TECHNICAL MANUAL

ORGANIZATIONAL, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL (INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST)

FOR

85' AERIAL LADDER FIRE FIGHTING TRUCK

NSN 4210-00-965-1254

HEADQUARTERS, DEPARTMENT OF THE ARMY

5 NOVEMBER 1986

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	8	Ladder Calibration and Adjustments
	9	Illustrations
TM 5-4210-227-24&P-2		General Information
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	2	Fuel System and Governors
	3	Air Intake Systems
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	2	Fuel System and Governors
	3	Air Intake System
	4	Lubricator System
	5	Cooling System
	6	Exhaust System
	7	Electrical Equipment, Instruments and Protective Systems
	8	Power Take-off and Torque Converter
	9	Transmissions (Sections 10 and 11 not included).
	12	Special Equipment
	13	Operation
	14	Tune-up
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TM 5-4210-227-24&P-8		Parts List and Foldouts Tools and Equipment
TM 5-4210-227-10	1	Introduction/Tabulated Data
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	3	Operator Maintenance
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	6	Operator's Manual, Series V-71 Engines
	7	Built-in Parts Book for Detroit Diesel Engines
	8	Operator's Manual, Fire Apparatus Chassis

FOREWORD

Descriptions, instructions and parts listing pertaining to the Model QWT 85 are discussed throughout this manual under the general headings Chassis, Pump and Ladder. Foldout illustrations and schematics are located at the rear of this volume. The foldout format is provided in order that illustrations and schematics may be referred to while the supporting text is being examined and studied.

A detailed description is given in the Introduction of each volume to assist the user in finding the information required to maintain the equipment.

- Operator's Manual (TM 5-4210-227-10)
  This manual is designed to provide the information necessary for a fire fighter or mechanic to properly operate the truck, the pump and the ladder.

- Maintenance Manual (TM 5-4210-227-24&P-6)
  This manual contains the. information necessary for an experienced mechanic to maintain and repair all facets of the apparatus. Each volume is individually indexed for ease of reference. This manual contains all the information necessary to obtain assemblies and subassemblies or individual parts, required to repair and maintain the fire truck.

MAINTENANCE MANUAL

SECTION I

1. INTRODUCTION/TABULATED DATA

1.1 INTRODUCTION

1.1.1. TM 5-4210-227-24&P, Organizational, Direct Support, and General Support Maintenance Manual for the.85' Aerial Ladder Fire Fighting Truck is divided into eight volumes. These eight volumes are further-subdivided into specific sections consisting of both Government and commercial literature. TM 5-4210-227-10,

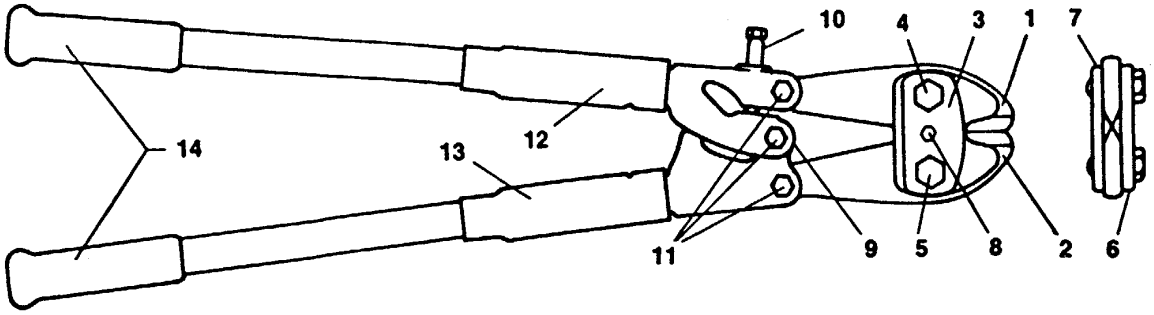
Operator's Manual for the 85' Aerial Ladder Fire Fighting Truck is one separate manual consisting of five separate sections.

1.1.2. This volume consists of 1* sections and is arranged as follows:

1. Wire Diagrams and Schematics
2. Miscellaneous Parts and Equipment
3. Inspection and Maintenance Procedures
4. Light and Sound Systems
5. Communication/Warning Systems
6. Valves
7. Pump, Operating and Maintenance Manual
8. Nozzles and Tips
9. Solenoid Valves
10. Hydraulic Valves and Equipment
11. Hydraulic System Startup and Maintenance Manual
12. Vane Pumps and Motors
13. Pump Overhaul Manual
14. Service Parts Information
15. Four-Way Solenoid Valves
16. Kunkle Valve, Miniature Regulators and Air Line Regulators
17. Cylinder Parts List
18. Joystick Testing Procedure and Technical Information Bulletin

MISCELLANEOUS PARTS AND EQUIPMENT

HEAVY DUTY FIBERGLASS HANDLED HARD METAL CUTTERS



PARTS FOR 0190FCX (01031)
Overall Length: 24" (610 mm)

ITEM NO.	PART NO.	CODE NO.	DESCRIPTION
	0113CX	01004	Cutterhead
	0112C	01002	Jaws, Pair
	0124X	01115	Cutterhead less Jaws
	0115FGS	01035	Handles, Pair
1	0111C	01040	Jaw, Left
2	0110C	01039	Jaw, Right
3	0156	01143	Lockplate
4	0135	01127	Bolt, Right Thd.
5	0136	01130	Bolt, Left Thd.
6	0120X	01101	Strap, Top
7	0121X	01109	Strap, Bottom
8	0157	01145	Screw, Lockplate
9	0184	01037	Bushing, Handle
10	0138M	01036	Screw, Adjusting
11	0127MS	01032	Bolt and Nut
12	0106FGS	01034	Handle, Left
13	0105FGS	01033	Handle, Right
14	0180FG	01038	Grip, Rubber

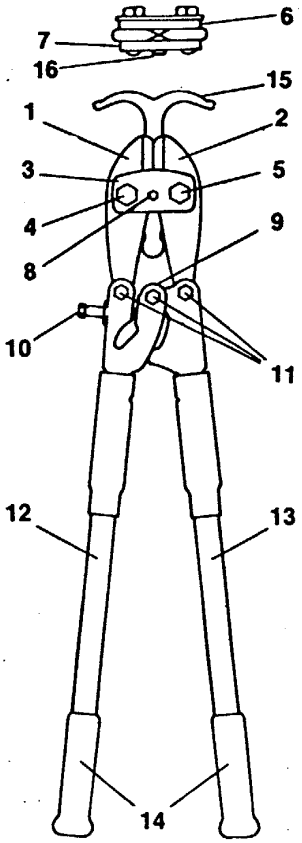
PARTS FOR 0290FCX (02012)
Overall Length: 30" (762 mm)

ITEM NO.	PART NO.	CODE NO.	DESCRIPTION
	0213CX	02004	Cutterhead
	0212C	02002	Jaws, Pair
	0224X	02070	Cutterhead less Jaws
	0215FGS	02028	Handles, Pair
1	0211C	02033	Jaw, Left
2	0210C	02032	Jaw, Right
3	0256	02084	Lockplate
4	0235X	02079	Bolt, Right Thd.
5	0236X	02081	Bolt, Left Thd.
6	0220X	02066	Strap, Top
7	0221X	02068	Strap, Bottom
8	0257	02085	Screw, Lockplate
9	0284	02031	Bushing, Handle
10	0238M	02030	Screw, Adjusting
11	0227MS	02029	Bolt and Nut
12	0206FGS	02027	Handle, Left
13	0205FGS	02026	Handle, Right
14	0280CS	02025	Grip, Rubber

PARTS FOR 0390FCX (03039)
Overall Length: 36" (914 mm)

ITEM NO.	PART NO.	CODE NO.	DESCRIPTION
	0313CX	03004	Cutterhead
	0312C	03002	Jaws, Pair
	0324X	03112	Cutterhead less Jaws
	0315FGS	03038	Handles, Pair
1	0311C	03044	Jaw, Left
2	0310C	03043	Jaw, Right
3	0356	03140	Lockplate
4	0335X	03125	Bolt, Right Thd.
5	0336X	03128	Bolt, Left Thd.
6	0320X	03104	Strap, Top
7	0321X	03109	Strap, Bottom
8	0557	05071	Screw, Lockplate
9	0384	03042	Bushing, Handle
10	0338M	03041	Screw, Adjusting
11	0327MS	03040	Bolt and Nut
12	0306FGS	03037	Handle, Left
13	0305FGS	03036	Handle, Right
14	0380FG	03039	Grip, Rubber

FIREMEN'S CUTTERS WITH FIBERGLASS HANDLES



PARTS FOR 0090FFC (00009)
Overall Length: 20" (508 mm)

ITEM NO.	PART NO.	CODE NO.	DESCRIPTION
	0013FC	00010	Cutterhead
	0012C	00003	Jaws, Pair
	0015FGS	00027	Handles, Pair
1.	0011C	00014	Jaw, Left
2	0010C	00013	Jaw, Right
3	0056	00053	Lockplate
4	0035	00048	Bolt, Right Thd.
5	0036	00049	Bolt, Left Thd.
6	0020	00035	Strap, Top
7	0021FC	00037	Strap, Bottom
8	0157	01145	Screw, Lockplate
9	0084	00058	Bushing, Handle
10	0038M	00051	Screw, Adjusting
11	0027MS	00043	Bolt and Nut
12	0006FGS	00026	Handle, Left
13	0005FGS	00025	Handle, Right
14	0280M	02093	Grip, Rubber
15	0051FC	00052	Hook
16	0052GC	86017	Bolt, Hook

PARTS FOR 0190FFC (01023)
Overall Length: 25" (635 mm)

ITEM NO.	PART NO.	CODE NO.	DESCRIPTION
	0113FC	01024	Cutterhead
	0112C	01002	Jaws, Pair
	0115FGS	01035	Handles, Pair
1	0111C	01040	Jaw, Left
2	0110C	01039	Jaw, Right
3	0156	01143	Lockplate
4	0135	01127	Bolt, Right Thd.
5	0136	01130	Bolt, Left Thd.
6	0120	01093	Strap, Top
7.	0121FC	01105	Strap, Bottom
8	0157	01145	Screw, Lockplate
9	0184	01037	Bushing, Handle
10	0138M	01036	Screw, Adjusting
11	0127MS	01032	Bolt and Nut
12	0106FGS	01034	Handle, Left
13	0105FGS	01033	Handle, Right
14	0180FG	01038	Grip, Rubber
15	0151FC	01138	Hook
16	0052GC	86017	Bolt, Hook

Section II
MISCELLANEOUS PARTS AND EQUIPMENT

MSA Air Mask

model 401

parts list

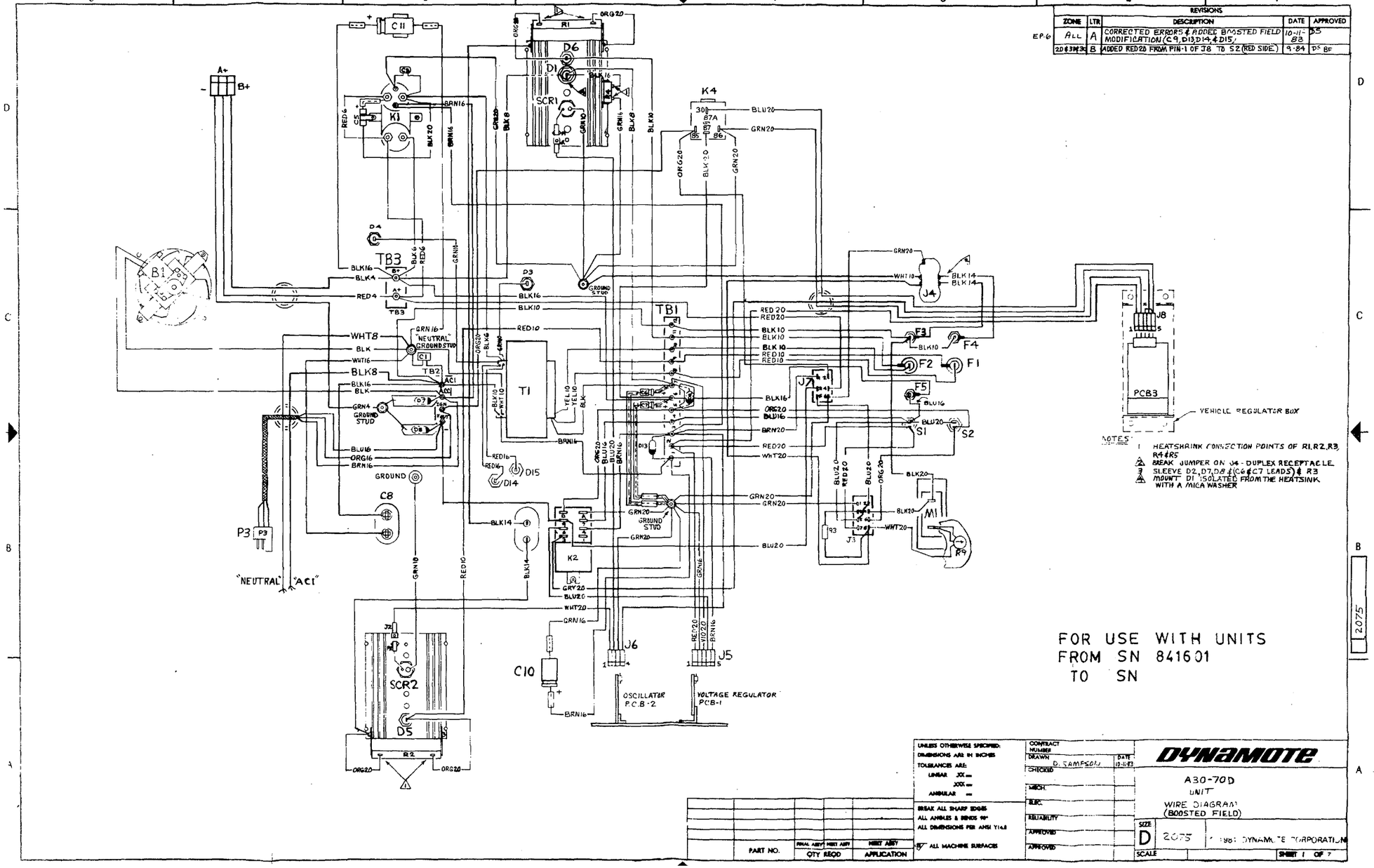
part no. 457153 Air Mask, complete in case
part no. 457154 Air Mask, conforming to Fed. Spec. GG-B-675
part no. 457152 Air Mask, less case
part no. 457155 Air Mask, with work mask regulator, complete in case
part no. 461696 Air Mask, Pressure Demand, less case
part no. 461704 Air Mask, Pressure Demand, complete in case.
part no. 461946 Air Mask, Pressure Demand, conforming to Fed. Spec. GG-B-675 less case
part no. 461947 Air Mask, Pressure Demand, conforming to Fed. Spec. GG-B-675 complete in case
part no. 463830 Air Mask, Demand, Composite Cylinder, in case
part no. 463827 Air Mask, Demand, Composite Cylinder, less case
part no. 463814 Air Mask, Pressure Demand, Composite Cylinder, less case
part no. 463831 Air Mask, Pressure Demand, Composite Cylinder, in case
part no. 470446 Air Mask, Demand, Hoop Wound Composite Cylinder, in case
part no. 470442 Air Mask, Demand, Hoop Wound Composite Cylinder, less case
part no. 470448 Air Mask, Pressure Demand, Hoop Wound Composite Cylinder, in case
part no. 470444 Air Mask, Pressure Demand, Hoop Wound Composite Cylinder, less case

Manufactured by

MINE SAFETY APPLIANCES COMPANY

PITTSBURGH, PENNSYLVANIA, U.S.A., 15208

SECTION I
WIRE DIAGRAMS AND SCHEMATICS



REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	ADDED BOOSTED FIELD. C9, D13, D14 & D15	10-83	DS BF
B	NEW DRAWING	9-84	DS BF

FOR USE WITH UNITS
FROM SN 841601
TO SN

AC1
GND.
F3 15 AMP.
F4 15 AMP.
J4 120 V.A.C.
FAN B1
R9 10K Ω POT
150 V.A.C. M1
C8-6μf 370 V.A.C.
C2-.1μf
T1
C5 470μf
A+
B+
C11 2500μf
K1 12 V.D.C.
F2 40 AMP.
F1 40 AMP.
D3 IN1184R
D4 IN1184R
D15 R20410
D14 R20410
C10 2500μf 50 V.
P.C.B-1 INVERTER VOLTAGE REGULATOR
P.C.B-3 VEHICLE VOLTAGE REGULATOR
D13 S6AB
C6 470μf
R4 20 Ω 20 W.
R2 25 Ω 50 W.
R1 25 Ω 50 W.
C4 125μf 125 V.
D5 IN1186
D6 IN1186
D1 S3720
NC
NO
C
K4
SCR2 039 (0-100 MA.)
SCR1 039 (0-100 MA.)
J6 1 2 3 4
TO P.C.B.-2 A-SERIES OSCILLATOR P.C.B.
S1 STOP
S2 START
D2 IN4005
K2
A
B
F15 AGC 15 15 AMP.
D7 IN4005
D8 IN4005
FIELD
IGNITION
ACC
J7 4-2600 TEST MODULE
J3 REMOTE CONTROL
R3 4.7 KΩ
2075

PART NO.	FINAL ASSY QTY REQD	NEXT ASSY QTY REQD	NEXT ASSY APPLICATION	

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
LINEAR .XX =
.XXX =
ANGULAR =
BREAK ALL SHARP EDGES
ALL ANGLES & BENDS 90°
ALL DIMENSIONS PER ANSI Y14.5
125 ALL MACHINE SURFACES

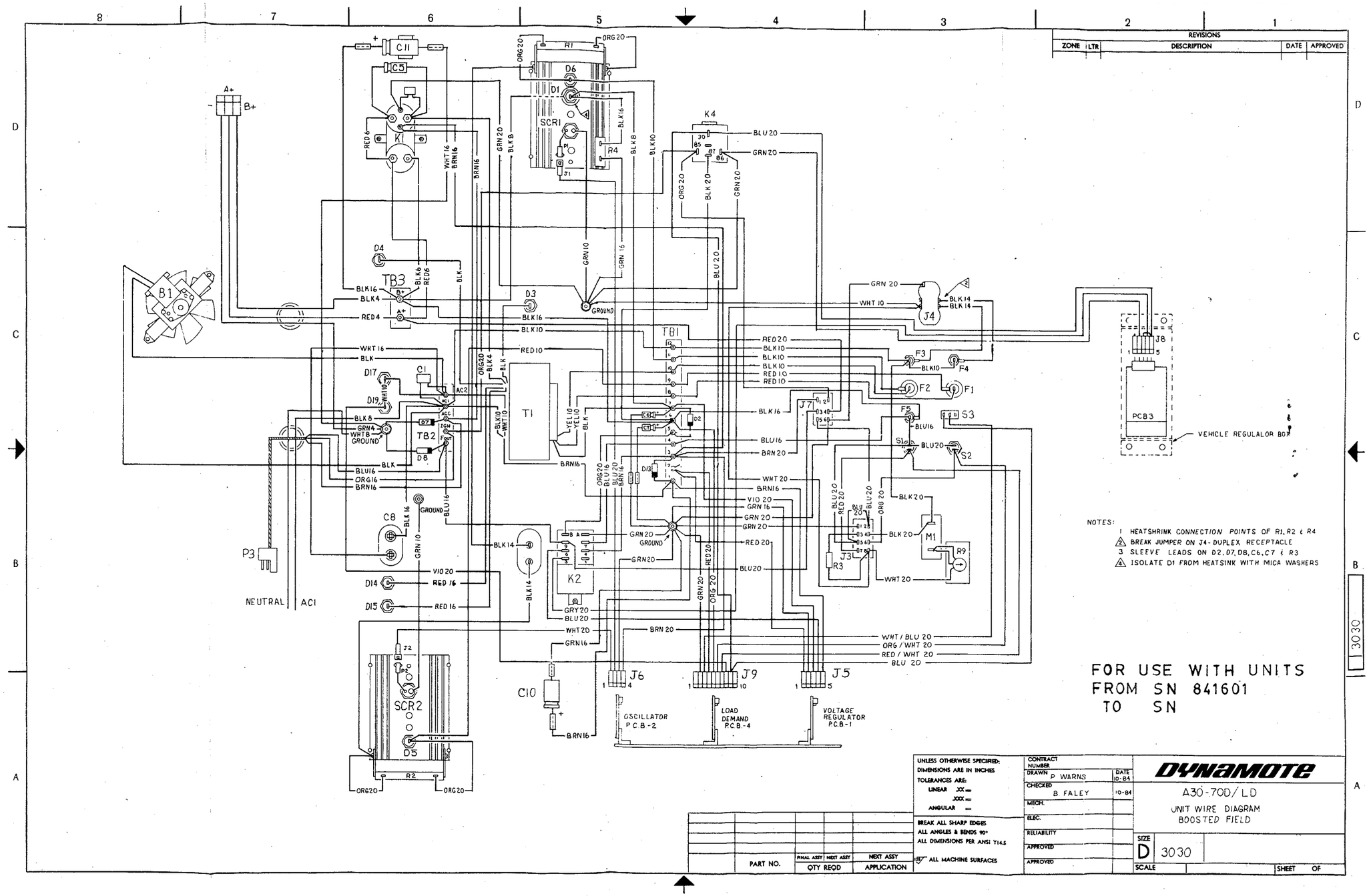
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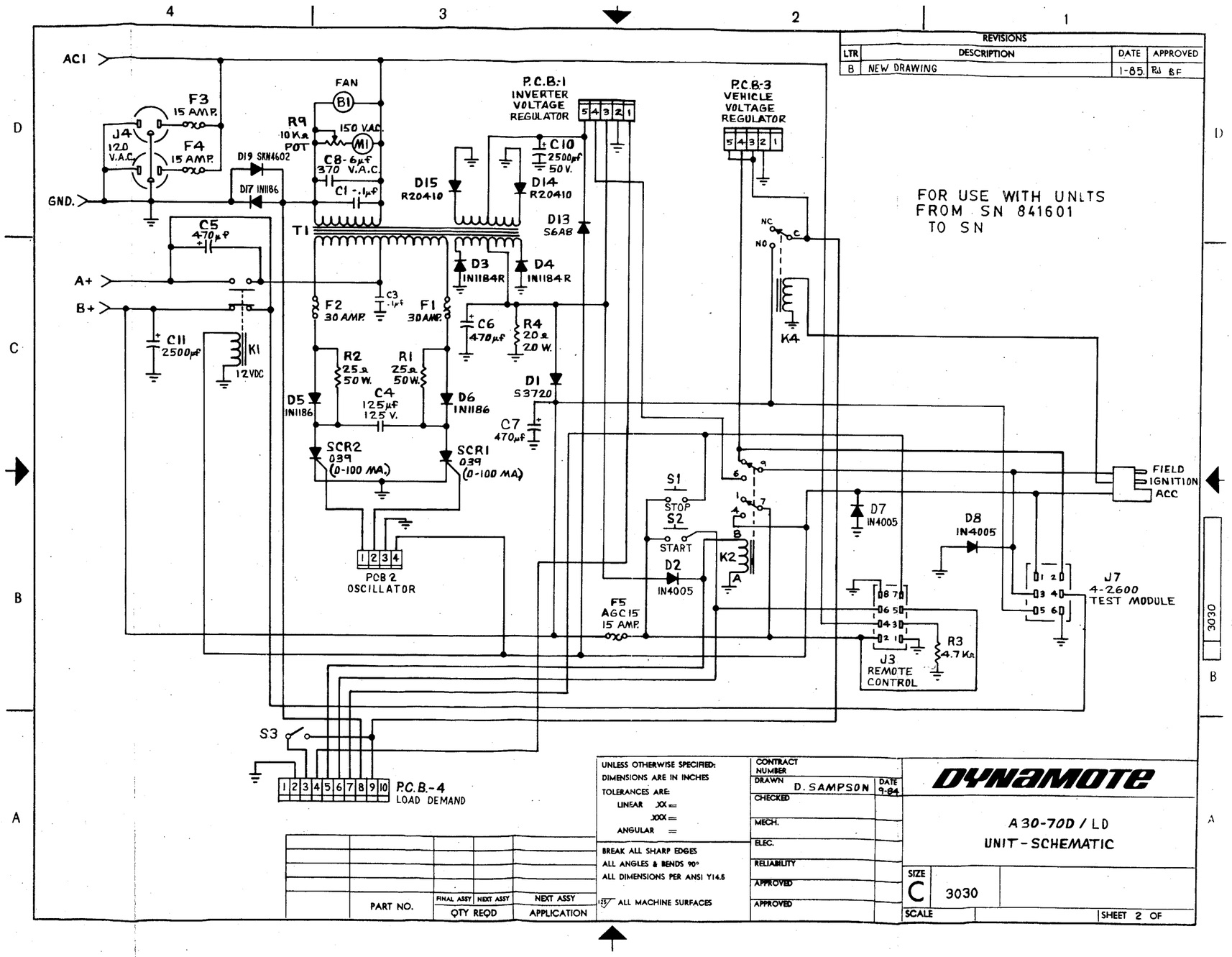
		DATE
DRAWN	D. SAMPSON	9-84
CHECKED		
MECH.		
ELEC.		
RELIABILITY		
APPROVED		
APPROVED		

DYNAMOTE

A 30-70D
UNIT - SCHEMATIC

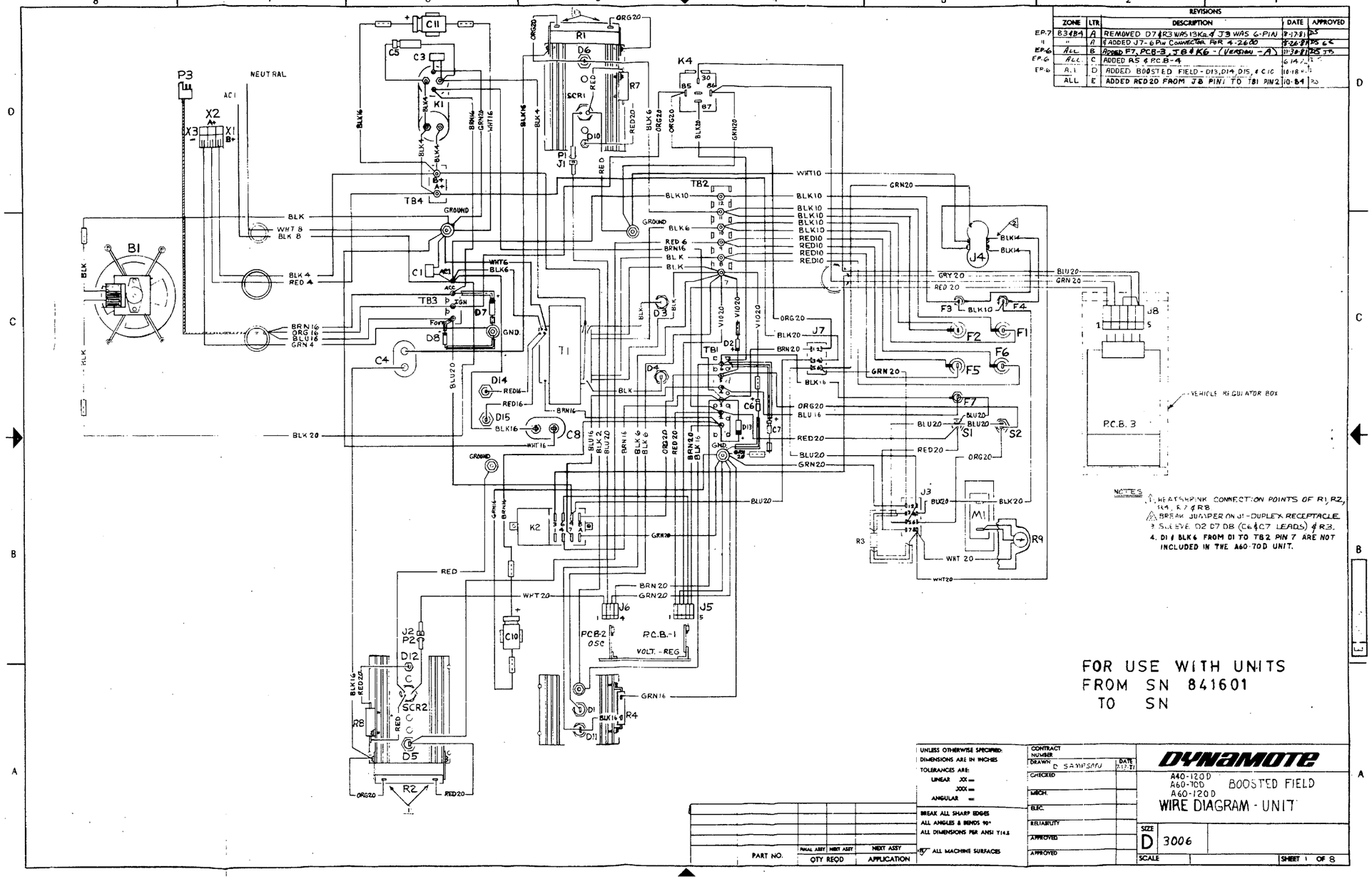
SIZE C 2075
SCALE
SHEET 2 OF


REVISIONS
ZONE | LTR | DESCRIPTION | DATE | APPROVED
C11
C5
R1
D6
D1
SCR1
R4
K1
K4
D4
TB3
B1
D3
GROUND
TB1
J4
F3
F4
F2
F1
J8
PCB3
VEHICLE REGULALOR BOX
D17
C1
D19
TB2
D8
T1
J7
S3
S1
S2
M1
R9
R3
J3
C8
P3
NEUTRAL
AC1
D14
D15
K2
C10
J2
P2
SCR2
D5
R2
J6
J9
J5
OSCILLATOR P.C.B-2
LOAD DEMAND P.C.B-4
VOLTAGE REGULATOR P.C.B-1
NOTES:
1 HEATSHRINK CONNECTION POINTS OF R1, R2 & R4
2 BREAK JUMPER ON J4- DUPLEX RECEPTACLE
3 SLEEVE LEADS ON D2, D7, D8, C6, C7 & R3
4 ISOLATE D1 FROM HEATSINK WITH MICA WASHERS
FOR USE WITH UNITS
FROM SN 841601
TO SN
UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
LINEAR .XX ±
.XXX ±
ANGULAR ±
BREAK ALL SHARP EDGES
ALL ANGLES & BENDS 90°
ALL DIMENSIONS PER ANSI Y14.5
63 ALL MACHINE SURFACES
CONTRACT NUMBER
DRAWN P WARNS 10-84
CHECKED B FALEY 10-84
MECH.
ELEC.
RELIABILITY
APPROVED
APPROVED
DYNAMOTE
A30-70D/LD
UNIT WIRE DIAGRAM
BOOSTED FIELD
SIZE D 3030
SCALE
SHEET OF
PART NO.
FINAL ASSY | NEXT ASSY
QTY REQD
NEXT ASSY
APPLICATION
3030


REVISIONS
LTR | DESCRIPTION | DATE | APPROVED
B | NEW DRAWING | 1-85 | RJ BF
AC1
GND.
A+
B+
F3 15 AMP.
F4 15 AMP.
J4 120 V.A.C.
D19 SKN4602
D17 IN1186
FAN B1
R9 10 KΩ POT
150 V.A.C. M1
C8 - 6μf 370 V.A.C.
C1 - .1μf
T1
C5 470μf
C11 2500μf
K1 12VDC
F2 30 AMP.
F1 30 AMP.
C3 .1μf
D3 IN1184R
D4 IN1184R
D15 R20410
D14 R20410
D13 S6AB
P.C.B.-1 INVERTER VOLTAGE REGULATOR
C10 2500μf 50 V.
P.C.B.-3 VEHICLE VOLTAGE REGULATOR
NC
NO
C
K4
C6 470μf
R4 20Ω 20 W.
R2 25Ω 50 W.
R1 25Ω 50 W.
C4 125μf 125 V.
D5 IN1186
D6 IN1186
D1 S3720
C7 470μf
SCR2 039 (0-100 MA.)
SCR1 039 (0-100 MA.)
P.C.B.-2 OSCILLATOR
S1 STOP
S2 START
K2
D2 IN4005
F5 AGC 15 15 AMP.
D7 IN4005
D8 IN4005
FIELD
IGNITION
ACC
J7 4-2600 TEST MODULE
J3 REMOTE CONTROL
R3 4.7 KΩ
S3
P.C.B.-4 LOAD DEMAND
FOR USE WITH UNITS FROM SN 841601 TO SN
UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
LINEAR .XX =
.XXX =
ANGULAR =
BREAK ALL SHARP EDGES
ALL ANGLES & BENDS 90°
ALL DIMENSIONS PER ANSI Y14.5
ALL MACHINE SURFACES
CONTRACT NUMBER
DRAWN D. SAMPSON 9-84
CHECKED
MECH.
ELEC.
RELIABILITY
APPROVED
APPROVED
DYNAMOTE
A30-70D / LD
UNIT - SCHEMATIC
SIZE C 3030
SCALE
SHEET 2 OF
PART NO. | FINAL ASSY | NEXT ASSY | NEXT ASSY
QTY REQD
APPLICATION
3030

SECTION I
WIRE DIAGRAMS AND SCHEMATICS

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
EP-7 B3484	A	REMOVED D7 & R3 WAS 13KΩ 4 J3 WAS 6-PIN	7-17-81	PS
"	B	ADDED J7-6 Pin Connector for 4-2600	8-26-81	PS & C
EP-6 ALL	B	ADDED F7, PCB-3, J8 & K6 - (VERSION - A)	11-30-81	PS JS
EP-6 ALL	C	ADDED A5 & PC B-4	6-14-82	JS
EP-6 A.1	D	ADDED BOOSTED FIELD - D13, D14, D15, & C10	10-18-82	JS
ALL	E	ADDED RED 20 FROM J8 PIN1 TO TB1 PIN2	10-84	JS



NOTES
1. HEATSHRINK CONNECTION POINTS OF R1, R2, R4, R7 & R8
2. BREAK JUMPER ON J1 - DUPLEX RECEPTACLE.
3. SLEEVE D2 D7 D8 (C6 & C7 LEADS) & R3.
4. D1 & BLK 6 FROM D1 TO TB2 PIN 7 ARE NOT INCLUDED IN THE A60-70D UNIT.

FOR USE WITH UNITS
FROM SN 841601
TO SN

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
LINEAR .XX ±
.XXX ±
ANGULAR ±
BREAK ALL SHARP EDGES
ALL ANGLES & BENDS 90°
ALL DIMENSIONS PER ANSI Y14.5
63 ALL MACHINE SURFACES

PART NO.	FINAL ASSY QTY REQD	NEXT ASSY QTY REQD	NEXT ASSY APPLICATION

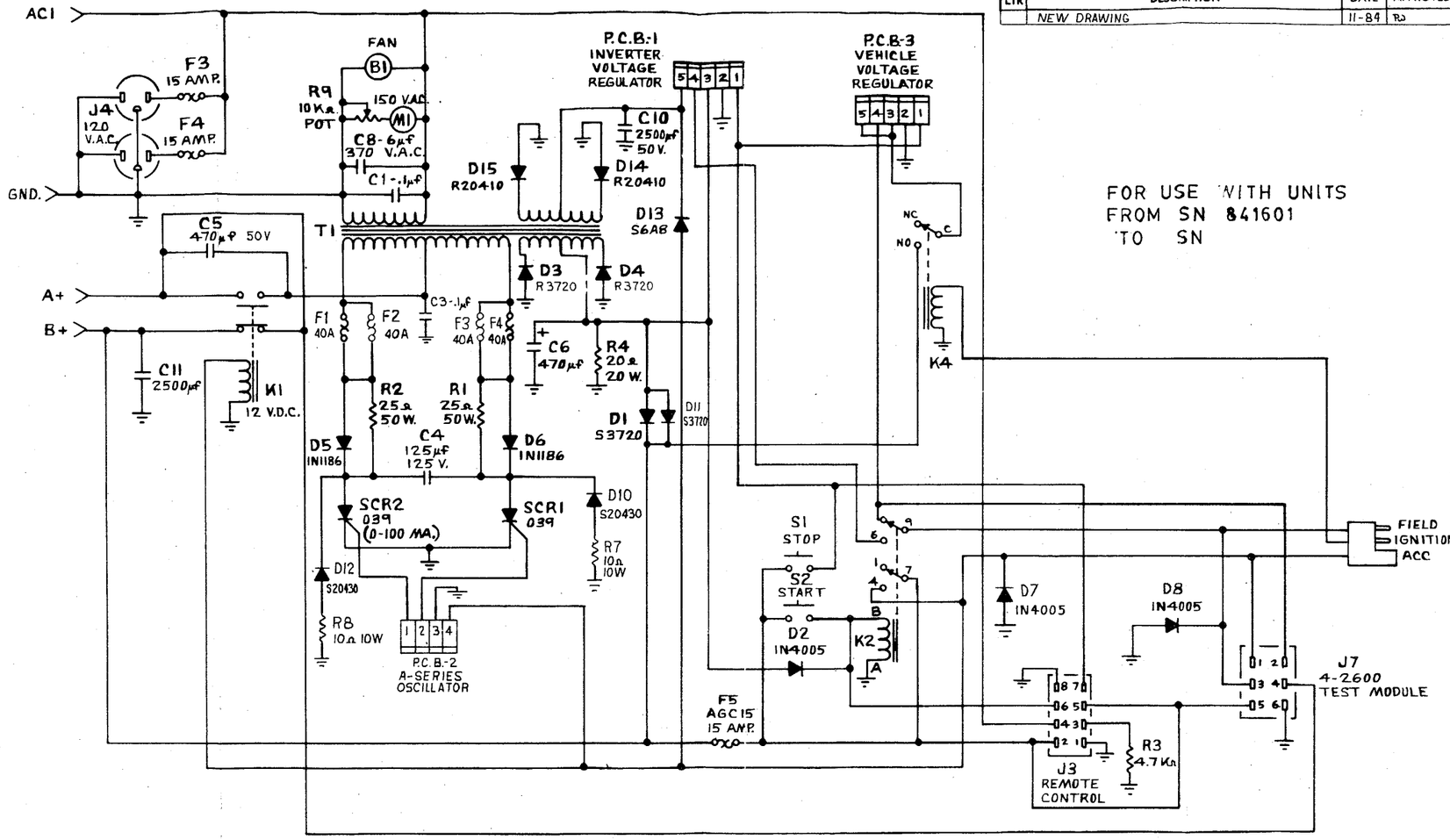
CONTRACT NUMBER
DRAWN D SAMPSON DATE 7-17-81
CHECKED
MECH.
ELEC.
RELIABILITY
APPROVED
APPROVED

DYNAMOTE
A40-120D
A60-70D BOOSTED FIELD
A60-120D
WIRE DIAGRAM - UNIT

SIZE D 3006
SCALE
SHEET 1 OF 8

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
	NEW DRAWING	11-84	RD

FOR USE WITH UNITS
FROM SN 841601
TO SN



	PART NO.	FINAL ASSY QTY REQD	NEXT ASSY	NEXT ASSY APPLICATION

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
LINEAR .XX ±
.XXX ±
ANGULAR ±

BREAK ALL SHARP EDGES
ALL ANGLES & BENDS 90°
ALL DIMENSIONS PER ANSI Y14.5

125 ALL MACHINE SURFACES

CONTRACT NUMBER		
DRAWN	D. SAMPSON	DATE 9-84
CHECKED		
MECH.		
ELEC.		
RELIABILITY		
APPROVED		
APPROVED		

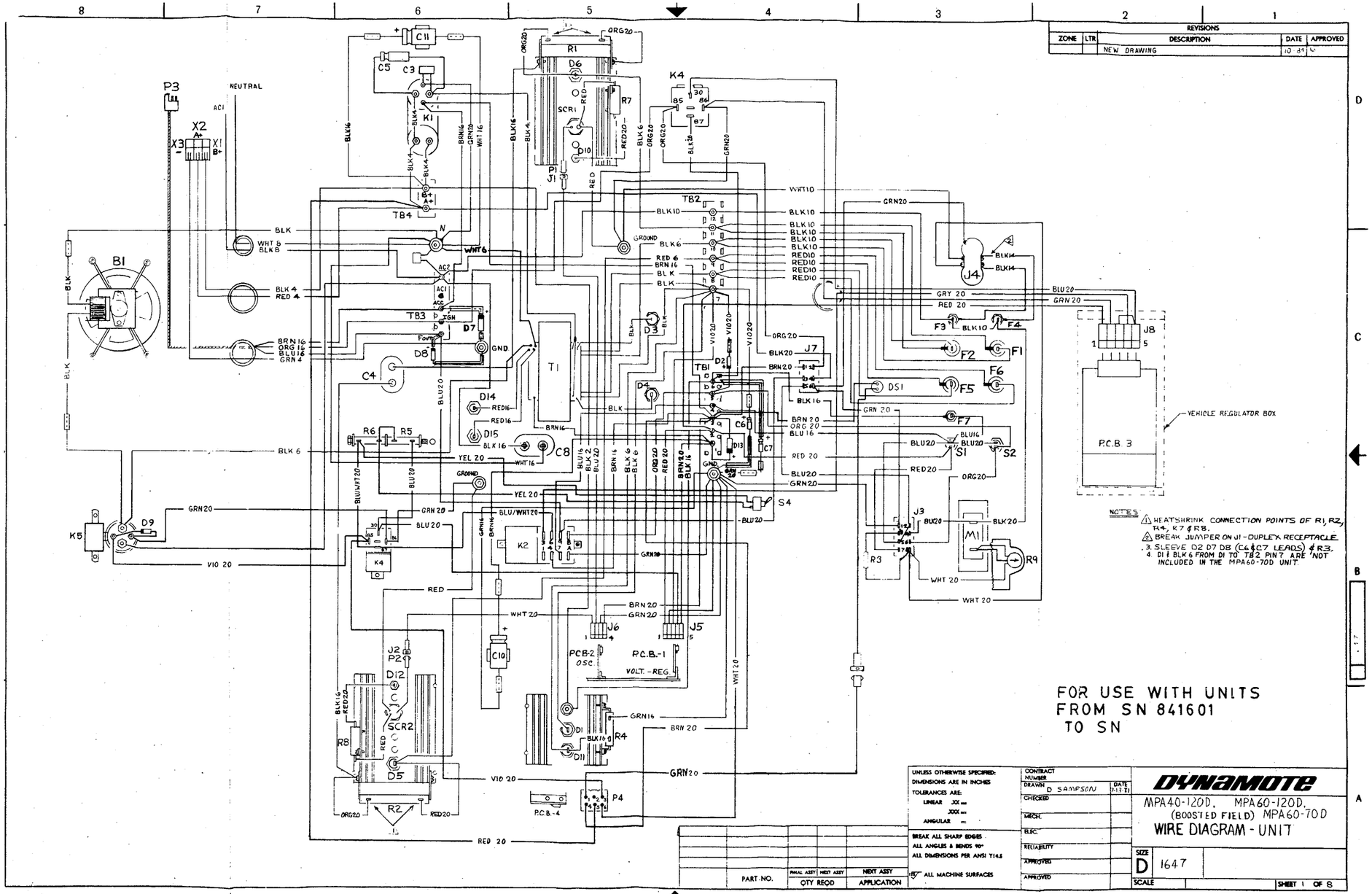
DYNAMOTE

A40-120D
A60-120D
UNIT - SCHEMATIC

SIZE C | 2007 3006

SCALE | SHEET 2 OF

2007 3006


8
7
6
5
4
3
2
1
D
C
B
A
REVISIONS
ZONE | LTR | DESCRIPTION | DATE | APPROVED
NEW DRAWING 10-89
P3
NEUTRAL
X2
X3
X1
B1
K1
K2
K4
K5
D9
C11
C5
C3
R1
D6
SCR1
R7
D10
P1
J1
K4
TB4
TB2
TB3
D7
D8
C4
T1
D14
D15
R6
R5
C8
D13
C6
C7
TB1
D2
D3
D4
J7
J4
J8
F1
F2
F3
F4
F5
F6
F7
DS1
S1
S2
S4
J3
M1
R3
R9
J6
J5
C10
P2
J2
D12
SCR2
R8
D5
R2
D1
R4
D11
P4
PCB-2 OSC.
P.C.B.-1 VOLT.-REG.
P.C.B.-4
P.C.B. 3
VEHICLE REGULATOR BOX
BLK
WHT 8 BLK 8
BLK 4
RED 4
BRN 16
ORG 16
BLU 16
GRN 4
BLK 6
GRN 20
VIO 20
RED
WHT 20
RED 20
YEL 20
BLU 20
BLU/WHT 20
GRN 16
BRN 20
GRN 20
WHT 10
BLK 10
RED 6
RED 10
GRY 20
BLK 14
BLK 20
BLU 16
ORG 20
RED 16
BLK 16
GROUND
NOTES
1. HEATSHRINK CONNECTION POINTS OF R1, R2, R4, R7 & R8.
2. BREAK JUMPER ON J1 - DUPLEX RECEPTACLE.
3. SLEEVE D2 D7 D8 (C4 & C7 LEADS) & R3.
4. DI & BLK 6 FROM DI TO T82 PIN 7 ARE NOT INCLUDED IN THE MPA60-70D UNIT.
FOR USE WITH UNITS
FROM SN 841601
TO SN
UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
LINEAR .XX ±.03
.XXX ±.010
ANGULAR ±1°
BREAK ALL SHARP EDGES
ALL ANGLES & BENDS 90°
ALL DIMENSIONS PER ANSI Y14.5
ALL MACHINE SURFACES
CONTRACT NUMBER
DRAWN D SAMPSON
DATE 7-13-89
CHECKED
MECH.
ELEC.
RELIABILITY
APPROVED
APPROVED
DYNAMOTE
MPA40-120D, MPA60-120D, (BOOSTED FIELD) MPA60-70D
WIRE DIAGRAM - UNIT
SIZE D
1647
SCALE
SHEET 1 OF 8
PART NO.
FINAL ASSY | NEXT ASSY
QTY REQD
NEXT ASSY
APPLICATION

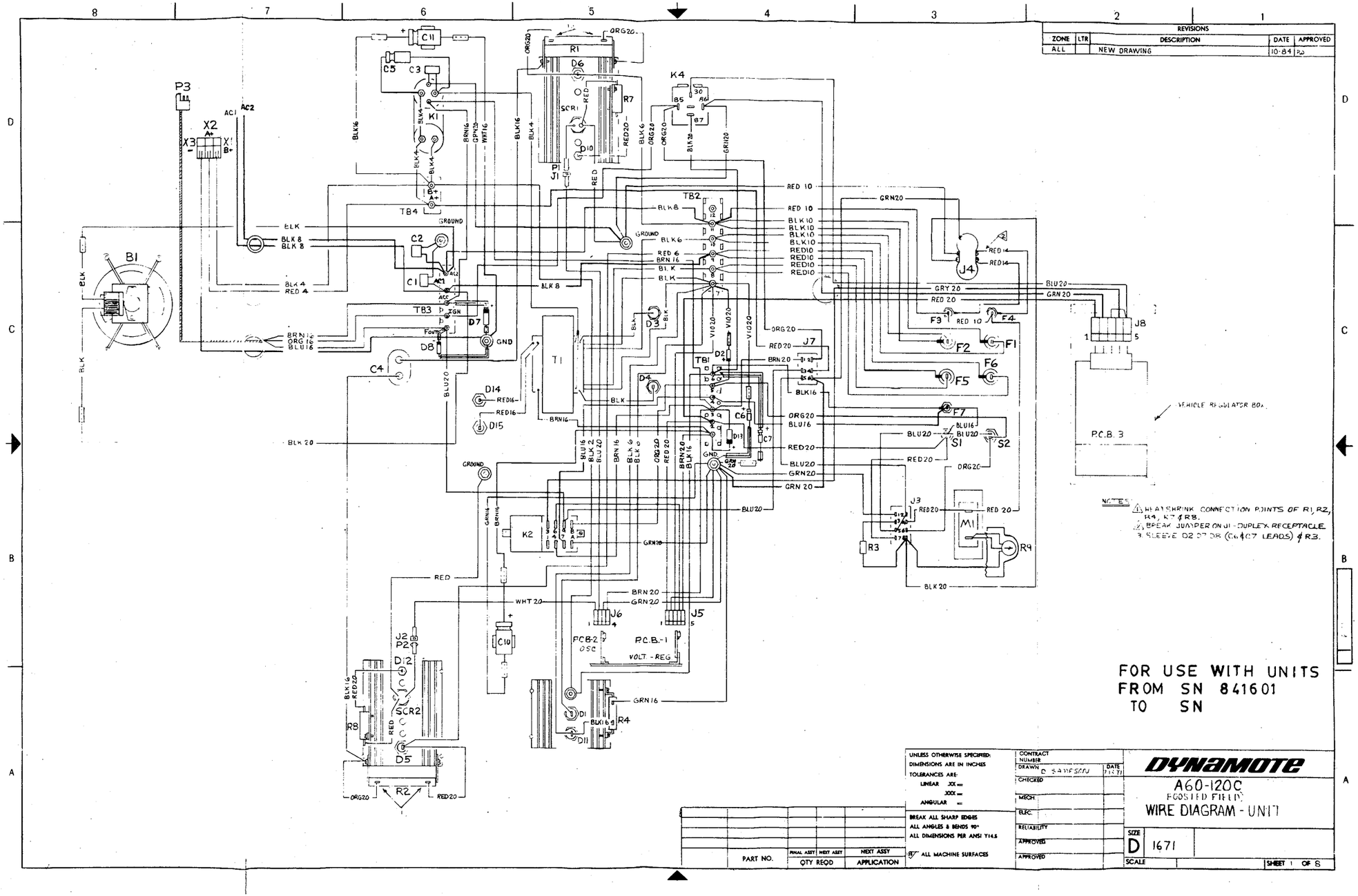
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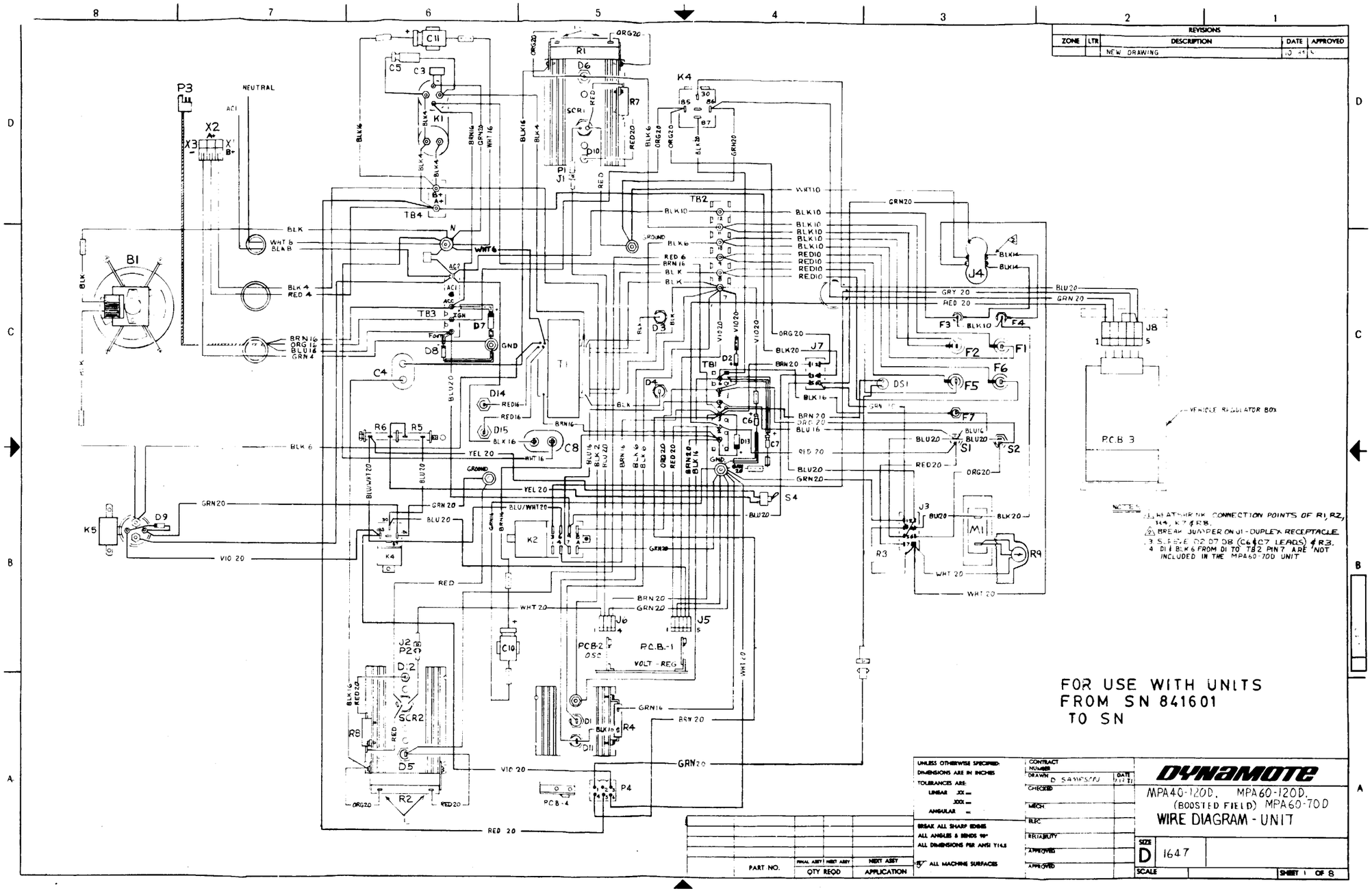
NOTES
1. HEATSHRINK CONNECTION POINTS OF R1, R2, R4, R7 & R8.
2. BREAK JUMPER ON J1 - DUPLEX RECEPTACLE.
3. SLEEVE D2 D7 D8 (C6 & C7 LEADS) & R3.
4. D1 & BLK 6 FROM D1 TO TB2 PIN 7 ARE NOT INCLUDED IN THE MPA60-70D UNIT.

FOR USE WITH UNITS
FROM SN 841601
TO SN

UNLESS OTHERWISE SPECIFIED:	CONTRACT NUMBER	DYNAMOTE
DIMENSIONS ARE IN INCHES	DRAWN D SAMPSON 3-13-91	MPA40-120D, MPA60-120D, (BOOSTED FIELD) MPA60-70D
TOLERANCES ARE: LINEAR .XX ±, .XXX ±, ANGULAR ±	CHECKED	WIRE DIAGRAM - UNIT
BREAK ALL SHARP EDGES	MECH.	SIZE D 1647
ALL ANGLES & BENDS 90°	ELEC.	SCALE
ALL DIMENSIONS PER ANSI Y14.5	RELIABILITY	SHEET 1 OF 8
ALL MACHINE SURFACES	APPROVED	
	APPROVED	

PART NO.	FINAL ASSY / NEXT ASSY QTY REQD	NEXT ASSY APPLICATION

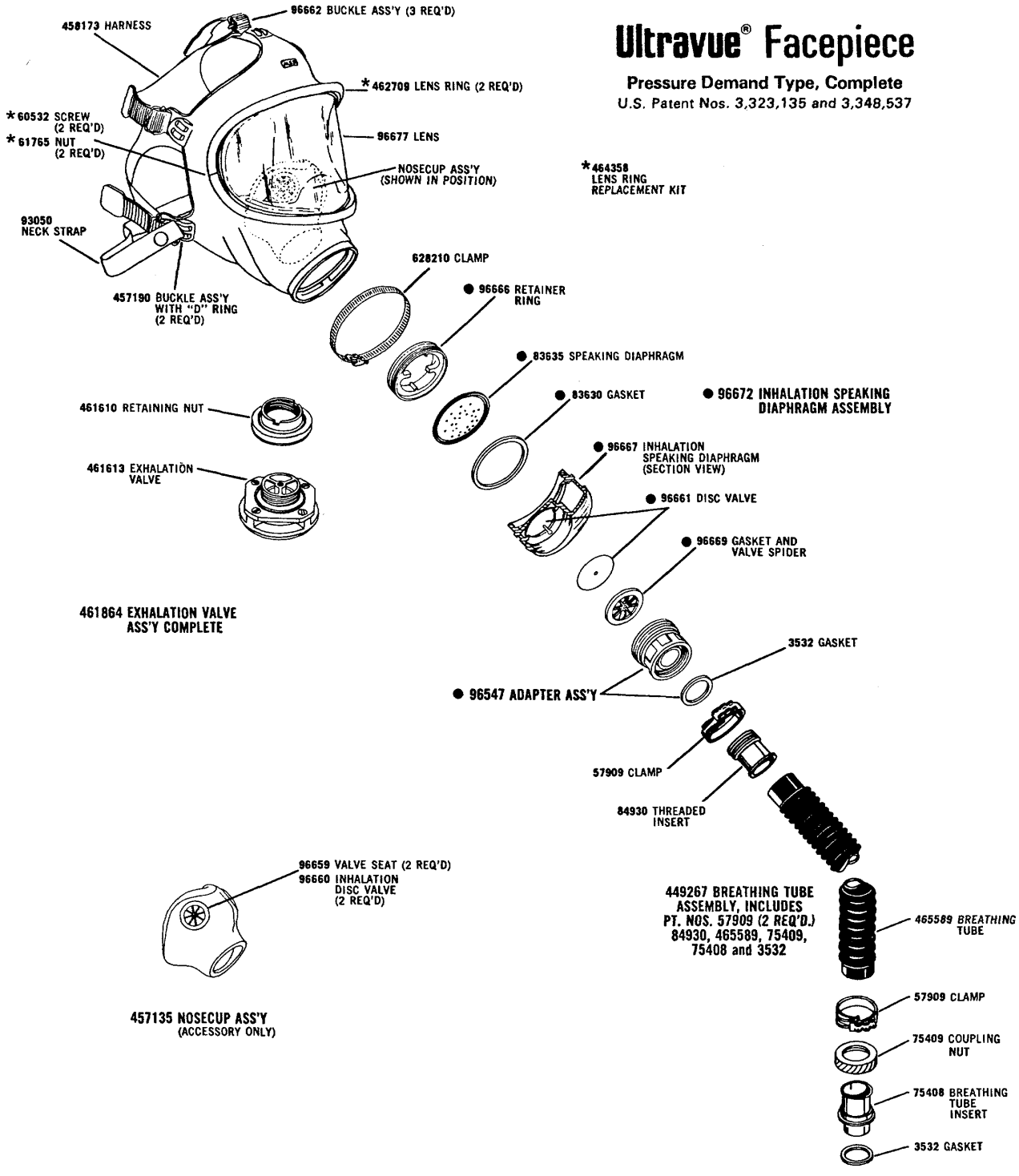

REVISIONS
ZONE | LTR | DESCRIPTION | DATE | APPROVED
ALL | | NEW DRAWING | 10-84 | PD
P3
X2
X3
X1
AC1
AC2
K1
K2
K4
R1
R2
R3
R4
R7
R8
R9
SCR1
SCR2
D6
D10
C11
C5
C3
C2
C1
C4
C10
TB1
TB2
TB3
TB4
D7
D8
D14
D15
D3
D4
D2
D1
D11
D12
D5
T1
J1
J2
J3
J4
J5
J6
J7
J8
M1
F1
F2
F3
F4
F5
F6
F7
S1
S2
B1
P.C.B. 1
VOLT - REG
P.C.B. 2
OSC
P.C.B. 3
VEHICLE REGULATOR BOX
GROUND
RED 10
BLK 8
BLK 6
RED 6
BRN 16
BLK
BLK 10
RED 14
GRN 20
GRY 20
RED 20
BLU 20
ORG 20
RED 16
BLK 16
BRN 20
GRN 16
BLU 16
BLK 20
RED
WHT 20
NOTES:
1. HEATSHRINK CONNECTION POINTS OF R1, R2, R4, R7 & R8.
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3. SLEEVE D2 D7 D8 (ON K7 LEADS) & R3.
FOR USE WITH UNITS
FROM SN 841601
TO SN
UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
LINEAR .XX ±
.XXX ±
ANGULAR ±
BREAK ALL SHARP EDGES
ALL ANGLES & BENDS 90°
ALL DIMENSIONS PER ANSI Y14.5
ALL MACHINE SURFACES
CONTRACT NUMBER
DRAWN C SAMPSON
DATE 7/17/91
CHECKED
MECH
ELEC.
RELIABILITY
APPROVED
APPROVED
PART NO.
FINAL ASSY
NEXT ASSY
QTY REQD
NEXT ASSY
APPLICATION
DYNAMOTE
A60-120C
FOOTED FIELD
WIRE DIAGRAM - UNIT
SIZE D
1671
SCALE
SHEET 1 OF 8


REVISIONS
ZONE | LTR | DESCRIPTION | DATE | APPROVED
NEW DRAWING
P3
NEUTRAL
X2
X3
B1
K1
K2
K4
K5
TB4
TB2
TB3
TB1
T1
C11
C5
C3
C4
C6
C7
C8
C10
R1
R2
R3
R4
R5
R6
R7
R9
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
D13
D14
D15
SCR1
SCR2
J1
J2
J3
J4
J5
J6
J7
J8
P1
P2
P4
S1
S2
S4
M1
F1
F2
F3
F4
F5
F6
F7
DS1
PCB-1
VOLT - REG
PCB-2
PCB-3
PCB-4
VEHICLE REGULATOR BOX
NOTES:
1. HEATSHRINK CONNECTION POINTS OF R1, R2, K4, K7 & R8.
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BREAK ALL SHARP EDGES
ALL ANGLES & BENDS 90°
ALL DIMENSIONS PER ANSI Y14.5
ALL MACHINE SURFACES
CONTRACT NUMBER
DRAWN D. SAMPSON 7/12/91
CHECKED
MECH
ELEC
RELIABILITY
APPROVED
APPROVED
DYNAMOTE
MPA40-120D, MPA60-120D,
(BOOSTED FIELD) MPA60-70D
WIRE DIAGRAM - UNIT
SIZE D 1647
SCALE
SHEET 1 OF 8
PART NO. | FINAL ASSY | NEXT ASSY | NEXT ASSY
QTY REQD | APPLICATION

MSA AIR MASK — MODEL 401

(Facepiece and Parts)

461614 PRESSURE DEMAND FACEPIECE COMPLETE.
NOTE: BREATHING TUBE ASS'Y, NOSECUP ASS'Y AND NECK STRAP MUST BE ORDERED SEPARATELY.



Ultravue® Facepiece

Pressure Demand Type, Complete
U.S. Patent Nos. 3,323,135 and 3,348,537

***464358 LENS RING REPLACEMENT KIT**

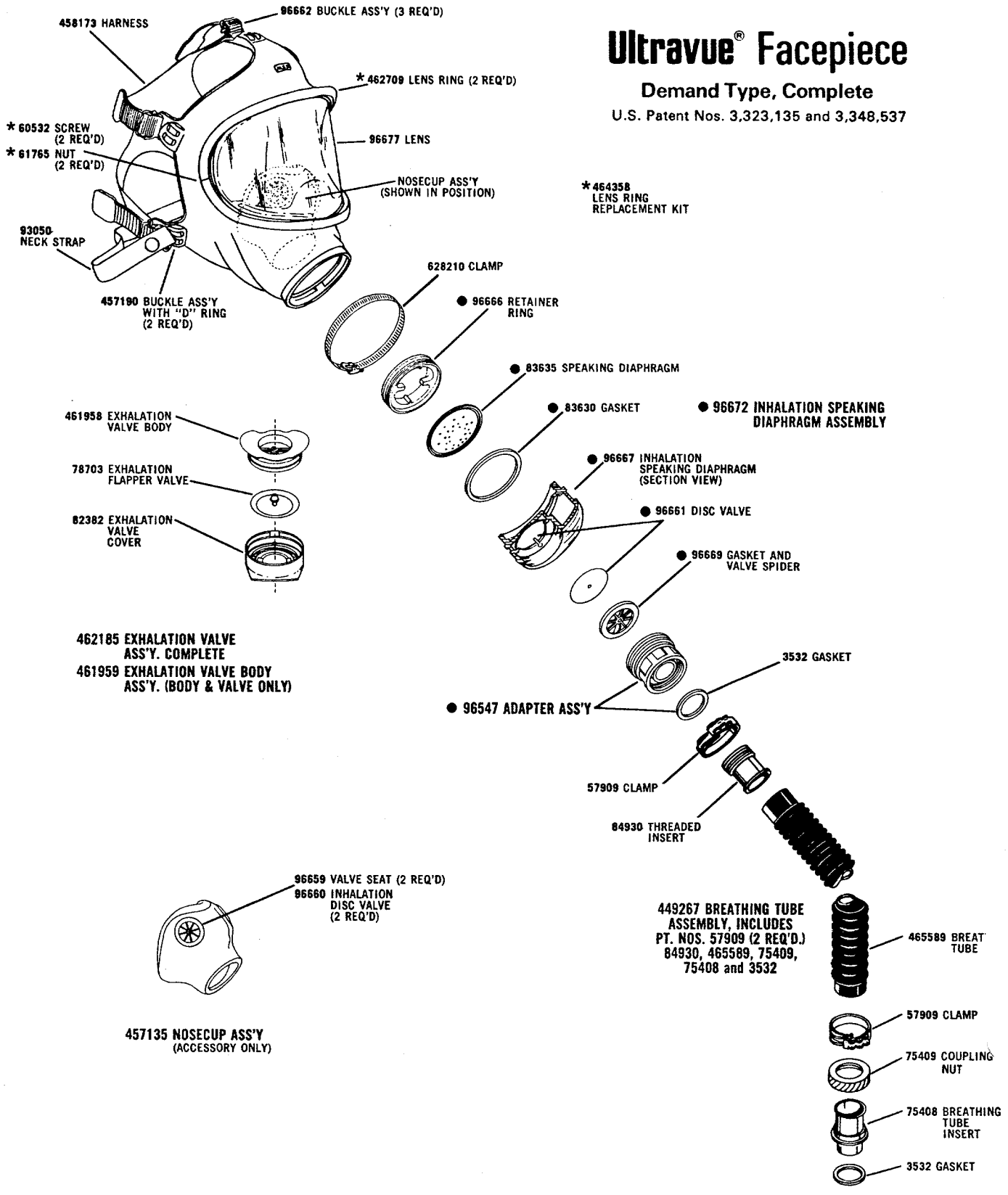
● **96672 INHALATION SPEAKING DIAPHRAGM ASSEMBLY**

Section II
MISCELLANEOUS PARTS AND EQUIPMENT

MSA AIR MASK — MODEL 401

(Facepiece and Parts)

457126 DEMAND FACEPIECE COMPLETE.
NOTE: BREATHING TUBE ASS'Y, NOSECUP ASS'Y AND NECK STRAP MUST BE ORDERED SEPARATELY.



Ultravue® Facepiece

Demand Type, Complete

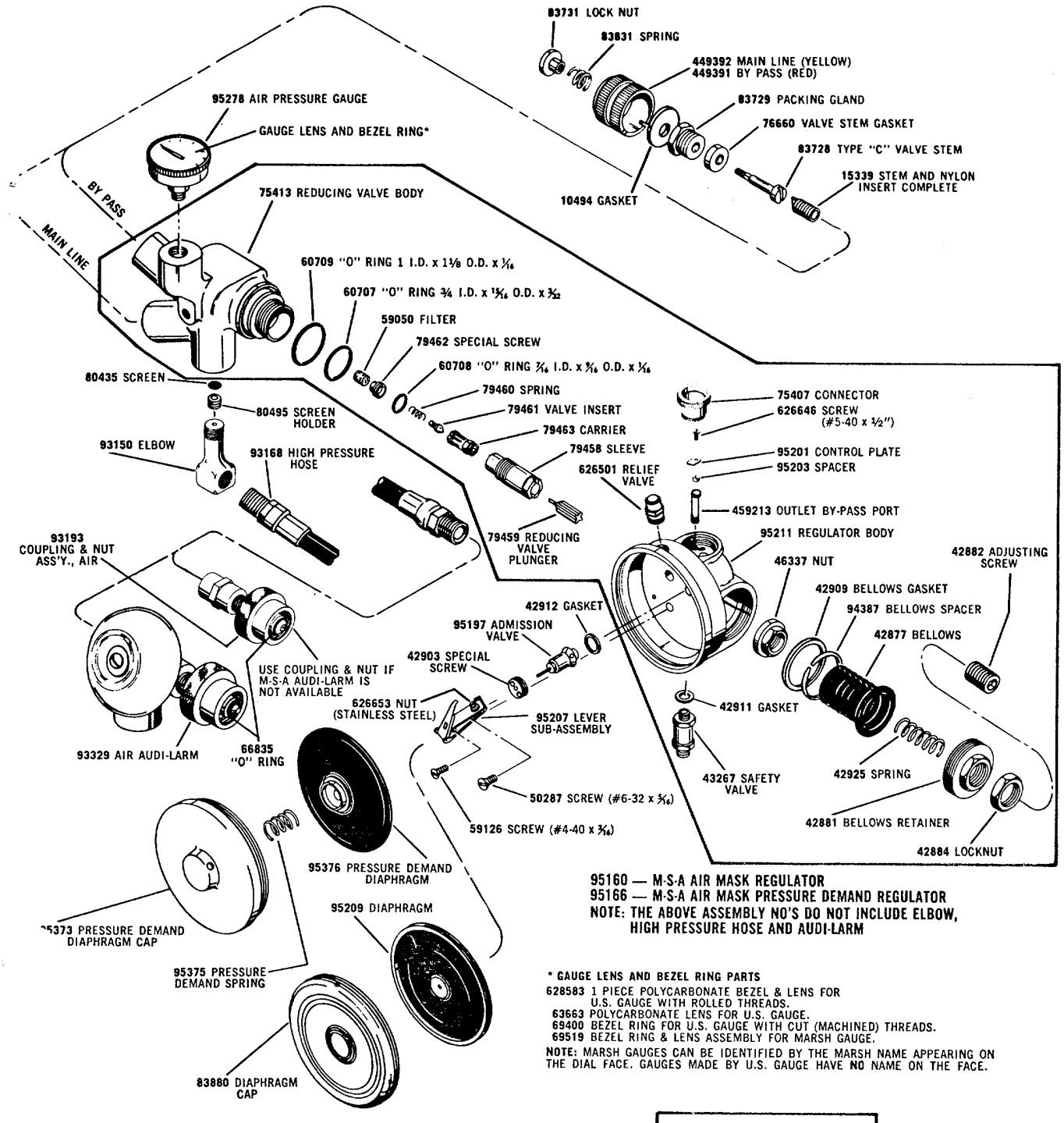
U.S. Patent Nos. 3,323,135 and 3,348,537

***464358 LENS RING REPLACEMENT KIT**

Section II
MISCELLANEOUS PARTS AND EQUIPMENT

MSA AIR MASK — MODEL 401

(Demand and Pressure Demand Regulator Parts)



95160 — M-S-A AIR MASK REGULATOR
95166 — M-S-A AIR MASK PRESSURE DEMAND REGULATOR
NOTE: THE ABOVE ASSEMBLY NO'S DO NOT INCLUDE ELBOW, HIGH PRESSURE HOSE AND AUDI-LARM

NG

* GAUGE LENS AND BEZEL RING PARTS

628583 1 PIECE POLYCARBONATE BEZEL & LENS FOR U.S. GAUGE WITH ROLLED THREADS.
63663 POLYCARBONATE LENS FOR U.S. GAUGE.
69400 BEZEL RING FOR U.S. GAUGE WITH CUT (MACHINED) THREADS.
69519 BEZEL RING & LENS ASSEMBLY FOR MARSH GAUGE.

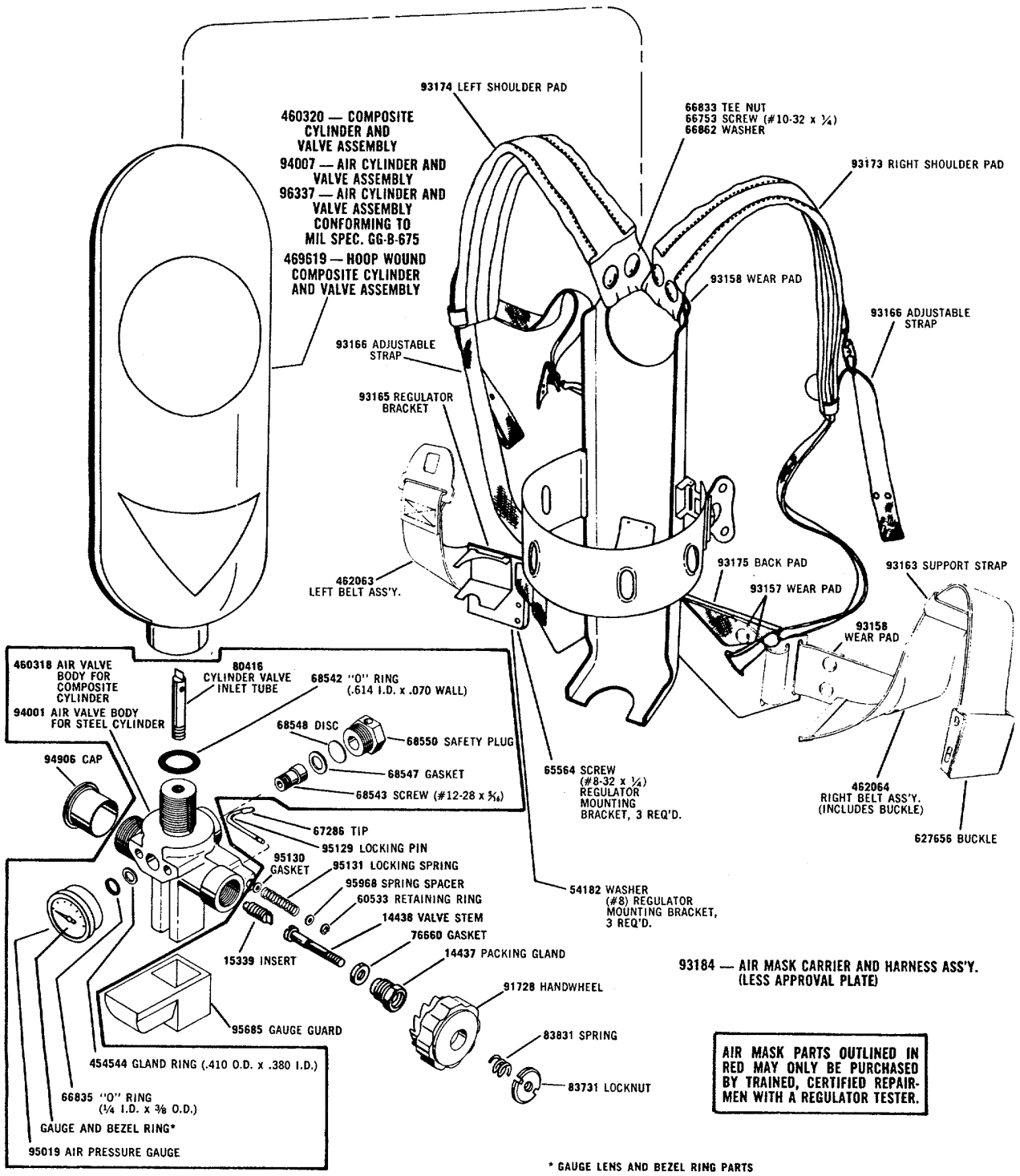
NOTE: MARSH GAUGES CAN BE IDENTIFIED BY THE MARSH NAME APPEARING ON THE DIAL FACE. GAUGES MADE BY U.S. GAUGE HAVE NO NAME ON THE FACE.

G

AIR MASK PARTS OUTLINED IN RED MAY ONLY BE PURCHASED BY TRAINED, CERTIFIED REPAIRMEN WITH A REGULATOR TESTER.

MSA AIR MASK — MODEL 401

(Harness, Carrier and Cylinder Assembly)



93998 — AIR VALVE ASSEMBLY FOR STEEL CYLINDERS
460321 — AIR VALVE ASSEMBLY FOR COMPOSITE CYLINDERS

93184 — AIR MASK CARRIER AND HARNESS ASS'Y. (LESS APPROVAL PLATE)

AIR MASK PARTS OUTLINED IN RED MAY ONLY BE PURCHASED BY TRAINED, CERTIFIED REPAIRMEN WITH A REGULATOR TESTER.

* GAUGE LENS AND BEZEL RING PARTS

628583 1 PIECE POLYCARBONATE BEZEL & LENS FOR U.S. GAUGE WITH ROLLED THREADS.
63663 POLYCARBONATE LENS FOR U.S. GAUGE.
69400 BEZEL RING FOR U.S. GAUGE WITH CUT (MACHINED) THREADS.
69519 BEZEL RING & LENS ASSEMBLY FOR MARSH GAUGE.

NOTE: MARSH GAUGES CAN BE IDENTIFIED BY THE MARSH NAME APPEARING ON THE DIAL FACE. GAUGES MADE BY U.S. GAUGE HAVE NO NAME ON THE FACE.

MISCELLANEOUS PARTS

Part No.	
465147	Carrying Case, Air
93329	Audi-Larm* Assembly, Air, Complete with Container

ACCESSORIES

(For Facepiece Only)

Part No.	
456975	Cover Lens (Clear) 25 per Pkg.
454819	Spectacle Kit

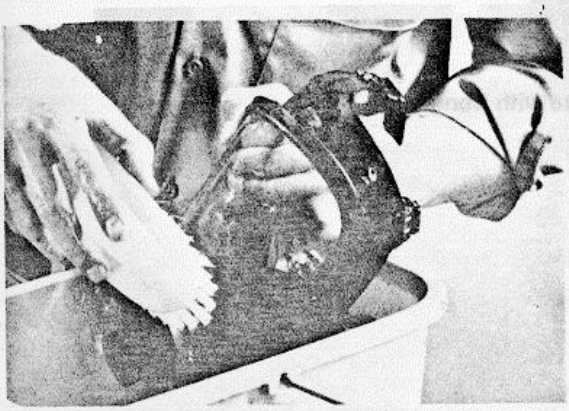
*Trade Mark of Mine Safety Appliances Co.

MSA

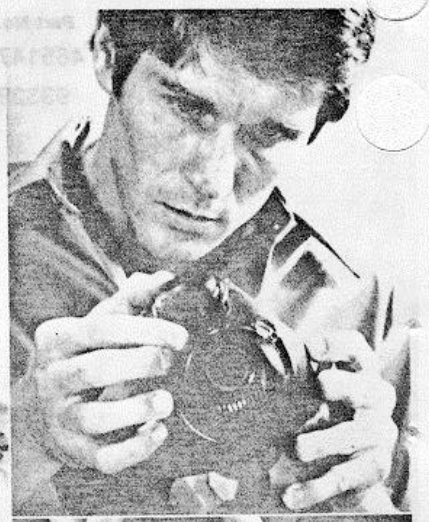
Section III

Inspection and Maintenance Procedures

For Self-Contained Breathing Apparatus

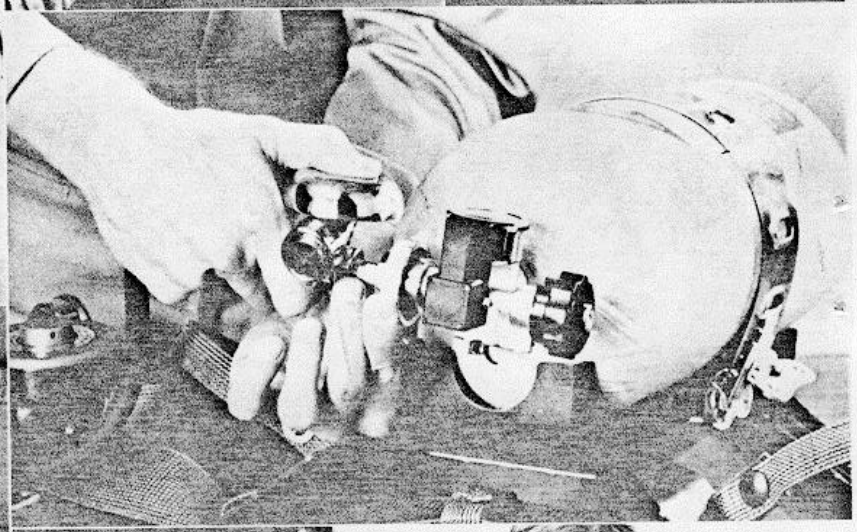


















ANSI and OSHA Requirements

`HA refers to Inspection and mainte-ıce under 1910.134 of the General Rules

Self-contained breathing apparatus is a vital part of personal protective equipment. It safeguards against hazardous atmospheres. But breathing apparatus is just like any other piece of professional equipment. It requires proper inspection and maintenance.

A move forward in the efforts to make jobs safer is the American National Standards Institute's (ANSI) Standards Z88.2 and Z88.5. Under provisions of the Standards, responsibility for the respiratory program must be assigned to one administrator. He and the person he designates must have sufficient knowledge and training to conduct effective programs for equipment maintenance and inspection.

ANSI Z88.2 and Z88.5 describe the inspection and maintenance procedures that designated personnel must follow during those checks made:

- at least weekly
- after each use of the apparatus

onthly during thorough examina-ıon and testing.

The end result of such inspection and maintenance procedures is that the user can be assured that his equipment will be checked by a designated qualified person in compliance with ANSI requirements.

Copies of ANSI Z88.2 and Z88.5 may be purchased from the American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.

Repairs by Qualified Persons Only

Here is one note of caution. Breathing apparatus must not be repaired beyond the manufacturer's recommendations. ANSI Z88.5 makes this clear: "Replacement or repairs shall be done only by qualified persons, using parts designed for the breathing apparatus. No attempt shall be made to replace parts or to make adjustments or repairs beyond the manufacturer's recommendations. Reducing or admission valves or regulators shall be returned to the manufacturer or to a trained technician for adjustment or repair. Parts shall not be interchanged among devices of different manufacturers."

MSA has a nationwide network of 330 organizations certified as Air Mask Service Centers. Qualified organizations are issued a certificate (see below). Only specified personnel at these service centers are authorized to 1) repair or adjust the components of the pressure regulating (high-pressure) portion of the regulator, and the Audi-Larm, and 2) replace or repair of certain parts of the cylinder valve. If there is no Air Mask Service Center in your area, return the unit to MSA for service.



Further, persons may be trained by MSA to perform certain maintenance and repair operations to the facepiece, breathing tube, hand operated valves, and the low pressure portion of the regulator.

Upon completion of training, persons will receive a manual of "Maintenance Procedures for Trained Personnel" and a "Certificate of Training."

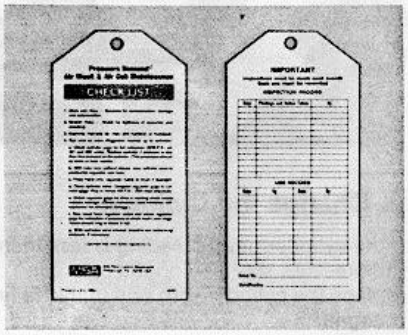
Under no circumstances, should any maintenance or repair operations be attempted unless personnel are trained or certified by MSA. Without training or certification, only those operations described in this bulletin may be performed on MSA breathing apparatus.

MSA Inspection Tags & Forms

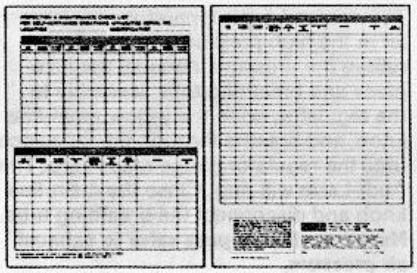
For easy checking and recording of inspections called for under OSHA 1910.134 and ANSI, an inspection tag (shown below) for the MSA Model 401 Demand and Pressure Demand Air Mask and Model 502 Demand and Pressure Demand Air Cub is available from MSA for each piece of equipment.

The inspection tag may be attached to the D-ring on the backplate of the breathing apparatus, or elsewhere, for easy reference. A check list on the front of the tag outlines procedures for conducting the inspections that must be made on breathing apparatus after each use and monthly, as prescribed by OSHA.

The back of the card has space available to record both monthly inspections and individual use of the apparatus.



In addition, MSA can supply you with a new permanent log for recording the weekly, after use, and monthly inspections. The log can be kept in the files, separate from the apparatus. This letter-size log (shown below) is a handy check-off list for designated personnel to use when making inspections of breathing apparatus. A serial number on the regulator can be used to identify each unit.



Routine Inspection at Least Weekly

Section III

1. Check Cylinder Pressure

The ANSI Standards call for a routine inspection of the cylinder pressure. Although ANSI Z88.5 suggests this check be made daily, inspection at least once a week is mandatory.

Check the cylinder gauge for full indication (2216 psi on Model 401 Air Mask and Model 502 Air Cub and 1980 psi on other models of Air Mask and Air Cub).



2. Change the Cylinder

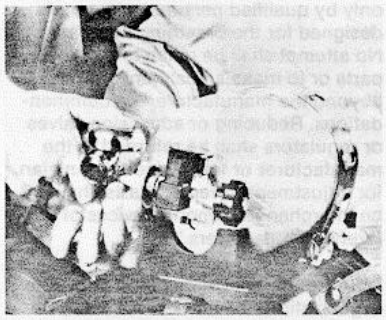
If the cylinder gauge reading is less than the pressure stamped on the cylinder, replace the cylinder with one that is fully charged.

Before changing the cylinder, be sure the cylinder valve is closed. There must not be any air in the high pressure line between the Audi-Larm and the regulator. Check the pressure gauge on the regulator.

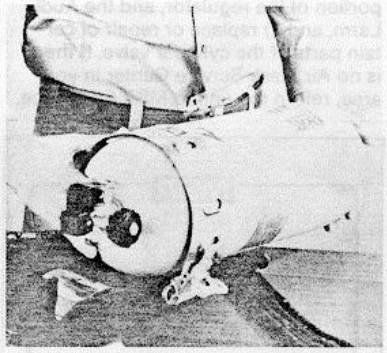
The gauge on a pressure demand apparatus should read zero because the unit automatically vents the air in the high pressure system with the main-line valve open.

The demand-type apparatus may have air in the high pressure system. To relieve the pressure, connect the facepiece and breathing tube assembly to the regulator, open the yellow main-line knob, and breathe through the facepiece until the regulator gauge reads zero. The Audi-Larm will ring. Close the main-line knob and disconnect the breathing tube. **Never use the by-pass valve to exhaust air pressure.**

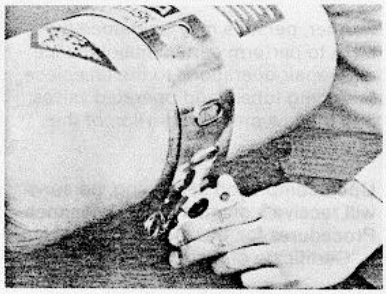
Disconnect the hand tight coupling nut at the cylinder valve. Do **not** disconnect with pressure shown on the regulator gauge.



Then loosen the cylinder clamp — or it may be opened completely — slide out the cylinder, and replace it with a fully charged one.



Twist the clamp to lock the cylinder into position again and connect the hand tight coupling nut at the cylinder valve.



3. Store the Unit Properly

The unit should be stored in the carrying case or storage rack in the ready position.

Before placing the mask in the case, release the pressure from the high pressure system as described in Step 2.

Place the apparatus in the case, carrier assembly face up, with the cylinder resting in the cradle provided at the bottom of the case and the cylinder valve resting snugly against the side of the case. Place the regulator in the compartment provided at the back of the case. Arrange the facepiece assembly along the back of the case.

Store the packed case, in a cool, dry place where possible.



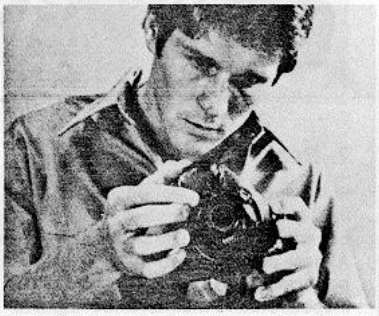
Inspection After Each Use

ANSI states that immediately after use, each device must be inspected for cylinder pressure; facepiece and breathing tube wear and cracking, including the exhalation valve and speaking diaphragm; and other parts for damage. Then the apparatus is cleaned, disinfected, checked again by sight and sound for normal operation, and stored in a ready position.

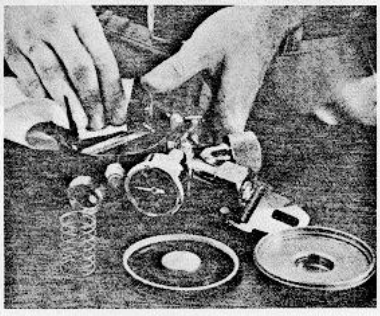
Repeat check of apparatus cylinder pressure described in Step 1. If necessary, replace cylinder (Step 2).

4. Examine Apparatus

At this time, look for missing, cracked, or broken parts in the facepiece, breathing tube assembly, regulator, and harness. Inspections of the exhalation valve must be limited to a visual check. Do not remove the exhalation valve assembly. For more specific information, refer to Inspection Check Points listed on page 7.



After each use, the regulator should be dried to help prevent corrosion and possible regulator freeze-up during cold weather. To do this, remove the diaphragm cap, spring, and diaphragm. Use a paper towel or clean cloth to dry the low pressure side of the regulator and the parts. Be careful not to bend the arms on the lever assembly.



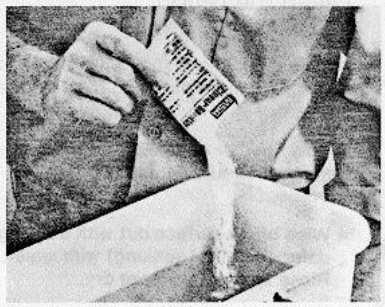
Examine the diaphragm for tears, and if it is torn or separated from the yellow plastic ring, replace it. When the regulator is dry, place the **short** lever arm on top of the **long** lever arm. To install the diaphragm, place the side with the metal plate down, facing the lever assembly. Insert the spring in the center hub of pressure demand units and replace the diaphragm cap.



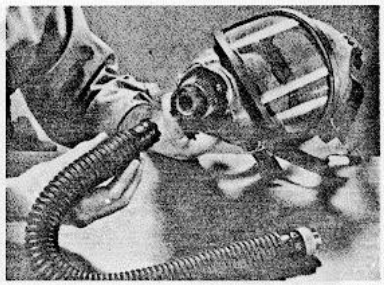
5. Clean and Sanitize

Depending upon the cleaning policy adopted, either the designated person or the user should clean each device after use. ANSI suggests that users should be trained in the cleaning procedure.

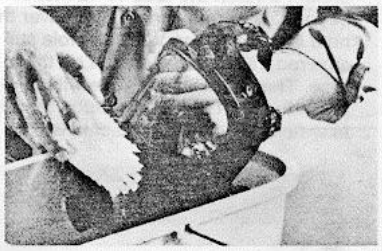
MSA's non-sudsing Cleaner-Sanitizer II solution can be used. Simply add a package of powdered Cleaner-Sanitizer II to one gallon of warm water, at a temperature of not more than 120° F. MSA Cleaner-Sanitizer II does the job in one step. It retains its germicidal efficiency even in hard water to inhibit the growth of bacteria. It will not deteriorate rubber, plastic, glass, or metal parts. Alcohol should not be used as a germicide because it may deteriorate the rubber.



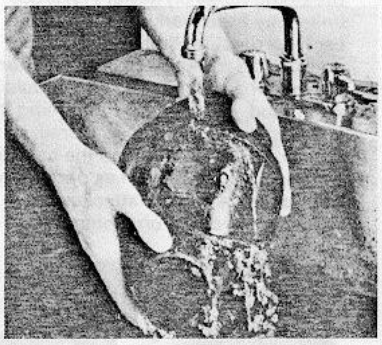
The first step in cleaning and sanitizing the unit is to remove the breathing tube (and the exhalation valve cover from the demand facepiece). Do not lose the gasket inside the coupling nut.



Thoroughly wash the facepiece and tube in the Cleaner-Sanitizer solution. A soft brush or sponge can be used to scrub the soiled facepiece, and clean the tube.



The pieces are then rinsed thoroughly in plain warm water, again at not more than 120 degrees Fahrenheit, with both the inside and outside of the inhalation tube thoroughly rinsed.

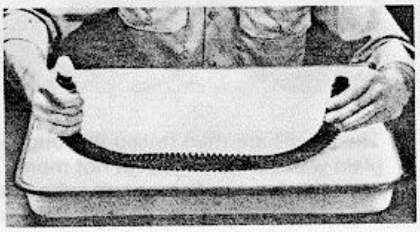


If MSA Cleaner-Sanitizer is not used, the parts should be washed in a mild cleaning solution and rinsed thoroughly. The facepiece and breathing tube are then submerged in a germicide solution for the time recommended by the manufacturer—usually about two minutes—and then thoroughly rinsed in clean water.

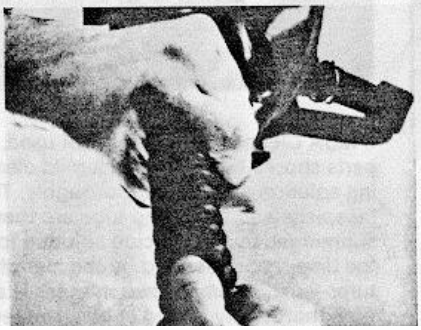
Stretch the breathing tube to remove water from between the convolutions. Closely inspect the tube for perforations, small cracks, or signs of wear, especially along the corrugations.



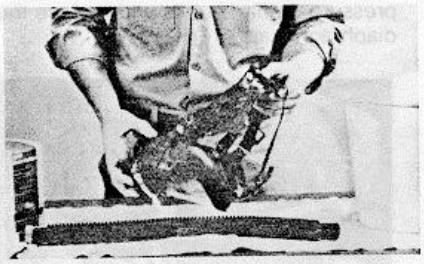
To check the breathing tube for leaks, close one end with a solid rubber stopper. Close the other end with a rubber stopper in which a ⅛-inch hole has been drilled. Stretch the tube 10-12 inches beyond its normal length and cover the hole in the stopper. With the hole still covered, release the tension on the tube. The air inside the tube will compress to about 3 psi. Submerge the tube in water. Bubbles will indicate leaks.



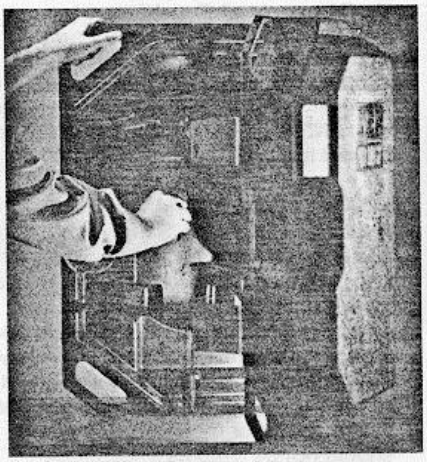
Breathing tubes on newer (1978-on) units may have marks at the base of each corrugation that appear to be cracks. The marks were created during the molding of the hose. This should be confirmed, however, by performing the leak test described above. If cracks appear in areas other than the base of the corrugations as well as perforations, cuts, or signs of wear are cause for replacement of the breathing tube.



Allow the facepiece and breathing tube to air-dry, remembering to stretch the breathing tube to release excess water. Do not attempt to force-dry the parts by placing them near a heater or in direct sunlight because the rubber will deteriorate.



The carrying case also should be cleaned. Turn it upside down and tap both the back and lid with the hands to loosen debris. The inside of the case then should be sponged off with the Cleaner-Sanitizer solution.



Clean the Nylon Harness Assembly

A soiled harness is an open invitation for eventual deterioration and may reduce the serviceable life of the equipment.

A mild soap or commercial cleaning detergent should be used on the harness.

- Wipe off all surface dirt with a sponge dampened (not soaking) with water. Rinse sponge; squeeze dry.
- Work up a thick lather with mild soap or commercial detergent. Thoroughly wash the harness with the lathered sponge, being careful to use the lather only.
- Wipe dry with a clean cloth.
- Let the harness air dry. Do not place it near hot steam pipes or other sources of excessive heat.

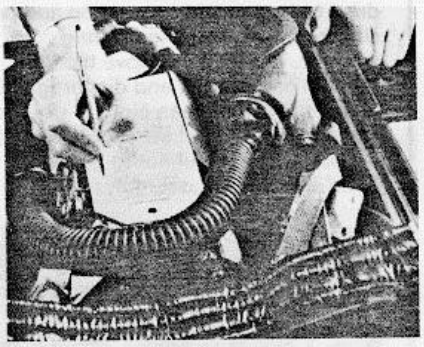
6. Inspection

Following the cleaning-sanitizing process, the entire apparatus is reassembled and inspected by sight and sound for normal operation. All connections on the apparatus should be checked for tightness.



7. Recordkeeping

Following the inspection, the date and initials of the designated person should be recorded on the MSA Inspection Tag. A more detailed record of the operations performed can be noted on the MSA inspection and maintenance log. See page 2 of this bulletin for more details.



When the inspection data has been recorded, the breathing apparatus is stored in a ready position (Step 3).

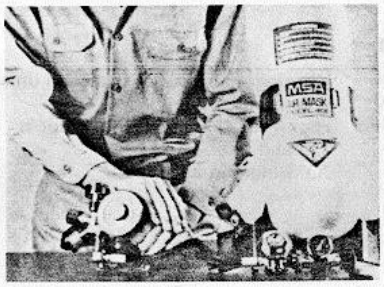
Monthly Inspection

In addition to routine inspections and inspections after each use, as called for by ANSI, a more thorough examination and testing procedure must be performed monthly by designated personnel to check cylinders, valves, connections and hoses for air tightness. The operation of the regulator valves must be tested and the apparatus cleaned, sanitized, and stored.

Check cylinder pressure as described in Step 1. If necessary, replace cylinder (Step 2). Also, examine the facepiece and breathing tube and dry the regulator as in Step 4.

8. Check Air Tightness

Test for air leaks between the cylinder and the regulator outlet by observing changes in gauge pressure. First, open both cylinder and main-line regulator valves and note the indicated regulator pressure (blocking the breathing tube outlet on pressure demand units).



After observing the regulator pressure, close the cylinder valve and watch the regulator pressure gauge.

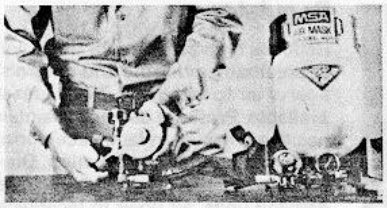


If the indicator drops more than 100 psig in 30 seconds, leaks are present. They may be located by applying soapy water to connections and couplings. Expanding bubbles indicate leaks. Close main-line valve to conserve air supply.

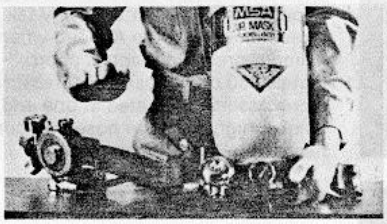
9. Check Audi-Larm Function

MSA recommends that the function of the Audi-Larm warning device be checked by observing the regulator gauge pressure at which the alarm rings. This test should be performed with a minimum cylinder pressure of 1200 psig.

To check a pressure demand apparatus, pressurize the system by opening the cylinder valve for a moment, then close it. Place your hand over the regulator outlet to block it leak-tight. Open the main-line valve. The alarm should **not** ring.



Remove your hand from the regulator outlet and observe the drop in pressure on the regulator gauge and the point at which the Audi-Larm begins to ring **(see chart below)**. The ringing will continue until air in the system is exhausted.



To check a demand apparatus, pressurize the system (1200 psig minimum), close the cylinder valve, open the by-pass valve slightly to permit the air to bleed out of the system, and observe the drop in pressure on the regulator gauge and the point at which the alarm rings. When the air is completely exhausted, close the by-pass valve.

If the Audi-Larm does not function properly, it must be replaced.

Audi-Larm No.*	Stamp. Cyl. Press.	Filled Cyl. Press.	Nom. Ring. Press.	Min. Ring. Press.	Max. Ring. Press.
1310	1800	1980	400	375	475
13E-10 13E-27 449910 449911 460255 460256	2015	2216	540	500	580

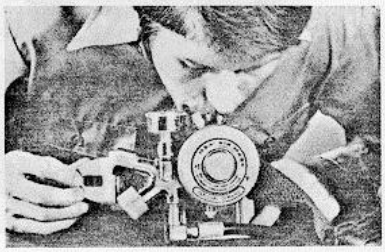
*Audi-Larm Bureau of Mines Approval Number or NIOSH/MSHA Part Number is located on alarm body.

10. Check Diaphragm Function

Remove the breathing tube and check that the cylinder and regulator valves are closed and that the system is not pressurized.

Gently **inhale** through the regulator outlet and hold for about 10 seconds. If the negative pressure is maintained, there is no leakage.

Gently **exhale** through the regulator outlet for about 10 seconds. If the positive pressure is maintained, there is no leakage.



The regulator outlet should be sanitized after testing. Do not use the apparatus if air flow through the regulator is detected in either test.

11. Check Regulator Function

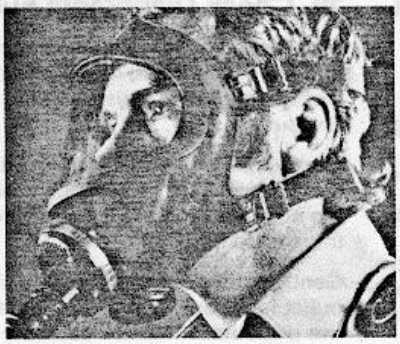
Regulator function should be checked at least monthly and preferably after each use to verify that performance is within specifications.

The MSA Portable Regulator Tester is used to measure the resistance and the flow of air through the regulator at the proper suction or positive pressure. For more information about the Regulator Tester, see page 8.

12. Check Main-Line and By-Pass Valves

Operation of the main-line valve and by-pass valve is tested by putting on the device and operating it normally. Venting of pressure relief valves, or continuing flow of air through the regulator when the user is not inhaling, indicates the regulator needs to be repaired. In addition, any unusual sounds such as whistling, chattering, clicking or rattling means that the regulator should be further checked.

Clean and sanitize the apparatus (Step 5), inspect the entire unit (Step 6), and record information on the MSA inspection tag or check list (Step 7). Finally, the unit is stored ready for the next use (Step 3).

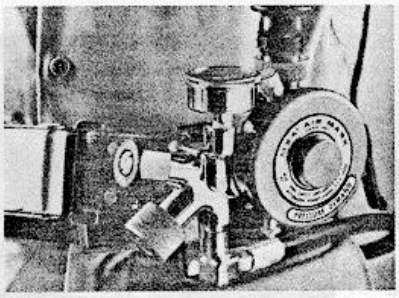


Facepiece and Breathing Tube

Molded from soft rubber compound. The Ultravue facepiece has one-piece polycarbonate lens that is replaceable, five adjustable headbands, and speaking diaphragm.* Exhalation valve is either pressure demand or demand type and must be compatible with the regulator type. Valve covers have distinctive shapes. Nosecup and spectacle mounting kit accessories available. Breathing tube connects facepiece to regulator.

Inspection Check Points

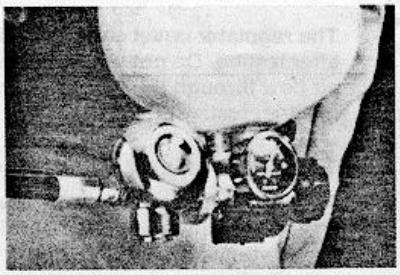
Rubber: distortion, dirt, cracks, tears, holes.
Harness: breaks, loss of elasticity, missing buckles and straps.
Serrations: wear.
Lens: cracks, scratches, proper seal.
Exhalation Valve: visual check for cleanliness.
Breathing Tube: cracks in corrugations, missing or loose hose connections.



Regulator

Reduces high pressure air from cylinder to breathable pressure and controls the flow of air to facepiece. Two types are available. Pressure demand maintains positive pressure in facepiece during both inhalation and exhalation. Diaphragm cap has raised hub in center. In demand units, air flows to facepiece only on inhalation by the wearer.

Diaphragm Cap: securely in place.
Pressure Gauge: damage.
Main-Line and By-Pass Valves: functional with unit pressurized.
Breathing Tube Connector: threads stripped or worn.



Audi-Larm Low Pressure Warning Alarm

Sounds a continuous loud warning for about six minutes for the Air Mask and three minutes for the Air Cub when the cylinder pressure reaches approximately 400 or 540 psi. Low pressure alarm assembly located at one end of flexible high pressure hose that connects cylinder to the regulator.

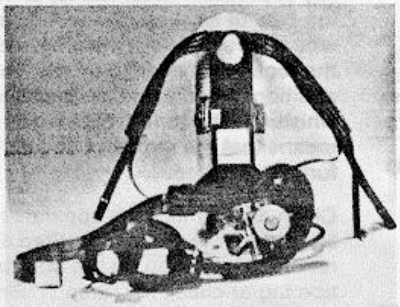
Warning Alarm: functional with unit pressurized.
High-Pressure Hose: connector is hand tight.
"O" Ring: dirt and wear.



Cylinder

Two types available: 1) Composite (aluminum liner wrapped with fiberglass) and 2) steel. Weights when empty: approximately 10.5 lbs. (Composite) and 18-20 lbs. (steel). Both cylinders have a capacity of 45 cubic feet of air and are charged to pressure of 2216 psi. Air Cub steel cylinder is smaller, (26 cubic feet) charged to 2216 psi.

Hydrostatic test date: 3 years (Composite) or 5 years (steel)
Cylinder pressure: 2216 psi.
Body: cracks, dents, weakened areas.
Valve: damage.
Valve lock: in place and functional.
Gauge: fully charged.



Harness

Harness has foam padded two-inch-wide nylon strap at each shoulder, a padded strap across bottom of backplate, and a chest strap. Backplate is made of anodized aluminum. Cylinder is held in position by cam-type latch that can engage any of six slots in the stainless steel spring clip.

Straps, clips: wear, in place.
Waist belt: wear, buckle functional.
Backplate: damage or defects.
Cylinder lock: holds cylinder tightly.

*Clearvue facepiece has CR39 lens and no speaking diaphragm in pressure demand facepiece.

Portable Regulator Tester

The Portable Regulator Tester is an easy-to-operate, self-contained instrument that can be used to make periodic performance checks of the regulators on MSA self-contained breathing apparatus.

The Tester measures the **static pressure** and **air flow rate** of pressure demand regulators and the **resistance** and **air flow rate** of demand-type regulators.

The instrument incorporates an electrically powered vacuum pump that simulates the suction of inhalation. Appropriate suction (negative pressure) for a given type of regulator is established by adjusting a flow control valve on the Tester's front panel. A chart supplied with the instrument lists correct test pressures for MSA regulators.

In operation, the pressure gauge (left side of panel) monitors positive or negative pressure while the flow gauge (right side of panel) measures the air flow delivered by the regulator under test.

Operation of the Tester involves five set-up steps:

1. Identify the flow characteristics of the regulator to be tested.

2. Check the Tester for leaks and the correct calibration.

3. Connect the breathing tube of the apparatus to the front panel of the Tester.

4. Open the cylinder and main-line valves fully.

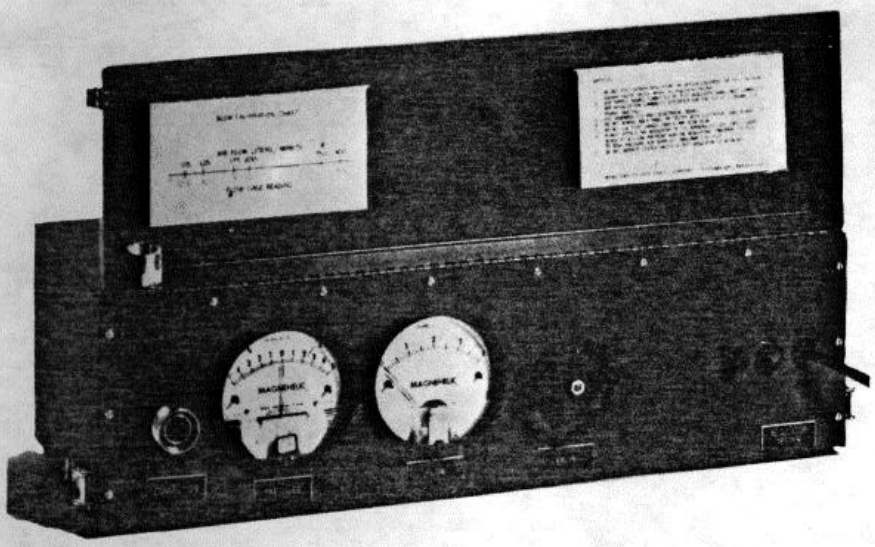
5. Close the flow valve and switch on vacuum pump in the Tester.

To test a pressure demand regulator:

- **Static Pressure Test:** Briefly open and close the Tester valve a number of times until a repeatable static pressure setting is read on the Tester pressure gauge.
- **Air Flow Test:** Adjust the Tester's flow valve until the flow gauge reaches the specified flow rate for the regulator. The pressure gauge must read zero or positive. A negative pressure reading is not acceptable.

To test a demand regulator:

- **Cracking Pressure Test:** Open the flow valve on the Tester slowly and listen for the flow to start through the regulator. The reading on the pressure gauge of the Tester when the flow starts is the crack pressure.
- **Air Flow Test:** Adjust the Tester's flow valve until the flow gauge reaches the minimum required flow rate for the regulator. The negative pressure on the pressure gauge should be less than the maximum negative pressure permitted.





Caution: The Portable Regulator Tester is designed and calibrated for use with **MSA regulators only.** It must not be used to test regulators of devices of other manufacturers.

The instrument must not be connected to any oxygen supply because of the possibility that oxygen may ignite the Portable Regulator Tester's internal motor.

Note: This bulletin is offered only as a general guide for the inspection and maintenance of MSA Model 401 Demand and Pressure Demand Air Masks and Model 502 Demand and Pressure Demand Air Cubs. Under no circumstances should these products be inspected and maintained except by qualified, trained personnel and not until the instructions, labels, or other literature accompanying the products have been carefully read and the precautions therein set forth are followed. Only they contain the complete and detailed information concerning these products.

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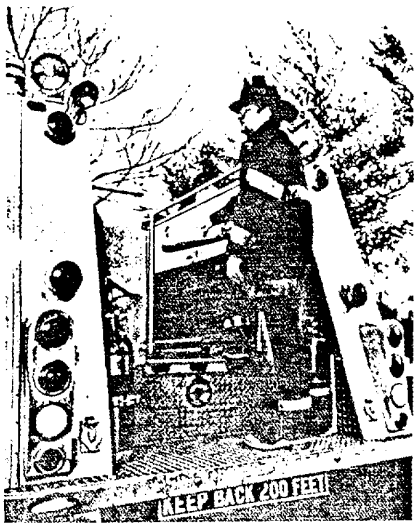
Bulletin No. 0105-51 Part No. 462949 Printed in U.S.A. 816(L)

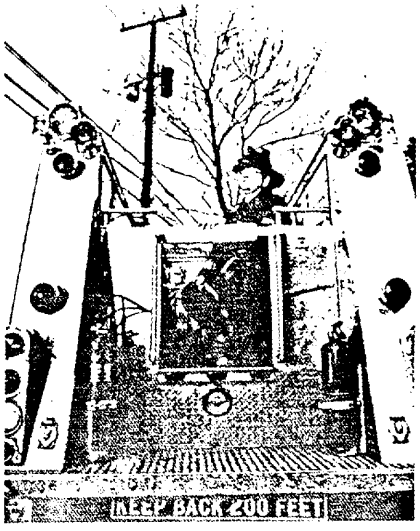
PUT YOUR MEN BEHIND BARS

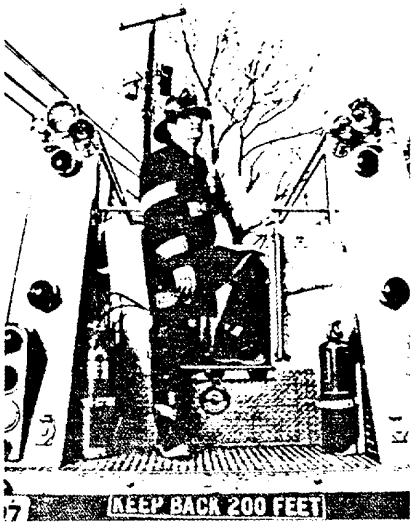












MAN SAVER™

Patent Pending

The MAN SAVER ™ is a safety bar that mounts across the jump seat opening. It is completely AUTOMATIC! There are NO hooks to latch or harnesses to buckle. It is spring loaded and returns to a safe position at all times!

To enter, simply push the bar away from you, step into the jump seat space, and the spring will gently return the bar to the original position across the jump seat opening.

If you are pushed or pressed against the bar while sitting or standing in the jump seat, the bar will NOT move! Helps to prevent falling from the truck!

To exit, simply lift the bar to the upright position and step out. It automatically returns to its original position!

In order to help protect against injuries, the safety bar is encased in a heavy layer of foam. A bright yellow water repellent cover is fitted over this foam. All other parts are made of aluminum and stainless steel which make this product lightweight and rustproof!

Some installations may require a wedge shim (angle adjustor). These wedge shims are available at a slight additional cost.

Please see other side of this page for instructions on measuring and ordering.

Instructions for the simple installations of this safety bar are sent with every order.

FIRE RESEARCH
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TLX 967 784

MEASURING INSTRUCTIONS FOR THE MAN SAVER ™

FIG. 1.

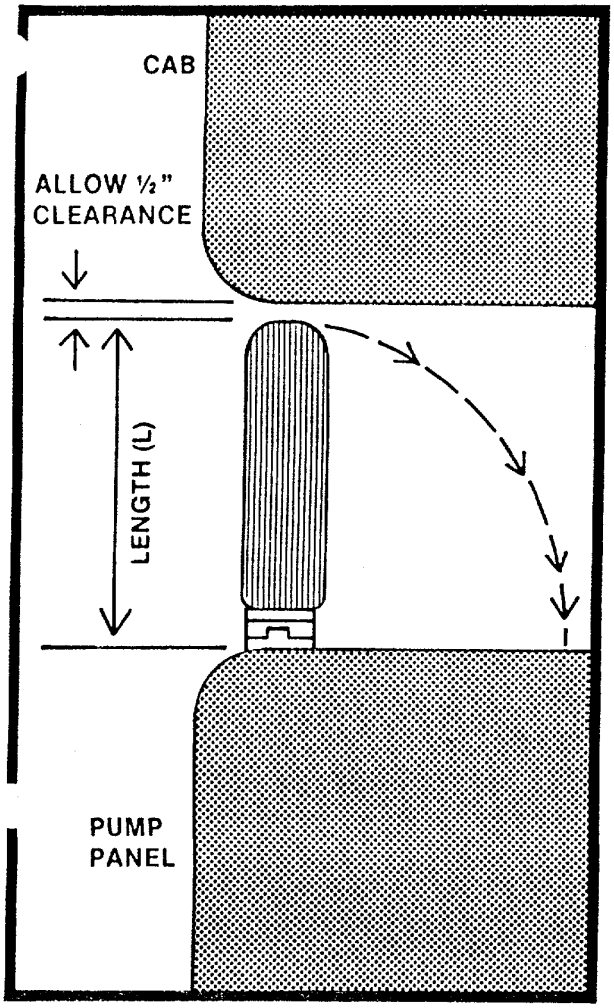
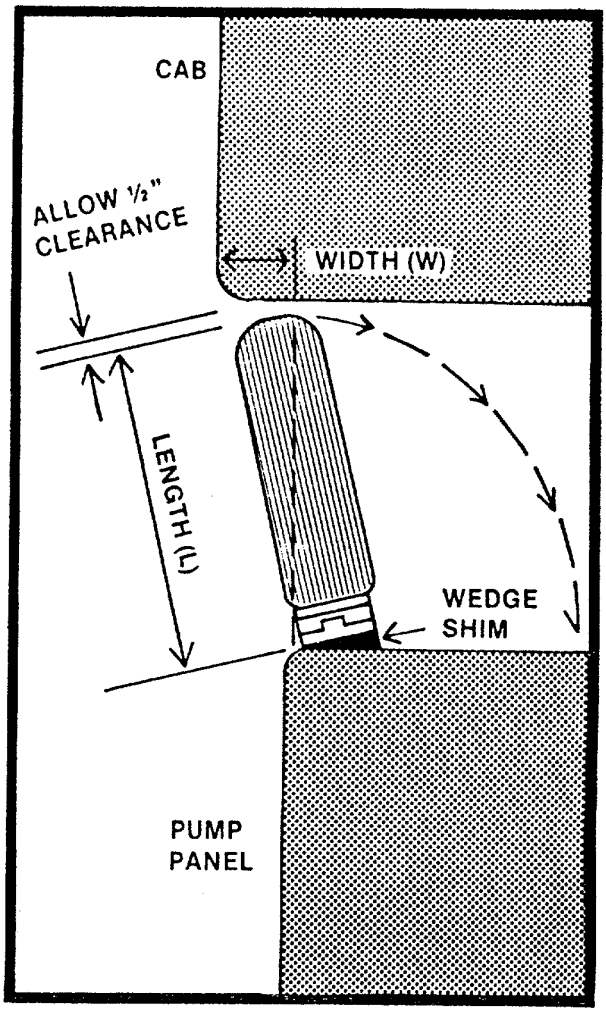


FIG.2.



