

WESTMINSTER COMPANY  
SITE WORK-PUMPS

UNACCOMPANIED ENLISTED PERSONNEL HOUSING  
MARINE CORPS BASE  
CAMP LEJEUNE, NORTH CAROLINA  
N62470-82-C-2244

from

**RAMSEY AIR CONDITIONING CO.**  
Commerce Street P. O. Box 1333  
JACKSONVILLE, NORTH CAROLINA 28540

UEPH  
Camp Lejeune, North Carolina  
N62470-87-C-2244



Comments for Transmittal # 32

Electrical changes required for proper installation of lift station equipment.

The following changes are necessary to accommodate the lift pumps. We had provided starters and two circuits, but the pumps are being furnished with starters in a control panel, and require only one circuit.

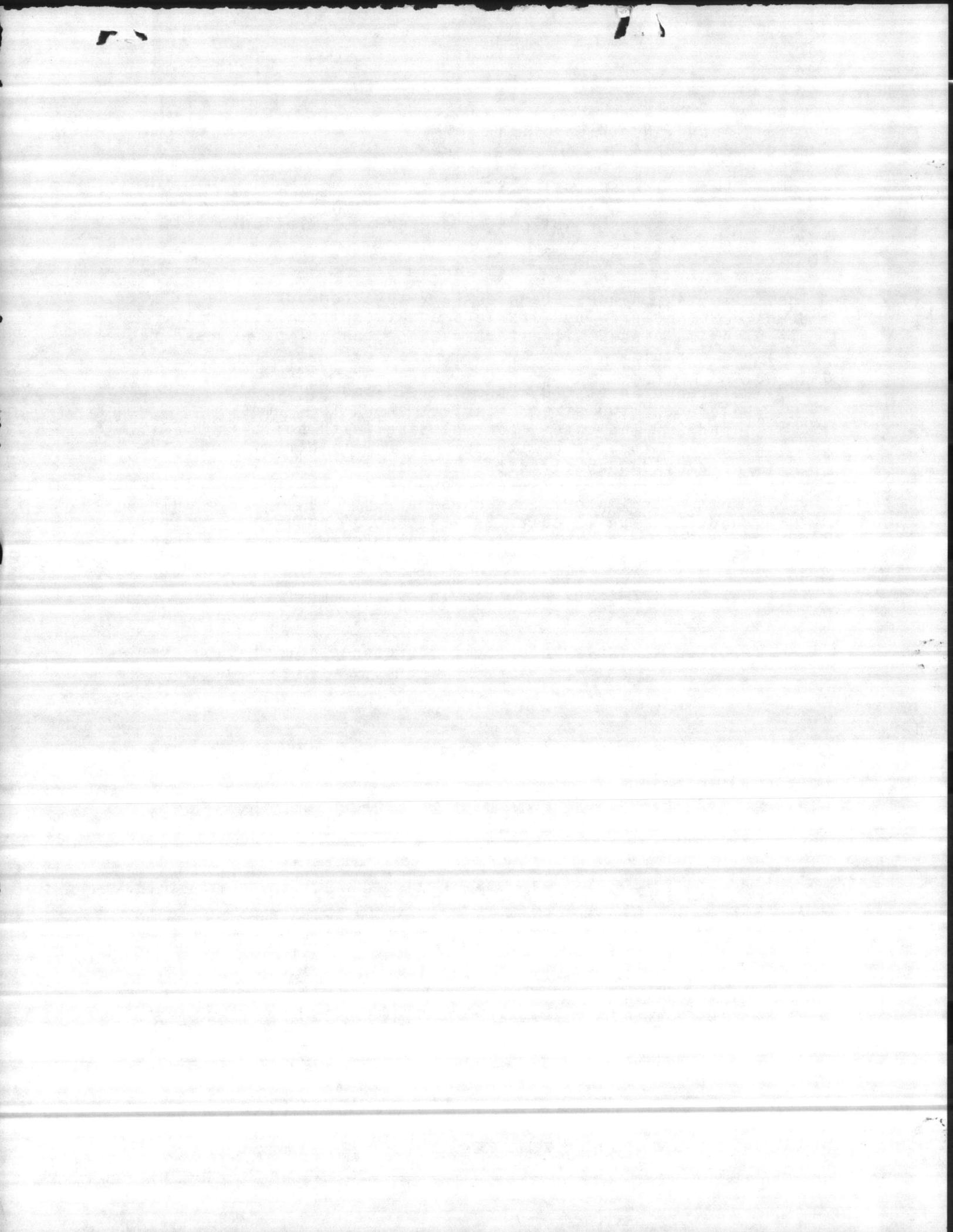
Reference Sheet E-8, Upper Level Floor Plan.  
Delete the two size 3 starters shown for Pumps 1 and 2. Indicate a control panel with built-in starters furnished with pumps. Delete circuits LP-6&7 and provide one circuit at 175 amps, 3 pole, 10,000 AIC, 3 #1, 1 #6G, 1½-inch conduit for control panel. From control panel to each pump run 3 #4, 1 #8G, 1¼-inch conduit. Run circuit LS-3 to control panel for control power. Also provide 2 #12, 1 #12G between control panel and remote light.

Change circuit breaker serving sump pump (LP-4) from 15 to 20 amps.

Provide suitable receptacle for connection of sump pump.

Reviewer  
Dale V. Thompson, P.E.  
J. N. Pease Associates

DVT/lgs



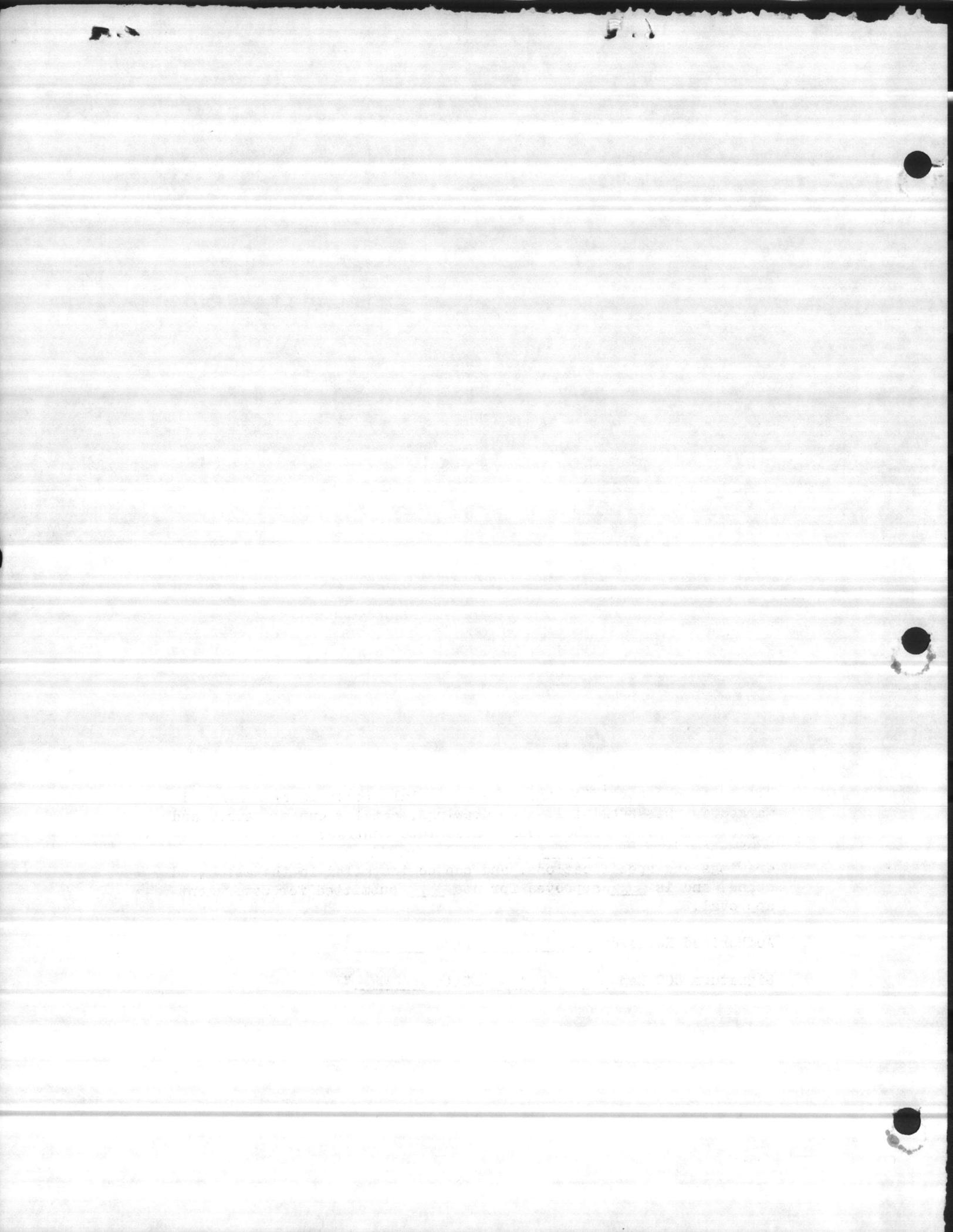
WESTMINSTER COMPANY  
SITE WORK-PUMPS

UNACCOMPANIED ENLISTED PERSONNEL HOUSING  
MARINE CORPS BASE  
CAMP LEJEUNE, NORTH CAROLINA  
N62470-82-C-2244

"It is hereby certified that the (material) (equipment) shown and marked in this submittal, shop drawings, catalog cut(s), etc., and approved/proposed to be incorporated into Contract Number N62470-82-C-2244, is in compliance with the contract drawings and specifications, and can be installed in the allocated space, and is  approved for use  submitted for Government approval.

Authorized Reviewer *[Signature]* Date 5/31/84

Signature CQC Rep *John McOmber* Date 6/1/84 "





# *Pump and Lighting Company*

## ENGINEERED PRODUCTS DIVISION

926 2ND STREET N.E. • P.O. BOX 2504 • HICKORY, N.C. 28601  
704/324-9705

### SUBMITTAL DATA

DATE: March 26, 1984

PROJECT: Unaccompanied Enlisted Personnel Housing  
IFB-N62470-82-B-2244

LOCATION: USMC Base Camp Lejeune, North Carolina

ENGINEER: J.N. Pease & Associates

CONTRACTOR: Ramsey Air Conditioning Company

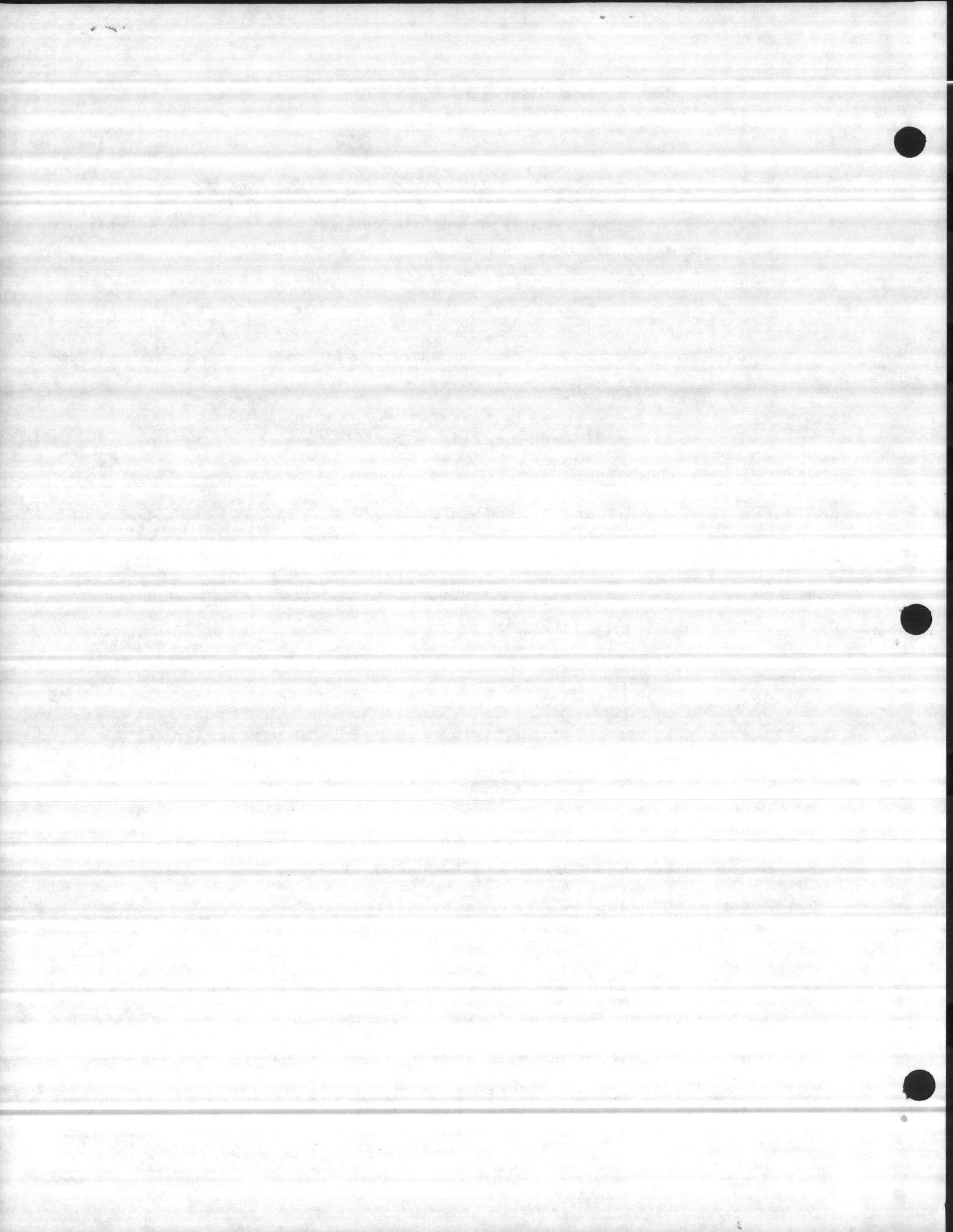
SUBJECT: SEWAGE LIFT PUMPS AND CONTROLS AND SUMP PUMP

DESCRIPTION:

CONDITIONS: 500 GPM @ 54' TDH  
RPM: 1165  
ROTATION Clockwise

Two (2) Fairbanks Morse 4" x 6" Figure B5413 T-30 vertical dry pit sewage pumps with:

- A. Certified performance tests
- B. Stainless steel impeller and case wear rings
- C. Packing box with Z.F. grease seals
- D. WVA-41 and WVB-41 flexible shafting
- E. W41-17 steady bearings
- F. Shaft guards and mounting kit guards are 4' long
- G. Motor ring bases
- H. General Electric 15 HP, 3-60-208 volt, 1165 RPM vertical solid shaft motors, frame C284HP10
- I. Spare parts:
  1. One (1) set of bearings
  2. One (1) set of wear rings
  3. One (1) shaft sleeve
- J. One (1) Mellis Duplex control, bubbler type complete as specified (bubbler line to wet well not included)
- K. One Zoeller Model M139 submersible sump pump with 15' of cord designed for 25 GPM @ 17' TDH for 1-60-120 volt operation. Sump pump is bronze.





# Pump and Lighting Company

## ENGINEERED PRODUCTS DIVISION

926 2ND STREET N.E. • P.O. BOX 2504 • HICKORY, N.C. 28601  
704/324-9705

March 29, 1984

Ramsey Air Conditioning  
P.O. Box 1333  
Jacksonville, NC 28540

Subject: CERTIFICATION OF EQUIPMENT FURNISHED BY PUMP AND LIGHTING COMPANY ENGINEERED PRODUCTS DIVISION FOR:

Project: Unaccompanied Enlisted Personnel Housing  
IFB-N62470-82-B-2244  
Camp Lejeune, North Carolina  
USMC  
Sewage Lift Pumps and Controls

EQUIPMENT TO BE BY PUMP AND LIGHTING COMPANY, ENGINEERED PRODUCTS DIVISION.

Equipment: Two (2) Fairbanks Morse 4" x 6" Figure B5413 T30  
Dry Pit Sewage Pump  
Flexible Shafting  
General Electric Motors  
Spare Parts  
Duplex Control  
Sump Pump

This is certification that the above equipment to be supplied by our company is in compliance with the specifications, performance and material for Project IFB-N62470-82-B-244. We are, to the best of our knowledge, in complete compliance with the specifications.

If you need additional information or service, please contact us.

Very truly yours,

PUMP AND LIGHTING COMPANY  
ENGINEERED PRODUCTS DIVISION

*R.M. Wilkinson*  
R.M. Wilkinson  
Division Manager

My commission expires

Subscribed and sworn before me this 29 day of March, 1984. R.M. Wilkinson did personally appear before me.

*Cheryl Brewer*  
Notary  
926 2nd St NE  
Hickory, N.C.  
Address  
June 10, 1984

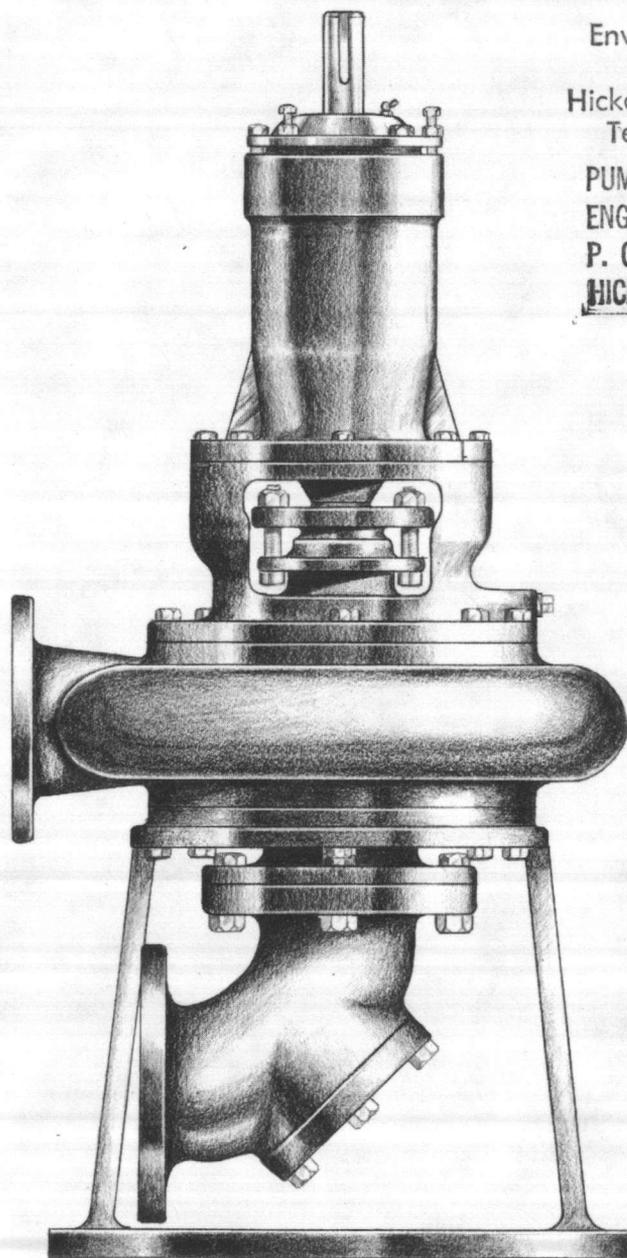


# 5410

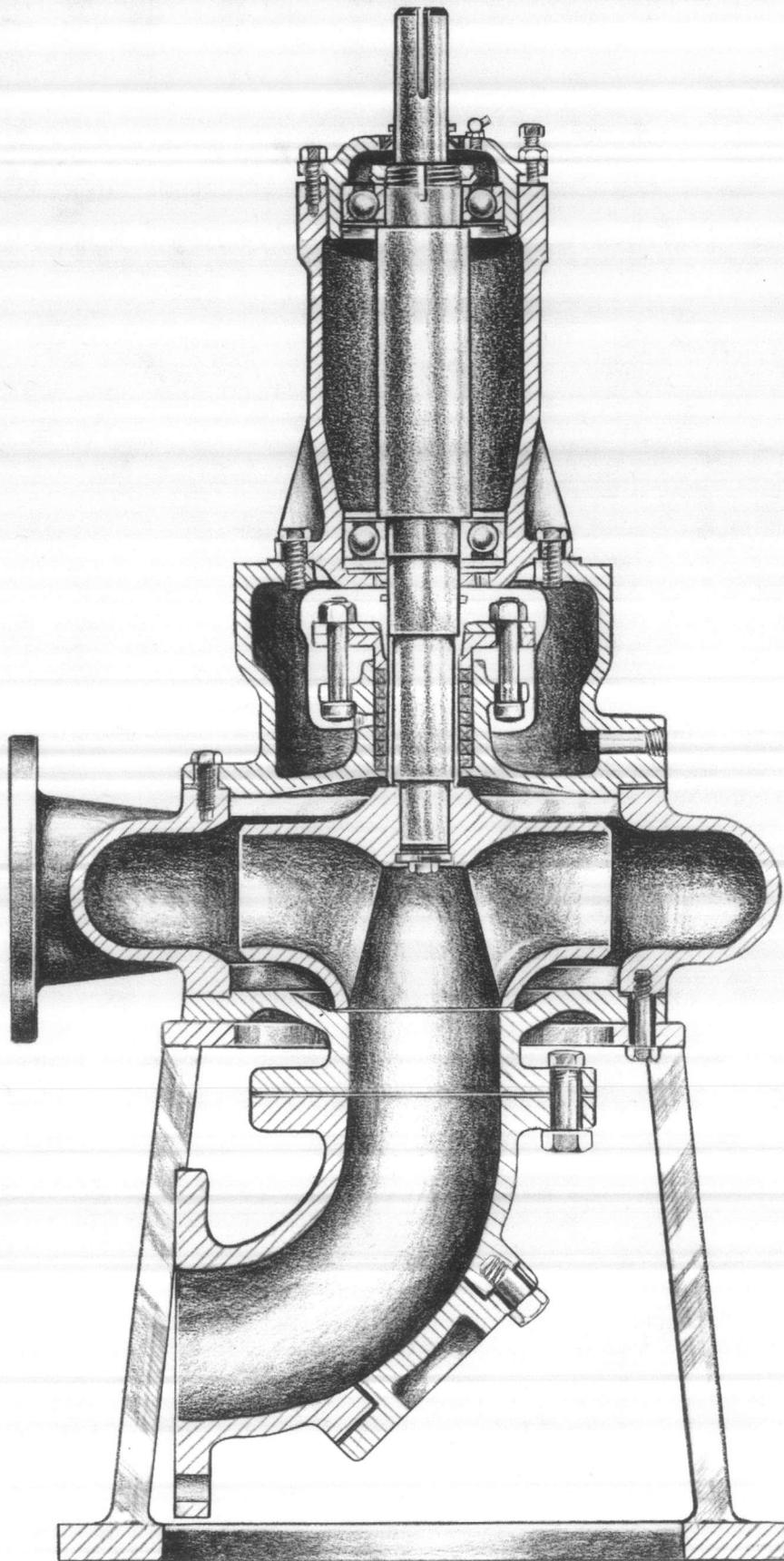
## VERTICAL NON-CLOG PUMPS

Environmental Products,  
P. O. Drawer 2385  
Hickory, North Carolina 28601  
Telephone 704-322-7003

PUMP & LIGHTING CO.  
ENGINEERED PRODUCTS DIV.  
P. O. BOX 2504  
HICKORY, NC 28603



# Fairbanks Morse



**Typical Applications:**

- Sewage and Water
- Industrial Wastes
- Drainage
- Foods

**SHAFT** - High quality alloy steel accurately machined and furnished with a renewable corrosion and wear resistant stainless steel sleeve.

**FRAME** - Rugged cast iron one piece design to house bearings and shaft. Grease lubricated anti-friction bearings are located in a dust proof housing.

**ADAPTER** - One piece cast iron with integrally cast stuffing box that can accommodate either packing or mechanical seals.

**CASING** - One piece cast iron with tangential discharge, clean out opening for inspection and clean-out, discharge gauge connections.

**IMPELLER** - Enclosed two-port or bladeless, non-clog one piece cast iron impeller designed to pass large solids. Clearance between impeller and fronthead is externally adjustable to provide sustained performance.

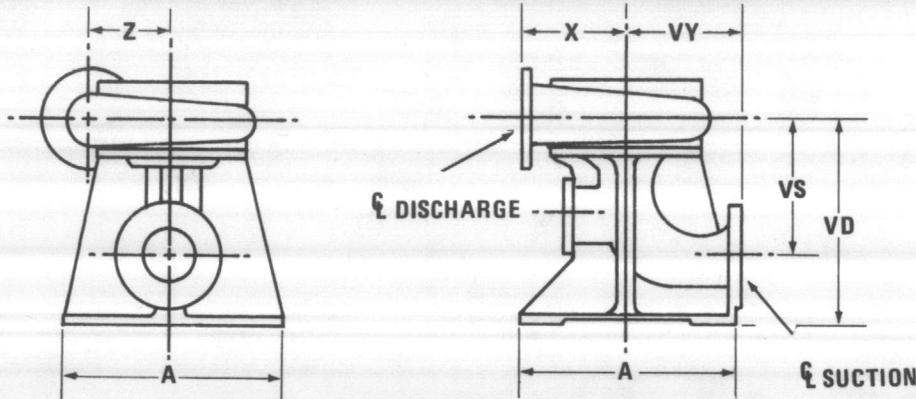
**FRONTHEAD** - One piece cast iron located between the base and casing, is designed to guide the liquid flow into the impeller.

**SUCTION ELBOW** - One piece cast iron bolted directly to fronthead has a contoured clean-out port and gauge connection.

**BASE** - Rugged heavy duty fabricated steel base bolted directly to the casing.

**COUPLING GUARD** - A removable guard that covers the coupling is provided for safety.





5411C, 5412C and 5413C (Combination Base Elbow)

Pump Size	Suction Size	A	X	Z	CP Maximum	VD	VS	VY
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**5411**

2	2	20	6 1/2	5 1/4	40 5/16	18	9	4 1/2
3	3	20	7 1/4	5 3/4	40 7/8	18 1/4	10 1/4	5 1/2
4	4	20	8 1/2	6 7/8	41 1/2	18 1/2	11 1/2	13 1/4

**5412**

2	2	20	8	6 5/8	39	16 5/8	9 1/4	4 1/2
3	3	20	9	7 1/4	39 1/2	16 7/8	10 1/2	5 1/2
4	4	20	10	7 7/8	40 1/2	17 3/8	11 3/4	13 1/4

**5413**

3	3	24	11	7 3/4	5 1/2	23 3/4	11	5 1/2
4	4	24	12	9	52 1/2	24 1/4	12 3/4	13 1/4
5	5	24	13	9 1/2	53 1/2	24 3/4	14 3/4	7 1/2
6	8	24	12	9	53 1/2	24 3/4	17	8

**5414**

4	5	30	14 3/4	10 3/8	59 3/8	25 15/16	14 13/16	7 1/2
5	6	30	16	11 1/2	60 3/16	26 3/8	14 7/8	10
6	8	30	17	12 13/16	60 1/2	26 1/2	16 3/8	8
8	10	30	18	14	61 1/2	27	18 1/8	11

**5415**

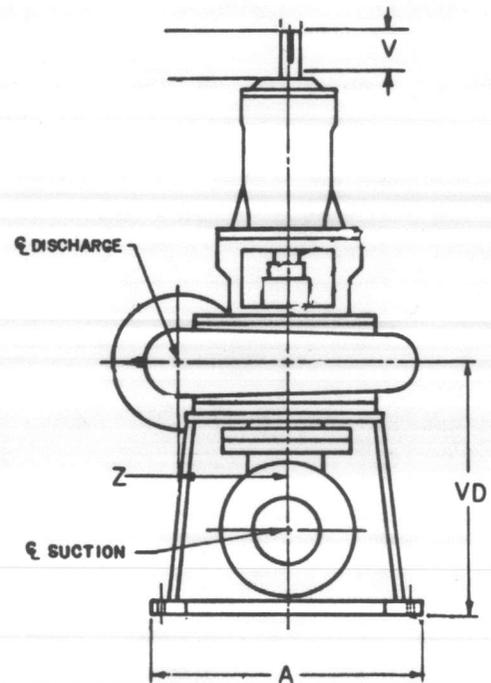
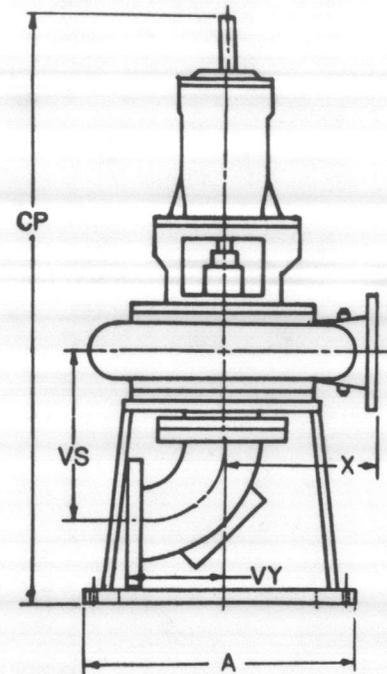
8	8	42	21	19 3/4	67 7/8	33 7/8	19 1/2	9
10	10	42	24	17 7/8	68 7/8	34 3/8	23	12

**5416**

5	8	30	14	12 3/8	59 3/8	25 15/16	18 9/16	9
6	10	42	14 1/2	12 5/8	67 1/2	34 3/16	23 5/16	11
8	12	42	21	19 3/4	67 7/8	33 7/8	22 1/2	12

5411C, 5412C and 5413C (Combination Base Elbow)

4	4	20	8 1/2	6 7/8	41	18	12	10 1/4
4	4	20	10	7 7/8	41	17 7/8	11 7/8	10 1/4
4	4	20	12	9	46 1/8	17 7/8	11 7/8	10 1/4



These dimensions are approximate and not to be used for installation purposes.  
CP dimension will vary with bearing frame size.

# Fairbanks Morse

Pump Division

Colt Industries



KANSAS CITY  
3601 Fairbanks Avenue  
Kansas City, Kansas 66110  
(913) 371-5000

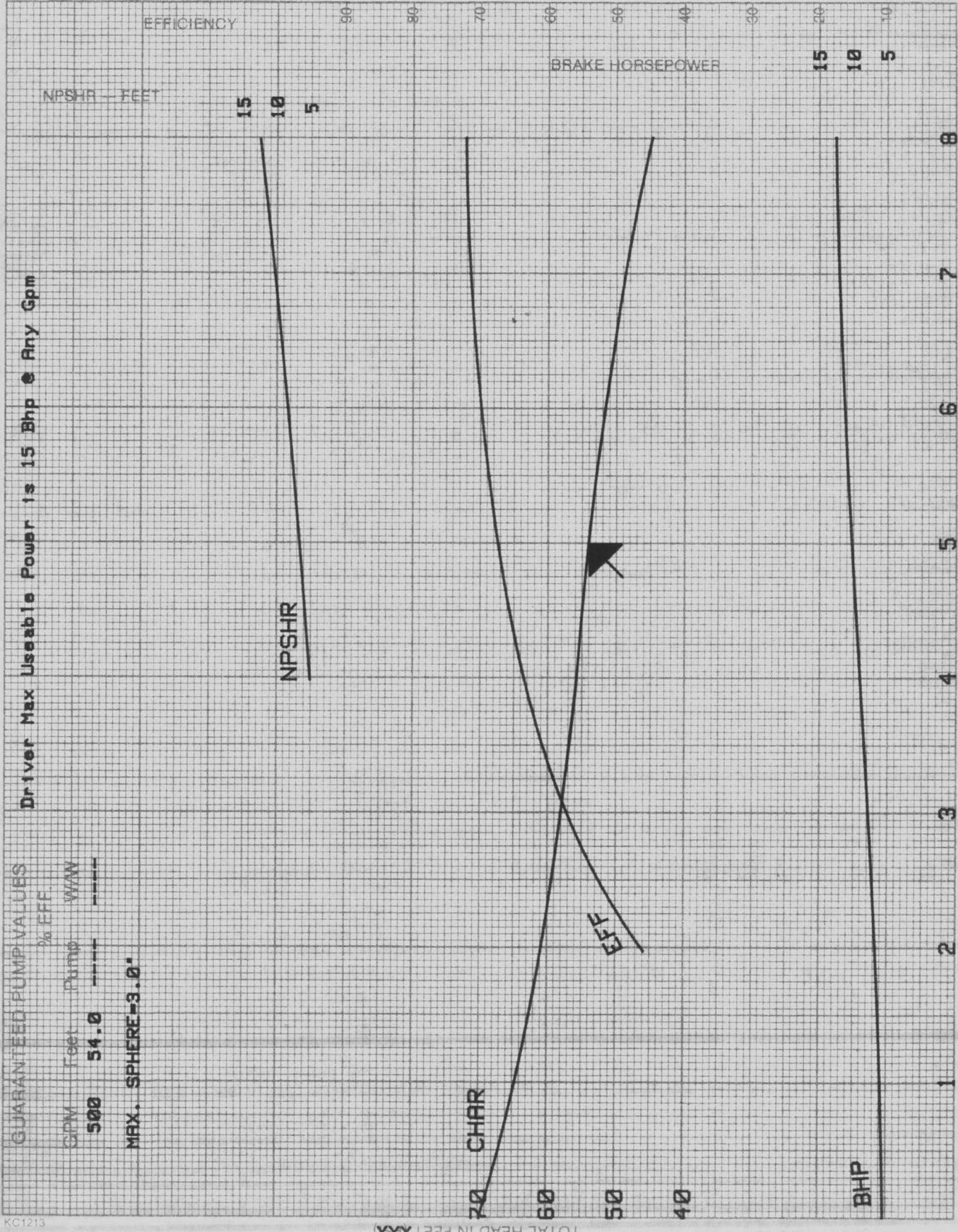
PUMP AND LIGHTING CO.  
CAMP LEJEUNE, NORTH CAROLINA

PUMP PERFORMANCE CURVE

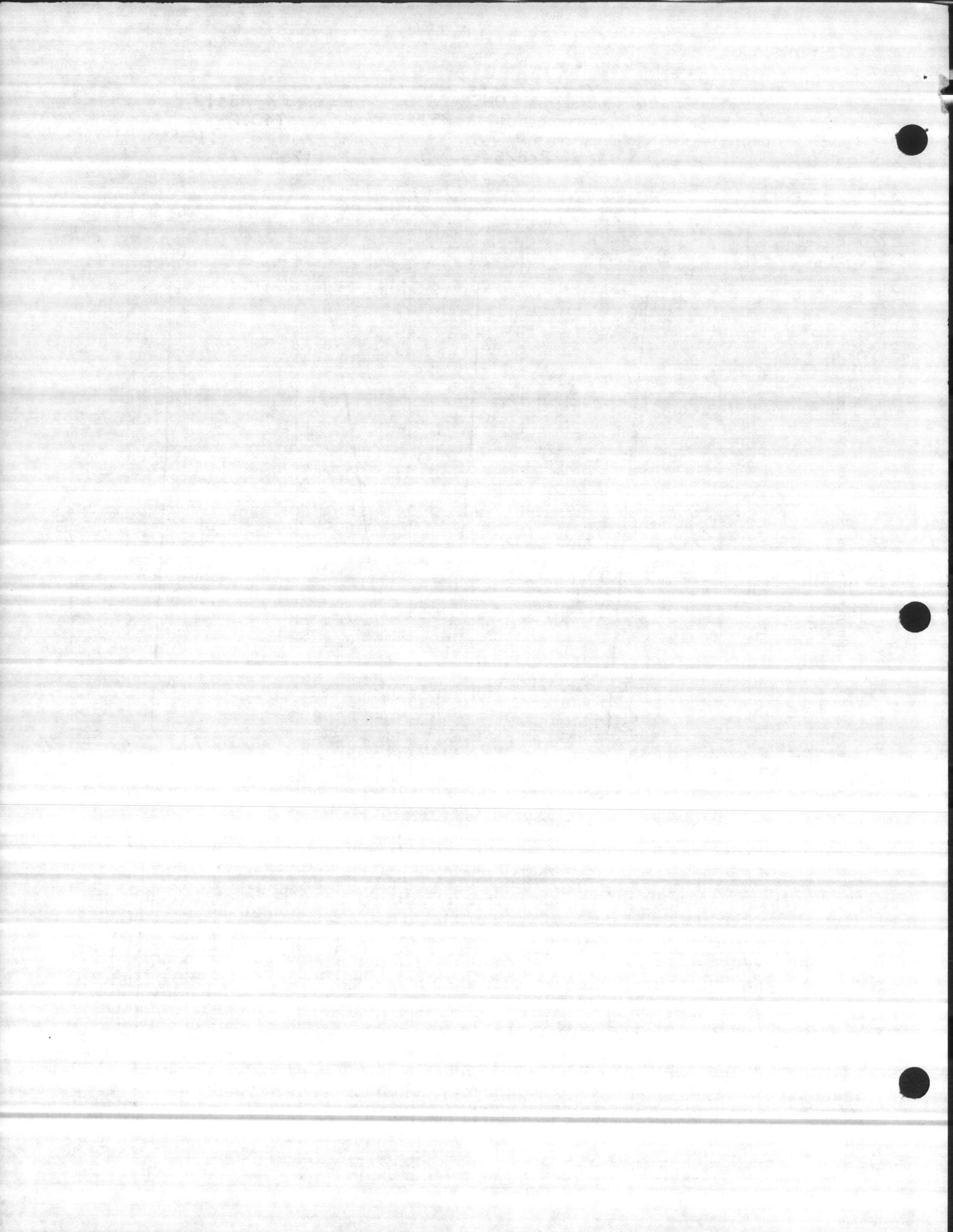
CURVE NO. CK3M1-054661

THIS CHART IS BASED ON ACTUAL TEST PERFORMANCE OF A SIMILAR PUMP. ONLY THE INDICATED POINT IS GUARANTEED.

NO. STAGES ONE  
 REFERENCE BC & 051497  
 PLOTTED BY: J.M.  
 DATE 2/8/84  
 SIZE-FIGURE 4-B5413  
 IMPELLER T4C1A  
 IMPELLER DIAMETER 11.7"  
 RPM 1175



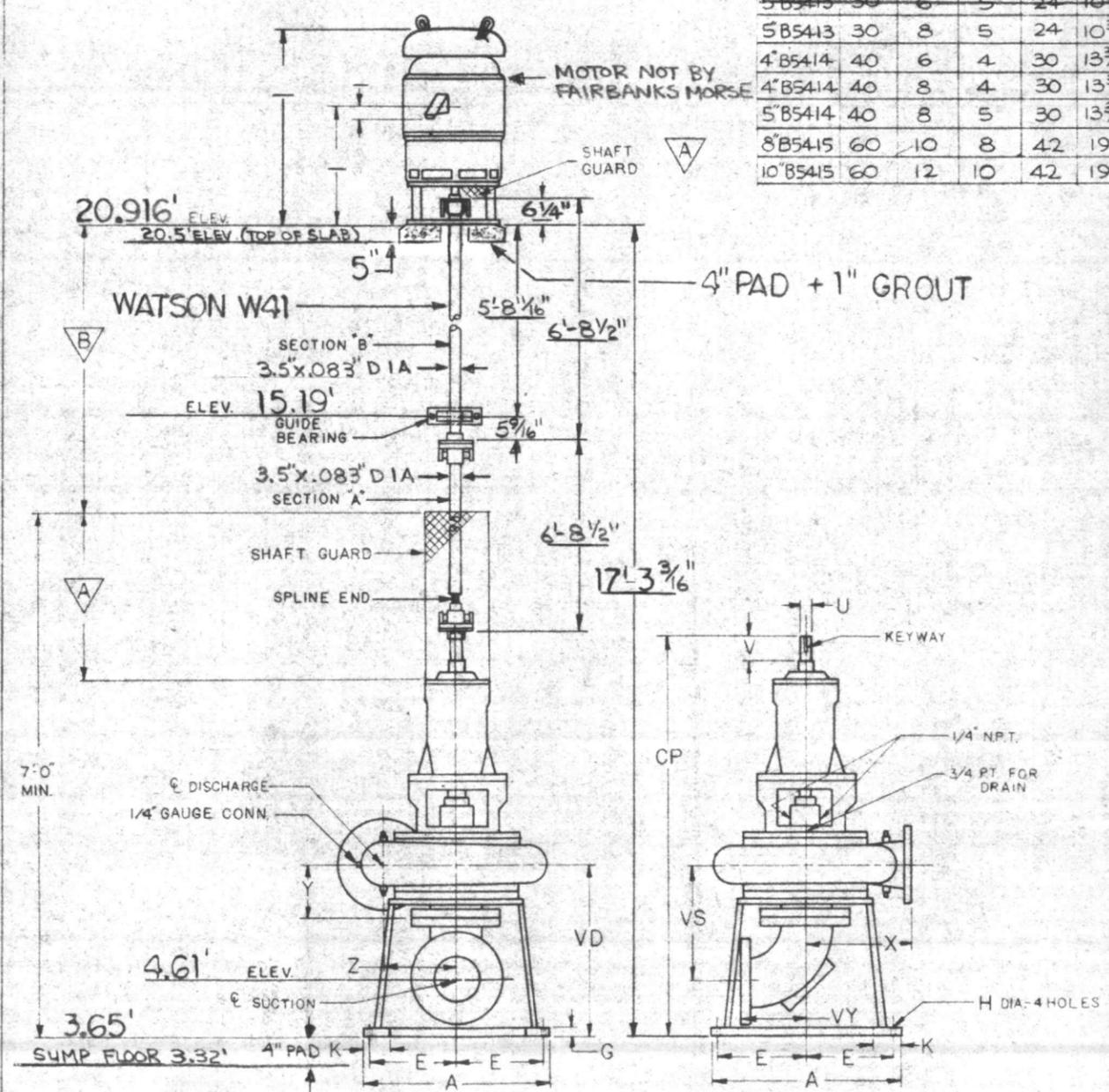
U.S. GALLONS PER MINUTE X 100



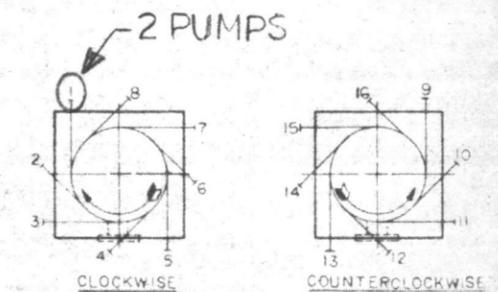
PROPRIETARY INFORMATION  
THIS DRAWING AND ALL INFORMATION THEREIN IS THE PROPERTY OF FAIRBANKS MORSE PUMP DIVISION OF COLT INDUSTRIES OPERATING CORP. AND IS CONFIDENTIAL AND MUST NOT BE MADE PUBLIC OR COPIED WITHOUT WRITTEN APPROVAL. THIS DOCUMENT MUST BE RETURNED ON DEMAND.

PUMP SIZE	PUMP FRAME	SUCT. SIZE	DISCH. SIZE	A	E	G	H	K	U	V	X	Y	Z	VD	VS	VY	KEYWAY	CP
3" B5411	20	4	3	20	8 1/4	1/2	1 1/8	4 5/16	1 3/8	2 1/4	7 1/4	4 1/4	5 3/4	18 1/4	11 1/4	6 1/2	5/16 x 5/32	40 7/8
4" B5411	20	6	4	20	8 1/4	1/2	1 1/8	4 5/16	1 3/8	2 1/4	8 1/2	4 1/2	6 7/8	18 1/2	11 1/2	13 1/4	5/16 x 5/32	41 1/2
3" B5412	20	4	3	20	8 1/4	3/4	1 1/8	4 5/16	1 3/8	2 1/4	9	5	7 1/4	16 7/8	11 1/2	6 1/2	5/16 x 5/32	39 1/2
4" B5412	20	6	4	20	8 1/4	3/4	1 1/8	4 5/16	1 3/8	2 1/4	10	5 1/4	7 7/8	17 3/8	11 3/4	13 1/4	5/16 x 5/32	40 1/2
3" B5413	30	4	3	24	10 3/4	1"	1 1/8	4 9/16	1 7/8	3 1/2	11	5 1/2	7 3/4	23 3/4	12	6 1/2	1/2 x 1/4	51 1/2
4" B5413	30	6	4	24	10 3/4	1"	1 1/8	4 9/16	1 7/8	3 1/2	12	6 1/4	9	24 1/4	12 3/4	13 1/4	1/2 x 1/4	52 1/2
5" B5413	30	6	5	24	10 3/4	1"	1 1/8	4 9/16	1 7/8	3 1/2	13	7 1/4	9 1/2	24 3/4	14 1/8	10	1/2 x 1/4	53 1/2
5" B5413	30	8	5	24	10 3/4	1"	1 1/8	4 9/16	1 7/8	3 1/2	13	7 1/4	9 1/2	24 3/4	16 1/4	9	1/2 x 1/4	53 1/2
4" B5414	40	6	4	30	13 3/4	3/4	1 1/8	5	2 3/8	4 1/4	14 3/4	7 5/16	10 3/8	25 5/8	14 3/16	10	5/8 x 5/16	59 3/8
4" B5414	40	8	4	30	13 3/4	3/4	1 1/8	5	2 3/8	4 1/4	14 3/4	7 5/16	10 3/8	25 5/8	16 5/16	9	5/8 x 5/16	59 3/8
5" B5414	40	8	5	30	13 3/4	3/4	1 1/8	5	2 3/8	4 1/4	16	8	11 1/2	26 3/8	17	9	5/8 x 5/16	60 3/8
8" B5415	60	10	8	42	19	1"	1 3/8	5	2 3/8	4 1/4	21	10 1/2	19 3/4	33 7/8	19 1/2	11	5/8 x 5/16	67 3/8
10" B5415	60	12	10	42	19	1"	1 3/8	5	2 3/8	4 1/4	24	11	17 7/8	34 3/8	23	12	5/8 x 5/16	68 7/8

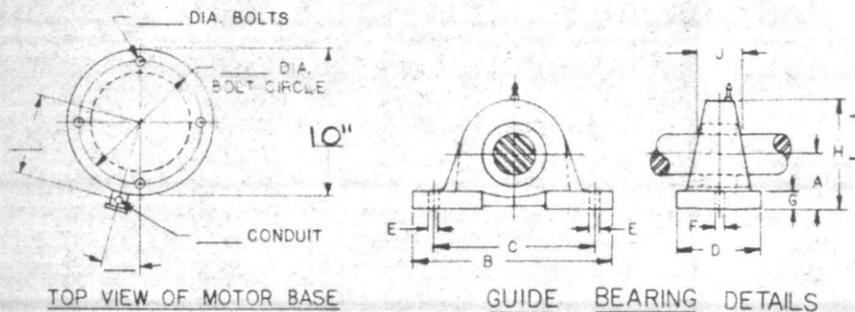
REV	LOC	DESCRIPTION	ECN #	DATE	BY	CHK	APP'D



SHAFT DIA.	SHAFT SERIES	A	B	C	D	E	F	G	H	J
1-3/16	V27	1-5/8	6	4 3/4	1-3/8	9/16	9/16	3/4	3-5/16	1 3/8
1-7/16	V41	1-7/8	6-1/8	5	1-3/4	1 1/16	1 1/16	7/8	3-3/8	1-9/16
1-11/16	V48	2-1/8	7-1/8	5-3/4	2-1/8	1 1/16	1 1/16	1 1/16	4-3/8	1-13/16
1-15/16	V55	2-1/4	7-3/4	6-1/4	2-1/4	1 1/16	1 1/16	1 1/16	4-5/8	1-13/16
1-15/16	V61	2-1/4	7-3/4	6-1/4	2-1/4	1 1/16	1 1/16	1 1/16	4-5/8	1-13/16



DRAWINGS ILLUSTRATES THE DISCHARGE POSITIONS AVAILABLE FOR C.W. AND C.C.W. ROTATION WHEN VIEWED FROM DRIVER END OF PUMP. POSITIONS NO. 1 AND 9 ARE CONSIDERED STANDARD POSITION. POSITION CIRCLED FURNISHED THIS ORDER. THIS DRAWING ILLUSTRATES THE CLOCKWISE POSITION NO. 1.



NOM. SIZE	FLG. O.D.	NO. OF BOLTS	BOLT DIA.	BC DIA.
2	6	4	5/8	4 3/4
3	7 1/2	4	5/8	6
4	9	8	5/8	7 1/2
5	10	8	3/4	8 1/2
6	11	8	3/4	9 1/2
8	13 1/2	12	3/4	16 5/8
10	16	12	7/8	14 1/4
12	19	12	7/8	17

\* DENOTES 250LB. ANSI. FLG. ALL OTHER FLG.'S ARE 125LB. ANSI.

NOTES:  
1. B5400'S AND B5400'S ARE DIMENSIONALLY IDENTICAL.

**WARNING**

DO NOT OPERATE THIS MACHINE WITHOUT PROTECTIVE GUARDS IN PLACE. ANY OPERATION OF THIS MACHINE WITHOUT PROTECTIVE GUARDS CAN RESULT IN SEVERE BODILY INJURY.

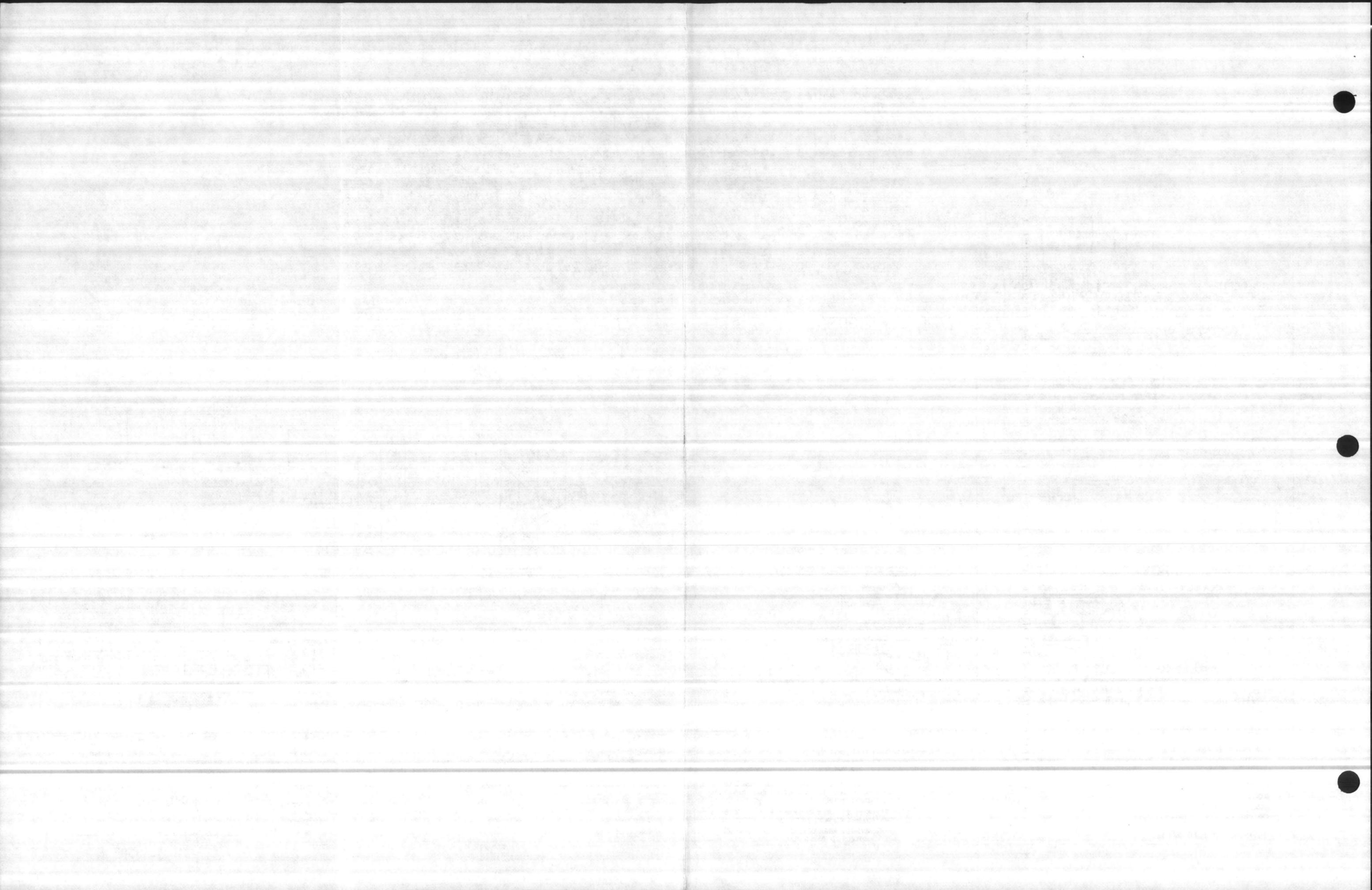
INDICATES AREA OF SHAFT PROTECTED BY GUARDS SUPPLIED BY FAIRBANKS MORSE.  
INDICATES AREA OF SHAFT THAT MUST BE PROTECTED BY USER.

NOTE:  
INSTALL SHAFTING PER THE UNIVERSAL DRIVE SHAFT MANUFACTURERS RECOMMENDATIONS, WITH AN ANGULAR OFFSET.

CUSTOMER	PUMP & LIGHTING COMPANY		PO	35221-12D	
JOB NAME	CAMP LEJEUNE, NORTH CAROLINA				
PUMP SIZE & FRAME NO.	GPM	T.D.H.	RPM	ROT.	
4x6 B5413	500	54	1175	CW	
MOTOR TYPE	HP	SYN RPM			
	15	1200			
FRAME	CYCLES	VOLTS	FRAME		
			C284 HP		
CERTIFIED BY ORDER NO.	CERTIFIED BY		DATE		
K3M1-054661	Rick Van Kirk		2-15-84		

INITIAL	DATE	<p>Colt Industries Fairbanks Morse Pump Division</p> <p>SETTING PLANS FOR B5410'S LARGE SUCTION PUMPS WITH TWO SECTION SHAFTING. VERTICAL DRY PIT-INSTALL.</p>			
DRW DYE	2-7-79				
CHK					
ENG					
APP'D					
REVIEW		SIZE	DRAWING NO.	REV	
		D	SK3M1-054661		
OTHERS		SCALE	NONE	WEIGHT	SHEET 1 OF 1

24LYA 2350B2



**B5410 AND B5410C  
VERTICAL DRY-PIT NON-CLOG PUMPS  
MATERIAL SPECIFICATIONS**

108

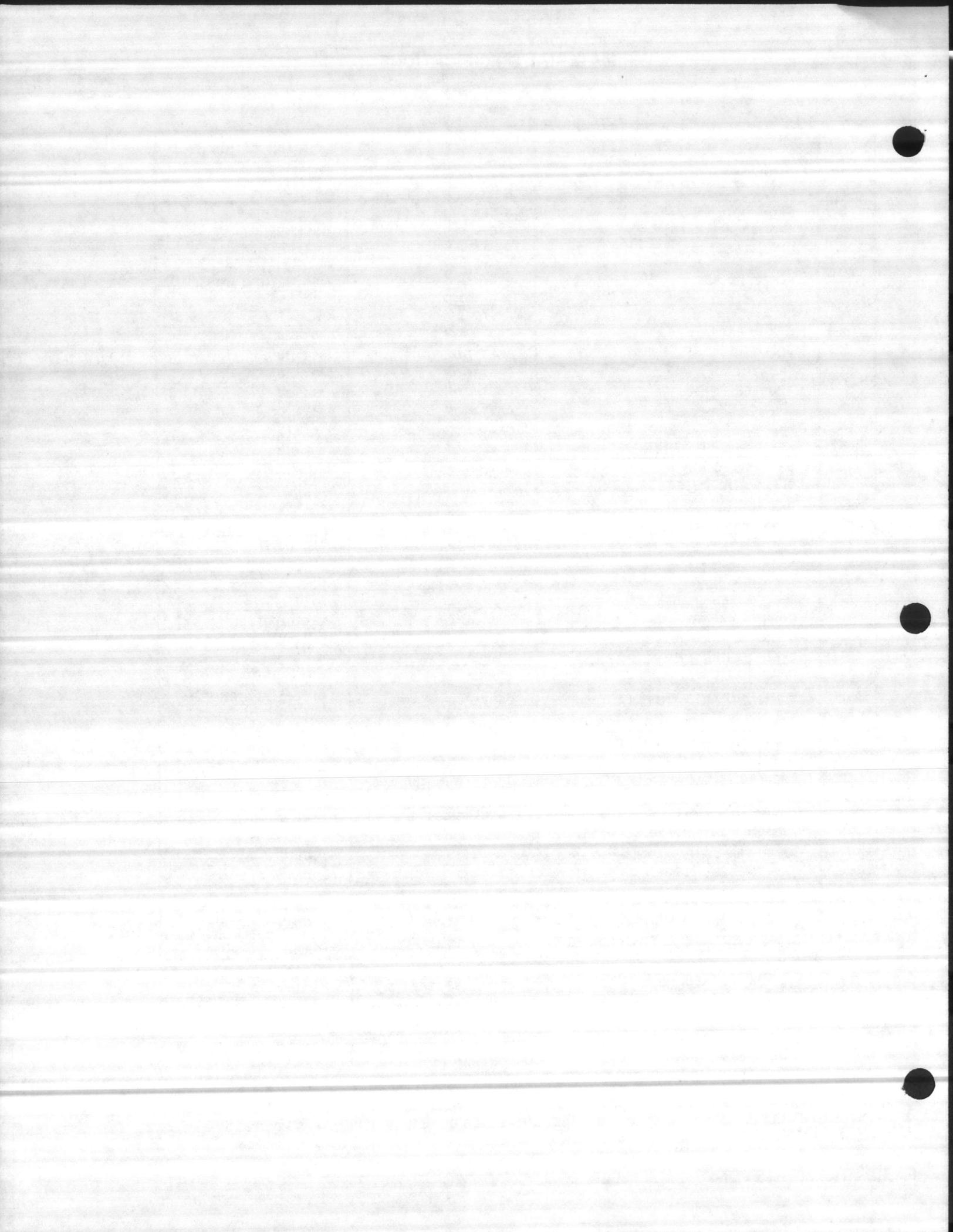
**5411 Thru 5418  
STANDARD FITTED (SF) PUMPS**

REF. NO.	DESCRIPTION	MATERIAL	SPECIFICATION (1)
1	IMPELLER	CAST IRON	A48-CL30
4	SHAFT	STAINLESS STEEL	416 SS
9	CAPSCREW, IMPELLER	STEEL	SAE BOLT STEEL
9A	WASHER, IMPELLER	STEEL	AISI-1215
10	RING, WATER SEAL	TEFLON	TEFLON
14	SLEEVE, SHAFT	STAINLESS STEEL	A296-CA15 OR A278-410 (MFG. OPTION) 300-350 BRINELL
15	BASE	CAST IRON	A48-CL30
19	GLAND HALF	CAST IRON	A48-CL30
30	VOLUTE	CAST IRON	A48-CL30
33	FRONTHEAD	CAST IRON	A48-CL30
34	ADAPTER, FRAME	CAST IRON	A48-CL30
44	SUCTION ELBOW	CAST IRON	A48-CL30
90	FRAME	CAST IRON	A48-CL30
102	KEY, IMPELLER	STEEL	AISI-1018
126A	DEFLECTOR, INNER	RUBBER	NEOPRENE
126B	DEFLECTOR, OUTER	RUBBER	NEOPRENE
139	HOUSING THRUST BEARING	CAST IRON	A48-CL30
140A	SEAL, INNER GREASE	-	-
154	GASKET, ELBOW	TAG BOARD	D1170-G3111
156	GASKET, VOLUTE	TAG BOARD	D1170-G3111
159	COVER, THRUST BEARING HOUSING	CAST IRON	A48-CL30
159A	SEAL, OUTER GREASE	-	-
161	LOCKNUT, BEARING	STEEL	SAE BOLT STEEL
162	LOCKWASHER, BEARING	STEEL	AISI-1215
163	BEARING, INNER	STEEL	-
168	BEARING, OUTER	STEEL	-
202	COVER, VOLUTE HANDHOLE	CAST IRON OR STEEL	A48-CL30 OR A283 GR. D (MFG. OPTION)
203	GASKET, VOLUTE HANDHOLE COVER	RUBBER	-
206A	RETAINER, INNER GREASE	STEEL	-
206B	RETAINER, OUTER GREASE	STEEL	-
212	PACKING	GRAPHITED ASBESTOS	-
272	KEY, COUPLING	STEEL	AISI-1018
290	COVER, HANDHOLE	CAST IRON	A48-CL30
291	GASKET, HANDHOLE	RUBBER	-
407	BALANCE WEIGHT, IMPELLER	CAST IRON	A48-CL30
464	SUCTION ELBOW (BASE COMBINATION)	CAST IRON	A48-CL30

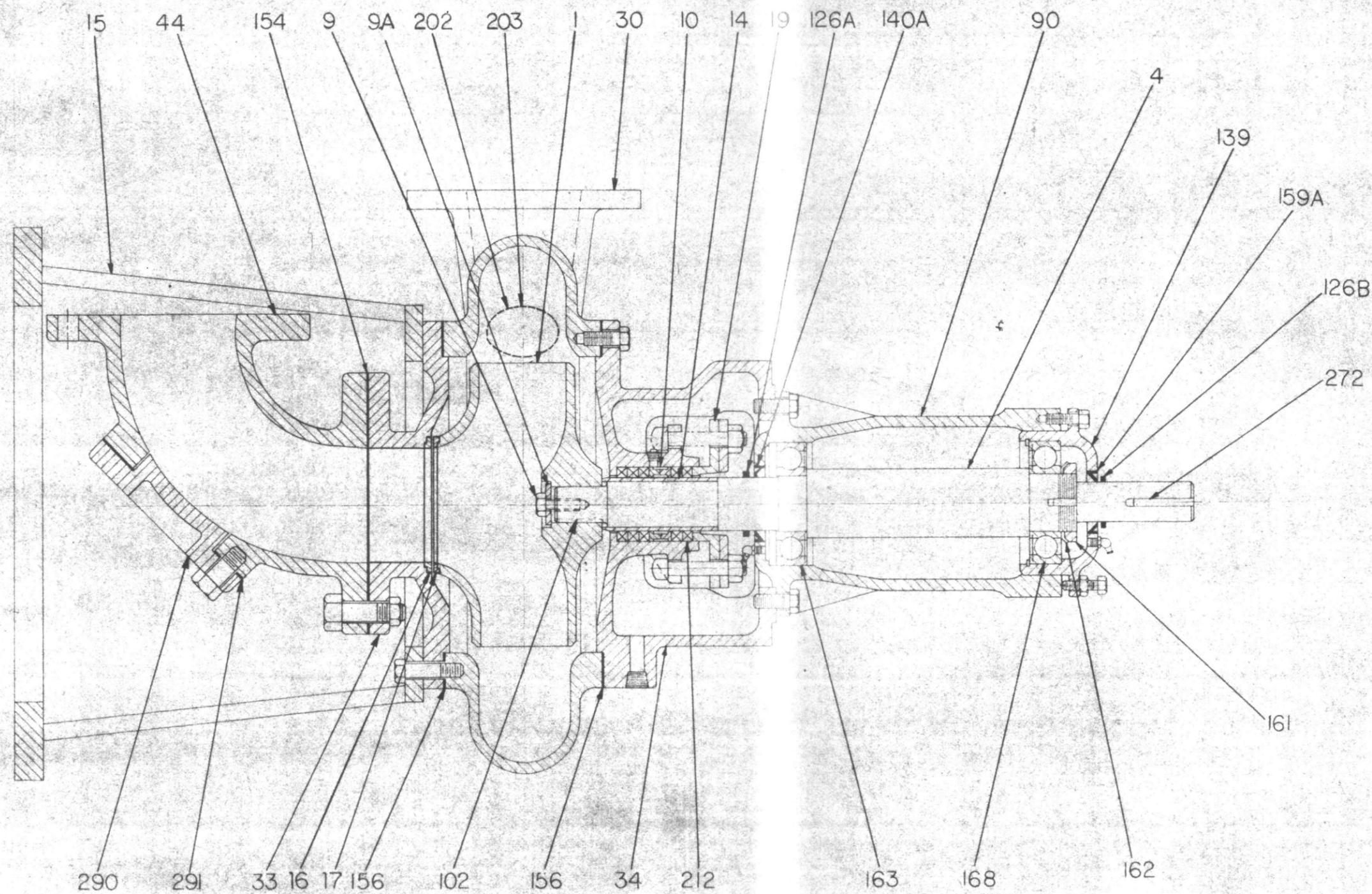
**OPTIONS TO BASIC PUMPS**

REF. NO.	DESCRIPTION	MATERIAL	SPECIFICATION
1	IMPELLER	BRONZE	B145(836)
16	WEAR RING, FRONTHEAD	STAINLESS STEEL (3)	AISI-416
17	WEAR RING, IMPELLER	STAINLESS STEEL (3)	AISI-416
19	GLAND HALF	BRONZE	B145(836)
31	SOLID GLAND	STEEL	A283 GR. D
456	MECHANICAL SEAL		

1. ALL MATERIAL DESIGNATIONS ARE ASTM UNLESS OTHERWISE NOTED, AND ARE FOR DESCRIPTION OF CHEMISTRY ONLY.
2. PLATE IS A283 GR. D AND CHANNEL IS A7 OR A36.
3. FRONTHEAD WEAR RING HARDNESS IS 300-350 BRINELL. IMPELLER WEAR RING HARDNESS IS 300-350 BRINELL.
4. MANUFACTURERS OPTION



REV	LOC	DESCRIPTION	ECN #	DATE	BY	CHK	APP'D

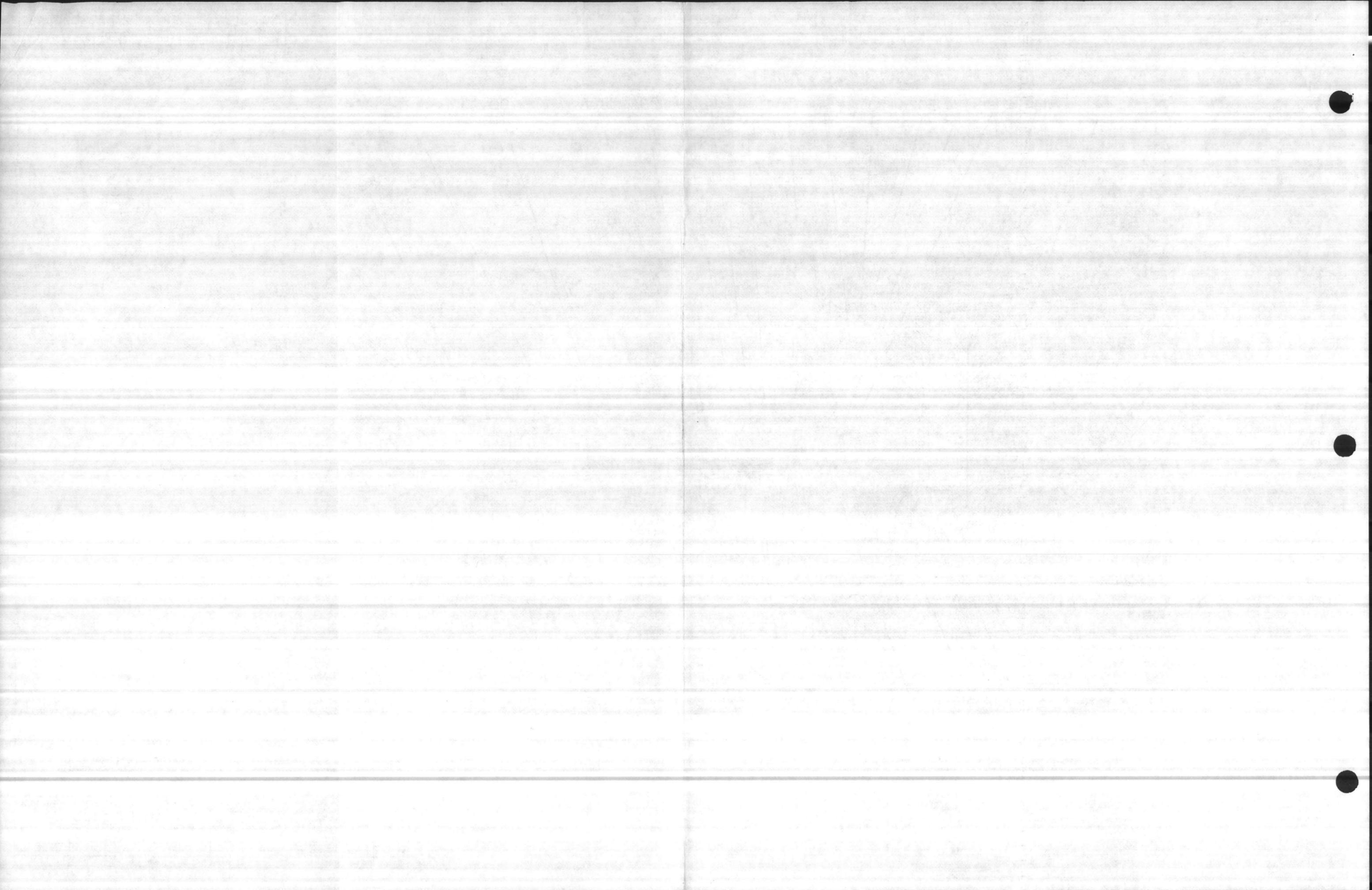


K3M1-054661

ITEM	QTY	PART NUMBER	DESCRIPTION
LIST OF MATERIALS			
Colt Industries Fairbanks Morse Pump Division			
TITLE ASSEMBLY B5411-20, B5412-20 & B5413-30 WITH WEARING RINGS			
SIZE		DRAWING NO.	
24 LYA 1934-77A		REV	
SCALE HALF		WEIGHT	
SHEET 1		OF 1	

DIST.	TOLERANCES & MACHINING LIMITS UNLESS OTHERWISE NOTED	INITIAL	DATE
1	1 PLACE .XX ±0.1	DRW DYE	10/30/78
2	2 PLACE .XXX ±0.02	CHK D. PALNEC	10/1/78
3	3 PLACE .XXX ±0.010	ENG	
4	ANGLES ±0°30'	APP'D	10/1/78
5	FILLETS 0.005/0.015	REVIEW	
6	BREAK CORNERS 0.030		
7	REMOVE BURRS		
8	DIMENSIONS IN INCHES		
9	FORM SYMBOLS & TOLER		
10	PER ANSI - Y14.5		
11	SURFACE FINISH 125 RMS		
12	THREADS UNC - 2A/2B		
13	RELEASE NO.		

NOTES  
 1. B5411-20 FRAME INTEGRAL CASING SUCTION COVER.



