Please leave a detailed message including your company name, phone number, and problem you're having with your EM equipment.

Electric Machinery Company provides both stock and manufactured parts for all equipment manufactured at our plant. We offer field service on all EM motors, generators, and drives. We have repair capabilities on all electrical machines at our Minneapolis, Minnesota, USA facility. We welcome your inquiries.



PURCHASER <b>AMERICAN ELECTRIC POWER</b>		PURCHASE ORDER NUMBER <b>PX71-000000103/118</b>		RENEWAL PARTS	
USER <b>AMERICAN ELECTRIC POWER</b>		LOCATION <b>COLUMBUS, OHIO</b>		ROTATING APPARATUS	
HP or KVA <b>7000</b>	RPM <b>895</b>	P.F. <b>N/A</b>	Phase <b>3</b>	Freq <b>60</b>	SALE NUMBER <b>01-1103-11</b>

SH-186 (4-84)  MOTOR  MG SET  AMPLI-SPEED MAGNETIC DRIVE  GENERATOR  AMPLI-SPEED MAGNETIC DRIVE

VOLTAGE **13200** FRAME **8IC6231** SERIAL NUMBER **101110311**

MOTOR OR GENERATOR CONSTRUCTION	MECHANICAL CONSTRUCTION		BEARINGS	BEARING LOCATION	ELECTRICAL CONSTRUCTION
	<input type="checkbox"/> ENGINE TYPE	<input type="checkbox"/> FLANGE MOUNTED	NONE		STATOR COILS
	<input type="checkbox"/> SINGLE BEARING BRKT	<input type="checkbox"/> FLANGE MOUNTED	A		<input type="checkbox"/> Random Wound
	<input type="checkbox"/> COUPLED ONE PEDESTAL		A & B		<input checked="" type="checkbox"/> Form Wound
	<input checked="" type="checkbox"/> COUPLED BRACKET	<input type="checkbox"/> VERTICAL - 2 BEARING	A, B & C		ROTOR WINDING
	<input type="checkbox"/> COUPLED TWO PEDESTAL	<input type="checkbox"/> 2 UNIT - 1 FRAME	B, C & D		<input type="checkbox"/> Salient Pole - Wire Wound
	<input type="checkbox"/> VERTICAL - 3 BEARING		A, B, C & D		<input type="checkbox"/> Salient Pole - Strap Wound
<input type="checkbox"/> AMPLI-SPEED MAGNETIC DRIVE 3 BRG. VERT.		A, B, C & D	<input type="checkbox"/> Two Pole - Strap Wound		
<input type="checkbox"/> AMPLI-SPEED MAGNETIC DRIVE 4 BEARING			<input checked="" type="checkbox"/> Squirrel Cage		
NOTE: ON MAGNETIC DRIVES, BEARING "B" IS ON "OUTPUT" END. ON DOUBLE SHAFT EXTENSION MOTOR OR GENERATORS, BEARING "A" IS ON COLLECTOR RING END.					

BEARING ARRANGEMENTS	Loc	BEARING PART NO.	* OIL RING PART NO.	* OIL SEAL (Inner) NO.	* OIL SEAL (Outer) NO.
	A	840D458F05	840D458F04	840D458F03	840D458F03
	B	840D458F05	840D458F04	840D458F03	840D458F03
	C				
	D				
	Loc	BRG. INSUL. (Top) NO.	* BRG. INSUL. (Bottom) NO.	* AIR SEAL (Inner) NO.	* AIR SEAL (Outer) NO.
A			840D458F07		
B			840D458F07		

WORK PARTS	DESCRIPTION	INSULATION	PART or WINDING NUMBER	* RECOMMENDED SPARES
	Motor Stator Coils ( )	VPI	129F105	1-4 UNITS      5-9 UNITS
	Gen. Stator Coils ( )			** 1-Repair Kit    ** 1-Repair Kit
	Motor Field Coils ( )			** 1-Repair Kit    ** 1-Repair Kit
Gen. Fld. <input type="checkbox"/> Coils <input type="checkbox"/> Wnd. poles ( )			1                      2	
** NOTE: Repair kit consists of four coils - requires EM serviceman to install.				

OPERATING DRIVERS	DESCRIPTION	PART NUMBER	DESCRIPTION	PART NUMBER
	* Brush ( )		Cage Assembly	Order by Description
	* Brushholder ( )		Bearing Temp. Relay/RTD	
	* Brushholder Spring ( )		* Air Filter	NONE PROVIDED
	* Brushholder Stud ( )		Tach. Gen. or Mag. Pick Up	
	Collector Ring Assembly		M.P.U. Cable Assembly	
	Thermo-O-Disc		Space Heater ( 8 )	117A487F04
	PMG			
	Outline <b>134D079</b>	Electrical Connection <b>134D080</b>	Shaft Details <b>134D081</b>	
	Rotor Weight (lb) <b>16540</b>	Stator Weight (lb) <b>27000</b>	Total Weight (lb) <b>57650</b>	

KIND OF EXCITER:  DIRECT CONNECTED  CUST. BUS FRAME  STATIC  MG SET  AMPLI-SPEED MAGNETIC DRIVE

EXCITATION PARTS	DESCRIPTION	PART NUMBER	DESCRIPTION	PART NUMBER
	Revolving Rect Assembly		* Syncrite Control	
	* Diode - St. Polarity ( )		* Syncrite Filter	
	* Diode - Rev. Polarity ( )		* Fld. Discharge Res. ( )	
	* Surge Suppressor		Wound Armature - Generator	
	* Fuses ( )		Wound Stator - Generator	
	* SCR1 ( )		Field Pole Assembly ( )	
	* SCR2 ( )		Field Coil ( )	

Copies for:  
Aftermarket (1 ea.)  
Marketing (1 ea.)  
Engineering folder (1 ea.)

Quantities are one each unless otherwise indicated in parenthesis.  
Where blanks are not filled in, these items are not applicable.  
When ordering parts, give part description and part number (if known). Also serial number and rating of machine parts are for.  
Parts not described above have no part number and should be ordered by description. Replacement parts will be of latest design and may have superseding part numbers.  
\*Recommended these items be stocked - refer orders and inquiries to factory in Minneapolis.

## SAFETY & WARNING INFORMATION

- A. Use extreme care when lifting rotating machinery. Lifting means have been furnished based upon equipment weight, plus a safety margin consistent with conservative engineering practices. However, the use of the spreader bars is highly recommended to prevent shearing forces from damaging the equipment. Check all lifting lugs, eyes, etc. for damage to insure that all threaded parts are tightly installed before lifting equipment.
- B. All machinery covers and terminal box covers should be inspected to insure proper installation and that all bolts are properly tightened and all missing bolts are accounted for and properly installed.
- C. The location of the equipment must meet the requirements of the National Fire Protection Association, OSHA standards, and must comply with local special industrial regulations.
- D. These motors are designed to operate with an ambient temperature of no more than 104°F (40°C). Operation in ambient temperatures greater than 104°F may result in temperature rises that exceed the design temperature rise.

**ELECTRIC MACHINERY**  
**INDUCTION MOTOR DATA SHEET**

EM SALE NUMBER: 01-1103-11  
 CUSTOMER: AMERICAN ELECTRIC POWER  
 USER: AMERICAN ELECTRIC POWER  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

REV A

HORSEPOWER .....	7000	Hp
VOLTAGE .....	13200	Volt
FULL-LOAD SPEED .....	895	Rpm
FULL-LOAD CURRENT .....	283	Amp
NO-LOAD CURRENT .....	93	Amp
FREQUENCY .....	60	Hz
PHASE .....	3	
SERVICE FACTOR .....	1.15	pu
TEMP. RISE AT 1.0 PU LOAD BY <u>RTD</u> .....	80	°C
RESISTANCE (T-T) @ 25 °C.....	0.2750	Ohms
EFFICIENCY:		
@ 4/4 LOAD .....	96.0	%
@ 3/4 LOAD .....	96.0	%
@ 2/4 LOAD .....	94.5	%
POWER FACTOR:		
@ 4/4 LOAD .....	84.0	%
@ 3/4 LOAD .....	82.0	%
@ 2/4 LOAD .....	74.0	%
TORQUES:		
STARTING .....	51	%
PULL-UP .....	50	%
BREAKDOWN .....	200	%
LOAD INERTIA .....	77265	lb-ft <sup>2</sup>
LOCKED ROTOR CURRENT (@ FULL-VOLTAGE) .....	1500	Amp
LOCKED ROTOR POWER FACTOR.....	.12	pu
ACCELERATION TIME (MOTOR & LOAD @ <u>90</u> % RATED VOLTAGE).....	16	sec
MAXIMUM ALLOWABLE TIME ON CAGE WINDING :		
WITHOUT INJURY TO CAGE (@ FULL VOLTAGE & ZERO SPEED.....	22	sec

Stator insulation is E-M Duraguard.  
 Stator wire strand is insulated with enamel plus mica tape.

*\$ 269,735.00 @  
 March 2001*

REV A: Service Factor Was 1.0 W L Billington 5/21/2001  
 REV B: Added notes on strand and coil insulation W L Billington 10/02/01

**MOTOR DATA SHEET**

(to be filled out by Manufacturer)

This data may be presented in manufacturer's standard format.

Horsepower		7000	HP
Voltage		13200	VOLTS
Full Load Speed		895	RPM
Full Load Current		283	AMPS
Guaranteed Efficiency	96.0	% @ 75% LOAD	96.0 % @ 100% LOAD
Guaranteed Power Factor		84.0	@ 100% LOAD
Locked Rotor Current	1200	AMPS @ 80% VOLTAGE	1500 AMPS @ 100% VOLTAGE
Stator Temperature Rise		80° C by RTD	DEG C
Starting Torque	13000	LB-FT @ 80% VOLTAGE	20900 LB-FT @ 100% VOLTAGE
Breakdown Torque		82000	LB-FT @ 100% VOLTAGE
Starting Time	20.0	SEC @ 80% VOLTAGE	13.0 SEC @ 100% VOLTAGE
Allowable Stall Time	34.0	SEC @ 80% VOLTAGE	22.0 SEC @ 100% VOLTAGE
Number Consecutive Starts	1	HOT	2 COLD
Core Length		31	INCHES
Air Gap		2.00	INCHES
Stator Core Iron	62.0	INCHED OD	47.0 INCHES ID
Number of Stator Slots		96	# SLOTS
Stator Slot Size		.810	INCHES
Rotor Core Iron	46.6	INCHES OD	27.0 INCHES ID
Number of Rotor Slots		77	# SLOTS
Rotor Slot Size	.755	INCHES	1.905 INCHES
Rotor Sorting Ring	46.6	INCHES OD	38 INCHES ID
Ring Thickness		1.0	INCHES
Stator Winding	11	TURNS / COIL	2 STRANDS / TURN
Stator Strand Size		.220	INCHES
Stator Insulation	.149	INCH THICKNESS	51.1 Vrms / mil
Bearing Temperature Rise		Less than 50° C	DEG C
Oil Quantity / Viscosity	6.4	GAL / BRG	250 SSU @ 100 DEG C
Grease		NIA	NLGI TYPE
Weights	16500	LBS ROTOR	56850 LBS ASSEMBLED MOTOR
Stator w/o rotor, bearings or end bells			27000 LBS
Rotor Inertia (H Constant)			29150 LBS-FT <sup>2</sup>
Maximum Transient Force on Base	10 sht ckt each of 4 ft		13525+22800 LBS
Space Heater	2.0	KW	208 VOLTS
Outline Drawing #			134D079
Instruction Book #			INS 1300
Frame Size Designation			84296-SE
Equivalent Circuit Parameters:			
R <sub>1</sub>	.14		ohm/phase @ 25 deg C
X <sub>1</sub>	4.22		"
X <sub>m</sub>	86.5		"
R <sub>2</sub>	.09		"
X <sub>2</sub>	3.51		"
T <sub>do</sub>	.08		Second
T <sub>d</sub>	.10		Second
S	.0055		P.U.
Bearing ABMA Number			NIA
Babbit Type			Tin Base
T <sub>do</sub>			1.9 Second



# ELECTRIC MACHINERY COMPANY TEST RESULTS

**Purchaser:** American Electric Power      **Date of Test** September 29, 2001  
221 No. Front Street      **Purchase Order No.** PX71-0000000103  
Columbus, OH 43215      **Manufacturer's Order No.** 01-1103-11

**User:** American Electric Power  
221 No. Front Street  
Columbus, OH 43215

### NAMEPLATE RATING

HP Output	Sync. Speed Rpm	RPM	Phase	Hz	Volts	Amperes	Type	Frame Number
7000	900	895	3	60	13200	283	IC	8IC6231

### CHARACTERISTICS

Slip Per Cent Full load	No Load					Resistance T-T. (ohms) At 25°C
	Volts	Hertz	RPM	Amperes	KW	
0.50	13200	60	899+	94.0	94.8	.274

### TORQUE AND STARTING CURRENT

### DIELECTRIC TEST

Locked-Rotor Torque Lbs. at 1 ft. Radius with 100% Volts Applied	Starting Current Amperes (locked rotor) with 100% Volts Applied	Stator A-C Volts for 60 sec.
28280	1390	27400

### EFFICIENCY %

115% Load	Full Load	75% Load	50% Load
96.3	96.4	96.3	95.7

### POWER FACTOR %

115% Load	Full Load	75% Load	50% Load
84.7	84.4	81.9	74.4

Notes: Data from test on THIS motor.      W# 129F105      Serial # 101110311

*Am I*



**Serial Number:** 101110311  
**Customer:** American Electric Power  
**User:** American Electric Power

Hp	Rpm	Phase	Freq	Volts	Amps
7000	895	3	60	13200	283

Rotation: CCW  
 Phase Sequence: 1-3-2  
 Single Air Gap: .195 inch  
 Current Balance Check: OK  
 Final Megger Reading in Megohms Corrected to 40°C: 5400

**Final Vibration Readings after 2.0 Hour No Load Run --  $\times 10^{-3}$  Inch Displacement:**

Front Housing						Rear Housing					
Horizontal		Vertical		Axial		Horizontal		Vertical		Axial	
Filter		Filter		Filter		Filter		Filter		Filter	
In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
.03	.10	.01	.09	.01	.03	.04	.10	.02	.13	.02	.22

**Bearing Temperature after 2.0 Hour Run:**

Front Bearing	
Ambient	Bearing Temp.
23.0	63

Rear Bearing	
Ambient	Bearing Temp.
23.0	58

**Space Heater Check:**

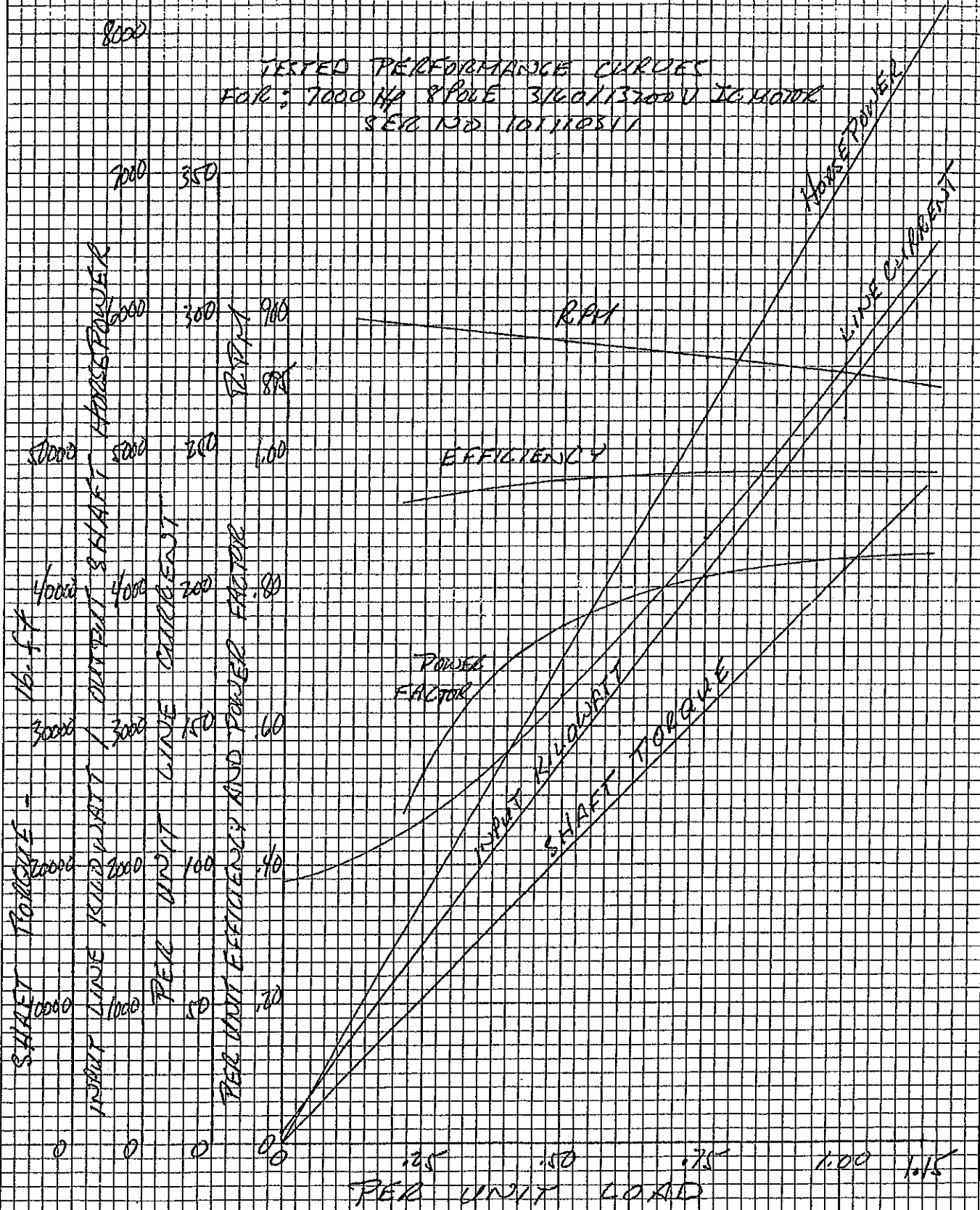
Phase	Volts	Amps.	KW
1	208	8.74	1.82

Approved by: W. H. Bellinger

Date: October 1, 2001



Electric Machinery Company  
800 Central Avenue  
Minneapolis, MN 55413



W. B. [Signature] / Sept 24, 2001  
EE 12764



# ELECTRIC MACHINERY COMPANY TEST RESULTS

**Purchaser:** American Electric Power      **Date of Test** September 29, 2001  
221 No. Front Street      **Purchase Order No.** PX71-0000000103  
Columbus, OH 43215      **Manufacturer's Order No.** 01-1103-11

**User:** American Electric Power  
221 No. Front Street  
Columbus, OH 43215

### NAMEPLATE RATING

HP Output	Sync. Speed Rpm	RPM	Phase	Hz	Volts	Amperes	Type	Frame Number
7000	900	895	3	60	13200	283	IC	81C6231

### CHARACTERISTICS

No Load						Resistance T-T (ohms) At 25°C
Volts	Hertz	RPM	Amperes	KW		
13200	60	899+	95.6	93.6		.277

### DIELECTRIC TEST

Stator A-C Volts for 60 sec.  
27400

Rotation: CCW  
Phase Sequence: 1-3-2  
Single Air Gap: .196 inch  
Current Balance Check: OK  
Final Megger Reading in Megohms Corrected to 40°C: 2645

Notes: Data from test on THIS motor.      W# 129F105      Serial # 201110311



# ELECTRIC MACHINERY

Serial Number: 201110311

Customer: American Electric Power

User: American Electric Power

<b>Hp</b>	<b>Rpm</b>	<b>Phase</b>	<b>Freq</b>	<b>Volts</b>	<b>Amps</b>
7000	895	3	60	13200	283

### Final Vibration Readings after 2.0 Hour No Load Run - x10<sup>-3</sup> Inch Displacement:

Front Housing						Rear Housing					
Horizontal		Vertical		Axial		Horizontal		Vertical		Axial	
Filter		Filter		Filter		Filter		Filter		Filter	
In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
.025	.105	.027	.119	.012	.090	.035	.111	.008	.109	.006	.037

### Bearing Temperature after 2.0 Hour Run:

Front Bearing	
Ambient	Bearing Temp.
23.0	57

Rear Bearing	
Ambient	Bearing Temp.
23.0	51

### Space Heater Check:

Phase	Volts	Amps.	KW
1	208	9.04	1.88

Approved by:

*William J. Bell*

Date:

*October 3, 2001*



# ELECTRIC MACHINERY COMPANY TEST RESULTS

**Purchaser:** American Electric Power      **Date of Test** October 9, 2001  
221 No. Front Street      **Purchase Order No.** PX71-0000000103  
Columbus, OH 43215      **Manufacturer's Order No.** 01-1103-11

**User:** American Electric Power  
221 No. Front Street  
Columbus, OH 43215

### NAMEPLATE RATING

HP Output	Sync. Speed Rpm	RPM	Phase	Hz	Volts	Amperes	Type	Frame Number
7000	900	895	3	60	13200	283	IC	8IC6231

### CHARACTERISTICS

No Load					Resistance T-T (ohms) At 25°C
Volts	Hertz	RPM	Amperes	KW	
13200	60	899+	95.2	96.0	.276

### DIELECTRIC TEST

Stator A-C Volts for 60 sec.  
27400

Rotation: CCW  
Phase Sequence: 1-3-2  
Single Air Gap: .197 inch  
Current Balance Check: OK  
Final Megger Reading in Megohms Corrected to 40°C: 4240

Notes: Data from test on THIS motor.      W# 129F105      Serial # 301110311



# ELECTRIC MACHINERY

Serial Number: 301110311

Customer: American Electric Power

User: American Electric Power

<b>Hp</b> 7000	<b>Rpm</b> 895	<b>Phase</b> 3	<b>Freq</b> 60	<b>Volts</b> 13200	<b>Amps</b> 283
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### Final Vibration Readings after 1.5 Hour No Load Run – x10<sup>-3</sup> Inch Displacement:

Front Housing						Rear Housing					
Horizontal		Vertical		Axial		Horizontal		Vertical		Axial	
Filter		Filter		Filter		Filter		Filter		Filter	
In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
.016	.085	.006	.083	.006	.037	.029	.103	.016	.114	.014	.068

### Bearing Temperature after 1.5 Hour Run:

Front Bearing	
Ambient	Bearing Temp.
20.0	53

Rear Bearing	
Ambient	Bearing Temp.
20.0	59

### Space Heater Check:

Phase	Volts	Amps.	KW
1	208	9.02	1.87

Approved by:

Date:

October 9, 2001



# ELECTRIC MACHINERY COMPANY TEST RESULTS

**Purchaser:** American Electric Power      **Date of Test** October 15, 2001  
221 No. Front Street      **Purchase Order No.** PX71-0000000103  
Columbus, OH 43215      **Manufacturer's Order No.** 01-1103-11

**User:** American Electric Power  
221 No. Front Street  
Columbus, OH 43215

### NAMEPLATE RATING

HP Output	Sync. Speed Rpm	RPM	Phase	Hz	Volts	Amperes	Type	Frame Number
7000	900	895	3	60	13200	283	IC	8IC6231

### CHARACTERISTICS

No Load					Resistance T-T (ohms) At 25°C
Volts	Hertz	RPM	Amperes	KW	
13200	60	899+	94.9	99.6	.276

### DIELECTRIC TEST

Stator A-C Volts for 60 sec.  
27400

Rotation: CCW  
Phase Sequence: 1-3-2  
Single Air Gap: .199 inch  
Current Balance Check: OK  
Final Megger Reading in Megohms Corrected to 40°C: 6680

es: Data from test on THIS motor.      W# 129F105      Serial # 401110311



# ELECTRIC MACHINERY

Serial Number: 401110311

Customer: American Electric Power

User: American Electric Power

**Hp**  
7000

**Rpm**  
895

**Phase**  
3

**Freq**  
60

**Volts**  
13200

**Amps**  
283

### Final Vibration Readings after 2.0 Hour No Load Run – x10<sup>-3</sup> Inch Displacement:

Front Housing						Rear Housing					
Horizontal		Vertical		Axial		Horizontal		Vertical		Axial	
Filter		Filter		Filter		Filter		Filter		Filter	
In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
.036	.044	.024	.028	.025	.084	.032	.042	.022	.026	.038	.110

### Bearing Temperature after 2.0 Hour Run:

Front Bearing	
Ambient	Bearing Temp.
22.0	59

Rear Bearing	
Ambient	Bearing Temp.
22.0	61

### Space Heater Check:

Phase	Volts	Amps.	KW
1	208	9.39	1.95

Approved by: \_\_\_\_\_

Date: \_\_\_\_\_

October 17, 2001



# ELECTRIC MACHINERY COMPANY TEST RESULTS

**Purchaser:** American Electric Power  
221 No. Front Street  
Columbus, OH 43215

**Date of Test** October 27, 2001  
**Purchase Order No.** PX71-0000000103  
**Manufacturer's Order No.** 01-1103-11

**User:** American Electric Power  
221 No. Front Street  
Columbus, OH 43215

### NAMEPLATE RATING

HP Output	Sync. Speed Rpm	RPM	Phase	Hz	Volts	Amperes	Type	Frame Number
7000	900	895	3	60	13200	283	IC	8IC6231

### CHARACTERISTICS

No Load					Resistance T-T (ohms) At 25°C
Volts	Hertz	RPM	Amperes	KW	
13200	60	899+	96.0	93.6	.276

### DIELECTRIC TEST

Stator A-C Volts for 60 sec.  
27400

Rotation: CCW  
 Phase Sequence: 1-3-2  
 Single Air Gap: .198 inch  
 Current Balance Check: OK  
 Final Megger Reading in Megohms Corrected to 40°C: 3500

s: Data from test on THIS motor.