The MAN SAVER ™ is normally attached to the wall adjacent to the pump panel. Refer to Figures 1 and 2 to determine length of safety bar needed, and for the most common installations.

1. The MAN SAVER™ is attached with four (4) 5/16" bolts (supplied) through the panel on a 1½" bolt circle.
2. Before ordering, make sure that:
   a. there is space inside the panel for the bolts to go through,
   b. the panel is strong enough to support the MAN SAVER. If not, a backing plate should be used inside the panel. *This is extremely important!*

The MAN SAVER™ comes in the following standard lengths:

20" 24" 28" 32"
22" 26" 30" 34"

4. Choose the nearest smaller size to your measurements.
5. If the installation in Figure 2 is preferred, use the following table to choose one of the four standard wedge shims (angle adjustors). Use the length closest to your measurements.

Note: If the pump panel extends past the cab, simply reverse the wedge shim.

WEDGE SHIM SELECTION CHART

LENGTH (L) INCHES	WEDGE SHIM TYPE A	B	C	D
20	2	3½	5	7
22	2	4	6	7½
24	2	4	6	8
26	2½	4½	6½	9
28	2½	5	7	9½
30	2½	5	7½	10
32	3	5½	8	11
34	3	6	9	11½

LENGTH (W) INCHES

EXAMPLE:
IF YOUR MEASUREMENTS ARE L 26½" AND W 6" - THE NEAREST SMALLER SIZE OR LENGTH IS 26", THEN MOVING TO THE RIGHT ON THAT LINE, THE CLOSEST WIDTH MEASUREMENT IS 6½", THE REQUIRED WEDGE SHIM IS SHOWN AT THE TOP OF THAT COLUMN AND IT IS 'C'. YOUR ORDER SHOULD READ AS FOLLOWS:

(1) MAN SAVER - LENGTH 26"
(1) WEDGE SHIM - TYPE "C"

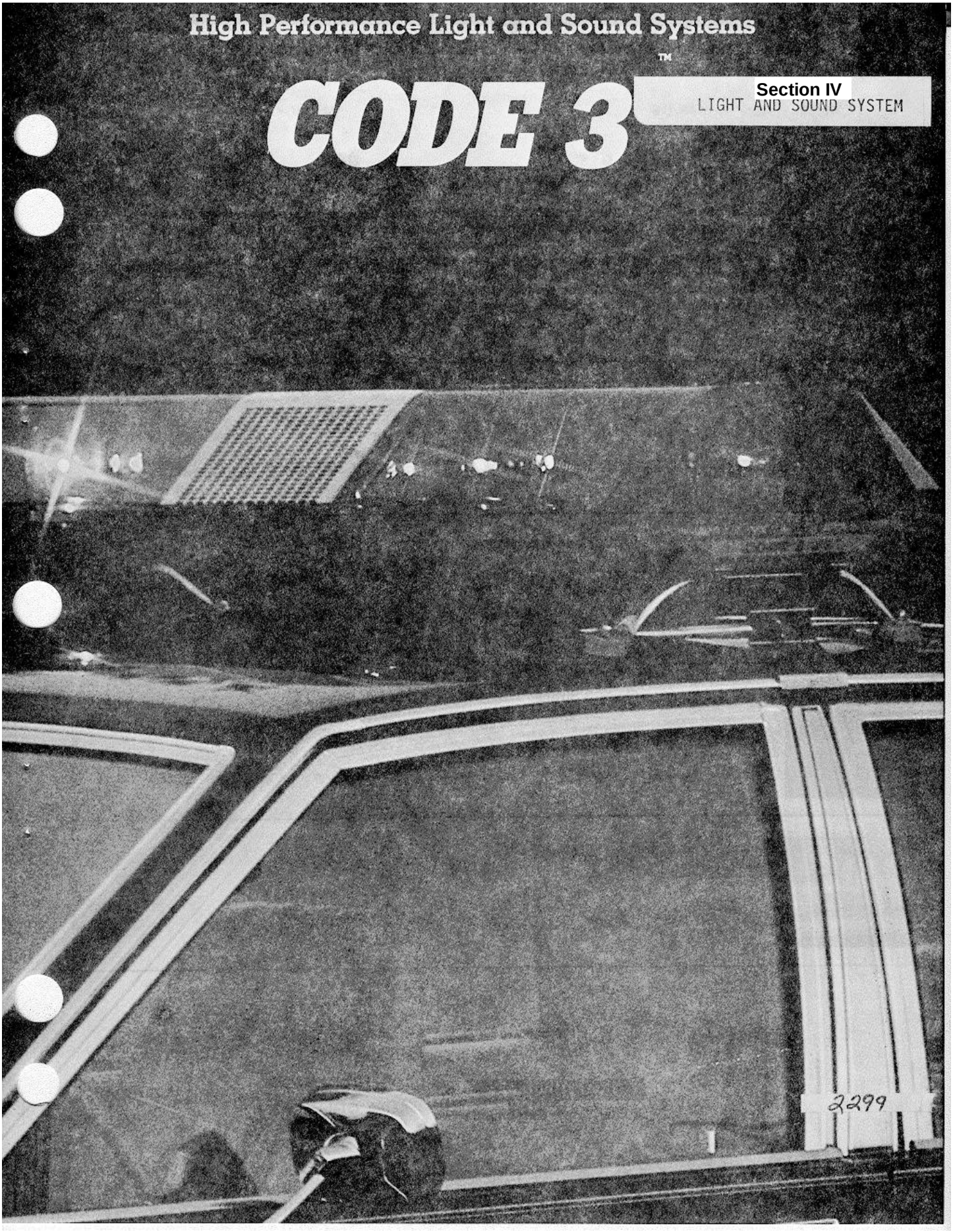
IF YOU NEED ANY ADDITIONAL INFORMATION, PLEASE CONTACT US.

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High Performance Light and Sound Systems

CODE 3™

Section IV
LIGHT AND SOUND SYSTEM



Code 3
Standard of Excellence

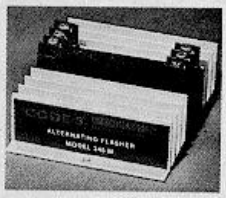
Over the years, the Code 3™ name has become synonymous with quality in safety equipment. We're proud of the reputation we've built. It's our goal to continue maintaining those high standards while developing improved, more efficient technology for your use.

Code 3 lights, including the fuel efficient XL model, and Code 3 sirens are just one part of that ongoing success story. A wide range of accessories is also available to meet your most demanding specifications. There's no job too difficult for Code 3 products to handle.

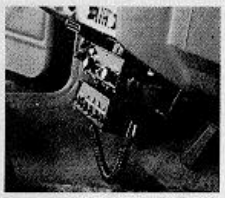
Test us against any other safety equipment manufacturer. You're sure to agree that for dependability, quality and economy - Code 3 has no equal.



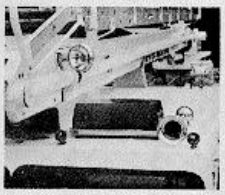
Code 3 Light Bars Page 5



Options and Accessories Page 10



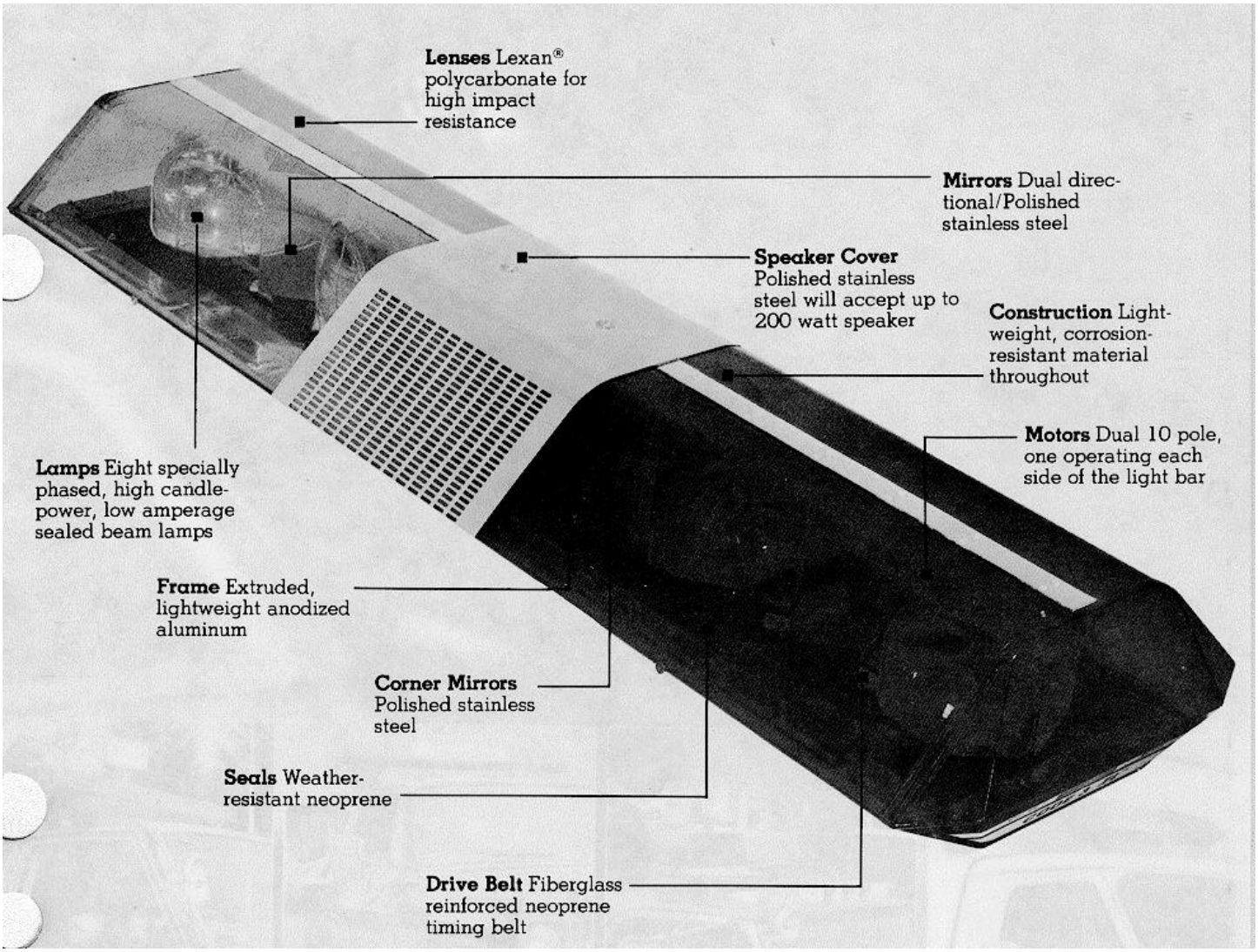
Code 3 Sirens Page 15

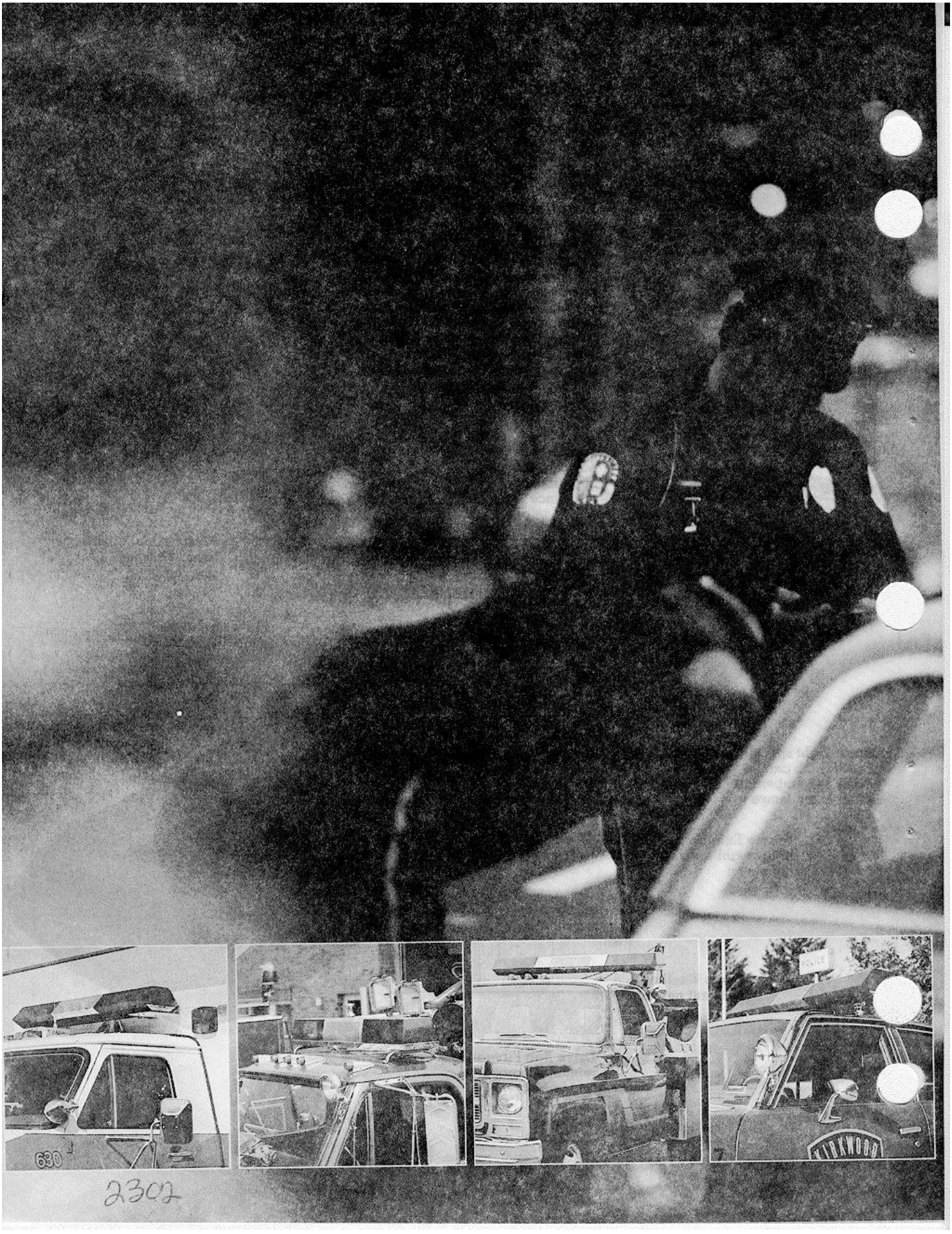


Code 3 Beacons Page 19

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TWX 910-765-0905


Lenses Lexan® polycarbonate for high impact resistance
Mirrors Dual directional/Polished stainless steel
Speaker Cover Polished stainless steel will accept up to 200 watt speaker
Construction Lightweight, corrosion-resistant material throughout
Motors Dual 10 pole, one operating each side of the light bar
Lamps Eight specially phased, high candlepower, low amperage sealed beam lamps
Frame Extruded, lightweight anodized aluminum
Corner Mirrors Polished stainless steel
Seals Weather-resistant neoprene
Drive Belt Fiberglass reinforced neoprene timing belt



2302

A Proven Fact: Aerodynamic Design Boosts Fuel Economy

The Code 3 XL has consistently proven to be the best in fuel savings over any other light bar on the market.

It's important to remember that fuel efficiency is a function of the vehicle being used as well as speed. Actual road testing in conformance with the SAE standard is the most significant evaluation of performance. Testing was done with a full-sized sedan running at 55 MPH using the light bar designed for that vehicle, the Code 3 XL Model 9000 Regular. On the 7½ mile track of Transportation Research Center, operated by the state of Ohio, Code 3 XL was the clear winner.

The closest competitor was more than 2% behind, and older style light bars were almost 8% less efficient than the Code 3 XL. The results are yours for the asking. See for yourself.

Comes on Strong— with Power to Spare

Code 3 light bars come with high candlepower sealed beam lamps. While the asymmetrical Code 3 signal provided by the standard sealed beams has proven to be more than satisfactory on thousands of emergency vehicles, even more light can be obtained by using the halogen sealed beam lamps. These sealed beams require virtually no additional energy to deliver almost twice the maximum beam candlepower.

A standard Code 3 light bar requires only 22 amperes at 12 volts. The PowerSaver™ and SelectAlert™ options offer special purpose signals at dramatically reduced current.

Trouble Free High-Powered Performance

Both the Code 3 XL and 2200 series light bars incorporate the same drive train, powerful independent motors and sealed beam lamps, mounted on a lightweight, high strength aluminum frame. All moving parts, including the motors, are located in the sealed lens area of the light bar.

Years of automotive experience have proven that sealed beam lamps are far superior and outperform any open reflector light source. Relatively inexpensive, these efficient sealed beam lamps are long lived and provide exceptionally well-focused light beams. Code 3 light bars measure up. Depend on them.



Models, Sizes and Mountings for a Wide Range of Vehicles

Any vehicle from subcompacts to the largest of fire trucks—not to mention heavy duty wrecker applications—can benefit from Code 3 light bars.

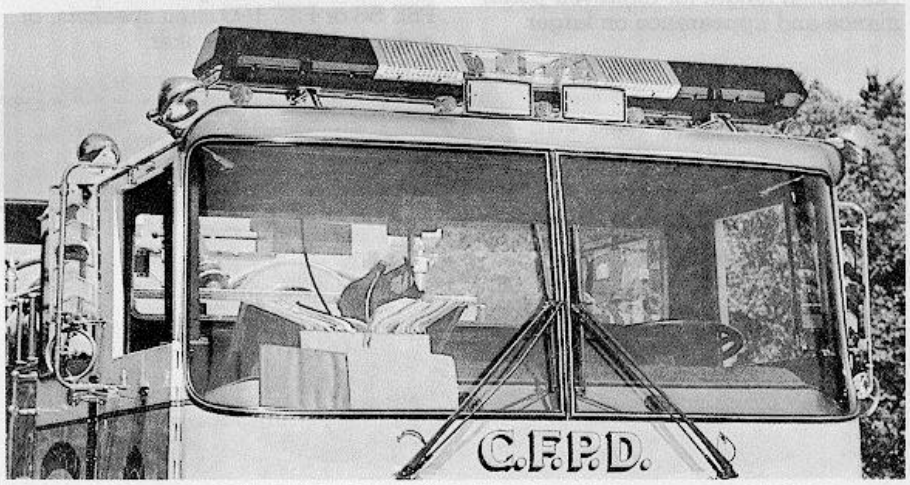
The 9000 XL Short is perfect for compacts and subcompacts while the 9000 XL Regular and the 2200 Short fill the need for full-sized and intermediate cars. Larger vehicles can use 55" light bars.

Both Code 3 light bars designated Extra Long are built for vehicles such as commercial trucks, vans and tow trucks where extra length is needed.

Models 9300 and 2300 are triple-lensed light bars with an extra margin of safety for large vehicles that pack a lot of momentum. These "Triple Threats" say it all.

Attachment of the Code 3 light bars to the vehicle can be accomplished with various hook-on kits or permanent mounts (see page 10). All Code 3 light bars come fully prewired and with a heavy-duty switch. The speaker enclosure is prewired for a siren speaker.

Choose Code 3 bars for their advanced technology and outstanding energy-efficient economy.

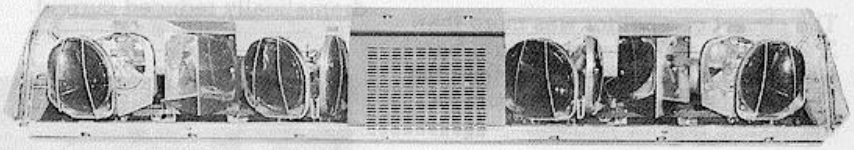


The Code 3 Light for the Eighties Designed for Less Resistance and Better Mileage
A light bar that virtually pays for itself by reducing operating fuel costs is indeed an engineering triumph. The Code 3 XL light bars combine aerodynamic shape with the proven Code 3 sealed beam signal and mechanical drive train to give superb, high-powered performance. For all this, the Code 3 XL is a reasonably priced product within reach of any department's budget.

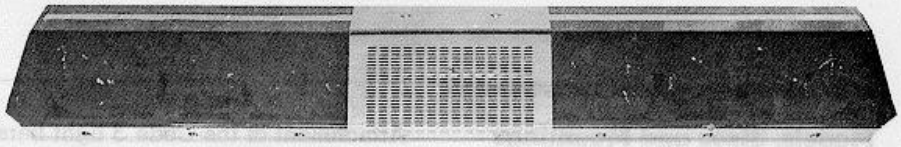
The Most Effective Lights Available
Code 3 XL light bars are the most effective emergency vehicle lighting systems available. While many other light bars offer only reduced levels of warning when viewed from the corners, side or rear, the Code 3 XL blasts out its unique spectacular warning signal from all these positions.

The Code 3 signal is generated directly from synchronized rotating lamps, four under each lens, rather than depending on reflection from mirrors. These efficient sealed beams combine penetrating visibility with reasonable current consumption.

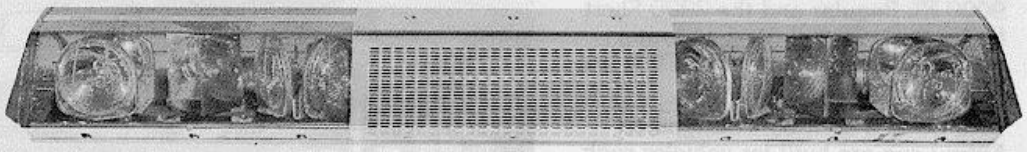
Model 9000 Short 45" Long
Full-size performance for compact and subcompact cars. The enclosed center of the Code 3 XL Model 9000 Short permits installation of a single PSE 58 or PSE 100 siren speaker.



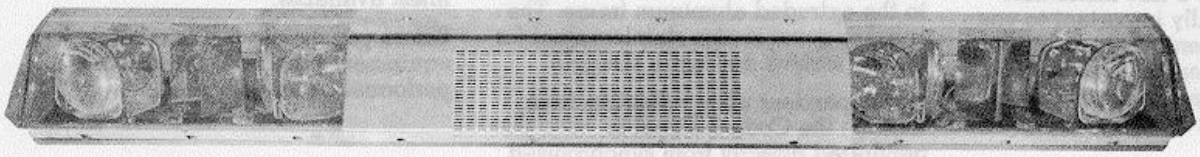
Model 9000 Regular 48½" Long
The new standard of excellence. The Code 3 XL Model 9000 Regular is the finest available light bar for all newer intermediate- and full-sized automobiles. Center space is provided for one PSE 58, PSE 100 or PSE 200 siren speaker.



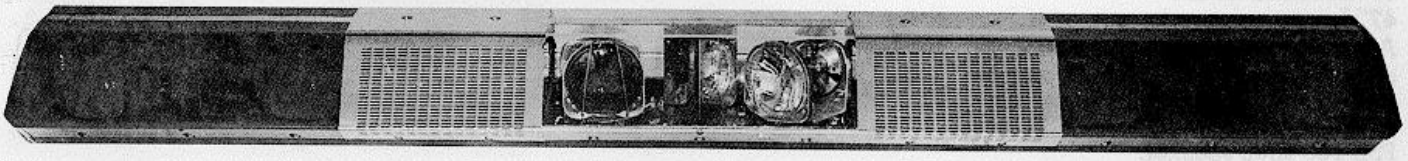
Model 9000 Long 55" Long
Additional length for improved performance and appearance on larger vehicles. Ample space is available under the center cover of the Code 3 XL Model 9000 Long for one or two PSE 58 or PSE 100 siren speakers, or a single PSE 200 speaker.



Model 9000 Extra Long
65" Long
Sized for vans, commercial cab and tow trucks. This extra long bar looks and fits right without the use of extension kits. Space is available for one or two PSE 58 or PSE 100 speakers or a PSE 200 speaker.



Model 9300
77" Long
"Triple Threat"—the ultimate in performance and style for the finest custom equipment. The Code 3 Model 9300 is the obvious choice to protect the pride of the department. Speaker covers permit mounting of one or two PSE 58, PSE 100 or PSE 200 speakers.



Specifications

Rotating Lamps-Eight #7400 sealed beam–35 watt–35,000 candlepower (Twelve lamps–Model 9300)
Red, blue, amber, clear and green lamps available
Optional–60,000 CP. Halogen Lamps

Permanent or Oscillating Lamps-See option pages 10-13

Lamp Holders-Quick change

Motors-Two, 10-pole American Bosch gearmotors (Three for Model 9300)

Bearings-Sintered bronze, permanently lubricated

Drive Belts-Glass fiber reinforced, neoprene timing belt

Power Requirements-22 amperes @12 volts DC

Mirrors-Polished stainless steel "V" mirrors centered front and rear plus corner mirrors (inboard)

Lenses-Lexan® polycarbonate–available in red, blue, amber and clear

Frame-Extruded anodized aluminum

Seals-Seamless neoprene

Speaker Enclosure-Stainless steel–accommodates 58 watt–200 watt enclosed bar speakers

Cable-12' jacketed, prewired, 105° C (includes speaker leads)

Switch-Heavy duty

Dimensions-Short-45", Regular-48½", Long-55", EL-65", 9300-77"
All are 6½" high and 14½" deep

Weight-Short-32 lbs., Regular-33 lbs., Long-35 lbs., EL-38 lbs., 9300-48 lbs.

Mounting-Extended hook-on, hook-on, permanent (see accessories page 10)

Options & Accessories
See pages 10-13

Premium Construction—Flawless Performance

The cornerstone of the Code 3 product family is the 2200 series light bar. Development and constant improvement of the Code 3 line maximizes protection so vitally important to you and your equipment. Eight brilliant rotating sealed beams give you that extra margin of safety not only from the front and rear but also on the corners.

Each rugged Lexan® lens seals to the frame with neoprene gaskets, keeping the rotating assemblies and motors protected in the weatherproof area of the bar. Stainless steel end caps and edge protection spell added durability to the extruded aluminum frame. The speaker cover is also stainless steel for lasting service and extra strength.

Not dependent upon reflection from mirrors, the Code 3 signal is generated directly from synchronized rotating lamps, four under each lens. These efficient sealed beams combine penetrating visibility with reasonable current consumption.

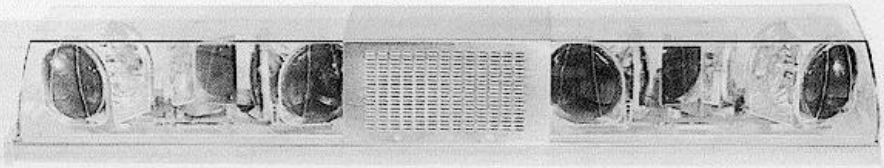
In side-by-side comparisons across the country, they consistently outperform all other light and strobe systems.

Incredibly powerful, quiet running and dependable, Code 3 light bars are the finest available.

Before you make your next safety equipment purchase, prove Code 3 performance for yourself.

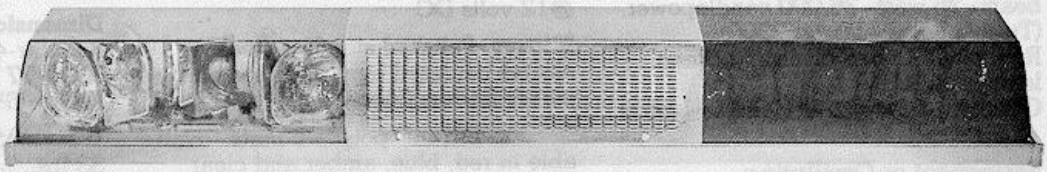
Model 2200 Short
47" Long

A proven performer for city patrol cars, the Model 2200 Short is built for today's down-sized automobiles. The enclosed center accepts one PSE 58 or PSE 100 siren speaker.



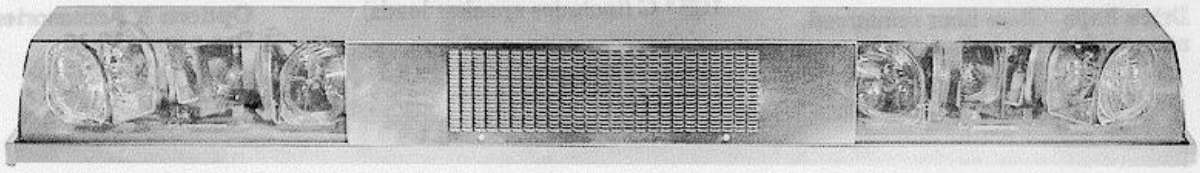
Model 2200 Long
55" Long

Space is available for either one or two PSE 58 or PSE 100 siren speakers in the center section. The 2200 Long is just the right size for larger vehicles.



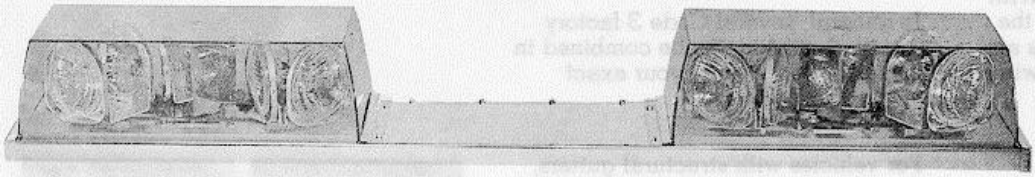
Model 2200 Extra Long
63" Long

The ideal light bar for commercial cab trucks, vans and pickups, the Code 3 Model 2200 Extra Long is sized to look right and mount securely without the use of extension kits. It will accommodate one or two PSE 58 or PSE 100 siren speakers.



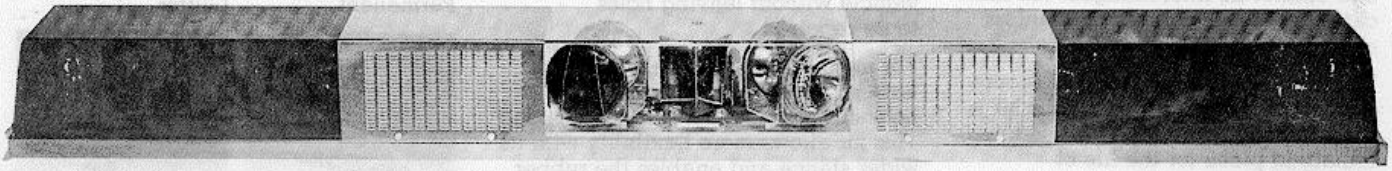
Model 2600 Long
55" Long
Model 2600 Short
47" Long (not shown)

The open center of the Model 2600 permits use of the largest, most efficient siren speakers available, as well as motor-driven sirens.



Model 2300
75" Long

With room for two siren speakers of up to 100 watts each, the Model 2300 "Triple Threat" is designed to give maximum warning for the largest apparatus.



Specifications

Rotating Lamps-Eight #7400 sealed beam–35 watt–35,000 candlepower (Twelve lamps–Model 2300)
Red, blue, amber, clear and green lamps available
Optional–60,000 CP. Halogen Lamps

Permanent Lamps-See options page 12

Lamp Holders-Quick change

Motors-Two, 10-pole American Bosch gearmotors (Three for Model 2300)

Bearings-Sintered bronze, permanently lubricated

Drive Belts-Glass fiber reinforced, neoprene timing belt

Power Requirements-22 amperes @ 12 volts DC

Mirrors-Forward facing, polished stainless steel "V" mirrors

Lenses-Lexan® polycarbonate–available in red, blue, amber, clear and green

Frame-Extruded aluminum

Seals-Neoprene

Speaker Enclosure-Stainless steel–accommodates 58 watt-100 watt enclosed bar speakers

Cable-12' jacketed, prewired, 105° C (includes speaker leads)

Switch-Heavy duty

Dimensions-Short-47", Long-55", EL-63", 2300-75"
All are 6¾" high and 9" deep

Weight-Short-34 lbs., Long-38 lbs., EL-41 lbs., 2300-51 lbs.

Mounting-Extended hook-on, hook-on, permanent and gutter mount (see accessories page 10)

Options & Accessories
See pages 10-13

Options to Fit Any Need

All Code 3 light bars are known for their penetrating 360° warning signal, proven effective on tens of thousands of emergency vehicles. However, everyone's needs are different. With that in mind, Code 3 offers you the most diverse selection of options and accessories ever available, allowing you to customize your equipment to fulfill all of your needs. From mounting kits, to the new "Stinger" and on to the sophisticated Deluxe NightProbe™ system, Code 3 has it all.

In general, several Code 3 factory installed options can be combined in one light bar to meet your exact needs. Since the Code 3 Model 1100 and XL Model 4500 beacons are the same as one end of a light bar most options can also be installed in these lights.

Mounting Kits

Four styles of mounting kits are available to secure Code 3 light bars to virtually any type of vehicle. While similar, the mounting kits for the standard Code 3 2200 series and the Code 3 XL series differ in dimensions and cannot be interchanged. All fabricated parts are made from stainless steel.

The permanent kit is the most secure method of mounting lights. This kit is recommended when the light is to remain in place for the life of the vehicle.

For vehicles with structural gutters, the gutter mounting kit provides the traditional means of attachment.

The hook-on mounting kit has become the standard for most automotive installations, because of its ability to be moved easily from vehicle to vehicle without leaving holes to be repaired.

For mounting shorter light bars on larger automobiles, the extended hook-on mounting kit is recommended. This kit allows more flexibility with its wider stance and enables the rubber mounting feet to be placed close to the stronger roof edges.


Permanent


Gutter

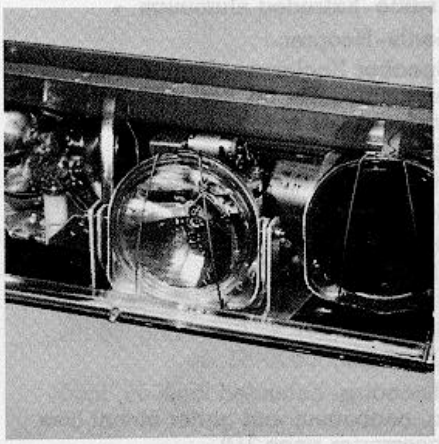

Hook-on


Extended Hook-on

New

Stinger™

This remarkable oscillating light is unequaled by any on today's market. Unlike other oscillating lights, the Stinger uses two independent motors to generate its vertical and horizontal action. Instead of tracing a repetitive pattern leaving blind spots, the Stinger's constantly changing orbit covers the area in front of the vehicle with high intensity light. An engineering triumph, the Stinger installs inside a Code 3 XL lens while still retaining the regular four-lamp rotating signal (Note: available only on Code 3 XL light bars and beacons).



"If one is good, two are better"—you can order a Stinger under each lens of a Code 3 XL light bar. Best of all, its reasonable cost makes this a reality.

Hook-Up Kit

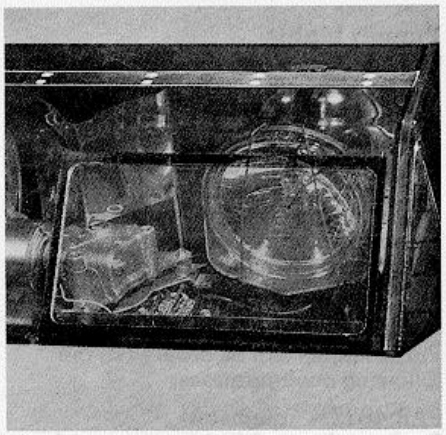
While all Code 3 and Code 3 XL light bars, as well as Models 1100 and 4500 beacons, come prewired and with their own heavy-duty switch, the Hook-Up Kit provides all necessary hardware for complete, professional installation. The kit includes a 35 ampere auto-reset circuit breaker, 10-gauge 105° C supply wire, assorted ring terminals, cable ties and snap-in grommets, along with installation tips.

Lens Polish

Keep your Code 3 lights looking like new! This special polish for cleaning and removing minor scratches from all Code 3 Lexan® polycarbonate lenses comes with polishing cloth.

Lens Inserts

When colored lenses are desired to convey the primary warning signal, use inserted lenses to create special multicolored effects. Specify ⅓, ½ or full-width inserts in front of rotating pod or stationary lamps to either the front or rear. With NightProbe™, a clear end insert is required for 2200 series lenses. Code 3 XL lenses can be fitted with clear end panels as well as different colors to the front and rear at no extra cost.



A popular application for an inserted lens is the half-width amber insert to the rear. When used with rotating SelectAlert, it gives a wide-angle rear flashing amber signal, associated with California-type light bars. Clear one-third width centered inserts are used for take-down lamps installed in colored lens bars, while colored inserts in front of stationary flashing lamps create multi-effect signals.

Lens inserts are available in all lenses.

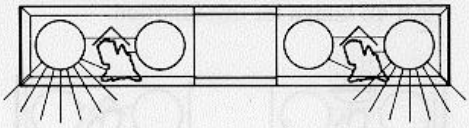
SelectAlert™ Rotating Pods

Order a bar with one or more SelectAlert rotating pods and choose between the power-conserving rear-only rotating signal or the regular full-circle Code 3 signal. This option is ideal for traffic cars or other vehicles which constantly require strong warning to protect them from rear-end collision. At the same time, it does not interfere with the flow of on-coming traffic or silhouette the officer approaching a stopped vehicle.

The option includes a heavy-duty, three-position switch, which, when placed in the first position, delivers approximately 100 degrees of rear-only coverage. Depending on the strength of the rear signal ordered, one, two or all four pods can be energized. Advancing the switch to the extreme position produces the full Code 3 signal.

In the rear-only mode, each SelectAlert pod requires two amperes for operation. SelectAlert rotating pods are frequently used in combination with lens inserts to produce special warning signals.

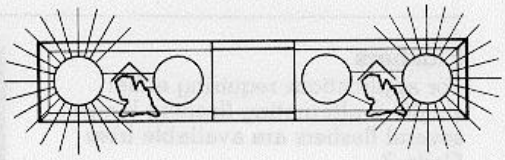
SelectAlert cannot be installed on a NightProbe pod; therefore, if this option is desired on a NightProbe light bar it is available only on the inboard pods.



PowerSaver™

Now you don't have to sacrifice energy efficiency for power. The inexpensive PowerSaver lets you choose between the full-strength Code 3 signal, produced by operating all lamps, and a reduced but still effective signal from fewer lamps. You'll find the PowerSaver ideally suited to many emergency vehicles where the electrical system operates near capacity, particularly at idle speeds.

When responding, the three-position switch is placed in the extreme position, and the light bar operates in the normal way. On reaching the scene, the signal and electrical load can be reduced, if necessary, by moving the switch to the first position. The reduced-level warning can be either driver's side, outboard pod only (5 amperes) or outboard pods, both sides (10 amperes) still providing a powerful 360° signal.



Halogen Sealed Beam Lamps

Halogen sealed beam lamps can be installed in all light bars and beacons at additional cost. Keep in mind that reasonable operating power requirements for today's vehicles are of the utmost importance. Therefore, two types of halogen lamps are available.

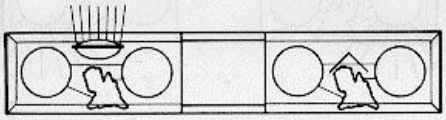
For light bars as well as the 1100 and 4500 beacons, a 37½ watt, 60,000 candlepower sealed beam can be installed, almost doubling the effective beam candlepower over the standard lamp. The advantage of this sealed beam is that it requires virtually no additional power to operate over the standard lamp.

For a dazzling punch of light from the Model 500, a 55-watt, 72,000 candle-power halogen lamp is available. Since this light utilizes only a single sealed beam lamp, the four amperes of power required is easily handled.

Stationary Lamps
The unique Code 3 system allows you to add special function stationary sealed beam lamps without sacrificing any of its unequaled rotating signal. Since stationary lamps can be used for several purposes, refer to the specific application you desire to determine what configuration best fits your needs.

Steady Burning
For a very directional signal, one or two stationary PAR 46 lamps (5¾" diameter) can be factory installed. These may be high intensity concentrated lamps (California Class A) or a broader coverage lamp (California Class B). They can be positioned to face either fore or aft on either side of the bar. While the forward mirror is replaced with the steady burning lamp, the rear mirror is retained on Code 3 XL lights.

The PAR 36 lamps described in the Alternating Flasher option can also be used as steady burning warning lamps but are not considered equivalent to PAR 46 lamps for this function.



Pursuit Lights
The addition of forward facing stationary lamps in a light bar creates an intensified directional warning in front of the vehicle. The beam pattern of these lights penetrates through the rear windows and off rear-view mirrors to help you move traffic. These lamps can be steady burning or flashing. Particularly useful on a bright day, pursuit lights are a powerful addition to the 360° rotating signal.

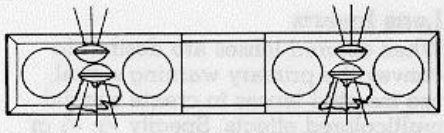
Pursuit lights can be ordered in the following configurations:

PAR 46 (5¾" diameter)
Replaces forward facing mirror and can be installed on either or both sides of the light bar.

PAR 36 (4½" diameter)
Replaces the mirrors and is the forward facing pair of lamps in the 4 lamp Alternating Flasher option.

Alternating Flashers
Four supplementary PAR 36 lamps let you add a high intensity corridor of warning to the front and rear of the vehicle, along with the full circle Code 3 warning. The factory-installed cable includes a conductor to each of the four lamps for maximum flexibility.

Using forward facing lamps as pursuit lights with the regular Code 3 signal yields extremely effective traffic breaking power.



Since there are different operating requirements for various installations, three different flashers are available at extra charge: the light duty, heavy duty and the Code 3 Mode 345 solid state flasher. See Flasher section on this page for details.

Take Down Lights
For that additional edge of protection Code 3 offers take down lights to shield the officer from potential danger. Either PAR 36 or the more intense PAR 46 lamps can be factory installed at a reasonable cost. When a pursuit light is also used, the take down lamp is installed on the passenger side and is of higher intensity than if both forward facing lamps were used as take down lights. If colored lenses are desired for the rotating signal, clear lens inserts should be ordered for the take down lights.

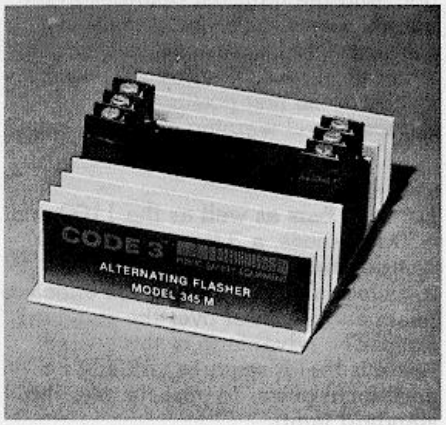
Take down lights can be ordered in the following configurations:

PAR 46 (5¾" diameter)
Replaces forward facing mirror and can be installed on either or both sides of the light bar.

PAR 36 (4½" diameter)
Replaces the mirrors and is the forward facing pair of lamps in the 4 lamp Alternating Flasher option.

Flashers
For applications requiring either single or alternating flashing lamps, several flashers are available from Code 3.

Particularly recommended is the premium, all solid state transistorized flasher, Model 345M. This unit has no relay or mechanical parts and is engineered for continuous operation. It will flash a single circuit of up to 12 amperes or will alternately flash two separate circuits of up to 12 amperes each. For larger loads, one or more slave flashers, Model 345S can be synchronously driven by a master



flasher. Ideal as a headlight flasher, the Model 345M can be wired to retain normal nighttime high and low beam functions.

For moderate applications, the Model 340, a thermal element flasher incorporating a heavy-duty relay, has proven effective on emergency vehicles for many years.

The inexpensive Model 339 flasher is available for light duty, low amperage service.

Alley Lights

Providing a clear, high intensity, side facing floodlight, Code 3 light bars can supply you with whatever alley light configuration you need. These alley lights can be internal or external, stationary or movable.

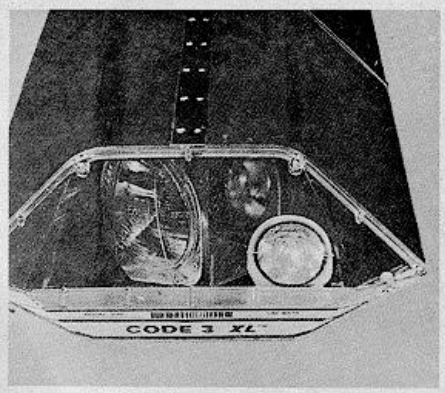
New

Stationary End Lights

Miniature in size but giant in performance, these internal alley lights utilize a prefocused halogen lamp. Its low profile permits full coverage of the primary 360° warning signal at all times.

By simply removing the lens, these alley lights can be preaimed to illuminate the precise zone desired. While normal installation consists of a single stationary end light in each rear corner, an additional lamp can be placed in each front corner. By adjusting these additional lamps you are able to either broaden or intensify the light beam.

Each end of the bar can be operated separately and the option includes control switches and mounting bracket. (Note: stationary end lights available only on Code 3 XL light bars.)



Basic NightProbe™ System

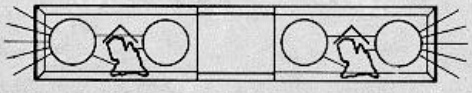
Available on any Code 3 or Code 3 XL light bar, the NightProbe system provides integral, internal alley lights. Unlike external alley lights, the NightProbe system is resistant to damage by vandals and car washes, and does not block out any of the warning signal.

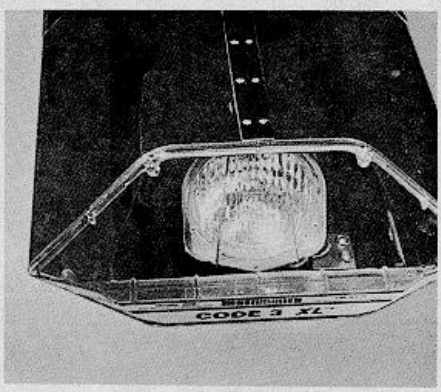
The NightProbe system uses a special dual-filament lamp in the outboard rotating pod on each end of the bar. When operating as a part of the warning signal, only one filament burns. Throw the alley light switch and the second filament is also energized with the lamp automatically locating to brilliantly illuminate the area to the side of the vehicle. On light bars with colored lenses, a clear end insert or end cap (XL series) must be used. Completely independent, either end of the bar can operate as a rotating beacon while the other is used as an alley light. If SelectAlert is desired on a NightProbe bar, it must be installed on the inboard pods.

The Basic NightProbe option comes with its own wiring harness and can be ordered in the following configurations:

1. With an attractive control head which matches the Code 3 Siren.
2. With left and right control switches and mounting bracket.
3. Without switches for operation with user supplied controls.

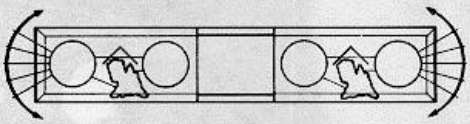
All of the above are available in a special 10-lamp circuit for use in California. (Note: the extra lamps are not used in the 360° rotating signal.)

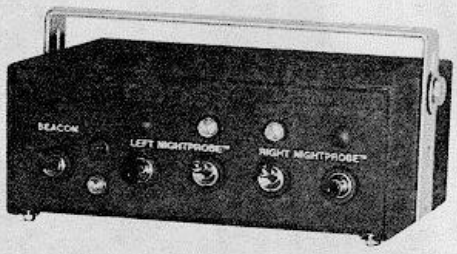




Deluxe NightProbe System

For maximum usefulness the Deluxe NightProbe system combines the features of the Basic NightProbe with horizontal position control circuitry. The operator can override the automatic positioning and direct the high-intensity beam anywhere needed. This option, which may eliminate the need for pillar mounted spotlights, requires the use of a clear lens and includes the prewired control head. This attractive module, designed to match Code 3 sirens, is backlighted and piloted for operator convenience.

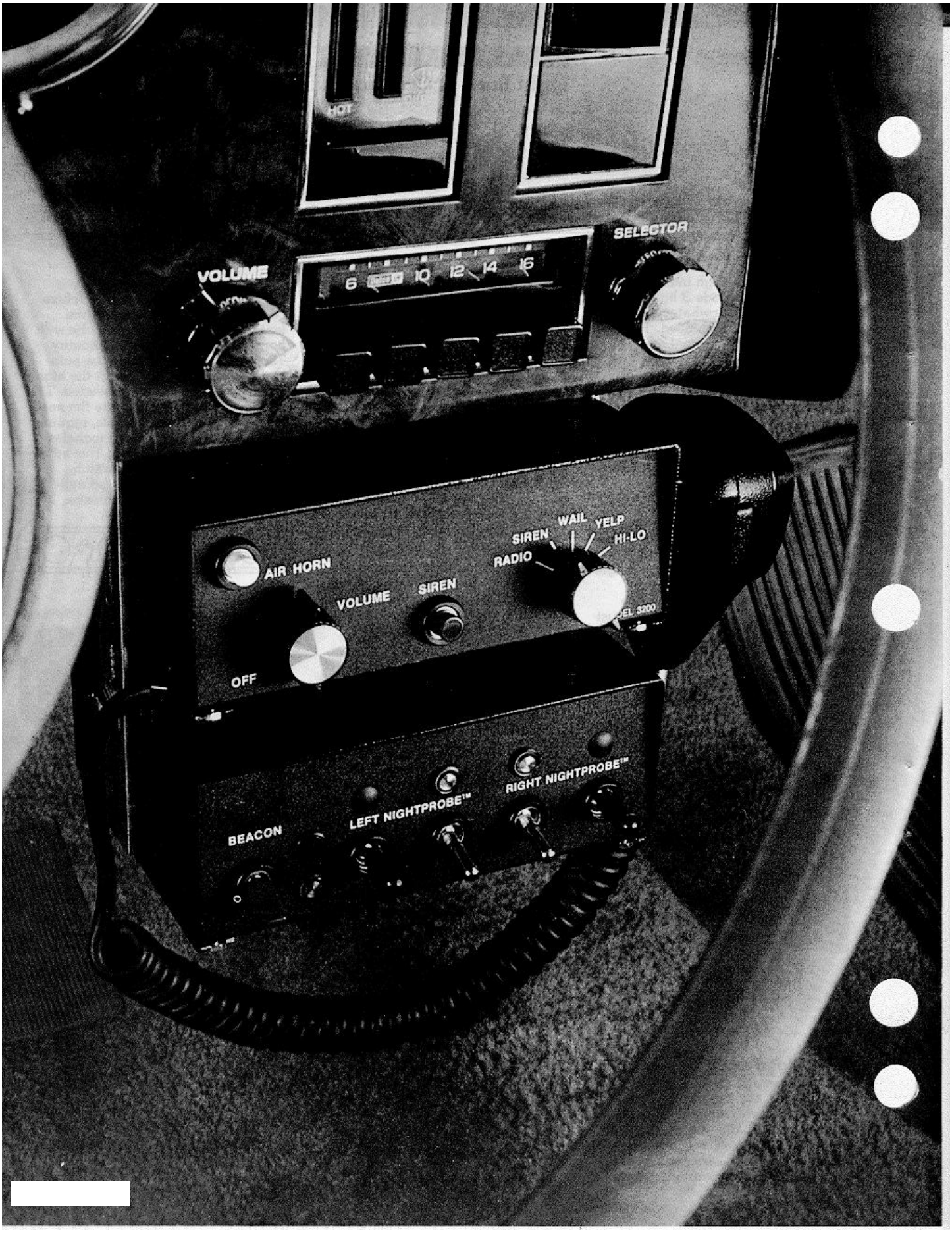




External Alley Lights

Code 3 light bars can also be ordered with the finest conventional halogen alley lights. Available in either the round or rectangular style, these high performance lamps install to the side, for alley lights, or to the front, as take-down lights.

Included in this factory option are control switches, mounting brackets, and prewiring of the light bar with extra conductors to permit independent operation of the lamps. Lamps are easily field-mounted on the bar to achieve the exact position desired by the user.


HOT
VOLUME
6
10
12
14
16
SELECTOR
AIR HORN
VOLUME
SIREN
OFF
SIREN
WAIL
YELP
HI-LO
RADIO
BEACON
LEFT NIGHTPROBE™
RIGHT NIGHTPROBE™

Sirens

Superb Performance–Maximum Efficiency

You'll be impressed by high performance, reasonably priced Code 3 sirens. They deliver the same reliability and convenience previously found only in much more expensive electronic sirens. Whatever your requirements for emergency use, there is a Code 3 siren priced for you.

Code 3 sirens incorporate new concepts in circuit design and state-of-the-art electronics to produce from 58 to 200 watts of siren power, depending upon speakers. A specially engineered output transformer and patented power amplifier circuit increase efficiency over other sirens and result in a cooler running unit—even on long runs at maximum power. This same circuitry provides extra protection against accidental reverse polarization and against either an open circuit or short circuit of the siren speakers.

When you think of outstanding quality at a fair price, think of Code 3.

Ease of Operation—and Convenience

Code 3 sirens have large, heavy-duty switches and controls for easy operation with or without gloves.

The rugged Lexan® face panel features white captions on a black background for outstanding daytime visibility. At night, the panel is backlighted for glare-free viewing. All legends are printed on the reverse of the face plate and won't wear away.

Simple to Install and Service

You'll especially appreciate the way Code 3 sirens are designed for easy mounting above or below the dash, on the tunnel, or in a console or communications rack.

Plug-in connectors and clamp terminal block make rapid installation and removal a snap. The extremely compact size of Code 3 sirens fits perfectly with the new down-sized autos. Special bales are available for stacking the siren with the Model 326 Control Head, the NightProbe™ Control Box and many two-way radio heads.

Single Control for Lights and Sirens

An exclusive enable circuit permits single switch operation of lights and siren. Simple connection of a siren control wire to the light bar switch completes integration of the unique enable system. The siren tone can now be preselected for quick action response.

Siren Functions

Siren Tones

A full range of tones is standard on Code 3 sirens. Whether you use Wail, Yelp, Hi-Lo or Siren (manual Wail), these clear powerful tones penetrate even today's sound-proofed cars.

Yelp Priority

This standard safety feature allows you to keep your eyes on the road while changing tones. Shift to Yelp from Wail or Hi-Lo by simply depressing the Siren button (or horn ring or foot switch). Release the button and the original tone resumes.

Public Address

Instant PA is available at all times by simply keying the microphone. When operating the siren, keying the microphone stops the siren and permits use of the PA without touching the selector switch. The siren resumes immediately upon release.

Special circuitry matches the audio signal to the speaker permitting much higher PA volume without distortion.

Air Horn

Command attention and immediate response with an electronic "air horn" tone blasting through your siren speaker. Use alone or to override siren tones.

After an air horn override, the siren tones resume as if they had run continuously—producing the illusion of a siren and separate air horn. A selector switch on the bottom of the siren allows you to choose the function of the horn ring or other remote switch. Select either air horn or siren button function—whatever your emergency needs.

Radio Rebroadcast

There's less chance of missing an important call when you rebroadcast your radio traffic over the PA system. Monitor everything simply by turning the selector to radio position. Improved circuitry creates increased clarity at greater distances from the vehicle.

Common Microphone

Models 3300 and 3400 are designed for common microphone use; i.e., the two-way radio mic is also used for the PA. The choice is yours with the pilot-lighted Radio/PA switch on the front of the siren.

It's good to know that special cable or adaptors are not required for these sirens. Interconnections are made at the radio control head by simple field splicing.

Model 3100

A basic siren with top performance at low cost. Designed for use with a separate PA microphone, the Model 3100 has Wail, Yelp, Hi-Lo, and Siren (manual Wail), as well as Yelp Priority and Radio Rebroadcast.



Model 3200

All the features of the Model 3100 plus electronic "air horn." Used either alone or to override the regular siren tones, this penetrating tone really works in the toughest situations.



Model 3300

An extremely cost-effective siren package for users preferring a common microphone for both two-way radio transmission and public address. The Model 3300 has the siren tones and features of the Model 3100.



Model 3400

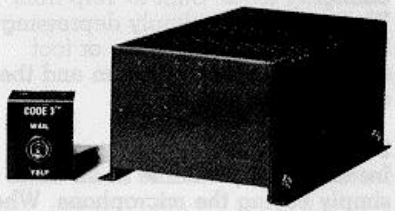
All the features of the Model 3100 plus the piercing "air horn" and common microphone capabilities.



New

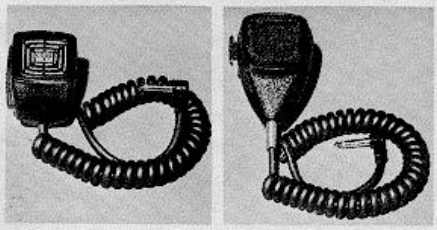
Model 3000
Model 3050 (not shown)

Full power siren (58-100 watts) designed for concealed installation with Code 3 quality for your emergency needs. The Model 3000 is equipped with both Wail and Yelp. The Model 3050 adds the clout of our electronic "air horn."



Accessories

Microphones
For PA function with Models 3100 and 3200, choose from a standard or noise-cancelling microphone at an additional cost. For many applications, the standard microphone will give satisfactory performance. For high-noise installations or for maximum PA volume without audio feedback, the noise-cancelling microphone is highly recommended.



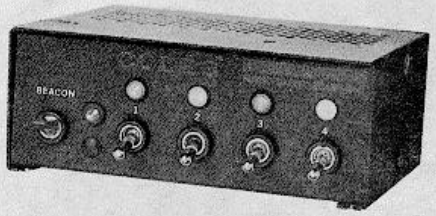
Automatic Horn Ring Transfer Kit
This inexpensive kit automatically transfers the horn ring to the siren when the warning lights are energized, permitting horn ring control of Yelp Priority and manual siren (and electronic "air horn" on Models 3200 and 3400 sirens).

Speakers
Code 3 speakers for mounting in enclosed light bars or under the hood come in power ratings of 58 watts (Model PSE 58), 100 watts (Model PSE 100), and 200 watts (Model PSE 200). Check the specifications of the various Code 3 light bars to determine the number of PSE 58 or PSE 100 speakers that can be placed in a particular light bar. The PSE 200 speaker will fit *only* in the XL Model 9000 Regular, Model 9000 Long, Model 9000 EL, and Model 9300.



Control Heads
Backlighted for nighttime visibility and styled to harmonize with Code 3 sirens, the Model 326 Control Head comes complete with switches, pilot lights, fuse block, terminal blocks and mounting bale.

In addition to the beacon switch, four auxiliary piloted switches perform such functions as brake light defeat, electric shotgun locks, remote trunk release, alley lights and grille lights.



Specifications

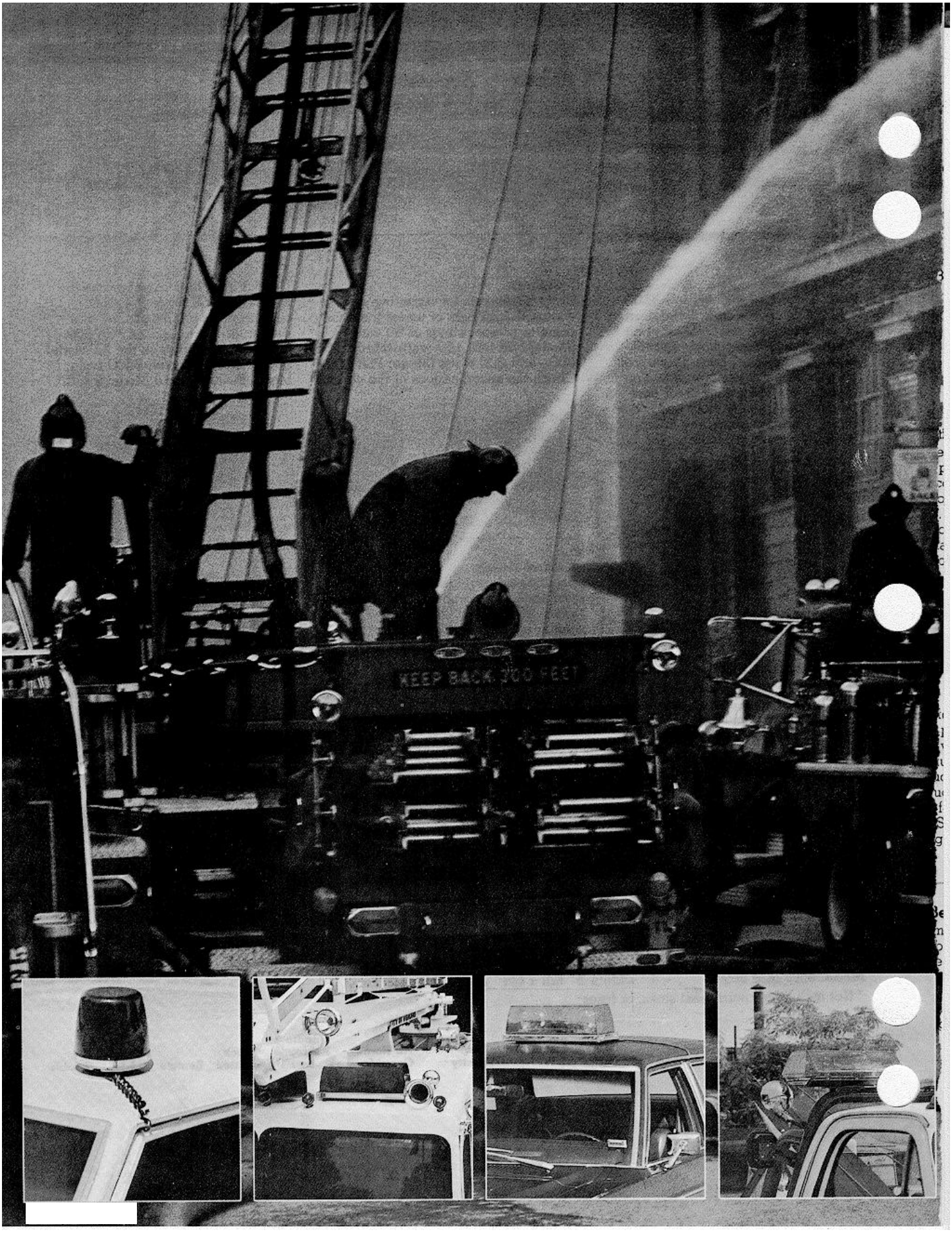
Operating Voltage: 10–16 Volts Negative Ground Only

Operating Current:	1-58 watt Speaker 5 amps	2-58 watt Speakers 8.5 amps	1-100 watt Speaker 8 amps	2-100 watt Speakers 14 amps	1-200 watt Speaker 14 amps

	Size*:	Weight:	Standby Current:
Models 3100-3400	6½" wide x 2½" tall x 5½" deep	3 lbs.	350 ma.
Model 3000 and 3050	4" wide x 3" tall x 6½" deep	3 lbs.	none

*Not including knobs, heat sinks, or fuses

Model	Wail	Yelp	Hi-Lo	Air Horn	Instant PA	Yelp Priority	"Air Horn" Override	Radio Rebroadcast	Back Lighted	Remote	Common Mic	Enable
3000	X	X								X		
3050	X	X		X			X			X		
3100	X	X	X		X	X		X	X			X
3200	X	X	X	X	X	X	X	X	X			X
3300	X	X	X		X	X		X	X		X	X
3400	X	X	X	X	X	X	X	X	X		X	X


KEEP BACK 300 FEET

Code 3 Beacons Count on Them in any Conditions

In your line of work, you need equipment you can depend on. When every second counts, Code 3 and Code 3 XL beacons won't let you down. These beacons give the same unique scintillating flash pattern that you have come to recognize from either end of the Code 3™ light bars. That's right, these four lamp beacons are packed with all the same quality features found under any lens of the Code 3™ light bar family.

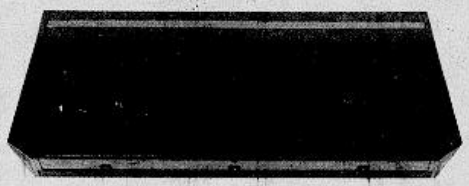
Used alone or in pairs, the flexibility of Code 3 beacons makes possible many different applications from magnetic mounting on unmarked police and fire vehicles to permanent installation on the outside corners of special service vehicles and large trucks.

You can also enjoy the same options available on the Code 3 light bar lines. Details of these options are found on pages 10 thru 13.

Compare these beacons for their superior performance and unparalleled flexibility, and you'll choose Code 3 above all others.

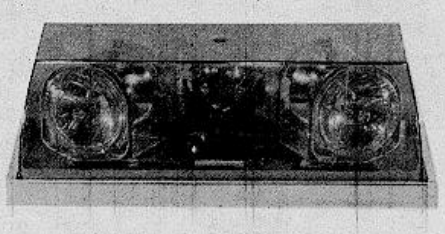
Model 4500
20½" long
Model 4500M (not shown)

Model 4500 is a four lamp beacon designed for minimum wind resistance and permanent mounting, either flat or by using the permanent mounting kit. Model 4500M is a magnetic mounting version with cord and cigar lighter plug. For options see pages 10-13.



Model 1100
20" long
Model 1100M (not shown)

Model 1100 delivers the same spectacular warning as one end of a Code 3 light bar and can be mounted either flat or by using the permanent mounting kit. For even more flexibility the Model 1100 is a magnetic version complete,with cord and cigar lighter plug. For options see pages 10-13.



Single Lamp Beacons

Designed and constructed with Code 3 integrity, the rugged Model 500 beacon combines sealed beam performance with a compact package. The Model 500 boasts a large continuous duty motor, positive drive gearbox, heavy aluminum base, Lexan® lens, and oversize oil impregnated bearings.

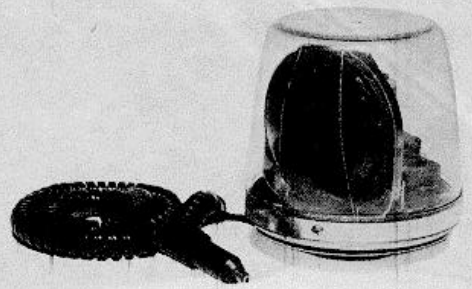
The result—35,000 beam candlepower directed wherever you need it. A 55 watt halogen sealed beam lamp delivers over twice the light and may be specified at additional cost.

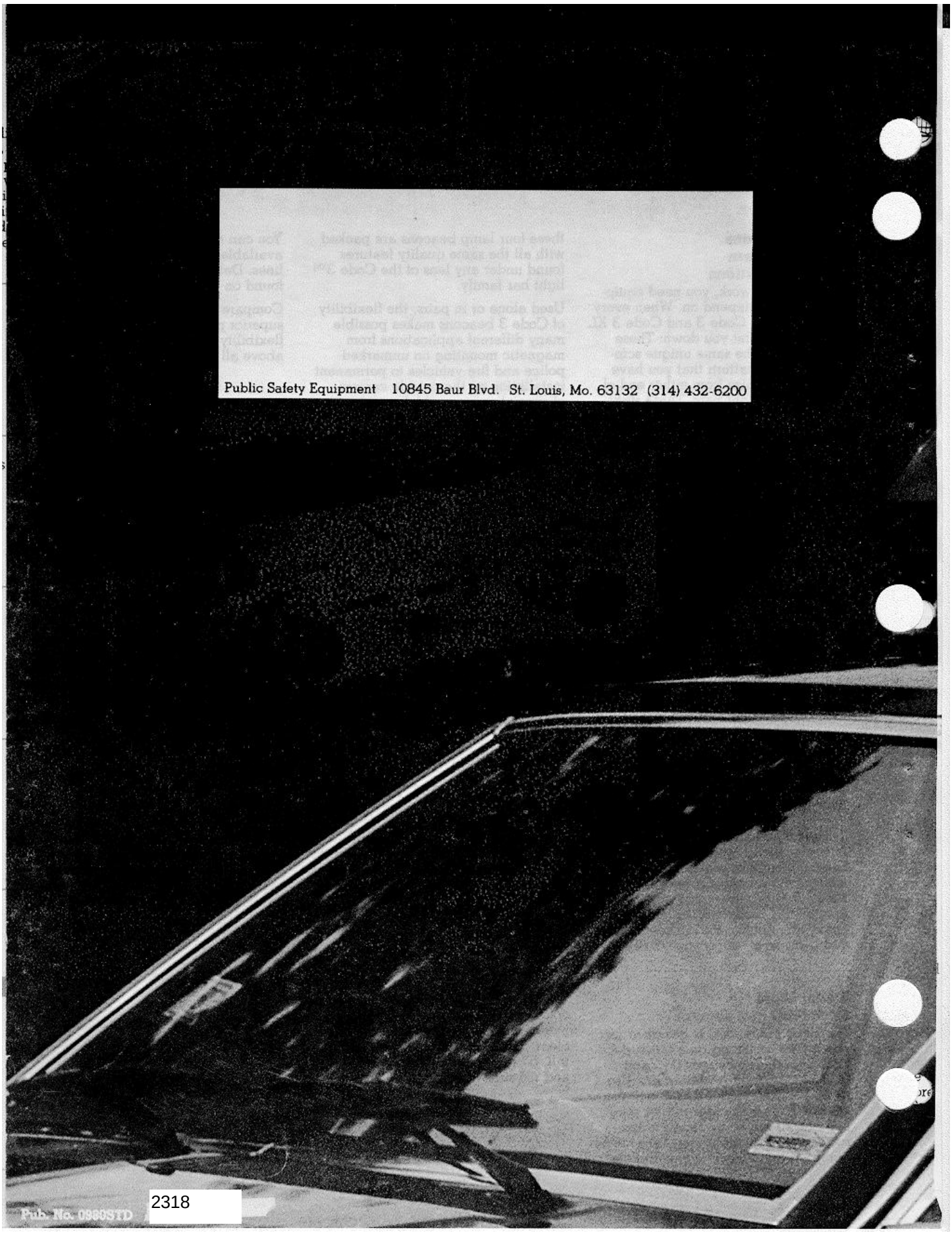
The tougher the job, the better they perform. Look to Code 3 beacons for years of economical, trouble-free performance.

Model 500M
Model 500 (not shown)

The basic Model 500 is designed for permanent mounting on a flat surface. Factory-installed flanges (½" and ¾") for stanchion mounting are also available. The Model 500M includes 10' coil cord with cigar lighter plug and coated magnetic base for non-scuff removable mounting. Lens colors are red, blue, amber, green and clear.

The standard bulbs come in the same colors, while the optional 55 watt halogen bulbs are available only in clear. The Model 500 beacon is 5½" tall, 6" in diameter, weighs 3½ lbs. and requires three amps at 12VDC.




Public Safety Equipment 10845 Baur Blvd. St. Louis, Mo. 63132 (314) 432-6200
2318
Pub. No. 0868STD

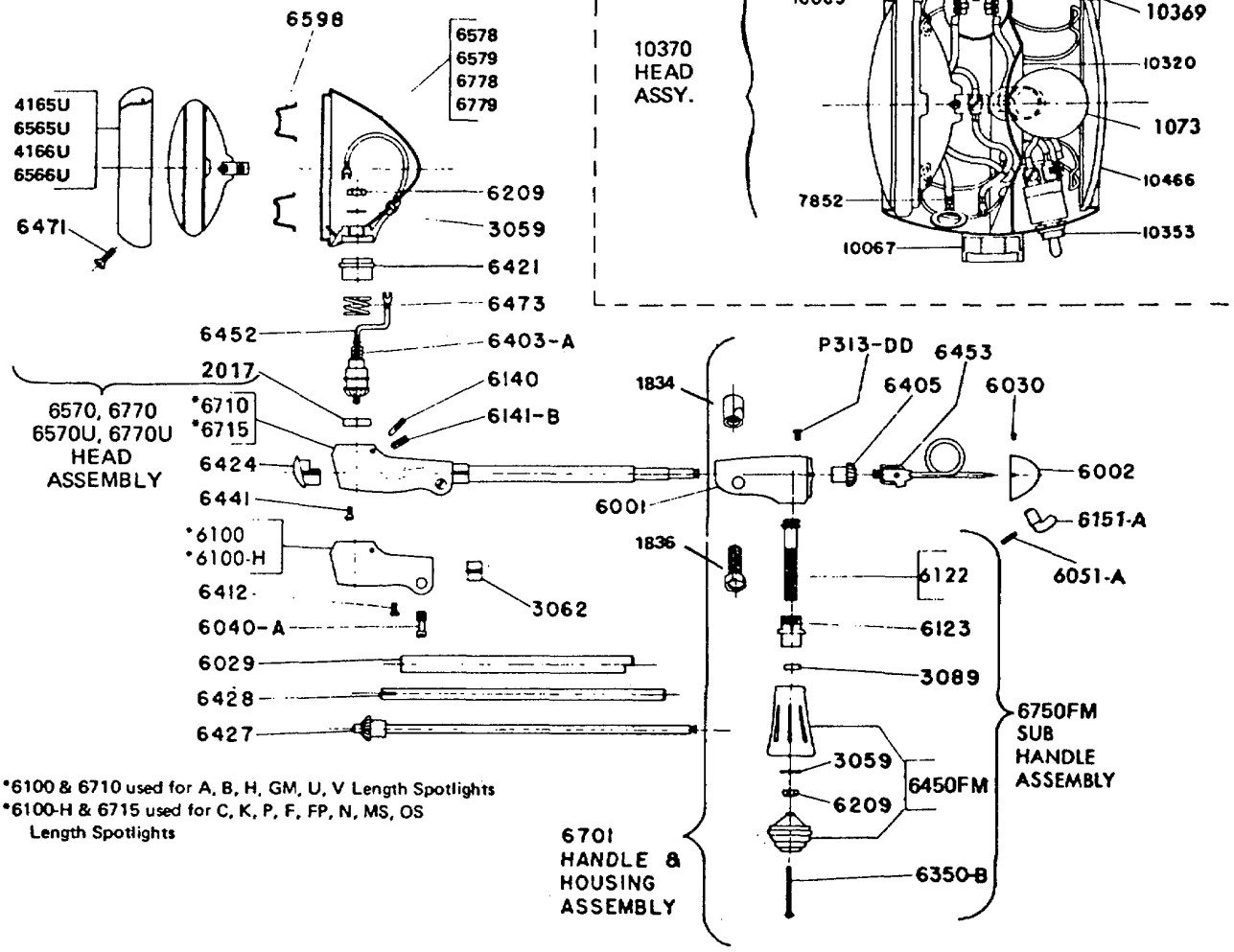
UNITY MANUFACTURING CO · 1260 N CLYBOURN AVE · CHICAGO IL 60610 · PHONE 312-943-5200

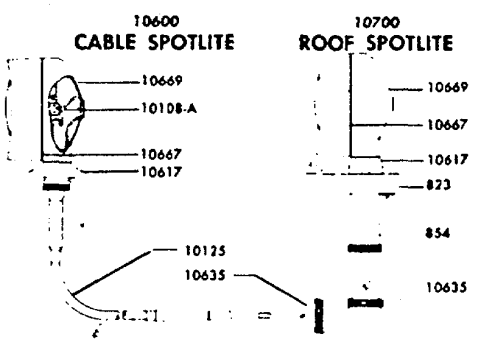
Section IV
LIGHT AND SOUND SYSTEM

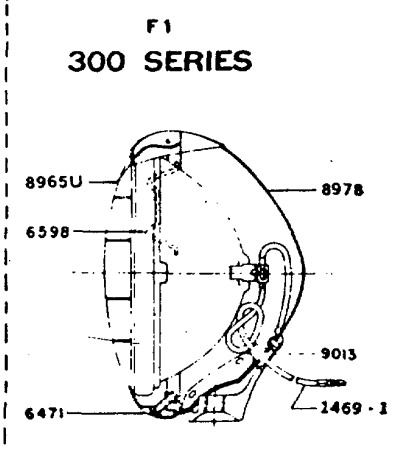
PARTS SHEET

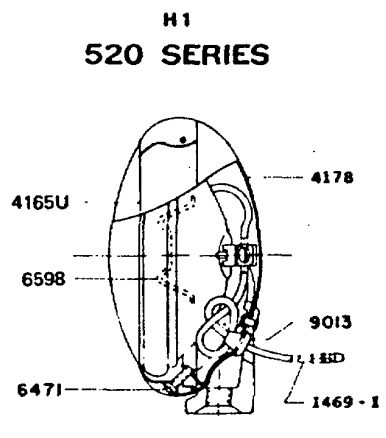
Form No. 105-6 10-81

	SPOTLIGHT	ROOFLIGHT
MODEL S-6	225	275
MODEL H-1	250	U250

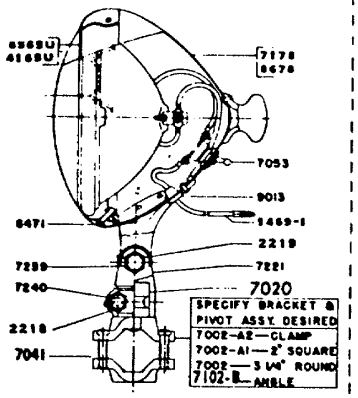




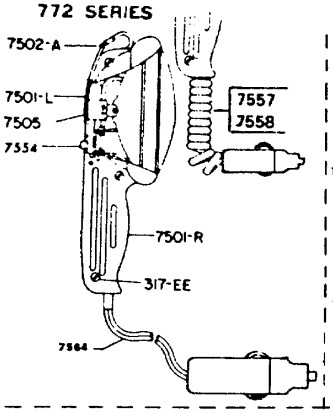




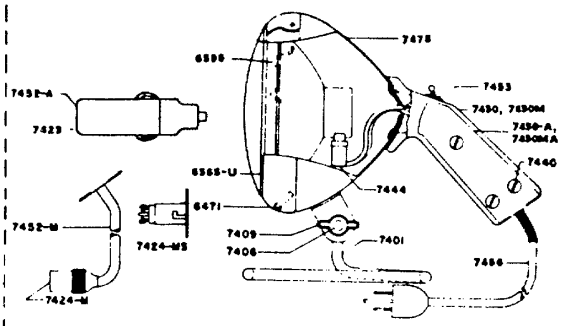
S6 & H1
AG & 5AG SERIES



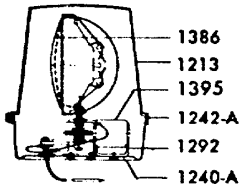
772 SERIES



SEARCHLIGHT
740, 742, 744

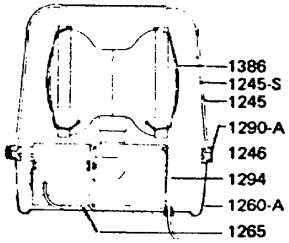


RV-15
UNIBEACON



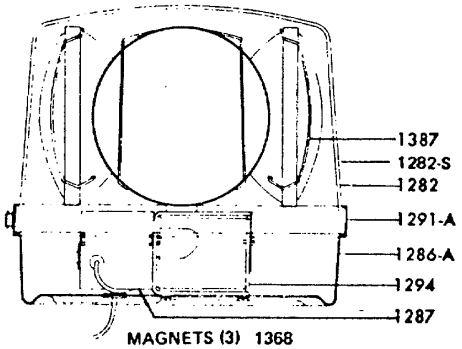
MAGNETS (3) 1270

RV-25
UNIBEACON



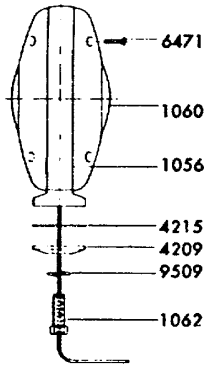
MAGNETS (3) 1347

RV-46
UNIBEACON

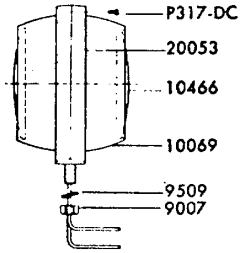


MAGNETS (3) 1368

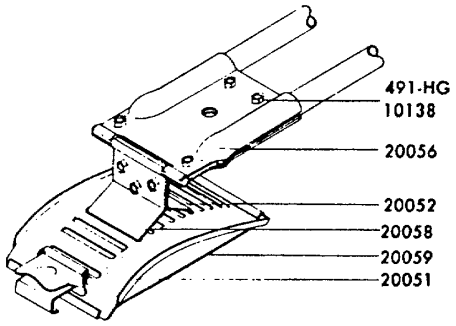
20110-7" WARNING LIGHT



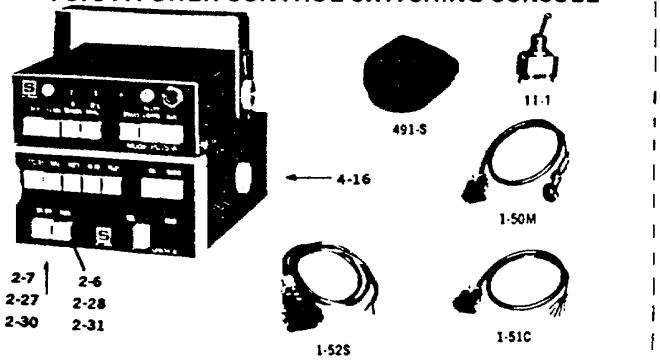
20040-5" WARNING LIGHT



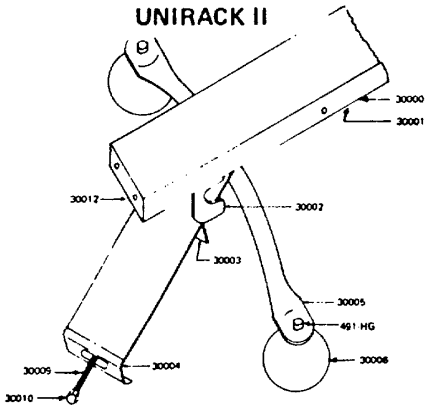
UNIRACK I END BRACKET



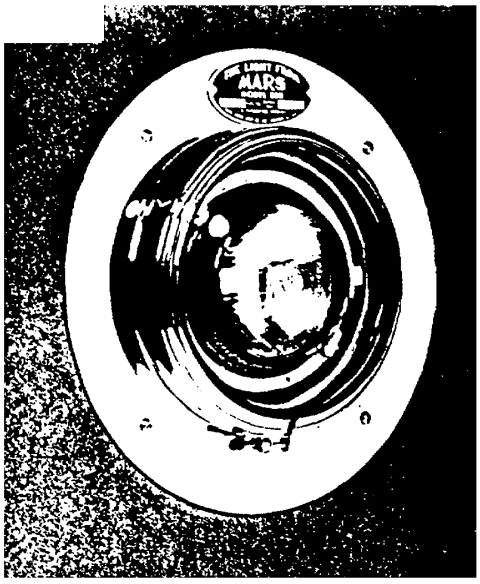
SPR-70A, 73A, 73B, 75A SI-TRON AMPLIFIER
PC75-A POWER CONTROL SWITCHING CONSOLE



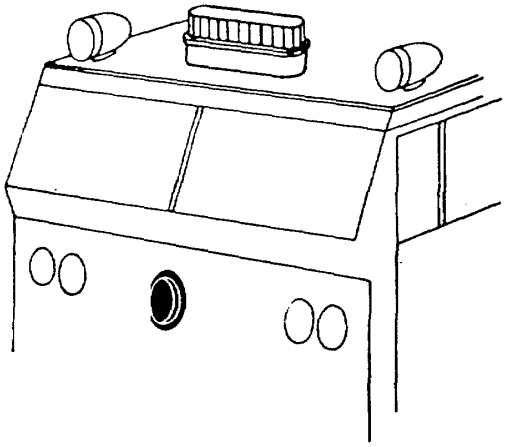
UNIRACK II

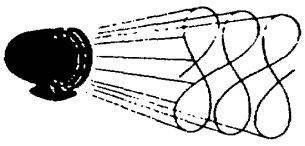


One of the most effective signal lights ever developed, the patented Mars "888" produces a highly distinctive pattern of light that instantly commands the attention of traffic ahead as well as cross-traffic at intersections. The rapidly-moving light pattern is brilliant, yet will not blind oncoming drivers. Developed to produce the most visible possible signal in busy city streets and commercial areas where a confusing variety of multicolored and moving lights could render ordinary signal lights ineffectual. Designed for flush mounting (with 2" chrome flange) within the front housing of the vehicle or within front bumper. May also be mounted on roof. Traditionally used on fire and ambulance vehicles only, police are using the oscillating movement of the "888" to clear on-coming traffic during pursuit. When used as a pursuit light the officer does not have to use the side spot light to flag an offender down. This allows the officer to keep both hands on the wheel at all times.



Part number 8-FL
Chrome flush mounting flange fits both models.





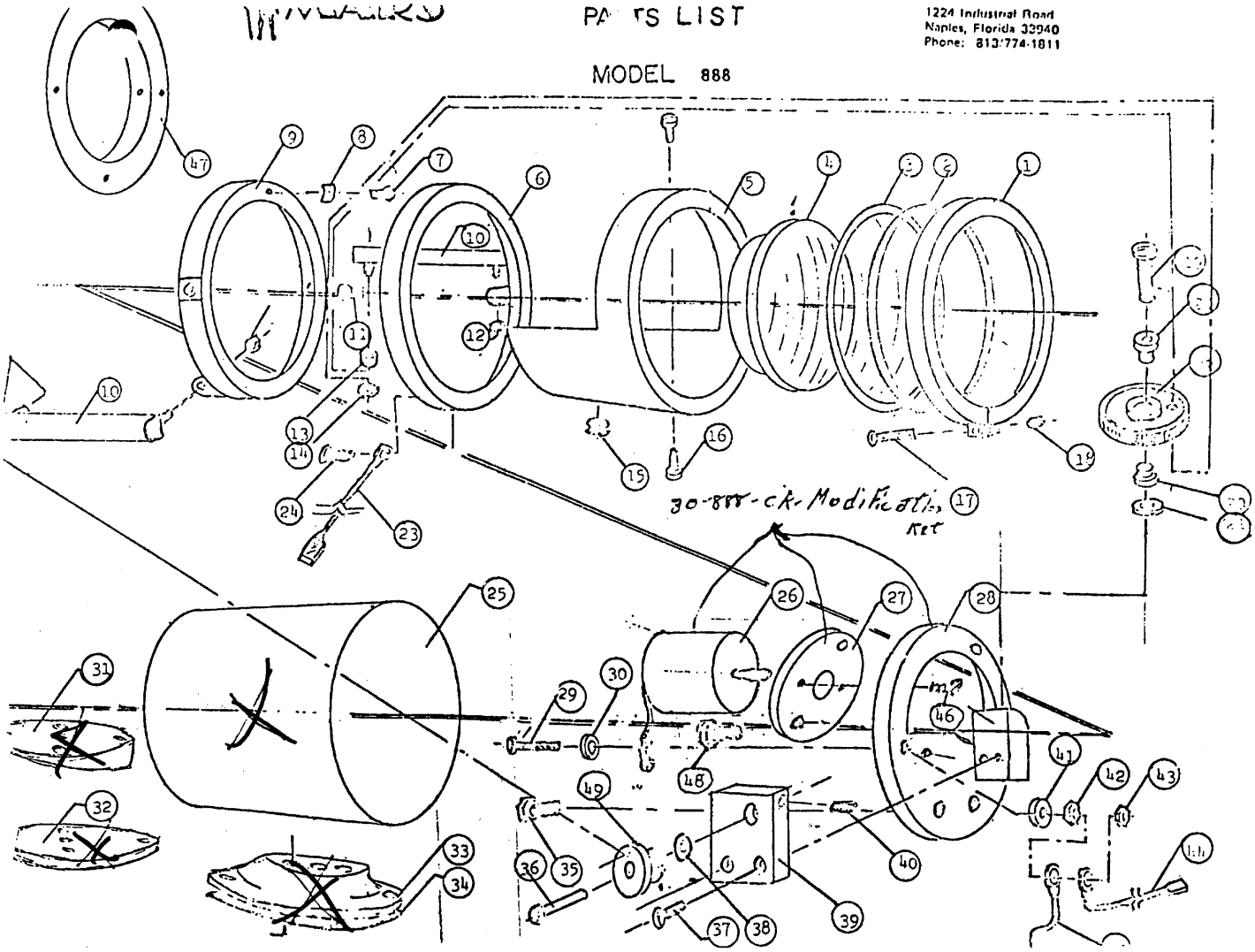
Model 888
Triple "8" Sealed-beam Signal Light. Overall: 8¾" high; 11" long; 7" diameter; 9 pounds; 12 volts, 5 amps. Red, blue or clear lens.



Model DL-8
Figure "8" Sealed-beam Signal Light. Original model. Produces repeated "8" pattern. Same specifications as model "888."

Part 57-DXA
Buffed Aluminum Surface Mount. 8° angle adjusts to slope of roof or hood. Fits both models. Overall: 1" to ½" high; 7½" long; 3" wide; 1 pound.

Section IV
LIGHT AND SOUND SYSTEM



Section IV
LIGHT AND SOUND SYSTEM

ITEM	PART NO.	REQ.	DESCRIPTION
1	DL	1	CLAMP RING
2	FL-7	1	RUBBER GASKET
3	FL-6	1	LENS - CLEAR
3	FL-6-B	1	LENS - BLUE
4	4416-1	1	BULB - CLEAR
5	DL-B	1	HOUSING CASTING
6	55-D-6	1	INNER RING
7		2	SCREW - 8 x 32 x ¾
8	6004	2	TINNERMAN NUT
9	888-3	1	BULB SOCKET
10	888-12	2	DRIVE ARM
11	FL-9	4	SHOULDER SCREW
12		1	NUT - 10 x 32
13	888-10	1	SPACER - FIBER
14		1	NUT - 10 x 32
15	888-11	1	GROMENT
16	FL-9	2	SCREW
17		1	SCREW - 6 x 32 x 1"
18		1	NUT - 6 x 32
9		1	BOLT - ¼ - 20 x 1"
20	4-SW-K	2	BUSHING
21	888-13	1	WASHER (¾ DIA. FLAT)
	4-SW-GH	1	GEAR - LARGE
23	W-45	1	GROUND WIRE - BULB LEAD
24		1	SCREW - 6 x 32 x ¾"
25	DLA	1	HOUSING
26	3-SW-12	1	MOTOR 12V
27	45-FL	1	MOTOR PLATE
28	29-D-8	1	MOTOR CHASSIS
29		1	SCREW - 6 x 32 x 3/4
30	69-RB	1	INSULATED WASHER
31	SD-57-DXA	1	TAPERED MOUNTING PLATE
32	DX-B	1	BAR MOUNTING PLATE
33	DX-A	1	BASE
34	DX	1	ROOF GASKET
35		1	BOLT - ¼ - 20 x 3/4"
36	FL-11	1	TRUNNION SCREW
37		2	SCREW - 8 x 32 x ½"
38	888-14	1	SHIM WASHER - 5/16 O.D. 3/16 I.D. 006 THICK
39	40-888	1	BLACK
40		1	SET SCREW - 8 x 32 x 3/16
41	69-RB	1	INSULATOR WASHER
42		1	NUT - 6 x 32
43		1	NUT - 6 x 32
44	W-9-R	1	LEAD - POWER BULB
45	W-6-R	1	LEAD - POWER 12V
[illegible]		2	SCREW - 8/32 x 5/16 FLAT HEAD
[illegible]	8-FL	1	FULSH MOUNTING RING
48		2	BOLT - ¼ x 20 x ½"
49	[illegible] 4/-D 17	1	GEAR - SMALL
	5 388 CA	1	MODIFICATION KIT

01/01/80

888 LIGHT REGULAR, FLUSH MOUNT

Part No.	Description	Price
DL	Clamp Ring	$ 29.80
FL-6	Lens (B,C,R,)-Color	14.40
FL-7	Lens Gasket	8.20
4416-1	Bulb (C,B,R,G,A,)-Color	10.64
DL-B	Front Casting	63.36
33-D-8	Inside Ring	22.68
6004	Tinnerman Nut	.75
888-3	Bulb Socket	34.06
888-12	Drive Arm	10.80
FL-8	Small Bushing	.75
F1-9	Shoulder Screw	1.44
888-10	Spacer - Fiber	.75
888-11	Grommet	.75
4-SW-K	Bushing	.75
888-13	Washer	.75
4-SW-G	Large Nylon Gear	6.75
W-45	Bulb Lead Wire	1.00
DLA	Housing	100.80
3-SW	Motor 12V, 24V	33.00
3-SW-EMI	Motor (EMI Supressed) 12V, 24V	50.40
45-FL	Motor Plate	13.50
29-D-8	Motor Chassis	27.70
69-RB	Insulated Washer	.75
57-DXA	Tapered Mounting Plate	28.44
DX-B	Bar Mounting Plate	27.14
DX-A	Base	24.07
DX	Roof Gasket	5.04
FL-11	Trunnion Screw	1.95
888-14	Shim Washer	.85
40-888	Gear Block	5.90
W-9	Power Lead Bulb Wire	1.25
W-6	Power Lead Wire	1.50
8-FL	Flush Mounting Ring	57.60
41-D-11	Ball Joint	10.08
41-D-12	Small Nylon Gear	8.50

Section IV
LIGHT AND SOUND SYSTEM

OLD 888 PARTS

Part No.	Description	Price
30-888	Large Brass Gear	$ 24.56
31-888	Small Brass Gear	24.56
600010	Motor Brush	4.00
41-D-8W	Drive Wheel	7.41

MODEL 888 MODIFICATION KITS

Part No.	Description	Price
30-888-CK	Motor Modification Kit	$160.00
30-888-CK-EMI	Motor Modification Kit(EMI Supressed)	172.80

Section IV
LIGHT AND SOUND SYSTEM

30-888-CK Modification Kit

ITEM	PART NO.	REQ.	DESCRIPTION
01	3-SW-12	1	Motor 12V
02	3-SW-12	1	Motor 12V E.M.I.
03	29-D-8	1	Motor Chassis
04	45-FL	1	Motor Plate
05	FL-11	1	Trunnion Screw
06	888-14	1	Shim Washer (5/16OD.3/16I.D. .006 Thick)
07	31-888	1	Gear - Small
08	4-SW-GH	1	Gear - Large
09	888-10	1	Spacer - Fiber - Large
10	888-15	1	Spacer - Fiber - Small
11	888-12	2	Drive Arm
12	W-9-R	1	Lead - Bulb
13	W-6-R	1	Lead - Power
14	69-RB	2	Insulator Washer

Section IV
LIGHT AND SOUND SYSTEM

PSE-100 ASSEMBLY INSTRUCTIONS

1. BEGIN THE ASSEMBLY BY ATTACHING THE MOUNTING BRACKET #11 TO THE DRIVER #1 USING THE 2 MOUNTING BOLTS #12 SUPPLIED. TAKE NOTE TO INSTALL THE BRACKET SO THAT THE SPEAKER TERMINALS ARE HORIZONTALLY ALIGNED.

2. INSTALL THE TWO WIRE LEADS BY SLIDING THE CONNECTORS OVER THE STUDS PROTRUDING FROM THE DRIVER. THE STUDS ARE MARKED 1 AND 2.

   NOTE: WHEN TWO SPEAKERS ARE CONNECTED TO THE SAME SIREN AMPLIFIER, THE SPEAKERS MUST BE CONNECTED IN PARALLEL AND PHASED CORRECTLY. (SEE SCHEMATIC BELOW).

   WARNING: DO NOT ATTEMPT TO SOLDER WIRES TO STUDS AS SERIOUS DAMAGE TO THE DRIVER WILL RESULT.

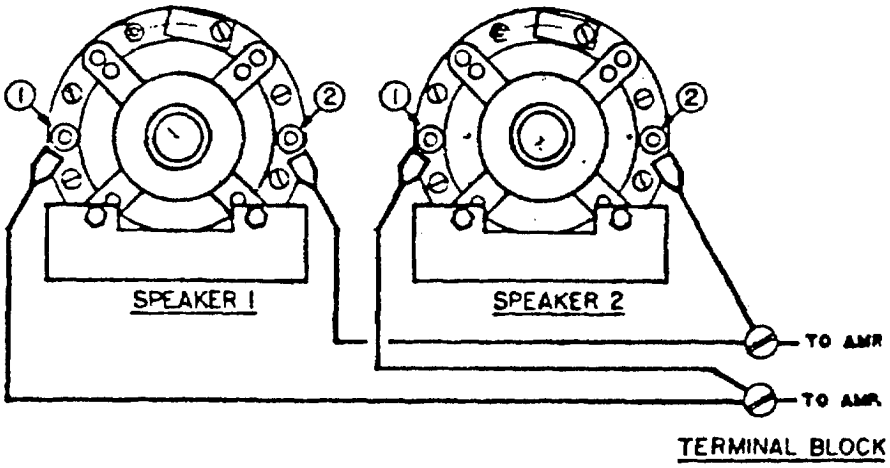
3. INSTALL TWO RUBBER WASHERS #7 AND ONE FIBER WASHER #6 IN SPEAKER TIP ASSEMBLY AND SET ASIDE.

4. INSTALL THE STEEL WASHER 12, PAPER WASHER #3, PLASTIC HORN #4, AND PAPER WASHER #5 OVER THE TIP OF THE DRIVER.

   NOTE: -THE SLOTS IN THE PLASTIC HORN SHOULD BE ON THE BOTTOM AS ARE THE SLOTS IN THE MOUNTING BRACKET.

5. THREAD THE TIP ASSEMBLY (WITH WASHERS INSTALLED) ONTO THE END OF THE DRIVER AND TIGHTEN DOWN HAND TIGHT. THE SIREN SPEAKER ASSEMBLY IS NOW COMPLETE AND IS READY TO INSTALL.

2 SPEAKER HOOK UP DIAGRAM



-OVER-

Section V
COMMUNICATION/WARNING SYSTEMS

Ratelco, INC.
POWER SYSTEMS DIVISION

1260 Mercer Street • Seattle, Washington 98109
Phone 206-624-7770 • Telex 888729

Battery Charging Equipment • DC Power Board Assemblies
Uninterruptible Power Systems • Inverters
DC Power Supplies • Industrial Mobile Intercoms

Ratelco

INTERCOM SYSTEM

TYPE: IC- 9 (CHROME)

MODEL: 120-2712-11

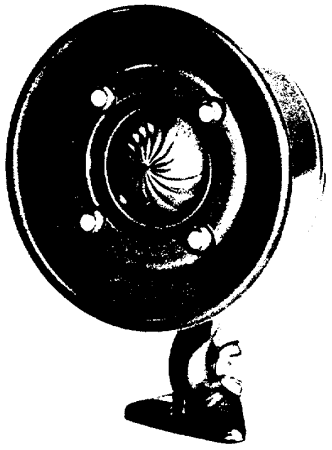
OPERATING AND SERVICE MANUAL

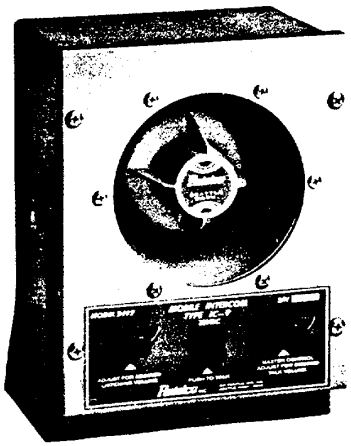
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Seattle, Wa. 98109
Tel. (206) 624-7770 Telex 32-1200

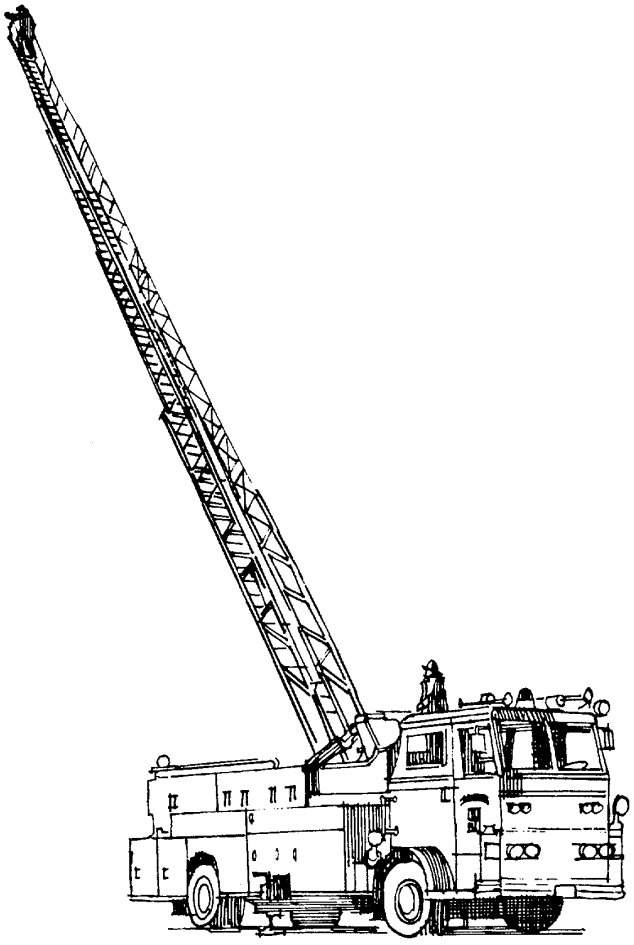
Ratelco

MOBILE INTERCOM

TYPE IC-9







Instant 2-Way Communications for Firefighters

With the IC-9 aboard mobile units, ground crews can hear and be heard clearly by firemen on ladders, in buildings, on roofs. The IC-9 system, developed especially for aerial firefighting equipment, consists of an 8 x 6 x 5 Master Control Amplifier unit on the truck and one or more compact 5 x 6 speakers mounted aloft on ladder, platform or tower. Operates on any battery system. A sound investment in increased safety and efficiency.

Ratelco Quality Features

- 18-Watt output
- Completely weatherproof
- Transistorized, low drain, maintenance-free
- Independent listen volume control
- "Hands Off" listen and talk capability

See reverse for more details

SHEET: IC-1-0
FORM: IC-110-53
(Replaces IC-110-77)
EFFECTIVE: 5-1-73

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Output—18 Watts. Enough power to amplify remote speech. Special circuit design "clips" close-by shouts to intelligible sound level.

Standby Drain—160 Milliamps. Can be left on continuously without running battery down.

Input Voltage—12 volts DC; 24 or 32 volts with adapter. Positive, negative or floating ground.

Dimensions—Master Control Amplifier—8¼" high, 6½" wide, 5½" deep. Talkback Speaker—6" diameter, 5" deep.

Controls—(All located on Master Control Amplifier unit.) **LISTEN VOLUME**—master control speaker volume. **MASTER VOLUME**—to control volume both ways on system. **PUSH-TO-TALK**—to talk from control to Talkback Speaker. **ON-OFF SWITCH**—combined with LISTEN VOLUME control.

Operation—The Master Control Amplifier is always "listening" to the Talkback Speaker at the top of the ladder except when the Push-To-Talk switch is pushed. The fireman on the ladder has "hands off" communication (he has no controls to operate) and anything he says is heard clearly by the ladder operator. The IC-9 is specially designed with two separate volume controls so the ladder operator can adjust his incoming volume without changing the outgoing volume at the top of the ladder. Powerful enough to use as an aerial public address system, the IC-9 provides two-way communication with firemen working on roofs or in buildings near the ladder as well as men on the ladder itself.

Construction—Made to high standards especially for aerial firefighting equipment. Weatherproof, solid state for years of reliable service.

Installation—May be installed on any aerial equipment: ladder, platform or towers. Weatherproof Master Control Amplifier unit mounts anywhere near ladder base. Submergence-proof Talkback Speaker mounts near top of ladder. Single twisted pair wire between Talkback Speaker and Master Control Amplifier installs using spring-driven reel or pulley system. (Reels available from Ratelco; pulleys and hardware for special installations should be obtained locally).

Typical Specifications

A 2-way intercom system shall be provided to allow continuous communication between ladder operator and crew. The mobile intercom system shall consist of only two units, a completely transistorized, maintenance-free, weatherproof master control amplifier unit and one submersion proof heavy-duty "crew" speaker.

The master control amplifier unit shall be in a phosphate treated baked enamel finished enclosure, compact in size (8¼" H x 6½" W x 5½" D) and shall contain the following controls:

(1) LISTEN volume control—to control master unit speaker volume

(2) MASTER volume control—to adjust overall system volume

(3) PUSH-TO-TALK switch—to allow operator at master unit to talk to crewman. This switch shall be of the momentary type so that when master unit operator releases it, the system will return to its normal function.

(4) ON-OFF switch—to allow system to be completely turned off if desired.

The CREW speaker shall be University Type MM-2 or equal.

The system shall be so designed that the person at the master unit normally hears anything said at the "crew" end, without necessity of any manual initiation by the crewman (i.e.: hands-free operation by the crewman). Should the master unit wish to talk, the operator pushes the P-T-T switch on the master unit which reverses the system.

The amplifier shall automatically provide transition to infinitely clipped speech for improved intelligibility when output is increased to overcome high noise levels. The output into a 16 ohm speaker shall be not less than 12 watts sine wave or 18 watts infinitely clipped.

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MOBILE TRANSISTORIZED INTERCOM

Installation and Operating Instructions

Type IC-9 and IC-11

The Types IC-9 and IC-11 are solid state amplifiers developed for mobile intercom use requiring outside mounting of the amplifier control unit. These intercoms may be used on any equipment where communication between a worker and operator is desired. This increases both operating efficiency and safety. They are designed to operate quietly and efficiently from the vehicle's regular 12 volt battery supply with either positive, negative, or floating ground. The standby battery drain is only 160 milliamps for the IC-9 and 120 milliamps for the IC-11, eliminating any battery trouble from these intercoms. The power output is 18 watts continuous RMS with 16 ohm speaker for the IC-9 and 5 watts continuous RMS with 8 ohm speaker for the IC-11. The remote speaker, which is weatherproof, is mounted at the worker's end of the system and the master unit (speaker - amplifier - control unit), which is also weatherproof, is mounted near the operator. Normally the operator is listening to anything being said at the remote speaker. If he wishes to speak to the worker, he pushes the button on the master unit (i.e., normal intercom push-to-talk operation). Additional outside speakers may be added to the system at any time if desired.

The intercoms are designed so that the connection between the master unit and remote speaker may be made with ordinary twisted pair, unshielded wire. Any #18 gauge or larger standard twisted pair may be used. The twisted pair must be spliced by any convenient, reliable means to the pigtail marked "SPKR" and routed to the remote speaker. Where the remote speaker wires are run parallel to ignition leads or where extreme noise pick-up may be expected, a shielded pair should be used. If the wires to the remote speaker must be routed through slip rings to a boom or removable platform, make sure that the slip rings used for the remote speaker are adjacent and separated from any ignition slip rings by at least one low electrical noise slip ring, ground potential if possible.

It is preferable that the power supply leads from the master unit are routed directly to the battery. However, if wiring through the ignition switch is desired, use of a relay is recommended to reduce possibility of noise pick-up. Carefully check the label on the wires. The power leads are marked 12 VDC, positive and negative. Be sure the proper polarity is observed before connecting to the battery.

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CAUTION

Do not connect the remote speaker leads to the battery or any other electrical connection. The intercom will be damaged by improper potential on the speaker leads.

When installed on extension ladders or telescoping booms, it is necessary to use a spring driven reel to extend or retract the wire connecting the talk-back speaker to the master control amplifier.

A quick-disconnect is provided within the intercom housing so the amplifier speaker assembly can be easily removed for servicing.

Ratelco products are guaranteed to be free from defects in materials and workmanship for a period of one year from date of purchase. Damage caused by external sources is not covered by the warranty.

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TROUBLE SHOOTING GUIDE
RATELCO MOBILE INTERCOMS

No Audio

a. Blown fuse
b. Broken wire(s)
c. Dirty switch or relay contacts
d. Volume controls misadjusted
e. Open speaker (s)
f. Reverse connection
   (i.e. DC Power connected to speaker leads)
g. Shorted speaker terminals

Blows Fuses

a. Power connection reversed. (pos. to neg. & vice versa)
b. Blown power transistors (Q1, Q2, Q3)
c. Shorted output
d. Shorted diode (D1) or transient protector (RV1)
e. Battery voltage greater than 16VDC
f. Shorted disc ceramic filter capacitor (0.05 ufd.,) from hot side to ground (C12, 13)

Listen But No Talkback

a. Dirty switch or relay contacts
b. Relay, when used, not properly seated

Talkback But No Listen

a. Dirty switch or relay contacts
b. Relay, when used, not properly seated

"Ticking" Noise on Transmission

a. Defective integrated circuit (U1)
b. Open input transformer

Motor Boating

a. Defective filter capacitor, 470 uFd., 16V (C8, C9)

Squeal

a. Acoustic feedback
b. Volume adjustment
c. Orientation of master unit and remote speaker
d. Sensitivity increased beyond factory adjustment (Trimmer R2 on circuit board)

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Distortion

a. Defective speaker
b. Defective integrated circuit (U1)
c. Defective transistor(s) (Q1, Q2, Q3)
d. Defective electrolytic capacitor
e. Input transformer shorted due to DC power connected to speaker leads
f. Input noise shunting resistors (R4, 5) shorted due to DC power connected to speaker leads
g. Low battery voltage (less than 11VDC)

Insufficient Volume

a. Defective speaker
b. Defective integrated circuit (U1)
c. Defective transistor(s) (Q1, Q2, Q3)
d. Defective electrolytic capacitor
e. Input transformer shorted due to DC power connected to speaker leads
f. Input noise shunting resistors (R4, 5) shorted due to DC power connected to speaker leads
g. Low battery voltage (less than 11VDC)
h. Dirty switch or relay contact
i. Dirty volume control

Failure to Switch (In Relay Operated Models)

a. Low battery voltage (less then 11 VDC)
b. Open relay coil
c. Relay when used, not properly seated

Noise pick up in the speaker leads.

Procedure: Listen at the remote speaker with the push-to-talk depressed and the volume set to normal volume settings. If the noise level is acceptable, the solution will be attained by revising the cabling from the master unit to the remote speaker. The speaker cables from the master to the remote speaker must be twisted and not run closely parallel to any other electrical leads. For electrical systems with excessive noise (such as strobes) the speaker leads must be twisted, shielded, and at least 6" from nearby power leads. If the speaker leads are routed through turntable rings and brushes the intercom speaker leads must be seperated from any noisy circuits by at least one low noise or ground potential ring.

Noise pick up from the battery.

Procedure: Disconnect the remote speaker leads at the master unit and while operating the engine and the other equipment, advance the volume controls above the normal listening levels. Is there objectionable noise coming from the master unit? If so, the noise is being introduced into the unit by means of the vehicle electrical system and can be solved with the addition of a Ratelco intercom filter part number 112-2700-00 which installs in the DC power leads.