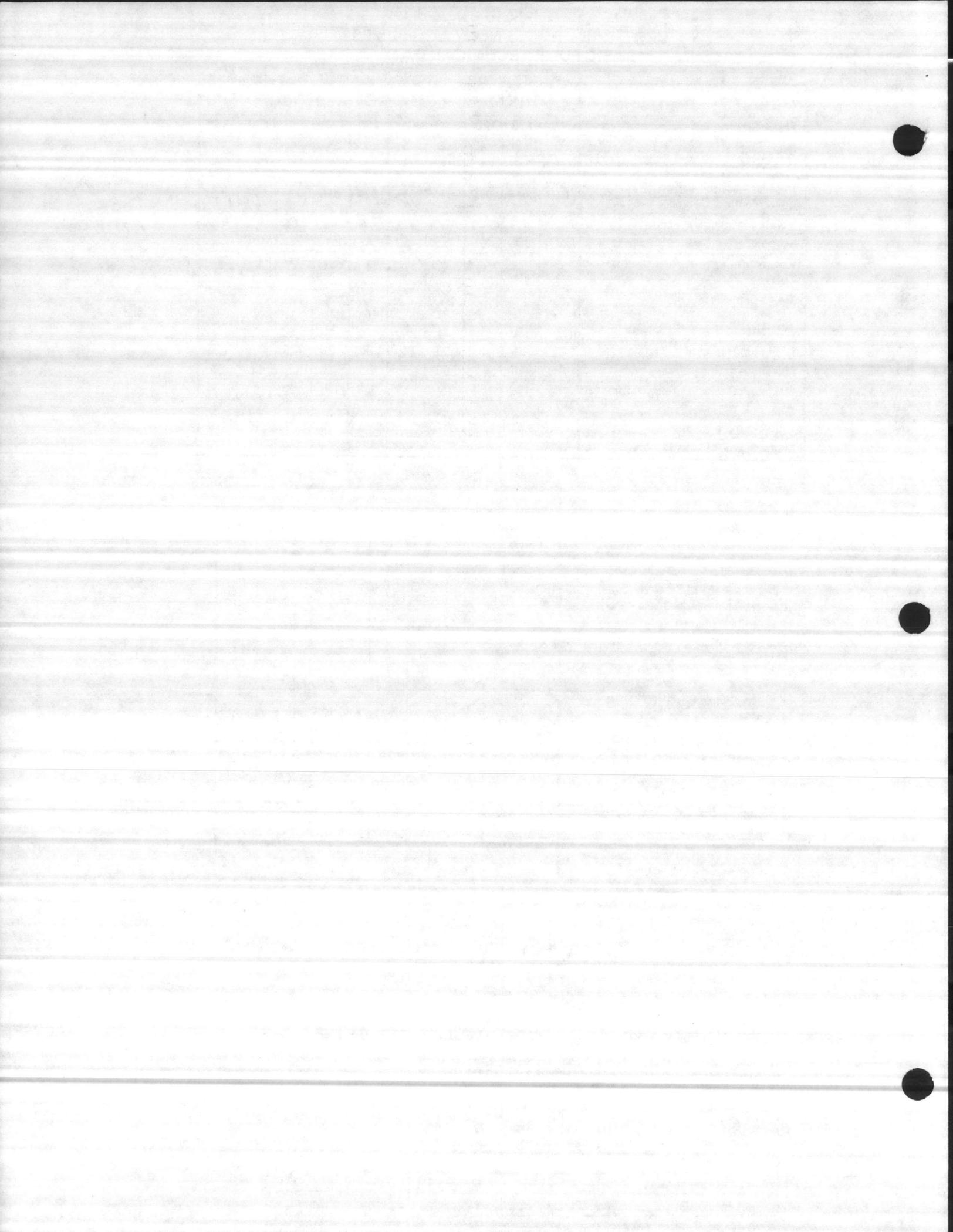
**B5410  
VERTICAL DRY-PIT NON-CLOG PUMPS  
BASIC PUMP TECHNICAL DATA**

	B5411, K			B5412, K			B5413,			
	T20	T20	T20	T20	T20	T20	T30	T30	T30	T30
Frame Size	2	3	4	2	3	4	3	4	5	6
Pump Size	2	3	4	2	3	4	3	4	5	6
Suction Size	2	3	4	2	3	4	3	4	5	6
Impeller Face to Suction Cover Nominal Clearance	.015	.015	.020	.015	.015	.020	.015	.020	.020	.025
Volute Cleanout Diameter	None	1 1/2	2	None	2 1/2	2 7/8	2 1/2	2 7/8	4 1/2	4 7/8
Suction Elbow Cleanout Diameter	2	3	4	2	3	4	3	4	5	6
Volute Priming or Air Vent Tap Size	1/4	1/4	1/4	1/4	1/4	1/2	1/4	1/2	1/4	1/2
Gauge Connection (NPT) Discharge Suction	1/4 1/4	1/4 1/4	1/4 1/4	1/4 1/4	1/4 1/4	1/2 1/2	1/4 1/4	1/2 1/2	1/4 1/4	1/2 1/2
Maximum Hydrostatic Test, PSI	65	65	65	90	90	90	125	125	125	125
Maximum Casing Working, PSI	45	45	45	60	60	60	85	85	85	85
Maximum Operating Temperature, °F	150	150	150	150	150	150	150	150	150	150
Minimum Diameter Opening to Install Pump (Inches)	28	30	32	30	32	34	36	40	40	40
Shipping Weight (Lbs.)	260	290	400	260	300	470	550	650	720	740
Minimum Casing Thickness	3/16	3/16	3/16	3/8	3/8	3/8	3/8	3/8	1/2	1/2

	B5414				B5415		B5416	
	T40	T40	T40	T40	T60	T60	T40	T60
Frame Size	4	5	6	8	8	10	5	6
Pump Size	4	5	6	8	8	10	5	6
Suction Size	5	6	8	10	8	10	8	10
Impeller Face to Suction Cover Nominal Clearance	.020	.020	.025	.025	.025	.030	.020	.025
Volute Cleanout Diameter	2 7/8	4 1/2	4 7/8	4 7/8	5 1/8	4 7/8	3 7/8	5 1/8
Suction Elbow Cleanout Diameter	5	5	6	6	6	6	6	6
Volute Priming or Air Vent Tap Size	3/4	3/8	1	1	1	1	3/4	1
Gauge Connection (NPT) Discharge Suction	1/2 1/2	1/4 1/4	1/4 1/4	1/4 1/4	1/4 1/4	1/2 1/2	3/4 3/4	1/2 1/2
Maximum Hydrostatic Test, PSI	150	115	115	115	115	115	190	225
Maximum Casing Working, PSI	100	75	75	75	75	75	125	150
Maximum Operating Temperature, °F	150	150	150	150	150	150	150	150
Minimum Diameter Opening to Install Pump (Inches)	46	48	50	52	68	70	48	58
Shipping Weight (Lbs.)	1060	1190	1250	1480	2650	2670	1260	1908
Minimum Casing Thickness	3/16	1/2	1/2	1/2	3/4	3/4	1 1/8	3/8

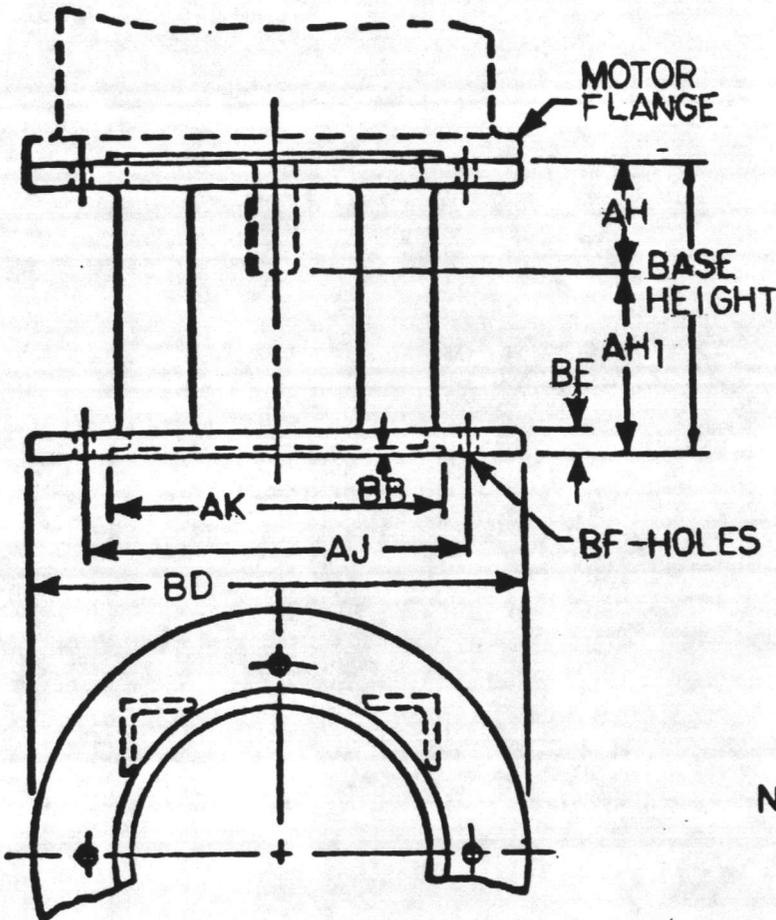
	T20	T30	T40	T60
Shaft Diameter:				
at Impeller	1 1/4	1 3/4	2 1/4	2 3/4
at Sleeve	1 1/2	2 1/8	2 5/8	3 1/2
at Thrust Bearing	1.969	2.756	2.953	2.953
at Radial Bearing	1.969	2.559	3.740	3.740
between Bearings	2 3/8	3 1/4	4	4
at Coupling	3/4	1 1/8	2 3/8	2 3/8
Center to Center of Bearings	8 3/4	11	14 1/8	13 5/8
Thrust Bearing No.	6310	6314	5315	7315
Radial Bearing No.	6310	6313	6219	5219
Stuffing Box:				
O.D. Sleeve	1 7/8	2 1/2	3	3 5/8
I.D. Box	2 5/8	3 1/2	4	4 5/8
Box Depth	2 7/8	3 1/2	3 7/4	3 3/4
Size Packing	3/8	1/2	1/2	1/2
Rings Packing per Box	5	5	5	5
Seal Cage Width	3/4	3/4	1	1

1. All dimensions are in inches.





NEMA "P" FLANGE



SERIAL NO. *K3MI-054661*

IDENTIFICATION PER CUSTOMERS ORDER OR ENGINEER'S SPECIFICATIONS

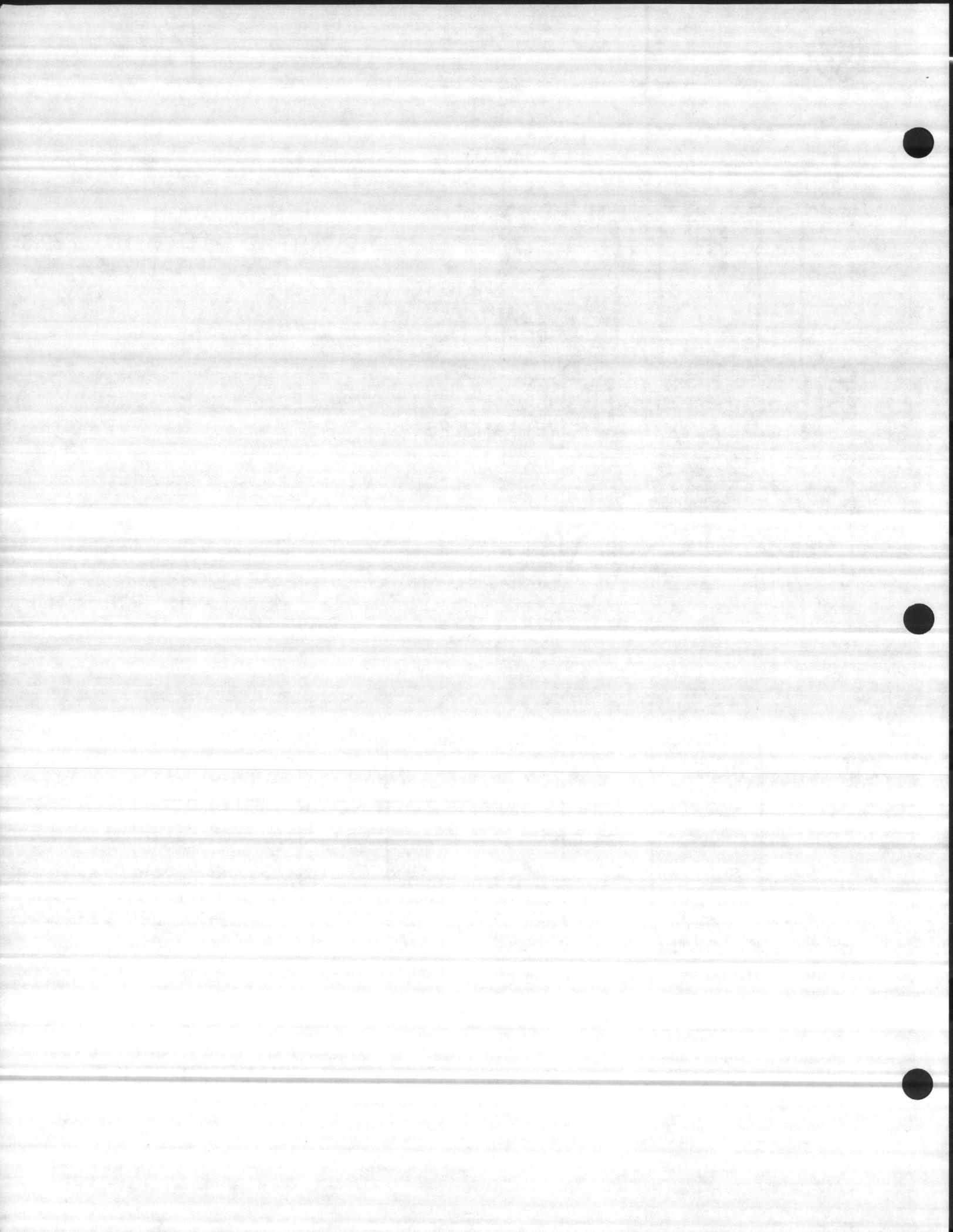
*PUMP & LIGHTING Co.*

NOTE: -AH<sub>1</sub>=BASE HEIGHT MINUS AH  
SEE MOTOR PRINT FOR SHAFT DIMENSIONS

FLANGE SIZE	BASE HEIGHT	AJ	AK	BB	BD	BE	BF HOLES	SYMBOL
10"	9"	9 1/8"	8 1/4"	3/16"	10"	3/4"	4-7/16"	T3A220A

FAIRBANKS MORSE  
PUMP DIVISION

KANSAS CITY, KANSAS 66110  
913/371-5000



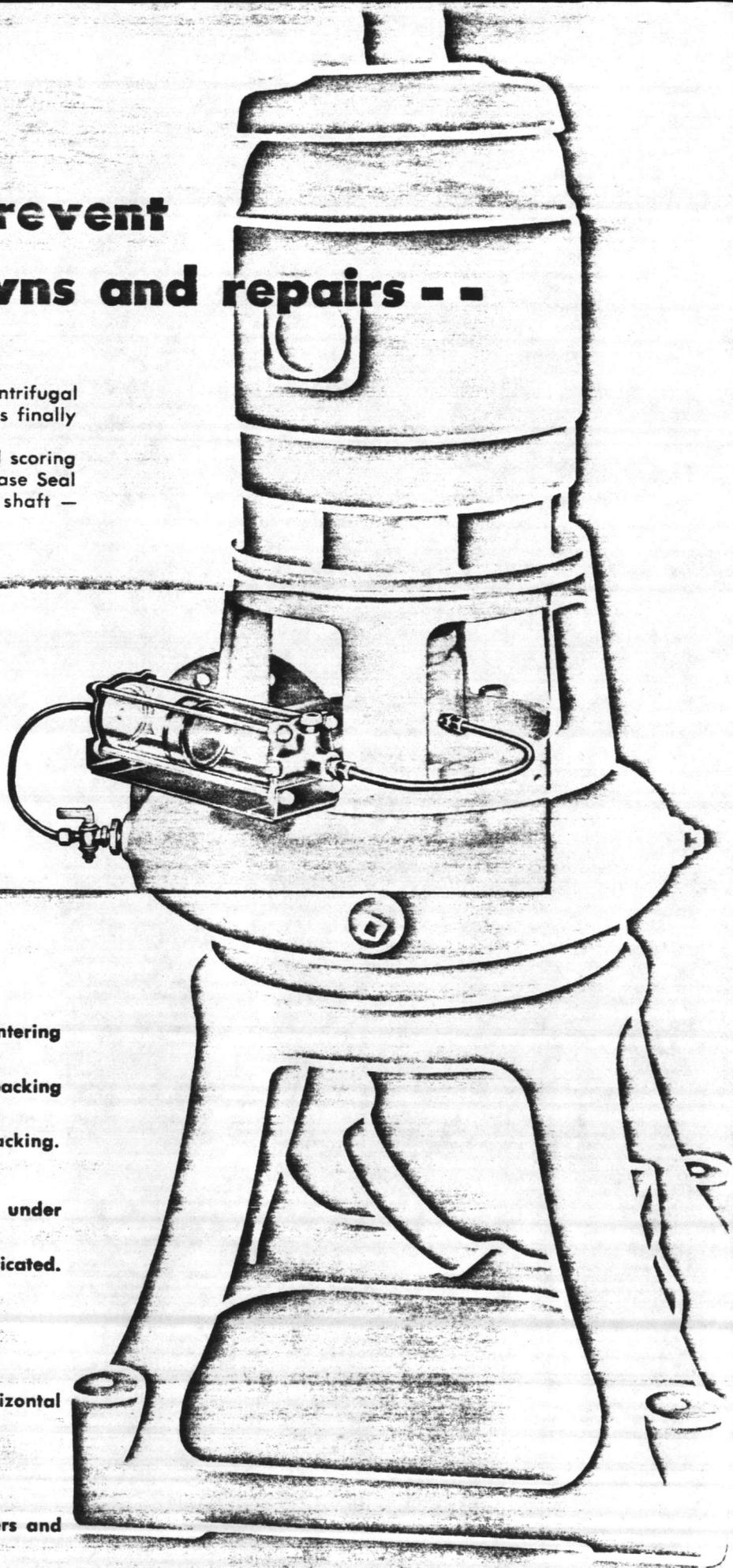
# Now you can prevent costly breakdowns and repairs - -

**Y**ES — that critical trouble point on all centrifugal pumps — where the shaft enters the casing is finally and positively eliminated.

Excessive heat — rapid wear — leakage and scoring need trouble you no longer. For the Z-F Grease Seal applies constant lubrication to packing and shaft — automatically!

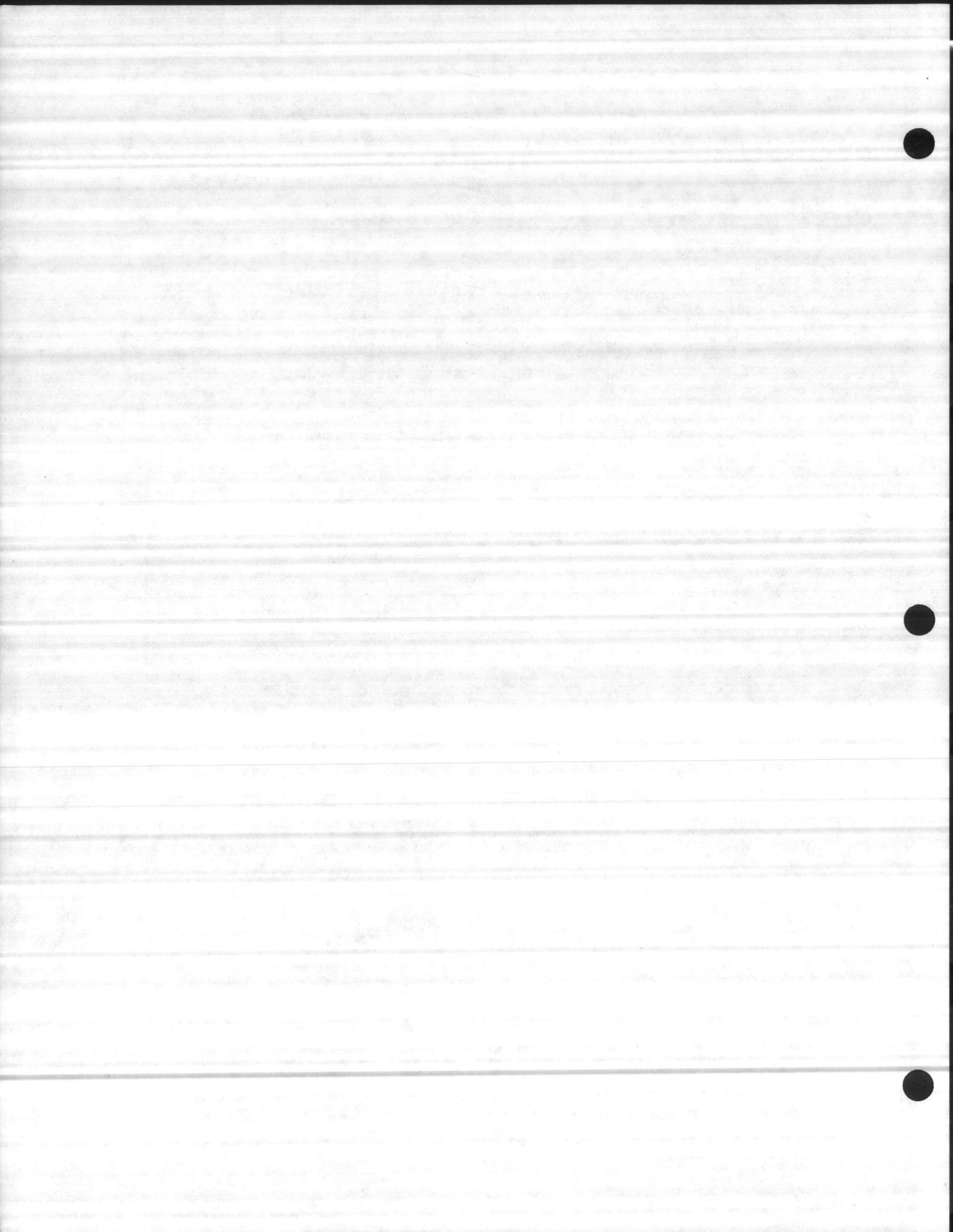
## THE Z-F GREASE SEAL

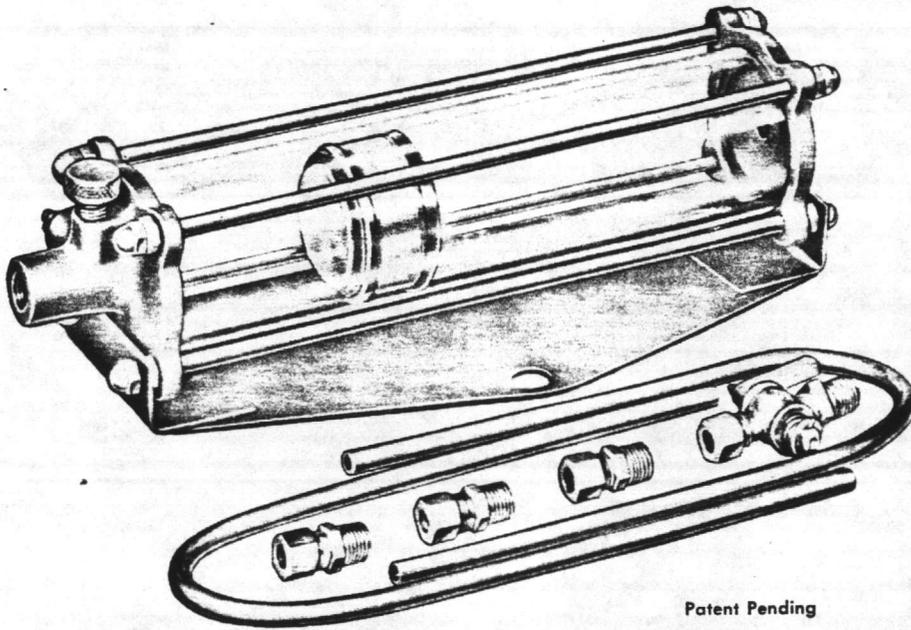
FOR CENTRIFUGAL PUMPS



### *Advantages*

1. Prevents grit and foreign matter from entering packing gland.
2. Adjustable control for grease flow to packing gland.
3. Stops leakage of pumped fluid through packing.
4. Automatic turn-on and cut-off.
5. Operates whether pump is on booster or under suction.
6. Keeps packing and shaft constantly lubricated.
7. Transparent cylinder tells when to refill.
8. Saves on grease and operator's time.
9. Reduces maintenance and repairs.
10. Easy to install — on either vertical or horizontal pumps.
11. Convenient fitting for reloading.
12. No complicated parts to wear or break.
13. Tested and approved by qualified engineers and well-known pump makers.





Patent Pending

**THE Z-F GREASE SEAL UNIT  
CONSISTS OF:**

Good strong frame of steel with brass end plates. Heavy glass cylinder with precision ground floating piston. Inlet and outlet pressure tubes with connecting adapters. Ready to install.

## How it works-

A look at the illustration at right will show you how the Z-F Grease Seal is attached to vertical and horizontal pumps. A single hole in the steel base slips over one of the bolts in the pump casting. Then a pipe connection is made to the air vent or to an existing tapping in the impeller casing. A pipe connection is made also to the grease or water seal hole on the packing gland. Each is attached to proper end of glass cylinder mounting. The glass cylinder is filled with grease through a fitting provided. And the unit is ready to perform.

When the pump is running, the delivery of grease to the packing gland is automatic. Since the pressure in the casing near the shaft is always less than the pressure at the periphery of the casing, the action of the piston is to force the grease through the pipe connection to the packing gland. This action is continuous so long as the pump is running. It stops when the pump stops.

### NOTE

**RECOMMENDED GREASE FOR Z-F GREASE SEAL**

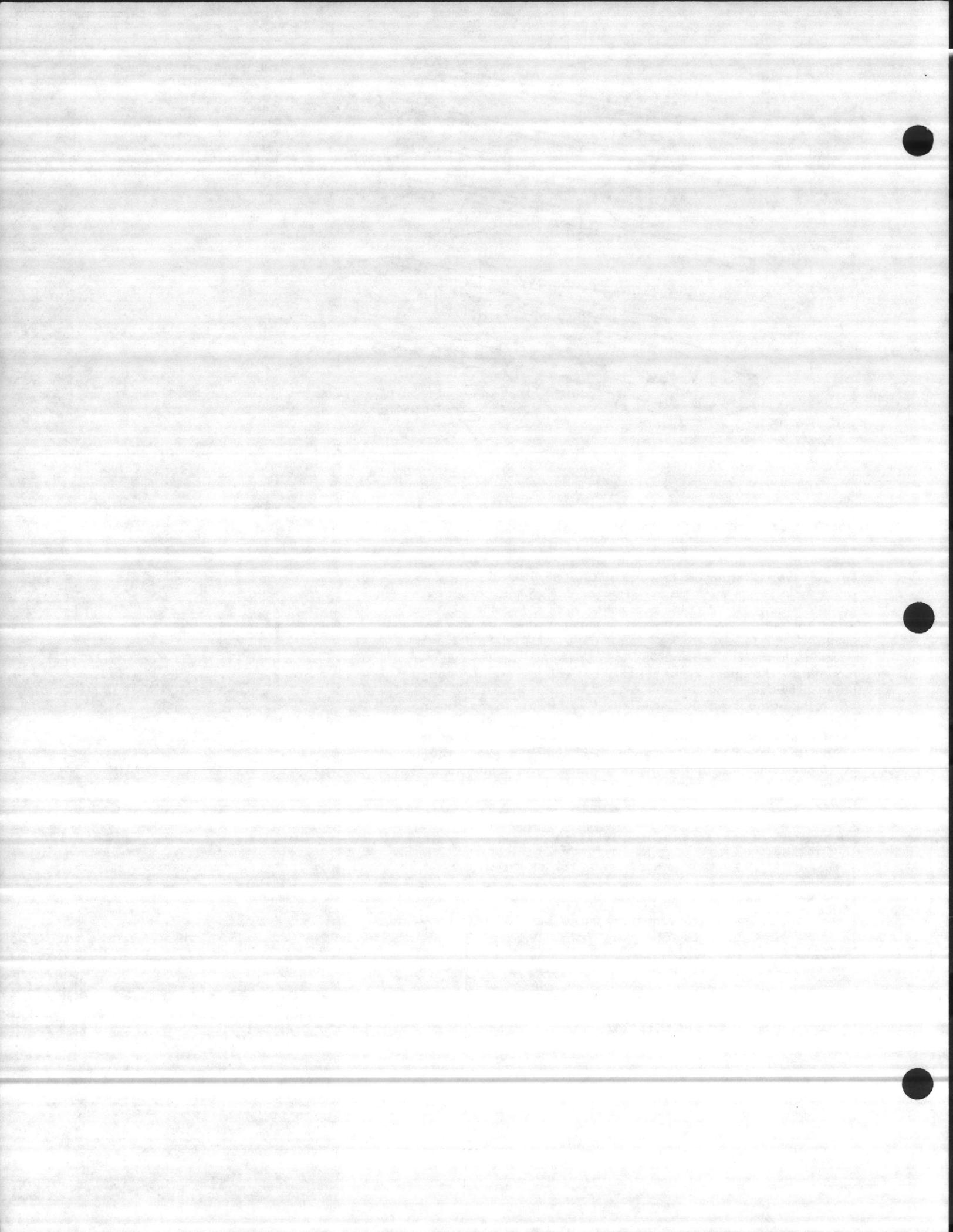
It is highly important that correct specification of lubricant is followed for satisfactory performance. Z-F Grease No. 77 has been especially developed for use in the Z-F GREASE-SEAL.



**DISTRIBUTED BY**

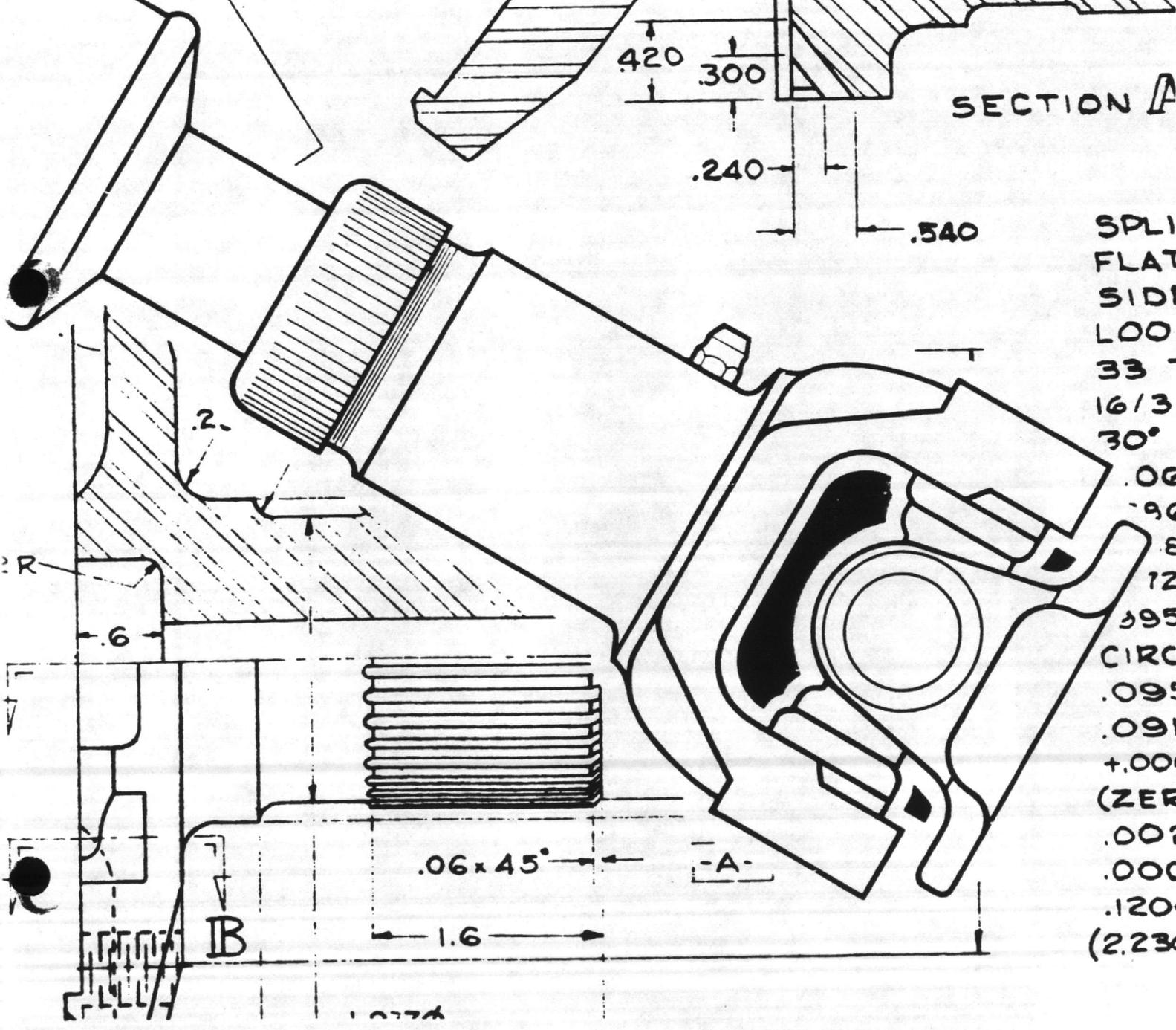
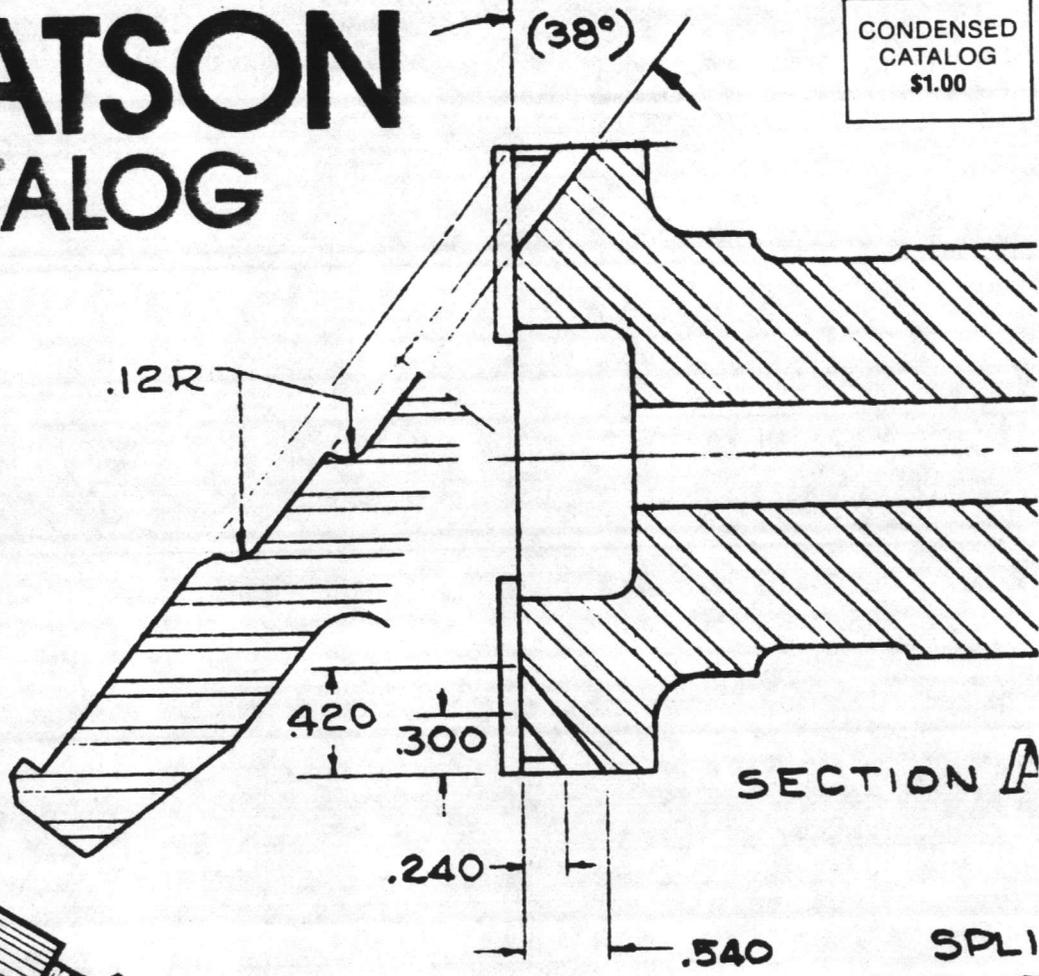
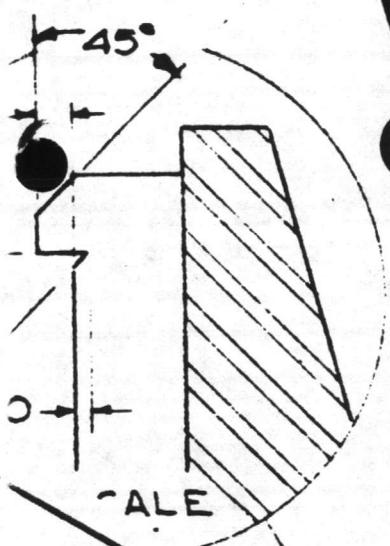
Manufactured by ZIMMER & FRANCESCON, Moline, Illinois





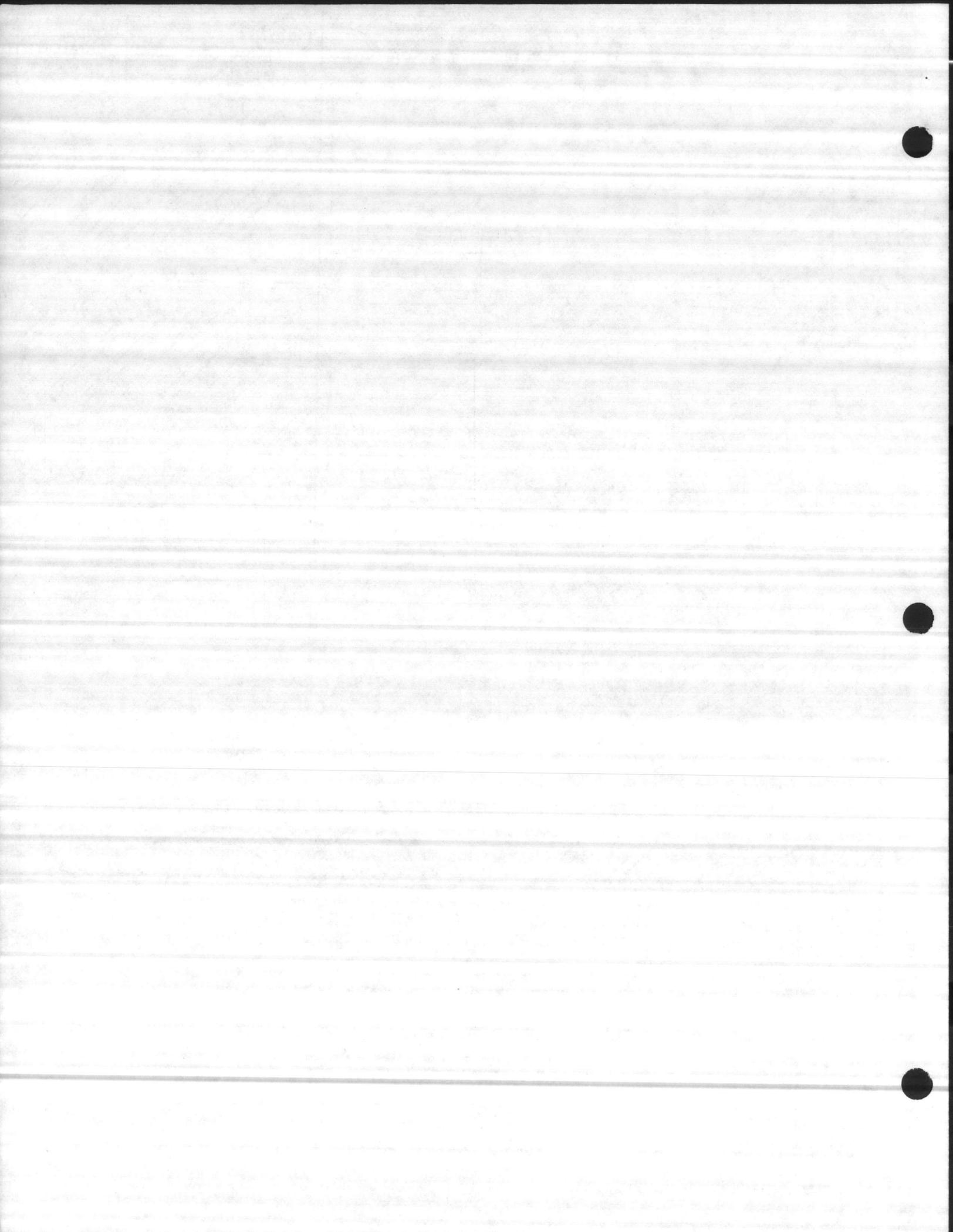
# WATSON CATALOG

CONDENSED  
CATALOG  
\$1.00



SPLI  
FLAT  
SIDE  
LOOK  
33 -  
16/3  
30°  
.06  
.96  
E  
72  
395  
CIRC  
.095  
.091  
+.001  
(ZER  
.002  
.000  
.120  
(2.23

10774



**TO SELECT THE PROPER DRIVE SHAFT, DO THE FOLLOWING:**

1. SELECT THE JOINT SERIES.
2. SELECT THE TUBE SIZE AND THE QUANTITY OF SHAFT SECTIONS.
3. SELECT THE FLANGES.
4. SELECT THE STEADY BEARINGS IF YOU HAVE MULTIPLE SHAFT SECTIONS.
5. SELECT THE SHAFT GUARD.

**NOTE:**

When using universal joints please observe these basic rules:

Yoke ears must be in the same plane to within 2 degrees.

Maximum joint angle and RPM combination must not be exceeded.

Universal joints must work in pairs.

Joint angles must be equal to within one degree.

**1. SELECT THE JOINT SERIES**

**TABLE I**

Power Source	F <sub>P</sub>
Electric motor or steam turbine	1.00
Gasoline engine with torsional elastic member	1.25
Gasoline engine without torsional elastic member	1.75
Diesel engine with torsional elastic member	1.50
Diesel engine without torsional elastic member	2.00

Determine the equivalent horsepower.

$$EH = HP \times F_A \times F_P \times F_L$$

HP = Horsepower

F<sub>A</sub> = Angle factor from Graph A

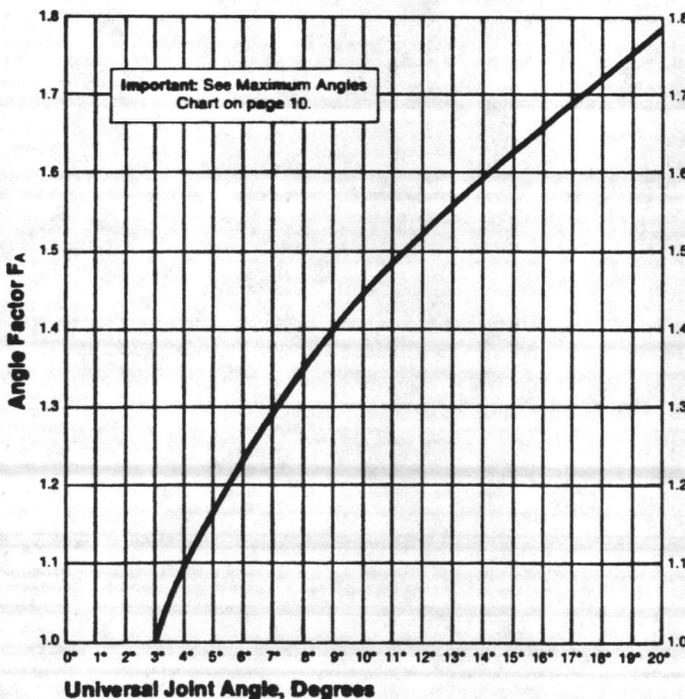
F<sub>P</sub> = Power factor from Table I

F<sub>L</sub> = Bearing life factor from Graph B

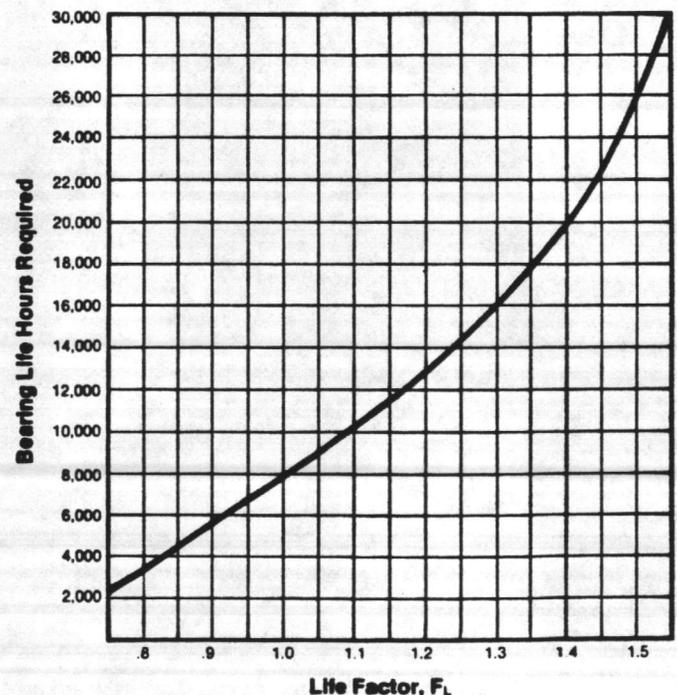
Select joint series from 8,000 hour graph on page 6.

Bearing Life Hours Required

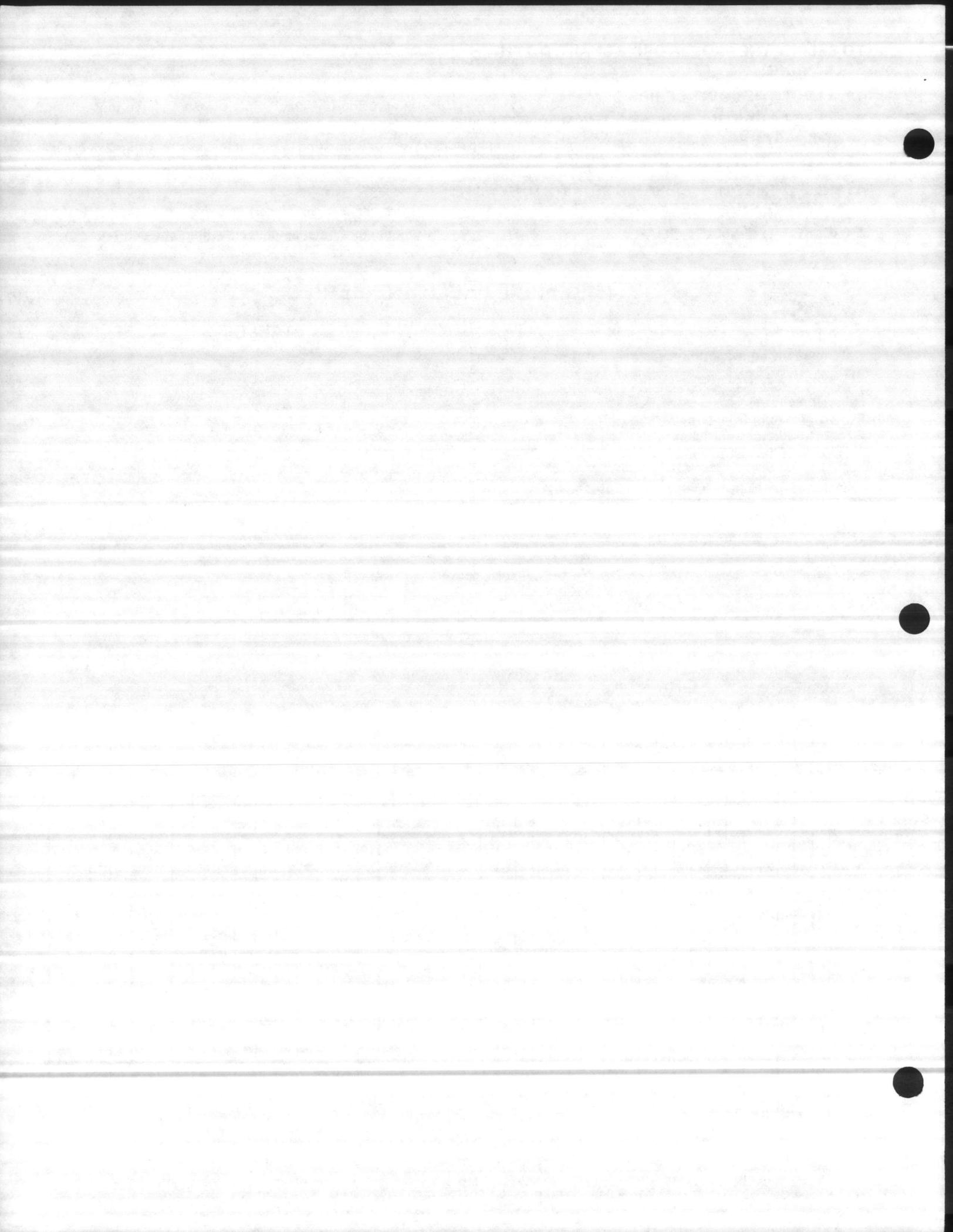
**GRAPH A**



**GRAPH B**

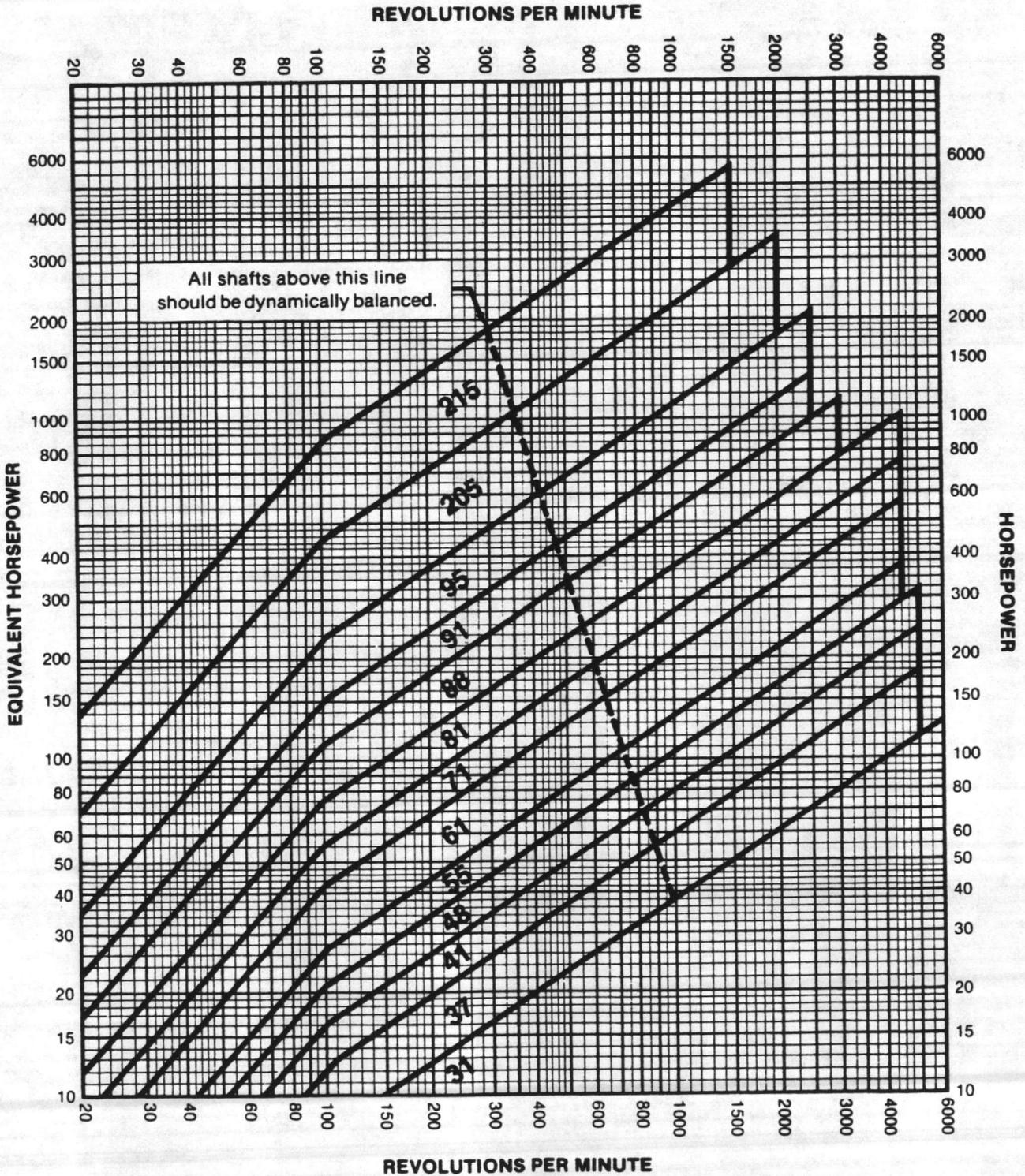


**WARNING:** Rotating drive shafts can be dangerous. Use shaft guards to help prevent serious injury to personnel.



# 8,000 HOUR GRAPH

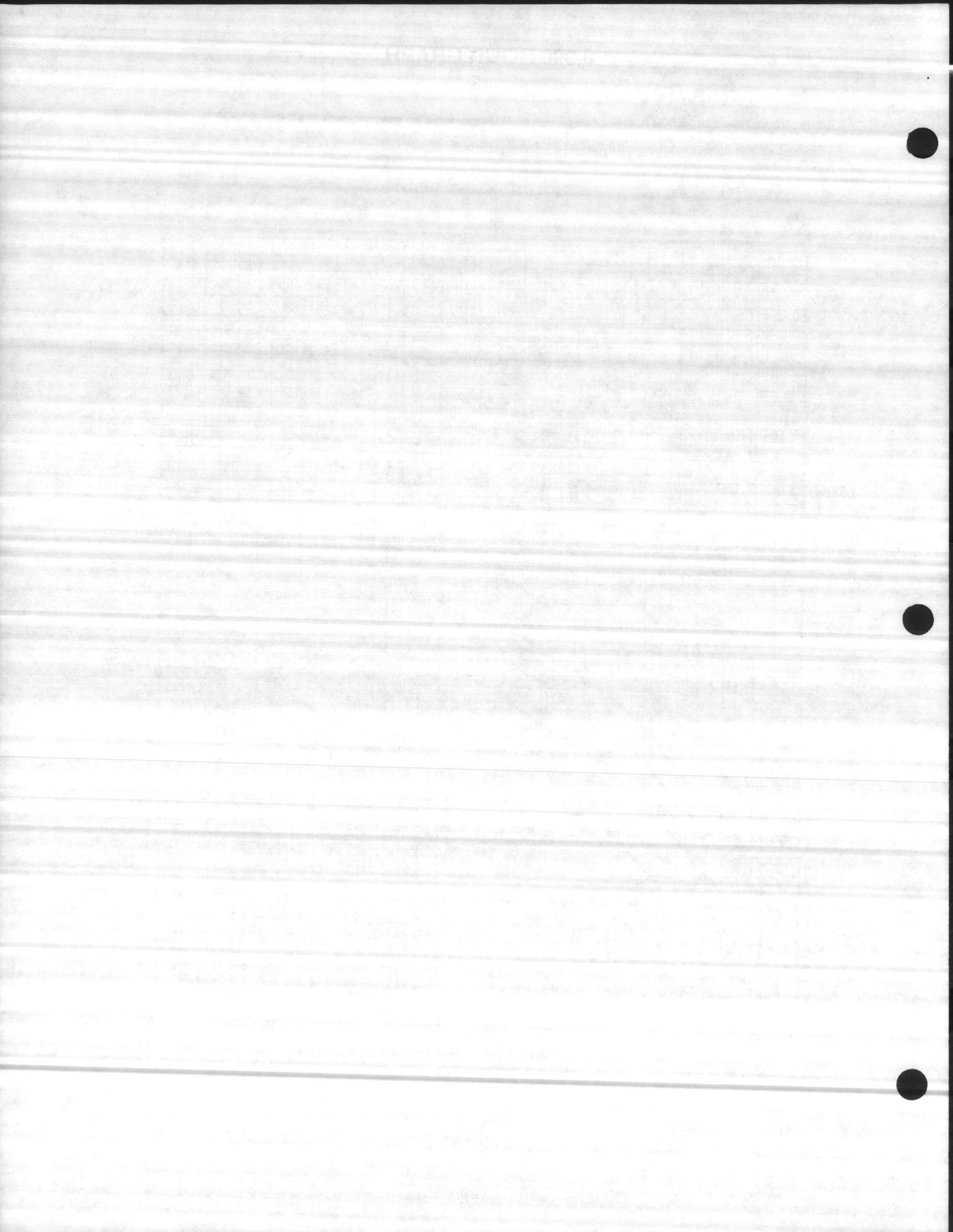
This graph is based on 8,000 hours of B-10 life at 3° angle with an electric motor as the driver.  
At speeds below 100 RPM, joint life is less than 8,000 hours.



**EXAMPLE:**

200 HP @ 900 RPM  
5 degree joint angle  
Gasoline engine  
No torsional elastic member  
30,000 hours B-10 life required

$EH = HP \times F_A \times F_P \times F_L$   
 $EH = 200 \times 1.17 \times 1.75 \times 1.55 = 635$   
 Enter graph with 635 HP and 900 RPM  
 Select 91 series joint



## 2. SELECT THE TUBE SIZE AND THE QUANTITY OF SHAFT SECTIONS

Drive Shafts have a Critical Speed. They will vibrate severely at this speed and they may also vibrate at their half Critical Speed. Drive Shafts should be designed so their maximum speed is no more than 75% of their Critical Speed and no closer to their half Critical Speed than  $\pm 8\%$ .

Variable speed shafts should be designed so their maximum speed is 8% below their half Critical Speed.

Try to use the standard tube size even if it requires using multiple shafts because costs are much lower and potential vibration and noise problems are minimized.

We do not recommend long (110" +) lengths with high speeds (1200 RPM +) on smaller series (31 to 48). In general, it is best to avoid using long shafts at high RPM's. Long shafts are difficult to balance and difficult to keep in balance. They are very sensitive to, and will pick up and magnify any noise or vibration caused by any member in the system, including pipes and supporting members. We also do not recommend using tube sizes larger on any series other than the special size shown for that series.

**TABLE II**

SERIES	TYPE		
	WVA	WVB	WVC
	SA	SB	SC
31	3	6	9
37	3	7	11
41	3	7	11
48	4	8	12
55	4	9	14
61	5	10	15
71	6	11	16
81	7	11	15
88	7	12	17
91	8.5	13.25	18
95	17.25	18	18.75
205	19	21.19	23.38
215	23.5	28.22	32.94

**TABLE III**

SERIES	STANDARD TUBE SIZE	USE GRAPH	SPECIAL TUBE SIZE	USE GRAPH
31	2.50 x .083	1	3.50 x .083	3
37	3.00 x .083	2	4.50 x .134	5
41	3.50 x .083	3	4.50 x .134	5
48	3.50 x .083	3	4.50 x .134	5
55	3.50 x .095	3	4.50 x .134	5
61	3.50 x .134	3	4.50 x .134	5
71	4.00 x .134	4	6.00 x .125	8
81	4.50 x .134	5	6.00 x .125	8
88	4.50 x .259	5	6.00 x .125	8
91	4.75 x .250	6	6.00 x .250	8
95	5.25 x .375	7	6.00 x .500	8
205	8.00 x .375	9	NONE	9
215	9.00 x .625	10	NONE	10

Effective length = shaft length less SA, SB or SC from Table II.

Go to the graph on the following pages that has the standard tube size for the series you are using.

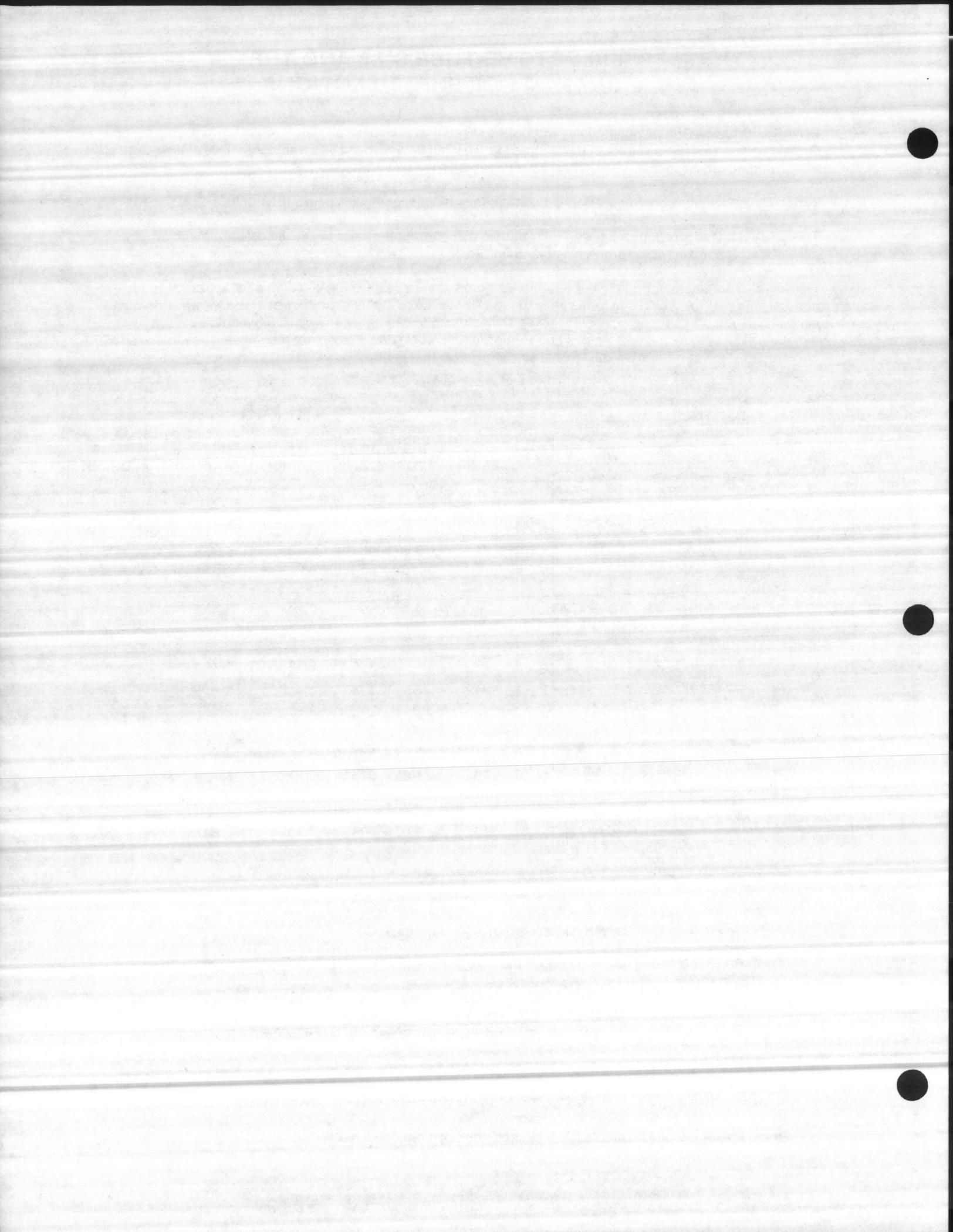
Graph will show you the safe effective length you can use.

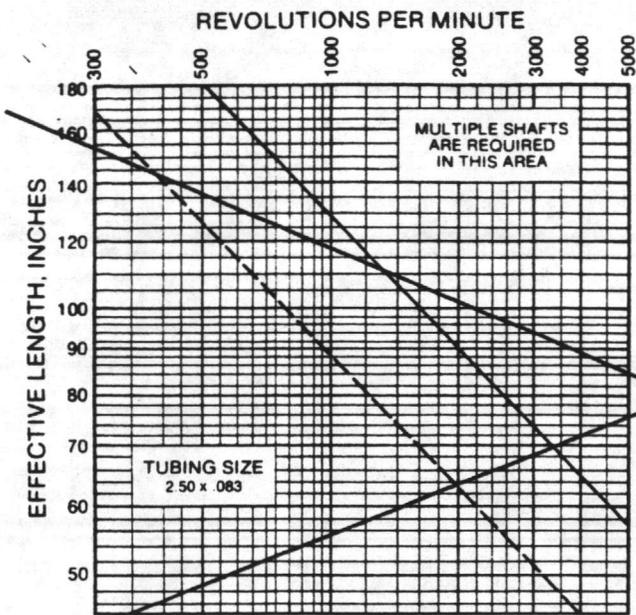
The solid line on the graph is the critical speed and the dotted line is the half critical.

Avoid the grey areas.

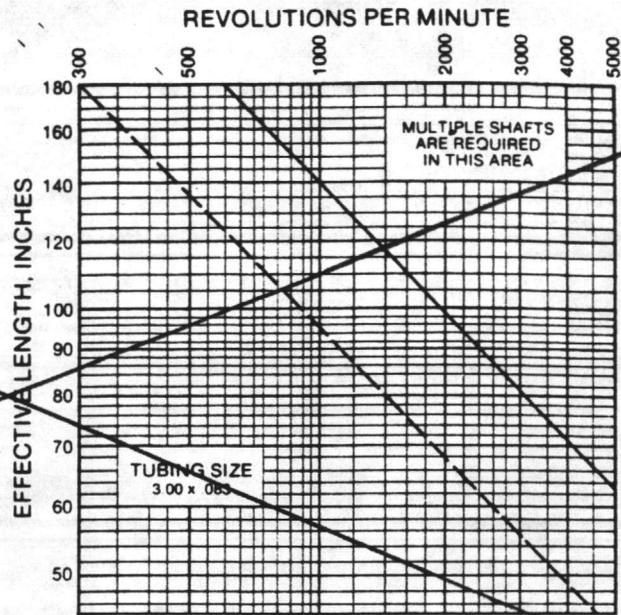
If the effective length is in the grey area, go to the graph that has the oversize tube.

If the effective length is still in the grey area you need multiple shafts.

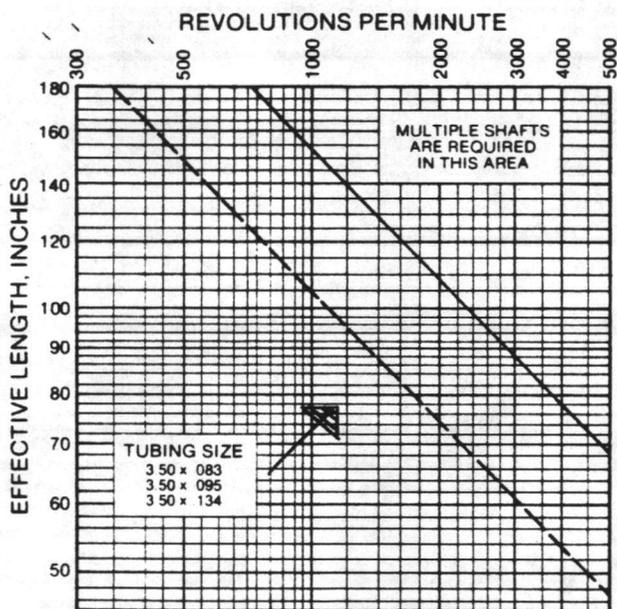




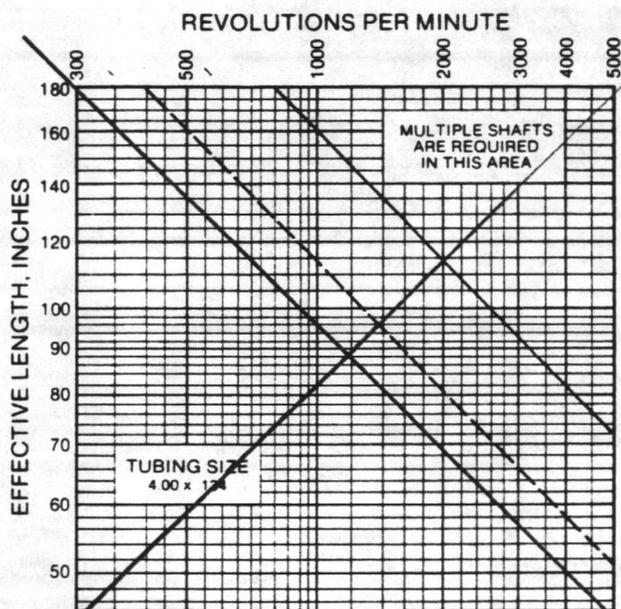
GRAPH NO. 1



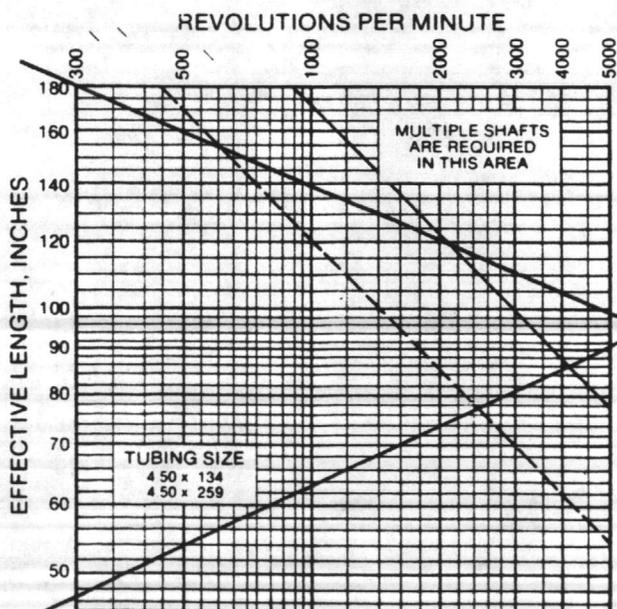
GRAPH NO. 2



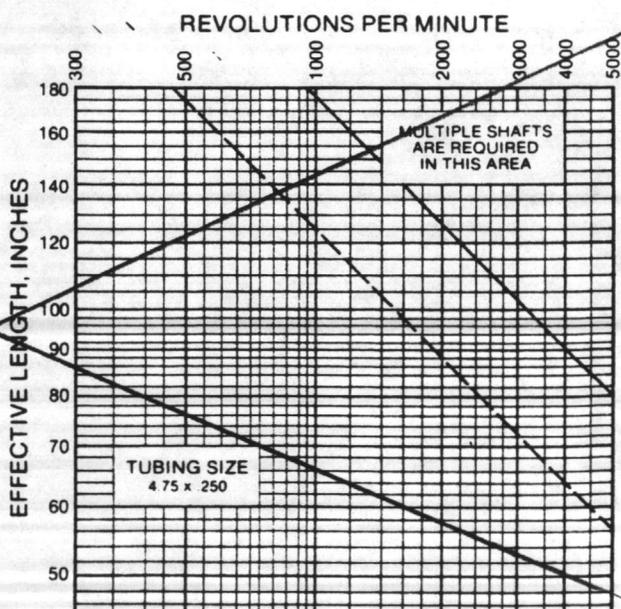
GRAPH NO. 3



GRAPH NO. 4

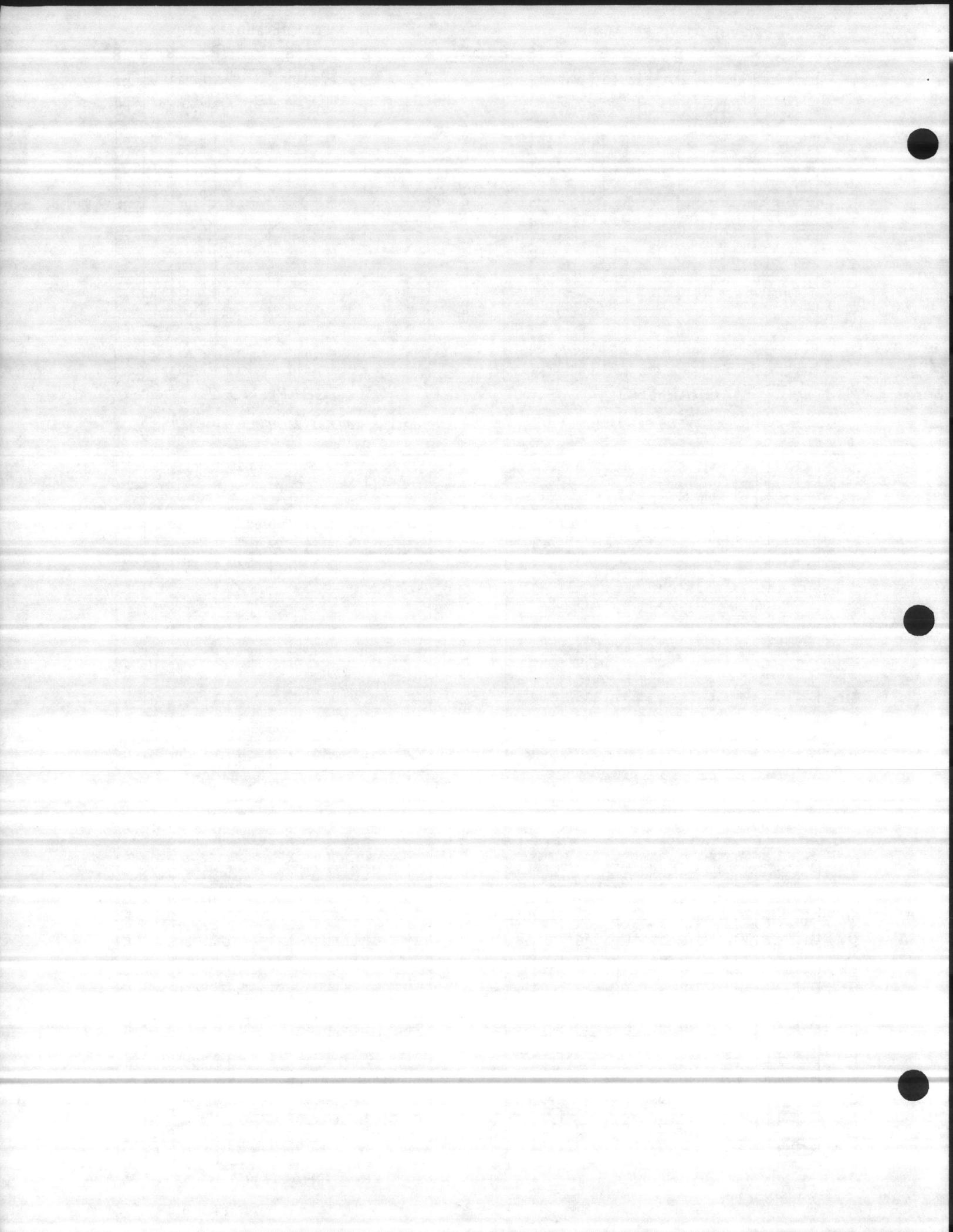


GRAPH NO. 5

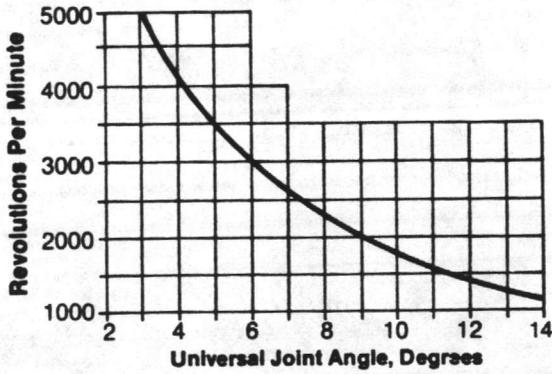


GRAPH NO. 6

**WARNING:** Rotating drive shafts can be dangerous. Use shaft guards to help prevent serious injury to personnel.



# UNIVERSAL JOINT SPEEDS AND ANGLES



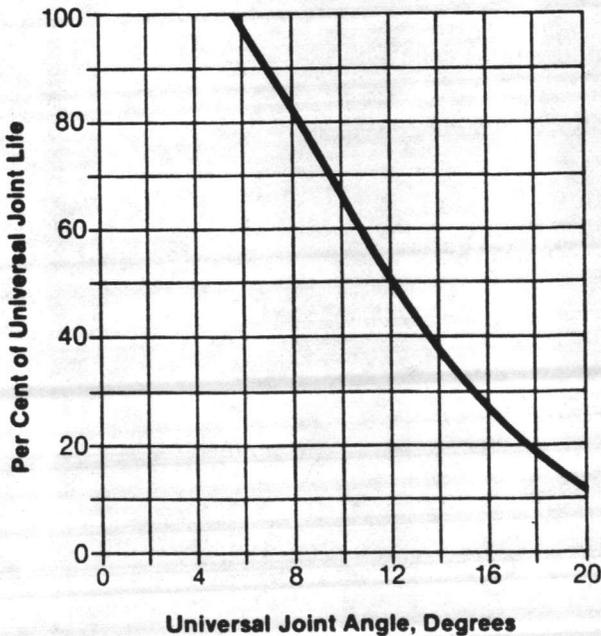
Graph at left shows maximum joint angle and speed combinations that cannot be exceeded.

The rate of acceleration and deceleration of universal joints will increase and cause a vibration as the curve is approached.

Joint Size	Maximum RPM
10	2500
11	4000
27	6000
31	6000
37	5000
41	5000
48	5000
55	4500
61	4500
71	4500
81	4500
88	3500
91	2500
95	2500
205	2000
215	1500

Table at left shows maximum speed that each series can operate at regardless of joint angle.