W# 129F105

Serial # 501110311



# ELECTRIC MACHINERY

Serial Number: 501110311

Customer: American Electric Power

User: American Electric Power

<b>Hp</b>	<b>Rpm</b>	<b>Phase</b>	<b>Freq</b>	<b>Volts</b>	<b>Amps</b>
7000	895	3	60	13200	283

### Final Vibration Readings after 1.0 Hour No Load Run – x10<sup>-3</sup> Inch Displacement:

Front Housing						Rear Housing					
Horizontal		Vertical		Axial		Horizontal		Vertical		Axial	
Filter		Filter		Filter		Filter		Filter		Filter	
In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
.025	.081	.025	.212	.004	.039	.037	.106	.041	.228	.021	.081

### Bearing Temperature after 1.0 Hour Run:

Front Bearing	
Ambient	Bearing Temp.
20.2	58.2

Rear Bearing	
Ambient	Bearing Temp.
20.2	55.4

### Space Heater Check:

Phase	Volts	Amps.	KW
1	208	9.47	1.97

Approved by: \_\_\_\_\_

Date: \_\_\_\_\_

October 29, 2001



# ELECTRIC MACHINERY COMPANY TEST RESULTS

**Purchaser:** American Electric Power      **Date of Test** October 27, 2001  
221 No. Front Street      **Purchase Order No.** PX71-0000000103  
Columbus, OH 43215      **Manufacturer's Order No.** 01-1103-11

**User:** American Electric Power  
221 No. Front Street  
Columbus, OH 43215

### NAMEPLATE RATING

HP Output	Sync. Speed Rpm	RPM	Phase	Hz	Volts	Amperes	Type	Frame Number
7000	900	895	3	60	13200	283	IC	8IC6231

### CHARACTERISTICS

No Load					Resistance T-T (ohms) At 25°C
Volts	Hertz	RPM	Amperes	KW	
13200	60	899+	95.4	93.6	.272

### DIELECTRIC TEST

Stator A-C Volts for 60 sec.  
27400

Rotation: CCW  
Phase Sequence: 1-3-2  
Single Air Gap: .198 inch  
Current Balance Check: OK  
Final Megger Reading in Megohms Corrected to 40°C: 3380

Data from test on THIS motor.

W# 129F105

Serial # 601110311



# ELECTRIC MACHINERY

Serial Number: 601110311

Customer: American Electric Power

User: American Electric Power

<b>Hp</b> 7000	<b>Rpm</b> 895	<b>Phase</b> 3	<b>Freq</b> 60	<b>Volts</b> 13200	<b>Amps</b> 283
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### Final Vibration Readings after 1.5 Hour No Load Run – x10<sup>-3</sup> Inch Displacement:

Front Housing						Rear Housing					
Horizontal		Vertical		Axial		Horizontal		Vertical		Axial	
Filter		Filter		Filter		Filter		Filter		Filter	
In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
.031	.093	.016	.066	.021	.149	.031	.085	.008	.119	.023	.173

### Bearing Temperature after 1.5 Hour Run:

Front Bearing	
Ambient	Bearing Temp.
21.6	58.8

Rear Bearing	
Ambient	Bearing Temp.
21.6	55.8

### Space Heater Check:

Phase	Volts	Amps.	KW
1	208	9.37	1.94

Approved by:

*W.B. Blanton*

Date:

*October 29, 2001*

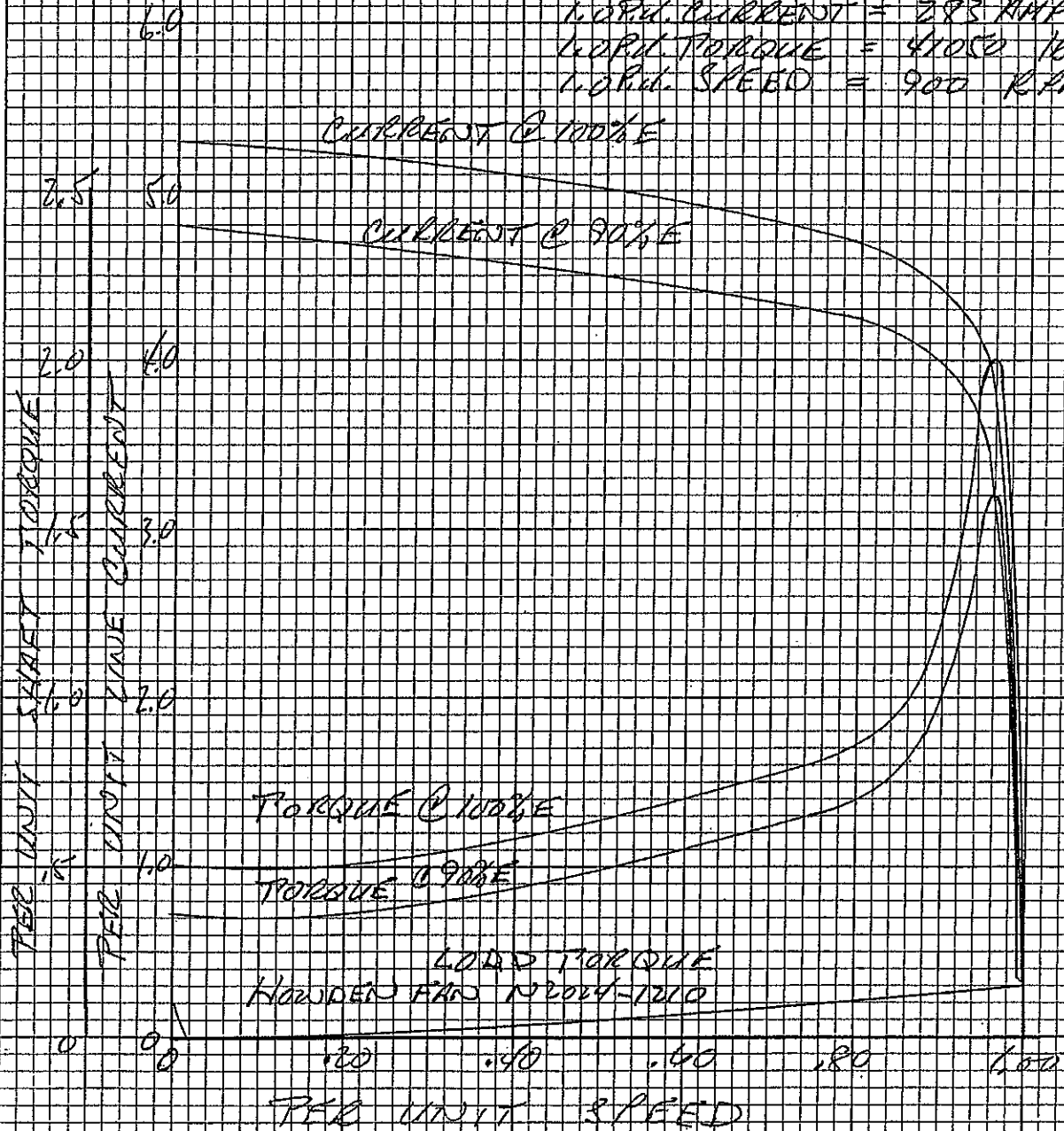


Electric Machinery Company  
800 Central Avenue  
Minneapolis, MN 55413

CALCULATED

TORQUE AND CURRENT VS. SPEED  
FREQ: 7000 RPM 8 POLE 3/60/13200 VOLT IC MOTOR  
SER 100 1-1001110311

LOAD CURRENT = 293 AMP  
LOAD TORQUE = 41000 LB-FT  
LOAD SPEED = 900 RPM



W. J. ... March 29, 2001  
EE 12682

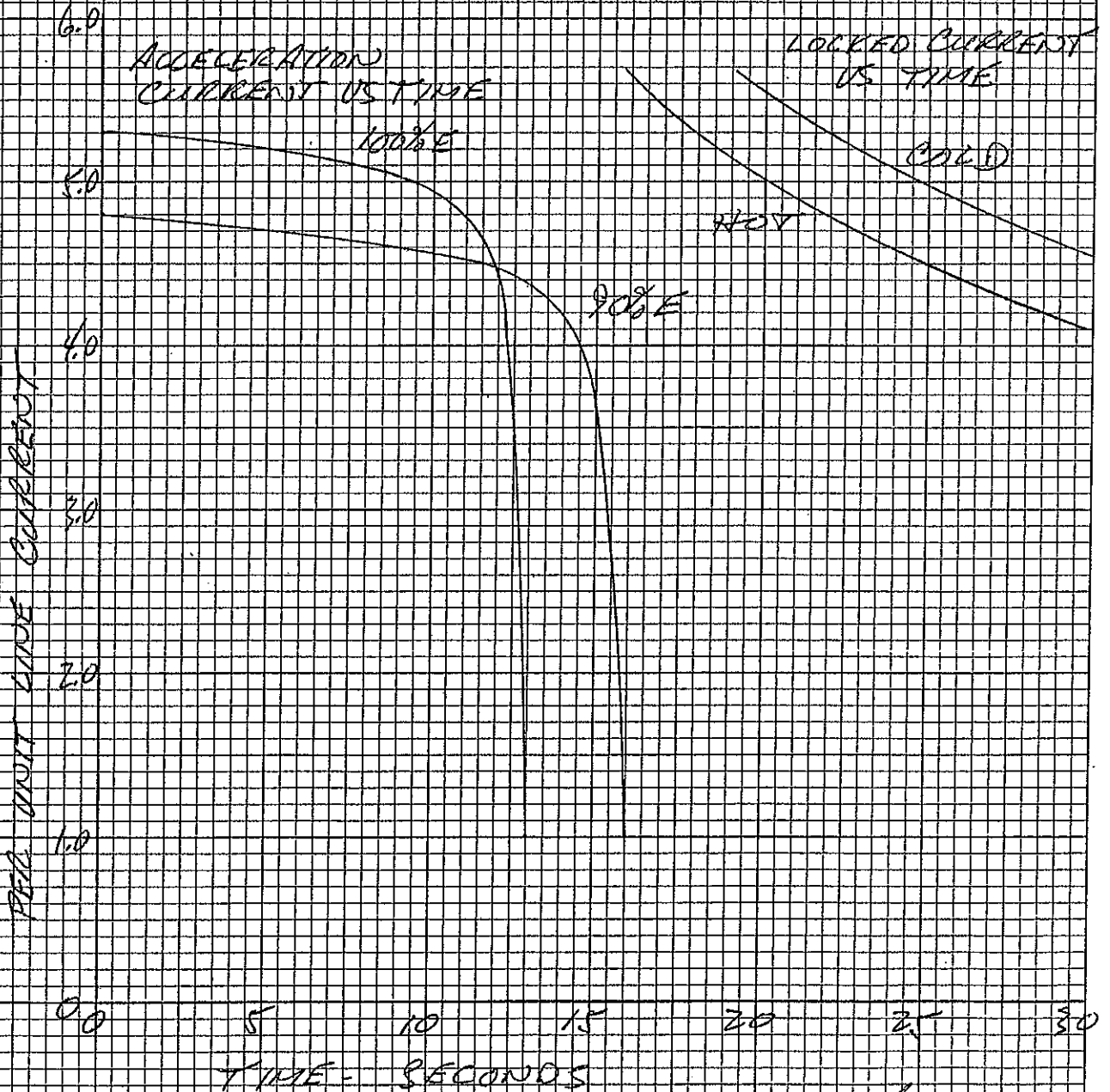
46 0780

KE 10 X 10 TO THE INCH • 7 X 10 INCHES  
REUFFEL & ESSER CO. MADE IN U.S.A.



Electric Machinery Company  
800 Central Avenue  
Minneapolis, MN 55413

CALCULATED  
LOCKED AND ACCELERATION CURRENT VS TIME  
FOR: 7000 HP 8 POLE 3 PH/13200 VOLT IC MOTOR  
SER NO 1-10 0110511  
L.O.P.M. CURRENT = 283 AMP  
LOAD WPK = 7725 HP  
LOAD TORQUE - SEE EE 12686



W. B. [Signature] March 29, 1961  
EE 12683

46 0780

10 X 10 TO THE INCH • 7 X 10 INCHES  
KEUFFEL & ESSER CO. MADE IN U.S.A.



# ELECTRIC MACHINERY COMPANY TEST RESULTS

**Purchaser:** American Electric Power      **Date of Test** November 15, 2001  
221 No. Front Street      **Purchase Order No.** PX71-0000000103  
Columbus, OH 43215      **Manufacturer's Order No.** 01-1103-11

**User:** American Electric Power  
221 No. Front Street  
Columbus, OH 43215

### NAMEPLATE RATING

HP Output	Sync. Speed Rpm	RPM	Phase	Hz	Volts	Amperes	Type	Frame Number
7000	900	895	3	60	13200	283	IC	81C6231

### CHARACTERISTICS

No Load					Resistance T-T (ohms) At 25°C
Volts	Hertz	RPM	Amperes	KW	
13200	60	899+	95.8	95.7	.276

### DIELECTRIC TEST

Stator A-C Volts for 60 sec.  
27400

Rotation: CCW  
Phase Sequence: 1-3-2  
Single Air Gap: .198 inch  
Current Balance Check: OK  
Final Megger Reading in Megohms Corrected to 40°C: 3240

### Notes:

Data from test on THIS motor.

W# 129F105

Serial # 701110311



**Serial Number:** 701110311  
**Customer:** American Electric Power  
**User:** American Electric Power

<i>Hp</i>	<i>Rpm</i>	<i>Phase</i>	<i>Freq</i>	<i>Volts</i>	<i>Amps</i>
7000	895	3	60	13200	283

**Final Vibration Readings after 1.0 Hour No Load Run – x10<sup>-3</sup> Inch Displacement:**

Front Housing						Rear Housing					
Horizontal		Vertical		Axial		Horizontal		Vertical		Axial	
Filter		Filter		Filter		Filter		Filter		Filter	
In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
.027	.188	.020	.188	.031	.188	.039	.219	.031	.156	.020	.188

**Bearing Temperature after 1.0 Hour Run:**

Front Bearing	
Ambient	Bearing Temp.
22.0	55.0

Rear Bearing	
Ambient	Bearing Temp.
22.0	53.0

**Space Heater Check:**

Phase	Volts	Amps.	KW
1	208	9.5	1.98

Approved by: *W. B. Billings*

Date: *November 16, 2001*



**ELECTRIC MACHINERY COMPANY  
TEST RESULTS**

**Purchaser:** American Electric Power **Date of Test** November 20, 2001  
221 No. Front Street **Purchase Order No.** PX71-0000000103  
Columbus, OH 43215 **Manufacturer's Order No.** 01-1103-11

**User:** American Electric Power  
221 No. Front Street  
Columbus, OH 43215

**NAMEPLATE RATING**

HP Output	Sync. Speed Rpm	RPM	Phase	Hz	Volts	Amperes	Type	Frame Number
7000	900	895	3	60	13200	283	IC	8IC6231

**CHARACTERISTICS**

No Load					Resistance T-T (ohms) At 25°C
Volts	Hertz	RPM	Amperes	KW	
13200	60	899+	94.8	88.8	.276

**DIELECTRIC TEST**

Stator A-C Volts for 60 sec.  
27400

Rotation: CCW  
Phase Sequence: 1-3-2  
Single Air Gap: .198 inch  
Current Balance Check: OK  
Final Megger Reading in Megohms Corrected to 40°C: 4480

s: Data from test on THIS motor. W# 129F105 Serial # 801110311



**Serial Number:** 801110311  
**Customer:** American Electric Power  
**User:** American Electric Power

<b>Hp</b> 7000	<b>Rpm</b> 895	<b>Phase</b> 3	<b>Freq</b> 60	<b>Volts</b> 13200	<b>Amps</b> 283
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**Final Vibration Readings after 1.0 Hour No Load Run – x10<sup>-3</sup> Inch Displacement:**

Front Housing						Rear Housing					
Horizontal		Vertical		Axial		Horizontal		Vertical		Axial	
Filter		Filter		Filter		Filter		Filter		Filter	
In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
.023	.188	.020	.188	.023	.219	.023	.188	.023	.188	.027	.219

**Bearing Temperature after 1.0 Hour Run:**

Front Bearing	
Ambient	Bearing Temp.
22.0	49.0

Rear Bearing	
Ambient	Bearing Temp.
22.0	47.0

**Space Heater Check:**

Phase	Volts	Amps.	KW
1	208	10.2	2.12

Approved by: W. B. Bellinger

Date: November 21, 2001



# ELECTRIC MACHINERY COMPANY TEST RESULTS

**Purchaser:** American Electric Power      **Date of Test** November 25, 2001  
221 No. Front Street      **Purchase Order No.** PX71-0000000118  
Columbus, OH 43215      **Manufacturer's Order No.** 01-1103-11

**User:** American Electric Power  
221 No. Front Street  
Columbus, OH 43215

### NAMEPLATE RATING

HP Output	Sync. Speed Rpm	RPM	Phase	Hz	Volts	Amperes	Type	Frame Number
7000	900	895	3	60	13200	283	IC	8IC6231

### CHARACTERISTICS

No Load					Resistance T-T (ohms) At 25°C
Volts	Hertz	RPM	Amperes	KW	
13200	60	899+	94.1	111.6	.274

### DIELECTRIC TEST

Stator A-C Volts for 60 sec.  
27400

Rotation: CCW  
Phase Sequence: 1-3-2  
Single Air Gap: .196 inch  
Current Balance Check: OK  
Final Megger Reading in Megohms Corrected to 40°C: 5970

3: Data from test on THIS motor.      W# 129F105      Serial # 901110311


**ELECTRIC MACHINERY**

**Serial Number:** 901110311  
**Customer:** American Electric Power  
**User:** American Electric Power

<i>Hp</i>	<i>Rpm</i>	<i>Phase</i>	<i>Freq</i>	<i>Volts</i>	<i>Amps</i>
7000	895	3	60	13200	283

**Final Vibration Readings after 3.0 Hour No Load Run – x10<sup>-3</sup> Inch Displacement:**

Front Housing						Rear Housing					
Horizontal		Vertical		Axial		Horizontal		Vertical		Axial	
Filter		Filter		Filter		Filter		Filter		Filter	
In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
.027	.156	.031	.188	.027	.219	.012	.188	.023	.188	.023	.219

**Bearing Temperature after 3.0 Hour Run:**

Front Bearing	
Ambient	Bearing Temp.
22.0	53.0

Rear Bearing	
Ambient	Bearing Temp.
22.0	57.0

**Space Heater Check:**

Phase	Volts	Amps.	KW
1	208	9.48	1.97

Approved by: W. B. Billington

Date: November 29, 2001



# ELECTRIC MACHINERY COMPANY TEST RESULTS

**Purchaser:** American Electric Power      **Date of Test** December 10, 2001  
221 No. Front Street      **Purchase Order No.** PX71-0000000118  
Columbus, OH 43215      **Manufacturer's Order No.** 01-1103-11

**User:** American Electric Power  
221 No. Front Street  
Columbus, OH 43215

### NAMEPLATE RATING

HP Output	Sync. Speed Rpm	RPM	Phase	Hz	Volts	Amperes	Type	Frame Number
7000	900	895	3	60	13200	283	IC	81C6231

### CHARACTERISTICS

No Load					Resistance T-T (ohms) At 25°C
Volts	Hertz	RPM	Amperes	KW	
13200	60	899+	95.2	110.4	.279

### DIELECTRIC TEST

Stator A-C Volts for 60 sec.  
27400

Rotation: CCW  
Phase Sequence: 1-3-2  
Single Air Gap: .197 inch  
Current Balance Check: OK  
Final Megger Reading in Megohms Corrected to 40°C: 2930

S: Data from test on THIS motor.      W# 129F105      Serial # 1001110311



# ELECTRIC MACHINERY

Serial Number: 1001110311  
 Customer: American Electric Power  
 User: American Electric Power

<b>Hp</b> 7000	<b>Rpm</b> 895	<b>Phase</b> 3	<b>Freq</b> 60	<b>Volts</b> 13200	<b>Amps</b> 283
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### Final Vibration Readings after 1.5 Hour No Load Run – x10<sup>-3</sup> Inch Displacement:

Front Housing						Rear Housing					
Horizontal		Vertical		Axial		Horizontal		Vertical		Axial	
Filter		Filter		Filter		Filter		Filter		Filter	
In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
.016	.219	.020	.156	.023	.125	.031	.156	.020	.313	.016	.156