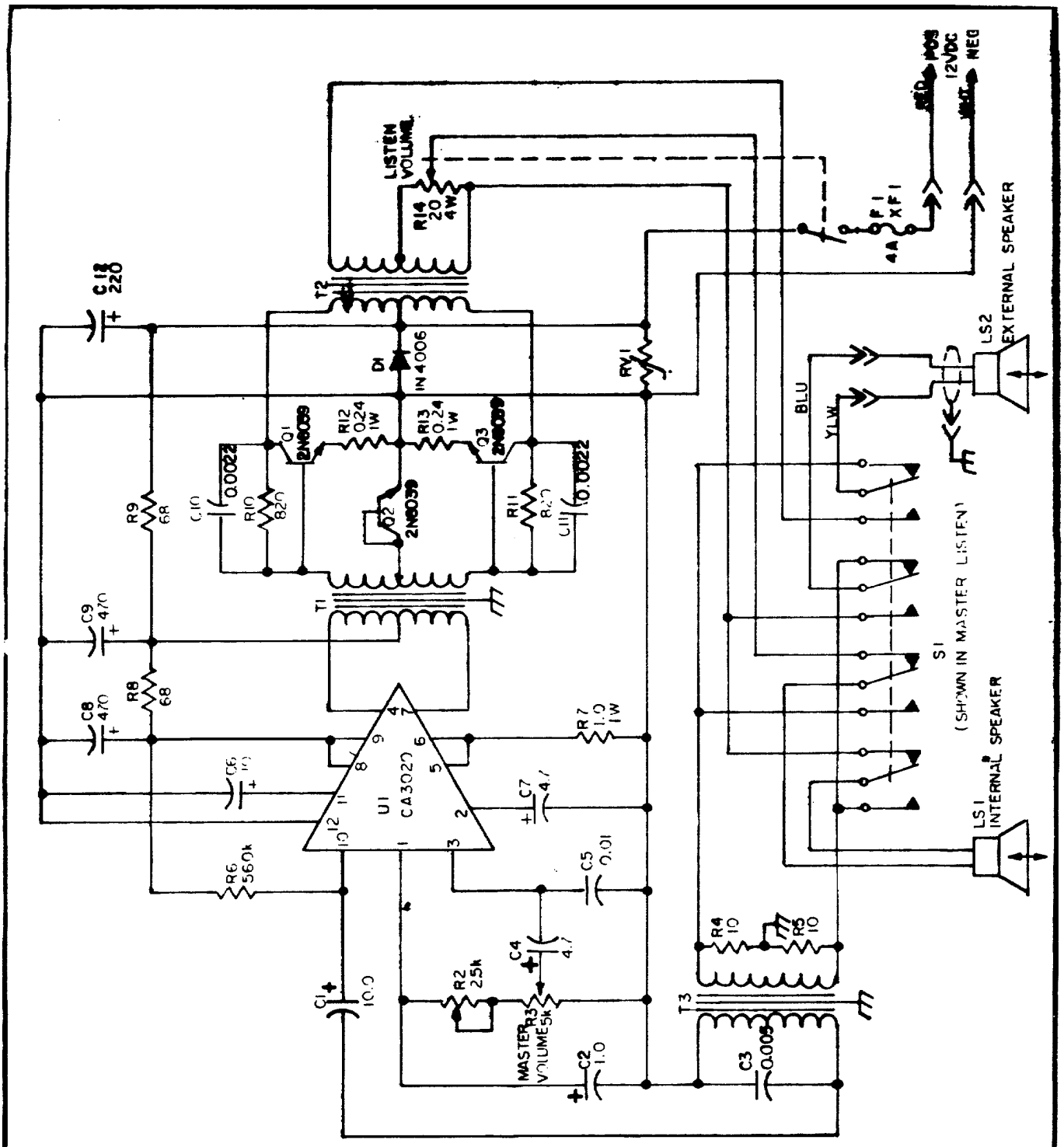
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ASSEMBLY :120-2712-11 DWG #: 120-2712-11 EFF :01-30-84
DESC :IC-9: CHROME INTERCOM, MASTER W/O EXT SPEAKER

REF	COMPONENT	DESCRIPTION	QTY	UM
C4	440-0400-00	CAP.,FXD ELCTLT: 4.7MFD 40V	1.0	EA
		SIEMENS B41313,4.7/40		
		PACCOM EH4.7/50		
		NTPPUN 111-4.7/63		
C5	400-0139-00	CAP.,FXD CER:0.01MFD 100V MAL	1.0	EA
		MALLORY GH1037		
		ARCO TCP-R01		
		PACCOM 103Y5P320M		
C7	440-0400-00	CAP.,FXD ELCTLT: 4.7MFD 40V	1.0	EA
		SIEMENS B41313,4.7/40		
		PACCOM EH4.7/50		
		NTPPUN 111-4.7/63		
C8	440-2601-00	CAP.,FXD ELCTLT: 470MFD 16V	1.0	EA
		SIEMENS B41283 470/16V		
		MALLORY IT15x500		
		PACCOM EH 470/16		
C9	440-2600-00	CAP.,FXD ELCTLT: 470MFD 16V	1.0	EA
C10	400-0110-00	CAP.,FXD CER:2000MMFD 1KV GPDx5F202	1.0	EA
		MALLORY GP 220		
		ARCO CCD-202G		
C11	400-0110-00	CAP.,FXD CER:2000MMFD 1KV GPDx5F202	1.0	EA
C12	440-2400-00	CAP.,FXD ELCTLT: 220MFD 25V	1.0	EA
		PANASONIC ECE-81EV221S		
		SIEMENS B41283 220/25V		
		PACCOM EH 220/25		
D1	576-0100-00	DIODE,RECT.:1N4006 1A 800V	1.0	EA
		MOTOROLA 1N4006		
		FSC 1N4006		
		ITT 104006		
F1	280-0250-00	FUSE: 4A 32V MDL	1.0	EA
		BUSSMANN MDL-4		
LS1	230-0160-00	SPEAKER: MTS-8 4" 7.5W 8 OHM WP UNIV	1.0	EA
		UNIVERSITY MTS-8-42 (OBSOLETE)		
		UNIVERSITY MIC-8C-42		
Q1	500-0902-00	TRANSISTOR:2N6039 N SI 4.0 80V DARL,SETS/3	1.0	EA
		MOTOROLA 2N6039		
		NATIONAL 2N6039		
Q2	500-0902-00	TRANSISTOR:2N6039 N SI 4.0 80V DARL,SETS/3	1.0	EA
Q3	500-0902-00	TRANSISTOR:2N6039 N SI 4.0 80V DARL,SETS/3	1.0	EA
R2	610-0150-00	RES.,VAR TRIM: 2500 OHMS VERT MTG	1.0	EA
		MALLORY MTC-252L1		
		PTHER PT15LR-2.5K		
R3	620-0300-00	RES.,VAR POT: 5K OHM 0.5W (WITH SHAFT LOCK)	1.0	EA
		CLAROSTAT CM42748-Z		
R4	655-0060-00	RES.,FXD COMP: 10 OHM 10% 0.5W	1.0	EA
		TRW JANRCR20G100KS		
R5	655-0060-00	RES.,FXD COMP: 10 OHM 10% 0.5W	1.0	EA
R6	655-0690-00	RES.,FXD COMP: 560K OHM 10% 0.5W	1.0	EA
		TRW JANRCR20G564KS		
R7	667-0060-00	RES.,FXD WW: 1 OHM 10% 1W	1.0	EA
		IRC BWH		

ASSEMBLY :120-2712-11 DWG #: 120-2712-11 EFF :01-30-84
DESC :IC-9: CHROME INTERCOM, MASTER W/O EXT SPEAKER

REF	COMPONENT	DESCRIPTION	QTY	UM
R8	655-0180-00	RES.,FXD COMP: 68 OHM 10% 0.5W	1.0	EA
		TRW JANRCR20G680KS		
R9	655-0180-00	RES.,FXD COMP: 68 OHM 10% 0.5W	1.0	EA
R10	655-0320-00	RES.,FXD COMP: 820 OHM 10% 0.5W	1.0	EA
		TRW JANRCR20G821KS		
R11	655-0320-00	RES.,FXD COMP: 820 OHM 10% 0.5W	1.0	EA
R12	667-0030-00	RES.,FXD WW: 0.24 OHM 5% 1W	1.0	EA
		IRC BWH		
R13	667-0030-00	RES.,FXD WW: 0.24 OHM 5% 1W	1.0	EA
R14	625-0200-00	RES.,VAR POT: 20 OHM 4W WITH SWITCH & SHAFT LOCK	1.0	EA
		CLAROSTAT CM42746/SW		
RV1	594-0102-00	MOV: 18V 3JOULE,V187A3	1.0	EA
		GENERAL ELECTRIC V187A3		
S1	240-2500-00	SW,PB: 4PDT PC BOARD DVR2212-02 SWCFT	1.0	EA
		SWITCHCRAFT XW3006(33S1028)		
T1	148-2703-00	XFMR,AUDIO:INTERCOM DRVR 2.5:1 .3W (NEW) PC LEADS	1.0	EA
		RATEL 148-2703-00		
T2	148-2702-00	XFMR,AUDIO:IC-9 OUTPUT 15W (NEW) PC LEADS	1.0	EA
		RATEL 148-2702-00		
		WESTERN XFORMER IMI #723A1		
		MOTOROLA 25-850556		
T3	148-2701-00	XFMR,AUDIO:INTERCOM INPT 12:1 .15W (NEW) PC LEADS	1.0	EA
		RATEL 148-2701-00		
U1	552-0500-01	INT CKT,AMP:CA3020A POWER AMP 25V	1.0	EA
		RCA CA3020A		
XF1	275-7000-00	FUSE CLIP;3AG SIZE PC 3530 KEYSTONE	2.0	EA



DWG NO 120-2712-11	NAME MOBILE INTERCOM, TYPE IC9
SHEET 1 OF 1	
DESIGNED	
CHECKED DH	FOR
DRAWN PKD 6-22-82	
REV NO 11/28/83	Ratelco INC 1260 MERCER ST SEATTLE, WASH 98109
REV ECO ECO 8361	

Ratelco

NO HASSLE
LIMITED WARRANTY POLICY

Ratelco, Inc. warrants each product it manufactures, when properly applied and operated within specified conditions, against defects due to faulty materials or workmanship until 90 days after the unit is activated or 6 months after shipment, whichever occurs first. If, during this period the product is found to be defective, Ratelco shall provide all material and labor necessary to repair or replace the product. In addition, Ratelco will repair or replace any parts discovered by buyer to be defective within one year from the date of shipment, provided Buyer promptly notifies Ratelco of the defect. If Ratelco determines that a defect may be remedied by a replacement of a defective part, replacement parts will normally be shipped via surface freight within 24 hours of Ratelco's receipt of notice of the defect. Equipment required to be repaired or replaced must be returned to the factory for repair or replacement and must be shipped freight prepaid. Equipment repaired under warranty will be returned via surface freight at no charge. Ratelco products repaired or replaced pursuant to this warranty shall be warranted for the unexpired portion of the warranty applying to the original date of sale.

Excepted from this warranty is equipment which has been abused or operated outside the limits of its electrical or environmental specifications. When equipment failure or field tests suggest that equipment may be defective, whether in or out of the warranty period, a full report of the difficulty should be telephoned to the Customer Service Department at the number listed below. Upon receipt of this report, the Customer Service Department will provide the appropriate assistance.

Ratelco will not be liable for any associated costs or losses incurred by the user, installing contractor, or wholesaler as a direct or indirect result of defects or of the replacement of defective, in-warranty material unless prior approval has been granted by Ratelco.

Any technical advice furnished before or after delivery in regard to use or application of Ratelco's equipment is furnished without charge and on the basis that it represents Ratelco's best judgment under the circumstances, but will not relieve the recipient from the terms of the warranty in case of negligent application of the equipment.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, (EXCEPT TITLE) INCLUDING WITHOUT LIMITATION, ANY IMPLIED WARRANT OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND/OR ANY OTHER OBLIGATION OR LIABILITY ON THE PART OF RATELCO. The sole and exclusive remedy for breach of any warranty, expressed or implied, concerning Ratelco hereunder shall be the repair or replacement of defective equipment, components, or parts; or, at Ratelco's option, refund of the purchase price or substitution with a new replacement product. RATELCO SHALL IN NO WAY BE RESPONSIBLE FOR CONSEQUENTIAL DAMAGES OF ANY KIND OR NATURE WHATSOEVER RESULTING FROM THE BREACH OF ANY WARRANTY, EXPRESSED OR IMPLIED.

810-184.1
(Replaces 810-1283)
EFFECTIVE: 1-1-84

Ratelco Inc.
1260 Mercer St.
Seattle, Wa. 98109-5589
Tel. (206) 624-7770 Telex 32-1200

Section V
COMMUNICATION/WARNING SYSTEMS

CODE 3™

ELECTRONIC SIREN INSTALLATION MANUAL

FOR MODELS: 3100, 3200, 3300, 3400

PUBLIC SAFETY EQUIPMENT, INC.
10845 BAUR BOULEVARD
ST. LOUIS, MO 63132
(314)432-6200

SECTION I

Section V
COMMUNICATION/WARNING SYSTEMS

GENERAL DESCRIPTION

The CODE 3™ family of electronic sirens consists of the basic siren unit, or the basic unit plus factory installed options, and is identified by model number as follows:

Model 3100 -- Basic Unit
Model 3200 -- Basic Unit plus electronic "air horn"
Model 3300 -- Basic Unit plus common microphone capability
Model 3400 -- Basic Unit plus electronic "air horn" and common microphone capability

All Models provide three distinct siren tones (Wail, Yelp and-Hi-Lo), plus Radio Rebroadcast and Public Address. Public Address automatically overrides all functions by simply keying the microphone. Yelp priority over Wail or Hi-Lo is also standard, and may be initiated by either the front panel Siren button or by remote means (horn ring, foot switch, etc.).

For use in jurisdictions not allowing Hi-Io as an emergency warning sound, all models can be supplied with the Hi-Lo tone disabled.

Also standard on all Models is a Siren Enable feature that permits control of the siren through the emergency warning light switch, if desired.

SECTION II

SPECIFICATIONS

Input Voltage:	10 VDC to 16 VDC (16 VDC operation limited to 15 minutes)
Polarity:	Negative ground only
Standby Current:	200 ma. (Excluding back lighting)
Operating Current at 13.6 VDC:	
1-58 Watt Speaker	5.0 amps
2-58 Watt Speakers	8.5 amps
1-100 Watt Speaker	8.5 amps
2-100 Watt Speakers	14.5 amps
Output Impedance:	1-11 ohm speaker or 2-11 ohm speakers in parallel (phased)

SECTION III

INSTALLATION

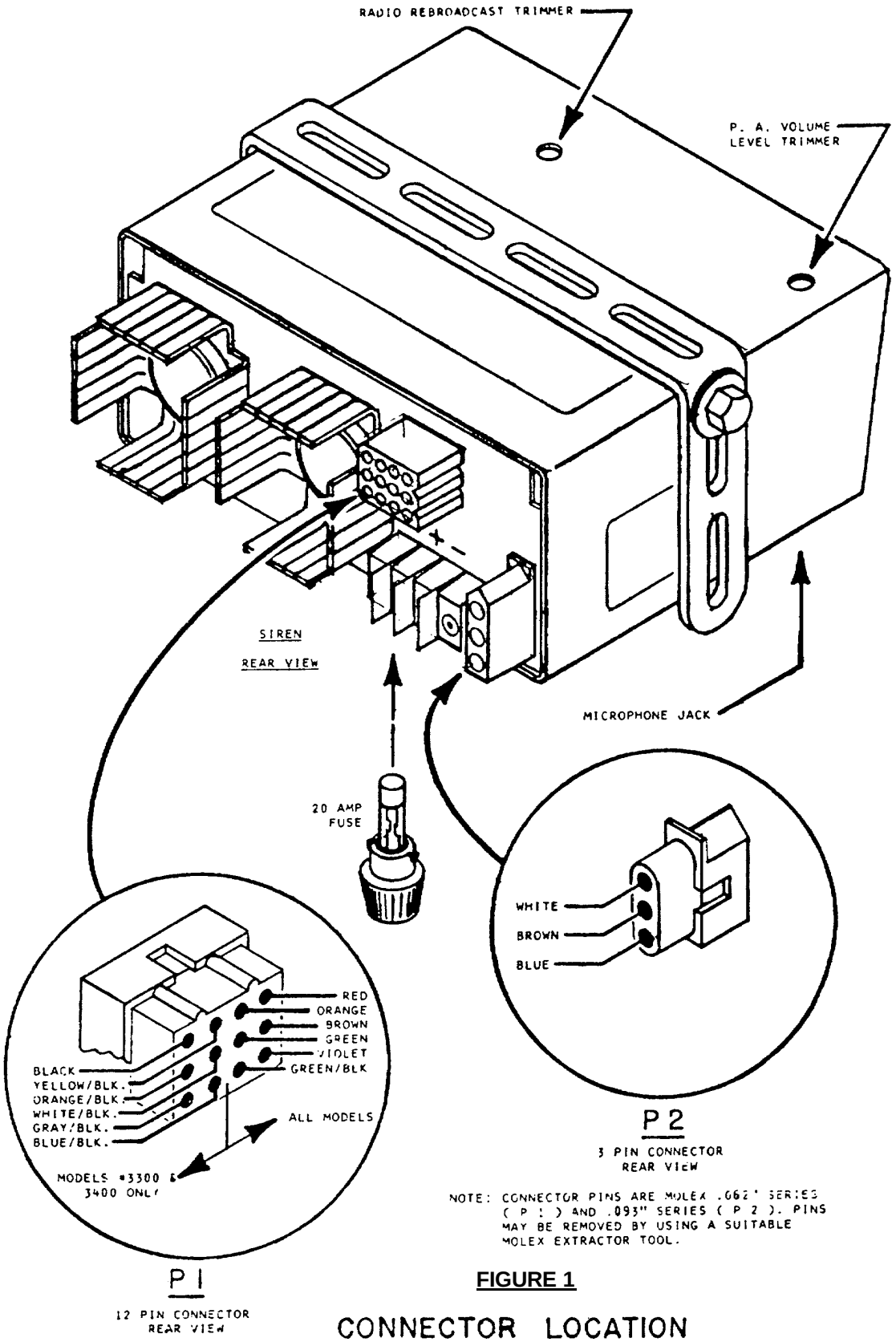
A. UNPACKING

After unpacking the CODE 3™ siren, carefully inspect the unit for damage that may have been caused in transit. Report any damage to the carrier immediately.

B. MOUNTING

The unit may be mounted either above or below the dash by means of the mounting bracket sale)and hardware supplied. Care should be taken in selecting a location that is convenient for the operator.

All installation and adjustments can be made without removing the top cover. See Figure 1 for location of adjustments.



NOTE: CONNECTOR PINS ARE MOLEX .062" SERIES (P 1) AND .093" SERIES (P 2). PINS MAY BE REMOVED BY USING A SUITABLE MOLEX EXTRACTOR TOOL.

FIGURE 1

CONNECTOR LOCATION

Section V
COMMUNICATION/WARNING SYSTEMS

CAUTION

Mount the unit in a position that is well ventilated and is away from heating ducts.

The following installation sequence is recommended:

1. Mount the bale on a suitable surface for convenient siren operation.
2. Wire the unit (see Section C for hook-up information) leaving enough slack to permit removal of the chassis by sliding it forward from under the cover.
3. Install the microphone plug in the ¼" jack provided on the bottom of the unit (Two microphone system). (See Figure 1)
4. Mount the microphone bracket in a convenient location.
5. Install the fuse and fuse holder in the socket provided on the bottom of the siren chassis. (See Figure 1)
6. Adjust the Radio-Rebroadcast and maximum P.A. volume levels (see Section D).
7. Test all functions.
8. Install the siren unit on the bracket using ¼-20 x ½" bolts and ¼" flat washers. NOTE: Longer bolts will prevent the removal of the chassis from the cover and may damage internal components;

C. WIRING (See Figure 1 for connector locations)

1. 3 Pin Connector P2: (See Figure 2)
   Blue -- Speaker Common
   Brown -- One or two 58 watt speakers
   White -- One or two 100 watt speakers

Note: If two speakers are used, be sure to phase the speakers for optimum performance. Check the speaker wires carefully for short circuits prior to energizing the siren. Short circuits may occur wire to wire or wire to vehicle frame. Note: Connection of a 58 watt speaker to the 100 watt lead will-cause the speaker coil to burn out. Be sure to insulate the unused wire (Brown or White) to prevent it from shorting out.

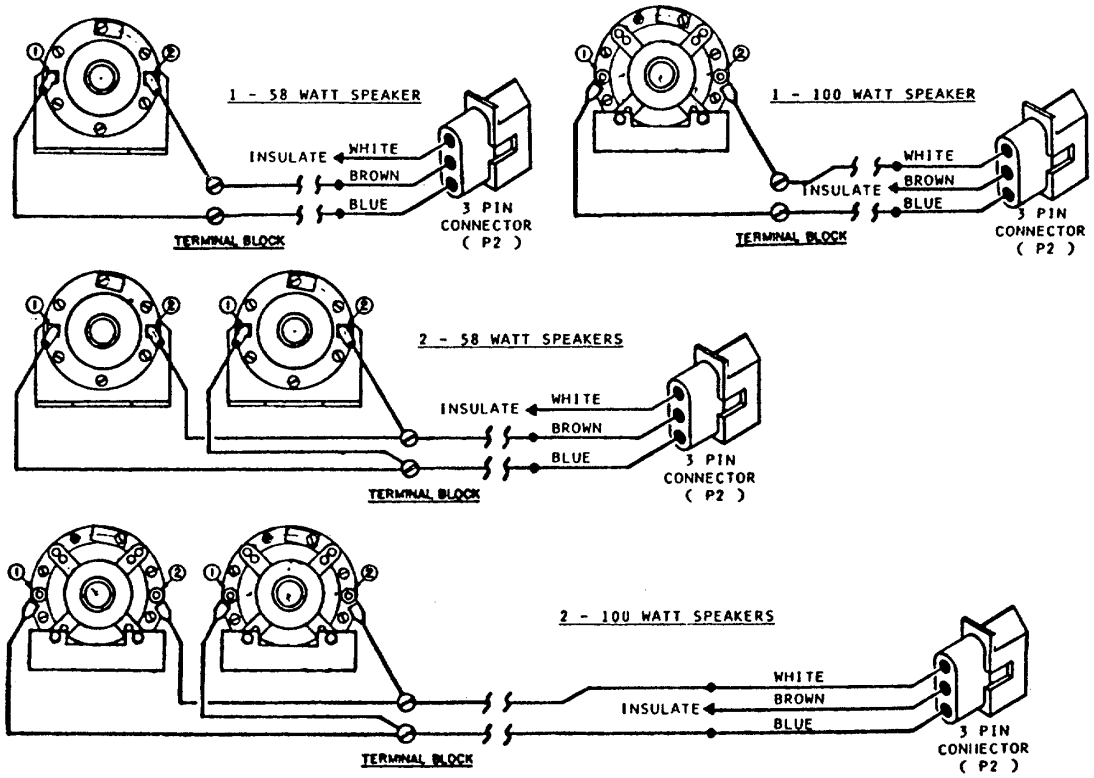


FIGURE 2

12 Pin Connector-P1:
Note: The red, orange and brown wires are spliced together at the factory.

Green & Green/Black (Radio Rebroadcast)
-See Figure 3-

Connect to 2-way radio speaker leads.

Violet (Yelp override/Air Horn)
-See Figure 4-

Connect to auxiliary switch (foot switch or horn ring). In order to disable the vehicle horn, it is advisable to install a selector switch or horn ring transfer relay (available from Public Safety Equipment, Product #B320). This circuit will respond to either a positive or a ground signal.

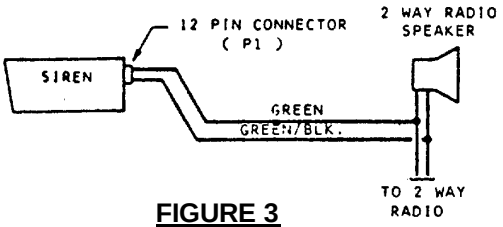


FIGURE 3

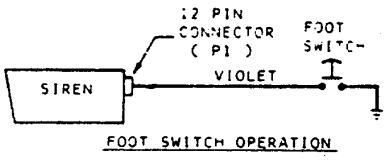


FIGURE 4

Brown (back lighting)

This wire controls the siren panel back lighting. It is factory wired to operate with the siren on/off switch, and may be reterminated at the vehicle panel light circuit if dimmer operation is desired. To do so, cut the wire at the splice cap and reterminate it to either a dash board lamp or the dimmer control of the head lamp switch.

Red (switched power)

The red wire is controlled by the siren on/off switch and applies vehicle power when the siren is on. This wire can be used to control the panel back lights in other control boxes, i.e. the NightProbe™ control head. Do not exceed 2 amps. maximum load.

Orange (siren enable)

This wire is factory connected to enable the siren tones whenever the unit is turned on. To enable the siren tones only when the warning lights are in operation, clip the orange wire at the splice cap and connect it to the switched side of the warning light switch.

Application of the +12 volts D.C. to the orange wire from the warning light switch allows the siren to perform automatically at whatever siren function the selector switch is set at.

Note: The air horn option operates with or without the enable wire powered, as do radio rebroadcast and public address.

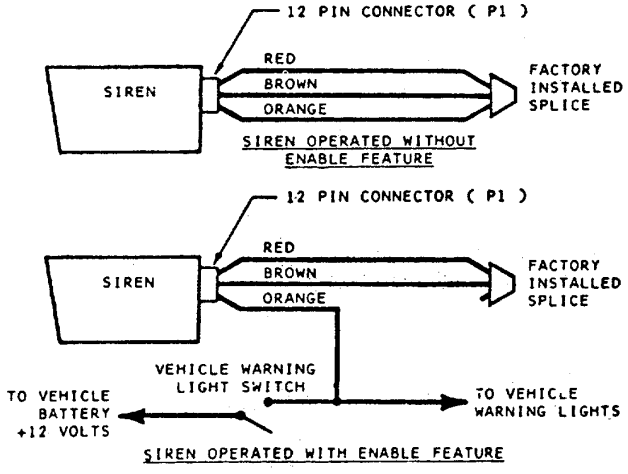


FIGURE 5

3. Terminal Block: (See Figure 6)

POS (+) Connect to vehicle battery or the stud on the battery side of the starter solenoid with a 12 ga. wire or larger. Protect this wire with a 20 amp. fuse or circuit breaker located at battery or solenoid.

NEG (-) Connect to vehicle frame with 12 ga. wire or larger as close to the siren unit as practical. Scrape any paint off the vehicle frame at the connection point.

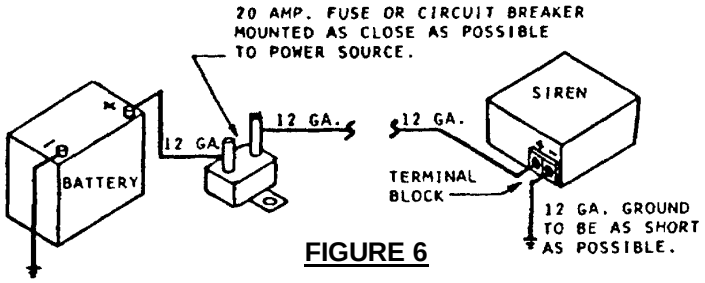


FIGURE 6

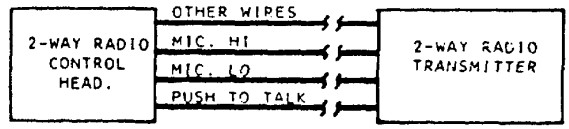
4. Interconnection for Common Microphone Operation (Disregard if 2 separate microphones are used) For Models 3300 and 3400 only: (See Figure 7)

Note: THE FOLLOWING CONNECTIONS MAY AFFECT 2-WAY RADIO OPERATION AND SHOULD BE MADE BY QUALIFIED PERSONNEL ONLY!

At the 2-way radio control head end of the control cable, cut the "Mic Hi", "Mic Lo", and "Push-to-Talk" wires, leaving enough wire to splice both ends of the cut wires as follows:

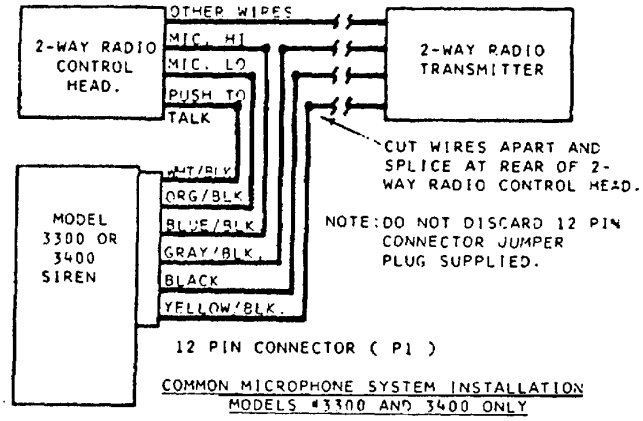
Blue/Black	Connect to "Mic Hi" at the radio control head.
Grey/Black	Connect to "Mic Hi" wire coming from the transmitter.
Orange/Black	Connect to "Mic Lo" at the radio control head.
Black	Connect to "Mic Lo" wire coming from the transmitter.
White/Black	Connect to "Push-to-Talk" terminal at the radio control head.
Yellow/Black	Connect to "Push-to-Talk" wire coming from the transmitter.

Insulate the ends of any unused wires.



EXISTING INSTALLATION

Note: Internal switching of all 2-way radio wires is accomplished by a relay (dry contacts), internal to the siren. The 12 pin connector jumper plug permits two way radio operation if the siren must be removed for service.



COMMON MICROPHONE SYSTEM INSTALLATION MODELS #3300 AND 3400 ONLY

FIGURE 7

5. Adjustments (See Figure 1 for control locations)
   1. Place the selector switch in the RADIO position.
   2. Adjust the Radio-Rebroadcast trimmer for balance (clockwise increases volume).
      Balance is achieved when normal volume inside the vehicle produces the desired volume outside the vehicle.
      If the outside volume level is insufficient, reverse the Green & Green/Black wires coming from the connector at the radio speaker termination.

   3. Adjust the maximum P.A. volume level trimmer in one of the following ways:
      a. For a two microphone system using standard microphone, fully counterclockwise.
      b. For a two microphone system using a noise cancelling microphone, turn the VOLUME control on the front panel fully clockwise and then adjust the internal trimmer for desired MAXIMUM volume while keying the microphone (clockwise increases the level).
      c. For a common microphone system, place the P.A. switch in the P.A. position, and turn the front panel VOLUME control fully clockwise, key the microphone, and then adjust the internal trimmer for the MAXIMUM volume desired.

   4. Install the siren unit in the bracket. This completes the installation, wiring, and adjustment of the unit.

SECTION IV

OPERATION

On-Off: This switch is part of the VOLUME control. Turning the knob fully counter-clockwise until a click is felt turns the unit off.

Volume Control: Controls the output level when the unit is being used for public address purposes. To utilize the public address feature, all that is required is that the microphone be keyed. Public address overring all siren amplifier functions (except Air Horn). This control does not affect the loudness of the siren tones or Radio-Rebroadcast level.

Siren Button:
a. Produces intermittent WAIL when depressed and the selector switch is in the SIREN position.
b. Overrides WAIL with the YELP tone when the selector is in the WAIL position.
c. Overrides HI-LO with the YELP tone when the selector switch is in the HI-LO position.

Selector Switch:
a. RADIO - Rebroadcasts 2-way radio messages through outside speaker. Outside volume is controlled by preadjusting the radio rebroadcast trimmer (see Section C) and by the setting of the 2-way radio volume control.

b. SIREN - Produces intermittent WAIL tones when the SIREN button is depressed. The tone will stop instantly when the button is released.

c. WAIL - Produces an automatic WAIL tone.

d. YELP - Produces an automatic YELP tone.

e. HI-LO - Produces an automatic HI-LO tone.

Enable Feature: This unit is pre-wired at the factory to allow the siren tones to operate when the on/off switch is turned on. Should the user elect to wire the unit so that the siren functions will automatically operate when the emergency lights are on, merely turn the siren on, select SIREN, WAIL, YELP, or HI-LO and that particular function will automatically activate when the emergency warning lights are turned on (see Section C wiring for hook-up). The enable feature has no effect on the operation of RADIO, P.A., or AIR HORN.

Air Horn: Supplied on Models 3200 and 3400 only. Depressing the AIR HORN button produces the AIR HORN sound and overrides all other functions.

Remote Switches: When connected, the horn ring (or foot switch) allows the operator to remotely "operate" the SIREN button and utilize all of its features.

On Models 3200 and 3400, a rocker switch is located on the bottom left front of the unit. This switch allows the operator to transfer the horn ring or remote switch function from SIREN to AIR HORN.

When connected, the Remote Switch circuit still allows operation of the SIREN and AIR HORN buttons in the normal manner from the siren unit itself.

Radio/P.A. Switch: Supplied on Models 3300 and 3400 only.

Placing the switching the P.A. position allows the 2-way radio microphone to be used for public address purposes. The blue light, when illuminated, indicates that the system is in the P.A. mode.

Should the siren unit not have power for any reason, the 2-way radio microphone will automatically work with the 2-way radio, regardless of the P.A. switch position.

In the event of siren removal, installation of the 12 pin jumpered connector (supplied) will allow normal 2-way radio operation.

SECTION V

MAINTENANCE AND SERVICE

Your CODE 3™ siren package has been designed to provide trouble free service.

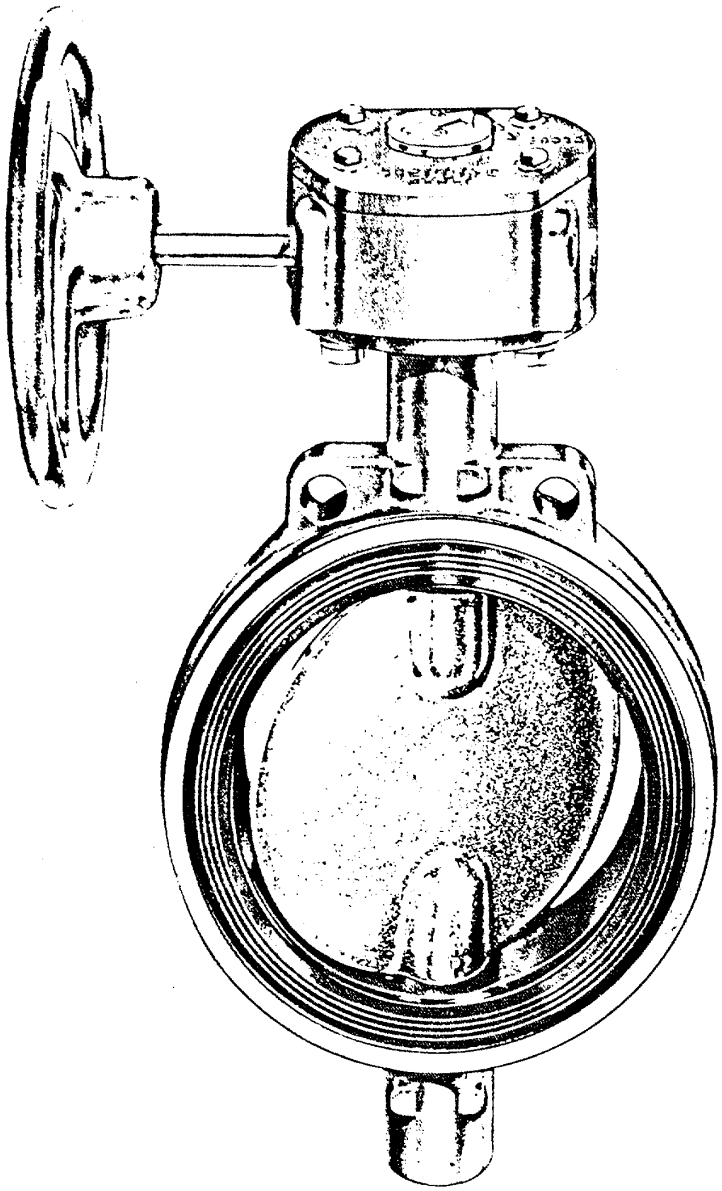
In case of difficulty, check the fuse located on the bottom of the unit and all external connections. Also check for shorted or open wires. The primary cause of short circuits has been found to be wires passing through firewalls, roofs, etc.

If further difficulty persists, return the unit to the factory for service through your distributor. Simply disconnect the two plug-in connectors as well as the plus and ground leads. Be sure to insulate the plus lead to prevent shorts. Models 3300 and 3400 are supplied with a service jumper (attached to the 12-wire harness) which must be installed in 12-pin plug (P1) to provide two way radio continuity.

Section VI
VALVES

Catalog CBFV-76

Butterfly Valves



ITT Grinnell
Division of *ITT Industries of Canada Ltd.*

Section VI
VALVES

SALES OFFICES

AND WAREHOUSES

Calgary, Alberta T2G 3H 1 4005 - 11th Street S.E.
Telephone (403) 243-6073

Edmonton, Alberta T5G OW5 11340 - 120th Street
Telephone (403) 454-4541

Montreal, Quebec H4P 1V6 3980 Jean Talon St. W.
Telephone (514) 342-2100

Richmond, British Columbia V.6V 1V7 390 Viking Way
Telephone (604) 273-9211

Sarnia, Ontario N7T 2GG 211 Campbell Street
Telephone (519) 336-7690

Stoney Creek, Ontario L8E 2V9 470 Seaman Street
Telephone (416) 561-7711

Toronto, Ontario M8Z 2C5 10 North Queen Street
Telephone (416) 251-4171

Winnipeg, Manitoba R3H OM2 777 Century Street
Telephone (204) 774-3461

MANUFACTURING PLANTS:
Oshawa, Ontario
Toronto, Ontario

ITT Grinnell
Division of *ITT Industries of Canada Ltd.*

MANAGEMENT OFFICES:

Toronto, Ontario M8Z 2C5 10 North Queen Street
Telephone (416) 252-3312

WHENEVER

PIPING

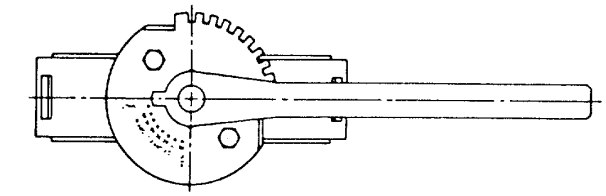
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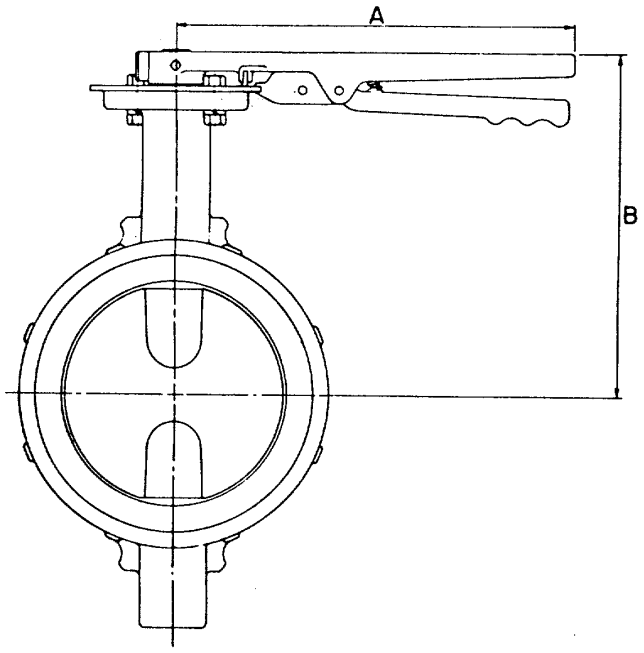
INVOLVED

Butterfly Valves – Series 8000

10 POSITION LEVER ACTUATOR

RECOMMENDED FOR VALVES
UP TO 6" ONLY ON WATER OR FLUID SERVICE
8"–12" FOR AIR OR GAS APPLICATIONS





DIMENSIONS

SIZE INCHES	A	B
2	9½	6¾
2½	9½	7¼
3	9½	7½
4	9½	8¼
5	9½	8¾
6	9½	9 3/8
8	15	11 3/16
10	15	12 9/16
12	15	14 1/16

Butterfly Valves – Series 8000

2" – 12"

DIMENSIONS

DIM. / SIZE	A	B	C	D	E	F	G	H	J	L
2	5¾	2 9/16	1 3/32	2	9/16	1 5/8	4	13/32	3	4¾
2½	6¼	2 7/8	1 3/32	2½	9/16	1¾	4	13/32	3	5½
3	6½	3¼	1 3/32	3	9/16	1¾	4	13/32	3	6
4	7¼	4¼	1 3/32	4	5/8	2	4	13/32	3	7½
5	7¾	5 5/16	1 3/32	5	7/8	2 1/8	4	13/32	3	8½
6	8 3/8	6	1 3/32	6	1	2 1/8	4	13/32	3	9½
8	9 9/16	7 9/16	1 5/8	8	1 1/8	2 3/8	6	17/32	5	11¾
10	11	9	1 5/8	10	1 1/8	2¾	6	17/32	5	14¼
12	12½	10 5/16	1 5/8	12	1 1/8	3 1/8	6	17/32	5	17

PARTS LIST

ITEM	DESCRIPTION	MATERIAL
1	DRIVE SHAFT	416 ST. ST.
2	'O' RING	BUNA N
3	WAFER BODY	C.I. ASTM 126 CL. B.
4	LOCK PIN	STEEL G1010
5	SEAT	BUNA
6	DISC	DUCTILE IRON CR. PLATED
7	BOTTOM SHAFT	416 ST. ST.
8	LOCK PIN	STEEL C1010
9	REINF RING	STEEL H.R.

	OPTIONS	
1	DRIVE SHAFT	316 ST. ST.
7	BOTTOM SHAFT	316 ST. ST.
6	DISC	AL. BRZ. ASTM 148 9B
6	DISC	316 ST. ST. (CF8M)
6	DISC	HARD FACED 500 BR.
5	SEAT	EPDM
5	SEAT	NEOPRENE
3	BODY LUG	C.I. ASTM 126 CL.B.

RECOMMENDED INSTALLATION PROCEDURES

ITT Grinnell Butterfly Valves are designed to fit and seal between ANSI 150 flanges. During installation the flanges should be spread wide enough apart so as to allow easy installation. Care should be taken so as not to roll back the seat lip on valve sizes 14" and larger.

The built-in gaskets are suitable for most flange types including full face, and slip-on, however, Cast Iron Pipe Flanges must be fully made-up and the flange face machined.

In the event that Welding Flanges are used, care must be taken to prevent heat transfer to the valve seat and seals. Slag removal from the line is recommended to prevent possible seat damage due to entrapment of scale or slag in the disc/seat area.

MAINTENANCE INSTRUCTIONS

These are minimal, and will normally be determined by the severity of the application. The drive shaft is lifetime lubricated with a silicone base grease, that is contained in the bearing load area by suitable "O" rings. On valves 14" and larger self lubricating bearings are standard.

If it becomes necessary to replace the Butterfly Valve seat, the following procedures should be followed:

1. Be sure all line pressure is removed, and the line on both sides of the valve suitably sealed off;
2. Disconnect and remove any pneumatic, or electric actuator, from the valve flange;
3. Loosen all flange bolts or studs, and remove sufficient to allow the valve to be withdrawn from between the flanges;
4. The valve should be suitably supported in a vise or clamp, and, if fitted with a lever actuator, the two screws securing the "Locking Plate" are removed;
5. If the valve is fitted with "Shaft Retaining Pins" these should be removed; on 14" and larger remove disc pins or studs.
6. The shafts are now removed from the valve body, the drive shaft can be gently pried free, and the lower shaft is provided with a tapped hole to facilitate removal;
7. This disc can now be removed;
8. Finally the valve seat is removed. This can be done by using a press, or by gently tapping with a rubber mallet; on 14" and larger the seat is snapped out;
9. Assembly is carried out by the reverse procedure, but care should be taken when installing the seat. The lead edge of the seat should be lightly coated with silicone lubricant, and the shaft holes in the seat must be aligned with the shaft holes in the valve body; no lubrication is required on liners 14" and larger.
10. Prior to installing the drive shaft, lightly coat with "Dow Corning" Alpha Molykote No. BR2-S grease (or equivalent). This will ensure lifetime lubrication of the butterfly valve drive shaft;
11. Check to be sure all "O" rings and pins have been replaced, and that the disc/shaft connection is correct and secure.
12. The valve can now be replaced in the line, the normal flange tightening sequence should be followed;
13. Finally, replace electric or pneumatic actuator as required.

The above sequence is based on 6-inch and smaller valves. For larger valves lifting equipment will be required. It is left to the discretion of the maintenance crew as to when removal of the actuator should be done, in the line, or at the repair bench.

Butterfly Valves – Series 8000

BUTTERFLY VALVE WEIGHTS – (APPROX.)

LEVER OPERATED – ANY DISC

	LUG	WAFER
2"	13#	10#
2½"	14¾#	11#
3"	15½#	12#
4"	23¼#	16#
5"	32#	22#
6"	35¾#	24#
8"	55#	44#
10"	69#	50#
12"	125#	92#

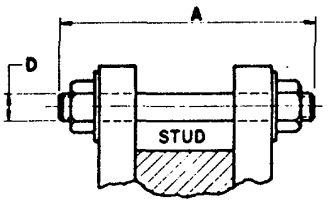
Handle and Latch Included in above.

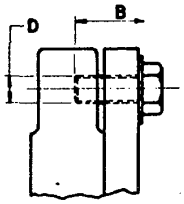
GEAR OPERATED – ANY DISC

	LUG	WAFER	FLANGED
2"	17#	14#	–
2½"	18¾#	16#	–
3"	19½#	16#	–
4"	27¼#	20#	–
5"	40#	30#	–
6"	43¾#	32#	–
8"	79#	68#	–
10"	115#	96#	–
12"	163#	130#	–
14"	180#	164#	–
16"	250#	201#	–
18"	290#	246#	–
20"	436#	371#	–
24"	–	535#	609#

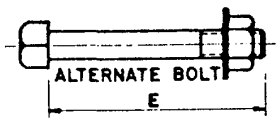
Gear operator & hand wheel included in above.

STUD AND BOLT LENGTH SPECIFICATION
2" – 24" WAFER
2" – 20" LUG
24" FLANGED
(NOTE: 24" AVAILABLE IN WAFER & FLANGED BODY ONLY)





LUG TYPE
B'F' VALVE



WAFER TYPE
BUTTERFLY VALVE
& 24" FLANGED BODY

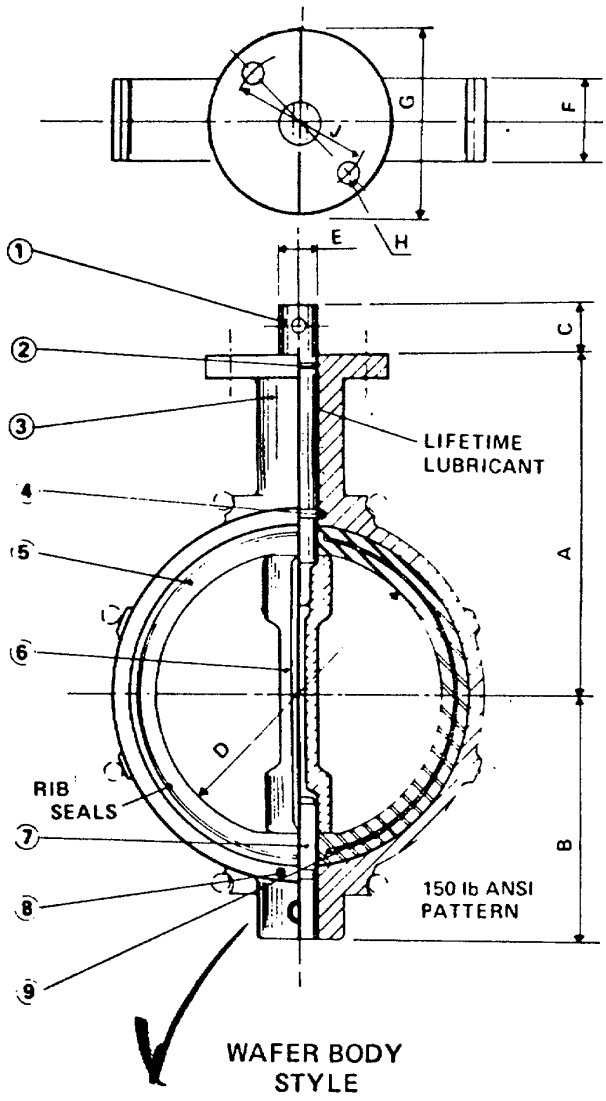
DIMENSIONS

SIZE INCHES	A	B	D	E
2	5	1½	5/8-11	4
2½	5½	1½	5/8-11	4½
3	5½	1½	5/8-11	4½
4	5¾	1¾	5/8-11	5
5	6½	1¾	¾-10	5½
6	6½	2	¾-10	5½
8	7	2¼	¾-10	6
10	7½	2¼	7/8- 9	6½
12	8¼	2½	7/8- 9	7½
14	8¾	2¾	1 - 8	7¾
16	10	3¼	1 - 8	9
18	10½	3½	1⅛ -7	9½
20	11¾	4	1⅛ -7	11
24	12½	–	1¼ -7	3½

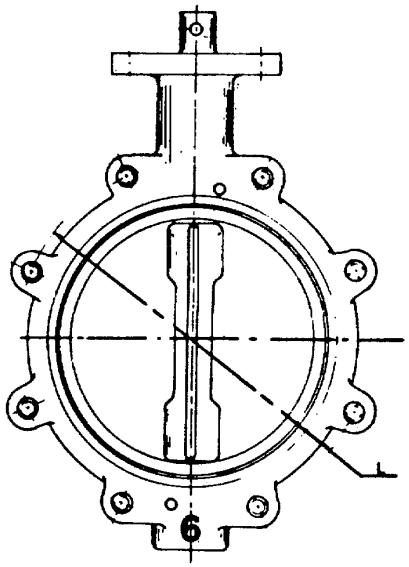
Butterfly Valves – Series 8000

2" – 12"

Illustrated below are details of construction and overall dimensions of both Wafer and Lug Body style valves. The Wafer style is designed to fit between the bolt circle of a 150# flange. The Lug style has matching tapped holes to suit a 150# flange and can be used for dead end service. In both cases the valves have built-in flange seals.



WAFER BODY
STYLE

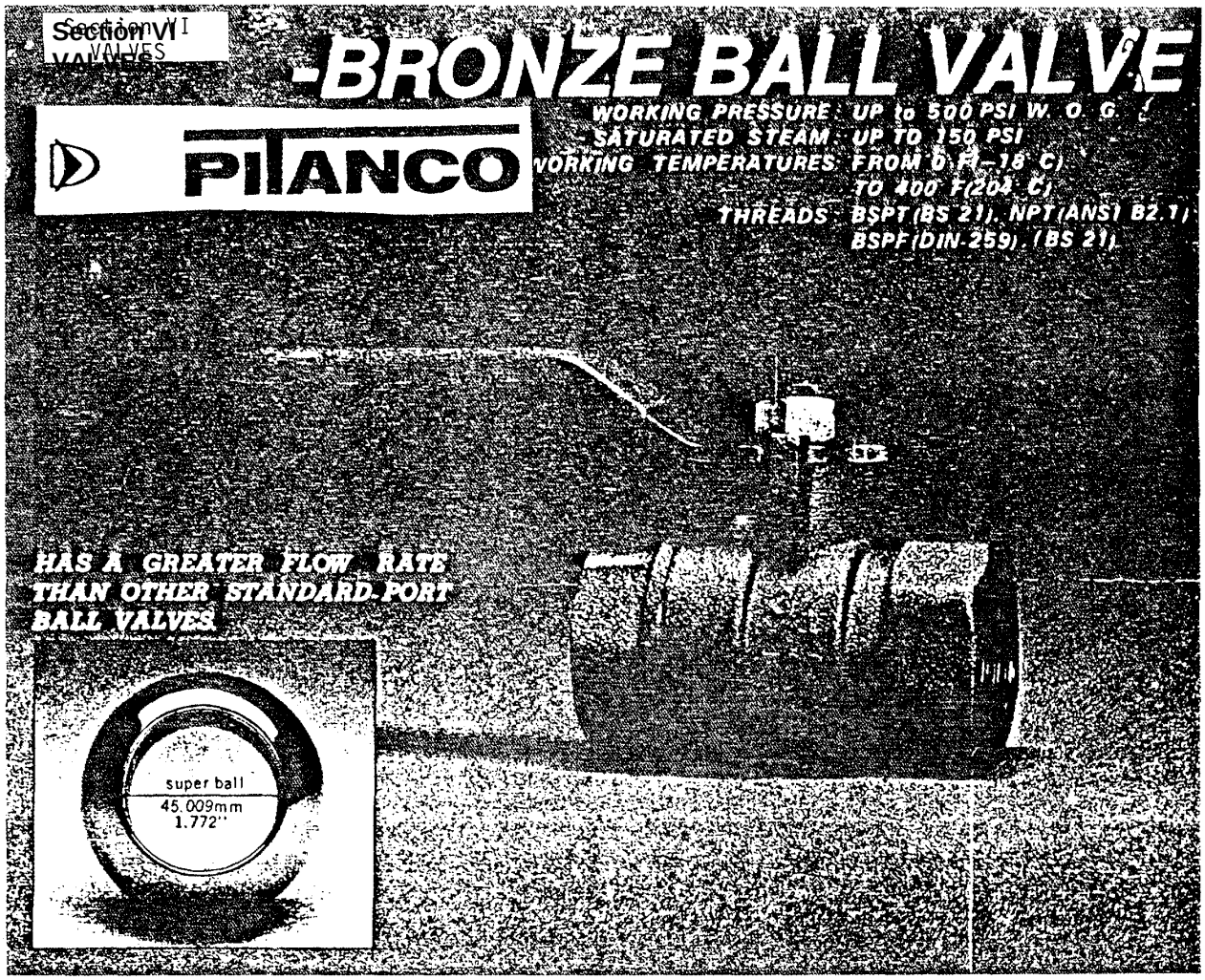


LUG BODY
STYLE

-BRONZE BALL VALVE

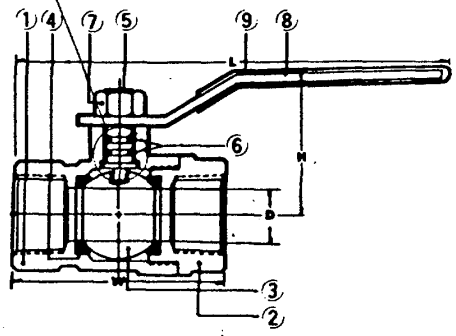
PITANCO

WORKING PRESSURE: UP to 500 PSI W. O. G.
SATURATED STEAM: UP TO 150 PSI
WORKING TEMPERATURES: FROM 0°F (-18°C)
TO 400°F (204°C)
THREADS: BSPT (BS 21), NPT (ANSI B2.1)
BSPF (DIN-259), (BS 21)



SIZE	D	W	H	L
1/4"	9.5m/m			
3/8"	9.5m/m			
DIMENSION mm.				
1/2"	12.7	55	44	127
3/4"	17.5	63	50	132
1"	22.5	78	55	200
1 1/4"	28.0	88	60	210
1 1/2"	35.0	95	72	218
2"	45.0	115	78	228

BLOW-OUT-PROOF STEM DESIGN



MATERIAL

NO.	NAME OF PART	Q'TY	MATERIAL
1	BODY	1	BRONZE
2	SEAT RETAINER	1	BRONZE
3	BALL	1	BRASS
4	SEAT	2	TEFLON
5	STEM	1	BRASS
6	O-RING	2	CR
7	NUT	1	CARBON STEEL
8	HANDLE	1	CARBON STEEL
9	HANDLE COVER	1	PVC

Télex: 055-66189

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QUÉBEC G1K 5W7
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400 LECLERC
Trois-Rivieres Ouest,
G9B 1R4 Qué.
Tél: 377-1277

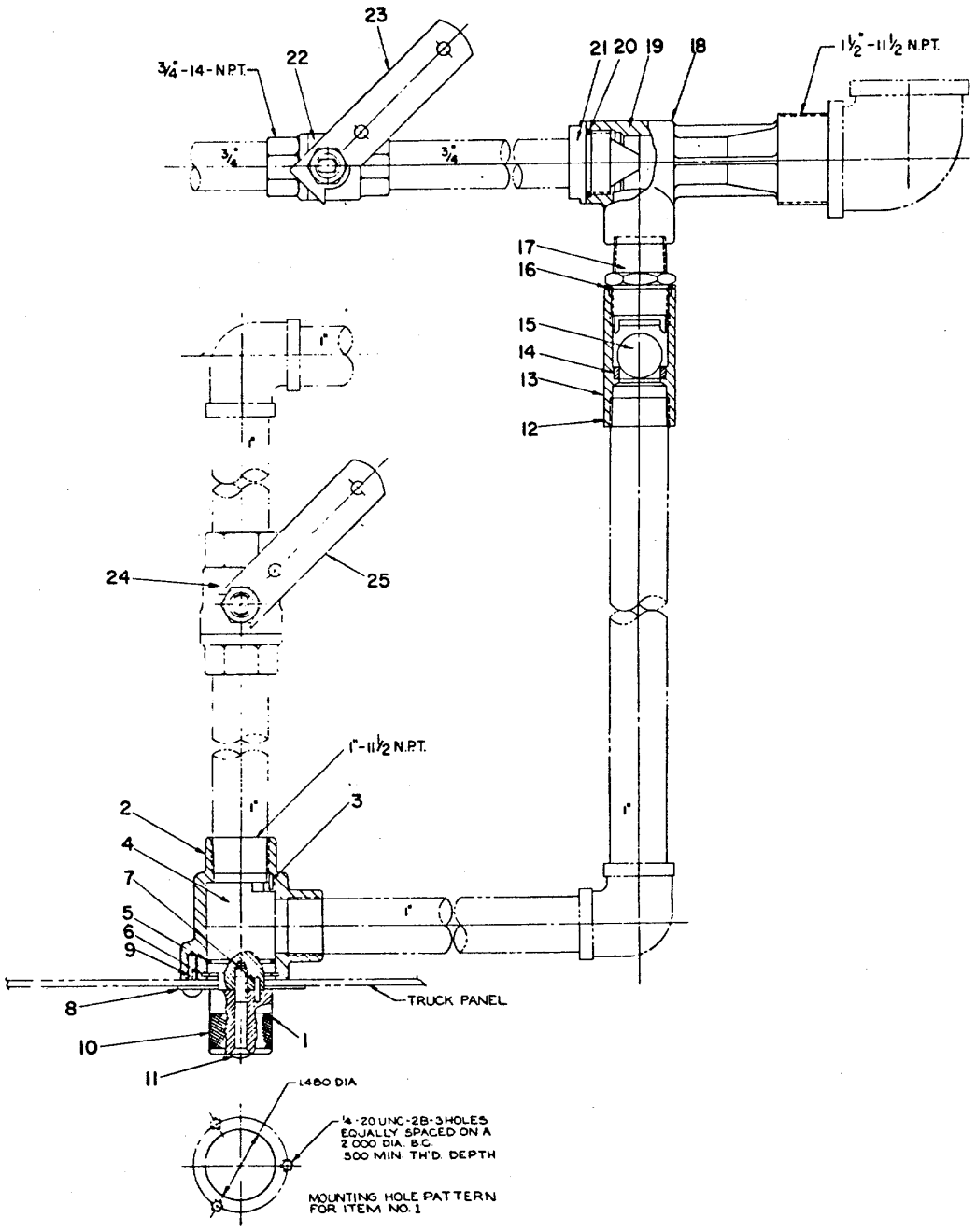
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FIG. NO. _____

ENGINEERING DATA SHEET

COBRA Nozzles

MODEL A.P. PROPORTIONER

00049720



FLOW 20 G.P.M. TO 400 G.P.M.

SHIPPING WEIGHT 9 ½ LBS.

REPLACEMENT PARTS LIST

Unit:	MODEL A. P. PROPORTIONER	200497	COBRA Nozzles
No.	Part Number	Part Name	No. Req'd.
1	01942-3	1" Metering Valve	1
2	200023	Valve Body	1
3	95210906	Roll Pin	1
4	01943-2	Valve Stem	1
5	95830028	"0" Ring	1
6	98100150	Retaining Ring	1
7	95210910	Roll Pin	1
8	100243	Dial Plate	1
9	93513108	Screw	3
10	01944-2	Knob	1
11	93523128	Screw	1
12	200223	1" Ball Check Valve Assembly	1
13	200221	Body, Check Valve	1
14	100222	Seat, Check Valve	1
15	100375	Ball	1
16	95830026	"O" Ring	1
17	100220	Cap, Check Valve	1
18	200110	A-P Eductor	1
19	200111	Body	1
20	95830026	"O" Ring	1
21	100109	Nozzle	1
22	97722704	Ball Valve 3/4"	1
23	100476	Handle	1
24	97722705	Ball Valve 1"	1
25	100872	Handle	1

Section VI
VALVES
USE AND SERVICE BULLETIN NO. 7122
FETCON MODEL AP PROPCRTIONER

General

The Feecon Model AP Proportioner is of the Around-the-Pump type. A small percentage of the water pump discharge is passed through the Feecon Eductor to provide the energy required to draw foam liquid, wetting agent or any other additive from a tank or storage container into the pump suction line. All components are essentially of bronze or brass construction. Seals are synthetic rubber or teflon.

Capacity

The Feecon Model AP Proportioner is capable of proportioning up to the flows indicated in the following table:

Agent	Flow Rate
6% Foam Liquid	200 gpm
6% Light Water (AFFF)	200 gpm
3% Foam Liquid	400 gpm
2% Wetting Agent or Hi-Expansion Foam	600 gpm
1% Wetting Agent or Hi-Expansion Foam	1200 gpm

Operation

1. Operator determines flow rate and sets metering valve to deliver proper percentage. Note, instruction plate mounted on operator's panel gives settings vs. flow rates for various agents.
2. Open 3/4" drive water valve.
3. If operating from a hydrant source, check pump suction pressure. Suction pressure must be 10 p.s.i. or less or proportioner will not function properly.
4. Open foam liquid suction valve.

Shut Down

1. Close foam liquid suction valve.
2. Flush Proportioner, pump and nozzle.
3. Close drive water valve..

Maintenance

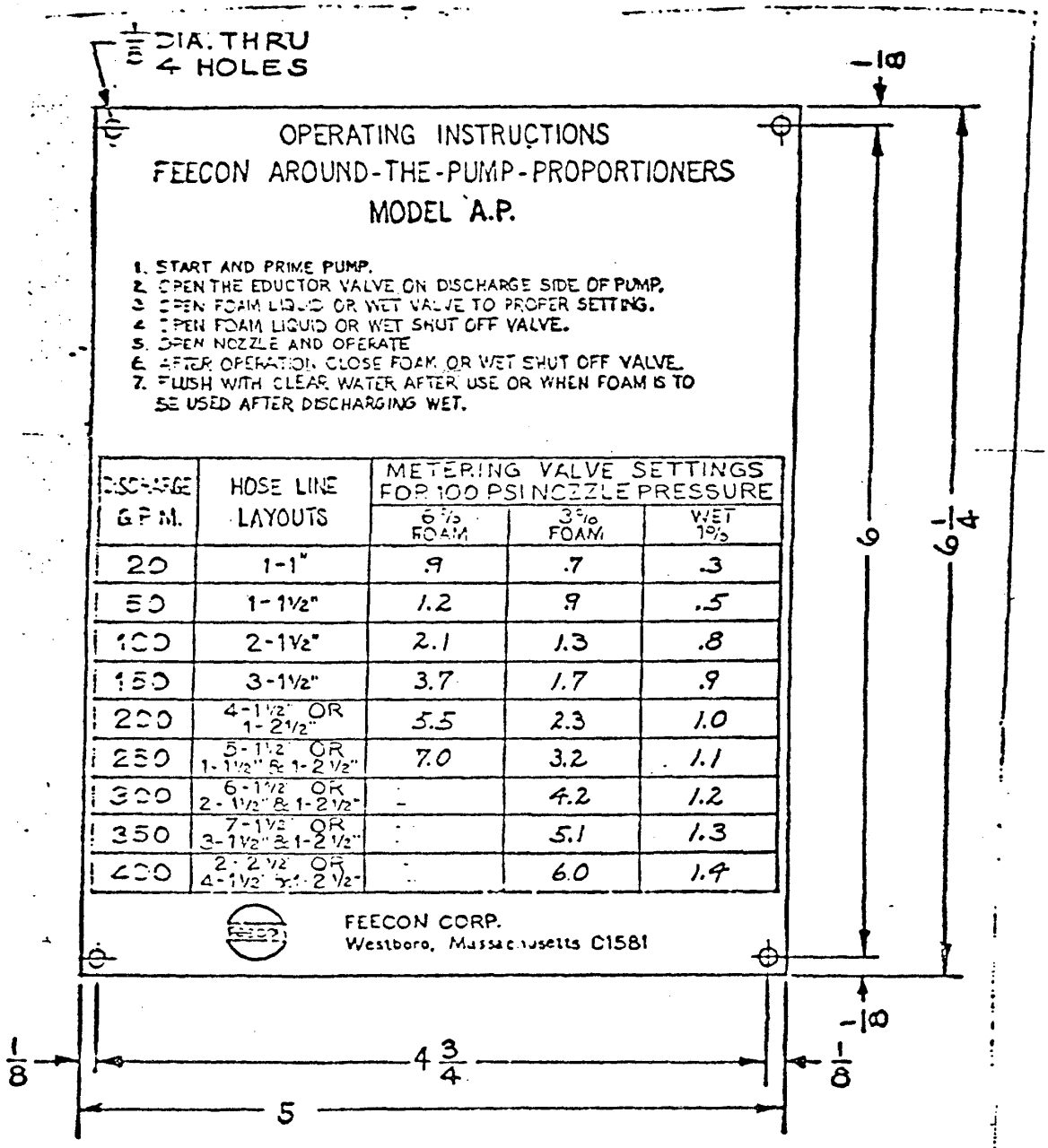
The Feecon Model AP Proportioner contains no moving parts and is essentially trouble-free. Some agents tend to leave a sticky residue which can reduce the carrying capacity of the piping or interfere with proper operation of the check valve. Occasional flushing through the flushing connection with clear water is recommended. Seals in the metering valve are standard "O" ring type and should very seldom require replacement.

Maintenance (continued)

The ball valves and check valves are low cost factory tested items which should be replaced if operating problems occur.

Limitations

1. Metering valve must be reset each time the flow rate is changed.
2. Suction pressure must not exceed 10 p.s.i.
3. Drive water pressure should not exceed 250 p.s.i. For higher pressures consult Feecon for a control orifice.



OPERATING INSTRUCTIONS
FEECON AROUND-THE-PUMP-PROPORTIONERS
MODEL A.P.

1. START AND PRIME PUMP.
2. OPEN THE EDUCTOR VALVE ON DISCHARGE SIDE OF PUMP.
3. OPEN FOAM LIQUID OR WET VALVE TO PROPER SETTING.
4. OPEN FOAM LIQUID OR WET SHUT OFF VALVE.
5. OPEN NOZZLE AND OPERATE
6. AFTER OPERATION, CLOSE FOAM OR WET SHUT OFF VALVE.
7. FLUSH WITH CLEAR WATER AFTER USE OR WHEN FOAM IS TO BE USED AFTER DISCHARGING WET.

DISCHARGE G.P.M.	HOSE LINE LAYOUTS	METERING VALVE SETTINGS FOR 100 PSI NOZZLE PRESSURE		
		6% FOAM	3% FOAM	WET 1%
20	1-1"	.9	.7	.3
50	1-1½"	1.2	.9	.5
100	2-1½"	2.1	1.3	.8
150	3-1½"	3.7	1.7	.9
200	4-1½" OR 1-2½"	5.5	2.3	1.0
250	5-1½" OR 1-1½" & 1-2½"	7.0	3.2	1.1
300	6-1½" OR 2-1½" & 1-2½"	-	4.2	1.2
350	7-1½" OR 3-1½" & 1-2½"	-	5.1	1.3
400	2-2½" OR 4-1½" & 1-2½"	-	6.0	1.4

FEECON CORP.
Westboro, Massachusetts 01581

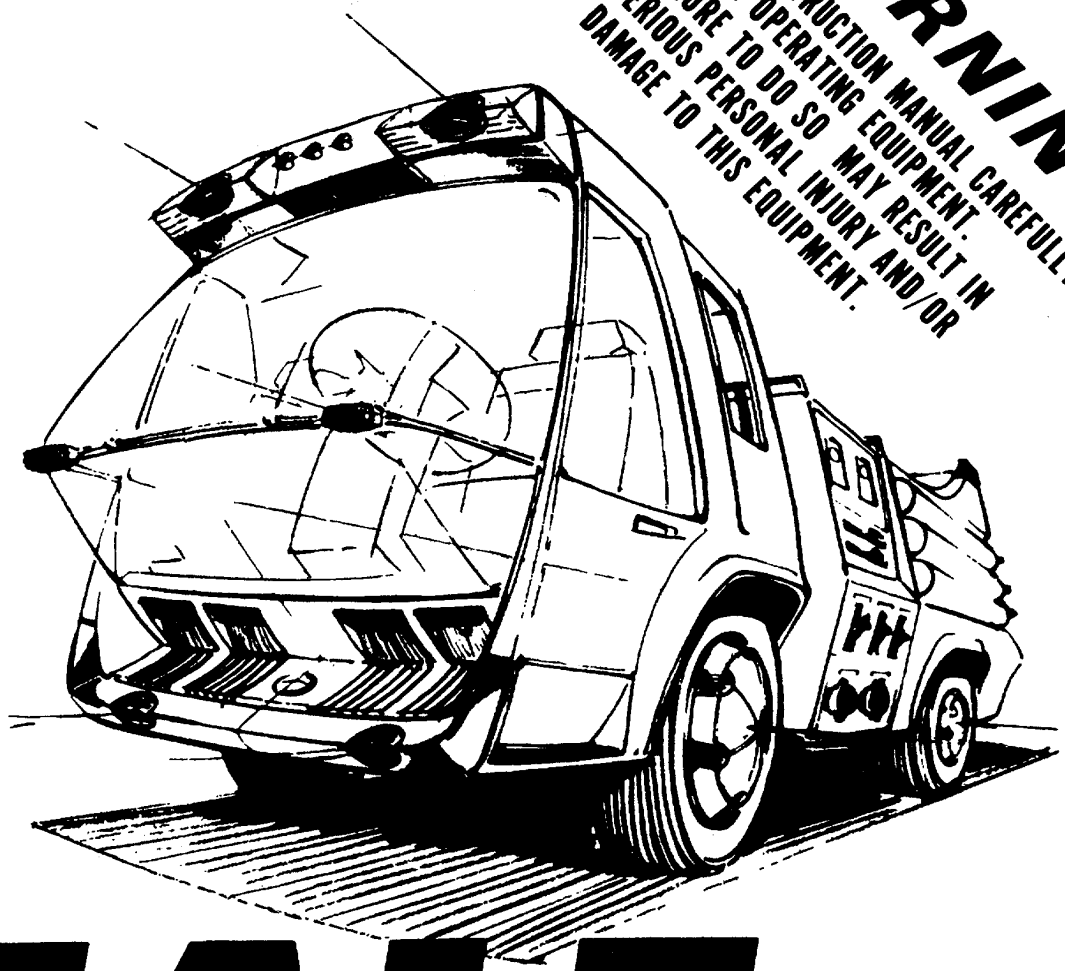
May 19, 1982

Operating and Maintenance Manual

PUMP, OPERATING AND MAINTENANCE MANUAL

WARNING

READ INSTRUCTION MANUAL CAREFULLY
BEFORE OPERATING EQUIPMENT.
FAILURE TO DO SO MAY RESULT IN
SERIOUS PERSONAL INJURY AND/OR
DAMAGE TO THIS EQUIPMENT.



HALE PUMPS

HALE PUMPS

CARE AND OPERATION

CENTRIFUGAL PUMP MANUAL

MODEL QSmFH0100-20

RATED CAPACITY 1000 GPM AT 150 P.S.I.

SERIAL NUMBER 51149

SINGLE STAGE ☑ TWO STAGE ☐ THREE STAGE ☐

DISCHARGE VALVES

SERIES BL ☐ B ☐ 25BDT ☑ 30BD ☐

OTHER _____

SUCTION VALVES

SERIES BL ☐ B ☐ 25BS ☑ 30BD ☐

OTHER _____

GEARSHIFT OPERATION

MANUAL ☐ POWER ☑ AIR ~~VACUUM~~

TRANSFER VALVE OPERATION

MANUAL ☐ POWER ☐

PRIMING PUMP AND VALVE(S) OPERATION

ELECTRIC ☑ CLUTCH ☐ AIR VACUUM

RELIEF VALVE ☑ GOVERNOR ☐

PACKING ARRANGEMENT PLATE NUMBER _____

A Hale Pump is a quality product; ruggedly designed, accurately machined, carefully assembled and thoroughly tested. In order to maintain the high quality of your pump and to keep it in a ready condition, it is important to follow the instructions on care and operation. Proper use and good preventive maintenance will lengthen the life of your pump.

ALWAYS INCLUDE THE PUMP SERIAL NUMBER IN CORRESPONDENCE

PUMP INNOVATIONS THRU HALE imagineering!

LIMITED WARRANTY

The Hale Fire Pump Company, herein referred to as "Hale", warrants products of its manufacture to be free from defects in material and workmanship, under *normal use* and service, for a period of *one year* or 2000 hours of usage, whichever comes first. Products used for rental or contracting purposes are warranted for a period of *six months* or 2000 hours of usage, whichever comes first. This limited warranty is effective only if the equipment or apparatus is used as directed, is not subjected to misuse, negligence or accident, and is not altered, treated or repaired by someone other than Hale or its designee. Items not manufactured by Hale shall bear only the limited warranties offered by their respective manufacturers.

The exclusive remedy for breach of this warranty shall be to give Hale written notice thereof and to request a Returned Goods Authorization. Upon receipt of the Returned Goods Authorization, the buyer will return the non-conforming material to Hale F.O.B. its plant within thirty days after the buyer has received the Returned Goods Authorization. Thereupon Hale at its own election shall repair or replace the same or repay the price thereof. No proximate, incidental, consequential or other damages shall be recoverable.

Hale shall not be liable for consequential damages or contingent liabilities including; but not limited to, loss of life, personal injury, loss of crops, loss due to fire or water property damage, and consequential trade or other commercial loss arising out of the failure of Manufacturer's product.

HALE MAKES NO WARRANTIES OF FREEDOM FROM PATENT INFRINGEMENT, OF MERCHANTABILITY, OF FITNESS FOR A PARTICULAR PURPOSE OR ARISING FROM A COURSE OF DEALING OR USAGE OF TRADE OR OTHER LIKE OR DIFFERENT EXPRESS OR IMPLIED WARRANTIES EXCEPT AS MADE ABOVE.

Hale Fire Pump Company
Conshohocken, Pa. 19428

F-173A

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Product Safety Policy

The policy of Hale Fire Pump Company is to produce products that will perform well during their intended life cycle, and be as safe as possible for our customers. Product safety has, and will continue to be, given primary consideration during new product development and production. Our products are always designed to meet the current requirements of applicable safety standards.

Instruction manuals are supplied with all Hale products. It is strongly recommended that our customer read and understand the information contained therein before operating any equipment.

We keep comprehensive records on parts or assemblies, whether completely manufactured by Hale or in part purchased from other manufacturers, so that it can be ascertained on what final product these items were used.

If a problem related to product safety is discovered before our product is shipped, shipment will not be made before corrections are made. If a problem is discovered after the equipment leaves Hale, we will notify our distributor. If a problem is discovered by our distributor or the ultimate customer, detailed information should be forwarded to Hale, as soon as possible. Once apprised of a problem, prompt discussions will be held to determine how to resolve the situation.

We recognize the need to place more emphasis on Product Safety and have, therefore, established a Product Safety Committee which is responsible for implementing the Hale Product Safety Policy. Product Safety meetings are held on a regularly scheduled basis, to review current problems and practices, to identify safety related problems that may develop, to analyze recommendations from the field and to administer corrective action.

Hale's Limited Warranty states that the Limited Warranty "is effective only if the equipment or apparatus is used as directed". We therefore strongly suggest that anyone who will use our product thoroughly familiarize themselves with the instruction manuals furnished with those products, before initial operation.

Hale Fire Pump Company
Conshohocken, Pa. 19428
April 1978

HALE PUMPS

MAINTENANCE CHECK LIST

YEAR_____ UNIT #_____

TRUCK MFR. _____

PUMP MODEL & SERIAL NO. _____

WEEKLY

Recommended test on the relief valve system or governor; test transfer valve (if applicable). Test the priming system and check oil level in priming oil tank—lubricate all valves, discharge, suction, hose drain and multi drain. Check pump shift warning indicator lights.

MONTHLY

Complete weekly checks .....

Lubricate remote controls .....

Check controlled packing leakage .....
(Adjust if necessary - 8 to 10 drops per min.)

Perform Dry Vacuum Test - Per NFPA-1901 Para. 11-2.2.4 22" Minimum Vacuum - Loss not to Exceed 10" Vacuum in 10 minutes .....

Check drive line bolts .....

Lubricate suction tube threads and clean strainer, inspect gaskets.

Check oil level in pump gear box, if contaminated replace with SAE EP 90 oil in midship pumps; SAE 10W-30 in front mount pumps .....

MONTHLY CHECK LIST

JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.

ANNUALLY

Complete all previous checks ☑ on-all-questions
Check gauge calibration
Check oil level in auto lube assembly (SAE-EP 90 oil)
Lubricate power transfer cylinder, power shift cylinder and shift control valve with vacuum cylinder oil.
Change pump gear box oil and refill (SAE-EP oil midship pumps; SAE 10W-30 front mounts).
Check individual drain lines from pump to multi drain to ensure proper drainage and protection from freezing.
Lubricate transfer valve mechanism on two stage pumps.
Run yearly standard pump test (Underwriters) to check pump performance levels—chart provided below.
Repacking of pump is recommended every two or three years.

NOTE: The above general recommendations are provided for normal use and conditions. Extreme conditions or variables may indicate a need for increased maintenance. Good preventative maintenance lengthens pump life and ensures greater dependability. Consult service chart in operator's manual for detailed information.

	Capacity @ 150PSI	70% Capacity @ 200PSI	50% Capacity @ 250PSI
Hose Layout			
Nozzle Size			
Nozzle Pressure			
Gallons Per Minute			
Pump Pressure			
Engine Speed			
Original Engine Speed			
Lift & Suction Hose			

Hale Fire Pump Company • Conshohocken, Pa. 19428 • 215-825-6300 • TWX 510-660-8931

imagineering!

HALE PUMPS

MIDSHIP SERVICE DIAGNOSTIC CHART

CONDITION	POSSIBLE CAUSE	SUGGESTED CORRECTION
PUMP WILL NOT ENGAGE		
Standard Transmission w/Manual Pump Shift	Clutch not fully disengaged or malfunction in shift linkage	Check clutch disengagement, drive shaft must come to a complete stop before attempting pump shift. Check pump shift linkage, lubricate and adjust if necessary.
Automatic Transmission w/Manual Pump Shift	Automatic transmission not in neutral position	Repeat recommended shift procedures with transmission in neutral position.
Standard Transmission w/Power Shift system	Insufficient air or vacuum supply in shift system	Repeat recommended shift procedures. Check system for loss of vacuum or air supply. Check for leaks in system. Employ shift override procedures as follows: Hole is provided in shifting shaft to accomplish emergency shifting. Complete shift of control in cab and proceed to complete shift of lower control manually.
Automatic Transmission w/Power Shift system	Automatic transmission not in neutral position	Repeat recommended shift procedures with transmission in neutral position.
	Pump Shift attempted before vehicle has been brought to a complete stop	Release braking system momentarily, then reset and repeat recommended shift procedures.
	Premature application of parking brake system (before truck comes to a complete stop)	Release braking system momentarily, then reset and repeat recommended shift procedures.
	Insufficient air or vacuum in shift system	Repeat recommended shift procedures. Check system for loss of air or vacuum. Check for leak in system. Employ manual override procedures if necessary. (See Standard Transmission w/Power Shift).
	Air or vacuum leaks in system	Attempt to locate leak and take necessary steps to repair. Leakage, if external, may be detected audibly. Leakage could be internal and not as easily detected. **NOTE: Do Not leave cab after completing pump shift unless shift indicator light is illuminated or a speedometer reading is noted.**
PUMP WILL NOT PRIME OR LOSES PRIME	No oil in priming oil tank	Refill priming oil tank with SAE30 motor oil.
	Engine speed too low(Rotary Gear Primer)	Increase engine RPM to recommended priming range 1000 to 1200 RPM.
	Electric Priming System	No recommended engine speed is required to operate the electric primer, however, 1000 engine RPM will maintain truck electrical system while providing enough speed for initial pumping operation.
	Defective Priming System	Check priming system by performing "Dry Vacuum Test" per NFPA 1901, Paragraph 11-2.2.4. If pump is tight but primer pulls less than 22" vacuum, it could indicate excessive wear in primer.
	Defective Priming Valve(Electric)	Defective sealing rings-replace if necessary. lubricate rings. Priming valve stuck open will allow loss of prime, also will permit unnecessary running of electric priming motor-assure complete closure of priming valve, dismantle and lubricate if necessary. **NOTE: Weekly use is recommended to keep priming system in good operating condition.**
	Defective Priming Valve (Air or Vacuum)	Priming valve not opening-employ manual override to open valve. Inactivity may cause the above. Remove and lubricate when practical. Defective diaphragm in priming valve-replace.
	Suction lifts too high	Do not attempt lifts exceeding 22' except at low elevations. Suction strainer must be at least two feet below water surface to prevent whirlpooling.
	Blocked suction strainer	Remove obstruction from suction hose strainer, do not allow suction hose and strainer to rest on bottom of water supply.
	Suction connections	Clean and tighten all section connections. Check suction hose and suction hose gaskets for possible defects.

CONDITION	POSSIBLE CAUSE	SUGGESTED CORRECTION
	Primer not operated long enough	Proper priming procedures should be followed, do not release primer control before assurance of complete prime, open discharge valve slowly during completion of prime to assure same. **NOTE: Do not run primer over 30 seconds in attempting prime. If prime is not attained in 30 seconds. stop and look for possible cause, i.e. air leaks, blocked suction, etc.**
	Air trap in section line	Avoid placing any part of the suction hose higher than the suction intake. Suction hose should be laid with continuous decline to water supply. If trap in hose is unavoidable. repeated priming may be necessary to eliminate air pocket in suction hose.
	Pump pressure too low when nozzle is opened	Reprime pump and maintain higher pump pressure while opening discharge valve slowly.
Air leaks	Attempt to locate and correct air leaks.	Use the following procedures to locate air leaks: Perform dry vacuum test on pump per NFPA 1901, paragraph 11-2.2.4, with 22" minimum vacuum required with loss not to exceed 10" vacuum in 10 minutes. If a minimum of 22" vacuum cannot be attained, priming device or system may be defective or leak is too large for primer to overcome (i.e. valve open). Loss of vacuum indicates leakage and could prevent priming or cause loss of prime. Attempt above dry prime and shut engine off, audible detection of leak is often possible. Connect suction hose from hydrant or the discharge of another pumper to pressurize pump with water and look for visible leakage and correct. A pressure of 100 PSI should be sufficient. Do not exceed pressure limitations of pump or pump accessories or piping connections. Check pump packing during attempt to locate leakage. If leakage is in excess of recommendations, adjust accordingly, following instructions outlined in pump manual.
INSUFFICIENT PUMP CAPACITY	Insufficient Engine Power	Engine power check or tune-up may be required for peak engine and pump performance. Engine linkage not opening throttle fully.
	Transfer Valve not in proper “Volume” position	Place transfer valve in "Volume" position (parallel) when pumping more than 2/3 rated capacity (Does not apply to single stage pumps). For pressure above 200 PSI. pump should be placed in "Pressure" (Series) position.
	Relief Valve set improperly	If relief valve control is set at too low a pressure, it will allow relief valve to open and by pass water. Reset Relief Valve Control. per recommended procedures, to correct pressure requirements. Other bypass lines (i.e. foam system, inline valves) may reduce pump capacity or pressure.
	Engine Governor set incorrectly	Engine governor, if set for too low a pressure setting when on automatic, will decelerate engine speed before desired pressure is attained. Reset governor according to recommended procedures.
	Truck transmission in wrong gear or clutch is slipping	Recheck pumping procedures for recommended transmission gear or range. Utilize mechanical speed counter on pump panel to check actual speed against possible clutch or transmission slipping or inaccurate tachometer (Check manual for proper speed counter ratio).
INSUFFICIENT PRESSURE	Check similar causes for insufficient capacity	Recheck pumping procedures for recommended transmission gear or range. Utilize mechanical speed counter on pump panel to check actual speed against possible clutch or transmission slippage or inaccurate tachometer (check manual for proper speed counter ratio).
	Transfer Valve not in "Pressure" position	For desired pump pressures above 200 PSI transfer valve should be in "Pressure" position. Does not apply to single stage pumps.
	Impeller Blockage	Blockage in the impeller can prevent loss of both capacity and pressure. Back flushing of pump from discharge to suction may free blockage. Removal of one half of pump body may be required to remove blockage.
	Worn Pump Impellers & Clearance Ring	Worn impellers and clearance (wear) rings will reduce both pump capacity and pressure. Installation of new parts required, considered major repair.
Engine speeds too high for required capacity or pressure	Impeller blockage	Same as impeller blockage above.
	Worn pump impellers and clearance rings	Installation of new parts required same as above "Pump Worn Out"
	Blockage of suction hose entry	Clean suction hose strainer of obstruction and follow recommended practices for laying suction hose-keep off the bottom of the water supply but at least 2 feet below the surface of water.
	Defective Suction Hose	Inner liner of suction hose may collapse when drafting and is usually undetectable. Try a different suction hose on same pump test mode for comparison against original hose and results.

CONDITION	POSSIBLE CAUSE	SUGGESTED CORRECTION
	Lift too high, suction hose too small	Higher than normal lift (10) will cause higher engine speeds, high vacuum, and rough operation. Larger suction hose will assist above condition.
	Truck transmission in wrong range or gear	Check recommended procedures for correct transmission selection.
RELIEF VALVE DOES NOT RELIEVE PRESSURE WHEN VALVES ARE CLOSED	Incorrect setting of Control Valve (Pilot valve)	Check and repeat proper procedures for setting relief valve system.
	Relief Valve inoperative	Possibly in need of lubrication. Remove relief valve from pump, dismantle, clean and lubricate. Weekly use of the Relief Valve System is recommended.
RELIEF VALVE DOES NOT RECOVER AND RETURN TO ORIGINAL PRESSURE SETTING AFTER OPENING VALVES	Dirt in system causing sticky or slow reaction	Relief Valve dirty or sticky, follow above instructions for disassembling, cleaning, and lubrication.
		Blocked. Clean with small wire or straightened paper clip.
RELIEF VALVE OPENS WHEN CONTROL VALVE IS LOCKED OUT	Drain hole in housing or piston blocked	Clean hole, same as above.
UNABLE TO ATTAIN PROPER SETTING ON RELIEF VALVE	Wrong procedures	Check instructions for setting Relief Valve Control and reset.
	Blocked strainer	Check and clean strainer in supply line from pump discharge to control valve. Check schematic in pump manual for exact location. Check and clean tubing lines related to the relief valve and control valve.
	Foreign matter in Control Valve	Remove and clean.
	Hunting condition	Insufficient water supply coming from pump to Control Valve - check strainer in relief valve system.
		Foreign matter in control valve - remove and clean.
EM GOVERNOR THROTTLE CONTROL KNOB DIFFICULT TO TURN	Dampening needle blocked	Remove dampening needle and clean capillary tube per "Governor Service" in pump manual.
	Governor unit dirty and in need of lubrication	Remove, clean, and lubricate per manual.
		Clean panel strainer and replace filter. Weekly use of governor nor system is recommended.
GOVERNOR SHAFT DOES NOT RETURN TO SHUT DOWN POSITION (IDLE)	Governor unit dirty and in need of lubrication	Remove, clean and lubricate per manual.
		Recommend weekly use of governor system for best operation.
UNABLE TO SET GOVERNOR ON AUTOMATIC AND RETAIN REFERENCE PRESSURE	Leak in system	Check for leaks, external leaks will be visible, internal leaks, ("O" rings) will cause pressure loss in reference system, replace sealing rings.
	Reference tank filled with water	Drain reference tank-Reference tank should have independent drain and must be drained with same. Multi drain valve will not drain reference tank.
	Improper procedure used	Reset governor on automatic. Caution: wait a full 3 seconds before pulling Actuator; longer if engine is slow responding to throttle setting
GOVERNOR SLOW RESPONDING ON AUTOMATIC SETTING	Dampening needle out of adjustment	Check manual for proper adjustment of dampening needle.
	Faulty throttles cable or linkage	Check throttle cable for proper clamping-see manual for recommendation.
GOVERNOR WILL NOT STOP HUNTING	Improper adjustment of dampening needle	See Governor operating and instruction in pump manual for proper adjusting.
	Check Valve Ball missing	Check unit for check valve ball and replace if missing.
LEAK AT PUMP PACKING	Adjust pump packing	Follow procedures in manual "Packing Adjustment" (8 to 10 drops per minute of leakage preferred).
	Replace pump packing	Follow pump manual for replacement of packing. Packing replacement is recommended every 2 or 3 years.

CONDITION	POSSIBLE CAUSE	SUGGESTED CORRECTION
WATER IN PUMP GEAR BOX (Midship only)	Leak coming from above pump	Check all piping connections and tank overflow for the possibility of spillage falling directly on pump gear box.
	Excessive leakage at pump packing	Follow above procedures for adjustment or replacement of packing. Excess packing leakage permits the flushing of water over the gear box casing to the input shaft area. Induction of this excessive water may occur thru the oil seal or speedometer connection. Inspect and replace oil seal if necessary. Check speedometer connection cap and tighten if necessary. Install modification of additional slinger and front bearing cap if desired: available from factory. (Not required on models after 1972) Drain contaminated oil from gear box, flush with lighter oil (SAE30), drain again and replace with SAE-EP-90 gear oil.
DISCHARGE VALVES DIFFICULT TO OPERATE	Lack of lubrication	Recommend weekly lubrication of discharge and suction valve. Use good grade petroleum base grease or silicon grease.
	Valve in need of more clearance	Add gasket to valve cover (per manual). Multi gasket design allows additional gaskets for more clearance and free operation. **NOTE: Addition of too many gaskets to valve will permit leakage.**
REMOTE CONTROL DIFFICULT TO OPERATE	Lack of lubrication	Lubricate remote control linkages and collar with oil.

HALE PUMPS

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EXPLANATION OF TERMS

Impeller

The working part of a centrifugal pump which, when rotating, imparts the energy to the water. Essentially, an impeller consists of two discs separated by curved vanes. The vanes force the water to rotate between the discs so that it is thrown outward at high velocity by centrifugal force. The water from the impeller discharges into diverging passages, converting the high velocity energy of the water into pressure.

Stages

The number of impellers in a pump which are used in series; that is, one following another in terms of flow. Each impeller develops part of the total pump pressure.

Transfer Valve

A two-position valve in the pump which changes the pump from parallel (Volume) to series (Pressure) operation or vice versa, (Not used on single stage pumps).

With the valve in "Volume" position, each of the two impellers acts as a separate single stage pump working in parallel or side by side. Each impeller takes suction from outside the pump and discharges its water to the pump discharge. Hence, in parallel, the impellers pump high volume.

With the transfer valve in "Pressure" position, the impellers act in series, creating a two stage pump. The discharge of one impeller is directed into the suction of the second impeller, thus reducing the volume previously discharged by 1/2 but doubling the pressure. Hence, in series, the impellers pump high pressure.

This change-over is accomplished in the various model pumps by one of the following methods.

(a) Push-pull rod: Push for Volume; pull for Pressure.
(b) Hand Wheel: Turn clockwise for Pressure, counter-clockwise for Volume.
(c) Power Operated: Push the button or turn the pilot valve to select Volume or Pressure position. Either vacuum or hydraulic pressure operates. the transfer valve. A means is provided for transferring manually in case of power failure.

Relief Valve

An automatic valve which, activated by the relief valve control, will hold the motor speeds and pump pressure steady when discharge valves or shut-off nozzles are closed. The valve maintains its given pressure by dumping the pump discharge flow into the pump suction.

Relief Valve Control

A hand adjustment valve which, when set to the desired pressure, will control the relief valve to maintain the working pressure.

Check Valves

In two stage pumps, there are two swing check valves or flap valves in the suction passage of the second stage. They are located in each side of the pump between the suction tube and the pump body. These valves swing open when pumping in parallel or Volume. They are closed by first stage pressure when pumping in series or Pressure.

Gearshift

The gearshift lever moves a sliding gear in the drive unit. This gear has three or four positions, depending on the type of priming system.

(a) Three Position (Clutch or Electric Priming)
  (1) Road: All the way back to drive truck
  (2) Neutral
  (3) Pump: All the way forward to drive pump
(b) Four Position (Gearshift Priming)
  (1) Road: All the way back to drive truck.
  (2) Neutral
  (3) Prime: To drive priming pump
  (4) Pump: All the way forward to drive pump.

NOTE: These positions apply to the sliding gear and not necessarily to the position of the gearshift lever.

Priming

Priming evacuates the air from the main pump and suction hose, thus creating a vacuum. This allows atmospheric pressure on the source of water to push the water up into the suction hose and pump.

Priming Pump

A positive displacement pump which creates a vacuum to prime the main pump. It is a gear driven on pumps with the four position gearshifts and clutch driven or electric motor driven on push button prime pumps-with the three position gearshifts. Either a vacuum piston or a vacuum diaphragm engages the clutch driven type.

Priming Valve

A poppet type valve located in the priming line between the priming pump and the main pump. It remains closed at all times except when priming.

(a) Manual: Pull rod to open valve.
(b) Automatic: Opens when Prime button is pushed. Engine vacuum acting on diaphragm opens valve. It can also be operated manually by pushing on the diaphragm or pulling the emergency manual lever.

Vacuum Valve

A push button valve supplying engine vacuum to operate the priming pump clutch and priming valve.
In addition, three button type supplies vacuum to operate transfer valve.

Pressure Gauge

The pressure gauge is usually graduated in pounds per square inch only. It is connected to the pump discharge manifold, thus indicating the pump discharge pressure.

Compound Gauge

The compound gauge is graduated to read pressure in pounds per square inch and vacuum in inches of mercury. It is connected to the pump suction thus indicating the suction pressure when pumping from a hydrant or the vacuum when pumping from draft.

OPERATION

The experienced operator will pump in the range (Pressure or Volume) which gives the desired flow and pressure at the lowest engine speed. To change from one range to the other, slow the motor to not over 30 pounds pressure and shift transfer valve to other range. When you shift the transfer valve from Volume to Pressure, you may hear a metallic click or two clicks. This will be the check valves closing. If this click is severe, it is because you are changing the transfer valve while the pressure is too high.

Hale Pumps are designed to pump up to 200 PSI net pump pressure in volume position at reasonable engine speeds. In general, Volume position should be used at any net pump pressure under 150 PSI, especially when pumping from a hydrant. When pumping from booster tank, or draft, pressure position may be used when volume is less than 1/2 the pump capacity, and desired pressure is over 100 PSI.

The selection of which range to use is a matter of judgment and not of definite rules. Desired flow and pressure at lowest RPM is a good guide to determine whether to use Pressure or Volume. These instructions apply to both hydrant and draft pumping.

The following instructions apply when the pump is to be put into operation immediately after arrival at the fire. If standing by without pumping, the pump should not be engaged.

WORKING FROM HYDRANT

1. Place sliding gear in pump position.

2. Place road transmission into proper pumping gear (usually high gear). Release clutch and open throttle to a fast idle.

3. Attach one end of the suction hose to the hydrant and the other end to the suction tube of the pump. If possible flush dirt from hydrant first.

4. Close discharge valves and "lock out"' relief valve control, by turning it clockwise as far as it will go.

5. Open hydrant.

6. Open discharge valve or valves.

7. Open motor throttle gradually until desired pressure is reached. If the compound gauge shows a vacuum before the desired pressure is reached, it is a definite indication that you are getting all the water the hydrant will supply. In this case, the only way to get more pressure is to use smaller nozzle tips.

As soon as desired pressure is reached, regulate valve for cooling motor. Also set automatic relief valve control by watching pressure gauge and turning the control counter-clockwise until the indicator is set for the working pressure. Whenever the pump pressure is changed, this control must be reset in the same manner. (See relief valve cross section drawing for more detailed instructions.)

Caution: For the sake of the water system, it is not good practice to reduce the pressure on the compound gauge below zero. Disregarding this could result in serious damage to the water mains.

Another good guide is to watch the pressure gauge as you open the motor throttle. If the motor speed goes up without the pressure going up, the pump is "running away" from the water. In this case, close the throttle slowly until the pressure begins to drop and the motor speed becomes reasonable. There is nothing to be gained by going beyond this point.

WORKING FROM DRAFT

Get as close to the water as possible. The pump will do better than its rated capacity with a 101 vertical lift, but as the vertical lift increases above ten feet, the pump capacity will fall off. This applies to any type or make of pump. The pump should normally be primed with the transfer valve in "Volume".

1. Gearshift Position:
   (A) Gearshift type priming: Place in "Neutral" position.
   (B) Clutch type or electric priming: Place in "Pump" position.

2. Attach suction hose to pump, put strainer on the opposite end and submerge strainer in water. It is very desirable to have two feet or more water over the strainer. Use every precaution to keep strainer off bottom. Also, be sure to keep sand, leaves, or other foreign matter away from strainer. No pump has ever been built which will pump water with sand and foreign matter with impunity. This pump will handle such water with as little damage resulting to the pump as any fire pump on the market - possibly less damage - but we do not recommend such abuse unless there is no other way to stop a fire. Be sure all suction hose couplings and suction tube caps are tight.

3. Close all discharge valves, drain valves and drain cocks.

4. Engage priming pump:

   (a) Gear shift type priming. Pump impellers stationary while priming.
      (1a) Open priming valve.
      (2a) With motor idling, disengage clutch and place pump gearshift in prime position.
      (3a) Engage clutch and open throttle to 1000 to 1200 motor RPM.
      (4a) When water first reaches the priming pump, it will come out mixed with air. Wait a few seconds until the discharge from the priming pump is uniform, then close priming valve, shift into main pump, open throttle until a pressure of about 20 pounds is built up.
      (5a) Open discharge valve slowly.

   (b) Clutch or electric priming type. Impeller rotating while priming.
      (1b) Set throttle to 1300 to 1500 motor RPM.
      (2b) Push priming button
      (3b) In 10 to 30 seconds, the water will enter the main pump, and the pressure will rise. Open the discharge valve slowly and lock in position. Do not release priming button until a full, steady stream is flowing through the discharge hose. Follow this procedure exactly.

Caution: If the priming pump does not discharge water in 30 seconds, do not continue to run. Stop and look for air leaks.

Nothing can be gained by running the engine at high speed while priming. It is much better to take it deliberately and be sure.

5. Open throttle gradually until the desired pressure is reached. Regulate valve for cooling motor and set relief valve control as described under "Working from Hydrant" and on the relief valve cross section drawing. As the throttle is opened, the pressure should build up as the motor speed increases. Should the motor speed go up without a corresponding increase in pressure, the pump is cavitating or "running away" from the water. There are two possibilities that can lead to this condition.

   A. The first of these two possibilities can occur only on high vertical lifts with several short lines having large tips - pumping large volumes. The remedy for this is the same as described under '"forking from Hydrant."

   B. The second occurs when pumping air with water due to air leaks. Even though primed, air leaks can cause rough operation and an increase of engine speed without a corresponding increase in pressure. If this is the case, eliminate air leak as described under maintenance.

The use of Pressure or Volume positions of transfer valve and setting the relief valve will be the same as described under 'Working from Hydrant". If a shut-down is desired when working from draft - for changing discharge hose or for any other reason - simply slow down to about 30 pounds and close discharge valves. Closing the discharge valves will prevent pump from losing its water if there are no air leaks. To resume pumping, simply open the discharge valves and throttle. If pump gets hot from continued churning without flow, open discharge valve periodically to release hot water.

WORKING FROM BOOSTER TANK

Place pump sliding gear into pump position (See "Working from Hydrant").

Place transfer valve in volume position. (Not required on single stage pumps).

Open valve between tank and pump suction.

Have discharge valves closed. Have valve from pump discharge to booster hose closed. Prime exactly as when working from draft.

After priming, if lower engine speed is desired, shift transfer valve to "Pressure " position.

When pumping a small volume through a fog nozzle or small booster hose tip, it is advisable to switch from Volume to Pressure two or three times to clear the pump of entrained air.

FINAL TEST BEFORE HOUSING ENGINE AFTER RETURNING FROM FIRE

After all instructions on maintenance and lubrication have been followed, close discharge valves, booster line valves, all drain valves and cocks. Tighten suction caps. Engage pump and prime until compound gauge shows about 20 inches of vacuum. Watch gauge. If vacuum falls more than 10 inches in 10 minutes, it is a certain indication of an air leak or leaks which must be eliminated before pump can be considered in serviceable condition. Air leaks may often be detected by ear if the motor is stopped.

It is further advisable to test suction hose by this same method at reasonably frequent intervals. This can be done by attaching the suction hose to pump and placing suction tube caps on end of suction hose in place of strainer.

If air leaks can not be detected by the above vacuum test, it is advisable to test the pump hydrostatically. To do this, connect the pump to some source of water and look for leaks.

A FEW SUGGESTIONS WHICH MAY BE USEFUL

Air leaks will cause high motor speed in relation to pressure.

Foreign matter in impellers will cause high motor speed and less than normal volume.

When working from draft, do not pump hard enough to cause a whirlpool at the strainer. This will allow air to get into the pump and result in rough operation and pulsation. If more water is needed, try to get a better submergence for the strainer.

LUBRICATION

MAIN PUMP AND DRIVE UNIT

The pump bearings, drive unit bearings and all gears are supplied with oil from the drive unit housing. Use good grade SAE 90 oil. Keep oil level between the high and low mark on bayonet gauge. Too much oil or too heavy an oil will result in unnecessary loss of power and unnecessarily high oil temperature. Drain oil and renew every 12 months.

PRIMING PUMP

Keep primer oil tank filled with SAE 30 motor oil. Always oil priming pump when returning to the fire house. This can be done by running the priming pump after the main pump has been drained.

(a) Gearshift Type - Place the priming pump in gear and run it at 800 to 1000 engine RPM.
(b) Clutch Type - Place the main pump in gear, run it at 800 to 1000 engine RPM and push priming button.
(c) Electric Priming Pump - Push Priming button.

Continue running the priming pump until oil sprays out the priming pump discharge. See attached Plate #413 for priming pump lubrication system. Should oil continue to leak from the primer, check the small air vent hole in the top of the tubing fitting at the primer oil tank. This should always be open so that air can flow into the hole. It prevents the oil in the tank from syphoning over into the priming pump.

TRANSFER VALVE - (Not required on single stage pumps).

The various type operating mechanisms should be lubricated by:

(a) Handwheel Geared Type: Remove old grease and paint with multipurpose grease every six months.
(b) Power Cylinder Type: Lubricate power cylinder once a year by removing the vacuum line at each end of the cylinder and adding one ounce of B-K Vacuum Cylinder oil.

If transfer valve is equipped with a grease fitting, lubricate monthly with waterproof grease.

MAINTENANCE

Except for lubrication this pump requires very little attention. The little required, however, is important.

First, during freezing weather, be sure to drain all water out of the pump. This can be done in the following manner: Open discharge valves, remove suction tube and discharge valve caps. Open all drain valves and cocks (Gauge lines, valves and cooling lines, etc.) If your pump is equipped with a Hale drain valve, the pump can be drained by opening this valve. After the pump is completely drained, all the caps should be replaced and the valves closed. Do not put off closing the drain cocks or valves until later, as forgetting to close them will result in failure to get water when attempting to work from draft.

After pumping salt water hook the pump to a fresh water hydrant or other source of fresh, clean water and pump for a few minutes to clean out salt water.

If you have been forced to pump water containing sand or other foreign matter, do the same as stated above for salt water, flushing out discharge valves, relief valve, gauge and cooling lines.

GASKETS AND WASHERS

Inspect 'suction hose rubber washers frequently and the washers in suction tube caps. Foreign matter under these washers or faulty washers will cause air leaks which may prevent getting water when working from draft and even if you get water, will cause al irregular pulsating stream.

CHECK VALVES

Frequently remove suction tube strainers and reach in to make sure valves are free to swing and that no foreign matter is caught between the valve and the seat.

SUCTION THREADS

If cast iron, coat lightly with grease once a month.

PACKING ADJUSTMENT

To adjust packing, proceed as follows:

1. Connect the pump to a hydrant or some other source of water of about 50 lbs. pressure. If this is not possible, operate the pump at about 100 lbs. from draft or from the booster tank discharging through the booster line or other small nozzle.

2. Loosen the packing gland lock. The lock is either a spring loaded pin or a screw and locknut. The end of the lock fits into a slot in the gland.

3. Adjust the gland until the leakage is about 10 drops a minute. To tighten the packing, insert a screw driver or rod into one of the slots and turn the gland opposite to engine rotation. To loosen the packing turn the gland the same as engine rotation. (Vice versa on special pumps with the drive unit in front of pump). The slight leakage will lubricate and cool the shaft and packing, thus preventing the packing from burning: and scoring the shaft. This is recognized water pump practice.

4. After the gland has been adjusted reset the lock.

REPACKING

When all the packing adjustment has been taken up, a single ring of packing can be added. However, it is usually more satisfactory to repack the pump.

Before repacking the pump, see cross section showing the packing arrangement, and number of packing rings. The three or four rings adjacent to the packing gland can be replaced without disassembling the pump. The ring in front of the lantern seldom needs replacing.

To repack proceed as follows:

1. Loosen the packing gland lock.

2. Loosen he packing gland. If the gland is tight on the threads, soak the threads with penetrating oil and work the gland back and forth to free it. If the front portion of the gland is of the split type, remove the two halves. If not, loosen the gland all the way until it drops out of the threads.

3. Remove the old packing rings with a packing hook. This hook can be made from a bent piece of stiff wire or small pointed rod, bent on one end. Another type of packing hook consists of a corkscrew on the end of a flexible shaft. Remove all shreds of old packing and clean out the packing housing as much as possible.

4. Remove any old packing, dirt or foreign matter from the bearing housing under the gland and clean out the drain holes. If this is not done, water leaking from the packing may accumulate and eventually get into the drive unit.

5. Repack with the proper "HALE" packing furnished for the pump. For most pumps, the packing is 7/16" square graphited asbestos cut to the proper length. Wrap one length of packing: around the shaft to form a ring and push the ring into the packing housing. Install the second ring the same way but stagger the joint one-third of the way around from the first joint. Install the other rings, again staggering the joint.

Repacking (Continued)

6. Replace the gland and adjust the packing as described under "Packing Adjustment".

The first packing adjustment may be required after a shorter interval than subsequent adjustments. Therefore, it is advisable to operate the pump for about a half hour and then tighten the packing again if necessary.

If pump requires frequent repacking it may be caused by a "scored" pump shaft. If this is the case, it is advisable to recondition or replace the shaft.

CHECKING PUMPER PE,RFORMANCE

The National Board of Fire Underwriters is most cooperative in checking the performance of pumpers. Many fire companies, however, like to make periodic checks themselves at reasonably frequent intervals, to determine that the apparatus is approximately up to its original performance. Every fire pumper has a "rating" usually Class A, or for older pumpers, Class B.

The Class A Underwriters' rating is:

RATING	EXAMPLE
Capacity at 150 PSI	750 GPM at 150 PSI
7/10 " " 200 PSI	525 " " 200 PSI
1/2 " "250 PSI	375 " " 250 PSI

The Class B Underwriters' rating is:

RATING	EXAMPLE
Capacity at 120 PSI	750 GPM at 120 PSI
1/2 " " 200 PSI	375 " " 200 PSI
1/3 " " 250 PSI	250 " " 250 PSI

Underwriter rated capacities have been 500, 600, 750, 1000, 1250 and 1500 GPM.

GAUGES & LAYOUTS

To accurately test a pumper for performance, a pitot gauge and a pump pressure gauge, both gauges carefully tested for accuracy, are required. Gauge testing can best be done with a dead weight gauge tester, usually available at the local water works. Pumpers should be tested from draft at not over 10 foot lift with 20 feet of suction hose. (1250 and 1500 GPM pumpers frequently require two separate 20 ft. lengths of suction hose.)

Smooth bore nozzles of accurate size should be used with the pitot gauge. The volume pumped is then determined by reference to discharge tables for smooth nozzles. Nozzles should preferably be used on a siamese deluge gun for greatest accuracy. A stream straightener, just upstream of the nozzle is advisable.

Appropriate nozzle sizes are tabulated below:

GPM	CAPACITY	7/10 CAP.	1/2 CAP.	1/3 CAP.
500	1-3/8	1-1/8	1	7/8
600	1-1/2	1-1/4	1-1/8	7/8
750	1-3/4	1-3/8	1-1/4	1
1000	2	1-5/8	1-3/8	1-1/8
1250 two	1-1/2	1-7/8	1-1/2	1-1/4
1500 two	1-3/4	2	1-3/4	1-3/8

For the 500, 600 and 750, two 21"1 lines should preferably be laid from the pumper to the nozzle. For the 1000 gallon, three lines, and for the 1250 and 1500, four or more from the pumper to the nozzle. Since deluge guns are not always available, other hose layouts may be made, such as one 2½" line to a 1-3/8 tip for 500 GPM. In general, the nozzle used on one 2i" hose should not be larger than 1i" for accuracy of measuring GPM. For another example, two separate 2111 lines

with a 1-1/4 nozzle on one and a 1 1/2 nozzle on the other would pass 1000 GPM flow. The sum of the flow from both nozzles is, of course, the GPM delivered by the pump. For good pitot gauge accuracy the nozzle pressures should be between 40 and 85 PSI.

Since the Underwriter's ratings specify both GPM and pressure, it is usually necessary to restrict the "low somewhat in order to build up the pump pressure. In normal pumping, this restriction would be caused by the friction loss in the lines. However, depending on line loss alone would require a large amount of hose for some tests. For example, testing a 500 GPM Class A pumper at 250 GPM and 250 PSI requires 72 PSI nozzle pressure on a 1" tip. To reduce the pressure from 250 PSI at the pump to 72 PSI at the nozzle would require 11001 to 1200! of 21" hose. Therefore it is common practice to use 501 or 100' of hose and gate the discharge valves as required.

TESTING AT CAPACITY

Underwriters now require the 10% reserve in pressure at the capacity run when the apparatus is delivered.

The pumper should first be tested for capacity, for instance, 750 GPM at 150 PSI. It is best to run at capacity for 20 to 30 minutes to be sure there will be no overheating or loss of power. If the pumper will not reach capacity at the rated pressure, it needs a thorough check up.

Assuming the pumper does reach capacity, it is then desirable to know how much reserve is available. If there is some reserve at capacity the engine throttle will not have been wide open. Now open the throttle wide. The pump pressure will increase, and the flow will also increase. Sate the discharge valves slightly until the nozzle pressure (and flow) is the same as during the capacity run. A 10% increase in pressure (150 to 165 PSI) indicates that the pumper has reasonable reserve and that the engine is delivering ample power and that the pump is in good condition. A lower increase is acceptable, but no increase, or a one to two percent increase in pressure when the throttle is opened wide may indicate that performance has dropped.

It may be that the pumper did not show a 10% reserve in pressure when it was delivered. Compare the test performance with the performance at time of delivery. These records should be on file with the pumper delivery papers. If not, they may be procured from she manufacturer of the apparatus or from the local Underwriters. If the pumper performance has dropped appreciably compared to its original performance, it is in need of service.

TESTING PRESSURE

The pumper should now be checked at 7/10 capacity (Class A) or 1/2 capacity (Class B) at 200 PSI, and 1/2 capacity (Class A) or 1/3 capacity (Class B) at 250 PSI. If the apparatus fails to pump its required volume at either 200 or 250 PSI, it should be thoroughly checked. Assuming the pressure tests did not require wide open throttle, the skillful operator will open the throttle wide long enough to determine the reserve in pressure at the 7/10, 1/2 or 1/3 capacity, as was done for capacity test. Compare results with performance of the pumper when new. An appreciable drop indicates need for service.

ENGINE SPEED

Engine speed is important on all three tests and should be recorded, and compared to the original speeds at time of delivery. Engine RPM should not exceed 80% of its peak horsepower speed at capacity and should not exceed 90% on the 200 and 250 pound run. Engine speed can, to some extent, be a guide to condition of pumps.

A substantially higher engine speed on any one of the three tests, compared to the speed on the same test when the pumper was new, indicates air leaks, a restricted suction hose or strainers, foreign matter within the pump, especially impellers, or too high a lift. A low engine speed, together with poor pump performance indicates lack of engine power, worn clearance rings and/or by-passing. Churn valves, circulator valves, relief valves, booster tank plumbing and valves, and sometimes central drains, can all allow by-passing.

MISCELLANEOUS

During the tests the priming system should be checked. See instructions under "Final Test Before Housing Fire Truck".

The relief valve should also be checked on the capacity and two pressure runs.

WHAT IS WRONG IF THE PUMPER DOES NOT MEET ITS CAPACITY AT ANY ONE OF THE THREE TESTS

1. Low Engine Horsepower. This is the most likely cause. This is especially true when engine speeds tend to be lower than the original speeds, at or near the three test spots. Possible causes of low engine power:

Throttle linkage not opening engine throttle fully.
Ignition timing incorrect.
Restricted fuel flow due to clogged filter bowl or other restriction.
Engine running too hot.

The above causes are relatively simple to correct and sometimes can be adjusted immediately so the test can proceed.

Slipping Clutch.
Exhaust restricted.
Bad Spark plugs, coil, condenser or points.
Poor carburetion.
Leaking or sticking valves.
Worn piston rings.
Poor compression in one or more cylinders.

These causes are more serious and indicate a thorough engine tune-up or other repairs are necessary.

2. *Air Leaks*. A frequent cause of low performance, recognized by excess motor speed, hose pulsation and unsteady pressure gauge. Remedy - Check pump for holding vacuum, find leaks. Sometimes these leaks are in the booster tank plumbing. Leaks can usually be heard when the motor is stopped. See instructions. Priming will be delayed by an excessively leaking packing gland.

3. *Suction Obstructions*. These cause higher than normal engine speed and reduced capacity. They also cause fluctuation of the pressure gauge and a high vacuum reading on the compound gauge.

The obstructions may be foreign matter such as grass or leaves on the suction hose strainer or in the pump suction tube strainer. To check the strainers, shut down and open a discharge valve very slightly, letting the water run back down the suction hose slowly. This will prevent the foreign matter from being flushed out so that it can be observed and the cause of the trouble determined.

The obstruction may be caused by a collapsed suction hose lining. Old or defective suction hose may have a loose lining that is pulled inward by a vacuum, substantially reducing the flow through the hose. It is difficult to see because the lining usually goes back into place when the hose is removed. Usually, however, there appears to be a low blister on the lining where it has pulled away from the carcass of the hose. Remedy - replace the defective hose.

4. *Foreign Matter in the Impellers*. This causes higher than normal engine speed and reduced capacity. However, it does not cause an abnormally high vacuum on the compound gauge.

To clean foreign matter out of impellers usually requires removal of half of the pump body and pushing the obstruction out of the impellers with a rod by hand. When the pump is open, it is well to check the "clearance" or "sealing" rings for abnormal wear. See '"Worn Clearance Rings and Impeller Hubs".

5. *Lift too High*. This will cause high engine speed, high vacuum, pump roughness and a pulsating pressure Gauge. Remedy - do not test at over 10 ft. lift, with not more than 20 ft. of suction hose.

6. *Pumping in Wrong Transmission Gear*. Not a frequent trouble, but has been done. Recognized by too high an engine speed (in lower gears), too low an engine speed (in overdrive). Shift into correct gear as specified by the manufacturer.

7. *By-Passing Around Pump*. Recognized by reduced capacity and greater than normal throttle opening. Cause - Relief valve control set at too low a pressure allowing main relief valve to by-pass. Screw in control until relief valve closes. Booster tank fill line open. Close this. Leaking valves in plumbing. Leaking churn or circulator valves (See "ENGINE SPEED'").

8. *Pump Operating in Pressure Instead of Volume*. If pump is operating in pressure instead of volume you will not be able to get the rated capacity at 120 or 150. Capacity pumping should be done in volume.

Pumping 7/10 capacity at 200 PSI may be done in volume or in pressure, whichever gives the better performance, (usually volume) at not more than 90% of peek speed.

It should be remembered that the pumping is being done from draft. Pumping from draft at volumes over 1/2 capacity should be done as a general rule in volume and for pressures of 200 PSI or under. This does not apply to single stage pumps.

9. Pumping in Volume Instead of Pressure. If pump is operating in volume instead of pressure at 1/2 or 1/3 capacity, the engine speed may be too high. Pumping 1/2 capacity at 200 PSI (Class B) may be done in Pressure or Volume, whichever gives the best performance (Usually pressure). Pumping 1/2 or 1/3 capacity at 250 is usually done in Pressure. As a general rule use the pressure position above 200 PSI. This does not apply to single stage pumps.

10. Not Enough Pressure in Series. (Two stage pumps only). The causes for low performance in Volume, such as low engine power, by-passing, etc. also apply to Pressure operation. An additional cause in Pressure could be check valve stuck open. Remove suction hose and opposite suction cap. Remove suction tube strainers. Reach into second stage suction by hand or with a rod and push check valve on each side of pump to determine that they swing freely. When released, they should strike the seat sharply. If they do not, there may be foreign matter on the seat. They must seat tightly. Remove the foreign matter. A leaking check valve allows by-passing of the first stage thereby reducing the pressure which it will develop. If the transfer valve is not fully turned into the proper position, it will also cause loss or pressure.

11. Worn Clearance Rings and Impeller Hubs. Since clearance ring replacement requires pump disassembly, it is advisable to thoroughly check other possible causes of low performance before assuming that clearance ring wear is the cause.

"Clearance" rings or "sealing" rings hold to a negligible amount the internal by-pass of water from the discharge side of the pump back to the suction. The radial clearance between the impeller hub and the clearance rings is only a few thousandths of an inch when new, effectively preventing a large by-pass. In clear water they continue to effectively seal for hundreds of hours of pumping. In dirty or sandy water the impeller hub and clearance ring will wear faster than in clean water. The more they wear the greater the by-pass and the lower the performance. Also, the greater the pressure at which each stage is operated, the larger will be the by-pass and the more the performance will be reduced.

When new, the radial clearance between the impeller hubs and the clearance ring is from 5 to 7 thousandths of an inch. Any increase will allow more by-pass and lower performance, but when the pump is adequately powered it should not be necessary to replace clearance rings and impellers until the average radial clearance reaches 15 to 20 thousandths or more, as measured by a feeler gauge.

Since the clearance rings normally wear faster than the impeller hubs, frequently it is necessary to replace only the clearance rings. This will largely reduce the by-pass (or slip as it is sometimes called) and restore the pump to near original performance. A complete restoration requires that the impellers also be replaced.

When the pump is partly disassembled for checking, the clearance rings, the shaft, packing and bearings should also be checked for wear.

HALE MODEL VPS AUTOMATIC PUMP SHIFT
(Midship type pumps only)

A. GENERAL

The Hale model VPS is a remote, pneumatically operated shifting device (an alternative to manual shift) to accomplish shifting of the pump transmission from "Road to Pump" position or "Pump to Road" position.