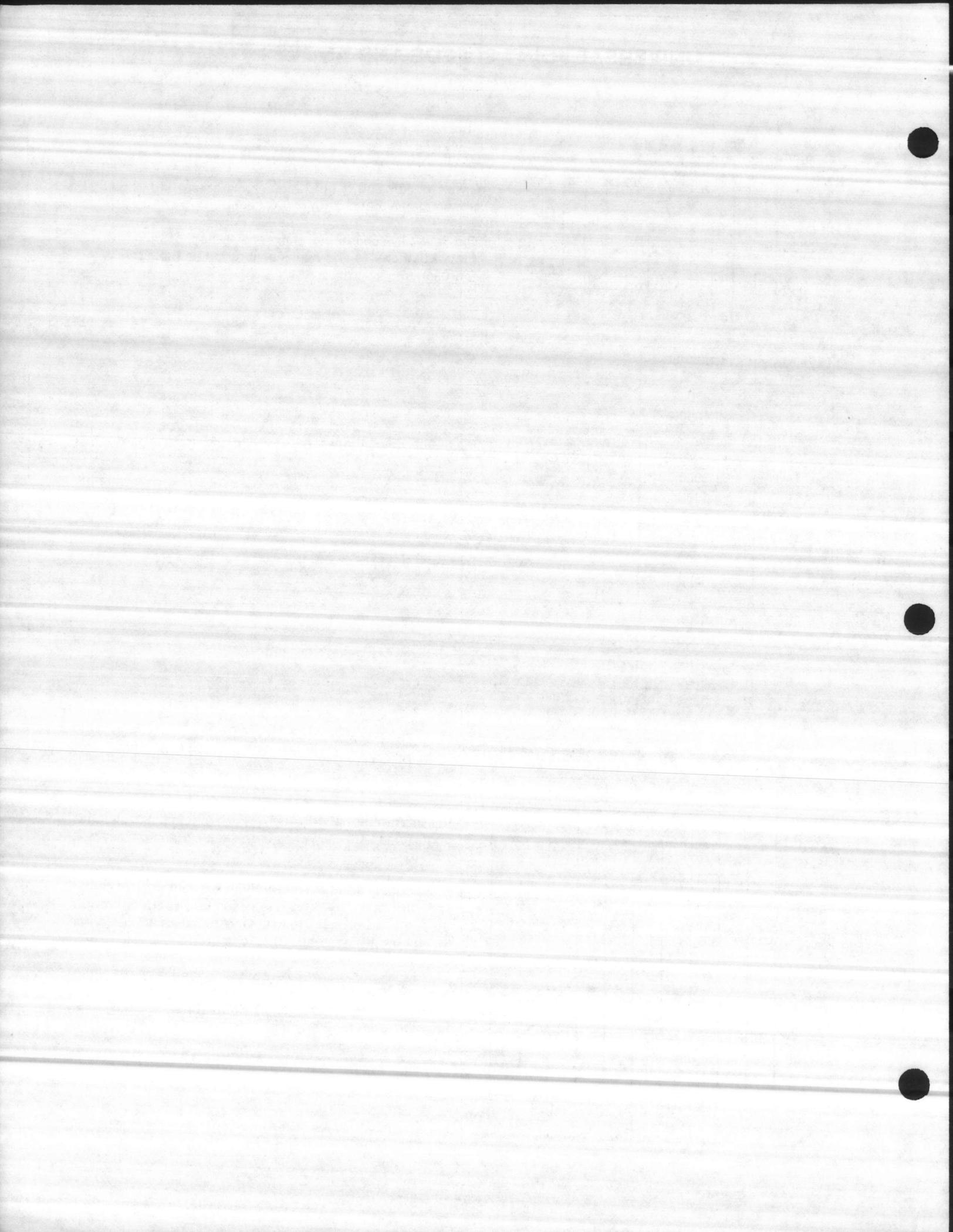
Decrease in Joint Life as Joint Angle increases.



It is important that universal joints work in pairs, at equal angles and with the yokes in the same plane or they will vibrate.

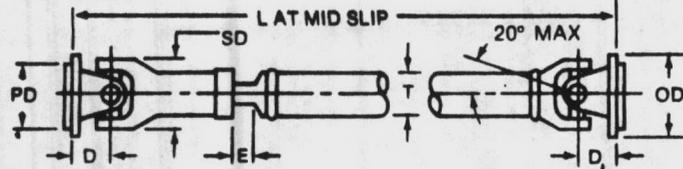
In a multiple shaft system with an even number of shafts (i.e. one A section and one B section) there is an odd number of universal joints. One or all of those joints should be set to operate at zero degrees.

The ideal universal joint operating angle is (3) three degrees. This angle will give 100% bearing life and make the needle bearings roll to distribute the wear if the joints are lubricated regularly.

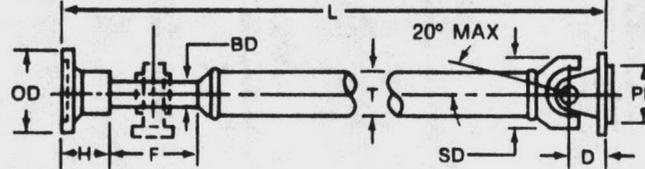


## DRIVE SHAFT SPECIFICATIONS

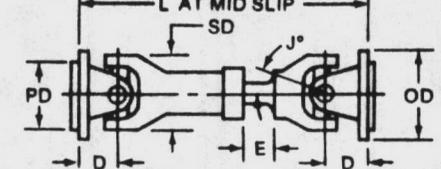
**WL & WVA**



**WVB**



**WS**



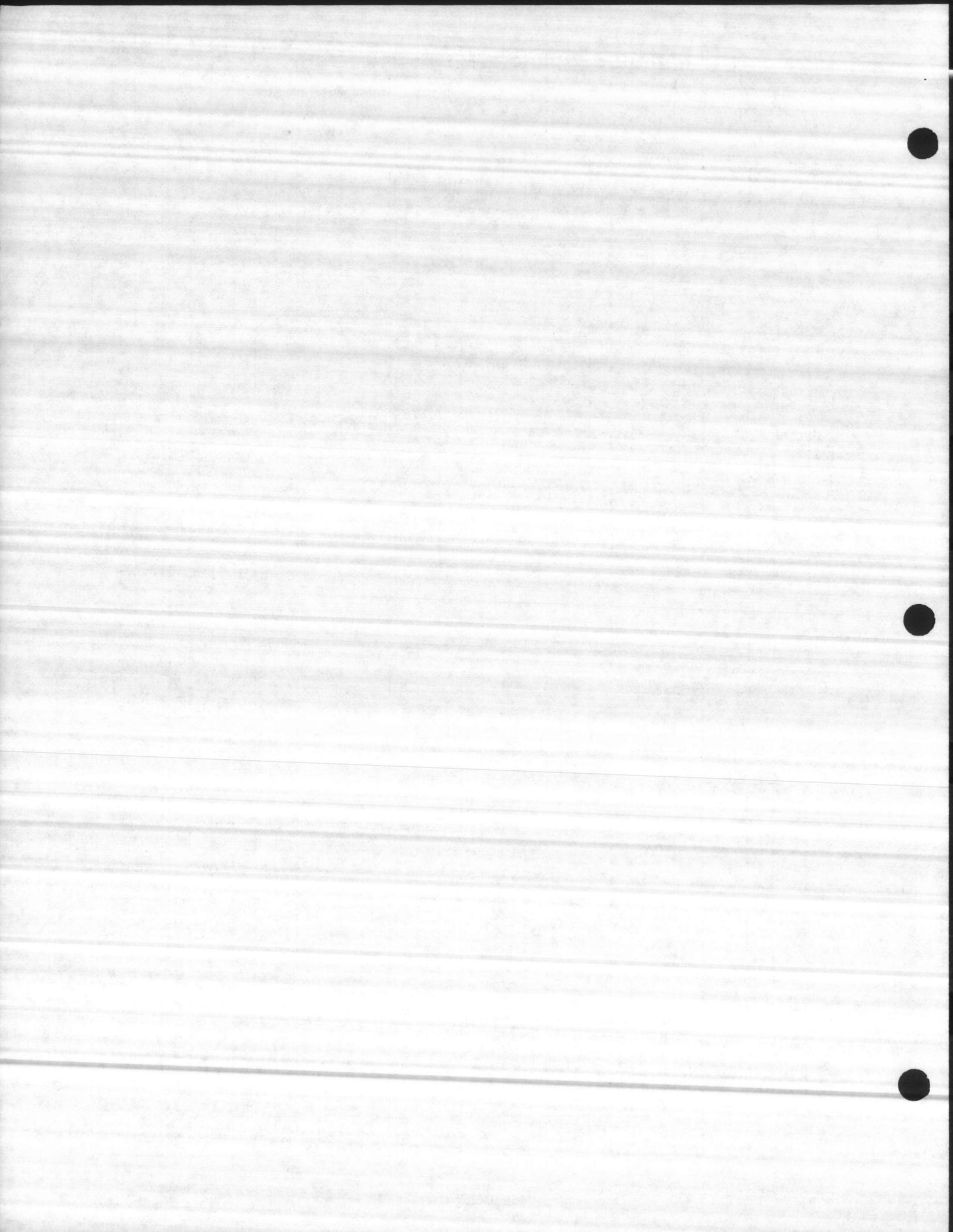
WL & WVA		31	37	41	48	55	61	71	81	88	91	95	205	215	
L	Minimum Length	15.22	16.77	17.54	16.75	17.00	25.38	24.25	26.44	27.44	31.85	46.50	52.32	63.94	
T	STD Tube	2.5 x .083	3.0 x .083	3.5 x .083	3.5 x .083	3.5 x .095	3.5 x .134	4.0 x .134	4.5 x .134	4.5 x .259	4.75 x .25	5.25 x .375	8.0 x .375	9.0 x .625	
	Overize Tube	3.5 x .083	4.5 x .134	6.0 x .125	6.0 x .125	6.0 x .125	6.0 x .25	6.0 x .5	NONE	NONE					
D	Face to $\epsilon$ Cross	1.38	1.56	1.69	2.00	2.00	2.75	3.60	3.38	3.50	4.25	8.62	9.50	11.75	
E	Lgthn or Shrtn	1.56	1.81	1.73	1.25	1.25	2.44	1.94	1.69	1.75	1.47	2.50	1.44	2.5	
**PD	Pilot Diameter	2.375	2.750	2.750	3.750	3.750	6.625	7.750	7.750	7.000	7.000	8.250	10.375	13.687	
**OD	Outside Diameter	3.875	4.562	4.562	5.875	5.875	6.875	8.000	8.000	9.625	9.625	11.187	13.625	17.500	
**SD	Swing Diameter	3.88	4.62	4.69	4.81	5.63	7.00	7.75	9.13	9.75	8.98	11.25	14.25	17.50	
A	Parts Weight	STD Tube	13.5	25.0	25.0	27.0	37.0	45.0	68.0	99.0	152	166	385	835	1460
		OS Tube	16.2	29.0	28.0	30.1	40.1	48.5	78.0	108	160	173	390	—	—
B	Tube WT/IN	STD Tube	.179	.215	.252	.252	.288	.401	.461	.521	.981	1.00	1.63	2.54	4.66
		OS Tube	.252	.521	.521	.521	.521	.521	.521	.653	.653	1.28	2.45	—	—

Weight = A + (B x Tube Length) = Lbs. (Tube Length = Shaft Length L - Minimum L) \*Same for WL, WVA & WVB \*\*Same on all shafts

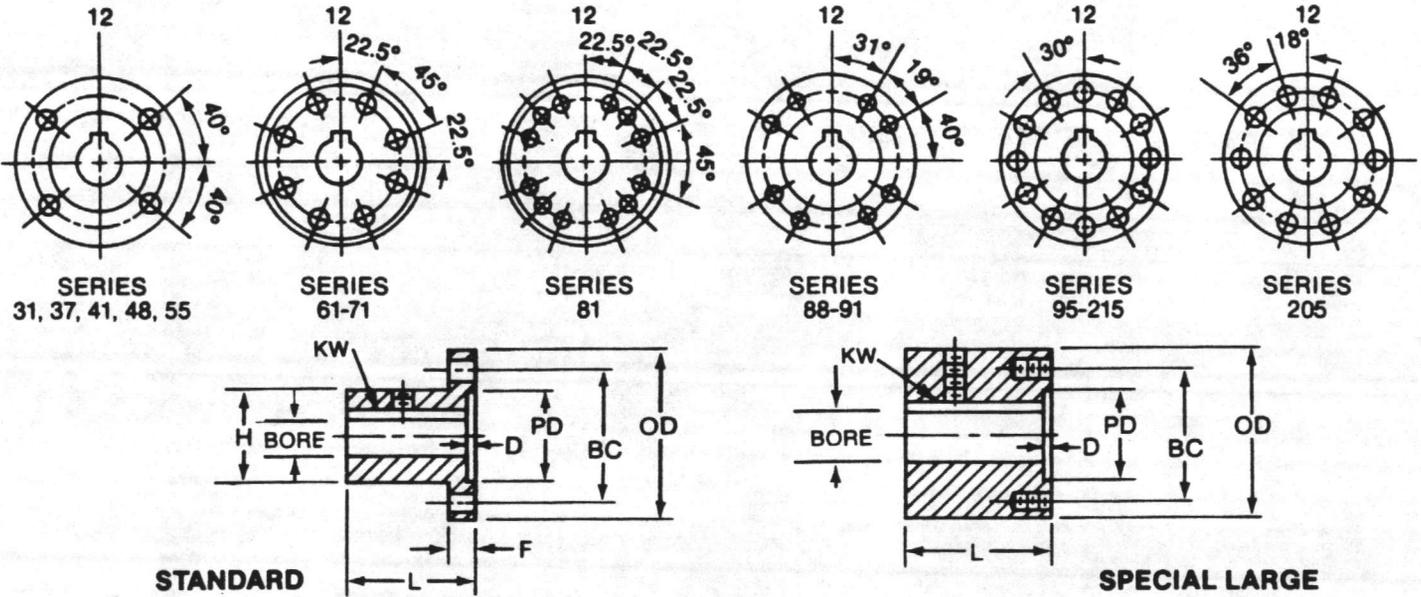
WVB		31	37	41	48	55	61	71	81	88	91	95	205	215	
L	Minimum Length	13	13	14	16	17	18	19	20	22	23	30	35	48	
F	Bearing Seat	6.00	6.00	6.00	8.00	8.00	8.00	8.00	8.00	8.00	7.75	8.25	12.75	18.00	
H	Flange Length	2.06	2.06	2.56	2.12	2.94	2.94	3.69	3.69	4.62	5.19	5.25	5.69	7.44	
BD	BRG Diameter	1.187	1.187	1.437	1.687	1.937	1.937	2.187	2.437	2.937	3.187	3.437	4.437	6.500	
A	Parts Weight	STD Tube	11.5	20.0	20.0	21.6	34.0	36.0	55.4	83.3	122	148	320	750	1318
		OS Tube	13.9	23.0	24.0	24.7	37.9	38.1	65.5	91.7	130	155	335	—	—
B	Tube WT/IN	STD Tube	.179	.215	.252	.252	.288	.401	.461	.521	.981	1.00	1.63	2.54	4.66
		OS Tube	.252	.521	.521	.521	.521	.521	.521	.653	.653	1.28	2.45	—	—

Weight = A + (B x Tube Length) = Lbs. Tube Length = Shaft = Length L - Minimum L

WS		31	37	41	48	55	61	71	81	88	91	95	205	215
L	Length	9.50	9.87	9.87	9.00	10.25	9.49	10.99	13.96	14.12	22.44	37.56	40.81	59.44
D	Face to $\epsilon$ Cross	1.38	1.56	1.69	1.50	2.00	1.68	2.00	2.59	2.50	4.25	8.62	9.50	11.75
E	Lgthn or Shrtn	0.62	0.37	0.37	0.50	0.50	0.37	0.37	0.56	0.50	0.78	1.75	1.44	2.5
A	Weight	8.0	11.0	13.5	19.5	29.5	44.0	47.0	78.0	142	195	390	840	1465
J	Max Angle	15°	8°	8°	8°	5°	8°	8°	12°	8°	22°	20°	17°	19°



### 3. SELECT THE FLANGES



SERIES		31	37-41	48-55	61	71	81	88-91	95	205	215	
NO. OF BOLTS		4	4	4	8	8	12	8	12	10	12	
BOLT		$\frac{1}{8}$ -24x1 $\frac{1}{2}$	$\frac{7}{16}$ -20x1 $\frac{1}{4}$	$\frac{1}{2}$ -20x1 $\frac{1}{2}$	$\frac{3}{8}$ -24x1 $\frac{1}{2}$	$\frac{3}{8}$ -24x1 $\frac{1}{2}$	$\frac{7}{16}$ -20x1 $\frac{1}{2}$	$\frac{5}{8}$ -18x2	$\frac{3}{4}$ -16x2 $\frac{1}{2}$	$\frac{7}{8}$ -14x3 $\frac{1}{2}$	1-12x4	
OD	OUTSIDE DIA	3.875	4.562	5.875	6.875	8.000	8.000	9.625	11.187	13.625	17.500	
BC	BOLT CIRCLE	3.125	3.750	4.750	6.125	7.250	7.250	8.250	9.8125	12.000	15.6875	
PD	PILOT DIA	2.375	2.750	3.750	6.625	7.750	7.750	7.000	8.250	10.375	13.6875	
D	PILOT DEPTH	.078	.078	.094	.094	.094	.094	.141	.125	.187	.203	
F	FLANGE WIDTH	.375	.375	.375	.375	.375	.375	.625	.750	1.00	1.250	
H	HUB DIA	2.437	2.875	3.750	5.410	4.910	4.910	6.875	8.000	9.00	13.000	
L	LENGTH											
		STD	2.00	2.00	3.00	3.50	4.00	4.00	5.00	5.87	7.50	8.00
		SPLG	2.50	3.00	4.00	5.00	5.50	6.00	6.00	8.00	9.00	10.00
WEIGHT												
		STD	3.4	4.7	12.1	24.2	25.5	25.5	58.8	93.7	192	412
		SPLG	6.4	13.9	30.8	52.7	85.6	85.6	164.4	225.9	416	820
MAXIMUM												
	BORE DIA	STD	1.687	1.875	2.437	3.125	5.000	3.000	4.625	5.000	6.000	7.500
		SPLG	2.375	2.750	3.750	4.500	5.500	5.500	6.375	7.250	8.750	10.500
ROUGH												
	BORE DIA	STD	.75	1.00	1.25	1.25	1.25	1.25	1.50	3.00	3.00	3.00
		SPLG	1.37	1.75	2.37	3.00	3.50	3.50	4.25	5.00	5.00	5.00
MAX KW WIDTH	STD	.375	.500	.625	.750	.750	.750	1.125	1.25	1.50	1.75	
MAX BORE	SPLG	.625	.750	1.00	1.00	1.25	1.25	1.25	1.50	2.00	2.50	

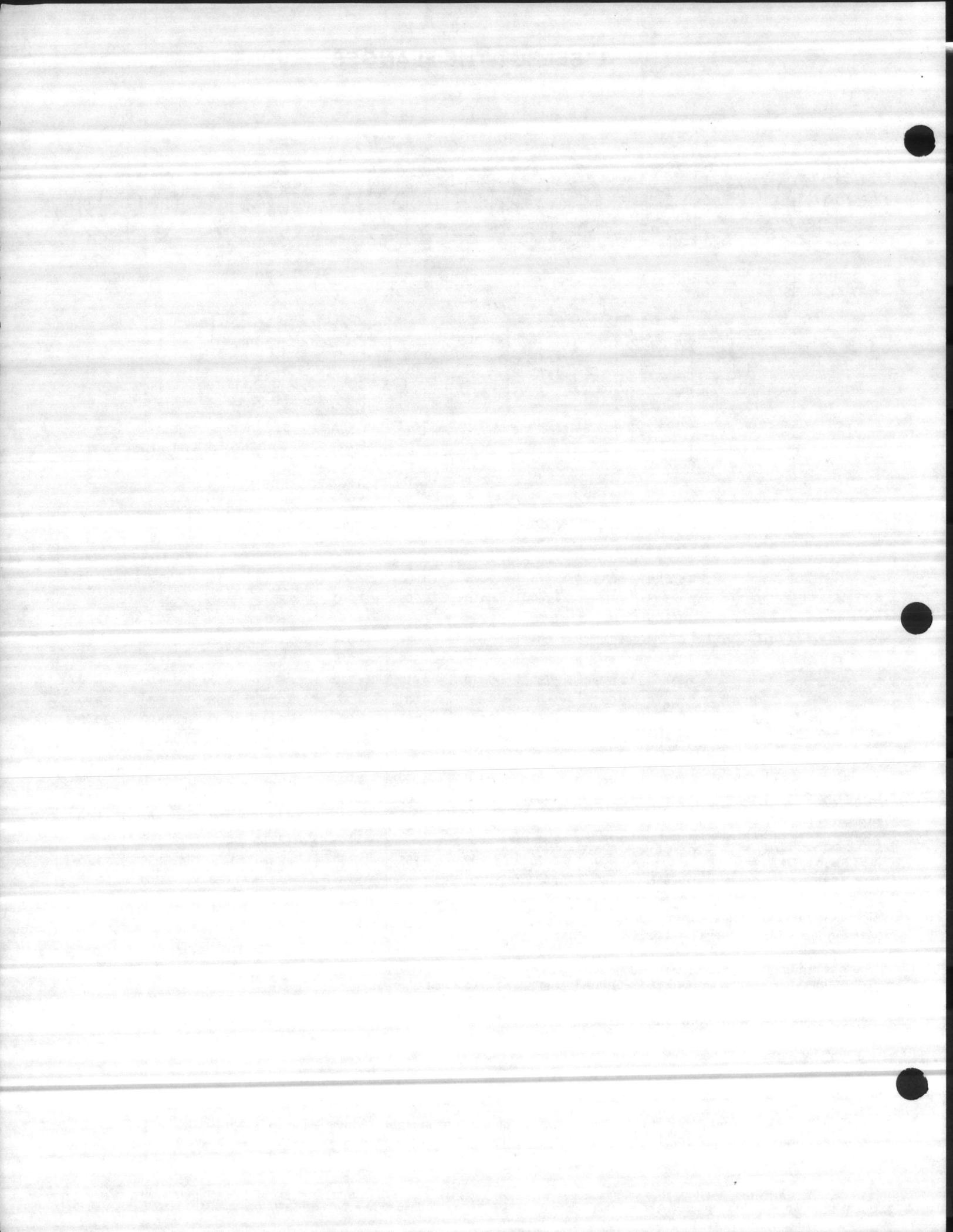
Weight in table is for flange with no bore  
 Bore weight = .2223 x bore<sup>2</sup> x L = Lbs.

All flanges are finish bored to  $-.000 + .001$   
 Special tolerances may be specified at additional cost

71 and 81 flanges with bore sizes between 3" and 4" diameter are available in a special flange which has dimensions same as standard flange except:  
 H = 6.375" Weight = 38 Lbs.  $WR^2 = 1.45 \text{ Lb. Ft.}^2$

$\frac{1}{8}$ -6 spline and  $\frac{1}{8}$ -21 spline flanges are available in Series 31 thru 55

Flanges with bore sizes larger than shown are available on special request. These large bore flanges are counter bored.

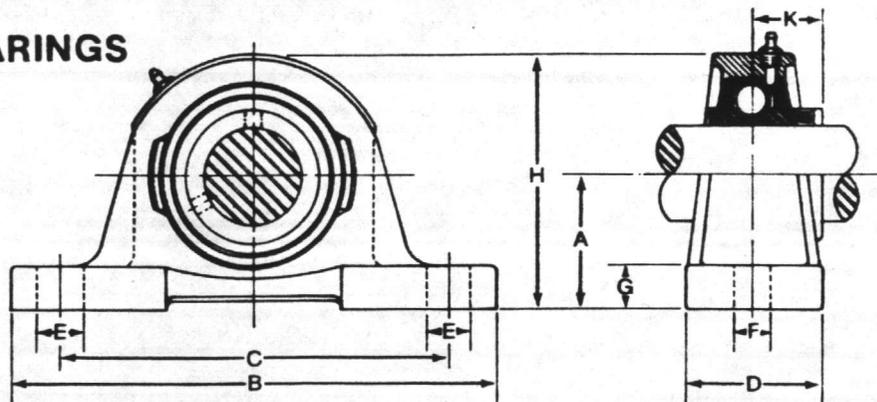


## 4. SELECT THE STEADY BEARINGS

Use one bearing for every B-Section.

Use two bearings for every C-Section.

Watson reserves the right to substitute another make of bearing with different dimensions.

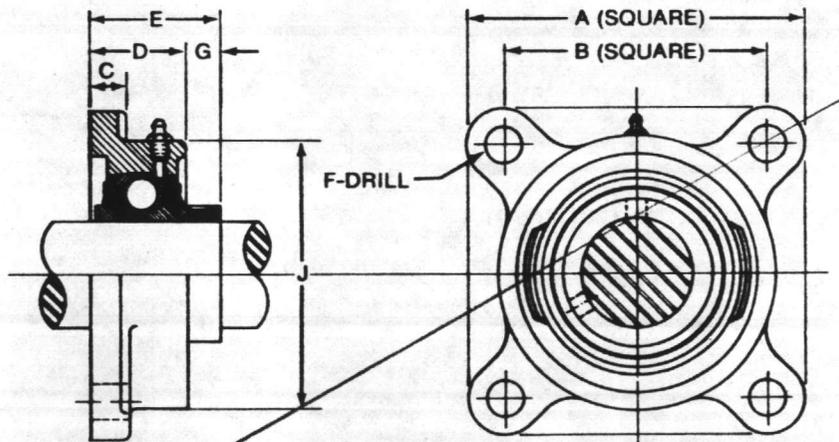


Watson Shaft Series	Bearing Assy. Number	Shaft Diam. Inches	DIMENSIONS IN INCHES									Bolt Size Inches	Wt. Lbs.
			A	B	C	D	E	F	G	H	K		
31	W31-17-1	1 <sup>3</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>	6 <sup>1</sup> / <sub>4</sub>	4 <sup>5</sup> / <sub>16</sub>	1 <sup>5</sup> / <sub>16</sub>	1	9 <sup>1</sup> / <sub>16</sub>	3 <sup>1</sup> / <sub>4</sub>	3 <sup>1</sup> / <sub>4</sub>	7 <sup>1</sup> / <sub>16</sub>	1/2	2.9
<del>37</del>	<del>W37-17-1</del>	<del>1<sup>3</sup>/<sub>16</sub></del>	<del>1<sup>1</sup>/<sub>16</sub></del>	<del>6<sup>1</sup>/<sub>4</sub></del>	<del>4<sup>5</sup>/<sub>16</sub></del>	<del>1<sup>5</sup>/<sub>16</sub></del>	<del>1</del>	<del>9<sup>1</sup>/<sub>16</sub></del>	<del>3<sup>1</sup>/<sub>4</sub></del>	<del>3<sup>1</sup>/<sub>4</sub></del>	<del>7<sup>1</sup>/<sub>16</sub></del>	<del>1/2</del>	<del>2.9</del>
41	W41-17-1	1 <sup>7</sup> / <sub>16</sub>	1 <sup>7</sup> / <sub>16</sub>	6 <sup>5</sup> / <sub>16</sub>	5 <sup>1</sup> / <sub>16</sub>	1 <sup>3</sup> / <sub>4</sub>	1	9 <sup>1</sup> / <sub>16</sub>	3 <sup>1</sup> / <sub>16</sub>	3 <sup>1</sup> / <sub>16</sub>	1	1/2	3.5
<del>48</del>	<del>W48-17-1</del>	<del>1<sup>1</sup>/<sub>16</sub></del>	<del>2<sup>1</sup>/<sub>16</sub></del>	<del>7<sup>3</sup>/<sub>16</sub></del>	<del>5<sup>1</sup>/<sub>16</sub></del>	<del>2</del>	<del>1<sup>1</sup>/<sub>16</sub></del>	<del>9<sup>1</sup>/<sub>16</sub></del>	<del>4<sup>1</sup>/<sub>16</sub></del>	<del>4<sup>1</sup>/<sub>16</sub></del>	<del>1<sup>1</sup>/<sub>16</sub></del>	<del>1/2</del>	<del>5.4</del>
55	W55-17-1	1 <sup>9</sup> / <sub>16</sub>	2 <sup>1</sup> / <sub>4</sub>	8 <sup>1</sup> / <sub>4</sub>	6 <sup>1</sup> / <sub>2</sub>	2 <sup>1</sup> / <sub>16</sub>	1	1 <sup>1</sup> / <sub>16</sub>	4 <sup>1</sup> / <sub>2</sub>	4 <sup>1</sup> / <sub>2</sub>	1 <sup>1</sup> / <sub>32</sub>	5/8	5.8
61	W61-17-1	1 <sup>9</sup> / <sub>16</sub>	2 <sup>1</sup> / <sub>4</sub>	8 <sup>1</sup> / <sub>4</sub>	6 <sup>1</sup> / <sub>2</sub>	2 <sup>1</sup> / <sub>16</sub>	1	1 <sup>1</sup> / <sub>16</sub>	4 <sup>1</sup> / <sub>2</sub>	4 <sup>1</sup> / <sub>2</sub>	1 <sup>1</sup> / <sub>32</sub>	5/8	5.8
71	W71-17-1	2 <sup>1</sup> / <sub>16</sub>	2 <sup>1</sup> / <sub>2</sub>	8 <sup>5</sup> / <sub>16</sub>	6 <sup>2</sup> / <sub>32</sub>	2 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>	5	5	1 <sup>1</sup> / <sub>32</sub>	5/8	7.5
81	W81-17-1	2 <sup>7</sup> / <sub>16</sub>	2 <sup>3</sup> / <sub>4</sub>	9 <sup>5</sup> / <sub>16</sub>	7 <sup>1</sup> / <sub>32</sub>	2 <sup>3</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>4</sub>	1 <sup>1</sup> / <sub>16</sub>	5 <sup>1</sup> / <sub>2</sub>	5 <sup>1</sup> / <sub>2</sub>	1 <sup>1</sup> / <sub>16</sub>	5/8	9.6
88	W88-17-1	2 <sup>1</sup> / <sub>16</sub>	3 <sup>1</sup> / <sub>2</sub>	10 <sup>5</sup> / <sub>16</sub>	9 <sup>5</sup> / <sub>16</sub>	2 <sup>1</sup> / <sub>16</sub>	2	1 <sup>5</sup> / <sub>16</sub>	6 <sup>5</sup> / <sub>16</sub>	6 <sup>5</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>2</sub>	7/8	17.1
91	W91-17-1	3 <sup>3</sup> / <sub>16</sub>	4	14	10 <sup>7</sup> / <sub>16</sub>	3 <sup>3</sup> / <sub>16</sub>	2 <sup>1</sup> / <sub>16</sub>	1 <sup>5</sup> / <sub>16</sub>	7 <sup>1</sup> / <sub>16</sub>	7 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>	7/8	27.3
95	W95-17-1	3 <sup>7</sup> / <sub>16</sub>	4	14	10 <sup>7</sup> / <sub>16</sub>	3 <sup>3</sup> / <sub>16</sub>	2 <sup>1</sup> / <sub>16</sub>	1 <sup>5</sup> / <sub>16</sub>	7 <sup>1</sup> / <sub>16</sub>	7 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>	3/4	26.4
205	W205-17-1	4 <sup>7</sup> / <sub>16</sub>	4 <sup>3</sup> / <sub>4</sub>	16 <sup>5</sup> / <sub>16</sub>	13 <sup>3</sup> / <sub>16</sub>	4 <sup>5</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>	3 <sup>1</sup> / <sub>4</sub>	9 <sup>5</sup> / <sub>16</sub>	9 <sup>5</sup> / <sub>16</sub>	3 <sup>3</sup> / <sub>16</sub>	3/4	81.0
215	W215-17-1	6 <sup>1</sup> / <sub>2</sub>	7 <sup>1</sup> / <sub>2</sub>	26	22 <sup>1</sup> / <sub>4</sub>	7 <sup>1</sup> / <sub>16</sub>	2	1 <sup>1</sup> / <sub>16</sub> **	15 <sup>1</sup> / <sub>16</sub>	15 <sup>1</sup> / <sub>16</sub>	5 <sup>1</sup> / <sub>4</sub>	1	210.0

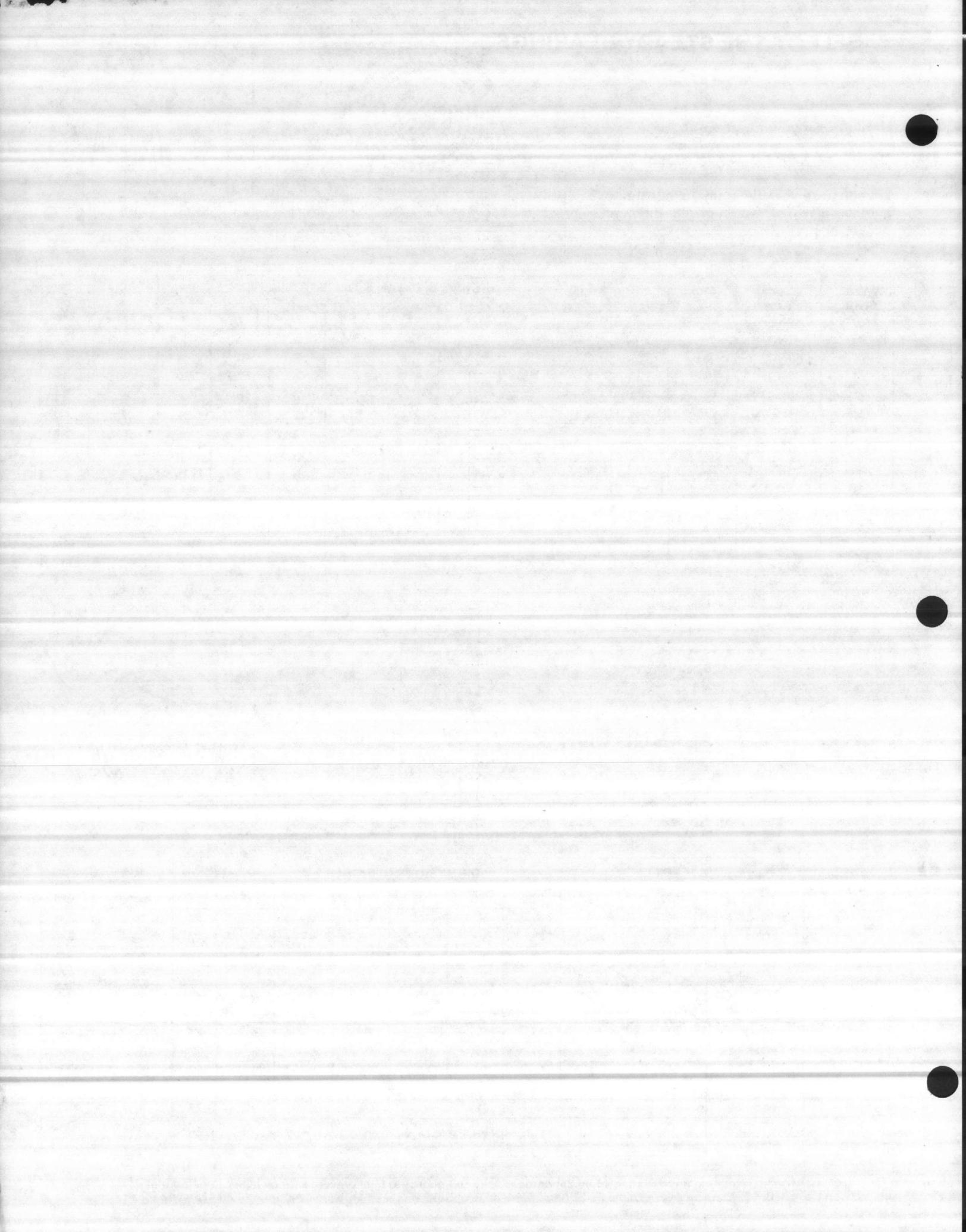
\*Two mounting bolts, 2<sup>1</sup>/<sub>2</sub>" between centers

\*\*Two mounting bolts, 4<sup>5</sup>/<sub>8</sub>" between centers

## FLANGE UNIT

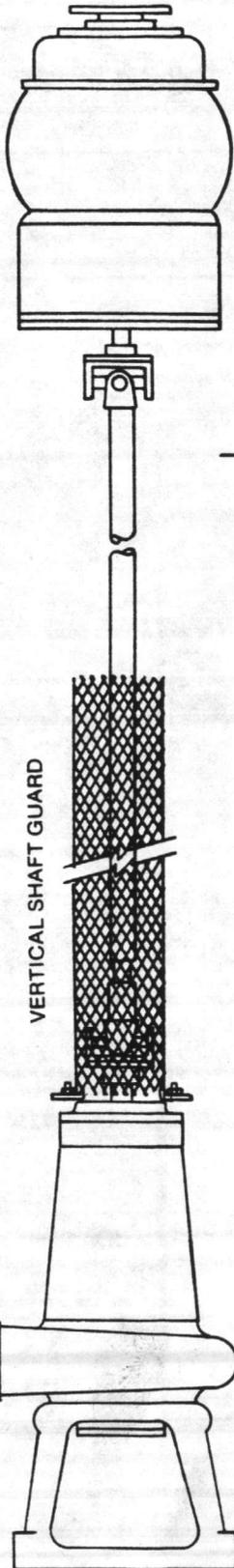


Watson Shaft Series	Bearing Assy. Number	Shaft Diam. Inches	DIMENSIONS IN INCHES								Bolt Size Inches	Wt. Lbs.
			A	B	C	D	E	F	G	J		
31	W31-17-2	1 <sup>3</sup> / <sub>16</sub>	4 <sup>1</sup> / <sub>4</sub>	3 <sup>1</sup> / <sub>16</sub>	1/2	1	1 <sup>7</sup> / <sub>16</sub>	1/2	1/2	3 <sup>1</sup> / <sub>4</sub>	7 <sup>1</sup> / <sub>16</sub>	2.4
37	W37-17-2	1 <sup>3</sup> / <sub>16</sub>	4 <sup>1</sup> / <sub>4</sub>	3 <sup>1</sup> / <sub>4</sub>	1/2	1	1 <sup>7</sup> / <sub>16</sub>	1/2	1/2	3 <sup>1</sup> / <sub>4</sub>	7 <sup>1</sup> / <sub>16</sub>	2.4
41	W41-17-2	1 <sup>7</sup> / <sub>16</sub>	4 <sup>5</sup> / <sub>16</sub>	3 <sup>5</sup> / <sub>16</sub>	1/2	1 <sup>1</sup> / <sub>16</sub>	1 <sup>5</sup> / <sub>16</sub>	9 <sup>1</sup> / <sub>16</sub>	1/2	3 <sup>1</sup> / <sub>4</sub>	1/2	3.3
48	W48-17-2	1 <sup>1</sup> / <sub>16</sub>	5 <sup>5</sup> / <sub>16</sub>	4 <sup>1</sup> / <sub>16</sub>	9 <sup>1</sup> / <sub>16</sub>	1 <sup>5</sup> / <sub>16</sub>	1 <sup>3</sup> / <sub>4</sub>	5/8	5/8	4 <sup>5</sup> / <sub>16</sub>	9 <sup>1</sup> / <sub>16</sub>	4.8
55	W55-17-2	1 <sup>9</sup> / <sub>16</sub>	5 <sup>5</sup> / <sub>16</sub>	4 <sup>5</sup> / <sub>16</sub>	5/8	1 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>	5/8	5/8	4 <sup>9</sup> / <sub>16</sub>	9 <sup>1</sup> / <sub>16</sub>	5.2
61	W61-17-2	1 <sup>9</sup> / <sub>16</sub>	5 <sup>5</sup> / <sub>16</sub>	4 <sup>5</sup> / <sub>16</sub>	5/8	1 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>	5/8	5/8	4 <sup>9</sup> / <sub>16</sub>	9 <sup>1</sup> / <sub>16</sub>	5.2
71	W71-17-2	2 <sup>1</sup> / <sub>16</sub>	6 <sup>5</sup> / <sub>16</sub>	5 <sup>5</sup> / <sub>16</sub>	5/8	1 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>	5/8	5 <sup>1</sup> / <sub>4</sub>	5/8	7.2
81	W81-17-2	2 <sup>7</sup> / <sub>16</sub>	6 <sup>5</sup> / <sub>16</sub>	5 <sup>5</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>	1 <sup>7</sup> / <sub>16</sub>	2 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>	5/8	5 <sup>1</sup> / <sub>16</sub>	5/8	8.9
88	W88-17-2	2 <sup>1</sup> / <sub>16</sub>	7 <sup>3</sup> / <sub>4</sub>	6	3/4	1 <sup>1</sup> / <sub>16</sub>	2 <sup>3</sup> / <sub>16</sub>	1 <sup>3</sup> / <sub>16</sub>	3/4	6 <sup>1</sup> / <sub>2</sub>	3/4	13.2
91	W91-17-2	3 <sup>3</sup> / <sub>16</sub>	8 <sup>1</sup> / <sub>16</sub>	6 <sup>3</sup> / <sub>4</sub>	1 <sup>5</sup> / <sub>16</sub>	2 <sup>1</sup> / <sub>16</sub>	2 <sup>3</sup> / <sub>4</sub>	1 <sup>3</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>	7 <sup>1</sup> / <sub>4</sub>	3/4	21.1
95	W95-17-2	3 <sup>7</sup> / <sub>16</sub>	8 <sup>1</sup> / <sub>16</sub>	6 <sup>3</sup> / <sub>4</sub>	1 <sup>5</sup> / <sub>16</sub>	2 <sup>1</sup> / <sub>16</sub>	2 <sup>3</sup> / <sub>4</sub>	1 <sup>3</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>	7 <sup>1</sup> / <sub>2</sub>	3/4	20.0
205	W205-17-2	4 <sup>7</sup> / <sub>16</sub>	*Contact H.S. Watson Engineering Department for dimensions on 205 and 215.									
215	W215-17-2	6 <sup>1</sup> / <sub>2</sub>										



## 5. SELECT THE SHAFT GUARD

The vertical shaft guard is 48" long. If a longer shaft guard is required, the 48" sections can be bolted together. Shaft guards can be cut to any length by using metal shears.



VERTICAL SHAFT GUARD		
Part No.	Size	For Shaft Series
2713-61	10" Dia.	27 thru 61
2713-91	14" Dia.	71 thru 91
2713-205	20" Dia.	95 thru 205

Choose one shaft guard assembly and one mounting kit.

Choose mounting kit with stud size the same as stud size on pump bearing cap.

MOUNTING KITS	
Kit No.	Stud Size
MK0375	3/8" x 4"
MK0500	1/2" x 4"
MK0625	5/8" x 4 1/2"
MK0750	3/4" x 5"
MK0875	7/8" x 5 1/2"
MK1000	1" x 5 1/2"
MK1025	1 1/8" x 6"

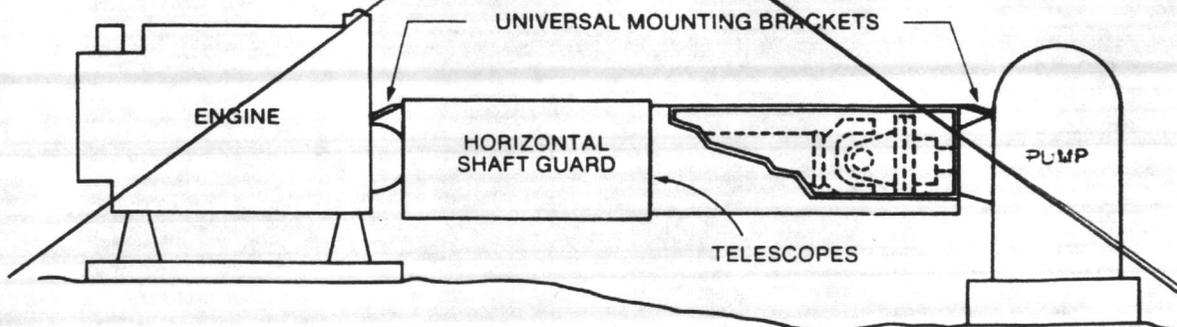
Bolt two shaft guards together with extender kit 2843 to make 8 ft. shaft guard.

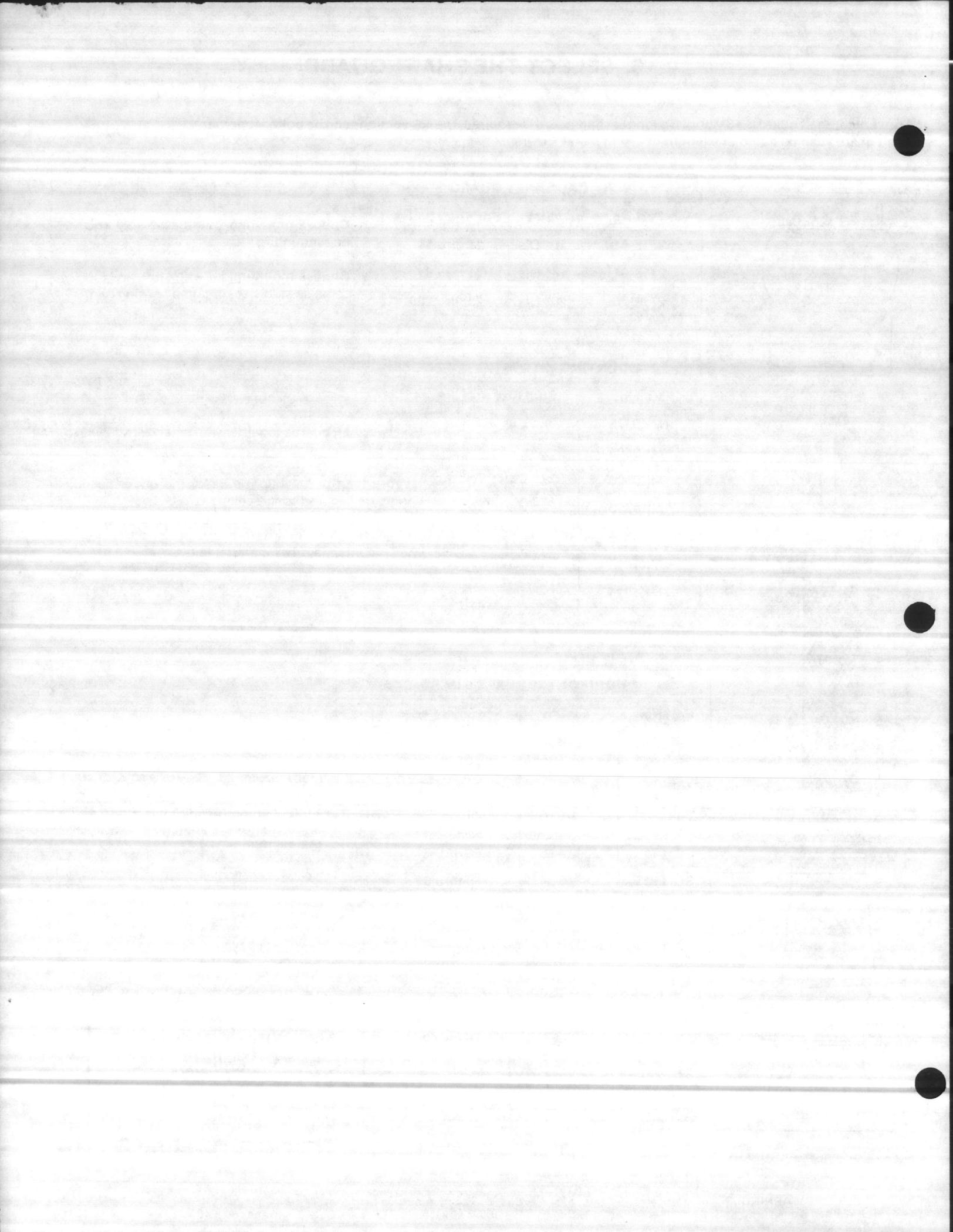
If more than one section is used, the upper section should be secured to the ceiling or a beam.

Our shaft guards are not designed to contain a drive shaft if it fails.

HORIZONTAL SHAFT GUARD			
Part No.	Length	For Shaft Series	Dia.
SGH 18	18" to 18"	27 thru 55	7"
SGH 24	14" to 24"	60 thru 81	12"
SGH 42	24" to 42"	27 thru 55	7"
SGH 66	35" to 66"	27 thru 55	7"
SGH 71	35" to 66"	60 thru 81	12"
SGH 915	28" to 54"	88 thru 95	15"

Made from 18 GA galvanized steel. Telescopes in 1" increments. Two inch wide opening runs the full length of the underside of the shaft guard for access to lube fittings.





## INSTALLATION INSTRUCTIONS

**Foundations** for driving and driven machines must be rigid since most machinery will vibrate to some extent. Proper steel beams and/or concrete foundations, with hold down bolts are necessary to maintain alignment and to minimize vibrations.

**Steady Bearing Supports** must have enough rigidity to avoid vibrations. We recommend the following:

1. Keep spans as short as possible.
2. Avoid cantilever supports unless they are very rigid.
3. Make end connections rigid.
4. Use very rigid beams.

All members (shafts, foundations, supports, motors, pumps, inlet and discharge pipes, etc.) have a natural frequency at which they will vibrate (resonate). This frequency with the drive train fully assembled, must not coincide with the operating RPM.

Foundations that are not adequate or steady bearing supports that are not rigid will void warranty.

**WARNING:** Rotating shafts can seriously injure personnel. We strongly recommend the use of shaft guards to help prevent injury to personnel.

### BASIC RULES FOR UNIVERSAL JOINTS

**1. They must work in pairs**

A universal joint, working at an angle, will vibrate if it is not canceled by another joint, at the opposite end of the shaft, working at the same angle and in the same plane.

**2. Joint angles must be equal to within one degree**

Joints, working in pairs will vibrate if they are not working at the same angle to within one degree.

**3. Yokes must be in phase**

Joints, working in pairs, will vibrate if their yoke ears are not in the same plane to within two degrees.

**4. Maximum joint angle and RPM combination cannot be exceeded**

A shaft, between two joints working at an angle, will accelerate and decelerate as the shaft rotates. The higher the RPM and the greater the angle, the higher the rate of acceleration and deceleration. As the rate increases it will cause a vibration. See Table 1 on next page.

If a universal joint operates at zero degrees the bearing needles may not rotate and lubricate themselves. This is not important if the power being transmitted is smooth.

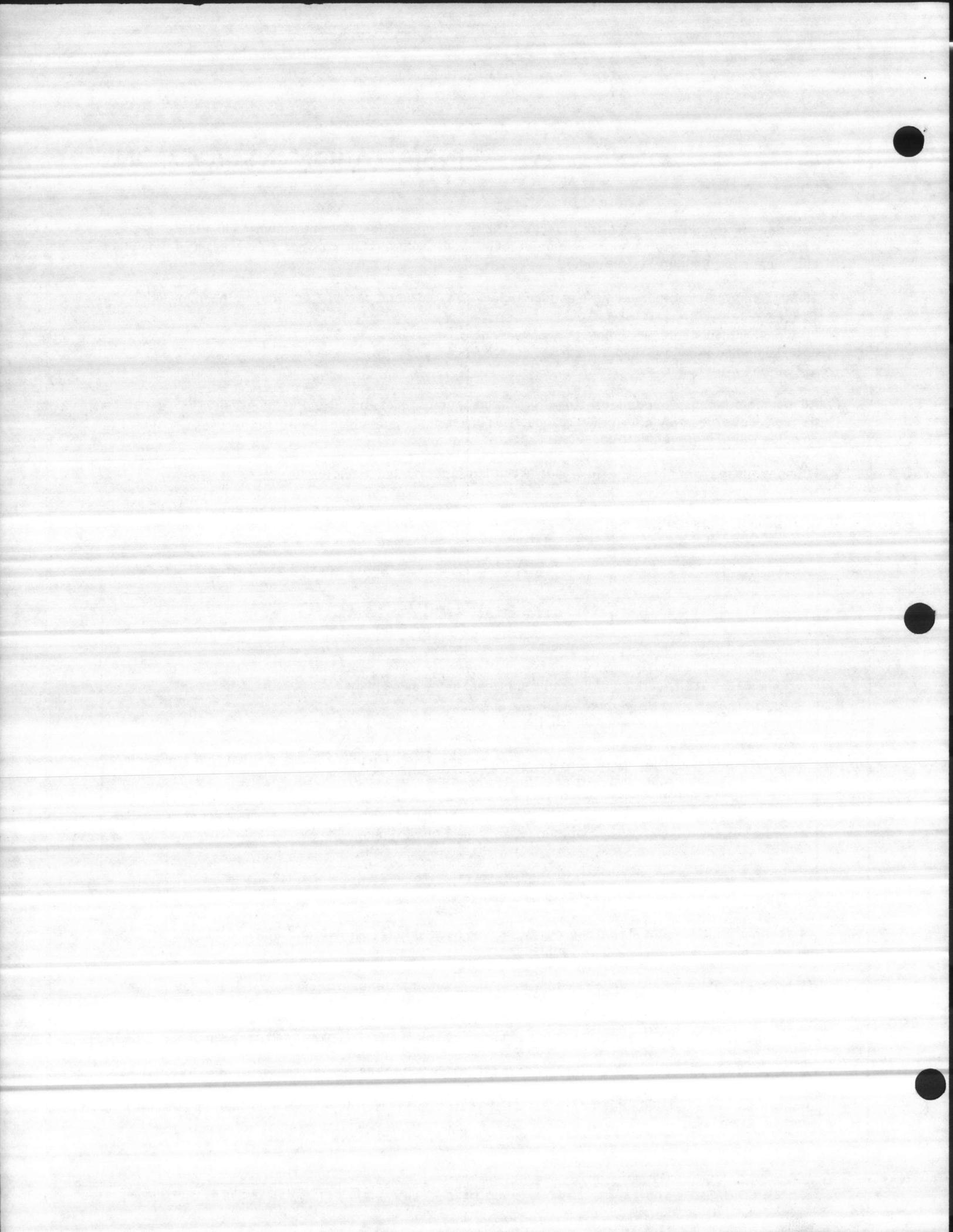
If there are torsional impulses such as from an engine, joint angles should be set to operate at three degrees to enable the needles to rotate and distribute the wear.

A joint operating at zero degrees does not need to be canceled and the yokes need not be in phase.

Flanges and keys must be seated properly on input and output shafts.

Lubricate all joints, splines and steady bearings before start up. Pressure lube cross until lube appears at all four needle bearing seals.

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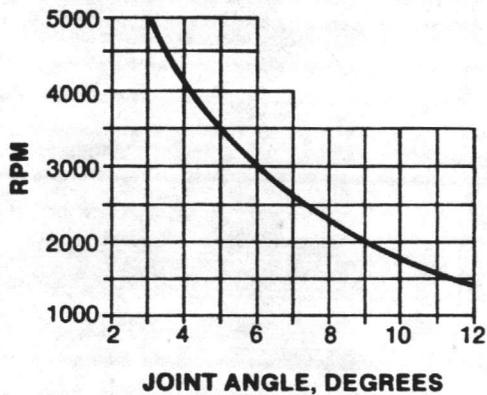




## INSTALLATION INSTRUCTIONS (Cont.)

**TABLE 1**

**MAXIMUM JOINT RPM AND ANGLE COMBINATIONS**



**TABLE 2**

**BOLT SPECIFICATIONS**

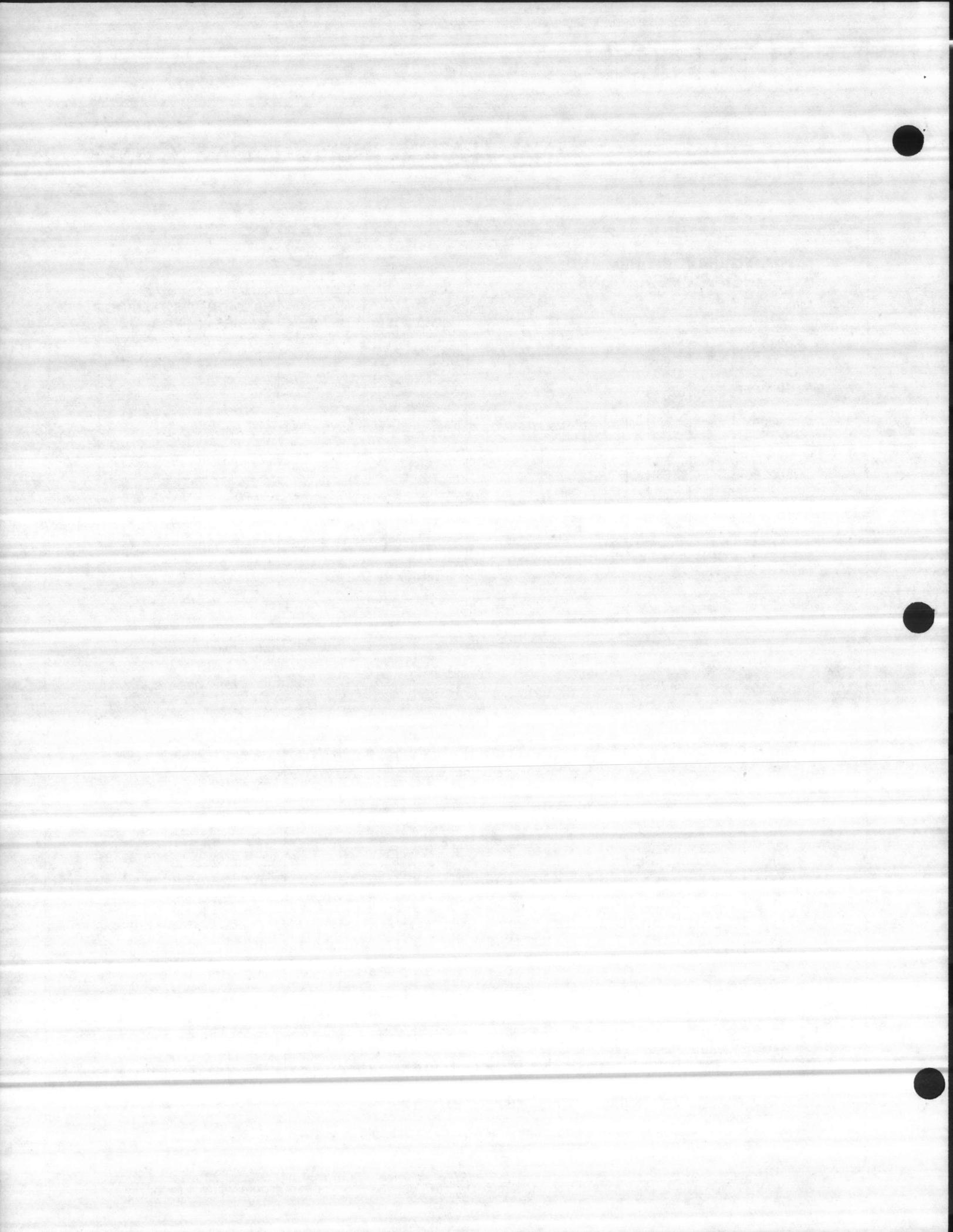
BOLT SIZE	GRADE	USED ON SERIES	TIGHTENING TORQUE	
3/8-24NF x 1 1/4	5	31	30 Lb. Ft.	
3/8-24NF x 1 1/2		61-71		
7/16-20NF x 1 1/4		37-41	45 Lb. Ft.	
7/16-20NF x 1 1/2		81		
1/2-20NF x 1 1/2		48-55		
5/8-18NF x 2	8	88-91	200 Lb. Ft.	
3/4-16NF x 2 1/2		95	340 Lb. Ft.	
7/8-14NF x 3 1/2		205	520 Lb. Ft.	
1-12NF x 4		215		900 Lb. Ft.

**TABLE 3**

HORIZONTAL LENGTH BETWEEN JOINT CENTERS INCHES	DEGREES								
	1	2	3	4	5	6	7	8	9
12	.2	.4	.6	.8	1.0	1.2	1.5	1.7	1.9
24	.4	.8	1.3	1.7	2.1	2.5	2.9	3.3	3.7
36	.6	1.3	1.9	2.5	3.1	3.8	4.4	5.0	5.6
48	.8	1.7	2.5	3.1	4.2	5.0	5.8	6.7	7.5
60	1.0	2.1	3.1	4.2	5.2	6.3	7.3	8.3	9.4
72	1.3	2.5	3.8	5.0	6.3	7.5	8.8	10.0	11.3
84	1.5	2.9	4.4	5.9	7.3	8.8	10.2	11.7	13.1
96	1.7	3.4	5.0	6.7	8.4	10.0	11.7	13.4	15.0
108	1.9	3.8	5.6	7.5	9.4	11.3	13.2	15.0	16.9
120	2.1	4.2	6.3	8.4	10.5	12.5	14.6	16.7	18.8

**OFFSET IN INCHES**

Use this table to determine joint angle or offset



## INSTALLATION INSTRUCTIONS (Cont.)

### TWO SHAFTS

#### EXAMPLE 1

1. Connect B-section to motor.
2. Modify support or shim out to steady bearing so B-section can hang vertical.
3. Connect B-section to support.
4. Connect A-section to B-section and pump.

#### EXAMPLE 2

1. Connect B-section to motor.
2. Connect A-section to B-section and to pump.
3. Set A-section vertical and modify support or shim out to bearing so A-section will remain vertical after B-section is connected to support.
4. Connect B-section to support.

#### EXAMPLE 3

1. Unscrew dust cap and remove splined sleeve yoke from A-section. Rotate yoke 90° and reinstall it. Screw on dust cap.
2. Use fish line and draw taut line from motor shaft to pump shaft.
3. Measure from taut line to support. This distance should equal distance from center to base of steady bearing. Modify support or shim out so drive shafts will be on a common center line.

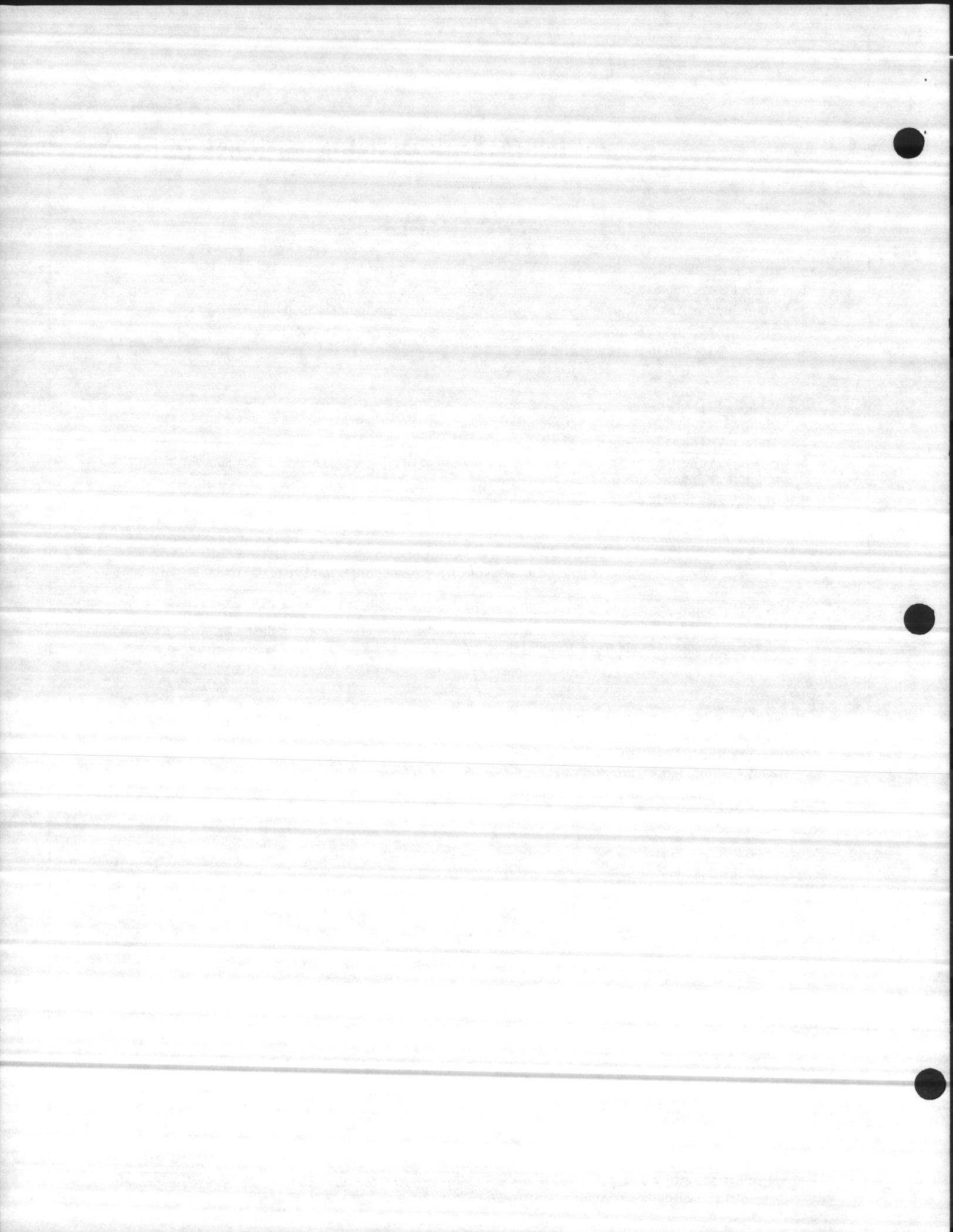
#### EXAMPLE 4

1. Drop plumb bob from center of motor shaft. If plumb bob is not at center of pump shaft, go to Example 1 and continue.
2. Measure from plumb bob string to support. This distance should equal distance from center to base of steady bearing. Modify support or shim out so shafts will hang vertical.
3. Connect B-section to motor and to support.
4. Connect A-section to B-section and to pump.

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**WARNING: Rotating drive shafts can be dangerous. Use shaft guards to help prevent serious injury to personnel**

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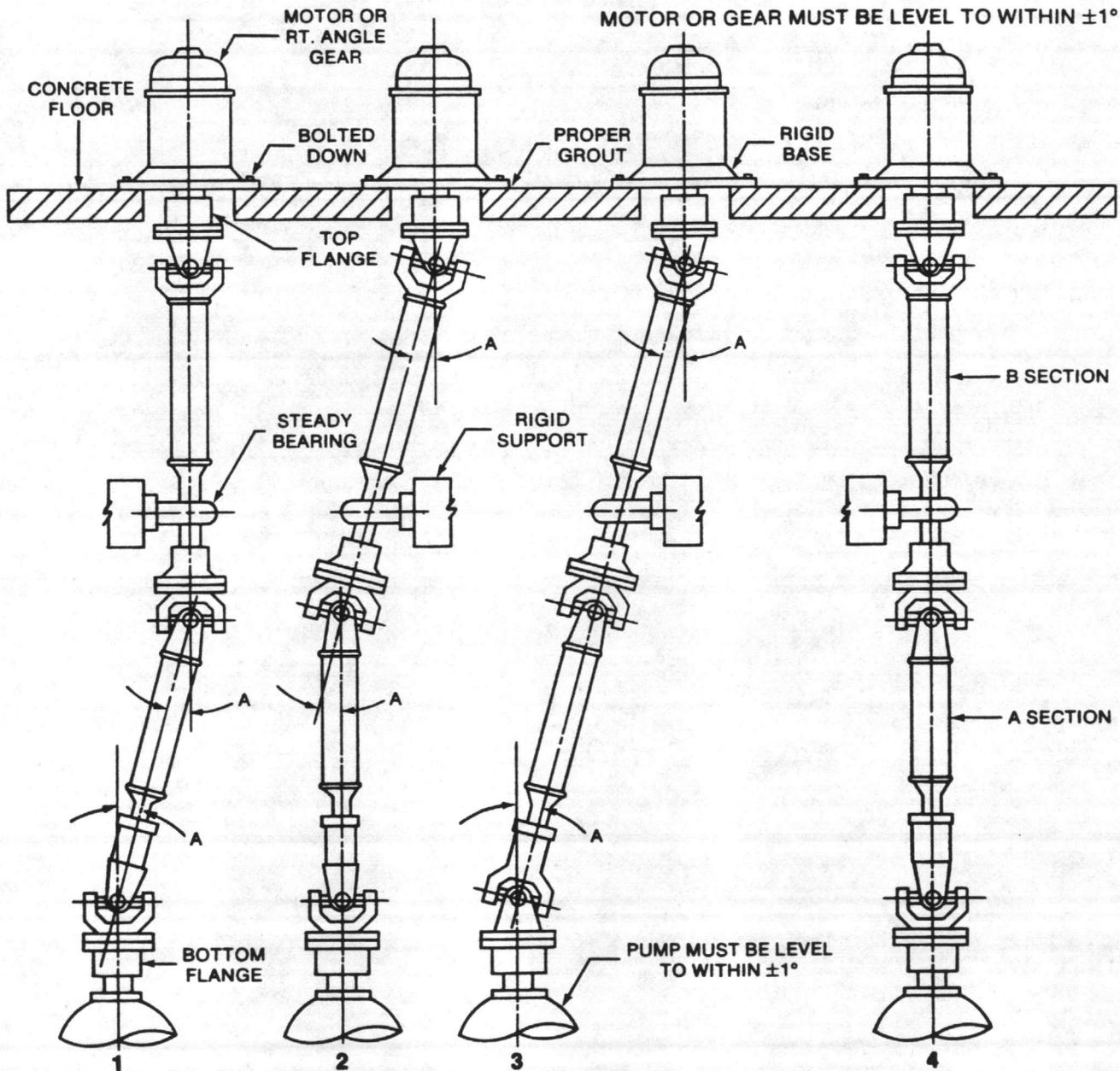




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## INSTALLATION INSTRUCTIONS (Cont.)

### TWO SHAFTS Instructions on following page.



All examples 1, 2, 3, and 4 are acceptable. Turn page 90° for horizontal applications. Driver (motor) and driven member (pump) must be parallel.

Joint angles "A" must be equal to within one degree and yokes are in phase.

Example 2 is preferable if shafts are engine driven. Make angle "A" about 3°. Joint without an angle is furthest from engine.

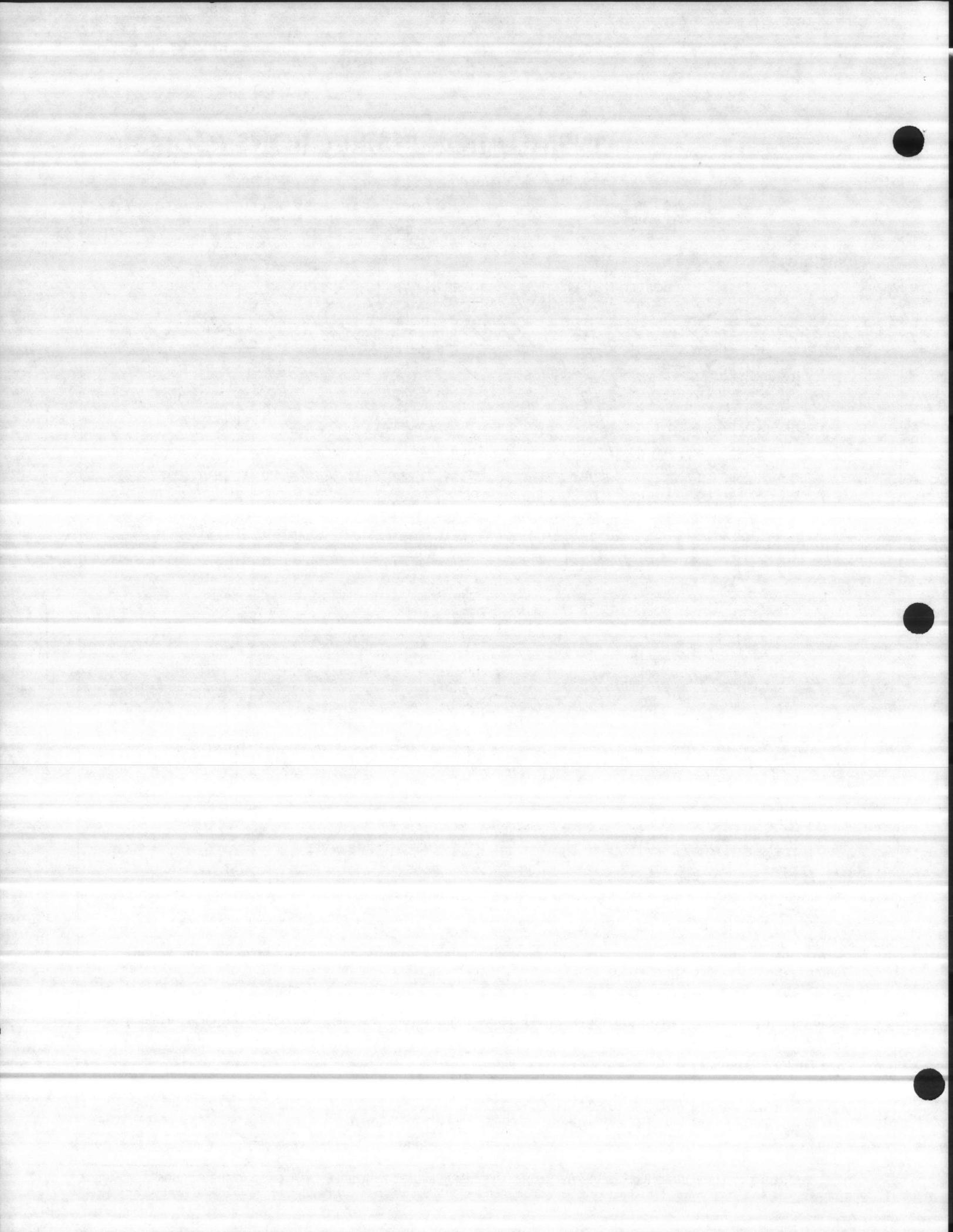
See Tables 1, 2, and 3.

Flange and key must be seated properly on motor and pump shafts. Top flange should have an additional set screw for shaft weights from 150 to 300 lbs. Over 300 lbs. we recommend an interference fit or a split ring retainer or a nut on the output shaft to support the weight of the drive shafts.