### Bearing Temperature after 1.5 Hour Run:

Front Bearing	
Ambient	Bearing Temp.
22.0	62.0

Rear Bearing	
Ambient	Bearing Temp.
22.0	58.0

### Space Heater Check:

Phase	Volts	Amps.	KW
1	208	9.43	1.96

Approved by: W. J. Bellinger

Date: December 11, 2001

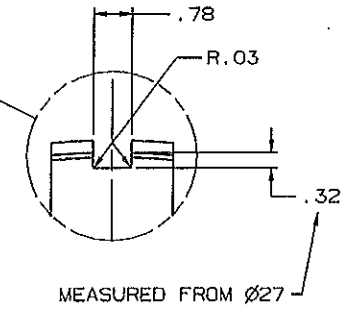
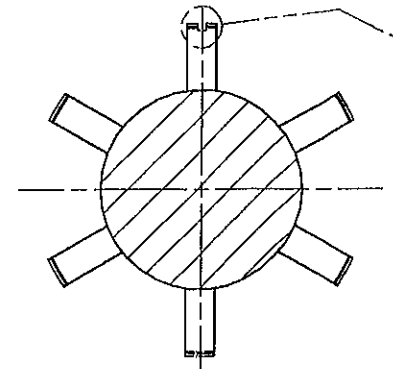
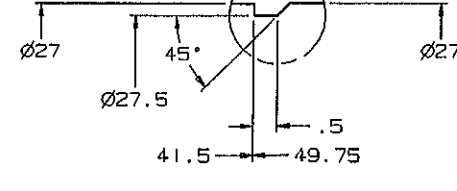
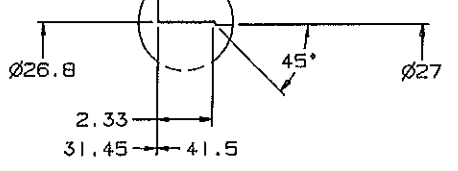
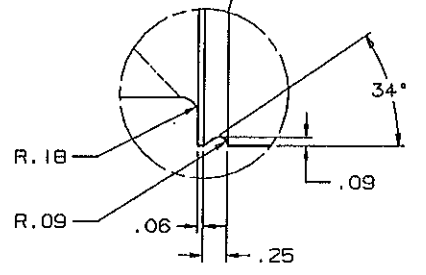
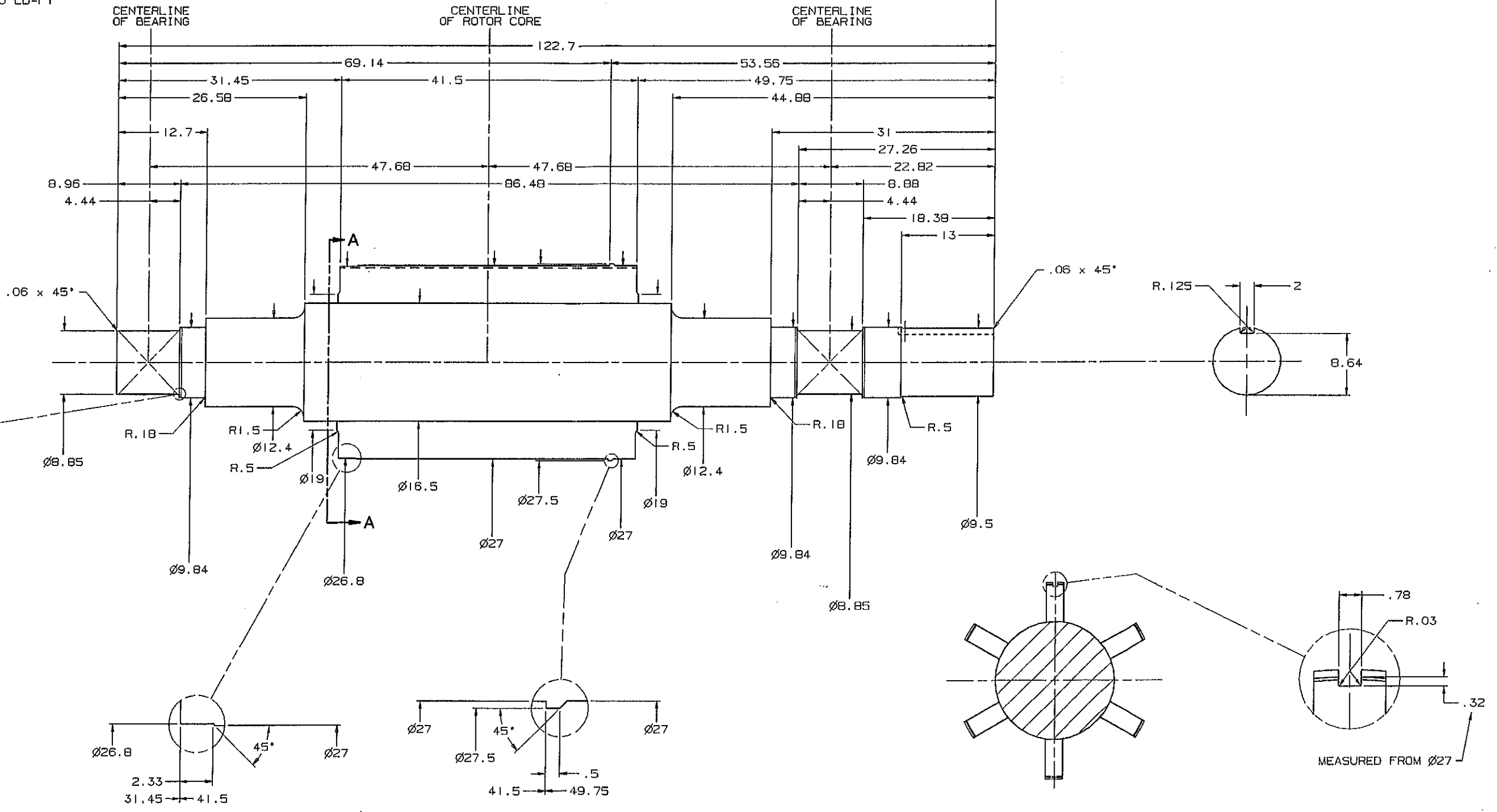
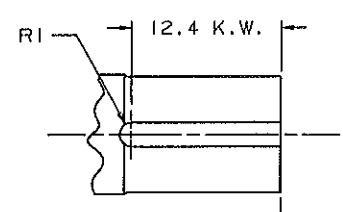




- NOTES -

1. ROTOR CORE MADE FROM 24 GA. LAMINATIONS PRESSED TOGETHER.
2. ROTOR CORE FIT .0134 MAXIMUM TO .0084 MINIMUM INTERFERENCE.
3. SHAFT MATERIAL: ASTM A668-78 CLASS E  
 MINIMUM ULTIMATE TENSILE STRENGTH: 82,000 PSI  
 MINIMUM YIELD POINT: 42,000 PSI  
 MODULUS OF ELASTICITY:  $30 \times 10^6$  PSI  
 MODULUS OF RIGIDITY:  $12 \times 10^6$  PSI

APPROXIMATE	WEIGHT	WK <sup>2</sup>
ROTOR CORE	10700 LBS	27450 LB-FT <sup>2</sup>
SHAFT	5840 LBS	1710 LB-FT <sup>2</sup>
TOTAL	16540 LBS	29160 LB-FT <sup>2</sup>



SECTION A-A

LTR. ZONE	REVISION DESCRIPTION	ENGINEERING REFERENCE
B	K-S 12.4 LONG KEYWAY WAS 10 LONG. REVISED TO ALLOW FOR CUSTOMER'S COUPLING HUB LENGTH. - 01-1103-11 - DAK 7 SEPTEMBER 2001 JJMC 9-7-01	
	ELIMINATED Ø11.42 x 3.87 LONG SECTION ON EACH END OF SHAFT (BETWEEN Ø9.84 AND Ø12.4) PER FINAL SEAL LAYOUT. SHAFT WT AND WK <sup>2</sup> WERE 5800 LBS AND 1700 LB-FT <sup>2</sup> . TOTAL WT AND WK <sup>2</sup> WERE 16500 LBS AND 29150 LB-FT <sup>2</sup> . - 01-1103-11 - DAK 8 JUNE 2001 JJMC 6-11-01 WLB 6/11/01	133D012
FIRST USED		
01-1103-11		

CERTIFIED PRINT FOR AMERICAN ELECTRIC POWER  
 P.O. NO. PX71-000000103 (SERIAL #1 THROUGH #8), EH SALE NO. 01-1103-11  
 P.O. NO. PX71-000000118 (SERIAL #9 AND #10)  
 BY: DAK DATE: 25 APRIL 2001

**Electric Machinery Company**  
 800 CENTRAL AVENUE, MINNEAPOLIS, MN 55413

TITLE: **SHAFT DETAILS**

DIMENSIONS IN INCHES - DO NOT SCALE

REF: **134D081**

DRAWING NUMBER: **134D081**

DATE: 25 APR 01

BY: DAK

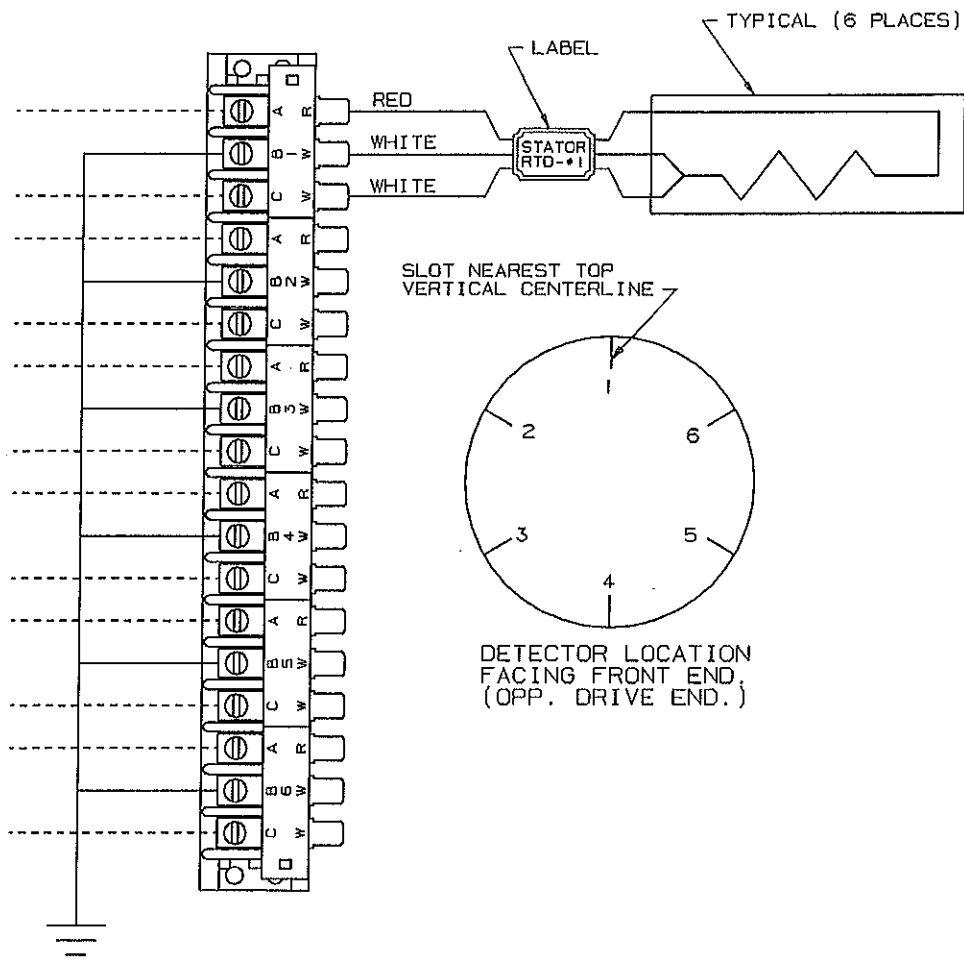
DATE: 25 APRIL 2001

APPD: WLB 4/25/01

REV B SHEET 1 OF 1

- NOTES -

1. DOTTED LINES INDICATE CONNECTIONS BY OTHERS.

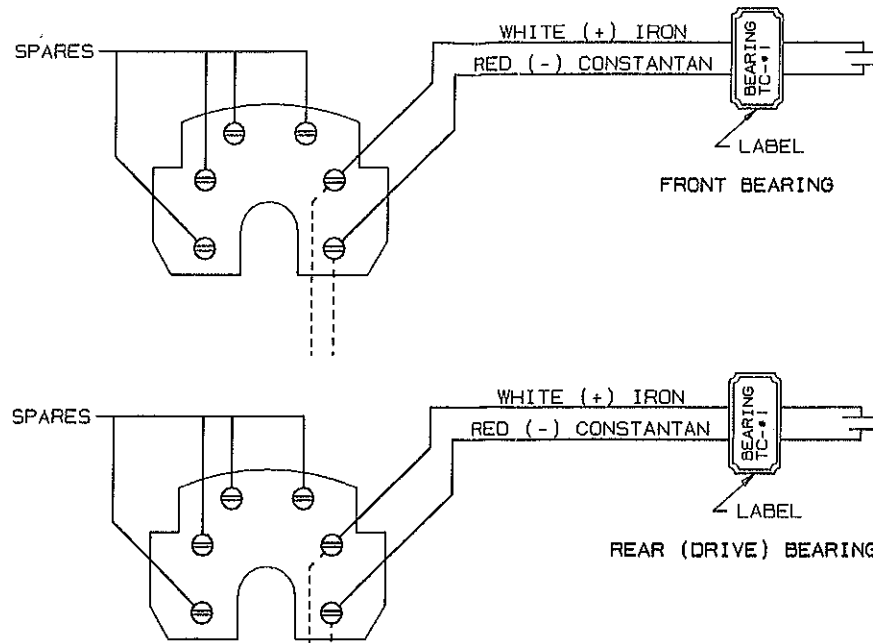


STATOR RESISTANCE TEMP. DETECTOR CONNECTION.

(6) DETECTORS RATED 10 OHMS AT 25° C. (COPPER).

MAX. STATOR RTD SETPOINTS: ALARM 145° C., SHUTDOWN 155° C. BASED ON CLASS F INSULATION MATERIALS.

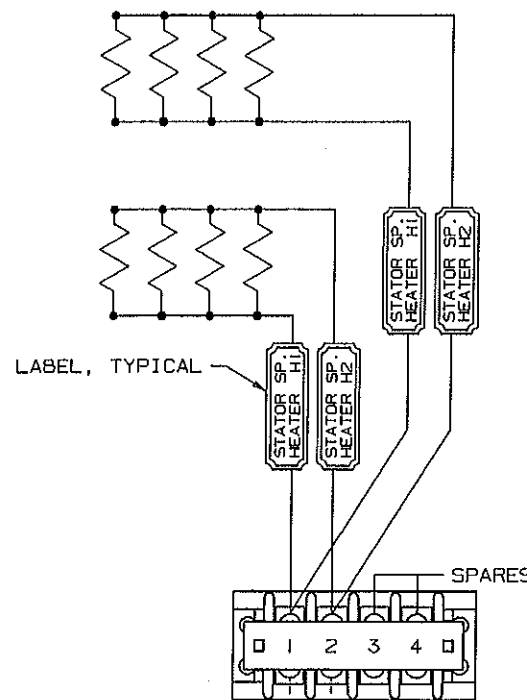
RESISTANCE TEMPERATURE DETECTOR CIRCUIT MUST BE GROUNDED TO PROTECT AGAINST POSSIBLE DANGEROUS INDUCED VOLTAGES.



BEARING THERMOCOUPLE CONNECTION

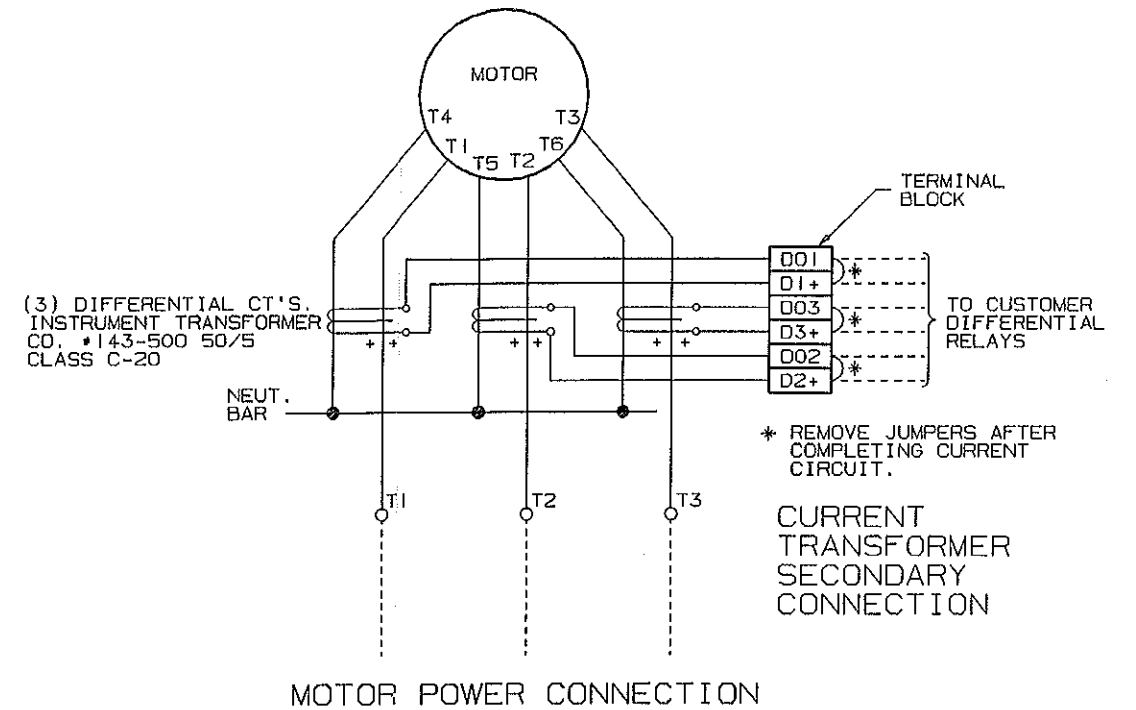
(1) TYPE J IRON-CONSTANTAN THERMOCOUPLE PER BEARING

MAXIMUM BEARING THERMOCOUPLE SETPOINTS:  
ALARM 95° C SHUTDOWN 105° C



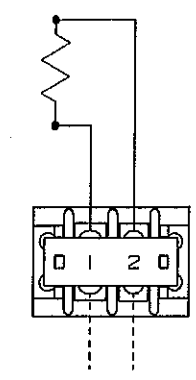
MOTOR SPACE HEATER CONNECTION

(8) SPACE HEATERS RATED 325 WATTS, 240 VOLTS  
TOTAL CONNECTED: 2000 WATTS, 208 VOLTS, 1 PHASE



(3) DIFFERENTIAL CT'S.  
INSTRUMENT TRANSFORMER  
CO. #143-500 50/5  
CLASS C-20

\* REMOVE JUMPERS AFTER COMPLETING CURRENT CIRCUIT.



TERMINAL BOX SPACE HEATER CONNECTION

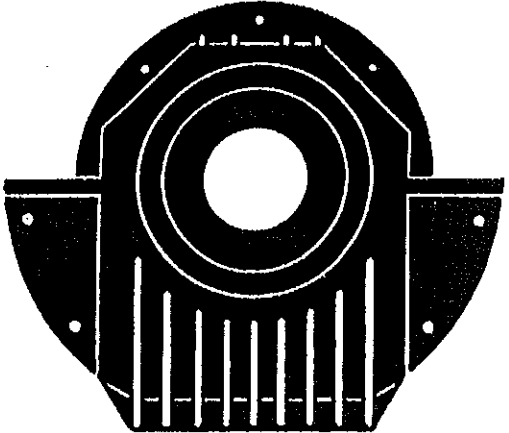
(1) SPACE HEATER RATED 200 WATTS, 240 VOLTS  
TOTAL CONNECTED: 150 WATTS, 208 VOLTS, 1 PHASE

ADDED MOTOR POWER CONNECTION, CURRENT TRANSFORMER SECONDARY CONNECTION, AND TERMINAL BOX SPACE HEATER CONNECTION DETAILS. REVISED MOTOR SPACE HEATER CONNECTION TO SHOW HEATER GROUPING AND LEAD ROUTING AS IT WILL BE IN MOTOR.	
- 01-1103-11 - DAK	8 JUNE 2001
JJMC 6-11-01	WLB 6/11/01
LTR. ZONE	REVISION DESCRIPTION
FIRST USED	ENGINEERING REFERENCE
01-1103-11	

CERTIFIED PRINT FOR AMERICAN ELECTRIC POWER	
P.O. NO. PX71-000000103 (SERIAL #1 THROUGH #9) EM SALE NO. 01-1103-11	
P.O. NO. PX71-000000118 (SERIAL #9 AND #10)	
BY: DAK	DATE: 25 APRIL 2001

Electric Machinery Company	
800 CENTRAL AVENUE, MINNEAPOLIS, MN 55413	
TITLE ELECTRICAL CONNECTIONS	
DIMENSIONS IN INCHES - 00 NOT SCALE	REF
DFTM DAK 18 APR '01	APPD
CHKD DAK 25 APR '01	APPD JJMC 4-29-01
APPD	APPD WLB 4/25/01
DRAWING NUMBER 134D080	
REV A SHEET 1 OF 1	

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**Slide Bearings TYPE EM  
with self lubrication**

3

3

3

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## Bearing Coding

# Installation and Operation

①	②	③	④	⑤	⑥
Type	Housing	Heat Dissipation	Shape of Bore and Type of Lubrication	Thrust part	Size - Diameter
E	M - centrally flange - mounted bearing	N - natural cooling W - water cooling ( finned cooler in oil sump )	L - plain cylindrical bore with loose oil ring	Q - without thrust part (non-locating bearing ) B - plain whitmetal lined shoulders with oil grooves (guide bearing) K - white metal lined shoulders with taper land faces (integrated)	9 80≤D≤100 11 100≤D≤125 14 125≤D≤160 18 160≤D≤200 22 200≤D≤250 28 250≤D≤315

### Example for bearing coding:

① ② ③ ④ ⑤ ⑥  
E M N L Q 22-200

Type EM slide bearing with centrally flange-mounted housing, natural cooling, plain cylindrical bore with loose oil ring, non located bearing without thrust part, size 22, diameter 200.

### Shaft seals

- Type10 - floating labyrinth seal (IP 44)
- Type11 - floating labyrinth seal with dust flinger (IP 54)
- Type12 - floating labyrinth seal with baffle (IP 55)
- Type20 - rigid labyrinth seal ( IP 44)
- Type21 - rigid labyrinth seal with dust flinger(IP 54)
- Type22 - rigid labyrinth seal with baffle (IP 55)

## 1 Considerations for Use

The instructions for installation and operation are addressed to qualified technical personnel (fitters, mechanic installers, mechanical engineers).

Read these instructions carefully before starting assembly.

Slide bearings of type EM are almost universally used in the engineering industry. Therefore it is not possible to provide detailed information on all possible types and range of applications for these bearing types. For instance, the position of the connection points for supply and monitoring equipment is determined by the place of application ( in the following called " installation " ). Please keep ready the guidelines with the technical documentation before starting assembly and operation of the slide bearings.

Additional technical documentation with detailed information is supplied in case of special design bearings. Please contact RENK Export or Domestic Department for supplementary information on bearings. Please indicate the bearing coding and the full reference number, too.

Following indications should be observed when reading these instructions.

Safety instructions are marked as follows:



**Danger!**  
Warning of dangers for personnel.  
Example: *Warning of injury*

**Attention!**  
Warning of damage for the bearing or installation.

Useful recommendations and additional information are framed.

**EMW...**

This is how chapters, instructions or recommendations are marked when referring to a single type or size of a bearing.

*Example: Slide bearing type EM with water cooler*

- Instruction follows.
- Beginning of an enumeration.
- ( ) This is how the different parts of a bearing as described in the general drawings( numbers ) are marked in the text.
- Use the enclosed check-list before starting assembly or operation. Copies available on request.

The check list provides the experienced mechanical fitters for RENK bearings with the necessary instructions for installation and operation.

## 2 Safety Instructions



### **Danger!**

The maintenance and inspection of the slide bearings should be carried out by:

- persons nominated by the safety representative
- persons correspondingly trained and instructed
- persons with knowledge on appropriate standards, regulations and accident prevention rules
- persons with knowledge on first-aid measures and local rescue centers.



### **Warning of injury!**

Before starting work on the bearing:

- Switch off the installation.
- Make sure the installation is not in operation.
- Never lift or transport machines, etc. by the bearing eye bolts. These are only intended for assembly and dismantling of the bearing !



### **Warning of injury!**

Do not grab such heavy bearing parts as the bearing housing during assembly or dismantling works. This could result in bruising or injury to hands !

### **Attention**

All metal parts of a slide bearing consisting of top and bottom part such as the housing, shells, shaft seals are marked by engraved numbers. Fit together only the parts with the same number.

### **Attention**

In case • the admissible bearing temperature exceeds 15 K

- inadmissible vibrations occur
- unusual noises or odours are noticed
- monitoring equipment triggers alarm

shut down the installation and inform the maintenance personnel in charge.

### **Attention**

Do not operate the bearing below the transition speed values indicated in the bearing calculation, thus avoiding inadmissible operating conditions, which could lead to damage of the bearing.

### 3 Preparatory Works

#### 3.1 Tools and equipment

- Following tools and equipment are necessary:
  - Allan key set
  - Wrenching key set
  - Open-jawed spanner set
  - Feeler gauges ( up 0,05 mm )
  - Caliper gauge
  - Emery paper, plain scraper
  - Oil rubber
  - Lifting equipment
  - Permanent sealing compound ( e.g. Curil T )
  - Clean cloth
  - Oil with the viscosity indicated (see bearing type plate)
  - Detergents
  - Liquid screw locking compound ( e.g. LOCTITE 242 )
  - Liquid sealing compound and Teflon-tape

#### 3.2 Use of lifting equipment



#### **Warning of injury!**

Before transport or lifting check if the eye bolts are tight ! Insecure eye bolts could result in bearing becoming loose.