This arrangement utilizes available truck vacuum or air pressure to power the shift system and is activated by an in-cab control valve. Current models of this system are equipped with two green warning lights; one in the truck cab adjacent to the shift control valve and another next to the throttle control on the pump operator's panel. The green lights will illuminate when a successful shift into pump position has been completed.

CAUTION: Do not leave driver's seat until the green light, adjacent to the shift control is lit. Do not open hand throttle (or attempt to pump) until green light on pump operators panel is lit.

B. SHIFT SEQUENCE

The procedures and sequence for completing the shift are as follows:

ROAD TO PUMP SHIFT

1) Bring vehicle to a complete stop before attempting to shift.
2) Apply vehicle parking brake.
3) Shift truck transmission into "Neutral" position,
4) Pull in-cab control valve all the way out (about 3/4") and twist clockwise to lock.

NOTE: If truck manufacturer has used another in-cab valve to achieve pump shift, follow instructions supplied with that valve.

5) The green shift warning light should come on in a second or two, indicating a completed shift.

NOTE: In addition, the speedometer should read 5-15 MPH after shift has been completed, If shift does not seem to be completed, repeat entire procedure,

6) Place truck transmission in proper operating range or gear for direct drive (1:1 ratio).

7) With the above completed satisfactorily, exit cab.

CAUTION: Do not leave cab or attempt pumping until warning lights in cab and pan el are both on,

PUMP TO ROAD SHIFT

1) Make sure pump operator's hand throttle or governor control has been returned to idle speed.
2) Shift truck transmission into "Neutral" position.
3) Twist valve knob counterclockwise and "Push" control valve all the way forward into "Road" position.
4) In-cab and panel warning lights should go out when pump transmission starts to shift into "Road" position.

Pre 1977 fire trucks (especially with automatic transmissions) should be modified by the apparatus builder to include the aforementioned green warning lights.

C. EMERGENCY SHIFT PROCEDURES

Before implementing manual override shift procedures, repeat recommended procedures as outlined previously. If shift fails to take place, follow these procedures.

1) Vehicle should be completely stopped, wheels chocked and parking brake set.
2) Truck transmission should be in neutral position.
3) For "Pump Position", pull in-cab control valve out and twist to lock. For "Road Position", push in-cab control valve in (forward or down).
4) Shut down engine.
5) Proceed to employ manual override procedures at the shift cylinder on the pump gear box.

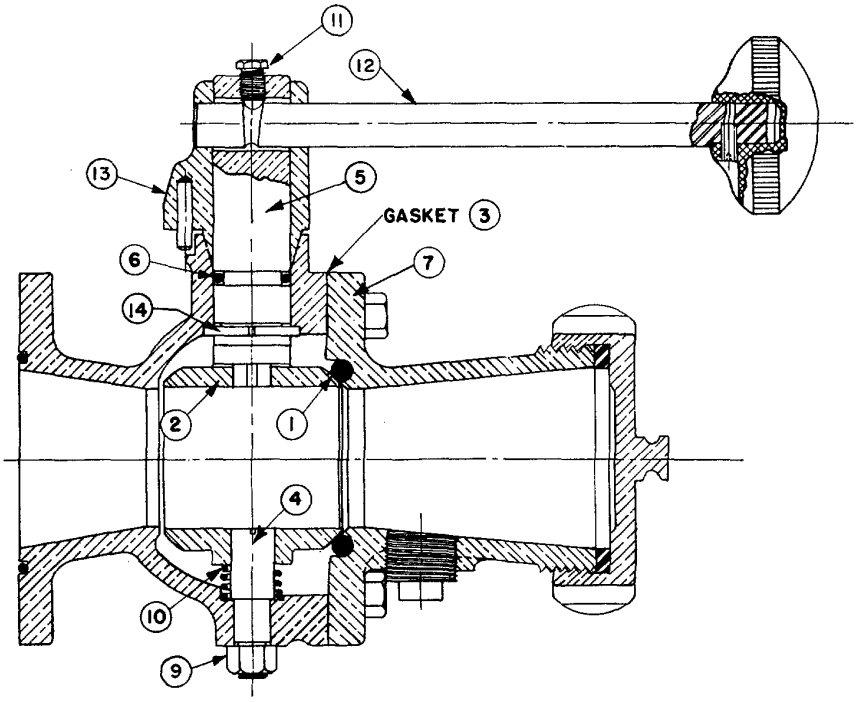
   A hole has been provided in the shift shaft to accept a drift punch or screw driver. By inserting this tool into the hole provided, it will enable you to pull or push the shaft manually. Pull the shift shaft "out" for Pump Position (after in-cab control valve selection) or push shift shaft "in" for Road Position (after in-cab control valve selection). If the shift stroke cannot be completed manually, rotate the drive shaft slightly by hand to realign the internal gears and repeat the manual shift effort.

D. MAINTENANCE

Minimum maintenance is required on this shift system. Lubricate the shift cylinder once a year by squirting a few drops of light cylinder oil (BK vacuum cylinder oil or equivalent) into the shift cylinder thru the compression fittings in the front or side of the cylinder.

Lubricate the in-cab control valve every three months by squirting a few drops of light oil into the valve thru the center (supply) compression fitting of the valve.

SERVICE INSTRUCTIONS FOR BL & B SERIES VALVES



LUBRICATION

Using a brush, lubricate the face of the ball (2) with a waterproof grease once a week. Additionally, on a suction valve, squirt some oil in the space next to the rubber washer to lubricate the swivel balls. The remote control linkage connecting the valves should be lubricated monthly.

If a drain valve is installed on the discharge valve, insert an oil can tip in the open end of the discharge valve and allow some oil to run down the connecting pipe to the closed drain valve. If the discharge valve has a built-in drain valve, oil the passageway that the drain valve piston slides in and then move the piston back and forth to lubricate the seal rings.

SERVICE

If the valve leaks, it is probably due to the "O" ring seal (1) not pressing tightly enough against the ball (2). To increase the pressure of the "O" ring (1) against the ball (2), remove on cover gasket (3) and reassemble. If valve still leaks, remove another gasket. The valve is usually assembled with two or three gaskets. Do not remove too many gaskets. The valve should turn easily yet hold a vacuum and pressure. Never remove the last gasket. If you are down to the last gasket and the valve still leaks, turn the "O" ring (1) around and put the new side against the ball (2). If this fails, install a new "O" ring (1). If the valve has high usage and wear, it might be necessary to install a new ball (2), pivot (4) or stem (5). Should the valve leak up thru the stem (5), install a new stem "O" ring (6).

If the valve handle is hard to turn, first check to see if the twist lock feature is releasing and all the parts are free to move. To do this, remove cover (7) (see disassembly instructions). If the handle is hard to turn with the cover removed, completely disassemble the valve, clean the parts, and check mating surfaces for nicks and scratches.

If the valve handle turns easy with the cover removed, the seal (1) may be swollen and is pressing too hard against the ball (2). Replace the seal (1) with a new one that is made from a special anti-swelling, synthetic rubber compound. The new rings made from this compound can be easily identified by the yellow dot on the outside surface.

TO DISASSEMBLE VALVE

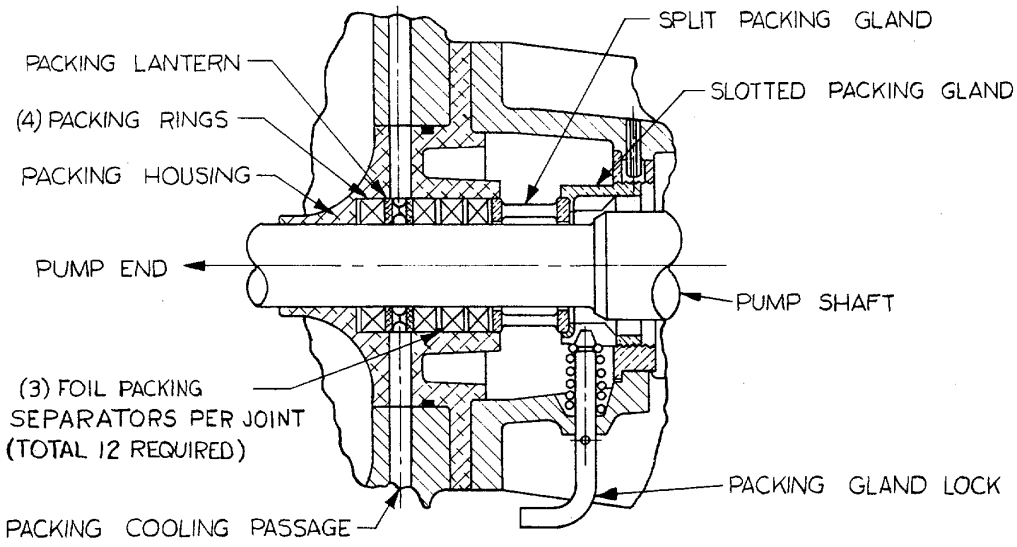
Remove cover (7) and "O" ring (1). Take off nut (9), tap pivot (4) up through the ball and remove. Remove ball (2) and spring (10). Remove adjusting screw (11), handle (12) and stop (13). On some valves, the handle adjusting screw (11) will be two pieces. In this case, loosen the nut and then remove the screw. Push stem (5)in and remove split shoulder ring (14). Pull out stem (5).

TO ADJUST HANDLE LOCK

Both the handle (12) and adjusting screw (11) are made of hardened steel and should wear very little in service. If the lock on the handle does not function, adjust as follows:

Put handle (12) thru stop (13) and stem (5). Enter adjusting screw (11) in the cam slot of handle (12). Turn knob to unlocked position and tighten adjusting screw (11). Back off on adjusting screw (11) until handle (12) locks with 1/8 to 1/4 turn. Valve ball (2) must be free to turn. The adjusting screw will stay in the set position due to the nylon locking element on the threads. If the valve is equipped with a set screw and nut, hold the screw in the set position and tighten the locking nut.

HALE FIRE PUMP COMPANY
700 Spring Mill Avenue/Conshohocken, Pa. 19428

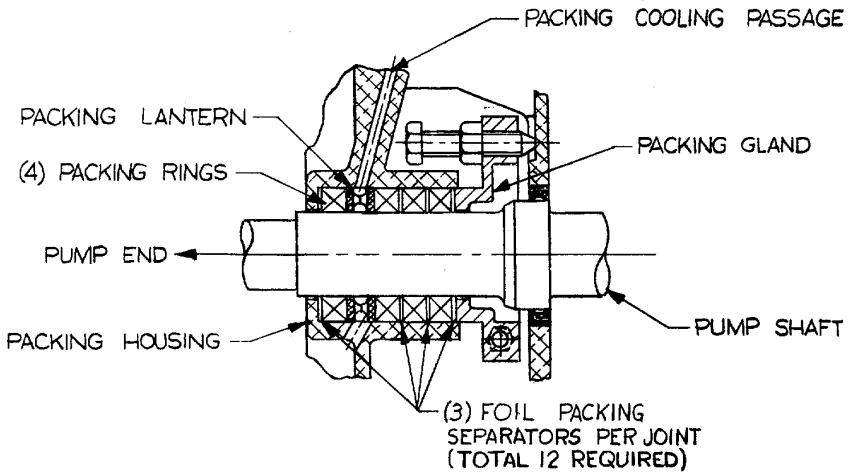


QLD, QLF, QSD, QSF, Q, QSMD & QSMF PUMP SERIES

PACKING ARRANGEMENT USED ON QLD PUMPS SERIAL NO. 24071 AND UP.
PACKING ARRANGEMENT USED ON Q PUMPS SERIAL NO. 26337 AND UP.

HALE FIRE PUMP CO.
CONSHOHOCKEN, PA.
5-21-76 FRE

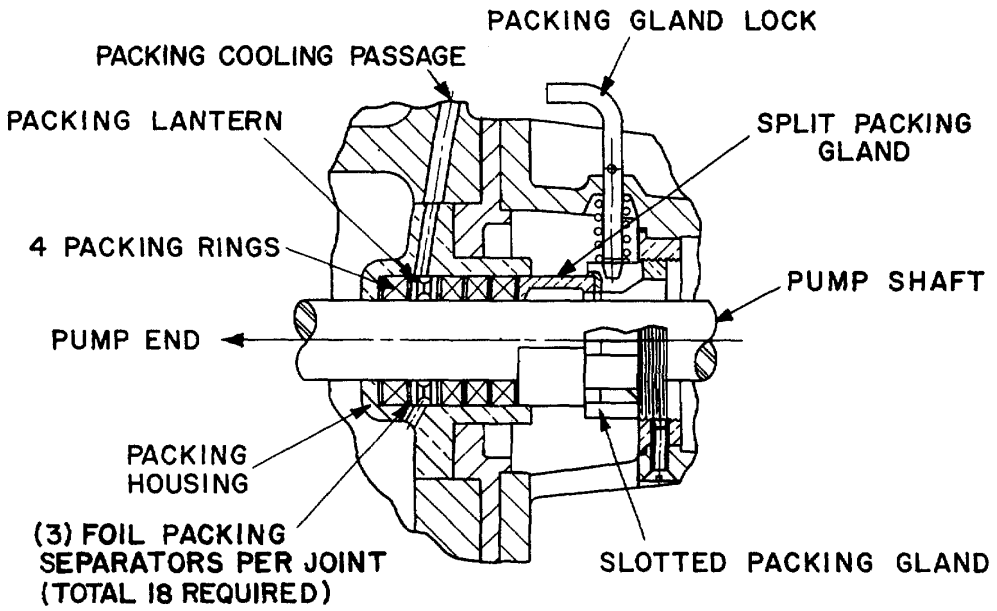
PLATE NO. 561A



P75 PUMP SERIES

HALE FIRE PUMP CO.
CONSHOHOCKEN, PA.
1-21-71 ADS

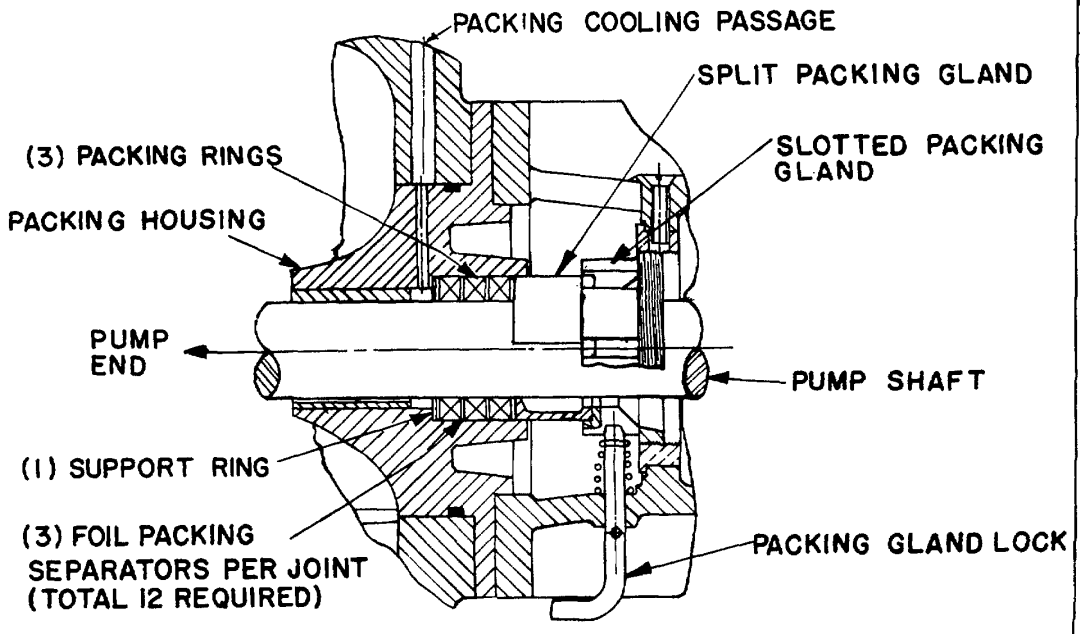
PLATE NO. 562A



HALE QL & QS PUMP SERIES

HALE FIRE PUMP CO.
CONSHOHOCKEN, PA.
1-21-71 ADS.

PLATE NO. 329A



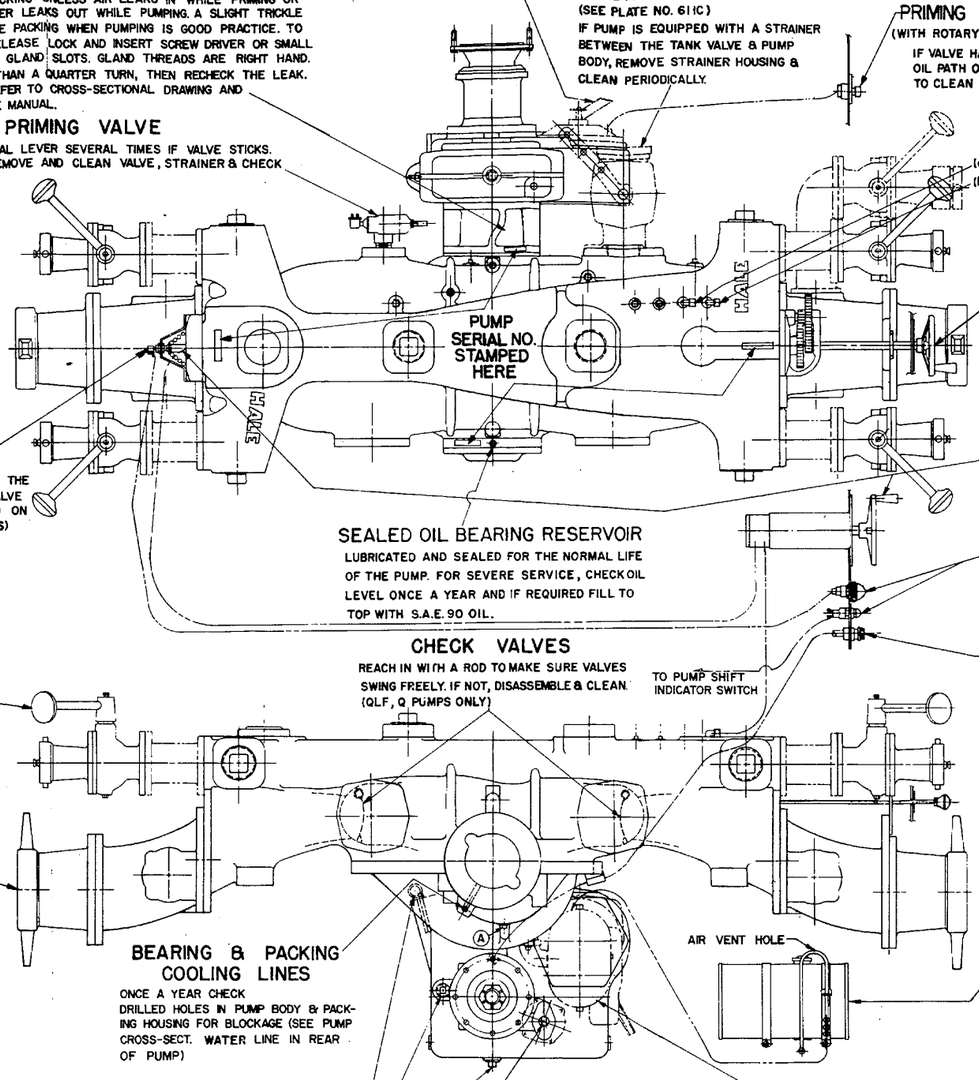
Q, QLD, & QSM PUMP SERIES

PACKING ARRANGEMENT USED ON QLD PUMPS UP TO SERIAL NO. 26149
PACKING ARRANGEMENT USED ON Q PUMPS UP TO SERIAL NO. 26336

HALE FIRE PUMP CO.
CONSHOHOCKEN, PA.
1-21-71 ADS

PLATE 398A

SERVICE CHART
HALE TYPE
QLF, QSF, Q & QSMF
PUMPS



PUMP PACKING

DO NOT TIGHTEN PACKING UNLESS AIR LEAKS IN WHILE PRIMING OR CONSIDERABLE WATER LEAKS OUT WHILE PUMPING. A SLIGHT TRICKLE OF WATER FROM THE PACKING WHEN PUMPING IS GOOD PRACTICE. TO TIGHTEN PACKING RELEASE LOCK AND INSERT SCREW DRIVER OR SMALL ROD IN ONE OF THE GLAND SLOTS. GLAND THREADS ARE RIGHT HAND. TIGHTEN NO MORE THAN A QUARTER TURN, THEN RECHECK THE LEAK. TO REPACK PUMP REFER TO CROSS-SECTIONAL DRAWING AND INSTRUCTIONS IN THE MANUAL.

PRIMING VALVE

OPERATE MANUAL LEVER SEVERAL TIMES IF VALVE STICKS. IF IT LEAKS, REMOVE AND CLEAN VALVE, STRAINER & CHECK "O" RINGS.

PRIMING PUMP MANUAL CONTROL

TANK VALVE & CHECK VALVE

INSPECT CHECK VALVE TO SEE THAT IT SWINGS FREELY & SEATS PROPERLY. (SEE PLATE NO. 611C)

IF PUMP IS EQUIPPED WITH A STRAINER BETWEEN THE TANK VALVE & PUMP BODY, REMOVE STRAINER HOUSING & CLEAN PERIODICALLY.

PRIMING CONTROL VALVE

(WITH ROTARY GEAR PRIMING PUMP ONLY.)

IF VALVE HAS A TENDENCY TO STICK, OIL PATH OF BUTTON OR DISASSEMBLE TO CLEAN & LUBRICATE.

STRAINERS

(a) FOR RELIEF VALVE CONTROL
(b) FOR POWER TRANSFER VALVE

TRANSFER VALVE (QLF & Q PUMP ONLY)

(a) MANUAL OPERATION GEARS - REMOVE OLD GREASE. APPLY MULTIPURPOSE GREASE ONCE A YEAR
(b) POWER OPERATION - IF EITHER THE PILOT VALVE OR THE HYDRAULIC POWER PISTON HAS A TENDENCY TO STICK, DISASSEMBLE & CLEAN THOROUGHLY. THE TRANSFER VALVE CAN BE MANUALLY OPERATED BY EITHER THE 1" HEX & A WRENCH OR BY A $\frac{3}{8}$ ROD IN THE HOLE IN THE END OF THE INDICATOR STEM.

RELIEF VALVE

PILOT LIGHT SWITCH
ONE WIRE CONNECTED TO THE BATTERY. THE OTHER WIRE CONNECTED TO RELIEF VALVE CONTROL PILOT LIGHT. (NOTE: LOCATED ON OPPOSITE SIDE ON QSF & QSMF PUMPS)

RELIEF VALVE & CONTROL VALVE (SHOWN)

SEE PLATE NO. 404D

ENGINE GOVERNOR SEE PLATE NO. 516A

SEALED OIL BEARING RESERVOIR

LUBRICATED AND SEALED FOR THE NORMAL LIFE OF THE PUMP. FOR SEVERE SERVICE, CHECK OIL LEVEL ONCE A YEAR AND IF REQUIRED FILL TO TOP WITH S.A.E. 90 OIL.

INDICATOR LIGHTS

BULB NO.	BASE	VOLTS	WHERE USED
81	SINGLE CONTACT BAYONET	6	RELIEF VALVE
89	SINGLE CONTACT BAYONET	12	RELIEF VALVE
906-6	DOUBLE CONTACT BAYONET	12	RELIEF VALVE
1891	SINGLE CONTACT BAYONET	12	RELIEF VALVE, THROTTLE & SHIFT INDICATOR LIGHTS

SPEED COUNTER ATTACHMENT & RATIO - STANDARD EQUIPMENT

CHECK VALVES

REACH IN WITH A ROD TO MAKE SURE VALVES SWING FREELY. IF NOT, DISASSEMBLE & CLEAN. (QLF, Q PUMPS ONLY)

TO PUMP SHIFT INDICATOR SWITCH

DISCHARGE VALVES

SEE PLATE NO. 313B ON CARE OF B & BL SUCTION OR DISCHARGE VALVES.

SUCTION TUBE

(a) STRAINERS - THESE ARE SPRUNG INTO POSITION AND CAN BE REMOVED EASILY FOR CLEANING.
(b) THREADS - IF CAST IRON, COAT LIGHTLY WITH GREASE ONCE A MONTH.
(c) WASHERS - CHECK SUCTION TUBE CAPS AND HOSE WASHERS FREQUENTLY, FOREIGN MATTER UNDER WASHERS WILL CAUSE AIR LEAKS AND MAKE PRIMING DIFFICULT OR PRODUCE A PULSATING STREAM.

BEARING & PACKING COOLING LINES

ONCE A YEAR CHECK DRILLED HOLES IN PUMP BODY & PACKING HOUSING FOR BLOCKAGE (SEE PUMP CROSS-SECT. WATER LINE IN REAR OF PUMP)

AIR VENT HOLE

OIL TANK

KEEP TANK FULL, USE S.A.E. 30 MOTOR OIL. IF PRIMING OPERATION IS NOT USING OIL, WATER IS COMING INTO THE TANK FROM THE MAJOR PUMP. THIS OCCURS IF THE PRIMING VALVE LEAKS WHILE MAJOR PUMP IS RUNNING. TO CORRECT, DRAIN TANK & SERVICE PRIMING VALVE.

GEAR CASE

(a) DIP STICK
(b) OIL LEVEL - FILL PLUG
(c) DRAIN PLUG - MAGNETIC
(d) FLUSH OUT OIL AND RENEW EVERY 6 TO 12 MONTHS DEPENDING ON USE OF PUMP.
(e) USE SAE EP-90 OIL.
FILL TO MARK "H" ON DIPSTICK.
CAPACITY - QLF & QSF = 4 QTS.
Q & QSMF = 4½ QTS.

PUMP SHIFT

IF EQUIPPED WITH VPS POWER SHIFT, LUBRICATE SHIFTING CYLINDER & PISTON ONCE A YEAR WITH A FEW DROPS OF VACUUM CYLINDER OIL.

PRIMING PUMP

ALWAYS OIL PRIMING PUMP AFTER USING.
(a) VACUUM OR AIR TYPE PRIMING - ENGAGE MAJOR PUMP AND SET ENGINE FOR 800-1000 R.P.M., THEN ENGAGE PRIMING PUMP.
(b) ELECTRIC TYPE PRIMING - ENGAGE PRIMING PUMP
RUN PRIMING PUMP UNTIL OIL SPRAYS OUT OF DISCHARGE.
IF OIL CONTINUES TO RUN AFTER MOTOR IS STOPPED, CHECK OIL TUBE AIR VENT HOLE TO MAKE SURE IT IS OPEN. SEE LUBRICATION SYSTEM IN THE INSTRUCTION MANUAL.
SEE PLATE NO. 509 (ELECTRIC PRIMING) OR PLATE NO. 413 (VACUUM OR AIR PRIMING)

DRAINS

AFTER USING THE PUMP, DRAIN IN THE FOLLOWING MANNER - (IMPORTANT IN FREEZING WEATHER)

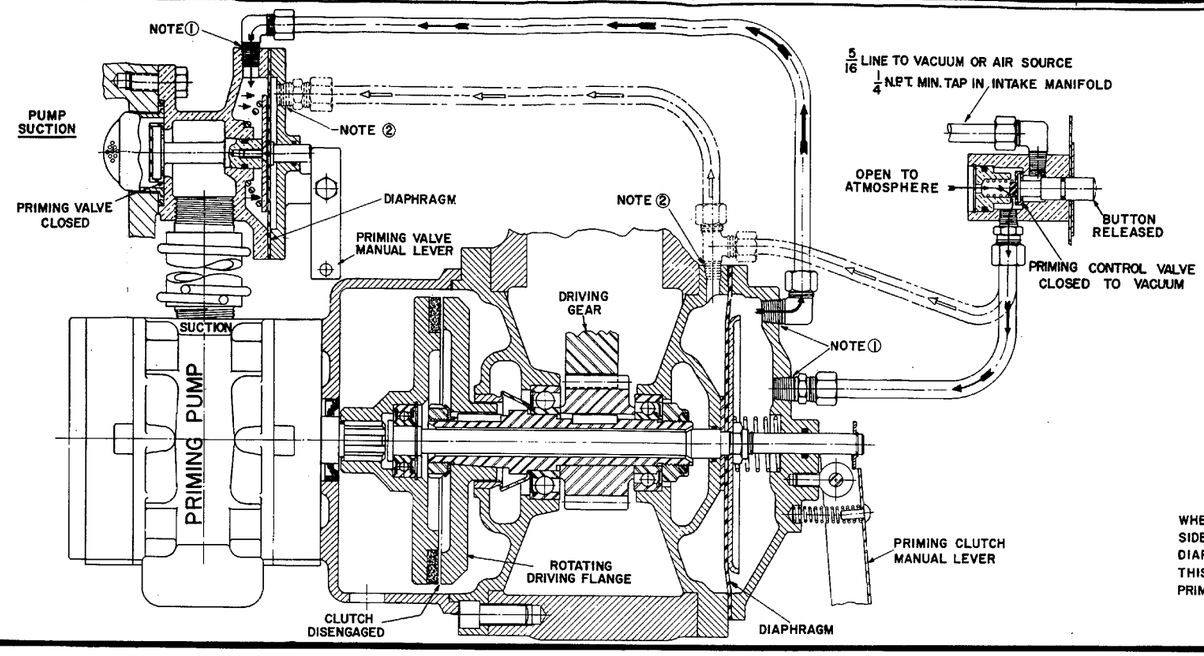
1. OPEN DISCHARGE VALVES, REMOVE SUCTION TUBE CAPS & DISCHARGE VALVE CAPS.
2. OPEN PUMP BODY DRAIN COCKS Ⓐ OR "HALE" MULTIPLE DRAIN VALVE. IF MULTIPLE DRAIN VALVE IS USED, ALL PUMP DRAIN LINES SHOULD BE CONNECTED TO THIS VALVE.
3. ON QLF & Q PUMP (2 STAGE) MOVE TRANSFER VALVE TO BOTH THE VOLUME & PRESSURE POSITIONS. NOTE: IF THE PUMP IS EQUIPPED WITH A POWER TRANSFER VALVE, OPEN THE DRAIN VALVES SO THAT THE PILOT VALVE AND ACTUATING PISTON WILL DRAIN.
4. SEE GOVERNOR INSTRUCTIONS FOR DRAINING ENGINE GOVERNOR.
5. AFTER THE PUMP IS COMPLETELY DRAINED, ALL THE CAPS SHOULD BE REPLACED AND THE VALVES CLOSED.

THIS CHART CAN BE SUPPLIED IN TWO SIZES
11 X 17 LITHOGRAPH
28 X 42 BLUEPRINT

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CONSHOHOCKEN, PENNA.

PLATE NO. 470E

1-18-78 FRE



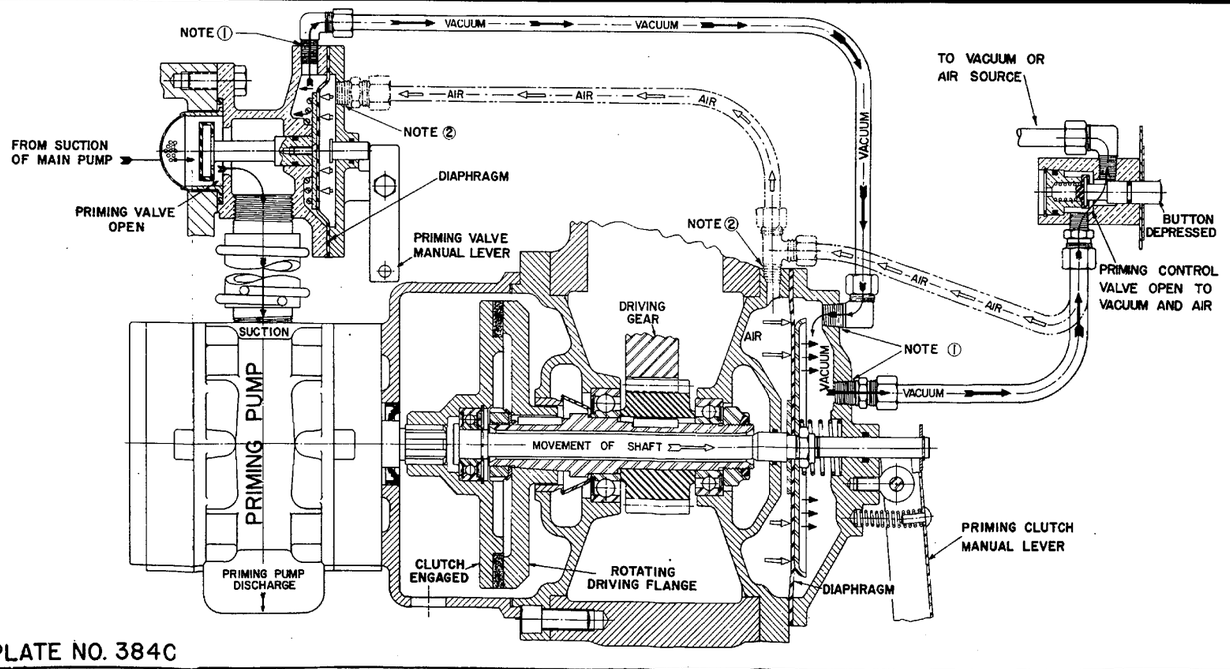
OPERATION OF

HALE CLUTCH PRIMING SYSTEM

VACUUM OR AIR OPERATION

NOT PRIMING

WHEN THE PRIMING BUTTON IS RELEASED, THE AREAS ON BOTH SIDES OF THE PRIMING VALVE DIAPHRAGM & PRIMING CLUTCH DIAPHRAGM ARE SUBJECTED TO ATMOSPHERIC PRESSURE. WHEN THIS CONDITION EXSISTS, THE PRIMING VALVE IS CLOSED & THE PRIMING PUMP CLUTCH IS DISENGAGED BY SPRING FORCE.



PRIMING

WHEN THE PRIMING BUTTON IS PUSHED IN, THE AREA ON THE INSIDE OF THE PRIMING VALVE DIAPHRAGM & THE OUTSIDE OF THE PRIMING CLUTCH DIAPHRAGM ARE SUBJECTED TO VACUUM FROM THE ENGINE INTAKE MANIFOLD. IN THE PRIMING VALVE, ATMOSPHERIC PRESSURE ON THE OUTSIDE OF THE DIAPHRAGM PUSHES THE VALVE OPEN, CONNECTING THE PRIMING PUMP SUCTION TO THE MAIN PUMP SUCTION. THE PRIMING CLUTCH IS ENGAGED BY ATMOSPHERIC PRESSURE PUSHING ON THE INSIDE OF THE PRIMING CLUTCH DIAPHRAGM, THUS DRIVING THE PRIMING PUMP.

LEVERS ARE PROVIDED ON THE PRIMING VALVE AND PRIMING PUMP CLUTCH FOR EMERGENCY MANUAL OPERATION.

THE ABOVE NOTE DESCRIBES VACUUM OPERATION. THE MECHANICAL OPERATION OF THE PRIMING VALVE AND PRIMING PUMP WILL BE THE SAME FOR AIR OPERATION EXCEPT THE AIR CONNECTION WILL BE ON THE OPPOSITE SIDE OF THE DIAPHRAGM.

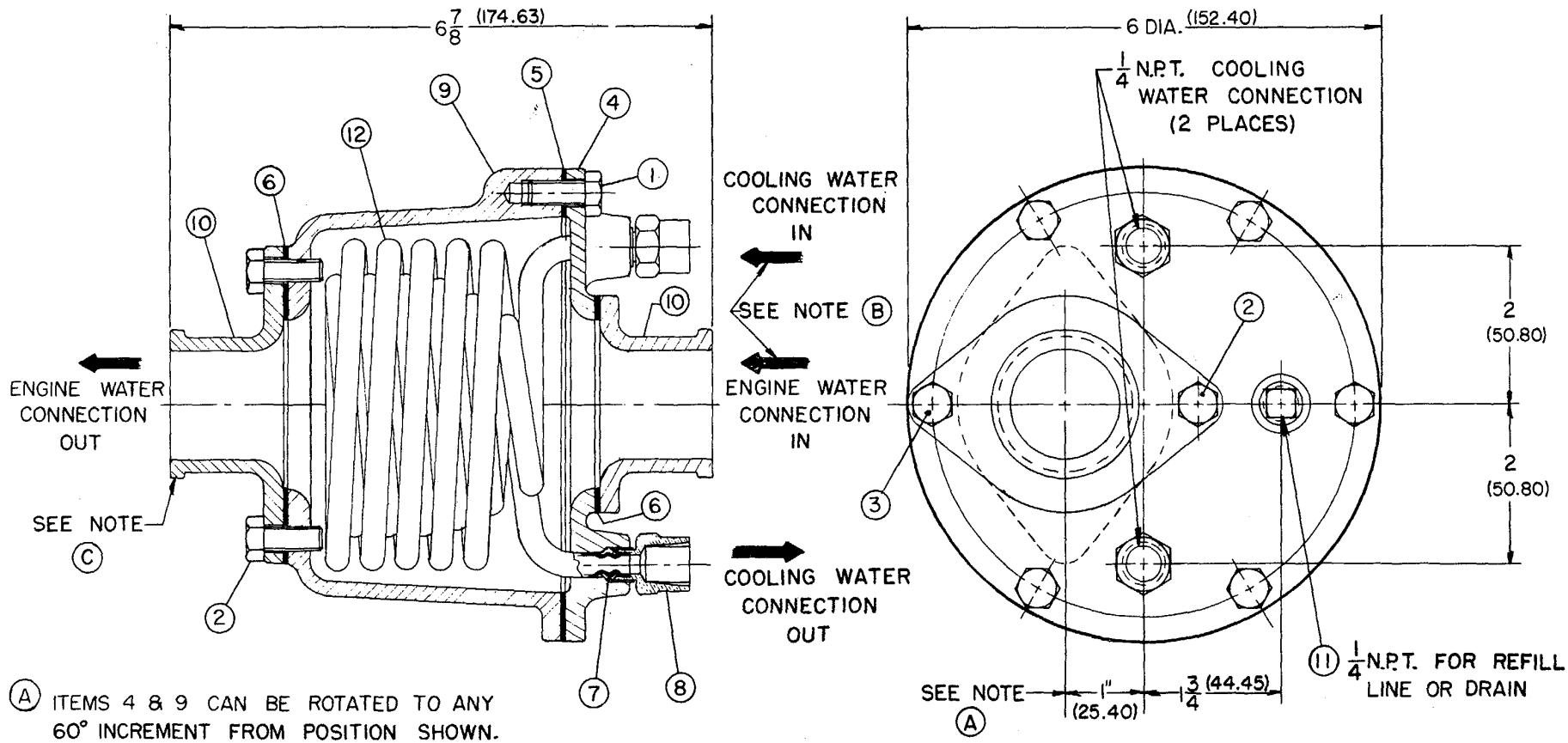
NOTE ① HOLES OPEN TO ATMOSPHERE FOR AIR OPERATION.
NOTE ② HOLES OPEN TO ATMOSPHERE FOR VACUUM OPERATION.

DRAWINGS ILLUSTRATE PRINCIPLE OF OPERATION AND ARE NOT NECESSARILY THE ACTUAL CONSTRUCTION.

HALE FIRE PUMP CO.
CONSHOHOCKEN, PENNA.

PLATE NO. 384C

8-5-68 M.D.D.



(A) ITEMS 4 & 9 CAN BE ROTATED TO ANY 60° INCREMENT FROM POSITION SHOWN.

(B) DIRECTION OF WATER FLOW CAN BE REVERSED.

(C) CONNECTIONS ARE AVAILABLE FROM 1 1/4 (31.75) THRU 2 1/2 (63.5), IN 1/4 (6.35) INCREMENTS.

DIMENSIONS IN "( )" ARE IN MILLIMETERS

HALE TYPE K SERIES HEAT EXCHANGER

HALE PUMPS
CONSHOHOCKEN, PA

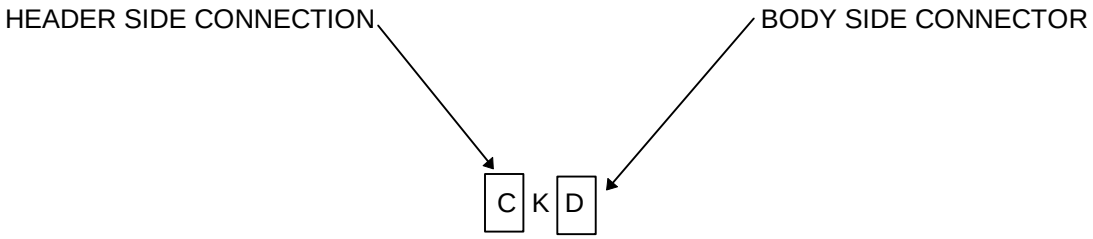
PLATE NO. EQ394

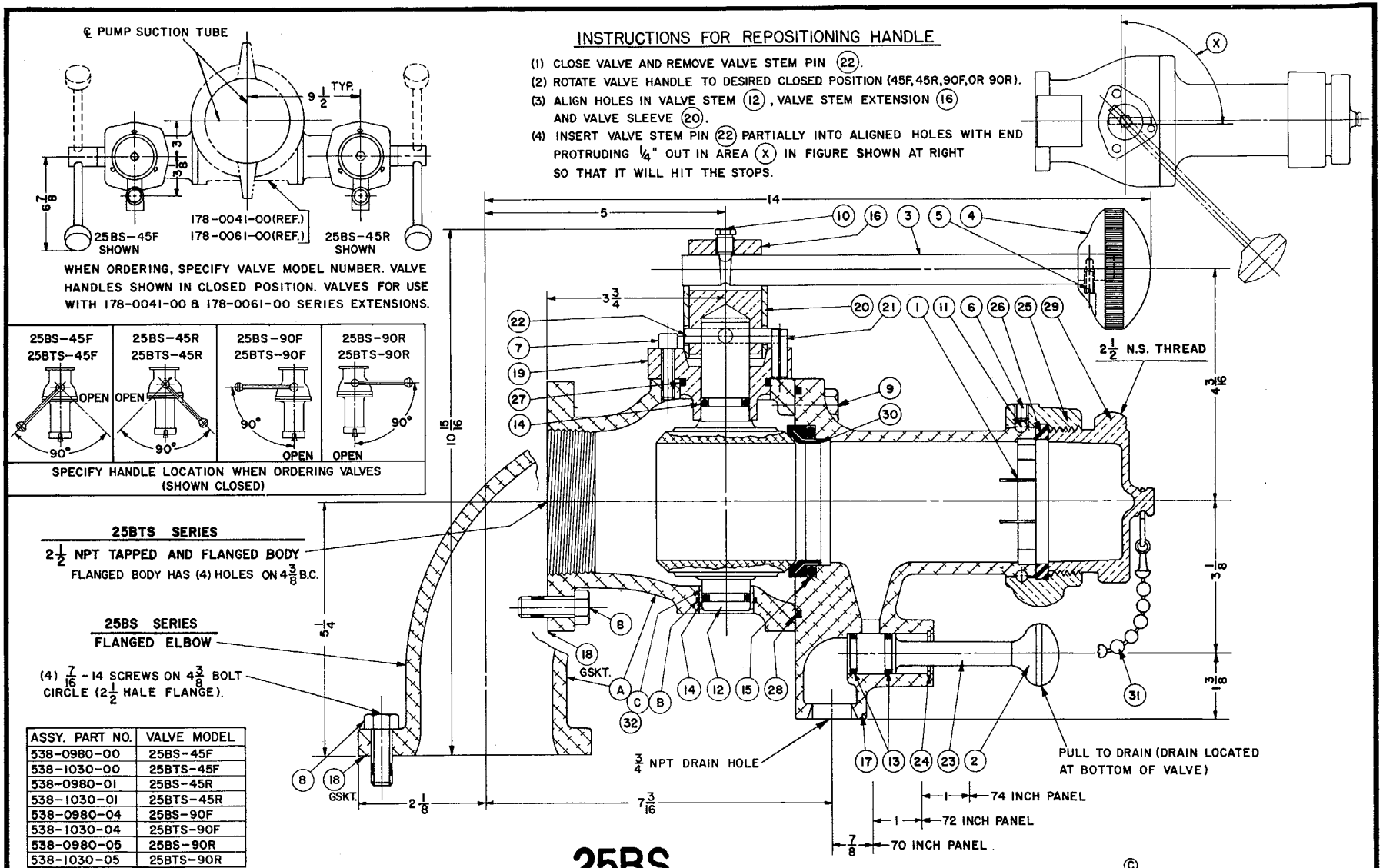
9-8-77 DLM

PARTS LIST HALE TYPE K SERIES HEAT EXCHANGERS PLATE #EQ394

ITEM NO.	PART NUMBER	NAME OF PART	NO. REQ.
1	018-1406-00	SCREW, 5/16-18 X 3/4 LG. STEEL HEX	5
2	018-1406-07	SCREW, 5/16-18 X 3/4 LG. STEEL HEX CAD. PLT. 360° NYLON LOCKING PATCH	3
3	018-1410-00	SCREW, 5/16-18 X 1" LG. STEEL HEX	1
4	044-0670-00	HEADER, HEAT EXCHANGER	1
5	046-5970-00	GASKET, HEADER	1
6	046-5980-00	GASKET, CONNECTION	2
7	048-0510-00	SLEEVE, 5/16" O.D. TUBING	2
8	082-3004-00	CONNECTOR, 1/4" NPT FEMALE X 5/16 TUBE	2
9	108-0180-00	BODY, HEAT EXCHANGER	1
10	*2 REQUIRED IN ANY COMBINATION AS NEEDED:		
	115-0800-01	CONNECTOR, 1-1/4 "B" COOLER	*
	115-0800-02	CONNECTOR, 1-1/2 "C" COOLER	*
	115-0800-03	CONNECTOR, 1-3/4 "D" COOLER	*
	115-0800-04	CONNECTOR, 2 "E" COOLER	*
	115-0800-05	CONNECTOR, 2-1/4 "F" COOLER	*
	115-0800-06	CONNECTOR, 2-1/2 "G" COOLER	*
11	217-0201-00	PLUG, 1/4 NPT M.I.	1
12	507-0150-00	COIL, HEAT EXCHANGER COOLER	1

HEAT EXCHANGER MODEL DESIGNATION





ASSY. PART NO.	VALVE MODEL
538-0980-00	25BS-45F
538-1030-00	25BTS-45F
538-0980-01	25BS-45R
538-1030-01	25BTS-45R
538-0980-04	25BS-90F
538-1030-04	25BTS-90F
538-0980-05	25BS-90R
538-1030-05	25BTS-90R

HALE TYPE 25BS 25BTS SUCTION VALVES

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CONSHOHOCKEN, PA.

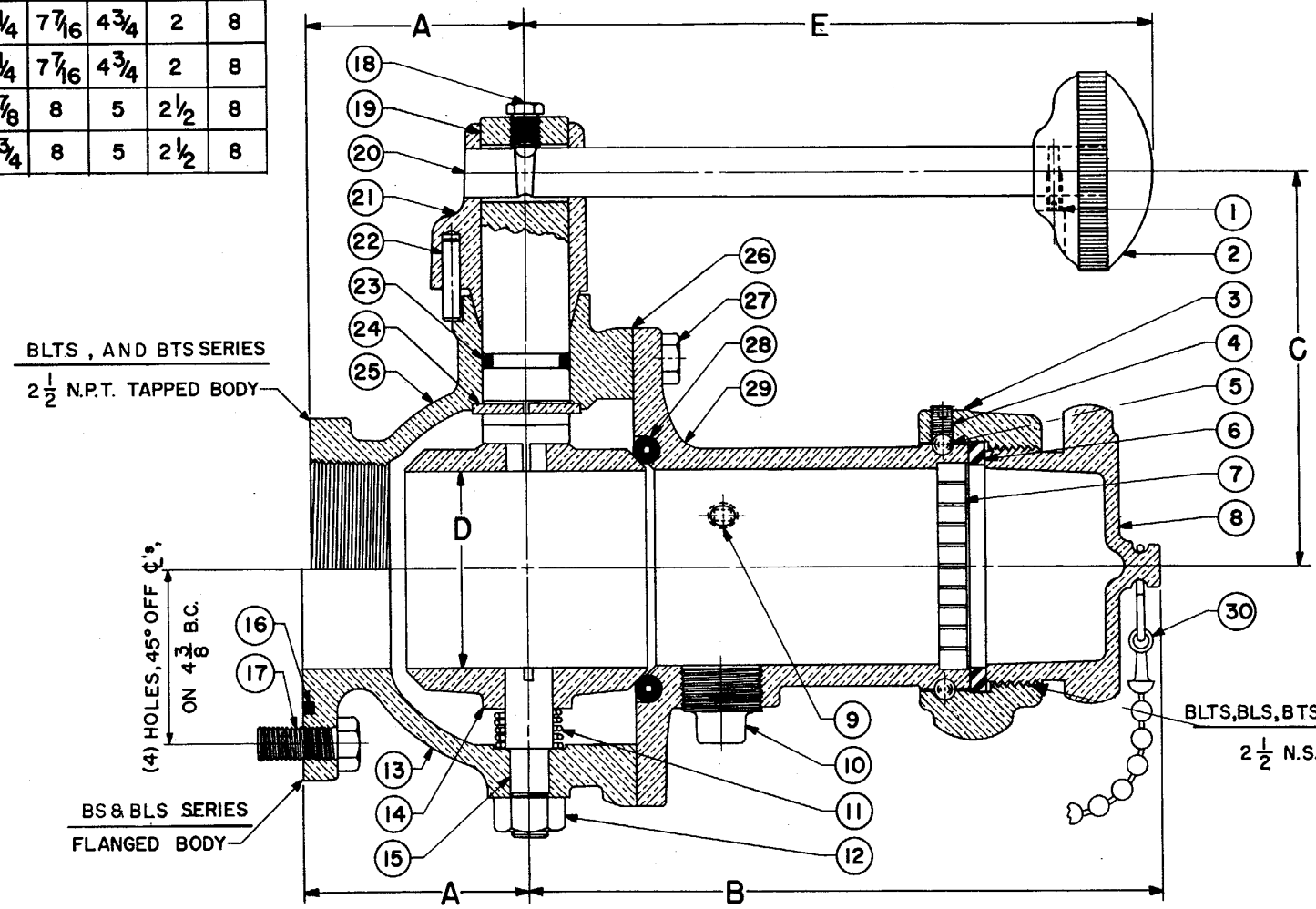
PLATE NO. 638D

8-19-82 T.C.

PARTS LIST HALE TYPE 25BS AND 25BTS SUCTION VALVES
PLATE NO. 638D

ITEM	PART NO.		NAME OF PART	NO. REQ.
1	010-0050-00	FZZ-G10OD-2-1/2	Strainer-Suction	1
2	012-0010-00	ZL-838D	Knob-Piston	1
3	012-0060-01	BL-12-9	Handle-Valve	1
3	012-0060-02	BL-12-10	Handle-Valve (Optional)	1
4	012-0070-00	BL-377D	Ball-Handle	1
5	018-1104-50		Screw-#10-32 x 1/2 Lg. Nylok SST Cup Point	1
6	018-1402-53		Screw-5/16-18 x 1/4 Lg. Stl. Flat Point Soc. Set	1
7	018-1412-15		Screw-5/16-18 x 1-1/4 Lg. Stl. Soc. Head Nylon Lock. Cap	2
8	018-1812-04		Screw-7/16-14 x 1-1/4 Lg. Stl. Hex, Head Nylon Locking Cap (25BS)	4
8	018-1812-04		Screw-7/16-14 x 1-1/4 Lg. Hex. Hd. St. (Optional on 25BTS)	4
9	018-2012-00		Screw-1/2-13 x 1-1/4 Lg, Stl. Hex. Head Cap	4
10	018-9010-00	BL-111F	Screw-Handle Adjusting	1
11	039-0040-00	FZZ-22	Ball-Swivel	38
12	039-0110-00	25B-39	Stem-Valve	1
13	040-1140-03	40-3G62	Ring-Piston Seal	2
14	040-2109-00	40Q-4N75	Ring-Valve Stem Seal	2
15	040-3350-01	40-6N275-50	Ring-Valve Seat Seal	1
16	041-0190-00		Extension-Valve Stem (45F & 45R)	1
16	041-0190-01		Extension-Valve Stem (90F & 90R)	1
17	044-0820-00		Cover-Valve	1
18	046-0050-00	46DW	Gasket-Valve Body	1
18	046-0050-00	46DW	Gasket-Valve Body (Optional on 25BTS)	1
19	048-0571-00		Collar-Valve Stem	1
20	048-0670-01		Sleeve-Valve	1
21	064-1016-01		Pin-Handle Stop	1
22	064-1032-11		Pin-Valve Stem	1
23	073-0180-00		Piston-Drain Valve	1
24	077-0810-10		Ring-Piston Retaining	1
25	088-0020-00	2242R-2-1/2	Coupling-2-1/2 Swivel	1
26	097-0110-00	A-9-2-1/2	Washer-Cap	1
27	142-0430-00		Ring-Valve Collar Seal	1
28	142-0440-00		Ring-Valve Cover Seal	1
29	217-3002-00	BL-217R	Plug-2-1/2 Swivel	1
30	276-0071-00		Seat-Valve	1
31	368-0020-01	BL-G368P11	Chain-Assembly	1
32	538-1050-00		Body-Valve Assy. (25BS)	1
	A 038-1050-00		Body-Valve	1
	B 040-0240-00		Ring-Seal	1
	C 250-9400-00		Bearing-Stem	1
32	538-1060-00		Body-Valve Assy. (25BTS)	1
	A 038-1120-00		Body-Valve	1
	B 040-0240-00		Ring-Seal	1
	C 250-9400-00		Bearing-Stem	1

TYPE	A	B	C	D	E
BLS	3 1/4	7 7/16	4 3/4	2	8
BLTS	2 1/4	7 7/16	4 3/4	2	8
BS	2 7/8	8	5	2 1/2	8
BTS	2 3/4	8	5	2 1/2	8



HALE TYPE BLS, BS, BLTS & BTS SUCTION VALVES

HALE FIRE PUMP CO.
CONSHOHOCKEN PA.
6-8-76 FRE

PLATE NO. 347F

PARTS LIST HALE TYPE TM REMOTE CONTROL
PLATE NO. 347F

ITEM	PART NUMBER		NAME OF PART	NO. REQ.
1	018-1104-50		Screw-#10-32 x 1/2 LG. Nylok SST. Cup Point Socket Head Set	1
2	012-0070-00	BL-377D	Ball-Handle	1
3	088-0020-00	2242R-2-1/2	Coupling-2-1/2 Swivel	1
4	018-1402-53		Screw-5/16-18 x 1/4 LG. Stl. F. P. Set	1
5	039-0040-00	FZZ-22	Ball-Swivel	38
6	097-0110-00	A-9-2-1/2	Washer-Suction Valve	1
7	010-0050-00		Strainer-Suction Valve	1
8	217-3002-00	BL-217R	Plug-2-1/2 Swivel	1
9	217-0101-01		Plug-1/8 NPT Brass	2
10	217-0501-00		Plug-3/4 NPT M.I.	1
11	042-0070-00	BL-42	Spring-Ball Valve	1
12	110-2100-02		Nut-1/2-20 Cad. Pl. St. Hex	1
13	038-0010-00	BL-38H	Body-Flanged Valve (BLS)	1
13	038-0030-00	B-38F	Body-Flanged Valve (BS)	1
14	039-0010-00	BL-39F	Ball-Valve (BLS)	1
14	039-0020-00	B-39H	Ball-Valve (BS,BTS)	1
15	041-0150-00	BL-404	Pivot-Valve Ball	1
16	040-2370-00	40-4N337	Ring-Valve Body Seal (BLS,BS)	1
17	018-1810-00		Screw-7/16-14 x 1 LG. Hex., Hd. St. Cap (BLS,BS)	4
18	018-9010-00	BL-111F	Screw-Handle Adjusting	1
19	041-0160-00	BL-41-45F	Stem-Valve (45F Valves)	1
19	041-0170-00	BL-41-45R	Stem-Valve (45R Valves)	1
19	041-0180-00	BL-41-90	Stem-Valve (90F & 90R Valves)	1
20	012-0060-00	BL-12-8	Handle-Valve (8" Lg.).	1
20	012-0060-01	BL-12-9	Handle-Valve (9" LG. Optional)	1
20	012-0060-02	BL-12-l10	Handle-Valve (10" LG. Optional)	1
21	048-0130-00	BL-280-45	Stop-Valve (45F & 45R Valves)	1
21	048-0140-00	BL-280-90	Stop-Valve (90F & 9CR Valves)	1
22	064-6080-00	BL-114	Pin-Handle Stop	1
23	040-2120-00	40-4N87	Ring-Valve Stem Seal	1
24	048-0100-00	BL-91	Collar-Valve Stem	2
25	038-0040-00	BT-38	Body-Tapped Valve (BTS)	1
26	046-5090-00'	BL-11	Gasket-Cover (BLS)	1 to 3
26	046-5090-01	BL-W11	Gasket-Cover (BLS)	2
26	046-0100-00	B-11	Gasket-Cover (BS,BTS)	1 to 3
26	046-0100-01	B-W11	Gasket-Cover (.BS,BTS)	2
27	018-1610-00		Screw-3/8-16 x 1 LG. Hex. Hd. Stl. Cap (BLS)	6
27	018-1610-00		Screw-3/8-16 x 1 LG. Hex. Hd. Stl. Cap. (BS,BTS).	8
28	276-0011-00		Seat-Valve (BLS)	1
28	276-0121-00		Seat-Valve (BS,BTS)	1
29	044-0010-00	BL-44S-4	Cover-Valve (Standard) (BLS)	1
29	044-0010-01	BL-44S-6	Cover-Valve (2" Longer Standard) (BLS).	1
29.	044-0030-00	B-44SF	Cover-Valve (BS,BTS)	1
30	368-0020-01	BL-G368P-11	Chain-Assembly (,Optional)	1

PARTS LIST HALE TPE BP & BPC IN-LINE VALVES

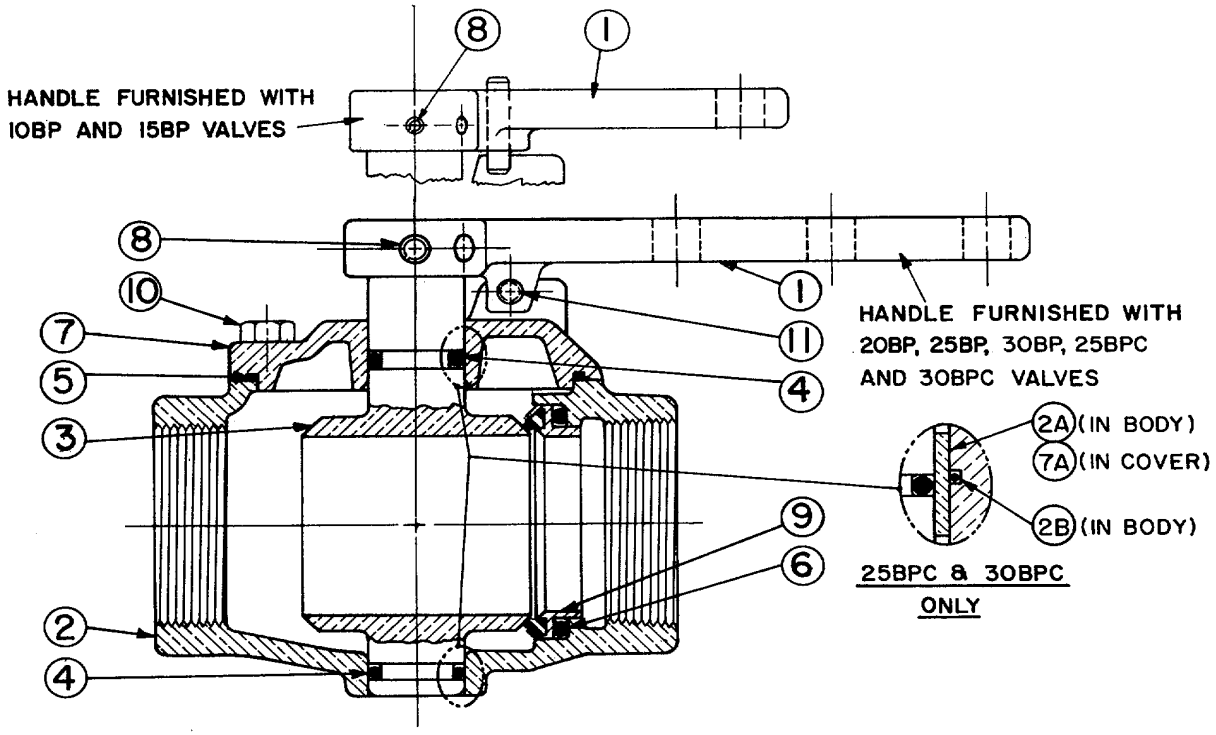
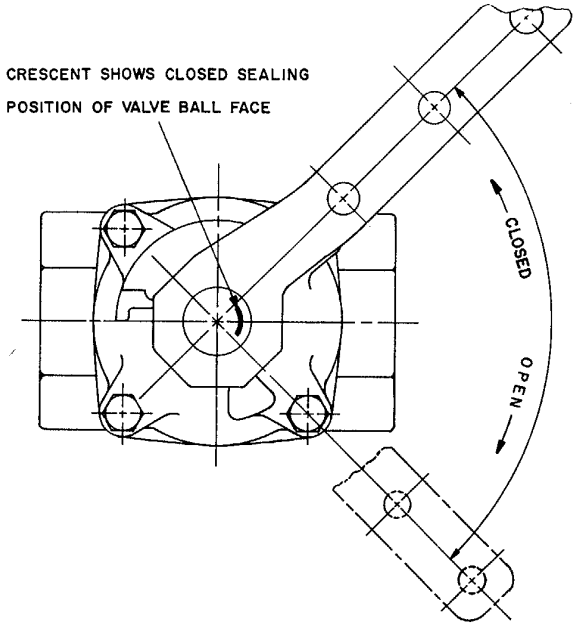


PLATE NO. 583D

			BP SERIES – BRONZE					BPC SERIES – CAST IRON BRONZE FITTED	
ASS'Y. PART NUMBER			538-0520-00	538-0530-00	538-0540-00	538-0550-00	538-0560-00	538-0550-01	538-0560-02
NO.	NAME	NO. REQ.	1" VALVE TYPE 10BP	1 1/2" VALVE TYPE 15BP	2" VALVE TYPE 20BP	2 1/2" VALVE TYPE 25BP	3" VALVE TYPE 30BP	2 1/2" VALVE TYPE 25BPC	3" VALVE TYPE 30BPC
1	HANDLE	1	512-0170-00 (B15-G12)	512-0170-00 (B15-G12)	012-0080-00 (20B-A12)	012-0080-00 (20B-A12)	012-0080-00 (20B-A12)	012-0080-00 (20B-A12)	012-0080-00 (20B-A12)
2	BODY	1	038-0310-00 (10BP-38)	038-0320-00 (15BP-38)	038-0330-00 (20BP-38)	038-0340-00 (25BP-38)	038-0350-00 (30BP-38)	538-1080-00 Assy. (CastIron)	538-1090-00 Assy. (CastIron)
2A	BEARING	1	- - -	- - -	- - -	- - -	- - -	250-9400-00	250-9400-00
2B	O-RING	1	- - -	- - -	- - -	- - -	- - -	040-0240-00	040-0240-00
3	STEM BALL	1	039-0080-00 (10B-39)	039-0090-00 (15B-39)	039-0100-00 (20B-39)	039-0110-00 (25B-39)	039-0030-00 (30B-39)	039-0110-00 (25B-39)	039-0030-00 (30B-39)
4	O-RING, STEM	2	040-1130-03 (40-3G56)	040-1130-03 (40-3G56)	040-2109-00 (40Q-4N75)	040-2109-00 (40Q-4N75)	040-2109-00 (40Q-4N75)	040-2109-00 (40Q-4M75)	040-2109-00 (40Q-4N75)
5	O-RING, COVER	1	142-0490-00	142-0500-00	142-0510-00	142-0520-00	142-0530-00	142-0520-00	142-0530-00
6	O-RING, SEAT	1	040-3210-01 40-6N115-50	040-8040-01 40-6N168-50	040-3310-01 40-6N225-50	040-3350-01 40-6N275-50	040-3390-01 40-6N325-50	040-3350-01 40-6N275-50	040-3390-01 40-6N325-50
7	COVER	1	044-0370-00 (10B-44)	044-0380-00 (15B-44)	044-0390-00 (20B-44)	044-0400-00 (25B-44)	044-0060-00 (30B-44)	044-0400-00 (25B-44) Bronze	544-0110-00 Assy. (CastIron)
7A	BEARING	1	- - -	- - -	- - -	- - -	- - -	- - -	250-9400-00
8	PIN-HANDLE	1	064-0622-01	064-0622-01	064-1032-11	064-1032-11	064-1032-11	064-1032-11	064-1032-11
9	SEAT	1	276-0040-00 (10B-G276)	276-0050-00 (15B-G276)	276-0060-00 (20B-G276)	276-0071-00	276-0020-00 (30B-G276D)	276-0071-00	276-0020-00 (30B-G276D)
10	SCREW	4	018-1206-02 1/4-20 x 3/4	018-1407-02 5/16-18 x 7/8	018-1610-02 3/8-16 x 1	018-1810-02 7/16-14 x 1	018-2012-02 1/2-13x1-1/4	018-1810-02 7/16-14 x 1	018-2012-02 1/2-13x1-1/4
11	SET SCREW	1	- - -	- - -	018-1204-51 1/4-20 x 1/2	018-1204-51 1/4-20 x 1/2	018-1204-51 1/4-20 x 1/2	018-1204-51 1/4-20 x 1/2	018-1204-51 1/4-20 x 1/2
12	INSTRUCTION TAG	1	- - -	- - -	101-0480-00	101-0480-00	101-0480-00	101-0480-00	101-0480-00

©HALE FIRE PUMP COMPANY
CONSHOHOCKEN, PA. 19428

HALE TYPE BP & BPC SERIES IN-LINE VALVES



TO DISASSEMBLE VALVE

1. IF LEVER POSITION IS NOT TO BE CHANGED, CLOSE VALVE HANDLE AND MAKE REFERENCE MARKS IN A LINE ACROSS TOP OF BALL STEM, LEVER, AND COVER AT ANY CONVENIENT LOCATION. IF LEVER POSITION IS TO BE CHANGED, OMIT REFERENCE MARKS.
2. REMOVE FOUR COVER SCREWS Ⓒ .
3. ROTATE HANDLE (AND COVER) 180 SO CRESCENT STAMPED ON VALVE STEM IS FACED OPPOSITE THE FLOW ARROW DIRECTION. THIS IS IMPORTANT BECAUSE THE VALVE SEAT IS AT THE ARROWHEAD END OF VALVE AND THE FLAT ON THE STEM BALL MUST BE AGAINST THE SEAT WHEN REMOVING TO PREVENT DAMAGING THE SEAL.
4. REMOVE THE STEM, COVER & HANDLE AS A UNIT.
5. IF BALL STEM SEAL RING IS TO BE REPLACED, REMOVE LEVER Ⓐ BY REMOVING SPRING PIN Ⓑ .

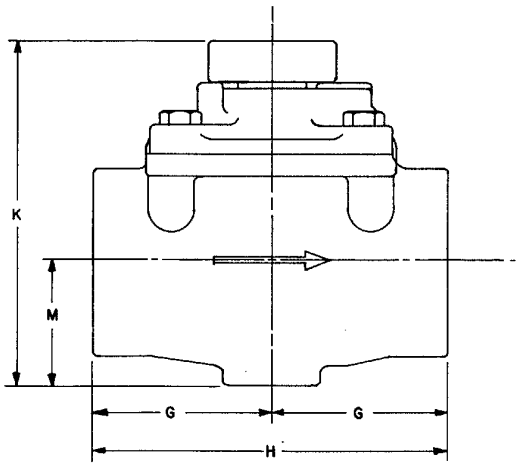
TO ASSEMBLE VALVE

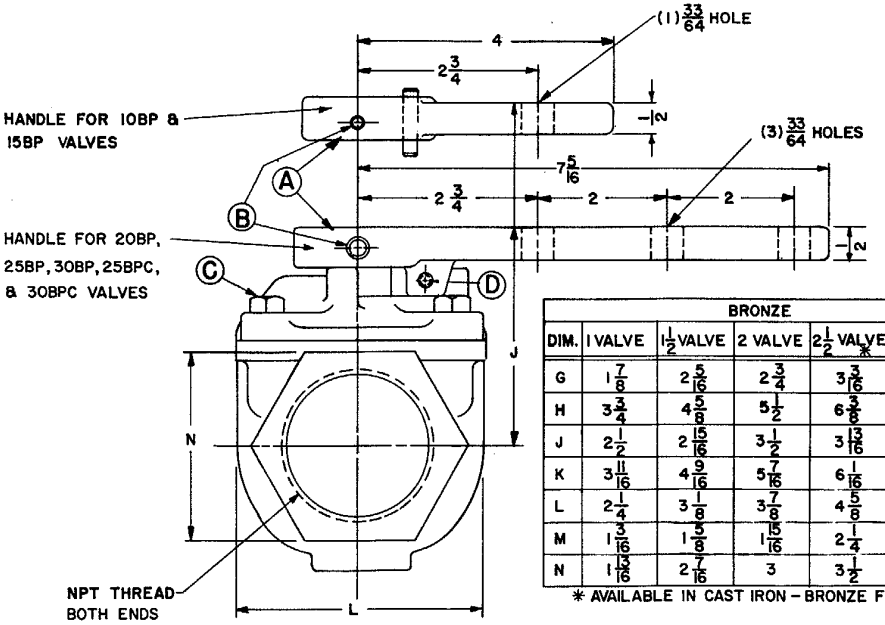
1. INSTALL VALVE SEAT AND BACK-UP O-RING USING A LIBERAL AMOUNT OF WATERPROOF GREASE TO HOLD THE PIECES IN PLACE.
2. USING WATERPROOF GREASE, LIGHTLY GREASE ENTIRE SPHERICAL SURFACE OF BALL AND INSTALL GREASED SEAL RINGS IN UPPER AND LOWER STEM.
3. WITH FLAT SIDE OF BALL TOWARD SEAT, PLACE BALL INTO VALVE BODY.
4. INSTALL GREASED SEAL-RING IN COVER AND SLIDE COVER OVER BALL STEM.
5. HOLDING COVER DOWN AND USING SOME SUITABLE ROD THROUGH HOLE IN STEM, ROTATE BALL TO THE CLOSED POSITION (CRESCENT FACING DIRECTION OF FLOW ARROW).
6. IF LEVER IS TO BE REPOSITIONED, PROCEED TO STEP 3 OF INSTRUCTIONS FOR REPOSITIONING LEVER. OTHERWISE LINE UP THE REFERENCE MARKS MADE DURING DISASSEMBLY ON TOP OF VALVE AND REPLACE SPRING PIN Ⓑ AND COVER SCREWS Ⓒ .

INSTRUCTIONS FOR REPOSITIONING LEVER ON VALVE

VALVE LEVER MAY BE POSITIONED AT 45° INTERVALS. TO ROTATE CLOCKWISE OR COUNTER CLOCKWISE BY USING THE FOLLOWING INSTRUCTIONS.

1. CLOSE VALVE. THE CRESCENT STAMPED ON VALVE STEM SHOWS CLOSED POSITION.
2. REMOVE LEVER Ⓐ BY REMOVING SPRING PIN Ⓑ .
3. REMOVE COVER CAP SCREWS Ⓒ AND TURN COVER, WITHOUT LIFTING COVER FROM VALVE BODY BORE, TO NEW POSITION FOR DESIRED LEVER ROTATION. REPLACE SCREWS.
4. PLACE LEVER IN REQUIRED POSITION.
5. REPLACE SPRING PIN IN HOLE WHICH IS IN LINE WITH HOLE IN THE VALVE STEM.
6. ADJUST SET SCREW Ⓓ FOR SETTING BALL AND LEVER STOP POSITIONS.





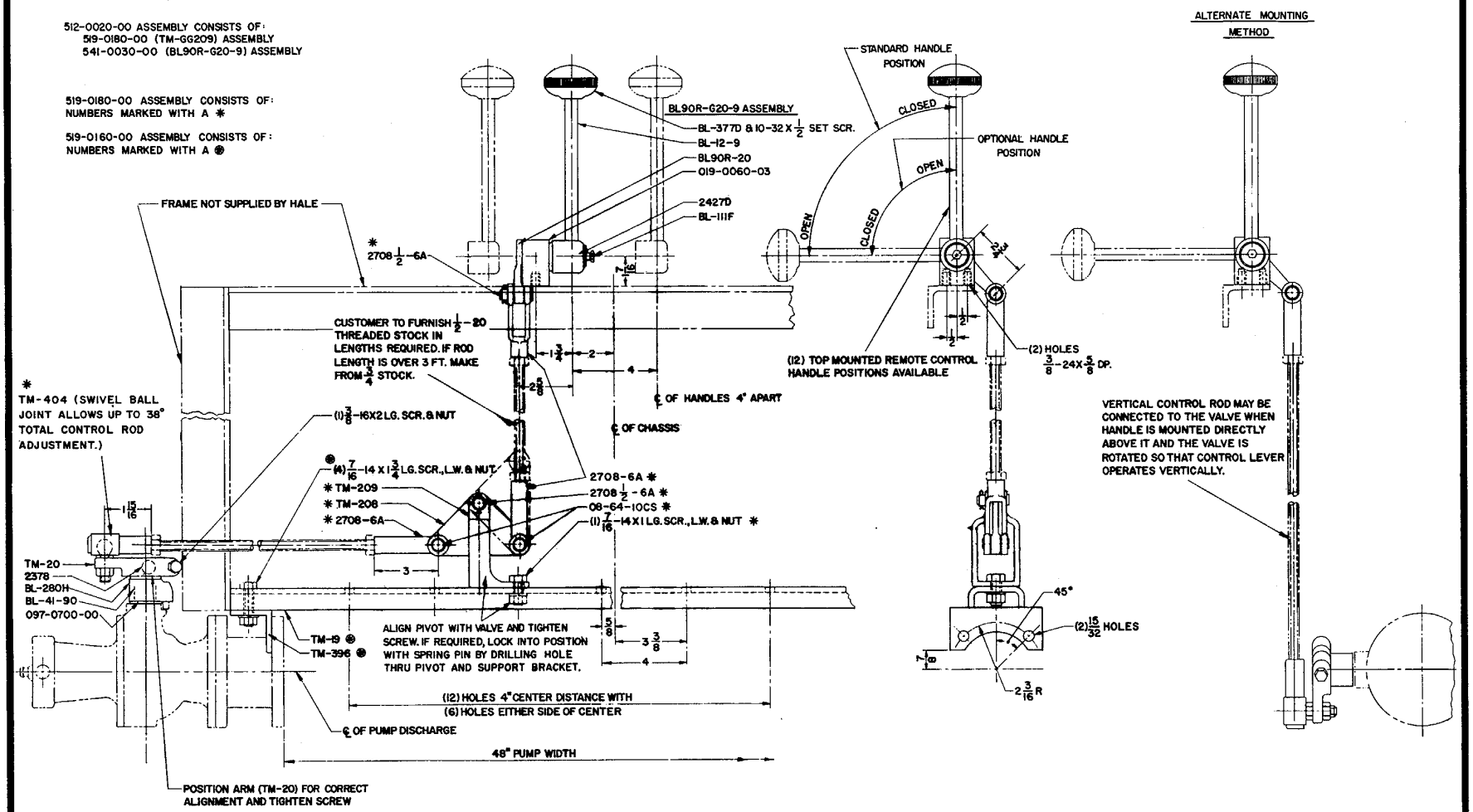
BRONZE					
DIM.	1 VALVE	1½ VALVE	2 VALVE	2½ VALVE *	3 VALVE *
G	1 7/8	2 5/16	2 3/4	3 3/16	3 11/16
H	3 3/4	4 5/8	5 1/2	6 3/8	7 3/8
J	2 1/2	2 15/16	3 1/2	3 13/16	4 7/16
K	3 11/16	4 9/16	5 7/16	6 1/16	7
L	2 1/4	3 1/8	3 7/8	4 5/8	5 3/4
M	1 3/16	1 5/8	1 15/16	2 1/4	2 9/16
N	1 13/16	2 7/16	3	3 1/2	4 3/16

* AVAILABLE IN CAST IRON – BRONZE FITTED

©HALE FIRE PUMP CO.
CONSHOHOCKEN, PA.

PLATE NO. 582C

6-27-84 K.S.B.



HALE "CENTROL"
TYPE TM REMOTE CONTROL

HALE FIRE PUMP CO.
CONSHOHOCKEN, PA.

PLATE NO. 612

9-17-79 P.W.

MF 7-72

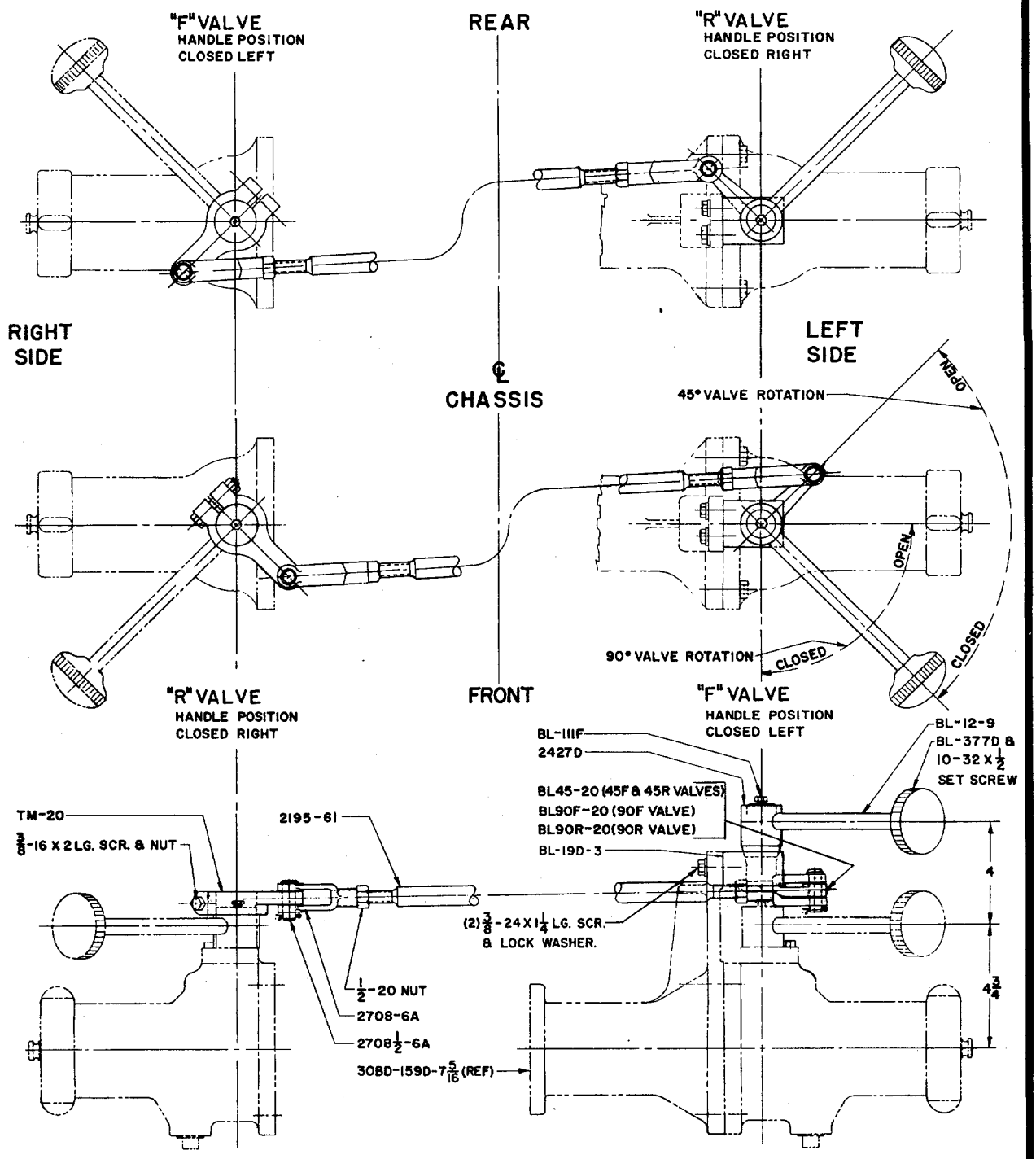
PARTS LIST HALE TYPE TM REMOTE CONTROL
PLATE NO. 612

PART NO.		NAME OF PART			NO. REQ.
Quantities shown for one remote control assembly to operate one valve. When ordering, specify number of remote control assemblies required and type of valves to be controlled.					
012-0200-00	*TM-20	Lever-Remote Control			1
018-1620-00		*Screw-3/8-16 x 2 LG. Hex. Head Steel Cap			1
041-0180-00	*BL-41-90	Stem-Valve			1
048-0140-01	*BL-280H	Stop-Remote Control Lever			1
064-6140-00	*2378	Pin-Valve Stem			1
097-0700-00		*Washertl-1/8 x 1-9/16 x 1/16 Thk. Nylon			1
110-1600-00		*Nut-3/8-16 Steel Hex			1
512-0020-00		TM Remote Control (Assembly)			1
519-0180-00	TM-GG209	TM Remote Control Pivot (Assembly)		1	
012-0310-00	TM-208	Linkage-Remote Control		1	
018-1810-00		Screw-7/16-14 x 1 LG. Hex. Head Steel Cap		1	
019-0190-00	TM-209	Pivot-Remote Control		1	
028-0030-00	2708-6A	Yoke-End		3	
064-1620-01	08-64-10CS	Pin-Yoke Spring		2	
064-6070-00	2708-1/2-6A	Pin-Yoke (Assembly)		2	
088-0060-00	TM-404	Joint-Remote Lever Ball		1	
097-0190-00		Washer-7/16 ,Steel Lock		1	
110-1800-00		Nut-7/16-14 Steel Hex.		1	
541-0030-00	BL90R-G20-9	Stem-Remote Control Block (Assembly)			1
018-9010-00		BL-111F	Screw-Handle Adjusting	1	
019-0060-03			Block-Remote Control	1	
041-0220-00		BL90R-20	Stem-Remote Control	1	
048-0160-00		2427D	Collar-Remote Control	1	
512-0060-01			Handle-Valve (Assembly)		1
012-0060-01		BL-12-9	Handle-Valve	1	
012-0070-00		BL-377D	Ball-Handle	1	
018-1104-50			Screw-#10-32 x 1/2 LG. Nylok St. Stl. Cup Pt. Soc. Hd. Set	1	
519-0160-00		TM Remote Control Bracket (Assembly)			1
018-1816-00		Screw-7/16-14 x 1-3/4 LG. Hex. Head Steel Cap (4 per Pump)		4	
019-0170-00	TM-19	Bracket-Remote Control (1 per Pump)		1	
019-0180-00	TM-396	Support-Remote Control Bracket (2 per. Pump)		2	
097-0190-00		Washer-7/16 Steel Lock		4	
110-1800-00		Nut-7/16-14 Steel Hex.		4	

PARTS TO BE OMITTED FROM STANDARD BL, B & 30BD SERIES VALVES
WHEN CONTROLLED BY TM REMOTE CONTROL

018-9010-00	BL-111F	Screw-Handle Adjusting	1
041-0160-00	BL-41-45F	Stem-Valve (45F Valve) (BL & B Series)	1
041-0170-00	BL-41-45R	Stem-Valve (45R Valve) (BL & B Series)	1
048-0120-00	3OBD-280	Sleeve-Valve Lock (30BD Series)	1
048-0130-00	BL-280-45	Stop-Valve Handle (BL & B Series)	1
512-0060-00	BL-G12-8	Handle-Valve (Assembly) (BL & B Series)	1
512-0060-01	BL-G12-9	Handle-Valve (Assembly) 3OBD Series)	1

* If 30BPFA Tank Valve, BP or BPA Series In-Line Valves are to be controlled by TM Remote Control, omit parts marked * in above parts list.



HALE TYPE 30BD REMOTE CONTROL

HALE FIRE PUMP CO.
CONSHOHOCKEN, PA.

PLATE NO. 627A

1-21-76 S.M.H.

PARTS LIST HALE TYPE 30BD REMOTE CONTROL

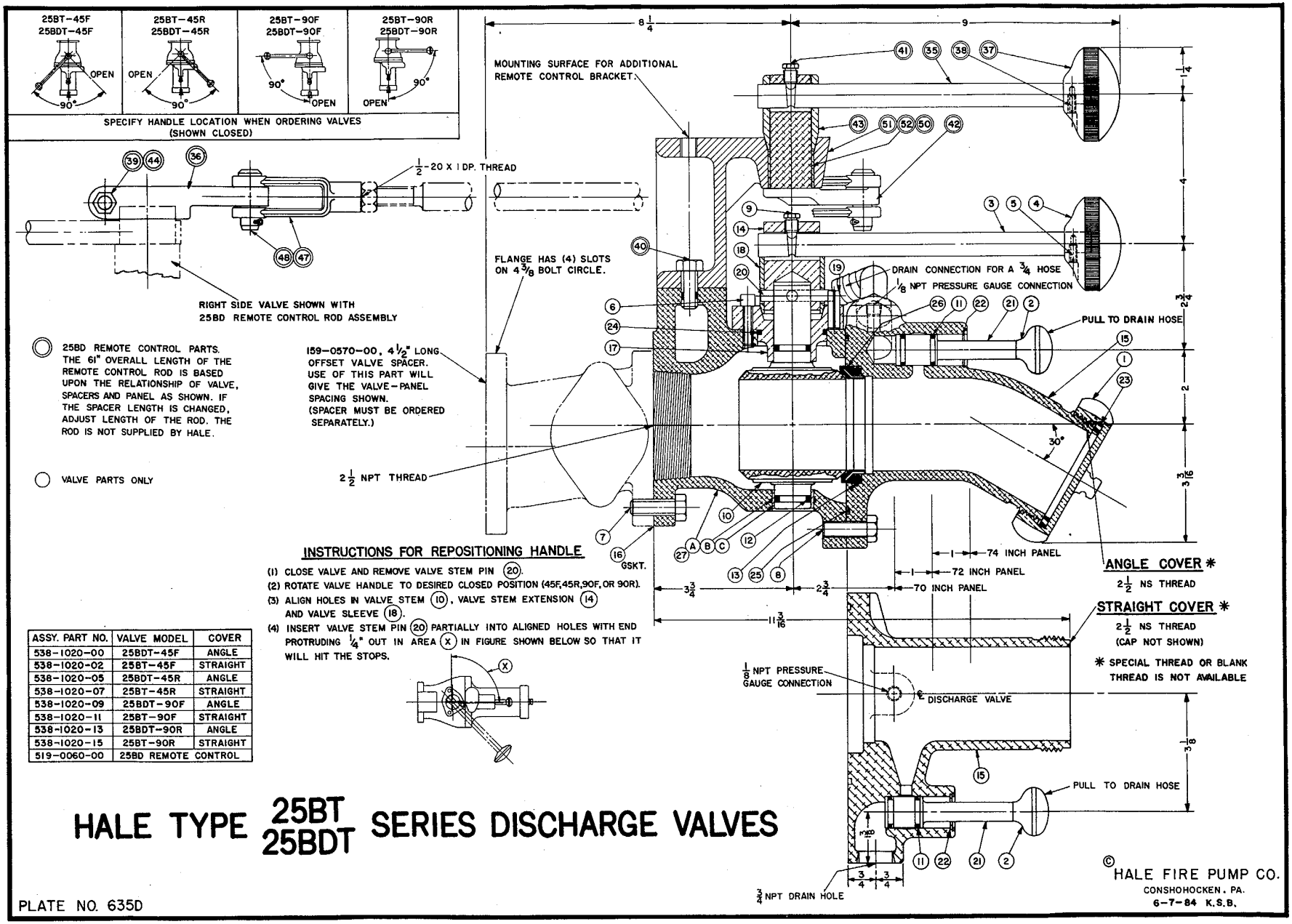
ASSEMBLY NO.	519-0111-00	Remote Control with rods (45F & 45R Valves)
ASSEMBLY NO.	519-0111-01	Remote Control with rods (when L.S. Valve is 90F)
ASSEMBLY NO.	519-0111-02	Remote Control with rods (when R.S. Valve is 90R)

PLATE NO. 627A

PART NO.		NAME OF PART	Parts for Required for one Remote Controlled Valve
012-0060-01	BL-12-9	Handle-Valve	1
012-0070-00	BL-377D	Ball-Handle	1
012-0100-01	2195-61	Rod-Remote Control (for use with 70,72,73,74 Panel) 1	
012-0200-00	TM-20	Lever-Remote Control	1
018-1104-50		Screw-#10-32 x 1/2 LG. Nylok, Stainless Steel, Cup Point, Soc. Hd. Set	1
018-1620-00		Screw-3/8-16 x 2 LG. Hex. Hd. Steel Cap	1
018-1712-00		Screw-3/8-24 x 1-1/4 LG. Hex. Hd. Steel Cap	2
018-9010-00	BL-111F	Screw-Handle Adjusting	1
019-0060-03	BL-19D-3	Block-Mounting	1
028-0030-00	2708-6A	Yoke-End	2
041-0200-00	BL45-20	Stem-Remote Control (45F & 45R Valves)	1
041-0210-00	BL90F-20	Stem-Remote Control (used when left side valve is 90F) 1	
041-0220-00	BL90R-20	Stem-Remote Control (used when left side valve is 90R)	1
048-0160-00	2427D	Collar-Remote Control	1
064-0070-00	2708-1/2-6A	Pin-Yoke, Assembly	2
097-0140-00		Washer-3/8 Steel Lock	2
110-1600-00		Nut-3/8-16 Hex Steel	1
110-2100-00		Nut-1/2-20 Hex Steel	2

NOTE: 1. When the 30BD remote control is connected to the right side valve., omit 3OBD-280 sleeve. The right side handle cannot be installed on the valve with this arrangement.

2. When right side handle assembly is not used, delete BL-111F screw and 30BD-280 sleeve on the right side valve.



INSTRUCTIONS FOR REPOSITIONING HANDLE

(1) CLOSE VALVE AND REMOVE VALVE STEM PIN (20).
(2) ROTATE VALVE HANDLE TO DESIRED CLOSED POSITION (45F,45R,90F, OR 90R).
(3) ALIGN HOLES IN VALVE STEM (10), VALVE STEM EXTENSION (14) AND VALVE SLEEVE (18).
(4) INSERT VALVE STEM PIN (20) PARTIALLY INTO ALIGNED HOLES WITH END PROTRUDING 1/4" OUT IN AREA (X) IN FIGURE SHOWN BELOW SO THAT IT WILL HIT THE STOPS.

ASSY. PART NO.	VALVE MODEL	COVER
538-1020-00	25BDT-45F	ANGLE
538-1020-02	25BT-45F	STRAIGHT
538-1020-05	25BDT-45R	ANGLE
538-1020-07	25BT-45R	STRAIGHT
538-1020-09	25BDT-90F	ANGLE
538-1020-11	25BT-90F	STRAIGHT
538-1020-13	25BDT-90R	ANGLE
538-1020-15	25BT-90R	STRAIGHT
519-0060-00	25BD REMOTE CONTROL	

HALE TYPE 25BT 25BDT SERIES DISCHARGE VALVES

PLATE NO. 635D

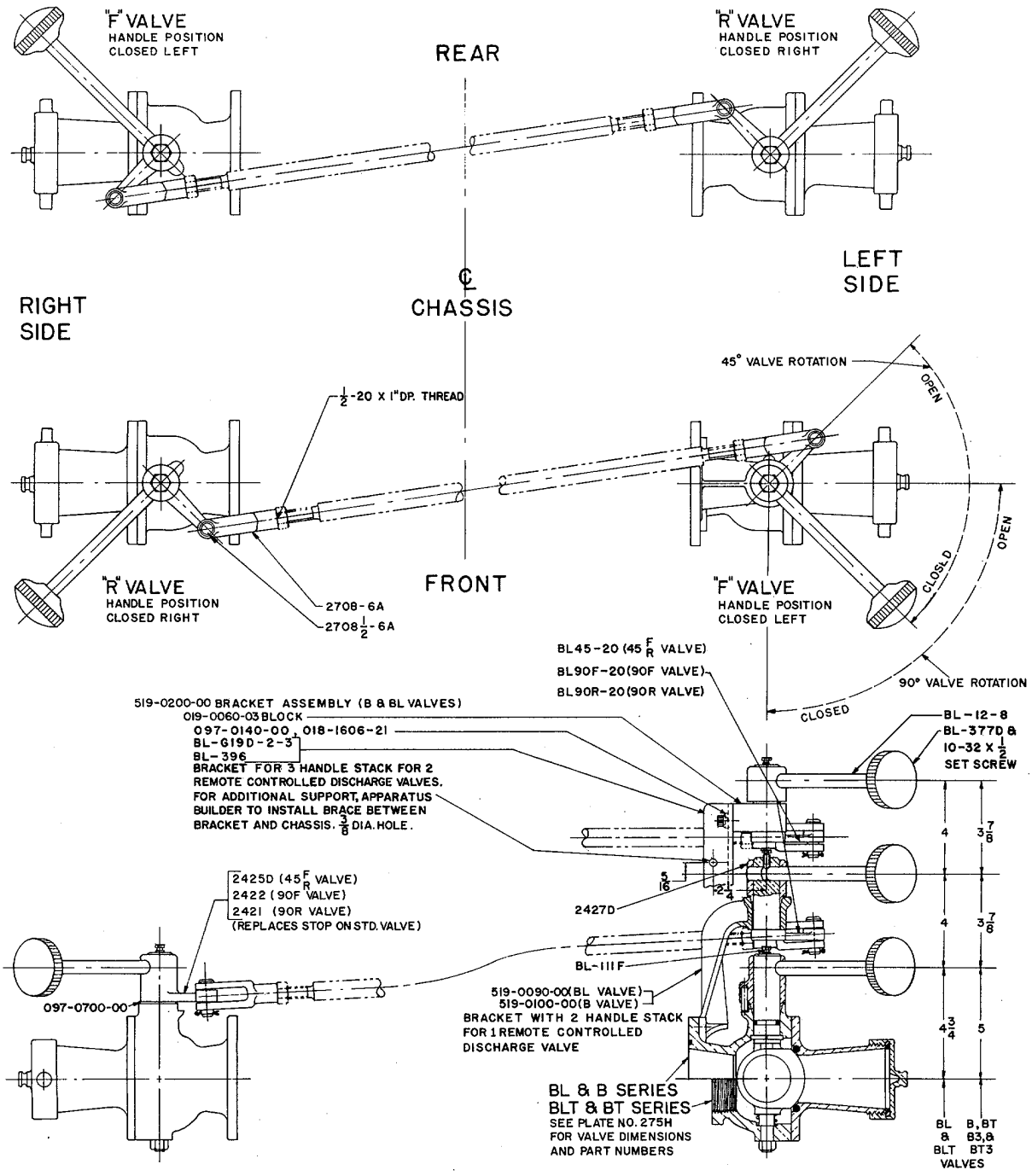
© HALE FIRE PUMP CO.
CONSHOHOCKEN. PA.
6-7-84 K.S.B.

PARTS LIST HIALE TYPE 25BT & 25BDT DISCHARGE VALVES
PLATE NO. 635D

ITEM NO.	PART NUMBER		NAME OF PART	NO. REQ.
1	008-0110-00	A-8R-2-1/2	Cap-2-1/2	1
2	012-0010-00	ZL-838D	Knob-Piston	1
3	012-0060-01	BL-12-9	Handle-Valve	1
3	012-0060-02	BL-12-10	Handle-Valve (Optional)	1
4	012-0070-00	BL-377D	Ball-Handle	1
5	018-1104-50		Screw-#10-32 x 1/2 LG. Nylok SST Cup Point Socket Hd. Set	1
6	018-1412-15		Screw-5/16-18 x 1-1/4 LG. Soc. Hd. Stl. Nylon Locking Cap	2
7	018-1812-00		Screw-7/16-14 x 1-1/4 LG. Hex Hd. Stl. Cap	4
8	018-2012-02		Screw-1/2-13 x 1-1/4 LG. Hex Hd. Stl. Cad. P1.	4
9	018-9010-00	BL-111F	Screw-Handle Adjusting	1
10	039-0110-00	25B-39	Stem-Valve	1
11	040-1140-03	40-3G62	Ring-Piston Seal	2
12	040-2109-00	40Q-4N75	Ring-Valve Stem Seal	2
13	040-3350-01	40-6N275-50	Ring-Valve Seat Seal	1
14	041-0331-00		Extension-Valve Stem (450)	1
14	041-0331-01		Extension-Valve Stem (900)	1
15	044-0561-00		Cover-Valve (25BDT)	1
15	044-0900-00		Cover-Valve (25BT)	1
16	046-0050-00	46DW	Gasket-Valve Body	1
17	048-0571-00		Collar-Valve Stem	1
18	048-0670-00		Sleeve-Valve	1
19	064-1016-01		Pin-Handle Stop	1
20	064-1032-11		Pin-Valve Stem	1
21	073-0180-00		Piston-Drain Valve	1
22	077-0810-10		Ring-Piston Retaining	1
23	097-0110-00	A-9-2-1/2	Washer-Cap	1
24	142-0430-00		Ring-Valve Collar Seal	1
25	142-0440-00		Ring-Valve Body Seal	1
26	276-0071-00		Seat-Valve	1
27	538-1060-00		Body-Valve Ass'y. (25BT & 25BDT)	1
	A 038-1120-00		Body-Valve	1
	B 040-0240-00		Ring-Bearing Seal	1
	C 250-9400-00		Bearing-Valve Body	1
28	082-0521-05		Elbow-Drain	1

PARTS LIST HALE TYPE 25BD REMOTE CONTROL
ASSEMBLY PART NUMBER 519-0060-00

35	012-0060-00	BL-12-9	Handle-Valve	1
36	012-0200-00	TM-20	Lever-Remote Control	1
37	012-0070-00	BL-377D	Ball-Handle	1
38	018-1104-50		Screw-#10-32 x 1/2 LG. Nylok St. Stl. Cup Pt. Soc. Hd. Set	1
39	018-1620-00		Screw-3/8-16 x 2 LG. Hex Hd. Stl. Cap	1
40	018-1810-04		Screw-7/16-14 x 1 LG. Hex Hd. St. Nylon Locking Cap	2
41	018-9010-00	BL-111F	Screw-Adjusting	1
42	041-0200-00	BL45-20	Stem-Remote Control (45F or 45R Valve)	1
42	041-0210-00	BL90F-20	Stem-Remote Control (90F Valve)	1
42	041-0220-00	BL90R-20	Stem-Remote Control (90R Valve)	1
43	048-0160-00	2427D	Collar-Remote Control	1
44	110-1600-00		Nut-3/8-16 Hex Steel	1
47	028-0030-00	2708-6A	Yoke-End	2
48	064-6070-00	2708-1/2-6A	Pin-Yoke with cotter pin	2
50	519-0260-00		Bracket-Remote Control Assy.	1
51	019-0631-00		Bracket-Remote Control	1
52	250-9081-00		Bearing-Remote Bracket	1



HALE TYPE BL/B REMOTE CONTROL

TWO HANDLE & THREE HANDLE STACK

©HALE FIRE PUMP CO.
CONSHOHOCKEN, PA.

3-1-83 RSB

PLATE NO. 223H

PARTS LIST HALE TYPE BL & B REMOTE CONTROL

Plate No. 223H

When ordering a complete Remote Control Assembly, specify two or three handle stack. In addition, specify left side valve handle location.

Parts shown are for a standard Hale valve arrangement.

BL Type Remote Control used on BL & BLT Series Valves, B Type on B & BT Series Valves.

PARTS REQUIRED FOR ONE REMOTE CONTROLLED VALVE (TWO HANDLE STACK)

PART NO.		NAME OF PART			NO.REQ.
012-0060-00	BL-12-8	Handle-Valve			1
012-0070-00	BL-377D	Ball-Handle			1
012-0090-00	2425D	Lever-Remote Control (45F & 45R Valves)*			1
012-0110-00	2422	Lever-Remote Control (90F Valve)*			1
012-0120-00	2421	Lever-Remote Control (90R Valve)*			1
018-1104-50		Screw #10-32 x 1/2 LG. Nylok. St. Stl. Cup Pt. Soc. Hd. Set			1
018-9010-00	BL-111F	Screw-Handle Adjusting			1
028-0030-00	2708-6A	Yoke-End			2
041-0200-00	BL45-20	Stem-Remote Control (45F or 45R Valves on Left Side)			1
041-0210-00	BL90F-20	Stem-Remote Control (90F Valve on Left Side)			1
041-0220-00	BL90R-20	Stem-Remote Control (90R Valve on Left Side)			1
048-0160-00	2427D	Collar-Remote Control			1
064-6070-00	2708-1/2-6A	Pin-Yoke Assembly			2
064-6140-00	2378	Pin-Lever (Used when R.S. Handle is omitted)			1
097-0700-00		Washer-Nylon			1
519-0090-00		Bracket-Remote Cont. Assy. (BL Series)(Two Handle Stack)			1
019-0050-00		2419D	Bracket-Remote Control (BL Series)	1	
250-9081-00			Bearing	1	
519-0100-00		Bracket-Remote Cont. Assy. (B Series)(Two Handle Stack)			1
019-0070-02			Bracket-Remote Control (B Series)	1	
250-9081-00			Bearing	1	

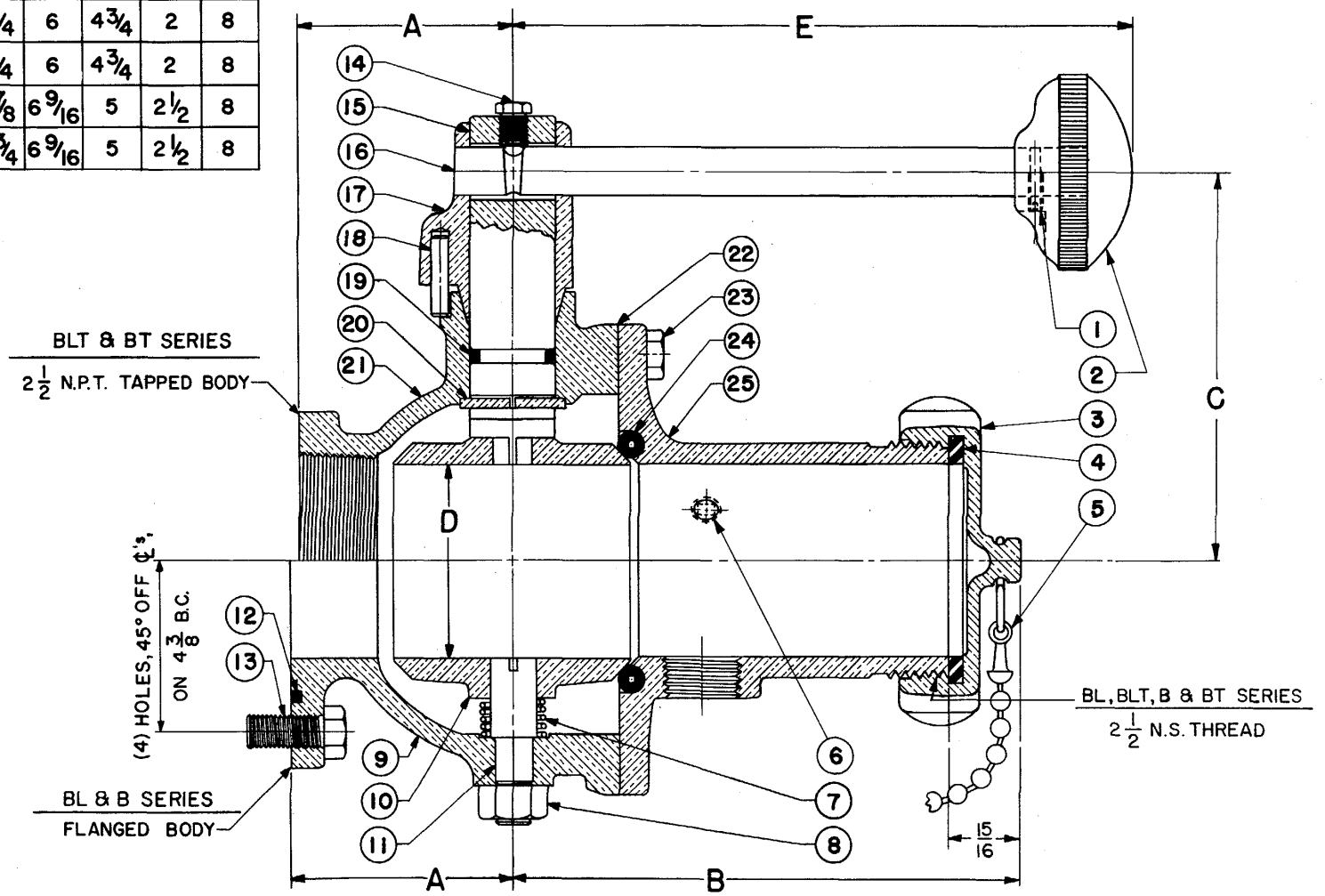
PARTS REQUIRED FOR TWO REMOTE CONTROLLED VALVES (THREE HANDLE STACK)

012-0060-00	BL-12-8	Handle-Valve			2
012-0070-00	BL-377D	Ball-Handle			2
012-0090-00	2425D	Lever-Remote Control (45F & 45R Valves)*			2
012-0110-00	2422	Lever-Remote Control (90F Valve)*			2
012-0120-00	2421	Lever-Remote Control (90R Valve)*			2
018-1104-50		Screw-#10-32 x 1/2 LG. Nyl. St. Stl. Cup Pt. Soc. Hd. Set			2
018-9010-00	BL-11F	Screw-Handle Adjusting			2
028-0030-00	2708-6A	Yoke-End			4
041-0200-00	BL45-20	Stem-Remote Control (45F or 45R Valves on Left Side)			2
041-0210-00	BL90F-20	Stem-Remote Control (90F Valve on Left Side)			2
041-0220-00	BL90R-20	Stem-Remote Control (90R Valve on Left Side)			2
048-0160-00	2427D	Collar-Remote Control			2
064-6070-00	2708-1/2-6A	Pin-Yoke Assembly			4
064-6140-00	2378	Pin-Lever (Used when R.S. Handles are omitted)			2
097-0700-00		Washer-Nylon			2

*REPLACES STOP ON STANDARD VALVE

519-0200-00	Bracket-Remote Cont. Assy.(Three Handle Stack)			1
018-1606-21	Screw-3/8 x 3/4 LG. Counter bore Stl.			4
019-0060-03	Block - Remote Control			2
019-0070-01	BL-G19D-2-3 Bracket-Remote Control (Three Handle Stack)			1
097-0130-00	BL-3.96 Washer (BL Valve only)			1
097-0140-00	Washer-3/8 Steel Lock			4

TYPE	A	B	C	D	E
BL	3 1/4	6	4 3/4	2	8
BLT	2 1/4	6	4 3/4	2	8
B	2 7/8	6 9/16	5	2 1/2	8
BT	2 3/4	6 9/16	5	2 1/2	8



HALE TYPE BL, B, BLT, & BT DISCHARGE VALVES

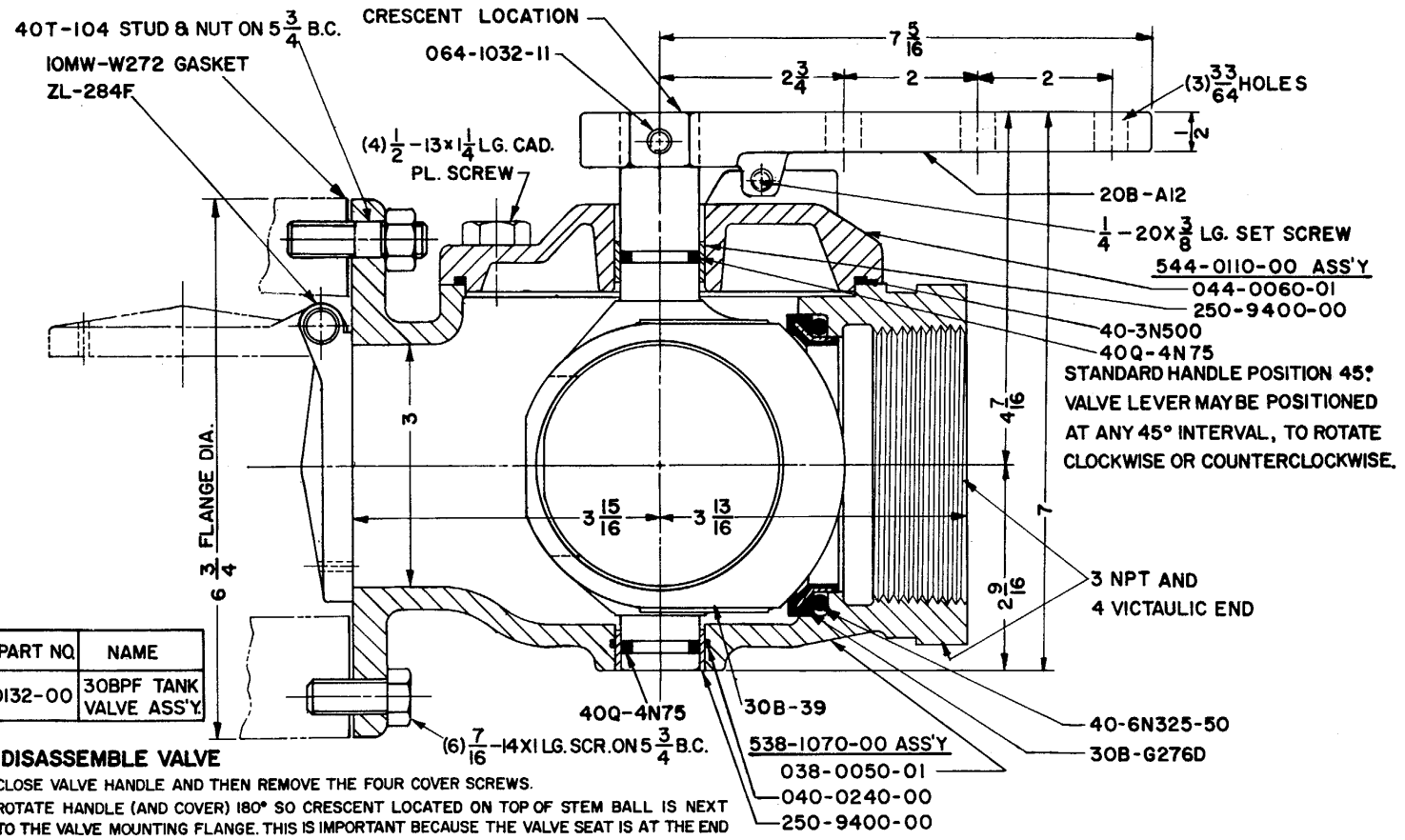
HALE FIRE PUMP CO.
CONSHOHOCKEN, PA.
12-1-75 S.M.H.

PLATE NO. 275H

PARTS LIST HALE TYPE BL, B, AND BT DISCHARGE VALVES
PLATE NO. 275H

NO. ITEM	PART NO.		NAME OF PART	REQ.
1	018-1104-50		Screw-#10-32 x 1/2 LG. Nylok Set Cup Point Socket Head Set	1
2	012-0070-00	BL-377D	Ball-Handle	1
3	008-0110-00	A-8R-2-1/2	Cap-2-1/2	1
4	097-0110-00	A-9-2-1/2	Washer-Cap	1
5	368-0020-01	BL-G368P-11	Chain-Assembly (Optional)	1
6	217-0101-01		Plug-1/8 NPT Brass	2
7	042-0070-00	BL-42	Spring-Valve Ball	1
8	110-2100-02		Nut-1/2- 20 Cad. Plated St. Hex.	1
9	038-0010-00	BL-38H	Body-Flanged Valve (BL)	1
9	038-0030-00	B-38F	Body-Flanged Valve (B)	1
10	039-0010-00	BL-39F	Ball-Valve (BL)	1
10	039-0020-00	B-39H	Ball-Valve (B,BT)	1
11	041-0150-00	BL-404	Pivot-Valve Ball	1
12	040-2370-00	40-4N337	Ring-Valve Body Seal (BL,B)	1
13	018-1810-00		Screw-7/16-14 x 1 LG. Hex. Hd. St. Cap (BL,B)	4
14	018-9010-00	BL-111F	Screw-Handle Adjusting	1
15	041-0160-00	BL-41-45F	Stem-Valve (.45F Valves)	1
15	041-0170-00	BL-41-45R	Stem-Valve (45R Valves)	1
15	041-0180-00	BL-41-90	Stem Valve (90F & 90R Valves)	1
16	012-0060-00	BL-12-8	Handle-Valve (8" Lg.)	1
16	012-0060-01	BL-12-9	Handle-Valve (9" LG. Optional)	1
17	048-0130-00	BL-280-45	Stop-Valve (45F & 45R Valves)	1
17	048-0140-00	BL-280-90	Stop-Valve (90F & 90R Valves)	1
18	064-6080-00	BL-114	Pin-Handle Stop	1
19	040-2120-00	40-4N87	Ring-Valve Stem Seal	1
20	048-0100-00	BL-91	Collar-Valve Stem	2
21	038-0040-00	BT-38	Body-Tapped Valve (BT)	1
22	046-5090-00	BL-11	Gasket-Cover (BL)	1 to 3
22	046-5090-01	BL-W11	Gasket-Cover (BL)	2
22	046-0100-00	B-11	Gasket-Cover (B, BT)	1 to 3
22	046-0100-01	B-W11	Gasket-Cover (B, BT)	2
23	018-1610-00		Screw-3/8-16 x 1 LG. Hex. Hd. St. Cap (BL)	6
23	018-1610-00		Screw-3/8-16 x 1 LG. Hex. Hd. St. Cap (B,BT)	8
24	276-0011-00		Seat-Valve (BL)	1
24	276-0121-00		Seat-Valve (B,BT)	1
25	044-0070-00	BL-44-4	Cover-Valve (4 LG. Standard) (BL)	1
25	044-0250-00	BL-44-6	Cover-Valve (6 LG. Optional) (BL)	1
25	044-0020-00	B-44F	Cover-Valve (B,BT)	1

HALE TYPE 30BPF TANK SUCTION VALVE
WITH CHECK VALVE



ASS'Y. PART NO.	NAME
538-0132-00	30BPF TANK VALVE ASS'Y.

TO DISASSEMBLE VALVE

1. CLOSE VALVE HANDLE AND THEN REMOVE THE FOUR COVER SCREWS.
2. ROTATE HANDLE (AND COVER) 180° SO CRESCENT LOCATED ON TOP OF STEM BALL IS NEXT TO THE VALVE MOUNTING FLANGE. THIS IS IMPORTANT BECAUSE THE VALVE SEAT IS AT THE END OPPOSITE VALVE MOUNTING FLANGE, AND THE FLAT ON THE STEM BALL MUST BE AGAINST THE SEAT WHEN REMOVING TO PREVENT DAMAGING THE SEAL.
3. REMOVE STEM, COVER AND HANDLE AS A UNIT.

©HALE FIRE PUMP CO.
CONSHOHOCKEN, PA.

PLATE NO. 611D

2-5-81 J.D.