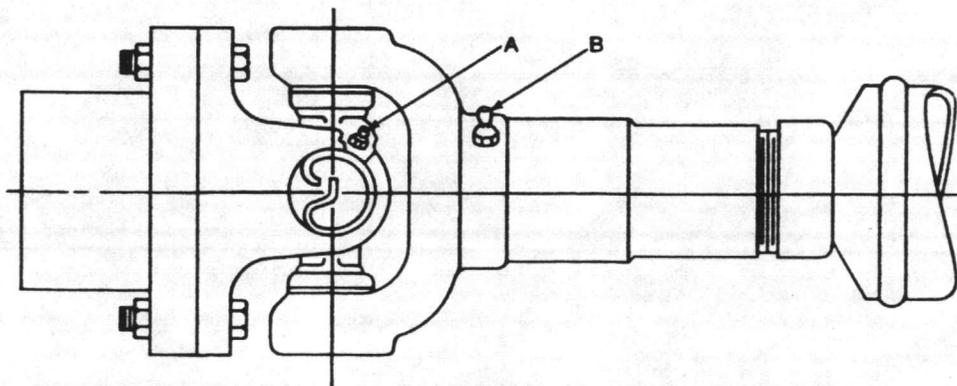
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## SERVICE INSTRUCTIONS



LUBRICATION of Watson Shafts is simple and easy. Two areas, "A" and "B," should be lubricated every 500 hours of normal service or every 200 hours of continuous service as follows:

**AREA "A" — Journal crosses:** Use any good grade E.P. No. 2 Grease such as Shell Alvania E.P. No. 2 or Texaco Marfac H.D.E.P. No. 2. When adding lubricant be certain that it appears at all four bearing seals to assure removal of dirt and contaminants. The bearing seals should relieve lubricant with a "pop" at about 80 PSI.

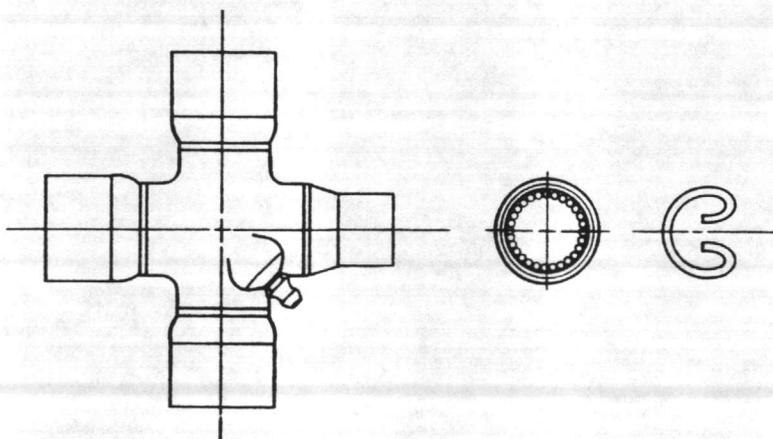
**AREA "B" — Sliding Splines:** Any good grade of long fibre grease is preferred, especially an extreme pressure (E.P.) type. Spline lubricants found to be satisfactory are Texaco Marfac No. 1 E.P., Texaco Marfac "O" E.P., Mobile Grease, Special No. 53-030 and Texaco All Temp. No. 1992.

For operating speeds less than 500 RPM use SAE 140 to 250 viscosity oil.

## BEARING REPLACEMENT

Never disassemble the needle bearings from their yokes unless it is necessary to replace the cross and bearing set. To inspect, remove the shaft and test bearings by moving the flange yoke in all angular positions to roll the needles.

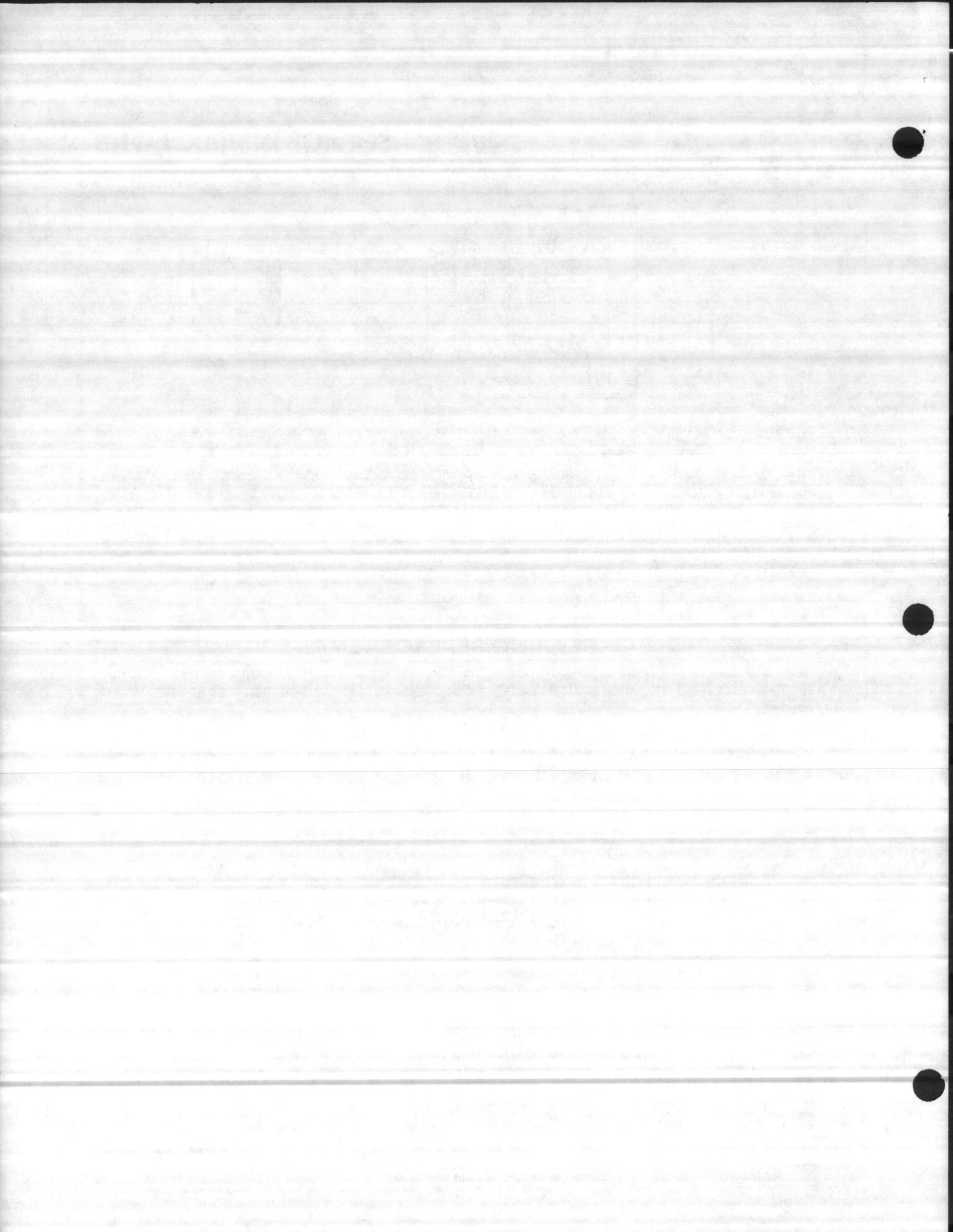
If the action of all four bearings is smooth, replacement is not necessary. If the action is rough or uneven, replace the entire cross and bearing set. See instructions below for both Snap-Ring and Bearing-Cap construction.



## DISASSEMBLY—SNAP-RING TYPE

Tap one end of the bearing lightly to remove pressure on the snap-ring. Remove the snap-ring with pliers; repeat procedure for opposite bearing. Then drive with a soft drift on one bearing to push the opposite bearing through its yoke. Remove the exposed bearing, turn the joint over, and remove the first bearing by driving on the exposed end of the journal cross. Repeat this operation for the other two bearings.

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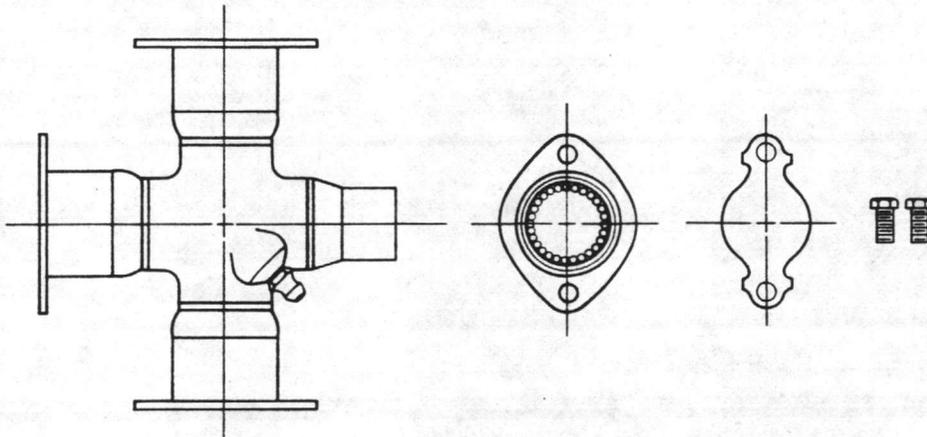


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## SERVICE INSTRUCTIONS (Cont.)

### ASSEMBLY—SNAP-RING TYPE

Remove the bearings from the new cross assembly, holding the cups so that the needles do not fall out. Position the cross in one yoke. Position one bearing cup with its needles in the yoke and insert the journal of the cross into this bearing. Press bearing into yoke. Repeat for opposite bearing. If press is not available, use a vise. NEVER hammer on new bearings. Install snap-rings and repeat operation for other two bearings.



### DISASSEMBLY—BEARING-CAP TYPE

Bend down the tabs on the lock-plates, remove the lock-plate capscrews, and remove the lock-plates. Clamp the flange yoke in a vise with its lugs horizontal. Tap on the top of the joint to start the top bearing out. Pull this bearing. Start the lower bearing by driving on the exposed end of the journal cross. Pull the lower bearing. Then remove from vise, turn 90 degrees, reclamp in vise, and repeat operation for other two bearings.

### ASSEMBLY—BEARING-CAP TYPE

Install the new cross and bearing set, following exactly the same procedure as used with the snap-ring type. Install the lock-plates and capscrews. Bend the tabs of the lock-plates up to lock the capscrews.

## SAFETY AND WARRANTY

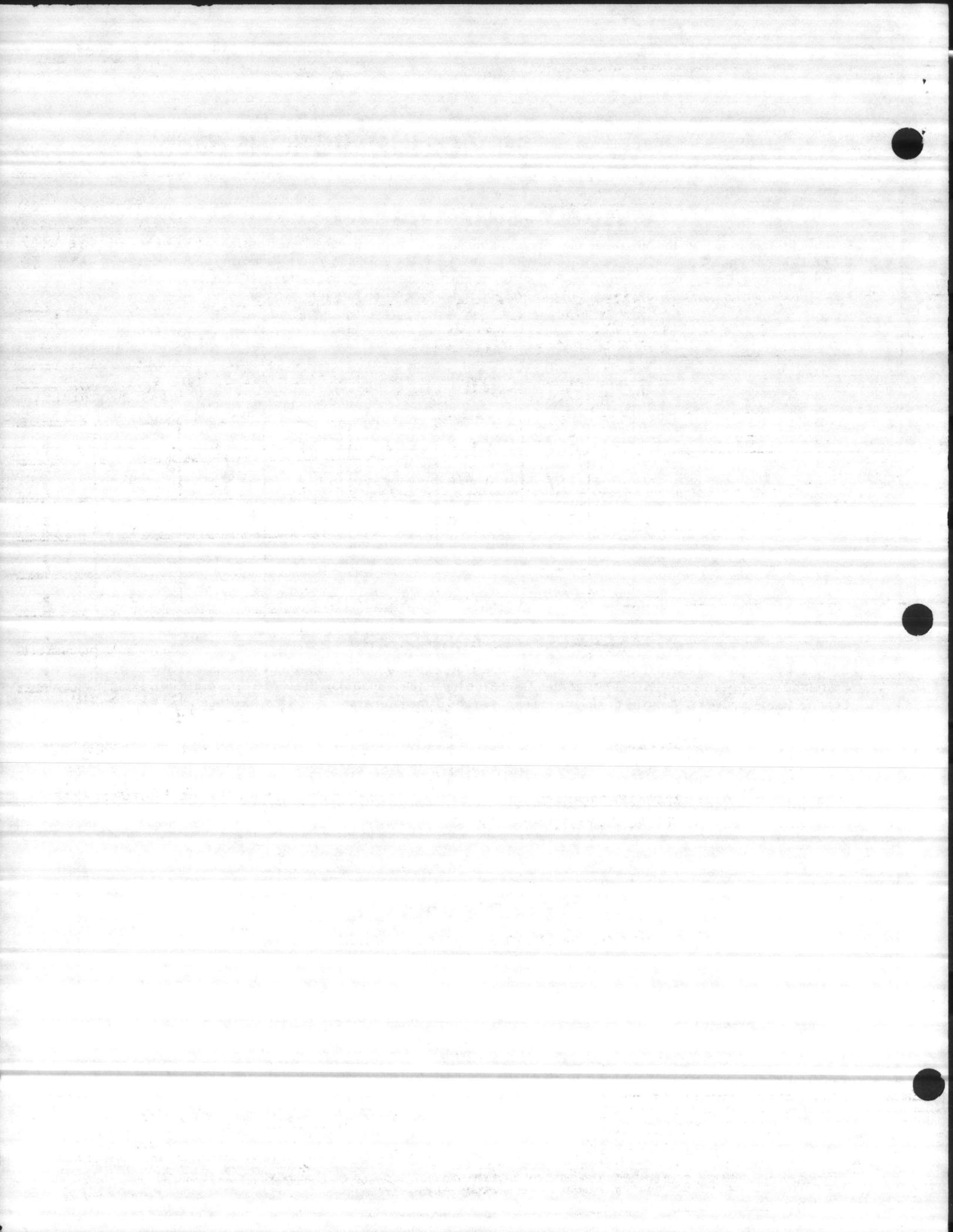
"We recommend the use of shaft guards to help protect personnel from contact with rotating drive shafts.

"H.S. Watson Company agrees to repair or replace without charge, f.o.b. our factory, or at our option allow credit for, any portion of a product which proves to be defective in material or workmanship within a period of 180 days from the date the product is placed in service. Products claimed to be defective must be held for our shipping instructions and no claim will be allowed unless we have had a reasonable opportunity to examine the products. WE MAKE NO WARRANTY AS TO MERCHANTABILITY OR AS TO FITNESS OF PRODUCTS FOR A PARTICULAR PURPOSE OR AS TO THE RESULTS TO BE OBTAINED FROM THEIR USE BY PURCHASER OR OTHERS. We make no warranties, express or implied, statutory or otherwise."

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ENGINEERED PROD. DIV.  
P.O. BOX 2504  
HICKORY, N.C. 28603  
ATTN: R.M. WILKINSON  
CUSTOMER P/O - 35220120

**REFER TO**  
GE REQ# #: 340-21455  
ITEM #: 1  
EDITOR: P. READING

**MARKS**

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MDT REVISION NO: 0 1 2 3 4 5  
SUBMITTED BY: TRUDY G.  
MDT SUBMITTAL DATE: 2/16/84

DATA DESCRIPTION	COPY/REPRO	DATA REV. NO./STATUS							
		STATUS CODE: A - FOR APPROVAL, R - FOR REFERENCE, I - FOR INSTALLATION							
MOTOR DESCRIPTION BELOW	7 /	0 / A	/	/	/	/	/	/	/
GEM 2561E	7 /	0 / A	/	/	/	/	/	/	/
OUTLINE	7 /	0 / A	/	/	/	/	/	/	/
GEH 4214C	7 /	0 / A	/	/	/	/	/	/	/
INSTRUCTION BOOK	7 /	0 / A	/	/	/	/	/	/	/
	/	/	/	/	/	/	/	/	/
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**MOTOR DESCRIPTION:** FL RPM: 1165 SHAFT TYPE: SOLID  
**MOTOR MODEL:** PHASE: 3 COUPLING:  
**TYPE:** K HERTZ: 60 BORE:  
**FRAME:** C284HP10 VOLTS: 200 AMBIENT: 40°C  
**HORSEPOWER:** 15 FLA: 49.3 INSULATION: F  
**ENCLOSURE:** WPI THRUST: NORMAL SERVICE FACTOR: 1.15  
**UP BRG:** BRB210ASRP320 LO BRG: BRB310ASNP300  
**NOTES:** VERTICAL INDUCTION MOTOR

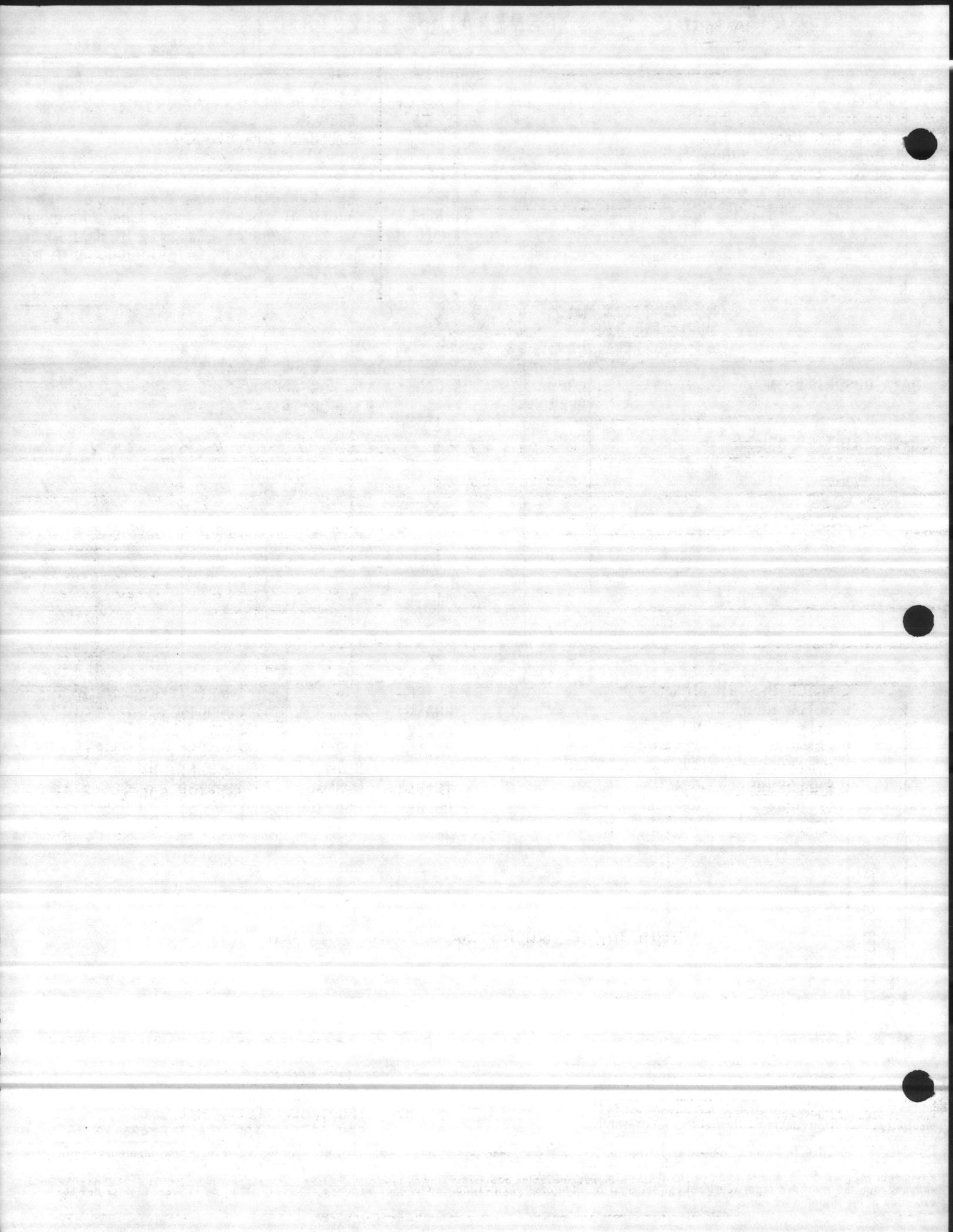
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BY: TRUDY GRESSLEY M/C 956  
SAN JOSE MOTOR PLANT 8\*425-2836

Drawings are intended to be in accordance with applicable purchase order specifications. Comments are solicited concerning any departures in this respect. Features not covered by purchase order specifications portray General Electric Company standard design practice. The shipping date for this equipment is based on obtaining approval by the above specified date, and any delay in approval may extend the shipping schedule. Any requested changes from the purchase order specifications, resulting in additional engineering and/or manufacturing costs, will entail an increase in price and the extension of the shipping schedule.



**INDUCTION MOTORS—INTEGRAL-HP**  
**VERTICAL • SQUIRREL-CAGE**

**TRI CLAD • Solid-Shaft • Weather Protected**  
 (NEMA Type I)

**Normal-thrust • Normal-starting-torque**

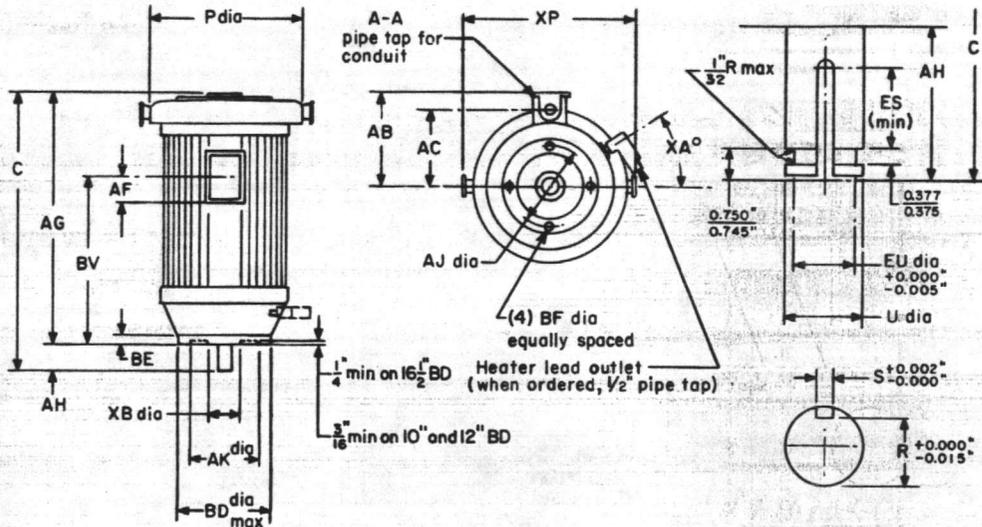
**Type K**  
**Frames L213HP to C404HP (3600 Rpm and Below)**

**NEMA Type P Base**  
**with HP and HPH Shaft**

**GEM-2561E**

Feb. 20, 1978

**DIMENSIONS—For ESTIMATING ONLY unless endorsed for construction.**



Frame No.	Approx Net Wt in Lb	Dimensions in Inches																					
		KEYSEAT			C	P	U	AA	AB	AC	AF	AG	AH †	AJ ‡	AK §	BD	BE	BF	BV	EU	XA°	XB	XP
<b>L213HP10</b>	120	0.986	1/4	1 1/32	18 3/4	13 1/4	1 1/4	1	9 3/4	7 3/4	4	16 1/4	2 3/4	9 1/2	8 1/4	10	3/4	7/16	8 3/4	7/8	55	3 1/2	14 3/4
<b>L215HP10</b>	130	.986	1/4	1 1/32	18 3/4	13 1/4	1 1/4	1	9 3/4	7 3/4	4	16 1/4	2 3/4	9 1/2	8 1/4	10	3/4	7/16	8 3/4	7/8	55	3 1/2	14 3/4
<b>L254HP10</b>	195	.986	1/4	1 1/32	23 3/16	15 1/2	1 1/4	1 1/4	10 3/4	8 3/4	4	20 7/16	2 3/4	9 1/2	8 1/4	10	3/4	7/16	10 3/4	7/8	45	3 1/2	17 1/4
<b>L256HP10</b>	215	.986	1/4	1 1/32	23 3/16	15 1/2	1 1/4	1 1/4	10 3/4	8 3/4	4	20 7/16	2 3/4	9 1/2	8 1/4	10	3/4	7/16	10 3/4	7/8	45	3 1/2	17 1/4
<b>D284HP10</b>	250	.986	1/4	1 1/32	22 3/4	16	1 1/2	1 1/2	11	8 13/16	4	19 3/4	2 3/4	9 1/2	8 1/4	10	3/4	7/16	12 3/4	7/8	33	2 1/2	18
<b>D284HPH16</b>	265	1.416	3/8	3 1/32	24 3/4	16	1 3/4	1 1/2	11	8 13/16	4	19 3/4	4 1/2	14 3/4	13 1/2	16 1/2	3/4	11/16	12 3/4	1 1/4	33	2 1/2	18
<b>C284HP10</b>	270	.986	1/4	1 1/32	23 3/4	16	1 1/2	1 1/2	11	8 13/16	4	20 3/4	2 3/4	9 1/2	8 1/4	10	3/4	7/16	13 1/16	7/8	33	2 1/2	18
<b>C286HP10</b>	270	.986	1/4	1 1/32	23 3/4	16	1 1/2	1 1/2	11	8 13/16	4	20 3/4	2 3/4	9 1/2	8 1/4	10	3/4	7/16	13 1/16	7/8	33	2 1/2	18
<b>K284HPH16</b>	285	1.416	3/8	3 1/32	25 1/4	16	1 1/2	1 1/2	11	8 13/16	4	20 3/4	4 1/2	14 3/4	13 1/2	16 1/2	3/4	11/16	13 1/16	1 1/4	33	2 1/2	18
<b>C286HPH16</b>	285	1.416	3/8	3 1/32	25 1/4	16	1 1/2	1 1/2	11	8 13/16	4	20 3/4	4 1/2	14 3/4	13 1/2	16 1/2	3/4	11/16	13 1/16	1 1/4	33	2 1/2	18
<b>K284HP10</b>	295	.986	1/4	1 1/32	24 3/4	16	1 1/2	1 1/2	11	8 13/16	4	21 3/4	2 3/4	9 1/2	8 1/4	10	3/4	7/16	14 1/16	7/8	33	2 1/2	18
<b>C286HP10</b>	295	.986	1/4	1 1/32	24 3/4	16	1 1/2	1 1/2	11	8 13/16	4	21 3/4	2 3/4	9 1/2	8 1/4	10	3/4	7/16	14 1/16	7/8	33	2 1/2	18
<b>K284HPH16</b>	310	1.416	3/8	3 1/32	26 1/4	16	1 3/4	1 1/2	11	8 13/16	4	21 3/4	4 1/2	14 3/4	13 1/2	16 1/2	3/4	11/16	14 1/16	1 1/4	33	2 1/2	18
<b>C286HPH16</b>	310	1.416	3/8	3 1/32	26 1/4	16	1 3/4	1 1/2	11	8 13/16	4	21 3/4	4 1/2	14 3/4	13 1/2	16 1/2	3/4	11/16	14 1/16	1 1/4	33	2 1/2	18
<b>D286HP10</b>	320	.986	1/4	1 1/32	25 3/4	16	1 1/2	1 1/2	11	8 13/16	4	22 3/4	2 3/4	9 1/2	8 1/4	10	3/4	7/16	15 1/16	7/8	33	2 1/2	18
<b>D286HPH16</b>	335	1.416	3/8	3 1/32	27 1/4	16	1 1/2	1 1/2	11	8 13/16	4	22 3/4	4 1/2	14 3/4	13 1/2	16 1/2	3/4	11/16	15 1/16	1 1/4	33	2 1/2	18
<b>C324HP16</b>	360	1.416	3/8	3 1/32	28 3/4	16	1 3/4	2	12 1/4	9 3/4	4 3/8	23 3/4	4 1/2	14 3/4	13 1/2	16 1/2	3/4	11/16	17 1/16	1 1/4	33	2 1/2	18
<b>C326HP16</b>	415	1.416	3/8	3 1/32	30 3/4	16	1 3/4	2	12 1/4	9 3/4	4 3/8	26 1/4	4 1/2	14 3/4	13 1/2	16 1/2	3/4	11/16	19 3/4	1 1/4	33	2 1/2	18
<b>D324HP16</b>	375	1.416	3/8	3 1/32	29 1/4	20	1 3/4	2	13 1/2	10 11/16	4 3/8	24 3/4	4 1/2	14 3/4	13 1/2	16 1/2	3/4	11/16	17 1/16	1 1/4	22 1/2	3 1/2	22 3/4
<b>K326HP16</b>	375	1.416	3/8	3 1/32	29 1/4	20	1 3/4	2	13 1/2	10 11/16	4 3/8	24 3/4	4 1/2	14 3/4	13 1/2	16 1/2	3/4	11/16	17 1/16	1 1/4	22 1/2	3 1/2	22 3/4
<b>K324HP16</b>	425	1.416	3/8	3 1/32	30 3/4	20	1 3/4	2	13 1/2	10 11/16	4 3/8	25 3/4	4 1/2	14 3/4	13 1/2	16 1/2	3/4	11/16	18 1/16	1 1/4	22 1/2	3 1/2	22 3/4
<b>D326HP16</b>	425	1.416	3/8	3 1/32	30 3/4	20	1 3/4	2	13 1/2	10 11/16	4 3/8	25 3/4	4 1/2	14 3/4	13 1/2	16 1/2	3/4	11/16	18 1/16	1 1/4	22 1/2	3 1/2	22 3/4
<b>D364HP16</b>	425	1.416	3/8	3 1/32	30 3/4	20	1 3/4	3	14 11/16	11 3/16	6 3/16	25 3/4	4 1/2	14 3/4	13 1/2	16 1/2	3/4	11/16	18 1/16	1 1/4	22 1/2	3 1/2	22 3/4
<b>C364HP16</b>	475	1.416	3/8	3 1/32	31 1/4	20	1 3/4	3	14 11/16	11 3/16	6 3/16	27	4 1/2	14 3/4	13 1/2	16 1/2	3/4	11/16	19 3/4	1 1/4	22 1/2	3 1/2	22 3/4
<b>K364HP16</b>	525	1.416	3/8	3 1/32	32 3/4	20	1 3/4	3	14 11/16	11 3/16	6 3/16	28 1/4	4 1/2	14 3/4	13 1/2	16 1/2	3/4	11/16	20 3/4	1 1/4	22 1/2	3 1/2	22 3/4
<b>D365HP16</b>	525	1.416	3/8	3 1/32	32 3/4	20	1 3/4	3	14 11/16	11 3/16	6 3/16	28 1/4	4 1/2	14 3/4	13 1/2	16 1/2	3/4	11/16	20 3/4	1 1/4	22 1/2	3 1/2	22 3/4
<b>D365HP16</b>	625	1.416	3/8	3 1/32	34 3/4	20	1 3/4	3	14 11/16	11 3/16	6 3/16	30 3/4	4 1/2	14 3/4	13 1/2	16 1/2	3/4	11/16	22 3/4	1 1/4	22 1/2	3 1/2	22 3/4
<b>C404HP16</b>	625	1.416	3/8	3 1/32	34 3/4	20	1 3/4	3	14 11/16	11 3/16	6 3/16	30 3/4	4 1/2	14 3/4	13 1/2	16 1/2	3/4	11/16	22 3/4	1 1/4	22 1/2	3 1/2	22 3/4
<b>C404HPH16</b>	625	1.845	1/2	3 1/32	34 3/4	20	2 1/4	3	14 11/16	11 3/16	6 3/16	30 3/4	4 1/2	14 3/4	13 1/2	16 1/2	3/4	11/16	22 3/4	1 3/4	22 1/2	3 1/2	22 3/4

THE FRAME NUMBERS SHOWN IN BOLD-FACE TYPE INDICATE STANDARD NEMA BASE SIZES.

† Tolerance for AH for Frames L213 through D365 is ±0.031; for Frames C404, it is ±0.062. Dimension measured with motor in vertical position, shaft down.

‡ AJ centerline of bolt hole within 0.025 inch for all frames of true location. True location is defined as angular and diametrical location with reference to centerline of AK.

§ AK diameters of 8 1/4 inches will come within the limits of +0.003 inch, -0.000 inch; diameters of 13 1/2 inches will come within the limits of +0.005 inch, -0.000 inch.

△ Shaft diameters 1 5/8 inches and smaller will come within the limits of +0.0000 inch, -0.0005 inch; diameters above 1 5/8 inch, +0.000 inch, -0.001 inch.

Provided mounting conditions permit, diagonally split conduit box may be turned so that entrance can be made from the bottom, or either side.

Tolerances: Face runout and permissible eccentricity of mounting rabbet—

For "AK" dimension 8 1/4 inches, 0.004 TIR.

For "AK" dimension 13 1/2 inches, 0.006 TIR.

Permissible shaft runout, 0.002 TIR.

For shipping weight add 5 percent to the net weight.

# INDUCTION MOTORS—INTEGRAL-HP

VERTICAL • SQUIRREL-CAGE

## TRI/CLAD • Solid-Shaft • Weather Protected

(NEMA Type J)

Normal-thrust • Normal-starting-torque

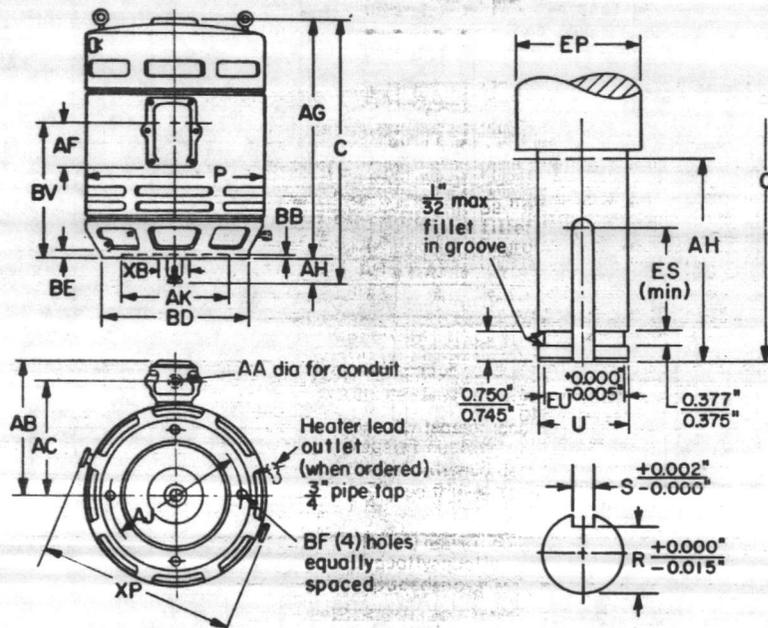
Type K  
Frames B405HP to B445HP (3600 Rpm and Below)

NEMA Type P Base  
with HP and HPH Shaft

# GEM-2561E

Feb. 20, 1978

**DIMENSIONS—For ESTIMATING ONLY unless endorsed for construction.**



Frame No.	Approx Net Wt in Lb	Dimensions in Inches																				Max U Dia			
		KEYSEAT			C	P	U Δ	AA	AB	AC	AF	AG	AH §	AJ	AK †	BB	BD	BE	BF	BV	EP Min		EU	XB	XP
		R	S	ES																					
<b>B405HP16</b>	855	1.416	3/8	3 1/32	34 3/8	18 7/16	1 3/8	3	15 3/8	12 1/2	6 1/2	30 3/8	4 1/2	14 3/4	13 1/2	1/4	16 1/2	3/8	1 1/16	19 1/2	2 1/4	1 3/4	4 1/2	20 1/2	2 1/4
<b>B405HPH16</b>	855	1.845	1/2	3 1/32	34 3/8	18 7/16	2 1/8	3	15 3/8	12 1/2	6 1/2	30 3/8	4 1/2	14 3/4	13 1/2	1/4	16 1/2	3/8	1 1/16	19 1/2	2 1/4	1 3/4	4 1/2	20 1/2	2 1/4
<b>B405HP20</b>	855	1.416	3/8	3 1/32	34 3/8	18 7/16	1 3/8	3	15 3/8	12 1/2	6 1/2	30 3/8	4 1/2	14 3/4	13 1/2	1/4	20	3/8	1 1/16	19 1/2	2 1/4	1 3/4	4 1/2	20 1/2	2 1/4
<b>B444HP16</b>	1060	1.845	1/2	3 1/32	40 3/16	20 3/8	2 1/8	3	16 13/16	13 3/16	6 1/2	35 19/16	4 1/2	14 3/4	13 1/2	1/4	16 1/2	1 1/8	1 1/16	23 1/4	2 1/4	1 3/4	4 1/2	22	2 1/4
<b>B444HP20</b>	1060	1.845	1/2	3 1/32	40 3/16	20 3/8	2 1/8	3	16 13/16	13 3/16	6 1/2	35 19/16	4 1/2	14 3/4	13 1/2	1/4	20	1 1/8	1 1/16	23 1/4	2 1/4	1 3/4	4 1/2	22	2 1/4
<b>B445HP16</b>	1210	1.845	1/2	3 1/32	40 3/16	20 3/8	2 1/8	3	16 13/16	13 3/16	6 1/2	35 19/16	4 1/2	14 3/4	13 1/2	1/4	16 1/2	1 1/8	1 1/16	23 1/4	2 1/4	1 3/4	4 1/2	22	2 1/4
<b>B445HP20</b>	1210	1.845	1/2	3 1/32	40 3/16	20 3/8	2 1/8	3	16 13/16	13 3/16	6 1/2	35 19/16	4 1/2	14 3/4	13 1/2	1/4	20	1 1/8	1 1/16	23 1/4	2 1/4	1 3/4	4 1/2	22	2 1/4

THE FRAME NUMBERS SHOWN IN BOLD-FACE TYPE INDICATE STANDARD NEMA BASE SIZES.

† AK diameters of 13 1/2 inches will come within the limits of +0.005 inch, -0.000 inch.

§ Tolerance for AH is ±0.062 inch.

Δ Shaft diameters 1 5/8 inches and smaller will come within the limits of +0.0000 inch, -0.0005 inch; diameters above 1 5/8 inch +0.000 inch, -0.001 inch.

Both upper guide bearing and lower thrust bearings are grease lubricated.

Provided mounting conditions permit, conduit box may be turned so that entrance can be made upward, downward, or from either side.

For shipping weight add 5 percent to the net weight.

Prints are:

For Approval



Prints are:

Approved for Construction



Customer PUMP & LGT. CO.

35220120

Frame C284HP10

Customer's Order No.

Frame

Our Req. No. 340-21455

Item 1

Approved by T. GRESSLEY

GENERAL ELECTRIC COMPANY • SMALL AC MOTOR DEPARTMENT • NASHVILLE MOTOR PLANT • HENDERSONVILLE, TENN. 37075 • SAN JOSE MOTOR PLANT • SAN JOSE, CALIF. 95112

**INSTALLATION,  
OPERATION AND  
MAINTENANCE  
INSTRUCTIONS**

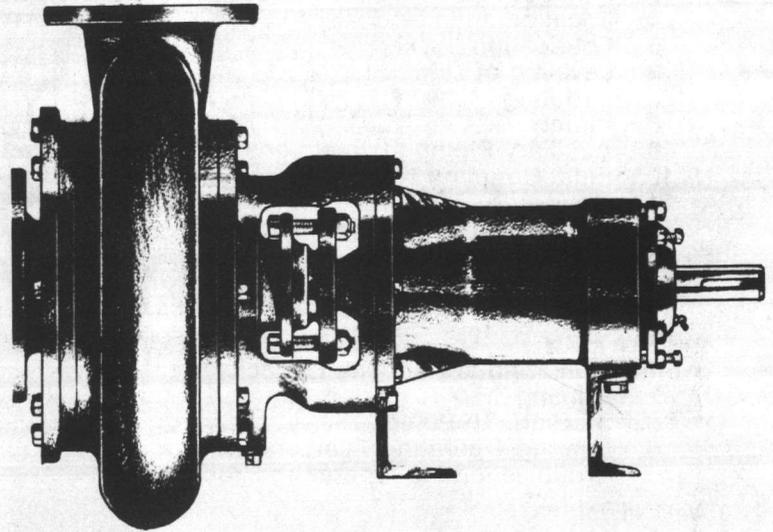
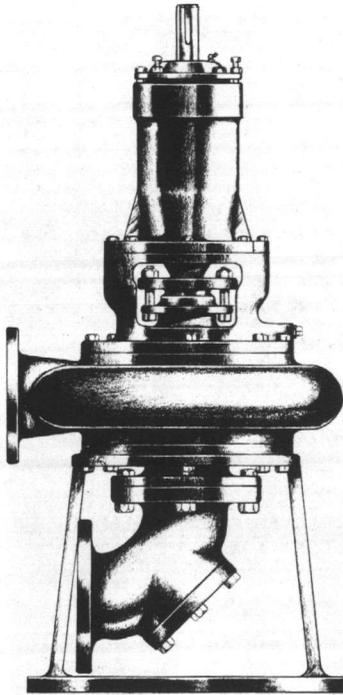
# 5400

**NON-CLOG PUMPS**

5410 VERTICAL

5420 HORIZONTAL

5440 VERTICAL CLOSE-COUPLED



**Colt Industries**



# Fairbanks Morse

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**Congratulations!** You are the owner of one of the finest pumps commercially available. If you give it the proper care as outlined and recommended by this manual, it will provide you with reliable service and long life ...

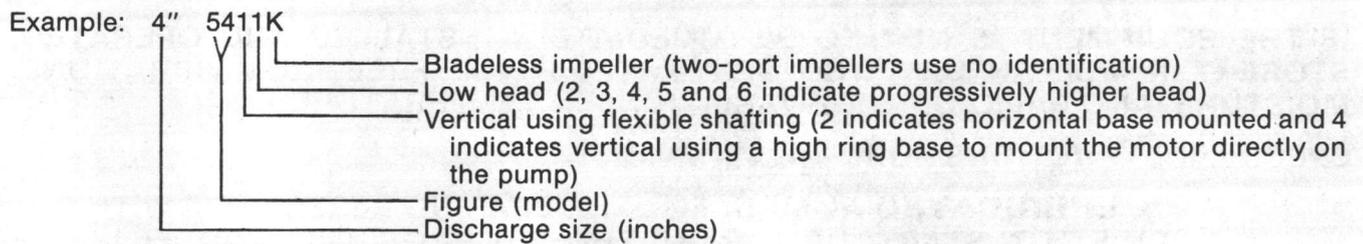
**5400 NON-CLOG PUMPS**

Your Fairbanks Morse 5400 is a rugged non-clog pump, available with two-port or optional bladeless impeller to allow the passage of large solids and stringy material. It is therefore ideally suited for applications such as sewage treatment plants, industrial wastewater handling, lift stations and food processing. Standard construction is cast iron with packed shaft seal box. A variety of materials and mechanical seals are available as standard options. Additional models are available from Fairbanks Morse in self priming, biltogether and submersible pull-up designs.

This manual applies to:

- 541X Vertical pumps — using a driver independently mounted from the pump and flexible shafting
- 542X Horizontal pumps — mounted on a common baseplate with the driver
- 544X Vertical close coupled pumps — using a high ring base between the pump and driver

**PUMP IDENTIFICATION**



Carefully record all of the following data from your pump nameplate. It will aid in obtaining the correct replacement parts for your pump.

**PUMP**

FIGURE: _____, SERIAL NUMBER: _____ IMPELLER DIAMETER: _____, SIZE: _____ CAPACITY: _____ GPM, TOTAL HEAD: _____ FT., RPM: _____
--

**DRIVER**

H.P.: _____ SERIAL NUMBER: _____ FRAME: _____ SPEED: _____ VOLTAGE: _____
--

To obtain additional data on hydraulics and pump selection and operation, we suggest you obtain both of the following reference books:

1. Fairbanks Morse "Hydraulic Handbook," available from the factory.
2. Hydraulic Institute Standards

Hydraulic Institute  
 1230 Keith Building  
 Cleveland, Ohio 44115

## STORAGE OF PUMPS AND CAUTION NOTES

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THESE INSTRUCTIONS APPLY TO THE PUMP ONLY. THEY ARE INTENDED TO BE GENERAL AND NOT SPECIFIC. IF YOUR OPERATING CONDITIONS EVER CHANGE, ALWAYS REFER TO THE FACTORY FOR REAPPLICATION. ALWAYS REFER TO THE MANUALS PROVIDED BY MANUFACTURERS OF THE OTHER EQUIPMENT FOR THEIR SEPARATE INSTRUCTIONS.

### CAUTION IMPORTANT SAFETY NOTICE

THE INSTALLATION, USE AND OPERATION OF THIS TYPE OF EQUIPMENT IS AFFECTED BY VARIOUS FEDERAL, STATE AND LOCAL LAWS AND THE REGULATIONS CONCERNING OSHA. COMPLIANCE WITH SUCH LAWS RELATING TO THE PROPER INSTALLATION AND SAFE OPERATION OF THIS TYPE OF EQUIPMENT IS THE RESPONSIBILITY OF THE EQUIPMENT OWNER AND ALL NECESSARY STEPS SHOULD BE TAKEN BY THE OWNER TO ASSURE COMPLIANCE WITH SUCH LAWS BEFORE OPERATING THE EQUIPMENT.

### STORAGE OF PUMPS

IF THE EQUIPMENT IS NOT TO BE IMMEDIATELY INSTALLED AND OPERATED, STORE IT IN A CLEAN, DRY, WELL VENTILATED PLACE, FREE FROM VIBRATIONS, MOISTURE, AND RAPID OR WIDE VARIATIONS IN TEMPERATURE.

SPECIAL INSTRUCTIONS FOR:

**OIL LUBRICATED PUMPS:** FILL THE BEARING RESERVOIRS WITH OIL. PRIOR TO START UP, DRAIN THE STORAGE OIL AND FILL THE RESERVOIRS TO THE PROPER LEVEL WITH NEW OIL.

**GREASE LUBRICATED PUMPS:** ROTATE THE SHAFT FOR SEVERAL REVOLUTIONS AT LEAST ONCE EVERY TWO WEEKS TO:

1. COAT THE BEARING WITH LUBRICANT,
2. RETARD OXIDATION OR CORROSION AND,
3. PREVENT POSSIBLE FALSE BRINELLING.

**MECHANICAL SEAL PUMPS:** POUR AT LEAST 4 OZS. OF MINERAL OIL INTO THE SEAL HOUSING AND DRAIN THE OIL JUST PRIOR TO START UP.

CONSIDER A UNIT IN STORAGE WHEN:

1. IT HAS BEEN DELIVERED TO THE JOBSITE AND IS AWAITING INSTALLATION.
2. IT HAS BEEN INSTALLED BUT OPERATION IS DELAYED PENDING COMPLETION OF CONSTRUCTION.
3. THERE ARE LONG (30 DAYS OR MORE) PERIODS BETWEEN OPERATION CYCLES.
4. THE PLANT (OR DEPARTMENT) IS SHUT DOWN FOR PERIODS OF LONGER THAN 30 DAYS.

**NOTE:** STORAGE REQUIREMENTS VARY DEPENDING ON THE LENGTH OF STORAGE, THE CLIMACTIC ENVIRONMENT AND THE EQUIPMENT. FOR STORAGE PERIODS OF THREE MONTHS OR LONGER, CONTACT THE MANUFACTURER FOR SPECIFIC INSTRUCTIONS. IMPROPER STORAGE COULD DAMAGE THE EQUIPMENT WHICH WOULD RESULT IN NON-WARRANTY COVERED RESTORATION REQUIREMENTS OR NON-WARRANTY COVERED PRODUCT FAILURES.

**STANDARD WARRANTY:** Seller warrants products of its own manufacture against defects in materials and workmanship under normal use, and service for one (1) year from date of installation or startup, but not more than eighteen (18) months after date of shipment. Accessories and components not manufactured by Seller are warranted only to the extent of the original manufacturer's warranty. Notice of the alleged defect must be given to Seller in writing with all identifying details including serial number, type of equipment and date of purchase within thirty (30) days of the discovery of same during the warranty period. Seller's sole obligation on this warranty shall be, at its operation, to repair or replace or refund the purchase price of any product or part thereof which proves to be defective as alleged. No allowances will be made for repairs or alterations effected without specific written authorization from Seller.

If requested by Seller, such product or part thereof must be promptly returned to the manufacturer prior to any attempted repair; or sent to an authorized service station designated by the manufacturer. All shipping expenses are to be prepaid by the buyer. Seller accepts no responsibility for loss or damage in transit of goods, nor will any warranty claim be considered unless the returned goods are received intact and undamaged as a result of shipment. Repaired or replaced material returned to customer will be shipped F.O.B. the manufacturer's factory.

Seller warrants repaired or replaced parts of its own manufacture against defects in materials and workmanship under normal use and service for ninety (90) days or for the remainder of the warranty on the product being repaired. This warranty applies to the repaired or replaced part and is not extended to the product or any other component of the product being repaired.

Under the terms of this warranty, Seller shall not be responsible nor liable for:

- a. Consequential, collateral or special losses or damages.
- b. Equipment conditions caused by fair wear and tear, abnormal conditions of use, accident, neglect, or misuse of said equipment.
- c. Labor charges, loss or damage resulting from the supplying of defective part(s) or improper repairs by unauthorized person(s).
- d. Damage caused by abrasive materials, chemicals, scale deposits, corrosion, lightning, improper voltage or mishandling.

Seller reserves the right to substitute new equipment and/or improve the part(s) on any equipment judged defective without further liability. All repairs and/or services performed by Seller, not adjusted as covered by this warranty, will be charged in accordance with the current equipment and service prices.

This warranty is VOID unless the purchaser provides protective storage, installs and maintains the equipment in accordance with published instructions.

Credit will NOT be allowed nor shipment accepted on any part(s) or equipment returned unless prior approval in writing has been obtained.

**THIS WARRANTY IS THE SOLE WARRANTY OF SELLER AND ANY OTHER WARRANTIES EXPRESS, IMPLIED IN LAW OR IMPLIED IN FACT, INCLUDING ANY WARRANTIES OR MERCHANTABILITY AND FITNESS FOR USE, ARE HEREBY SPECIFICALLY EXCLUDED.**

No employee of the Seller and no agent, dealer or distributor has any authority to change or enlarge the terms of this warranty to obligate the Seller to other than strictly the terms of this written warranty.

**LIABILITY LIMITATIONS:** Under no circumstances shall the Seller have any liability for liquidated damages or for collateral, consequential or special damages or for loss of profits, or for actual losses or for loss of production or progress of construction, whether resulting from delays in delivery or performance, breach of warranty, negligent manufacture or otherwise. The aggregate total liability of Seller in connection with the performance of this order, whether for breach of contract or warranty, negligence, or otherwise shall in no event exceed the contract price. Buyer agrees to indemnify and hold harmless Seller from all claims by third parties in excess of these limitations.

Since the compliance with the various Federal, State and Local laws and regulations concerning occupational health and safety and pollution are affected by the use, installation and operation of the equipment and other matters over which the Seller has no control, the Seller assumes no responsibility for compliance with those laws and regulations, whether by way of indemnity, warranty or otherwise.

## INTRODUCTION

This manual contains descriptions and instructions which are the result of carefully conducted engineering and research efforts. It is designed to supply adequate instructions for the safe and efficient installation, operation and maintenance of your pump. Failure or neglect to properly install, operate or maintain your pump may result in personal injury, property damage or unnecessary damage to the pump.

Variations exist in both the equipment used with these pumps and in the particular installation of the pump and driver. Therefore, specific operating instructions are not within the scope of this manual. The manual contains general rules for installation, operation and maintenance of the pump.

Observe all caution or danger tags attached to the equipment or included in this manual.

## INSTALLATION

### 1. GENERAL

**CAUTION: CAREFULLY READ ALL SECTIONS OF THIS MANUAL AND ALL OTHER INSTRUCTION MANUALS PROVIDED BY MANUFACTURERS OF OTHER EQUIPMENT SUPPLIED WITH THIS PUMP.**

Upon receipt of the shipment, unpack and inspect the pump and driver assemblies and individual parts to insure none are missing or damaged. Carefully inspect all boxes and packing material for loose parts before discarding them. Report immediately to the factory, and to the transportation company involved, any missing parts or damage incurred during shipment, and file your "damaged and/or lost in shipment" claim with the carrier.

Horizontal pump and driver assemblies mounted on a structural steel base are aligned at the factory. However, alignment may be disturbed in transit or during installation. It must be checked after the unit is leveled on the foundation, after the grouting has set and the foundation bolts are tightened, and after piping is completed.

Tapped mounting blocks are furnished with horizontal pumps when the driver is to be field mounted. After the alignment of the driver is completed, the mounting blocks must be welded to the base and the alignment rechecked.

When the pump and driver are mounted on separate base structures, the pump should be leveled and aligned first, and then the driver leveled and lined up with the pump. With separate bases, a flexible shaft between pump and driver must be used. (See the "flexible shafting alignment" section of this manual for specific instructions.)

The installation of a vertical pump is essentially the same as for the horizontal configuration. Foundation, piping and alignment adjustments are accomplished using the same basic techniques.

### 2. NET POSITIVE SUCTION HEAD (NPSH)

NPSH can be defined as the head (energy) that causes liquid to flow through the suction pipe and enter the eye of the impeller.

NPSH is expressed in two values: (1) NPSH required (NPSHR) and, (2) NPSH available (NPSHA). It is essential that NPSHA always be greater than NPSHR to prevent cavitation, vibration, wear and unstable operation.

**NPSHR** is a function of the pump design and therefore varies with the make, size, capacity and speed of the pump. The value for your pump can be obtained from your pump performance curve or the factory.

**NPSHA** is a function of your system and may be calculated as follows:

A. When the source of liquid is above the pump:

$$\text{NPSHA} = \text{barometric pressure (feet)} + \text{static suction head (feet)} - \text{friction losses in suction piping (feet)} - \text{vapor pressure of liquid (feet)}$$

B. When the source of liquid is below the pump:

$$\text{NPSHA} = \text{barometric pressure (feet)} - \text{static suction lift (feet)} - \text{friction losses in suction piping (feet)} - \text{vapor pressure of liquid (feet)}$$

**3. MINIMUM SUBMERGENCE OF SUCTION PIPE AND PIT DESIGN**

Generally, it is required that an evenly distributed flow of non-aerated water be supplied to the suction bell. Improper pit design or insufficient suction pipe submergence can result in intake vortexing which reduces the pump's performance and can result in severe damage to the pump.

We recommend that you secure the advice of a qualified Consulting Engineer for the analysis and design of the suction pit. Significant engineering data on pit design is provided in the Hydraulic Institute Standards.

Upon request, Fairbanks Morse will review plans and give general comments on the installation, but will not approve such plans for a specific installation and will accept no responsibility or liability for the performance of the pump intake structure.

**4. LOCATION AND HANDLING**

The pump should be installed as near the fluid as possible so a short direct suction pipe can be used to keep suction losses at a minimum. If possible, locate the pump so the fluid will flow to the suction opening by gravity. The discharge piping should be direct and with as few elbows and fittings as possible. The total net positive suction head available (NPSHA), which includes the suction lift and pipe friction losses, must be equal to or greater than the net positive suction head required (NPSHR) by the pump.

The pump and driver should be located in an area that will permit periodic inspection and maintenance. Head room and access should be provided and all units should be installed in a dry location with adequate drainage.

**WARNING: DO NOT PICK UP THE COMPLETE UNIT BY THE DRIVER OR PUMP SHAFTS OR EYE BOLTS.**

To lift a horizontal mounted unit, a chain or suitable lifting device should be attached to each corner of the base structure. Vertical mounted units may be lifted by using a sling through the motor high ring base, or by the eye bolts when provided in the pump casing. The individual driver may be lifted using the proper eye bolts provided by the manufacturer, but these should not be used to lift the assembled unit.

**5. FOUNDATION**

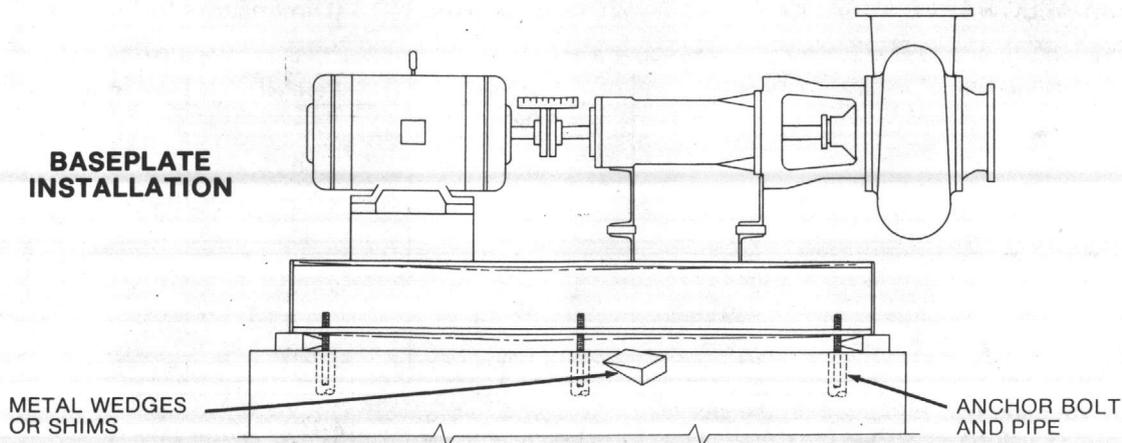
The foundation should have a level surface and be of sufficient mass to prevent vibration and form a permanent rigid support for the unit. The most satisfactory foundations are concrete with anchor bolts of adequate size imbedded in the foundation in pipe sleeves with an inside diameter 2½ times larger than the bolt diameter. This will allow for final accurate positioning of the unit.

**6. LEVELING OF THE UNIT**

Lower the unit onto the foundation, positioning the base structure or vertical pump base so the anchor bolts are aligned in the middle of the holes in the base. On all units, horizontal or vertical, always disconnect the coupling halves and never reconnect them until all the alignment operations are complete.

The base should be supported on metal shims or metal wedges placed directly under the part of the base carrying the greatest weight, and spaced close enough to give uniform support and stability.

Adjust the metal supports or wedges until the shaft of the pump and driver are level or vertical as appropriate. Alignment corrections can be accomplished by adjusting the supports under the base. When proper alignment is obtained, tighten the foundation bolts snugly, but not too firmly, and recheck the alignment before grouting.



**7. GROUTING**

When the alignment is correct, the unit should be grouted using a high grade nonshrinking grout. The entire base should be filled with grout. Be sure to fill all gaps and voids. **Allow the grout to fully cure before firmly tightening the foundation bolts. Then recheck the alignment before connecting the piping.**

**8. PIPING**

**CAUTION: ALL PIPING CONNECTIONS MUST BE MADE WITH THE PIPE IN A FREE SUPPORTED STATE, AND WITHOUT THE NEED TO APPLY VERTICAL OR SIDE PRESSURE TO OBTAIN ALIGNMENT OF THE PIPING WITH THE PUMP FLANGE.**

**CAUTION: AFTER ALL THE PIPING IS CONNECTED, THE PUMP AND DRIVER ALIGNMENT MUST BE RECHECKED.**

All piping should be independently supported near the pump so that pipe strain will not be transmitted to the pump casing. The suction and discharge piping should be one or two sizes larger than the pump flange sizes, especially where the piping is of considerable length. Any flexible joints installed in the piping must be equipped with tension rods to absorb piping axial thrust.

The suction pipe must be air tight and sloped upward to the pump flange to avoid air pockets which will impair satisfactory pump operation. The discharge pipe should be as direct as possible with a minimum of valves to reduce pipe friction losses.

A check valve and closing valve should be installed in the discharge line and a closing valve in the suction line. The check valve, between the pump and closing valve, protects the pump from water hammer and prevents reverse rotation in the event of power failure. The closing valves are used in priming, starting and when the pump is shut down. The pump must never be throttled by the use of a valve in the suction line.

**9. AUXILIARY PIPING CONNECTIONS AND GAUGES**

In addition to the primary piping connections, your pump may require mechanical seal filter connections to the lantern ring (see the "stuffing box" and "mechanical seal" sections of this manual), stuffing box drain, discharge and suction flange gauges, or baseplate drain connections. All these lines and gauges should now be installed.

**10. FINAL COUPLING ALIGNMENT**

The alignment of the coupling must be carefully checked during the installation and as the last step before starting the pump. If realignment is required, the piping should be disconnected first. After aligning, reconnect the piping in accordance with the previous instructions and again recheck the alignment.

A flexible coupling must not be used to compensate for misalignment resulting from poor installation or temperature changes.

Fairbanks Morse pumps are supplied with several different types of commercial couplings. The following instructions apply to units supplied with a Woods coupling. If your unit has a different make coupling, a loose leaf instruction sheet will be attached to this manual and should be thoroughly studied before proceeding.

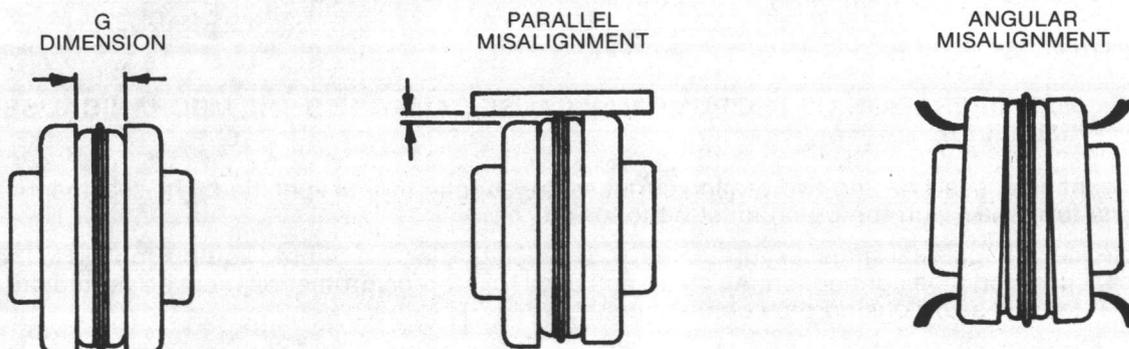
**NOTE: FOR MAXIMUM LIFE, KEEP MISALIGNMENT VALUES AS NEAR TO ZERO AS POSSIBLE.**

**MAXIMUM ALLOWABLE MISALIGNMENT — WOODS COUPLINGS (Dimensions In Inches)**

Sleeve Size	G Dimension	Types E & N		Type H*	
		Parallel	Angular	Parallel	Angular
4	5/8	.005	.021	—	—
5	3/4	.007	.028	—	—
6	7/8	.007	.035	.005	.008
7	1	.010	.040	.006	.010
8	1 1/8	.010	.047	.007	.012
9	1 1/16	.012	.054	.008	.014
10	1 5/8	.012	.064	.010	.016
11	1 7/8	.016	.075	.011	.018
12	2 5/16	.016	.087	.012	.021
13	2 11/16	.020	.092	.015	.025
14	3 1/4	.022	.121	.017	.030
16	4 3/4	.031	.165	—	—

The coupling type is printed on the sleeve.

\*Type H sleeves SHOULD NOT be used as direct replacements for EPDM or Hytrel sleeves.



#### 10. FINAL COUPLING ALIGNMENT (continued)

- A. Use a blunt screwdriver to slip the wire ring out of its groove and remove the two piece sleeve. Check the G dimension. If it is not as listed in the preceding table, loosen one flange of the coupling and reposition it to achieve the specified G dimension.  
(NOTE: On a sleeve bearing electric motor, the armature should be at it's electrical center when the G dimension is measured.)
- B. Check parallel alignment by placing a straightedge across the two coupling flanges and measuring the maximum offset at various points around the periphery of the coupling. **DO NOT ROTATE THE COUPLING.** If the maximum offset exceeds the figure shown under "Parallel" in the preceding table, realign the coupling.
- C. Check angular alignment with a micrometer or caliper. Measure from the outside of one flange to the outside of the other at intervals around the periphery of the coupling. Determine the maximum and minimum dimensions. **DO NOT ROTATE THE COUPLING.** The difference between the maximum and minimum must not exceed the figure shown under "Angular" in the preceding table. If a correction is required, you must recheck the parallel alignment.
- D. If the coupling employs the two-piece sleeve with the wire ring, force the ring into its groove in the center of the sleeve. It may be necessary to pry the ring into position with a blunt screwdriver.

**WARNING: CHECK SAFETY CODES, AND ALWAYS INSTALL PROTECTIVE GUARD OR SHIELD AS REQUIRED BY THE VARIOUS FEDERAL, STATE AND LOCAL LAWS AND THE REGULATIONS CONCERNING OSHA.**

**WARNING: COUPLING SLEEVES MAY BE THROWN FROM THE ASSEMBLY WHEN SUBJECTED TO A SERVICE SHOCK LOAD.**

#### 11. DOWELLING

After the piping is connected and the final coupling alignment completed, the pump and driver should be drilled, reamed and dowelled to the baseplate using a minimum of two dowels each for the pump and driver.

#### 12. FLEXIBLE SHAFTING ALIGNMENT

**WARNING: THE WEIGHT OF THE INTERMEDIATE SHAFT MUST NOT BE SUPPORTED BY THE PUMP BEARINGS. IF THE WEIGHT OF THE SHAFT CANNOT BE SUPPORTED BY THE DRIVER BEARINGS, A SPECIAL THRUST BEARING SHOULD BE INSTALLED IMMEDIATELY BELOW THE DRIVER OR A SPECIAL BEARING MUST BE FURNISHED IN THE PUMP.**

For installation and alignment of intermediate flexible shafting, refer to the manufacturer's manual.

**13. ROTATION**

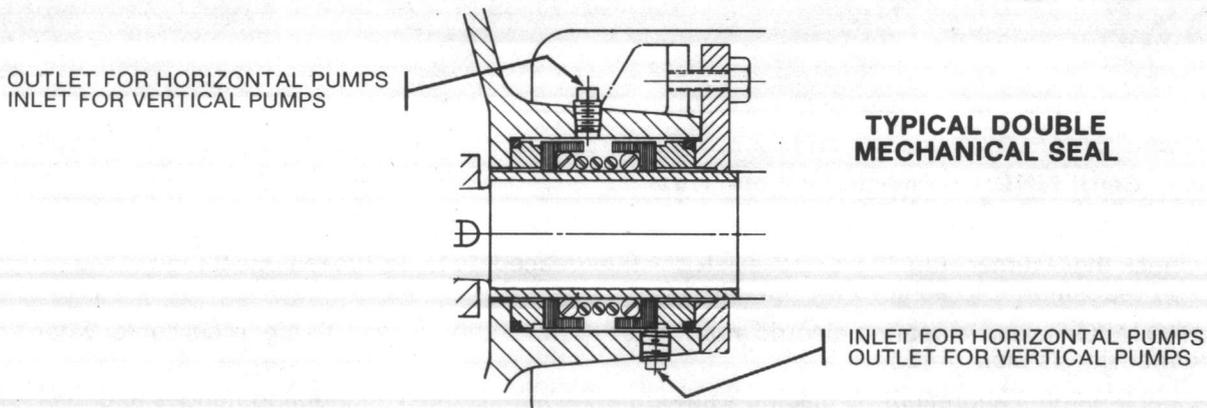
Before connecting the coupling halves, bump start the driver and verify rotation is in the proper direction. The correct pump rotation is indicated by a directional arrow on the pump casing.

**14. MECHANICAL SEALS**

**CAUTION: DRY OPERATION OF THE PUMP MAY CAUSE DAMAGE TO THE MECHANICAL SEAL AND IMPELLER.**

Double mechanical seals having two sealing surfaces are supplied when specified. The seal manufacturer's instructions furnished with the pump must be followed.

The double mechanical seals must be lubricated and cooled by clean or filtered liquid supplied to the bottom (lowest) seal housing pipe connection. All air and oil used for storage protection must be vented out through the upper (highest) seal housing pipe connection.



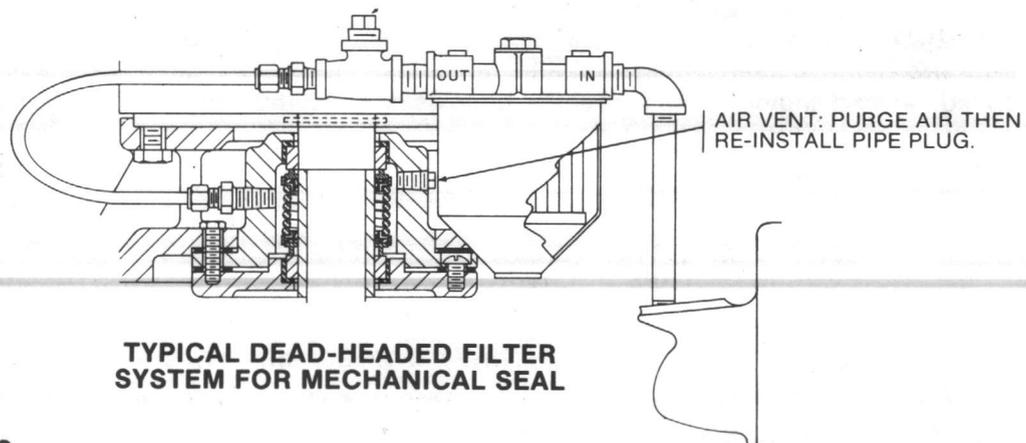
A pressure of 0 to 10 PSI higher than maximum pump discharge pressure must be maintained in the seal housing liquid.

Since a continuous flow is not usually required, the liquid to the seal is normally dead-headed.

For operation of mechanical seals at higher pressures, circulation of the liquid may be required by the seal manufacturer and you should refer to his instructions for specific requirements.

**15. OPTIONAL FILTER SYSTEM FOR MECHANICAL SEAL**

Some small loss of seal box fluid will occur due to vaporization of the fluid film between the seal faces, therefore, a filter capable of trapping particles larger than 25 microns is recommended for all dead-headed seals. Install the filter in the primary line between the 1/4" volute discharge tap and the seal housing connection. Either 1/4" or 3/8" tubing may be used. Under normal conditions, replace the filter element every 3-4 months. If the pumped fluid contains minerals or particles which tend to precipitate, a separate seal liquid source may be required.



Because variations may exist in both the equipment used with these pumps, and in the particular installation of the pump and driver, specific operating instructions are not within the scope of this manual. However, there are general rules and practices that apply to all pump installations and operation.

**CAUTION: BEFORE STARTING OR OPERATING THE PUMP, READ THIS ENTIRE MANUAL, ESPECIALLY THE FOLLOWING INSTRUCTIONS:**

- A. BEFORE STARTING THE PUMP, INSTALL CLOSED GUARDS AROUND ALL EXPOSED ROTATING PARTS.
- B. BEFORE STARTING THE PUMP, ROTATE THE UNIT OR ASSEMBLY BY HAND TO ASSURE ALL MOVING PARTS ARE FREE.
- C. OBSERVE ALL CAUTION OR DANGER TAGS ATTACHED TO THE EQUIPMENT.
- D. NEVER RUN THE PUMP DRY AS THE CLOSE RUNNING FITS WITHIN THE PUMP ARE WATER LUBRICATED. RUNNING DRY MAY RESULT IN PUMP SEIZURE.
- E. BEFORE STARTING THE PUMP, FILL THE CASING AND SUCTION LINE WITH LIQUID. THE PUMP MAY BE PRIMED BY USING AN EJECTOR OR VACUUM PUMP.
- F. BEFORE STARTING A MECHANICAL SEAL PUMP, TURN ON THE SEAL WATER, VENT THE SEAL HOUSING AND CONFIRM SEAL WATER IS AT SUFFICIENT PRESSURE.
- G. BEFORE STARTING A PACKED BOX PUMP, ADJUST THE PACKING GLAND SO THERE IS SUFFICIENT LEAKAGE TO LUBRICATE THE PACKING AND ASSURE A COOL STUFFING BOX (SEE MAINTENANCE INSTRUCTIONS).
- H. IF EXCESSIVE VIBRATION OR NOISE OCCURS DURING OPERATION, SHUT THE PUMP DOWN AND CONSULT A FAIRBANKS MORSE REPRESENTATIVE.

#### 1. OPERATING AT REDUCED CAPACITY

In a typical application covering a wide range of flow rates, a variable speed driver is often used to adjust pump capacity, and this intent is taken into consideration by Fairbanks Morse when selecting the pump and impeller trim. Although these pumps are applicable over a wide range of operating conditions, care should be exercised when doing so, especially when the actual conditions differ from the sold for conditions. You should always contact your nearest Fairbanks Morse sales office before operating the pumps at any condition other than that for which they were sold.

Generally, these pumps can be operated for sustained periods at or above 25% of the capacity at maximum efficiency and for intermittent periods at less than 25%.

#### 2. PRIMING

Since the pumped medium is used to lubricate various internal parts, running a centrifugal pump dry can result in extensive damage and possible seizing. It is therefore imperative that the pump be primed prior to initial start up and that that prime be maintained through subsequent start-stop cycles.

The priming procedure is different for positive and negative suction head systems and the following procedures should be followed:

- A. Positive suction head —
  1. Open the vent on the highest point on the pump casing.
  2. Open all suction valves.
  3. Allow the liquid to flow from the vent hole until all air bubbles are vented, and then close the vent.
  4. The pump is now primed.
- B. Negative suction head —
  1. Install an ejector or vacuum pump on the vent on the highest point on the pump casing.
  2. Close the discharge valve.
  3. Open the suction valve.
  4. Start ejector or vacuum pump.
  5. Allow the liquid to flow until a continuous flow is exhausted from the ejector, and then close the valve to the vent.
  6. The pump is now primed.

**3. STARTING THE PUMP**

- A. After the pump is primed, and with the discharge valve closed and the suction valve open, start the driver according to the driver manufacturer's instructions.
- B. Open the discharge valve slowly to prevent water hammer.
- C. After the pump has run for approximately one-half hour, check bearing temperature, stuffing box lubrication/operation and pump noise level.

**4. BEARING OPERATING TEMPERATURE**

These pumps are designed to operate over a wide ambient temperature range. The bearing temperature, when measured on the outside surface of the bearing housing, should not exceed 190°F. Temperatures in excess of 190°F may indicate a lack of lubricant, bearing overload or incipient bearing failure. If the temperature exceeds this limit, the pump should be stopped and the cause investigated and corrected.

**5. TROUBLESHOOTING OPERATING PROBLEMS**

If you have followed the installation and start up procedures outlined in this manual, your pump should provide reliable service and long life. However, if operating problems do occur, significant time and expense can be saved if you use the following check list to eliminate the most common causes of those problems.