Before moving the bearing by the eye bolts make sure that the split line screws are tightened, otherwise the bottom half of the bearing could become detached.

Make sure that the eye bolts are not exposed to bending stress, otherwise the bolts could break.

Follow exactly the instructions for the use of lifting equipment.

- Use lifting equipment for assembly or transport of the following items:

Transport/Assembly of:	Use lifting equipment for the following bearing sizes
Whole bearing unit	9-28
Top half of the housing	14-28
Bottom half of the housing	11-28
Bearing shells	14-28

- Following steps are to be observed before using the lifting equipment:

### Whole bearing unit

- Check if the split line screws are tight (16):

Bearing size	9	11	14	18	22	28
Torque [Nm] for $\mu_{tot}$ (lightly oiled)	40	69	170	330	570	1150

- Check if the eye bolts (7) are tight.
- Connect the lifting equipment to the eye bolts (7).

### Top half of the housing

- Check if the eye bolts (7) are tight.
- Connect the lifting devices to the eye bolts (7).

Size  
22 and  
28

- Sizes 22 and 28 are delivered equipped with an assembly device.  
When not in use this assembly device is located in the "parking position" behind the flange and as such it is not allowed to use it as transport device.

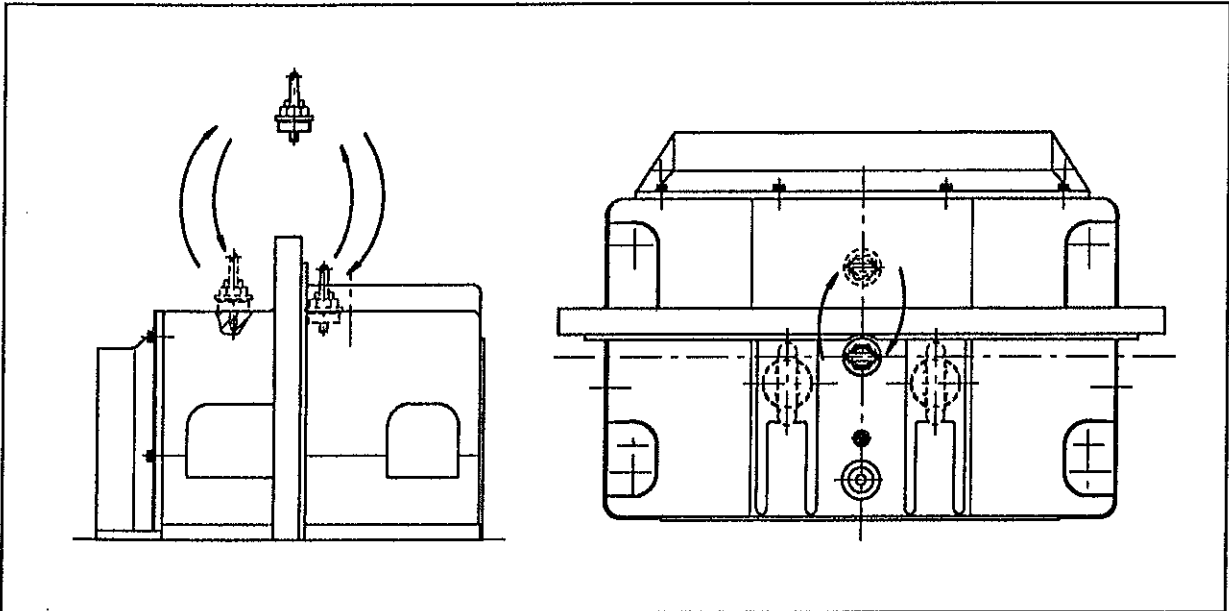


Illustration 1: Assembly device

To mount the top half of the housing remove the top sight glass and screw in the assembly device. By using the appropriate lifting equipment and with the help of the assembly device it is possible to lift and mount the top half of the housing in a straight position. After assembling the top half of the housing put the assembly device back into the "parking position" behind the flange and screw in the top sight glass.

### Bottom half of the housing

- Screw 2 eye bolts (7) with suitable threads tight into the cross-placed opposite tap holes (19).

Bearing size	9	11	14	18	22	28
Tap hole	M 10	M 12	M 16	M 20	M 24	M 30

- Connect the lifting equipment to the eye bolts (7).

## Bearing shells

- Screw 2 eye bolts or screw hooks with suitable threads tight into the tap holes (10):

Bearing size	14	18	22	28
Tap hole	M 8	M 12	M 12	M 16

- Connect the lifting equipment to the eye bolts or to the screw hooks.

### 3.3 Dismantling of the bearing

#### Attention

Make sure that the work place and the parts to be assembled are clean. Contamination and damages to the bearing, especially of the running surfaces, have a negative influence on the operating quality and could lead to premature fatigue.

#### 3.3.1 Dismantling of the shaft seal - outboard side

- Dismantle the shaft seals of the bearing. Proceed according to the sealing type:

Type  
12

#### Floating labyrinth seal with baffle ( Type 12 ):

- Unscrew the top half of the baffle (55) and the bottom (57). To do so, loosen the screws (56).
- Further proceed as in the case of type 10 and 11 seal.

Type  
10  
Type  
11

#### Floating labyrinth seal (Type 10)

#### Floating labyrinth seal with dust flinger (Type 11)

- Loosen and remove all screws (44).
  - Simultaneously take away in axial direction both top half (37) and bottom half (40) of the seal carrier from the housing.
  - Lift off the top half of the seal carrier (37) and take out the floating labyrinth seal from the bottom half of the seal carrier (40).
  - Remove the protective cardboard (transport protection) from the floating labyrinth seal.
- Proceed as indicated for sizes

- 9-11
- 14-28

Size  
9-11

- Take hold of the floating labyrinth seal with both hands. Press out the protective cardboard with both thumbs.

Size  
14-18

- Take both halves of the seal (41),(42) by the split line. Pull both halves apart, till you can press out the protective cardboard. Remove carefully by pressing along the edge of the split line.



#### Warning of injury!

During dismantling of the floating labyrinth seal hold on tight to the spanned hook spring (38) which otherwise could bounce and lead to injury.

- Take both seal halves (41),(42) and pull them apart by approximately 20 mm.
- Open the hook spring (38).

Type  
22

### **Rigid labyrinth seal with baffle (type 22)**

- Unscrew the top and bottom half (55),(57) of the baffle, by untightening the screws (56).
- Further proceed as in the case of types 20 and 21.

Type  
20  
Type  
21

### **Rigid labyrinth seal (type 20)**

#### **Rigid labyrinth seal with dust flinger (type 21)**

- Untighten all screws (49) and remove them.
- Simultaneously remove in axial direction both top and bottom (48) ,(52) halves of the rigid labyrinth seal.
- Remove the split line screws (50).
- Separate the top half of the rigid labyrinth seal (48) from the bottom half (52) and take out the protective cardboard (for safe transport).

### 3.3.2 Dismantling of the machine seal

- Loosen the hose clamps at the bottom half of the housing.
- Pull off the pressure equalizing hose (23).
- Loosen the split line screws (17) of the machine seal and turn them out.
- Loosen the screws (12) and remove the seal parts.

### 3.3.3 Dismantling of the housing

Size 22  
and 28

- Replace the top sight glass (9) by the assembly device. The top half of the housing can be lifted and transported by using the assembly device, well tight, and the appropriate lifting equipment.
- Unscrew the split line screws (16) and lift the top half of the housing (2).
- Take out both top (11) and bottom (18) halves of the shell from the bottom half (21) of the housing.

#### **Attention!**

**Do not damage the thrust and radial running surfaces!**

- Unscrew the split line screws (24) and separate top and bottom half of the shell (11), (18) without using any tools or other devices.

EMW

**The oil cooler (31) is already assembled and does not have to be removed for cleaning purposes.**

### 3.3.4 Dismantling of the shaft seal - machine-side

The machine side seal is of Type 10, floating labyrinth seal.

- Remove the floating labyrinth seal from the bottom half of the housing.
- Notice the anti-rotation pin at the split line of the bottom half of the housing.
- Remove the protective cardboard (transport protection) from the floating labyrinth seal.

Proceed as indicated for sizes

- 9-11
- 14-28

Size  
9-11

- Take hold of the floating labyrinth seal with both hands. Press out the protective cardboard with both thumbs.

Size  
14-28

- Take both halves of the seal (41)(42) by the split line. Pull both halves apart, till you can press out the protective cardboard. Remove carefully by pressing along the edge of the split line.



#### Warning of injury!

During dismantling of the floating labyrinth seal hold on tight to the spanned hook spring (38) which otherwise could bounce and lead to injury.

- Take both seal halves (41),(42) and pull them apart by approximately 20 mm.
- Open the hook spring (38).

### 3.4 Cleaning of the bearing

#### Attention!

Use only non-aggressive detergents, such as for instance:

- VALVOLINE 150.
- Alkaline cleaning compounds (pH-value 6 to 9, short reaction time).



#### Warning of injury!

Please observe the instructions for the use of the detergents.

#### Attention!

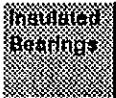
Never use cleaning wool or fibrous cloth. Residues of such materials left in the bearing could lead to excessive temperatures.

- Clean the following parts thoroughly, to remove all residues of preservation :
  - inside the top half of the housing (2)
  - inside the bottom half of the housing (21)
  - all plain parts of the top and bottom half of the housing (2),(21)
  - top half of the shell (11)
  - bottom half of the shell (18)
  - sealing surfaces of the top (37) and bottom (40) half of the seal carrier or of the rigid labyrinth seal
  - loose oil ring (33).

### 3.5 Check-up

- Please check if there is any visible damage. Check the split line and the running surfaces in particular.

The loose oil ring (33) should show absolutely no burrs or have no shoulders.



- Check the insulating layer of the spherical seatings (26).
- If necessary, change the damaged parts.

## 4 Assembly of the Bearing

### **Attention!**

Remove all impurities or other objects such as screws, nuts, etc. from inside the bearing. If left inside they could lead to damage to the bearing. Cover up the opened bearing during breaks.

### **Attention!**

Carry out all assembly operations without making use of force.

### **Attention!**

Use a liquid screw locking compound (e.g. LOCTITE 242) for all housing, split line and flange screws.

### 4.1 Assembly of the machine seal

- Place the bottom half of the machine seal with the spigot fit into the bottom half of the housing.
- Align the split lines of the housing and of the seal in true alignment.
- Tighten the screws(12) by using the following torque value:
- Place the top half of the machine seal with the spigot fit into the top half of the housing.
- Align the split lines of the housing and of the seal in true alignment.
- Tighten the screws(12) by using the following torque value:

Bearing size	9	11	14	18	22	28
Tap hole	M6	M6	M6	M8	M8	M8
Torque [Nm]	8	8	8	20	20	20

- Place the pressure equalizing hoses (23) between the machine-side seal (13) and the bottom half of the housing into the clamps and tighten them.

### 4.2 Assembly opening for bearing fitting

The machine shield is designed in two versions:

#### • Split machine shield:

In this case the bottom half has a thick wall and is provided with the spigot fit to permit the fitting of the housing. The top half of the machine shield can have either the thick wall or only a thin sheet. In both cases, after completed bearing installation, the top half of the machine shield is fastened to the top half of the bearing housing.

#### • Non-split machine shield

In this case the bottom half is provided with the spigot fit to permit the fitting of the bottom half of the housing. The top half is provided with a greater opening which is used as assembly opening for the bearing. The following graph shows the minimum values necessary for the different bearing sizes.

Bearing size	9	11	14	18	22	28
Diameter of the spigot fit [mm]	375	450	530	630	800	1000
Flat surface of the bottom half /Radius $R_{u_{min}}$ [mm]	215	255	305	360	455	565
Flat surface of the top half /Radius $R_{o_{min}}$ [mm]	240	280	310	360	455	565
Opening height H [mm]	195	230	280	330	415	515
Opening width A [mm]	135	150	85	95	120	155

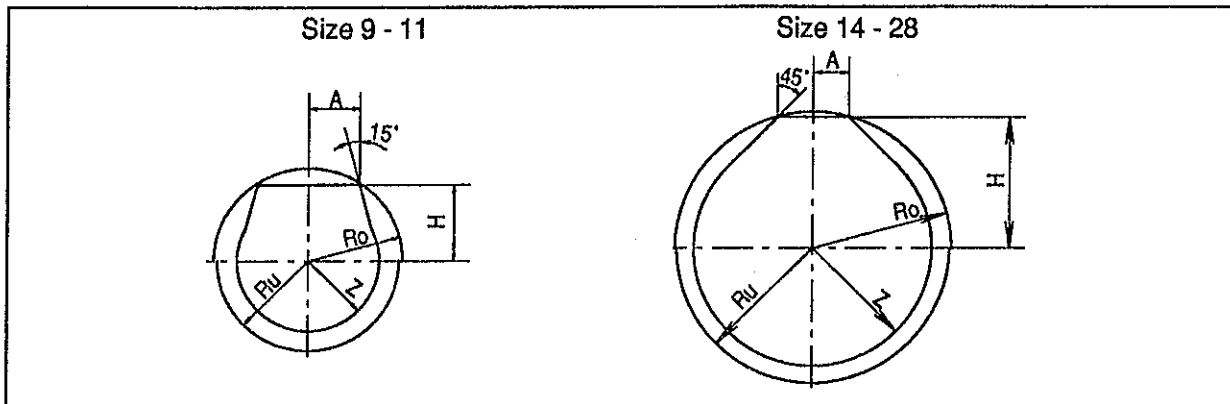


Illustration 2: Assembly opening slide bearing type EM

After completed bearing installation the remaining opening is covered by a thin metal plate (5).

#### 4.3 Assembly of the bottom half of the housing into the machine shield

##### Attention!

The lifting equipment should not come in touch with the seal and running surfaces of the shaft.

- Lift the shaft high enough to have place for the assembly operations.
- Protect the shaft against unintended movement.
- Place the bottom half of the housing with the recess (22) into the spigot fit of the machine shield.
- Tighten the flange screws by using the following torque values. Use only 8.8 quality screws.

Bearing size	9	11	14	18	22	28
Suitable flange screws	M 10	M 12	M 16	M 20	M 24	M 30
Torque [Nm] for $\mu_{tot}$ (lightly oiled)	40	69	170	330	570	1150

#### 4.4 Fitting in the bottom half of the shell

- Apply some lubricant on the spherical seating (26) in the bottom half of the housing (21) and on the running surfaces of the shaft. Use the same type of lubricant as indicated for bearing operation ( see type plate ).
- Place the bottom half of the shell (18) on the running surface of the shaft. Turn the bottom half of the shell (18) into the bottom half of the housing (21) with the split line surfaces of both halves in true alignment.

In case the bottom half of the shell doesn't turn in easily, check the position of the shaft and the alignment of the bearing housing

EM B  
EM K

#### **Attention!**

These operations should be carried out most carefully. The thrust parts of the bottom shell should not be damaged.

- Lower down the shaft till it sits on the bottom half of the shell (18).

#### 4.5 Assembly of the shaft seal - machine-side

The machine-side shaft seal is standard-wise a floating labyrinth seal. The integrated seal groove is in the top and bottom halves of the housing.



#### **Warning of injury!**

During assembly hold the hook spring ends securely to avoid them suddenly releasing and causing possible injury !

Check the movement of the floating labyrinth seal on the shaft in the seal area outside the housing.

- Put the hook spring (38) around the shaft and hook both ends into each other.
- Put both halves of the seal (41),(42) in their place on the shaft.
- Put the hook spring (38) into the spring groove (39).
- Turn the floating labyrinth seal on the shaft.

#### **Attention!**

The floating labyrinth seal should turn easily on the shaft. A jammed seal could lead to overheating during operation and even to shaft wear.

If the floating labyrinth seal jams,

- dismantle the shaft
- remove the worn parts of the seal carefully, by using emery paper or a plain scraper.

- Dismantle the floating labyrinth seal.
- Apply Curil T on the guide surfaces of the integrated seal groove in the bottom half of the housing.

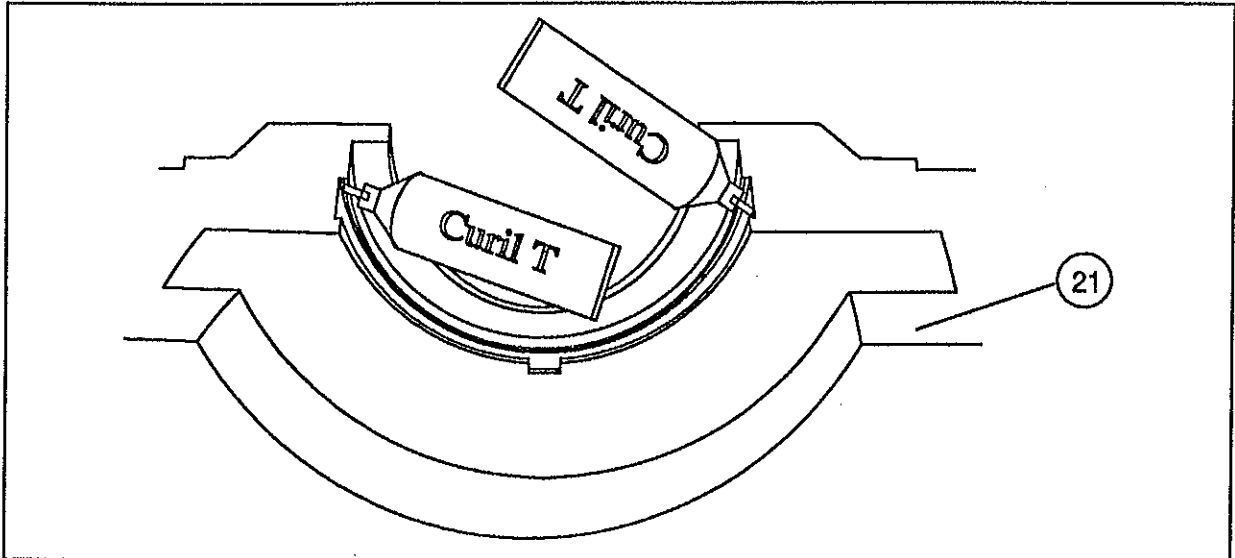


Illustration 3: Application of Curil T on the integrated seal groove

- Apply a uniform layer of Curil T on the guide surfaces and on the split line surfaces of both halves of the seal (41), (42).

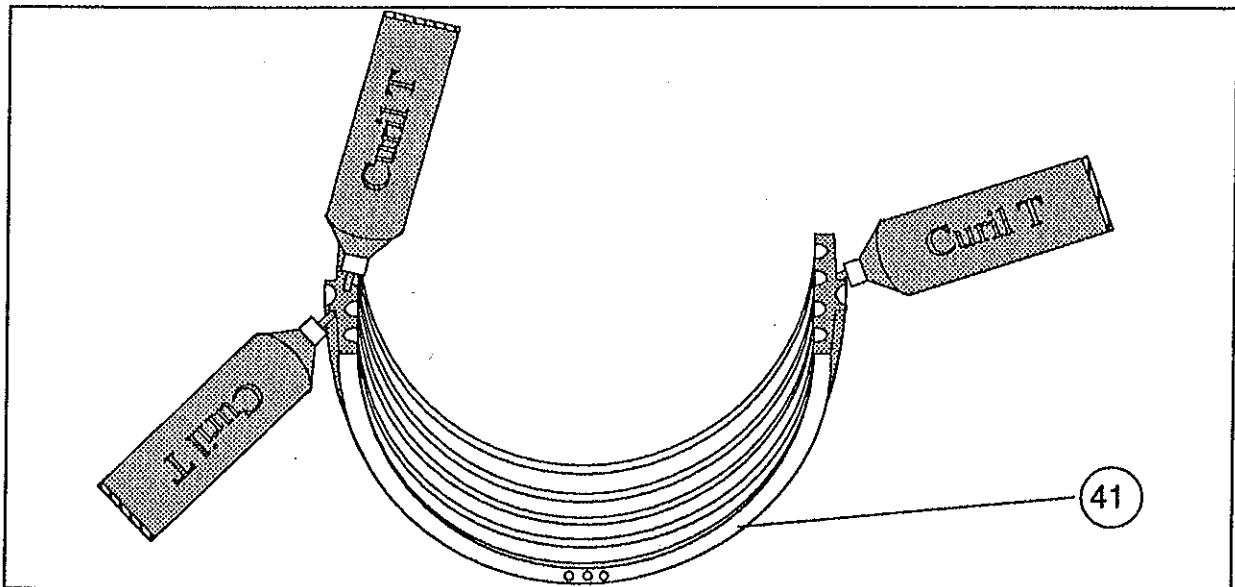


Illustration 4: Application of Curil T on the floating labyrinth seal

Please observe the instructions for the use of Curil T.

- Place the bottom half of the seal (41) with the labyrinths onto the shaft.
- The oil return holes at the bearing side must be opened.
- Turn the seal in opposite direction from the anti-rotation pin into the groove of the housing until the split lines of the bottom half of the housing and the bottom half of the seal match each other.
- Remove the rests of Curil T.
- Push the spring hook into the integrated seal groove between the bottom half of the housing and the seal until both ends jut out from the split line.
- Place the top half of the seal with the cam facing the inside of the bearing on the bottom half of the seal.
- Stretch the hook spring till both ends can be hooked.

#### 4.6 Installation of the loose oil ring

- Open both split lines of the loose oil ring (33) by untightening and removing the screws (36).  
Separate both halves of the loose oil ring (33) carefully without using any tools or other devices.

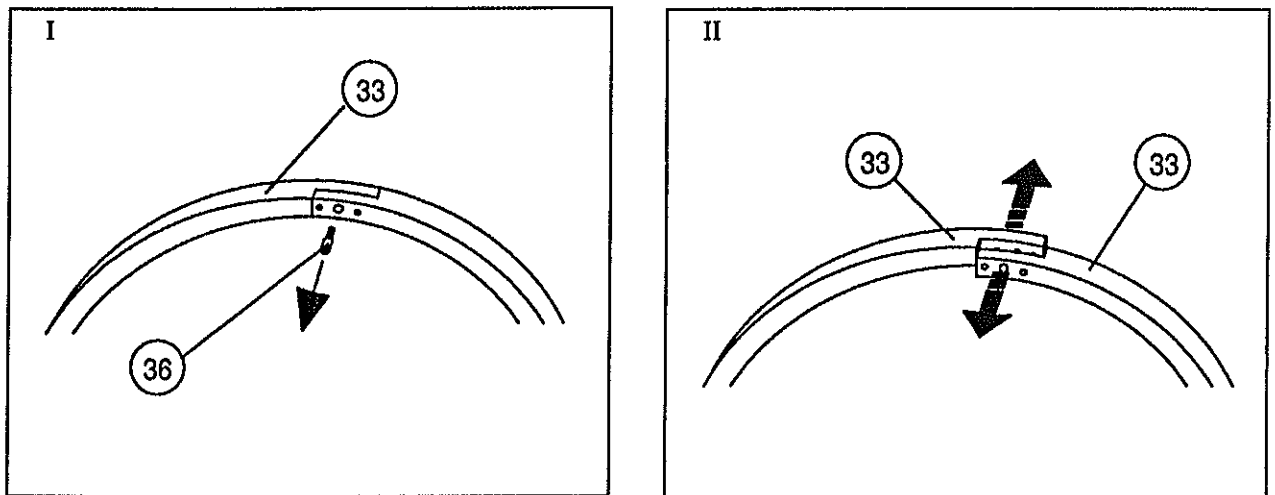


Illustration 5: Opening of the loose oil ring

- Place both halves of the loose oil ring into the shell groove encircling the shaft. Press the positioning pin (34) of each split line into the corresponding hole (35).
- Adjust both halves of the loose oil ring till the split lines match each other.