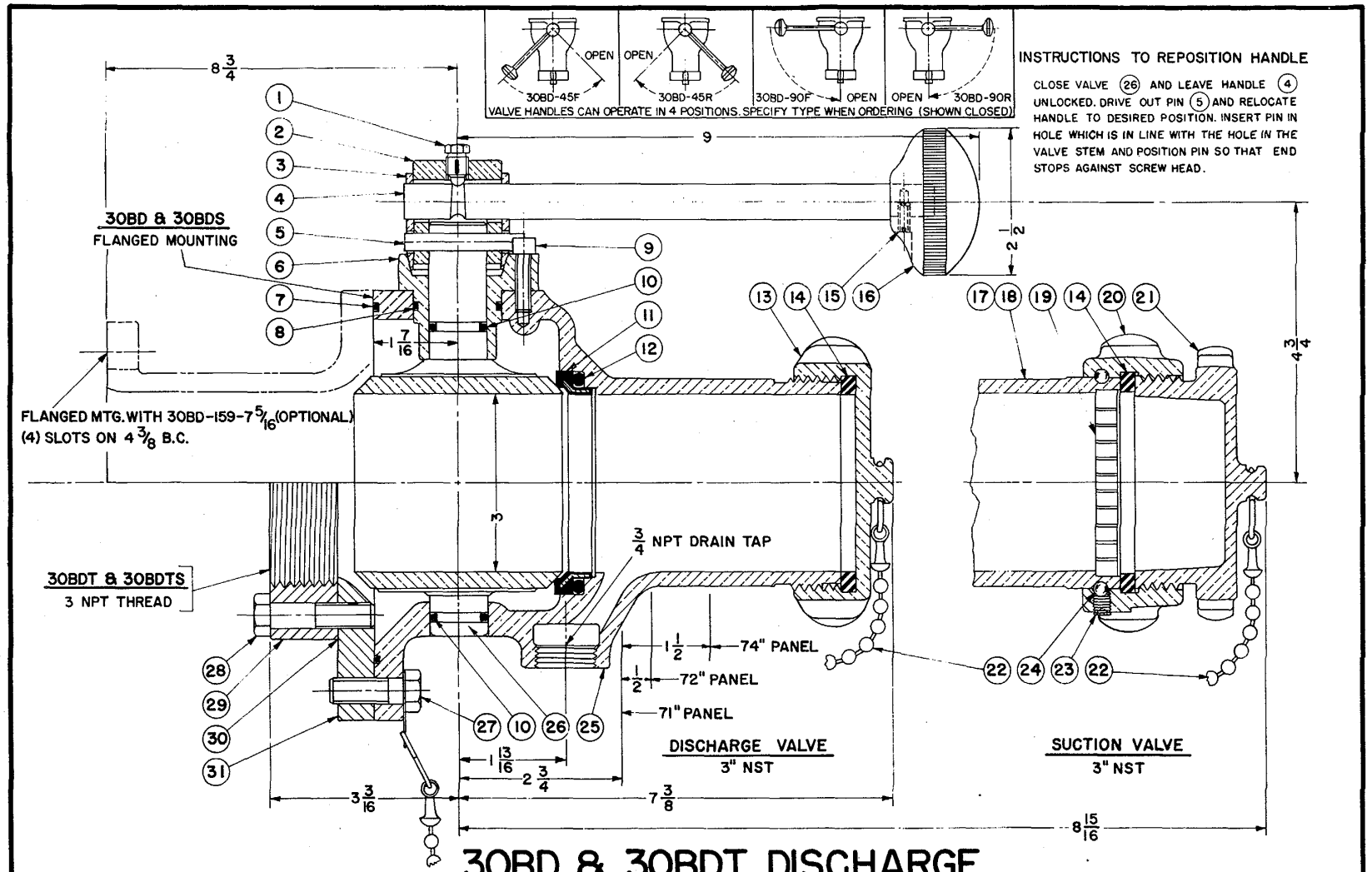
PARTS LIST HALE TYPE 30BPF
TANK SUCTION VALVE
Plate No. 611D

PART NO.		NAME OF PART		NO.REQ.
012-0080-00	20B-A12	Handle-Valve		1
018-1203-51		Screw-1/4-20 x 3/8 LG. Flat Pt. Nylon Locking Stl. Set		1
018-1810-00		Screw-7/16-14 x 1 LG. Hex. Hd. Stl. Cap		6
018-2012-02		Screw-1/2-13 x 1-1/4 LG. Hex. Hd. Stl. Cad. Pl. Cap		4
018-8040-00	40T-104	Stud-Body		2
039-0030-00	30B-39	Stem-Valve		1
040-1590-00	40-3N500	Ring-Cover Seal		1
040-2109-00	40Q-4N75	Ring-Stem Seal		2
040-3390-01	40-6N325-50	Ring-Seat Seal		1
046-0060-00	10OMW-W272	Gasket-Body		1
064-1032-11		Pin-Handle		1
101-0480-00		Tag-Instruction		1
110-1800-00		Nut-7/16-14 Steel Hex		2
276-0020-00	30B-G276D	Seat-Valve		1
538-1070-00		Body-Valve (Assembly)		1
038-0050-01		Body-Valve	1	
040-0240-00		Ring-Seal	1	
250-9400-00		Bearing-Valve Body	1	
544-0110-00		Cover-Valve (Assembly)		1
044-0060-01		Cover-Valve	1	
250-9400-00		Bearing-Valve Cover	1	

ZL-284F TANK SUCTION CHECK VALVE

038-0120-00	ZL-284F	Valve-Check (Bronze) (Optional)	1

When the 038-0120-00 (ZL-284F) check valve is used with the 4" NPT tank connection flange, furnish (1) 115-0130-00 (QLF-329D) check valve flange and (1) 046-0060-00 (10MW-W-272) additional gasket.



HALE TYPE 30BD & 30BDT DISCHARGE 30BDS & 30BDTS SUCTION VALVES

PLATE NO. 618

HALE FIRE PUMP CO.
CONSHOHOCKEN, PA.

8-9-73 G.P.D.

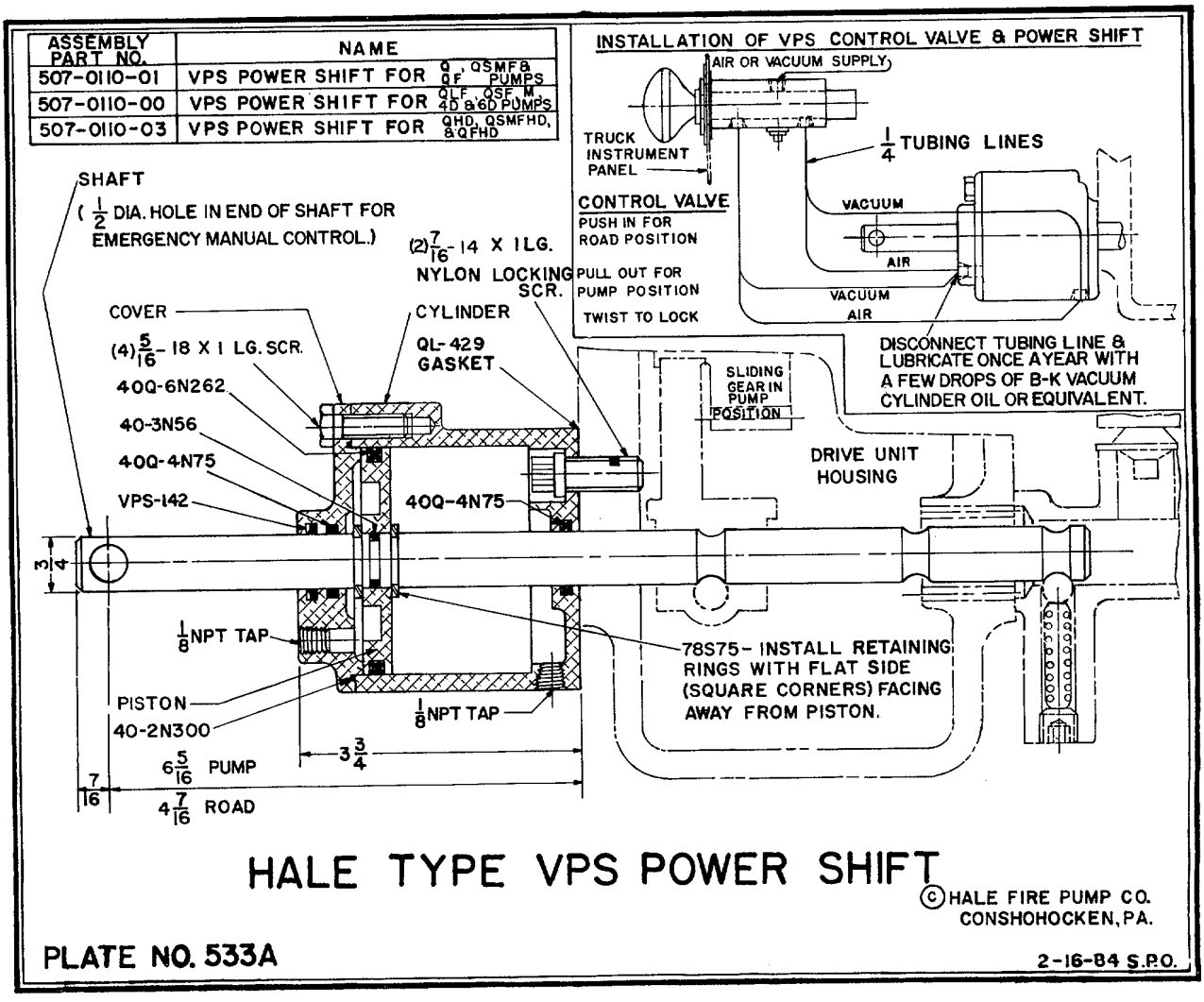
PARTS LIST HALE TYPE 30BD & 30BDT DISCHARGE VALVES
30BDS & 30BDTS SUCTION VALVES
PLATE NO. 618

ITEM NO.	PART NO.		NAME OF PART	NO.REQ.
1	018-9010-00	BL-111F	Screw-Handle Adjusting	1
2	041-0190-00	30BD-41	Extension-Valve Stem	1
3	048-0120-00	30BD-280	Sleeve-Valve Lock	1
4	012-0060-01	BL-12-9	Handle-Valve (9 LG. Standard)	1
4	012-0060-02	BL-12-10	Handle-Valve (10 LG. Optional)	1
5	064-1032-11	05-64M-16CS	Pin-Handle Stop	1
6	048-0110-00	30BD-91	Collar-Valve Stem	1
7	040-1620-00	40-3N575	Ring-Valve Body Seal	1
8	040-1250-00	40-3N131	Ring-Stem Collar Seal	1
9	018-1210-10		Screw-l/4-20 x 1 LG. Socket Head Steel Cap	2
10	040-2100-00	40Q-4N75	Ring-Valve Stem Seal	2
11	276-0020-00	30B-G276D	Seat-Valve	1
12	040-3390-01	40-6N325-50	Ring-Valve Seat Seal	1
13 -	008-0120-00	B-8R-3	Cap-Discharge Valve (30BD & 30BDT)	1
14	097-0120-00	B-9-3	Washer-Cap	1
15	018-1104-50		Screw-#10-32 x 1/2 LG. Nylok Stainless Steel Cup Point Socket Head Set	1
16	012-,0070-00	BL-377D	Ball-Handle	1
17	217-0501-00		Plug-3/4 NPT Black Mal. Iron (30BDS & 30BDTS)	1
18	038-0070-00	30BD-38S	Body-Suction Valve (30BDS & 30BDTS)	1
19	010-0130-00	30BD-G10-3	Strainer-Suction Valve (30BDS & 30OBDTS)	1
20	088-0030-00	2242R-3	Coupling-3 Swivel (30BDS & 30BDTS)	1
21	217-3003-00	B3-217R	Plug-3 Swivel (30BDS & 30BDTS)	1
22	368-0020-01	BL-G368P-11	Chain-Assembly (Optional)	1
23	018-1402-53		Screw-5/16-18 x 1/4 LG. Steel Flat Pt. Soc. Hd. Set (30BDS & 30BDTS)	1
24	039-0040-00	FZZ-22	Ball-Swivel (30BDS & 30BDTS)	44
25	038-0060-00	30BD-38	Body-Discharge Valve (30BD & 30BDT)	1
26	039-0030-00	30B-39	Stem-Ball	1
27	018-1812-00		Screw-7/16-14 x 1-1/4 LG. Hex. Head Steel Cap	4
28	018-1816-04		Screw-7/16-14 x 1-3/4 LG. Hex. Head Steel 3600 Nylon Locking Cap (30BDT & 30BDTS)	4
29	115-0080-00	115-3	Flange-3 NPT (30BDT & 30BDTS)	1
30	046-0050-00	46DW	Gasket-Adapter (30BDT & 30BDTS)	1
31	007-0090-00	30BD-174	Adapter-Valve (30BDT & 30BDTS)	1

To mount the 30BD disch. valve on the pump body, use (1) 30BD-159D-7-5/16 spacer, (1) 46DW gskt., (2) 30BD-896 washers and (4) 7/16-14 x 1-1/4 LG. Hex. Hd. St. Cap Screw Order by part no. 30BD-7

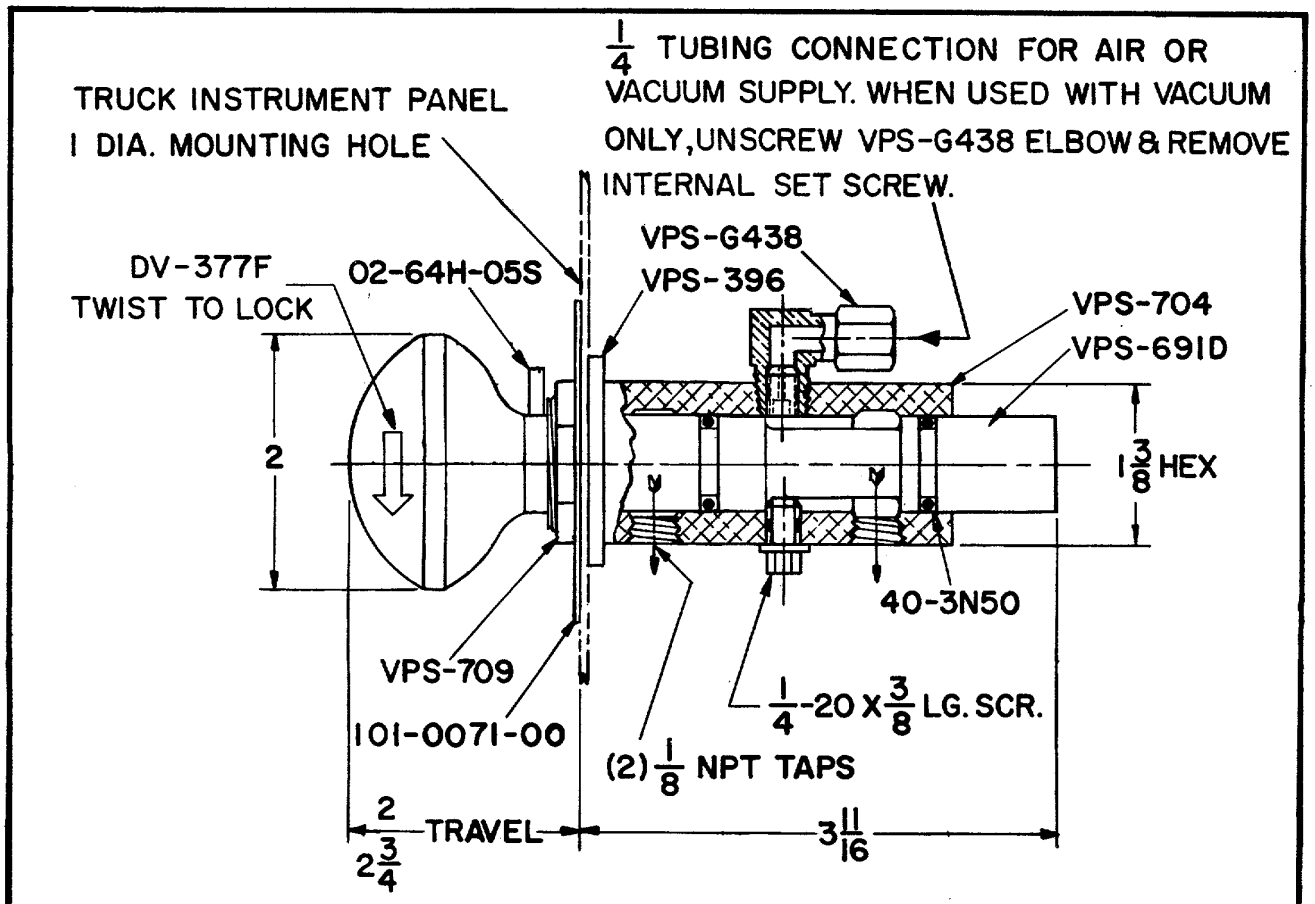
PARTS LIST HALE TYPE VPS POWER SHIFT
Plate No. 533A

PART NO.		NAME OF PART	NO.REQ.
007-0080-00	VPS-654D	Cylinder-Shifting (QLF,QSF,M,4D,6D,Q,QSMF & QF pumps)	1
007-0080-01		Cylinder-Shifting (QHD,QSMFHD & QFHD pumps)	1
018-1410-02		Screw-5/16-18 x 1 Lg. Hex Hd. Steel Zinc Pl. Cap	4
018-1810-23		Screw-7/16-14 x 1 Lg. Counter-Bore 360° Nylon Locking Steel Zinc Pl. Cap	2
037-0120-00	QL-25V	Shaft-Gearshift (QLF,QSF,M,4D & 6D pumps)(037-0120-00 power shaft replaces the 037-0070-00 QL-25F manual shifting shaft)	1
037-0450-00	Q-25V	Shaft-Gearshift (Q,QSMF & QF pumps) (037-0450-00 power shaft replaces the 037-0130-00 Q-25D manual shifting shaft. Check shaft part number to determine if new shaft is required)	1
037-1340-00		Shaft-Gearshift (QHD,QSMFHD & QFHD pumps) (the 037-1340-00 power shaft is standard on these pumps)	1
040-0410-00	40-2N300	Ring-Cylinder Cover Seal	1
040-1130-03	40-3G56	Ring-Piston Inner Seal	1
040-2109-00	40Q-4N75	Ring-Gearshift Shaft Seal	2
040-3349-00	40Q-6N262	Ring-Piston Outer Seal	1
044-0210-00	VPS-671D	Cover-Cylinder (QLF,QSF,M,4D,6D,Q,QSMF,QF pumps)	1
044-0210-01		Cover-Cylinder (QHD,QSMFHD & QFHD pumps)	1
046-5060-00	QL-W429	Gasket-Shifting Cylinder	1
073-0020-00	VPS-A673	Piston-Cylinder (QLF, QSF,M,4D,6D,Q,QSMF & QF pumps)	1
073-0020-01		Piston-Cylinder (QHD,QSMFHD & QFHD pumps)	1
077-0750-05	78S75	Ring-Piston Retaining	2
296-0020-00	VPS-142	Scraper-Gearshift Shaft	1



PARTS LIST HALE TYPE VPS CONTROL VALVE PART NO. 538-0180-00
Plate No. 595A

PART NO.		NAME OF PART	NO. REQ.
012-0140-00	DV-377F	Knob-Stem	1
018-1203-07		Screw-1/4-20 x 3/8 Lg. Countr-Bor 360° Nylon Patch Steel Cap	1
038-0130-00	VPS-704	Body Control Valve	1
040-1120-00	40-3N50	Ring-Stem Seal	2
041-0230-00	VPS-691D	Stem-Control Valve	1
064-0410-12	02-64H-05S	Pin-Indicator	1
097-0150-00	VPS-396	Washer-Lock	1
101-0071-00		Plate-Instruction	1
101-0240-00		Tag-Vps Control Valve Instruction	1
110-7030-00	VPS-709	Nut-Panel	1
598-0020-00	VPS-G438	Elbow-Metering, Assy.	1



HALE TYPE VPS CONTROL VALVE

HALE FIRE PUMP CO.
CONSHOHOCKEN, PA.

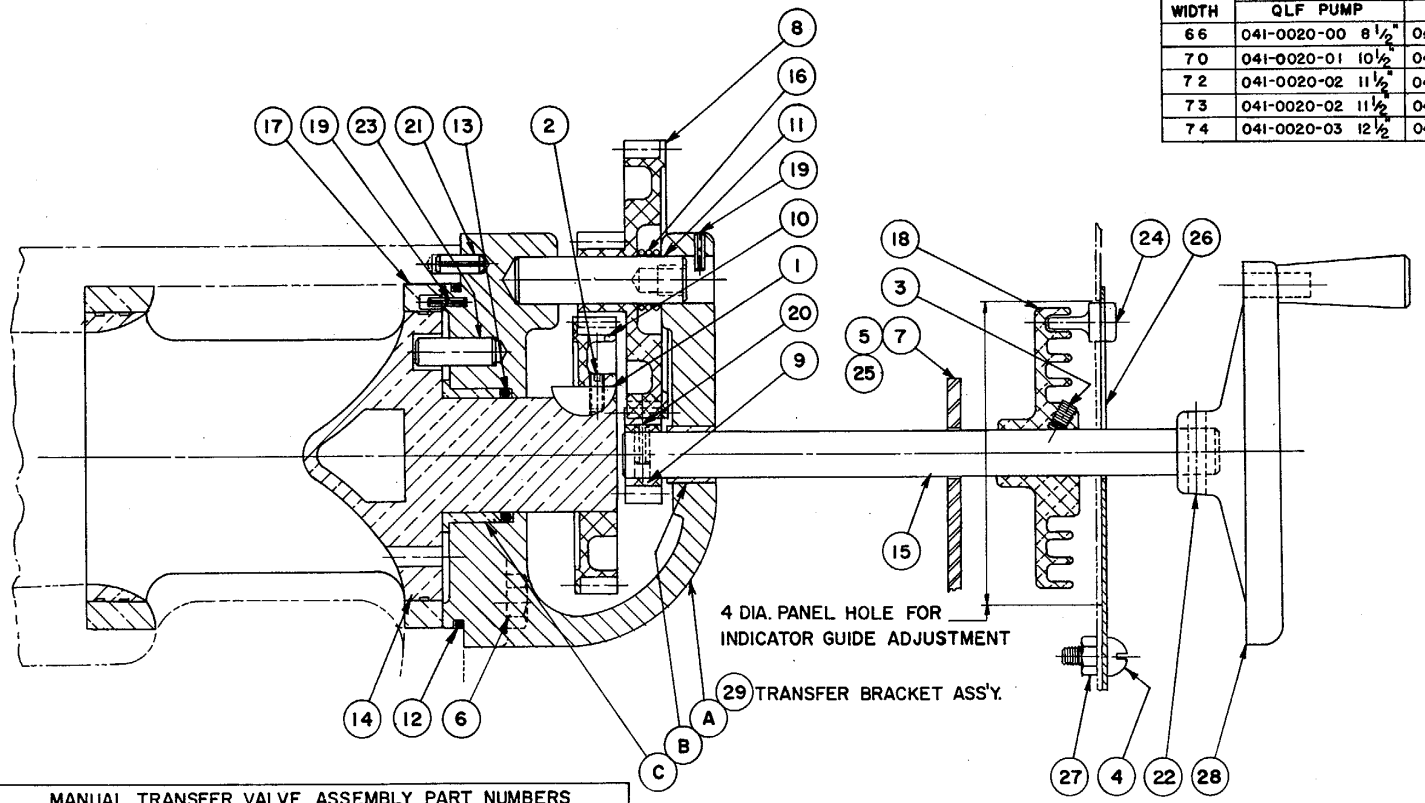
PLATE NO. 595A

5-9-77 F.R.E.

HALE TYPE QD & QLF TRANSFER VALVE

(MANUAL OPERATION)

PANEL WIDTH	⑮-STEM LENGTH	
	QLF PUMP	Q PUMP
66	041-0020-00 8½"	041-0020-01 10½"
70	041-0020-01 10½"	041-0020-03 12½"
72	041-0020-02 11½"	041-0020-04 13½"
73	041-0020-02 11½"	041-0020-05 14½"
74	041-0020-03 12½"	041-0020-05 14½"



PANEL WIDTH	MANUAL TRANSFER VALVE ASSEMBLY PART NUMBERS			
	QLF PUMP		Q PUMP	
	CAST IRON BRONZE FITTED	ALL BRONZE	CAST IRON BRONZE FITTED	ALL BRONZE
66	538-0220-02	538-0220-03	538-0470-02	538-0470-03
70	538-0220-04	538-0220-05	538-0470-04	538-0470-05
72	538-0220-00	538-0220-01	538-0470-00	538-0470-01
73	538-0220-00	538-0220-01	538-0470-06	538-0470-07
74	538-0220-06	538-0220-07	538-0470-06	538-0470-07

HALE FIRE PUMP CO.
CONSHOHOCKEN, PA.

PLATE NO. 472E

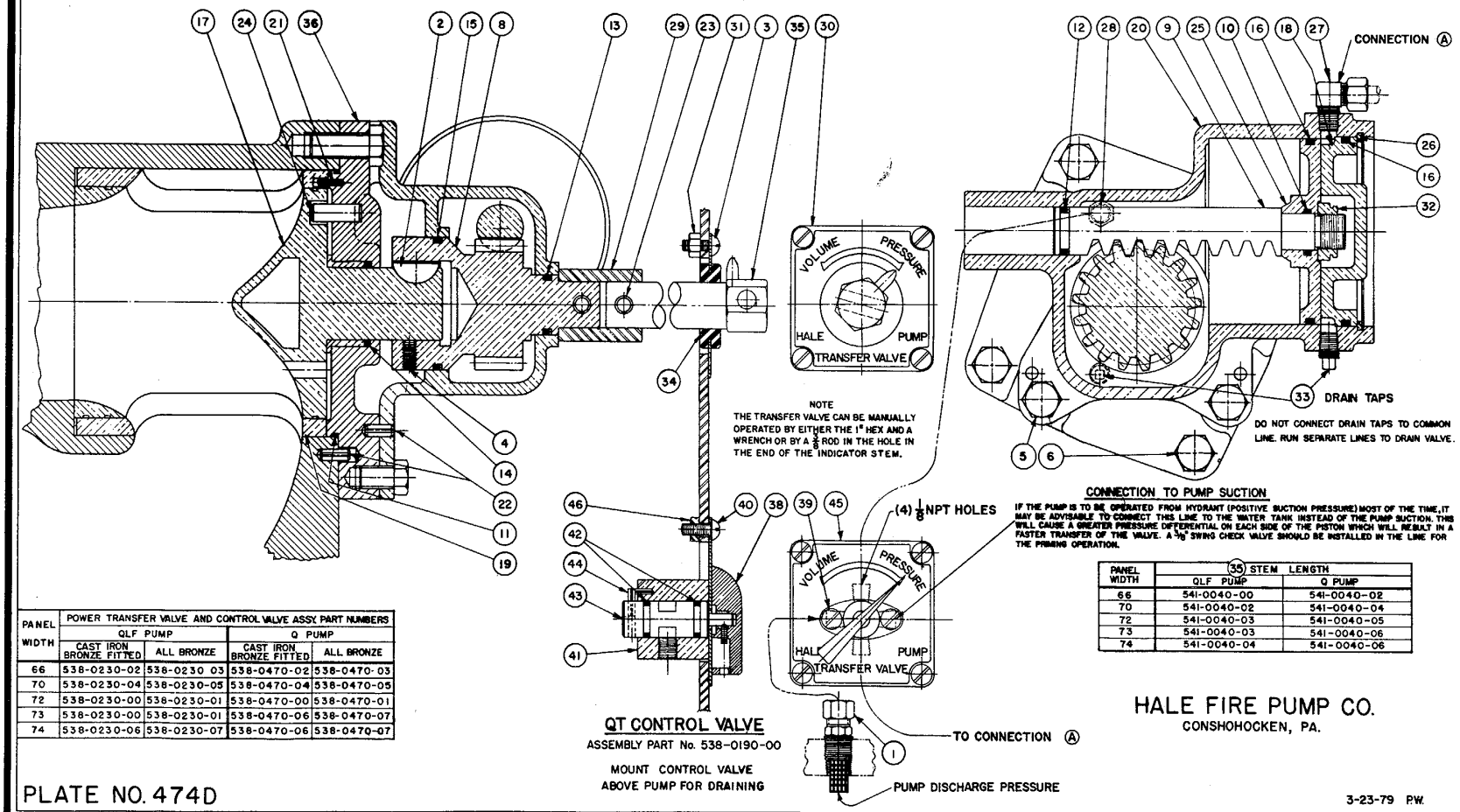
12-6-76 F.R.E.

PARTS LIST HALE TYPE QLF & QD MANUAL TRANSFER VALVE
Plate No. 472E

ITEM	PART NO.		NAME OF PART		NO. REF
1	017-0030-00	QLF-17	Key-Gear		1
2	018-1104-50		Screw-#10-32 x 1/2 LG. Nylon St. Stl. Cup Pt. Soc. Hd. Set		1
3	018-1203-54		Screw-1/4-20 x 3/8 LG. Knurled Point Stl. Set		1
4	018-1205-44		Screw-1/4-20 x 5/8 LG. Rd. Hd. Chrome Pl. Stl. Mach.		4
5	018-1806-00		Screw-7/16-14 x 3/4 LG. Hex. Hd. Steel Cap		2
6	018-1812-00		Screw-7/16-14 x 1-1/4 LG. Hex. Hd. Steel Cap (QLF Pump)		4
6	018-2012-00		Screw-1/2-13 x 1-1/4 LG. Hex. Hd. Steel Cap (Q Pump)		4
7	019-0020-00	QLF-282	Support-Transfer		1
8	031-0060-00	Q-258D	Gear-Countershaft		1
9	031-0070-00	Q-258D-11	Pinion-Transfer		1
10	031-0080-00	Q-258D-35	Gear-Transfer Drum		1
11	037-0020-00	QLF-140	Countershaft-Transfer		1
12	040-1550-00	40-3N400	Ring-Transfer Bracket Seal (QLF Pump)		1
12	040-1590-00	40-3N500	Ring-Transfer Bracket Seal (Q Pump)		1
13	040-2220-00	40-4N150	Ring-Transfer Drum Stem Seal		1
14	041-0010-00	QLD-257	Drum-Transfer (QLF Pump)		1
14	041-0040-00	Q-257D	Drum-Transfer (Q Pump)		1
15	041-0020-XX	Q-279D Length	Stem-Transfer (See Table on Cross Section)		1
16	042-0030-00	QLF-721	Spring-Countershaft Gear		1
17	048-0060-00	QLF-256	Sleeve-Transfer Drum (QLF Pump)		1
17	048-0180-00	Q-256D	Sleeve-Transfer Drum (Q Pump)		1
18	048-0190-00	QLF-73	Guide-Transfer Indicator		1
19	064-0408-02	02-64-04S	Pin-Locating		2
20	064-0608-02	03-64-04S	Pin-Gear Lock		1
21	064-0810-00	04-64-05	Pin-Bracket Locating		1
22	064-0818-02	04-64-09S	Pin-Wheel Lock		1
23	064-6050-00	QL-232	Pin-Transfer Drum Stop		1
24	064-6100-00	QLF-450F	Indicator-Transfer		1
25	097-0020-00	VHQ-396	Washer-7/16 SAE Flat Steel		2
26	101-0090-00	QLF-737D	Plate-Instruction		1
27	110-1200-00		Nut-1/4-20 Steel Hex		4
28	512-0070-00	PM-G697D	Wheel-Adjusting (Assembly)		1
	A. 012-0170-00		PM-697D	Wheel-Adjusting	1
	B. 012-0180-00		QL-157D	Handle-Wheel	1
	C. 064-1016-00		05-64-08	Pin-Wheel Handle Lock	1
29	519-0010-00	QLF-G70	Bracket-Transfer (Assembly) (QLF Pump)		1
	A. 019-0010-00		QLF-70	Bracket-Transfer	1
	B. 250-9020-00		QLF-290	Bearing-Bracket Stem	1
	C. 250-9030-00		QLF-252	Bearing-Bracket Drum	1
29	519-0120-00	Q-G70D	Bracket-Transfer (Assembly) (Q Pump)		1
	A. 019-0090-00		Q-70D	Bracket-Transfer	1
	B. 250-9020--00		QLF-290	Bearing-Transfer Bracket Stem	1
	C. 250-9030--00		QLF-252	Bearing-Transfer Bracket Drum	1

HALE TYPE QLF & QD TRANSFER VALVE

(POWER OPERATION)



NOTE
THE TRANSFER VALVE CAN BE MANUALLY OPERATED BY EITHER THE 1" HEX AND A WRENCH OR BY A 3/8 ROD IN THE HOLE IN THE END OF THE INDICATOR STEM.

DO NOT CONNECT DRAIN TAPS TO COMMON LINE. RUN SEPARATE LINES TO DRAIN VALVE.

CONNECTION TO PUMP SUCTION

IF THE PUMP IS TO BE OPERATED FROM HYDRANT (POSITIVE SUCTION PRESSURE) MOST OF THE TIME, IT MAY BE ADVISABLE TO CONNECT THIS LINE TO THE WATER TANK INSTEAD OF THE PUMP SUCTION. THIS WILL CAUSE A GREATER PRESSURE DIFFERENTIAL ON EACH SIDE OF THE PISTON WHICH WILL RESULT IN A FASTER TRANSFER OF THE VALVE. A 1/8" SWING CHECK VALVE SHOULD BE INSTALLED IN THE LINE FOR THE PRIMING OPERATION.

PANEL WIDTH	POWER TRANSFER VALVE AND CONTROL VALVE ASSY. PART NUMBERS			
	QLF PUMP		Q PUMP	
	CAST IRON BRONZE FITTED	ALL BRONZE	CAST IRON BRONZE FITTED	ALL BRONZE
66	538-0230-02	538-0230 03	538-0470-02	538-0470-03
70	538-0230-04	538-0230-05	538-0470-04	538-0470-05
72	538-0230-00	538-0230-01	538-0470-00	538-0470-01
73	538-0230-00	538-0230-01	538-0470-06	538-0470-07
74	538-0230-06	538-0230-07	538-0470-06	538-0470-07

PANEL WIDTH	(35) STEM LENGTH	
	QLF PUMP	Q PUMP
66	541-0040-00	541-0040-02
70	541-0040-02	541-0040-04
72	541-0040-03	541-0040-05
73	541-0040-03	541-0040-06
74	541-0040-04	541-0040-06

QT CONTROL VALVE

ASSEMBLY PART No. 538-0190-00

MOUNT CONTROL VALVE ABOVE PUMP FOR DRAINING

HALE FIRE PUMP CO.
CONSHOHOCKEN, PA.

PLATE NO. 474D

3-23-79 P.W.

M/F 7-77

PARTS LIST HALE TYPE QLF & QD POWER TRANSFER VALVE
Plate No. 474D

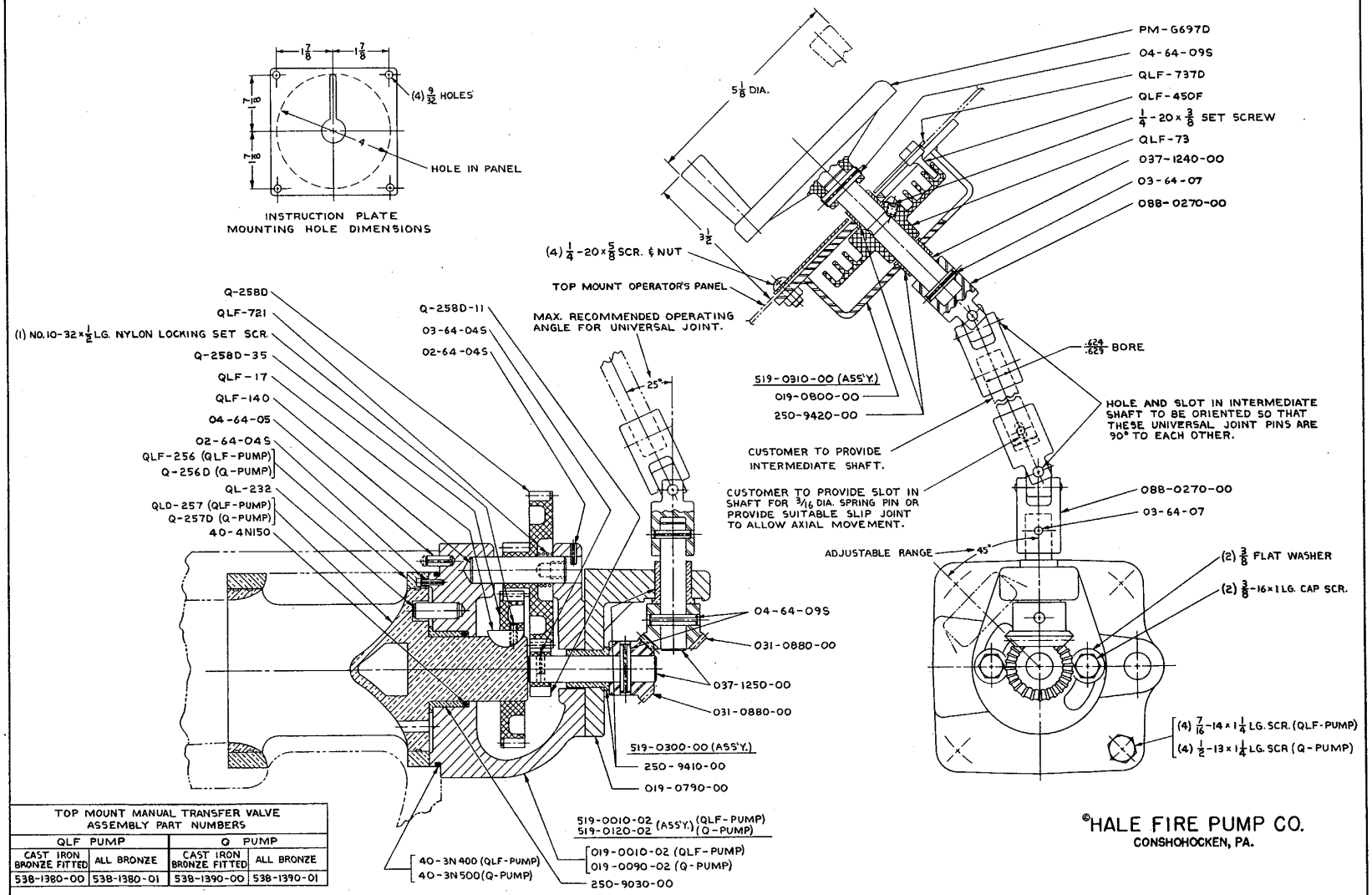
ITEM	PART NO.		NAME OF PART	NO. REF
1	010-0080-01		Strainer-Connector	1
2	017-0040-00	FZZ-17	Key-Transfer Drum Gear	1
3	018-1205-44		Screw-1/4-20 x 5/8 LG. Rd. Hd. Chrome P1. Steel Mach.	4
4	018-1404-52		Screw-5/16-18 x 1/2 LG. Sil. Brz. Soc. Hd. Cup Pt. Set	1
5	018-1806-00		Screw-7/16-14 x 3/4 LG. Hex. Hd. Steel Cap (Q Pump)	3
5	018-1816-00		Screw-7/16-14 x 1-3/4 Lg. Hex. Hd. Steel Cap (QLF Pump)	2
5	018-8010-00	QLF-104	Stud-Transfer Cover (QLF Pump)	1
6	018-1812-00		Screw-7/16-14 x 1-1/4 Lg. Hex. Hd. Steel Cap (QLF Pump)	1
6	018-2112-00		Screw-I/2-20 x 1-1/4 LG. Hex. Hd. Steel Cap (Q Pump)	3
6	018-2112-21		Screw-1/2-20 x 1-1/4 LG. Flanged 12 Pt. Stl. Cap (Q Pump)	1
8	031-0090-00	Q-258A	Gear-Transfer Valve	1
9	031-0180-00	Q-288A	Rack-Transfer	1
10	040-1160-00	40-3N75	Ring-Piston Shaft Seal	1
11	040-1550-00	40-3N400	Ring-Transfer Cover Seal (QLF Pump)	1
11	040-1590-00	40-3N500	Ring-Transfer Cover Seal (Q Pump)	1
12	040-2100-00	40-4N75	Ring-Transfer Rack Seal	1
13	040-2140-03	40-4G100	Ring-Transfer Gear Seal (Small)	1
14	040-2220-00	40-4N150	Ring-Transfer Drum Stem Seal	1
15	040-2300-00	40-4N250	Ring-Transfer Gear Seal (Large)	1
16	040-2390-00	40-4N362	Ring-Cover & Piston Seal	2
17	041-0010-00	QLD-257	Drum-Transfer (QLF Pump)	1
17	041-0040-00	Q-257D	Drum-Transfer (Q Pump)	1
18	044-0140-00	Q-358	Cover-Piston Head	1
19	048-0060-00	QLF-256	Sleeve-Transfer Drum (QLF Pump)	1
19	048-0180-00	Q-256D	Sleeve-Transfer Drum (Q Pump)	1
20	062-0060-00	Q-120D	Housing-Transfer Valve	1
21	064-0408-02	02-64-04S	Pin-Locating	1
22	064-0810-00	04-64-05	Pin-Cover & Transfer Housing Locating	3
23	064-1224-00	06-64-12	Pin-Coupling	2
24	064-6050-00	QL-232	Pin-Transfer Drum Stop	1
25	073-0010-00	Q-673T	Piston-Transfer	1
26	077-3930-00	79S393	Ring-Piston Cover Stop	1
27	082-0104-02		Elbow-1/8 NPT x 3/8 Tube Compression	1
28	082-0107-02		Connection-1/8 NPT x 3/8 Tubing Compression	1
29	088-0010-00	Q-88	Coupling-Transfer Stem	1
30	101-0030-00	Q-737AD	Plate-Instruction	1
31	110-1200-00		Nut-1/4-20 Steel Hex	4
32	110-2704-96	CBP-274D	Nut-Piston Lock	1
33	217-0101-00		Plug-1/8 NPT Black Mal. Iron	2
34	250-9040-00	Q-252A	Bearing-Transfer Stem	1
35	541-0040-XX	Q-G279AF	Stem-Transfer (Assembly)(See Table on Cross Section)	1
36	544-0020-00	QLF-G254	Cover-Transfer Drum (Assembly) (QLF Pump)	1
36	544-0040-00	Q-G254	Cover-Transfer Drum (Assembly) (Q Pump)	1

QT CONTROL VALVE

	538-0190-00	QT-G38	Valve-Transfer Valve (Assembly)		1
38	012-0020-00		QT-12	Knob-Indicator	1
39	018-1203-44		Screw-1/4-20 x 3/8 Lg. Rd, Hd. Chr. P1, Stl. Mach.		2
40	018-1205-44		Screw-1/4-20 x 5/8 Lg. Rd. Hd. Chr. P1, Stl. Mach.		4
41	038-0110-00		QT-38	Body-Valve	1
42	040-1130-00		40-3N56	Ring-Valve Stem Seal	2
43	041-0070-00		QT-41	Stem-Valve	1
44	064-0408-02		02-64-04S	Pin-Stop	3
45	101-0040-00		QT-737D	Plate-Instruction	1
46	110-1200-00			Nut-1/4-20 Steel Hex,	4

HALE TYPE QD & QLF TOP MOUNT MANUAL TRANSFER VALVE

INSTRUCTION PLATE
MOUNTING HOLE DIMENSIONS



TOP MOUNT MANUAL TRANSFER VALVE ASSEMBLY PART NUMBERS			
QLF PUMP		Q PUMP	
CAST IRON BRONZE FITTED	ALL BRONZE	CAST IRON BRONZE FITTED	ALL BRONZE
538-1380-00	538-1380-01	538-1390-00	538-1390-01

PLATE NO. 664

©HALE FIRE PUMP CO.
CONSHOHOCKEN, PA.

4-14-81 J.D.

PARTS LIST HALE TYPE QD & QLF TOP MOUNT MANUAL TRANSFER VALVE
Plate No. 664

PART NO.		NAME OF PART		NO.REQ.
017-0030-00	QLF-17	Key-Gear		1
018-1104-50		Screw-#10-32 x 1/2 LG. Nylon St. Stl. Cup Point Soc. Hd. Set		1
018-1203-54		Screw-1/4-20 x 3/8 LG. Knurled Pt. Stl. Set		1
018-1205-44		Screw-1/4-20 x 5/8 LG. Rd. Hd. St. Stl. P.H. Mach.		4
018-1610-02		Screw-3/8-16 x 1 LG. Hex. Hd. Cad. P1. Stl. Cap		2
018-1812-00		Screw-7/16-14 x 1-1/4 LG. Hex. Hd. Stl. Cap (QLF Pump)		4
018-2012-00		Screw-1/2-13 x 1-1/4 LG. Hex. Hd. Stl. Cap (Q Pump)		4
031-0060-00	Q-258D	Gear-Countershaft		1
031-0070-00	Q-258D-11	Gear-Transfer		1
031-0080-00	Q-258D-35	Gear-Transfer Drum		1
031-0880-00		Gear-Remote Transfer Valve Miter		2
037-0020-00	QLF-140	Countershaft-Transfer		1
037-1240-00		Shaft-Handwheel		1
037-1250-00		Shaft-Miter Gear		2
040-1550-00	40-3N400	Ring-Transfer Bracket Seal (QLF Pump)		1
040-1590-00	40-3N500	Ring-Transfer Bracket Seal (Q Pump)		1
040-2220-00	40-4N150	Ring-Transfer Drum Stem Seal		1
041-0010-00	QLD-257	Drum-Transfer (QLF Pump)		1
041-0040-00	Q-257D	Drum-Transfer (Q Pump)		1
042-0030-00	QLF-721	Spring-Countershaft Gear		1
048-0060-00	QLF-256	Sleeve-Transfer Drum (QLF Pump)		1
048-0180-00	Q-256D	Sleeve-Transfer Drum (Q Pump)		1
048-0190-00	QLF-73	Guide-Transfer Indicator		1
064-0408-02	02-64-04S	Pin-Locating		2
064-0608-02	03-64-04S	Pin-Gear Lock		1
064-0614-00	03-64-07	Pin-Universal Joint		4
064-0810-00	04-64-05	Pin-Bracket Locating		1
064-0818-02	04-64-09S	Pin-Wheel Lock		3
064-6050-00	QL-232	Pin-Transfer Drum Stop		1
064-6100-00	QLF-450F	Indicator-Transfer		1
088-0270-00		Joint-Universal		2
097-0170-00	FZ-396	Washer		2
101-0090-00	QLF-737D	Plate-Instruction		1
110-1200-00		Nut-1/4-20 Steel Hex		4
512-0070-00	PM-G697D	Wheel-Adjusting (Assembly)		1
012-0170-00		PM-697D Wheel-Adjusting	1	
012-0180-00		QL-157D Handle-Wheel	1	
064-1016-00		05-64-08 Pin-Wheel Handle Lock	1	
519-0010-02		Bracket-Transfer (Assembly) (QLF Pump)		1
019-0010-02		Bracket-Transfer	1	
250-9030-00		QLF-252 Bearing-Bracket Drum	1	
519-0120-02	QG70D	Bracket-Transfer (Assembly) (Q Pump)		1
019-0090-02		Bracket-Transfer	1	
250-9030-00		QLF-252 Bearing-Bracket Drum	1	
519-0300-00		Bracket-Miter Gear (Assembly)		1
019-0790-00		Bracket-Miter Gear	1	
250-9410-00		Bearing-Miter Gear	2	
519-0310-00		Bracket-Handwheel Panel (Assembly)		1
019-0800-00		Bracket-Handwheel Panel	1	
250-9420-00		Bearing-Handwheel Bracket	2	

PARTS LIST HALE TYPE DV5 DRAIN VALVE
ASSEMBLY PART NO. 538-1010-00
PLATE NO. 438D

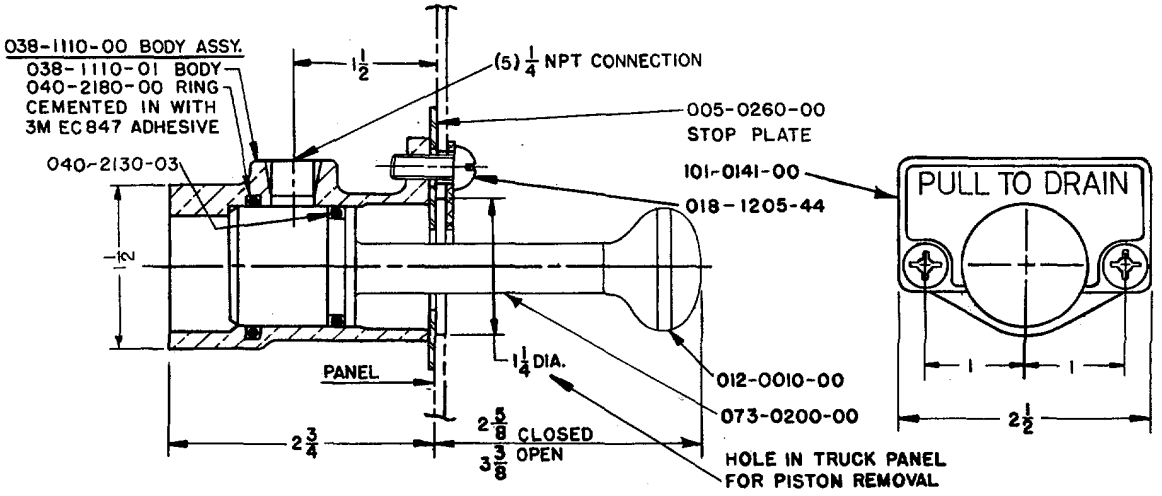
PART NO.	NAME OF PART	NO. REQ.
005-0260-00	Plate-Piston Stop	1
012-0010-00	Knob-Valve Piston	1
018-1205-44	Screw-1/4-20 x 5/8 Lg. Rd. Hd. SST P.H.Mach.	2
038-1110-00	Body-Drain Valve(Assembly)	1
038-1110-01	Body-Drain Valve	1
040-2180-00	40-4N125 Ring-Body Seal	1
040-2130-03	Ring-Piston Seal	1
073-0200-00	Piston-Valve Handle	1
101-0141-00	Plate-Instruction	1

OPERATING INSTRUCTIONS:

TO OPEN VALVE:
PULL THE VALVE KNOB OUT.
TO CLOSE VALVE:
PUSH THE VALVE KNOB IN.
NOTE: THE VALVE MUST BE SEATED COMPLETELY TO PREVENT LEAKAGE WHILE PRIMING OR PUMPING.

MOUNTING INSTRUCTIONS:

VALVE SHOULD BE RIGIDLY MOUNTED WITH CONNECTING TAPS IN UPRIGHT POSITION.
USE 3/8 TUBE FOR DRAIN LINES.
PANEL MOUNTING:
DRILL (3) HORIZONTAL HOLES USING A TEMPLATE MADE FROM INSTRUCTION PLATE.
MOUNT VALVE WITH PANEL BETWEEN STOP WASHERS AND INSTRUCTION PLATE.



HALE TYPE DV5 DRAIN VALVE

ASSEMBLY PART NO.	NAME
538-1010-00	DV5

©HALE FIRE PUMP CO.
CONSHOHOCKEN, PA.

PLATE NO. 438D

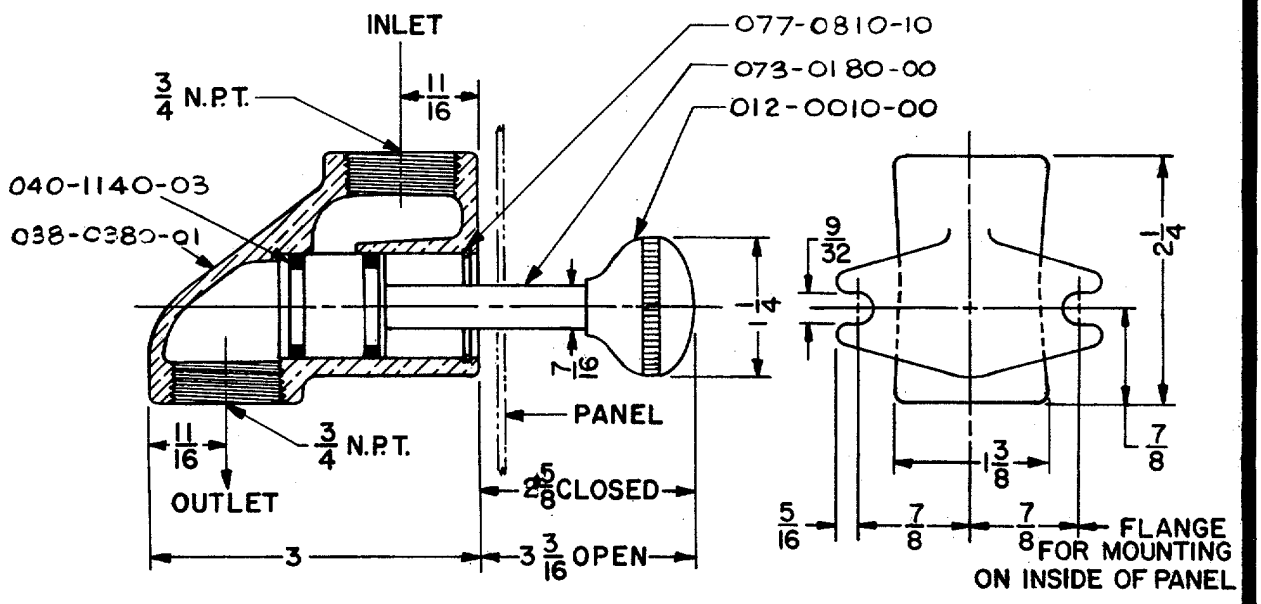
6-24-80 P.W.

M/F 3-80

PARTS LIST HALE TYPE HD DRAIN VALVE
ASSEMBLY PART NO. 538-0600-01
Plate No. 479C

PART NO.		NAME OF PART	NO. REQ.
012-0010-00	ZL-838D	Knob-Valve	1
038-0380-01		Body-Valve	1
040-1140-03	40-3G62	Ring-Piston Seal	2
073-0180-00		Piston-Valve	1
077-0810-10		Ring-Piston Retaining	1

HALE TYPE HD VALVE



ASSEMBLY PART NO.	NAME
538-0600-01	HD

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CONSHOHOCKEN, PA.

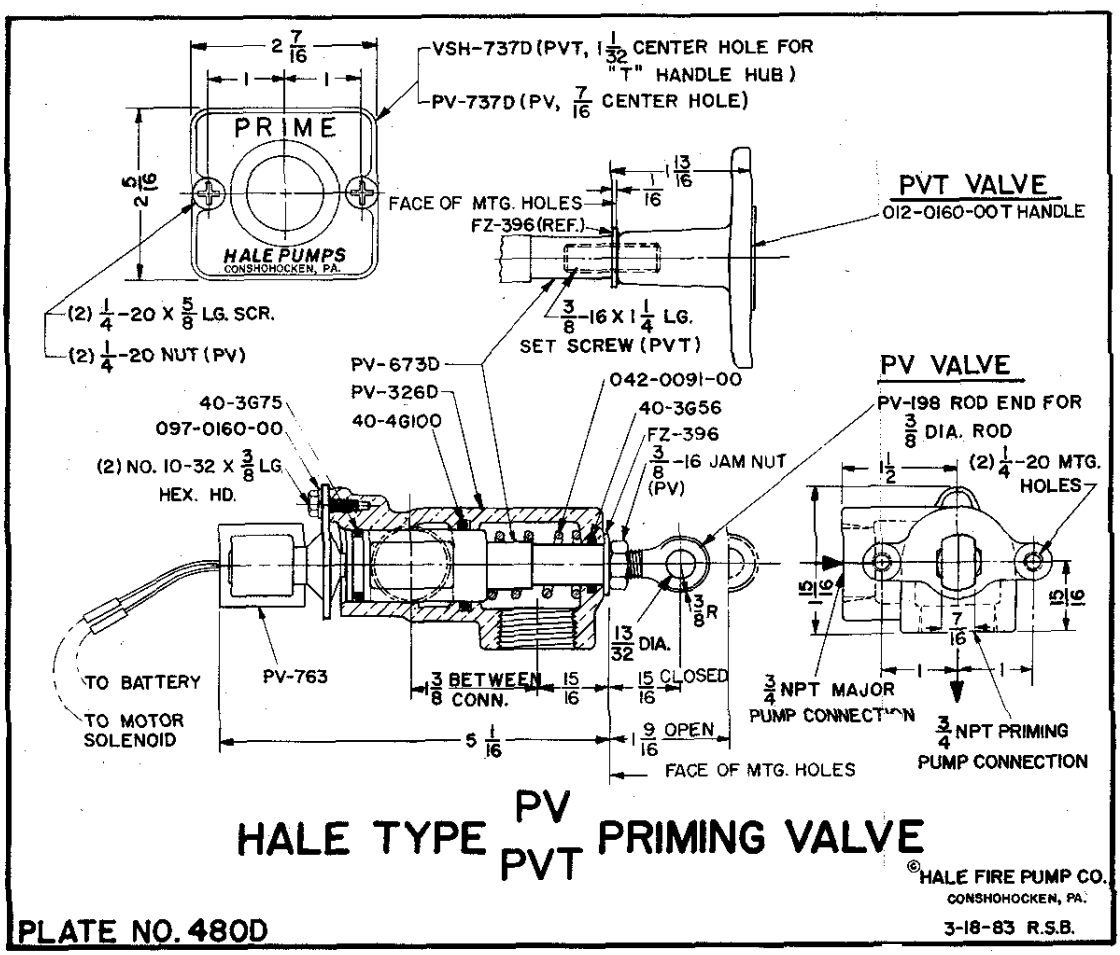
PLATE NO. 479C

2-14-80 W.P.P.

PARTS LIST HALE TYPE PV & PVT PRIMING VALVE
PLATE NO. 480D

ASSEMBLY PART NO.	DESCRIPTION
538-0210-00	PV Priming Valve Assembly
538-0280-02	PVT Priming Valve Assembly

PART NO.		NAME OF PART	NO. REQ.
012-0160-00		Handle-(PVT Valve)	1
018-1103-00		Screw-#10-32 x 3/8 Lg. Hex Hd. Steel	2
018-1205-44		Screw-1/4-20 x 5/8 Lg. Ph. Rd. Hd. SST. Mach.	2
018-1612-54		Screw-3/8-16 x 1-1/4 Lg. Soc. Hd. Stl. Knurled Pt. Set. (PVT Valve)	1
028-0050-00	PV-198	End-Rod (PV Valve)	1
038-0170-00	PV-326D	Body-Valve	1
040-1130-03	40-3G56	Ring-Body Seal	1
040-1160-03	40-3G75	Ring-Piston Seal	1
040-2140-03	40-4G100	Ring-Body Seal	1
042-0091-00		Spring	1
073-0040-00	PV-673D	Piston-Valve	1
097-0160-00		Washer-Lock	2
097-0170-00	FZ-396	Washer-Valve Piston (PV Valve)	1
101-0020-00	PV-737D	Plate-Instruction (PV Valve)	1
101-0050-00	VSH-737D	Plate-Instruction (PVT Valve)	1
110-1200-00		Nut-1/4-20 Steel Hex (PV Valve)	2
110-1601-00		Nut-3/8-16 Hex Steel Jam (PV Valve	1
200-0020-00	PV-763	Switch-Priming Valve	1



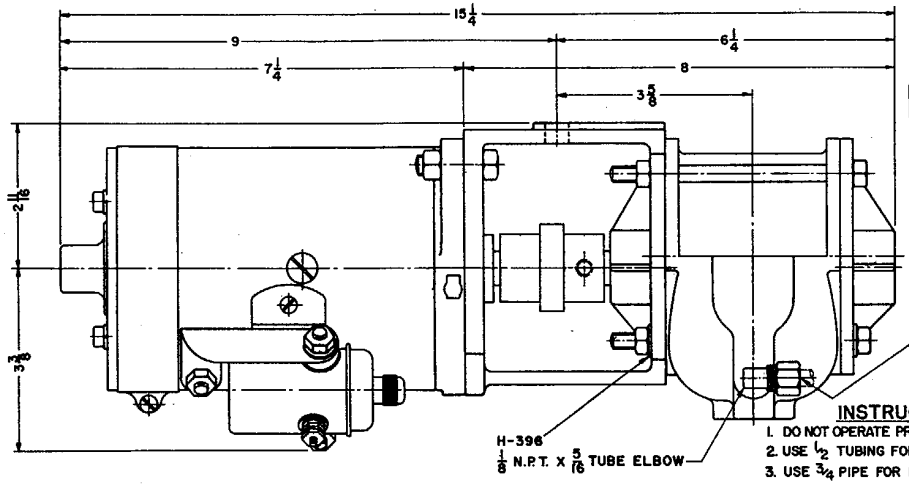
HALE TYPE PV / PVT PRIMING VALVE

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CONSHOHOCKEN, PA.

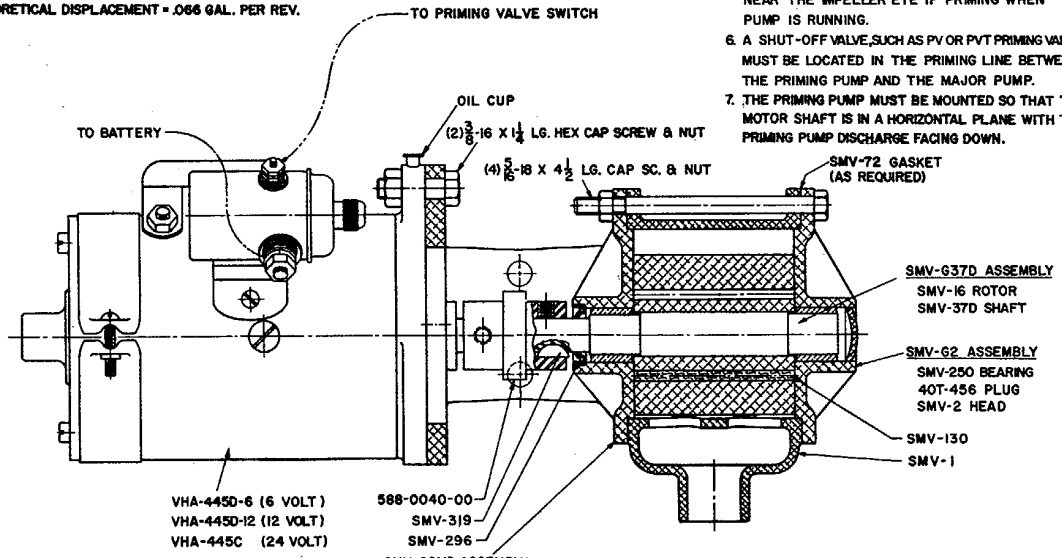
PLATE NO. 480D

3-18-83 R.S.B.

SMV-6
HALE TYPE SMV-12 PRIMING PUMP
SMV-24



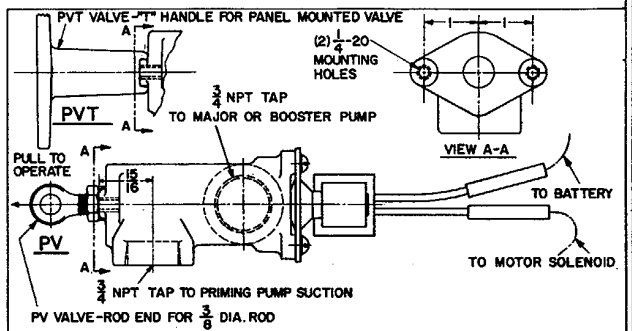
NOTE: WEIGHT OF PRIMING PUMP & MOTOR = 28 LBS.
THEORETICAL DISPLACEMENT = .056 GAL. PER REV.



ASSY. NO.	NAME
501-0280-01	SMV-6 PRIMING PUMP AND TANK
501-0280-03	SMV-12 PRIMING PUMP AND TANK
501-0280-02	SMV-24 PRIMING PUMP AND TANK

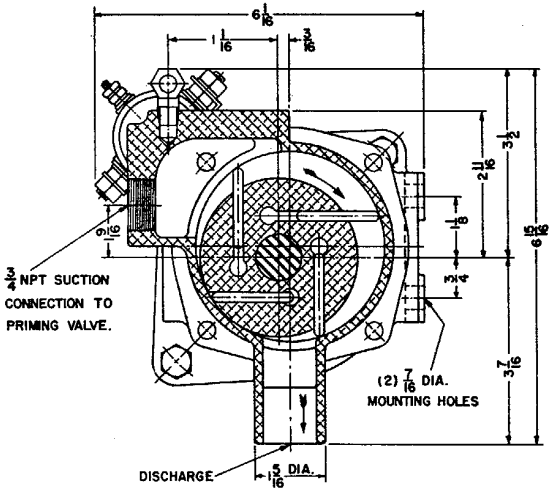
INSTRUCTIONS

1. DO NOT OPERATE PRIMING PUMP WITHOUT OIL IN TANK.
2. USE 1/2 TUBING FOR BOOSTER PUMPS.
3. USE 3/4 PIPE FOR MIDSHIP PUMPS.
4. CONNECT TO HIGHEST POINT ON DISCHARGE OF PUMP IF PRIMING WHILE PUMP IS STATIONARY.
5. CONNECT TO HIGHEST POINT ON THE SUCTION NEAR THE IMPELLER EYE IF PRIMING WHEN PUMP IS RUNNING.
6. A SHUT-OFF VALVE, SUCH AS PV OR PVT PRIMING VALVE, MUST BE LOCATED IN THE PRIMING LINE BETWEEN THE PRIMING PUMP AND THE MAJOR PUMP.
7. THE PRIMING PUMP MUST BE MOUNTED SO THAT THE MOTOR SHAFT IS IN A HORIZONTAL PLANE WITH THE PRIMING PUMP DISCHARGE FACING DOWN.



HALE PV & PVT PRIMING VALVE

THE PV & PVT PRIMING VALVE IS AVAILABLE AS OPTIONAL EQUIPMENT. IT COMBINES A COMPACT PRIMING LINE VALVE AND AUTOMATIC STARTING MOTOR CONTROL THAT OPERATES WHEN THE HANDLE IS PULLED. A PANEL NAMEPLATE & MOUNTING SCREWS ARE SUPPLIED.



© HALE FIRE PUMP CO.
CONSHOHOCKEN, PA.

PLATE NO. 492A

9-22-82 T.C.

PARTS LIST HALE TYPE SMV PRIMING PUMP
Plate No. 492A

ASSEMBLY PART NO.		DESCRIPTION
501-0280-01	SMV-6	Priming Pump (with motor) and tank
501-0280-02	SMV-24	Priming Pump (with motor) and tank
501-0280-03	SMV-12	Priming Pump (with motor) and tank

PART NO.		NAME OF PART		NO. REQ.
001-0130-00	SMV-1	Body-Pump		1
117-0190-00	SMV-319	Key-Drive Shaft		1
018-1444-02		Screw-5/16-18 x 4-1/2 Lg. Hex Hd. Stl.Cap Zinc Pl.		4
018-1612-02		Screw-3/8-16 x 1-1/4 Lg. Hex Hd. Stl. Cap Zinc Pl.		2
046-5200-00	SMV-72	Gasket-Pump Head		As Req.
082-0103-02		Elbow-1/8 NPT to 5/16 Tube Compression		1
097-0240-00	H-396	Washer-Flat		2
108-0011-00		Tank-Oil (Assembly)		1
110-1400-02		Nut-5/16-18 Hex Steel Zinc Pl.		4
110-1600-02		Nut-3/8-16 Hex Steel Zinc Pl.		2
130-0010-00	SMV-130	Vane-Rotor		4
200-0040-00	VHA-445D-12	Motor-Priming Pump (12 Volt)		1
200-0050-00	VHA-445D-6	Motor-Priming Pump (6 Volt)		1
200-0060-00	VHA-445C	Motor-Priming Pump (24 Volt)		1
296-2130-00	SMV-296	Seal-Oil		1
502-0060-00	SMV-G2MD	Head-Pump Mounting Assembly		1
002-0110-00		SMV-2MD	Head-Pump Mounting	1
250-9110-00		SMV-250	Bearing-Pump	1
502-0070-00	SMV-G2	Head-Pump (Assembly)		1
002-0120-00		SMV-2	Head-Pump	1
217-3004-00		40T-456	Plug-Expansion	1
250-9110-00		SMV-250	Bearing-Pump	1
537-0280-00	SMV-G37D	Shaft-Pump (Assembly)		1
016-0170-00		SMV-16	Rotor	1
037-0270-00		SMV-37D	Shaft-Pump	1
588-0040-00		Coupling Drive		1

INSTALLATION AND SERVICE INSTRUCTIONS FOR HALE ELECTRIC & CLUTCH PRIMING PUMP LUBRICATION SYSTEMS

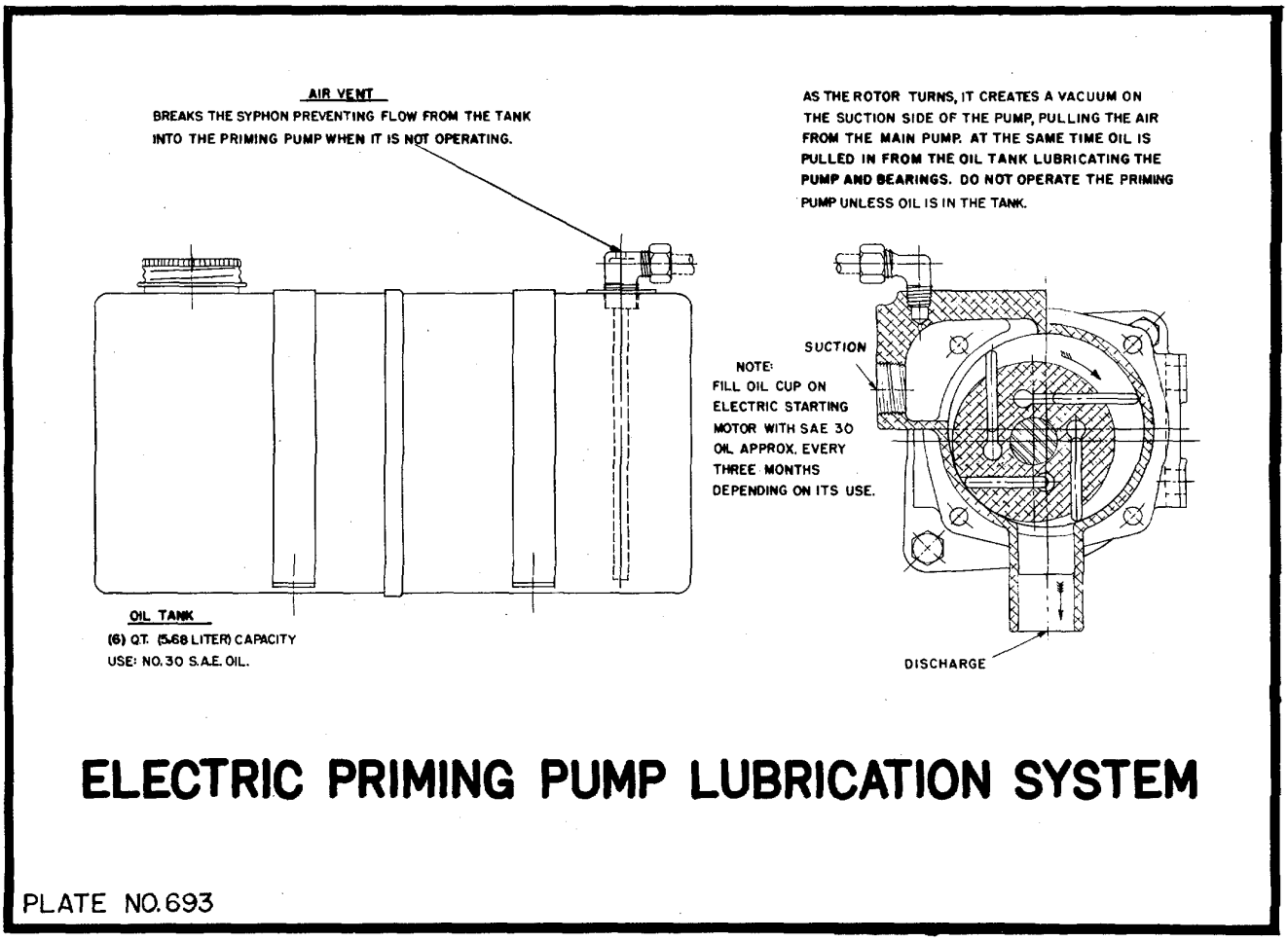
The "self priming" priming pumps, which prime centrifugal pumps, are lubricated as shown. Priming instructions are covered in the pump instruction manual.

The priming pump oil tank should be kept full of SAE 30 motor oil. Never run the priming pump unless oil is in the tank and lubricating the priming pump. After using the priming pump, it should be oiled by engaging the pump until oil sprays out of the discharge. If oil continues to run after the pump is stopped, check the oil tube air vent hole to make sure it is open.

If the priming operation is not using oil, water might be entering the oil tank from the major centrifugal pump. This can occur if the priming valve leaks while the major pump is in operation. To correct, drain tank and service the priming valve.

The air vent in the priming tank tube is to break the syphon preventing oil flow from the tank into priming pump after the priming operation. This hole is made with a No. 60 drill and should not be enlarged. It should be kept open at all times. The air vent in the filler cap should similarly be left open.

The location of the oil tank on the apparatus is optional with the manufacturer mounting the pump and will be determined by accessibility for inspection, filling and conditions of mounting. The electric priming pump must be mounted so that the shaft is in a horizontal plane with the priming pump discharge facing down. The tank is furnished with strap mounting brackets. Tubing connecting oil tank with priming pump (5/16 O.D.) is not supplied by Hale.



CLUTCH PRIMING PUMP LUBRICATION SYSTEM

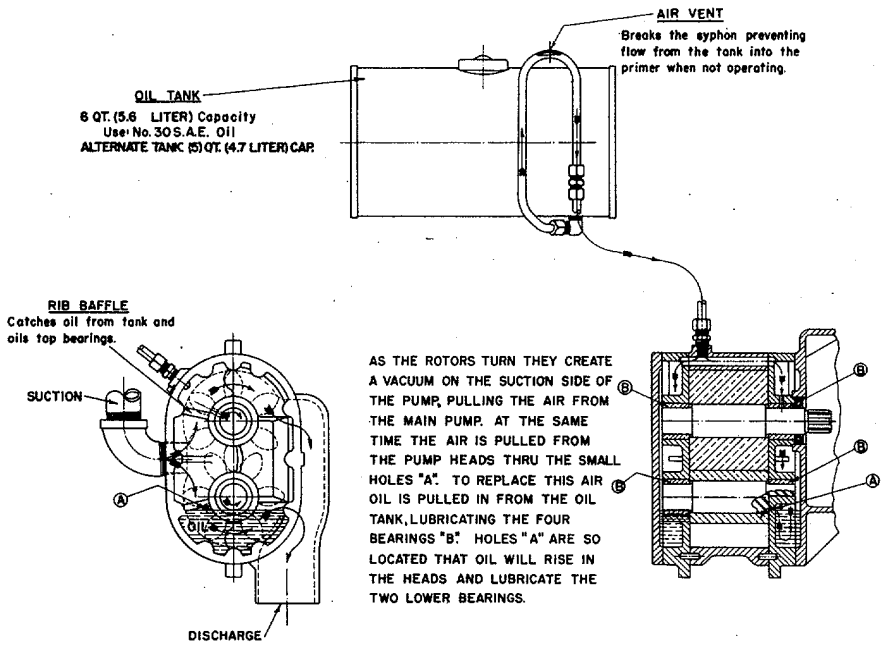
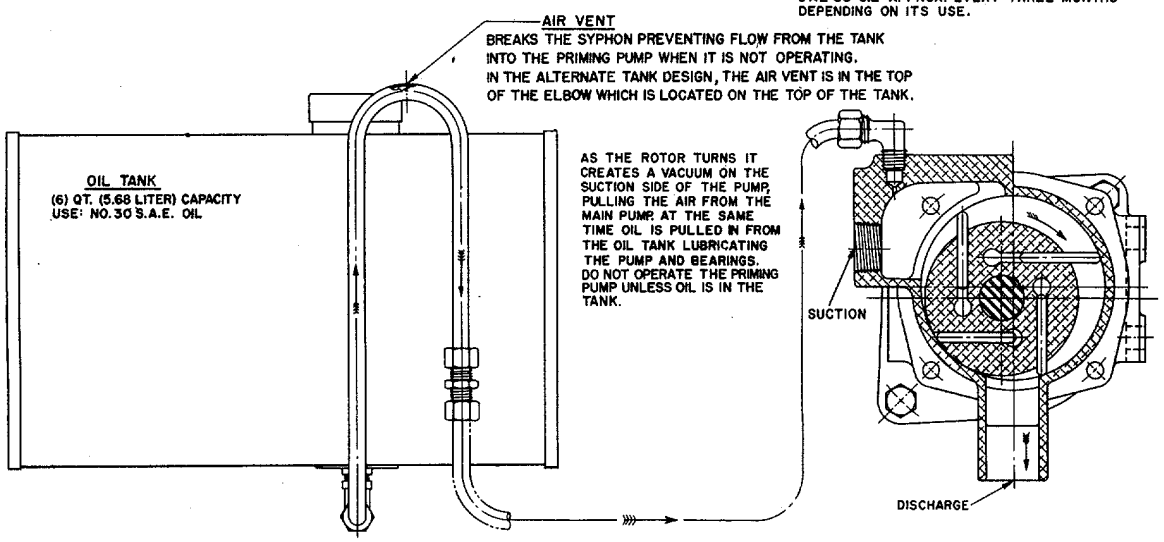


PLATE NO. 413

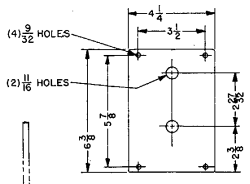
NOTE:- FILL OIL CUP ON ELECTRIC STARTING MOTOR WITH SAE 30 OIL APPROX. EVERY THREE MONTHS DEPENDING ON ITS USE.



ELECTRIC PRIMING PUMP LUBRICATION SYSTEM

PLATE NO. 509

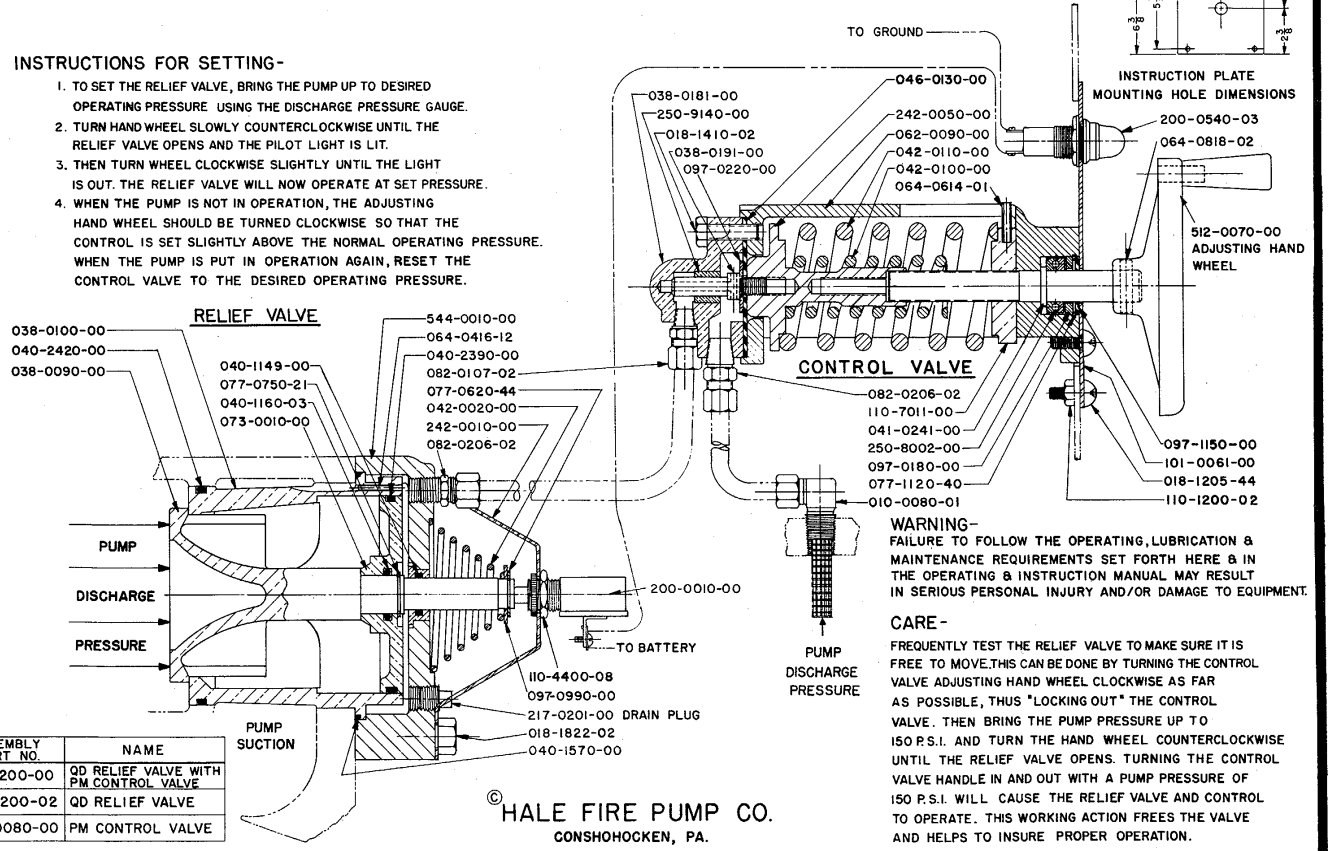
HALE TYPE QD RELIEF VALVE
WITH PM CONTROL VALVE



INSTRUCTION PLATE MOUNTING HOLE DIMENSIONS

INSTRUCTIONS FOR SETTING-

1. TO SET THE RELIEF VALVE, BRING THE PUMP UP TO DESIRED OPERATING PRESSURE USING THE DISCHARGE PRESSURE GAUGE.
2. TURN HAND WHEEL SLOWLY COUNTERCLOCKWISE UNTIL THE RELIEF VALVE OPENS AND THE PILOT LIGHT IS LIT.
3. THEN TURN WHEEL CLOCKWISE SLIGHTLY UNTIL THE LIGHT IS OUT. THE RELIEF VALVE WILL NOW OPERATE AT SET PRESSURE.
4. WHEN THE PUMP IS NOT IN OPERATION, THE ADJUSTING HAND WHEEL SHOULD BE TURNED CLOCKWISE SO THAT THE CONTROL IS SET SLIGHTLY ABOVE THE NORMAL OPERATING PRESSURE. WHEN THE PUMP IS PUT IN OPERATION AGAIN, RESET THE CONTROL VALVE TO THE DESIRED OPERATING PRESSURE.



ASSEMBLY PART NO.	NAME
538-0200-00	QD RELIEF VALVE WITH PM CONTROL VALVE
538-0200-02	QD RELIEF VALVE
562-0080-00	PM CONTROL VALVE

WARNING-

FAILURE TO FOLLOW THE OPERATING, LUBRICATION & MAINTENANCE REQUIREMENTS SET FORTH HERE & IN THE OPERATING & INSTRUCTION MANUAL MAY RESULT IN SERIOUS PERSONAL INJURY AND/OR DAMAGE TO EQUIPMENT.

CARE-

FREQUENTLY TEST THE RELIEF VALVE TO MAKE SURE IT IS FREE TO MOVE. THIS CAN BE DONE BY TURNING THE CONTROL VALVE ADJUSTING HAND WHEEL CLOCKWISE AS FAR AS POSSIBLE, THUS "LOCKING OUT" THE CONTROL VALVE. THEN BRING THE PUMP PRESSURE UP TO 150 P.S.I. AND TURN THE HAND WHEEL COUNTERCLOCKWISE UNTIL THE RELIEF VALVE OPENS. TURNING THE CONTROL VALVE HANDLE IN AND OUT WITH A PUMP PRESSURE OF 150 P.S.I. WILL CAUSE THE RELIEF VALVE AND CONTROL TO OPERATE. THIS WORKING ACTION FREES THE VALVE AND HELPS TO INSURE PROPER OPERATION.

©HALE FIRE PUMP CO.
CONSHOHOCKEN, PA.

PLATE NO. 404E

6-7-84 K.S.B.

HALE TYPE QD RELIEF VALVE WITH PM CONTROL VALVE
PART NO. 538-0200-00
Plate No. 404E

PART NO.		NAME OF PART	NO. REQ.
		QD RELIEF VALVE PART NO. 538-0200-02	
018-1822-02		Screw-7/16-14 x 2-1/4 Lg. Stl. Hex Zinc Pl.	4
038-0090-00	Q-682	Valve-Relief Valve	1
038-0100-00	Q-670H	Body-Relief Valve	1
040-1149-00	40Q-3N62	Ring-Cover Seal	1
040-1160-03	40-3N75	Ring-Piston Seal (Small)	1
040-1570-00	40-3N450	Ring-Valve Body Seal	1
040-2390-00	40-4N362	Ring-Piston Seal (Large)	1
040-2420-00	40-4N400	Ring-Valve Body Seal	1
042-0020-00	Q-721	Spring-Valve	1
064-0416-12	02-64H-08S	Pin-Relief Valve Body	1
073-0010-00	Q-673T	Piston-Relief Valve	1
077-0620-44		Ring-Spring Retaining	1
077-0750-21	77SS75	Ring-Piston Retianing	1
082-0206-02		Connector-Compression 1/4 NPT to 3/8 Tubing	1
097-0990-00		Washer	1
110-4400-08		Nut-5/8-32 x 3/32 Thick Brass	1
200-0010-00	PM-763	Switch-Indicator Light	1
217-0201-00		Plug-1/4 NPT Mal. Iron	1
242-0010-00	Q-227	Strap-Switch	1
544-0010-00	Q-G671H	Cover-Relief Valve (Assembly)	1
004-0120-00		Q-671H Cover-Relief Valve	1
048-0050-00		Q-705 Sleeve-Relief Valve Cover	1
		PM CONTROL VALVE PART NO. 562-0080-00	
010-0080-01		Strainer-Relief Valve Control	1
018-1205-44		Screw-1/4-20 x 5/8 Lg. Rd. Hd. SST. Philips Head Mach.	8
018-1410-02		Screw-5/16-18 x 1 Lg. Hex Hd. Stl. Cap Zinc Pl.	4
038-0191-00		Valve-Control	1
041-0241-00		Stem-Adjusting	1
042-0100-00	PM-693	Spring-Inside	1
042-0110-00	PM-694	Spring-Outside	1
046-0130-00	PM-688	Diaphragm-Control Body	1
062-0090-00	PM-665	Housing-Spring	1
064-0614-01	03-64-07	Pin-Adjusting Nut	1
064-0818-02	04-64-09S	Pin-Wheel Lock	1
077-1120-40		Ring-Bearing Washer Retaining	1
082-0107-02		Connector-Compression 1/8 NPT to 3/8 Tubing	1
082-0206-02		Connector-Compression 1/4 NPT to 3/8 Tubing	1
097-0180-00	PM-689	Washer-Bearing	1
097-0220-00	FIR-396	Washer-Diaphragm Support	1
097-1150-00		Washer-Sealing	1
101-0010-00	PM-443	Tag-Instruction	1
101-0061-00	PM-737F	Plate-Instruction	1
110-1200-02		Nut-1/4-20 Steel Hex Zinc Pl.	4
110-7011-00		Nut-Adjusting	1
200-0540-03		Light-Indicator	1
242-0050-00	PM-662D	Clamp-Diaphragm	1
250-8002-00	CS-230	Bearing-Thrust	1
512-0070-00	PM-G697D	Wheel-Adjusting (Assembly)	1
012-0170-00		PM-698D Wheel-Adjusting	1
012-0180-00		QL-157D Handle-Wheel	1
064-1016-01		05-64-09CS Pin-Spring	1
538-0790-00		Body-Control (Assembly)	1
038-0181-00		Body-Control	1
250-9140-00		Bearing-Control Valve	1

working at its maximum output unless the water supply can be increased. Speeding up the pump in the vain hope of increasing pressure and flow will only cause cavitation to become much worse, increase the chances of pump damage and may cause an even worse occurrence, interruption of fire fighting streams already in use.

The fact that subjecting water to a vacuum has the results of lowering the boiling point, can also have a great bearing on the pump's ability to draft warm or hot water. One reason is because water that is already hot requires only a small amount of vacuum to make it give off excessive vapors. This may cause the pump to lose its prime much the same way it would if an air leak occurred from the outside.

Remember that the warmer water becomes, the faster it gives off vapors until the boiling point is reached. At the boiling point, the vapor pressure of water is equal to atmospheric pressure and water reaches its maximum vaporization rate.

When taking suction from a hydrant, the temperature does not have a significant effect until the pump begins to exceed the capacity of the hydrant. Once this happens and a vacuum is created, it has the same effect of increasing vaporization because the water is nearing its boiling or equalization point just the same.

Cavitation while drafting

As stated earlier, cavitation occurs any time the pump tries to deliver more water than it is receiving, thereby creating a vacuum on the suction side of the pump. When the pump is operating at draft, it has a vacuum on the suction side. However, when it tries to pump more than it is drafting, the pressure on the discharge side is reduced and the amount of vacuum on the suction side is increased until cavitation or loss of prime occurs.

This situation can be brought about by pumping at high altitutdes, which have the same effect as low atmospheric pressure, a partially blocked suction strainer, a suction hose too long or too small, a lift that is too high, a drafting source that is too warm, or a combination of these conditions.

Don't depend on gages

It is poor practice to depend entirely on vacuum gages to indicate that a pump is nearing cavitation. This is because gages are usually tapped into the intake chamber several inches away from the leading edge of the impeller eye where the greatest amount of vacuum occurs. Some of the most experienced pump operators may be able to judge by the gage, but it is a poor indication at the best.

Indication of cavitation

Whether taking water from a hydrant or drafting, the most reliable indication that a pump is approaching cavitation is when an increase in engine rpm does not cause an increase in pump discharge pressure. Small capacity pumpers usually are not overly concerned with cavitation while pumping from a hydrant, but with modern 1250, 1500 and 2000-gpm pumpers, the problem is becoming more prevalent.

If the pump is approaching cavitation and more pressure is needed but no more water is available, discharge gates may have to be choked down. This will allow pressure to increase but will result in a reduction of flow to hose lines. At no time should a pump be operated under cavitation-producing conditions for long periods. There is nothing to gain by such practices but an unnecessary repair bill.

Pump operators who are knowledgeable about the causes and effects of cavitation can better operate to avoid it, thereby saving substantial amounts of money and preventing unnecessary shop time for equipment that is needed on the fireground. □ □

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HALE PUMPS

HALE FIRE PUMP COMPANY
700 SPRING MILL AVE.
CONSHOHOCKEN / PA. / 19428

Cavitation: Warning Signs And Reasons Why It Occurs

BY LT. G. E. REEVES
Bureau of Training
Montgomery, Ala., Fire Dept.

One of the most common errors on the fireground is the tendency of pump operators to try and pump more water to hose lines than the pump is receiving. This procedure is often referred to as "running away from the water supply" or cavitation.

Most fire department pump operators have a general idea of what cavitation is and some of the ways to go about reducing or avoiding it, but when probing beyond these very general concepts, knowledge seems to be somewhat limited in most cases.

It is a known fact that cavitation does serious damage to fire pumps. This is especially true if the pump is subjected to cavitation over a long time. Since the effects are cumulative, the damage that occurs each time the pump cavitates is added to the damage previously caused by cavitation. If prolonged or repeated cavitation is allowed to occur, pretty soon the pump will no longer function properly and it will have to be overhauled.

Understanding cavitation

Engineers or pump operators are usually trained with this in mind, but it might prove beneficial to take the training a step further and examine some of the causes and effects of cavitation in more detail. A better understanding of what is taking place inside the pump will enable pump operators to foresee and avoid unnecessary and costly damage to equipment.

First of all, to gain a better insight into what takes place inside the pump, we need to take into consideration a few of the unique characteristics of water.

We know that at sea level water will boil if its temperature is raised to approximately 212°F. This assumes a normal atmospheric pressure of 14.7 psi. If we place the water in a closed container and add pressure, the boiling point rises. This is why we use pressure caps on auto radiators and pressure cookers to prepare food. It stands to reason that food will cook faster when boiled at 250 degrees than it will at 212 degrees. This elevated boiling point is obtained by adding 15 psi pressure. An auto will also stand a much less chance of running hot and boiling out its coolant if the boiling point of the coolant is raised several degrees.

So far, the best way found to achieve an elevated boiling point is with the addition of pressure. Without it, water will reach 212° and continue boiling until it has completely vaporized. The temperature of the water will not rise above 212°. Additional heat only speeds the evaporation or boiling rate. Boiling is nothing more than rapid vaporization of water. It occurs whenever the vapor pressure within the liquid becomes equal to atmospheric pressure.

We most often associate this equalization of pressures with the addition of heat, but the same results can be obtained by reducing atmospheric pressure. At higher elevations, water boils at a temperature less than 212° due to lower atmospheric pressure. Of course, lower atmospheric pressure is normal at higher elevations, but we can create the same effect at any elevation by placing water under a vacuum.

The boiling point of water is raised according to the amount of pressure applied and it is lowered according to the amount of vacuum to which it is subjected.

In other words, if water in a closed container is subjected to positive pressure, the boiling point will go up. How far up it will go is determined by the amount of pressure applied. But if this same container is subjected to a vacuum, the boiling point will be lowered from the normal 212°. The greater the vacuum, the lower the boiling point will be.

Pressure and vacuum effects

The effects of pressure and vacuum on the boiling point of water are shown in the accompanying table. The boiling point of water is 212°F at sea level, where the atmospheric pressure is 14.7 pounds per square inch absolute (psia). Pressure gages at sea level show a reading of 0 pounds per square inch gage (psig). Thus, positive pressures in the table are psig, which means they are in addition to the normal sea level atmospheric pressure of 14.7 psia. Negative pressures in the table, stated in inches of mercury, are less than 14.7 psia, the normal sea level atmospheric pressure.

As you can see from the table, at 29.8 inches of mercury, the boiling point of water is 34.57°F. This is close to the normal freezing point of water, but the freezing point also is lowered when water is subjected to a vacuum. This particular characteristic of water is not important to the phenomenon of cavitation, however, and will not be pursued further.

Boiling Point of Water

(At sea level, 14.7 psia, 212°F)

Positive Pressure		Vacuum	
PSIG	Degrees F	In Hg	Degrees F
5	227.96	5	203.08
10	240.07	10	192.37
15	250.33	15	179.14
20	259.28	20	161.49
25	267.25	25	133.76
30	274.44	27	101.96
35	281.01	29	79.03
		29.5	58.80
		29.8	34.57

When a centrifugal pump is attempting to discharge more water than it is receiving, a vacuum is created near the eye of the impeller. This may happen while pumping from draft or a hydrant. The real problem in either case is running away from the supply and causing a vacuum to occur.

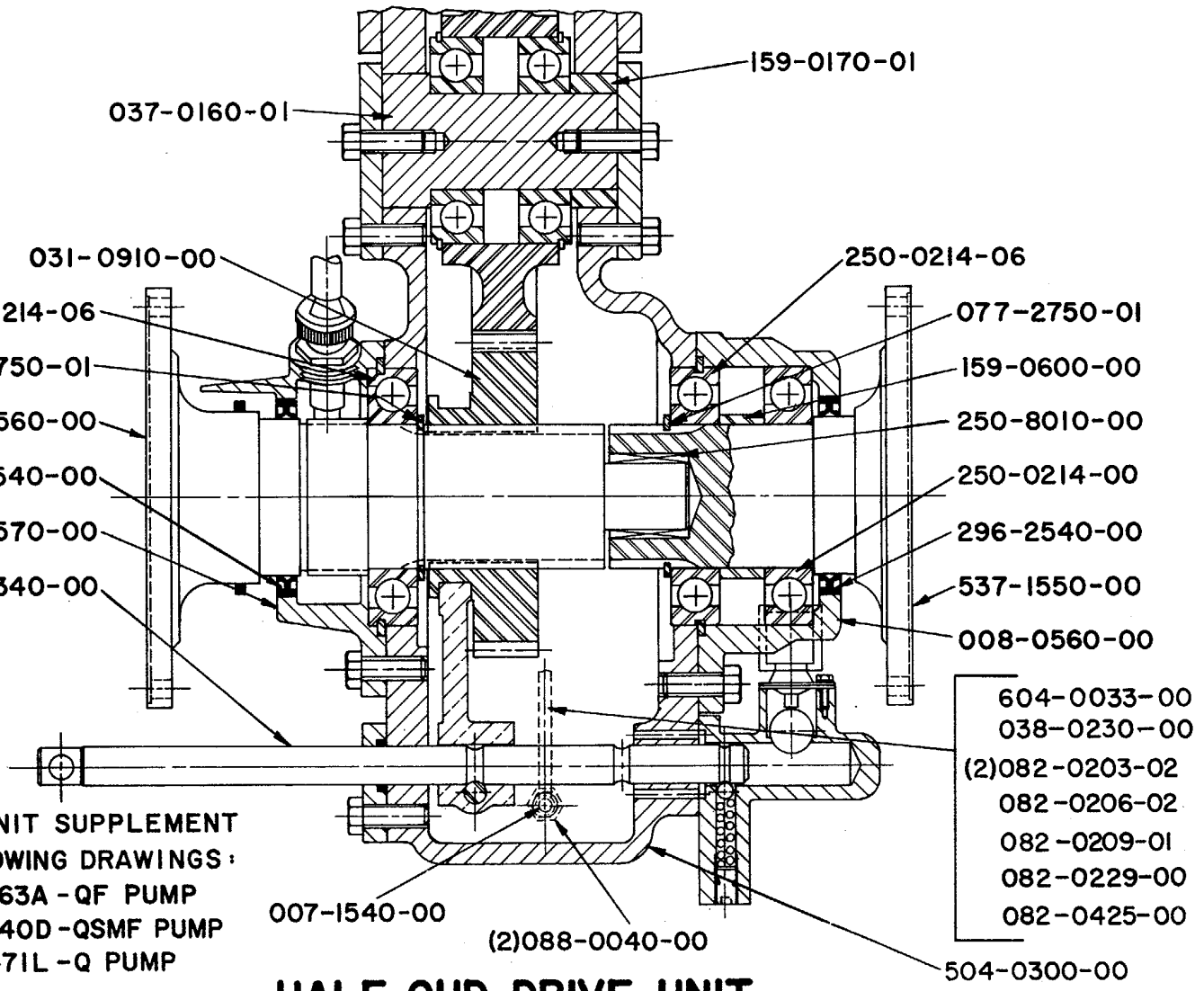
As the vacuum increases, the boiling point of the water is lowered until it reaches a point near the impeller eye where it flashes into vapor and enters the impeller.

Once the vapor pockets, or bubbles, enter the impeller, the process begins to reverse itself. As the vapor reaches the discharge side of the pump, it is subjected to a high positive pressure which condenses the vapor back to a liquid. The sudden change from vapor pockets to a liquid generates a shock effect that damages the impeller and pump housing. Usually there are thousands of tiny vapor pockets rather than a few large ones. The collapse of these vapor pockets is referred to as implosions. To implode means to burst inwardly.

The damage done during any one period of cavitation is not great, but if cavitation is repeated over a long period, the effects can disable an otherwise perfectly good pump. Implosions occuring during cavitation tend to break away or erode tiny pieces of metal from moving parts and from the pump casing. When enough metal has been chipped away, the impeller becomes unbalanced, thereby causing an undue strain and vibration on bearings, bushings and shafts.

The sound created by a pump while cavitating has been described as similar to that of a handful of pebbles circulating throughout the pump. This sound is not made by the numerous vapor pockets passing through the pump, as is often assumed, but it is the sound resulting from the implosion of these vapor pockets as they become subjected to positive pressure and condense.

Once cavitation begins, the pump is



QHD DRIVE UNIT SUPPLEMENT
TO THE FOLLOWING DRAWINGS:
PLATE NO. 663A - QF PUMP
PLATE NO. 640D - QSMF PUMP
PLATE NO. 471L - Q PUMP

HALE QHD DRIVE UNIT
WITH HEAVY DUTY DRIVE SHAFT

HALE FIRE PUMP CO.
CONSHOHOCKEN PA.
6-20-84 M.C.

PLATE NO. 678

SUPPLEMENTARY PARTS LIST HALE TYPE QHD DRIVE UNIT
PLATE NO. 678

PART NO.	NAME OF PART		NO. REQ.
007-1540-00	Tube-Drive Unit Cooling		1
008-0560-00	Cap-Rear Bearing		1
008-0570-00	Cap-Front Bearing		1
031-0210-00**	Gear-Pump Shaft (18 Teeth)(QHD-20 & QSMFHD-20)		1
031-0220-00**	Gear-Pump Shaft (20 Teeth)(QHD-18 & QSMFHD-18)		1
031-0230-00**	Gear-Pump Shaft (22 Teeth)(QHD-16 & QSMFHD-16)		1
031-0240-00**	Gear-Pump Shaft (24 Teeth)(QHD-15 & QSMFHD-15)		1
031-0860-00	Gear-Pump Shaft (16 Teeth)(QFHD-22)		1
031-0870-00	Gear-Pump Shaft (19 Teeth)(QFHD-18)		1
031-0910-00	Gear-Sliding		1
037-0160-01	Shaft-Intermediate		1
037-1340-00	Shaft-Gearshift		1
038-0230-00	Cock-Drain		1
062-0130-00**	Housing-Rear Bearing (QHD-15 & QSMFHD-15)		1
062-0140-00**	Housing-Rear Bearing (QHD-16, QHD-20, QSMFHD-16 & QSMFHD-20)		1
062-0150-00**	Housing-Rear Bearing (QHD-18 & QSMFHD-18)		1
062-0560-01	Housing-Rear Bearing (QFHD-18 & QFHD-22)		1
077-2750-01	Ring-Sliding Gear & Tail Shaft Retaining		2
082-0425-00	Elbow-1/2 Compression & 3/8 Compression		1
082-0203-02	Elbow-1/4 NPT x 3/8 Compression		2
082-0206-02	Connector-1/4 NPT x 3/8 Tube		1
082-0209-01	Tee-1/4 NPT Galv.		1
082-0229-00	Connector-1/4 NPT x 1/2 Tube		1
088-0040-00	Connector-Cooling Tube		2
159-0170-01	Spacer-Intermediate Gear Shaft		1
159-0600-00	Spacer-Tail Shaft Bearing		1
250-0214-0C	Bearing-Sliding Gear & Tail Shaft		1
250-0214-06	Bearing-Tail Shaft		2
250-8010-00	Bearing-Sliding Gear Shaft Needle Roller		1
296-2540-00	Seal-Drive Shaft Oil		2
504-0300-00	Housing-Drive Unit (Assembly)		1
004-0030-00	*Housing-Drive Unit	1	
005-0090-00	Plate-Oil Baffle	1	
018-2014-04	Screw-1/2-13 x 1-1/2 Lg. Hex Stl. Nyl.Lock Cap	4	
018-5002-00	Screw-#4 x 1/4 Lg. Cad. Pl. Drive	4	
044-0220-00	*Cover-Housing	1	
046-5120-00	Gasket-Housing Cover	2	
537-1550-00	Shaft-Tail		1
537-1560-00	Shaft-Sliding Gear		1
604-0033-00	Tubing-3/8 O.D. x .032 Wall Copper		74"

* Replace parts only as a matched set

** For conversions to heavy duty drive unit, compare part numbers of existing ratio to part numbers new ratio to see if a change is necessary

PARTS LIST HALE TYPE QSMF PUMP SERIES
PLATE NO. 640D

PART NO.		NAME OF PART	NO. REQ.
001-0072-00		Body-Pump (Assembly)	1
001-0072-01		Body-Pump (Lower Half)*	1
001-0072-02		Body-Pump (Upper Half)*	1
018-2016-07		Screw-1/2-13 x 1-3/4 Lg. Hex Hd. Zinc Pl. Stl. 360° Nylon Locking	15
018-2434-22		Screw-5/8-11 x 3-1/2 Lg. Flgd. 12 Pt.Zinc Pl.Stl.	4
018-2454-22		Screw-5/8-11 x 5-1/2 Lg. Flgd. 12 Pt.Zinc Pl.Stl.	4
046-0940-00		Gasket-Pump Body	1
064-6010-00	AB-68-3/4	Pin-Dowel	2
217-0201-00		Plug-1/4 NPT Black Mal. Iron	8
217-0401-00		Plug-1/2 NPT Black Mal. Iron	1
005-0010-00	ZMQ-650-3/4	Plate-Priming Valve**	1
005-0050-00	QL-5D	Support-Priming Valve Stem**	1
007-0010-00	ZN-75D-4-1/2	Tube-4-1/2 Suction	2
007-0020-00	ZM-75F-5	Tube-5 Suction	2
007-0030-00	ZM-75F-6	Tube-6 Suction	2
008-0010-00	C-8F-4-1/2	Cap-4-1/2 Suction Tube	2
008-0020-00	C-8F-5	Cap-5 Suction Tube	2
008-0030-00	C-8-6	Cap-6 Suction Tube	2
010-0010-00	C-G10F-4-1/2	Strainer-4-1/2 Suction Tube	2
010-0020-00	C-G10F-5	Strainer-5 Suction Tube	2
010-0030-00	C-G10D-6	Strainer-6 Suction Tube	2
010-0040-00	ZMQ-329H	Strainer-Priming Valve**	1
012-0160-00		Handle-Priming Valve Stem**	1
016-0080-00	QSM15-16-10-1/2	Impeller	1
017-0120-00	QSM-17	Key-Impeller	1
018-1606-08		Screw-3/8-16 x 3/4 Lg. Soc. Head Zinc Pl. Steel Cap	2
018-1812-02		Screw-7/16-14 x 1-1/4 Lg. Hex Head Zinc Pl. Stl. Cap	66
018-1812-07		Screw-7/16-14 x 1-1/4 Lg. Hex Hd. Xinc Pl. Steel Nylon Locking Cap	16
018-1816-02		Screw-7/16-14 x 1-3/4 Lg. Hex Head Zinc Pl. Stl.Cap	12
018-2012-02		Screw-1/2-13 x 1-1/4 Lg. Hex Head Zinc Pl. Stl. Cap	20
018-2012-07		Screw-1/2-13 x 1-1/4 Lg. Hex Head Zinc. Pl. Stl. Nylon Lock. Cap	8
018-2016-07		Screw-1/2-13 x 1-3/4 Lg. 360° Nylon Locking Hex Head Zinc Pl. Steel Cap	12
018-2020-07		Screw-1/2-13 x 2 Lg. 360° Nylon Locking Hex Hd. Zinc Pl. Stl. Cap	12
018-2412-07		Screw-5/8-11 x 1-1/4 Lg. Hex Head Zinc Pl. Steel Nylon Lock. Cap	1
031-0210-00	ZM-31C	Gear-Pump Shaft (18 Teeth) (QSMF Pump)	1
031-0220-00	ZM2-31C	Gear-Pump Shaft (20 Teeth) (QSMF2 Pump)	1
031-0230-00	ZM3-31C	Gear-Pump Shaft (22 Teeth) (QSMF3 Pump)	1
031-0240-00	ZM4-31C	Gear-Pump Shaft (24 Teeth) (QSMF4 Pump)	1
031-0250-00	ZMF5-31C	Gear-Pump Shaft (26 Teeth) (QSMF5 Pump)	1
037-0201-00		Shaft-Pump	1
040-2260-00	40-4N200	Ring-Priming Valve Seal**	1
040-2550-00	40-4N562	Ring-Rear Bearing Housing Seal	1
041-0060-XX	ZS-325D	Stem-Priming Valve (Length to suit panel)**	1
042-0010-00	ZMM-363	Spring-Packing Gland Lock	1
044-0280-00	QSM-167	Cover-Front Bearing	1
044-0290-00	ZMF3-84	Cover-Rear Bearing Housing	1
046-0030-00	QSM-W448	Gasket-Suction Tube Extension	2
046-0040-00	T-W292	Gasket-Suction Tube	2
046-0050-00	46DW	Gasket-Flange	12
046-0060-00	10MW-W272	Gasket-Tank Connection	1

PARTS LIST HALE TYPE QSMF PUMP SERIES
PLATE NO. 640D

PART NO.		NAME OF PART	NO. REQ.
046-0080-00	Q-W702D	Gasket-Relief Valve Plug (Used when R.V. is omitted)	1
046-0220-00	QSMD-W263	Gasket-Front Bearing Housing & Packing Housing	3
046-5170-00	QSM-674	Diaphragm-Front Bearing	1
046-6020-00	CIR-W263	Gasket-Rear Bearing Housing Cover	2
048-0200-00	Q57R	Gland-Rear Packing	1
048-0210-00	Q-57FD	Gland-Front Packing	2
048-0220-00	ZM-A273	Lantern-Packing	2
048-0230-00	ZM-371D	Sleeve-Packing Gland Adjusting	1
062-0120-00	QSM-262H	House-Packing	1
062-0130-00	Q-261D	Housing-Rear Bearing (QSMF & QSMF5 Pumps)	1
062-0140-00	Q2-261D	Housing-Rear Bearing (QSMF2 & QSMF4 Pumps)	1
062-0150-00	Q3-261D	Housing-Rear Bearing (QSMF3 Pumps)	1
064-1016-01		Pin-Packing Sleeve Lock	1
064-1416-12	07-64M-08S	Pin-Cooling Line	1
064-5040-00		Pin-1/8 x 1 Lg. Steel Cotter**	1
077-1500-25		Ring-Impeller Retaining	1
077-1871-20	S79SS187	Ring-Oil Seal Retaining	1
082-0501-01		Nipple-3/4 NPT Galv. Close**	1
082-0503-02		Nipple-3/4 NPT x 2 Lg. T.O.E. Galv.**	1
082-0508-01		Elbow-3/4 NPT Galv. Service**	1
082-0602-01		Nipple-1 NPT x 5 Lg. T.O.E. Galv.***	1
082-0604-01		Nipple-1 NPT x 7 Lg. T.O.E. Galv.***	1
082-0607-01		Elbow-1 NPT Galv. Service***	2
097-0030-00	C-9D-4-1/2	Washer-4-1/2 Suction Cap	2
097-0040-00	C-9D-5	Washer-5 Suction Cap	2
097-0050-00	M-9D-6	Washer-6 Suction Cap	2
097-0230-00	Q-58ZD	Separator-Packing	12
097-0830-01		Washer-Rear Bearing	1
101-0380-00		Plate-Panel Instruction	1
110-1600-02		Nut-3/8-16 Zinc Pl. Steel Hex**	1
115-0020-00	2433D-2-1/2	Flange-Tank Connection	1
115-0050-00	115-B	Flange-Discharge Blank-Off	8
115-0070-00	115-2-1/2	Flange-2-1/2 NPT	4
142-0060-00	Q-142	Slinger-Pump Shaft	1
178-0020-00	QSM-178DF	Extension-Suction Tube	2
217-0201-00		Plug-1/4 NPT Black Mal. Iron	2
217-0201-04		Plug-1/4 NPT Brass Hex Socket Head Pipe	2
217-1001-00		Plug-2-1/2 NPT Black Mal. Iron	4
217-3001-00	Q-115	Plug-Relief Valve (when pump is furnished without relief valve or with Governor, use (4) 7/16-14 x 1-1/4 Lg. Hex Head Zinc Pl. Steel 360° Nylon Locking Cap Screw)	1
242-0030-00	E-16	Clamp-Priming Line Hose**	2
242-0040-00	E-22	Clamp-Priming Line Hose***	2
250-0310-00	310K	Bearing-Rear (Inside)	1
250-0409-00	409S	Bearing-Rear (Outside)	1
296-0030-00	ZM-58	Packing-Pump Shaft	4
296-2080-00	QSMD-296	Seal-Front Bearing Oil	1
296-2090-00	QSM-296	Seal-Drive Unit Oil	1
321-0231-00		Ring-Clearance	2
340-0010-00	ZSF-340	Hose-Priming Line**	1
340-0020-00	QL-340	Hose-Priming Line***	1
562-0090-00	QSM-G259F	Housing-Front Bearing (Assembly)	1
062-0110-00		QSM-259F Housing-Front Bearing	1
250-9100-00		QSM-250F Bearing-Front	1
564-0010-00	ZMHD-G18	Pin-Packing Gland Lock Assembly	1

* Replace Parts only as Matched Set
** Used with Electric Priming
*** Used with Clutch Priming

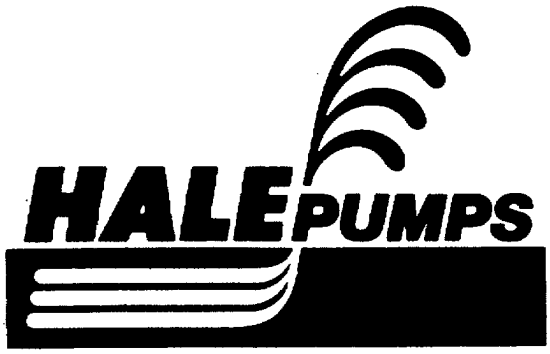
PARTS LIST HALE TYPE Q DRIVE UNIT
(QSMF PLATE NO. 640D and Q PLATE NO. 471L)

PART NO.		NAME OF PART	NO. REQ.
005-0030-00	Q-5	Plate-Intermediate Gear Shaft	2
007-0040-00	ZSF-425	Adapter-Speedcounter Drive	1
08-0051-00		Cap-Gearshift Shaft	1
08-0070-00	ZSF-666	Cap-Speedcounter Drive Sleeve	1
008-0080-00	Q-49	Cap-Front Bearing	1
008-0480-00		Cap-Rear Bearing	1
013-0010-00	ZSF-741F-54	Shaft-Speedcounter Flexible	1
017-0070-00	ZS-314	Key-Speedcounter Drive Gear	1
017-0080-00	T-95X	Key-Drive Shaft	2
018-1103-02		Screw-#10-32 x 3/8 Lg. Hex Hd. Zinc Pl. Steel Cap	2
018-1810-07		Screw-7/16-14 x 1 Lg. Hex Hd. Zinc Pl. Stl. 360° Nylon Lock Cap**	12
018-1810-07		Screw-7/16-14 x 1 Lg. Hex Hd. Zinc Pl. Stl. 360° Nylon Lock Cap	17
018-1814-07		Screw-7/16-14 x 1-1/2 Lg. Hex Hd. Zinc Pl. Stl. 360° Nylon Lock Cap	1
018-2104-61		Screw-1/2-20 x 1/2 Lg. Flat Point Zinc Pl. Stl. 360° Nylon Locking Set	1
018-5002-00		Screw-No. 4 x 1/4 Lg. Rd. Hd. Cad. Pl. Drive	4
018-8040-00	40T-104	Stud-Gearshift Cap	1
028-0041-00		Fork-Gearshift	1
031-0050-00	Q-203	Gear-Speedcounter Drive	1
031-0170-00	ZSF-204	Gear-Speedcounter Driven	1
31-0190-00	Q-30	Gear-Sliding (35 Teeth)	1
031-0200-00	Q-51	Gear-Intermediate	1
037-0140-00	Q-36	Shaft-Sliding Gear	1
037-0150-00	Q-34	Shaft-Tail	1
037-0160-00	ZSF-35D	Shaft-Intermediate Gear	1
037-0450-00	Q-25V	Shaft-Gearshift	1
039-0050-00	T-22	Ball-Gearshift Shaft	1
039-0180-00		Ball-Shift Indicator Switch	1
040-2100-00	40-4N75	Ring-Gearshift Shaft Seal	1
042-0060-00	T-23D	Spring-Gearshift Shaft Lock	1
044-0190-00	VHQ-228D	Cover-Priming**	2
044-0200-00	S-171D	Vent-Air**	1
046-0010-00	QL-W263	Gasket-Rear Bearing Cap	1
046-0090-00	VHQ-295V	Gasket-Priming Cover**	2
046-0420-00	Q-265V	Gasket-Intermediate Gear Shaft Plate	2
046-0950-00		Gasket-Shift Indicator Switch	2
046-5060-00	QL-W429	Gasket-Gearshift Cap	1
046-5130-00	ZSF-W292	Gasket-Front Bearing Cap	1
048-0070-00	ZSF-118	Bushing-Speedcounter Drive	1
048-0090-00	ZSF-426	Sleeve-Speedcounter Drive	1
048-0150-00	344-11	Shim-Tail Shaft Bearing	Approx. 4
54-5070-00		Pin-5/32 x 2 Lg. Steel Cotter	2
77-2120-01	77S212	Ring-Speedcounter Drive Gear Retaining	1
082-0502-00		Nipple-3/4 NPT x 2 Lg.**	1
097-0160-01		Washer-#10 Cad. Pl. Steel Lock	2
097-0460-0?		Washer-7/16 Cad.Pl. Flat	18
01-0081-00		Plate-Serial Number	1
101-0251-00		Plate-Indicator Light	1

PARTS LIST HALE TYPE Q DRIVE UNIT
(QSMF PLATE NO.640D and Q PLATE NO. 471L)

PART NO.		NAME OF PART	NO. REQ.
101-0291-00		Plate-Throttle Warning	1
110-1800-02		Nut-7/16-14 Zinc Pl. Steel Hex	1
110-7020-00	C-110	Nut-Companion Flange	2
115-0090-00	QL-228	Cover-Gearshift Shaft Front	1
115-0140-00	Q-95F-1700	Flange-Front & Rear Companion	2
142-0160-00	QSMD-142	Slinger	1
159-0160-00	Q-48	Spacer-Tail Shaft Bearing	1
159-0170-00	ZSF-146	Spacer-Intermediate Gear Shaft	1
217-0401-00		Plug-1/2 NPT Black Mal. Iron	1
217-0501-08		Plug-3/4 NPT Magnetic	1
200-0020-00	PV-763	Switch-Priming Valve	1
200-0540-00		Light-Throttle Warning	2
250-0211-20	211M	Bearing-Sliding Gear & Tail Shaft	3
250-0306-00	306K	Bearing-Sliding Gear Shaft (Small)	1
250-0309-26	309MG	Bearing-Intermediate Gear	2
296-2050-00	ZM-296	Seal-Drive Shaft Oil	2
504-0060-00	Q-G4D	Housing Drive Unit (Assembly)	1
004-0030-00		*Q-4D Housing-Drive Unit	1
005-0090-00		HPZL-142 Plate-Oil Baffle	1
018-2014-07		Screw-1/2-13 x 1-1/2 Lg. Hex Zinc Pl. Stl. Nylon Lock Cap	4
018-5002-00		Screw #4 x 1/4 Lg. Cad. Pl. Drive	4
044-0220-00		*ZSF-291 Cover-Housing	1
046-5120-00		ZSF-293 Gasket-Housing Cover	2

* Replace parts only as a matched set
** Used with standard electric priming
*** Used with optional clutch priming

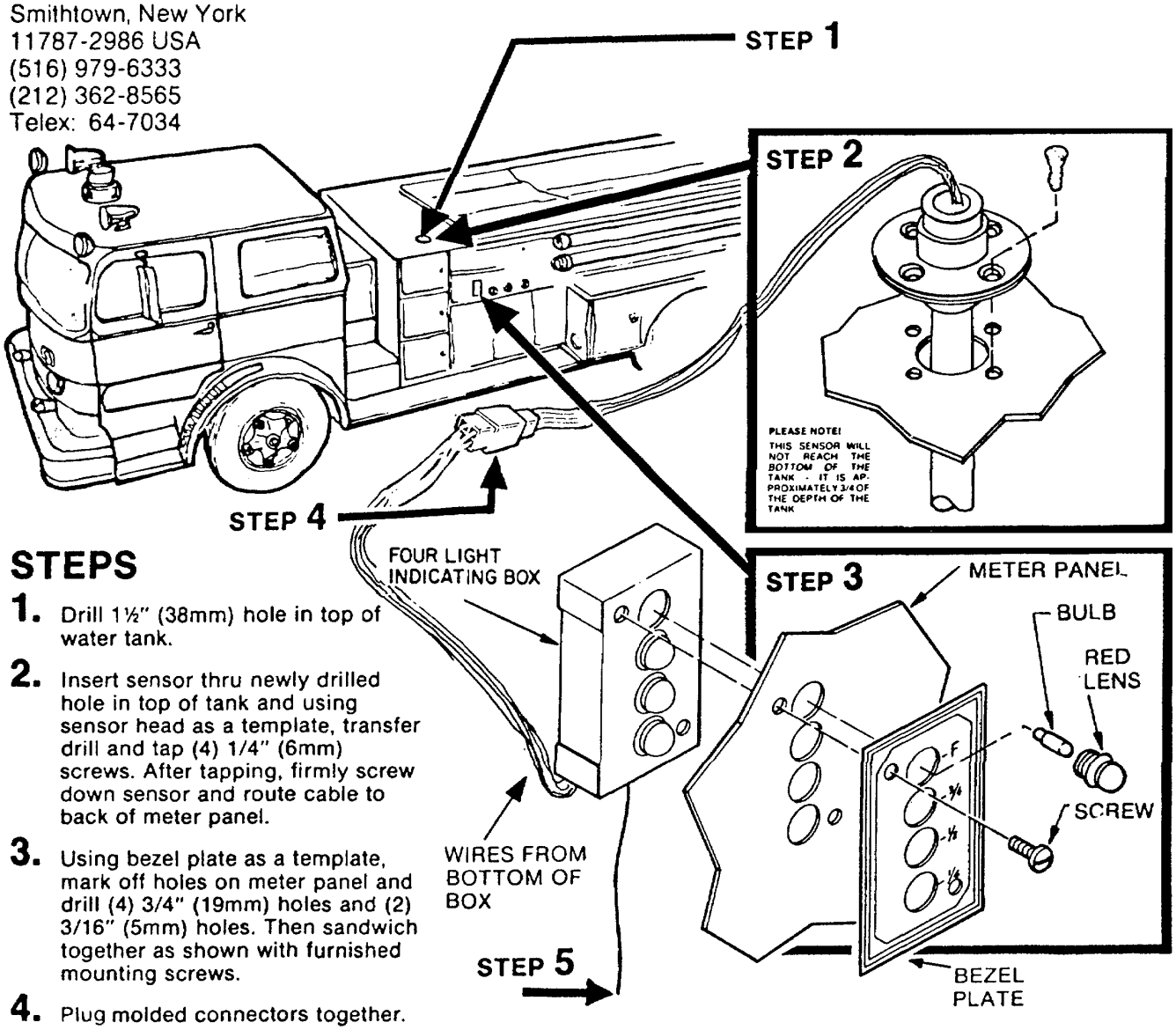


Hale Fire Pump Company, Conshohocken, PA 19428 215/825-6300

15M-4/82 Printed in U.S.A.