**INSUFFICIENT DISCHARGE PRESSURE OR FLOW**

1. Pump not primed.
2. Speed too low. Check driver.
3. Discharge head too high.
4. Suction lift too high.
5. Wrong direction of rotation.
6. Air leaks into suction piping, stuffing box or gaskets.
7. Impeller passage partially plugged.
8. Impeller damaged.
9. Impeller running clearance too large.
10. Insufficient suction line submergence.
11. Air in liquid.
12. Impeller diameter too small.
13. Insufficient net positive suction head.

**LOSS OF SUCTION DURING OPERATION**

1. Suction line leaks.
2. Water seal line plugged.
3. Suction lift too high.
4. Air or gases in liquid.
5. Air leaks into suction piping, stuffing box or gaskets.
6. Wrong direction of rotation.
7. Insufficient suction line submergence.

**EXCESSIVE POWER CONSUMPTION**

1. Speed too high.
2. Head lower than rating, pumps too much liquid.
3. Specific gravity or viscosity of liquid pumped is too high.
4. Mechanical defects:
  - \*Shaft bent.
  - \*Rotating element binds.
5. Misalignment.
6. System head lower than design.
7. Incorrect diameter impeller.

**VIBRATION OR NOISE**

1. Misalignment between driver and pump.
2. Foundation bolts loose or defect in grouting.
3. Mechanical defects:
  - \*Shaft bent.
  - \*Rotating element binds.
4. Head lower than rating, pumps too much liquid.
5. Pipe strain — improperly supported or aligned.
6. Pump running at shut-off condition.

**OVER-HEATING**

1. Bearings:
  - \*Excessive grease.
  - \*Shaft bent.
  - \*Rotating element binds.
  - \*Pipe strain.
  - \*Insufficient bearing lubrication.
  - \*Incorrect type grease.
2. Packing box:
  - \*Packing gland too tight.
  - \*Water seal line plugged.
  - \*Air not vented out of mechanical seal.
  - \*Flushing water not circulating for mechanical seal.



## 2. INSPECTIONS AND PREVENTATIVE MAINTENANCE REQUIREMENTS

To assure satisfactory operation of the pump, daily inspections and periodic maintenance are required. We suggest that an inspection and maintenance log be kept and that the inspector immediately report any problems. A guide for preventative maintenance for normal applications is given below. Unusual applications with abnormal heat, moisture, dust, etc., may require more frequent inspections and service.

ITEM	ACTION REQUIRED	FREQUENCY (HOURS OF OPERATION)
Packing Box	Adjust gland, inspect packing for possible replacement	150 hours
Mechanical Seal Filter	Replace or clean	4,000 hours
Pump Alignment	Check for change in alignment	ANNUALLY
Vibration	Check for change in vibration	ANNUALLY
Bearings	Lubricate	2,000 hours — but at least once a year

## 3. BEARING LUBRICATION

Fairbanks Morse 5400 pumps are furnished with grease lubricated bearings.

Under normal operating conditions, the bearings must be lubricated after every 2,000 hours of running time, but at least once a year regardless of total operating hours.

**CAUTION: ANY APPLICATION WITH ABNORMAL HEAT, MOISTURE, DUST, ETC., MAY REQUIRE A CHANGE IN THIS SCHEDULE AND YOU SHOULD REFER TO A LUBRICATION ENGINEER OR THE FACTORY FOR SPECIFIC INSTRUCTIONS.**

**CAUTION: THE GREASES RECOMMENDED IN THIS MANUAL WILL PROVIDE SATISFACTORY LUBRICATION OVER A WIDE TEMPERATURE RANGE. THERE IS, HOWEVER, A PRACTICAL LIMIT AND OPERATION OF THE PUMP SHOULD BE DISCONTINUED AND THE FACTORY CONSULTED IF THE TEMPERATURE, WHEN MEASURED ON THE OUTSIDE OF THE BEARING HOUSING, EXCEEDS 190° F.**

RECOMMENDED GREASE: N.L.G.I. No. 2 lithium base multi-purpose with a mineral oil viscosity of 950-1250 SUS at 100° F., and 80-82 SUS at 210° F.

Proceed as follows for bearing lubrication:

**WARNING: EXTREME CARE SHOULD BE EXERCISED AND STEPS TAKEN TO INSURE THAT THE DRIVER CANNOT BE ACCIDENTALLY STARTED. KEEP HANDS, FINGERS, CLOTHING AND ANY TOOLS AWAY FROM THE COUPLING. FAILURE TO DO SO COULD RESULT IN SERIOUS PERSONAL INJURY.**

- A. Stop the unit and connect a grease gun to the lubrication fittings.
- B. Start the unit and inject grease until it relieves at the bearing cover lip seals.
- C. Immediately after lubrication, bearing temperatures may rise above the normal level. Continue running the unit until bearing temperatures stabilize at the normal level and grease stops seeping at the lip seals.
- D. Stop the unit, remove the grease gun, and wipe off the relieved grease.
- E. Start the unit and resume normal operation.

**4. STUFFING BOX**

The stuffing boxes on Fairbanks Morse pumps are packed at the factory. All packing is subject to wear and should be given regular inspections and, if necessary, periodic adjustments. Generally, packed box pumps require inspection of the packing and adjustment of the gland after each 150 hours of operation.

Adjustment is accomplished by lightly tightening the gland nuts, and then loosening them so they can be adjusted with finger pressure to allow a small flow of liquid to lubricate the packing. If the flow of liquid has increased and cannot be reduced by a slight tightening of the gland, replace the packing and/or shaft sleeve.

**CAUTION: DO NOT TIGHTEN THE GLAND TO STOP ALL LEAKAGE. LEAKAGE IS NECESSARY TO INSURE THE COOLING, FLUSHING AND LUBRICATION OF THE PACKING AND TO PREVENT SHAFT SLEEVE DAMAGE.**

The stuffing boxes may be fitted with water seal rings. When a seal ring is furnished, the sealing chamber should be connected to a source of clear, fresh water.

**5. PACKING REPLACEMENT**

Use a good grade of soft, square, long fiber asbestos packing, thoroughly graphited. The replacement procedure should be as follows:

- A. Stop the pump.
- B. Unbolt and remove the gland.
- C. Use a packing hook to remove the worn packing and water seal rings. Note the location of the water seal ring relative to the amount of packing on each side of ring.
- D. Clean the packing box and shaft sleeve.
- E. Inspect the shaft sleeve for wear or rough finish and replace if necessary.
- F. Install the new packing and new water seal ring.

**CAUTION: STAGGER THE PACKING END JOINTS 180° AND FIRMLY SEAT THE PACKING. THE FOLLOWING TABLE GIVES THE PERTINENT STUFFING BOX, SEAL CAGE AND PACKING DIMENSIONS.**

	FRAME SIZE			
	T20	T30	T40	T60
Stuffing Box O.D. Sleeve	1 <sup>7</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>3</sub>	3	3 <sup>5</sup> / <sub>8</sub>
I.D. Box	2 <sup>5</sup> / <sub>8</sub>	3 <sup>1</sup> / <sub>2</sub>	4	4 <sup>5</sup> / <sub>8</sub>
Box Depth	2 <sup>7</sup> / <sub>8</sub>	3 <sup>1</sup> / <sub>2</sub>	3 <sup>3</sup> / <sub>4</sub>	3 <sup>3</sup> / <sub>4</sub>
Packing Size	<sup>3</sup> / <sub>8</sub>	<sup>1</sup> / <sub>2</sub>	<sup>1</sup> / <sub>2</sub>	<sup>1</sup> / <sub>2</sub>
Rings of Packing per Box	5	5	5	5
Seal Cage Width	<sup>3</sup> / <sub>4</sub>	<sup>3</sup> / <sub>4</sub>	1	1

- G. Reinstall the gland and tighten the gland nuts.
- H. Loosen the gland nuts so they can be adjusted with finger pressure to obtain correct leakage for lubrication after start-up.

**6. IMPELLER RUNNING CLEARANCE**

As the impeller and front head wear, the clearance increases causing internal leakage. This decreases the performance of the pump. The clearance can be adjusted to compensate for wear. If the desired clearance cannot be obtained, it may be necessary to rebuild the pump.

The clearance may be checked by removing the suction hand-hole cover and placing a feeler (thickness) gauge between the impeller and the front head (refer to the impeller adjustment drawing on page 14).

**6. IMPELLER RUNNING CLEARANCE (continued)**

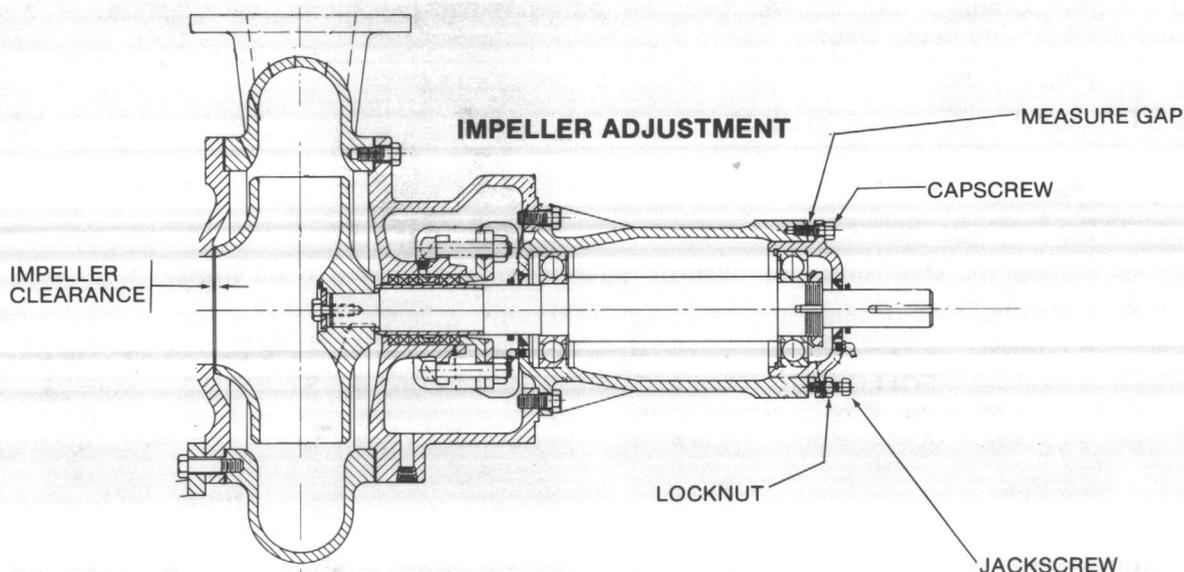
- A. Back off the jackscrews, and tighten the cap screws at the bearing housing until the impeller just contacts the front head.
- B. Measure the gap between the bearing housing and the frame.
- C. Loosen the capscrews and tighten each jackscrew in a criss-cross method,  $\frac{1}{8}$  of a turn at a time, until the gap between the bearing housing and frame is increased by the amount of required impeller clearance shown below:

**PUMP SIZE**  
2", 3", 4" and 5"  
6", 8" and 10"

**CLEARANCE**  
.010" to .020"  
.020" to .030"

- D. Tighten the capscrews and recheck the clearance.

**CAUTION: THE CLEARANCE SHOULD BE RECHECKED AFTER TIGHTENING THE CAPSCREWS. IF THE GAP IS NOT AS SPECIFIED, REPEAT THIS ENTIRE PROCEDURE UNTIL THE PROPER CLEARANCE IS ACHIEVED.**

**7. PUMP DISASSEMBLY**

**CAUTION: READ THIS ENTIRE DISASSEMBLY PROCEDURE BEFORE PROCEEDING.**

Major maintenance beyond lubrication, adjustment of running clearance and replacement or adjustment of the packing will require disassembly of the pump. The following are step-by-step instructions:

- A. Lock out the power to the driver and close the suction and discharge valves. Drain the pump, disconnect and remove the coupling or flexible shafting and the outer water deflector (126B). Disconnect and remove gauges and all other auxiliary piping. (Stuffing box lubrication, oil or grease lines, etc.)
- B. Remove the cap screws holding the frame adapter (34) to the volute (30).
- C. Install an eyebolt of adequate strength in the tapped (coupling) end of the shaft (4) and remove the frame and rotating assembly from the volute.

**CAUTION: THE USE OF A CRANE OR HOIST OF ADEQUATE CAPACITY IS RECOMMENDED.**

- D. Support the frame and rotating assembly in a horizontal position and remove the impeller capscrew (9) and washer (9A). Because the impeller capscrew is installed with Loctite, it may be necessary to heat the capscrew to approximately 450°F. to break the bond.

**WARNING: TO PREVENT POSSIBLE SERIOUS PERSONAL INJURY, HEAT RESISTANT GLOVES MUST BE WORN WHEN HANDLING HEATED PARTS.**

**7. PUMP DISASSEMBLY (continued)**

- E. Remove the impeller (1) and the impeller key (102) from the shaft. The impeller and shaft have a straight bore with close tolerance fits, and it will be necessary to use a wheel puller or similar device. In addition, because the impeller is installed with Loctite, it may be necessary to heat the impeller hub to approximately 450°F. to break the bond. Attach the puller or other equipment at the impeller vane area only — do not use the impeller shroud.

**WARNING: TO PREVENT POSSIBLE SERIOUS PERSONAL INJURY, HEAT RESISTANT GLOVES MUST BE WORN WHEN HANDLING HEATED PARTS.**

**CAUTION: CARE SHOULD BE TAKEN NOT TO DAMAGE THE IMPELLER WHEN USING A PULLER OR SIMILAR DEVICE.**

- F. If your pump has wearing rings, they are secured to the impeller and/or fronthead (33) with Loctite. The rings may be removed by heating them to approximately 450°F. to break the bond and then tapping them with a brass or copper mallet. If heating fails to affect removal, the rings may be ground off.

**WARNING: TO PREVENT POSSIBLE SERIOUS PERSONAL INJURY, HEAT RESISTANT GLOVES MUST BE WORN WHEN HANDLING HEATED PARTS.**

**WARNING: TO PREVENT POSSIBLE SERIOUS PERSONAL INJURY, EXTREME CARE SHOULD BE EXERCISED TO SELECT THE PROPER GRINDING EQUIPMENT, AND APPROVED SAFETY GLASSES SHOULD BE WORN WHEN GRINDING.**

- G. Loosen the packing box gland (19 or 31).

- H. Remove the capscrews that secure the frame adapter (34) to the frame (90) and remove the frame adapter and water deflector (126A).

- I. Remove the capscrews and jackscrews from the thrust bearing housing (139).

- J. Remove the shaft assembly from the frame using the eyebolt installed in the tapped (coupling) end of the shaft in Step 3 of these instructions.

**CAUTION: THE USE OF A CRANE OR HOIST OF ADEQUATE CAPACITY IS RECOMMENDED.**

- K. Remove the shaft sleeve (14). Because the shaft sleeve is secured with Loctite, it will be necessary to heat the shaft sleeve to approximately 450°F. to break the bond.

**WARNING: TO PREVENT POSSIBLE SERIOUS PERSONAL INJURY, HEAT RESISTANT GLOVES MUST BE WORN WHEN HANDLING HEATED PARTS.**

- L. T20 and T30 frame pumps use a snap ring to hold the bearing in the thrust bearing housing (139). Remove the snap ring and the thrust bearing housing. T40 and T60 frame pumps use a thrust bearing housing cover (159) to hold the bearing in the thrust bearing housing (139). Remove the thrust bearing housing cover and slide the thrust bearing housing away from the bearings.

- M. Remove the bearing locknut (161) and lockwasher (162). Use a bearing puller or similar device to remove the inboard (163) and outboard (168) bearing. T60 frame pumps use grease retainers (206A and 206B) between the inner and outer bearings and the bearing shaft shoulder. Remove the grease retainers.

**WARNING: TO PREVENT POSSIBLE SERIOUS PERSONAL INJURY AND DAMAGE TO THE BEARINGS, PRESSURE SHOULD BE APPLIED TO THE INNER BEARING RACE ONLY.**

**CAUTION: BECAUSE OF POSSIBLE DAMAGE OR CONTAMINATION DURING REMOVAL, BEARINGS AND GREASE SEALS SHOULD NOT BE REUSED AND NEW BEARINGS AND GREASE SEALS SHOULD ALWAYS BE INSTALLED.**

- N. Remove the split (19) or solid (31) glands, packing (212) and water seal ring (10) or mechanical seal (456), from the frame adapter stuffing box.

**7. PUMP DISASSEMBLY (continued)**

- O. T20 and T30 frame pumps use an inner grease seal (140A) in the frame and an outer grease seal (159A) in the thrust bearing housing (139). T40 and T60 frame pumps use an inner grease seal (140A) in the frame and an outer grease seal (159A) in the thrust bearing housing cover (159). Remove these grease seals.

**CAUTION: BECAUSE OF POSSIBLE DAMAGE DURING DISASSEMBLY, GREASE SEALS SHOULD NOT BE REUSED AND NEW GREASE SEALS SHOULD ALWAYS BE INSTALLED.**

- P. The pump disassembly is now complete. All parts should be thoroughly cleaned and inspected for wear or damage and replaced if required.

**8. PUMP ASSEMBLY**

**CAUTION: READ THIS ENTIRE ASSEMBLY PROCEDURE BEFORE PROCEEDING.**

The following are step by step instructions for assembly of the pump and are essentially the reverse order of the instructions for disassembly.

- A. Thoroughly clean all parts to remove all oil, grease and any foreign material and inspect for wear or damage and replace if required. Remove all parts to a clean and dust free location for assembly. Gaskets, grease seals, grease retainers and bearings should not be reused, and should always be replaced with new parts.
- B. T20, T30 and T40 frame pumps do not use a grease retainer. Install the inner bearing (163) on the shaft (4). T60 frame pumps use a grease retainer (206A) between the inner bearing and the shaft bearing shoulder. Install the grease retainer and inboard bearing.

**WARNING: TO PREVENT POSSIBLE SERIOUS PERSONAL INJURY AND DAMAGE TO THE BEARINGS, PRESSURE SHOULD BE APPLIED TO THE INNER BEARING RACE ONLY.**

- C. T20 and T30 frame pumps use a snap ring to hold the outer bearing (168) in the thrust bearing housing (139) and a grease seal (159A) in the thrust bearing housing cover.

Install the grease seal in the thrust bearing housing, slide the snap ring over the shaft and install the thrust bearing on the shaft. Install the bearing lockwasher (162) and locknut (161). Slide the thrust bearing housing over the bearing and install the snap ring in the housing.

T40 frame pumps use a thrust bearing housing cover (159) to hold the outer bearing (168) in the thrust bearing housing (139) and a grease seal (159A) in the thrust bearing housing cover. Install the grease seal in the thrust bearing housing cover, slide the thrust bearing housing onto the shaft, and install the bearing and thrust bearing housing cover.

T60 frame pumps are similar to T40 frame with the addition of a grease retainer (206B) between the outer bearing (168) and the shaft bearing shoulder. Install the grease seal in the thrust bearing housing cover, slide the thrust bearing housing onto the shaft, and install the grease retainer, bearing and thrust bearing housing cover.

**WARNING: TO PREVENT POSSIBLE SERIOUS PERSONAL INJURY AND DAMAGE TO THE BEARINGS, PRESSURE SHOULD BE APPLIED TO THE INNER BEARING RACE ONLY.**

- D. Install the inner bearing grease seal (140A) and shaft/bearing assembly in the frame (90).
- E. Install the capscrews and jackscrews that hold the outer bearing assembly to the frame.

**CAUTION: DO NOT TIGHTEN THE CAPSCREWS OR JACKSCREWS. THEY WILL BE USED TO MAKE THE FINAL IMPELLER CLEARANCE ADJUSTMENT AFTER THE PUMP IS COMPLETELY ASSEMBLED.**

8. PUMP ASSEMBLY (continued)

- F. Apply a bead of Loctite No. 271 or 601 around the impeller end of the shaft/shaft sleeve fit. Slide the shaft sleeve (14) part way onto the shaft and rotate it at least one full revolution to evenly spread the Loctite, then slide the shaft sleeve over the shaft until it butts firmly against the shaft shoulder.

**CAUTION: ALLOW THE LOCTITE TO CURE FOR TWO (2) HOURS BEFORE OPERATING THE PUMP.**

- G. Install the water deflectors (126A and 126B) on the shaft.
- H. Install the packing (212) and water seal ring (10), or the mechanical seal, in the frame adapter (34) stuffing box.

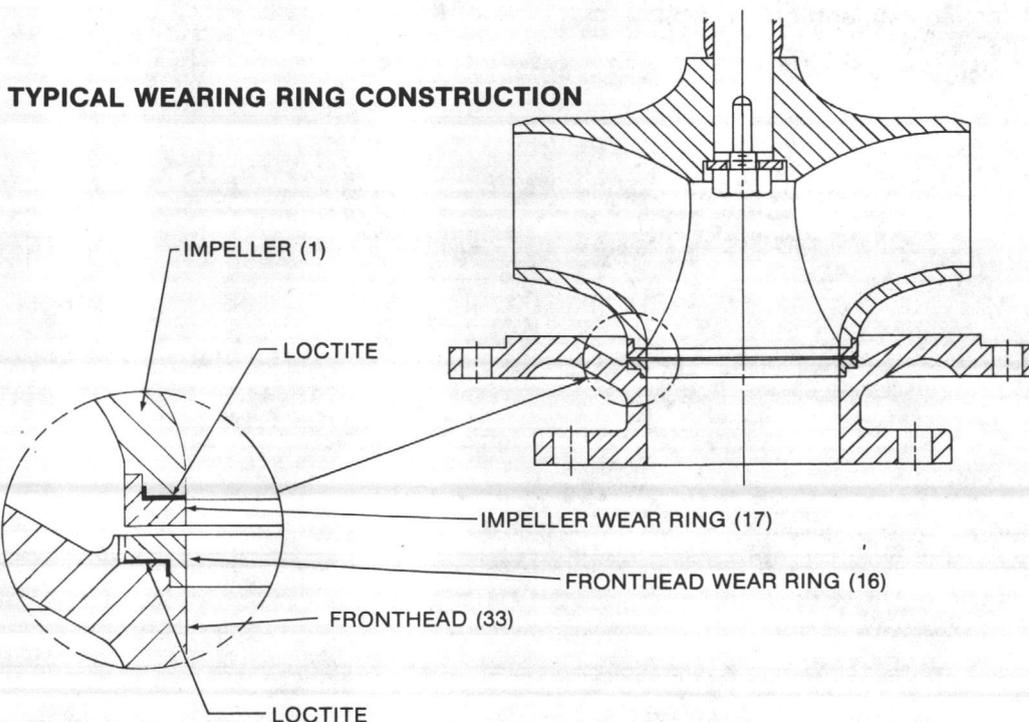
**CAUTION: REFER TO THE MAINTENANCE SECTION OF THIS MANUAL FOR SPECIFIC INSTALLATION INSTRUCTIONS FOR THE PACKING OR MECHANICAL SEAL.**

- I. If your pump uses a mechanical seal, slide the one (1) piece mechanical seal gland (31) over the shaft.
- J. Apply a light coat of grease to the shaft sleeve and slide the adapter (34) over the shaft, being careful not to damage the packing or mechanical seal.
- K. Secure the adapter to the frame with the capscrews. Install the packing gland (19) and gland nuts.

**CAUTION: DO NOT TIGHTEN THE GLAND NUTS. REFER TO THE MAINTENANCE SECTION OF THIS MANUAL FOR SPECIFIC PACKING ADJUSTMENT INSTRUCTIONS AFTER THE PUMP ASSEMBLY IS COMPLETED.**

- L. If your pump uses impeller and front head wearing rings (16 and 17) they are a light press fit installed with Loctite No. 271 or 601. Apply a bead of Loctite around the impeller and front head between the wearing ring mating surface and install the wearing rings.

**CAUTION: BE CAREFUL TO PRESS THE WEARING RINGS COMPLETELY IN PLACE. THEY SHOULD BE FIRMLY BUTTED AGAINST THE CORRESPONDING IMPELLER OR FRONTHEAD SHOULDER.**



**8. PUMP ASSEMBLY (continued)**

M. Prior to installing the impeller (1), impeller key (102) and impeller capscrew (9): the key shaft, impeller bore and the threads on the capscrew and it's mating threads in the shaft must be thoroughly cleaned and free from oil, dirt or any foreign substance. Apply a sufficient amount of Loctite No. 271 or 601 to the shaft to cover the entire impeller fit area. Install the impeller key (102) in the shaft (4). Slide the impeller (1) in place, making sure it butts firmly against the shaft sleeve. Apply 3 or 4 drops of Loctite No. 271 or 601 to the capscrew threads, and with the impeller washer (9A) in place, install the capscrew and torque to the values shown in the following table.

**CAUTION: THESE CAPSCREW TORQUE VALUES ARE FOR SAE GRADE 8 STEEL CAPSCREWS ONLY. IF OTHER MATERIAL IS USED, CONSULT WITH THE FAIRBANKS MORSE ENGINEERING DEPARTMENT FOR PROPER TORQUE VALUES.**

**B5410, B5420 or B5440 PUMPS**

Pump Size-Figure	Pump Frame	Impeller Fastener (Capscrew Size)	Torque Foot-Pounds
2", 3" or 4" - B54X1	T20	1/2-13	80
2", 3" or 4" - B54X2	T20	1/2-13	80
3", 4", 5" or 6" - B54X3	T30	5/8-11	120
4", 5", 6" or 8" - B54X4	T40	3/4-11	200
5" - B54X6	T40	3/4-11	200
8" or 10" - B54X5	T60	7/8-9	240
6" or 8" - B54X6	T60	7/8-9	240

- N. Install the rotating assembly in the volute (30) using a new gasket and secure with the appropriate capscrews.
- O. Install the front head (33) in the volute using a new gasket and secure with the appropriate capscrews.
- P. Refer to the maintenance section of this manual for specific instructions on impeller running clearance adjustment and adjust that clearance to the proper value.
- Q. Install the gaskets, handhole covers and mechanical seal piping if the pump uses a mechanical seal.

The pump assembly is now complete except for packing adjustment, which should be accomplished after the pump is installed, primed and started up. Refer to the maintenance section of this manual for specific packing or mechanical seal adjustment instructions.

**ORDERING PARTS**

There are a variety of options available for this pump. When ordering parts, give pump serial number, size, and figure number and a complete description and item number of each part. Refer to the drawing and parts list in the back of this manual. You may order parts from your local Fairbanks Morse Distributor or directly from the factory. Consult your local telephone yellow pages for the office nearest you.

**RETURNING PARTS**

Unnecessary delays and wasted effort will be avoided if you use the proper procedure to return parts or equipment. All materials or parts returned to the factory must have prior approval and a "Returned Goods Tag".

Contact your nearest Fairbanks Morse distributor, listing the material to be returned and the reasons for the return. He will contact the factory to obtain the required approval and "Returned Goods Tag". All material to be returned should be carefully packed to avoid damage in route from rough handling or exposure to weather. The "Returned Goods Tag" will give shipping instructions. All material to be returned freight prepaid.

Fairbanks Morse makes improvements on its products from time to time and reserves the right to furnish improved parts for repairs. A part that is received and is not identical in appearance, or has a different symbol from the original part, may be interchangeable. Examine the part carefully before contacting your Fairbanks Morse representative. The parts should never be returned to the factory without first obtaining proper authorization from your Fairbanks Morse representative.

**RECOMMENDED SPARE PARTS  
For Normal Duty:**

REF. NO.	DESCRIPTION
14	SLEEVE SHAFT
16	WEAR RING, FRONTHEAD (IF ON ORIGINAL CONSTRUCTION)
17	WEAR RING, IMPELLER (IF ON ORIGINAL CONSTRUCTION)
126A	DEFLECTOR, INNER
126B	DEFLECTOR, OUTER
140A	SEAL, GREASE
159A	SEAL, GREASE
163	BEARING, INNER
168	BEARING, OUTER
212	PACKING (OR MECHANICAL SEAL)
	GASKETS, COMPLETE SET

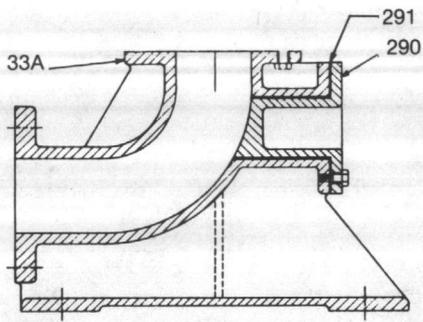
**For Severe Duty, Add The Following:**

REF. NO.	DESCRIPTION
1	IMPELLER
4	SHAFT

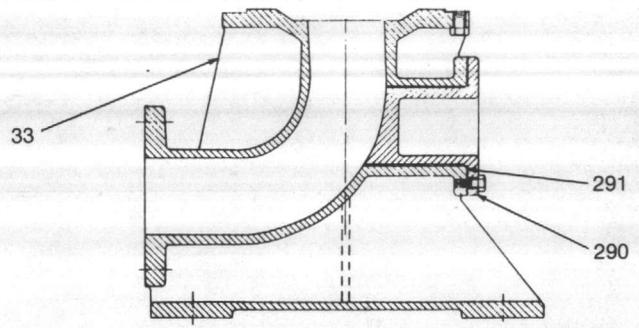




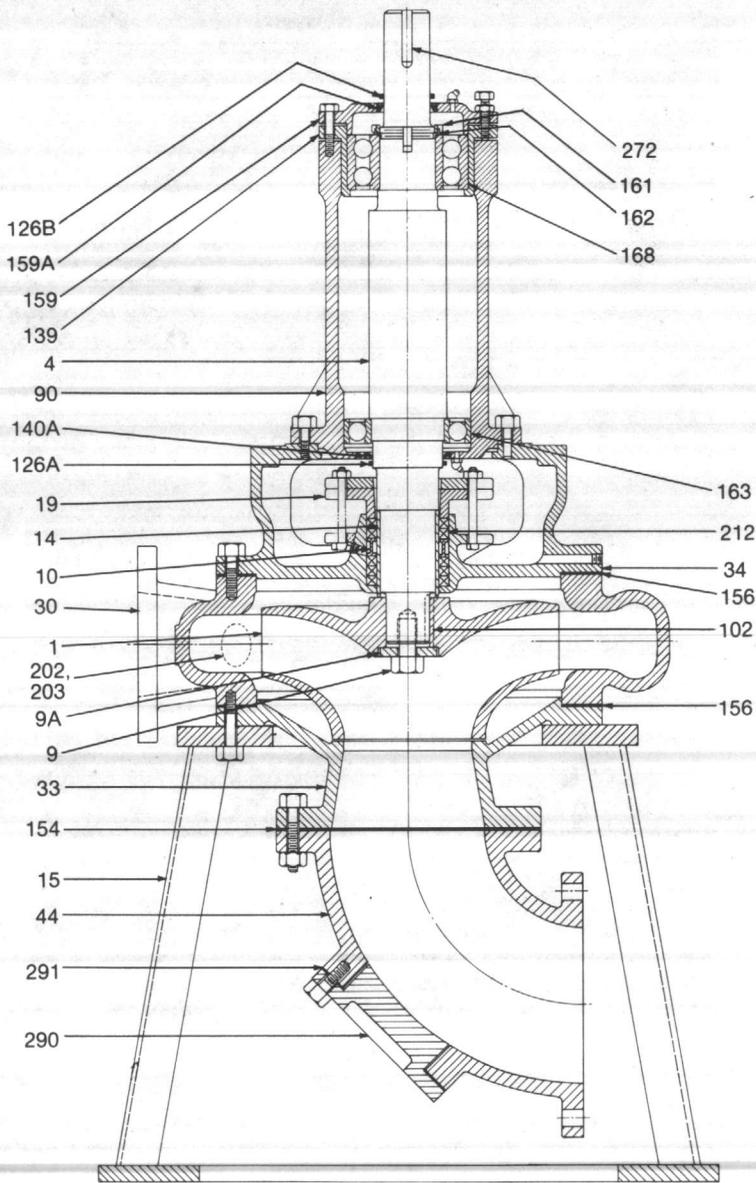
**CROSS-SECTIONAL DRAWINGS  
AND PARTS LISTS — 5410**



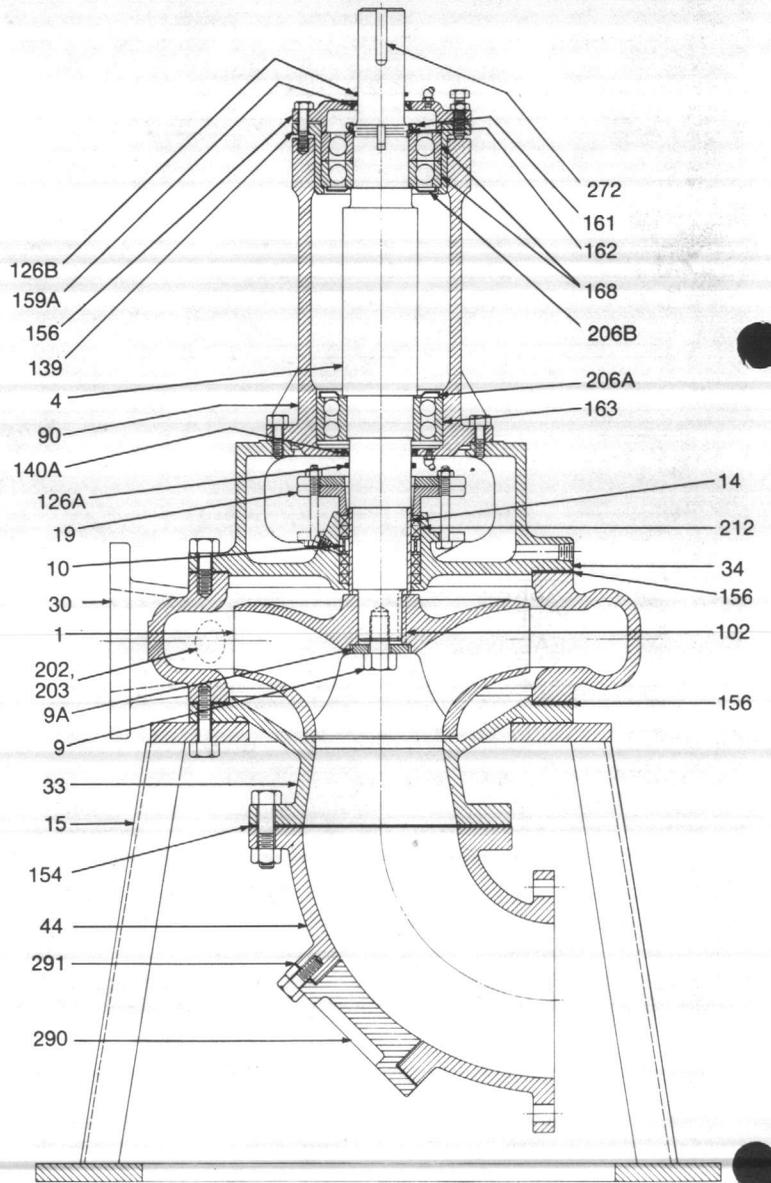
**B5411C - 4"  
(COMBINATION BASE-ELBOW)**



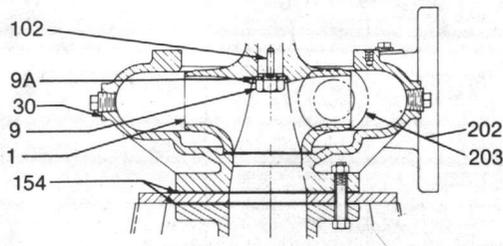
**B5412C - 4" AND B5413C - 4"  
(COMBINATION BASE-ELBOW)**



**B5414 AND 5" B5416  
FRAME T40**



**B5415 AND 6" AND 8" B5416  
FRAME T60**



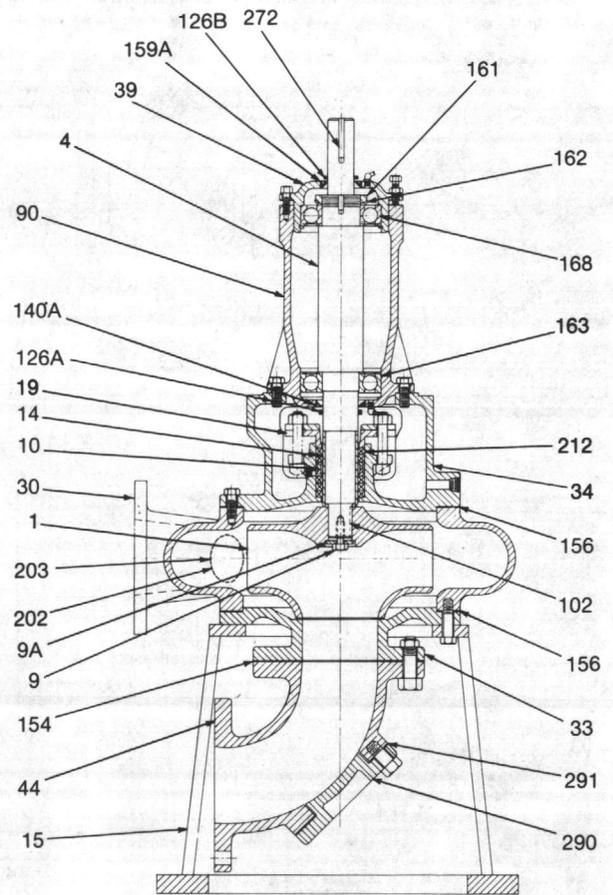
**B5411 INTEGRAL VOLUTE**

**B5410 AND B5410C  
VERTICAL DRY-PIT NON CLOG PUMPS  
PARTS LIST**

REF. NO.	DESCRIPTION
1	IMPELLER
4	SHAFT
9	CAPSCREW, IMPELLER
9A	WASHER, IMPELLER
10	RING, WATER SEAL
14	SLEEVE, SHAFT
15	BASE
19	GLAND HALF
30	VOLUTE
33	FRONTHEAD
34	ADAPTER, FRAME
44	SUCTION ELBOW
90	FRAME
102	KEY, IMPELLER
126A	DEFLECTOR, INNER
126B	DEFLECTOR, OUTER
139	HOUSING THRUST BEARING
140A	SEAL, INNER GREASE
154	GASKET, ELBOW
156	GASKET, VOLUTE
159	COVER, THRUST BEARING HOUSING
159A	SEAL, OUTER GREASE
161	LOCKNUT, BEARING
162	LOCKWASHER, BEARING
163	BEARING, INNER
168	BEARING, OUTER
202	COVER, VOLUTE HANDHOLE
203	GASKET, VOLUTE HANDHOLE COVER
206A	RETAINER, INNER GREASE
206B	RETAINER, OUTER GREASE
212	PACKING
272	KEY, COUPLING
290	COVER, HANDHOLE
291	GASKET, HANDHOLE
407	BALANCE WEIGHT, IMPELLER
464	SUCTION ELBOW (BASE COMBINATION)

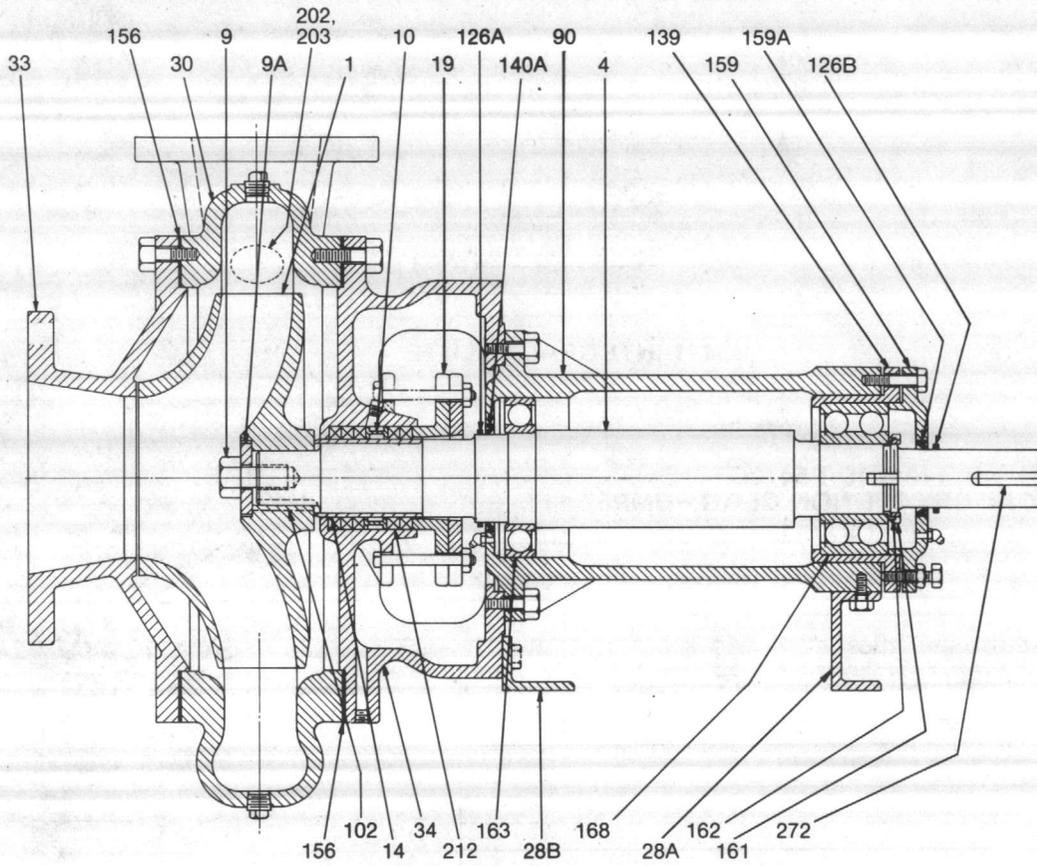
**OPTIONS TO BASIC PUMPS**

REF. NO.	DESCRIPTION
1	IMPELLER
16	WEAR RING, FRONTHEAD
17	WEAR RING, IMPELLER
19	GLAND HALF
31	SOLID GLAND
456	MECHANICAL SEAL

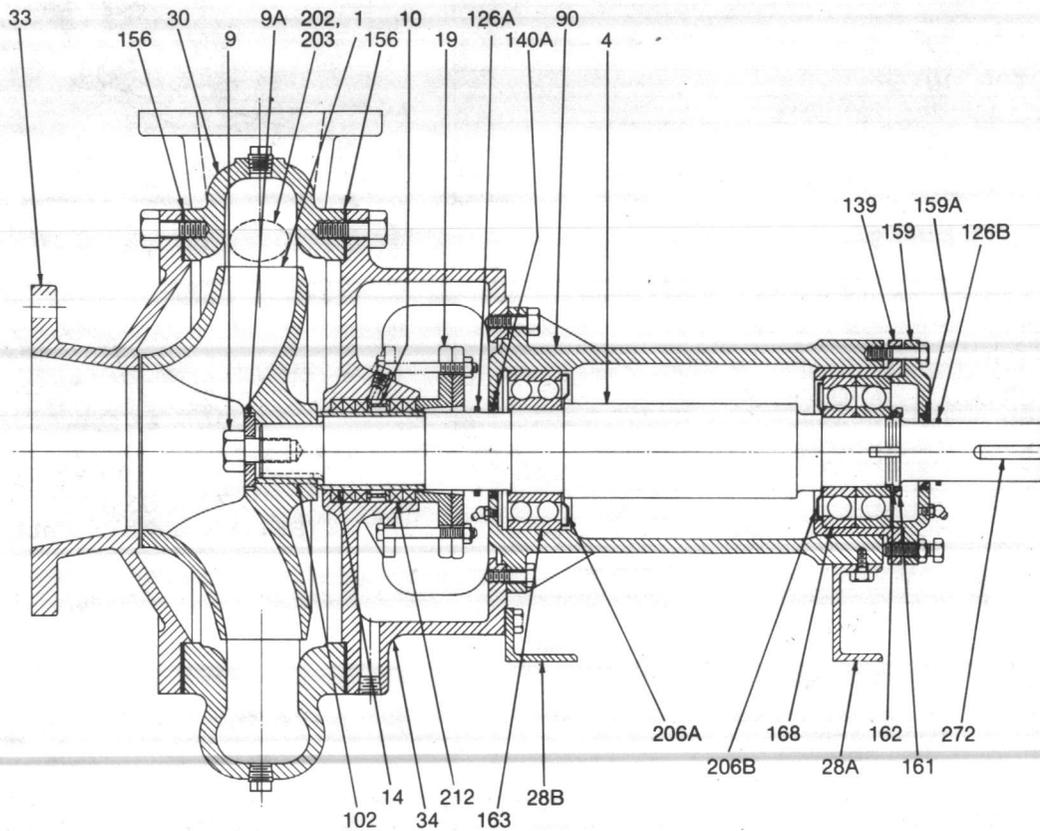


**B5412 FRAME T20  
AND B5413 FRAME T30  
(B5411 is same except integral volute)**

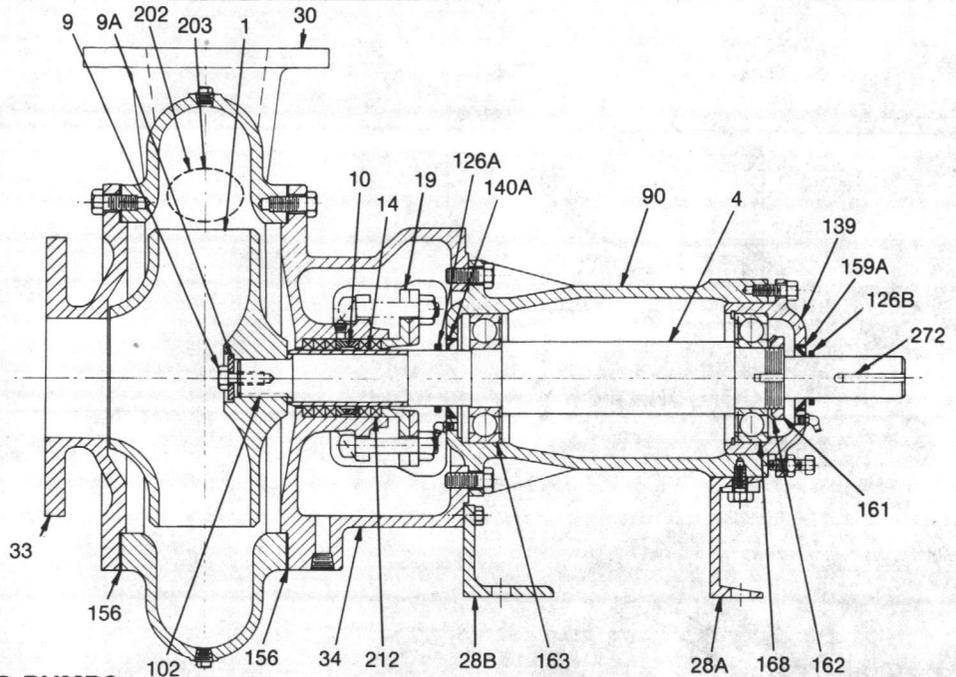
CROSS-SECTIONAL DRAWINGS  
AND PARTS LISTS — 5420



**B5424 AND B5426 FRAME T40**



**B5425 AND B5426 FRAME T60**



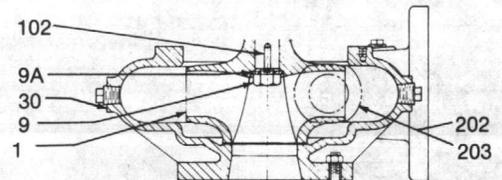
**B5420  
HORIZONTAL NON CLOG PUMPS  
PARTS LIST**

REF. NO.	DESCRIPTION
1	IMPELLER
4	SHAFT
9	CAPSCREW, IMPELLER
9A	WASHER, IMPELLER
10	RING, WATER SEAL
14	SLEEVE, SHAFT
19	GLAND HALF
28A	FOOT, MOUNTING
28B	FOOT, MOUNTING
30	VOLUTE
33	FRONTHEAD
34	ADAPTER, FRAME
90	FRAME
102	KEY, IMPELLER
126A	DEFLECTOR, INNER
126B	DEFLECTOR, OUTER
139	HOUSING, THRUST BEARING
140A	SEAL, INNER GREASE
156	GASKET, VOLUTE
159	COVER, THRUST BEARING HOUSING
159A	SEAL, OUTER GREASE
161	LOCKNUT, BEARING
162	LOCKWASHER, BEARING
163	BEARING, INNER
168	BEARING, OUTER
202	COVER, VOLUTE HANDHOLD
203	GASKET, VOLUTE HANDHOLE COVER
206A	RETAINER, INNER GREASE
206B	RETAINER, OUTER GREASE
212	PACKING
272	KEY, COUPLING
407	BALANCE WEIGHT, IMPELLER

**OPTIONS TO BASIC PUMPS**

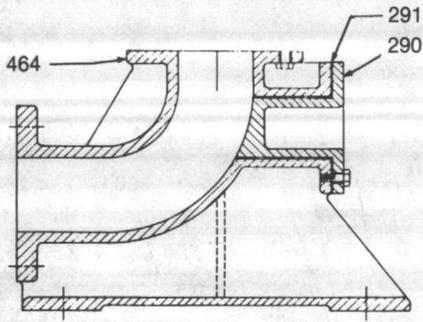
REF. NO.	DESCRIPTION
1	IMPELLER
16	WEAR RING, FRONTHEAD
17	WEAR RING, IMPELLER
31	SOLID GLAND
456	MECHANICAL SEAL

**B5422 FRAME T20  
AND B5423 FRAME T30  
(B5421 is same except integral volute)**

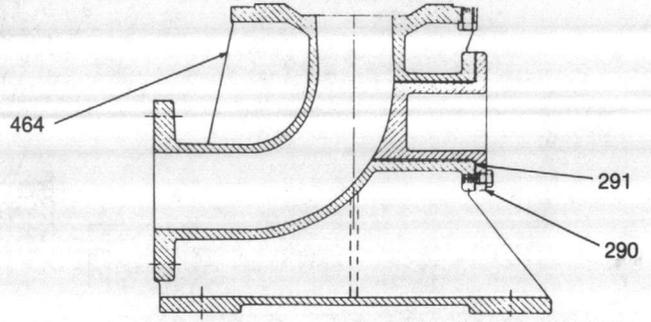


**B5421 INTEGRAL VOLUTE**

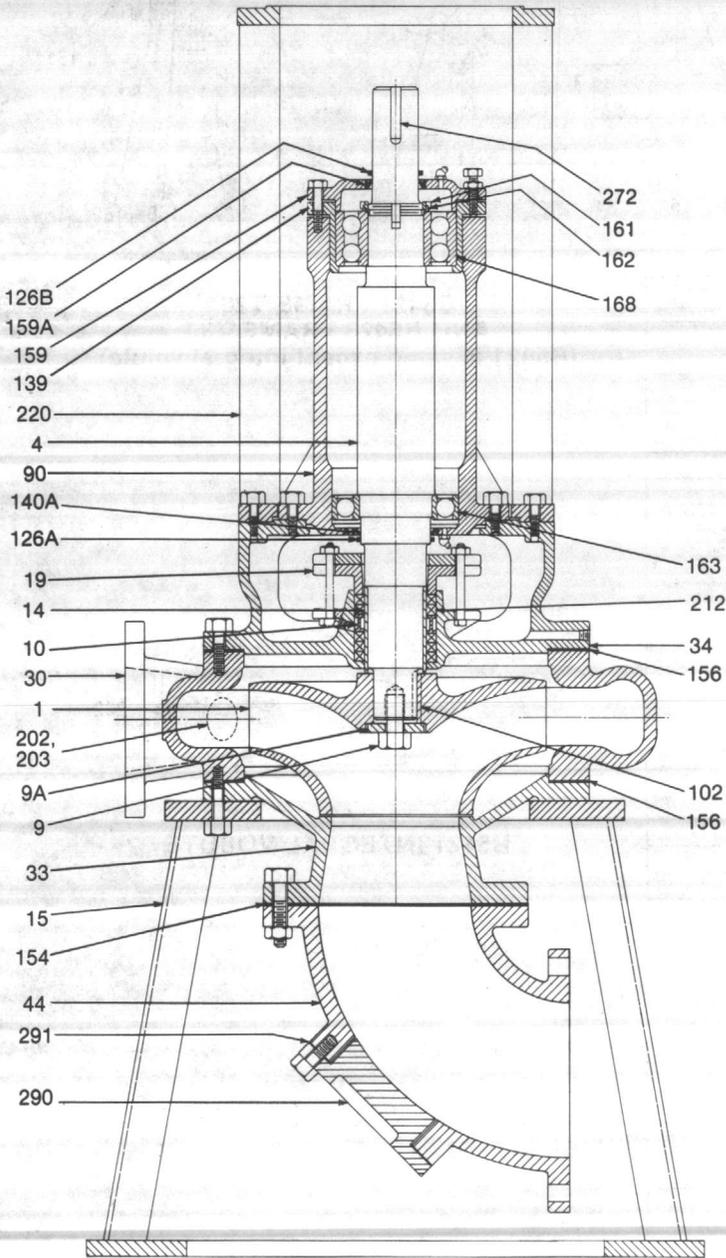
CROSS-SECTIONAL DRAWINGS  
AND PARTS LISTS — 5440



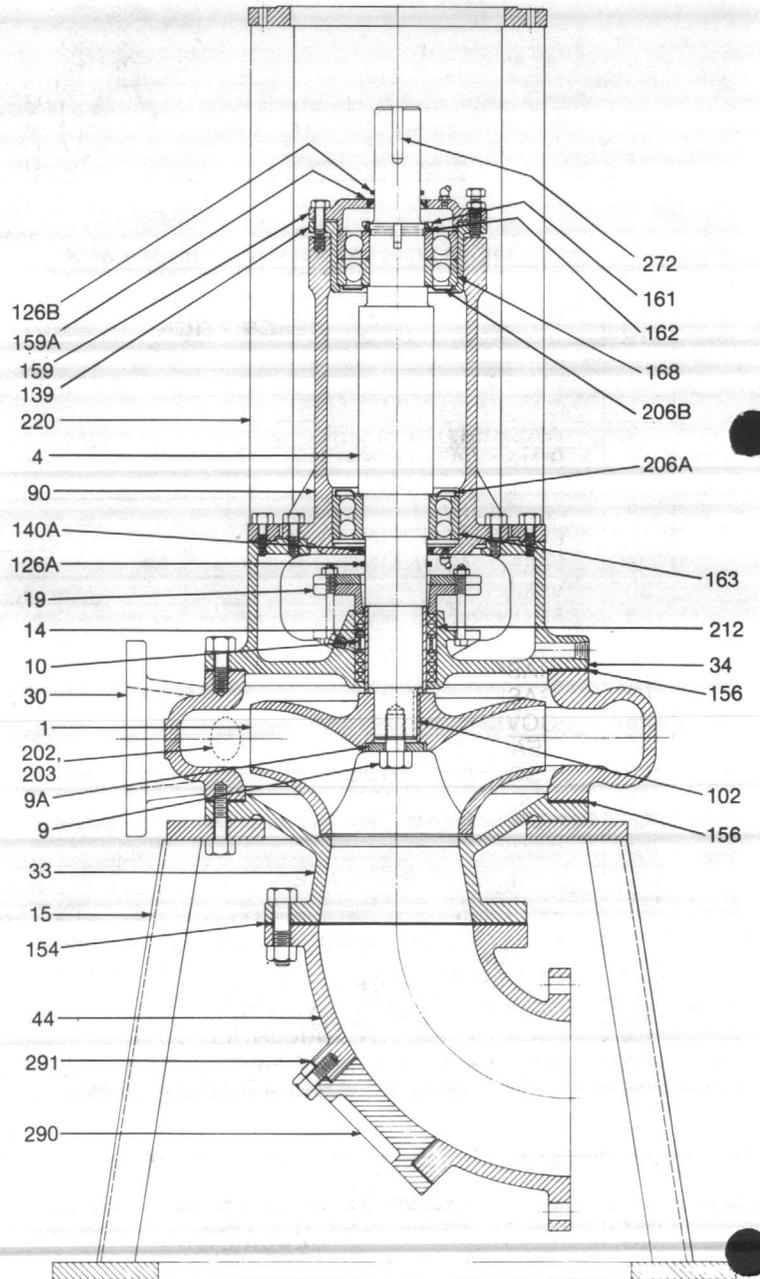
**B5441C - 4"**  
**(COMBINATION BASE-ELBOW)**



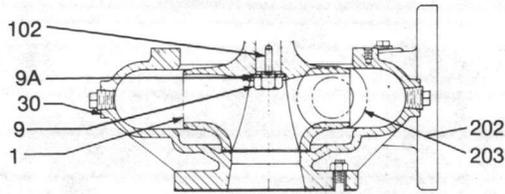
**B5442C - 4" AND B5443C - 4"**  
**(COMBINATION BASE-ELBOW)**



**B5444 AND B5446 - 5"**  
**FRAME T40**



**B5445 AND B5446 - 6" AND 8"**  
**FRAME T60**



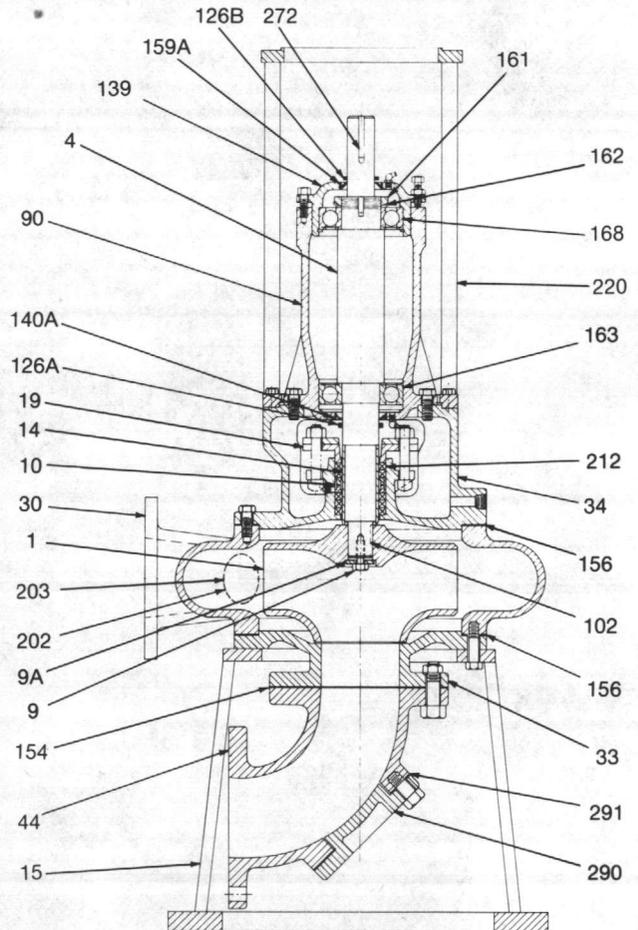
**B5441 INTEGRAL VOLUTE**

**B5440 AND B5440C  
VERTICAL COUPLED NON CLOG PUMPS  
PARTS LIST**

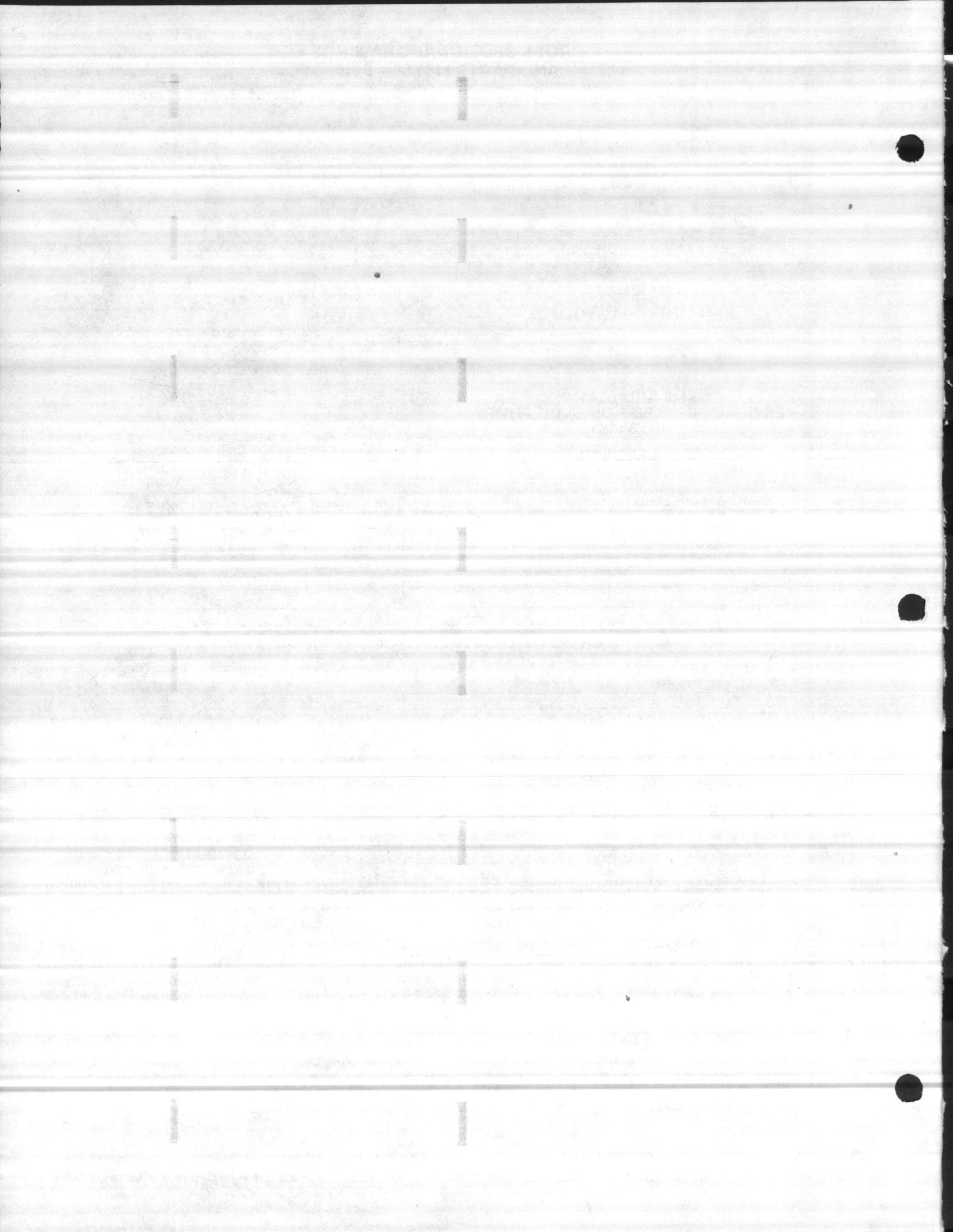
REF. NO.	DESCRIPTION
1	IMPELLER
4	SHAFT
9	CAPSCREW, IMPELLER
9A	WASHER, IMPELLER
10	RING, WATER SEAL
14	SLEEVE, SHAFT
15	BASE
19	GLAND HALF
30	VOLUTE
33	FRONTHEAD
34	ADAPTER, FRAME
44	SUCTION ELBOW
90	FRAME
102	KEY, IMPELLER
126A	DEFLECTOR, INNER
126B	DEFLECTOR, OUTER
139	HOUSING, THRUST BEARING
140A	SEAL, INNER GREASE
154	GASKET, ELBOW
156	GASKET, VOLUTE
159	COVER, THRUST BEARING HOUSING
159A	SEAL, OUTER GREASE
161	LOCKNUT, BEARING
162	LOCKWASHER, BEARING
163	BEARING, INNER
168	BEARING, OUTER
202	COVER, VOLUTE HANDHOLE
203	GASKET, VOLUTE HANDHOLE COVER
206A	RETAINER, INNER GREASE
206B	RETAINER, OUTER GREASE
212	PACKING
220	HIGH RING BASE
272	KEY, COUPLING
290	COVER, HANDHOLE
291	GASKET, HANDHOLE COVER
407	BALANCE WEIGHT, IMPELLER
464	SUCTION ELBOW (BASE COMBINATION)

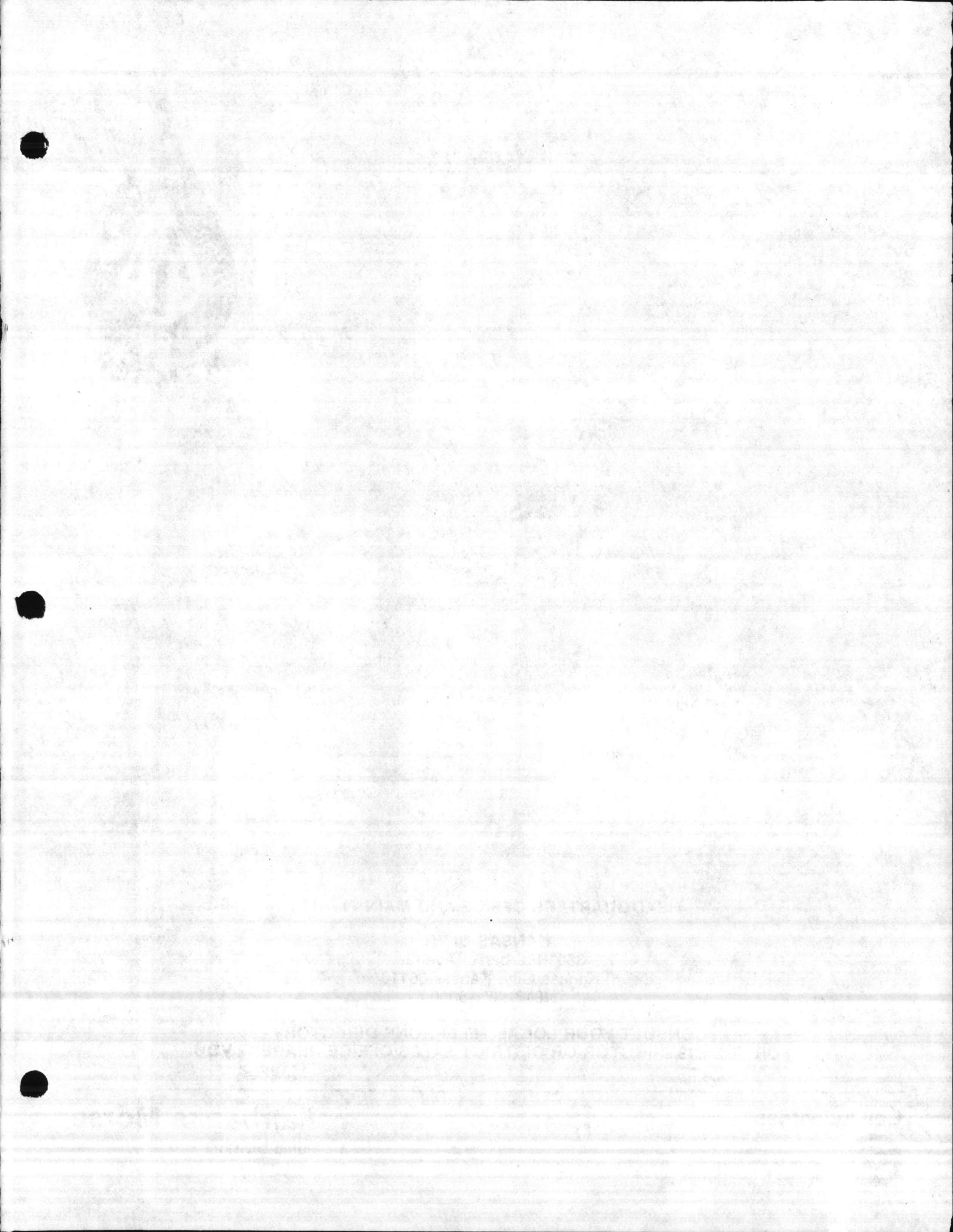
**OPTIONS TO BASIC PUMPS**

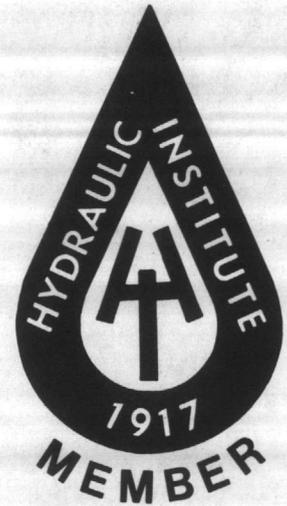
REF. NO.	DESCRIPTION
1	IMPELLER
16	WEAR RING, FRONTHEAD
17	WEAR RING, IMPELLER
19	GLAND HALF
31	SOLID GLAND
456	MECHANICAL SEAL



**B5442 AND B5443  
FRAME T20 AND T30  
(B5441 is same except integral volute)**







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**Fairbanks Morse**

Pump Division



## INSTRUCTIONS

GEH-4214C

# TRI/CLAD<sup>®</sup> VERTICAL INDUCTION MOTORS

## NORMAL THRUST, SOLID SHAFT, "P" BASE

### FRAMES C254-C405, D254-D405, K254-K405, L213-L256

### OPEN ENCLOSURES

#### INTRODUCTION

General Electric vertical motors covered by these instructions are carefully constructed of high-quality materials and are designed to give long periods of trouble-free service when properly installed and maintained.

The ventilating openings and the bearing lubrication system have been arranged for the ultimate in vertical motor operation. Therefore, these normal-thrust motors (see Fig. 1) are suitable for operation in the shaft-down position only unless otherwise recommended by the General Electric Company.

General mechanical construction for wound-rotor motors is the same as for other types with the addition of rings, brushes, rotor windings, etc. (see Fig. 4).

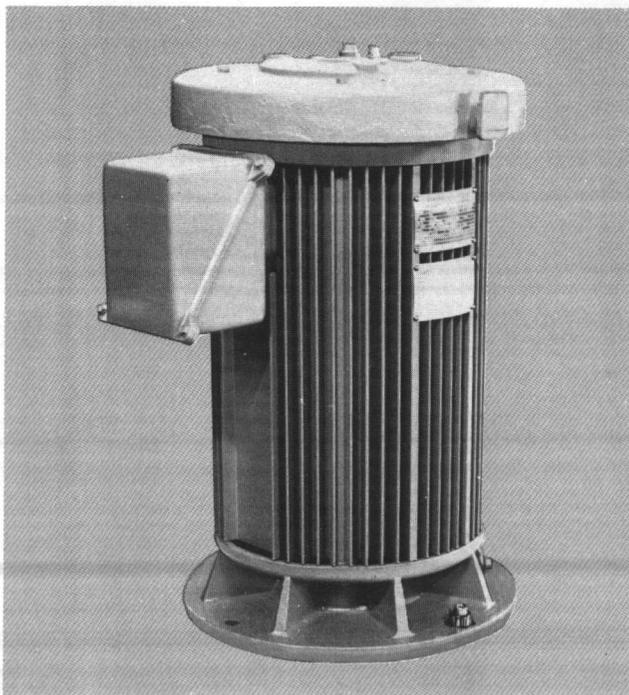


Fig. 1. Typical vertical motor

#### RECEIVING, HANDLING AND STORAGE

Each motor should be carefully examined upon arrival, and any damage reported promptly to the carrier and to the nearest office of the General Electric Company.

**WARNING:** *LIFTING DEVICES ARE NORMALLY INTENDED TO BE USED IN HANDLING THE MOTOR ONLY, AND ARE NOT INTENDED TO LIFT THE COMBINED WEIGHT OF THE MOTOR AND ITS CONNECTED LOAD. HOWEVER, IF A SPREADER BAR IS USED TO PROVIDE PARALLEL LIFTING FORCES IN LINE WITH THE AXIS OF THE MOTOR AND PRECAUTION IS USED TO AVOID SHOCK LOADING, CONNECTED LOADS NOT EXCEEDING 200 PERCENT OF THE MOTOR WEIGHT CAN NORMALLY BE SAFELY HANDLED WITH THE MOTOR LIFTING DEVICES.*

If the motor is not to be installed immediately, it should be stored in a clean, dry location. Precautions should be taken to prevent the entrance of moisture, dust, or dirt during storage and installation.

During storage, windings should be protected from excessive moisture absorption by some safe and reliable method of heating. Space heaters, if supplied, may be used for this purpose. The temperature of the windings should always be maintained a few degrees above the temperature of the surrounding air. It is recommended that motors in storage be inspected, the windings meggered, and a log of insulation resistance and temperature kept. Any significant decrease in insulation resistance should be investigated.

See **RELUBRICATION** for details of lubrication of motors in storage.

If the motor is to be in storage for over one year, it is recommended that competent technical inspection service be contracted for, such as General Electric Installation and Service Engineering Department, to ensure that the storage has been adequate and that the motor is suitable for service.

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

## SAFETY PRECAUTIONS

### WARNING

High voltage and rotating parts can cause serious or fatal injury. The use of electric machinery, like all other utilization of concentrated power and rotating equipment, can be hazardous. Installation, operation, and maintenance of electric machinery should be performed by qualified personnel. Familiarization with NEMA Publication MG2, *Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators*, the National Electrical Code, and sound local practices is recommended.

For equipment covered by this instruction book, it is important to observe safety precautions to protect personnel from possible injury. Among the many considerations, personnel should be instructed to:

- avoid contact with energized circuits or rotating parts,
- avoid by-passing or rendering inoperative any safeguards or protective devices,
- avoid extended exposure in close proximity to machinery with high noise levels, and
- use proper care and procedures in handling, lifting, installing, operating and maintaining the equipment.

Safe maintenance practices with qualified personnel are imperative. Before initiating maintenance procedures, be sure that *all* power sources are disconnected from the machine and accessories to avoid electric shock. High potential insulation test for this equipment is not recommended; however, should it be required, procedures and precautions outlined in NEMA Standards MG-1 should be followed.

Failure to properly ground the frame of this machine may cause serious injury to personnel. Grounding should be in accordance with the National Electrical Code and consistent with sound local practice.

## INSTALLATION

### LOCATION AND MOUNTING

**WARNING:** MOTORS SHOULD BE LOCATED IN A SUITABLE ENCLOSURE TO PREVENT ACCESS TO THE MOTOR BY CHILDREN OR OTHER UNAUTHORIZED PERSONNEL IN ORDER TO PREVENT POSSIBLE ACCIDENTS. THIS IS ESPECIALLY IMPORTANT FOR MOTORS THAT ARE REMOTELY OR AUTOMATICALLY CONTROLLED OR HAVE AUTOMATIC RESETTING OVERLOAD RELAYS, SINCE SUCH MOTORS MAY START UNEXPECTEDLY.