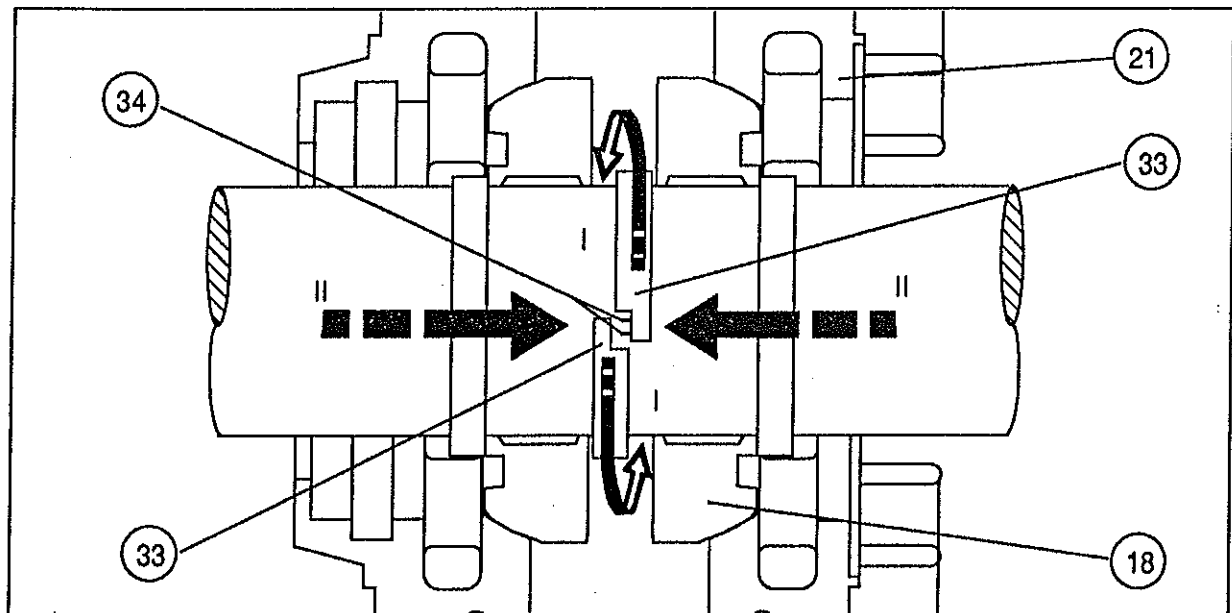


Illustration 6: Installation of the loose oil ring

- Tighten the screws (36) by using the following torque values:

Bearing size	9	11	14	18	22	28
Torque [Nm]	1,4	1,4	1,4	2,7	2,7	2,7

#### 4.7 Fitting in the top half of the shell

- Apply some lubricant on the running surfaces of the shaft. Use the same type of lubricant as indicated for bearing operation (see type plate).
- Check if the engraved number (20) on the bottom half of the shell corresponds with the engraved number (20) on the top half of the shell.
- Place the top half of the shell (11) on the shaft; both engraved numbers(20) should be on one side.

**Attention!**

An incorrectly placed shell could jam the shaft thus leading to the damage of both shaft and bearing.

EM. B,  
EM. K

**Attention!**

Place the top half of the shell carefully on the shaft. The thrust parts of the top half of the shell should not be damaged.

- Tighten up the split line screw (24) by using the following torque values:

Bearing size	9	11	14	18	22	28
Torque [Nm]	8	8	20	69	69	170

- Check the split line of the bearing shell by using a feeler gauge. The split line gap should be less than 0,05 mm. If the split line is greater than this, dismantle both top (11) and bottom (18) halves of the shell. Rework the split line surfaces of the top (11) and bottom (18) half of the shell with an oil rubber.
- Check the mobility of the loose oil ring (33).

Marine  
bearings

A guide bush in the top half of the shell secures the function of the loose oil ring.

- Check the mobility of the loose oil ring (33) in the guide bush.

#### 4.8 Assembly of the top half of the housing

- Check the true alignment of the split lines of the shell (11),(18) and bottom (21) half of the housing.

The positioning pin (8) in the top half of the housing fits in the corresponding positioning pin hole (4) in the shell.

- Check if the engraved numbers (1) on the top and bottom halves of the housing correspond.
- Clean the split line surfaces of the top and bottom halves of the housing.
- Apply Curil™T over the whole surface of the split line of the bottom half (21) of the housing.

Please observe the instructions for the use of Curil T.

- Place the top half of the housing carefully into the machine shield, without touching the seals or the bearing shell.

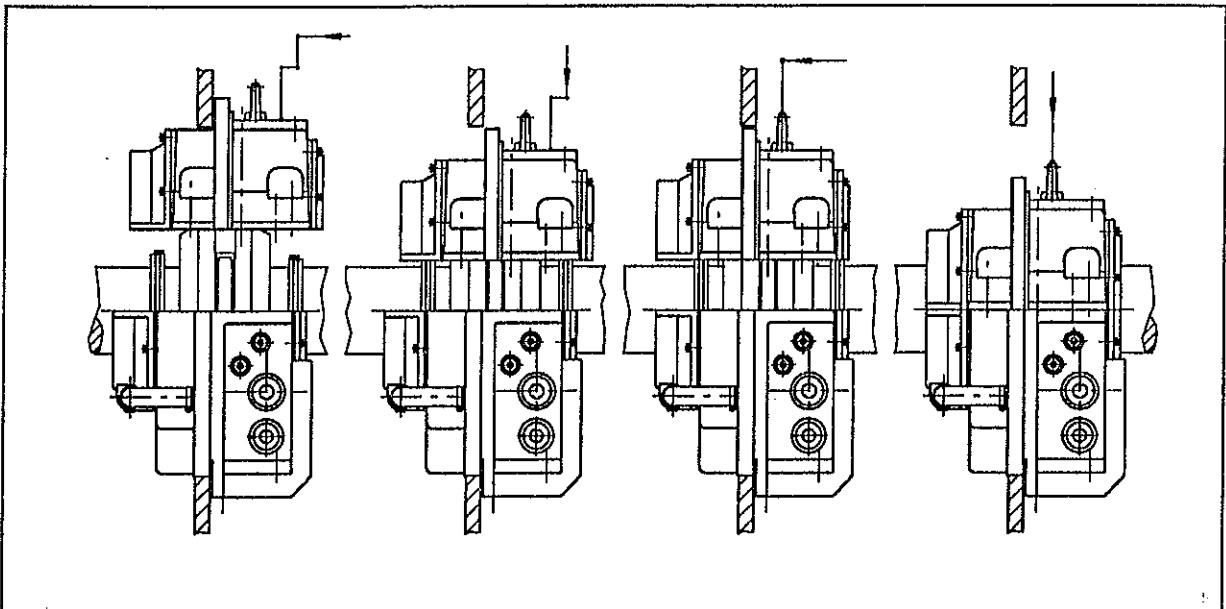


Illustration 7: Assembly of the top half of the housing

- Lower the top half of the housing (2) vertically on the bottom half of the housing (21). Lower the top half of the housing (2) till the split line of the housing is not visible any more.
- Gently hit the bottom half of the housing (21) with a nylon hammer, thus ensuring the alignment of the spherical seating.
- Insert the split line screws (16). Tighten them crosswise by using the following torque values:

Bearing size	9	11	14	18	22	28
Torque [Nm]	40	69	170	330	570	1150

- Tighten the split line screws of the machine seal hand-tight.

**Size 22  
and 28**

- Unscrew the assembly device and put it back into its "parking position" behind the flange. Tighten the assembly device by using the following torque: 40 Nm.
- Put the top sight glass and screw it hand-tight.

## 5 Assembly of the Seals - Outboard Side

- Assemble the outboard side seals.  
Proceed according to the seal type used.

- |   |             |
|---|-------------|
| • Floating labyrinth seal (Type 10)                   | Chapter 5.1 |
| • Floating labyrinth seal with dust flinger (Type 11) | Chapter 5.2 |
| • Floating labyrinth seal with baffle (Type 12)       | Chapter 5.3 |
| • Rigid labyrinth seal (Type 20)                      | Chapter 5.4 |
| • Rigid labyrinth seal with dust flinger (Type 21)    | Chapter 5.5 |
| • Rigid labyrinth seal with baffle (Type 22)          | Chapter 5.6 |

Type  
10

### 5.1 Floating labyrinth seal (Type 10)



#### **Warning of injury!**

During assembly hold the hook spring ends securely to avoid them suddenly releasing and causing possible injury !

Check the movement of the floating labyrinth seal on the shaft.

- Put the hook spring (38) around the shaft and hook both ends into each other.
- Put both halves of the seal (41),(42) in their place on the shaft.
- Put the hook spring (38) into the spring groove (39).
- Turn the floating labyrinth seal on the shaft.

#### **Attention!**

The floating labyrinth seal should turn easily on the shaft. A jammed seal could lead to overheating during operation and even to shaft wear.

If the floating labyrinth seal jams,

- dismantle the shaft
- remove the worn parts of the seal carefully, by using emery paper or a plain scraper.

- Dismantle the floating labyrinth seal.
- Apply a uniform layer of Curil T on the guide surfaces and on the split line surfaces of both halves of the seal (41), (42).

Please observe the instructions for the use of Curil T.

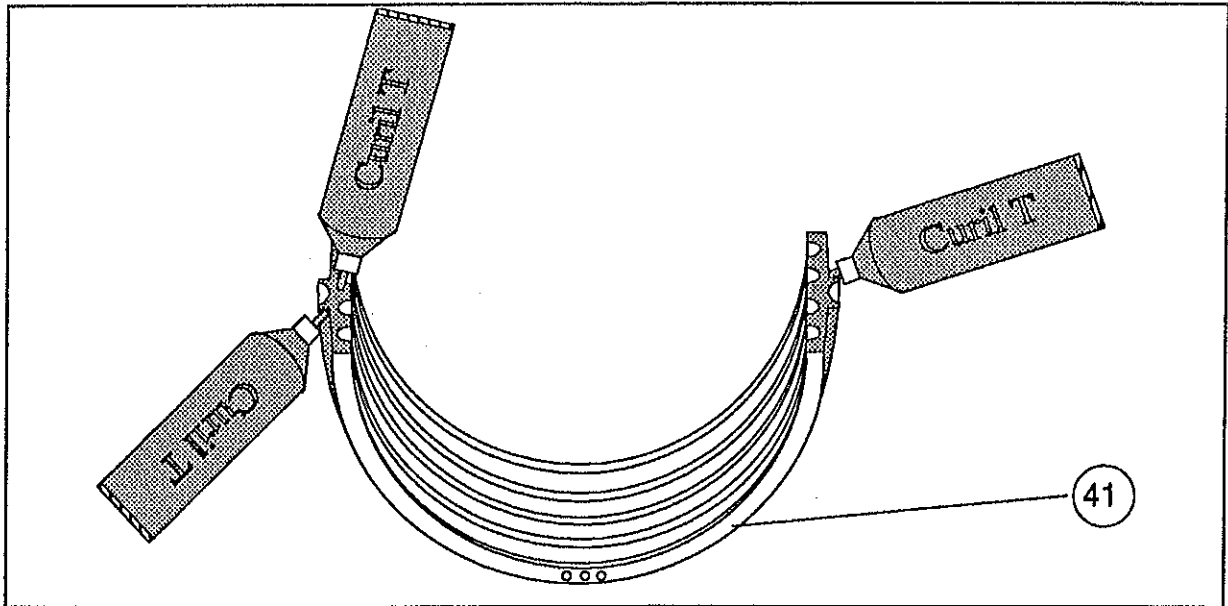


Illustration 8: Application of Curil T on the floating labyrinth seal

- Press the bottom half of the seal (41) against the shaft.
- Place the top half of the seal (42) on the shaft and align both halves of the seal to each other.
- Place the hook spring (38) into the spring groove (39) and stretch until both ends can be hooked.

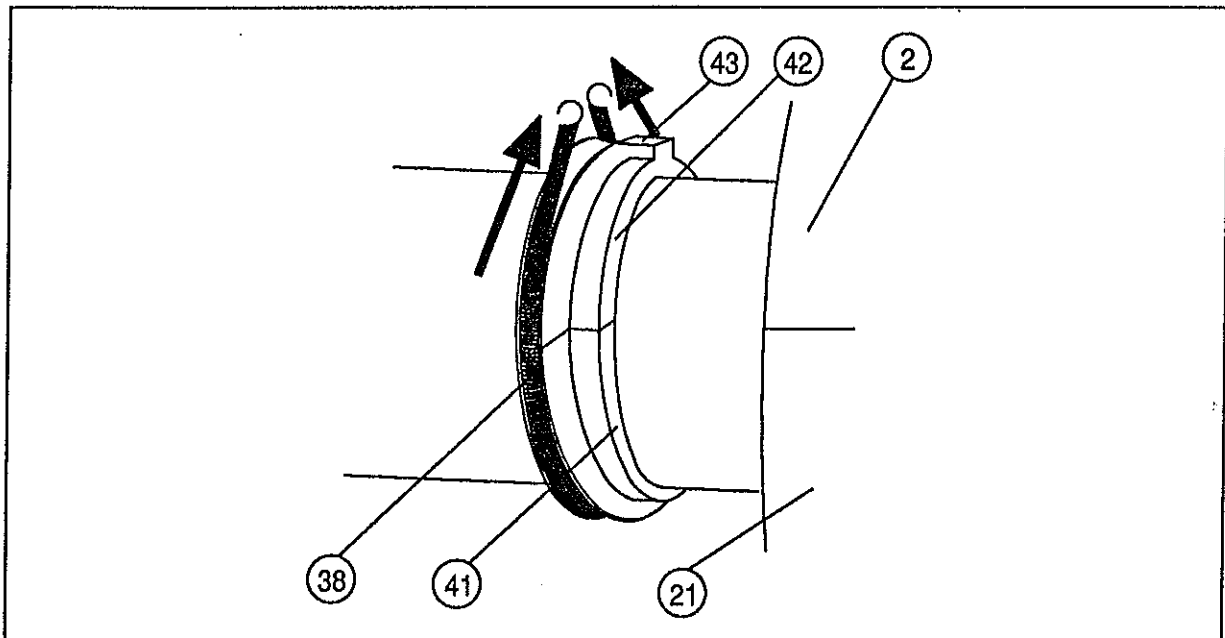


Illustration 9: Assembly of the floating labyrinth seal

- Place in true alignment the split line of the floating labyrinth seal and the split line of the seal carrier.
- Check that both engraved numbers (45) and (47) on top and bottom halves of the seal carrier (37), (40) correspond.

- Clean the following parts:
  - the seal surfaces of the top (37) and bottom (40) half of the seal carrier (the groove of the floating labyrinth seal, the flange surfaces)
  - the split line surfaces of the top (37) and bottom half (40) of the seal carrier
  - the flange surfaces of the housing.

- Apply a uniform layer of Curil T on:
  - the lateral surfaces of the groove at the top (37) and bottom half (40) of the seal carrier
  - the flange surfaces of the top (37) and bottom (40) half of the seal carrier
  - the split line surfaces of the bottom half of the seal carrier (40).

Please observe the instructions for the use of Curil T.

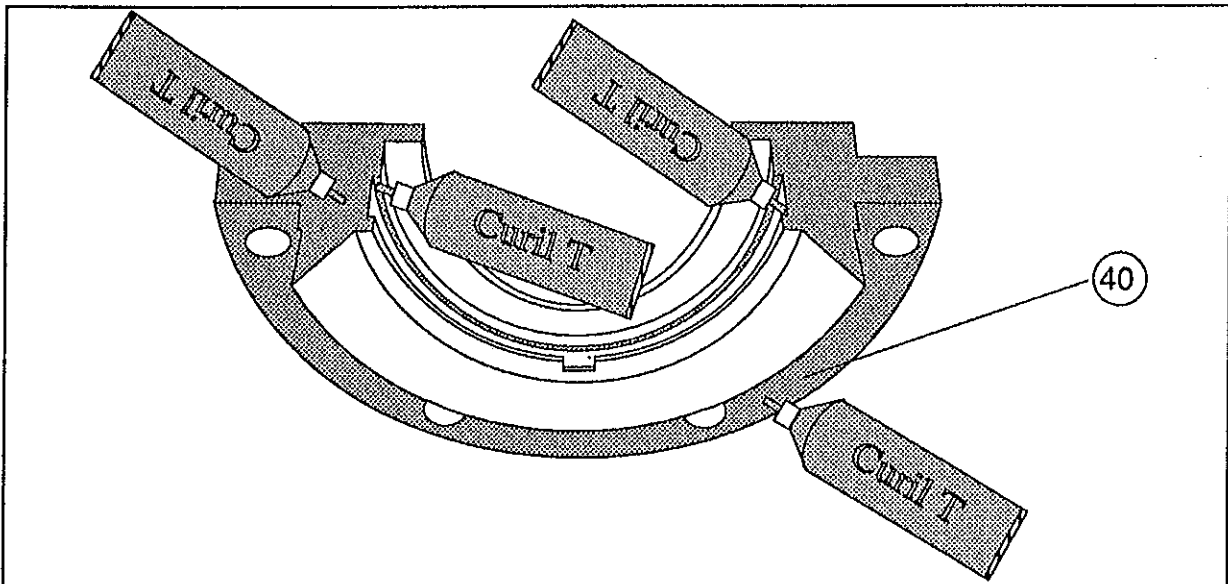


Illustration 10: Application of Curil T on the seal carrier

- Place the top half of the seal carrier (37) on the top half of the seal (42). Press the bottom half (40) of the seal carrier against it. Push the shaft seal completely into the housing.

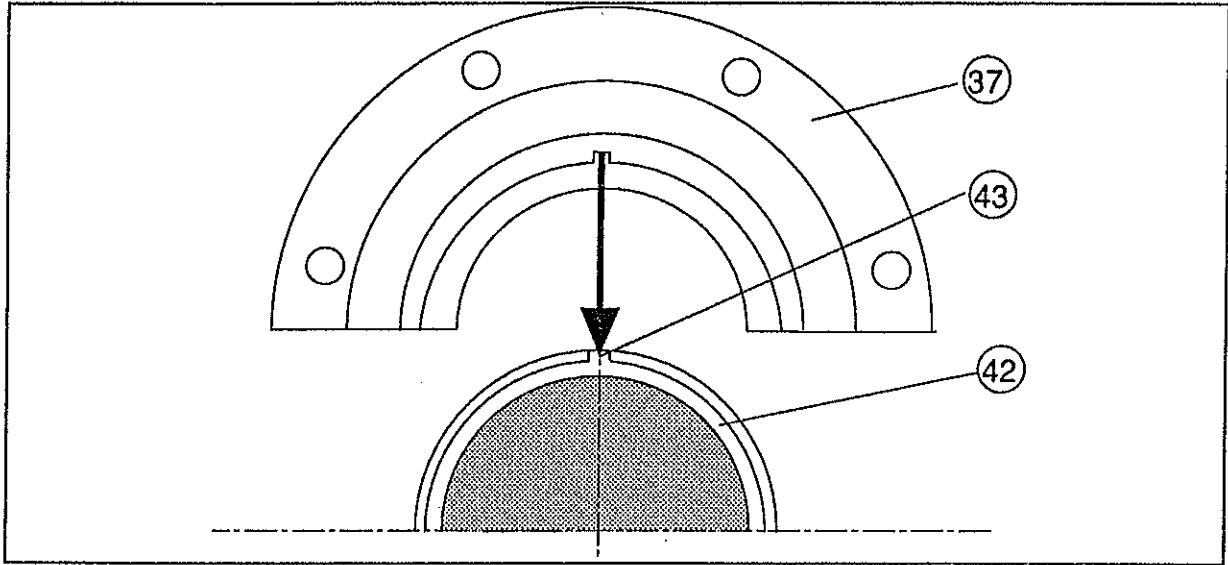


Illustration 11 Assembly of the seal carrier

- Place in true alignment the split lines of the seal carrier and the housing.
- Tighten up the screws (44) by using the following torque values:

Bearing size	9	11	14	18	22	28
Torque [Nm]	8	8	8	20	20	20

## 5.2 Floating labyrinth seal with dust flinger (Type 11)

- Assemble the floating labyrinth seal with dust flinger as described in Chapter 5.1, Floating labyrinth seal type 10.
- Place both halves of the dust flinger (58) in front of the shaft seal around the shaft. Loosely screw in the split line screws (59).

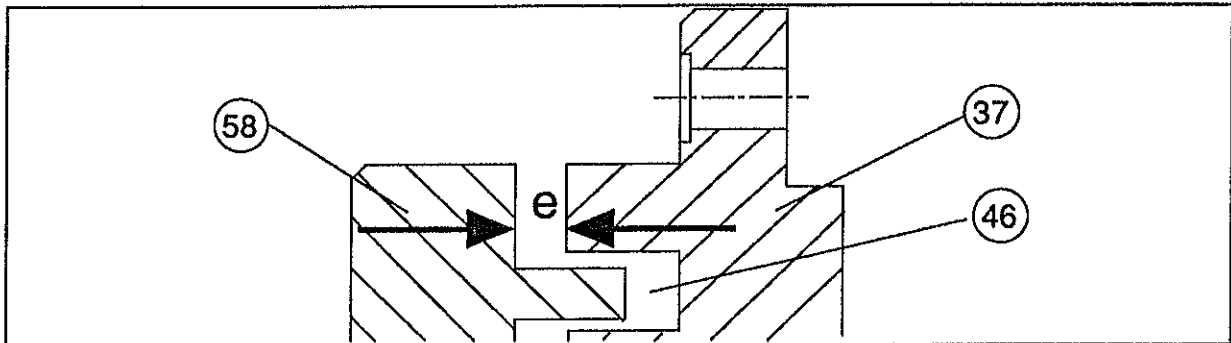


Illustration 12: Clearance between dust flinger and seal carrier

EM.O

- Push the dust flinger (58) into the groove (46) of the seal carrier.
- Set the clearance "e" at the following figure around the whole unit:

**maximum longitudinal extension of the shaft in operation + 1 mm**

(Parameters indicated in the Technical Documentation of the Installation).

- Tighten up both screws (59) at the split line by using the following torque values:

Seal diameter [mm]	80-140	>140
Torque [Nm]	7	18

EM.B,  
EM.K

- Push the dust flinger (58) into the groove (46) of the seal carrier.
- Set the clearance "e" at **1 mm** around the whole unit.
- Tighten both screws (59) at the split line by using the following torque values:

Seal diameter [mm]	80-140	>140
Torque [Nm]	7	18

Type  
12

5.3 Floating labyrinth seal with baffle (Type 12)

- Assemble the floating labyrinth seal with baffle as described in Chapter 5.1, type 10.
- Apply a uniform layer of Curil T on the flange surfaces of the top half (55) and bottom half (57) of the baffle.
- Screw
  - the top half of the baffle (55) onto top half of the seal carrier (37)
  - the bottom half of the baffle (57) onto bottom half of the seal carrier (40).
- Tighten the screws (56) by using the following torque values:

Seal diameter [mm]	80-140	>140
Torque [Nm]	4	10

Type  
20

5.4 Rigid labyrinth seal (Type 20)

- Check if the engraved numbers (53) and (54) on the bottom half (52) and top half (48) of the rigid labyrinth seal correspond.
- Clean
  - the flange surfaces of the top half (48) and bottom half (52) of the rigid labyrinth seal
  - the split line surfaces of the top half (48) and bottom half (52) of the rigid labyrinth seal
  - the flange surfaces of the housing.
- Apply a uniform layer of Curil T on the following parts:
  - the flange surfaces of the top (48) and bottom half (52) of the rigid labyrinth seal
  - the split lines of the bottom half (52) of the rigid labyrinth seal.