FIRE PUMPER INSTALLATION FOR LIQUID LEVEL FLUIDMETER

PRODUCTS, INC.
330 East Jericho Tpke.
Smithtown, New York
11787-2986 USA
(516) 979-6333
(212) 362-8565
Telex: 64-7034



STEPS

1. Drill 1½" (38mm) hole in top of water tank.
2. Insert sensor thru newly drilled hole in top of tank and using sensor head as a template, transfer drill and tap (4) 1/4" (6mm) screws. After tapping, firmly screw down sensor and route cable to back of meter panel.
3. Using bezel plate as a template, mark off holes on meter panel and drill (4) 3/4" (19mm) holes and (2) 3/16" (5mm) holes. Then sandwich together as shown with furnished mounting screws.
4. Plug molded connectors together.
5. Splice yellow wire to ignition or hot line as very last step.

11-FOOT EXTENSION CABLES FURNISHED ON REQUEST.

CHECK ALL GAGES DAILY FOR PROPER OPERATION.

IF THIS UNIT IS TO BE USED ON A FIBERGLAS OR CHASSIS ISOLATED TANK, A GROUND WIRE IS NEEDED FROM THE SENSOR HEAD TO THE READOUT BOX AND TRUCK CHASSIS.

BUYERS PRODUCTS CO.

23520 ST. CLAIR AVE. • CLEVELAND, OHIO 44117 • PHONE: AC 216/531-6553-4-5

BUYERS VERNIER LOCKING CONTROL CABLE VCG SERIES

MICROMETER ADJUSTMENT WITH RAPID SHUT DOWN FEATURE. DESIGNED FOR FIRE AND EMERGENCY EQUIPMENT, WRECKERS, SWEEPERS, TANK TRUCKS, STATIONARY ENGINES, ETC.



TO ENGAGE THROTTLE DEPRESS LARGE RED BUTTON AND PULL OUT BLACK HEX KNOB. WHEN APPROXIMATE R.P.M. IS REACHED, RELEASE RED BUTTON AND TURN BLACK HEX KNOB CLOCKWISE OR COUNTER CLOCKWISE TO REACH EXACT R.P.M. REQUIRED. TO DISENGAGE, DEPRESS THE RED BUTTON AND SLIDE THE CONTROL KNOB TO ITS ORIGINAL POSITION.



THE .072" STAINLESS STEEL CORE WIRE SLIDES IN A NON-METALLIC INNER LINER REINFORCED WITH GALVANIZED STEEL BRAIDED WIRE AND COVERED WITH A MOLDED PLASTIC OUTER SHELL, ELIMINATING METAL TO METAL CONTACT AND CORROSION PROBLEMS.



TENSION ADJUSTMENT FROM ZERO DRAG TO FULL LOCK IN 1/4 TURN. THIS TENSION FEATURE ENABLES ACCURATE SETTINGS TO BE MAINTAINED FOR EXTENDED PERIODS. A MUST FOR STATIONARY ENGINES.

AVAILABLE IN 6', 10', 15', 20', 25', 30' LENGTHS.

FIG. 1

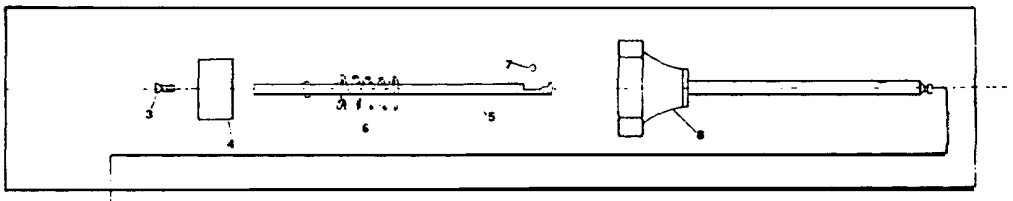
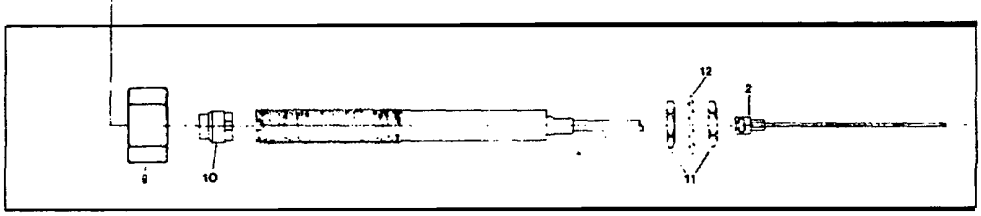


FIG. 2



COMPONENT PARTS AND ASSEMBLIES FOR VCG CABLES

	PART NO.			PART NO.	
1 —	VP-1	COMPLETE PLUNGER ASSEMBLY	7 —	VP-7	STEEL LOCK BALL
2 —	VP-2	CORE WIRE ASSEMBLY 30'	8 —	VP-8	LARGE BLACK HEX KNOB AND PLUNGER
3 —	VP-3	PHILLIPS SCREW	9 —	VP-9	TENSION ADJUSTMENT KNOB
4 —	VP-4	RED INNER KNOB	10 —	VP-10	TENSION COLLET
5 —	VP-5	INNER PLUNGER SHAFT W/"O" RING	11 —	VP-11	BODY NUT 3/4"
6 —	VP-6	COIL SPRING	12 —	VP-12	SERRATED LOCK WASHER

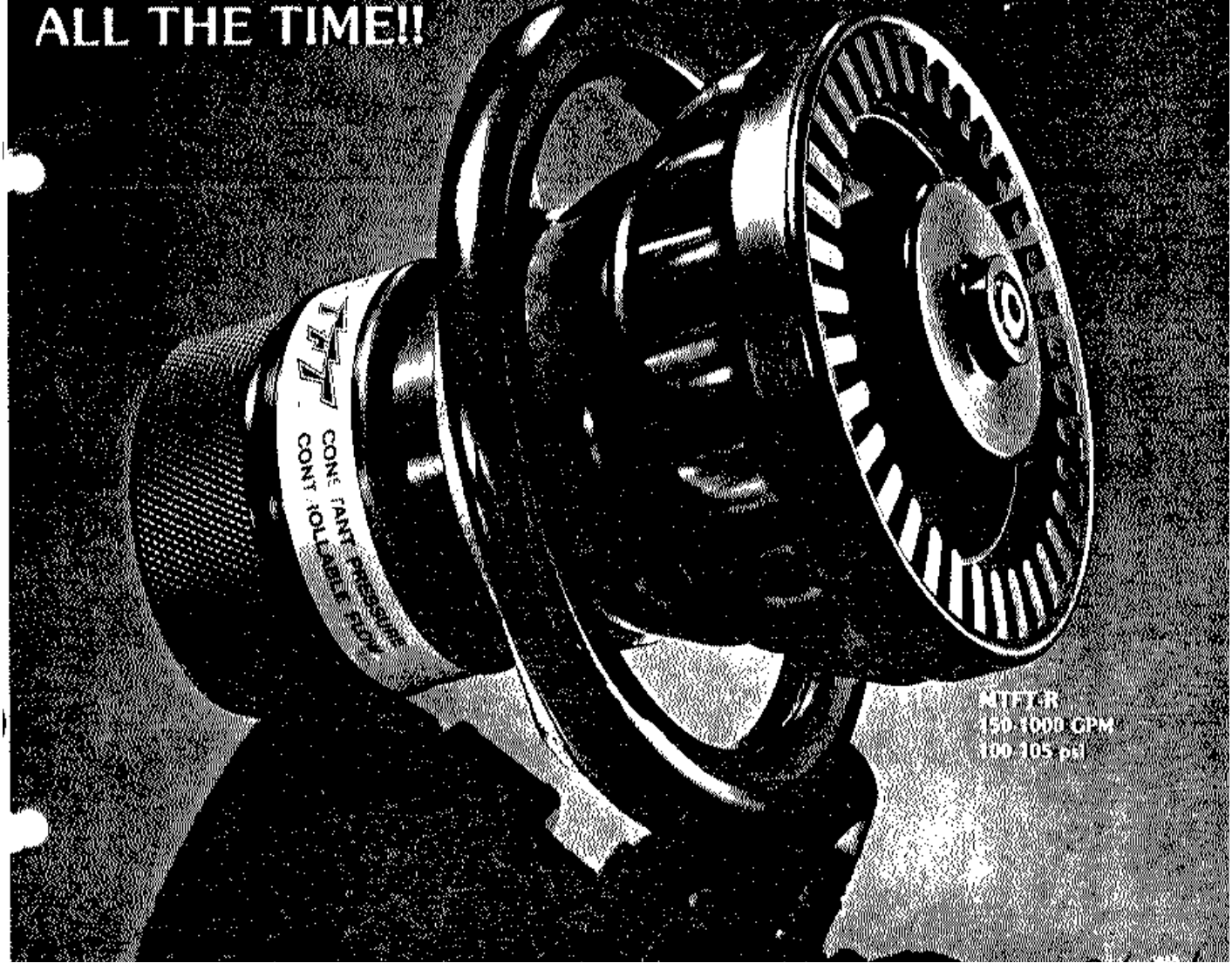
* VP-1 INCLUDES ALL PARTS IN FIG. 1 SHIPPED ASSEMBLED.

MTT MASTER®

150-1000 GPM
100-105 psi
constant nozzle pressure

A single deluge nozzle for all flows, all patterns, and all purposes.

MAXIMUM REACH AND OPTIMUM PRESSURE ALL THE TIME!!





SPECIFICATIONS

Flow - 150-1000 GPM (575-3750 lpm)
Pressure - 100-105 psi
Length - 10"
Ring Dia. - 8½"
Bumper Dia. - 6¾"
Body Dia. - 4"
Weight 10.2 lbs. (4.6 kg.)



A larger volume at the right time can produce tremendous results. A fully involved house is **"blitzed"** *with a preconnected deck gun from the booster tank flowing* **400 GPM.** *The quick application knocks down most primary fire.* **A terrific stop!**

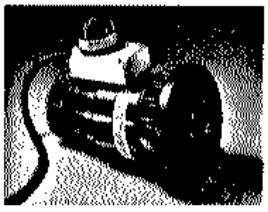


TFT Master stream nozzles with the widest flow range available (150-1000 gpm), automatically regulate the nozzle pressure to 100-105 psi with pilot gauge accuracy. The nozzle acts similar to a pumper relief valve and consistantly controls nozzle pressure. The self-draining control unit is protected from freezing by continuous through flow of filtered water eliminating possibility of plugging mechanism.

The master series is constructed of high strength heat-treated aluminum alloy, hard anodized for maximum corrosion resistance. The **TFT** Master is exceptionally well protected by a rubber coated 'halo' ring and strong specially formulated bumper. Fog teeth are molded directly into this tough durable bumper producing the dense **TFT** full-fill fog pattern; no metal teeth or plastic "gimmicks" to jam or break!!

Built-in stream straighteners correct turbulence for a clean stream without need for an additional straightener tube. If large debris should become trapped, the **TFT** Master is the **ONLY** nozzle which can be quickly and easily field disassembled for flushing without special tools or equipment.

TFT Masters come in a variety of configurations to fit your particular needs. Manual 'halo' ring is standard; hydraulic or electric pattern control is optional. Conversion units are also available to convert older constant gallonage nozzles to fully automatic pressure regulation.



MTFT-ER 12V ELECTRIC Pattern



MTFT-H HYDRAULIC Pattern



MTFT-I INDUSTRIAL



MASTER CONVERSIONS

TFT Masters are easily the most dependable, rugged and troublefree nozzles available. Although rare, if service should be needed on a **TFT**, it will be repaired and returned within one day of receipt, at **NO CHARGE** except in cases of obvious abuse or accident. That's the unique five year **TFT** service policy; service you can count on!!

Invented by a firefighter for firefighters, the **TFT** Master is one nozzle for all flows, all patterns, and all purposes on aerials, platforms, deluge devices, deck pipes, etc.

Contact the **TFT** distributor nearest you or call **TFT** Toll Free for more information.

WARRANTY

TFT nozzles are warranted against defects in materials or workmanship for **FIVE YEARS** of free repair or replacement. Only excessive abuse or accident are excluded. No consequential or other indirect liability is assumed.

NO service charges or long delays. Repairs are normally return shipped one working day after receipt. **TASK FORCE TIPS** stands behind every **TFT** product!!

YOUR AUTHORIZED

DISTRIBUTOR IS:

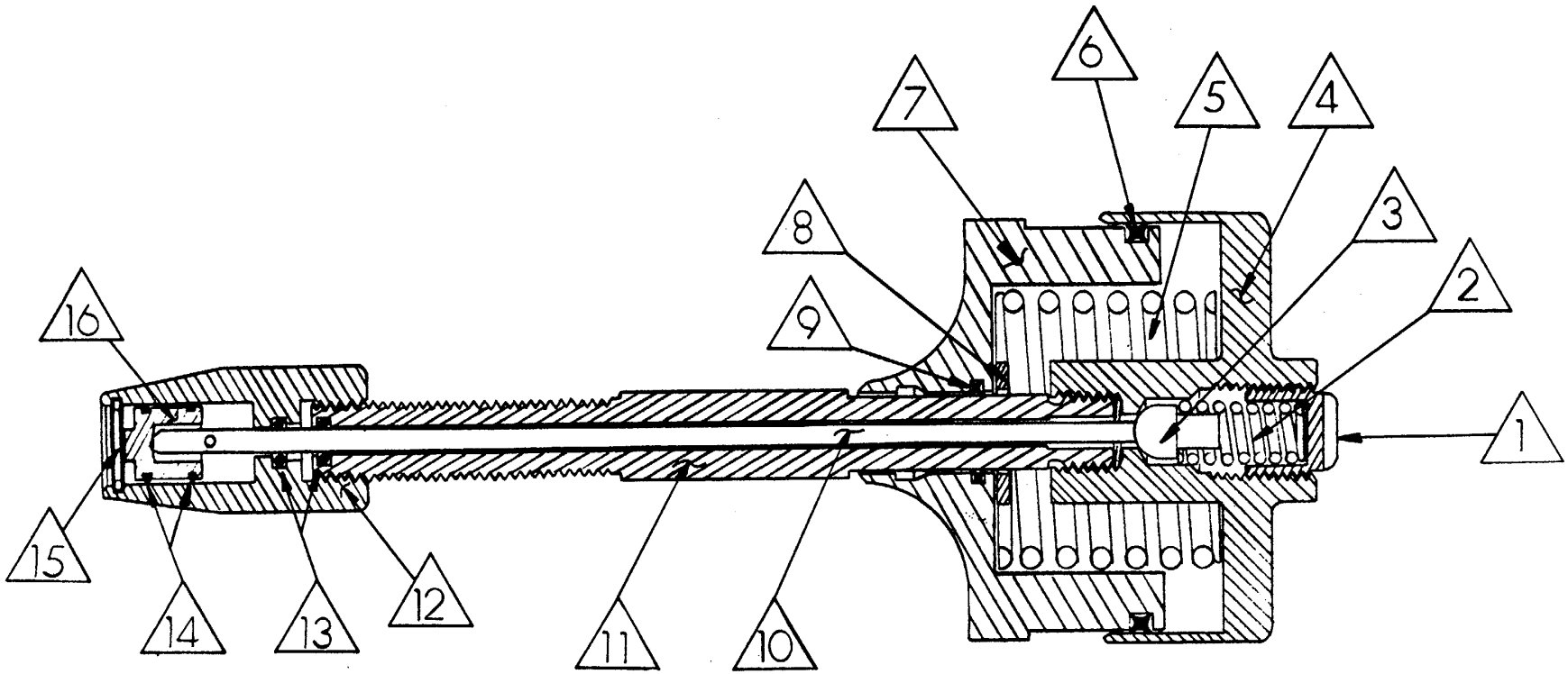
TASK FORCE TIPS
FIRE TASK FORCE Innovations Inc
2901 E. Cascade Drive,
Valparaiso, Indiana 46383
"Hydraulics Hotline" 1-800-348-2686
In Indiana Call Collect 219-462-6161

TASK FORCE TIPS ®
FIRE TASK FORCE Innovations INC.
2901 EAST CASCADE DRIVE VALPARAISO, INDIANA 46383
DAY (219) 462-6161 NIGHT 462-6000

1000 AC CONTROL UNIT ASSEMBLY

Parts List

Reference No.	Number Req'd	Stock No.	Description
1.	(1)	C090	Adjusting screw (standard)
2.	(1)	C085	Control Spring
3.	(1)	C095	Control Button
4.	(1)	C020	1000 Cylinder
5.	(1)	C075	1000 Return Spring
6.	(1)	V3070	Large Piston Seal
7.	(1)	C025	1000 Piston
8.	(1)	C023	Anti-Bloom Washer
9.	(1)	V3060	Small Piston Seal
10.	(1)	C096	Control Rod
11.	(1)	C030	1000 Shaft
12.	(1)	C100	Control Nut
13.	(2)	V3250	008 Shaft Seal
14.	(2)	V3080	Control Nut Piston Shaft Seal
15.	(1)	V2010	Control Unit Snap Ring
16.	(1)	C105	Control Nut Piston



PROPERTY OF: FIRE TASK FORCE INNOVATIONS
215-462-6161 7831 W. CASCADE DRIVE
VALPARAISO, IN 46383

TFI PART # 1000AC

PART: CONTROL UNIT ASS'Y.

DRAWN BY: Don Steimbu 02/07/83

APPROVED BY: R W Steingass 2/8/83

REV 1 REV 3

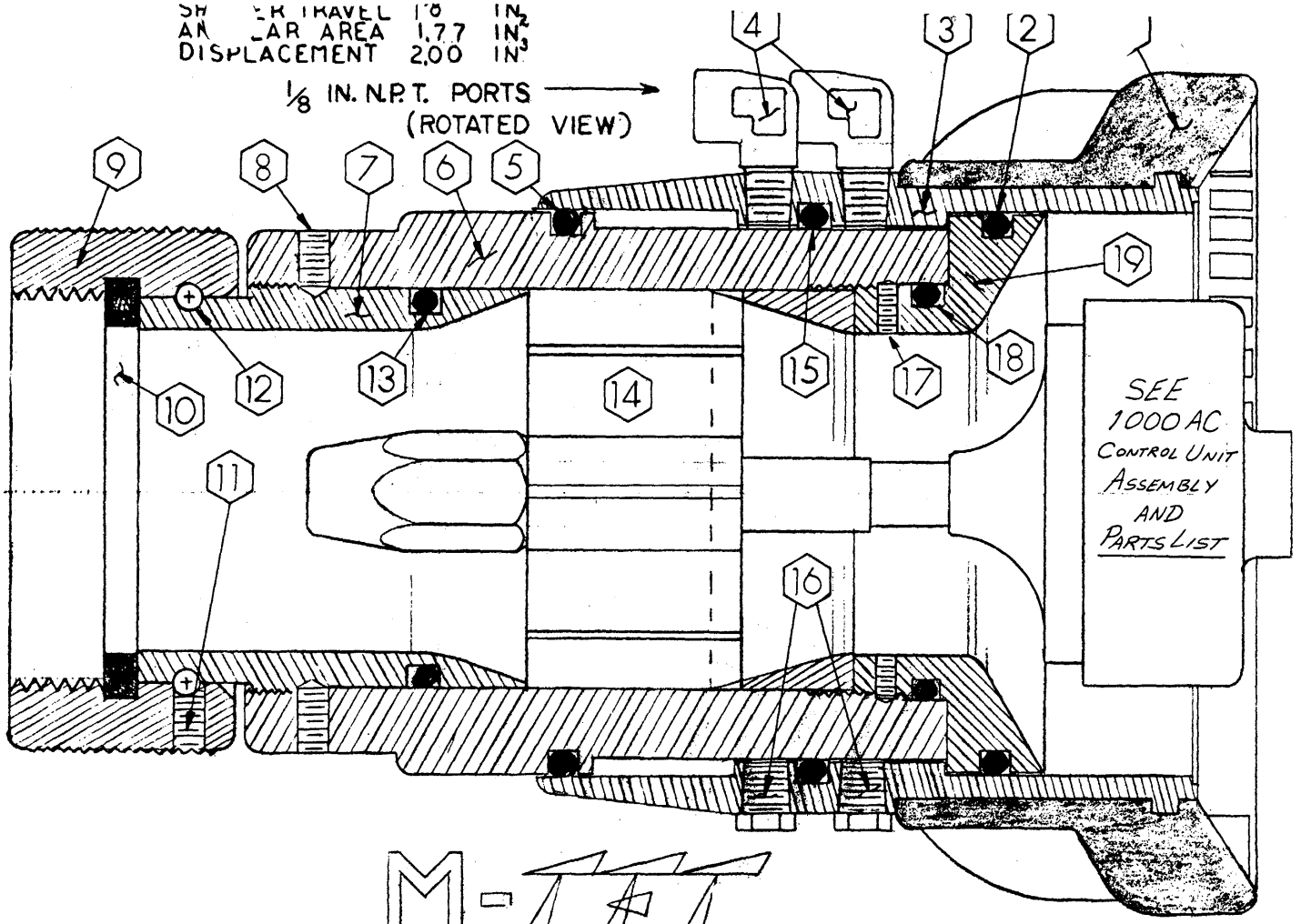
REV 2 REV 4

TASK FORCE TIPS ®
FIRE TASK FORCE Innovations INC.
2901 EAST CASCADE DRIVE VALPARAISO, INDIANA 46383
DAY (219) 462-6161 NIGHT 462-6000

MTFT HYDRAULIC PATTERN CONTROL

M-Hydraulic Remote Tip
Parts List

Reference No.	Number Req'd	Stock No.	Description
1.	(1)	M240	Bumper
2.	(1)	V3160	345 Shaper Seal
3.	(1)	M220	Shaper - Hydraulic
4.	(2)	V2180	1/8" N.P.T. Forged Street "ELL"
5.	(1)	V3260	Same as Reference Number two
6.	(1)	M210	Barrel - Hydraulic
7.	(1)	M206	Barrel Base Ring
8.	(2)	V1100	1/4" - 28 x 3/8 S.S. Setscrew
9.	(1)	M300	Coupling
10.	(1)	V3190	2.5" Coupling Gasket
11.	(1)	V1100	Same as Reference Number eight
12.	(48)	V2120	3/16" Aluminum Balls
13.	(1)	V3170	335 Barrel Seal
14.	(1)	M250	Fins
15.	(1)	V3165	346 Hydraulic Body Seal
16.	(2)	V2190	1/8" N.P.T. Pipe Plug
17.	(2)	V1030	1/4" - 28 x 1/4 S.S. Setscrew
18.	(1)	V3170	Same as Reference Number thirteen
19.	(1)	M200	Barrel Cone

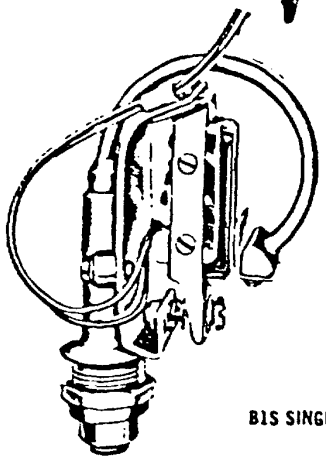


M-141

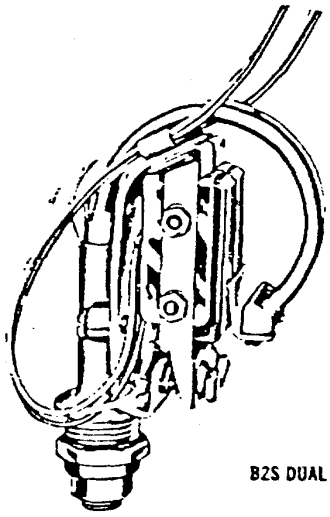
HYDRAULIC REMOTE

Robert W Steingass
5/17/79. REVISION #1
REV 7-21-82 BDL
REV 02/07/83 DTS

Stripped Bourdon Tube Models



B1S SINGLE SETTING



B2S DUAL CONTROL

PRESSURE SWITCHES — All values given in P.S.I. (Gauge)

Proof (Test) Pressure	Adjustable Range				Approx. Actuation Value (Differential)	Wetted Material*	B1S Catalog Number	B2S Catalog Number
	Decreasing		Increasing					
	Min.	Max.	Min.	Max.				
1500	50	1180	70	1200	10 to 20	Bronze	B1S-H12	B2S-H12
1500	50	1173	77	1200	11 to 27	316	B1S-A12SS	B2S-A12SS
4000	160	3170	190	3200	15 to 30	Bronze	B1S-H32	B2S-H32
4000	160	3161	199	3200	16 to 39	316	B1S-H32SS	B2S-H32SS
6000	240	4715	325	4800	40 to 85	316	B1S-A48SS	B2S-A48SS
**8125	325	6385	440	6500	54 to 115	316	B1S-A65SS	B2S-A65SS
**15000	600	11450	1150	12000	275 to 550	316	B1S-A120SS	B2S-A120SS
**20000	600	17450	1150	18000	275 to 550	316	B1S-A180SS	B2S-A180SS
Approximate shipping weight lbs.							1.5	1.5

*"Bronze" represents Phosphor Bronze Tube with SAE 88 Brass Socket
"316" represents 316 Stainless Steel Tube & Socket

**"AMINCO" female opening for ¼" OD tube connection. To change -A65SS and -A120SS switches to ¼" npt, add -P4 suffix to model number. Price addition required.

ELECTRICAL CHARACTERISTICS: All models incorporate Underwriters' Laboratories, Inc. listed single pole double throw snap-action switching elements. Electrical rating (continuous inductive) 10 amps 125 or 250 volts AC, 3 amps 480 volts AC. Automatically reset by snap-action of switch. *For more details and other switch classes, see pages 34-36.*

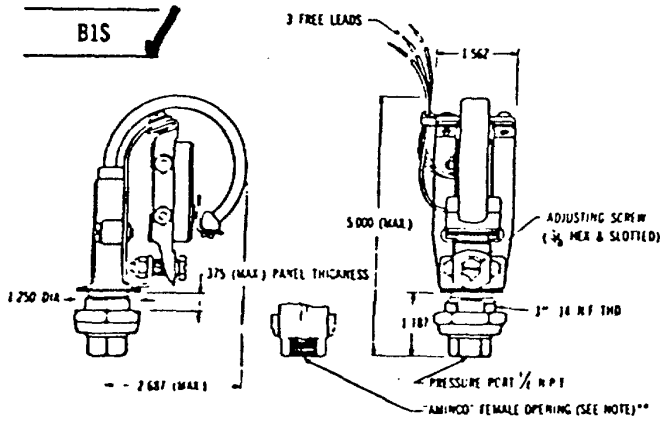
ELECTRICAL CONNECTION: Switches may be wired 'normally open' or 'normally closed' to free leads approximately 18" long.

WIRE CODING — PRESSURE
Circuit #1: Common — Purple
Normally Closed — Blue
Normally Open — Red
Circuit #2: Common — Brown
Normally Closed — Orange
Normally Open — Yellow

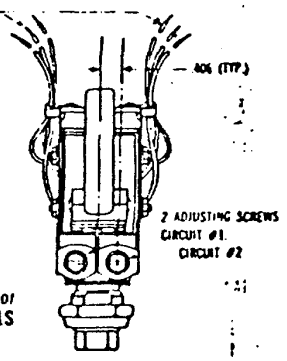
PRESSURE CONNECTION: ¼" N.P.T. internal thread, except as noted**, models with Proof Pressures above 8,000 P.S.I. have "AMINCO" female opening for ¼" O.D. tube connection.

ADJUSTMENT INSTRUCTIONS
Turn adjustment screw clockwise to lower actuation point (switch setting).

B1S



B2S



Note: All other dimensions for B2S are the same as B1S (left).

Section IX
SOLENOID VALVES

Method of Operation

Relief/Unloader Valve MUV/3-Way Flow Control

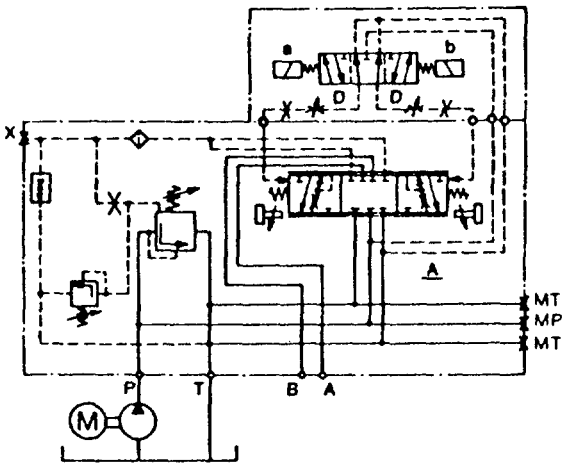
The flow control spool has a pilot bore which connects the pump pressure to the base end of the spool. On the opposite end is a spring (nominally 87 psi and 175 psi), consequently, the pump will unload over the flow control spool to tank at the spring induced pressure.

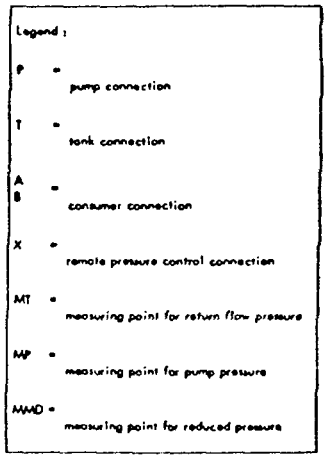
This spring end of the flow control spool is connected by pilot bores to the work ports. Should the main spool (4-way) be shifted, then the load pressure will be sensed at the spring end of the flow control spool and thereby shift it toward the closed position until the pump pressure reaches the value of the load pressure plus the spring value.

As the load pressures are balanced and the spring rate is fixed, the pressure drop (Δp) is constant and the flow over the 4-way spool becomes a function of its position (area), and is consequently pressure compensated.

Should the 4-way spool be set at an intermediate position, then the excess oil will pass over the flow control spool to tank at the load pressure plus the spring, not relief pressure.

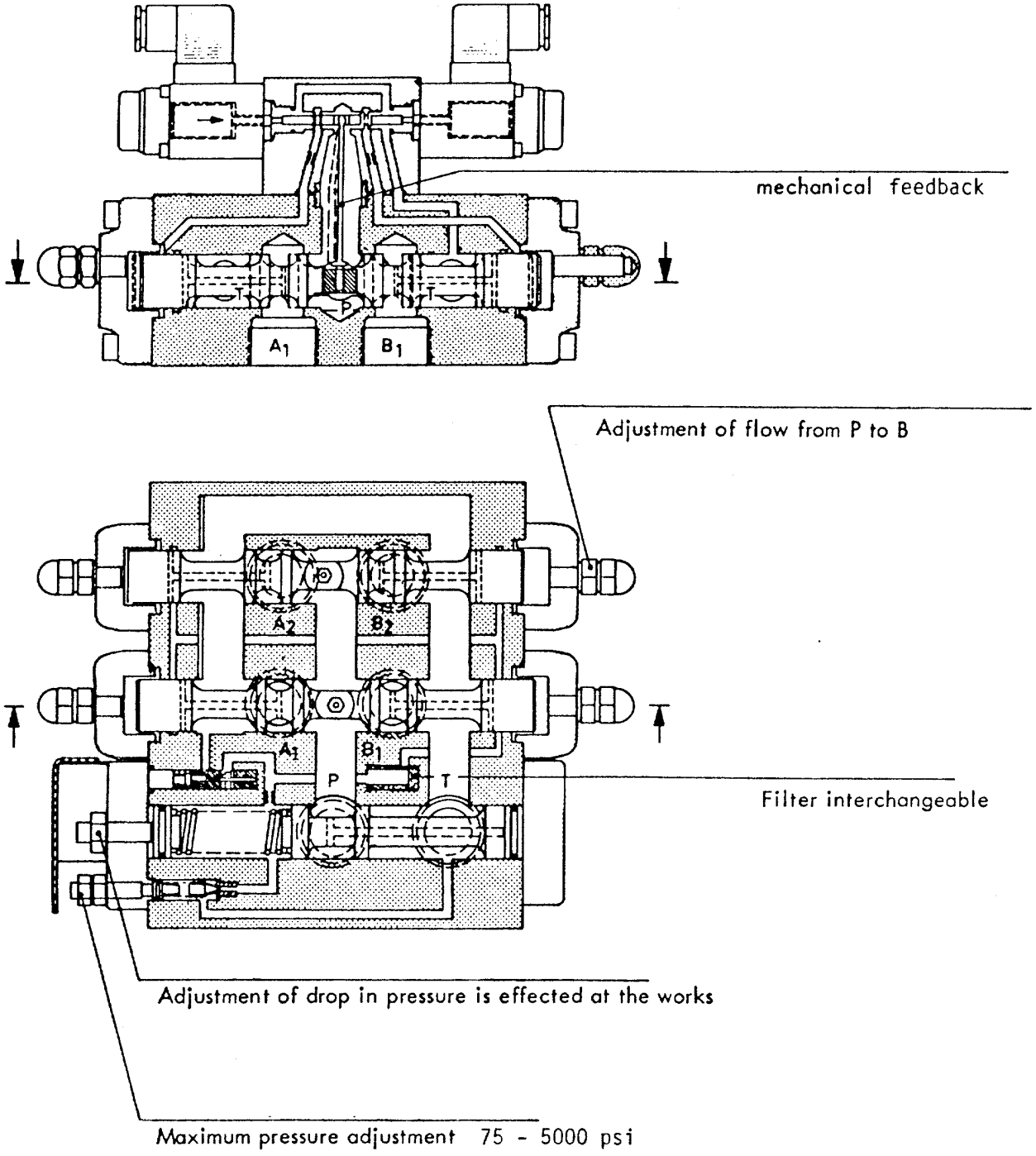
Hydraulic circuit MEV with MUV





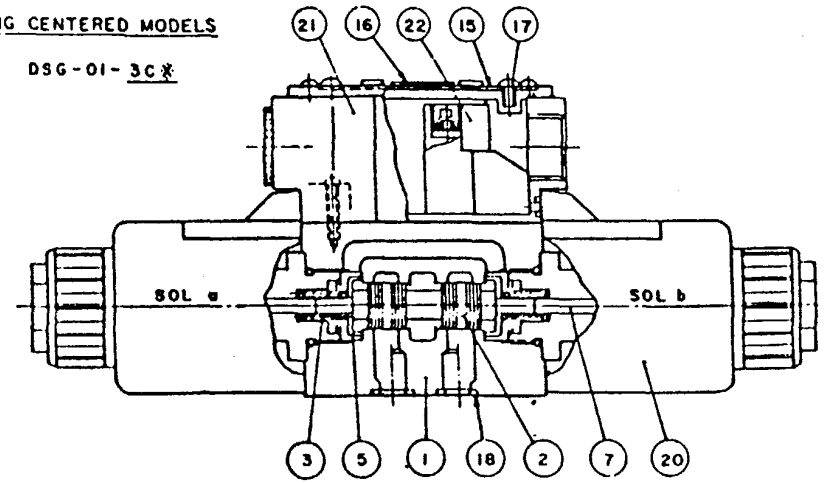
Sectional diagrams

Double solenoid control valve with 3-way flow control



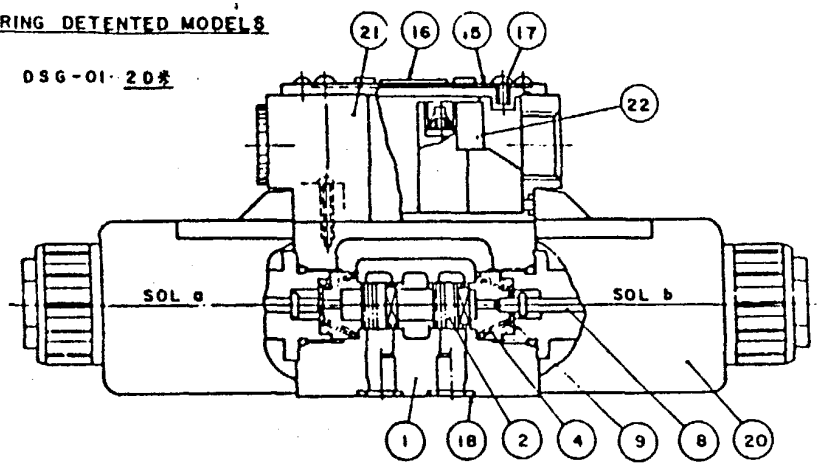
SPRING CENTERED MODELS

DSG-01-3C※

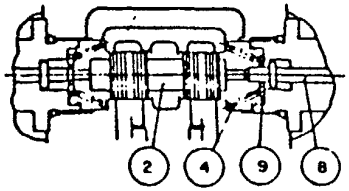


NO-SPRING DETENTED MODELS

DSG-01-2D※

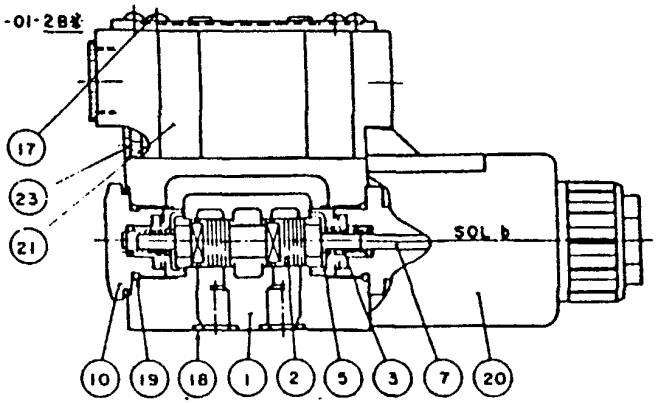


DSG-01-2D※A

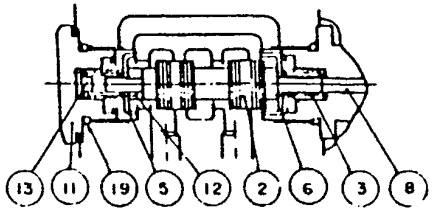


SPRING OFFSET MODELS

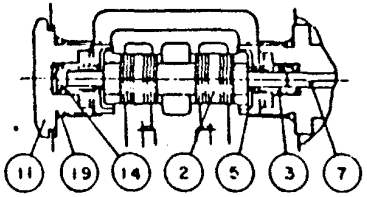
DSG-01-2B※



DSG-01-2B※A



DSG-01-2B※B



YUKEN KOGYO CO., LTD. TOKYO JAPAN	
NAME	SOLENOID OPERATED DIRECTIONL VALVES 1/8, SUB-PLATE MOUNTING
MODEL	DSG-01-※※※-A※※-4090 K-DSG-01-※※※-D※※-4090
DATE '80-02-05	PL NO P9-042800

RUCKER YUKEN

PARTS LIST

TABLE 1

ITEM	PART NUMBERS	NAME OF PARTS	REQ. 3C※	2D※	2D※A	2B※	2B※A	2B※B	REMARKS
1	1790S-VK110274-8	BODY	1	1	1	1	1	1	
2	SEE TABLE 2	SPOOL	1	1	1	1	1	1	
3	1790S-VK411081-3	SPRING	2	–	–	2	2	2	
4	1790S-VK411675-2	SPRING	–	2	2	–	–	–	
5	1790S-VK411082-1	SPRING FOLLOWER	2	–	–	2	1	2	
6	1790S-VK411084-2	SPRING FOLLOWER	–	–	–	–	1	–	
7	1790S-VK411672-9	PUSH PIN	2	–	–	1	–	1	
8	1790S-VK411676-0	PUSH PIN	–	2	2	–	1	–	
9	1790S-VK411674-5	DETENT	–	2	2	–	–	–	
10	1790S-VK411076-3	PLUG	–	–	–	1	–	–	
11	1788S-VK410160-6	PLUG	–	–	–	–	1	1	
12	1790S-VK411085-4	COLLAR	–	–	–	–	1	–	
13	1790S-VK411080-5	SHIM	–	–	–	–	1	–	
14	1790S-VK411083-9	SHIM	–	–	–	–	–	1	
15	1790S-VK311056-6	NAME PLATE	1	1	1	1	1	1	
16	1790S-VK210328-1	DIAGRAM PLATE	1	1	1	1	1	1	
17	TT-SP-M3×6	TAPPING SCREW	2	2	2	2	2	2	
18	SO-NB-P9	O-RING	4	4	4	4	4	4	
19	SO-NB-P18	O-RING	–	–	–	1	1	1	
20	S※1-※-40	SOLENOID ASS'Y	2	2	2	1	1	1	FOR DETAIL, REFER TO SHEET 3.
21	TB-A-10	TERMINAL BOX ASS'Y	1	1	1	1	1	1	
22	※R1-※-10	RECEPTACLE	1	1	1	1	1	1	SEE TABLE 3
23	17908-VK411669-3	PLUG	–	–	–	2	2	2	

TABLE 2

VALVE TYPES 3C※	2B※A	2B※B	SPOOL PART NUMBERS	VALVE TYPES 2D※	2D※A	2B※	SPOOL PART NUMBERS
3C2	2B2A	2B2B	1790S-VK310707-6	2D2			1790S-VK311067-4
3C3	2B3A	2B3B	1790S-VK310708-3	2D3			1790S-VK311058-2
3C4	2B4A	2B4B	1790S-VK310709-1	2D7			1790S-VK311247-1
3C40	2B40A	2B40B	1790S-VK310710-9	2D8			1790S-VK311059-0
3C5	2B5A	2B5B	1790S-VK310711-7		2D2A		1790S-VK311606-8
3C60	2B60A	2B60B	1790S-VK310712-5		2D3A		1790S-VK311607-6
3C7	2B7A	2B7B	1790S-VK310713-3		2D4A		1790S-VK311591-2
3C8	2B8A	2B8B	1790S-VK310714-1		2D40A		1790S-VK311608-4
3C9	2B9A	2B9B	1790S-VK310715-8		2D6A		1790S-VK311609-2
3C10	2B10A	2B10B	1790S-VK310716-6		2D7A		1790S-VK311592-0
3C11	2B11A	2B11B	1790S-VK310717-4		2D9A		1790S-VK311610-0
3C12	2B12A	2B12B	1790S-VK310716-6		2D10A		1790S-VK311611-8
					2D11A		1790S-VK311612-6
					2D12A		1790S-VK311613-4
						2B2	1790S-VK310718-2
						2B3	1790S-VK310719-0
						2B8	1790S-VK310720-8

TABLE 3

VALVE MODEL NUMBERS	RECEPTACLE PART NUMBERS
DSG-01-※※※-A100	R1-10
DSG-01-※※※-A120	
DSG-01-※※※-A200	
DSG-01-※※※-A240	
K-DSG-01-※※※-D12	KR1-A-10
K-DSG-01-※※※-D24	
K-DSG-01-※※※-D48	KR1-B-10
K-DSG-01-※※※-D100	KR1-C-10
K-DSG-01-※※※-D110	
K-DSG-01-※※※-D200	KR1-D-10
K-DSG-01-※※※-D220	
DSG-01-※※※-R100	RR1-10
DSG-01-※※※-R110	
DSG-01-※※※-R200	
DSG-01-※※※-R220	

AC SOLENOID ASS'Y "SA1-※-40"
DC SOLENOID ASS'Y "SD1-※-40"
R TYPE SOLENOID ASS'Y "SR1-※-40"

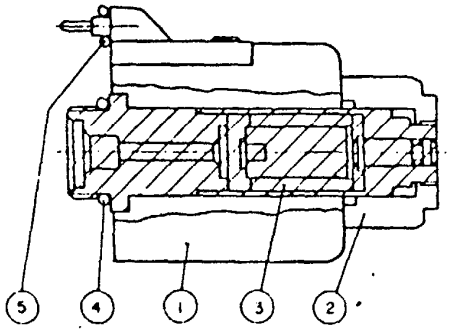


TABLE 2

VALVE MODEL NUMBERS	SOLENOID ASS'Y NO	COIL ASS'Y NO
DSG-01-※※※-R220	SR1-220-40	1790S-VK311070-7
DSG-01-※※※-R200	SR1-200-40	1790S-VK311069-9
DSG-01-※※※-R110	SR1-110-40	1790S-VK311068-1
DSG-01-※※※-R100	SR1-100-40	1790S-VK311067-3
K-DSG-01-※※※-D220	SD1-220-40	1790S-VK311085-5
K-DSG-01-※※※-D200	SD1-200-40	1790S-VK311084-8
K-DSG-01-※※※-D110	SD1-110-40	1790S-VK311083-0
K-DSG-01-※※※-D100	SD1-100-40	1790S-VK311082-2
K-DSG-01-※※※-D48	SD1-48-40	1790S-VK311081-4
K-DSG-01-※※※-D24	SD1-24-40	1790S-VK311080-6
K-DSG-01-※※※-D12	SD1-12-40	1790S-VK311079-8
DSG-01-※※※-A240	SA1-240-40	1790S-VK311066-5
DSG-01-※※※-A200	SA1-200-40	1790S-VK311065-7
DSG-01-※※※-A120	SA1-120-40	1790S-VK311064-0
DSG-01-※※※-A100	SA1-100-40	1790S-VK311063-2

TABLE 1

ITEM	PART NUMBERS	NAME OF PARTS	REQ. AC	REQ. DC	REQ. R TYPE	REMARKS
5	S0-NA-P4	O-RING	2	2	2	INCLUDED IN COIL ASS'Y
4	S0-N8-P18	O-RING	1	1	1	INCLUDED IN IRON CORE ASS'Y
3	1790S-VK311061-6	IRON CORE ASS'Y	—	1	1	
	1790S-VK311060-8		1	—	—	
2	1790S-VK311062-4	NUT	1	1	1	
1	SEE TABLE 2	COIL ASS'Y	1	1	1	

TERMINAL BOX ASS'Y "TB-A-10"

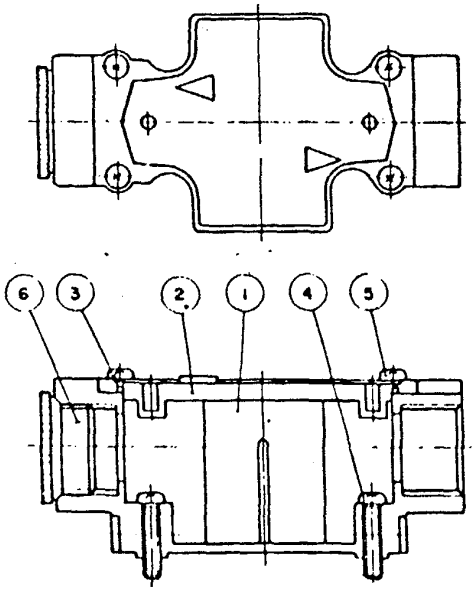
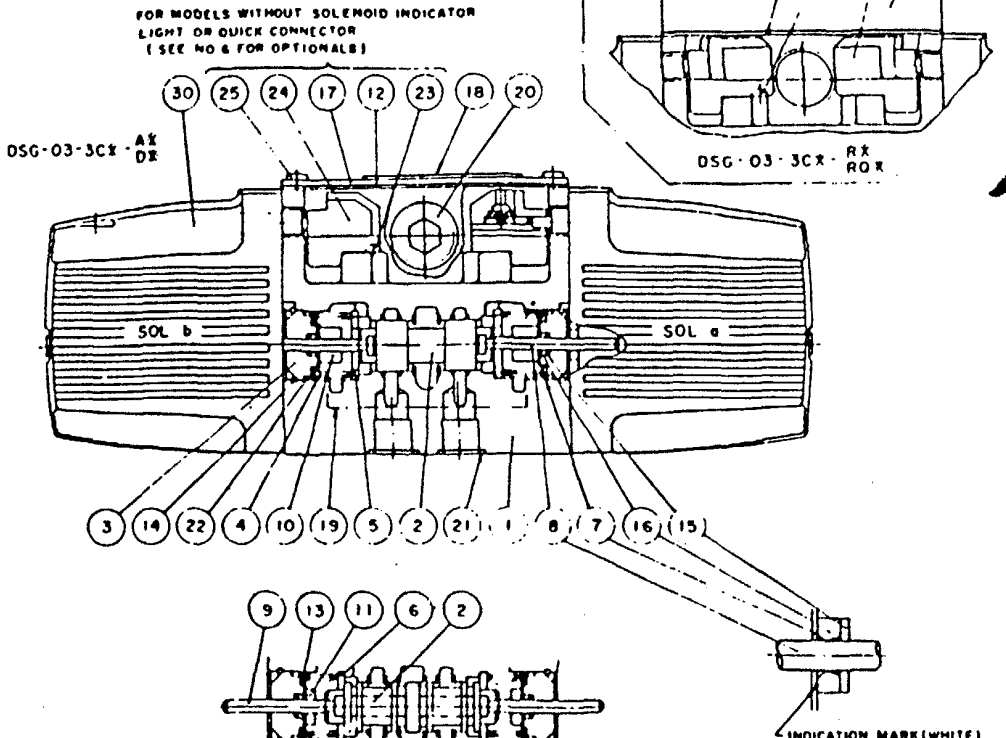
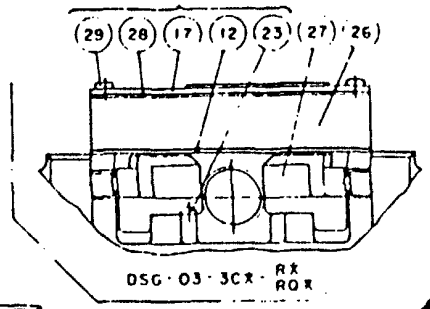


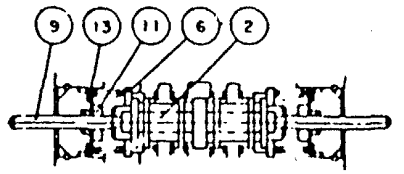
TABLE 1

ITEM	PART NUMBERS	NAME OF PARTS	REQ.	REMARK
6	17515-V47071	PLUG	1	
5	1790S-VK411697-6	SCREW	4	
4	1790S-VK411687-7	SCREW	2	
3	1790S-VK411686-9	GASKET	1	
2	1790S-VK311095-4	COVER	1	
1	1790S-VK311094-7	CASE	1	

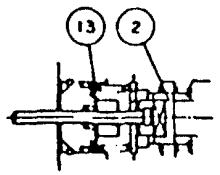
SPRING CENTERED MODELS



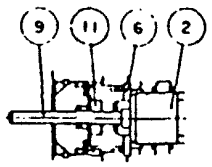




DSG-03-3C60



DSG-03-3C5



DSG-03-3C8

TABLE 2

MODEL NUMBERS	PART NUMBERS	NAME OF PARTS
DSG-03-3C*-RQ240	RQ2-240-40	QUICK RETURN DIODE STACK
DSG-03-3C*-RQ230		
DSG-03-3C*-RQ220	RQ2-200-40	
DSG-03-3C*-RQ200		
DSG-03-3C*-RQ120	RQ2-120-40	
DSG-03-3C*-RQ115		
DSG-03-3C*-RQ110	RQ2-100-40	
DSG-03-3C*-RQ100		
DSG-03-3C*-R*	RK2-40	DIODE STACK

TABLE 1

MODEL NUMBERS	PART NUMBERS
DSG-03-3C12	17615-V32980
DSG-03-3C11	17615-V32981
DSG-03-3C10	17615-V35460
DSG-03-3C9	17515-V32978
DSG-03-3C8	17615-V35678
DSG-03-3C7	17615-V35677
DSG-03-3C60	17615-V35676
DSG-03-3C6	17615-V35675
DSG-03-3C40	17615-V35674
DSG-03-3C4	17515-V32973
DSG-03-3C3	17515-V35673
DSG-03-3C2	17615-V32971

ITEM	PART NUMBERS	NAME OF PARTS	3C*	3C5	3C60	3C8	REMARKS
			REQ				
30	S-4-*-40	SOLENOID ASS'Y	2	2	2	2	***
29	17615-V48060	SCREW	4	4	4	4	
28	17615-V48086	GASKET	1	1	1	1	
27	17615-V33360	RECEPTACLE	2	2	2	2	**
26	SEE TABLE 2	STACK	1	1	1	1	
25	17515-V44665	SCREW	4	4	4	4	
24	17615-V32987	RECEPTACLE	2	2	2	2	*
23	PT-3*8	TAPPING SCREW	1	1	1	1	
22	ORK-16-70	O RING	2	2	2	2	
21	ARMAK-014	O RING	5	5	5	5	
20	17515-V47071	PLUG	2	2	2	2	
19	17515-V44468	PORT INDICATION PLATE	1	1	1	1	
18	17615-V30613	DIAGRAM PLATE	1	1	1	1	
17	17615-V32988	NAME PLATE	1	1	1	1	
16	17615-V48523	PENTA SEAL	2	2	2	2	
15	17615-V40302	BACK UP RING	2	2	2	2	
14	877-V45821	SNAP RING	2	2	2	2	
13	17615-V48180	SPACER	–	2	2	–	
12	17515-V48178	GASKET	1	1	1	1	
11	17615-V48190	CUSHION	–	–	2	2	
10	17615-V48175	CUSHION	2	2	–	–	
9	17515-V48174	PUSH PIN	–	–	2	2	
8	17515-V48171	PUSH PIN	2	2	–	–	
7	17515-V48170	CUP WASHER	2	2	2	2	
6	17615-V48189	SPRING FOLLOWER	–	–	2	2	
5	17615-V48188	SPRING FOLLOWER	2	2	–	–	
4	17515-V48187	SPRING	2	2	2	2	
3	17615-V48186	PUSH PIN GUIDE	2	2	2	2	
2	SEE TABLE 1	SPOOL	1	1	1	1	
1	Z90-1715-V48742	BODY	1	1	1	1	

NOTE
★ APPLICABLE ONLY FOR MODEL NUMBERS DSG-03-3C8-A* D*
★★ APPLICABLE ONLY FOR MODEL NUMBERS DSG-03-3C8-R* RQ*
★★★ SEE NO.4 AND NO.5 FOR SOLENOID ASS'Y

YUKEN KOGYO CO., LTD.
TOKYO JAPAN

NAME: SOLENOID OPERATED DIRECTIONAL VALVES 3/8, SUB-PLATE MOUNTING

MODEL: DSG-03-***-*-4090

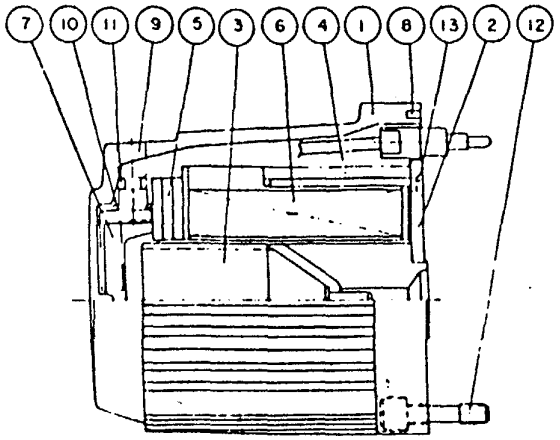
DATE: '74-09-01

P.L.NO.: P9-042900A

NO.1

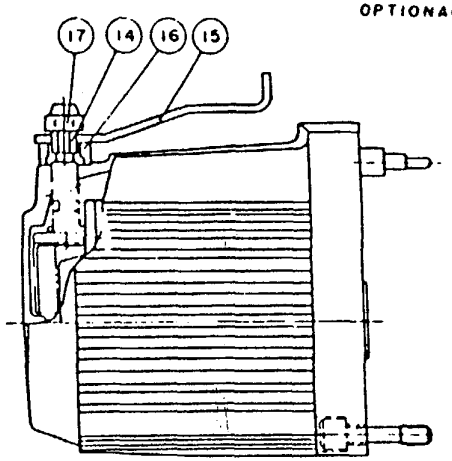
YUKEN

DC SOLENOID ASS'Y

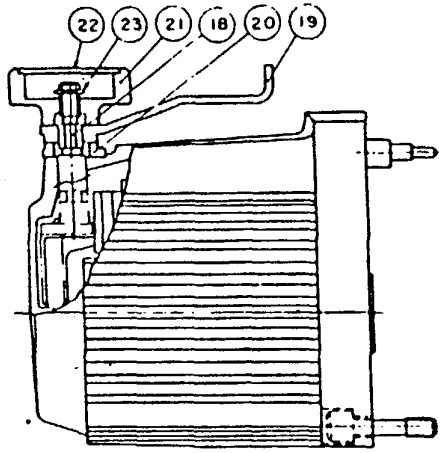


STANDARD
(SD4 - X - 40)

OPTIONALS



TYPE B
(SD4 - X - B - 40)



TYPE C
(SD4 - X - C - 40)

TABLE 1

MODEL NUMBERS	SOLENOID ASS'Y NUMBERS	COIL PART NUMBERS
K-DSG-03- X X X -D220-C-4190	SD4-220-C-40	1761S-V33463
K-DSG-03- X X X -D200-C-4190	SD4-200-C-40	1751S-V33462
K-DSG-03- X X X -D110-C-4190	SD4-110-C-40	1751S-V33461
K-DSG-03- X X X -D100-C-4190	SD4-100-C-40	1751S-V33460
K-DSG-03- X X X -D48-C-4190	SD4-48-C-40	1751S-V33459
K-DSG-03- X X X -D24-C-4190	SD4-24-C-40	1751S-V33458
K-DSG-03- X X X -D12-C-4190	SD4-12-C-40	1751S-V33206
K-DSG-03- X X X -D220-B-4190	SD4-220-B-40	1761S-V33463
K-DSG-03- X X X -D200-B-4190	SD4-200-B-40	1751S-V33462
K-DSG-03- X X X -D110-B-4190	SD4-110-B-40	1751S-V33461
K-DSG-03- X X X -D100-B-4190	SD4-100-B-40	1751S-V33460
K-DSG-03- X X X -D48-B-4190	SD4-48-B-40	1751S-V33459
K-DSG-03- X X X -D24-B-4190	SD4-24-B-40	1751S-V33458
K-DSG-03- X X X -D12-B-4190	SD4-12-B-40	1751S-V33206
K-DSG-03- X X X -D220-4190	SD4-220-40	1751S-V33463
K-DSG-03- X X X -D200-4190	SD4-200-40	1751S-V33462
K-DSG-03- X X X -D110-4190	SD4-110-40	1751S-V33461
K-DSG-03- X X X -D100-4190	SD4-100-40	1751S-V33460
K-DSG-03- X X X -D48-4190	SD4-48-40	1751S-V33459
K-DSG-03- X X X -D24-4190	SD4-24-40	1751S-V33458
K-DSG-03- X X X -D12-4190	SD4-12-40	1751S-V33206

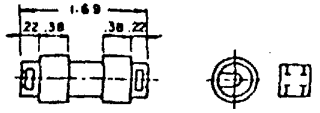
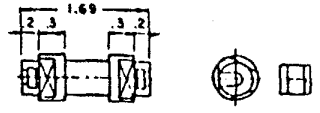
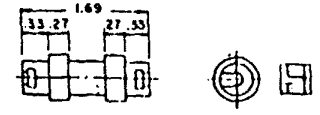
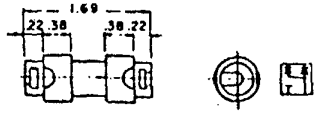
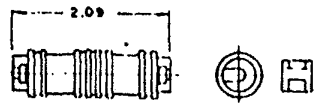
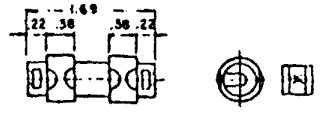
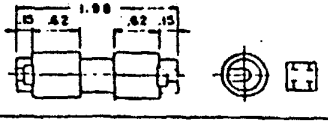
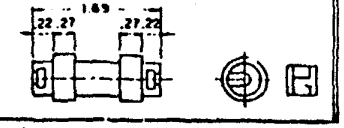
ITEM	PART NUMBERS	NAME OF PARTS	STD.	TYPE B REQ	TYPE C	REMARKS
23	SR-E-4	SNAP RING	-	-	1	
22	1761S-V48810	INDICATION PLATE	-	-	1	
21	1751S-V48808	KNOB	-	-	1	
20	1761S-V48809	SPACER	-	-	1	
19	1761S-V48806	LEVER	-	-	1	
18	1761S-V48811	SHIFTER	-	-	1	
17	1751S-V49848	NUT	-	1	-	
16	1751S-V49226	SPACER	-	1	-	
15	1751S-V49225	LEVER	-	1	-	
14	1761S-V49848	SHIFTER	-	1	-	
13	BD-3.5 x 0.6 x 8	MACHINE SCREW	2	2	2	
12	1761S-V48479	SOC HD CAP SCREW	4	4	4	
11	SO-NA-P5	O-RING	1	1	1	
10	1761S-V49847	SPRING	1	1	1	
9	1751S-V48478	SHIFTER	1	-	-	
8	1751S-V43662	PACKING	1	1	1	
7	1751S-V48661	STOPPER	1	1	1	
6	SEE TABLE 1	COIL	1	1	1	
5	1751S-V48660	YOKE	3	3	3	
4	1751S-V48659	FOLLOWER	4	4	4	
3	1751S-V48656	O-PLUNGER	1	1	1	
2	1761S-V48657	O-FRAME	1	1	1	
1	1751S-V20936	HOUSING	1	1	1	

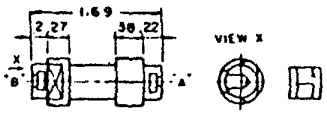
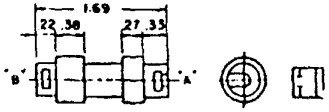
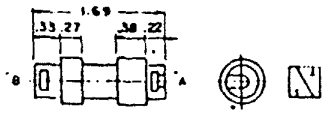
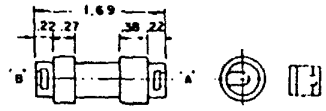
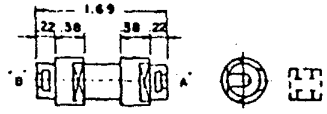
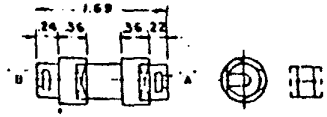
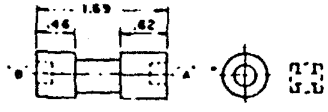
RUCKER YUKEN

P.I. NO. P 9-042900

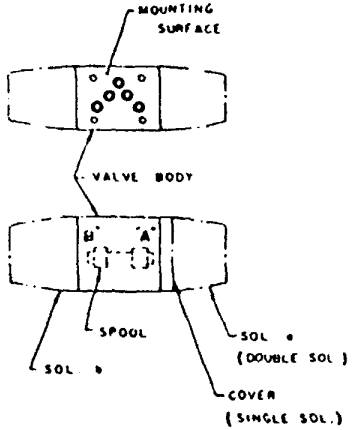
NO. 9

CHARACTERISTICS OF SPOOLS

SPOOL PART NO.	APPLICABLE VALVE TYPES	CHARACTERISTICS OF SPOOLS
17S1S-V32971	3C2 2D2 2D2A 2B2A 2B2B	
17S1S-V32972	3C3 2D3 2D3A 2B3A 2B3B	
17S1S-V32973	3C4 2D4A 2B4A 2B4B	
17S1S-V32974	3C40 2D40A 2B40A 2B40B	
17S1S-V32976	3C60 2B60A 2B60B	
17S1S-V32977	3C7 2D7 2D7A 2B7A 2B7B	
17S1S-V32978	3C8 2D8 2B8A 2B8B	
17S1S-V32979	3C9 2D9A 2B9A 2B9B	

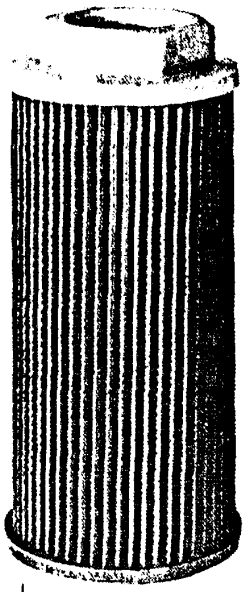
SPOOL PART NO.	APPLICABLE VALVE TYPES	CHARACTERISTICS OF SPOOLS
17S1S-V32975	3C5 2D5A 2B5A 2B5B	
17S1S-V32980	3C10 2D10A 2B10A 2B10B	
	3C12 2D12A 2B12A 2B12B	
17S1S-V32981	3C11 2D11A 2B11A 2B11B	
17S1S-V32982	2B2	
17S1S-V32983	2B3	
17S1S-VK32984	2B8	

SPOOL DIRECTION IN VALVE BODY



CAN FLO® HYDRAULICS LTD.

CFSE – SUCTION STRAINERS



SPECIFICATIONS

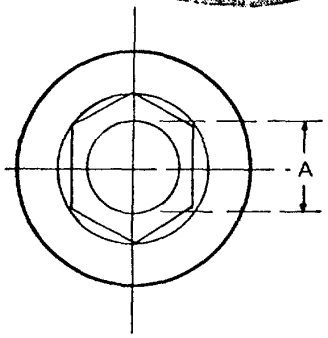
- PHOSPHOR BRONZE MEDIA
- CONTINUOUS EPOXY BOND COMPATIBLE WITH ALL FLUIDS
- CLEANABLE
- OPTIONAL 3 PSI BYPASS

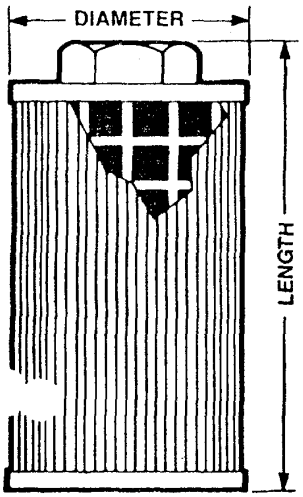
ORDERING INFORMATION

CF	SE	20	B	200
Can Flo Identity	Suction Element	"A" Dimension	3 PSI Bypass Omit if not required	SCREEN SIZE

Suction Element:
5 - ¾" NPT
10 - 1" NPT
20 - 1¼" NPT
30 - 1½" NPT
40 - 1½" NPT
50 - 2" NPT
75 - 2½" NPT
100 - 3" NPT
150 - 3" NPT

SCREEN SIZE:
100 - Standard (omit)
200 - 74 Micron
60 - 238 Micron





MODEL No.	FLOW RATE		SCREEN AREA		DIAMETER		LENGTH		WEIGHT	
	GPM	LPM	SQ. INS.	SQ. CM	INS.	MM	INS.	MM	LB.	KG
CFSE - 5	5	19	80	387	2.75	70	5.0	127	.30	0.14
CFSE - 10	10	38	125	806	2.75	70	6.5	165	.40	0.18
CFSE - 20	20	76	180	1032	3.90	99	6.5	165	.5	0.23
CFSE - 30	30	114	300	1935	3.90	99	8.5	216	.65	0.30
CFSE - 40	50	190	350	2258	3.90	99	10.0	254	.80	0.36
CFSE - 50	50	190	350	2258	3.90	99	10.0	254	.80	0.36
CFSE - 75	75	285	400	2581	5.35	136	12.48	317	1.00	0.45
CFSE - 100	100	380	500	3226	5.35	136	13.0	330	1.25	0.57
CFSE - 150	150	570	700	4516	5.35	136	15.0	381	1.50	0.68

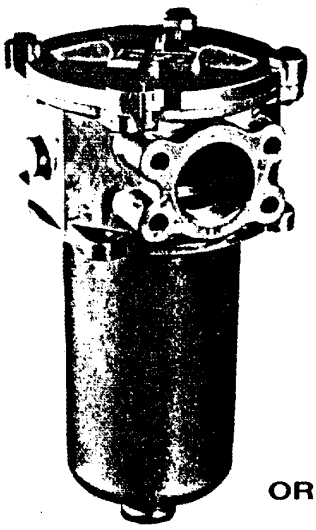
Flow rates are based on pressure drops across the element of less than 0.25 psi (0.017 BAR.) with a fluid viscosity of 150 SSU (28 centistokes) at 100°F with a clean element.

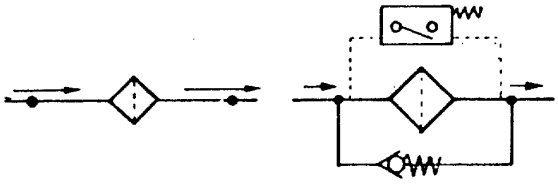
We recommend you size the suction strainer at twice the pump capacity to avoid pump cavitation.

Section IX
SOLENOID VALVES

CAN FLO® HYDRAULICS LTD.

CMPF SERIES TANK MOUNTED RETURN LINE FILTER





ORDERING INFORMATION

CMPF	—	7	—	12N	—	16N	—	10N	—	X	—	M	—	NB
Can Flo Identity		Model Size		Port A		Port B		Element Type		Indicator				By-Pass

- Model Size: 7, 11, 20, 50
- Port A: 12N — ¾" NPT; 16N — 1" NPT; 20N — 1¼" NPT; 32N — 2" NPT
- Port B: 16N — 1" NPT; 12N — ¾" NPT; Omit — *
- Element Type: 10N — 10 Micron; 25N — 25 Micron
- Indicator: X — None; D — Visual gauge; E — Electrical
- Fluid Type: M — Mineral; W — Water glycol; P — Phosphate ester
- By-Pass: NB — No by-pass. Omit if standard 15 PSI by-pass is required.

*Normally blank. Specify if required.

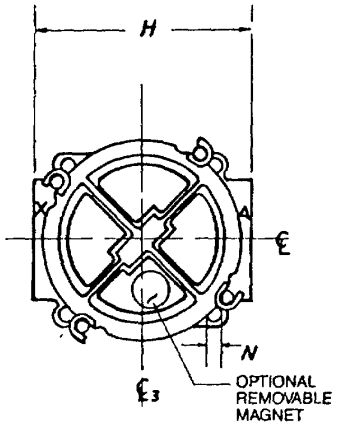
REPLACEMENT ELEMENT			
F	20	10N	M
Element Identity	Model Size 7 11 20 50	Filtration 10N — 10 Micron Paper 25N — 25 Micron Paper	Fluid Type M — Mineral W — Water Glycol D — Phosphate Ester

REPLACEMENT INDICATORS		
PART NUMBER	DESCRIPTION	TYPE
CF-30-D	0-100 PSI	Visual gauge
CFG-15R-4C-EL	Set @ 15 PSI	Electrical

Section IX
SOLENOID VALVES

CAN FLO® HYDRAULICS LTD.

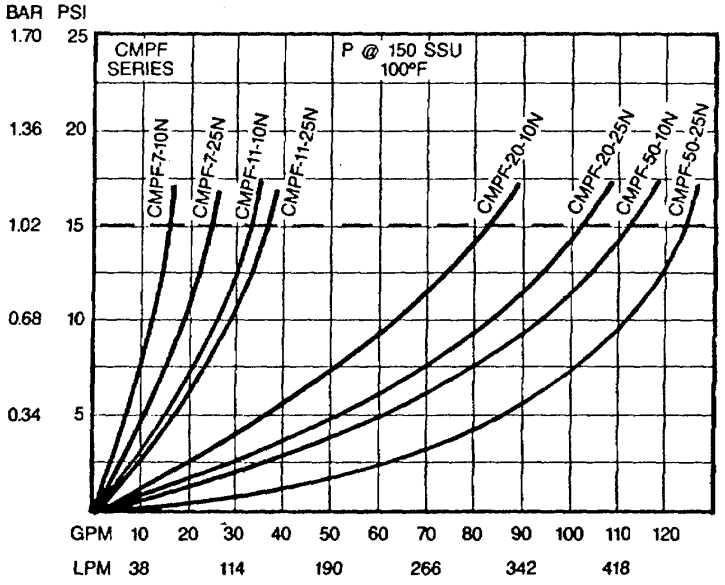
CMPF SERIES TANK MOUNTED RETURN LINE FILTER

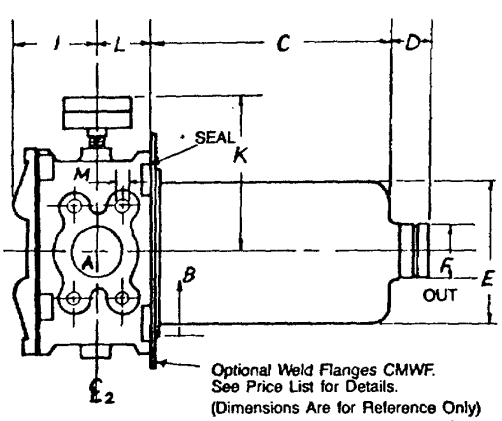


design "B" shown with "P" bolt circle dia.

SPECIFICATIONS

- 100 PSI WORKING PRESSURE
- FLOWS UP TO 80 GPM
- ELEMENTS ARE REPLACEABLE THROUGH FILTERCOVER
- OPTIONAL INDICATORS
- DIRECT TANK MOUNTING





Optional Weld Flanges CMWF.
See Price List for Details.
(Dimensions Are for Reference Only)

design "A"-2 mtg holes on with "P" bolt circle

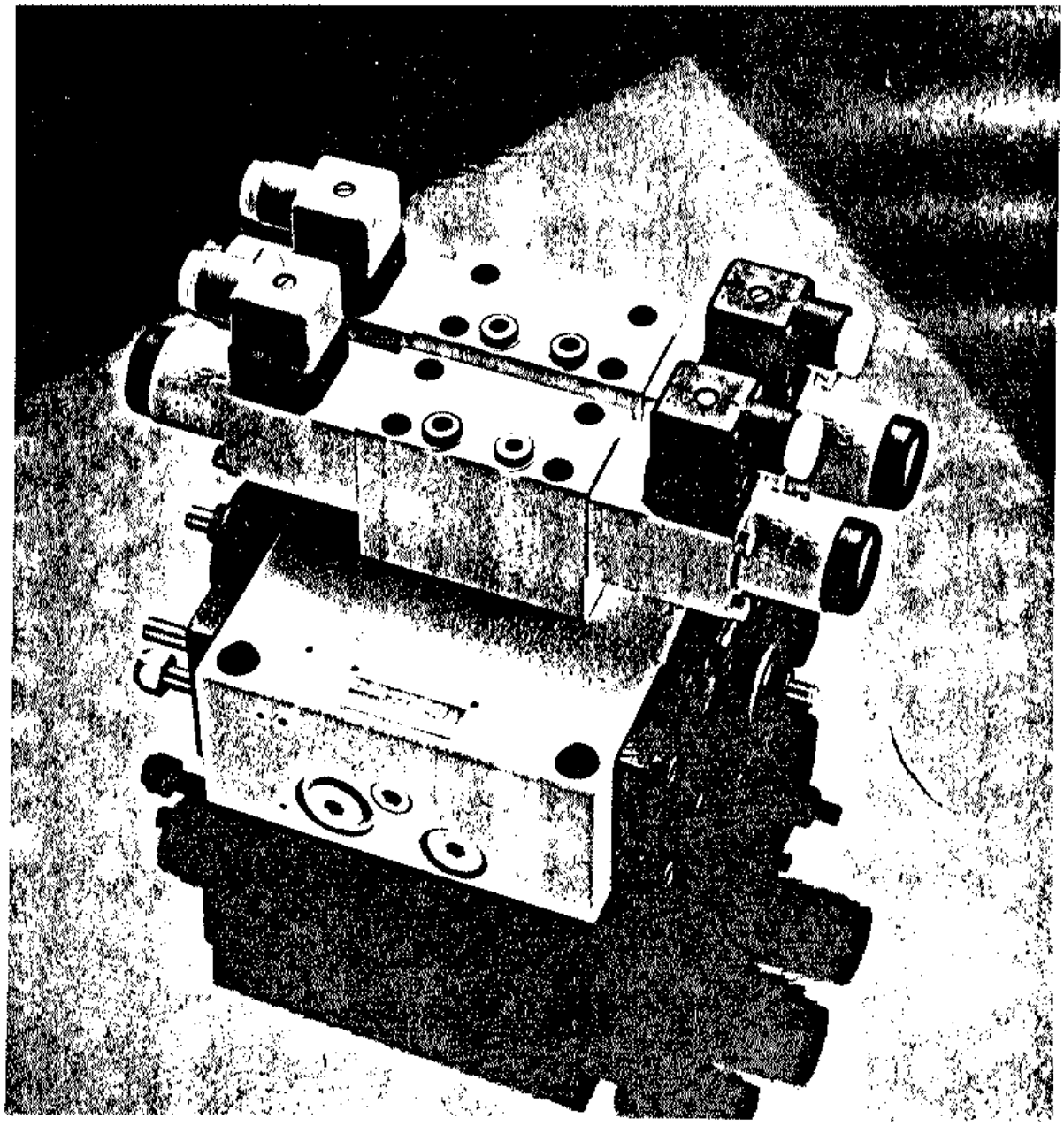
DESIGN TYPE	FILTER MODEL BASIC		B	C	D	E	F	G	H	I	K	L	M	N	P	WEIGHT
A	CMPF- 7	INS.	3.45	2.66	1.00	3.10	1.12	¼-20	5.30	1.35	0.90	1.13	—	.33	4.51	1.75 lbs.
		MM	87.6	67.6	25.4	78.7	28.5	UNC	134.6	34.3	22.9	28.7	—	8.4	114.50	0.80 lbs.
A	CMPF-11	INS.	3.45	4.35	1.00	3.10	1.12	¼-20	5.30	1.35	0.9	1.13	—	.33	4.51	2.00 lbs.
		MM	87.6	110.5	25.41	78.7	28.5	UNC	134.6	34.3	22.9	28.7	—	8.4	114.51	0.90 lbs.
B	CMPF-20	INS.	4.95	7.00	.25	4.35	1.55	⅜-18	6.70	2.38	0.9	1.70	⅛-13	.44	6.25	5.00 lbs
		MM	125.7	178	31.8	110.5	39.4	UNC	170.2	60.5	22.9	43.2		11.2	158.8	2.27 lbs.
B	CMPF-50	INS.	6.89	8.03	1.50	5.85	1.97	⅜-18	8.25	2.45	0.9	1.94	⅛-13	.44	8.68	7.5 lbs.
		MM	175	204	38.1	148.6	50	UNC	209.6	62.2	22.9	49.3		11.2	220	3.41 lbs.

barmag hydraulic

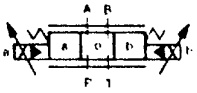
Proportional valves in monobloc design

Spool valve electro-hydraulically piloted
with mechanical feed-back
Operating pressure max. 350 bar
Sizes 8 · 12 · 18 · 25

1.1.02



Proportional valves in monobloc design 1.1.02



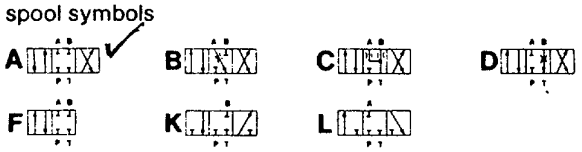
Barmag proportional valves in monobloc design are used for the load-independent control of a hydroflow. The valves serve for start, stop and return of motion, as well as for speed metering of the consumer. Dependent on the design of the pressure compensator, which can contain max. pressure limitation as well as a flow control valve, the valve can be used in open or closed loops, with constant or variable pumps (for further information see summary leaflet 1.0.01).

Type code

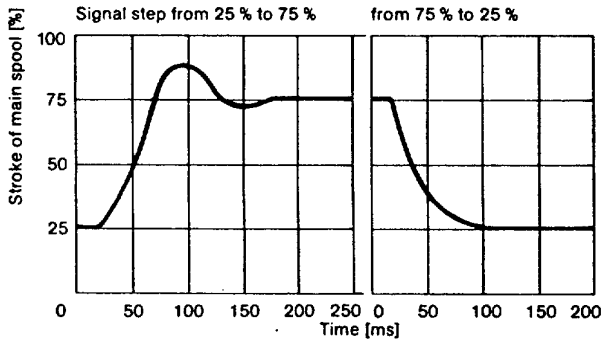
12	MU	300	ER	F	2	1	A	60	80	Z	
			ER	F	1	1	C	90	90		

- Size: 8, (12), 18, 25
- Design of the pressure compensator: MU = 3-way flow control, MD = 2-way flow control
- MR = 3-way flow control with loadable return
- Maximum pressure limitation [bar]
- Operation: ER = electro-hydraulically with mechanical feed-back
- Functioning: F = proportional, N = on/off
- Solenoid design: 1 = 12 V –, 3 = 110 V ~ *1), 5 = ExsG 4; 2 = 24 V –, 4 = 220 V ~ *1), 6 = intrinsically safe
- Plug design: 1 = plug connector as per DIN 43615, 2 = rectifier plug, 3 = special design (intrinsically safe, ExsG 4)
- Spool symbols *3): A, B, C, D, F, K, L
- Max. flow rate: port P-A [l/min]
- Max. flow rate: port P-B [l/min]
- Additional indication in plain language: indicate Z separately for each section
- Valve section 2 *2)
- Valve section 1

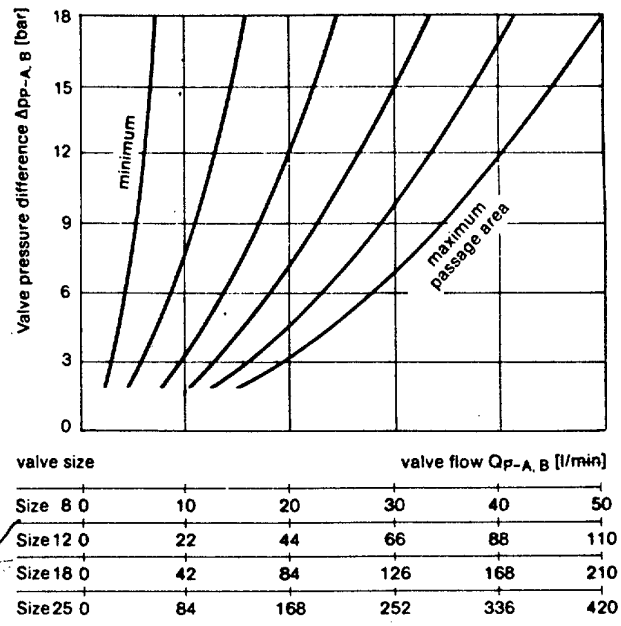
*1) design 3, 4 only in on/off version available
*2) more than 4 valve sections only upon request
*3) spool symbols



Step function response
(proportional to the voltage)



Throughflow characteristics with maximum spool decentering

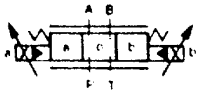


The main control spools – apart from different spool symbols – can be produced individually according to the application with different flow passage areas. The diagram shows curves of different spools.

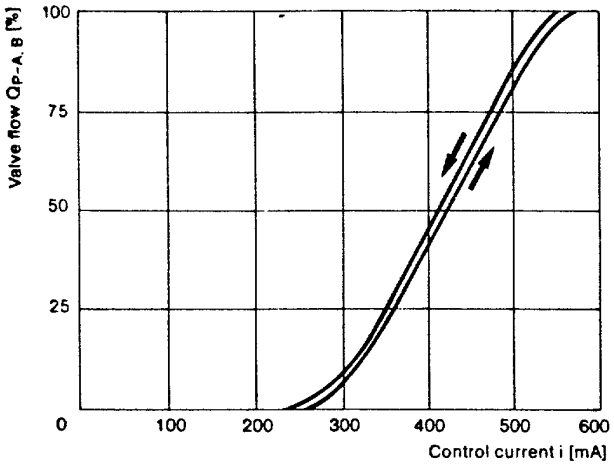
Electrical characteristic values

		12 V – solenoid		24 V – solenoid	
		coil temperature		coil temperature	
		20 °C	60 °C	20 °C	60 °C
DC resistance	[Ω]	7,1	8,2	23,5	27,2
Electrical control range for flow control Q = 0...100 %	[mA]	400...1000	400...1000	240...560	240...560
Corresponds to voltage	[V]	2...7,1	2,2...8,2	3,5...12,9	4,1...15
Electric power	[W]	0,5...7,1	0,6...8,2	0,5...7,1	0,6...8,2
Dither*4)	[mA]	180 ± 5 %		100 ± 5 %	
Current max.	[A]	1,34		0,74	
Power max.	[W]	19,5		19,5	
Max. coil temperature	[°C]	155		155	
Insulation class		F		F	
Max. permissible voltage with 100 % ED (continuous duty)	[V]	14,5		26	
Inductivity of the coil	[H]	0,1		0,25	

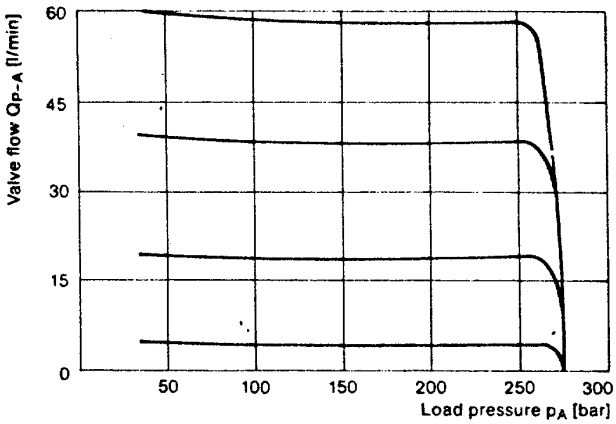
*4) In order to recieve an optimum function and low hysteresis we recommend pulsating currents (Dither) of 100 Hz with the help of which the solenoids A and B can be controlled alternately also in center position of the valve.
Appertaining amplifier (12 V – and 12 V –): SCRU 9 as per leaflet 14.1.2
Appertaining remote controller: VE per leaflet 13.1.01



Control characteristics (for 24 V solenoid)



Direct-flow characteristics



Monobloc valve size 12 with 3-way directional flow control (MU pressure compensator). Pressure-relief valve adjusted to 275 bar.

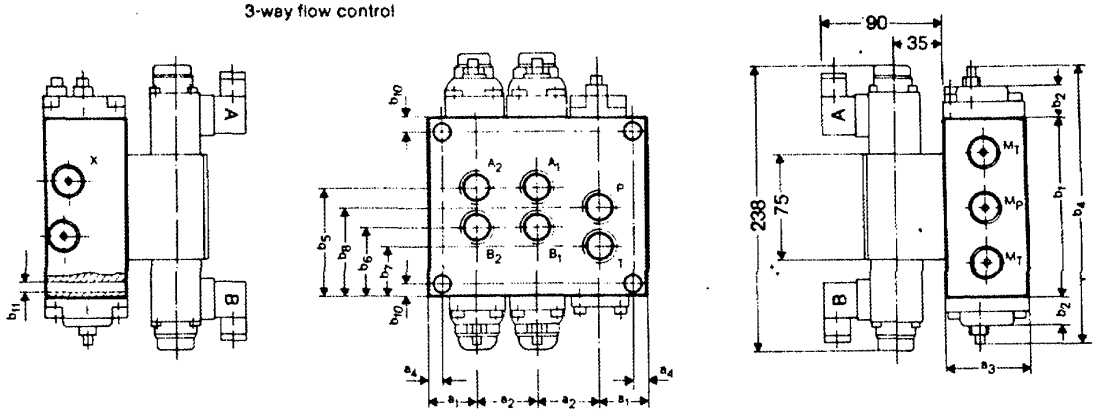
Hydraulic characteristic values

Operating pressure	[bar]	...350			
Return pressure	[bar]	port T		port T_1	
MU – 3-way flow controller		...50		–	
MD – 2-way flow controller		–		...50	
MR – 3-way flow controller		...350		...50	
Maximum flow rate $Q_{max.}$ per section at Δp_{P-A} = 18 bar valve pressure decrease	[l/min]	size 8	size 12	size 18	size 25
1. valve section		50	112	228	420
2. valve section		47	100	220	410
3. valve section		44	93	215	400
4. valve section		42	85	205	390
Recommended filtration	[µm]	25 absolute			
Fluid		mineral oil according to DIN 51524 and DIN 51525 not easily inflammable pressure fluid upon request			
Fluid temperature range	[°C]	– 20...+ 70 lowest temperature construction upon request			
Viscosity range	[mm^2/s]	2,8...380			
Installation position		horizontal			

Weight	[kg]	size 8		size 12		size 18		size 25	
Design of the pressure compensator		MU	MD	MU	MD	MU	MD	MU	MD
with 1 valve section		5,8	6,0	8,6	8,5	15,8	17,0	36,5	38,3
with 2 valve sections		9,5	9,7	13,3	13,0	24,6	25,8	56,2	58,0
with 3 valve sections		13,3	13,5	18,0	17,5	33,4	34,6	74,0	75,8
with 4 valve sections		17,0	17,2	22,5	22,3	42,2	43,4	93,0	94,8

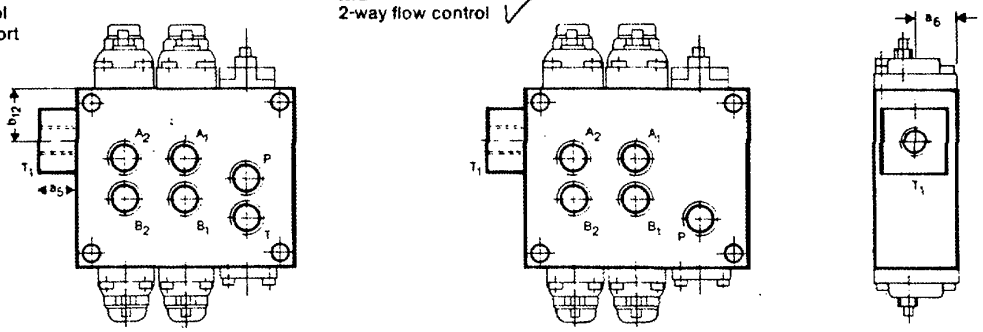
The solenoid is provided with a manual override

MU
3-way flow control



MR
3-way flow control
with loadable T port

MD
2-way flow control



Size	Threaded port cylindrical pipe thread ISO 228			Equipment dimensions [mm]															
•	A/B/P/T/T_1	X	Mp/M_T	a_1	a_2	a_3	a_4	a_5	a_6	b_1	b_2	b_4	b_5	b_6	b_7	b_8	b_{10}	b_{11}	b_{12}
8	G ¾	G ¼	G ½	32	40	50	7,5	–	27	100	26	186	64	36	22	50	7,5	6,4	24
12	G ½	G ¼	G ¼	35	45	60	10,0	25,5	30	130	26	212	84	46	27	65	10,0	8,4	27
18	G 1	G ¼	G ½	45	60	80	14,0	26,5	40	180	27	274	117	63	36	90	10,0	10,5	36
25	G 1½	G ¼	G ¾	55	90	110	18,0	37	55	240	37	364	157	83	46	120	10,0	13,0	47

Subject to technical alterations

barmag

BARMAG BARMER MASCHINENFABRIK AKTIENGESELLSCHAFT
5630 Remscheid 11, Postfach 110240, Tel.: (02191) 6091, Telex 8513210 · Fax 02191 609204 · Bundesrepublik Deutschland

AMERICAN BARMAG CORPORATION
1101 Westinghouse Boulevard, Charlotte, N.C. 28217, P.O. Box 7046, Tel.: Area Code 704/5880072, Telex 810 6210485 · Fax 001 704 554 0141 · U.S.A.

BUK BARMAG HYDRAULIC U.K.
Dunbeath Road, Elgin, Swindon SN2 6EA, Wiltshire, Tel.: 0793 487414, Telex 444485 · England

OVERCENTER VALVES

PILOT ASSISTED STYLE

FOR OIL - TO 50 G.P.M., (190 L/MIN) 5000 P.S.I. (350 bar) SETT

USE

To control moving loads and prevent loads from running ahead of pump. Locks load in any position without drift and provides static overload relief and thermal expansion relief with open center control valves. Models shown here are rated up to 50 GPM (190 L/MIN). Others available to 80 GPM (303 L/MIN).

OPERATION

An overcenter valve is basically a counterbalance valve with a pilot override or assist on the relief valve section. The load is raised by free flow of oil thru check section. With control valve centered load is locked (relief must be set at least 1.3 times higher than the maximum load induced pressure).

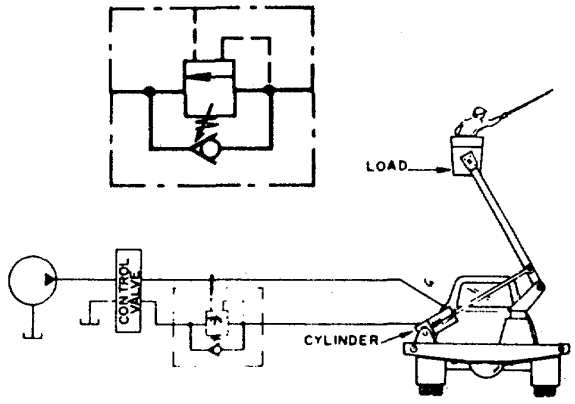
To lower the load, pilot pressure is required which effectively reduces the relief valve setting. Calculations for pilot pressure requirement to move load is simply:

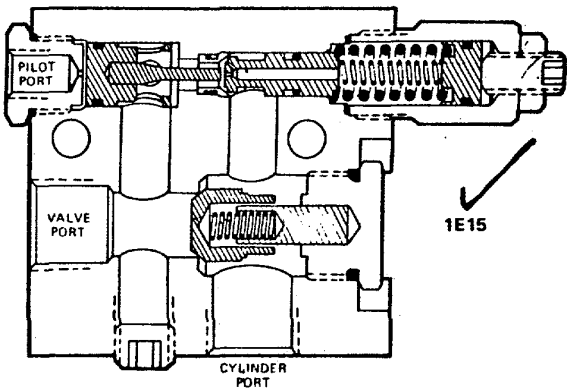
$$\frac{\text{(Relief Setting)} - \text{(Load Pressure)}}{\text{Pilot Ratio}} = \text{Pilot Pressure Required}$$

For example: With 10:1 pilot ratio, relief set at 2500 PSI (175 bar) and 1500 PSI (105 bar) Load pressure, then 100 PSI (7 bar) pilot pressure is needed to move load.

$$\left(\frac{2500\ \text{PSI} - 1500\ \text{PSI}}{10} = 100\ \text{PSI}\right)$$

This allows the load to be smoothly controlled with minimum energy loss. If load tries to run ahead of pump the relief section will throttle or close to prevent runaway.





SPECIFICATIONS

MATERIALS: Body, hi-strength wrought aluminum alloy
Internal parts, hardened steel

	Rated Flow:	Maximum Relief Setting:	Maximum System Working Pressure:
1E15, 1EE15	25 G.P.M. (95 L/MIN)	5000 P.S.I. (350 bar)	2250 P.S.I. (158 bar) (3000 P.S.I. (210 bar) Range)
1E16	50 G.P.M. (190 L/MIN)	5000 P.S.I. (350 bar)	3750 P.S.I. (263 bar) (5000 P.S.I. (350 bar) Range)

PILOT RATIOS:

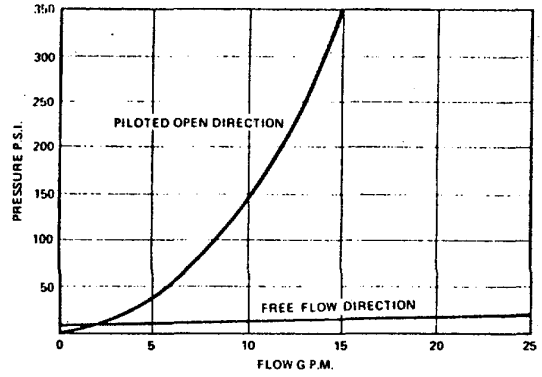
10.75 to 1 - Standard - Best suited for applications where load remains relatively constant.

Optional pilot ratio available upon request - 5:1

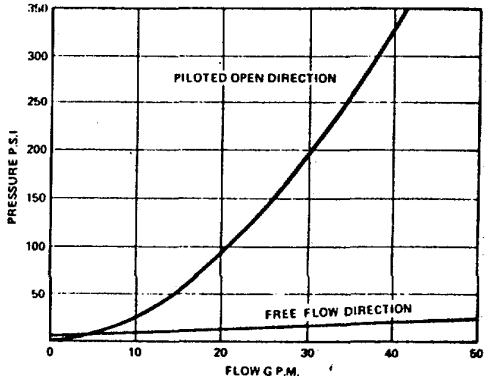
2.75 to 1 Suffix "45" - Best suited for applications where load varies and machine structure can induce instability.

Optional pilot ratio available upon request - 1.2:1

1E15

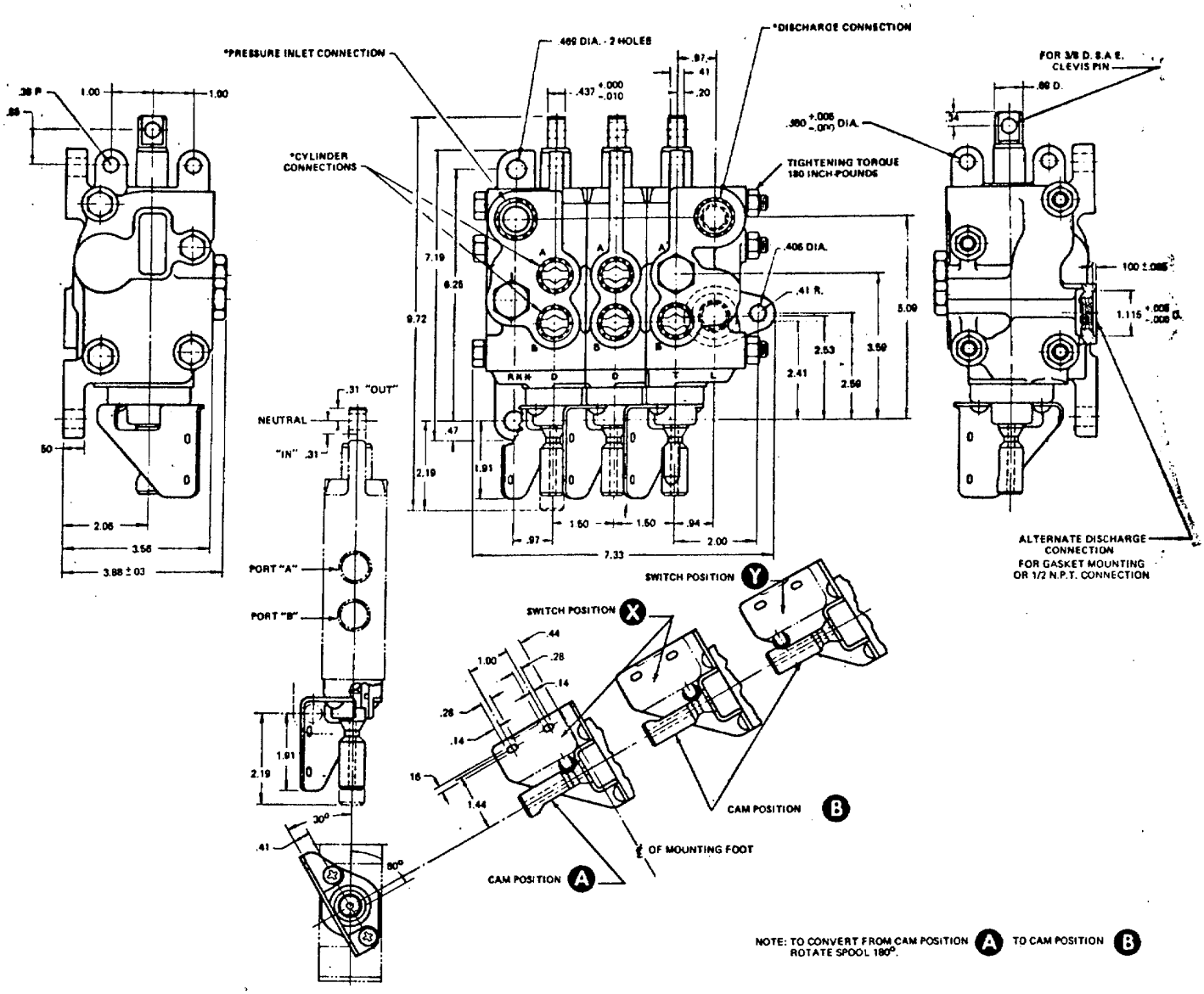


1E16



Installation Dimensions

CM11 SERIES – ELECTRIC SWITCH ACTUATORS



*REFER TO CHART ON PRECEDING PAGE FOR OPTIONAL PORT CONNECTIONS.

NOTE: TO CONVERT FROM CAM POSITION (A) TO CAM POSITION (B) ROTATE SPOOL 180°.

NOTE: SWITCH BRACKETS AND ACTUATORS ARE PROVIDED BY VICKERS. CUSTOMER MUST PROVIDE AND MOUNT MICROSWITCH MODEL BZ 2RW822 ** OR EQUIVALENT. SPACE IS PROVIDED FOR 0.06 INCH DI-ELECTRIC MATERIAL BETWEEN SWITCH AND BRACKET.

SWITCH POSITIONS FOR VARIOUS VALVE SECTIONS.

VALVE SECTION TYPE	SHIFTED SPOOL POSITION	FLOW		SWITCH POSITION	CAM POSITION
		CYL.PORT "A"	CYL.PORT "B"		
DOUBLE ACTING "B" & "D"	IN	TANK	PRESSURE	X	A
	OUT	PRESSURE	TANK		
SINGLE* ACTING "T"	IN	PLUGGED	PRESSURE	X	B
	OUT		TANK		
SINGLE ACTING "W"	IN	TANK	PLUGGED	Y	B
	OUT	PRESSURE			

CM3 SERIES CONTROL LEVER

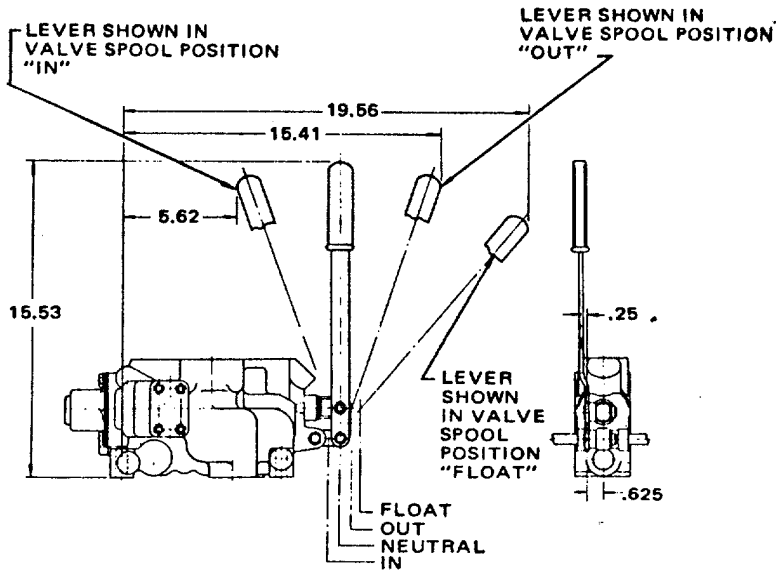
Hand operating lever assemblies are available for directional valve sections in groups of one to ten levers.

Lever groups include necessary fulcrum rod, links and "E" washers for assembly.

Specify number of levers required in addition to valve assembly or section selected as in the following example:

One (1) CM3NO1-R25DDDL-30 Valve Assembly
One (1) CM3-H3-30 Hand Lever Assembly

NOTE: Number after the "H" denotes number of operating sections.



CM11 SERIES CONTROL LEVER

Levers may be assembled with fulcrum in the lower holes to extend levers in the opposite direction.

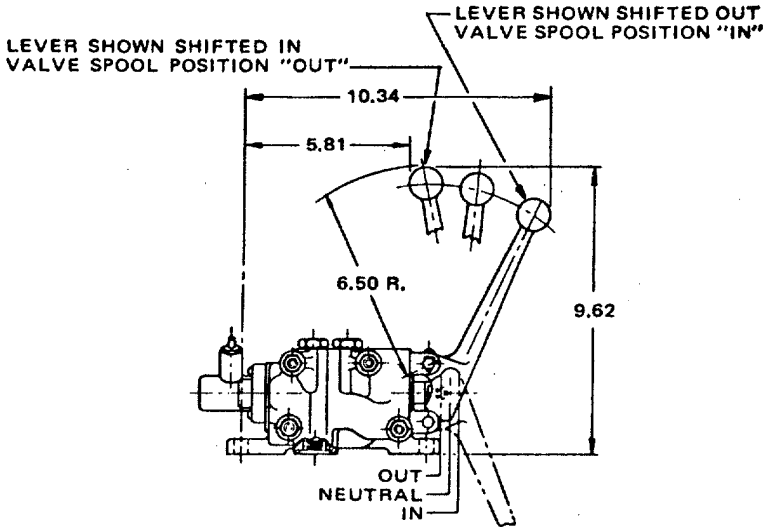
Hand operating lever assemblies are available for directional valve sections in groups of one to ten levers.

These lever groups include the necessary fulcrum rod, "E" washers, and clevis pins for assembly.

Specify in addition to valve assembly or section selected and indicate the number of levers required as in the following example:

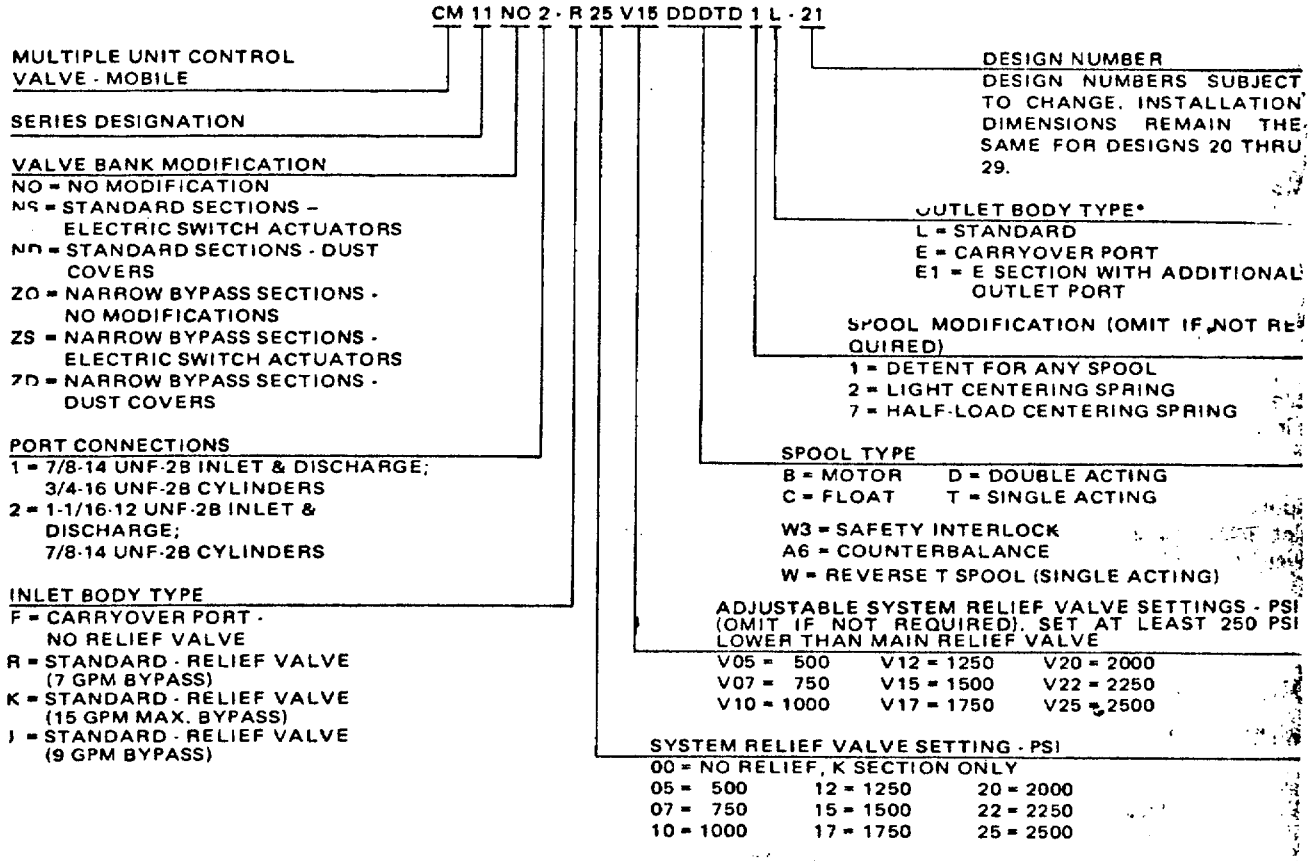
One (1) CM11NO1-R**DBTTWCL-21 Valve Assembly
One (1) CM11-H6-20 Hand Lever Assembly

NOTE: Number after the "H" denotes number of operating sections.



Model Code

SERIES CM11 ✓



*OUTLET BODY CONTAINS A SPOOL IN MULTI-SPOOL BANKS. OUTLET BODY CONTAINS NO SPOOL IN A SINGLE SPOOL VALVE; SPOOL IS IN INLET BODY.

CONSULT YOUR VICKERS REPRESENTATIVE REGARDING THE ORDERING OF OPTIONS UNLISTED IN THIS CODE.