Allow enough space around the motor to permit free flow of ventilating air and to maintain an ambient temperature of not over 40 C. Where a choice of locations is possible, install the motor so it will be subjected to the least amount of dirt, dust, liquid, and other harmful materials. Mount the motor securely on a level, firm foundation, align accurately with the driven equipment, and tighten mounting bolts securely.

Some precautions are necessary to assure satisfactory operation of motors in pumping service. The packing gland in the pump head should be kept

in good condition so that the liquid being pumped will not be forced out along the shaft and enter the motor through the lower bearing housing. Motors driving pumps in pressure systems, where the pressure is maintained after shutdown, should be protected from overspeeding by check valves.

### Direct Drive

Normal-thrust motors (see Fig. 2) utilize heavy-duty, deep-groove ball bearings which are suitable for some continuous up or down axial-thrust load. Since overloading greatly reduces bearing life, the amount of thrust applied should not exceed the recommended values. There are some applications which require special bearing constructions as shown in Fig. 3 or alternate end-shield constructions shown in Fig. 5.

### V-Belt Drive

Since belting places relatively high radial loads on the shaft and bearings, motors must be specifically ordered for such service. To limit these loads to reasonable values, adhere to the minimum sheave diameter and maximum sheave width specified by the General Electric Company. Belt speed, center distance, and pulley ratios should be within the limits of good belting practice as specified by the belt manufacturer. The belt speeds should not exceed 5,000 feet per minute unless otherwise recommended by the manufacturer of the belt.

After October 1, 1983, the San Jose Motor Plant will start using a higher temperature grease in our motor product line.

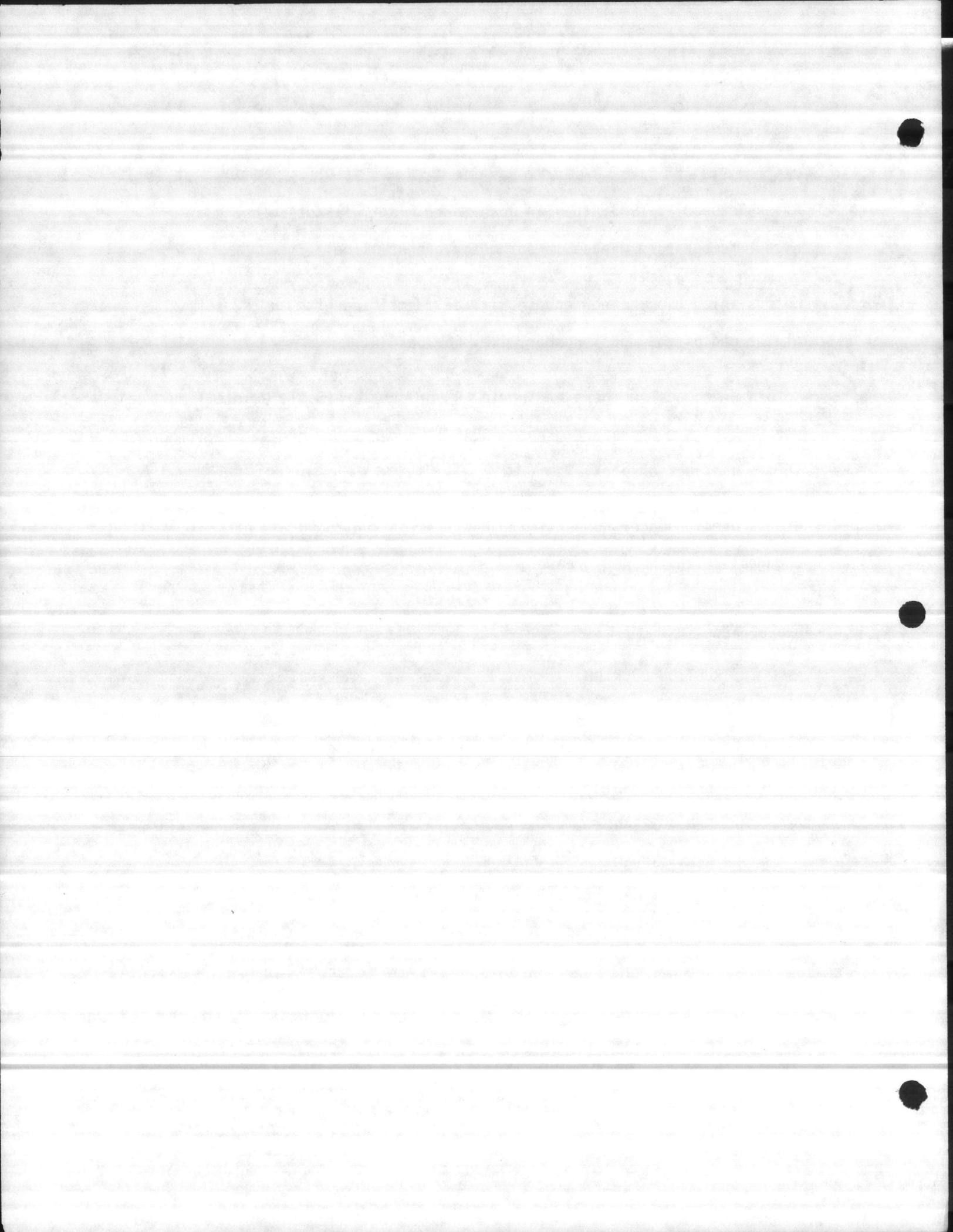
Motors which use the new grease will be identified with an "R" suffix at the end of the model number, i.e. 5K6256XC1R.

Motors with model numbers ending in "R" or greater (S, T, U, etc.) must use G.E. high temperature grease #D6A2C14 and not the grease specified in the instruction book.

Grease used on model numbers with suffixes "A" up to "Q" is not interchangeable with the new grease.

REFERENCE:

INSTRUCTION BOOK NO.	PAGE NO.
GEH - 3290E	7
GEH - 3291E	8
GEH - 3293D	7
GEH - 3294D	8
GEH - 3296C	4
GEH - 3297C	4
GEH - 4210D	7
GEH - 4211C	5
GEH - 4212C	7
GEH - 4213B	7
GEH - 4214C	4



**WARNING: ALL BELTS SHOULD BE ENCLOSED TO PREVENT INJURY FROM THROWN PARTS IN CASE A BELT SHOULD BREAK IN SERVICE.**

Align the sheaves carefully to avoid axial thrust on the bearings and excessive belt wear. Tighten the belts only enough to prevent slipping. Excessive tension will reduce bearing life and may cause the shaft to break.

### **ELECTRICAL CONNECTIONS**

Select and install control equipment and wiring according to National Electrical Code and sound local practice. Check the voltage and frequency with nameplate values. The motor will operate successfully, but with somewhat modified characteristics, when the line voltage is within plus or minus ten percent of nameplate value, the frequency within plus or minus five percent, or the combined variation within plus or minus ten percent (provided the frequency variation does not exceed five percent).

200-volt motors are designed for use on 208-volt systems.

Operation of a motor rated 230 volts on a 208-volt system is not recommended because utilization voltages are commonly encountered below the minus 10-percent tolerance on the voltage rating for which the motor is designed. Such operation will generally result in excessive overheating and serious reduction in torques (National Electrical Manufacturers Association).

### **LUBRICATION**

All grease-lubricated bearing housings are packed with the proper amount of GE grease before leaving the factory and will not require regreasing until they have been in service for a time.

See instructions under MAINTENANCE for relubrication recommendations.

### **OPERATION**

Check the electrical connections.

When possible, leave the motor disconnected from the load for the initial start. First, make sure that the rotor turns freely; then, operate the motor without load for about an hour to test for excessive vibration and for any unusual, localized heating in the bearings and winding.

To reverse the direction of rotation of a three-phase motor, interchange any two line leads; to reverse direction of a two-phase motor, interchange T<sub>1</sub> and T<sub>3</sub>.

Operate the motor under load and check the current. Do not exceed the steady value of nameplate amperes times service factor.

### **MAINTENANCE**

**WARNING: BEFORE INITIATING MAINTENANCE PROCEDURES, DISCONNECT ALL POWER SOURCES TO THE MACHINES AND ACCESSORIES AND COMPLETELY DISCHARGE ALL PARTS AND ACCESSORIES WHICH MAY RETAIN ELECTRIC CHARGE. FAILURE TO DO SO CAN RESULT IN SEVERE PERSONAL INJURY.**

### **INSPECTION AND CLEANING**

A systematic inspection should be made at regular intervals, depending on service and operating conditions.

Keep both the interior and exterior of the motor free from dirt, oil, and grease. Open motors should be kept as dry as possible; if operating in dirty places, they should be disassembled periodically and thoroughly cleaned.

Motors may be blown out with dry compressed air of moderate pressure, but cleaning by suction is preferred due to the possibility of water in the compressed air lines and the danger of blowing metal chips into the insulation with compressed air.

**WARNING: SCREENS AND COVERS ARE PROVIDED AS NECESSARY FOR PROTECTION OF THE EQUIPMENT AND PERSONNEL. ALL SCREENS MUST BE KEPT FREE OF DIRT AND DEBRIS TO ENSURE PROPER VENTILATION, AND MAINTAINED IN PLACE FOR PROTECTION OF PERSONNEL.**

### **RELUBRICATION**

Motors covered by these instructions employ grease lubrication for both the upper (guide) bearing and the lower (thrust) bearing.

The bearing housings are packed at the factory with sufficient long-life grease for an initial operating period. Since the oil in the grease will ultimately become depleted, it is necessary to regrease at intervals consistent with the service. The following recommendations are offered as a guide in determining the relubrication period.

## GEH-4214, Vertical Induction Motors

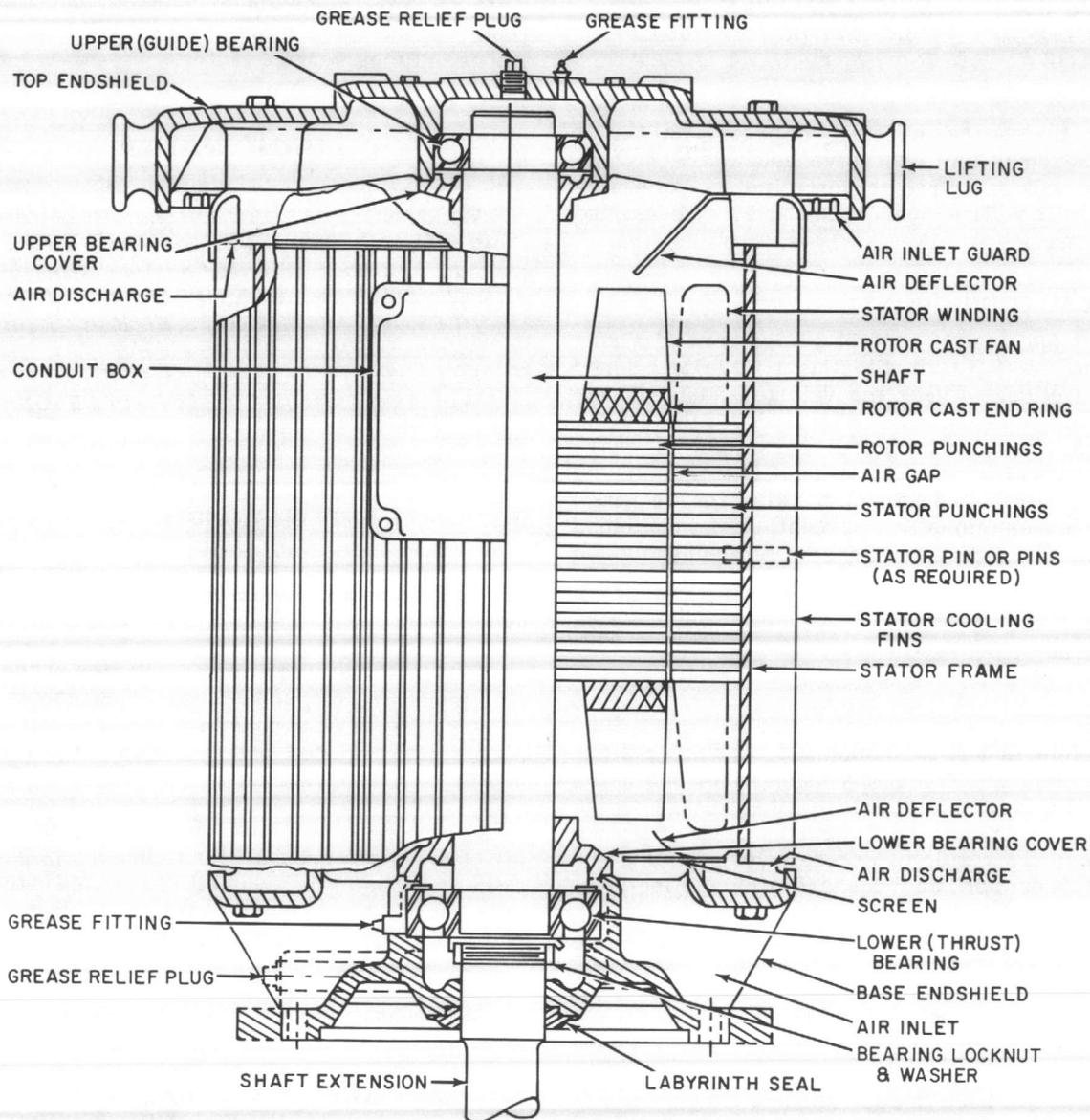


Fig. 2. Typical normal-thrust, solid-shaft motor for frames C, D, K254-405 or L213-256

Guide bearings in vertical motors carry relatively light loads, and, under normal conditions of operation, can be regreased every three to five years. When conditions are more severe (high temperatures, dirty locations, motor running continuously, etc.), regrease every one to three years.

Regrease the thrust bearings of motors with speeds above 1800 rpm every 1000 hours of operation with the interval not to exceed three months. For motors with speeds 1800 rpm and below, regrease every 2000 hours of operation, with the interval not to exceed six months.

Relubrication procedure is as follows. Remove the grease relief plug and free the relief passage

of hardened grease. Wipe the grease fitting clean. Or, if no fitting is supplied, replace the 1/8-inch pipe plug with a standard fitting.

For best results, use GE long-life grease (No. D6A2C5). Take care to exclude dirt from the bearing housing and lubricant. With the motor at standstill, add grease, using a hand-operated gun, until the grease begins to move in the relief passage. Allow the motor to run about ten minutes before replacing the relief plug.

Motors in storage and motors that are to stand idle for a prolonged period and be subjected to moisture from condensation should have the thrust-bearing housing filled with grease to minimize corrosion.

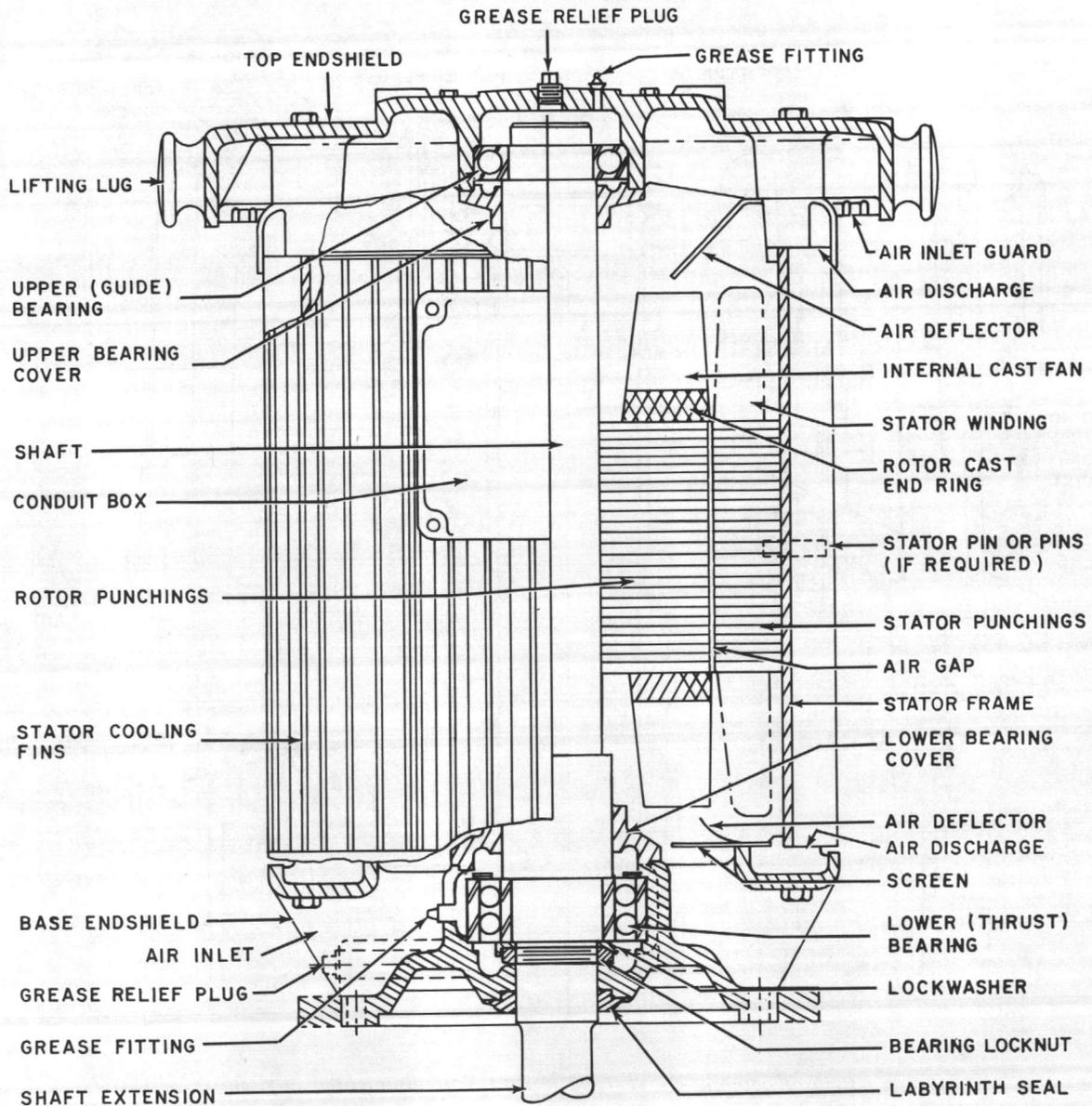


Fig. 3. Special lower bearing construction for frames C, D, K254-405 or L213-256

Add grease until it comes all the way out of the relief passage. When the motor is again started, run it with the relief plug removed for about ten minutes to expel excess grease.

Since the above method tends to purge the bearing housing of used grease, complete removal of all grease should be required only at infrequent intervals. Whenever the motor is disassembled for general cleaning and reconditioning, the housing should be cleaned of old grease, using a suitable cleaning solvent, and dried thoroughly. Refer to the mixture described under INSULATION CARE. Pack the cavity above the bearing with D6A2C5 grease until it is approximately two-thirds full before reassembling.

#### INSULATION CARE

Whenever the motor is disassembled for general cleaning, the windings should be brushed free of dust and washed with a cloth or brush wet with a suitable cleaning solvent.

The cleaning fluid used to clean the coils must have grease-dissolving properties, but must not affect the electric insulation or varnish. Many cleaning fluids in common use, which are suitable with respect to the foregoing, may be extremely hazardous because of their toxicity, inflammability, or both. The following mixture is a suitable solvent for cleaning windings, bearings, and the bearing housing:

## GEH-4214, Vertical Induction Motors

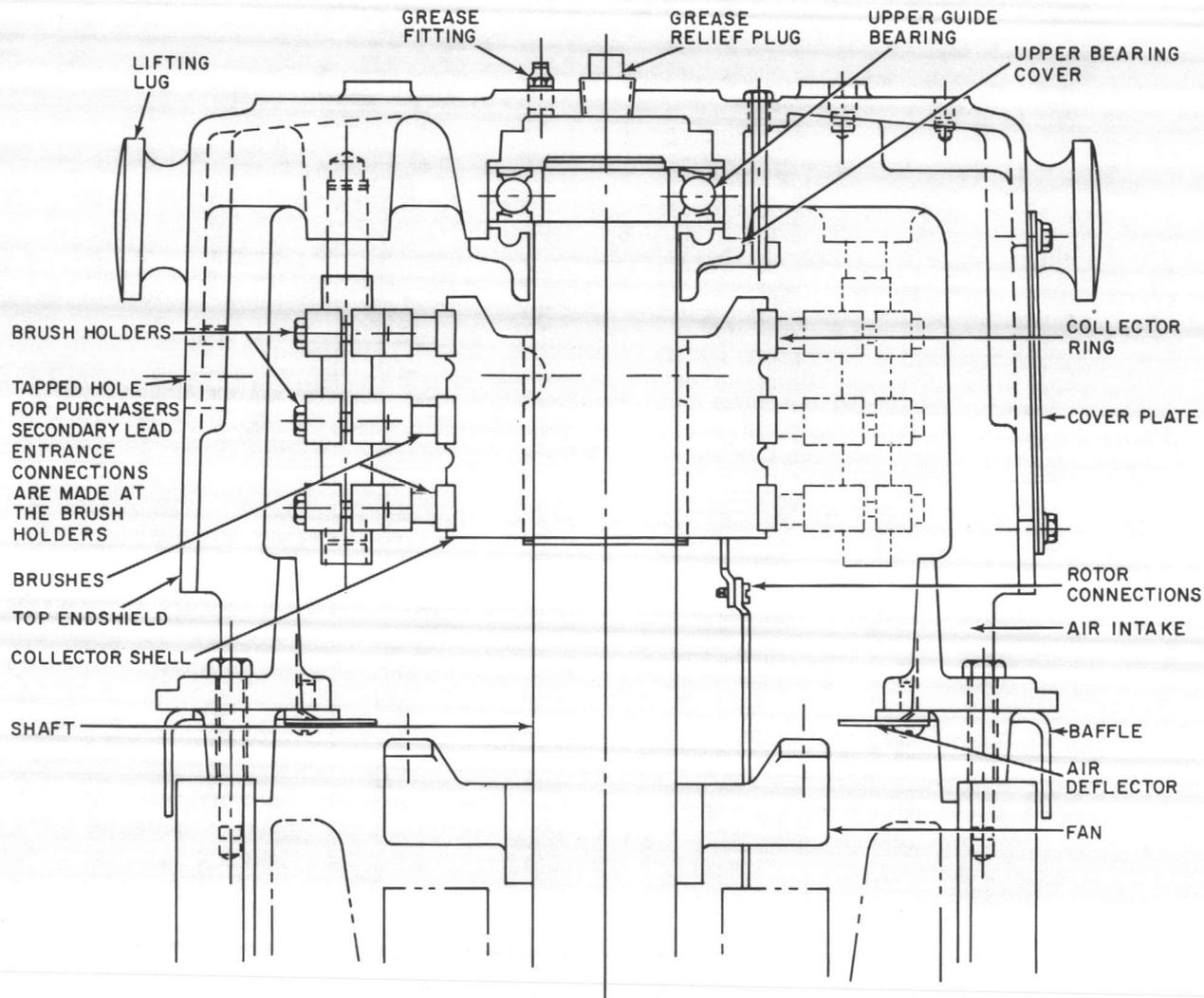


Fig. 4. Typical wound-rotor-type motor, showing rings, brushes, etc.

25 percent methylene-chloride (if unavailable, trichlorethylene may be substituted)

70 percent Stoddard solvent (petroleum spirits)

5 percent perchlorethylene

**WARNING:** WHEN USING THE ABOVE CLEANING FLUID, THE AREA MUST BE WELL VENTILATED AND SMOKING OR OPEN FLAMES PROHIBITED. FAILURE TO COMPLY CAN RESULT IN PERSONAL INJURY OR DEATH.

For best results, the windings should then be varnished with an air-drying varnish. More than one coat may be required, depending on the condition of the winding.

The General Electric Company can furnish insulating varnish best suited for definite operating conditions. Consult the nearest General Electric Sales Office.

**REWINDING CAUTION:** TO AVOID DAMAGE, THE TEMPERATURE OF THE ALUMINUM FRAME MUST NOT EXCEED 200C DURING THE STRIPPING OR BAKING PROCESS. AN OPEN FLAME SHOULD NOT BE USED.

### END-SHIELD ASSEMBLY

Add a thin coating of a non-conducting grease on end-shield rabbet and to threads of end-shield cap screws when assembling end shields to the aluminum frame. (GE Grease D6A2C5 is excellent for this purpose.)

## WOUND-ROTOR MOTORS

### COLLECTOR RINGS

Keep the rings clean and maintain their polished surfaces. Ordinarily, the rings will require only occasional wiping with a piece of canvas or nonlinting cloth. Do not let dust or dirt accumulate between the collector rings.

### BRUSHES

The brushes should move freely in the holders, and, at the same time, make firm, even contact with the collector rings.

When installing new brushes, fit them carefully to the collector rings. Be sure that the pigtail conductors are securely fastened to, and make good contact with, the brush holders.

**CAUTION:** DURING STARTING, EXTERNAL RESISTANCE MUST BE PROVIDED IN THE SECONDARY CIRCUIT TO PREVENT HIGH INRUSH CURRENT WHICH WOULD DAMAGE THE COLLECTOR RINGS AND BRUSHES.

### RENEWAL PARTS

When ordering parts, give description and state the quantity of parts desired, together with the nameplate rating and model and serial number of the motor.

Requests for additional copies of these instructions or inquiries for specific information should be addressed to the nearest office of the General Electric Company.

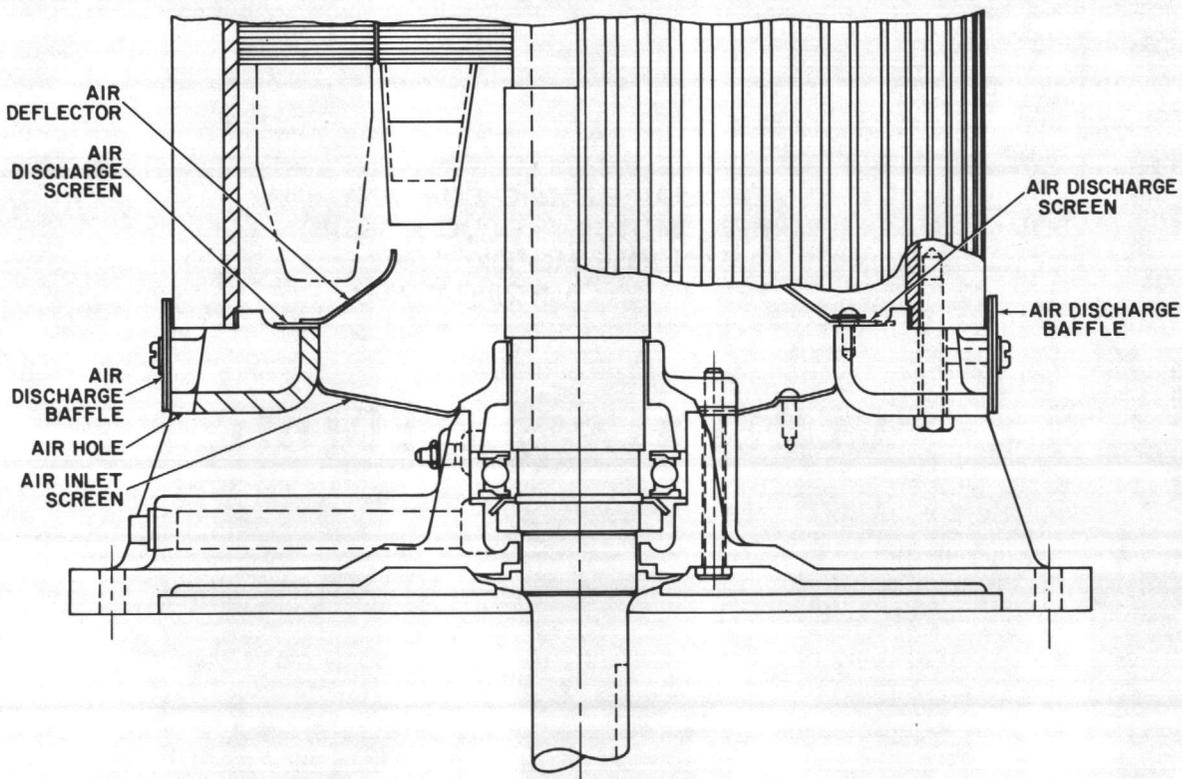


Fig. 5. An alternate lower end-shield construction used on frames C, D and K324 and above.

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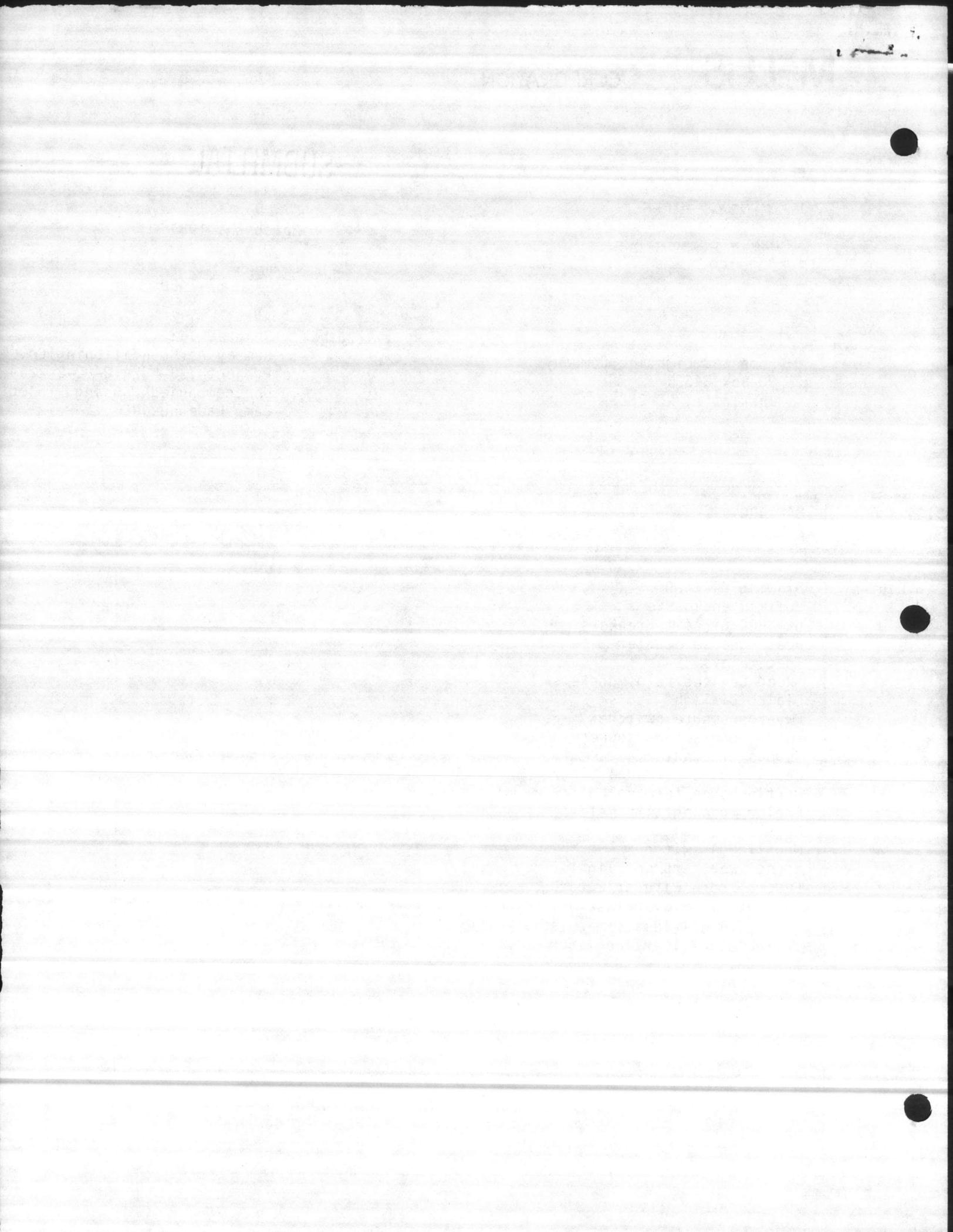
DATE March 20, 1984

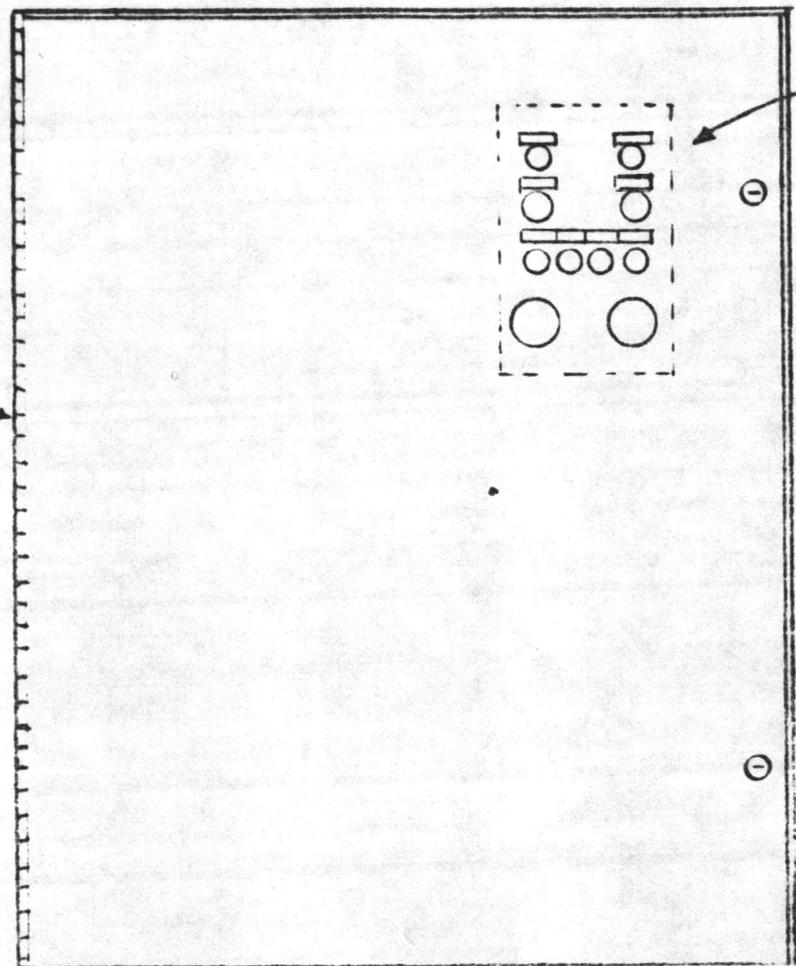
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9164-12D	84-1400			
QUANTITY	DESCRIPTION		PRICE	AMOUNT
8 Copies	Drawing 84-1400 Hoffman enclosure GE THQC Circuit Breakers Westinghouse Starter Idec relays Reed Devices relay sockets Dialco Dialight lamps Dwyer pressure switches Dwyer ratemaster flowmeters Furnas alternator Westinghouse terminal blocks Westinghouse terminal block mounting track Engler running time meters Mcgill TNS switch Mcgill HOA switch Stonco weatherproof light Federal horn with projector Eagle time delay relay Speedaire oil-less compressors Dayton air-filter/regulator <input checked="" type="checkbox"/> Marshalltown pressure guage			





Continuous Hinge

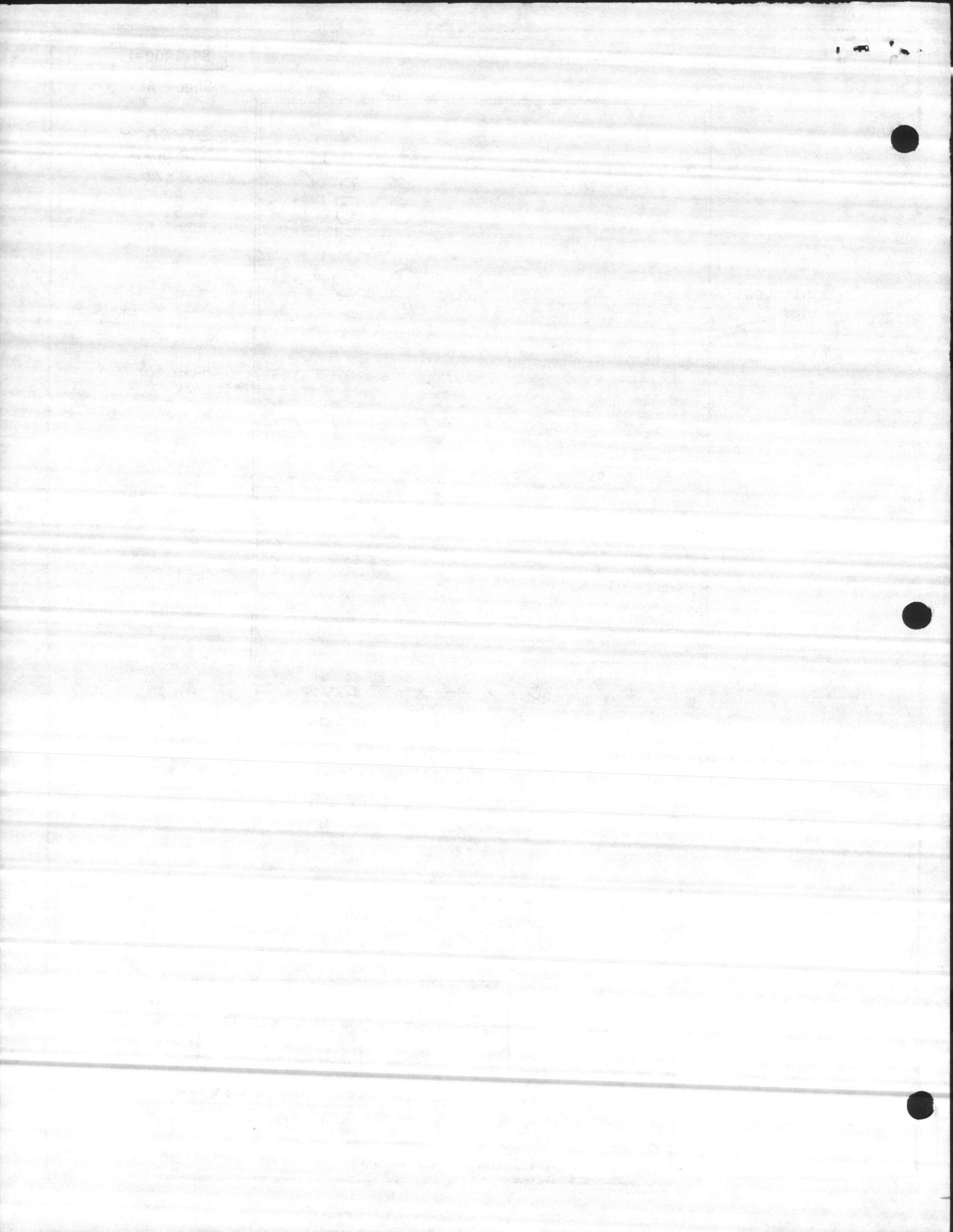
SWITCH PLATE INSIDE

Hasp for Lock

30" X 24 X 8" DEEP  
NEMA ENCLOSURE

Duplex Pump Control Enclosure with switches and indicating lights inside		
Scale	Ref #	DWG.
NONE	39164-12D	84-1400-1

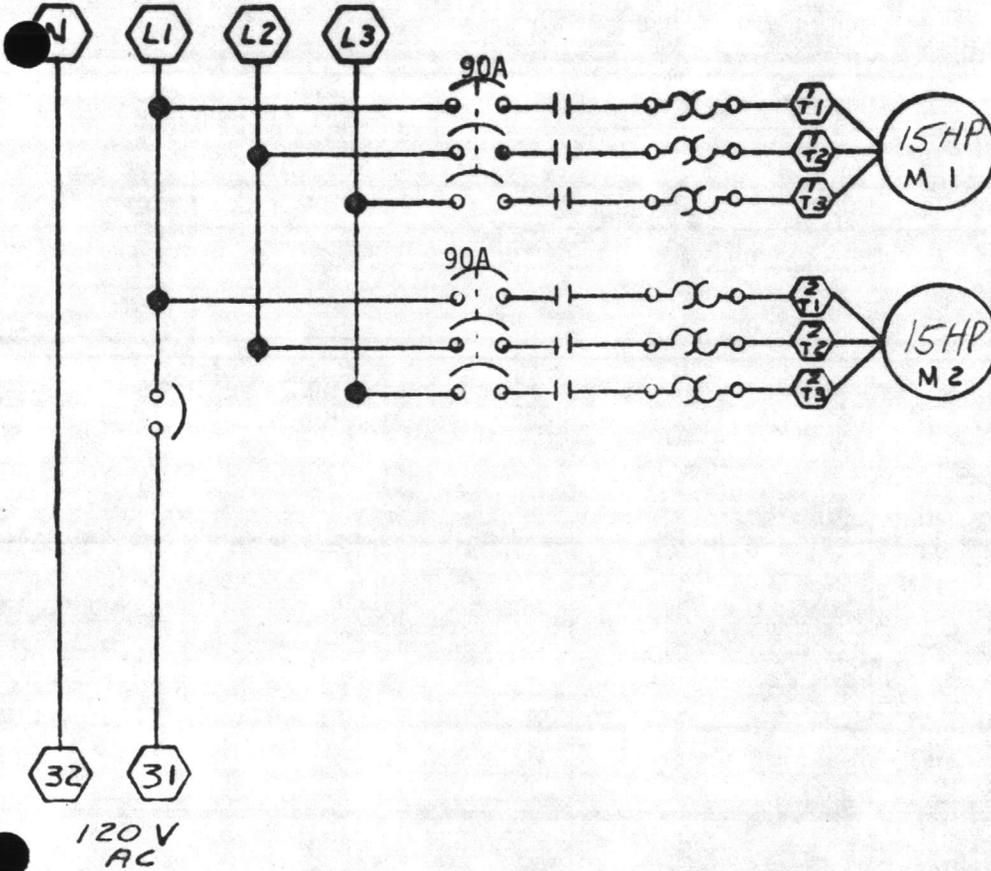
**MELLIS CORPORATION**  
 P.O. BOX 357      101 W. McIVER ST.  
 ANGIER, N.C. 27501      919-639-4100



Disconnect By Others  
208 Volt 3 Phase 60 Cycle  
4 Wire

84-1400-2

Sheet B - 4



PUMP CONTROL POWER SUPPLY Pump and Lighting Co. Ramsey Air Conditioning, Camp LaJeune NC		
CUSTOMER REF # 39164-12D		
Scale	Date	Dwg. #
NONE	3-20-84	84-1400-2

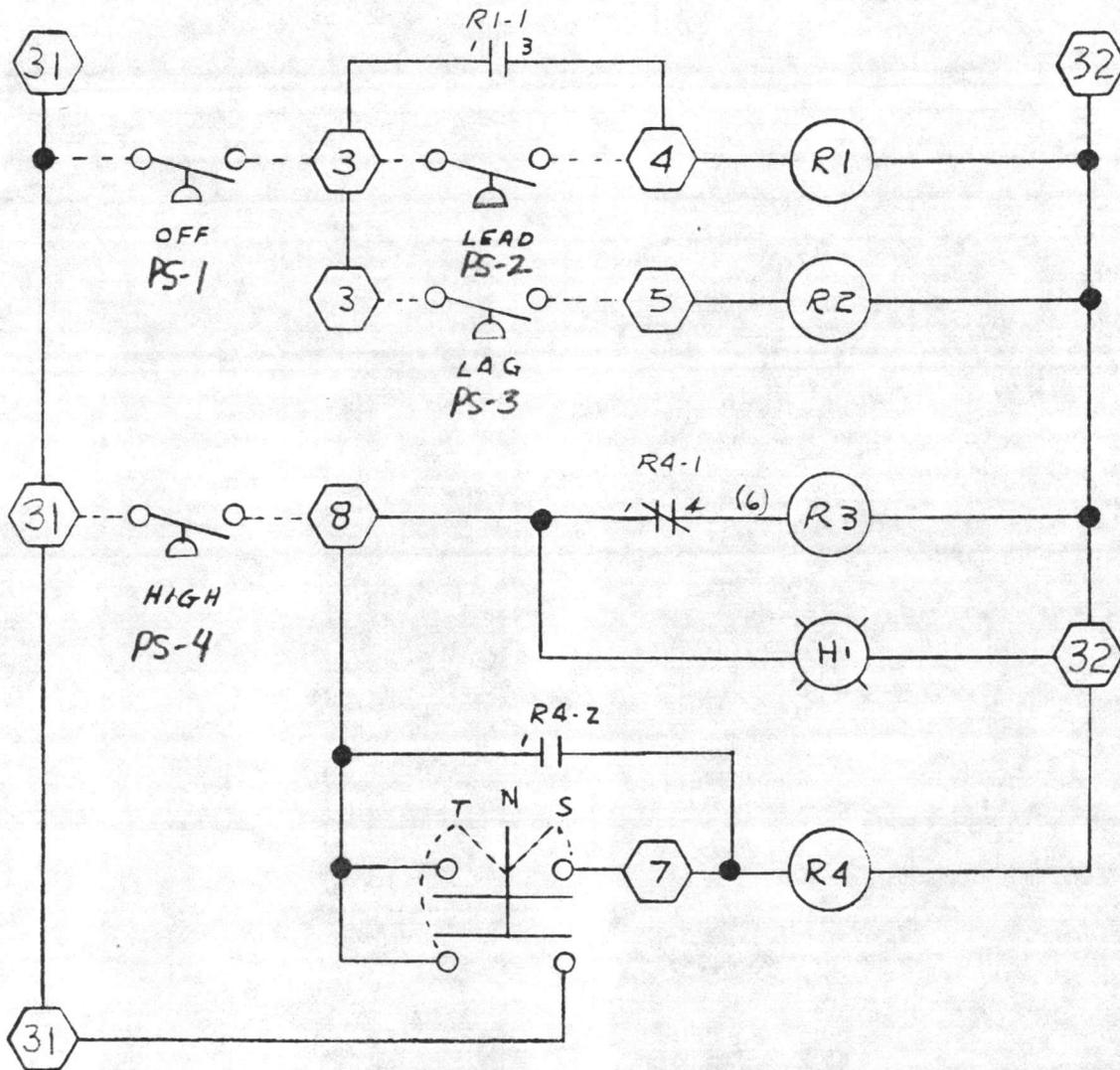
**MELLIS CORPORATION**  
P.O. BOX 357      101 W. McIVER ST.  
ANGIER, N.C. 27501      919-639-4100



4211-100-100-100-100-100

100-100-100-100-100-100

100-100-100-100-100-100



24 Volt Control for Floats & Alarm

Customer Ref. # 39164-12D

Scale

Date

Dwg. #

NONE

3-20-84

84-1400-3

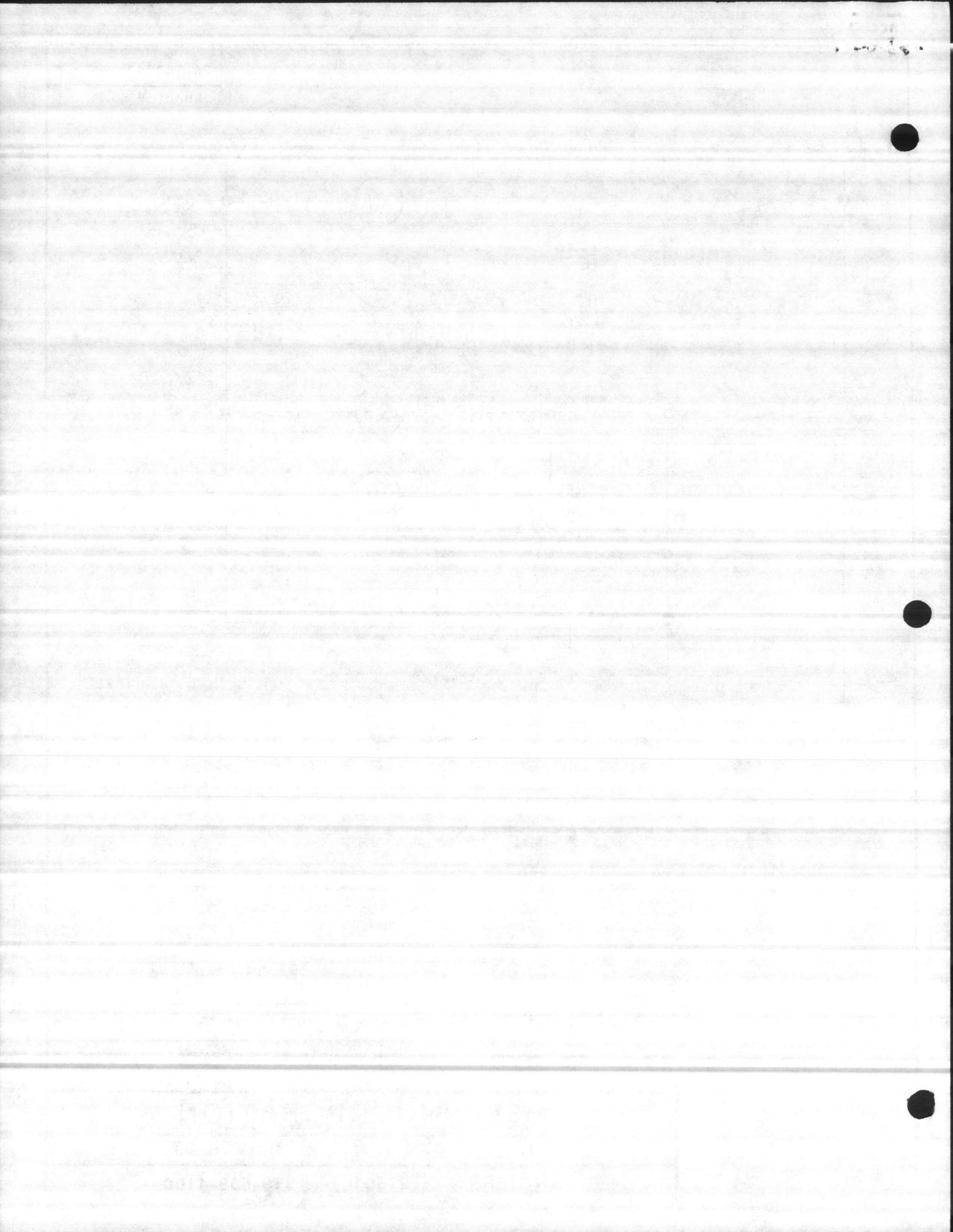
**MELLIS CORPORATION**

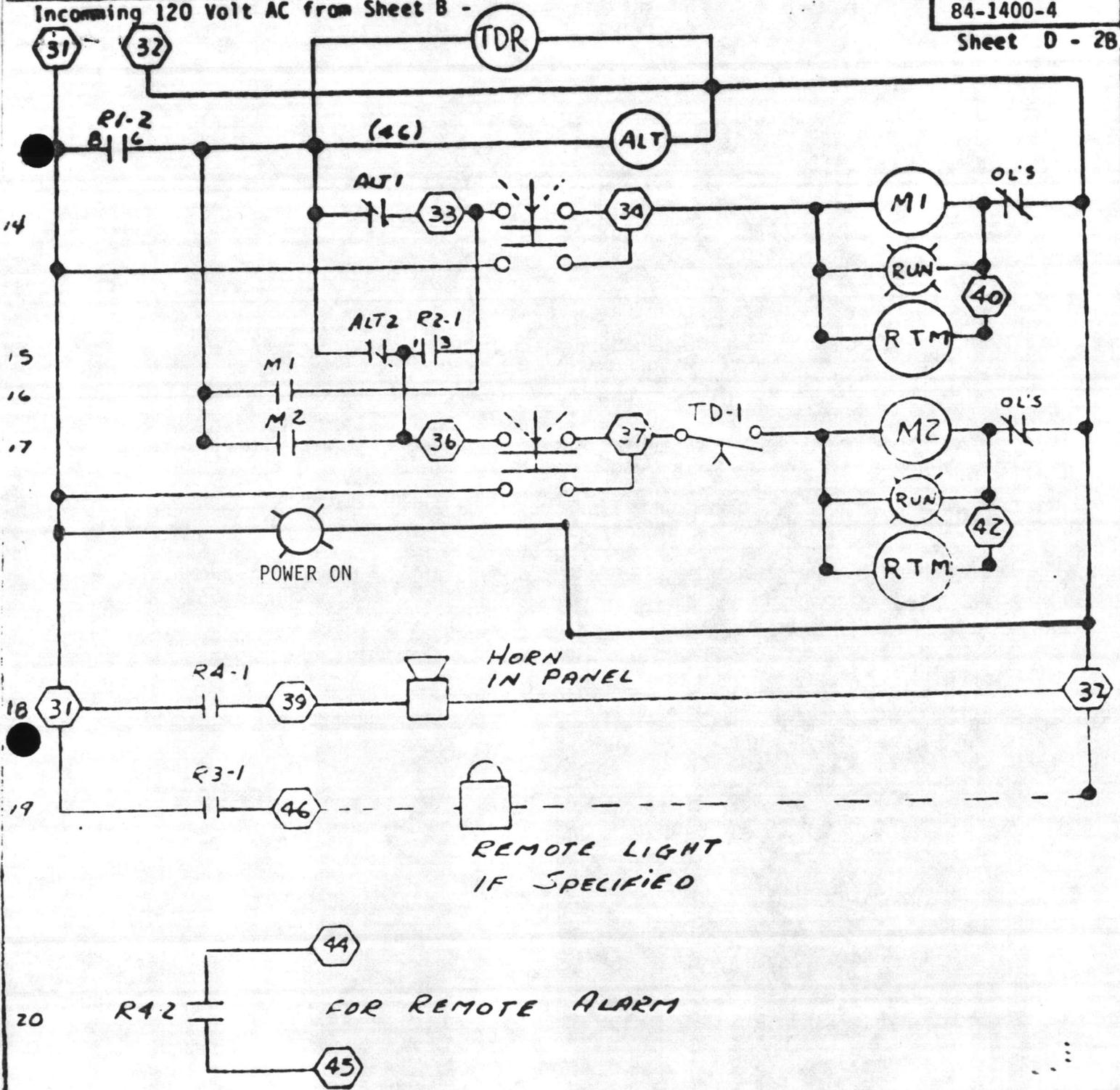
P.O. BOX 357

101 W. McIVER ST.

ANGIER, N.C. 27501

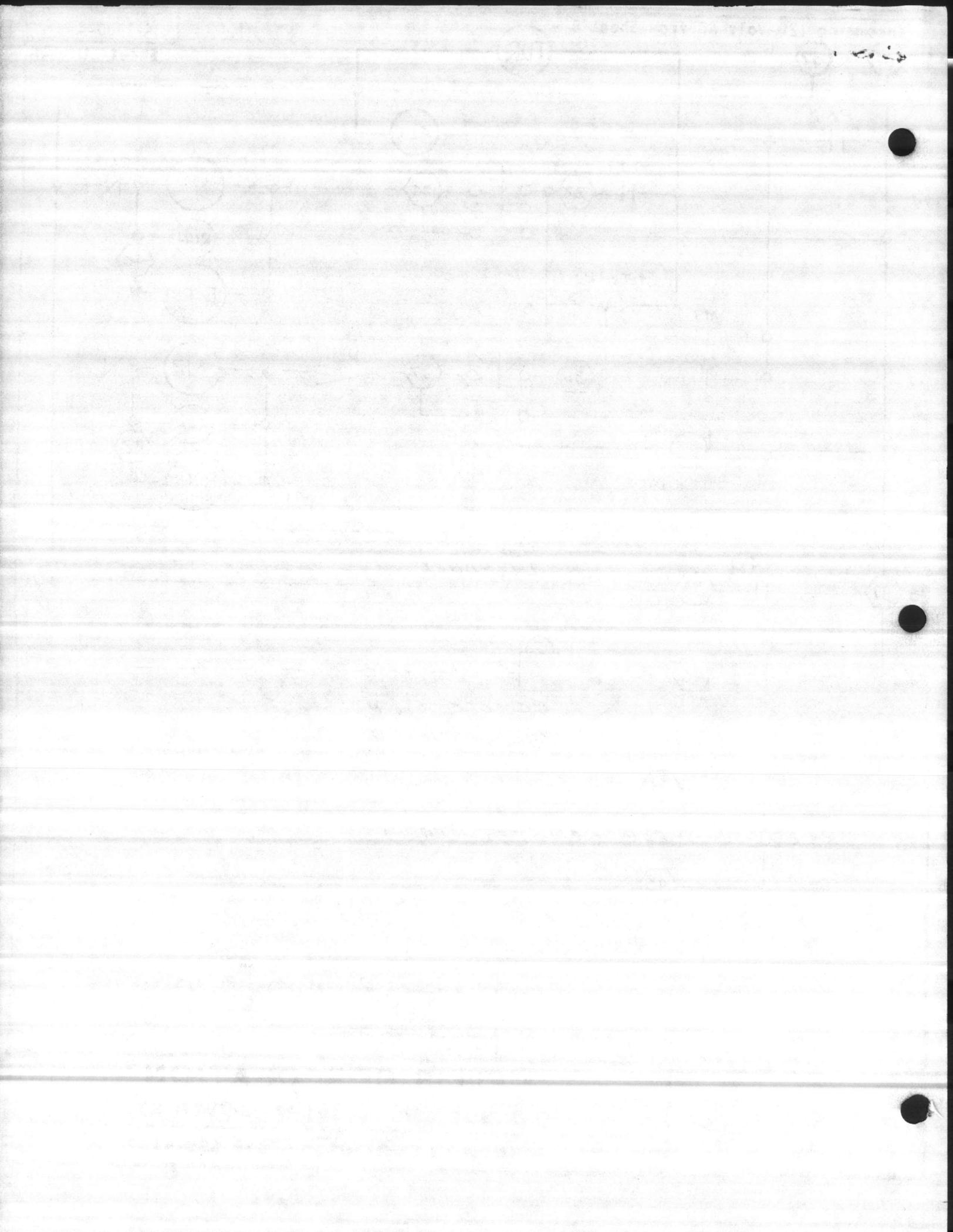
919-639-4100



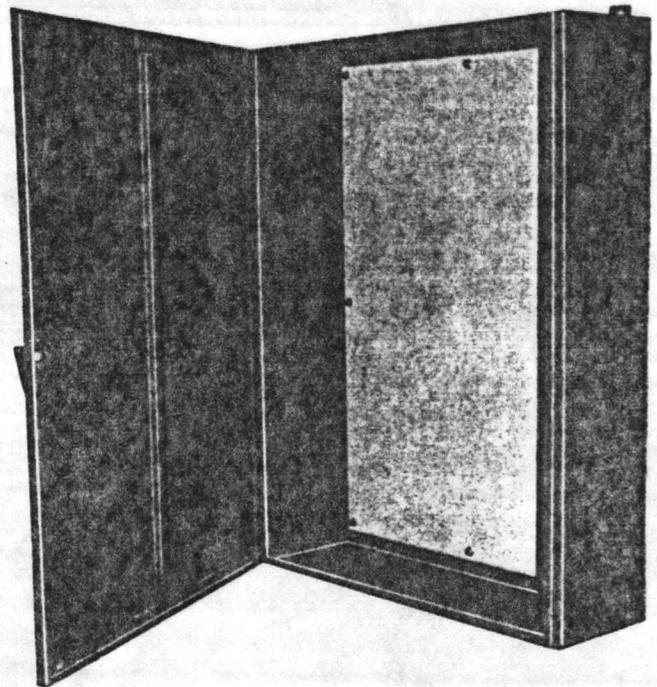
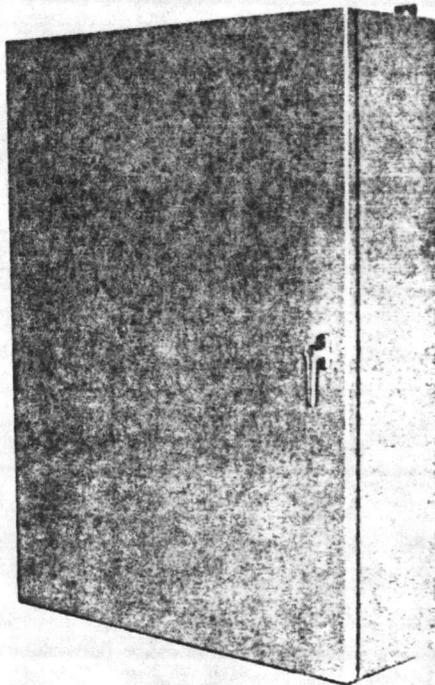


120 V Control Switches - Relays - Starters w/ optional remote light		
Ref. #39164-12-D	Date	Dwg.
Scale NONE	3-20-84	84-1400-4

**MELLIS CORPORATION**  
 P.O. BOX 357      101 W. McIVER ST.  
 ANGIER, N.C. 27501      919-639-4100



## EXTRA LARGE NEMA TYPE 1 ENCLOSURES



**APPLICATION** — Designed to house electrical and electronic controls, instruments, and components in areas which do not require the oil-tight and dust-tight characteristics of Hoffman NEMA Type 12 enclosures.

**CONSTRUCTION** — Made from 14 gauge steel. Doors have continuous hinges and non-locking handles with a single point latch. The door can be removed by pulling the hinge pin. Body stiffeners and door stiffeners are provided in larger enclosures for extra rigidity. External feet are furnished for mounting. Collar studs are provided for mounting the optional panels. **PANELS MUST BE ORDERED SEPARATELY.**

**ACCESSORIES** —

**PANELS** — Panels must be ordered separately as they are not furnished with the enclosures. Panels are 12 gauge steel.

**KEY-LOCKING LATCH KIT** — A key-locking handle can be installed in place of the regular handle. The catalog number of the key-locking latch kit is A-L2A, and it is described in Bulletin A-80.

**COOLING & VENTILATING PRODUCTS** — Air conditioners, blowers, fans, and louver plates provide cool air for overheated components. See Bulletin A-85 for details.

**TERMINAL KIT ASSEMBLIES** — Bracket assemblies and terminal straps are available for mounting terminal blocks. See Bulletin A-80 for details.

**WINDOW KITS** — Enable a person to see meters, displays, indicators, and other components located inside the enclosure. See Bulletin A-80 for details.

**SWING-OUT PANEL KITS** — Provide easy access to components mounted on swing-out panel located near front of enclosure. See Bulletin A-80 for details.

**MISC. ACCESSORIES** — Other accessories include hole seals, touch-up paint, and panel support kits. See Bulletin A-80 for details.

**FINISH** — The standard finish is gray prime inside and out over phosphatized surfaces. Panels are white enamel.

**MODIFICATIONS** — Hoffman can supply holes, hubs, louvers, cutouts, special finishes, special materials, special enclosure sizes, and many other modifications. Consult the factory for prices.

**INDUSTRY STANDARDS** — Conform to the National Electrical Manufacturers Association (NEMA) standard for Type 1 enclosures. All enclosures are listed by Underwriters Laboratories, Inc. For current Canadian Standards Association (CSA) listings, consult the factory. Conform to European Standard IEC 529, IP30.

**STANDARD SIZES**

Enclosure Catalog Number	Enclosure Size A x B x C	*Panel Catalog Number	Panel Size
A-42N3009	42 x 30 x 9 $\frac{1}{4}$	A-42P30	39 x 27
A-42N3609	42 x 36 x 9 $\frac{1}{4}$	A-42P36	39 x 33
A-48N3609	48 x 36 x 9 $\frac{1}{4}$	A-48P36	45 x 33
A-42N3011	42 x 30 x 11 $\frac{1}{4}$	A-42P30	39 x 27
A-42N3611	42 x 36 x 11 $\frac{1}{4}$	A-42P36	39 x 33
A-48N3611	48 x 36 x 11 $\frac{1}{4}$	A-48P36	45 x 33
A-48N3617	48 x 36 x 17 $\frac{1}{4}$	A-48P36	45 x 33

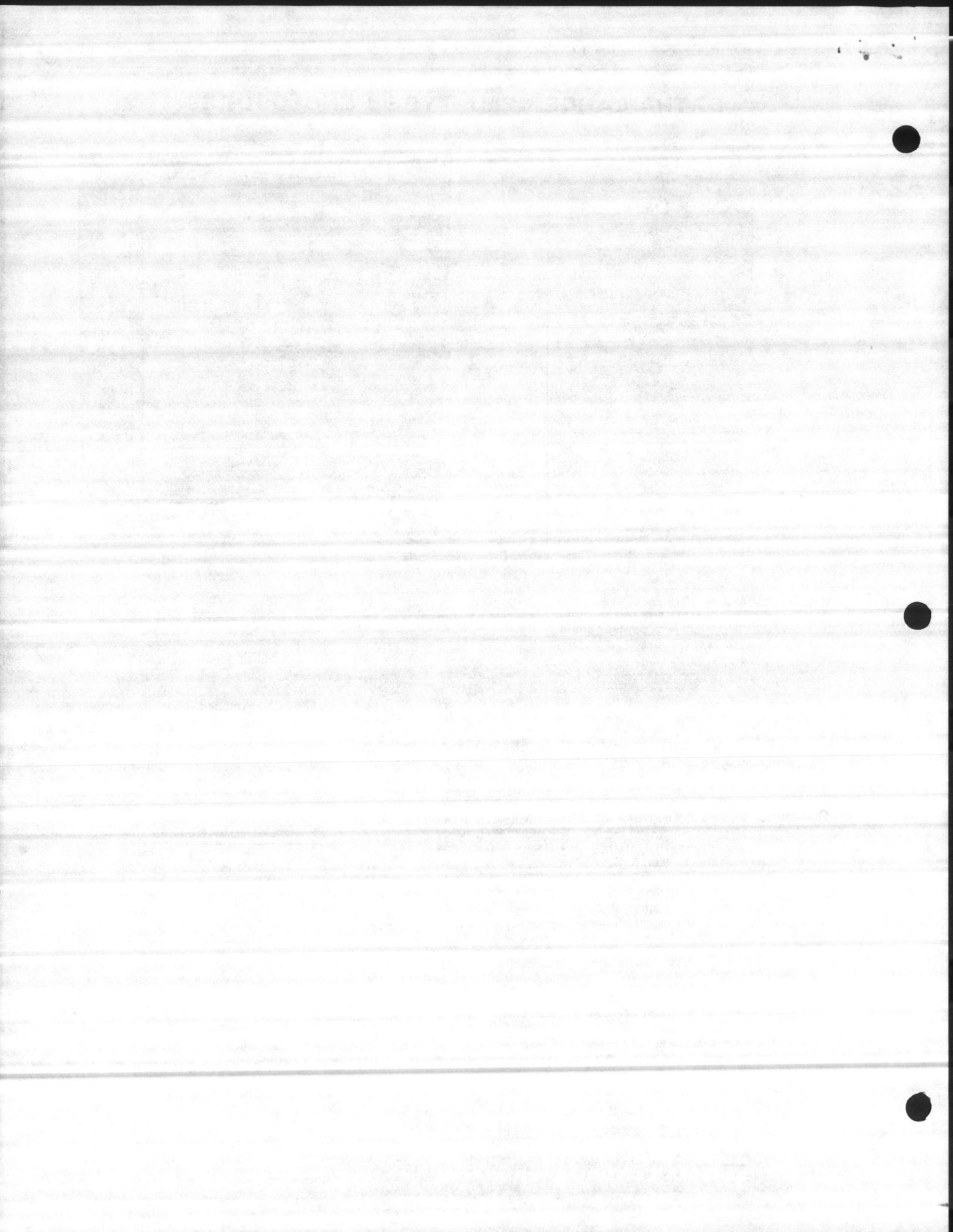
\*Panels must be ordered separately.

SEE DRAWING ON REVERSE SIDE

MC Job 84-1400 Pump and Lighting PO#  
39164-12D Ramsey Air Conditioning Co.  
Camp LaJeune, NC

**HOFFMAN ENGINEERING COMPANY**  
DIVISION OF FEDERAL CARTRIDGE CORP. ANOKA, MINNESOTA

Copyright December 1983 by Hoffman Engineering Company





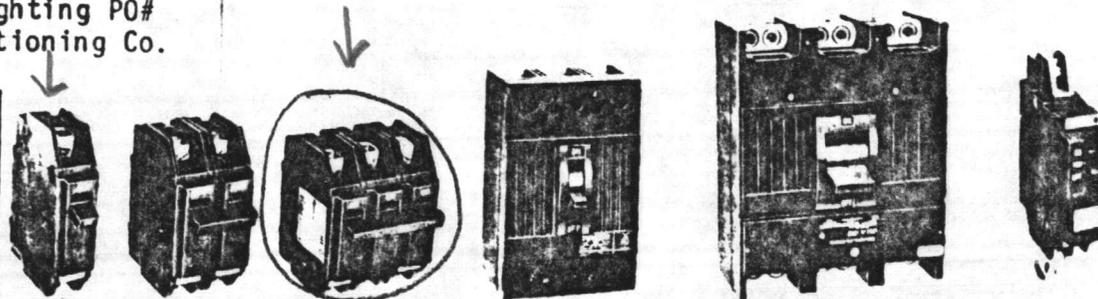
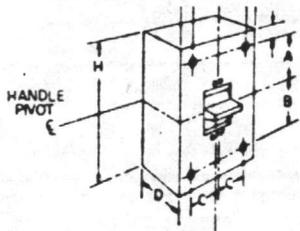
# MOLDED CASE CIRCUIT BREAKERS Quick Selection Guide

5-400 Amperes

Lug-Lug  
Q Line, J400

240V ac Maximum

MC Job 84-1400 Pump and Lighting PO#  
39164-12D Ramsey Air Conditioning Co.  
Camp LaJeune, NC



		TQC, THQC, THQC, TXQC			TQD, THQD			TJD		THQC...GF						
Type		TQC, THQC			THQC			TXQC	TQD	THQD	TJD	THQC...GF				
Poles		1	2	3	1	2	3	1, 2, 3	2	3	2	3	1	2		
Max. Voltage	Ac	120 240	120 240 240	240	120 240	120 240 240	240	120 240 240	240		240		120			
	Dc										250					
Ampere Range	Min.	5 <sup>①</sup>	5 <sup>①</sup>	5 <sup>①</sup>	15	15	15	15	100		250		15			
	Max.	70	100	100	70	100	30	30	225		400		30			
Interrupting Ratings	120V ac													10K		
	120/240V ac				22K	22K		65K								
	240V ac		10K <sup>②</sup>				22K	22K	65K	10K	22K		22K			
	277V ac															
	480V ac															
	600V ac															
UL Listed RMS Sym. Amps																
	125V dc															
	250V dc															
UL File Number		E11592						E11592				E51075				
Time Current Curve		15-50A GES-6201, 50-100A GES-6203						GES-6202	GES-6108B		GES-6112		GES-6200			
Outline Drawing		455C874							455C765		139C3602		139C4005			
Dimensions	H	3 <sup>3</sup> / <sub>8</sub>				3 <sup>3</sup> / <sub>8</sub>		3 <sup>3</sup> / <sub>8</sub>	6 <sup>1</sup> / <sub>8</sub>		10 <sup>1</sup> / <sub>8</sub>		3 <sup>3</sup> / <sub>8</sub>			
	W	1	2	3	1	2	3	1, 2, 3	2 <sup>3</sup> / <sub>4</sub>	4 <sup>1</sup> / <sub>8</sub>	2 <sup>3</sup> / <sub>4</sub>	4 <sup>1</sup> / <sub>8</sub>	8 <sup>1</sup> / <sub>8</sub>	1	2	
	D	2 <sup>3</sup> / <sub>8</sub>				2 <sup>3</sup> / <sub>8</sub>		2 <sup>3</sup> / <sub>8</sub>	2 <sup>5</sup> / <sub>8</sub>		3 <sup>11</sup> / <sub>16</sub>		2 <sup>3</sup> / <sub>8</sub>			
	A								2 <sup>1</sup> / <sub>8</sub>		3 <sup>13</sup> / <sub>16</sub>					
	B								2 <sup>1</sup> / <sub>8</sub>		3 <sup>13</sup> / <sub>16</sub>					
	C								1 <sup>1</sup> / <sub>16</sub>		1 <sup>1</sup> / <sub>16</sub>		1 <sup>3</sup> / <sub>8</sub>			
	E								2 <sup>7</sup> / <sub>32</sub>		1 <sup>3</sup> / <sub>8</sub>					
F																
Ship Wt./Std. Pack		9 lb 24	10 lb 12	9 lb 8	9 lb/24	10 lb 12	9 lb 8	①	2 <sup>1</sup> / <sub>2</sub> /1	3 <sup>1</sup> / <sub>2</sub> /1	2 <sup>1</sup> / <sub>2</sub> /1	3 <sup>1</sup> / <sub>2</sub> /1	16/1	17 <sup>1</sup> / <sub>2</sub> /1	6lb/10	8lb/10
Trip Unit		FIXED THERMAL MAGNETIC														
Line Cat. No.		TCAL3						TCAL25		TCAL47						
Wire Range		#14-1/0 CU #12-1/0 AL						#1-300MCM		750MCM		#14-10 CU #12-8 AL				
Load Cat. No.		Same as line						Same as line		TCAL47						
Wire Range		Same as line						Same as line		750MCM		#14-10 CU #12-8 AL				
NEMA 1		TQC100F, S						TQD225F, S		TJ400F, S		TQCGF30S				
NEMA 3R		TQC100RH						TQD225NRH		TJ400R						
NEMA 4/5										TJ400CS						
NEMA 12										TJ400D, J						
Buylog Page Reference		128, 129						129		129		89, 133				

Page References:

- Accessories ..... 151-163
- Enclosures ..... 146-150
- Terminals ..... 130-160

Publication ..... GEA-8481 Q Line  
GEA-10665 Ind'l C/R

- ① 5 amp not UL listed. 3000 amp IC based upon NEMA test procedure. Not ambient compensated.
- ② For specific lug wire sizes for 1, 2 or 3 pole circuit breaker by amperes range refer to page 130.

- ③ 10 amp has 5K amp IC.
- ④ Same as TQC, THQC, THQC.
- ⑤ Ground Fault Circuit Breaker. Also available in switching neutral, bell alarm and auxiliary switch versions.