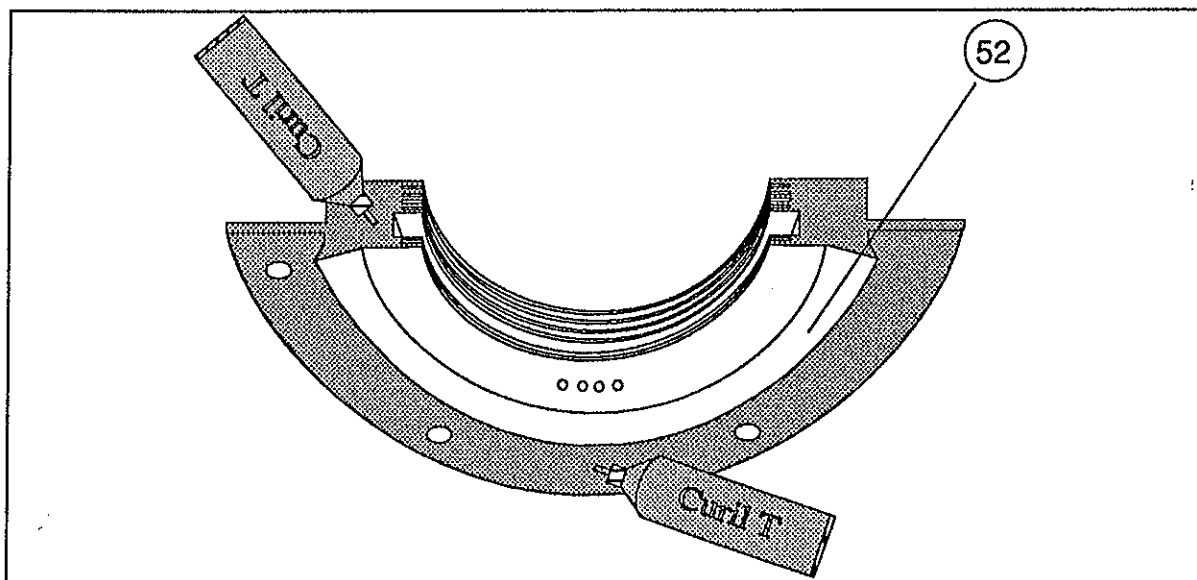


Illustration 13: Application of Curil T on the rigid labyrinth seal

- Place the top half (48) of the rigid labyrinth seal on the shaft and press slightly the bottom half (52) of the rigid labyrinth seal from below against it. Lightly push the rigid labyrinth seal completely into the housing.
- Tighten the split line screws (50).

- Place in parallel alignment the split line of the rigid labyrinth seal and the split line of the housing. Press the rigid labyrinth seal slightly from below against the shaft. Adjust the rigid labyrinth seal in such a way that the clearance "f" between the shaft and the rigid labyrinth seal at both split lines has the same figure.

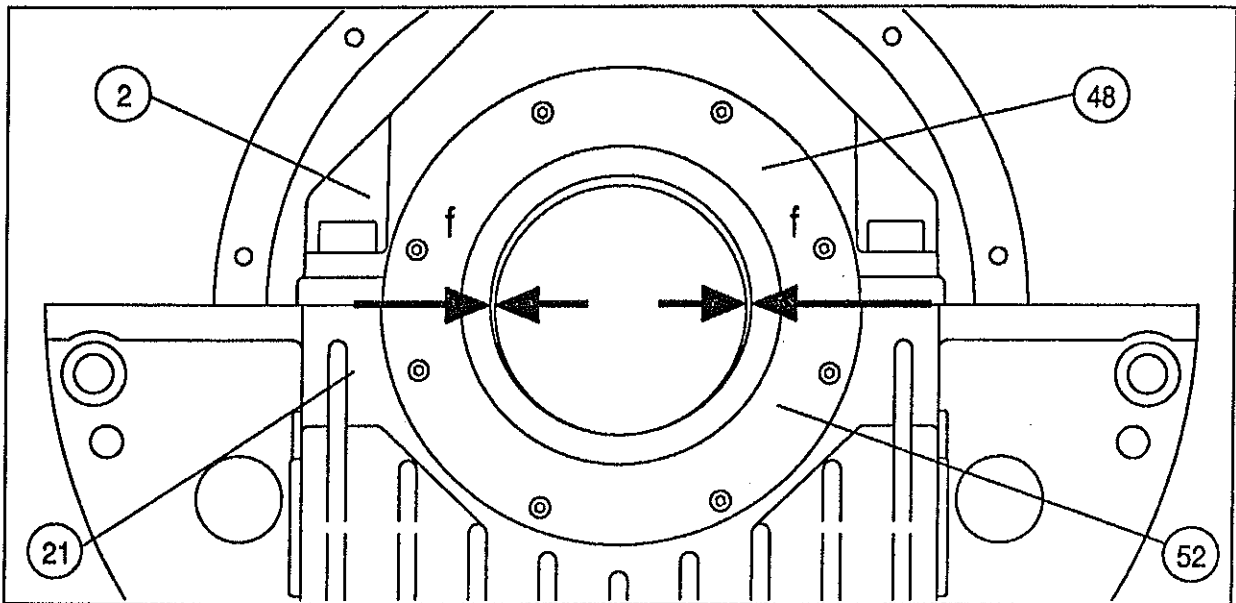


Illustration 14: Alignment of the rigid labyrinth seal

- Tighten the screws (49) by using the following torque values:

Bearing size	9	11	14	18	22	28
Torque [Nm]	8	8	8	20	20	20

#### 5.5 Rigid labyrinth seal with dust flinger (Type 21)

Type  
21

- Assemble the rigid labyrinth seal with dust flinger as described in Chapter 5.4, type 20.
- Place both halves of the dust flinger (58) round the shaft, in front of the rigid labyrinth seal. Loosen both screws (59) of the split line.

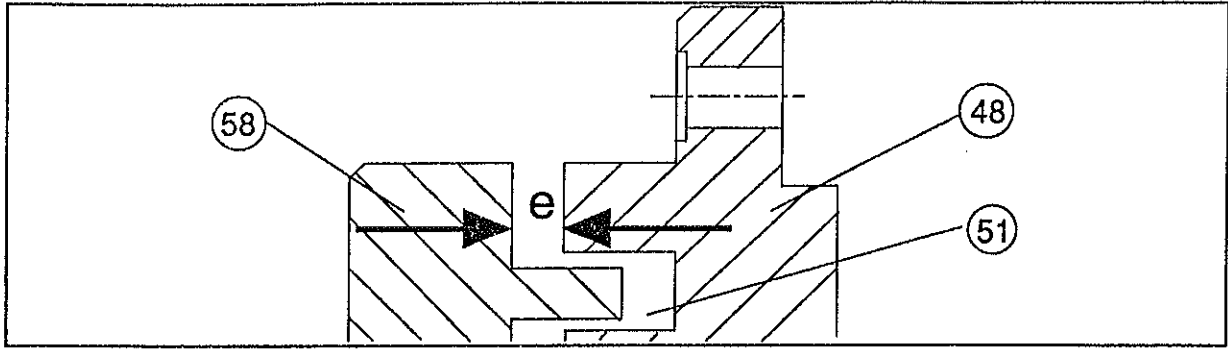


Illustration 15: Clearance between dust flinger and rigid labyrinth seal

EM. Q

- Push the dust flinger (58) into the groove (51) of the rigid labyrinth seal.
- Set the clearance "e" at the following figure around the whole unit.

**maximum longitudinal extension of the shaft in operation + 1 mm**

(Parameters are indicated in the Technical Documentation of the Installation).

- Tighten both screws (59) at the split line with the following torque values:

Seal diameter[mm]	80-140	>140
Torque [Nm]	7	18

EM. B.  
EM. K

- Push the dust flinger (58) into the groove (51) of the rigid labyrinth seal.
- Set the clearance "e" at **1 mm** around the whole unit.
- Tighten both screws (59) at the split line by using the following torque values:

Seal diameter [mm]	80-140	>140
Torque [Nm]	7	18

Type  
22

**5.6 Rigid labyrinth seal with baffle (Type 22)**

- Assemble the rigid seal with baffle as described in Chapter 5.4, type 20.
- Apply a uniform layer of Curil T on the flange surfaces of the top half (55) and bottom half (57) of the baffle.
- Tighten
  - the top half of the baffle (55) on the top half (48) of the rigid labyrinth seal
  - the bottom half of the baffle (57) on the bottom half (52) of the rigid labyrinth seal.
- Tighten the screws (56) by using the following torque values:

Seal diameter [mm]	80-140	>140
Torque [Nm]	4	10

## 6 Instructions for Assembly of Peripheral Equipment

### 6.1 Temperature measurement

- Fix suitable feeler gauges:

- into one of the connection holes (27) for temperature measurements of the journal parts
- into one of the connection holes (29) for temperature measurements of the oil sump

Proceed as follows:

- Take out the screw plugs from the connection holes.
- Place the thermo sensor into the bore by using Teflon tape or sealing compound.
- Connect the thermo sensor at the temperature monitoring equipment of the installation (see the Technical Documentation of the Installation for connecting and adjustment).

EMW.

### 6.2 Water supply

Following requirements should be observed before connecting the oil cooler (31):

- water velocity of maximum 1,5 m/s in the cooling water inlet
- water pressure of maximum 5 bar
- adjusting tap on inlet
- outlet of cooling water under no pressure.

The direction of the cooling water passage in the oil cooler (31) is arbitrary.

### 6.3 Closing of the assembly opening

After completed bearing assembly and before starting operation close the assembly opening of the machine shield (with the thin metal plate (5)).

## 7 Bearing Insulation

These bearings are delivered insulated. The electrical insulation is guaranteed by:

- plastic coating of the spherical seatings (26)
- shaft seals out of non-conducting materials
- insulated positioning pin (8)
- insulated screwed connections for thermometers.

It is not necessary to insulate the pipelines.

- Mark the insulated bearing with the delivered plate " Insulated bearing shells". Mount the plate at a visible place by using 2 grooved drive studs.

## 8 Operation

### 8.1 Fill up lubrication oil

#### Attention!

Make sure that no impurities get into the bearing.

- Tighten all screw plugs in the connection holes (27), (28), (32) with the necessary torque values:

Screw plug threads	G 3/8	G 1/2	G 3/4	G 1	G 1 1/4	G 1 1/2	G 2	G 2 1/2
Torque [Nm]	30	40	60	110	160	230	320	500

- Check if:

- the top sight glass (9) is tight, the screws should be hand-tight.
- Oil sight glass (28) is tight, the screws should be hand-tight.

In the case thermo sensors or / and oil sump thermometers are used:

- Check if they are tight (according to the manufacturer's instructions).

- Remove the screw plugs from the oil filler hole (3).

- Use a lubricant with the viscosity indicated on the bearing type plate. Fill the lubricant through the oil filler hole (3) up to the middle point of the oil sight glass (28).

The oil level limits are as follows:

**minimum oil level: bottom of the oil sight glass**

**maximum oil level: top of the oil sight glass**

#### Attention!

- Not enough lubricant leads to temperature rises and thus to damages to the bearing.
- Too much lubricant leads to leakages. In the case of bearings with lubrication by loose oil ring too much lubricant could brake the oil rings considerably, thus leading to damages to the bearing.

- Tighten the screw plug into the oil filler hole (3) by using the following torque values:

Bearing size	9	11	14	18	22	28
Torque [Nm]	30	30	30	40	60	60

- Remove the protective layer from the top sight glass (9).

## 8.2 Trial run

- Before the trial run, check the following:

- oil level (see Chapter 8.1)
- if the temperature monitoring equipment works

**EMW**

- if the water cooling installation works.

The bearing is ready for operation.

- Supervise the bearing during the trial run (5-10 operating hours). Pay special attention to:

- oil level (see Chapter 8.1)
- bearing temperature
- sliding noises of the shaft seals
- tightness
- occurrence of inadmissible vibrations.

### **Attention!**

If the bearing temperature exceeds the calculated value of 15 K (see Bearing calculation) stop the installation immediately. Carry out an inspection of the bearing as described under Instructions for Service and Inspection of the Slide Bearings Type EM with self lubrication.

- Baffle** With bearing types 10 and 20 the baffles are assembled externally in front of the shaft seals. The baffle, made of reinforced polyamide, protects the bearing from dust and water.
- Rigid labyrinth seal** The rigid labyrinth seal (type 20) is used with slide bearings type E with high oil throughput. It corresponds to the protective system IP44 and is made of an aluminium alloy. The rigid labyrinth seal is built of 2 halves, flanged at the bearing housing. The labyrinths that wipe out the lubricant are arranged into two groups. The first two labyrinths, lying inside keep back most of the lubricant. Five further labyrinths protect the bearing from outside. They prevent the lubricant overflow and the penetration of impurities. The overflow lubricant is collected into a chamber lying between the both groups of labyrinths. Through the return bores the lubricant flows back into the bearing.
- Spherical seating** The spherical seating is a special form to provide the alignment of the shell in the housing. The shell is placed on two spherical seatings. The advantages of the spherical seating are:
- easy assembly
  - good heat transfer from the shells to the housing
  - suitable for such applications where high thrust or radial forces occur
- Dust flinger** In the case of bearing types 10 and 20 a light alloy ring is clamped on the shaft in front of the shaft. This ring fits into a groove in the seal carrier or the rigid labyrinth seal, thus building a labyrinth. The labyrinth protects the shaft exit against low pressure that could otherwise "absorb" the lubricant. Low pressure occurs for instance in the case of rotating discs, such as couplings or cooling discs.
- Floating labyrinth seal** The floating labyrinth seal (type 10) in the seal carrier is used as a shaft seal in the case of bearings of type E operating under normal conditions. It prevents the lubricant and lubricant mist coming out and the penetration of impurities. The floating seal has a high capacity of resistance to wear. It is made of a high-performance, high temperature stability and electrically insulated plastic material. The floating seal consists of two halves held together by a spring. Both ends of the spring are hooked into one another, that is why this part is also called hook spring. In the case of slide bearings of type EM the floating seal is mounted into a two-piece seal carrier. The seal carrier permits radial movements of up to 1 mm. The seal is thus insensitive to shaft movement or deflexion. The sealing effect is produced by the labyrinths wiping off the lubricant from the shaft. Through the return holes the lubricant flows back into the bearing.
- Machine seal** In the case of the flange-mounted bearings the machine seal prevents leakages at the machine-side seal in reducing the positive and negative pressure in the machine. The pressure equalizing cavity between the machine seal and the bearing housing must always be connected to pressureless atmosphere. The gap between shaft and machine seals is limiting the sealing effect. For higher requirements the seal can be provided with hamp packing or a gap seal. These types of seals are placed into the grooves of the machine seal. The groove for the hamp packing is standard-wise provided.

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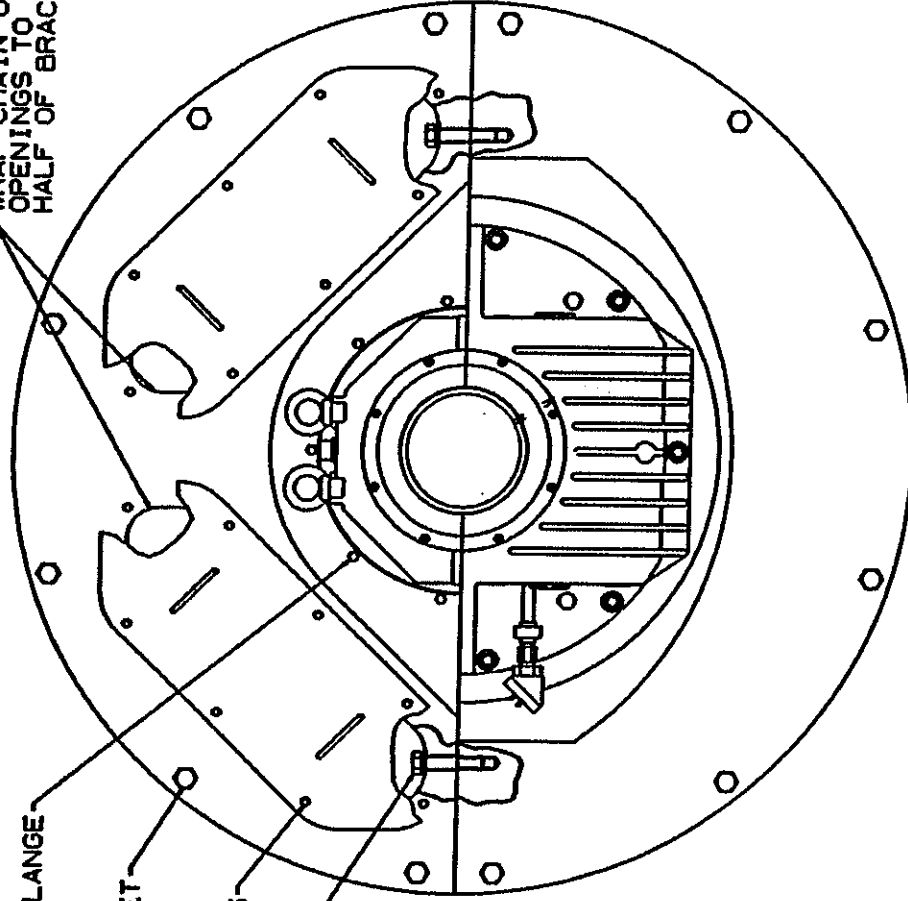
WRAP CHAIN OR STRAP THRU OPENINGS TO LIFT UPPER HALF OF BRACKET

REMOVE 5 X M10 X 1.5 SCREWS IN FLANGE

REMOVE 6 X 1"-8 BOLTS IN UPPER HALF OF BRACKET

REMOVE 16 X 3/8-16 SCREWS FROM COVERS

REMOVE 2 X 1"-8 BOLTS AT SPLIT



21-1103-11  
MOTOR  
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Machines with sleeve type bearings have a daron-my-lar-daron shield installed at the factory to protect the bearings during shipment and storage. As long as this shield remains in place the shaft must not be rotated. Bearings protected in this manner have a warning tag attached to the machine.  
Be sure to open the bearings, remove the protective shield, and lubricate properly before turning the rotor.

**MAINTENANCE · OPERATION**

**DESCRIPTION · INSTALLATION**

# FRAME D II INDUCTION MOTORS

**INSTRUCTION MANUAL**



1300-INS-338

It is our sincere hope that this publication will help you to get your new E-M equipment unloaded, installed, and operating promptly and successfully. To insure future success, please read this manual carefully. Observe all notes, cautions, and warnings.

Do not use this equipment for any purpose other than that for which it was intended, nor operate it in excess of its rated capacity nor otherwise than in accordance with the instructions contained in this manual.

This equipment, or a prototype, has been tested to prove satisfactory for the conditions for which it was sold. Operation in excess of these conditions may subject the equipment to stresses and strains which it was not designed to withstand.

Failure to heed this warning may result in damage to the equipment or in an accident causing personal injury.

#### NOTICE

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## SECTION I INTRODUCTION AND DESCRIPTION

### 1.1 INTRODUCTION AND SCOPE

This instruction manual presents general information on intermediate sized induction motors used in the E-M D II frames. The general range of application in this manual is to 10,000 HP and 1800 RPM.

### 1.2 GENERAL DESCRIPTION

1.2.1 Motor stator - The stator is made up of the frame, core, and windings.

The stator frame is fabricated from steel plate into an assembly which provides a rigid and durable support for the machine. (FIG.1)

The core is built up of segments or one piece laminations that are securely clamped and welded on the back side of the laminations to an inner stator frame. In turn the inner assembly is welded to the outer frame. (FIG.2)

Interconnected groups of insulated coils form the stator winding. Each coil contains multiple turns of insulated copper strands. Coils are placed in slots which are uniformly distributed around the stator core.

Main power leads may be either cable or strap copper depending on current rating. Lead location is optional.

1.2.2 Induction motor rotors - The rotor consists of the shaft, the core, and the windings. (FIG. 3)

The rotor shaft provides the mechanical support for the

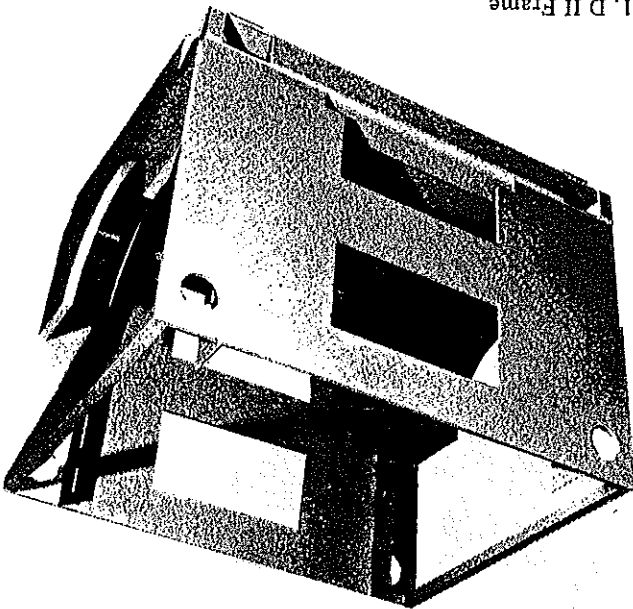


Figure 1. D II Frame

rotor core. It is machined from high grade steel stock of appropriate rigidity for acceptable operation in driving the motor load.

The rotor core consists of a stack of electrical grade steel laminations that are maintained under pressure on the shaft. Slots are provided to insert the rotor bars and retain them against radial forces. Radial vents are provided to allow air

This Instruction Manual covers a wide variety of different constructions. The general information applies to all the different machines. There may, however, be a visual difference between construction features illustrated herein and your particular equipment.

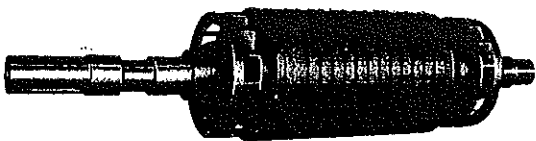


Figure 3. D II Rotor

to cool the interior of the rotor. The primary function of the rotor core is to provide a low reluctance path for the magnetic fields in the rotor.

The rotor winding consists of conductive bars placed in slots in the core and are short circuited at each end by a continuous conductive ring. The bars and end rings are made of fabricated copper or copper-alloy. The rotor winding has current induced in it by the stator magnetic field and in turn also sets up a magnetic field which interacts with the stator field to produce torque.

1.2.3 Ratings - NEMA ratings of electrical machines are based on surrounding air temperature of 40° C (104° F) maximum at 3300 feet elevation maximum.

1.3 PROTECTIVE ENCLOSURES

To assure continued operation and protection from temperature, humidity and other adverse environmental conditions, several different types of machine enclosure designs have been standardized by NEMA (see Table 1).

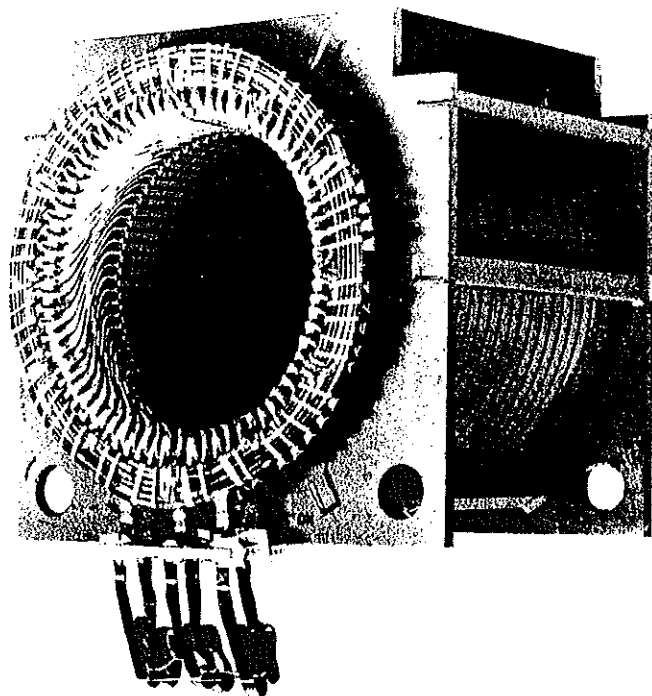


Figure 2. Wound Stator

NEMA Type	Description
Drip-proof	An open machine in which the ventilating openings are so constructed that successful operation is not interfered with when drops of liquid or solid particles strike or enter the enclosure at any angle from 0 to 15 degrees downward from the vertical.
Splash-proof	An open machine in which the ventilating openings are so constructed that successful operation is not interfered with when drops of liquid or solid particles strike or enter the enclosure at any angle not greater than 100 degrees downward from the vertical.
Weather-protected Type I	An open machine with its ventilating passages so constructed as to minimize the entrance of rain, snow and air-borne particles to the electric parts and having its ventilated openings so constructed as to prevent the passage of a cylindrical rod 0.75 inch in diameter.
Weather-protected Type II	A Type II machine has, in addition to the enclosure defined for a Type I machine, its ventilating passages at both intake and discharge so arranged that high-velocity air and air-borne particles blown into the machine by storms or high winds can be discharged without entering the internal ventilating passages leading directly to the electric parts of the machine itself. The normal path of the ventilating air which enters the electric parts of the machine shall be so arranged by baffling or separate housings as to provide at least three abrupt changes in direction, none of which shall be less than 90 degrees. In addition, an area of low velocity not exceeding 600 feet per minute shall be provided in the intake air path to minimize the possibility of moisture or dirt being carried into the electric parts of the machine.
TEWAC	(Totally-Enclosed Water-Air Cooled) A totally-enclosed machine which is cooled by circulating air which, in turn, is cooled by circulating water. It is provided with a water-cooled heat exchanger for cooling the ventilating air and a fan or fans, integral with the rotor shaft or separate, for circulating the ventilating air.
TEPV	(Totally-Enclosed Pipe-Ventilated) A totally-enclosed machine except for openings so arranged that inlet and outlet ducts or pipes may be connected to them for the admission and discharge of the ventilating air. This air may be circulated by means integral with the machine or by means external to and not a part of the machine. In the latter case, these machines shall be known as separately- or forced-ventilated machines.