Section X
HYDRAULIC VALVES AND EQUIPMENT

HYDRAULIC SELECTOR VALVE

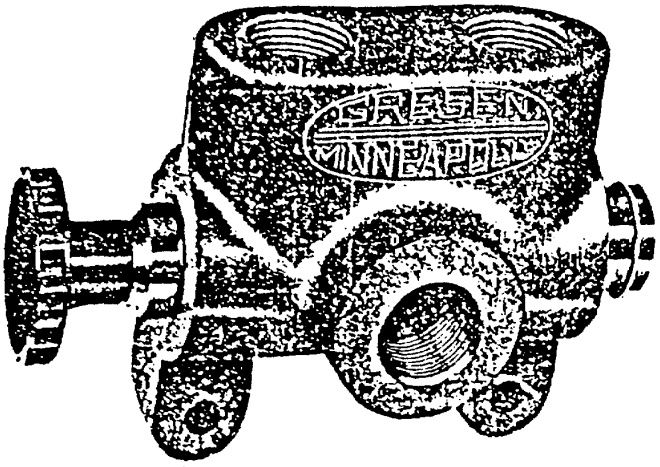
S SERIES

(Available in Three Sizes)

MODELS S-50 S-75 S100

Optional Models—S-50 R S-75 R S-100 R
W/Reverse Spool Assembly

This is a simple and inexpensive method of directing under pressure the flow of oil in your Hydraulic System to two separate hydraulic lines.



FEATURES

• • •

Cast Iron Body

• • •

Pressure Balanced Spool

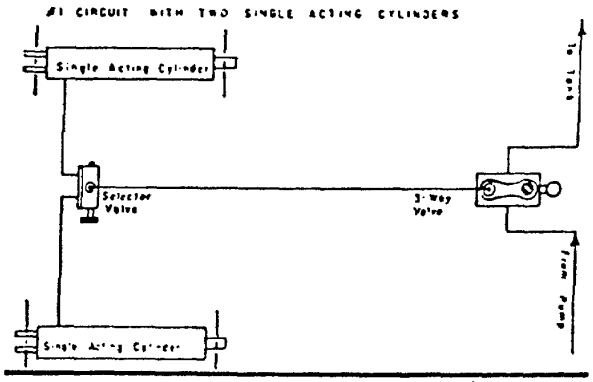
• • •

Easy to Mount

• • •

Chrome Plated Spool

The GRESEN S-Series Selector Valve is a two-way hydraulic selector. The addition of this selector to your Hydraulic System will enable you to operate two single acting cylinders with one three-way control valve.



SPECIFICATIONS			
MODELS	S-50	S-75	S-100
Pressure Range	0 to 2000 P.S.I.	0 to 2000 P.S.I.	0 to 2000 P.S.I.
All Openings	½" NPT	¾" NPT	1" NPT
Capacity	15 GPM @15FT/SEC	24 GPM @15FT/SEC	40 GPM @15FT/SEC
Ship Weight	2¾ Lbs.	5½ Lbs.	9½ Lbs.

See Dimentional Diagrams on Reverse Side

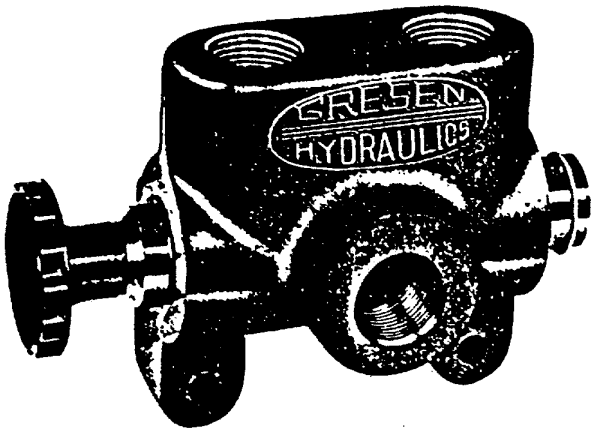
GRESEN MANUFACTURING COMPANY
405 - 35TH AVENUE N. E. MINNEAPOLIS 18, MINNESOTA

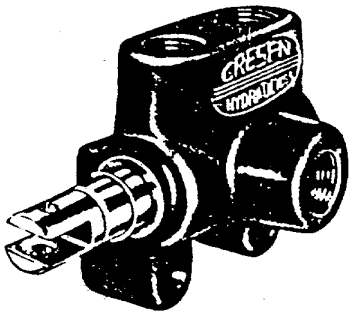
MANUFACTURERS OF
• HYDRAULIC COMPONENTS •
MOBILE - INDUSTRIAL
AGRICULTURAL

PRINTED IN U. S. A.
FORM 213 REV. 8/57

MODEL

S TWO-POSITION SELECTOR VALVES





WITH OPTIONAL CLEVIS ASSEMBLY

3 SIZES FROM WHICH TO CHOOSE

S-50 • S-75 • S-100

The Model S, Two-Position, Selector Valves offer a simple method of directing the flow of hydraulic oil to two separate hydraulic lines. The addition of these Selector Valves to the hydraulic circuit will permit operation of two single-acting cylinders with one three-way control valve. In some applications, two double-acting cylinders may be operated with one 4-way control valve.

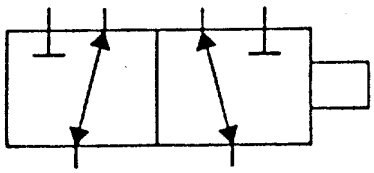
The hydraulic circuit which is to be operated should be selected before pressure is applied.

Valve Spool is of the open crossover type. As Spool is moved and one outlet port starts to close, the other outlet port starts to open.

Three sizes; 15 GPM [56 litres/min], 24 GPM [90 litres/min] and 40 GPM [151 litres/min] permit selection for any application.

FEATURES

- Pressure balanced Spool
- Easy to Mount
- Chrome Plated Spool
- High-Tensile Cast Iron Body

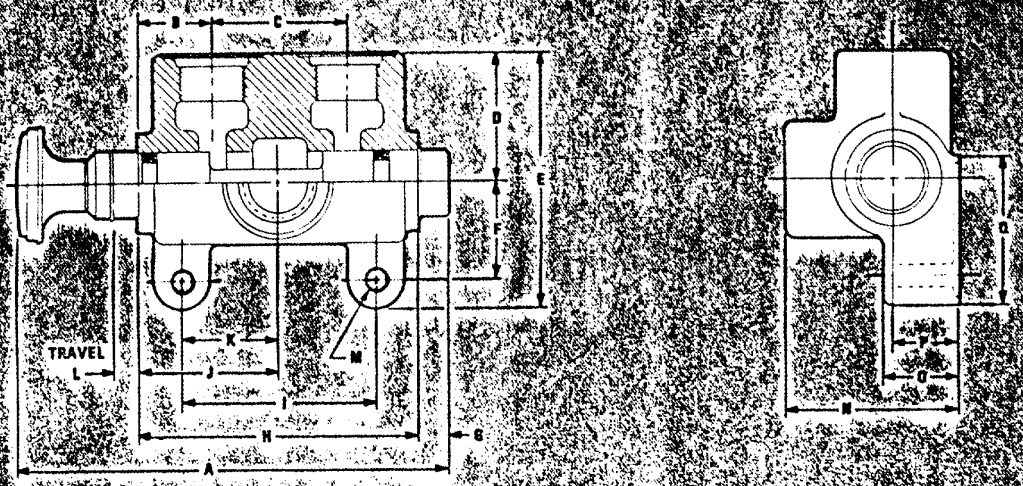


SPECIFICATIONS

	S-50	S-75	S-100
Capacity (nominal)	15 GPM [56 litres/min]	24 GPM [90 litres/min]	40 GPM [151 litres/min]
*Maximum Operating Pressure	2000 PSI [138 bar]	3000 PSI [207 bar]	3000 PSI [207 bar]
Shipping Weight	2-3/4 Pounds [1,3 kg]	5-1/2 Pounds [2,5 kg]	9-1/2 Pounds [4,3 kg]

DIMENSIONS

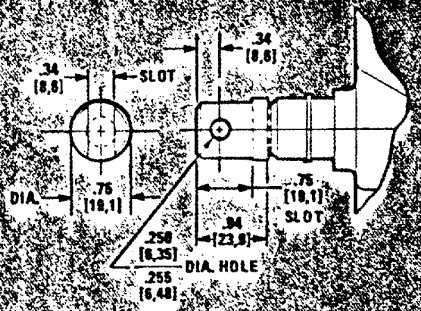
ALL DIMENSIONS ARE IN INCHES [MILLIMETRES] AND ARE FOR REFERENCE ONLY



MODEL	"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"	"I"	"J"	"K"	"L"	"M"	"N"	"O"	"P"	"Q"
S-50	5.69 [144,5]	.97 [24,6]	1.63 [41,4]	1,69 [42,9]	3.31 [84,1]	1.19 [30,2]	.25 [6,4]	3.56 [90,4]	2.13 [54,1]	1.78 [45,2]	1.06 [26,9]	.31 [7,9]	.31 [7,9]	2.63 [66,8]	1.13 [28,7]	1.00 [25,4]	2.00 [50,8]
S-75	6.56 [166,6]	1.13 [28,7]	2.13 [54,1]	2.00 [50,8]	3.94 [100,1]	1.50 [38,1]	.25 [6,4]	4.38 [111,3]	3.00 [76,2]	2.19 [55,6]	1.50 [38,1]	.38 [9,7]	.31 [7,9]	2.63 [66,8]	1.13 [28,7]	1.00 [25,4]	2.31 [58,7]
S-100	7.31 [185,7]	1.19 [30,2]	2.56 [65,0]	2.25 [57,2]	4.50 [114,3]	1.69 [42,9]	.25 [6,4]	4.94 [125,5]	3.44 [87,4]	2.47 [62,7]	1.72 [43,7]	.38 [9,7]	.38 [9,7]	3.50 [88,9]	1.38 [35,1]	1.25 [31,8]	2.88 [73,2]

OPTIONAL CLEVIS

An optional "clevis" assembly instead of a knob is available for Model S Selector Valves, specify part no. 1478-001.



ORDERING INSTRUCTIONS

MODEL NO. S - 50 - R

PORT SIZES (ALL PORTS)	
S-50 Model	
50	1/2" – 14 NPT
8	SAE 8 (3/4" – 16 UNF)
10	SAE 10 (7/8" – 14 UNF)
51	1/2" – 14 BSP
S-75 Model	
75	3/4" – 14 NPT
12	SAE 12 (1-1/16" – 12 UN)
71	3/4" – 14 BSP
S-100 Model	
100	1" – 11-1/2 NPT
16	SAE 16 (1-1/16" – 12 UN)
101	1" – 11 BSP

NOTE: NPT pipe ports are not recommended for pressures above 2000 PSI [138 bar].

–	Control Knob and Spool Assembly Standard as Shown.
R	Control Knob and Spool Assembly Reversed From That Shown.

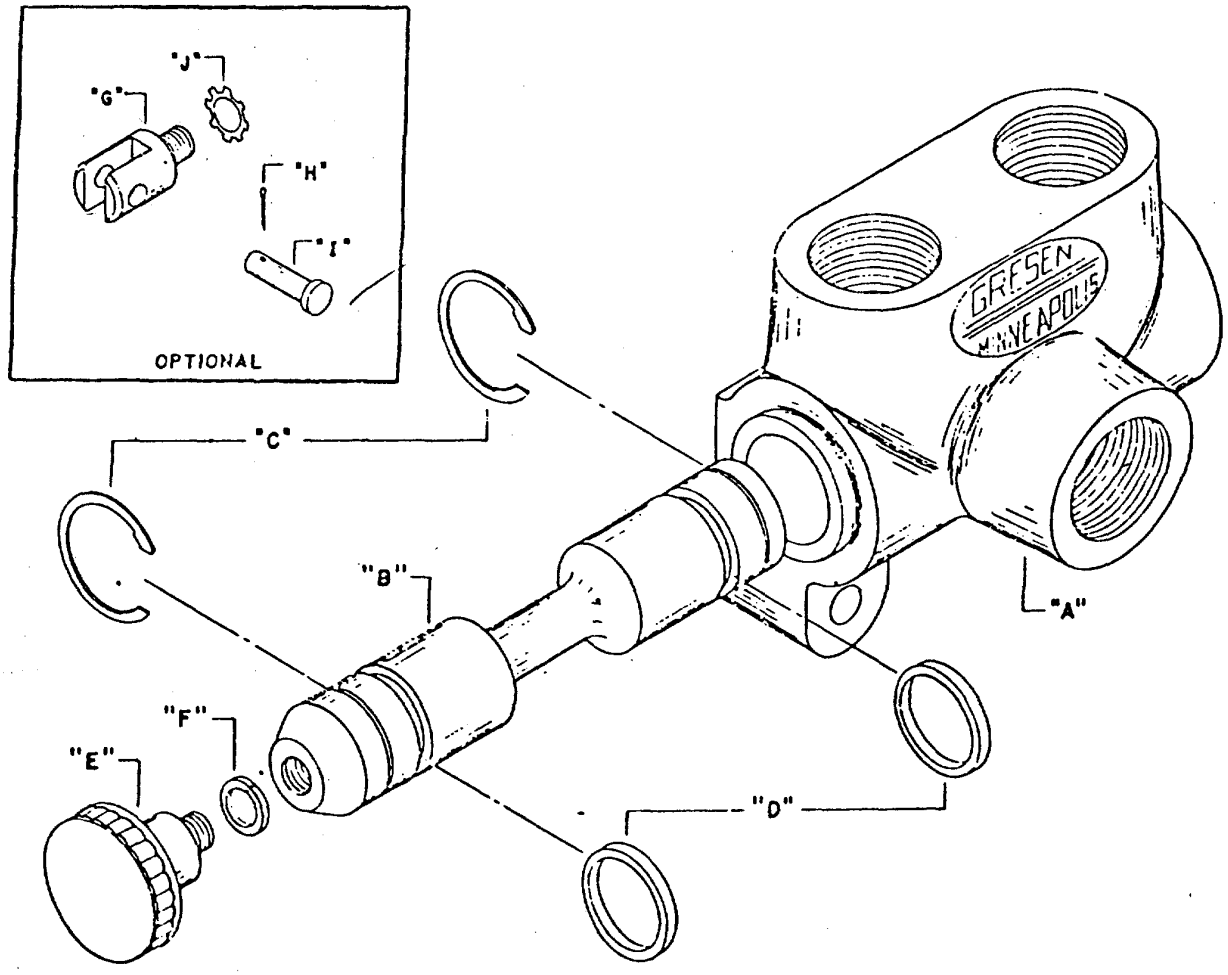
Control Knob is standard
Clevis is optional. Specify: With Clevis, part no. 1478-001
If neither Control Knob nor Clevis is desired, Specify: Less Control Knob and Clevis.

SELECTOR VALVE
MODELS S-50 - S-75 - S-100
PARTS LIST

Ref. Letter	No. Req'd	Description	S-50 Part No.	S-75 Part No.	S-100 Part No.
A	1	Valve Housing	*1140	*1120	*1310
B	1	Valve Spool	*1139	*1130	*1311
C	2	Snap Ring	602	1127	1312
D	2	Quad Ring Seal	1136	1129	1313
E	1	Control Knob	081	081	081
F	1	Lock Washer	1291	1291	1291
G	Opt.	Handle Adapter	1478	1478	1478
H	Opt.	Cotter Pin	086	086	086
I	Opt.	Handle Pin	085	085	085
J	Opt.	Lock Washer	603	603	603

* Not sold as separate items. Spools are factory honed to individual housing and are not interchangeable. Repair service available at factory.

(See seal replacement instructions on reverse side)



GRESEN MANUFACTURING COMPANY
405 - 35TH AVENUE N. E. MINNEAPOLIS 18, MINNESOTA
MANUFACTURERS OF
• HYDRAULIC COMPONENTS
MOBILE • INDUSTRIAL
AGRICULTURAL

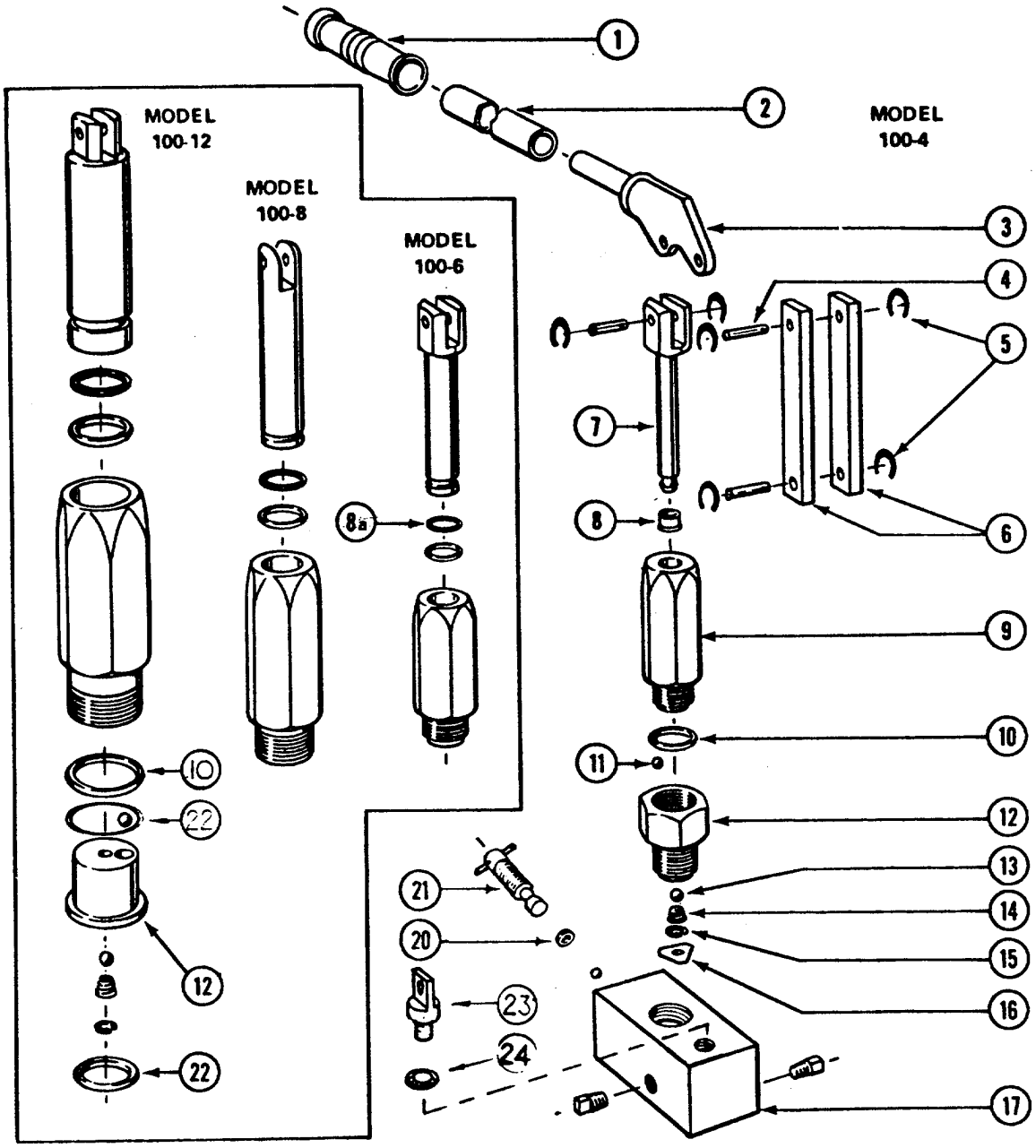
Modular Hand Pumps

Single Piston

PARTS LIST AND DATA SHEET

Models:

100-3, 100-4, 100-6, 100-8, 100-12



TR ENGINEERING INCORPORATED
201 Lost Lake Lane, Campbell, CA 95008
Telephone 408/370-0258

PARTS LIST

ITEM	QTY	DESCRIPTION	PARTS NUMBERS				
			MODEL 100-3	MODEL 100-4	MODEL 100-6	MODEL 100-8	MODEL 100-12
1	1	HAND GRIP	100-8-0	100-8-0	100-8-0	100-8-0	100-8-0
1	1	HANDLE	100-2-0	100-2-0	100-2-0	100-2-0	100-2-0
3	1	LEVER	100-1-0	100-1-0	100-1-0	100-1-0	100-1-0
4	3	PIN	100-13-0	100-13-0	100-13-0	100-13-0	100-13-0
5*	6	RETAINING PIN	100-27-0	100-27-0	100-27-0	100-27-0	100-27-0
6	2	LINK	100-15-4	100-15-4	100-15-4	100-15-12	100-15-12
7	1	PISTON	100-14-3	100-14-4	100-14-6	100-14-8	100-14-12
8*	1**	SEAL,PISTON	100-10-3	100-10-4	100-10-6	100-10-8	100-10-12
8a*	1	BACK-UP RING	--	--	100-11-6	100-11-8	100-11-12
9	1	BARREL	100-9-3	100-9-4	100-9-6	100-9-8	100-9-12
10*	1	SEAL,BARREL	100-12-4	100-12-4	100-12-4	100-12-8	100-12-12
11*	1	CHECK BALL	100-19-4	100-19-4	100-19-4	100-19-4	100-19-12
12	1	VALVE BLOCK	100-24-3	100-24-4	100-24-4	100-24-8	100-24-12
13*	1	CHECK BALL	100-21-4	100-21-4	100-21-4	100-21-4	100-21-12
14*	1	SPRING	100-23-4	100-23-4	100-23-4	100-23-4	100-23-12
15*	1	SNAP RING	100-22-4	100-22-4	100-22-4	100-22-4	100-22-12
16*	1	WASHER	100-17-4	100-17-4	100-17-4	100-17-4	--
17	1	BLOCK,ASSY	100-3-4	100-3-4	100-3-4	100-3-8	100-3-12
18*	1	RELEASE BALL	100-18-0	100-18-0	100-18-0	100-18-0	100-18-0
19	1	SEAL,VALVE BLOCK	--	--	--	--	100-42-12
20*	1	SEAL, REL. SCREW	100-6-0	100-6-0	100-6-0	100-6-0	100-6-0
21	1	REL.SCREW	100-5-0	100-5-0	100-5-0	100-5-0	100-5-0
22	1	SEAL,VALVE BLOCK	--	--	--	--	100-26-12
23	1	LUG	100-36-0	100-36-0	100-36-0	100-36-0	100-36-0
24	1	WASHER,LOCK	100-37-0	100-37-0	100-37-0	100-37-0	100-37-0
		REPAIR KIT	100-3-200	100-4-200	100-6-200	100-8-200	100-12-200

* ITEM CONTAINED IN REPAIR KIT
** -3 REQUIRES 2 100-10-3 SEALS

NOTE: When ordering pumps or repair kits with Viton or EPR Seal, Add, -V or -EPR suffix to Part Number.

WARRANTY

TR Engineering, Inc. warranties its products for a period of 90 days from date of shipment against defects in material and workmanship; providing equipment is operated for its intended use, and proper hydraulic fluid (Mil-H-5606) is used. Excluded are: seals and normal wear.

WARRANTY RETURN

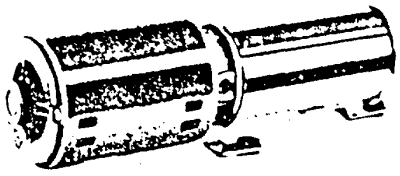
Should a warranty claim arise, the user should return his unit to the nearest repair station prepaid for inspection, along with proof of purchase date. If claim comes under warranty policy, repair station will repair or replace and return prepaid.

Dura-Hypac Systems

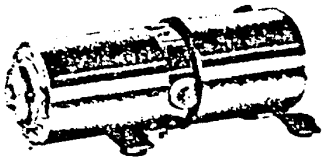
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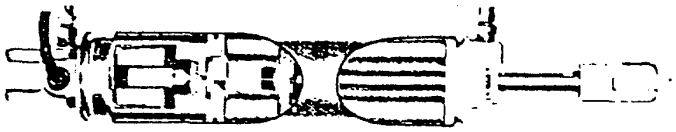
HYDRAULIC VALVES AND EQUIPMENT



115 VOLT, 60 Hz. &
220 VOLT, 50 Hz.
MOTOR/PUMP UNITS
PAGE 4



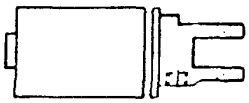
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EXTERNAL
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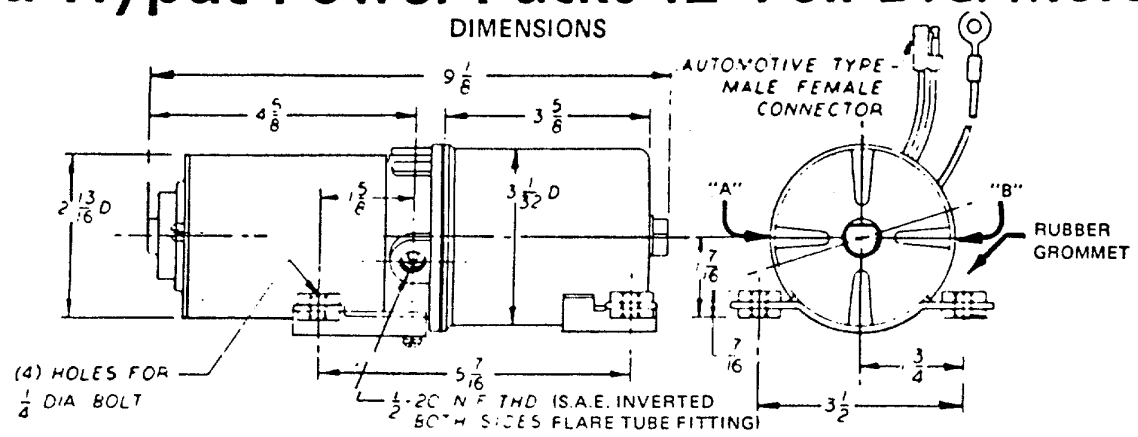
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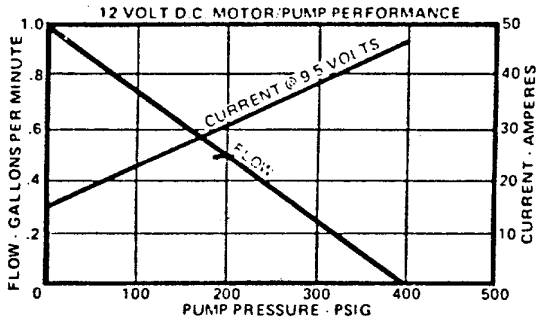
Dura-Hypac Power Packs-12 Volt D.C. Motor

DIMENSIONS



Wiring Legend: Red & Black Leads To Line Pressure At Port "B"
Yellow & Black Leads To Line Pressure At Port "A"

Part No. 2017922-19 Cu. In. Reservoir (As Shown Above)
Part No. 2017918-25 Cu. In. Reservoir (Dimensions on Request)



GENERAL SPECIFICATIONS

12 volt, direct current, 1/3 H.P. instant reversible motor for intermittent duty.

Aluminum die cast pump body and pump cover plate connects integral to motor stator shell with pump body serving as lower end shield of motor. Positive displacement "G" rotor design with zinc plated reservoir.

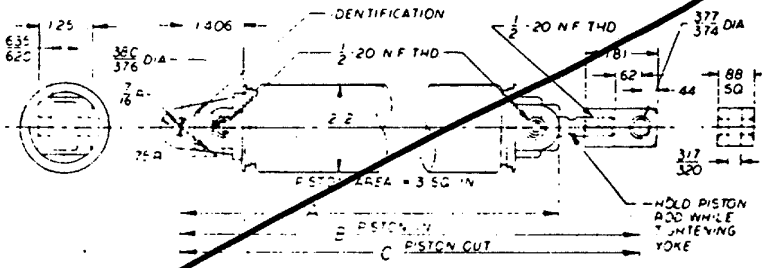
For horizontal - feet down - or vertical - reservoir up installation.

Dura-Hypac Double Acting Cylinders

*STANDARD CYLINDERS WITH 115 V. OR 220 V. SOLENOID VALVES			
STROKE	DIMENSIONS – INCHES		
	A	B	C
3 7/8	10.34	13.12	17.00
4 7/8	11.34	13.12	18.00
4 7/8	11.34	16.37	21.25
6 1/2	12.96	14.74	21.24
10	16.46	19.18	29.18

*Specify lead length & 115V.60Hz. or 220V.50Hz.

STANDARD CYLINDERS WITHOUT SOLENOID VALVES			
STROKE	DIMENSIONS – INCHES		
	A	B	C
1 3/4	5.43	7.50	9.24
4	7.68	11.98	15.97
6 1/8	9.81	11.63	17.75
6 21/32	10.34	11.98	18.63
7.65	11.34	13.36	21.01
10	13.68	16.42	26.42



GENERAL SPECIFICATIONS:

Dura Cylinders are double acting type available up to ten inch maximum stroke with three sq. in. piston area end are suitable for 600 p.s.i. working pressure. Aluminum tubing, die cast and fittings with one half inch dia. chrome plated steel rod and clevis. Equipped with self-aligning Molythane piston rod seal.

Internal solenoid valve types (115 V. 60 Hz. & 220 V. 50 Hz. only) are for applications that require holding a sustained load (reacting against rod extension) when motor/pump unit is stopped.

Cylinders without internal solenoid valves are for applications that do not require holding of sustained load in either direction or where external solenoid valves are required.

Solenoid valves are available (see accessories) for installation in plumbing circuit as required.

Clevis pins available if required. (see accessories)

SPERRY VICKERS
POWER AND MOTION
CONTROL SYSTEMS

HYDRAULIC SYSTEM START UP AND MAINTENANCE MANUAL

SPERRY VICKERS IS A DIVISION OF SPERRY INC.

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INTRODUCTION

Quality. A difficult word to define. For most users of hydraulic power units, Quality means durability and reliability, combined with reasonable initial and operating costs. For decades, Sperry Vickers has been the leading supplier of quality hydraulic equipment. Constant research into materials, manufacturing methods and operating environments helps Sperry Vickers to maintain its world-wide position as the Quality hydraulic manufacturer.

To take full advantage of the performance, reliability and other quality benefits built into your hydraulic installation, read this manual thoroughly and follow the instructions carefully. A satisfactory environment for the class of equipment discussed here is the average enclosed workshop, heated during winter and ventilated during summer, so that the temperature range is from about 59 degrees F (16 degrees C) to 85 degrees F (30 degrees C).

We recommend that you consult our Service Department for advice if your operating conditions are unusual. Very high or low temperatures, extreme humidity or a dust-laden atmosphere may require modified operating procedures.

INSTALLATION

Carry out the installation according to the approved piping diagram, paying particular attention to the pipe work. The piping must not transmit mechanical stress or vibration to components or to the power unit; it must be securely supported to avoid vibration or movement, and should present an attractive appearance. Use soft tubing (up to $1^{1/4}$ inches diameter) which can be bent cold in a bending machine. Choose good quality fittings and hoses. Please remember that fittings are assembly elements, not pipe hangers.

All piping should be pickled. If you use threaded fittings, the pipes can be pre-pickled and oiled. When piping is welded, pickling should follow welding. See Sperry Vickers Drawing 1221-S.

Install flexible hoses according to the specifications on the diagram. The hoses cannot stand sharp bends or torque. For this reason, check the bending radius to make sure that it is large enough, and that the hose is long enough to move freely. To select the bending radius, use the table on page 2.

Outside Diameter in inches	under 1	1 to 1 1/2	1 1/2 to 2	2 & over
Least bending radius	6 x D	7 x D	8 x D	9 x D

Sperry Vickers guarantees that the delivered components and actuators have been cleaned and are free from dirt and scale. Before the power unit and (when applicable) valve panel are connected to the rest of the system, examine the piping between the power unit and the actuators, to be sure that it is absolutely clean. The care we have exercised will be meaningless if contaminants are introduced into the system during installation.

Please make sure that no damage has occurred during transportation to your site. Check to make sure that covers, dust caps, air filters and the like, which may have been removed during the installation, are replaced and secured, before proceeding with the initial start-up.

INITIAL START-UP

ELECTRICAL EQUIPMENT

Check that the supply voltage and frequency are correct for the electro-hydraulic components and motors supplied.

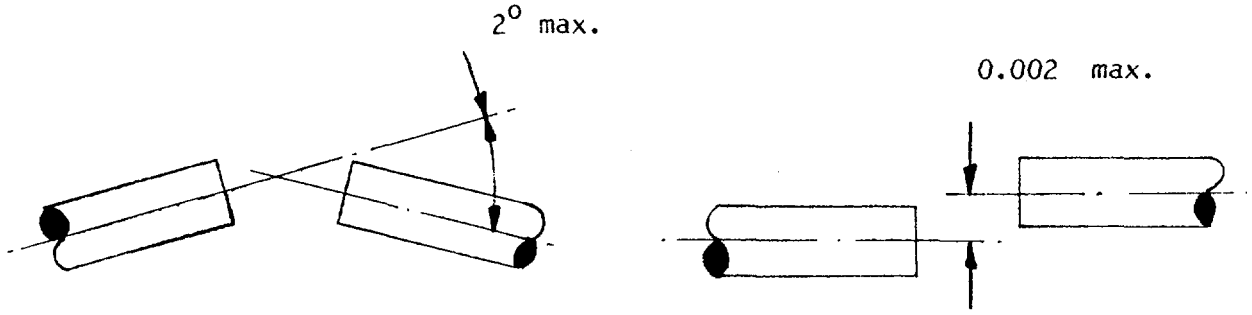
ALIGNMENT

Check the mechanical alignment of all pumps, motors, cylinders and other moving components. The electric motor and hydraulic pump were carefully aligned at the factory, but they may have become mis-aligned by shock during transportation or by being mounted on an uneven foundation. Check as follows:

Angular alignment - measure points 90° apart with a taper gauge or inside calipers.

Parallel alignment - measure points 90° apart with a straight-edge.

Correct mis-alignment by shimming either the driving or the driven unit.
The best maintenance practice calls for frequent alignment checks.



Flexible coupling

Careful alignment extends the life of rotating parts. The values shown should be regarded as extremes; the alignment should be as close to zero tolerance as possible

ACCUMIULATORS

Accumulators should be pre-filled with Nitrogen (N2) on the gas side. Fill until the pre-fill pressure shown on the circuit-diagram is obtained, and check at regular intervals that the pressure has not fallen. An accumulator will not work satisfactorily if the fill pressure is incorrect.

WARNING:

Systems incorporating an accumulator will operate after the electrical supply to the equipment has been disconnected. Do not attempt to inspect or service a system with an accumulator without first draining the fluid from the accumulator.

FILLING WITH FLUID

We recommend that you use a transfer unit which incorporates a fluid filter. Sperry Vickers PortaFilter is an example of this type of unit. Fill the system with all cylinders in the retracted position. The fluid level may fall due to trapped air bleeding from the system; refill to the normal level. Standard fluid reservoirs contain the correct (nominal) system volume at the upper fluid level. The maximum fluid volume which can be removed is 35% of the nominal J volume. See Sperry Vickers drawing I-286-S1.

PUMP SHAFT ROTATION DIRECTION

Check that the direction of rotation corresponds to the direction arrow on the pump. The arrow should correspond to the pump specification. For Sperry Vickers pumps, the standard is right-turn (clockwise), as seen from the shaft end. Left-turn is usually indicated by L or LH added to the Model Code number.

STARTING AND VENTING

Different types of Sperry Vickers pumps require different methods of starting. With the angle-type axial piston pumps (types PF, PV, PFA and PVA), we recommend that you contact our Service Department for assistance with the starting procedure; alternatively, you may make use of one of our Courses for Servicemen.

An incorrect start-up procedure may damage or destroy the pump in a few seconds.
Please follow these instructions.

VANE PUMPS

The Round Vane Pumps are designed to start up UNDER LOAD and should be started up against moderate pressure.

All other vane pumps, the Square or Intra Vane Pumps, are designed to start UNLOADED. It is important that new pumps are started with the pressure line unloaded so that air can be expelled from the system, otherwise the pump may not prime and will be destroyed by lack of lubrication. Check that the directional valves are in a position such that the pump is unloaded. If the pump is to start with a valve in the blocked centre position, a loaded accumulator or a closed check valve, the pressure line should incorporate an automatic air bleed valve, Type ABT. If such a valve is not supplied, a fitting close to the pressure side of the pump should be loosened and should not be tightened until a constant clear flow of fluid runs out. Start the electric motor and let it run a number of revolutions without reaching full speed. If the pump does not prime immediately, stop the motor. Repeat at 10 second intervals until the pump has primed. If the pump does not prime, fill with clean fluid. Operate all cylinders and motors one by one and vent where necessary. Watch the fluid level in the reservoir, and if necessary, add fluid to maintain the correct level. Before a hydraulic system is used, all air must be expelled from the system. Air in the system makes pressure setting difficult, or impossible. In small systems, venting can usually be accomplished by operating the cylinders once or twice over their full travel, with a pause of 2 to 3 seconds under maximum pressure at the stroke extremes.

PISTON PUMPS

Fill the housing with fluid BEFORE starting a piston pump. Remove the fitting screwed into the drain connection on the top of the pump, fill the pump casing J and replace the fitting. Variable displacement pumps should be set at NOT LESS THAN HALF of the maximum pump displacement. Start the pump UNILOADED as discussed under Vane Pumps.

Pumps incorporating a booster pump usually require a special start-up procedure, which will vary with the pump and its application. Please follow the special instructions supplied with the system.

FILTERS AND STRAINERS

Clean filters and strainers frequently during the initial operating period. If you have a Sperry Vickers filling and filtering unit (PortaFilter), we recommend that you use it as a continuous filter for the first week of system operation.

TEMPERATURE

After the system has been running for 6 to 8 hours under normal working conditions, check that bearings, sealing glands, fluid, electric motors and solenoids are not overheated.

Energy conversion losses in a hydraulic system will heat the fluid; it is normal for a system to run warm. The fluid is not overheated until the fluid temperature exceeds 150 degrees F (65 degrees C). Hydraulic systems may, however, be designed for higher operating temperatures.

PRESSURE SETTING.

The pressure in the system is adjusted by the relief valve or other pressure limiting device. The pressure must never exceed the maximum pressure indicated on the piping diagram. When setting the pressure by means of a pilot operated relief valve, adjust the pressure a little higher than the necessary working pressure of the system. For instance, if 1 300 psi is required to do the work, the relief valve should be adjusted to between 1 500 and 1 600 psi. If the valve is set at

a higher pressure, the system may be exposed to higher pressure than necessary, with the risk of shorter life. On the other hand, the relief valve setting should never be the same as the working pressure; the result will be loss of efficiency with excess fluid heating. When the pressure has been set, we recommend that you seal the adjustment screws, to prevent unauthorized persons from tampering with the system.

ROUTINE SERVICE

The following items should be checked at intervals of 7 days or longer if experience shows a longer interval to be practicable.

FLUID LEVEL

Experience with the system will establish the maximum safe interval between fluid level checks. If appreciable fluid loss occurs, the cause should be found as soon as possible. Lost mineral oil can be replaced by adding oil. Some types of fire- resistant hydraulic fluid may pose a serious health hazard under some circumstances. If you are using a fire-resistant fluid, consult your fluid supplier for advice on replenishing or disposal, and on special ventilation which may be required in the event of a serious leak. Any type of fluid which becomes contaminated MUST be changed IMMEDIATELY.

ALIGNMENT

Pumps, motors, valves and cylinders should be checked at working temperature, and where possible, at working pressure.

ACCUMULATORS

Measure the N2 (Nitrogen) pre-charge pressure. Discharge all hydraulic fluid from the accumulator before making the measurement.

PIPE WORK

Check all pipes, couplings and connections for signs of leaks. Replace defective parts, adjust joints and brackets where necessary. Extra pipe hangers should be installed if necessary.

PERFORMANCE

Check the system performance and general condition. Inspect strainers, filters, relief valve locks, tank cover and solenoid cover. Check fluid temperature and pressure, and listen for unusual sounds. Usually, pressure gauge isolation valves should be closed during normal operation.

PERIODIC MAINTENANCE

Hydraulic components, like all moving machinery, are subject to wear and after some time in operation they should be overhauled. The time between overhauls will vary from 1 to 5 years, depending upon the type of system and local operating conditions, but both shorter and longer periods are possible.

The fluid should be checked for deterioration and contamination, and changed if necessary. A dark coloured, cloudy fluid bearing suspended contaminants should be changed. The life of a good hydraulic fluid should range from 5 000 hours to 25 000 operating hours. Hydraulic fluid producers will sample the fluid, give data on contamination and recommend possible action. Clean the air and oil filters, magnetic traps and, when necessary, clean the reservoir, pipes, pumps and valves. Take care that no dirt enters the system during overhaul. Packing and damaged or worn parts should be replaced where necessary. Inspect the pipe hangers and fittings and replace if necessary.

Whenever it is practicable to do so, use spare parts to make major repairs. The original parts can be returned to Sperry Vickers or to one of our Authorized Distributors for repair or re-manufacture.

To derive the maximum benefit from both planned and unplanned maintenance, it is essential to keep an accurate history of repairs, additions to or alterations of the equipment, and observations by operating and maintenance personnel. Records should include, but not be limited to:

A description of any signs of trouble with the equipment.

A description of the preliminary investigation and findings.

An explanation of corrective action taken, replacement parts required and duration of down-time.

Fundamental to any records system, of course, is that each note, observation or comment must be dated! If the machine record is analyzed regularly, certain trends will become evident and the utilization time of the equipment can be planned to include anticipated service and adjustments. External factors peculiar to each installation exert considerable influence on the type of maintenance operations which will be necessary, and on the frequency with which they should be performed. If, however, it should be necessary to call for service assistance, save time and money by preparing for the visit: CLEAN THE MACHINE THOROUGHLY. Have piping diagrams, spare parts, special tools and clean cloths ready. Remove equipment screens and covers. Have the maintenance report ready and have an experienced man available to assist our service representative.

TROUBLE-SHOOTING CHART

A hydraulic system which is correctly designed, installed, started and maintained, will be trouble-free and will have a long service life. It is only reasonable, therefore, to take advantage of the benefits inherent in the equipment and institute a planned maintenance programme to avoid breakdowns. If, however, a problem should occur, it is a definite advantage to be able to locate the cause and correct it quickly. Most problems will have an obvious cause and, therefore, an obvious cure. When there is an elusive problem with the system, refer to the circuit diagram and use the following trouble-shooting guide to help to pinpoint both cause and cure.

Sperry Vickers has many years of experience in hydraulic system service and maintenance. Our Service Department will respond to your request for assistance by placing our years of accumulated expertise at your disposal.

A GENERAL RULE

A pump generates fluid flow. Pressure is the result of resistance to flow. If there is no pressure in the system, find out where the fluid is going. If actuators don't move, or move slowly, the fluid must be by-passing them. Trace it, if necessary by disconnecting lines. Start with the connection closest to the pump and work out. Zero or reduced flow in a system at a connection close to the output side of the pump indicates that the pump or pump drive is defective.

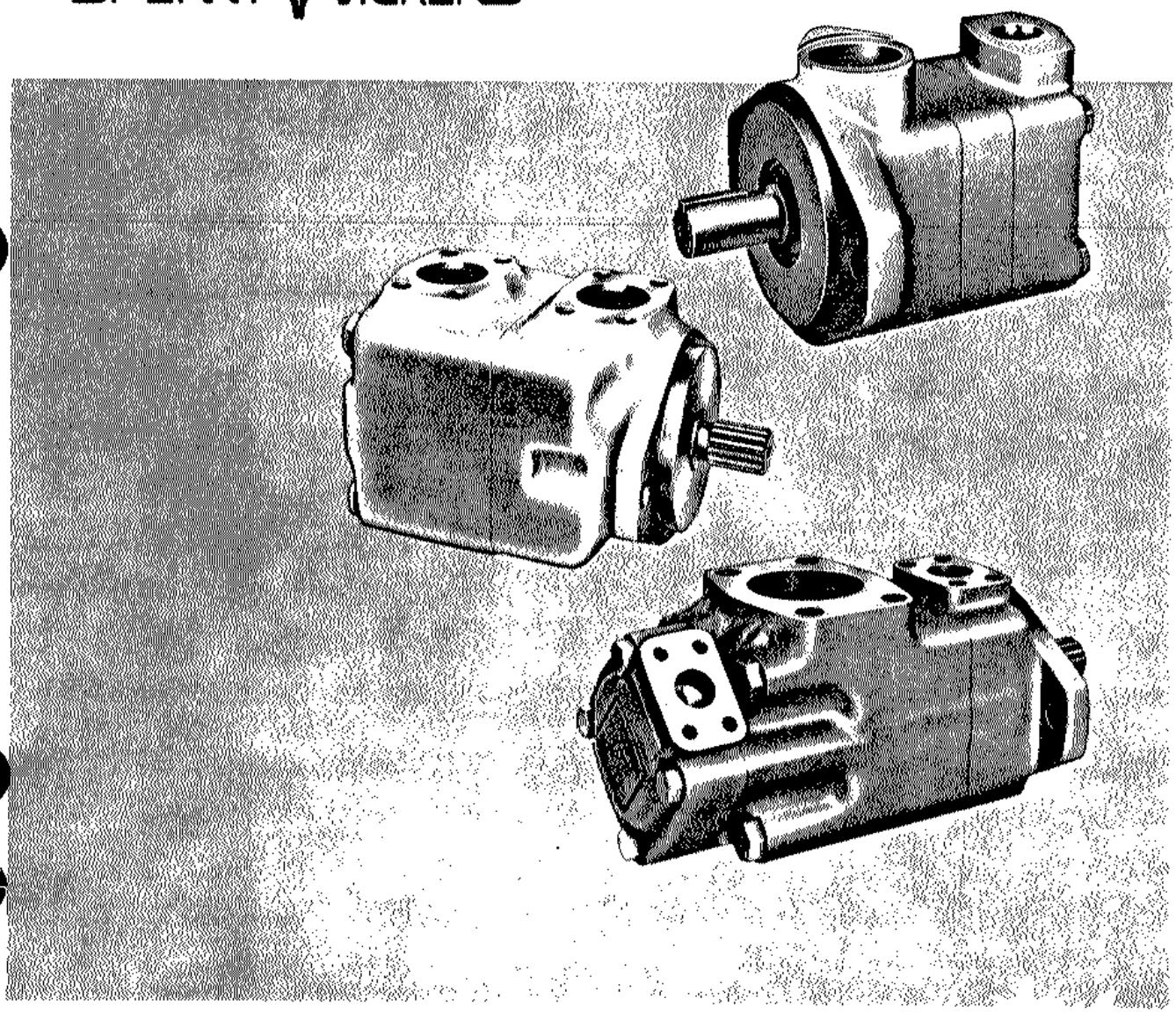
INDICATION	POSSIBLE CAUSE	CHECK FOR
Noisy Pump	Cavitation	Inlet strainer or piping obstructed
		Fluid viscosity too high
		Operating temperature too low
		Worn vanes or ring, sticking vanes
		Worn or damaged gears or housing
		Shaft mis-aligned
		Worn or faulty bearings
	Aeration	Low fluid level
		Loose or damaged intake pipe
		Worn or damaged shaft seal
		Return lines above reservoir fluid level
Low or erratic pressure	Contaminants	Gross contaminants in fluid
		Dirt or chip(s) jammed in valve
	Adjustments	Pressure control setting too low
Actuator won't move	Faulty pump	
	Directional control not shifting	Electrical components failure - solenoid, limit switch.
		Insufficient pilot pressure
		Interlock device not actuated
		Mechanical interference
		Low operating pressure
		Worn or damaged cylinder or hydraulic motor
Slow or erratic operation	Fluid viscosity too high	
	Pump drive speed too slow	
	Air entrained or trapped in system	Worn pump shaft seals
		Internal leaks through actuators, valving
		Low fluid level
Erratic Feed Rates	Mechanical interference	Sticking, warping, or binding
		Air in fluid
		Faulty or dirty flow control valves
System overheats	Heat exchanger inoperative	Shutters, dampers, water supply, valves
	Continuous operation at relief setting	Load too high
		Setting Too low
		Fluid viscosity too high
	Excessive slippage or internal leakage	Fluid viscosity too low, check stall leakage past motors and cylinders

Section XII

vane pumps and motors

For Mobile Equipment

SPERRY VICKERS



high speed–high pressure pumps

Design Features. Fluid flow is developed in a new pump cartridge which consists principally of a cam ring, rotor, ten vanes, and unique new side plates and support plates. The bimetallic flexible side plates are located on each side of the rotor with their bronze face toward the rotor and their steel face toward the support plate to provide low-friction rotating surfaces. Two cavities in each support plate hold high pressure oil against the flexible side plate, thereby hydrostatically balancing the flexible plate and providing optimum clearance with the rotor.

Hydraulically Balanced For Long Life. Inlet and outlet ports are diametrically opposed as shown in Figure 1. As a result, the rotor is hydraulically balanced. Bearings thus encounter no hydraulic loads, assuring long life.

Figure 1

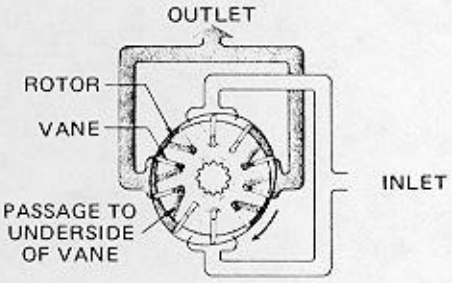


Figure 2

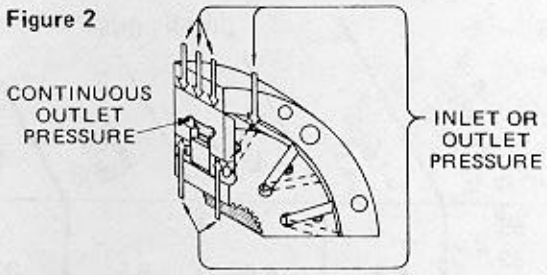
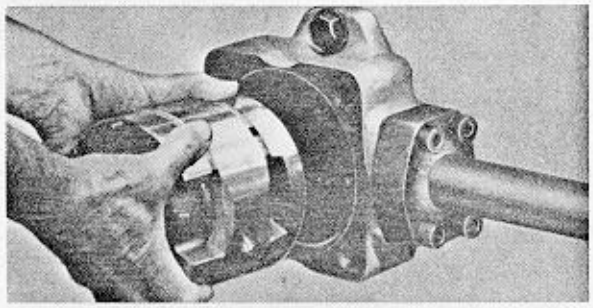


Figure 2 shows an insert fitted into a slot in the vane. Outlet pressure is applied continuously only to the space between the vane and insert. Top and bottom areas of the vane are subject to either inlet or outlet pressure, depending upon the vane's location during rotor rotation. See Figure 1. Complete hydraulic balance is effected in the outlet pressure areas. Outward thrust by the vane in the inlet area is equal to the outlet pressure times the projected area of the end of the insert.

More Reliable and Efficient. Axial and radial running clearances, along with lubricating oil film on the rotor and vanes, are optimized over the entire operating pressure range. Excellent cold-start capability and superior resistance to seizure make Sperry Vickers' new pumps highly reliable, and volumetric efficiency is 2 to 4% greater compared to the previous design. For a combination of maximum horsepower in a small package, high efficiency, serviceability and economy, Sperry Vickers' new "high output" pumps are unequalled.

Easily Interchanges With Previous Design. The new cartridge or pump is totally interchangeable with the previous design and can be used with petroleum oil or water glycol fluids. The cartridge is easy to service and can normally be replaced in ten minutes or less without removing the pump from its mounting. A small stock of cartridges can serve many pump models on a variety of vehicles.



Optimum Installation Flexibility. Pumps can be ordered with ports located in any of several positions to facilitate installation. Should installation requirements change, the ports can be easily repositioned.

Double Pumps. Double pumps provide a single power source capable of serving two separate hydraulic circuits or of providing greater volume through combined delivery. Two pumps in a single housing with a common inlet connection and common drive shaft result in a more compact and simple installation.

Double pumps are available with an optional flow control/relief valve. The flow control/relief valve is located in the pump's cover and is operative in the cover-end pump circuit. The volume delivered from the cover-end pump is limited by the flow control valve with excess flow diverted to the tank port. Pressure protection of the cover-end pump circuit is provided by the integral relief valve. Operating pressure of the shaft-end pump must be controlled by a separate relief valve.

low cost–high performance pumps

Versatile. High flow, pressure and speed capabilities meet the needs of modern vehicle hydraulic circuits.

Optional flow control and priority valve covers offer even more versatility.

Flow Control. The flow control cover limits flow to the operating system to the desired maximum. Excess flow is diverted to tank. On double pumps, shaft-end pump delivery is proportional to speed.

The flow control cover also includes a relief valve to limit maximum system pressure.

A typical use of the flow control is in power steering applications where it provides an essentially constant supply of oil over the useful engine speed range.

Priority Valve. The priority valve cover maintains nearly a constant flow to a primary circuit and diverts remaining flow to a secondary circuit. Flow going to the secondary circuit is determined by pump delivery. The primary circuit is protected by an integral relief valve. An external relief valve must be provided for the secondary circuit.

On double pumps, shaft-end pump delivery is proportional to speed.

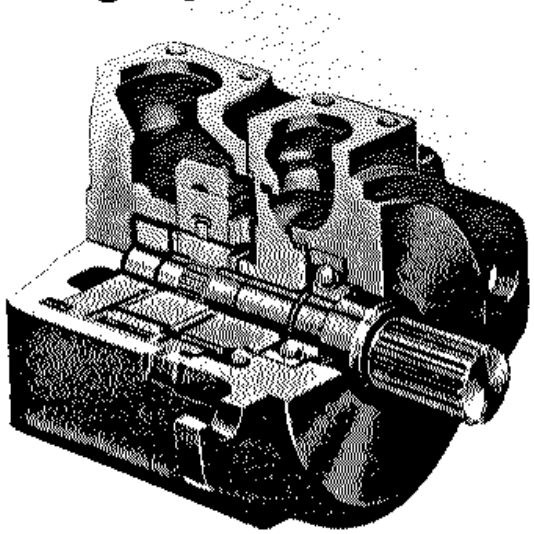
Reliable. The superior design of these units makes them last longer . . . they've proven they'll hold up in rugged applications such as trenchers, backhoes and tractors.

Performance. Low vane-tip/ring loading allows high-pressure operation. High speeds are possible because inlet flow paths give uniform oil acceleration–thus better filling–particularly at low inlet pressures.

Low Cost. Sperry Vickers' efficient design produces extra horsepower per dollar of pump investment–providing industry with low pump cost per horsepower capacity.

high speed–high pressure single pumps

- 11 flow ratings to choose from
- Maximum flows to 96 GPM
- Maximum speeds to 2700 RPM
- Maximum pressures to 3000 PSI
- High horsepower per cubic inch of installed space
- Ten-minute cartridge replacement
- Choice of mounting and port connections

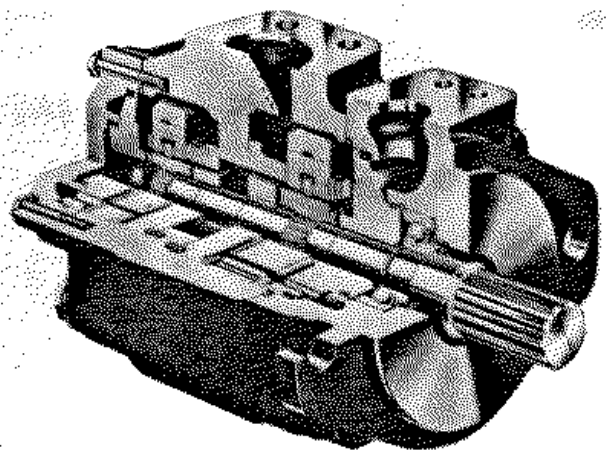


Model Series	Delivery (gpm) at 1200 rpm 100 psi	Max. rpm	Max. psi	Typical Del. (gpm) at Max. Speed & Pressure	Typical Input hp at Max. Speed & Pressure	DIMENSIONS * Length inches	Width inches	Height inches	Weight lbs.
25VQ	12	2700	3000	23	55	6.4	4.6	5.5	32
	14	2700		27	62.5				
	17	2500		31	69.5				
	21	2500		38	83				
35VQ	25	2500	3000	45	101	7.3	5.5	6.0	50
	30	2500		55	117.5				
	35	2400		60	132				
	38	2400		65	140				
45VQ	42	2200	2500	66.5	122.5	8.5	6.3	6.9	75
	50			79	141				
	60			96	170				

Performance Constants: SAE 10W Fluid @ 180°F.
Pump Inlet @ 0 PSIG (14.7 PSIA)

* From face of mounting flange to end of pump cover.

high speed–high pressure
double pumps



- Two separate flow sources
- 95 flow combinations to choose from
- Maximum flows 11 to 59 GPM on cover end pump
- Maximum flows 23 to 96 GPM on shaft end pump
- Maximum speeds to 2700 RPM
- Maximum pressures to 3000 PSI
- Foot or flange mounting
- Choice of port connections and location
- Ten-minute cartridge replacement
- High horsepower per cubic inch of installed space

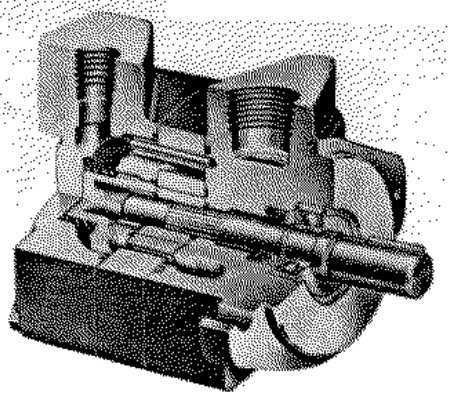
	SHAFT END PUMP					COVER END PUMP				DIMENSIONS			
* Model Series	Delivery (gpm) at 1200 rpm 100 psi	Max. rpm	Max. psi	Typical Del. (gpm) at Max. Speed & Pressure	Typical Input hp at Max. Speed & Pressure	Delivery (gpm) at 1200 rpm 100 psi	Max. rpm	Max. psi	Typical Del. (gpm) at Max. Speed & Pressure	Typical Input hp at Max. Speed & Pressure	* Length inches	Width inches	Height inches	Weight lbs.
2520VQ	12 14 17 21	2700 2700 2500 2500	3000	23 27 31 38	55 62.5 69.5 83	5 8 11 12 14	2700	3000 3000 3000 2300 2000	11 17 23 25.5 30	24 35 47.5 38 39	9.8	5.2	5.9	45
3520VQ	25 30 35 38	2500 2500 2400 2400	3000	45 55 60 65	101 117.5 132 140	5 8 11 12 14	2500	3000 3000 3000 2300 2000	10 16 21 23.5 27.5	22 32.5 44 35 36	10.8	5.5	6.3	76
3525VQ	25 30 35 38	2500 2500 2400 2400	3000	45 55 60 65	101 117.5 132 140	12 14 17 21	2500	3000	21 24 31 38	51 58 69 83	11.3	5.8	6.4	76
4520VQ	42 50 60	2200	2500	66.5 79 96	122.5 141 170	5 8 11 12 14	2200	3000 3000 3000 2300 2000	8.5 13.5 18 20.5 24	19.5 28.5 38.5 31 32	12.0	6.4	7.3	94
4525VQ	42 50 60	2200	2500	66.5 79 96	122.5 141 170	12 14 17 21	2200	3000	18 21 26 33	44 51 61 73	12.8	6.4	7.3	101
4535VQ	42 50 60	2200	2500	66.5 79 96	122.5 141 170	25 30 35 38	2200	3000	38.5 47 55 59	88 104 120 130	13.9	6.4	7.3	118

Performance Constants: SAE 10W Fluid @ 180°F.
Pump Inlet @ 0 PSIG (14.7 PSIA)

* The **20VQ models are available with flow control and relief valves in the cover.
* From face of mounting flange to end of pump cover.

high performance
Single pumps

- 19 flow ratings to choose from
- Maximum flows to 26 GPM
- Maximum speeds to 4800 RPM
- Maximum pressures to 2500 PSI
- Low pump cost per horsepower capacity
- Choice of mounting, port connections and port positions



Model Series	Delivery (gpm) at 1200 rpm 100 psi	Max. rpm	Max. psi	● Typical Del. (gpm) at Max. Speed & Pressure	Typical input hp at Max. Speed & Pressure	●● Length inches	DIMENSIONS Width inches	Height inches	Approx. Weight lbs.
V10 V10F* V10P*	1	4800	2500	3.6	7	4.6	3.0	4.0	9
	2	4500	2500	7.3	13.6	4.6			
	3	4000	2500	9.4	17.8	4.6			
	4	3400	2500	10.9	20.4	4.8			
	5	3200	2500	12.8	22.8	4.8			
	6	3000	2200	14.6	24.5	5.0			
	7	2800	2000	16	24	5.0			
V20 V20F* V20P*	6	3400	2500	16.1	29	4.9	4.4	4.8	16 - 19
	7	3000	2500	16.7	29.5	5.2			
	8	2800	2500	17.7	32.6	5.2			
	9	2800	2500	19.8	36.5	5.2			
	11	2500	2500	22.9	37.5	5.4			
	12	2400	2200	23	36	5.5			
	13	2400	2200	25.9	39	5.5			
V200	5	2800	2000	12.2	19.5	5.0	4.3	4.8	18 - 23
	6	2800		14.5	22.2	5.0			
	8W	2500		15.6	23.4	5.2			
	9	2500		19	28.2	5.2			
	11W	2000		18	26.7	5.4			

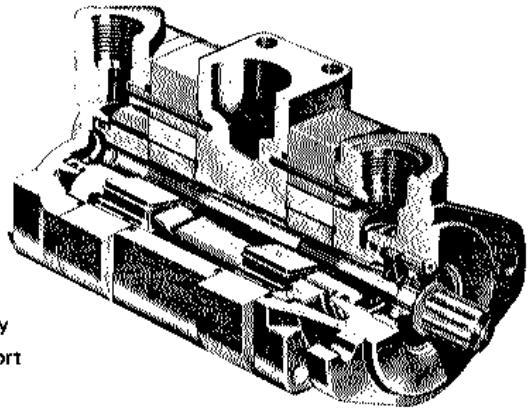
● V10F and V20F have flow control and relief valves in cover. V10P and V20P have priority and relief valves in cover. Operation is described at bottom of page 2. V10F controlled flow rates are 2, 3, 4, 5, 6 and 7 gpm. V20F controlled flow rates are 2, 4, 6 and 8 gpm. V10P and V20P controlled flow rates are 2, 4 and 6 gpm. Relief valve settings are 250 to 2500 psi (in increments of 250 psi) for all models.

●● Length dimensions are for models V10 and V20. Add .8 inch to length for V10F, .8 for V10P, and 1.0 for V20F and V20P. Length dimension is from face of mounting flange to end of pump cover.

● With oil temperature 120°F, viscosity 150 SSU at 100°F.

high performance double pumps

- Two separate flow sources
- Maximum flows 2 to 23 GPM on cover end pump
- Maximum flows 16 to 26 GPM on shaft end pump
- Maximum speeds to 3000 RPM
- Maximum pressures to 2500 PSI
- Choice of shafts
- Low pump cost per horsepower capacity
- Choice of port connections and port positions



Model Series	SHAFT END PUMP					COVER END PUMP					DIMENSIONS			
	Delivery (gpm) at 1200 rpm 100 psi	Max. rpm	Max. psi	●Typical Del. (gpm) at Max. Speed & Pressure	Typical Input hp at Max. Speed & Pressure	Delivery (gpm) at 1200 rpm 100 psi	Max. rpm	Max. psi	●Typical Del. (gpm) at Max. Speed & Pressure	Typical Input hp at Max. Speed & Pressure	**Length inches	Width inches	Height inches	Weight lbs.
V2010 V2010F* V2010P*	7 8 9 11 12 13	3000 2800 2800 2500 2400 2400	2500 2500 2500 2500 2200 2200	16.5 17.5 20 23 23 26	30 32.5 36 37.5 36 39	1 2 3 4 5 6 7	3000 3000 3000 3000 3000 3000 2800	2500 2500 2500 2500 2500 2200 2000	2 4.7 7 9.5 12 14.5 16	4.5 9 13.4 18 21.5 24.5 24	8.4 to 9.2	4.4	5.2	30
V2020 V2020F* V2020P*	7 8 9 11 12 13	3000 2800 2800 2500 2400 2400	2500 2500 2500 2500 2200 2200	16.5 17.5 20 23 23 26	30 32.5 36 37.5 36 39	6 7 8 9 11	3000 3000 2800 2800 2500	2500	14.5 16.5 17.5 20 23	26 30 32.5 36 37.5	8.4 to 9.2	4.4	5.1	35

*V2010F and V2020F have flow control and relief valves in cover. V2010P and V2020P have priority and relief valves in cover. Operation is described at bottom of page 2. Controlled flow rates are 1, 2, 3, 4, 6 and 8 gpm for all models. Relief valve settings are 250 to 2500 psi (in increments of 250 psi) for all models.

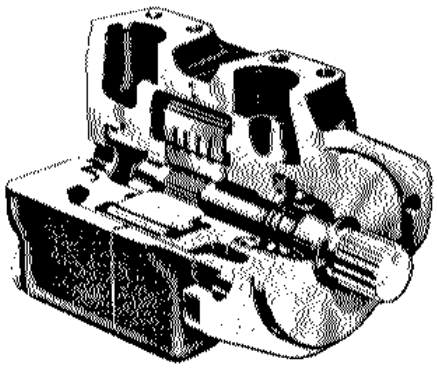
**Length dimensions are for models V2010 and V2020 and vary with ring size. Add .5 inch to length for V2010F, .6 for V2010P, and .8 for V2020F and V2020P. Length dimension is from face of mounting flange to end of pump cover.

●With oil temperature 120°F, viscosity 150 SSU at 100°F.

high speed–high pressure

vane motors

- 12 torque ratings to choose from
- Maximum speeds to 4000 RPM
- Maximum pressures to 2500 PSI
- Choice of mountings and shafts
- Ten-minute cartridge replacement
- Reversible shaft rotation
- Choice of port positions



Model Series	Torque lb. in. per 100 psi	Displacement cu. in./rev.	GPM Req'd. at 1200 rpm	Max. Torque lb. in. at Max. Pressure	Max. Speeds and Pressures	DIMENSIONS • Length in.	Width in.	Height in.	Approx. Weight lbs.
25M	42 55 65	2.68 3.52 4.19	13.9 18.3 21.8	1025 1340 1600	4000 rpm @ 500 psi	7.2	4.6	5.3	40
35M	80 95 115	5.10 6.12 7.44	26.5 31.8 38.6	1960 2340 2840	3000 rpm @ 2500 psi	8.4	5.5	6.3	64
45M	130 155 185	8.42 9.96 11.79	43.7 51.7 61.3	3200 3800 4450		9.8	6.3	6.8	85
50M	220 255 300	14.11 16.36 19.35	73.3 85.0 100.5	5450 6350 7470	3200 rpm @ 500 psi 2400 rpm @ 2500 psi *	11.6	7.8	8.7	160

* 2500 psi for counterclockwise rotation; 2250 psi for clockwise rotation (models with 114 suffix).
2500 psi for bidirectional rotation (models with 124 suffix).

• From face of mounting flange to end of motor cover.

high performance

vane motors

- Maximum speeds to 2800 RPM
- Maximum pressures to 2000 PSI
- Choice of shafts and mountings
- Choice of port positions

Model Series	Torque lb. in. per 100 psi	Displacement cu. in./rev.	Max. Torque lb. in. at Max. Pressure	Max. Speeds and Pressures	DIMENSIONS • Length in.	Width in.	Height in.	Approx. Weight lbs.
M2-200*	25 35	1.51 2.16	410 500	2200 rpm @ 2000 psi 1800 rpm @ 1750 psi	5.9	4.2	4.8	21
M2U	18 25 35	1.32 1.55 2.29	340 410 600	2800 rpm @ 2000 psi 2500 rpm @ 2000 psi 2000 rpm @ 2000 psi	5.1 5.4 5.6	4.1	4.9	17

* Shaft rotation is reversible in this series.

• From face of mounting flange to end of motor cover.

SPERRY VICKERS

HYDRAULIC OIL RECOMMENDATIONS

FOR INDUSTRIAL MACHINERY

UNIT TYPE	VISCOSITY	OIL TYPE
Inline Piston (Pumps & Motors)	● Viscosity Grades: 150-315 SUS (32-68 cSt) @ 100° F. (38° C.) Running: 70-250 SUS (13-54 cSt) At Start Up: 1000 SUS (220 cSt) Max.	Antiwear type industrial hydraulic oils or automotive crankcase oils having letter designations "SC", "SD", or "SE". Per SAE Technical Report J-183a.
Angle Piston Vane (Except MHT) Gear (Pumps & Motors)	● Viscosity Grades: 150-315 SUS (32-68 cSt) @ 100° F. (38° C.) Running: 70-250 SUS (13-54 cSt) At Start Up: 4000 SUS (860 cSt) Max.	
◆ MHT (High Torque/ Low Speed Vane Motors)	● Viscosity Grades: 150-315 SUS (32-68 cSt) @ 100° F. (38° C.) Running: 70-250 SUS (13-54 cSt) At Start Up: ★ 500 SUS (110 cSt) Max.	
◆ EHPM (Electro-Hydraulic Pulse Motors)	● Viscosity Grade: 150 SUS (32 cSt) @ 100° F. (38° C.) Running: 70-250 SUS (13-54 cSt) At Start Up: 1000 SUS (220 cSt)	Antiwear type industrial hydraulic oils.
HAS Drives (Hydraulic Adjustable Speed Drives)	● Viscosity Grade: 315 SUS (68 cSt) @ 100° F. (38° C.)	SAE 20-20W. Automotive crankcase oils designated "SC", "SD", or "SE" or antiwear type industrial hydraulic oils.

SUS: Saybolt Universal Seconds

cSt: Centistokes

★ On start-up or idle running of MHT Motors adhere to the minimum case flow requirements of the installation drawing or contact your Vickers representative.

● Viscosity Grades are the standard viscosity grades listed in ASTM D-2422 titled "Viscosity System for Industrial Fluid Lubricants", but any intermediate viscosity is acceptable.

◆ Adhere to the oil recommendations for EHPM or MHT units rather than the pumps involved.

SELECTION OF VISCOSITY GRADES

Use the following tabulation to determine the temperature extremes between which the viscosity grades can be used to remain within Vickers start-up and running viscosity range recommendations.

The SAE 10W grades fall between the 150 SUS (32 cSt) and 215 SUS (46 cSt) grades and the SAE 20-20W approximates the 315 SUS (68 cSt) grade.

VISCOSITY GRADE @ 100° F. (38° C.)	START UP 4000 SUS (860 cSt)	START UP 1000 SUS (220 cSt)	START UP 500 SUS (110 cSt)	RUNNING 250 SUS (54 cSt) MAX.	RUNNING 70 SUS (13 cSt) MIN.
150 SUS (32 cSt)	11° F. (-12° C.)	42° F. (6° C.)	58° F. (14° C.)	80° F. (27° C.)	143° F. (62° C.)
215 SUS (46 cSt)	22° F. (-6° C.)	54° F. (12° C.)	72° F. (22° C.)	94° F. (34° C.)	159° F. (71° C.)
315 SUS (68 cSt)	32° F. (0° C.)	66° F. (19° C.)	84° F. (29° C.)	108° F. (42° C.)	177° F. (81° C.)

GENERAL DATA

Oil in hydraulic systems performs the dual function of lubrication and transmission of power. It constitutes a vital factor in a hydraulic system, and careful selection of it should be made with the assistance of a reputable supplier. Proper selection of oil assures satisfactory life and operation of the system components with particular emphasis on hydraulic pumps and motors. Any oil selected for use with pumps or motors is acceptable for use with valves.

Some of the factors especially important in the selection of oil for use in an industrial hydraulic system are:

(1)The oil must contain the necessary additives to ensure high antiwear characteristics. Not all hydraulic oils contain these in sufficient amounts.

(2)The oil must have proper viscosity to maintain adequate sealing and lubricating quality at the expected operating temperature of the hydraulic system.

(3)The oil must have rust and oxidation inhibitors for satisfactory system operation.

Two specific types of oil meet the requirements of the modern industrial hydraulic systems:

(1)Antiwear type industrial hydraulic oils. A new generation of industrial hydraulic oils containing adequate quantities of antiwear compounds is recommended by Vickers for general hydraulic service. These oils are generally developed and evaluated on the basis of pump wear tests such as ASTM-D2882. These oils offer superior protection against pump and motor wear and the advantage of long service life. In addition, they provide good demulsibility as well as protection against rust.

(2)Automotive type crankcase oils having letter designation "SC", "SD", or "SE" per SAE Technical Report J-183a.

The above classes of oils in the 100W and 20-20W SAE viscosity ranges are excellent for severe hydraulic service where there is little or no water present. The only adverse effect is that the "detergent" additive tends to hold water in a tight emulsion and prevents separation of water, even on long time standing. It should be noted that very few water problems have been experienced to date in the use of these crankcase oils in machinery hydraulic systems. Normal condensation has not been a problem.

Over the years, Vickers hydraulic oil recommendations have been based on oils that (1) provide adequate wear protection, (2) have proper viscosity, and (3) are sufficiently stable to withstand the chemical, thermal, and mechanical stresses of severe hydraulic service. There are many engine oils that are outside of the SC, SD, and SE classes that meet the above basis of recommendation with lower concentrations of some of the less critical additives (such as the detergent-dispersants) and result in lower costs. The other classes in SAE J-183a do not have performance criteria limiting valve train wear, although many of the oils in all of the classes (with the exception of SA) may be good candidates for hydraulic service. The selection of engine oils for hydraulic service requires careful review of the oil's formulation with the supplier. It is highly desirable to have data from pump wear tests similar to ASTM-D-2882.

VISCOSITY

Viscosity is the measure of resistance to flow. The selection of a hydraulic oil of a specific viscosity range must be based on the needs of the system, limitations of possible critical components, or proper performance of specific types of units. Vickers recommends that certain maximum and minimum viscosity ranges of the oil at start-up and during running be maintained. (See chart.) Very high viscosities at start-up temperatures can cause noise and cavitational damage to pumps. Continuous operation at moderately high viscosities will tend to hold air in suspension in the oil while passing through the reservoir which can cause noise and early failure of pumps, motors and erosion of valves. Low viscosities result in decreased system efficiency and impairment of dynamic lubrication.

Choose the proper oil viscosity for your particular system so that over the entire temperature range encountered, the start-up viscosity and the running viscosity range shown in the chart is met. This is important, and assurance should be obtained from your oil supplier that the viscosity of the oil being used will not be less than the minimum recommended at maximum oil temperature encountered.

A number of antiwear hydraulic oils containing polymeric thickeners (V. I. improvers) are available. The temporary and permanent viscosity loss of some of these oils at operating temperature may be sufficient to affect the life and performance of components. Be certain you know the extent of loss of viscosity of polymer containing oils under hydraulic service before using them so that you do not operate below the recommended minimum viscosity.

TEMPERATURE

To obtain optimum service life from both the oil and the hydraulic system, operate between 120°F (49°C) and 130°F (54°C), but 150°F (66°C) normally is the maximum oil temperature recommended. Vickers HAS Drives operate at a slightly higher temperature, but this is permissible because of controlled design.

MHT Motors are permitted to operate at higher temperatures, but this is permissible by meeting special application requirements. Pumps can be approved to operate MHT Motors at these higher temperatures. Contact your Vickers Representative.

1-286-S1

CLEANLINESS
Thorough precautions should always be observed to insure that the hydraulic system is clean:

(1)Clean (flush) entire system to remove paint, metal chips, welding shot, lint, etc.

(2)Filter each change of oil to prevent introduction of contaminant into the system.

(3)Provide continuous oil filtration to remove sludge and products of wear and corrosion generated during the life of the system.

(4)Provide continuous protection of system from entry of airborne contamination by proper filtration of air through breathers,

(5)During usage, proper oil filling of reservoir and servicing of filters, breathers, reservoirs, etc. cannot be over emphasized.

(6) Refer to installation data for recommended filtration.

SOUND LEVEL
Noise is only indirectly affected by the fluid selection, but the condition of the fluid is of paramount importance in obtaining the optimum reduction of system sound levels.

Some of the major factors affecting the fluid conditions that cause the loudest noises in a hydraulic system are:

1. Very high viscosities at start-up temperatures can cause pump noises due to cavitation.
2. Running with a moderately high viscosity fluid will impede the release of entrained air. The fluid will not be completely purged of such air in the time it remains in the
reservoir before recycling through the system.
3. Aerated fluid can be caused by ingestion of air through the pipe joints of inlet lines, high velocity discharge lines, cylinder rod packings, or by fluid discharging above the fluid level in the reservoir. Air in the fluid causes a noise similar to cavitation.

4. Contaminated fluids can cause excessive wear of internal pump parts which may result in increased sound levels.

5. Systems using water based fluids are susceptible to noise created by vaporization of the fluid if excessive vacuums and temperatures are encountered.

FIRE RESISTANT FLUIDS

Hydraulic systems using fire resistant fluids require special engineering consideration.

Proper design, operation and maintenance of fluid power systems is of paramount importance to obtain the optimum performance of fire resistant fluids such as synthetics, water glycol, and water in oil emulsion types.

For general information on the properties, characteristics, application and use of fire resistant fluids consult the "ANSI B93. 5-19**-Standard Practice for Use of Fire Resistant Fluids for Fluid Power Systems."

For specific applications of fire resistant fluids consult your Vickers representative.

LOW VISCOSITY HYDRAULIC FLUIDS
For specific applications of low viscosity hydraulic fluids such as "Soluble oil in water emulsions" and "Aluminum rolling oils of the mineral seal type" consult your Vickers Representative. Many Vickers units are designed for use with these low viscosity fluids as noted on the appropriate installation drawings.

SOLUBLE OIL IN WATER EMULSION
An oil in water emulsion containing a 5% concentration of soluble oil is recommended. (A 6 to 10% concentration is preferred.) The soluble oil should be a stable, high quality, heavy duty type soluble oil and should be checked frequently.

To assure an effective emulsion, the water should not have excessive hardness or have an acid nature, and it should be distilled or deionized. When preparing the mixtures, the soluble oil should always be added to the water while maintaining good fluid agitation. The water should never be added to the soluble oil. Do not mix soluble oil brands.

Proper maintenance of oil content in the emulsion requires periodic testing for alkaline pH and oil concentration. The alkaline pH should be maintained at 8. 0-9. 2 pH in accordance with the suppliers recommendation. A reduction of predicted life from that of petroleum oil should be expected when using oil in water emulsions.

LOW VISCOSITY PETROLEUM PRODUCTS
Aluminum rolling oil of the mineral seal type containing 10% butyl stearate lubricity additive may also be used as the fluid medium. Comparing aluminum rolling oil and oil in water emulsions, both fluids bear the same ratings and life expectancy.

PREPARATION OF PIPES, TUBES, AND FITTINGS BEFORE INSTALLATION- IN A HYDRAULIC SYSTEM

General requirements. When installing the various iron and steel pipes, tubes, and fittings of a hydraulic system, it is necessary that they be absolutely clean, free from scale, and all kinds of foreign matter. To attain this end, the following steps should be taken.

1. Tubing, pipes, and fittings should be brushed with boiler tube wire brush or cleaned with commercial pipe cleaning apparatus. The inside edge of tubing and pipe should be reamed after cutting to remove burrs.

2. Short pieces of pipe and tubing and steel fittings are sandblasted to remove rust and scale. Sandblasting is a sure and efficient method for short straight pieces and fittings. Sandblasting is not used, however, if there is the slightest possibility that particles of sand will remain in blind holes or pockets in the work after flushing.

3. In the case of longer pieces of pipe or short pieces bent to complex shapes where it is not practical to sandblast, the parts are pickled in a suitable solution until all rust and scale is removed. Preparation for pickling requires thorough degreasing in TRI-CHLORETHYLENE or other commercial degreasing solution.

4. Neutralize pickling solution.

5. Rinse parts and prepare for storage.

6. Tubing must not be welded, brazed, or silver soldered after assembly as proper cleaning is impossible in such cases. It must be accurately bent and fitted so that it will not be necessary to spring it into place.

7. If flange connections are used, flanges must fit squarely on the mounting faces and be secured with screws of the correct length. Screws or -studs-nuts must be drawn up evenly to avoid distortion in the valve or pump body.

8. Be sure that all openings into the hydraulic system are properly covered to keep out dirt and metal slivers when work such as drilling, tapping, welding, or brazing is being done on or near the unit.

9. Threaded fittings should be inspected to prevent metal slivers from the threads getting into the hydraulic system.

10. Before filling the system with hydraulic oil, be sure that the hydraulic fluid is as specified and that it is clean. Do not use cloth strainers or fluid that has been stored in contaminated containers.

11. Use a #120 mesh screen when filling the reservoir. Operate the system for a short time to eliminate air in the lines. Add hydraulic fluid if necessary.

12. Safety precautions. Dangerous chemicals are used in the cleaning and pickling operations to be described. They should be kept only in the proper containers and handled with extreme care.

PICKLING PROCESS

1. Thoroughly degrease parts in degreaser, using trichlor Ethylene or other commercial degreasing solution.

2. **Tank No. 1**
Solution. Use a commercially available derusting compound in solution as recommended by the manufacturer. The solution should not be used at a temperature exceeding that recommended by the manufacturer, otherwise the inhibitor will evaporate and leave a straight acid solution. The length of time the part will be immersed in this solution will depend upon the temperature of the solution and the amount of rust or scale which must be removed. The operator must use his judgment on this point.

3. After pickling, rinse parts in cold running water and immerse in tank No. 2. The solution in this tank should be a neutralizer mixed with water in a proportion recommended by the manufacturer. This solution should be used at recommended temperatures and the parts should remain immersed in the solution for the period of time recommended by the manufacturer.

4. Rinse parts in hot water.

5. Place in tank No. 3. The solution in this tank should contain antirust compounds as recommended by the manufacturer. Usually the parts being treated should be left to dry with antirust solution remaining on them.
If pieces are stored for any period of time ends of the pipes should be plugged to prevent the entrance of foreign matter. Do not use rags or waste as they will deposit lint on the inside of the tube or pipe. Immediately before using pipes, tubes and fittings they should be thoroughly flushed with suitable degreasing solution.

NOTES

SPERRY VICKERS

280 ATTWELL DRIVE
REXDALE, ONTARIO M9W 5B6
TELEPHONE (416) 675-7780
TELEX 06-989152

high speed-high pressure motors

Reliable. The performance of these motors has been proven on rugged earth moving, agricultural, mining and material handling applications. They have been overwhelmingly successful on elevator scraper drives, hydrostatic drives and many other auxiliary applications.

Efficient. Sperry Vickers exclusive dual-alternate pressure plate design provides overall efficiency of about 85%.

Reversibility. Through the dual plate design, these motors may be reversed simply by reversing the direction of oil flow.

Series Operation. These motors are suited to series applications. Inlet and outlet ports can be pressurized simultaneously without affecting service life or operating smoothness.

Replaceable Cartridge. Replaceable cartridges permit motor overhauls in just 10 minutes in the field! A cartridge can be replaced without removing the unit from the vehicle, and usually without disconnecting hydraulic lines.

High Speed and Pressure. These motors offer speeds to 3000 rpm at maximum pressure. Speeds up to 4000 rpm are obtainable, as in transmission applications where high travel speeds under light loads are required.

---

low cost-high performance motors

Characteristics. These motors are an economical, efficient, and compact means of converting hydraulic energy to mechanical energy. They can be stalled under load without damage when protected by a relief valve.

Hydraulic Balance. Two internal inlet areas are diametrically opposed as are two outlet areas. This construction eliminates bearing loads resulting from pressure, a major cause of shaft bearing wear in designs without this feature.

Efficiency. Optimum running clearances and hydraulic balance assure sustained high efficiency over the life of the motor.

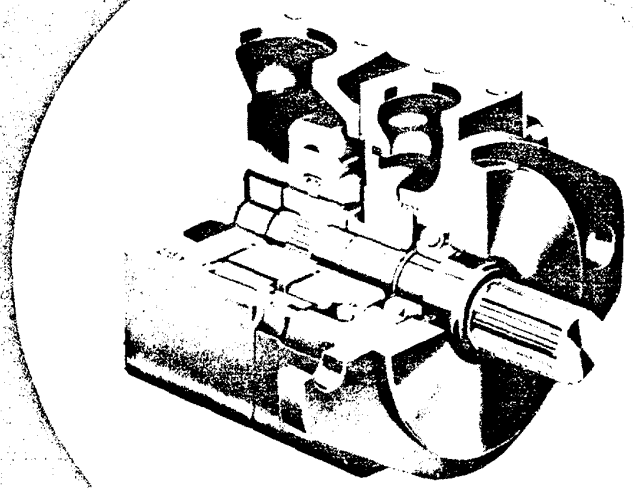
Smooth Operation. Inertia of rotating parts is low parts are symmetrical, providing dynamic balance and freedom from vibration.

VICKERS

The hydraulics people who listen
SPERRY VICKERS •DIVISION OF SPERRY CORPORATION •TROY, MICHIGAN 48084
FORM MB 185C litho in U.S.ATHO IN U.S.A.

SPERRY VICKERS

SINGLE PUMPS



OVERHAUL MANUAL

25VQ, 26VQ, 30VQ, 31VQ, 35VQ AND 45VQ

SPERRY VICKERS
TROY, MI. 48084

Revised 3-1-79

I-3144-S

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SECTION I - INTRODUCTION

A. PURPOSE OF MANUAL

This manual is to assist users of Sperry Vickers ·gh Performance VQ, single pumps in properly in- alling, maintaining and repairing their units. The single pumps are described in detail.

Their theory of operation is discussed and instructions for installation, maintenance and overhaul are presented.

The general series of models covered are 25VQ, 26VQ, 30VQ, 31VQ, 35VQ, and 45VQ. The information given applies to the -20 design series listed in Table 1.

B. GENERAL INFORMATION

1. Related Publications - Service parts information and installation dimensions are not contained in this manual. The parts and installation drawings listed in Table 2 are available from any Sperry Vickers application engineering office or from:

Technical Publications
P. O. Box 302
Troy, Michigan 48084

MODEL CODE BREAKDOWN

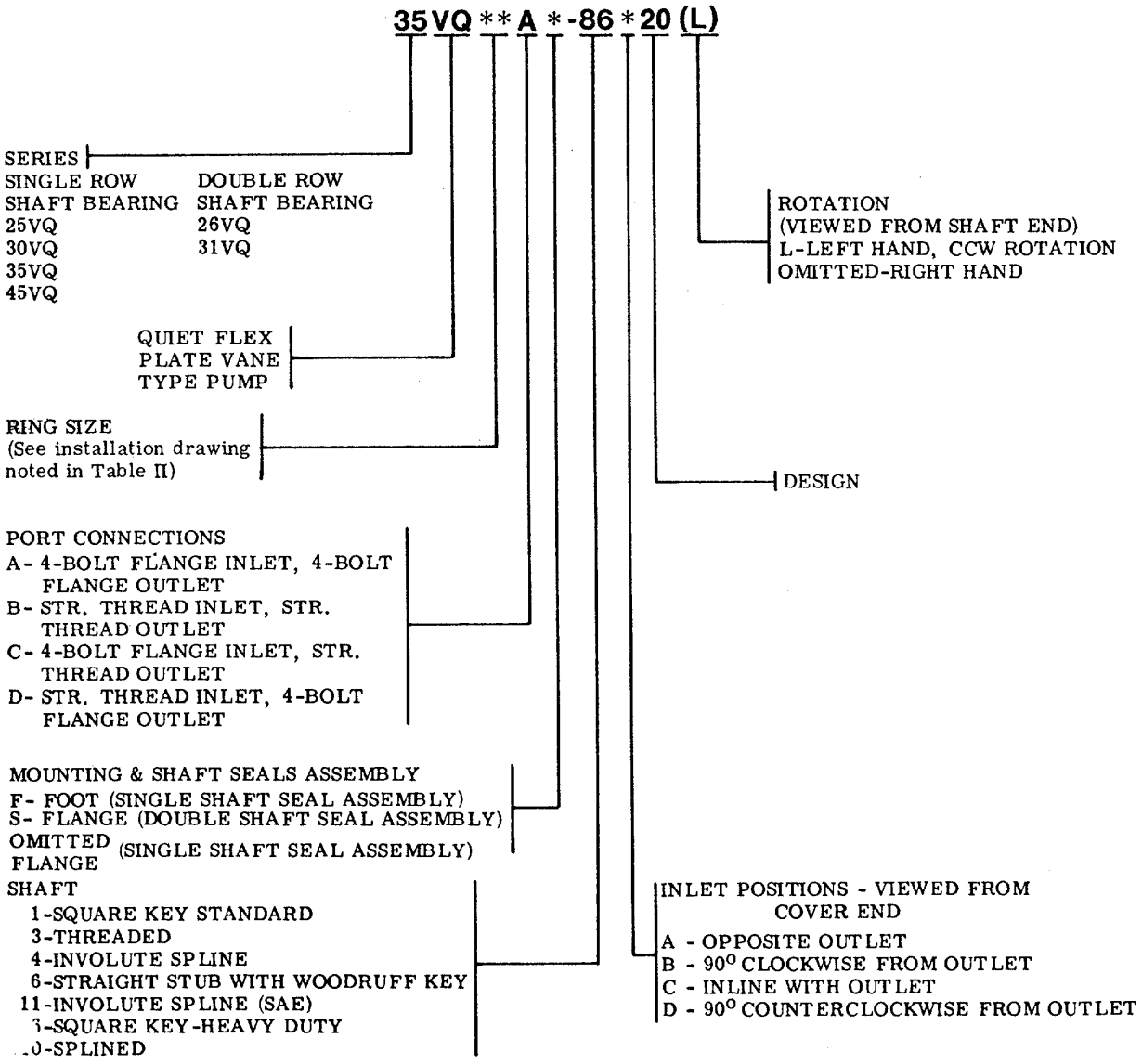


TABLE 1.

2. Model Codes - Variations within each basic model series are covered in the model code. Table 1 is a complete breakdown of the codes covering these units. Service inquiries should always include the complete unit model code number as stamped on the pump cover.

MODEL SERIES	PARTS DRAWING	INSTALLATION DRAWING
25VQ, 26VQ	I-3165-S	MB-53E
30VQ, 31VQ		
35VQ	I-3167-S	
45VQ	I-3168-S	

Table 2 - Available parts and installation drawings

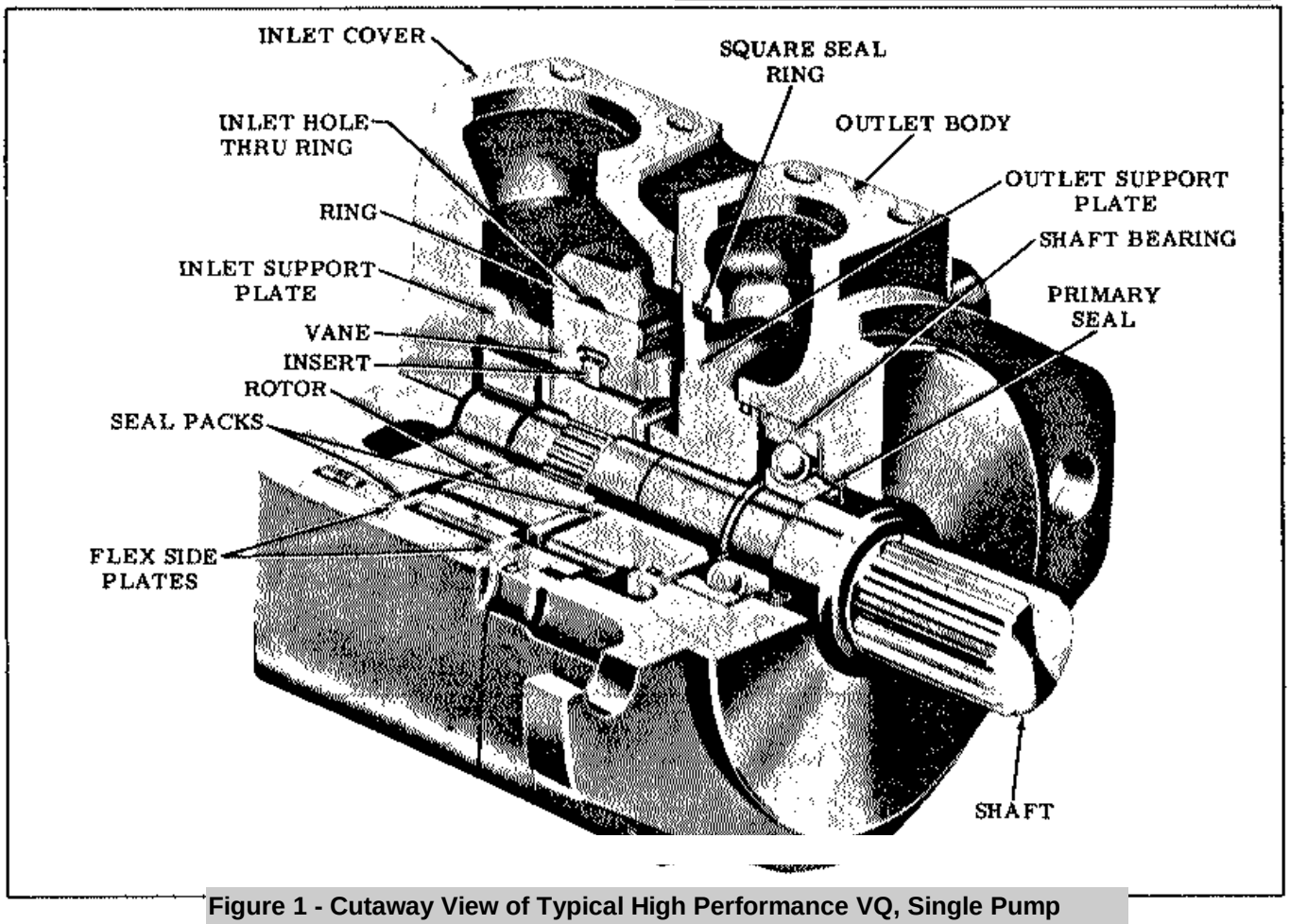


Figure 1 - Cutaway View of Typical High Performance VQ, Single Pump

SECTION II - DESCRIPTION

A. GENERAL

Pumps in this series are used to develop hydraulic fluid flow for the operation of Industrial and Mobile equipment. The positive displacement pumping cartridges are of the rotary vane type with shaft side loads hydraulically balanced. The flow rate depends on the pump size and the speed at which it is driven.

All units are designed so that the direction of rotation, pumping capacity and port positions can be readily changed to suit particular applications.

B. ASSEMBLY AND CONSTRUCTION

1. Basic Pumps - The pump illustrated in Figure 1 is representative of all single pumps in this series. The unit consist principally of an inlet cover, outlet body, driveshaft and pumping cartridge. The principal components of the cartridge are an elliptical cam ring, a slotted rotor splined to the driveshaft, an inlet and outlet support plate fitted with four special seal packs, two flex side plates, and ten vanes and inserts fitted to the rotor slots. Fluid enters the cartridge through the inlet port in the cover and is discharged through the outlet flex side plate and support plate to the outlet port in the body.

C. APPLICATION

Pump ratings in GPM, as shown in the model coding, are at 1200 RPM and 100 PSI. For ratings at other speeds and pressures, methods of installation or other application information, refer to the applicable sales installation drawing or consult a Sperry Vickers application engineer.

SECTION III - PRINCIPLES OF OPERATION

A. PUMPING CARTRIDGE

As mentioned in Section II, fluid flow is developed in the pumping cartridge. The action of the cartridge llustrated in Figure 2. The rotor is driven within *the ring by the driveshaft, which is coupled to a power* source. As the rotor turns, centrifugal force on the vanes, aided by under-vane pressure fed from the outlet port, causes the vanes to follow the elliptical inner surface of the ring.

Radial movement of the vanes and turning of the rotor causes the chamber volume between the vanes to increase as the vanes pass the inlet sections of the ring. This results in a low pressure condition which allows atmospheric pressure to force fluid into the chambers.

An additional inlet fluid path exists through a drilled hole in the cam ring. This hole connects the inlet port directly to the inlet areas of the cam ring and pro*vides an additional flow path for fluid to get into the* cartridge. (See figure 1.)

Fluid is trapped between the vanes and carried past a sealing land to the outlet section of the ring. As the outlet section is approached, the chamber volume decreases and the fluid is forced out into the system. System pressure is fed under the vanes, assuring their sealing contact against the ring during normal operation.

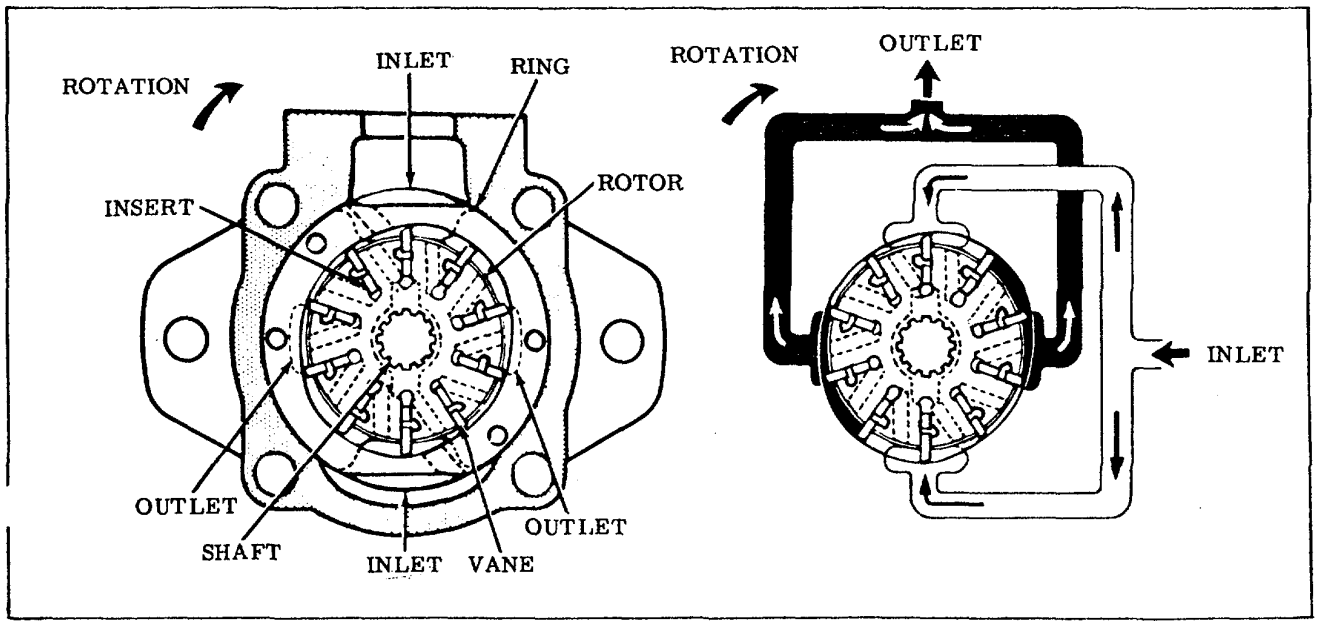


Figure 2 - Operation of Balanced, Vane-Type Cartridge.

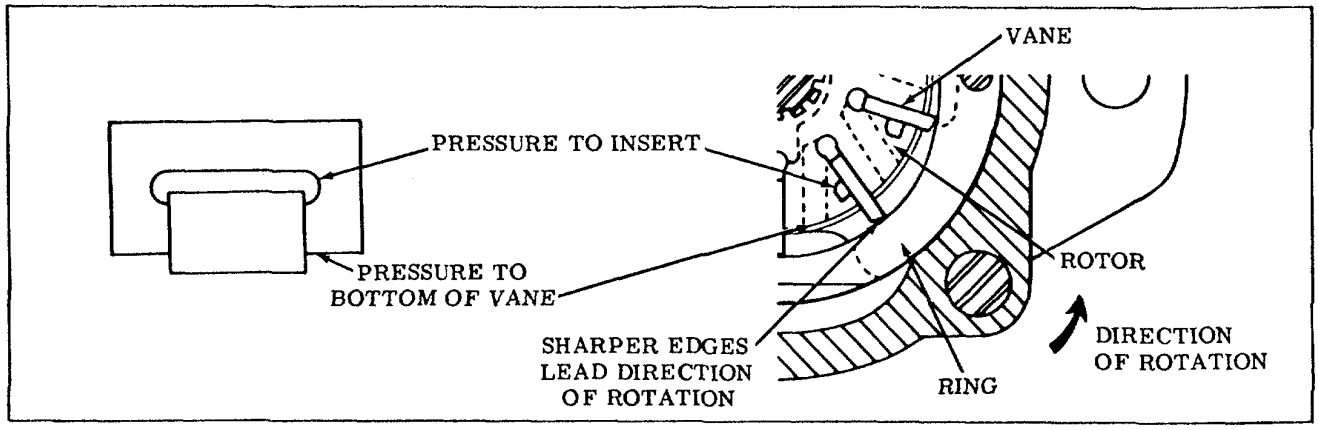


Figure 3 - Pressure Feed to Vanes in Intra-Vane Cartridge.

B. VANE PRESSURE FEED

The intra-vane design provides a means of con-olling the outward thrust of the vane against the ring and maintains tip loads within reasonable limits. In the intra-vane cartridge, full system pressure is continuously applied only to the area between the vane and insert. This area is small and thrust is correspondingly light. During vane travel through pressure areas, full system pressure is applied against the bottom area of the outer vane. The valving of pressure to and from the bottom area of the vane is through holes drilled in the rotor, as shown in Figure 3. This selective application of pressure maintains the vane in substan-

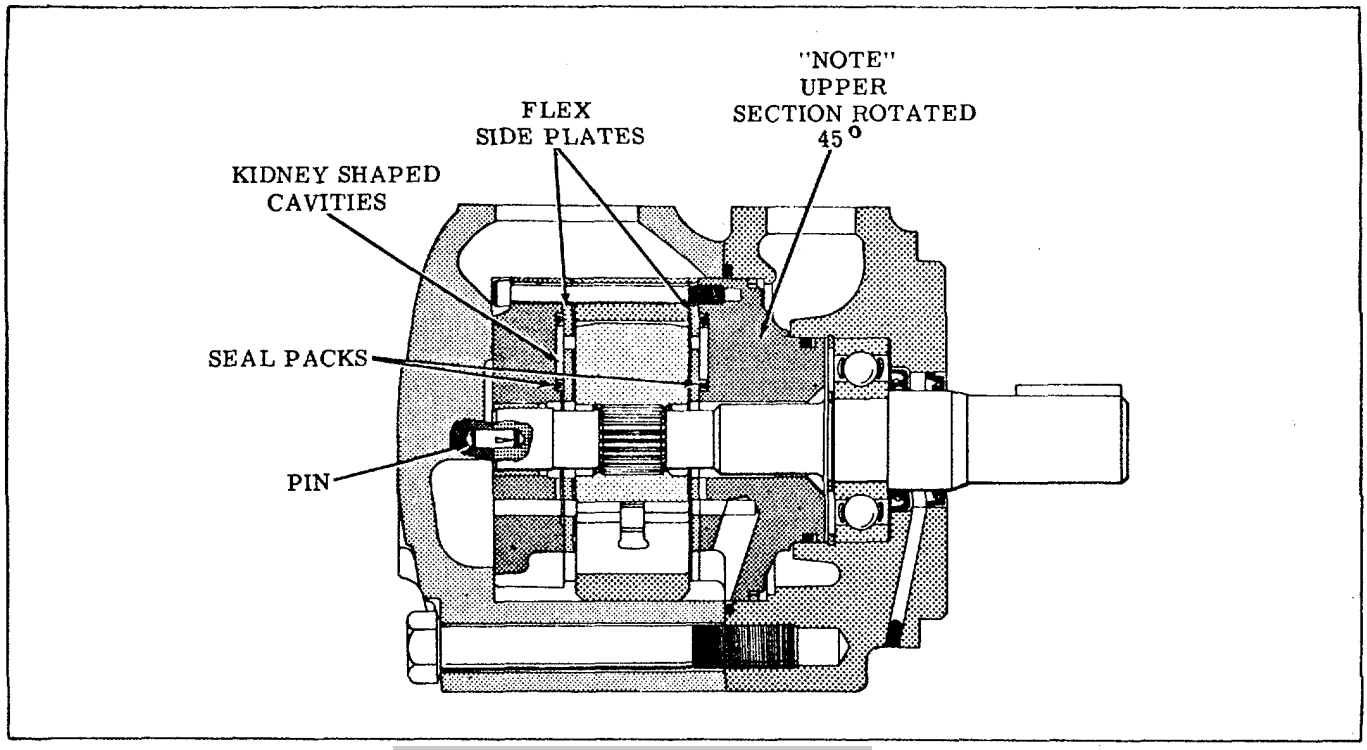


Figure 4 - Flex Side Plate Operation

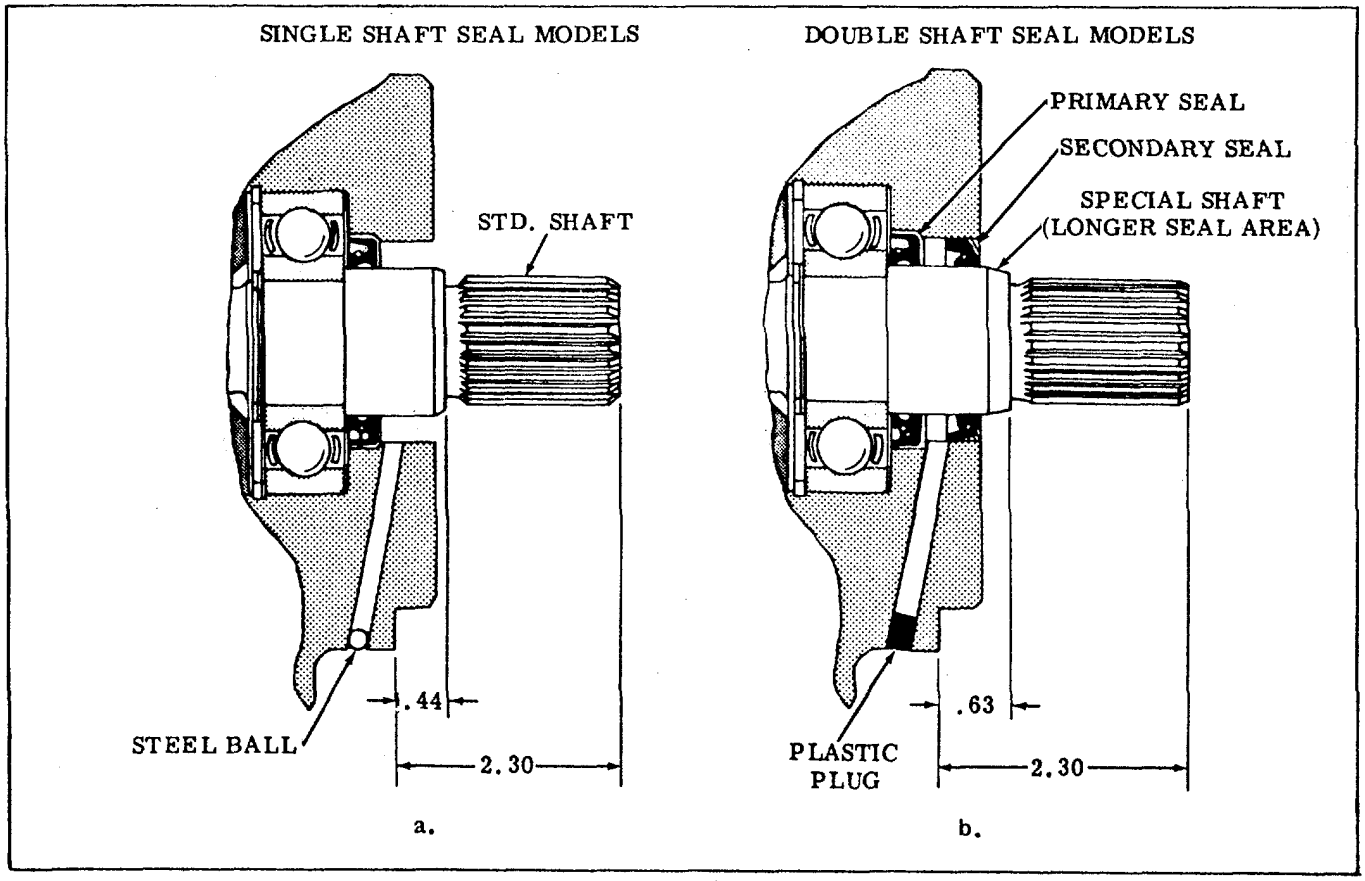


Figure 5 - Shaft Seal Arrangements

tially constant radial hydraulic balance in all positions. Vane tip wear is compensated for automatically. As the vane wears, pressure moves the vane farther out in the rotor slot holding the vane tip against the cam ring.

HYDRAULIC BALANCE

The pump ring is shaped so the two pumping chambers are formed 180 degrees apart (Figure 2.) Thus, opposing hydraulic forces which develop side loads on the shaft, cancel out.

D. FLEX SIDE PLATE OPERATION

The flex side plates for both inlet and outlet symmetrical. Pressure is fed behind each side plate into two kidney shaped cavities which are sealed by special seal packs. The two flex side plates and their associated kidney shaped cavities function in the following manner. As pressure builds up in the outlet, pressure also builds up in the cavities. The pressure in the cavities hold the flex side plates in hydrostatic balance against the rotor and provide optimum running clearances for minimum internal leakage and minimum friction. (See figure 4.) The flex side plates also provide passages for feeding under vane pressure to the space between the vane
and insert. The bronze faces of the flex side plates ride next to the rotor and provide excellent wear and cold start characteristics. The inlet and outlet support plates hold the flex side plates in position and contain passages which allow fluid to pass from the inlet to the pumping cartridge and from the cartridge to the outlet port.

E. INLET BODIES

Two inlet body configurations and two shaft seal arrangements are available in this pump series. (See figure 5) When a single shaft seal is used, a steel ball is pressed into the body. (See figure 5a.) Double shaft seal models use a plastic plug to seal the body drain opening. This prevents external contamination from entering the area between the seals. (Refer to figure 5b.) The outer shaft seal is rated 7 PSI from an internal source and 2 PSI from an external source. Double shaft seal models require a different shaft that may or may not be interchangeable with previous designs. This is due to an increase in shaft shoulder length to accommodate the second shaft seal. The overall shaft length of both models are the same as previous designs.

SECTION IV INSTALLATION AND OPERATING INSTRUCTIONS A.

A. INSTALLATION DRAWINGS

The installation drawings listed in Table 2 show correct installation dimensions and optional port locations.

B. MOUNTING AND DRIVE CONNECTIONS

Sperry Vickers high performance VQ vane pumps are designed for foot or flange mounting.

1. Direct Drive A pilot on the pump mounting flange (Figure 6) assures correct mounting and shaft alignment, provided the pilot is firmly seated in the accessory pad of the power source. Care should be exercised in tightening all flange mounting screws to prevent misalignment. If gaskets are used between flanges, they should be installed carefully so as to lie flat and should not be. the type that will take a set. Shaft keys and couplings must be properly seated to avoid slipping and possible shearing. Proper coupling alignment is essential to prolong pump life.

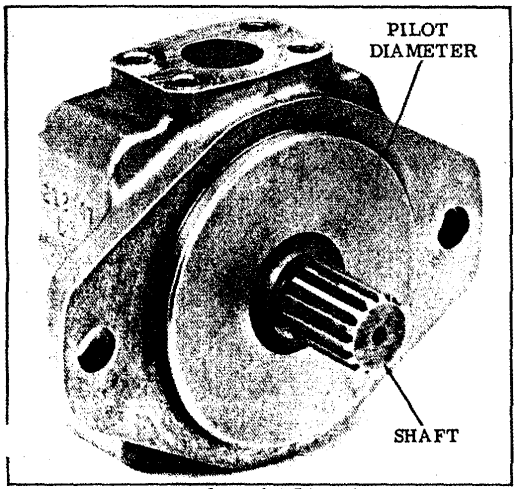


Figure 6 - Pilot Diameter

CAUTION

Pump shafts are designed to be installed in couplings with a slip fit or very light press. Pounding the coupling end on the shaft can ruin the bearings. Shaft tolerances are shown on the pump installation drawings. (See Table 2).

2. Indirect Drive Indirect drive is not recommended for these pumps.

C. SHAFT ROTATION

NOTE

Pumps are normally assembled for right-hand (clockwise) rotation as viewed from the shaft end. A pump made for left-hand rotation is identified by an "L" in the model code. (See Table 1.)

If it is desired to reverse the direction of drive rotation, it is necessary to disassemble the pump and reverse the location of the cartridge inlet and outlet support plates, (See Sec tion VI.) Figure 6 Pilot Diameter

CAUTION

Never drive a pump in the wrong direction of rotation. Seizure may result, necessitating extensive repairs.

D. PIPING AND TUBING

1. All pipes and tubing must be thoroughly cleaned before installation. Recommended methods of cleaning are sandblasting, wire brushing and pickling.

NOTE

For instructions on pickling refer to instruction sheet 1221-S.

2. To minimize flow resistance and the possibility of leakage, use only as many fittings and connections as are necessary for proper installation.

3. The number of bends in tubing should be kept to a minimum to prevent excessive turbulence and friction of oil flow. Tubing must not be bent too sharply. The recommended radius for bends is three times the inside diameter of the tube.

E. HYDRAULIC FLUID RECOMMENDATIONS

GENERAL DATA

Oil in a hydraulic system performs the dual function of lubrication and transmission of power. It constitutes a vital factor in a hydraulic system, and careful selection of it should be made with the assistance of a reputable supplier. Proper selection of oil assures satisfactory life and operation of system components with particular emphasis on hydraulic pumps. Any oil selected for use with pumps is acceptable for use with valves or motors.

Data sheets for oil selection are available from Sperry Vickers Technical Publications Troy, Michigan. For Industrial Applications order data sheet 1-286-S. For Mobile Applications order M-2950-S. The oil recommendations noted in the datasheets are based on our experience in industry as a hydraulic component manufacturer.

Where special considerations indicate a need to depart from the recommended oils or operating conditions, see your Sperry Vickers representative.

CLEANLINESS

To insure the hydraulic system is clean:

A. Clean (flush) entire new system to remove paint, metal chips, welding shot, etc.

B. Filter each change of oil to prevent introduction of contaminants into the system.

C. Provide continuous oil filtration to remove sludge and products of wear and corrosion generated during the life of the system.

D. Provide continuous protection of system from entry of airborne contamination, by sealing the system and or by proper filtration of the air.

E. Proper oil filling and servicing of filters, breathers, reservoirs, etc. , cannot be over emphasized.

F. Good system and reservoir design will insure that aeration of the oil is kept to a minimum.

SOUND LEVEL

Noise is indirectly affected by the fluid selection, but the condition of the fluid is of paramount importance in obtaining optimum reduction of system sound levels. Some of the major factors affecting fluid conditions that cause the loudest noises in a hydraulic system are:

1. Very high viscosities at start-up temperatures can cause pump noises due to cavitation.

2. Running with a moderately high viscosity fluid will slow the release of entrained air. The fluid will not be completely purged of such air in the time it remains in the reservoir and air will be recycled through the system.

3. Aerated fluid can also be caused by ingestion of air through the pipe joints of inlet lines, high velocity discharge lines, cylinder rod packings, or by fluid discharging above the fluid level in the reservoir. Air in the fluid causes a noise similar to cavitation.

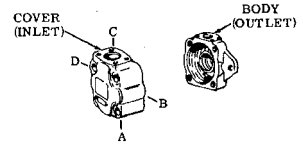
4. Contaminated fluids can cause excessive wear of internal pump parts which may result in increased sound levels.

F. OVERLOAD PROTECTION

A relief valve must be installed in the system as close to the pump outlet as possible. The relief valve limits pressure in the system to a prescribed maximum and protects the components from excessive pressure. The setting of the relief valve depends on the work requirements of the system.