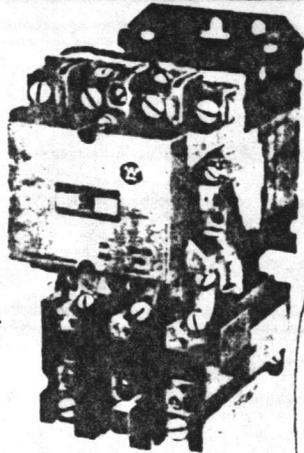
# CONTACTORS, STARTERS, Full Voltage Ac

## Magnetic, NEMA Sizes 00-9

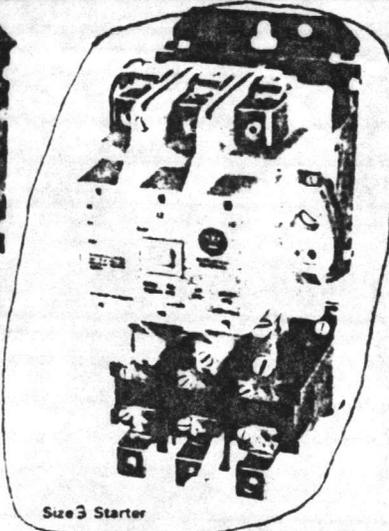
### Class 200

263

MC Job 84-1400 Pump and Lighting PO#  
39164-12D Ramsey Air Conditioning Co.  
Camp LaJeune, NC



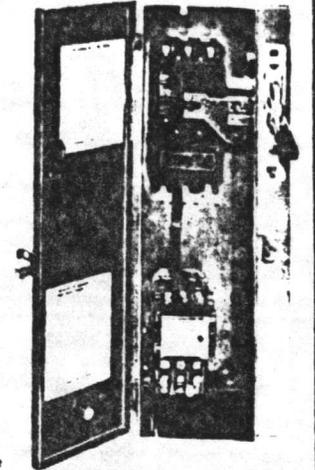
Size 1 Starter



Size 3 Starter



NEMA 1 Enclosure.  
Starter Sizes 0-4



Class 207 Size 1.  
NEMA 1 Enclosure

#### Application

Magnetic contactors are used to control electrical power circuits such as heating, lighting and motors that require no overload protection, or where overload protection is separately provided. They can be operated remotely by manual or automatic pilot devices.

Magnetic starters are used for full-voltage, across-the-line starting and stopping of squirrel cage motors, or as primary control for wound rotor motors. They can be operated locally or remotely by manual or automatic pilot devices.

#### Description

##### Sizes 00-4

Magnetic starters use contactors as described above. Positive motor protection is provided through the use of bimetallic overload relays. For solid state overload protection and specific motor protection problems, the Type MOR modular overload relay is available.

The modular overload relay is covered in detail on page 324. Briefly, it provides three phase protection and consists of three small C.T.'s, an output circuit and logic. The C.T.'s monitor all three phases and provide basic input to the overload. A single, plug-in heater module protects all three phases, and a LED provides positive trip indication. The MOR will operate in ambient temperatures ranging from -20 C to +70 C. Plug-in modules are available for special functions, such as phase unbalance, long acceleration, underload and jam detection.

Non-reversing starters are supplied as open devices or in NEMA Type 1, 3R, 4, 7, 9 and 12 enclosures. All starters are supplied with a Normally Open holding interlock.

For reversing applications, a starter and a contactor electrically and mechanically

interlocked are supplied on a common baseplate. Reversing starters are used to start, stop and reverse Ac squirrel cage motors and for primary control of reversing wound rotor motors. These starters may also be used with a plugging switch for quick stops on non-reversing or reversing applications. For this service, both motor and control must be suitable for reversing duty cycle required.

Reversing starters are available as open devices or in NEMA Type 1, 3R, 4, 7, 9 and 12 enclosures.

For across-the-line starting of two speed constant hp, constant torque and variable torque squirrel cage motors, two speed starters are available. These starters consist of two starters, one for each motor speed, mechanically and electrically interlocked and wired for manual speed selection by means of pushbuttons. Auxiliary relays may be added to provide automatic acceleration or deceleration.

Starters for two speed, two independent winding motors consist of two three-pole starters electrically and mechanically interlocked. Starters for two speed, single reconnectable winding motors consist of one three-pole and one five-pole starter mechanically and electrically interlocked.

Two speed starters are available as open devices in a horizontal design or in NEMA Type 1, 3R, 4 and 12 enclosures.

##### Sizes 5-9

Sizes 5 and 6 starters use contactors described on page 264, plus a block type B three-pole overload relay and three current transformers. An interposing relay is provided on size 6 starters.

Sizes 7, 8 and 9 starters use the Dc operated contactors described on page 264, a Dc power supply, block type B three pole overload relay, three current transformers and an interposing relay.

#### Combination Starters

Combination starters combine a starter with a disconnect device (fusible or non-fusible switch, or circuit breaker) in a single enclosure, providing line disconnect and short circuit protection in a neat, compact, space-saving assembly. They can be applied where enclosed starters are used separately in conjunction with a safety switch or circuit breaker.

#### Design Features

Sizes 0-9, 3 Phase, 3 to 1600 Hp

Class 203: Non-fusible Switch

Class 204: Fusible Switch

Class 206: Circuit breaker or MCP

Class 207: MCP with current limiter

**Type DS Disconnect Switch:** This is a compact visible blade loadbreak device which can be furnished as a fusible or non-fusible switch.

**Molded Case Circuit Breaker:** Available in 200 and 250 volt starters through size 2. Operates on thermal magnetic principle.

**MCP Motor Circuit Protector:** Permits fastest tripping time possible on low level faults. Provides optimum protection with circuit breaker convenience, quick-make, quick-break action and deadfront safety.

#### Enclosures Available

Combination starters can be furnished in Type 1, General Purpose, Type 3R Rain-proof, Type 4, 4X Watertight, Type 7 and 9 Hazardous Location, and Type 12 Dust-tight enclosures. Type 4X can be supplied as stainless steel or polyester. All enclosures provide space for factory or field installation of a control transformer and pilot devices.

#### Special Application Contactors

##### Lighting Contactors

Refer to page 268

##### Heavy Duty Special Purpose Contactors

Refer to pages 266, 267.

Refer to pages 285, 286.

UNITED STATES DEPARTMENT OF JUSTICE  
FEDERAL BUREAU OF INVESTIGATION  
WASHINGTON, D. C. 20535

[The body of the document contains several paragraphs of text that are extremely faint and illegible due to the quality of the scan. The text appears to be a formal report or letter, possibly containing a subject line, a salutation, and several paragraphs of descriptive text.]

# Non-Reversing, Sizes 00-9 Class 200, 3 Phase, 60 Hertz

These starters will be supplied with Ambient Compensated Overload Relays as standard effective Dec. 1, 1983.

## 3 Phase, 60 Hertz Starters—List Prices Do Not Include Overload Relay Heaters

NEMA Size	Cont. Amps.		Motor Volts	Coil Volts	Max. Hp	Type 1		Type 2R		Type 4		Type 12			
	Open	Encl.				Cat. No.	List Price								
Class 200—Order by Catalog Number (See Ordering Information) Discount C10-S1															
00	10	9	200 230 460 575	120 <sup>①</sup> 208 240 480 600	1 1/2 1 1/2 2 2	A200 MACAC MACB MACW MACX MACE	\$ 108	A200 SACAC SACB SACW SACX SACE	\$ 116						
0	20	18	200 230 460 575	120 <sup>①</sup> 208 240 480 600	3 3 5 5	M0CAC M0CB M0CW M0CX M0CE	138	S0CAC S0CB S0CW S0CX S0CE	144	A200 R0CAC R0CB R0CW R0CX R0CE	\$ 192	A200 W0CAC W0CB W0CW W0CX W0CE	\$ 284	A200 J0CAC J0CB J0CW J0CX J0CE	\$ 192
1	30	27	200 230 460 575	120 <sup>①</sup> 208 240 480 600	7 1/2 7 1/2 10 10	M1CAC M1CB M1CW M1CX M1CE	156	S1CAC S1CB S1CW S1CX S1CE	164	R1CAC R1CB R1CW R1CX R1CE	212	W1CAC W1CB W1CW W1CX W1CE	308	J1CAC J1CB J1CW J1CX J1CE	212
2	50	45	200 230 460 575	120 <sup>①</sup> 208 240 480 600	10 15 25 25	M2CAC M2CB M2CW M2CX M2CE	284	S2CAC S2CB S2CW S2CX S2CE	324	R2CAC R2CB R2CW R2CX R2CE	412	W2CAC W2CB W2CW W2CX W2CE	612	J2CAC J2CB J2CW J2CX J2CE	412
3	100	90	200 230 460 575	120 <sup>①</sup> 208 240 480 600	25 30 50 50	A200 M3CAC M3CB M3CW M3CX M3CE	460	A200 S3CAC S3CB S3CW S3CX S3CE	540	A200 R3CAC R3CB R3CW R3CX R3CE	844	A200 W3CAC W3CB W3CW W3CX W3CE	948	A200 J3CAC J3CB J3CW J3CX J3CE	644
4	150	135	200 230 460 575	120 <sup>①</sup> 208 240 480 600	40 50 100 100	M4CAC M4CB M4CW M4CX M4CE	1052	S4CAC S4CB S4CW S4CX S4CE	1220	R4CAC R4CB R4CW R4CX R4CE	1564	W4CAC W4CB W4CW W4CX W4CE	1916	J4CAC J4CB J4CW J4CX J4CE	1564
5	300	270	200 230 460 575	120 <sup>①</sup> 208 240 480 600	75 100 200 200	M5CAC M5CB M5CW M5CX M5CE	2522	S5CAC S5CB S5CW S5CX S5CE	2878	R5CAC R5CB R5CW R5CX R5CE	3758	W5CAC W5CB W5CW W5CX W5CE	3758	J5CAC J5CB J5CW J5CX J5CE	3758
6	600	540	200 230 460 575	120 <sup>①</sup> 208 240 480 600	150 200 400 400	M6CAC M6CB M6CW M6CX M6CE	8110	S6CAC S6CB S6CW S6CX S6CE	8110	R6CAC R6CB R6CW R6CX R6CE	10110	W6CAC W6CB W6CW W6CX W6CE	10110	J6CAC J6CB J6CW J6CX J6CE	9190
7	900	810	230 460 575	240 480 600	300 600 600	M7CW M7CX M7CE	9058	S7CW S7CX S7CE	11058	R7CW R7CX R7CE	13058	W7CW W7CX W7CE	13058	J7CW J7CX J7CE	12138
8	1350	1215	230 460 575	240 480 600	450 900 900	M8CW M8CX M8CE	13550	S8CW S8CX S8CE	15552	R8CW R8CX R8CE	17550	W8CW W8CX W8CE	17550	J8CW J8CX J8CE	16630
9	2500	2250	230 460 575	240 480 600	800 1600 1600	M9CW M9CX M9CE	21902	S9CW S9CX S9CE	22702	R9CW R9CX R9CE	25902	W9CW W9CX W9CE	25902	J9CW J9CX J9CE	24882
Single Phase With One Single Pole Overload Relay (Price Does Not Include Heater For Relay) Discount C10-S1															
00	10	9	120 240	1/2 3/4	240	A200 MABR	108	A200 SABR	116	A200 R0BR	178	A200 W0BR	270	A200 J0BR	178
0	20	18	1		2	M0BR	122	S0BR	130	R1BR	186	W1BR	294	J1BR	198
1	30	27	2		3	M1BR	142	S1BR	150	R2BR	242	W2BR	338	J2BR	222
1 1/2	40	36	3		5	M2BR	186	S2BR	194	R3BR	306	W3BR	418	J3BR	286
2	50	45	3		7 1/2		258		298				618		

- ① 120 volt starters wired for separate control.
- ② Single pole overload relays available on open devices.
- ③ For other coil voltages, see page 285.
- ④ Dual voltage coil.
- ⑤ Terminal lugs for copper only. Not included with size 5. See field modifications.
- ⑥ For 380 volt horsepower ratings, see page 282.
- ⑦ For alternate overload relay, see Modifications, page 306.
- ⑧ For ambient compensated overload relay with auto-reset, add suffix "D".
- ⑨ Normally stocked.

Order by catalog number. Complete catalog numbers consist of A200 in bold type in catalog number column, plus suffix letters in catalog number column.  
Example: A200 + MACAC = A200 MACAC

Modification Kits, Accessories:  
Pages 302-305  
Factory Modifications, Page 306  
Heaters, Page 326  
Dimensions: Page 284  
Renewal Parts, Pages, 307, 308  
Other Available Coil Voltages, Page 285  
Catalog Section 8220

MC Job 84-1400 Pump and Lighting PO#  
39164-12D Ramsey Air Conditioning Co.  
Camp LaJeune, NC

Class 300, 3 Phase, 50 Hertz

Class 300, 3 Phase, 50 Hertz



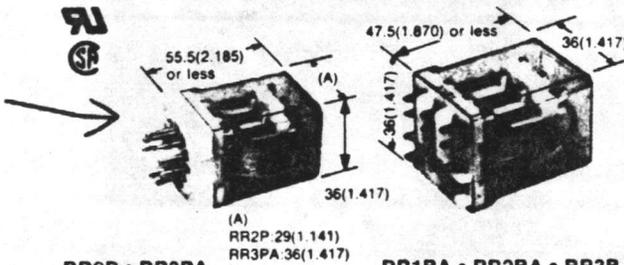


**IDEC**  
SYSTEMS & CONTROLS  
CORPORATION

MC Job 84-1400 Pump and Lighting PO#  
39164-12D Ramsey Air Conditioning Co.  
Camp LaJeune, NC

## RR SERIES POWER TYPE LARGE CAPACITY-10A 1, 2 AND 3 POLES

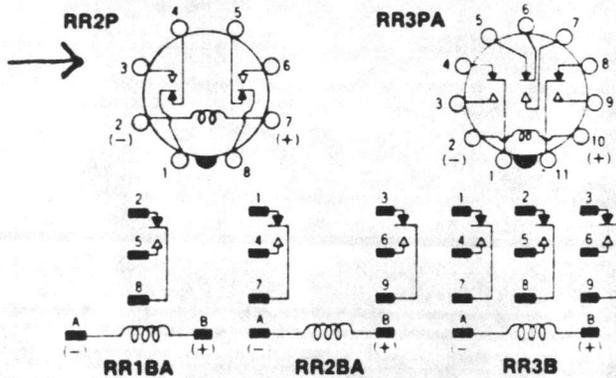
The RR Series is a heavy-duty relay with a 10A contact capacity. Available in pin and blade terminal style.



RR2P • RR3PA

RR1BA • RR2BA • RR3B

### CIRCUIT DIAGRAMS



### TYPES OF RR SERIES

Terminal Style	Contact Config.	Basic Type	with Indicator Light	with Check Button
P, PA (Pin)	DPDT 3PDT	(RR2P-U) RR3PA-U	RR2P-L RR3PA-L	RR2P-C RR3PA-C
B, BA (Blade)	SPDT DPDT 3PDT	RR1BA-U RR2BA-U RR3B-U	RR1BA-L RR2BA-L RR3B-L	RR1BA-C RR2BA-C RR3B-C

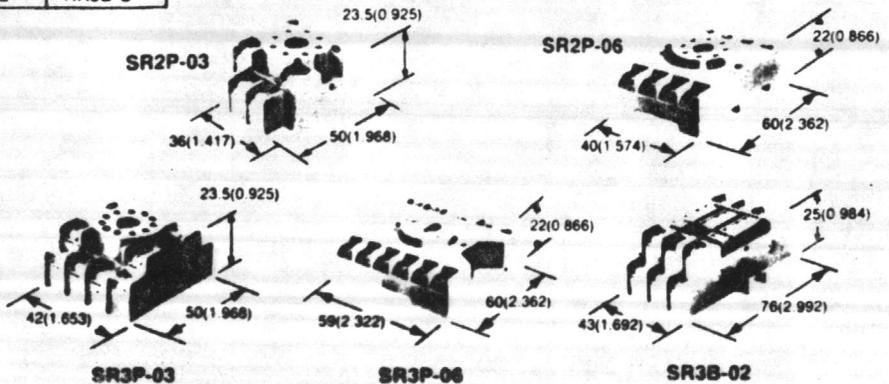
Type	Coil			Contact	
	Input	Resist Ohms	Norm. Power	Arrange	Amps. (Max.)
RR2P	6VAC 12VAC 24VAC 120VAC 240VAC	4.4 20 80 2300 8930	Approx. 2.5VA	DPDT	10A* (10A)**
	6VDC 12VDC 24VDC 48VDC 110VDC	25 100 400 1600 8450	Approx. 1.5W		
RR3PA	6VAC 12VAC 24VAC 120VAC 240VAC	4.4 20 80 2300 8930	Approx. 2.5VA	3PDT	10A* (10A)**
	6VDC 12VDC 24VDC 48VDC 110VDC	25 100 400 1600 8450	Approx. 1.5W		
RR1BA	6VAC 12VAC 24VAC 120VAC 240VAC	4.4 20 80 2300 8930	Approx. 2.5VA	SPDT	10A* (10A)**
	6VDC 12VDC 24VDC 48VDC 110VDC	25 100 400 1600 8450	Approx. 1.5W		
RR2BA	6VAC 12VAC 24VAC 120VAC 240VAC	4.4 20 80 2300 8930	Approx. 2.5VA	DPDT	10A* (10A)**
	6VDC 12VDC 24VDC 48VDC 110VDC	25 100 400 1600 8450	Approx. 1.5W		
RR3B	6VAC 12VAC 24VAC 120VAC 240VAC	4.4 20 80 2300 8930	Approx. 2.5VA	3PDT	10A* (10A)**
	6VDC 12VDC 24VDC 48VDC 110VDC	25 100 400 1600 8450	Approx. 1.5W		

NOTE: \* UL Rated, \*\* CSA Rated.

- Options (Add to List Price): Light Emitting Diode, Check Button and Neon, Neon, Check Button.
- L.E.D. suited for 110VAC and less. Neon suited for greater than 110VAC.

### SOCKETS FOR RR SERIES

Relay	Socket No.
RR2P	SR2P-03
	SR2P-05 (Snap On)
	SR2P-06 (Snap On)
	SR8P-02
	SR2P-51
RR3PA	SR3P-03
	SR3P-05 (Snap On)
	SR3P-06 (Snap On)
	SR3P-51
RR1BA, RR2BA, RR3B	SR3B-02 SR3B-05 (Snap On) SR3B-51





IDEC  
SYSTEMS & CONTROLS  
CORPORATION

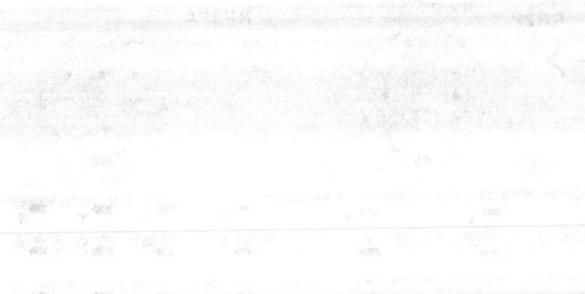
# RR SERIES POWER TYPE LARGE CAPACITY-1GA 1, 2 AND 3 POLES

Model	Capacity	Current	Voltage
RR1	1000	100	115V
RR2	2000	200	115V
RR3	3000	300	115V



Model	Capacity	Current	Voltage
RR1	1000	100	115V
RR2	2000	200	115V
RR3	3000	300	115V

CIRCUIT DIAGRAMS



MECHANICAL DATA

Model	Capacity	Current	Voltage
RR1	1000	100	115V
RR2	2000	200	115V
RR3	3000	300	115V

TABLE OF RR SERIES

Model	Capacity	Current	Voltage
RR1	1000	100	115V
RR2	2000	200	115V
RR3	3000	300	115V



Model	Capacity	Current	Voltage
RR1	1000	100	115V
RR2	2000	200	115V
RR3	3000	300	115V

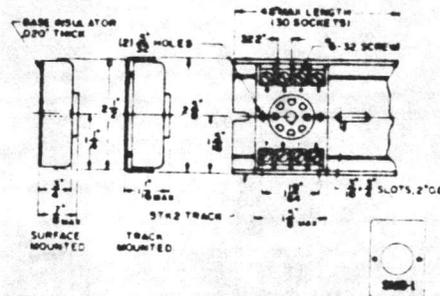
# THE NEW SM SERIES

Sockets for surface mounting plug-in relays, timers, tubes, etc.

## SM8 Series

### SPECIFICATIONS

- Contacts:** Phosphor-bronze.  
**Rating:** 10 Amperes, 300 Volts for relays, timers; 600 volts for other devices.  
**Isolation:** 400 volt/mil.  
**Material:** Body U.L. recognized polycarbonate, grade 101 for 94V-2, 115°C. duty.  
**Base Insulator:** .020" thick, supplied. Optional Top Insulator for back plane wiring.  
**Terminals:** #6-32 screws with or without captive wire-clamp plates. Clamps accept two different size wires.  
**Wire Range:** #12 through #20 AWG.



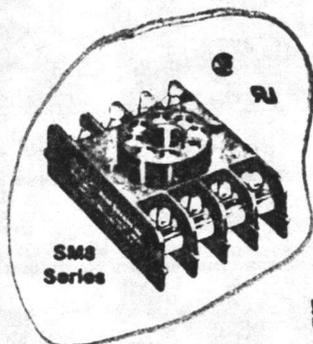
### ORDERING

#### SOCKETS

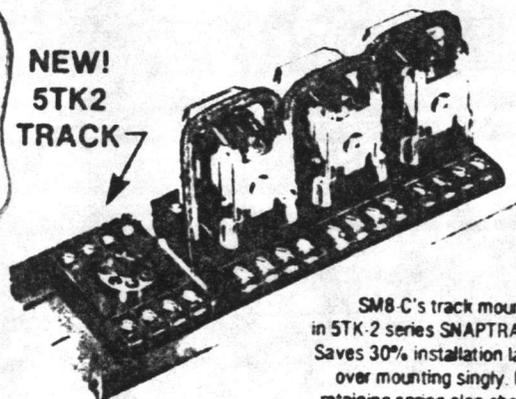
- | Cat. No. | Description   |
|----------|---|
| SM8-C    | Captive wire clamping plate screws, base insulator.               |
| SM8-A    | Binder head screws, base insulator.                               |
| SM8-RC   | Reverse screws for thru panel mount, top insulator, clamp plates. |
| SM8-R    | Same as SM8-RC except Binder head Screws.                         |

#### ACCESSORIES

- |         |  |
|---------|--|
| SM8-1   | Top insulator .020" thick. Used when mounting thru-panel.  |
| 5TK2-48 | 48-inch length SNAPTRACK. Also available 6, 12, and 24 inches, specified as 5TK2-6, -12, or -24. |
| RB5     | Retaining Spring. Accommodates all relays and timers.  |



NEW!  
5TK2  
TRACK



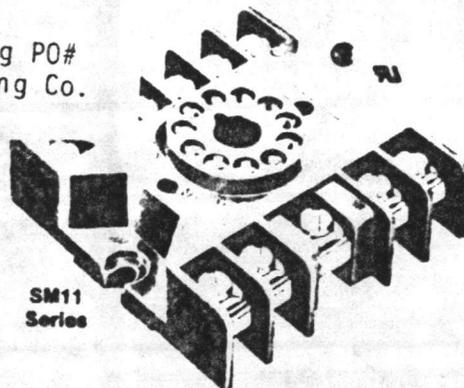
SM8-C's track mounted in 5TK-2 series SNAPTRACK. Saves 30% installation labor over mounting singly. RB5 retaining spring also shown.

## SM11 Series

### SPECIFICATIONS

- Contacts:** Phosphor-bronze.  
**Rating:** 10 Amperes, 300 Volts for relays, timers; 600 volts for other devices.  
**Isolation:** 400 volt/mil.  
**Material:** Body U.L. recognized polycarbonate, grade 101 for 94V-2, 115°C. duty.  
**Base Insulator:** .020" thick supplied.  
**Terminals:** #6-32 screws with or without captive wire-clamp plates. Clamps accept two different size wires.  
**Wire Range:** #12 through #20 AWG.

MC Job 84-1400 Pump and Lighting PO#  
39164-12D Ramsey Air Conditioning Co.  
Camp LaJeune, NC



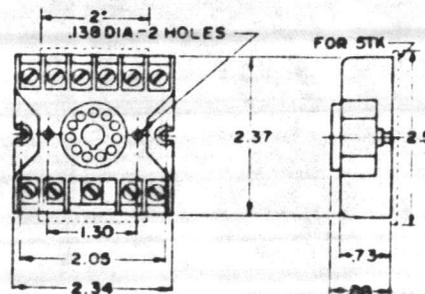
### ORDERING

#### SOCKETS

- | Cat. No. | Description   |
|----------|---|
| SM11-C   | Captive wire clamping plates, base insulator.               |
| SM11-A   | Binder head screws, base insulator.                         |
| SM11-CA  | SM11-C with factory installed adapter for 5TK Series Track. |
| SM11-AA  | SM11-A with factory installed adapter for 5TK Series Track. |

#### ACCESSORIES

- |         |   |
|---------|---|
| 5TK2-48 | 48-inch length snapback. Also available 6, 12, and 24 inches, specified as 5TK2-6, -12, or -24. |
| RB5     | Retaining Spring. Accommodates all relays and timers.   |



3M Series

# DIALIGHT

MC Job 84-1400 Pump and Lighting PO#  
39164-12D Ramsey Air Conditioning Co.  
Camp LaJeune, NC

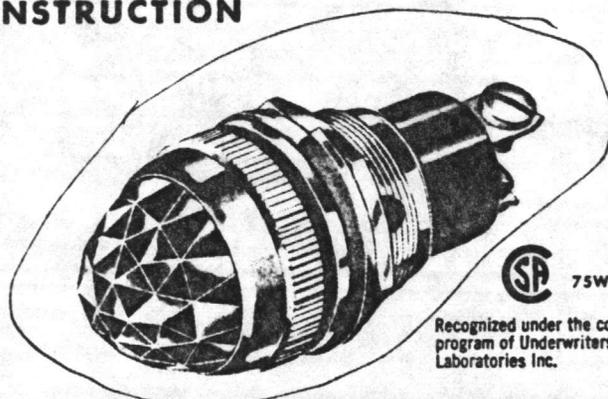
## OIL TIGHT INDICATOR LIGHTS

WITH RETAINED "O" RING SEAL CONSTRUCTION

for **HEAVY DUTY**

**Industrial Applications**

*Exceptionally Rugged—designed  
for severe vibration conditions*



75W., 125V.

Recognized under the component  
program of Underwriters'  
Laboratories Inc.

### ESSENTIAL FEATURES OF DIALCO'S OIL-TIGHT INDICATOR LIGHTS

- One-piece Solid Brass Mounting Bushing
- Complete Seal on Face of Panel Is Achieved by Use of Retained Oil-proof Gasket and "O" Rings.
- Solid Brass Knurled Lens Holder with Gasketed Lens
- Omnidirectional Permanent Color Lens
- High Impact Phenolic Insulation
- Rugged Terminals—Binding Screw Type
- Single Hole Mounting — 11/16", 1", or 1-3/16"
- Incandescent or Neon Lamps—Screw or Bayonet Type

**OIL TIGHT**

**WATER TIGHT**

**DUST TIGHT**

**OMNIDIRECTIONAL**

with torpedofaceted lens (as shown above)

### How COMPLETE OIL-TIGHTNESS is achieved in this series of DIALCO heavy duty Pilot Lights

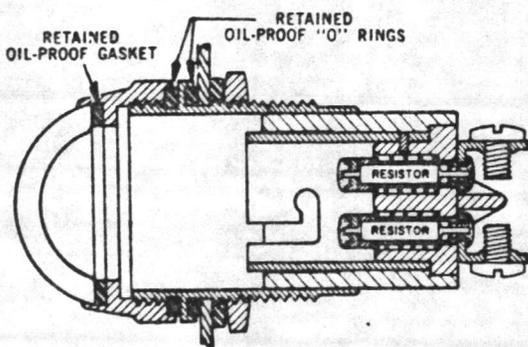
As shown in the schematic at the left, oil-tightness — i.e. resistance to permeation by oil, water, dust, or fumes—is achieved by means of three retained elastomer seals of inert material, consisting of a gasket and two "O" Rings.

The gasket is used in the assembly of the lens into its metal holder. This part is permanently sealed. . . The first "O" Ring makes the closure when the cap is screwed on to the bushing. The "O" Ring is retained — snapped into a groove cut to receive it. The cap has a skirt which goes over it and prevents it from being squeezed out of place no matter how many times the cap is removed and replaced. . . The second "O" Ring completes the job of sealing everything on the face of the panel by making the seal of the bushing to the panel surface. This "O" Ring, too, is retained by an undercut that forms a confining skirt. No oil, water, dust, or fumes can pass these barriers to interfere with dependable performance.

### RUGGED—VIBRATION RESISTANT

Often, in industrial applications, conditions may be really tough. There may be excessive vibration and possibly shock. Temperatures may be high or low. All of these conditions are met and overcome by the relatively simple and compact DIALCO Oil-Tight Pilot Lights. The mounting bushing is made of one-piece solid brass; all other parts are also of heavy solid brass. The molded high-impact phenolic socket is accurately seated in the mounting bushing which is then rolled over to secure it permanently.

All terminals — Binding Screw, Soldering, or Quick Connect — are of substantial, rugged construction. The hexagonal brass nut and lockwasher make mounting easy, secure, permanent. Added protection against vibration is afforded by the use of lamps with double contact bayonet base which insures that the lamp will never loosen in its socket. Meets NEMA 4 when Neoprene gaskets are used.



### BUILT-IN FEATURES

This cutaway drawing shows how oil-tightness is achieved by a retained gasket and two "O" Rings; also, how resistors are built-in as an integral part of DIALCO units which are made for Neon lamps with bayonet base.

The built-in resistor is an exclusive DIALCO feature—U.S. Pat. No. 2,421,321.

Full 180° light spread is obtained by the use of Dome, Torpedo, or Stovepipe Lenses.



**DIALIGHT**

ON THE RIGHT INDICATOR LIGHTS

THESE LIGHTS

ARE USED TO

INDICATE THE POSITION OF THE

STEERING WHEEL

AND TO INDICATE THE

POSITION OF THE

STEERING WHEEL

AND TO INDICATE THE

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STEERING WHEEL

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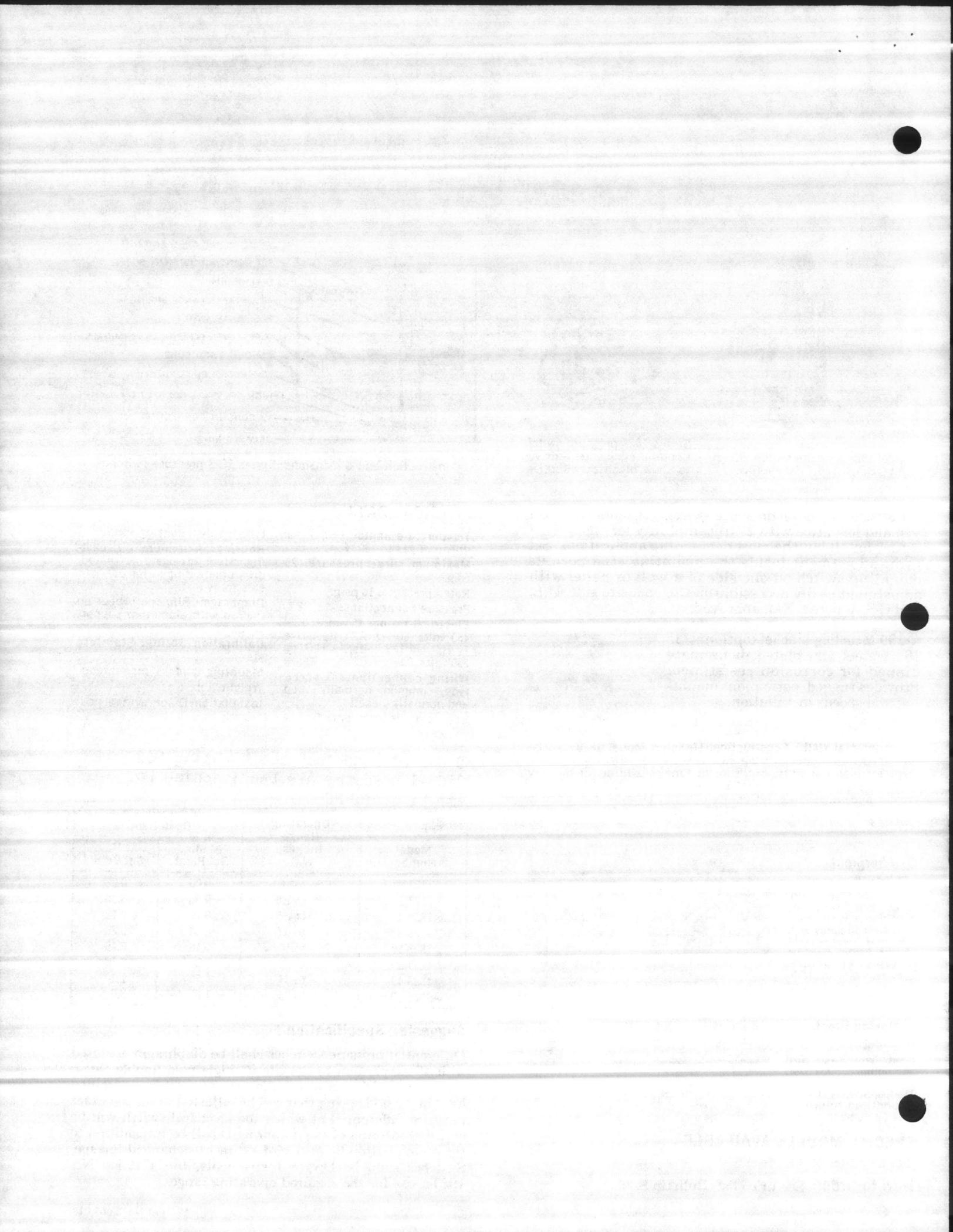
STEERING WHEEL

AND TO INDICATE THE

POSITION OF THE

STEERING WHEEL





**Dwyer** SERIES  
RM

# Rate-Master® Flowmeters

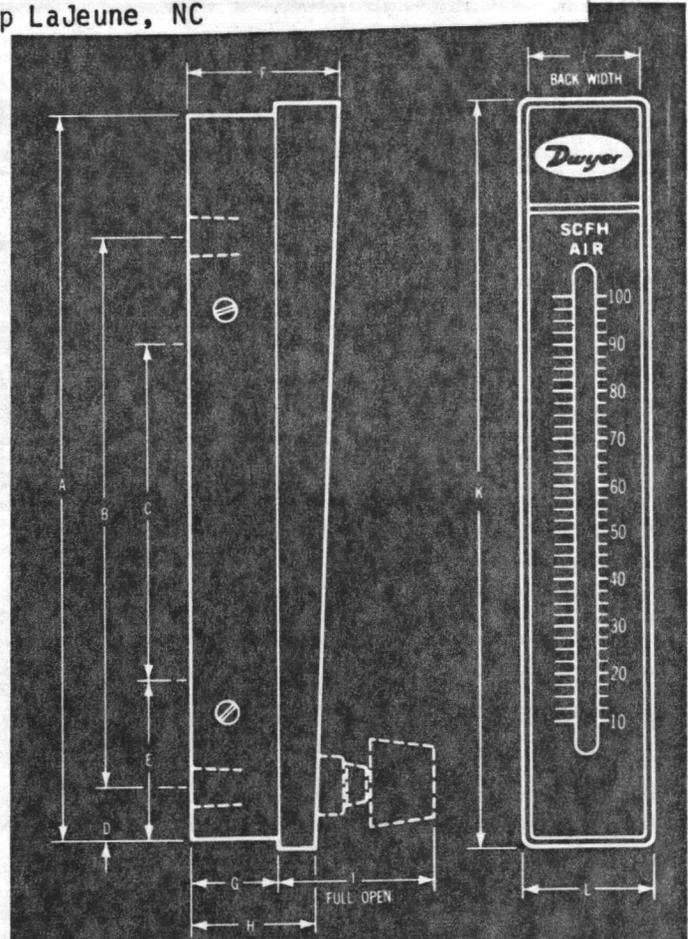
## SPECIFICATIONS

Meter Body, Bezel and Tube	Polycarbonate
Wetted Metal Parts	Stainless Steel (except for optional brass valves)
Floats	St. Steel, Blk. Glass, Alum., K Monel
Float Stops	Polycarbonate
Pipe Connections	Model RMA; 1/4", Model RMB; 1/4", Model RMC; 1/2" NPT
"O" Rings	Neoprene and Buna N
Fittings	Stainless Steel brazed to Stainless Steel backbone plate
Rivets	Stainless Steel, set into slots
Scale	Brushed Aluminum - Clear Epoxy Coated
Knobs	ABS Plastic
Pressure Rating	RMA 100 P.S.I., RMB 70 P.S.I., RMC 35 P.S.I. max.
Temperature Rating	To 130° F. maximum
Accuracy	Model RMA, 4%; Model RMB, 3%; Model RMC, 2% of full scale
<b>OPTIONS AND ACCESSORIES</b>	
Metering Valve	Brass BV Stainless Steel SSV
Top Mounted Valve	Stainless Steel - available only on RMA for air (vacuum applications) TMV
Pointer Flag	Polycarbonate PF

## Series RM RATE-MASTER® Models and Ranges

Model RMA - 2" Scale	Model RMB - 5" Scale	Model RMC - 10" Scale
Range SCFH Air	Range SCFH Air	Range SCFH Air
Ordering No.	Ordering No.	Ordering No.
.05-5	1	5-50
.1-1	2	10-100
.2-2	3	20-200
.5-5	4	40-400
1-10	5	60-600
2-20	6	100-1000
5-50	7	120-1200
10-100	8	180-1800
15-150	9	SCFM Air
20-200	10	1-10
CC Air/min.	Gal. Water per hour	2-20
5-50	151*	3-30
5-100	150*	123
20-240	11	Gal. Water per hour
50-500	12	1-20
100-1000	13	8-90
200-2500	14	Gal. Water per min.
		.1-1
LPM Air		.2-2.2
.5-5	26	.3-3.6
1-10	21	.6-6
2-25	22	1-8
5-50	23	
5-70	24	
10-100	25	
CC Water/min.		
5-50	32	
10-110	33	
20-300	34	
Gal. Water/hr.		
1-11	42	
2-24	43	
4-34	44	
5-50	45	

\*Accuracy ±8%

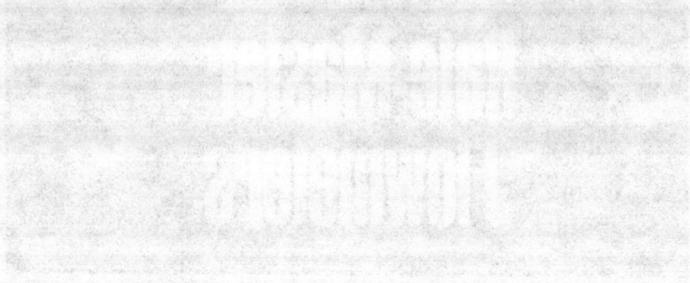


## DIMENSIONS - IN INCHES

	Model RMA	Model RMB	Model RMC
A	4 1/2	8 1/2	15 1/2
B	3	5 1/2	12 1/4
C	1 1/2	3 1/4	8 1/4
D	3/4	3/4	1
E	1 1/2	1 3/4	2 3/4
F	1 1/2	1 3/4	2 1/4
G	3/4	1	1 1/4
H	1	1 1/4	1 3/4
I	1 3/4	1 3/4	2 1/2
J	3/4	1 1/4	2
K	4 1/2	8 1/4	15 1/4
L	1	1 1/4	2 1/4

## HOW TO ORDER

- Select model desired by letter designation, RMA, RMB, RMC, VFA or VFB.
- Specify range desired by adding the order number after a dash following the letter designation. Example: RMA 101.



# ALTERNATOR

NEMA Rated A600

MC Job. 84-1400 Pump and Lighting PO# 39164-12D Ramsey Air Conditioning Co. Camp LaJeune, NC

## OPEN TYPE

	Volts 60 Hz	Cat. No.	Price
	24	47AB10AJ	\$75
	120	47AB10AF	
	200	47AB10AD	
	240	47AB10AG	
	480	47AB10AH	
	600	47AB10AE	

## NEMA 1

	Volts 60 Hz	Cat. No.	Price
	24	47AB10BJ	\$ 91
	120	47AB10BF	
	200	47AB10BD	
	240	47AB10BG	
	480	47AB10BH	
	600	47AB10BE	

NEMA 1 outline dimensions, 6<sup>3</sup>/<sub>32</sub> x 4<sup>1</sup>/<sub>16</sub> x 3<sup>1</sup>/<sub>16</sub>

## NEMA 4

	Volts 60 Hz	Cat. No.	Price
	24	47AB10EJ	\$155
	120	47AB10EF	
	200	47AB10ED	
	240	47AB10EG	
	480	47AB10EH	
	600	47AB10EE	

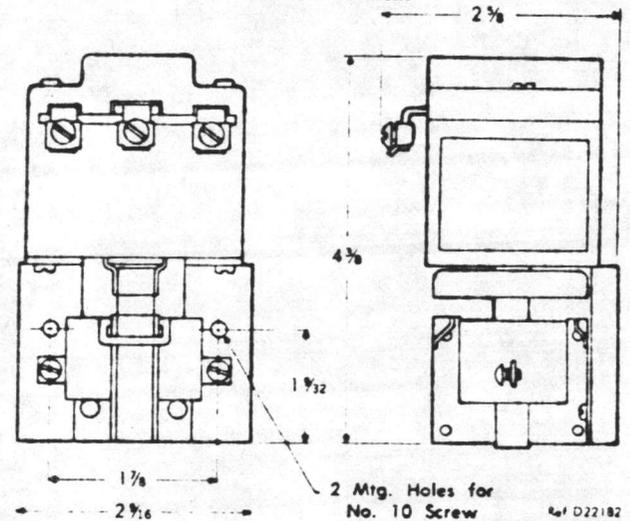
NEMA 4 outline dimensions, 9<sup>1</sup>/<sub>2</sub> x 7<sup>1</sup>/<sub>2</sub> x 3<sup>3</sup>/<sub>8</sub>

## RATINGS

AC Volts	Make	Break	Continuous
0-120	60 amps	6 amps	10 amps
120-600	7200 VA	720 VA	

## OPEN TYPE

Outline Dimensions



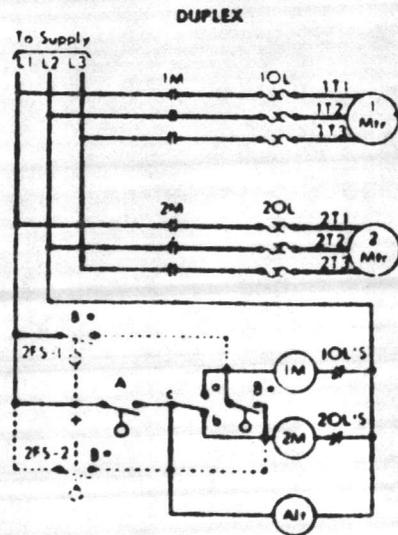
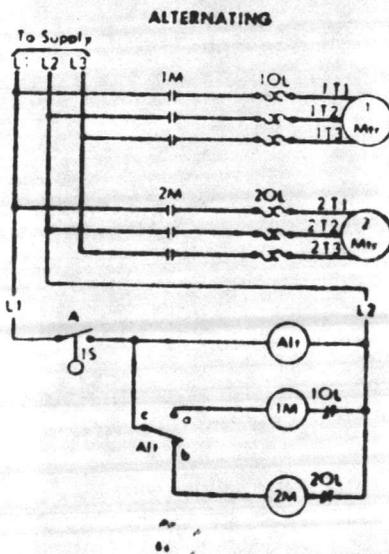
Shipping Weight: 1 1/4 lbs.

This compact alternator of industrial relay quality is designed specifically for pump and compressor applications. It is easily installed and wired in control panels, pump panels or as an enclosed unit for surface mounting to be used with standard enclosed starters.

The alternator has single pole double throw heavy duty silver cadmium oxide contacts enclosed in a transparent dust cover. The snap action contacts transfer when the coil is de-energized.

The alternator is wired in the circuit to operate the other motor the next time the operation is started. Usually the circuit is designed for the idle motor to cut in if the running motor does not have the capacity to handle the load.

## TYPICAL ALTERNATING CONTROL CIRCUITS



\* For added safety, replace the single pole float switch with a 2-pole auxiliary (B) float switch. (See dotted wiring.)





July 25, 1977

Supersedes Catalog Section 16-921  
pages 1-8, dated November 1, 1971;  
Supp. page .01, dated Jan. 10, 1972.  
Prices effective June 20, 1977; subject  
to change without notice.  
Resale Prices Suggested Only  
(Reference SP 7000, Dis. C10-S15)  
Mailed to: E. D. C/1831/PL

## Modular Terminal Blocks

MC Job 84-1400 Pump and Lighting PO#  
39164-12D Ramsey Air Conditioning Co.  
Camp LaJeune, NC

### General Information

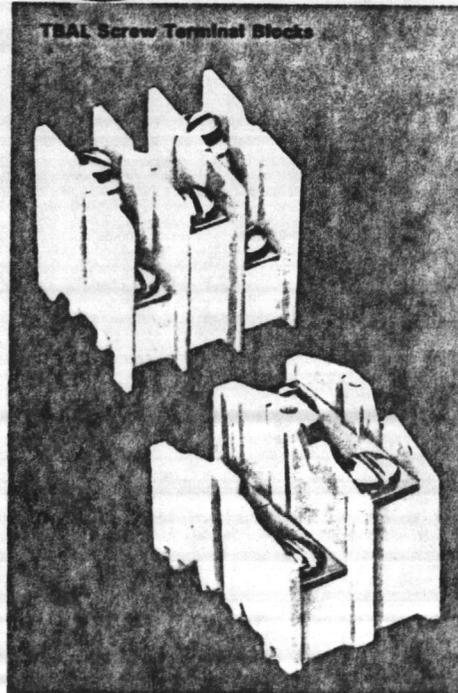
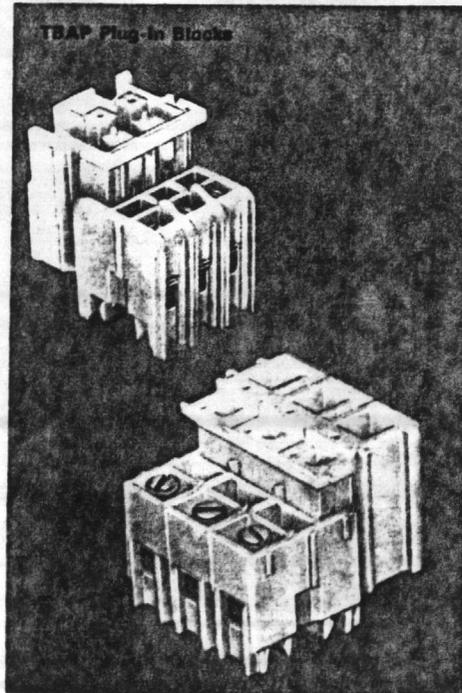
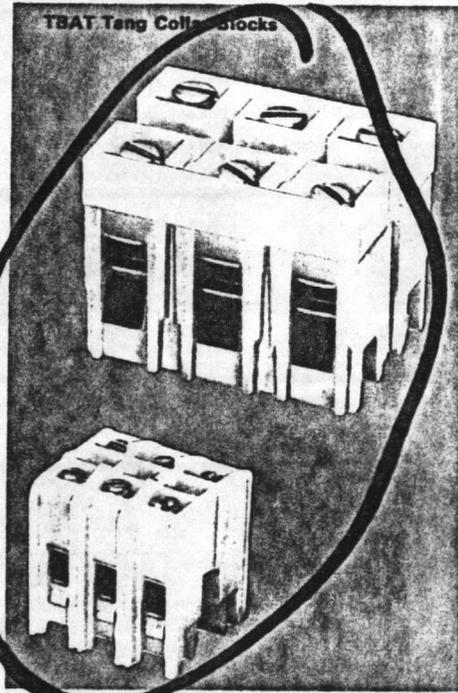
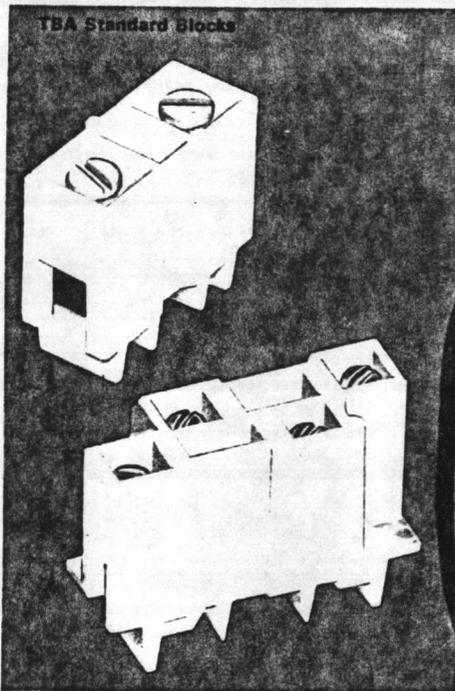
- Designed for Automation
- Turned out screws permit use of power screwdriver, reduces cost.
- Standard blocks are white nylon. Variety of colors are available.

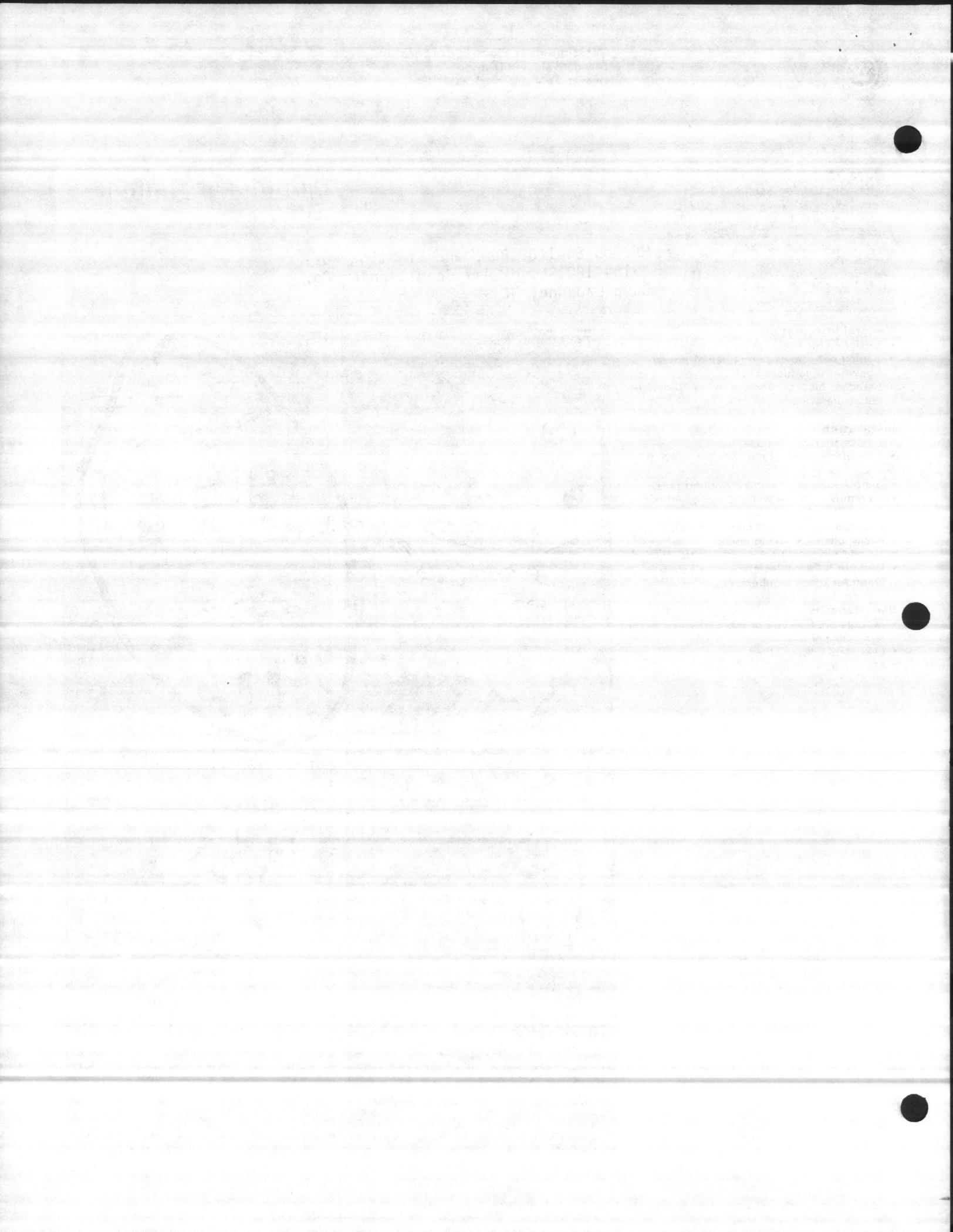
### Installation

- Blocks are ready for use.
- Clamping screws are installed to prevent loss.
- Simply snap blocks into mounting rails.
- To remove, simply pull out block without disturbing adjacent units.
- Only requirements are mounting rail, circuit blocks, marking strips.
- No end pieces or backing plates are needed.
- Uniform  $\frac{1}{2}$ " modules make easy calculation for space requirements.

### User Benefits

- Mounts 38, 600 volt or 90, 300 volt terminals per foot.
- Live parts fully shielded.
- Maximum flexibility.

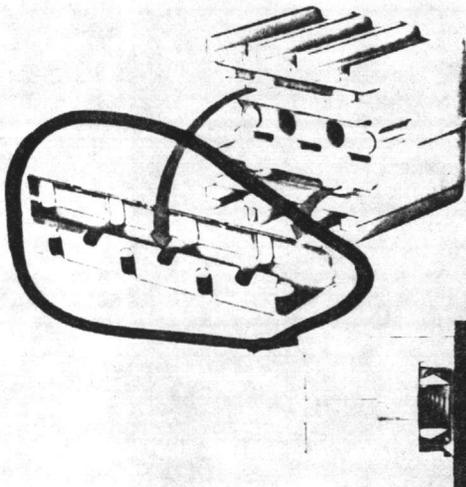






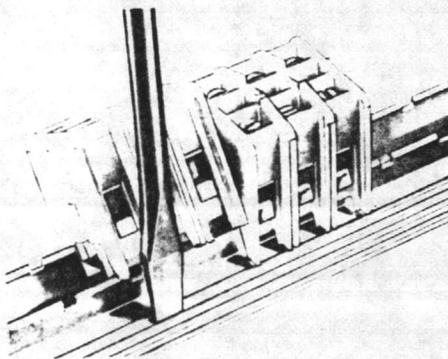
### Mounting Rails

#### TMR12, TMR37, Stainless Steel



- Provides rigidity with ease of snapping off to desired length.
- Terminal blocks snap-in, lock and are retained in position.
- Available in 12½" or 37½" length.

#### TBATR72 Aluminum Rail



- Reduces force to insert blocks but increases holding power.
- Blocks locked in place, preventing accidental removal.
- Rail sides are "fishhook" design which interlocks with block.
- Extended side ledge has 3 grooves which serve as pivots for removing blocks with screwdriver.
- Center section has mounting holes every 1¼".
- Each section of rail is 72" in length.

### Accessories

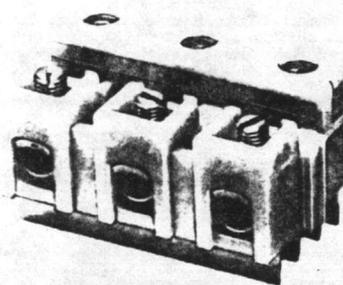
#### Marking Strips

Type TMS for all terminal blocks except TBBS 300 volt blocks.

Type TMSB for TBBS 300 volt blocks.

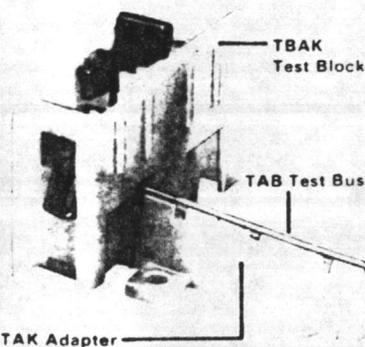
Type TMS-6 for TBBT-4 300 volt blocks.

TAS Lug Shield for TBA 100 Block



- Snap-on shield provides dead-front construction, prevents accidental terminal contact.

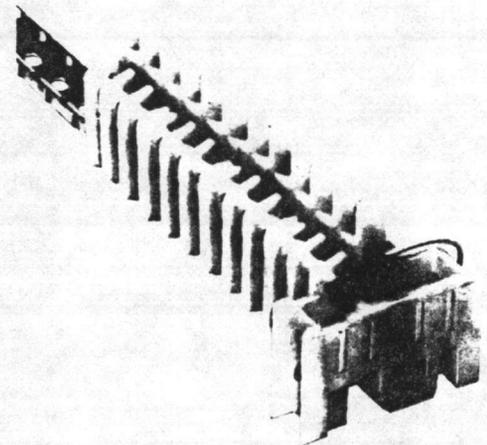
#### Type TBAK Switching Test Block



- Quickly locates ground faults on machine tools.
- Permits speedy testing of critical control circuits to isolate faulty ones.
- Accomplished by means of a blade which switches the normal connection of a solenoid or limit switch from the control panel circuitry to a special test bus, Type TAB⊗.
- Test bus is connected to a ground fault such as an Ohm meter or neon light.
- When ground is indicated on main panel, maintenance man merely depresses plungers in the row of test blocks in rapid succession watching the meter to determine which circuit is faulty.

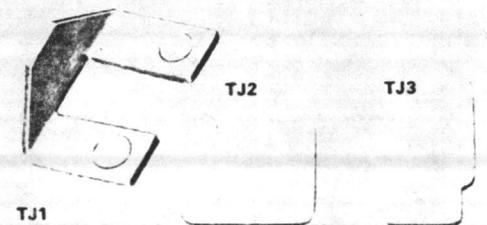
- Plunger construction permits leaving block in "test" position until fault is removed. Flick of finger restores normal connection.
- Very good in other applications such as circuit tracing or test equipment where the ability to connect at will any number of circuits to a common or shorting bus is of great value.
- Designed to permit tying two or three adjacent block handles together for use on two or three wire circuits.

#### Type TBA3L Indicating Blocks



- Used in circuit tracing and ground fault detection.
- Consists of a resistor and a neon light assembly in each circuit with a common lead for connection to ground or test potential.
- Although basically 3 circuit units, they are normally supplied pre-wired with a common lead in accordance with customer specs.
- Common lead may be factory connected to a switching block (such as TBAK) or a fuse block.

#### Shorting Jumpers

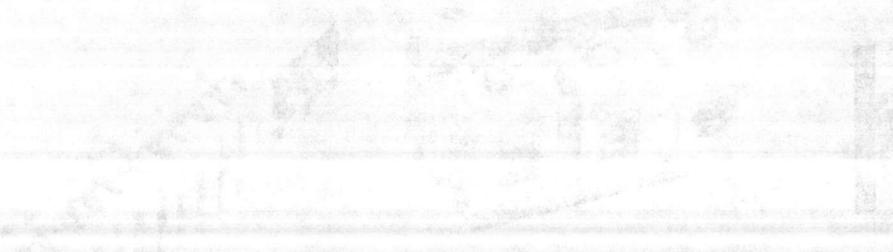


- Used for shorting adjacent points on TBA1, 2, and 3 terminal blocks
- TJ1 used with TBA1
- TJ2 used with TBA2
- TJ3 used with TBA3

⊗ Adapter TAK must be used with TAB test bus.



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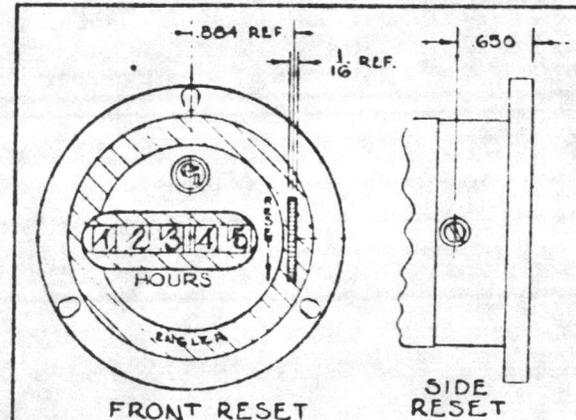
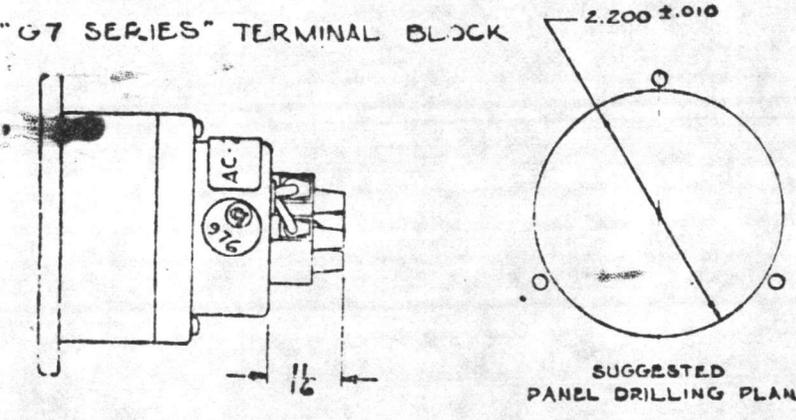
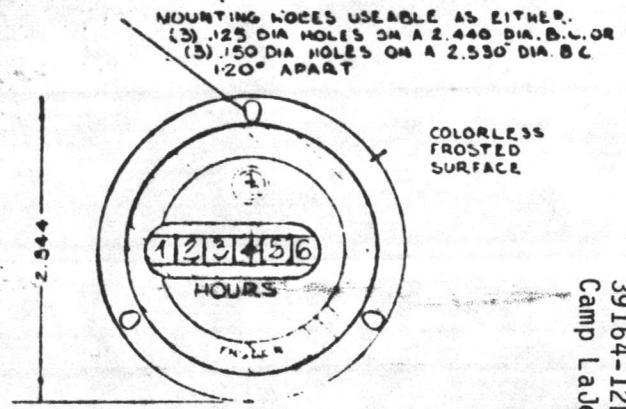
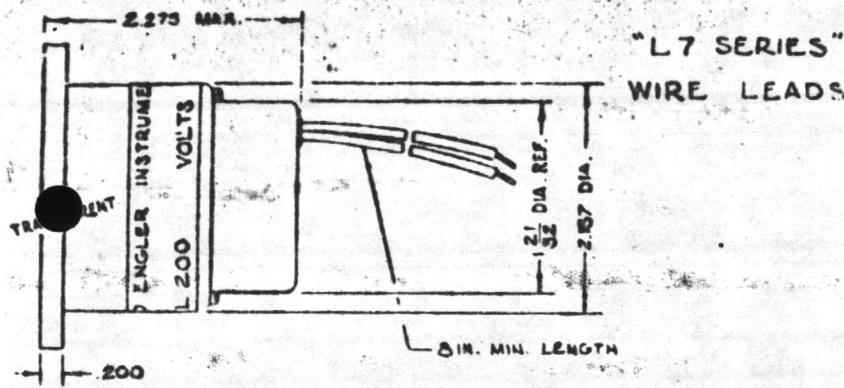


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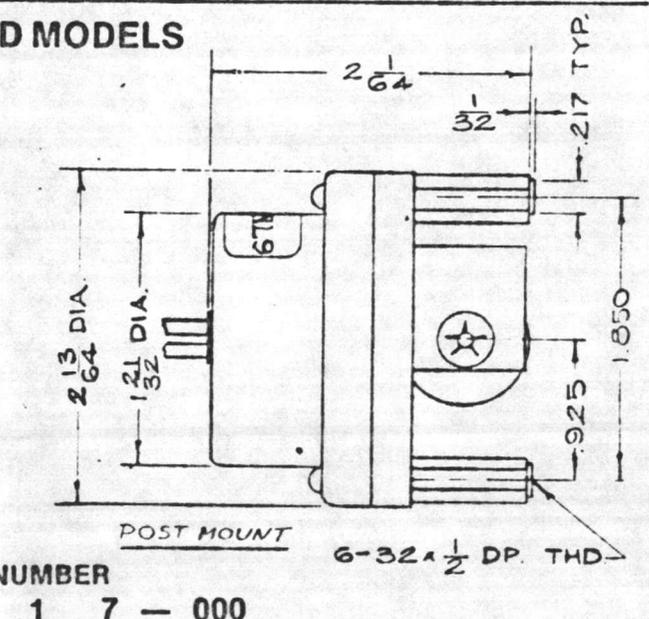
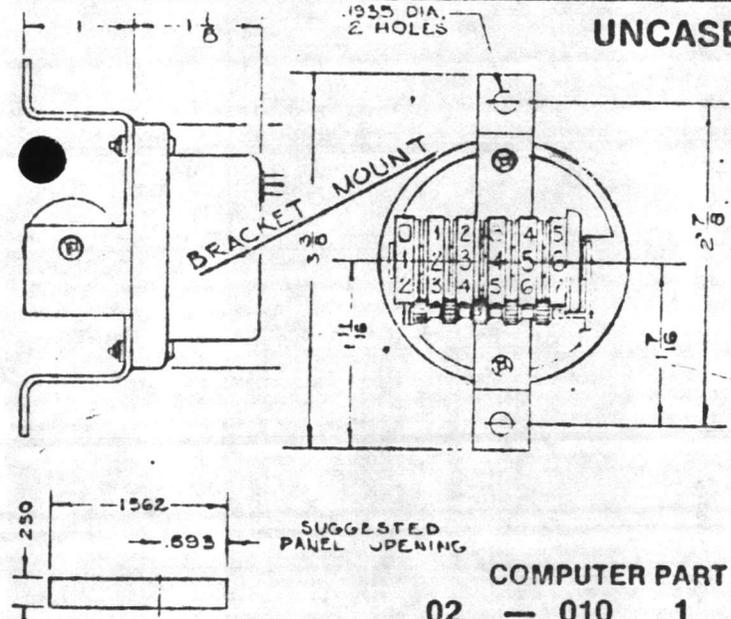
A block of very faint text or a list of items, mostly illegible due to low contrast and blurriness.

Another block of faint text or a list, continuing the illegible content from the previous section.

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MC Job 84-1400 Pump and Lighting PO#  
39164-12D Ramsey Air Conditioning Co.  
Camp LaJeune, NC



COMPUTER PART NUMBER  
02 - 010 1 1 7 - 000  
**AC 200 1 0 N - L 7**

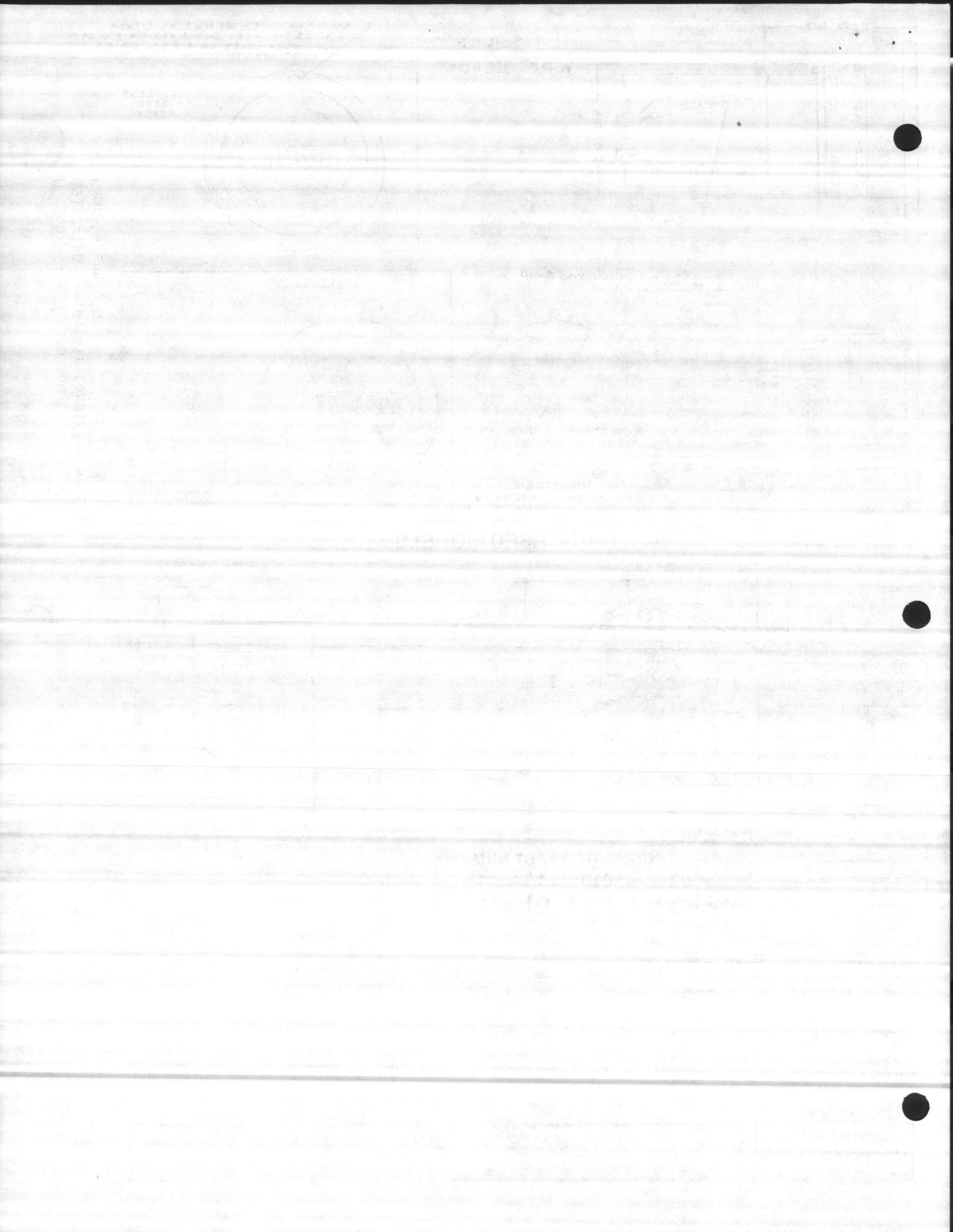
VOLTAGE	MAXIMUM READING	RESET	TERMINALS	MOUNTING
1 115V 60 HZ	0 99999 HRS.	1 N - NON-RESET	1 L - 8" WIRE LEADS	7 7 - DUST COVER
2 230V 60 HZ	1* 99999 HRS.	2 F - FRONT RESET	2 G - TERMINAL BLOCK	0 18 - BRACKET
6 115V 50 HZ	2 99999 HRS.	3 S - SIDE RESET		9 19 - POST MOUNTING
7 230V 50 HZ	3*** 99999 MIN.			
9** 24V 60 HZ	5*** 99999 MIN.			

\* STOCKED IN 115V-60HZ ONLY  
\*\* HOURS OR HOURS AND 1/10-60HZ ONLY  
\*\*\* STOCKED IN 115V-60HZ or 50HZ ONLY  
RESET METERS HAVE ONE LESS DIGIT  
EXAMPLE 0-9999 9 HRS

FOR OTHER MODIFICATIONS OR VOLTAGES,  
CONSULT FACTORY.

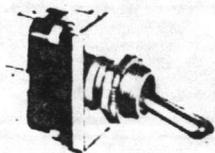
**SANGAMO WESTON**  
Schlumberger

ENGLER INSTRUMENTS / DIVISION OF SANGAMO WESTON, INC.  
260 CUNY AVENUE, JERSEY, N.J. 07105  
201 332 5353

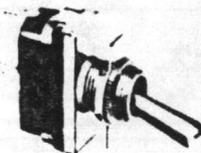


MC Job 84-1400 Pump and Lighting PO# 39164-12D Ramsey Air Conditioning Co. Camp LaJeune, NC

- Electrical ratings up to 20 Amp
- Performance-proved mechanisms
- Case construction protects against dust, dirt and moisture
- Composite contacts for longer life
- Underwriters' Laboratories, Inc. Listed. C.S.A. Approved



3192-0003



90-0003



4125-0004

**6 Amp. Single Pole**

6 Amp. 125 V AC  
3 Amp. 250 V AC  
1/4 HP 125-250 V AC

Circuit Arrangement			Poles	CATALOG NUMBERS		
A	B	C		Screw	Solder	Spade
ON	—	OFF	SPST	3190-0001	3190-0002	3190-0003
ON	OFF	ON	SPDT	3191-0001	3191-0002	3191-0003
ON	—	ON	SPDT	3192-0001	3192-0002	3192-0003
(ON)	OFF	(ON)	SPDT	3193-0001	3193-0002	3193-0003
ON	OFF	(ON)	SPDT	3193-1001	3193-1002	3193-1003

( ) — Momentary.

**19 Amp. Single Pole 2-Circuit**

19 Amp. 125 V AC  
4 Amp. 125 V AC center position  
15 Amp. 125 V AC end position  
Operating sequence: off-on (4 Amp.) — one and two (15 Amp.)  
No. 96-1001 — same as 96-0001 but 3rd position is "on" momentary.

Circuit Arrangement			Poles	CATALOG NUMBERS	
A	B	C		Screw	Spade
OFF	ON	ON	SPXX	96-0001	
OFF	ON	(ON)	SPXX	96-1001	

( ) — Momentary.

**Dimensions**

	Case	Bushing
3190 & 90 Series	1 1/4" x 3/4"	1/2"-32 thd. 1/2" long
4125	1 3/8" x 3/8"	1/2"-32 thd. 1/2" long

Terminals 1/2" male Spade. For more detailed data, see McGill Catalog 89.

**20 Amp. Single Pole, Single Circuit**

20 Amp. 125 V AC  
10 Amp. 250 V AC  
1 HP 125-250 V AC  
20 Amp. 250 V AC (non-inductive)  
Also available 25 Amp. 125-250 V AC (non-inductive)

Silver cadmium oxide contacts.  
Brown general purpose phenolic cases.  
Nickel plated bats.  
Cadmium plated covers.