TABLE 1. AVAILABLE PROTECTIVE ENCLOSURES.

## SECTION II HANDLING AND INSTALLATION

### 2.1 SHIPMENT

Most machines described in this manual are shipped assembled. In some larger sizes it may be necessary to ship disassembled because of physical size and weight limitations.

### NOTE

Before accepting shipment from the transportation company, examine crating to determine whether damage has occurred in transit. If crating is not intact, the machine may have been damaged. If so, determine extent of damages and immediately notify the transportation company and the nearest E-M Field Sales Office giving full details. Check the shipping papers against material received and immediately report any discrepancies.

### 2.2 UNPACKING

Care must be used in unpacking and handling to avoid damage to any part of the equipment. In cold weather, after removal to a warm place, allow the machinery to reach room temperature before uncovering. This will minimize wetting of the windings by moisture condensing from the air.

### 2.3 STORAGE

If the machine is to be stored for any length of time before installation it is always best to store indoors in a clean, dry place. If stored six months or longer the windings should be megger tested every three to six months (more often in extreme atmospheric conditions). A record of insulation readings and other pertinent factors should be recorded, e.g. temperature, time, humidity and length of voltage application, to monitor winding condition.

### CAUTION

Machines with sleeve type bearings have a daron-my-lar-daron shield installed at the factory to protect the bearings during shipment and storage. As long as this shield remains in place the shaft must not be rotated. Bearings protected in this manner have a warning tag attached to the machine.

Be sure to open the bearings, remove the protective shield, and lubricate properly before turning the rotor.

### NOTE

For all storage situations a systematic inspection and maintenance schedule should be established and a written record kept.

When storing machines out of doors or where adverse conditions exist a weatherproof cover should be employed to prevent intrusion of salt, dust or other abrasive or corrosive materials.

Normally, the insulation resistance value will be well above minimum recommended value. In the event the insulation resistance is below minimum or questionable, much can be learned by preparing a Polarization Index. This is the ratio of the 10 minute resistance value to the one minute resistance value with constant applied voltage. A recommended minimum value is 2.0. A relatively flat curve (ratio under 2.0) indicates a wet or dirty winding even though insulation resistance may be above minimum.

### 2.4.2 Polarization Index

Refer to FIG. 4 for megger reading conversion to 40° C.

$$\text{Insulation Resistance in Megohms} = \frac{\text{Rated Voltage}}{1000} + 1$$

2.4.1 Minimum insulation resistance - During shipment and possible storage prior to installation, the equipment may have experienced many temperature and humidity fluctuations causing moisture accumulation in the windings. A megger can be used to determine whether drying is necessary. Recommended stator minimum insulation resistance in megohms at 40° C (104° F) is shown by the following formula: (Reference - IEEE Guide No. 43 - Guide for Test- ing Insulation Resistance of Rotating Machinery).

### 2.4 INSULATION RESISTANCE

Before machine startup after long term storage, bearing oil should be drained off, and the housing flushed with Military Specification compound MIL-L-644A. Then, refill housing with the lubricant specified in the machine instructions or on the machine lubricant name plate.

### CAUTION

To combat sudden temperature changes (and consequent moisture condensation in the windings) space heaters should be used when practicable. The space heaters should maintain a temperature of 10 degrees F. above ambient temperature.

### CAUTION

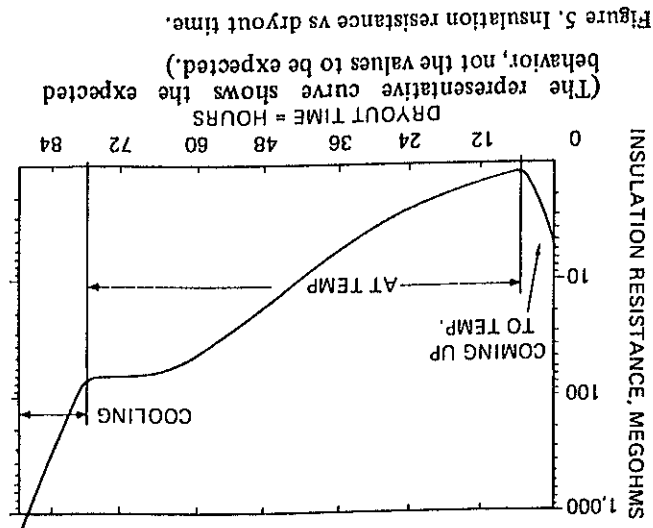


Figure 5. Insulation resistance vs dryout time.

the enclosure so that moisture evaporated from the windings may escape into the atmosphere. The drying out process should not be hurried or damaged to windings can occur. Sufficient time should be allowed for the process, and at no time should the temperature be allowed to reach a value greater than 85 degrees C (185° F).

2.5.3 Drying stator of motor with direct current.

Use a welding set wired in parallel to circulate a direct current through the stator windings. The current should be half of the rated ac current specified on the nameplate. Do not exceed a temperature of 65° C (149° F) as read by a thermometer on the coils when using the direct current method. The dc in the stator will dry both the rotor and the stator. Do not attempt to make any electrical connections to the rotor. To facilitate more rapid heating, cover the machine, if possible, with a tarpaulin open at the top and bottom to promote air circulation.

**CAUTION**

On a machine furnished with a top-mounted enclosure, the lifting bolts or holes in the enclosure are intended for lifting the enclosure only. Never attempt to lift the entire machine by these devices. Use the designated lifting holes in the main frame.

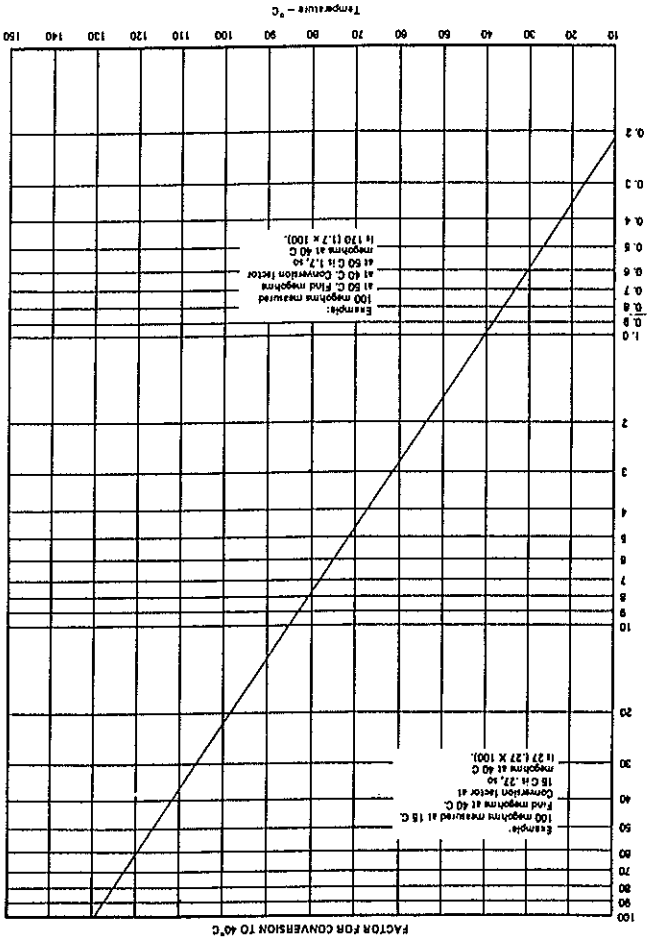
2.6 MACHINE LOCATION AND LIFTING

2.6.1 The location of the machine must meet the requirements of the National Fire Protection Association and must comply with local and special industrial regulations. The temperature of the surrounding air should not exceed 40° C (104° F) unless designed to operate at a higher ambient temperature. The machine should be in a well-ventilated location and should be easily accessible for cleaning, inspection and assembly.

2.7 FOUNDATION PREPARATION

2.7.1 For smooth operation, a rigid foundation is necessary.

Figure 4. Temperature conversion factors.



If values indicate that a dry-out is needed follow methods outlined in 2.5. An insulation resistance versus time curve (FIG. 5) should be made during the dry-out time.

2.5 DRYING OF ROTATING MACHINERY WINDINGS

2.5.1 Insulation resistance vs dry-out time.

The insulation resistance drops rapidly at first as the winding heats up, rises slowly as the moisture is removed, and levels off as shown in Figure 5. The dry-out may be concluded when a fairly steady acceptable value is reached. Take readings every ½ hour during heating and every hour during drying, and plot against elapsed time. Continue drying until curve is level for two hours.

2.5.2 Drying stator of motor with external heat.

External heat should be applied to the motor located in an enclosure. Supply the heat from a number of steam pipes or from electric strip heaters, and provide a vent in the top of

The top of the concrete foundation should be left rough to provide an anchorage for grout and should be approximately 1 inch lower than the bottom of the base rail to allow for grouting. Follow foundation bolt anchoring illustration (Figure 6) to secure base to concrete foundation.

Foundation bolts - The purpose of foundation bolts is to anchor the machine to the foundation so that structurally the

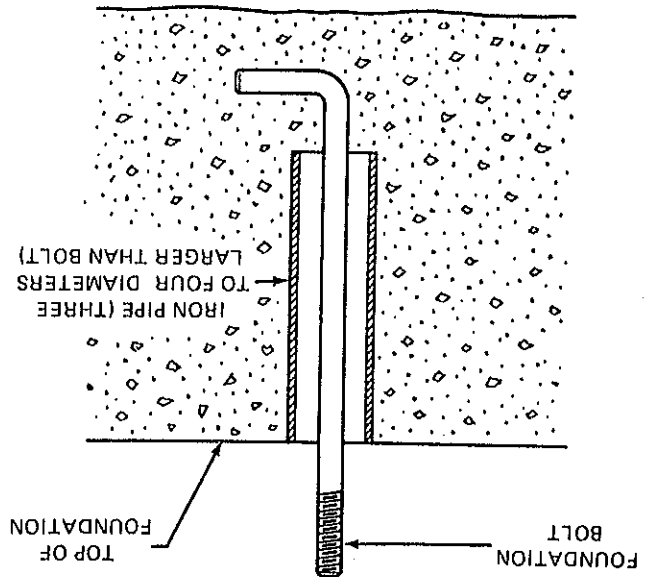


Figure 6. Anchoring foundation bolt.

foundation and the machine become a single mass. This may be done by the method illustrated in Figure 6. The bolt is enclosed in a casing three or four diameters larger than the bolt which allows the bolt to be sprung horizontally when placing the machine bedplate in position for mounting, thereby permitting adjustments for slight errors in foundation bolt location. Concrete is not placed inside the casing when the foundation is being poured, but the casing is filled with grout at the time the motor is grouted in position.

## 2.8 ADJUSTMENT AND LEVELING OF BASE

When adjusting and leveling the base of the foundation, work with the motor frame bolted to the base with a 1/16 inch to 1/8 inch thickness of shims temporarily placed between the frame feet and the base so that appropriate coupling alignment may be established. The base (bedplate or soleplate) should be adjusted and leveled on the foundation by means of iron wedges placed between the top of the foundation and the steel base at regular intervals from the foundation bolts, allowing 3/4 inch to 1 inch between the base and foundation for grout. Place the wedges close to the bolts. Do not remove the wedges when grouting the base, but cut off or burn off so as not to interfere with the grout form.

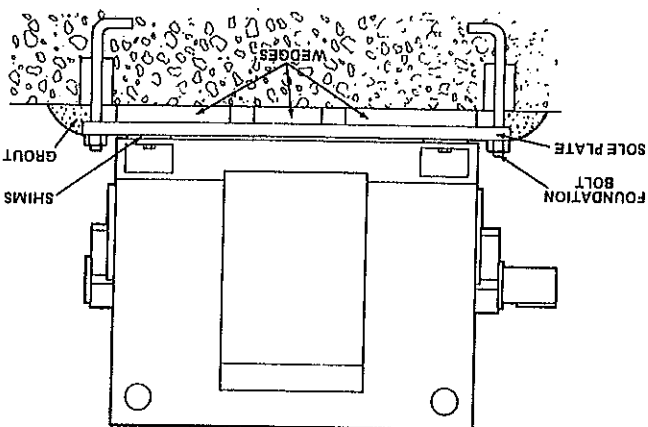
## 2.9 GROUTING

After the correct adjustment and leveling are obtained with the foundation bolts tightened, grout the base of the foundation.

## 2.10 MAGNETIC CENTER

The magnetic center of machines equipped with oil lubricated sleeve bearings is established by the E-M Quality Assurance Department while the machine is on test. It is indicated by a scribe mark on the extension end of the shaft outside the bearing housing and in line with the outer top edge of the housing. It is not cut deep, but is definite enough so that it can be located by a close examination of the shaft. It is important that the rotor be on magnetic center since an error could cause undue forces on bearings, coupling or both. Therefore, align the scribe mark and the top edge of the bearing housing before coupling to the drive or drive unit.

Figure 7. Motor grouted in position.

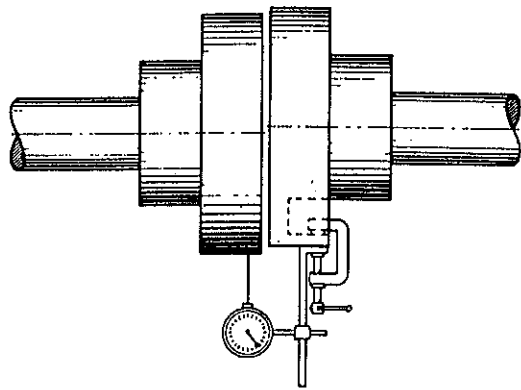


## 2.11 FRAME LEVELING & COUPLING ALIGNMENT

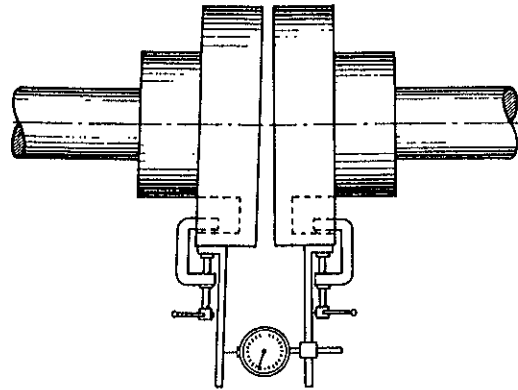
When the base has been adjusted, leveled and grouted, the correct leveling and coupling alignment are obtained with the aid of shims between the frame and the base. To give proper support, it is important that the base and shims extend as shown in Figure 7.

Rigid Coupling - Extreme care must be taken to obtain correct alignment when using rigid couplings. Circular concentric surfaces of the two coupling halves must indicate correct alignment within 0.0005 inches to 0.001 inch when the two coupling halves are rotated together. The separation between the faces of the two coupling halves must also be maintained within the same tolerance.

The alignment may be checked by utilizing a dial indicator as shown in Figure 8 or with the aid of a straight edge and thickness gauge or feelers as shown in Figure 9.



A. Clamp the dial indicator to the coupling as indicated above to measure the circular concentric peripheral surfaces of the coupling halves for parallel alignment.



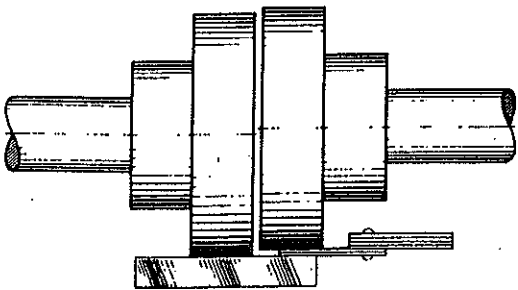
B. Clamping a reference surface to the opposite coupling half allows the dial indicator to be used for measuring the separation of the coupling halves for axial alignment as shown above.

**RIGID COUPLING TOLERANCES 0.0005 INCH  
TO 0.001 INCH  
FLEXIBLE COUPLING TOLERANCE: .002 INCH**

Figure 8. The preferred method of measuring coupling alignment is with a dial indicator.

The preferred method of checking alignment is with the dial indicator. Bolt the indicator to one of the coupling halves and indicate the position of the dial button on the opposite coupling half with a chalk mark. Set the indicator dial to zero at the first position and then rotate both halves of the coupling to a new position where a check reading is to be made. All readings must be made with the dial button located at the chalk mark, and not less than six different sets of readings should be taken. A variation in the dial reading at different positions of coupling rotation will indicate whether the machine has to be raised, lowered or moved to one side or another to obtain alignment of the circular con-

A. Use a straight-edge and thickness gauge or feeler gauge to check the alignment of the circular concentric peripheral surfaces of the coupling halves as shown above.



B. The separation between the faces of the coupling halves can be measured as shown above.

**RIGID COUPLING TOLERANCES 0.0005 INCH  
TO 0.001 INCH  
FLEXIBLE COUPLING TOLERANCE: .002 INCH**

Figure 9. The straight-edge and thickness gauge or feeler gauge is an alternate method of measuring coupling adjustment.

centric peripheral surfaces of the two coupling halves within the specified tolerance.

In addition to the above check, a check of the separation of the coupling faces must be made to establish correct alignment. The separation between the faces of the coupling may be checked with a dial indicator fastened to one coupling half and a reference surface fastened to the other coupling half. Mark the location of the dial button on the reference surface and make all readings with the indicator at this position. Set the dial of the indicator to zero for the first reading and use this as the reference. Be sure to rotate both halves of the coupling the same amount, aligning the button of the indicator and the mark on the reference surface for each of the six readings. A variation of the readings at different positions will indicate how the machine has to be adjusted to obtain correct alignment. After each adjustment of the frame, repeat the above procedure to be certain that correct alignment and leveling have been obtained.

Flexible Coupling - Units coupled through flexible couplings should be aligned as accurately as possible. As a suggested

limit, the two halves should indicate correct alignment within 0.002 inch on both the circular concentric peripheral surfaces and the separation between faces. Although most flexible couplings will withstand greater misalignment than rigid couplings, extreme misalignment can cause vibration possibly resulting in failure of motor bearings and/or shaft.

Thermal Expansion must be allowed for when the motor and driven equipment operate at appreciably different temperatures which will create a difference in shaft elevation. This may be the case when driving a fan handling high temperature air or a pump handling very cold or hot water. This allowance may be established on the basis of .001 inch per each 15 inches of shaft height above the common base or foundation for each 10 F difference between the average temperatures of the two bearing brackets, pedestals, or other structures directly supporting the two shafts.

The machine having the higher operating temperature should be set that amount low when checked at normal room temperature. The best procedure is to make a "hot check" after the machines have reached normal operating temperature. This involves shutting down and quickly opening the coupling and rechecking alignment. The difference between these readings and the original ones will be the amount that the alignment changed when hot.

If the method shown in Figure 9 is used to check alignment of the machines, correct alignment exists — if the peripheries of the coupling halves are true circles of the same diameter and if the faces are flat — when the separation between the faces is held to within the specified tolerance at all points and a straight edge lies squarely across the rims at any point. Non-parallel faces will be indicated by a variation in the separation of the coupling halves as they are rotated, and a difference in height of the coupling halves will be indicated by the straight edge and a feeler gauge test.

When the coupling halves have been correctly aligned with the frame feet bolted in position, place temporary bolts in two coupling holes for clamping the halves together. Then, ream bolts for a light drive fit through both halves for regular coupling

**2.12 PREVENTION OF SHAFT CURRENTS**

Shaft currents are stray currents which may flow through a circuit established by the rotor shaft, rotor bearings, and frame base. The presence of these currents could cause injury to the rotor bearing surfaces. Therefore, rotor bearings on the D II machine are insulated to prevent shaft current flow within the machines.

Shaft current insulation can be checked by placing one terminal of a 500 volt megger inside the insulation ring (perhaps on the shaft) and the other outside the ring (on the bearing housing). If properly insulated, there will be an insulation resistance of at least 0.1 megohm.

**2.13 BEARINGS**

2.13.1 Ball bearing units are packed with lubricant at the factory. No special handling is required.

2.13.2 A special lubricant is added to sleeve bearing units at the factory. This lubricant provides adequate protection for storage of up to one month. For longer storage periods, it is

necessary to flush bearing housing and add specified lubricant. Bearings must be lubricated in strict accordance with instructions found on the lubrication nameplate which is attached to the stator frame. The oil ring should be checked frequently to be certain that it is rotating with the shaft. Further bearing information in Section 3 - Maintenance.

**2.14 ELECTRICAL INSTALLATION**

2.14.1 Refer to Schematics and wiring diagrams supplied for the specific installation and machinery. Make all intercomponent and external electric connections in accordance with the requirements of the National Electrical Code and local regulations.

Be sure the machine frame is reliably grounded to all other components of the complete installation with a ground wire which is at least the same size conductor as the load leads. Use a heavy duty terminal lug for connecting the ground wire to the frame, and similar terminal lugs or good quality clamps for bonding the wire to the other components. All contact surfaces should be scraped clean to assure good electrical bonding.

**NOTE**

To avoid unnecessary disconnections, it is suggested that the megger check (paragraph 2.4 & Section 4) be performed before power and control connections are made.

E-M machines may have six stator leads brought out so that differential protection can be used.



Do not install control wires in same conduit with power circuit wires. This prevents the possibility of false signals being induced in the circuits.

2.14.2 Space Heaters: Wiring-Refer to paragraph for Drying Procedures.

If your motor is so equipped, it is advisable to wire up the heater as soon as practicable after the motor has been installed on its foundation. Control for space heaters should be located in a prominent place and have an indicating light to show when the heaters are on. If feasible, it is desirable to have heaters controlled by a normally closed (NC) auxiliary interlock on the motor contactor. Control of the heaters can also be by thermostat, arranged to turn the heaters on whenever the air in the protected apparatus drops to a predetermined temperature.

**2.14.3 Neutral Grounding**

Motors do not normally have their neutrals grounded.

## SECTION III MAINTENANCE

### 3.1 MECHANICAL - GENERAL

A preventive maintenance program, which includes periodic inspection and cleaning periods will depend upon environment, application conditions, and plant operation.

Preventive maintenance should include routine checks, the frequency of which depends on local conditions, for:

- a. Cleanliness.
- b. Lubrication.
- c. Heating of bearings.
- d. Vibration.
- e. Surrounding factors, i.e. excessive humidity, moisture, dust, etc.

### 3.2 PERIODIC CLEANING

3.2.1 General - Operated under normal conditions the following cleaning and inspection procedures are recommended every 3 months or 2000 hours of accrued operating time, whichever comes first. If the equipment is installed in a location where excessive moisture, heat, dust, or other undesirable operating conditions prevail, reduce the interval between cleaning and inspection procedures accordingly.

3.2.2 Cleaning - Remove all dust, dirt, oil, grease and other foreign material from the external surfaces of the frame by wiping with a shop cloth. If necessary use a clean cloth moistened with a non-flammable cleaning solvent to remove stubborn deposits of grease, oil or similar substances.

**CAUTION**

Use of compressed air at pressures above 25 psi when cleaning windings may cause winding insulation damage and should be avoided.

### 3.3 INSPECTION

Inspection - After removal of coil guards, covers, and screens, inspect the rotor and stator windings to determine their general condition. If the finish varnish appears cracked or deteriorated, touch up the accessible areas with a high grade, thoroughly with a solvent saturated cloth before applying the varnish.