Circuit Arrangement			Poles	CATALOG NUMBERS		
A	B	C		Screw	Solder	Spade
ON	—	OFF	SPST	90-0001	90-0002	90-0003
ON	OFF	ON	SPDT	91-0001	91-0002	91-0003
ON	—	ON	SPDT	92-0001	92-0002	92-0003
(ON)	OFF	(ON)	SPDT	93-0001	93-0002	93-0003
ON	OFF	(ON)	SPDT	93-1001	93-1002	93-1003
(OFF)	—	ON	SPST	93-2001	93-2002	93-2003
(ON)	—	OFF	SPST	93-3001	93-3002	93-3003
ON	—	(ON)	SPDT	93-4001	93-4002	93-4003

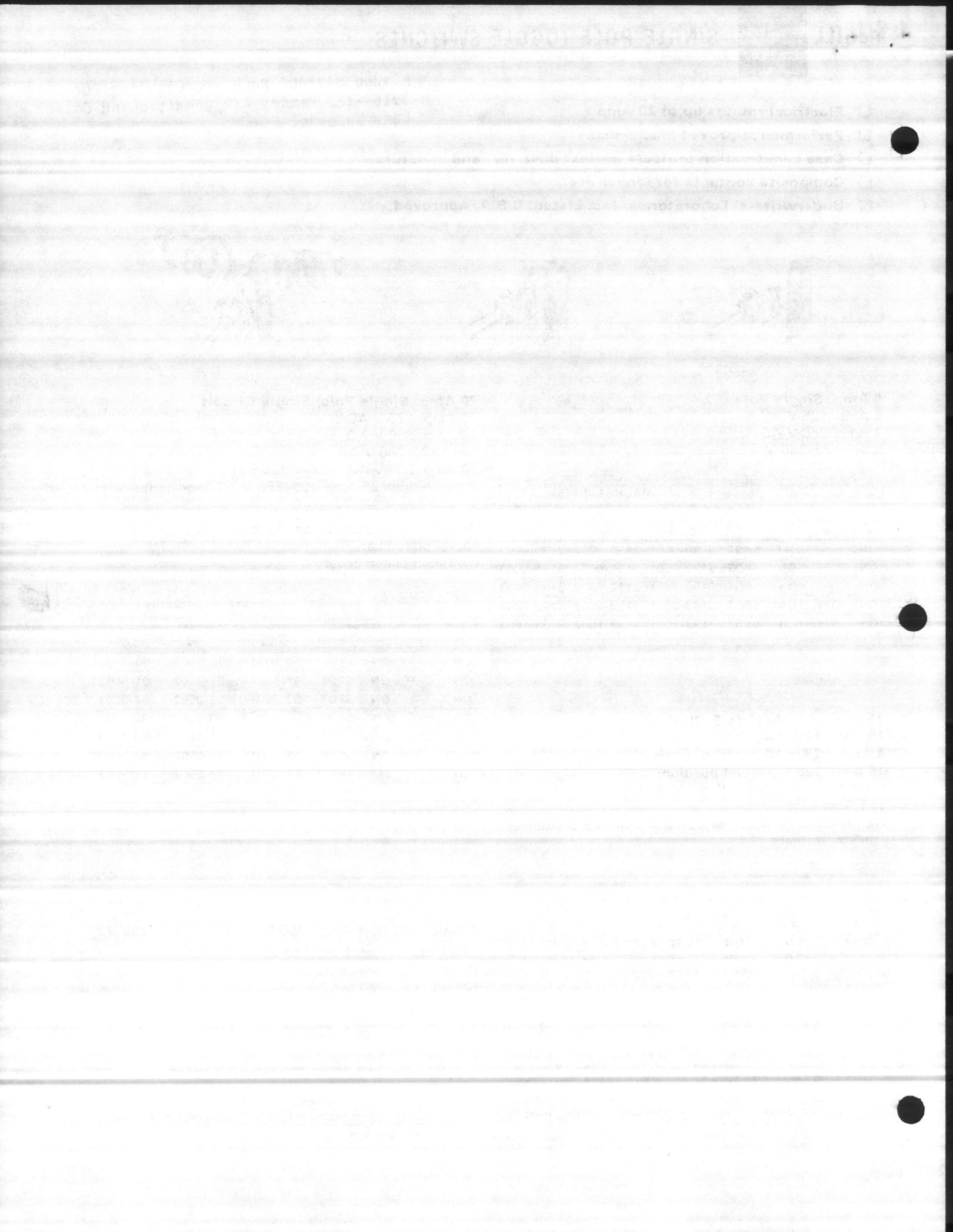
( ) — Momentary.

**8 Amp. 125 V, 4 Amp. 250 V, 1/2 HP 125 V-250 V**

SPST double-break mechanism  
Phosphor bronze contacts  
Brown phenolic case  
Nickel plated bat  
Cadmium plated cover

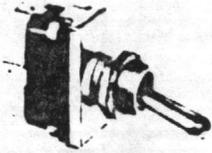
Circuit Arrangement			Poles	CATALOG NUMBERS			
A	B	C		Screw	Solder	Spade	Wire Leads
ON	—	OFF	SPST	4125-0001	4125-0002	4125-0003	4125-0004

Double-break mechanism.

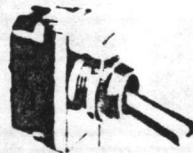


MC Job 84-1400 Pump and Lighting PO#  
39164-12D Ramsey Air Conditioning Co.  
Camp LaJeune, NC

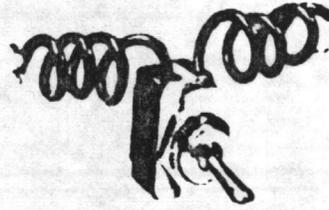
- Electrical ratings up to 20 Amp
- Performance-proved mechanisms
- Case construction protects against dust, dirt and moisture
- Composite contacts for longer life
- Underwriters' Laboratories, Inc. Listed. C.S.A. Approved



3192-0003



90-0003



4125-0004

**6 Amp. Single Pole**

6 Amp. 125 V AC  
3 Amp. 250 V AC  
1/4 HP 125-250 V AC

Circuit Arrangement			Poles	CATALOG NUMBERS		
A	B	C		Terminals		
				Screw	Solder	Spade
ON	—	OFF	SPST	3190-0001	3190-0002	3190-0003
ON	OFF	ON	SPDT	3191-0001	3191-0002	3191-0003
ON	—	ON	SPDT	3192-0001	3192-0002	3192-0003
(ON)	OFF	(ON)	SPDT	3193-0001	3193-0002	3193-0003
( )	OFF	(ON)	SPDT	3193-1001	3193-1002	3193-1003

( ) — Momentary

**19 Amp. Single Pole 2-Circuit**

19 Amp. 125 V AC  
4 Amp. 125 V AC center position  
15 Amp. 125 V AC end position  
Operating sequence: off-on (4 Amp.) — one and two (15 Amp.)  
No. 96-1001 — same as 96-0001 but 3rd position is "on" momentary.

Circuit Arrangement			Poles	CATALOG NUMBERS	
A	B	C		Terminals	
				Screw	
OFF	ON	ON	SPXX	96-0001	
OFF	ON	(ON)	SPXX	96-1001	

( ) — Momentary.

**Dimensions**

	Case	Bushing
3190 & 90 Series	1 1/8" x 3/4"	1/8" -32 thd. 1/2" long
4125	1 1/8" x 1/2"	1/8" -32 thd. 1/2" long

terminates 1/4" male Spade For more detailed data, see McGill Catalog 89

**20 Amp. Single Pole, Single Circuit**

20 Amp. 125 V AC  
10 Amp. 250 V AC  
1 HP 125-250 V AC  
20 Amp. 250 V AC (non-inductive)  
Also available 25 Amp. 125-250 V AC (non-inductive)

Silver cadmium oxide contacts.  
Brown general purpose phenolic cases.  
Nickel plated bats.  
Cadmium plated covers.

Circuit Arrangement			Poles	CATALOG NUMBERS		
A	B	C		Terminals		
				Screw	Solder	Spade
ON	—	OFF	SPST	90-0001	90-0002	90-0003
ON	OFF	ON	SPDT	91-0001	91-0002	91-0003
ON	—	ON	SPDT	92-0001	92-0002	92-0003
(ON)	OFF	(ON)	SPDT	93-0001	93-0002	93-0003
ON	OFF	(ON)	SPDT	93-1001	93-1002	93-1003
(OFF)	—	ON	SPST	93-2001	93-2002	93-2003
(ON)	—	OFF	SPST	93-3001	93-3002	93-3003
ON	—	(ON)	SPDT	93-4001	93-4002	93-4003

( ) — Momentary

**8 Amp. 125 V, 4 Amp. 250 V, 1/4 HP 125 V - 250 V**

SPST double-break mechanism  
Phosphor bronze contacts  
Brown phenolic case  
Nickel plated bat  
Cadmium plated cover

Circuit Arrangement			Poles	CATALOG NUMBERS			
A	B	C		Screw	Solder	Spade	Wire Leads
ON	—	OFF	SPST	4125-0001	4125-0002	4125-0003	4125-0004

Double break mechanism

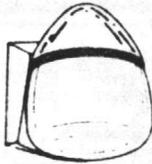
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**KEENE STONCOLINE  
TEARDROP  
PRISMATIC/OPALS**



P8301RM



P8401RM



P83011R



P84011R

Satin aluminum finish standard. Weatherproof cast aluminum fixtures with internal specular reflector and prismatic refractor or opal diffuser. Fixtures with RM suffix have additional external reflector.

**Wall Brackets —**

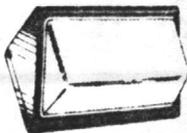
Incandescent fixtures on 5 x 7" mounting plate that fits all recessed FS, gems, 3-4" outlet boxes or Stonco matching 5 x 7" surface or corner box.

**Flush Ceiling —**

Incandescent fixtures on 5 3/16" square canopy plate that fits all recessed FS, gem, 3-4" outlet boxes or Stonco matching 5 3/16" square surface box.

No.	Globe	Each
<b>Incandescent 100 Watts Max.</b>		
P8301RM	Prismatic	\$124.66
P8401RM	Opal	140.66
<b>Incandescent - 200 Watts Max.</b>		
P83011R	Prismatic	\$143.86
P84011R	Opal	159.86

**KEENE STONCOLINE  
WALL CUBE BRACKETS**

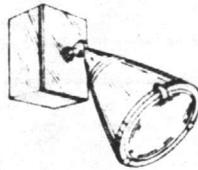


For mercury lamps. Gun-metal finish. Die-cast aluminum weatherproof housing with ballast.

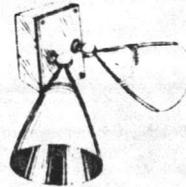
Specify 120, 240 or 277 volts.

No.	Lamp	Each
543-250MM	250W, E/BT28 Mog.	\$548.26
553-400MM	400W, BT37 Mog.	720.14

**KEENE STONCOLINE  
MERCURY VAPOR  
BULLET ASSEMBLIES**



68701-MM



68102-MM

Medium Base R-40 (Ballast Included)

Long cone design adjustable bullets on cast aluminum weatherproof boxes with integral constant wattage 90+% power factor ballasts.

Mount on any flat surface or over any recessed 3-4" outlet box.

Four side, two back holes tapped 1/2" NPS for surface or thru-wall conduit.

Four-close-up plugs.

Satin finish standard.

Fully enclosed fixtures with gasketed clear heat resistant lens (7" dia.) for face-up use in rain, snow, sleet.

Open fixtures used outdoors should be aimed below horizontal.

Specify voltage: 120V, 240V or 277V.

Other voltages available.

If voltage is not specified, 120V will be shipped. 4 in a carton.

No.	Lamps	Style	Each
68101-MM	1-100W	Open	\$482.54
68701-MM	1-100W	Enclosed	523.46
68102-MM	2-100W	Open	907.74
68702-MM	2-100W	Enclosed	989.86
68175-MM	1-175W	Open	636.80
68575-MM	1-175W	Enclosed	677.74
68176-MM	2-175W	Open	1061.20
68576-MM	2-175W	Enclosed	1143.20

**KEENE STONCOLINE  
RECESSED PHANTOMS**



For 100W medium base mercury lamp. Anodized cast aluminum weatherproof recessed with constant wattage ballast. Six 1/2" conduit holes and five plugs. Rough-in cover included.

No.	Cover	Each
A413-100MM	Glass Only	\$590.26
A411-100MM	Straight Louver	514.86
A412-100MM	45° Louver	595.00

**KEENE STONCOLINE  
VAPORTIGHT FIXTURES**



VP-11GC



VK-1GC



VCXL-11GC



VW-1GC



VWXL-11GC



VCP

Die-cast aluminum fixtures fully enclosed with gasketed clear heat-resistant glass or breakproof clear prismatic Lexan globes. Cast aluminum screw-on guards available. 6 in a carton.

VP Pendant Fixtures - (Stems not included.) Top hub tapped 1/2" NPT.

MC Job 84-1400 Pump and Lighting PO# 39164-12D Ramsey Air Conditioning Co. Camp LaJeune, NC

3 1/2" and 4" round and octagon boxes.

VCXL 4" Box-Mounted Fixtures - Four side and one top hole tapped 1/2" NPT. Three plugs included.

VW Wall Brackets for Standard Boxes - (Boxes not included.) Fits all recessed 4" round or octagon boxes. Use VCP mounting plate for all 3 1/2" boxes and for plumb alignment.

VWXL 4" Box-Mounted Wall Brackets - Four side and one back hole tapped 1/2" NPT. Three plugs included.

No.	Watts	Mounting	Each
<b>With Globe And Guard</b>			
VP-11GC	100	Pendant	\$46.00
VP-21GC	200	Pendant	60.54
VK-1GC	100	Surface	42.68
VK-2GC	200	Surface	55.60
VCXL-11GC	100	Box	60.14
VCXL-21-GC	200	Box	73.06
VW-1GC	100	Wall	55.46
VW-2GC	200	Wall	70.80
VWXL-11GC	100	Wall	72.94
VWXL-21GC	200	Wall	88.26

No.	Watts	Mounting	Each
<b>With Glass Globe Less Guard</b>			
VP-11K	100	Pendant	\$30.66
VP-21K	200	Pendant	41.34
VK-1K	100	Surface	27.34
VK-2K	200	Surface	36.40
VCXL-11K	100	Box	44.80
VCXL-21K	200	Box	53.86
VW-1K	100	Wall	40.14
VW-2K	200	Wall	57.60
VWXL-11K	100	Wall	57.60
VWXL-21K	200	Wall	69.06

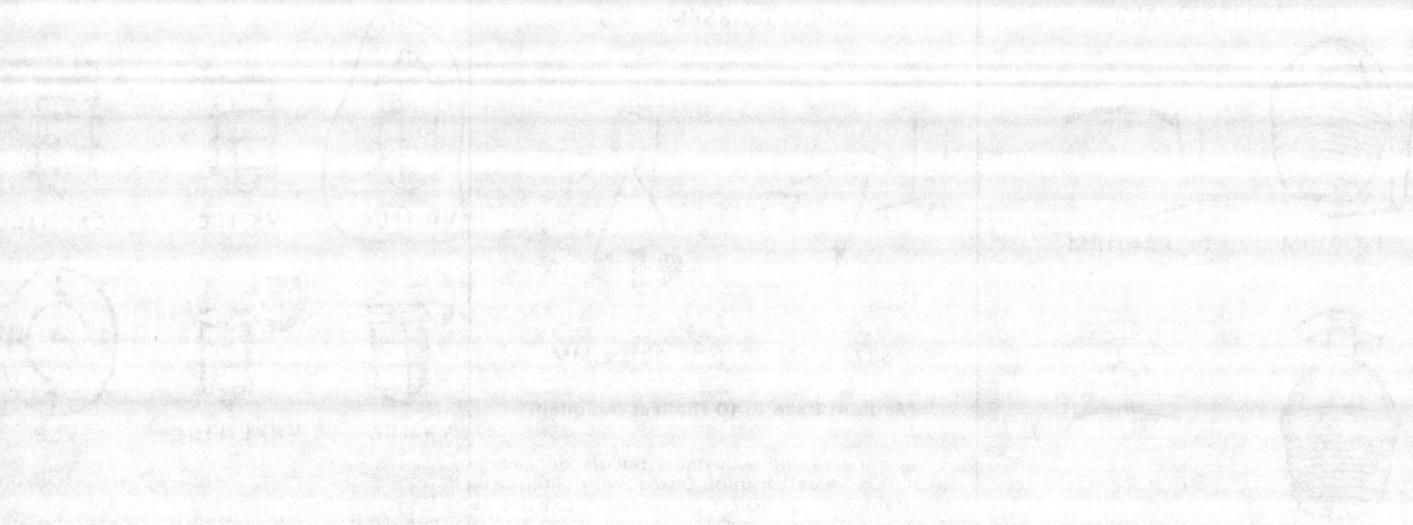
No.	Watts	Mounting	Each
<b>With Lexan Globes (For Vertical Mounting Only)</b>			
VCXL-SA	50	Box	\$62.14
VWXL-SA	50	Wall	74.94
VWXL-10A	100	Wall	87.46
<b>Adapter Plates</b>			
VCP	-	-	\$7.46

KEPNE STONCOPLINE LIGHTING

HELP ME STONCOPLINE  
VACUUM TIGHT ENDS

M. BOUSY VACOP  
P. O. BOX 1000

12-A 1000

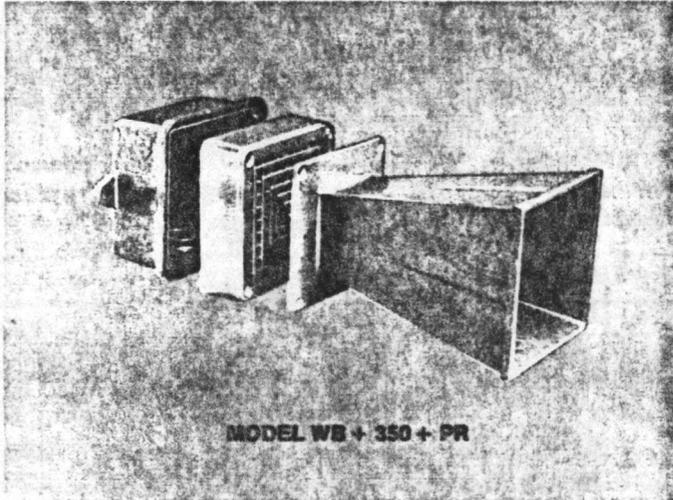


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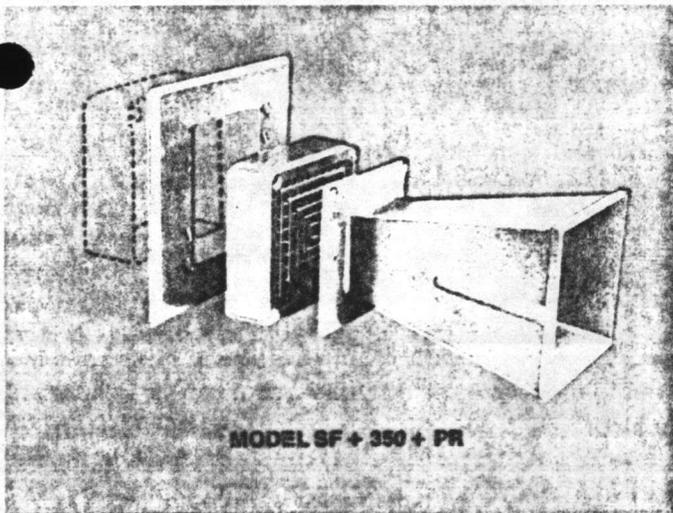
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# Vibratone® Horns Single Projector Models

MC Job 84-1400 Pump and Lighting PO#  
39164-12D Ramsey Air Conditioning Co.  
Camp LaJeune, NC



MODEL WB + 350 + PR



MODEL SF + 350 + PR

Addition of the PR projector to the basic #350 or #450 unit or any of its variations produces a corresponding projector model. While illustrations may make this obvious, a few applicable notations follow.

**BASIC PROJECTOR TYPE** consists of the 350 (or 450) plus the PR projector. For application to panels, cabinets and outlet boxes.

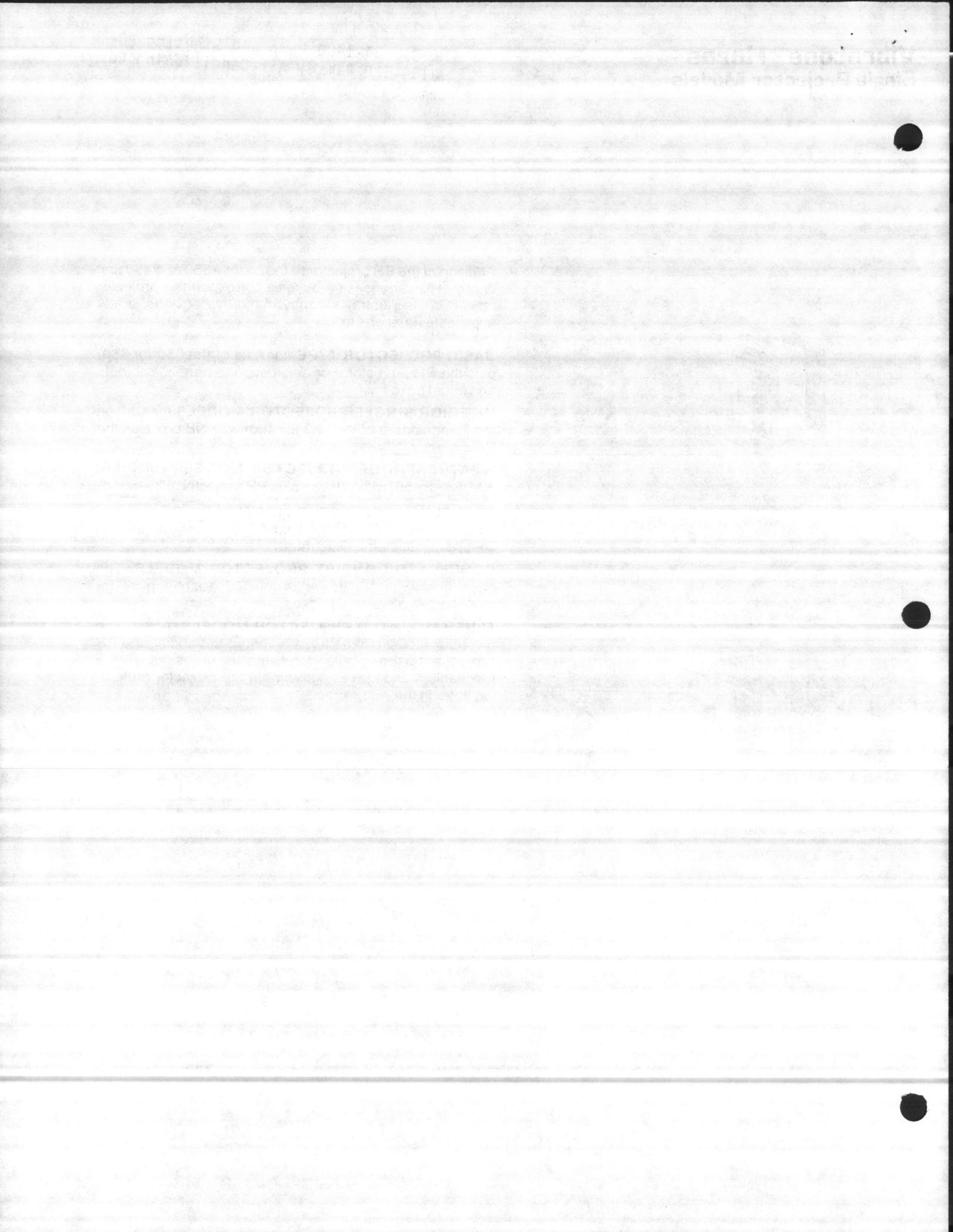
**INTERIOR SINGLE PROJECTOR MODELS** for surface mounting consist of the 350 (or 450) with NB box plus the PR projector.

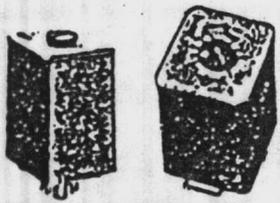
**WEATHERPROOF PROJECTOR MODELS** consist of the 350 (or 450) with WB box plus PR projector. (illustrated)

**SEMI-FLUSH PROJECTOR MODELS.** The PR projector added to the 350 (or 450) with SF plate for partially recessed installations. (illustrated)

**CONCEALED CONDUIT PROJECTOR MODELS.** The basic horn with NB box plus the CC adapter plate for mounting on a variety of boxes.

**FLUSH MOUNTED PROJECTOR MODELS.** Actually no projector model can be flush mounted but adding the PR projector to the regular flush model recesses all the mechanism and leaves nothing but the projector protruding beyond the wall surface.

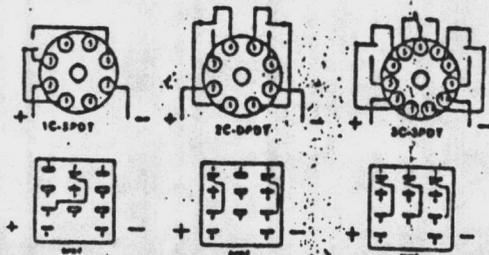




Standard

With Features 01\* and 14  
Latching Relay  
Press to Test  
Latch Release

Wiring Diagrams



General Information

- An inexpensive and compact fixed or adjustable time delay.
- Models feature plug-in octal base (11 pin for DPDT units) or screw base design. Plug-in screw base also features universal blade type terminals for solder or quick connect terminals. Printed circuit terminals are available on screw base units. (See ordering information.)
- Polycarbonate dust cover has low moisture absorption and high impact strength.
- All standard configurations recognized under the component program of Underwriters Laboratories, Inc., UL File E-39006. CSA certified by request only. File LR2681.
- Delay time is obtained by using a CMOS integrated circuit, an internal potentiometer controlled oscillator, a programmable binary counter and output controlled logic.
- Available in 3 voltages and DPDT 10 ampere output contacts.
- Gold diffused 5 ampere contacts optional.
- Available in 15 standard time ranges from 1 second to 4.5 hours.
- Optional range mounting.
- Push to test, simulating timed out condition. (OPTIONAL)
- Latch in manual reset. Retaining contacts in timed out condition after time out. Reset button must be depressed and power removed to reset timer. (OPTIONAL)
- Indicator light. On when power is applied to timer. (Standard on this series.)

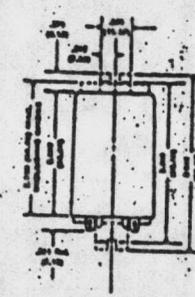
Specifications

Repeat Timing Accuracy	± 1.5% under load conditions
Fixed Time Accuracy	± 0% of rated voltage and room temperature.
Reset Time	75 milliseconds after time-out 150 milliseconds if reset during timing
Drop-Out Speed	30 milliseconds typical (including bounce)
Input Voltage Variation	Rated voltage ±10%, ±15%
Polarity Protection	Inverse polarity protection on DC units
Transient Protection	Immune to +600 volts peak transients up to 50 microseconds in duration.
Insulation Resistance	100 Megohms minimum
Dielectric Strength	300 volts R.M.S. 50% between open contacts 1500 Volts R.M.S. 50% between all elements.
Temperature Range	Operating: +10°F to +104°F (-10°C to +40°C) Storage: -4°F to +169°F (-20°C to +65°C)
Life Expectancy	In excess of 10 million operations
Electrical	100,000 minimum at full rated load
Duty Cycle	Continuous

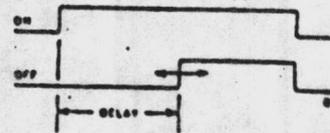
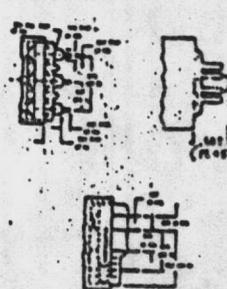
Output Rating

CONTACTS	Rating
Silver Cadmium Oxide (AgCdO)	10 Amp 70 VDC (resistive) 10 Amp 250 VAC 1/2 Hp 250 VA, 175 VAC 1/3 Hp 240 VA, 250 VAC

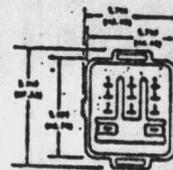
Flanged Case



Printed Circuit



ON DELAY: Time delay starts upon application of power. Relay energizes after delay. Deenergizing terminates reset timer.



Suggested PC Board Layout



	Socket	Rotators
Type O 1C (1C)	60SR2P05 60SR3P05 60SR2P51	N/A 60SFA201 Cto N/A
Type O 3C	60SA3P05 60SA3P51	N/A 60SFA201 Cto N/A
Type E Square Base	60SR3005 60SR3051 4270-0501	60SFA201 Cto N/A N/A

Ordering Information

80 E 2 A6 01 07

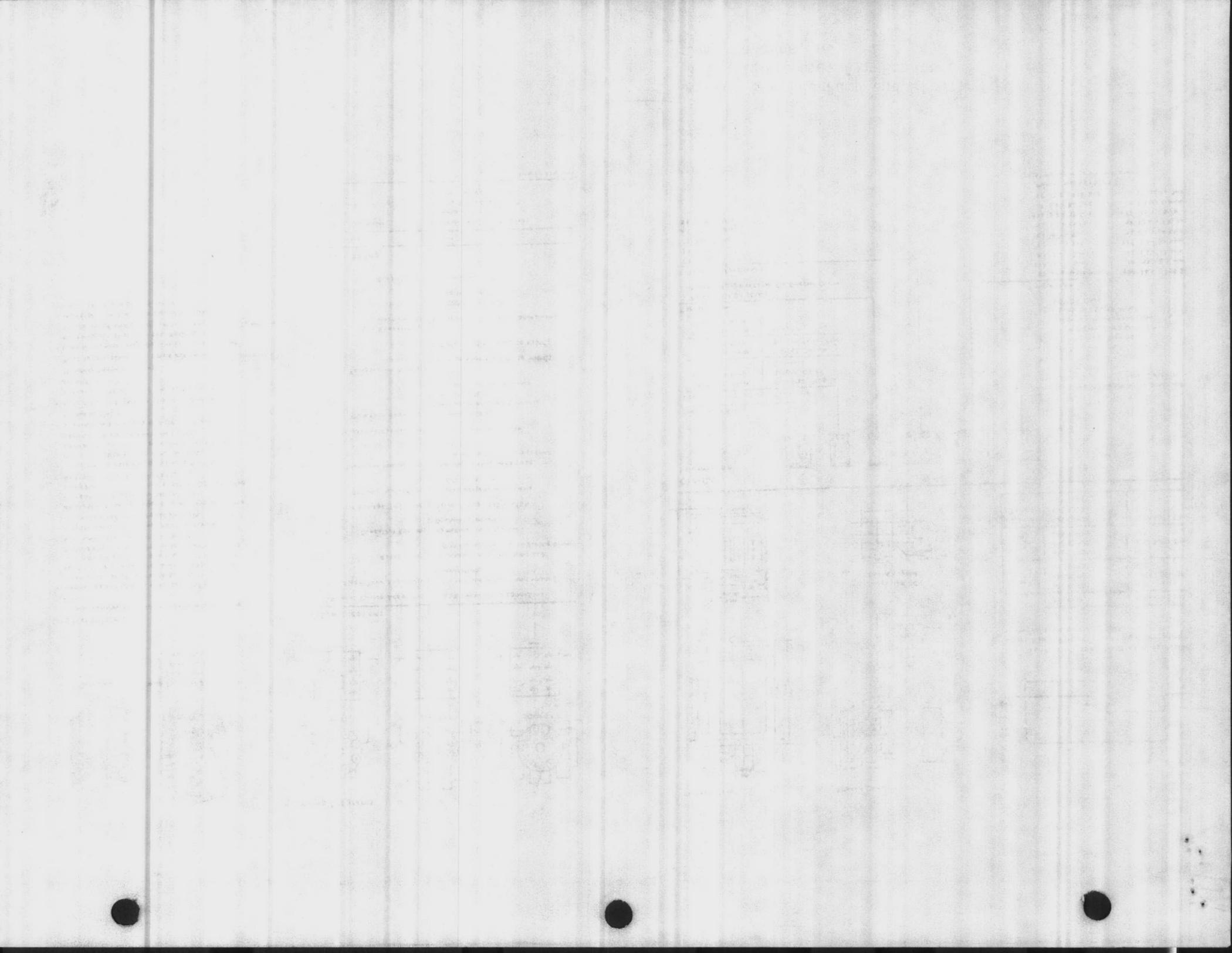
Time Delay Relay	Contact Materials	Terminals
5	Silver Cadmium Oxide, 10 Amp	Universal Plug-In, Solder, Quick Connect
M	Silver Cadmium Oxide, 10 Amp	Printed Circuit
0	Silver Cadmium Oxide, 10 Amp	Special Order Only
		Plug-In

Contact Form  
1 Form C DPDT (Std.)  
1 and 3 Pole Available On Special Order

Voltage and Frequency	Time Range	Part No.
21 12VDC	00 Unprogrammable	100 25.0 - 250 S
21 24VDC	01 1 - 1 Sec	10 05 - 05 1hr
26 24V 50Hz	02 2 - 2 Sec	01 17 - 17 1hr
41 120V 50Hz	03 4 - 4 Sec	102 2.0 - 30 1hr
51 240V 50Hz	04 0 - 4 Sec	10 0.0 - 0.0 1hr
	05 1.6 - 16 Sec	10 12.0 - 120 1hr
	06 3.2 - 32 Sec	115 0.5 - 0.5 hr
	07 6.0 - 60 Sec	00 Fixed Timing (Specify Time)
	08 12.0 - 120 Sec	

Features  
(More than one feature may be specified)  
\*01 - Manual (Push to Test) Operator  
2 Pole Only  
05 - Flanged Case Mounting  
"E" Series ONLY  
07 - 5 Amp Heat Treated, Fine Silver, Gold Diffused (for low level applications)  
\*14 - Latch In - Latch Release DPDT Only

MC Job 84-1400 Pump and Lighting PO#  
39164-12D Ramsey Air Conditioning Co.  
Camp LaJeune, NC



NEW ITEM ON THIS PAGE

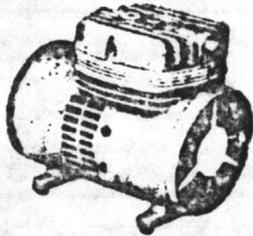
## 1/12 HP OIL-LESS COMPRESSOR & VACUUM PUMP

Lightweight Diaphragm Construction With Balanced Eccentrics for Smooth, Low Vibration Operation

**SPEEDAIRE**

NEW LINE

No. 42791



Only No. 42791

Designed for commercial and institutional applications that include printing and lithographing operations, laboratory uses, photo and chemical processing, computers and medical equipment as well as for hobby, classroom, painting and maintenance functions.

Made of lightweight die cast aluminum with Swedish stainless steel reed valves. All ball bearings and component parts permanently lubricated and sealed for maximum protection. Balanced eccentrics provide smooth, low vibration operation. 1/12 HP, 115V, 60 Hz, thermally protected, automatic reset motor with 6 ft grounded power cord. Green metallic finish. Speedaire brand.

No. 42791 Diaphragm Compressor delivers 3.5 CFM at 20 PSI, maximum 35 PSI. UL listed. No. 42792 Diaphragm Vacuum Pump pulls up to 15" Hg vacuum.

### OIL-LESS COMPRESSOR & VACUUM PUMP SPECIFICATIONS AND PRICES

Oil-Less Type	Length	Width	Height	Stock No.	Shpg. Wt.
Compressor	5"	4 1/4"	7"	42791	10
Vacuum Pump	5"	4 1/4"	7"	42792	10

### DIAPHRAGM COMPRESSOR/VACUUM PUMPS

Oil-less diaphragm compressor and vacuum pumps for continuous duty applications in labs, printing, medical use, water aeration, computers, chemical and photo processing. Maintain 24" Hg vacuum. Quiet operation: 55 dbA maximum sound level at 50 PSI for No. 22866, 64 dbA maximum at 50 PSI for No. 42791.

**CONSTRUCTION FEATURES:** Inlet valve seats are cast in head, eliminate valve plate and gasket for maintenance clearance and higher pressure. All inlet and exits at head; no danger of vapors from bearings being picked up and system. Reversible 1/4" NPT female in and out ports. Lifetime lubricated bearings. Large motor and rod bearings; large diameter motor shaft. Connecting rod permanently bonded to rod bearing to prevent loosening. Cast aluminum head, housing, connecting rod. Swedish stainless steel reed type valves. No. 22866 has 1/8 HP, shaded pole automatic thermal overload protected motor and No. 42791 has 1/12 HP permanent split-capacitor automatic thermal overload protected motor. 6 ft. 3-wire cord with molded 3 prong plug. Gray metallic finish.



- Pressure or vacuum without modification
- Rugged diaphragm of bonded aluminum

MC Job 84-1400 Pump and Lighting PO# 39164-12D Ramsey Air Conditioning Co. Camp LaJeune, NC

No. 22866

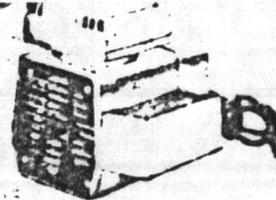
**\$125.36**

Lots 3

No. 42791

**\$168.72**

Lots 3



### DIAPHRAGM COMPRESSOR/VACUUM PUMP PERFORMANCE DATA

HP	Stock No.	Free Air CFM* at Vacuum in./Hg					Free Air CFM* at Pressure—PSI					
		5	10	15	20	24	10	20	30	40	50	60
1/8	22866	.80	.56	.36	.18	.00	.86	.70	.55	.40	.25	.1
1/3	42792	1.4	1.05	.65	.30	.00	1.5	1.2	.90	.70	.50	.3

(\* Performance rated with motor run at 60 Hz for No. 42792. If 50 Hz is used, deduct 1/5 off ratings.

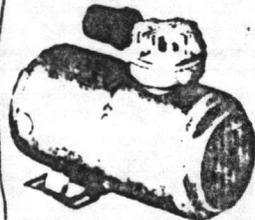
### DIAPHRAGM COMPRESSOR/VACUUM PUMP SPECIFICATIONS AND PRICES

HP	Motor Volts	Hz	RPM	Dimensions, Inches			Stock No.	Retail	Each	Lots 3	Shpg. Wt.
				Length	Width	Height					
1/8	115	60	1725	7 3/4	5 1/4	7 1/4	22866	\$114.45	\$131.93	\$125.36	19
1/3	115	50/60	2450	7 3/4	7 1/4	7 1/4	42024	\$107.95	\$127.32	\$168.72	17

### COMPLETE LINE OF STEEL SHELVING & SHOP EQUIPMENT AVAILABLE THROUGH YOUR LOCAL GRAINGER SALES OFFICE/WAREHOUSE

Grainger carries in stock steel shelving, service carts, tool stands, work benches and other shop equipment most often asked for. In addition, we can supply your needs for any other item in our comprehensive line of material handling equipment—tell us your requirements.

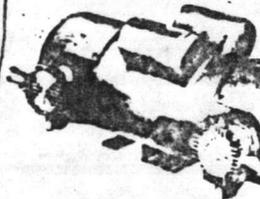
## 1/6 to 2 1, 2 and 4-Cylinders.



1/8 HP, 1-Cylinder

**\$164.70**

No. 22867, Lots 3



1/2 HP, 4-Cylinder

**\$655.28**

No. 42468, Lots 3

Dayton Speedaire oil-less air compressors are used for high pressure, continuous duty applications in printing, laboratory, computer, medical, and photographic processing applications.

All models are equipped with inlet filter for each cylinder. Protected motors with high ratings. Nos. 22867 and 22868 are 1/8 HP, 115V, 60 Hz; Nos. 22869, 22870, 42468 are 1/2 HP, 230V, 60 Hz; and No. 42707 is 1/2 HP, 115V, 60 Hz.

Exclusive lap-joint Teflon stainless steel seals help un-

### OIL-LESS

HP	Cyls.	Length	Width	Height
1/6	1	11 1/2"	5 1/2"	8 1/2"
1/3	2	12 1/2"	10 1/2"	8 1/2"
1/2	2	13 1/2"	11 1/2"	8 1/2"
3/4	2	13 1/2"	11 1/2"	8 1/2"
1	2	17 1/2"	12 1/2"	8 1/2"
1 1/2	4	21 1/2"	12 1/2"	8 1/2"
2	4	23 1/2"	12 1/2"	8 1/2"

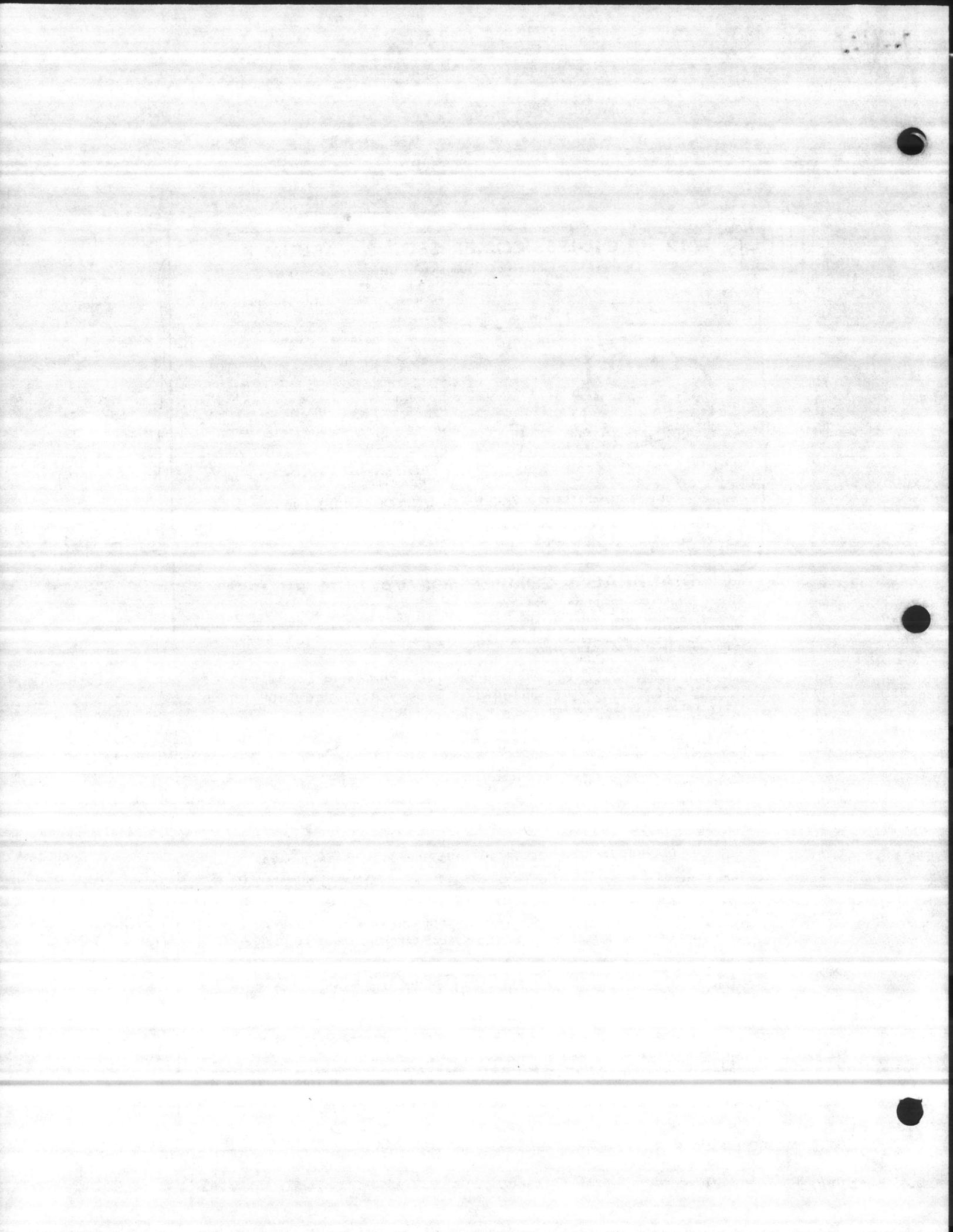
(\* in 60 PSI.)

### SPEEDAIRE AND DAYTON

Speedaire and Dayton Speed selling air equipment. Requ Warehouse.

Literature available on air:  
Bulletin 404 —Speedaire C  
405 —Dayton Spee  
406 —Compressor  
408 —Air Cleanin

SEE WARR



**21 150 PSI AIR LINE MINI-FILTER**

5 micron filter element for removal of extra fine particles. 1/4" port size. 150 PSI maximum supply pressure at 125°F maximum operating temperature. Aluminum body. 21 CFM flow rate at 100 PSI inlet and 5 PSI drop. Clear, shatterproof polycarbonate bowl. Easy to operate push-type drain. 3 3/4" H x 1 1/4" W. Shpg. wt. 4 oz. No. 22764. Retail \$10.00. Each \$9.77; lots 4 99.19

**22 250 PSI AIR-LINE MINI-REGULATOR**

Self-relieving type: pressure can be set without flow thru the unit. 1/4" port size. 1/4" gauge ports. 250 PSI maximum supply pressure. 0 to 125 PSI regulated pressure range. -10° to 175° F operating temperature. 13 CFM flow rate measured at 10 PSI drop. Easy adjustment with push lock feature. Aluminum body. 3 H x 1 1/4" W. Shpg. wt. 4 oz. No. 22767. Retail \$9.25. Each \$8.20; lots 4 57.70

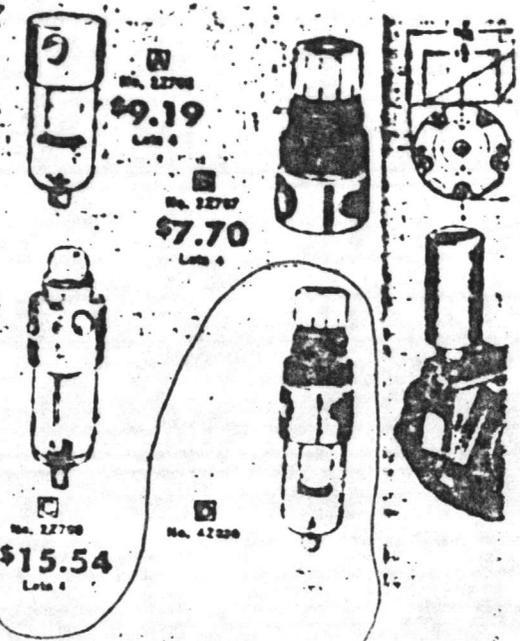
**23 150 PSI OIL MIST MINI-LUBRICATOR**

Ideal for small cabinets, air tools. 1/4" port size. 150 PSI maximum supply pressure. 125°F maximum operating temperature. Bypass gives wide operating range without excessive pressure drop. Clear, shatterproof plastic bowl. Aluminum body. 4 1/2" H x 1 1/4" W. Shpg. wt. 3 oz. No. 22768. Retail \$18.40. Each \$16.53; lots 4 515.54

**24 150 PSI MINI-FILTER/REGULATOR "PIGGYBACK"**

Compact "Piggyback" unit combines all filter and regulator features to provide optimal performance in minimal space. 5 micron element. Easily removed, shatterproof polycarbonate bowl. Minimal pressure drop. Non-rising locking knob. 1/4" port size. Two full flow 1/4" gauge ports. 125°F maximum operating temperature. Manual drain. 1 oz. bowl capacity. 5 1/2" H x 1 1/2" W. Shpg. wt. 1 lb. No. 42030. Retail \$20.00. Each \$18.00; lots 4

011 207A 0017 8773 10 027



No. 22764  
**\$9.19**  
Lots 4

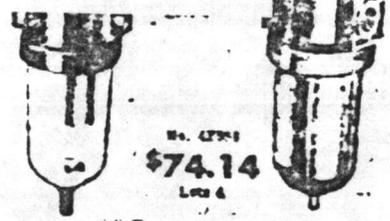
No. 22767  
**\$7.70**  
Lots 4

No. 22768  
**\$15.54**  
Lots 4

No. 42030

Dual filtration by paper support w/ remove up to 99 clean filtered air 125°F max. oper polycarbonate bowl models 22999, 42035, 42036, 250 PSI max supply pressure and 175°F max. operating temperature on metal bowl with sight glass models 42558, 42559. Manual drain. Bowls easily remove for filter replacement.

NPT	CFM	Height	Width	Capacity	Bowl	Stock No.	Retail	Each	Lots 4	Shpg. Wt.
1 1/4"	5	6 1/2"	2 1/4"	5 oz	5 oz	42035	\$11.55	\$30.18	\$36.81	1
1 1/2"	10	8	3 1/4"	5 oz	5 oz	42036	\$11.55	\$46.58	\$43.85	1
1 1/2"	20	8	3 1/4"	5 oz	5 oz	22999	\$5.25	\$7.74	\$3.81	2
1	4	10 1/2"	5	12 oz	12 oz	42558	\$7.50	\$8.04	\$4.14	15
1	8	10 1/2"	5	12 oz	12 oz	42559	\$10.25	\$8.18	\$3.78	45



No. 42030  
**\$74.14**  
Lots 4

No. 5X403  
**\$69.13**  
Lots 3 Complete Kit



**PARKER O-RING KIT**

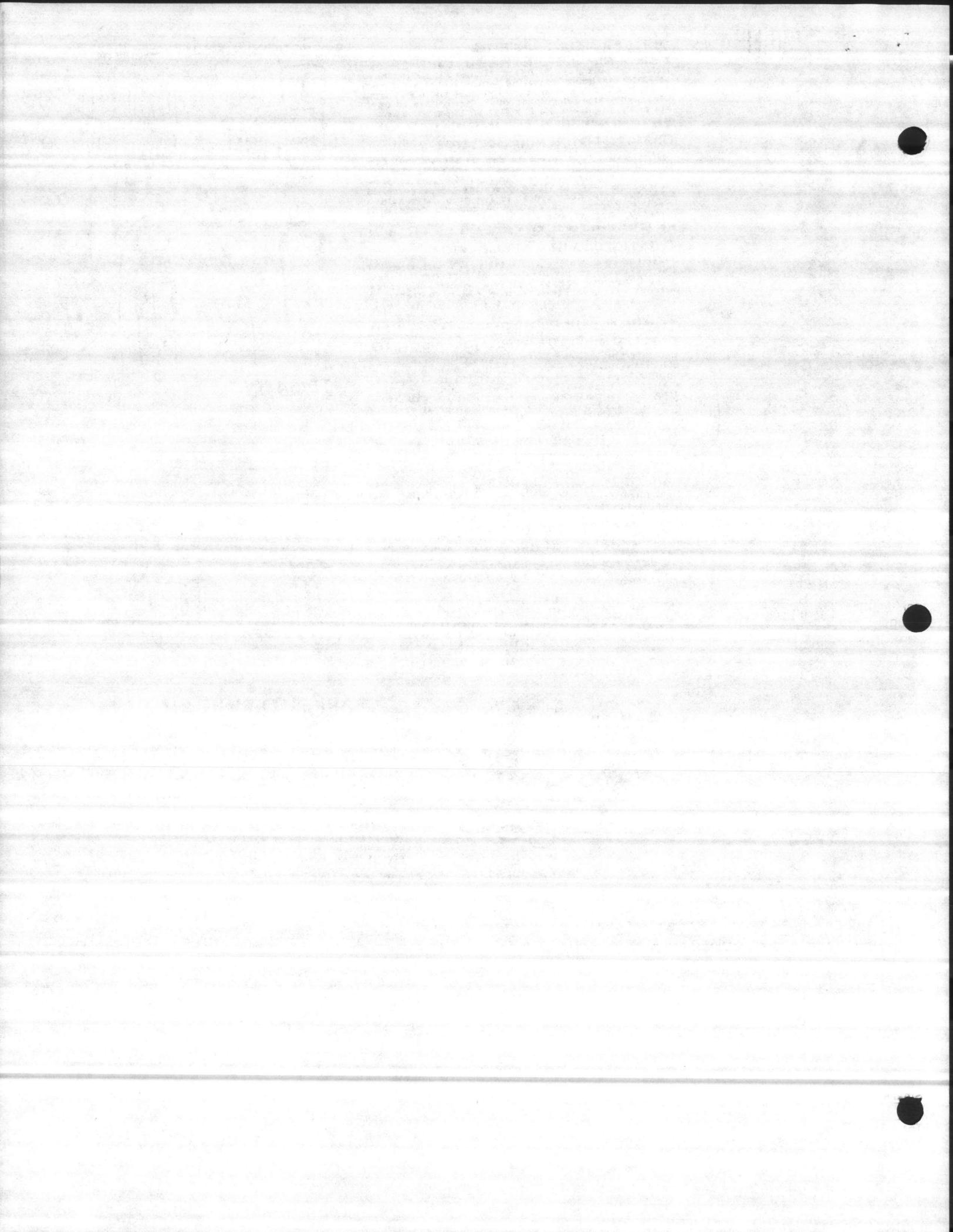
Parker Series 2 O-Rings, made of 70 durometer Buna-N, come in a sturdy two-compartment plastic carrying case with molded handle. A total of 485 O-Rings in 37 sizes are held securely in place on plastic pegs. Size gauge included.

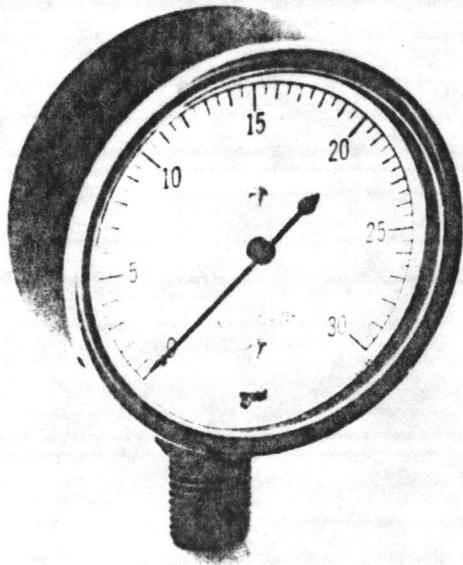
Parker Series 2 Dash Numbers\* included in kit are: 32 each of Nos. 006, 007, 008, 009, 010, 011, 012, 12 each of -110, -111, -112, -113, -114, -115, -116, 9 each of -210, -211, -212, -213, -214, -215, -216, -217, -218, -219, -220, -221, -222; 6 each of -322 thru -334 Shpg. wt. 4 1/2 lbs. Parker Hannifin.

No. 5X403. Retail \$84.60. Each \$76.04; lots 3 \$69.13. \*Dash numbers equivalent to Aerospace Standard AS568A used in fluid power applications.

Air In	Output RPM
1100	50
2400	170
3600	240
4800	300
5400	400
6000	

(\* Not recom)





MC Job 84-1400 Pump and Lighting PO#  
39164-12D Ramsey Air Conditioning Co.  
Camp LaJeune, NC

**Drawn Steel Case  
Diaphragm Gauge  
Fig. No. 83K**

**Application**

To indicate vacuum or pressure from 200 inches of water vacuum through 10 psi - a range where a Bourdon tube type gauge is not practical.

**Internal Features**

**Accuracy** - ANSI Grade A - 1% except ranges under 30 inches of water or equivalent within 1% in middle half of scale - 3% elsewhere.

**Diaphragm** - Phosphor bronze.

**Movement** - Polycarbonate and brass.

**Corrector** - Available to order when specified. (See price list)

**External Features**

**Gauge Size** - 2 1/2", 3 1/2" and 4 1/2", except that 4 1/2" not available in Type B and D construction.

**Case** - Drawn steel - Phosphatized for

rust resistance, baked black enamel finish.

**Window** - Clearlok® - Acrylonate R570, except 4 1/2" has pressed ring and glass window.

**Dial** - White coated aluminum.

**Pointer** - Brass with black lacquer finish.

**Socket** - Brass.

**Checkscrew** - .013 checkscrew is standard except on range of 10" water pressure where no checkscrew is furnished.

**Case Variations**

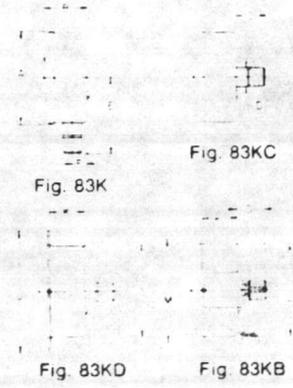
**Fig. 83K** - 1/4 NPT male bottom connection is standard. When specified, 1/8" male bottom connection can be furnished on 2 1/2" size only.

**Fig. 83KC** - 1/4 NPT male center back connection is standard. 1/8" male center back connection is available on 2 1/2" and 3 1/2" sizes.

**Fig. 83KB** - Flush mounted type with

U-clamp and studs for clamping. 1/4 NPT male center back connection is standard. 1/8 NPT male center back connection is available.

**Fig. 83KD** - Flush mounted type with front flange with three mounting holes. 1/4 NPT male center back connection is standard. 1/8 NPT male center back connection is available.



\*2 1/2" size Fig. 83KB and 83KD not available with Clearlok crystal. These cases will be provided with pressed ring and plastic window.

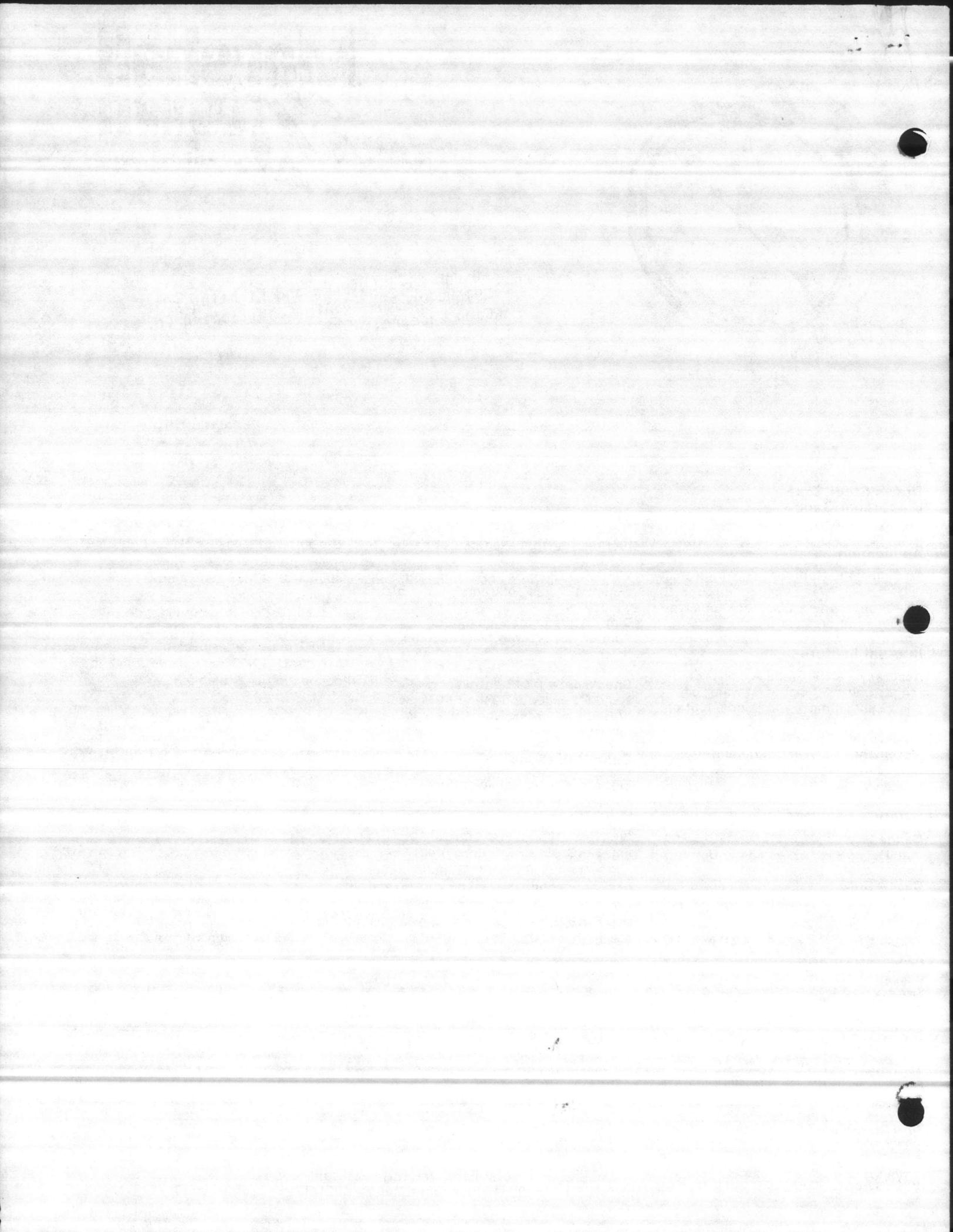
**CASE DIMENSION**

Gauge Size	A	B	C	D	E	F	G	H	J	K	L	M	O
2 1/2	2 5/8	1 1/2	13/16	9/16	2 3/16	3/8	3 1/32	5/32	3 15/32	1 1/4	2 19/32	2 15/16	7/8
3 1/2	3 11/16	1 19/32	13/16	9/16	2 23/32	3/8	4 13/32	7/32	4 3/4	1 1/4	3 21/32	4	7/8
4 1/2	4 25/32	1 15/32	13/16	9/16	3 3/8	13/16							

	Single Scale, Oz./Sq. In. or In. H <sub>2</sub> O (Pressure or Vacuum)										Dual Scale, Oz. In.					
	10**	15	30	60	100	160	200	300***	8 3/4	15	20	35	32	55	58	100
Total Graduation	1	3	5	10	10	20	20	50	1	3	2	5	4	5	8	10
Figure Intervals	1/8	1/4	1/2	1	1	2	2	5	2	1/4	1/2	1	1/2	1	1	2
Smallest Sub-Division																
	Pressure, psi															
Total Graduation				3†				5				10				
Figure Intervals				1/2				1				1				
Smallest Sub-Division				1/16				1/16				1/8				

\*\*Not available in inches of water vacuum.  
\*\*\*Not available in ounces.

**Note:** For correct use and application of pressure gauges, see PRESSURE



*"QUALITY PUMPS SINCE 1939"*

**ZOELLER CO.**



FM 4  
091

3280 OLD MILLERS LANE  
P.O. BOX 16347 • LOUISVILLE, KY. 40216  
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## COMPARE THESE FEATURES

- Vortex Impeller Design
- Float operated, submersible (NEMA 6) mechanical switch.
- Durable cast construction. Cast switch cap, motor shell, pump housing, base and impeller. No sheet metal parts to rust or corrode.
- Stainless steel screws, bolts, float rod, handle, guard, and arm and seal assembly.
- Bronze units available.
- 10 foot UL-approved 3-wire neoprene cord & plug.
- Automatic reset thermal overload protection.
- Oil filled motor — hermetically sealed.
- Carbon and ceramic shaft seal.
- 60 cycles, 1725 RPM
- Passes 5/8 inch solids (sphere).
- No screens to clog.
- 1 1/2" NPT Discharge.
- On point — 9 3/4".
- Off point — 3".
- Major width — 11 3/4".
- Height — 13".
- Weight — 49 lb.

**SIMPLEX AND DUPLEX  
SYSTEMS AVAILABLE**

**PACKAGED SYSTEMS  
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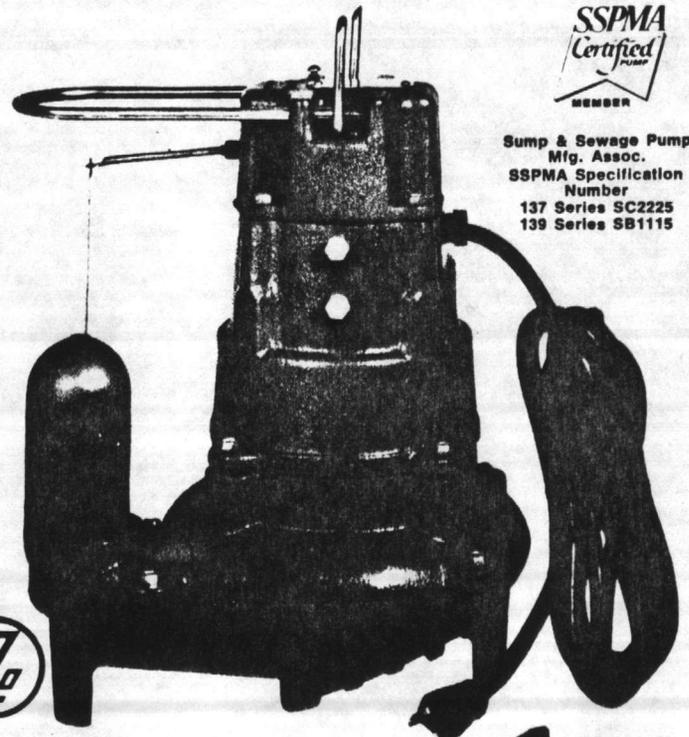
Manufacturers of ...

*"QUALITY PUMPS SINCE 1939"*

## *"137" Cast Iron Series* → *"139" Bronze Series* ← **"FLOW MATE"**

FOR SEPTIC TANK SYSTEMS  
**EFFLUENT**  
OR DEWATERING PUMP

SUBMERSIBLE  
1 1/2" NPT DISCHARGE



Sump & Sewage Pump  
Mfg. Assoc.  
SSPMA Specification  
Number  
137 Series SC2225  
139 Series SB1115



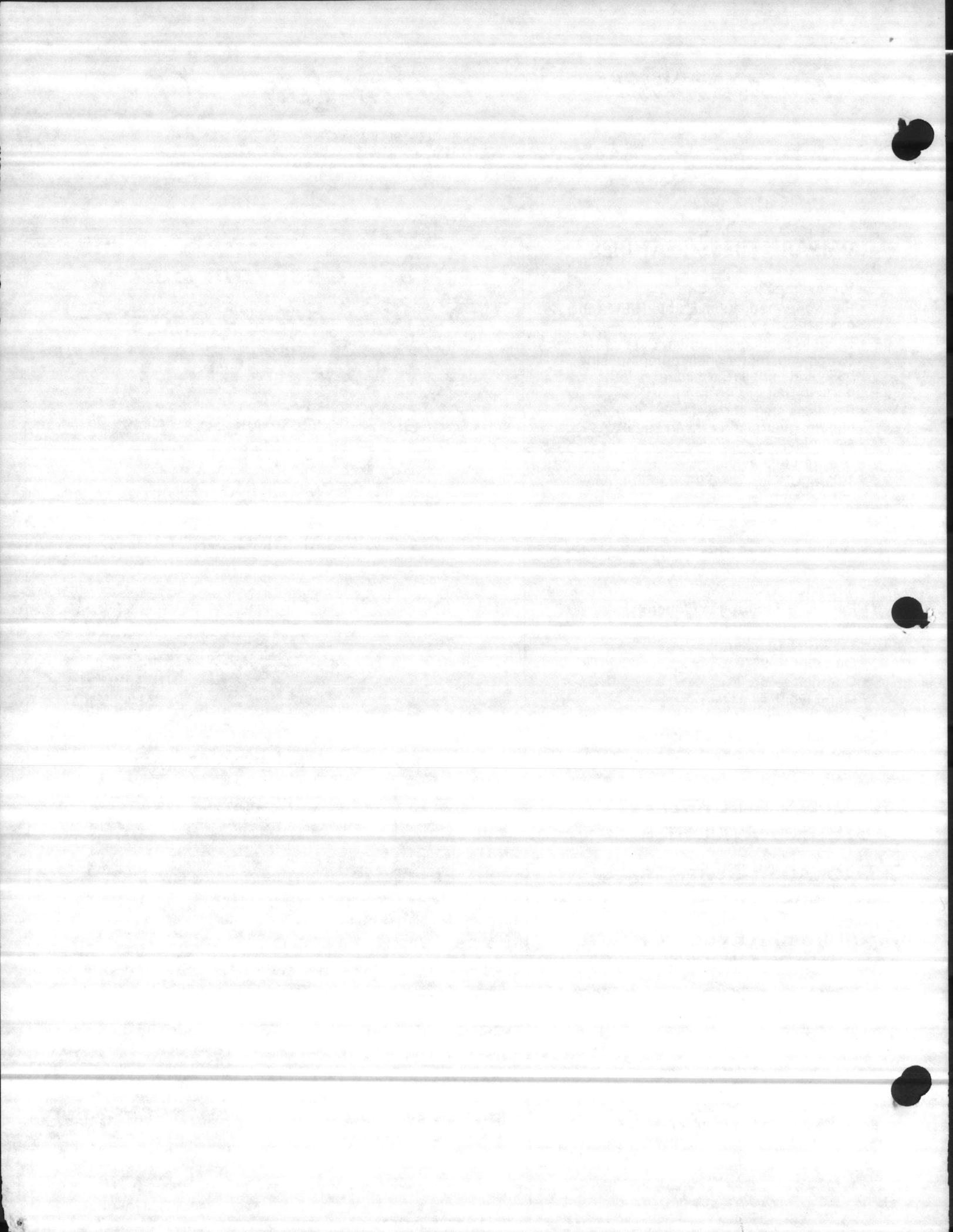
DESIGNED FOR  
HEAVY DUTY  
EFFLUENT APPLICATION

### MODELS AVAILABLE

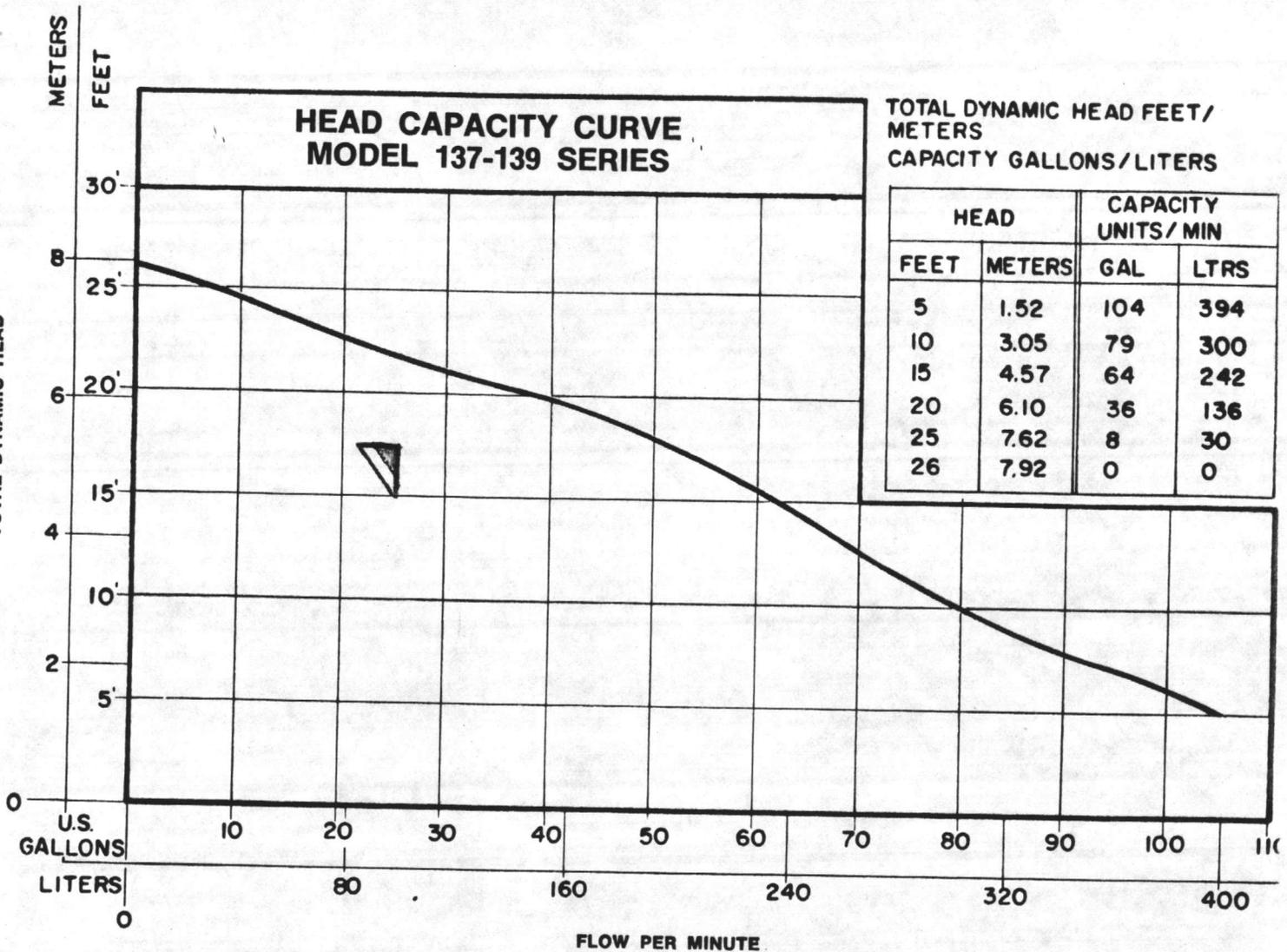
- Automatic or Non-Automatic
- 1/2 H.P., 1 Ph., 115V, 200-208V or 230V
- 1/2 H.P., 3 Ph., 200-208V or 230V



Vortex Type Impeller



TOTAL DYNAMIC HEAD



**CONSULT FACTORY FOR SPECIAL APPLICATIONS**

- Electrical alternators for duplex systems available with mercury float switches.
- High water alarms available.
- Minimum recommended basin size  
Simplex — 18" x 30"  
Duplex — 36" x 36"
- Mechanical alternators available for duplex systems.
- Long cords available
- Dewatering — 150 degrees.

Zoeller can provide complete packaged systems or combination of components including controls, pumps, polyethylene or fiberglass basins.

**SINGLE PHASE UNITS**

Cast Iron Model	Ph.	H.P.	Volts	Amps	Wt.	Bronze Model	Ph.	H.P.	Volts	Amps	Wt.
M137 Automatic	1	½	115	10.4	49 lbs.	M139 Automatic	1	½	115	10.4	49 lbs.
D137 Automatic	1	½	230	5.2	49 lbs.	D139 Automatic	1	½	230	5.2	49 lbs.
N137 Non-Automatic	1	½	115	10.4	49 lbs.	N139 Non-Automatic	1	½	115	10.4	49 lbs.
E137 Non-Automatic	1	½	230	5.2	49 lbs.	E139 Non-Automatic	1	½	230	5.2	49 lbs.

*"You Get More for Your Dollar—When You Buy a Zoeller"*

**RESERVE POWERED DESIGN**

Engineered purposely to pump less than design characteristics permit in order to allow a safety factor for unusual conditions.



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