### NOTE

Check the insulation resistance of the stator windings at least once each year in accordance with the instruction contained in Section IV of this Instruction Manual.

Check for loose or damaged leadwires, loosely mounted components and other indications of damage.

### 3.4 BEARING LUBRICATION

Lubrication is one of the most important check points of proper maintenance and must be carried out in accordance with the instructions supplied with the machine. Lubricants are used for bearings to reduce friction and wear between rubbing surfaces and to carry off heat.

The need for cleanliness in working with bearings and lubricants is extremely important. Dirt and other foreign materials can severely shorten the service life of the bearing.

Periodically, the bearing lubricant should be checked to insure proper operation. If inspection indicates that the lubricant is dirty, it should be changed immediately. Always maintain the level shown on the gauge. It is especially important to check lubrication levels during the first few operating hours, since a dropping level may indicate leakage. It should be noted that machines may have a different lubricant level while running than stationary. This difference is usually shown by two marks on the level gauge. A general classification of grades is shown in Table II.

TABLE II. CORRESPONDING SAE OIL NUMBERS AND VISCOSITIES.

SAE NO.	APPROX. SUS *
10	170
20	300
30	450
40	800

\*Viscosity determined by Saybolt Universal Standard Viscosimeter at 100 F.

**CAUTION**

The lubricant pour point temperature must be lower than the lowest expected ambient air temperature. Be very careful to check this in climates with severe winter temperatures. We suggest consultation with your lubricant supplier to establish the best lubricant for your application and installation.

**CAUTION**

Do not overfill bearings.

3.4.1 Sleeve Bearings

Sleeve bearings may be lubricated by oil ring or by a flood lubrication unit with oil ring assist. Figure 10 shows a cut-a-

way of a sleeve bearing with labyrinth oil seals.

It is important that bearings be kept clean and free from grit. Sleeve bearings should be examined to see that oil supply is properly maintained and that oil rings do not stick. Drain and refill bearing housings periodically — every four to six months for a machine in continuous use. The oil level sight

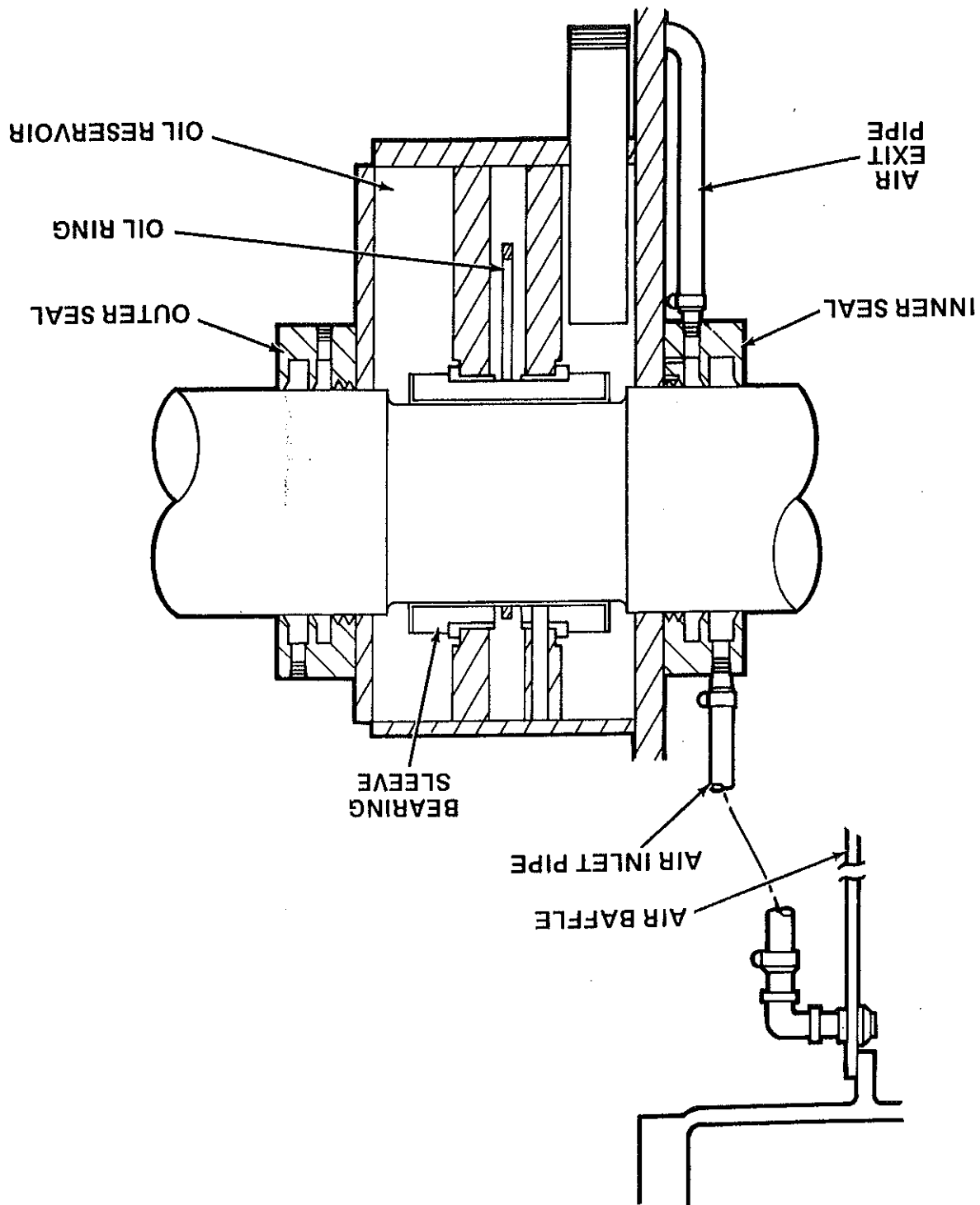


Figure 10. Sleeve bearing showing labyrinth oil seals.

gauge is located to indicate the standing oil level. Do not overfill or oil may be thrown out along the shaft into the windings.

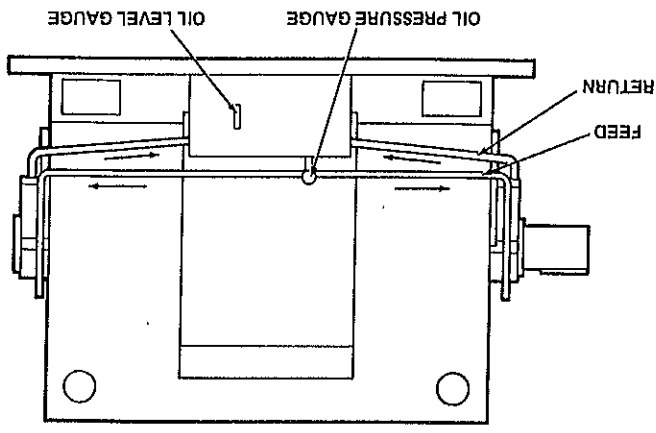


Figure 11. Oil flow diagram for typical flood lubricated bearing.

3.4.2 Anti-friction Bearings - Machines equipped with anti-friction bearings are shipped with the bearings packed with grease. If the machine is stored for one year or longer, the bearings should be repacked with new grease before putting into service. Repacking is also recommended after every 3 to 4 years of operating time. Replenishment and repacking instructions appear on the nameplate of your machine.

**CAUTION**

Do not overgrease the bearings.

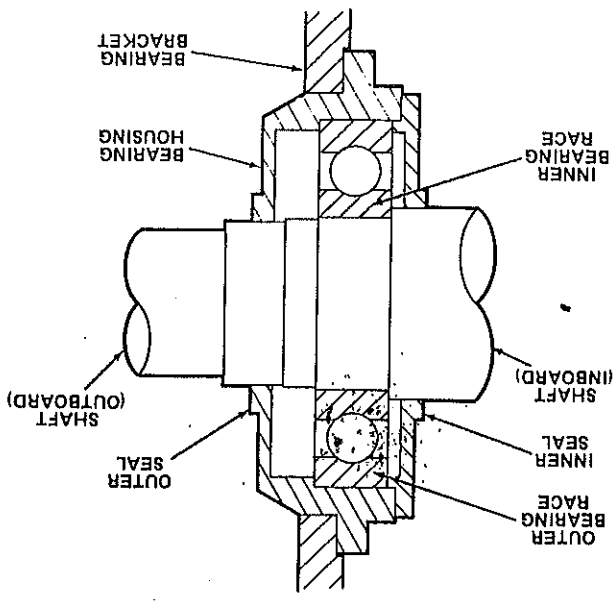


Figure 12. Grease lubricated anti-friction bearing.

If it is necessary to remove or replace a bearing on the shaft, do not apply pressure through the outer race of the bearing. A steady pressure should be applied to the inner race.

**3.5 SLEEVE BEARING MAINTENANCE**

3.5.1 Hot Sleeve Bearing - Bearing temperatures taken with a thermometer close to the babbit on top of the bearing should not exceed room temperature by more than 40°C (104°F). An excessively hot sleeve bearing is probably due to one of the following causes:

- a. Oil level too low in reservoir and oil ring is not rolling in the oil.
- b. Excessive loading.
- c. Improper alignment.
- d. Failure of the oil rings to revolve with the shaft.
- e. Rough bearing surface.
- f. Improper fitting of babbit linings particularly in the vicinity of oil grooves.
- g. Use of poor quality, dirty, or improper grade oil.
- h. End thrust. A bearing may become hot because of excessive axial pressure exerted by the shoulder of the shaft against the side of the bearing.
- i. Shaft currents.
- j. Plugged oil filters in a flood lubricated system.

When a bearing becomes excessively hot, shut the motor down and check for improper operation as described above.

**3.6 PRESSURIZED LABYRINTH OIL SEALS**

The purpose of labyrinth oil seals is to prevent fan suction from pulling oil mist from the bearings into the machine which could result in contamination of the winding insulation. This is accomplished by neutralizing the suction preventing the oil mist from moving toward the rotor. In Figure 13, A is at negative air pressure since it is near the intake or suction eye of the blower. This tends to draw the oil mist from the bearing in and along the shaft toward the main part of the rotor. This is prevented as follows:

- a. High pressure air at B is bled at a controlled rate through pipes C into annular grooves D in the inboard bearing seal. The high pressure air sweeps along the shaft in two directions, neutralizing the suction.
- b. The high pressure air flowing toward the bearing is vented through pipes E to the outside of the machine. This venting maintains atmospheric pressure in the bearing housing.

To disassemble labyrinth oil seals:

- 1. Remove upper half of guard.
- 2. Remove upper air baffle.

3. Remove seals.

4. Remove pipe assembly parts.

Reassembly of bearing housing cap and oil seals for horizontal motors and generators.

The following materials are needed:

- Locite Superflex Ultra Blue Silicone (Item #58775 - 10.15 oz Cartridge or #58730 - 2.7 oz squeeze tube) or equivalent oil resistant RTV with Oxime cure system
  - Locite Safety Solvent (Item #75559 - 12 oz aerosol can) or any mineral spirits
  - Locite Chisel Gasket Remover (Item #79040 - 18 oz aerosol can) or methylene chloride.
  - Safety Glasses, Gloves, Caulking Gun, Sharp Scrapers
- For a local Locite distributor, call 1-800-323-5106 (Outside CT) 1-800-842-4484 (Within CT)

**NOTE**

For machines with oil seals cast in the bearing housing, disregard sections dealing with oil seals.

To reassemble the bearing housing cap and oil seals, perform the following steps:

a. Plug up exposed holes of the bearing housing with rags prior to cleaning off old sealant on bearing housing split.

b. Scrape off old sealing material on mating surfaces of the bearing housing split, the oil seal splits, and the bearing housing-oil seal interface.

c. Following the instructions on the can of Chisel, remove remaining sealant which could not be scraped off.

**CAUTION**

Chisel removes paint. Safety glasses are mandatory. Allow to evaporate with good ventilation. Rubber or plastic gloves are recommended.

d. Clean all mating surfaces with the safety solvent. If blind holes are used to bolt and/or dowel mating surfaces, be sure to wipe them out.

f. Apply sealant under the cap's bolt heads and also on the threads of the bolts and the tapped holes.

**NOTE**

Bead size depends on area of mating surfaces, the estimated assembly time, and the ambient temperature and relative humidity. Normal ambient curing conditions are 80°F and 50% relative humidity. Use a larger bead size to seal a given area if reassembly is between 30 to 45 minutes and/or the normal ambient conditions are exceeded. Under normal conditions, a typical bead size may be 1/8 to 3/16 inch. Slight skimming of the sealant is acceptable. However, if more than 20% of total bead has cured (skinned over), the sealant has lost its effectiveness.

tiveness and should be replaced with a new bead. For best results, apply sealant to individual parts as they are assembled.

Apply a continuous bead of sealant in the center of the contact area to only one-half of mating surface. To ease future part separation, apply a very thin coat of clean oil to the other half and wipe (do not rub) it back off with a clean cloth.

Use safety solvent to wipe up any excess uncured sealant.

**CAUTION**

Bearing housing and oil seals may contain holes, channels, or other openings for ventilation. When applying the sealant, anticipate the flow pattern of the sealant when the parts are assembled so these are not plugged and a quality seal is still established.

g. Reinstall the bearing temperature detector.

h. Apply sealant to bearing housing split encircling all bolt and dowel holes.

i. Line up the cap with the bracket and cautiously lower the cap squarely onto the bearing locating pin and bracket.

j. Install dowel pins to align the cap properly on the bracket.

k. Insert all cap bolts and uniformly draw cap down in an incremental fashion. Finish by torquing bolts to specification. Wipe up any secreted sealant.

l. Apply sealant under the bolt heads of the bottom half of the outer oil seal, and also on the threads of the bolts and the tapped holes.

m. Apply sealant to the mating surface between the bottom half of the outer seal and the bearing housing.

n. Install seal tightening bolts finger tight. Wipe up secreted sealant.

o. Apply sealant to the mating surface between the top half of the outer seal and the bearing housing.

p. Apply sealant to the oil seal split.

q. Attach seal to housing tightening bolts finger tight.

r. Tighten split bolts finger tight.

**NOTE**

The clearance between the bottom of the shaft and the oil seals depends on the type of seal used.

For brass or aluminum seals, this clearance can range from 0.0 - 0.001 inch. For other materials (glass reinforced polyester, etc.), the clearance has a prescribed value set at Electric Machinery.

s. Adjust the clearance between the bottom of shaft and the seal ensuring the side clearances are equal.

Engineering Department for assistance in diagnosing the cause of vibration.

**3.8 ROTOR REMOVAL**

3.8.1 The rotor is removable from either end of the D II frame. The following steps are suggested for sleeve bearing type machines:

a. Drain oil from bearing housing.

b. Remove end louvers.

c. Remove upper bearing caps.

d. Remove the upper bearing halves.

e. Raise shaft (approximately 0.1 inch) and rotate out the lower bearings.

f. With the shaft still in raised position remove the bearing bracket assembly from each end.

g. Remove baffles.

h. Rotor can now be axially removed with dual crane lifts and pipe.

To reassemble reverse the general procedure. Adjust baffles for proper uniform clearances.

If bearing seals have been damaged they should be replaced.

The following steps are suggested for grease lubricated type machines:

a. Remove end louvers.

b. Remove bearing bracket assembly each end.

c. Remove ball bearing housing and bearings (see paragraph 3.4.2).

d. Remove baffles.

e. Rotor can now be axially removed with dual crane lifts and pipe.

To reassemble reverse the general procedure. Adjust baffles for proper uniform clearances.

t. In succession, torque the bolts of the bottom seal, the split, and the top seal to specification. Wipe up secreted sealant.

u. Repeat steps 1 through 5 for the inner seal.

v. Reinstall hoses.

w. Reinstall end cover(s), vibration probes.

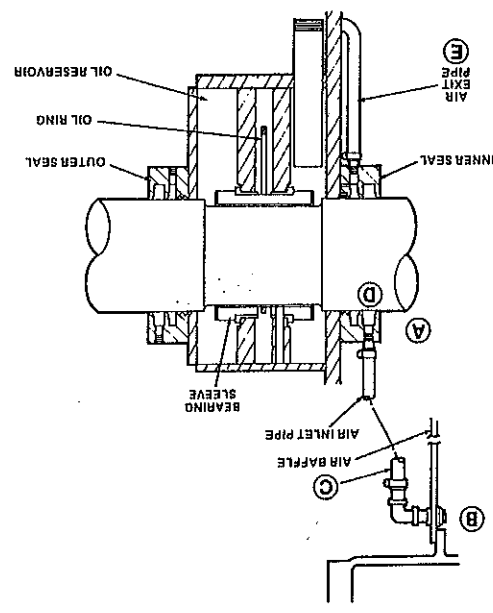


Figure 13. Labyrinth oil seals neutralize air pressure along the rotor shaft and prevent oil mist from moving toward the inside of the machine.

**3.7 VIBRATION**

To assure smooth operation, E-M machines are balanced to values substantially better than commercial acceptable limits. For best overall operation on the job, therefore, all other elements of the installation should be in proper balance.

If there is vibration in the installation, measure it with a vibrometer or other amplitude meter. Vibration is measured at the bearing housing for vertical, horizontal and axial movement. When readings exceed values in TABLE III, corrective measures should be taken. Consult the E-M Service

OPERATING SPEED	600 AND SLOWER	700	900	0.0030	0.0030	0.0025	0.0020	0.0010
MAXIMUM VIBRATION	0.0030	0.0030	0.0030	0.0030	0.0030	0.0025	0.0020	0.0010

TABLE III. VIBRATION LIMITS ON THE BEARING HOUSING AT ONE TIMES SHAFT SPEED.

## SECTION IV INDUCTION MOTOR OPERATION

### 4.1 PRE-OPERATIONAL CHECKS

- a. Winding Insulation Resistance - It is highly recommended that the winding insulation of the motor be given a thorough dielectric (megger) check before initial start-up. It is assumed that no power or control connections have been made as yet to the newly installed motor.

If this cannot be done, care must be exercised to prevent the megger output from being applied to control cabinet components. The winding may be meggered by connecting one clamp to each individual lead (i.e. T1, T2, T3, T4, T5 and T6) in sequence with the other clamp fastened to a convenient spot on the frame. This can be done by phases (i.e. T1 and T4 in one clamp and other clamp to frame, T2 and T5 and frame, and T3 and T6 and frame), or in total with all six leads in one clamp and the other clamp to the frame. Physical size of the specific machine may dictate which of the above methods is appropriate.

Refer to Section 2 for megger reading conversion.

Insulation resistance at 40° C (104° F) should be more than that shown by the following formula:

$$\text{Insulation Resistance in Megohms} = \frac{\text{Rated Motor Voltage} + 1}{1000}$$

If the insulation resistance requirements are not met, the winding must be dried out before being put into operation. See Section 2 on dry out procedures.

#### b. High Potential Test

Windings above 7000 volts may be given a high potential test. Be sure insulation resistance or polarization index (from megger test) shows winding in good condition.

NEMA Standards permit 75% of the factory test (twice rated volts + 1000) volts, 60 Hz to be applied for one minute, or 1.70 times the above value of dc volts.



High potential or proof tests have a weakening effect on the winding when repeated, and are of a "pass or fail" nature. Due to risk involved they should be undertaken only where utmost reliability is necessary.

Dc tests, particularly step-voltage curves, are preferred. They take longer, but much can be learned about the condition of the winding without the hazard of a breakdown. Voltage is applied in predetermined steps and held at each step for a given time - usually two minutes while leakage current is read. Data is plotted as it is taken, so that the slope of curve

can be observed. Curve should be relatively flat over most of voltage range. There should be no sharp breaks in curve. Refer to IEBE no. 95 ("Guide for Insulation Testing of Large AC Rotating Machinery with High Direct Current Voltage").



After testing with dc, winding MUST be grounded a short time (10-15 minutes) after short tests and a long time (1-2 hours) after long tests like the step voltage test.

- c. Check the voltage and frequency of the line against the control nameplates. The motor will operate satisfactorily, but not necessarily in accordance with the standards established for operating at normal rating, with not more than a 10% voltage variation or a 5% frequency variation. Successful motor operation is also possible when the sum of the voltage and frequency variations do not exceed by 10% the normal rating as stamped on the motor nameplate, provided the variation in frequency does not exceed 5%.

- d. Check all connections to the motor with the wiring diagram furnished with the starters. Be certain that the motor is connected to the proper number of phases and Be sure that all gaskets are in place and all bolts and screws are tight.

- f. Check lubrication of motor to determine that it has been lubricated in accordance with the instructions provided in SECTION 3 MAINTENANCE, Paragraphs 3.4.

- g. Inspect the motor for foreign materials and general cleanliness. Be certain that there is no mechanical interference preventing rotation of the rotor. DO NOT turn the rotor over by inching.

- h. Check alignment of the motor and coupled load so that shaft and bearings of the motor will not be subjected to unnecessary strain and wear.
- i. Space heaters should be turned off when motor is operating.

### 4.2 INITIAL STARTING PROCEDURES

Before putting the motor into continuous operation...

- a. Run motor to check connections, installation and direction of rotation. Motors with straight radial blowers are suitable for either direction of rotation. Motors with unidirectional blowers can only be operated in the direction shown on the rotation plate attached to the motor. If it is desired to reverse the direction of rotation, refer to the E-M factory or to the nearest E-M Field Engineering Office.

- b. Operate the motor without load for approximately one hour to check for any unusual heating of bearings and windings. This also permits lubrication warm-up before torque is placed on rotating parts.
- c. Check the bearing housing occasionally when the motor is first started under load to be certain that overheating of the bearing does not occur.

Bearings should be periodically checked for excessive heating. This is very important during the "run-in" period when overheating is most likely to occur. If overheating does occur, determine the cause immediately and take corrective measures.

Overheating of sleeve bearings - The bearing temperature (taken with a thermometer close to the bearing lining) should not be more than 40° C (104° F) over ambient temperature. Bearing failure is likely to result if the total bearing temperature reaches 90° C (194° F).

If excessive heating does occur, immediately shut down the motor and determine the cause of the overheating which

will probably be due to one of the following. In each case, corrective measures should be taken immediately to insure dependable operation.

- a. Improper alignment
- b. Rough bearing surfaces.
- c. Improper fitting of linings particularly around the oil grooves.
- d. Use of poor grade, dirty or too heavy an oil.

Bearings should also be checked for vibration. See Section 3 Maintenance.

#### 4.3 TROUBLESHOOTING

The following chart lists the various troubles that may occur, their probable cause and suggested solutions. This chart is intended both as a diagnostic aid and as a quick answer sheet. If source of malfunction is unknown, or correction is not achieved after using this chart, report matter to the nearest E-M Field Engineering Office.

PLEASE REFER TO THE FOLLOWING PAGE FOR TROUBLESHOOTING CHART

TABLE IV. TROUBLESHOOTING CHART

Trouble	Probable Cause	Remedy
Failure to start	Loose, unattached or incorrectly fastened connections. Low line voltage.	Tighten all mechanical and electrical connections. Check panel meters.
Motor overheating	Overloaded. Improper line voltage or incorrect frequency. Ventilation impeded by dirt.	Shed or adjust load applied at control panel. Clean motor.
Noisy or overheated bearings	Misalignment between motor and driven machine. Low oil level. Improper fit of bearings (especially in oil grooves) or in babbit liners.	Check alignment and correct as necessary. Drain and fill to correct level with correct viscosity. Check for scoring of bearing surfaces. Replace bearings if damaged. Replace if damaged.
Vibration	General Improper alignment between motor and driven machine. Loose or incorrect base attachment. Worn bearings. Unbalanced load. Warped base.	First, measure amount incurred with vibrometer on the bearing housing. Second, ascertain if source is in motor or in driver machine. Third, if vibration is in excess of that shown in Table III (Section 3 - Maintenance), corrective measures must be taken. Measure around concentric periphery of coupling with either clamps and dial or with feeler gauge and straight edge. Realign if needed. Check vertical with a bubble scale or plumb bob. Check and adjust. Replace Worn drive gears of the driven machine. If on either machine, the effect is magnified after coupling.

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For either Service, Sales or Engineering information: refer to form SA-1 for name and address of the nearest E-M Field office or write to the factory at the address listed below.

**NOTICE**