G. PORT POSITIONS

The pump cover can be assembled in four positions with respect to the body. A letter in the model



MODEL	INLET COVER POSITIONS (VIEWED FROM COVER END)
VQA-***A-20(L)	OPPOSITE OUTLET PORT
VQA-***B-20(L)	90° CLOCKWISE FROM OUTLET
VQA-***C-20(L)	IN-LINE WITH OUTLET
VQA-***D-20(L)	90° COUNTERCLOCKWISE FROM OUTLET

Figure 7 - Cover Positions

code (Table 1) identifies the cover position as shown in Figure 7.

Disassembly and assembly procedures are in Section. VI-B and D.

START-UP

Whenever it is possible to do so, fill the pump ports with system hydraulic fluid. This will make it easier for the pump to prime when it is first started.

Self-Priming With a minimum drive speed of 600 RPM, a pump should prime almost immediately. Failure to prime within a reasonable length of time may result in damage due to lack of lubrication. Inlet lines must be tight and free from air leaks. However, it may be necessary to crack a fitting on the outlet side of the pump to purge entrapped air. No Load Starting These pumps are designed to start up with no load on the pressure ports. They should never be started against a load or a closed center valve.

SECTION V SERVICE, INSPECTION AND MAINTENANCE

A. SERVICE TOOLS

Two special tools are required to service these pumps. A driver should be used to assure installation of the primary shaft seal without damage, and a "bullet" should be placed over the end of the shaft, to avoid damaging the seal lip when the shaft is installed. Installation of the secondary seal does not require a driver. (See figure 5) The driver can be made from tubular stock as shown in Figure 8. The tool applies a uniform pressure to the recessed area of the seal, rather than to the lip of the seal. The inside diameter of the tool will not interfere with the garter spring located around the lip of the seal.

PUMP SERIES	LENGTH "A" (INCHES)	UNDERCUT "B" (INCHES)	O.D. "C" (INCHES)	I.D. "D" (INCHES)
VQ, 26VQ, 31VQ	3.500	.281	1.580	1.375
35VQ	3.500	.331	1.765	1.622
45VQ	3.750	.375	2.187	1.938

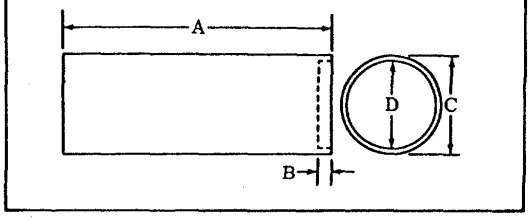


Figure 8 - Primary Shaft Seal Driver

B. INSPECTION

Periodic inspection of the fluid condition and tube or piping connections can save time-consuming breakdowns and unnecessary parts replacement. The following should be checked regularly.

1. All hydraulic connections must be kept tight. A loose connection in a pressure line will permit the fluid to leak out. If the fluid level becomes so low as to uncover the inlet pipe opening in the reservoir, extensive damage to the pump can result. In suction or return lines, loose connections permit air to be drawn , the system, resulting in noisy and/or erratic operation.

2. Clean fluid is the best insurance for long service life. Therefore, the reservoir should be checked periodically for dirt or other contaminants. If the fluid becomes contaminated the system should be thoroughly drained and the reservoir cleaned before new fluid is added.

3. Filter elements also should be checked and replaced periodically. A clogged filter element results in a higher pressure drop. This can force particles through the filter which would ordinarily be trapped, or can cause the by-pass to open, resulting in a partial or complete loss of filtration.

4. Air bubbles in the reservoir can ruin the pump and other components. If bubbles are seen, locate the source of the air and seal the leak. (See Table 3.)

5. A pump which is running excessively hot or noisy is a potential failure. Should a pump become noisy or overheated, the machine should be shut down immediately and the cause of improper operation corrected.

C. ADDING FLUID TO THE SYSTEM

When hydraulic fluid is added to replenish the system, it should always be poured through a firewire screen (200 mesh or finer) or preferably pumped through a 10 micron (absolute) filter. It is important that the fluid be clean and free of any substance which could cause improper operation or wear of the pump or other hydraulic units. Therefore, the use of cloth to strain the fluid should be avoided to prevent lint getting into the system.

D. ADJUSTMENTS

No periodic adjustments are required, other than to maintain proper shaft alignment with the driving medium.

E. LUBRICATION

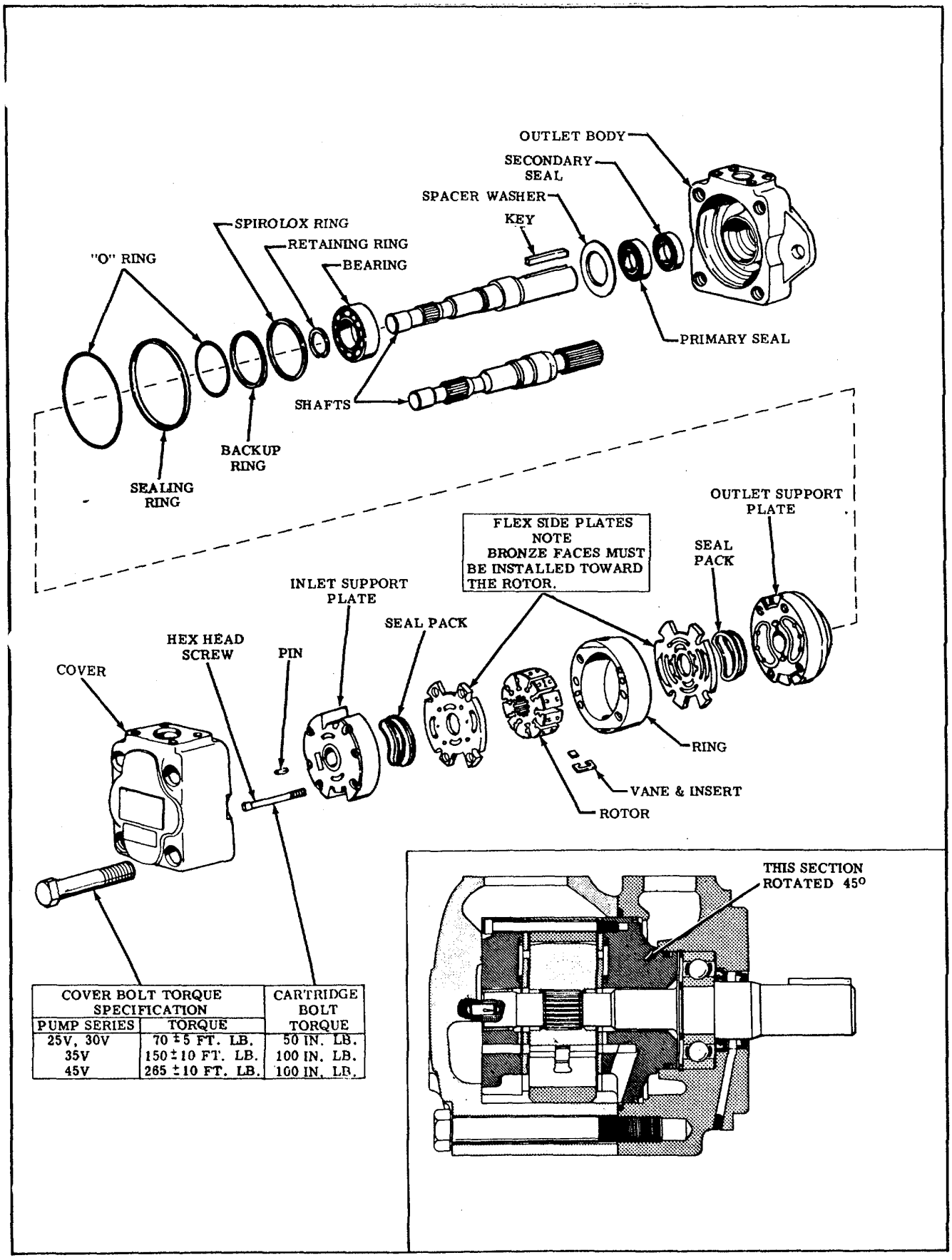
Internal lubrication is provided by the fluid in the system. Lubrication of the shaft couplings should be as specified by their manufacturers.

F. REPLACEMENT PARTS

Reliable operation throughout the specified operating range is assured only if genuine Sperry Vickers parts are used. Sophisticated design processes and material are used in the manufacture of our parts. Substitutions may result in early failure. Part numbers are shown in the parts drawings listed in Table 2.

TABLE 3 - TROUBLE SHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
PUMP NOT DELIVERING FLUID	DRIVEN IN THE WRONG DIRECTION OF ROTATION	The drive direction must be changed immediately to prevent seizure. Refer to section VI. D. for the correct ring position for each direction of rotation.
	COUPLING OR SHAFT SHEARED OR DISENGAGED	Disassemble the pump and check the shaft and cartridge for damage. (See Section VI.) Replace the necessary parts.
	FLUID INTAKE PIPE IN RESERVOIR RESTRICTED	Check all strainers and filters for dirt and sludge. Clean if necessary.
	FLUID VISCOSITY TOO HEAVY TO PICK UP PRIME	Completely drain the system. Add new filtered fluid of the proper viscosity.
	AIR LEAKS AT THE INTAKE. PUMP NOT PRIMING	Check the inlet connections to determine where air is being drawn in. Tighten any loose connections. See that the fluid in the reservoir is above the intake pipe opening. Check the minimum drive speed which may be too slow to prime the pump.
	RELIEF VALVE STUCK OPEN. (MODELS WITH INTEGRAL RELIEF VALVE ONLY)	Disassemble the pump and wash the valve in clean solvent. Return the valve to its bore and check for any stickiness. A gritty feeling on the valve periphery can be polished with crocus cloth. Do not remove excess material, round off the edges of the lands or attempt to polish the bore. Wash all parts and reassemble the pump.
	VANE(S) STUCK IN THE ROTOR SLOT(S)	Disassemble the pump. Check for dirt or metal chips. Clean the parts thoroughly and replace any damaged pieces. If necessary flush the system and refill it with clean fluid.
INSUFFICIENT PRESSURE BUILD-UP	SYSTEM RELIEF VALVE SET TOO LOW	Use a pressure gage to correctly adjust the relief valve.
	COMPLETE LOSS OF FLOW FROM PUMP.	-A valve is stuck open permitting free flow to tank. -Broken inlet or pressure line. -Actuator bypassing the full flow. (Motor valve plate lift)
PUMP MAKING NOISE	PUMP INTAKE PARTIALLY BLOCKED	Service the intake strainers. Check the fluid condition and, if necessary, drain and flush the system. Refill with clean fluid.
	AIR LEAKS AT THE INTAKE OR SHAFT SEAL. (OIL IN RESERVOIR WOULD PROBABLY BE FOAMY)	Check the inlet connections and seal to determine where air is being drawn in. Tighten any loose connections and replace the seal if necessary. See that the fluid in the reservoir is above the intake pipe opening.
	PUMP DRIVE SPEED TOO SLOW OR TOO FAST	Operate the pump at the recommended speed.
	COUPLING MISALIGNMENT	Check if the shaft seal bearing or other parts have been damaged. Replace any damaged parts. Realign the coupled shafts.



COVER BOLT TORQUE SPECIFICATION		CARTRIDGE BOLT TORQUE
PUMP SERIES	TORQUE	
25V, 30V	70 ± 5 FT. LB.	50 IN. LB.
35V	150 ± 10 FT. LB.	100 IN. LB.
45V	265 ± 10 FT. LB.	100 IN. LB.

Figure 9 - Exploded and cross-section views of typical pump

G. TROUBLE-SHOOTING

Table 3 lists the common difficulties experienced with vane pumps and hydraulic systems. It also indicates the probable causes and remedies for each of the troubles listed.

It should always be remembered that many apparent pump failures are actually the failures of other parts of the system. The cause of improper operation is best diagnosed with adequate testing equipment and a thorough understanding of the complete hydraulic system.

SECTION VI OVERHAUL

NOTE

Complete cartridges are available in service kits for rebuilding these pumps. Refer to the parts drawings listed in Table 2 for part numbers. If a replacement cartridge is being installed, proceed as in step B-1 for disassembly and step D-2 for assembly.

WARNING

Before breaking a circuit connection, be certain that power is off and the system pressure has been relieved. Lower all vertical cylinders, discharge all. accumulators and block any load whose movement could generate pressure. Plug all units and cap all lines to prevent entry of dirt into the unit or system.

A. GENERAL

Plug all removed units and cap all lines to prevent the entry of dirt into the system. During disassembly, pay particular attention to identification of the parts, especially the cartridges, for correct assembly. Figure 9 is an exploded view which shows the proper relationship of parts for disassembly and assembly. Refer to Figure 1 and Figure 9 for the correct assembled relationship of the parts. Various steps in the overhaul process are shown in Figures 10 through 22.

B. DISASSEMBLY

1. Basic Pump - Remove the foot mounting and shaft key, if used. Support the pump on blocks or clamp the body in a vise as shown in Figure 10. If a vise is used, use protective jaws to avoid damage to the body and its machined surfaces. Mark the pump body and cover for correct reassembly.

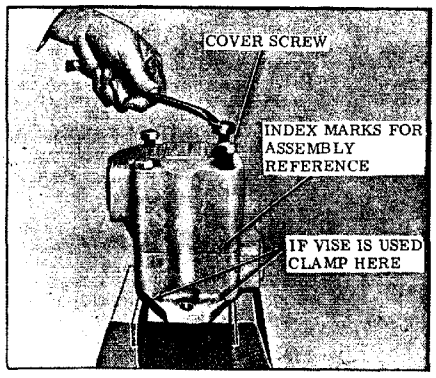


Figure 10 - Beginning Disassembly

Remove four cover screws and lift the cover off the pump. Remove the cover "O"ring. Pull and/or pry out the cartridge as shown in Figure 11. Remove the large spirolox ring and pull the shaft and bearing from the body. Drive the shaft seals out of the body. If it is necessary to remove the shaft bearing, first remove the small snap ring and then press the shaft out of the bearing while supporting the bearing inner race.

2. Cartridge disassembly -

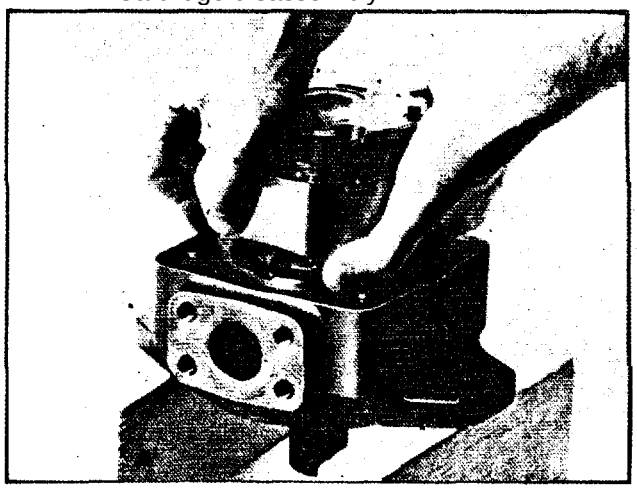


Figure 11 - Cartridge removal

a. Remove the "O"ring, back-up ring and square sealing ring from the outlet support plate.

b. Scribe a line across the outer surface of the cartridge kit. (See figure 12). The scribe marking will provide a reference for parts during assembly.

c. Place the cartridge on a flat surface (outlet support plate down) and remove the two socket head screws.

CAUTION

Do not slide flex side plates across the ring and rotor. Burrs on the ring or rotor can cause deep scratches in the soft brass surface.

d. Slide the inlet support plate and seal packs off the cartridge. DO NOT allow the flex side plate to slide with the support plate. (See figure 13).

Move the flex side plate off center just enough to grab the edge and lift up and away without sliding. (See figure 14).

If a small flat piece of wood is available, place it over the ring and rotor and reverse the cartridge to have the outlet support plate pointing up. (See figure 15). Slide the outlet support plate and seal packs off the cartridge, do not allow the flex side plate to slide with the support plate. Refer to figure 16.

Move the flex side plate off center just enough to lift up and away without sliding. (See figure 17). Remove the cam ring from the rotor and vanes. Locate the arrow stamped into the rotor periphery. Remove the vanes and inserts in order, starting at the arrow. Keep them in order for inspection. (See figure18).

NOTE

Do not remove cartridge locating pins from the inlet support plate unless they are damaged. The pins are of a driv-oc type and can be difficult to remove.

C. INSPECTION AND REPAIR

CLEANING. All parts must be throughly cleaned and kept clean during inspection and assembly. The close tolerance of the parts makes this requirement very important. Clean all removed parts, using a commercial solvent that is compatible with the system fluid. Compressed air may be used in cleaning, but it must be filtered to remove water and contamination.

1. Discard the shaft seal(s), "O"rings, back-up rings and seal packs. Use a new seal kit for reassembly. Refer to parts drawings noted in Table 2 for kit numbers. Wash the metal parts, blow them dry with air and place on a clean surface for inspection.

2. Check the cartridge wear surfaces for pickup, scoring and excessive wear. Slight heat discoloration of the flex side plate bronze surface is normal. Score marks deeper than .001 inch and scratches deeper than .002 inch indicate a new part is needed. Slight scoring and/or scratches can be removed with an oiled arkansas stone.

CAUTION

DO NOT use a dry stone on the bronze surface or scratches will result.

3. Inspect both sides of each vane and insert in order. If pickup, heavy wear or scoring is found, inspect the appropriate rotor slot. Replace scored parts. Refer to the parts drawings noted in Table 2 for part numbers.

4. Inspect the cam ring for vane chatter marks, wear and/or scratches. Replace if scoring is evident.

NOTE

All cartridge kit parts must be free of burrs. Stone the mating surfaces of each part with an oiled arkansas stone prior to assembly.

NOTE

Pre-assembled replacement cartridge kits are available. If the old cartridge is worn extensively, a new kit should be used. Refer to the parts drawings listed in Table 2.

5. Vane and rotor wear canbe checked by inserting the vane in the rotor slot and checking for excessive play. Replace the rotor and vanes if wear is evident.

6. Rotate the bearing while applying pressure to check for wear, looseness and pitted or cracked races.

7. Inspect the seal and bushing mating surfaces on the shaft for scoring or wear. Replace the shaft if larks cannot be removed by light polishing.

D. ASSEMBLY

NOTE

Coat all parts except seals and back-up rings with clean hydraulic fluid to facilitate assembly and provide initial lubrication. Use small amounts of petroleum jelly to hold the "O" rings in place during assembly.

IMPORTANT

During handling and shipping of the precision machined cartridge parts, it is possible to raise burrs on the sharp edges. All sharp edges on the parts of a new cartridge kit should be stoned prior to installation.

NOTE

To reverse direction of a new cartridge kit, simply reverse location of the inlet and outlet support plates, and realign the cartridge with the cover. See steps V.D.1. h thru j.

1. Cartridge - The direction of rotation is as viewed from the shaft end; right hand rotation is clockwise; left hand, counterclockwise.

NOTE

If locating pins were removed from the inlet support plate, install new pins with locking flutes located within the inlet support plate Drive the new pins into the support plate, with a soft tip hammer.

a. Place the inlet and outlet support plates on a flat surface as shown in figure 19. Install seal packs into cavities with seal retainer surface up. ("O"rings facing downward into the cavities.)

b. Place a flex side plate over each of the support plates with bronze wear surface facing up. Align scribe marks to make sure the correct flex side plate is used with the correct support plate.

NOTE

Flex side plates develop a wear pattern with the rotor and vanes and should not be interchanged.

c. For right hand rotation units, set the rotor on the flat wooden board with the arrow pointing right. (For left hand rotation the arrow should point left.) Assemble the vanes and inserts into the rotor in reverse order. (See figure 18). Make sure the sharp chamfer edge of each vane leads in the direction of rotation. All vanes must move freely in the rotor slots with no evidence of bind.

d. Assemble the cam ring over the rotor and vanes with the arrow pointing in the same direction as the rotor. Lubricate the top surface of the rotor and vanes liberally with system fluid.

e. Locate the scribe mark on the cam ring, the outlet support plate, and the flex side plate. marks in-line.

f. Hold the cartridge together to prevent movement and turn the assembly over so the outlet support

plate rests on a flat surface, and the flat wooden board is up. (See figure 20). Remove the flat wooden board.

g. Lubricate the exposed surface of the rotor and vanes with system fluid. Locate the scribe mark on the inlet support plate and flex side plate. Hold the inlet support plate and flex side plate together and assemble over the cam ring and rotor with scribe marks in-line. (See figure 21).

NOTE

The cast-in arrows located next to the socket head screws, indicate cartridge direction of rotation.

h. Thread the two socket head screws into the cartridge until snug, (hand tight).

NOTE

The O.D. of all component parts of the cartridge kit must be in-line with each other or the cover cannot be installed. Align the cartridge as follows:

i. Install the cover over the cartridge. Tap lightly on the cover with your hand until each part centers. Remove the cover gently so as not to disturb alignment. Torque socket head screws to the torque noted on figure 9, and recheck kit alignment with the cover. Repeat until cartridge kit is aligned. (See figure 22.)

j. Check the rotor for bind by inserting the index finger through the shaft opening of the inlet support plate. Hold the cartridge kit in a horizontal shaft position and lift the rotor with the finger. The rotor should move freely back and forth within the cartridge. If the rotor binds, open the kit, clean and stone all possible areas of bind, then reassemble using the aforementioned procedure. The rotor MUST move freely within the cartridge when assembled.

2. Basic Pump - Clamp the body in a vise or place on 2x4 wooden blocks to facilitate assembly. (See figures 10 and 11.)

a. Lubricate the primary shaft seal with petroleum jelly and place in position within the body, garter spring up. See figure 5 for seal arrangements.

b. Use the seal installation tool shown in figure 8 to prevent damage to the seal. Press the seal into the body until it bottoms out.

NOTE

Two shaft seal arrangements are available in the VQ pump series. See figure 5 and table 1. If the pump model code (table 1) indicates that a secondary seal is required, perform the following step.

c. Lubricate the secondary seal with petroleum jelly and place the seal in position against the shaft end of the body. See figure 5b. Use a small hardwood block to drive the seal evenly into the body. Installation is complete when the seal face is flush with the front of the body. DO NOT drive the seal past flush as it can block the body drain opening.

NOTE

If the shaft bearing was defective, install a, new bearing as follows:

d. Press the shaft into the new bearing with an arbor press while supporting the bearing inner race. Refer to figures 5 and 9 for correct location of bearing on the shaft. Install a small snap ring behind the bearing.

e. Place the bearing spacer washer over the shaft, against the front of the bearing. Use a "bullet" over the shaft end to prevent damage to the seal(s). Lubricate the "bullet" with petroleum jelly and carefully push the shaft through the seals until the bearing and spacer is in location within the body. Install the large spirolox ring into the body snap ring groove behind the bearing.

f. Install the square sealing ring into the body. See figures 1 and 9 (sectional view) for location.

g. Install the "O"ring and back-up ring on the cartridge, outlet support plate hub. See figure 9 for location.

h. Carefully install the cartridge into the body so one of the chamfers on the cam ring aligns with the cover inlet port.

i. Lubricate and install the large cover to body "O"ring in place.

j. Install the cover in position; move back and forth until the cartridge pins drop into the cover holes.

k. Oil and install the cover to body bolts, (4 required). Torque to the value noted in figure 9.

l. Turn the pump shaft by hand to verify freedom of the cartridge.

SECTION VII - TESTING

Sperry Vickers Industrial and Mobile application engineering personnel should be consulted for test stand circuit requirements and construction. If test equipment is available, the pump should be tested at the recommended speeds and pressures shown on the installation drawings. (See Table 2).

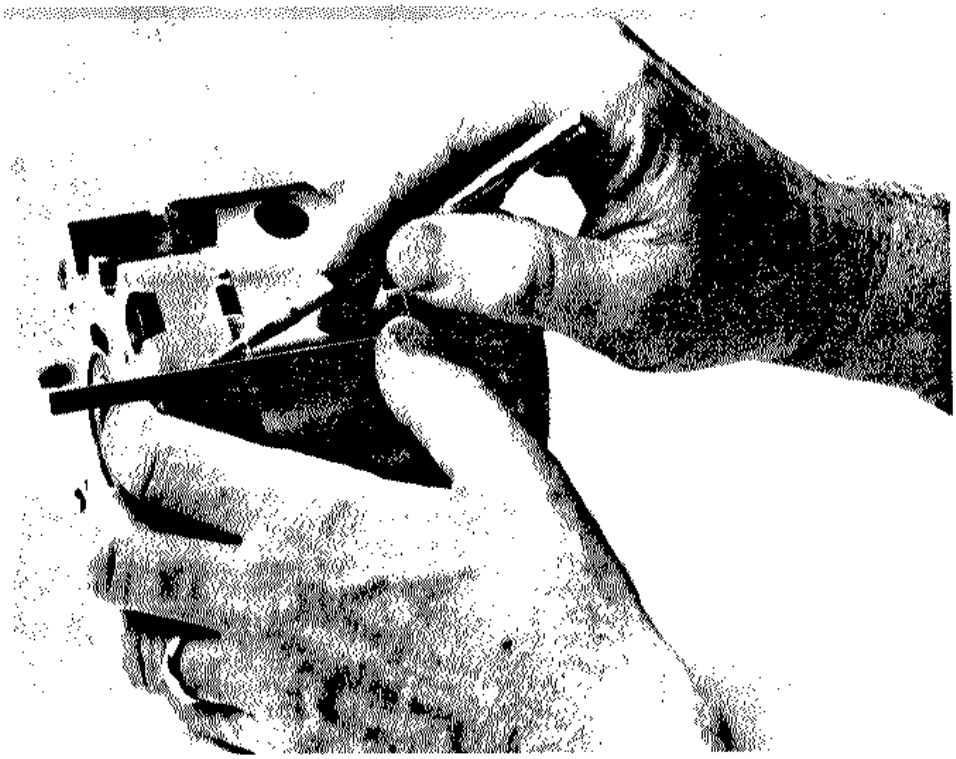


Figure 12 - Scribing the cartridge.

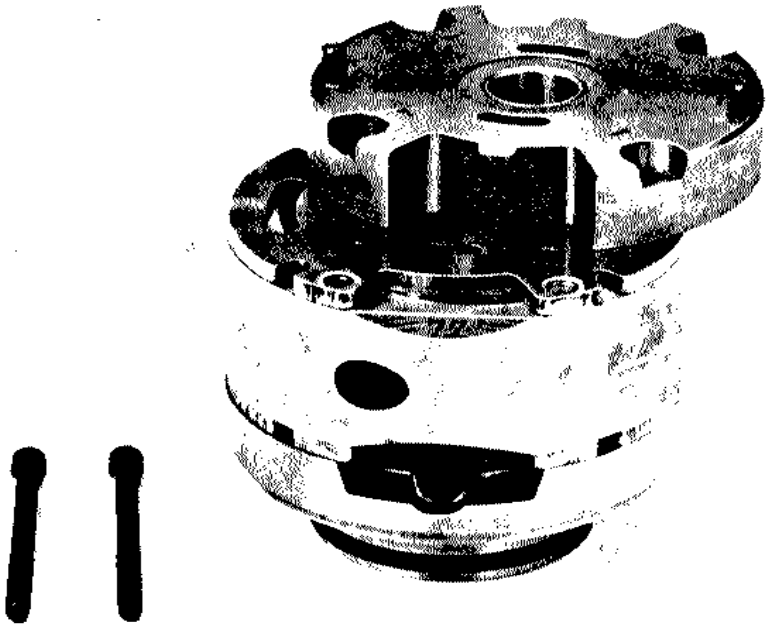


Figure 13 - Inlet support plate removal.

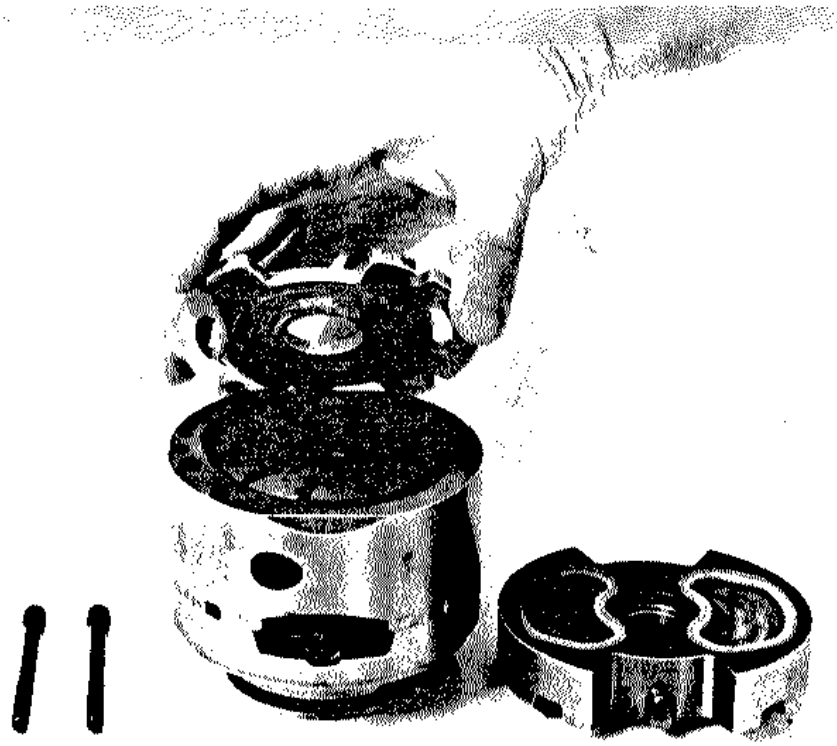


Figure 14 - Inlet flex side plate removal.

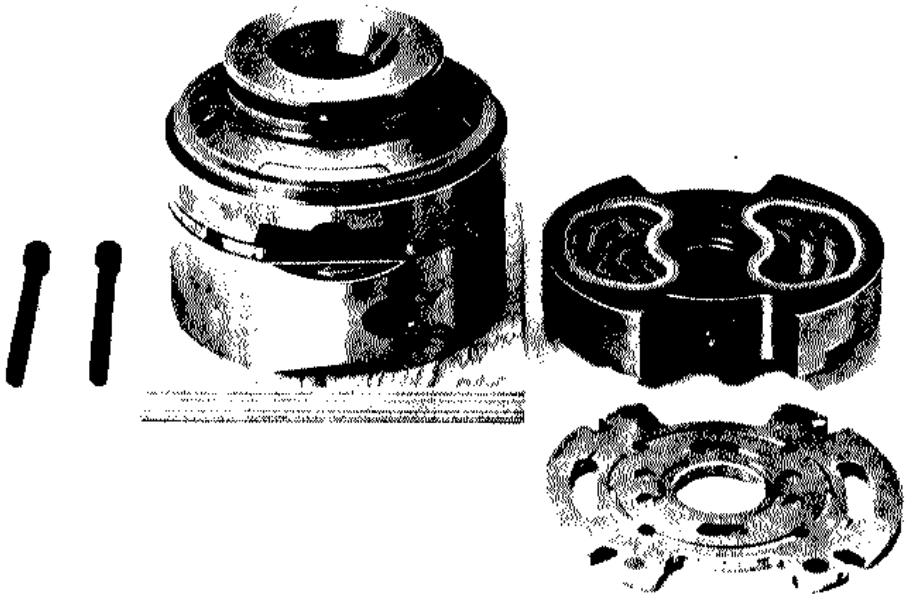


Figure 15 - Reverse cartridge, use a piece of wood to hold ring, rotor and vanes.

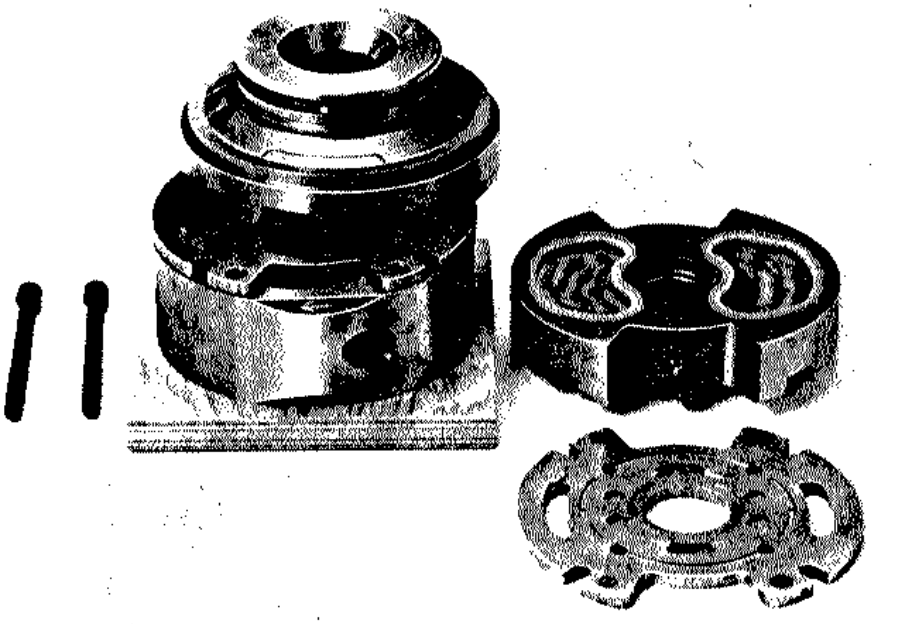


Figure 16 - Outlet support plate removal.

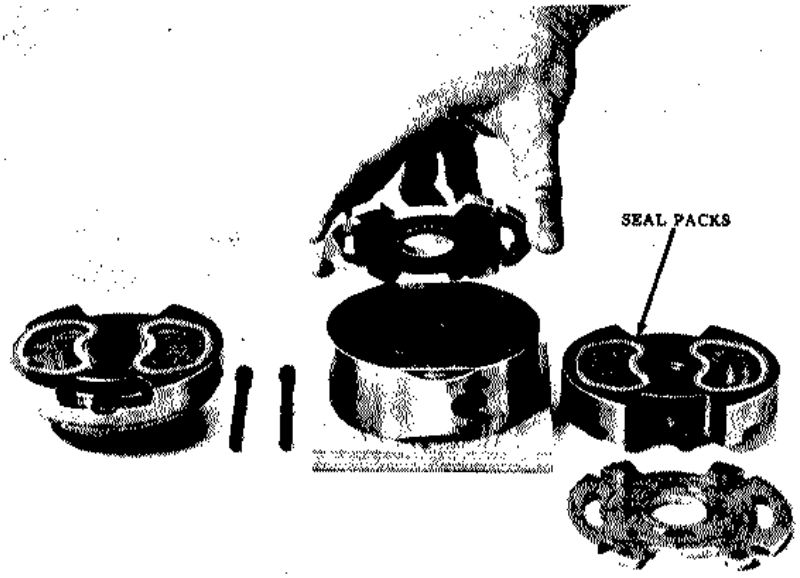


Figure 17 -Outlet flex side plate removal.

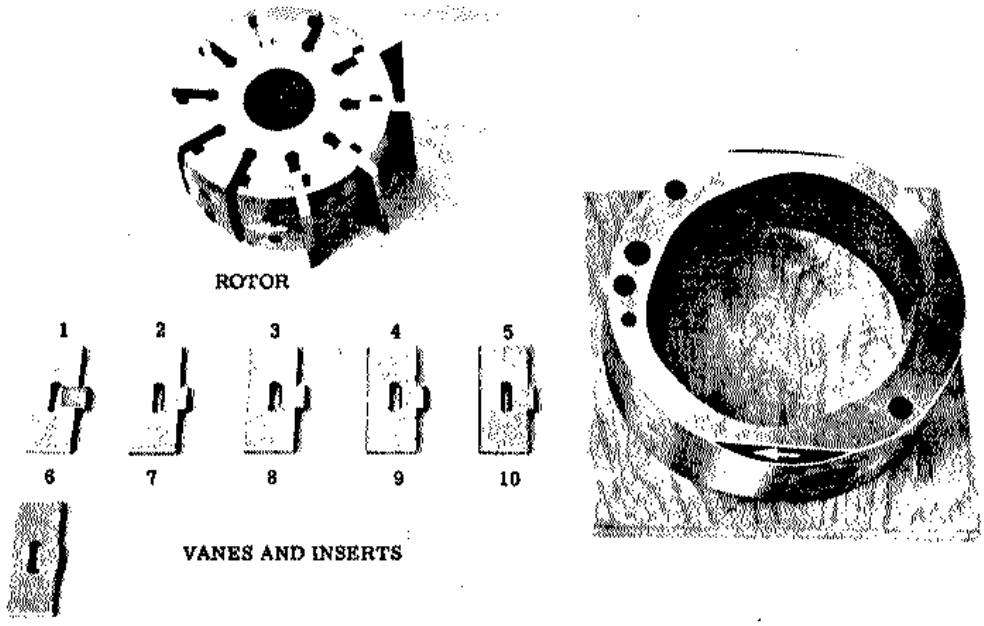


Figure 18 - Sequential removal of vanes from rotor. Starting at arrow on rotor.

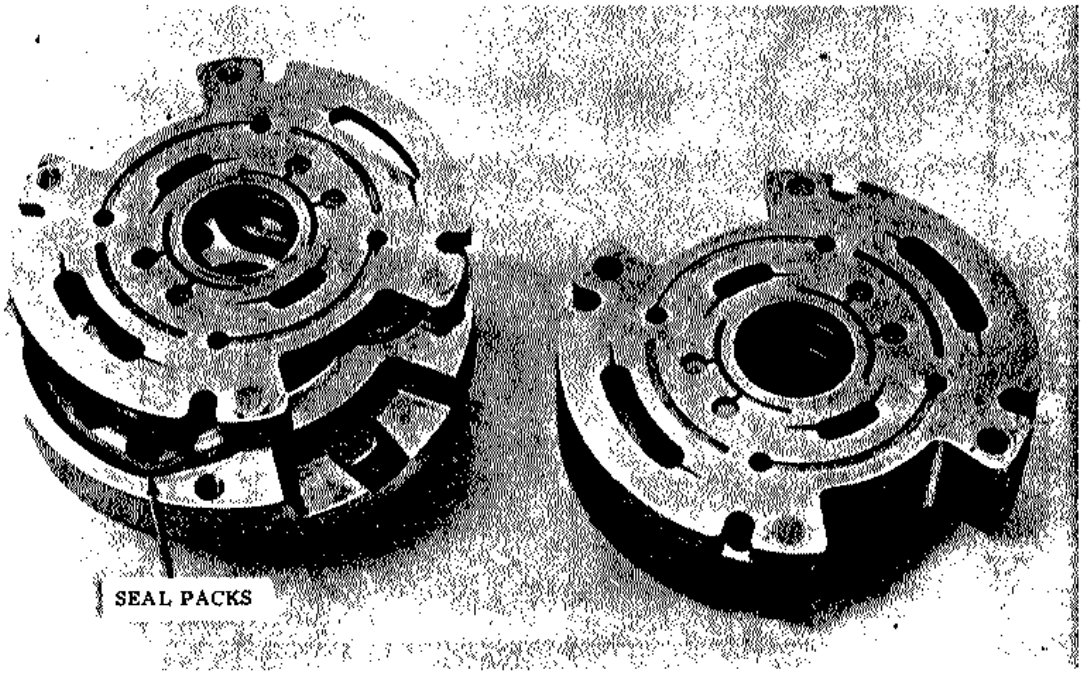


Figure 19 - Assembly of flex side plates over seal packs onto the inlet and outlet support plates.

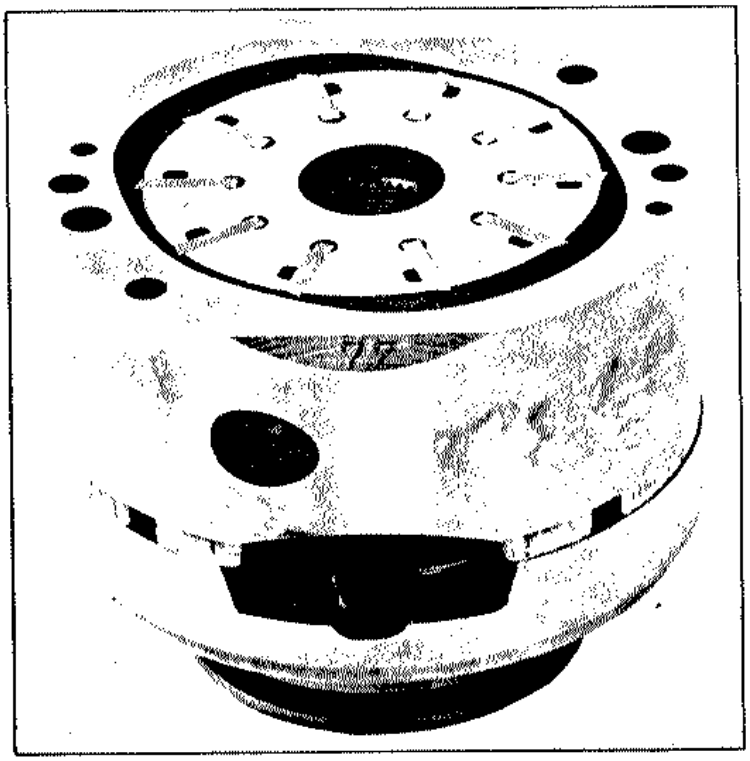


Figure 20 - Outlet support plate and flex side plate assembled to cartridge. Ready for installation of inlet support plate and flex side plate.

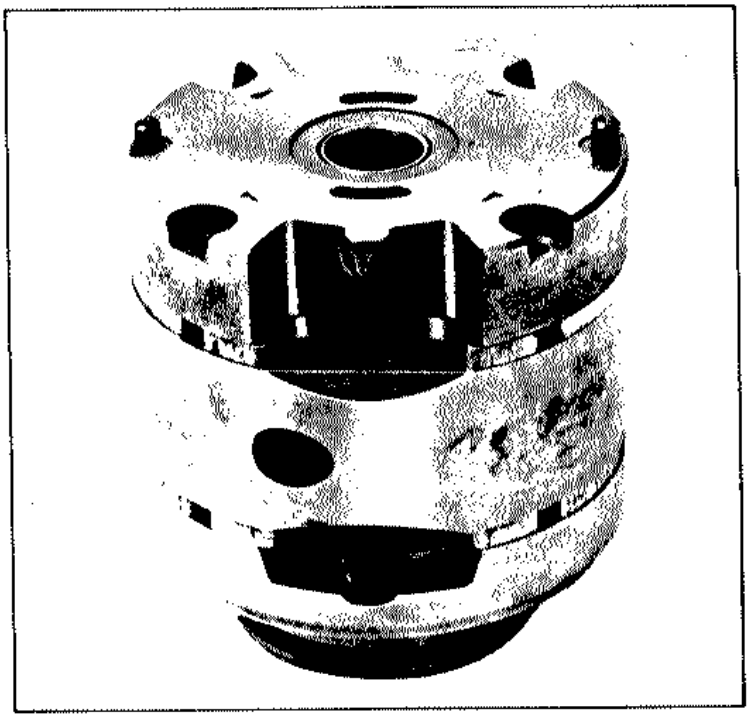


Figure 21 - Cartridge ready for installation of socket head screws.

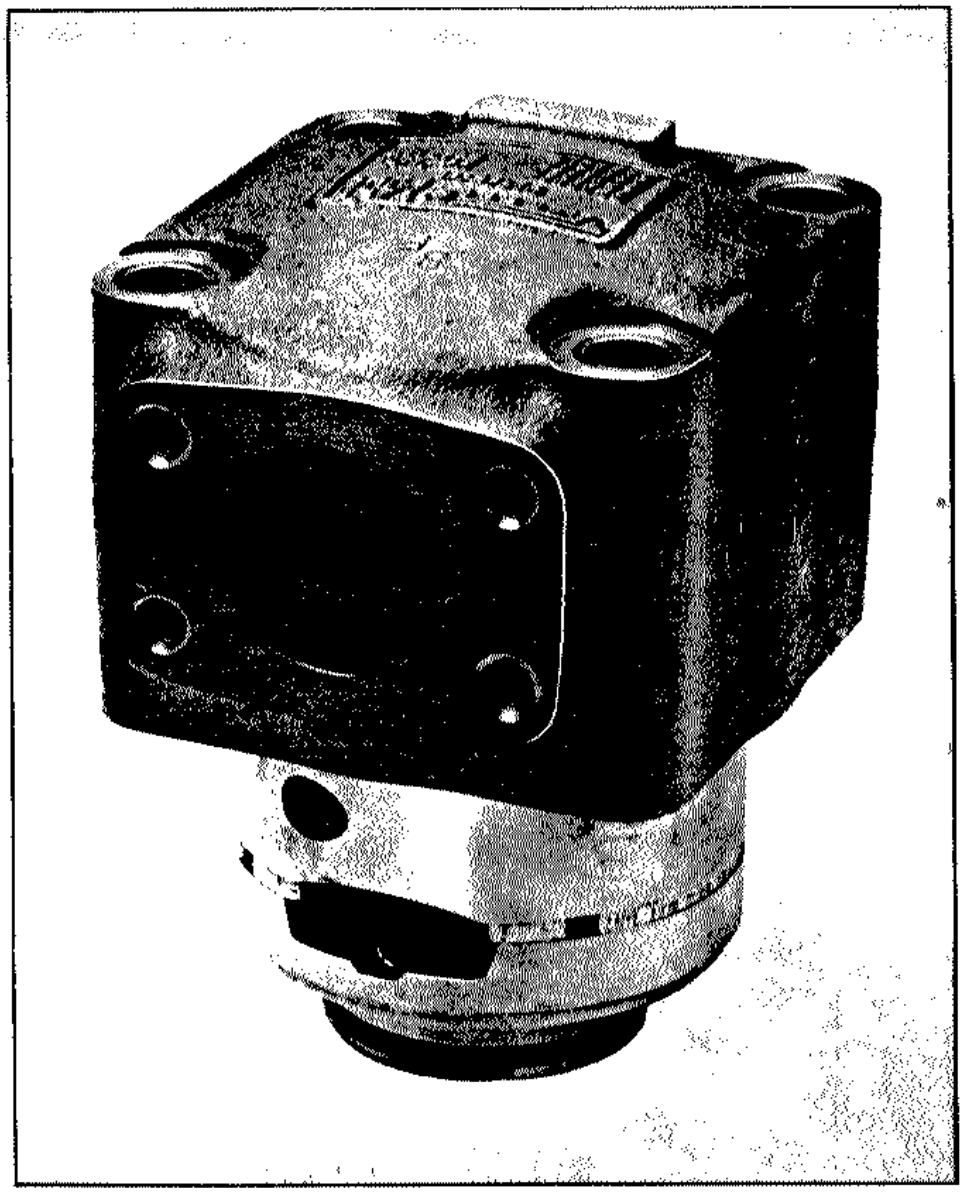
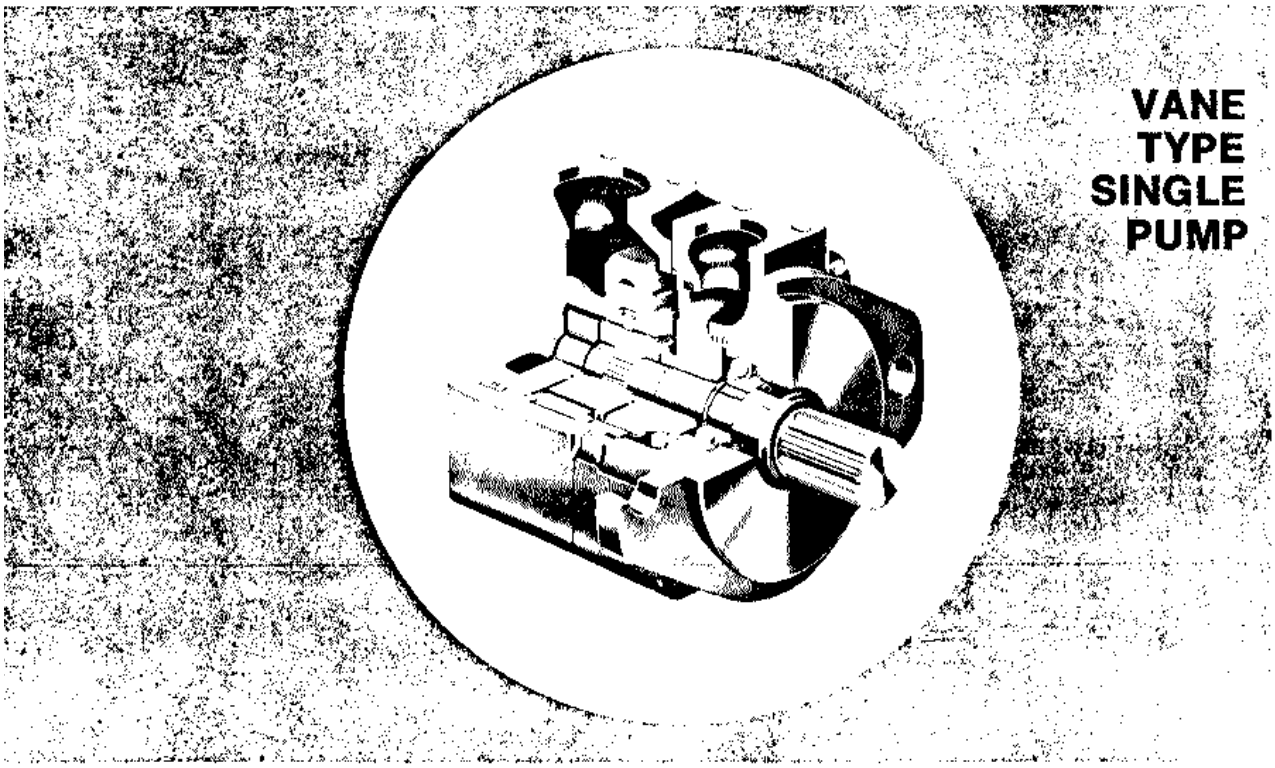


Figure 22 - Aligning cartridge kit with cover.

SPERRY VICKERS



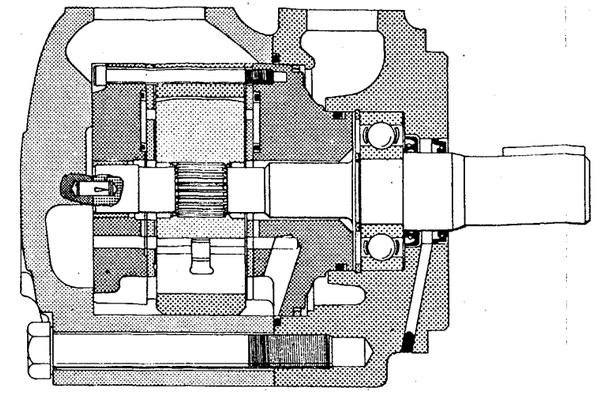
SERVICE PARTS INFORMATION

35VQ**A-86*-20-(L)
36VQ**A-86*-20-(L)

SPERRY VICKERS
TROY, MI. 48084

Revised 5-1-78

I-3167-S



⊖ TO REVERSE CARTRIDGE KIT ROTATION, REMOVE THE TWO (2) 410609 SCREWS, AND REVERSE THE LOCATION OF THE INLET SUPPORT PLATE (409346) AND OUTLET SUPPORT PLATE (412001). REINSTALL THE TWO (2) SCREWS HAND TIGHT. USE PUMP COVER TO ALIGN ALL SECTIONS OF THE CARTRIDGE. REMOVE COVER CAREFULLY AND TIGHTEN SCREWS TO 100 LBS. IN. TORQUE.

□ WIPE O.D. OF SEAL WITH OIL BEFORE PRESSING INTO BODY. APPLY GREASE TO SEAL I.D. BEFORE INSTALLATION OF SHAFT.

* INCLUDED IN CARTRIDGE KIT

○ ASSEMBLE SEAL WITH SPRING LOADED SEALING MEMBER TOWARD BEARING

● ASSEMBLE SEAL FLUSH WITH PILOT FACE WITH SPRING LOADED SEALING MEMBER FACING INWARD AS SHOWN.

MODEL	TYPE DRIVE	BEARING
35V-	DIRECT-	38441
36V-	INDIRECT-	239092

▲ INCLUDED IN SINGLE SHAFT SEAL KIT 920015

▲▲ INCLUDED IN DOUBLE SHAFT SEAL KIT 920016

F3 EQUIVALENT SINGLE SHAFT SEAL KIT 920029

F3 EQUIVALENT DOUBLE SHAFT SEAL KIT 920030

11173 BOLT (4 REQ'D) (OIL & TORQUE TO 150 ± 10 lbf. ft.

234248 COVER (INLET)

TORQUE TO 105 ± 5 lbf. ft.

NOTE
BRONZE FACES MUST BE INSTALLED TOWARD THE ROTOR.

119982 RETAINING RING

193144 SPIROLOX RING

*▲263717 BACK-UP RING

*▲154084 "O" RING

*▲419674 RING SEALING (ASSEMBLY NOTE: INSTALL IN BODY BEFORE INSTALLATION OF CARTRIDGE KIT.)

*▲154101 "O" RING

942355 BODY S/A (OUTLET)

▲□○394973 SHAFT SEAL

193220 RETAINER

KEY

FB-C-10 MOUNTING KIT (INCLUDES SCREWS)

205533 SCREW (2 REQ'D)

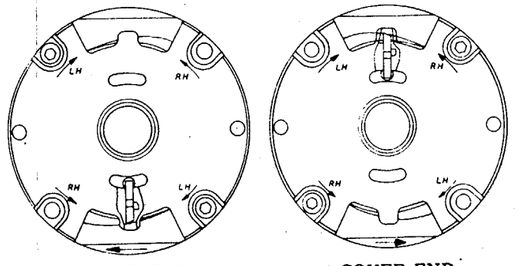
▲□●412009 SHAFT SEAL (USE ON "S" FLANGE MOUNTED MODELS ONLY)

SHAFTS				KEY	TYPE
SINGLE SEAL MODELS		DOUBLE SEAL MODELS			
SHAFT NO.	PART NO.	SHAFT NO.	PART NO.		
1	233624	—	—	88678	STRAIGHT-STANDARD
4	247803	—	—	—	SPLINE-14 TOOTH
11	242287	—	—	—	SPLINE-14 TOOTH
86	392669	—	—	393536	STRAIGHT-HEAVY DUTY
110	413019	110	413019		SPLINE-14 TOOTH

◆NOTE
WHEN ORDERED INDIVIDUALLY, FLEX SIDE PLATE KIT INCLUDES (4) F3 SEAL PACK SUBASSY'S.

CAPACITY (GPM)	SCREW (2 REQ'D)	PIN (2 REQ'D)	INLET SUPPORT PLATE	▲SEAL PACK (4 REQ'D)	◆FLEX-SIDEPLATE KIT	ROTOR	VANE KIT	RING	OUTLET SUPPORT PLATE	CART. KIT	F3 CART. KIT
	THESE PARTS ARE INCLUDED IN CARTRIDGE KIT										
3*VQ21A-(*)***-20(*)	410609	418108	430806 (INCLUDES 327009 BUSHING)	433765 S/A	923953	262154	922700 (INCLUDES 10 VANES & 10 INSERTS)	394961	412003	413420	421582
3*VQ25A-(*)***-20(*)								319396		413421	421583
3*VQ30A-(*)***-20(*)								319397		413422	421584
3*VQ35A-(*)***-20(*)								319398		413418	421585
3*VQ38A-(*)***-20(*)								319399		413419	421586

SHARP EDGE OF VANE MUST LEAD DIRECTION OF ROTATION



⊖COVER END L.H. ROTATION

⊖COVER END R.H. ROTATION

MODEL CODE BREAKDOWN

35VQA* - 86 * 20 (L)**

SERIES

QUIET FLEX
PLATE VANE
TYPE PUMP

SAE RATED CAPACITY
(1200 RPM - 100 PSI)
21 - 21 GPM
25 - 25 GPM
30 - 30 GPM
35 - 35 GPM
38 - 38 GPM

PORT CONNECTIONS
SAE 4-BOLT

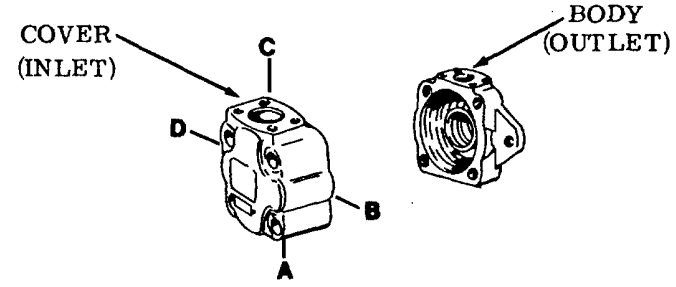
MOUNTING & SHAFT SEALS ASSEMBLY
F-FOOT (SINGLE SHAFT SEAL ASSEMBLY)
S-FLANGE (DOUBLE SHAFT SEAL ASSEMBLY)
OMITTED - FLANGE - (SINGLE SHAFT SEAL)

SHAFT
1 - 86 - SQUARE KEY
4 - 11 - 110 - SPLINED

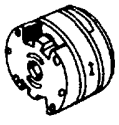
DESIGN NUMBER

PORT POSITIONS

ROTATION
(VIEWED FROM SHAFT END)
L-LEFT HAND, CCW ROTATION
OMITTED-RIGHT HAND



MODEL	INLET COVER POSITIONS (VIEWED FROM COVER END)
35VQ**A-***A-20(L)	OPPOSITE OUTLET PORT
35VQ**A-***B-20(L)	90° CLOCKWISE FROM OUTLET
35VQ**A-***C-20(L)	IN-LINE WITH OUTLET
35VQ**A-***D-20(L)	90° COUNTERCLOCKWISE FROM OUTLET



WHEN ORDERING SPARE CARTRIDGE PARTS, IT IS RECOMMENDED THEY BE OBTAINED IN CARTRIDGE KITS. KITS ARE ASSEMBLED AND TESTED BY VICKERS FOR EITHER RIGHT OR LEFT HAND ROTATION. IF LEFT HAND ROTATION IS REQUIRED, IT SHOULD BE SPECIFIED ON PARTS ORDER BY ADDING SUFFIX "L" TO CARTRIDGE KIT NUMBER: FOR EXAMPLE, 413420-L.

To insure sustained efficiency and maximum trouble-free life of this precision equipment, initial and continuous filtration of the fluid medium to 25 microns absolute or less is essential. (For information pertaining to Sperry Vickers economical 3 or 10 micron filters, see installation drawing 522140.)

Litho in U. S. A.

PRINTED IN U. S. A.

SPERRY VICKERS

HIGH PERFORMANCE HYDRAULIC MOTORS

MODEL SERIES 35M (–20 DESIGN)
FIXED DISPLACEMENT – VANE TYPE
2-BOLT FLANGE OR FOOT MOUNTING

General Data

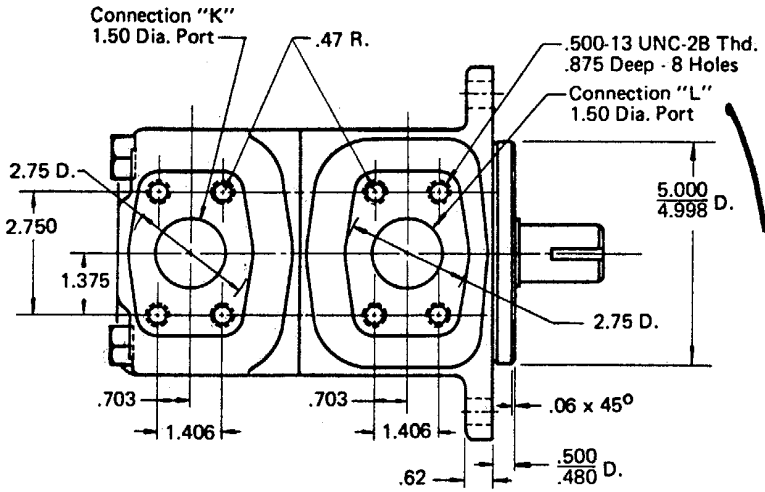
These 35M motors are of Sperry Vickers "balanced vane type" construction. Operation may be intermittent or continuous in either direction of rotation. When properly protected by valving, motors may be used for cycle reversing or stalled without damage.

Torque Output (Lb. In.) . . . . . See Curves Page 2
Speed (RPM) Maximum. . . . . See Chart Page 3
Pressure (PSI) Rating. . . . . See Chart Page 3

Fluid supply to connection "L" turns shaft clockwise as viewed from shaft end. Fluid supply to connection "K" turns shaft counter-clockwise.

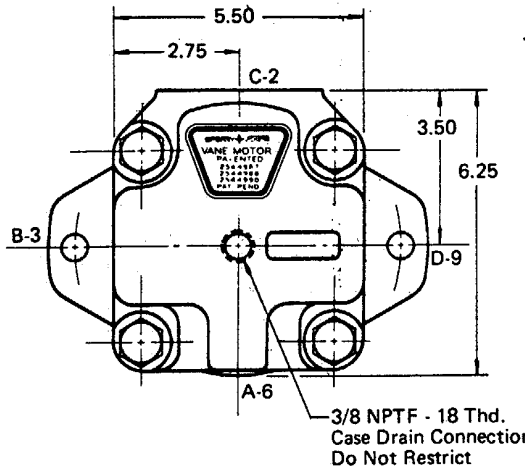
Connection "K", shown assembled in line with connection "L", is designated by letter "C" in model number.

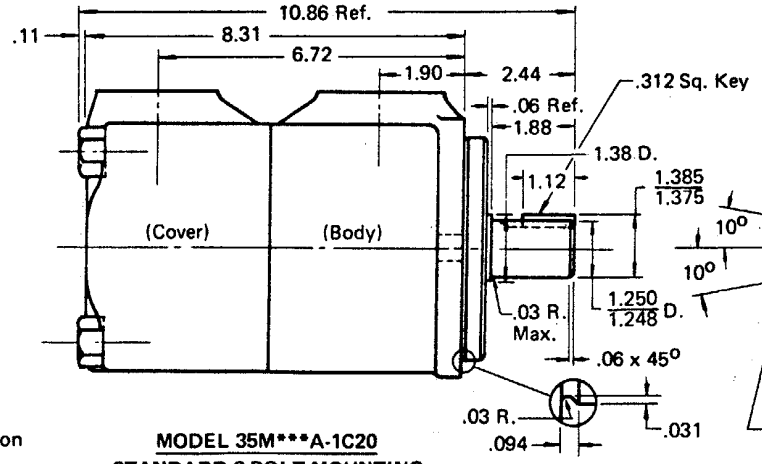
4-bolt SAE pad connections will also accommodate appropriate 2-bolt flanges.



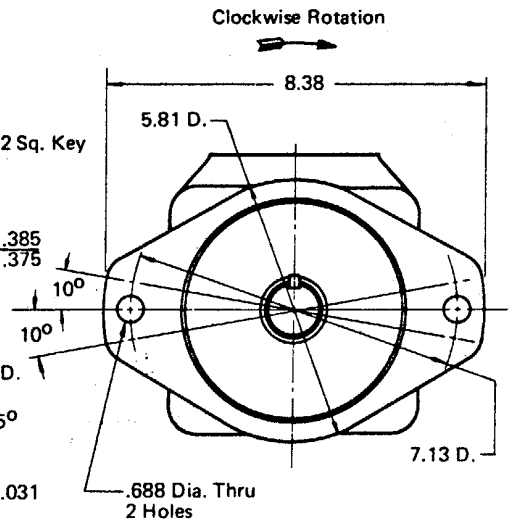
Model Number	Torque Lb. In. Per 100 PSI	Displacement Cu. In./Rev.
35M80A-1C20	80	5.10
35M95A-1C20	95	6.12
35M115A-1C20	115	7.44

"K" and "L" ports are 4-bolt connection pads for use with SAE 4-bolt flanges and accept Sperry Vickers model FL1-12-12P-10 or FL1-12-12W-10 flanges. Refer to drawing 522930 for selection.

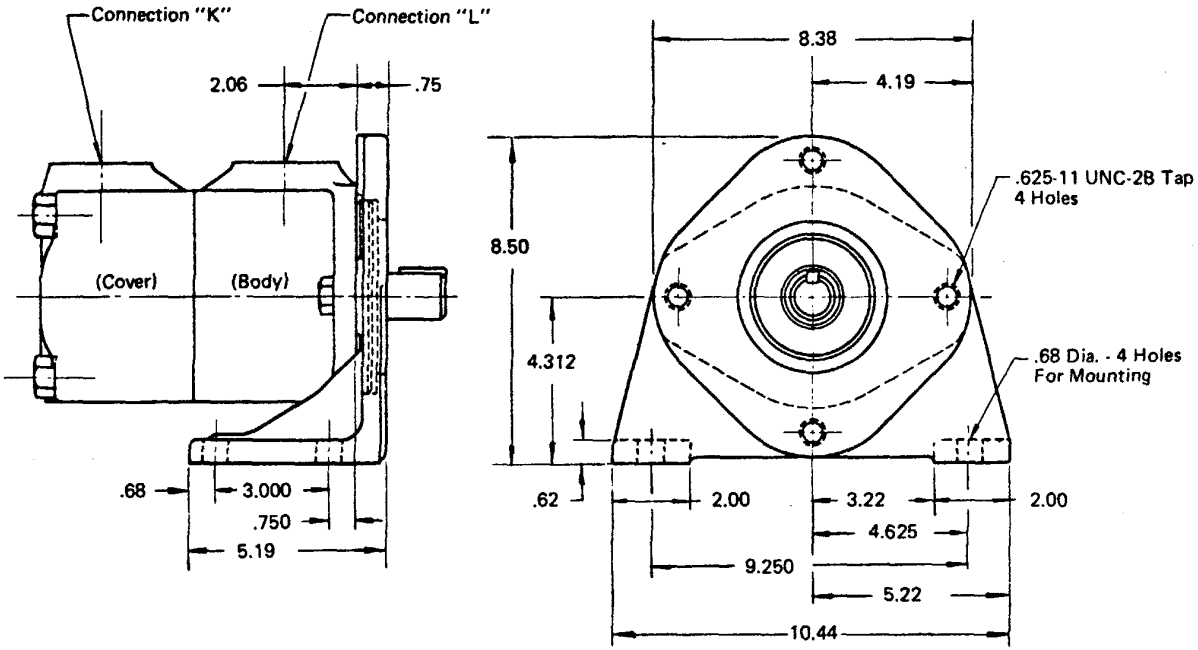




MODEL 35M***A-1C20
STANDARD 2-BOLT MOUNTING
NO. 1 STRAIGHT KEYED SHAFT



Revised 1 - 2 - 81



MODEL 35M***A2-1C20
FOOT MOUNTING

Foot Bracket Mounting

Motor may be assembled to foot bracket with connection "L" in any one of four positions. The four optional positions are specified in the model number as shown below:

35M**A2-1C20
└ As shown – connection "L" at 12 o'clock

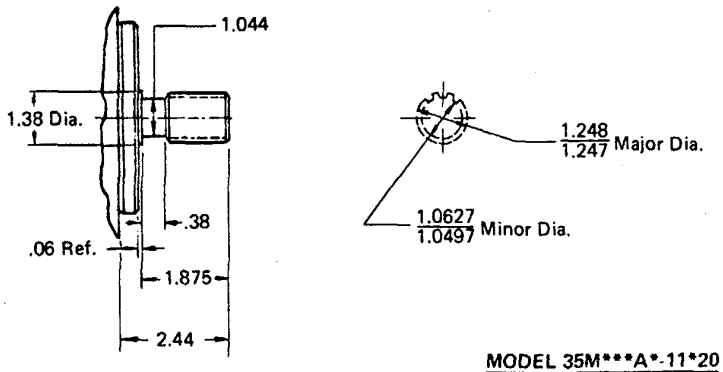
35M**A3-1C20
└ Connection "L" at 3 o'clock – viewed from shaft end

35M**A6-1C20
└ Connection "L" at 6 o'clock – viewed from shaft end

35M**A9-1C20
└ Connection "L" at 9 o'clock – viewed from shaft end

Note

For separate "foot bracket kit" order model FB-C-10 (see model code).



MODEL 35M***A*-11*20
NO. 11 SPLINED SHAFT

SAE Involute Spline Data
Flat Root – Major Dia. Fit (Modified OD)
12/24 Diametral Pitch
14 Teeth – 30° Pressure Angle
1.0822 T.I.F. Dia.
1.1667 Pitch Dia.
Cir. Tooth Thickness:

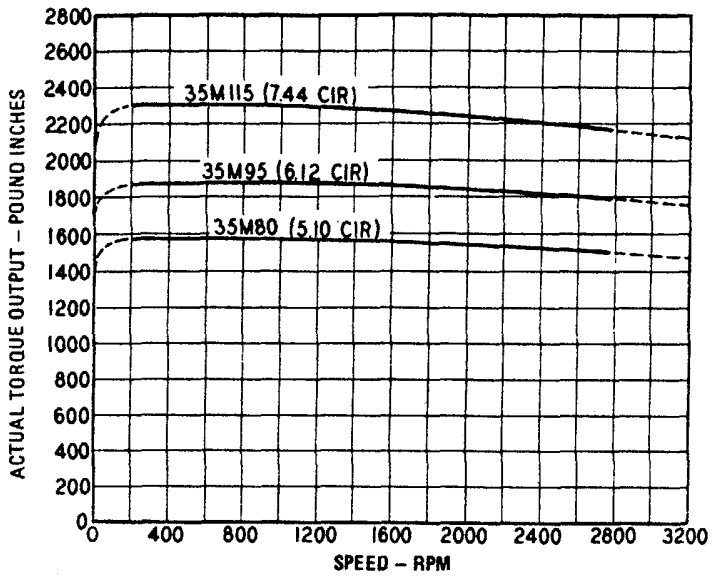
Max. Effective	.1294
Min. Effective	.1282
Max. Actual	.1277
Min. Actual	.1265

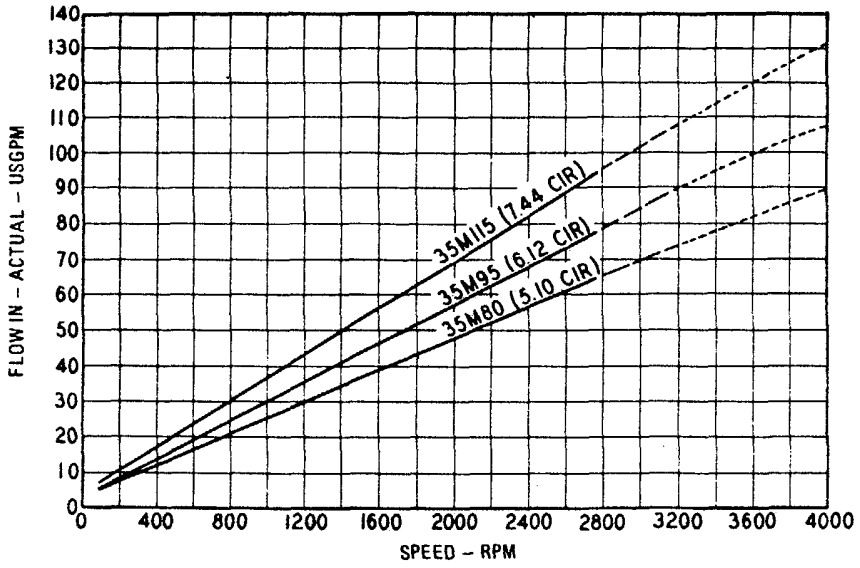
520150-1

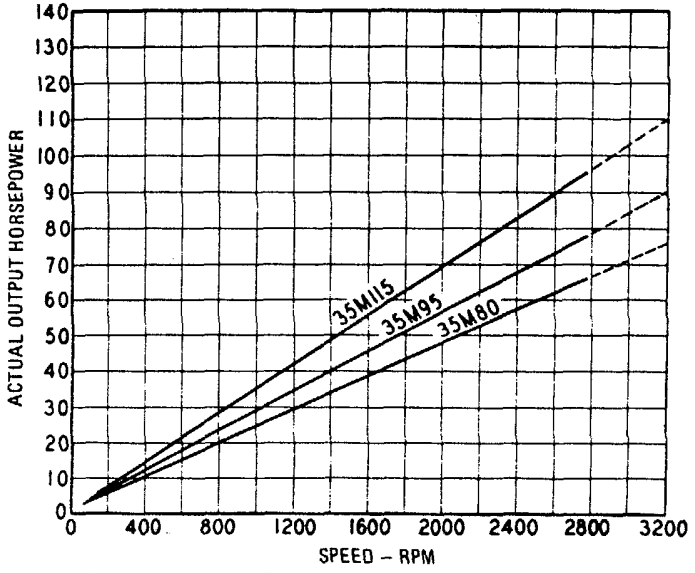
TYPICAL PERFORMANCE CURVES

Oil Temperature – 120° F. Oil Viscosity – 150 SSU At 100° F. Operating Pressure – 2000 PSI
(Dashed Portion of Curves Represents Intermittent Operation)

SERIES 35M VANE MOTORS (-20 DESIGN)







520150-2

Operating Specifications

Maximum Speed and Pressure Ratings

Continuous Operation		● Intermittent Operation	
Speed - RPM	Pressure - PSI	Speed - RPM	Pressure - PSI
3600	500	4000	500
3300	1000	3800	1000
2800	2000	3200	2000
2600 & Lower	2250	3000 & Lower	2500

● Intermittent service equals 10% of overall time, each application of pressure and or speed not to exceed over 6 seconds.

■ Minimum Operating Speed

Minimum speed is normally 100 RPM. Lower speeds are permissible depending upon torque requirements and nature of load.

Case Drain Connection

A full size unrestricted drain line must be connected directly from the case drain connection to a location below the lowest fluid level in the system reservoir.

Pressure surges at the drain connection may not exceed 25 PSI. Nominal pressure not to exceed 10 PSI. Minimum pressure 0 PSI.

Running Torque. . . . . See Curves
Starting Torque. . . . . 65% (Minimum) of 400 RPM Torque

■ Type of Drive

Direct drive through a flexible coupling is recommended. However, belt, chain, or gear drives can be used. For specific recommendations contact your local Sperry Vickers representative.

Drive Rotation

Rotation can be to maximum RPM in either direction.

Oil supply to connection "L" turns shaft clockwise. Oil supply to connection "K" turns shaft counterclockwise.

Filtration (Mandatory). . . . . 25 Microns or Less

■ Fluid and Temperature Data

Petroleum Oils - Use antiwear industrial hydraulic oils or automotive crankcase oils having letter designations SC, SD, SE or SF.

Running viscosity range 70 to 250 SUS. Operating temperature 120° F. recommended, 150° F. usual maximum.

For details, refer to hydraulic fluid and temperature recommendations for industrial machinery, data sheet I-286-S in catalogue.

Weight Lbs. (Approx.) 64
With Foot 77

■ This motor is designed to meet specifications as outlined. To insure maximum motor performance in conjunction with your specific application, **consult your local Sperry Vickers representative if your:**

Required minimum speed is less than 100 RPM
Application requires an indirect drive
Application has overrunning loads
Application requires braking or retarding
System requires fire resistant fluid
Oil viscosity at operating temperature is not within 100 to 250 SUS
Operating temperature is not within 100 to 150° F. With *proper application and fluid* consideration, a greater temperature range is permissible
Needs require application assistance

Model Code

35 M 115 A 2 – 1 C 20 – ***

Series Designation
35 – Standard Bearing
36 – Heavy Duty Bearing

Vane Motor

Ring Size and Nominal Torque Rating (Lb. In.) / 100 PSI
80 – 80
95 – 95
115 – 115

Mounting Flange and Port Connections
A – SAE 4-Bolt Flange Connections and SAE Type 2-Bolt Type "C" Mounting

Foot Bracket Mounting
(Omit If Not Required)
For Separate "Foot Bracket Kit" Order Model FB-C-10
See Page 1 For Complete Details

Shaft Type
1 – Straight Keyed
11 – Splined

Cover Position
(Viewed From Cover End)
A – Cover Port Opposite Body Port
B – Cover Port 90° Counterclockwise From Body Port
C – Port Connections In Line
D – Cover Port 90° Clockwise From Body Port

Design Number
Subject To Change. Installation Dimensions Remain The Same For Design Numbers 20 Thru 29.

Special Features

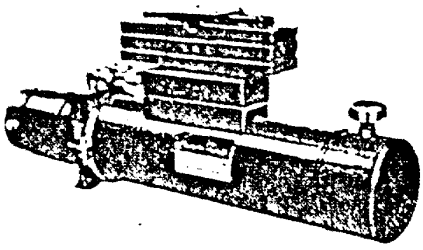
GENERAL SPECIFICATIONS

BULLETIN FPI353.2

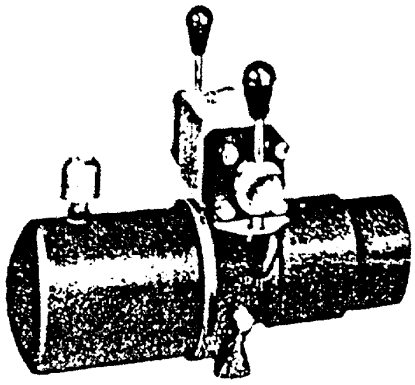
WEBSTER FLUID POWER EQUIPMENT

DC MPT POWER PACS

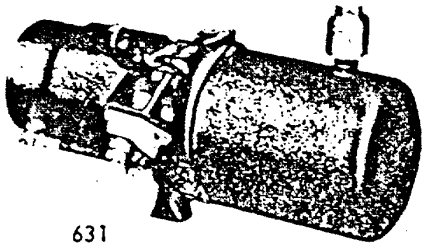
MARCH



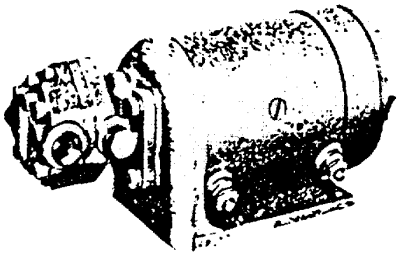
639 With 4V Solenoid Valve



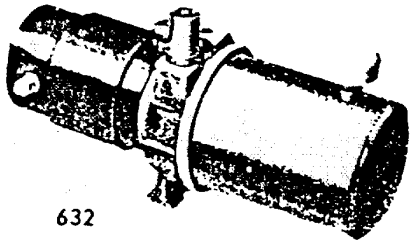
637



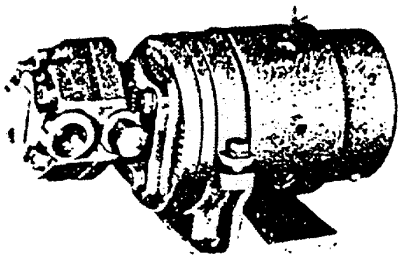
631



640 Y MOTOR

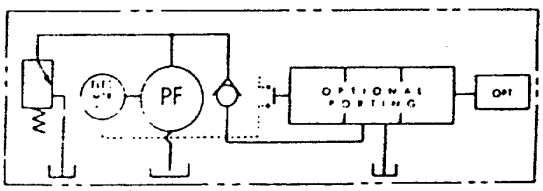


632



640 W MOTOR

Completely versatile . completely dependable the DC MPT units provide a compact, convenient, economical source of fluid power. Operating from standard auto, aircraft or marine batteries, they are ideal units for applications such as industrial lift trucks, tail gate lifts, small dump bodies, snow plow lifts, truck-mounted hoists and lifts, trailer landing gear, telescoping ladders and similar operations. They give fast response and positive raise-hold-lower operation, at pressures to 2500 psi. Units are completely assembled, ready to attach to cylinders, motors and other components. This, combined with the simple two-bolt mounting makes installation easy.



STA-RITE INDUSTRIES, INC.

FLUID POWER DIVISION

WEBSTER ELECTRIC COMPANY, INC.

general specifications

motors:
6, 12, 24 and 36 volt automotive, intermittent duty 'w' series motors standard. 12, 24 and 36 volt heavy duty motors 'y' series are available on 640 model, and others on special order. 'y' series motors may be operated for longer periods than 'w' series motors. Neither, however is a continuous duty motor. If continuous duty motor is desired consult factory. All DC motors include motor starter solenoid except on 632 & 640 Series - WHERE IT IS OPTIONAL.

pumps:
Eight models available. Positive displacement, gear type pumps are supplied with internal check valve on discharge port and externally adjustable relief valve unless otherwise specified (in writing).

tanks:
Available in 1/2, 3/4, 1, 1-1/2 and 2 gal. capacities. Constructed of heavy gage deep draw steel. Tanks have leakproof mounting, easily removed for cleaning.

mounting:
2 bolt for vertical mounting with motor up or down or for horizontal mounting with tank filler rotated 90°, 180°, or 270° from standard (specify in code).

strainer:
The 35 mesh suction line strainer supplied with each unit is positioned in tank to afford maximum submersion in specified mounting position.

oil recommendation:
SAE type 'A' transmission oil.

models:
DC-MPT's are available in several models, with or without tanks, with lever, solenoid or manual control valves and each with a selection of pump capacities and DC motor voltages. General specifications above apply to all models.

model 630:
This model is equipped with a 3 position, raise, hold, lower control valve with built in switch which energizes motor in 'raise' position. Lever moves parallel to length of unit, has 3-1/2" of travel with position stops. Available with spring centering (code AB) or without (code AA).

model 631:
Identical to model 630 except control lever moves at right angle to length of unit. Specify 'AB' spring center or without 'AA' in code.

model 632:
This model is equipped with a solenoid valve for remote control of raise, hold and lower functions. Optional starter solenoid on motor energizes motor to raise and valve solenoid to lower. A 1/4" NPTF pressure port, relief and check valves are standard for this series. Does not include control box and cord.

model 636:
This model is equipped with a Webster 3-way (code AA), tandem center, shear seal control valve, or 4-way (code BA) for use with double acting cylinders. Switch on valve energizers motor in 'raise' position.

model 637:
Similar to model 636 but equipped with dual 4-way valves (code BA/BA) or combination 3-way and 4-way valves (code AB/BA) with handle options.

model 639:
This model similar to model 636, includes a solenoid motor starter and may be ordered with 3/8" NPTF porting (code N) or with 1/4 NPTF pressure and 3/8 NPTF return ports (code T). 639 may be ordered with 4V-AAA-A 12 or 24 VDC solenoid valve.

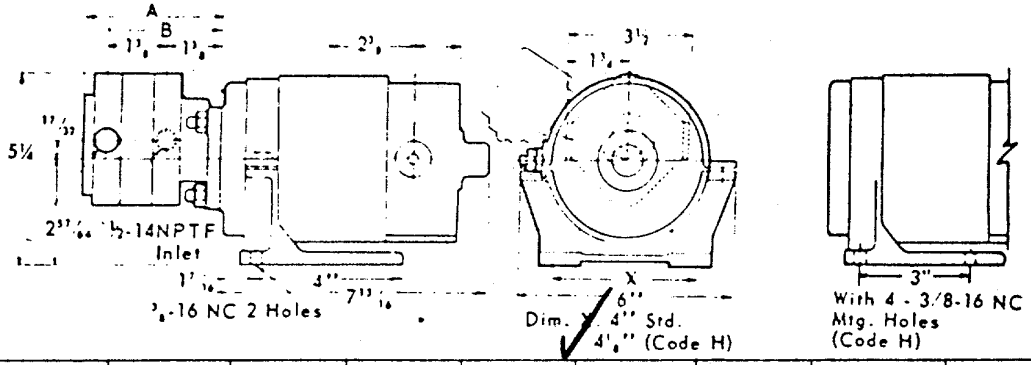
model 640:
This unit consists of a motor and pump unit only and may be ordered with optional motor solenoid (code A) or without (code B). Omit tank size in code.

Standard
Relief valve settings on model 640 DC power pacs are as indicated below. Relief valve settings other than those indicated may be available, please consult factory for details prior to ordering

PUMP	SETTING (PSI)	PUMP	SETTING (PSI)
0H6B	2000	0H3B	2000
0H0B	2000	1HBS	1500
0H1B	2000	2HBS	1500
0H2B	2000	3HBS	1225

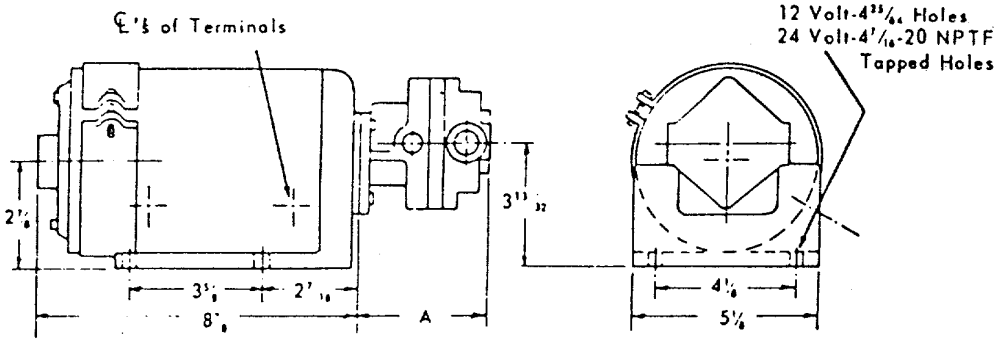
When ordered with the series 'W' motors the 2 hole mounting is standard. Units with 4 hole mounting (code H) or less mounting (code I) are available.

In addition to the standard models offered above, almost any component configurations are available to quantity users. Indicate specific requirements.



Pump	OH6BS	OH0BS	OH1BS	OH2BS	OH3BS	1HBS	2HBS	3HBS
Dim. A	3-5 16	3-5 16	3-3 8	3-1 2	3-5/8	3-3/4	3-15/16	4-1/8
Dim. B	2-11 16	2-11 16	2-3 4	2-7 8	3	3-1 8	3-5/16	3-1/2

model 640 with 'w' series motor (standard duty)



model 640 with 'y' series motor (heavy duty)

ordering code

example – 630 WC 09 D B 1500 A * (Number assigned to denote customers special model)

Omit from code on 640 models — Valve Options See Below

Model Number	Motors*	Pumps	Tanks	Mounting	Pressure
630	'W' Series STD	03 - OH6B	D - 1/2 gal.	A - none	specify full blowing pressure in PSI.
631	WB - 6 volt	07 - OH0B	E - 3/4	B - horz-std.	
632	WC - 12 volt	09 - OH1B	F - 1	C - rotated 90° } CCW	
	WD - 24 volt	14 - OH2B	H - 1-1/2	D - rotated 180° } TANK	
636	WE - 36 volt	20 - OH3B	J - 2	E - rotated 270° } END	
637	YC - 12 volt HD	25 - 1HBS	K - special	F - motor up	
639	YD - 24 volt HD	28 - 2HBS	size	G - motor down	
640		35 - 3HBS		H - 4 hole mtg. (640 with 'W' motor only)	
				I - no mtg. (640 with 'W' motor only)	

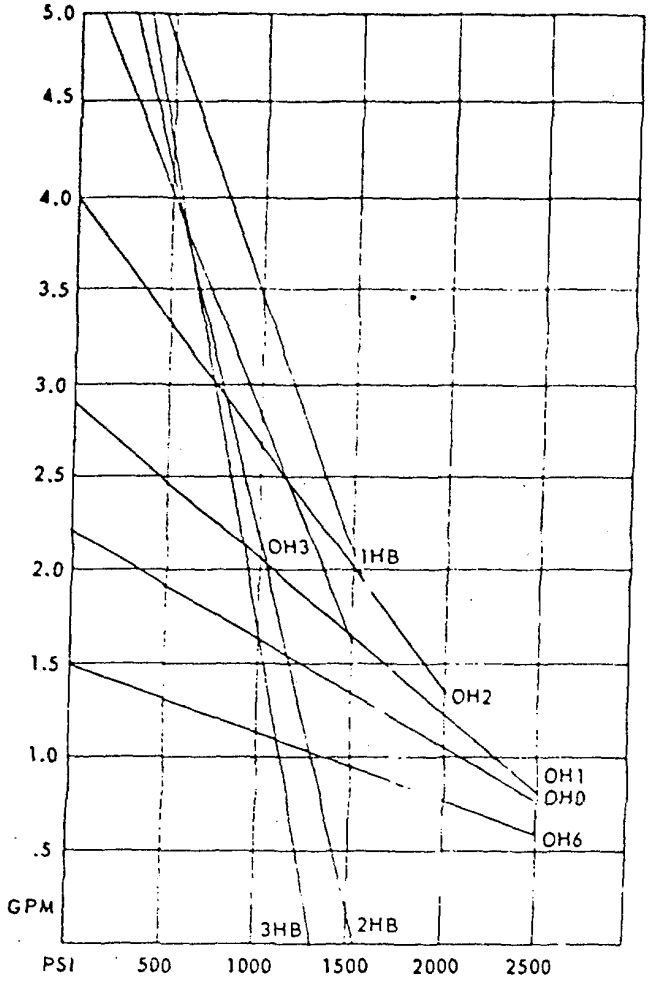
* 'W' STD duty motors
'Y' Heavy duty motors

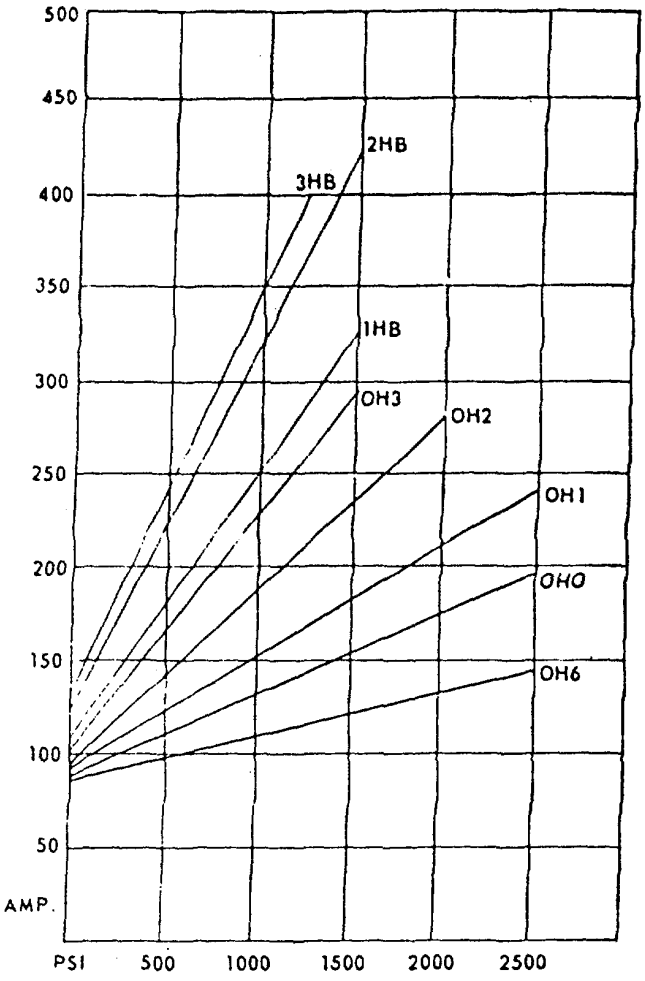
valve option code per model

Models	Code	Description
630 & 631	AB	Spring centered
	AA	No spring
636	AA	3 way valve (2)
	BA	4 way valve (2)
637	BA BA	2 – 4 way valves (2)
	AB BA	1 – 3 way and 1 – 4 way valve (2)
639	N	3 8 NPTF ports
	T	1 4 NPTF pres. & 3 8 NPTF tank ports
632 & 640	A	With motor solenoid
	B	Without motor solenoid

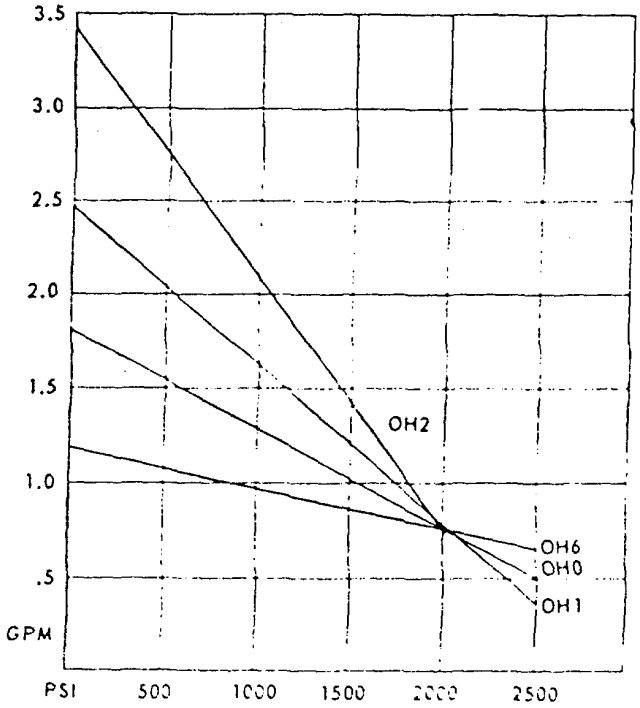
(2) Spring centered ball handle standard

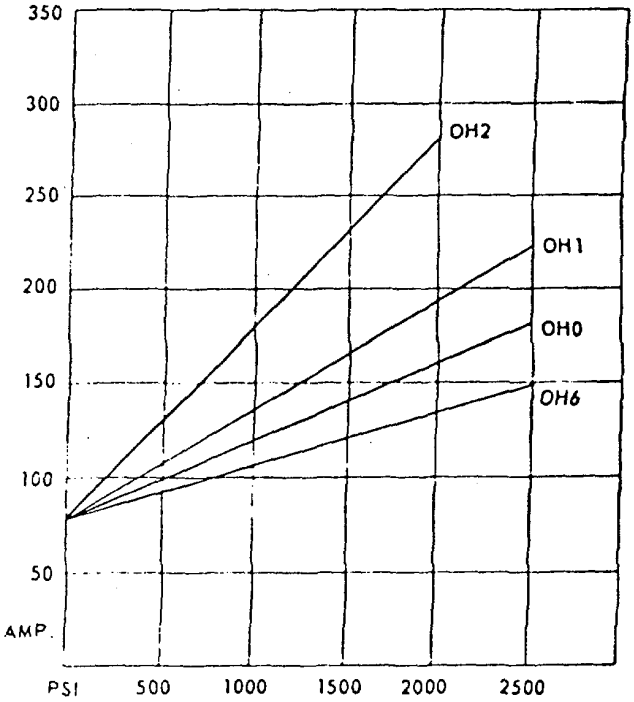
note curves run with ATF type 'A' oil @ 72° – 400 SSU. 12 V DC motors.





performance curves – 640 series 12VDC





performance curves – 630, 631, 636, 637 and 639 series 12VDC

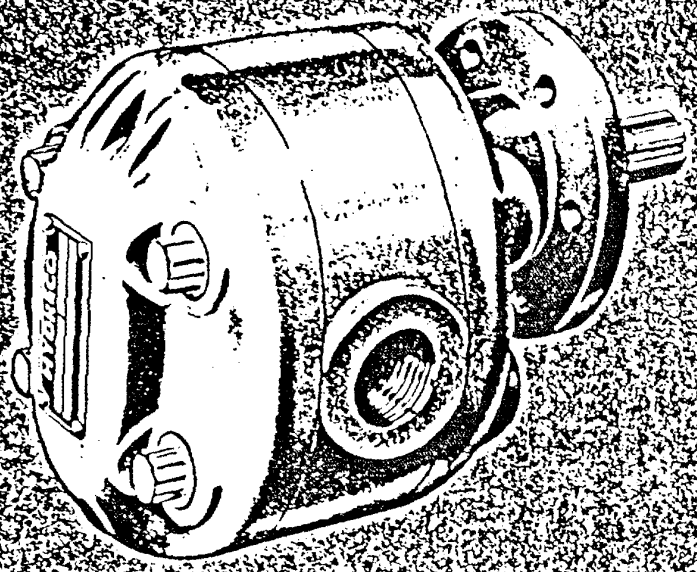
HYDRECO

HYDRAULIC EQUIPMENT

BULLETIN
10-110.1
MARCH, 1964

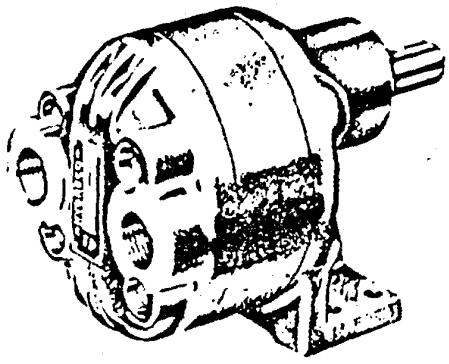
PRESSURE BALANCED BI-ROTATIONAL GEAR PUMPS

1500 AND 2000 SERIES



Hydreco Gear Pumps are expressly designed for fluid power applications on heavy duty, high capacity earth moving, materials handling and farm equipment where the duration of the pressure cycle at maximum operating pressures is long and where the requirements of life expectancy are high. Hydreco Gear Pumps likewise meet the severe duty requirements of many machinery and industrial applications.

- 1500 PSI CONTINUOUS
- 2400 RPM — 1500 SERIES
- 2000 RPM — 2000 SERIES
- 3 TO 25 GPM AT 1200 RPM
- SIDE OR REAR PORTS
- FOOT OR FLANGE MOUNT



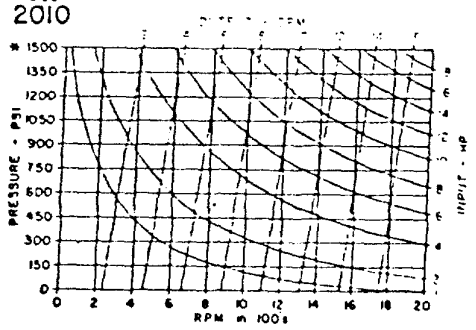
Refer to the performance data to select desired pump size, then change the 2000 portion of any required model number to 2010, 2015, 2020 or 2025

Tested with oil at 120°F and viscosity of 120-135 SSU 10 Micron filtration recommended for maximum life.

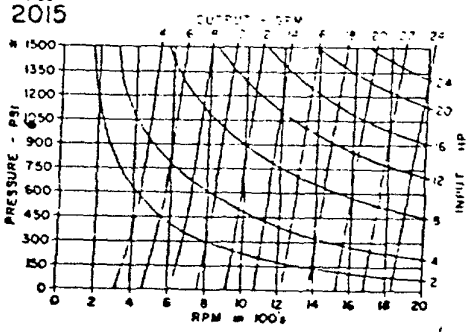
Use models with an outboard bearing for applications where the drive shaft is subject to side thrust

Inlet is on left when pump rotates clockwise and on the right for counterclockwise rotation - when viewed from shaft end.

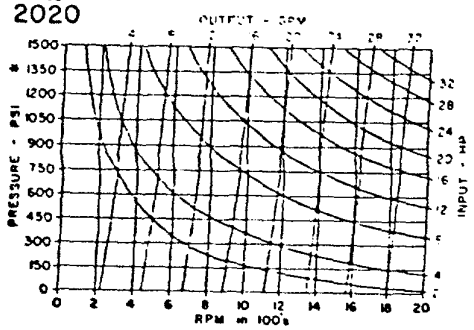
SIZE
2010



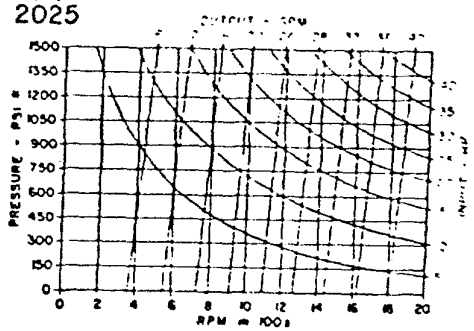
SIZE
2015



SIZE
2020



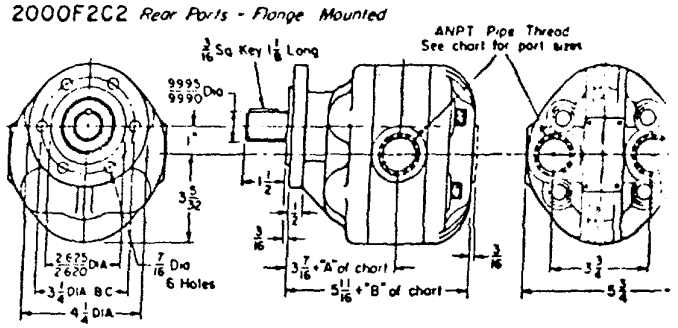
SIZE
2025



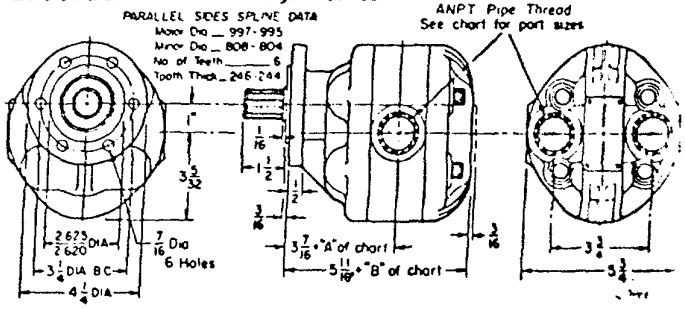
*Consult Hydreco Sales Department for operating oil pressures above those marked with an asterisk and speeds greater than shown

Models less outboard bearing

Model 2000F2B2 *Side Ports - Flange Mounted*
Model 2000F2C2 *Rear Ports - Flange Mounted*

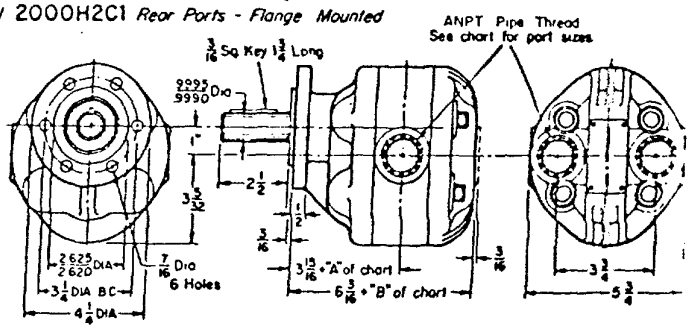


Model 2000F2B1 *Side Ports - Flange Mounted*
Model 2000F2C1 *Rear Ports - Flange Mounted*

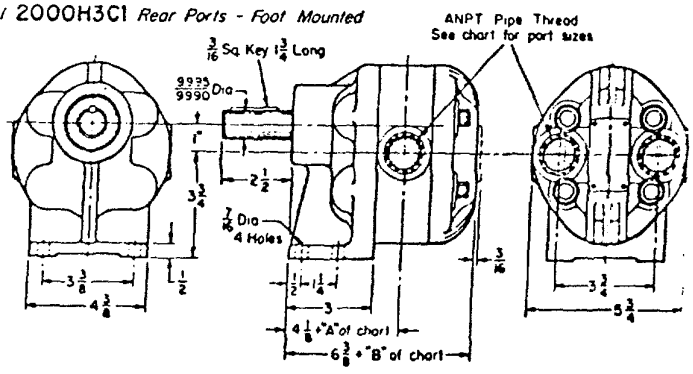


Models with outboard bearing

Model 2000H2B1 *Side Ports - Flange Mounted*
Model 2000H2C1 *Rear Ports - Flange Mounted*



Model 2000H3B1 *Side Ports - Foot Mounted*
Model 2000H3C1 *Rear Ports - Foot Mounted*



PUMP SIZE	DIM. "A"	DIM. "B"	SIDE PORTS	REAR PORTS	NET WT. APPROX.
2010	0	0	None	1"	30 lbs
2015	1/4	1/2	3/4	1"	32 lbs
2020	1/2	1"	1"	1"	35 lbs
2025	3/4	1-1/2	1-1/4	1"	38 lbs

A

HONEYWELL DIVISION FOUR-WAY SOLENOID VALVES

New Britain, Connecticut, U. S. A. 06050

INSTALLATION AND OPERATION INSTRUCTIONS 1/4" 4 WAY SOLENOID VALVES TYPES H9 AND XH9

DESCRIPTION--The H9 or XH9 Series Solenoid valves are four way valves with five portsf 2 position spring return, single solenoid operated. They are for air* service with a minimum operating pressure of 30** PSI.

These valves may be used as three way valves, see piping instructions for further information.

*Consult Skinner for operation on other media.

MOUNTING--Mount the valve securely on an appropriate surface. Two 17/64" diameter holes are provided in the valve body for mounting bolts. The valve will operate in any position.

PIPING--Remove all protective dust covers from the body ports.

Caution: Do not allow foreign particles or thread compound to enter the port cavities during installation. Blow out the feed line delivering the air supply to the valve before connecting to the "P" port.

Make all necessary pipe connections to the 1/4" NPT body ports which are identified by raised script on the top body surface and above the respective port.

Tightening torque should not exceed 15 foot-pounds (180 inch pounds) when the ½ pipes or fittings are screwed into the body ports.

The valves may be used as a three way normally open or three way normally closed valves by plugging the appropriate ports.

For three way normally open operation plug the port marked "A."

For three way normally closed operation plug the port marked "B."

WIRING--ALL H9 and X119 TYPES:
Check to see that the voltage and frequency shown on the valve nameplate corresponds to the power supply.

The two leads should be connected to the power supply in accordance with standard electrical practices. No attention to polarity is required.

Note: H9 and XH9 valves with the Magnelatch electrical option require special wiring as shown on the wiring diagram decal attached to the Magnelatch coil housing.

These valves are supplied with coils which are constructed to UL standards for continuous duty service. When the coil is energized for long periods, the coil housing will become hot, up to 185 degrees F. The coil is designed to operate at this temperature indefinitely.

Note: Normal free space must be provided around the solenoid pilot valve to allow for proper ventilation of the heated solenoid during electrical energization.

PORT IDENTIFICATION:
"P" port--Inlet port for air supply pressure to the valve.

"A" port--Working (cylinder) port that is normally closed (no flow) with respect to the "P" port and normally open with respect to the "EA" port with the valve in the de-energized position (electrical power off).

"B" port--Working (cylinder) port that is normally open (flow) with respect to the "P" port and normally closed with respect to the "EB" port with the valve in the de-energized position (electrical power off).

Issued 2-.69, Revised 1-76

"EA" port--Pressure exhaust port to "A" port.

"EB" port--Pressure exhaust port to "B" port.

Note: When the valve is in the energized position (electrical power on) "A" port is open to the "P" port and closed to the "EA" port and "B" port is closed to the "P" port and open to the "EB" port.

OPERATION--With the solenoid coil de-energized (electrical power off) the port marked "B" is open (flow) to the port marked "P" and closed (no flow) to the port marked "EB. " The port marked "A" is closed (no flow) to the port marked "P" and open (flow) to the port marked "EA."

When the valve is energized (electrical power on) the port marked "B" is closed (no flow) to the port marked "P" and open (flow) to the port marked "EB. " The port marked "A" is open (flow) to the port marked "P and closed (no flow) to the port marked "EA."

Pressure must not exceed 150 PSIG and not be below 30** PSIG during maximum flow conditions to either "A" port or "B" port.

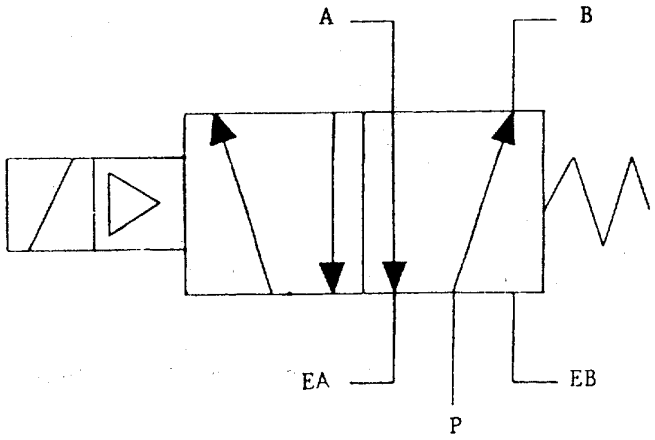
If the air supply pressure to the valve does not contain finely divided particles of oil in suspension to provide lubrication of all dynamic valve seals, it is recommended that an oil mist lubricator be installed, as close as possible and practical, to provide positive lubrication. Adequate lubrication will provide fast, positive response of the valve during operation and also protect the components controlled by the valve.

Media filtration is not necessary unless airborne particles or pipe scale exceeding 80 microns are anticipated in the supply pressure line.

If a speed control is required on a component controlled by the valve, the speed control device should be installed in either the "A" and "B" or "EA" and EB" lines and/or ports, not in the "P" port line. This will prevent any malfunction due to low control pressure at the "P" port.

PARTS KIT NUMBER

Tile maintenance parts kits numbers for the H9 and X't9 valves are IHKT-001, V5-60-S013.



U.S.A. STANDARD SYMBOL

**This information on the minimum operating pressure supersedes that shown in our condensed catalog and our general catalog. For operation at pressures below 30 PSI, please consult Skinner.

SKINNER

Honeywell Limited, Components Division
740 Ellesmere Road, Scarborough,
Ontario M1P 2V9

INSTALLATION, OPERATING AND MAINTENANCE INSTRUCTIONS

Three Way Normally Open—types V55, X55 series valves
Three Way Normally Closed—types V53, X53, V53A, X53A
Three Way Directional Control—types V56, X56
Three Way Multi Purpose—types V54, X54
Three Way Normally Closed—quick exhaust,
Types Q53, XQ53, Q53A, XQ53A

DESCRIPTION AND OPERATING INSTRUCTIONS

The Three Way valves above are all direct acting valves

PRINCIPLES OF OPERATION

Port Identification

Types V53-X53-V53A-X53A—"P" Port in body, Cylinder Port "A" in body, Exhaust Port "E" in sleeve.

Types V55-X55—"P" Port in sleeve, Cylinder Port "A" and Exhaust Port "E" in body.

Types V56-X56—NO Port in sleeve, NC and "P" Port in body. NO Port marked (B), NC Port marked (A).

Types V54-X54—NO Port in sleeve, Common Port and NC Port in body. NC Port marked (1), COM Port marked (2), NO Port marked (3).

Types Q53-Q53A-XQ53-XQ53A—"P" Port in body, quick exhaaust port in body, Cylinder Port in body—Exhaust Port in sleeve.

Types V53-X53-V53A-X53A—Three Way Normally Closed Valves.

When the valves are de-energized pressure is applied to the IN Port "P" located in the body. The fluid at the port is sealed off by the force of the plunger return spring and the seal in the plunger assembly. Cylinder Port "A" is open to Exhaust Port "E".

When current is applied to the coil, the plunger assembly moves to open the IN Port "P" to the Cylinder Port "A". Exhaust Port "E" is sealed by the plunger assembly.

Types V55-X55—Three Way Normally Open Valves.

Pressure is applied to the IN Port "P". With the valve de-energized, the fluid flows from the IN Port "P" and out the Cylinder Port "A". The Exhaust Port "E" is sealed by the plunger assembly and spring.

When current is applied to the coil, the plunger assembly moves to seal the IN Port "P", and opens the Cylinder Port "A" to the Exhaust Port "E".

Types V56-X56—*Three Way Directional Control* Valves.

Pressure is connected to the IN Port "P". With the valve de-energized, the fluid flows out the normally open Port "B". The normally closed port is sealed by the plunger assembly and spring.

When current is applied to the coil, the plunger assembly moves to open the IN Port "P" to the normally closed Port "A". The normally open Port "B" is sealed by the plunger assembly.

Types V54-X54—Three Way Multi Purpose Valves.

Pressure can be applied to any of the three ports. With the valve de-energized, the normally closed Port "1" is closed. The Common Port "2" is open to the normally open Port "3".

When current is applied to the coil, the plunger assembly moves to open the normally closed Port "1" to the Common Port "2". The normally open Port "3" is closed by the plunger assembly.

Types Q53-XQ53-Q53A-XQ53A—Three Way Normally Closed Quick Exhaust Valves.

This valve is provided with an additional Exhaust Port controlled by a piston. Pressure is connected to the IN Port "P". With the valve de-energized, the fluid at the "P" Port is sealed off by the force of the plunger return spring and the seal in the plunger assembly. *The Cylinder Port "A" is open to both* Exhaust Ports "E".

When current is applied to the coil, the plunger assembly moves to open the IN Port "P" to the Cylinder Port "A". Exhaust Port "E" in the sleeve is sealed by the top plunger seal. Quick Exhaust Port "E" is sealed by the piston and seal assembly.

INSTALLATION INSTRUCTIONS

Port Identification—See Principles of Operation.

Mounting position and pressure limits: Valves can be mounted directly on piping and are designed to operate in any position. Two 10-32 tapped mounting holes ¼" deep are provided in the base of the body. Line pressure must conform to the nameplate rating.

Piping: Remove closures from ports and connect lines to the proper ports, see valve types and port identifications in principles of operation. All valves incorporate ⅛" or ¼" NPT connections. When threading pipe fittings into the sleeve port use an open end wrench on the flats of the adapter. Failure to do so may result in a leaky pipe joint and possible damage to valve ports. Tightening torques should not exceed 50 inch pounds for ¼" NPT and 38 inch pounds for ⅛" NPT.

IMPORTANT:

Media Filtration—Although these valves have no sliding fits and are generally not sensitive to a small amount of foreign material, filtration of air or oil lines is recommended to protect the soft rubber inserts. Install the filter in the inlet side as close to the valve as possible. Dirt or foreign material in the media may cause excessive leakage, excessive wear or, in exceptional cases, malfunction.

Lubrication is not required although air line lubrication will substantially increase valve life.

Electrical Connection

Electrical supply must conform to nameplate rating. Connect coil leads to electrical circuit using standard electrical practice. Coil housings are available with grommets or ½" NPT conduit as standard. If the coil housing is located in an inconvenient position the housing nut can be loosened, and the housing rotated to any convenient position. Then re-tighten the nut to 35 inch pounds torque.

Coil Housing Temperature

Standard valves are supplied with coils designed for continuous duty service. Normal free space must be provided for proper ventilation. When the coil is energized continuously for long periods of time the coil housing will become hot. The coil is designed to operate permanently under these conditions. Any excessive heating will be indicated by smoking and/or odor of burning coil insulation.

MAINTENANCE INSTRUCTIONS

Note—Depending on service conditions, fluid being used, filtration and lubrication it may be required to periodically clean and/or replace worn components. See disassembly instructions.

CAUTION—Do not expose plunger assembly, seals or "O" rings to any type of commercial cleaning fluid. Parts should be cleaned with a mild soap and water solution.

Trouble Shooting

PROBLEMS	PROCEDURE
Valve fails to operate	1. Check electrical supply with voltmeter. 2. Check coil with ohm meter for shorts or open coil.
External leakage—valve leaks around sleeve assembly, metering stem, or manual override stem.	1. Remove "O" rings and inspect for imperfections—replace if defective. 2. If external leakage occurs around threaded plug at bottom of the Q5 valve remove seal and inspect for imperfections. 3. Tighten flange and threaded plug to 135 inch pounds using wrench nut.
Internal leakage—sticking valve leaks internally—or plunger sticks in energized position.	1. Remove plunger and examine soft insert seal for excessive wear or dirt. If there is excessive wear—replace plunger assembly. 2. If insert is conspicuously swollen or hardened replace plunger. It is possible that a different type insert material should be used on application. Submit complete details of application to factory. 3. In Q53-XQ53-Q53A-XQ53A—Examine piston insert for excessive wear. Also inspect main exhaust orifice for dirt accumulation, scratches and nicks.
Noise or buzzing	1. Check voltage with voltmeter to be sure it corresponds with nameplate rating. Also check pressure for same. 2. Examine inside sleeve assembly for dirt or foreign material—remove any foreign matter imbedded.
Q5-XQ5 Valve is sluggish	1. If valve is sluggish during energization and de-energization, check for dirt accumulation or wear on both piston and piston bore. The piston should slide freely into the piston bore without binding. Inspect and clean all passageways of dirt or foreign matter.

Disassembly Instructions—V53-V53A-V54-V55-V56 (See Fig. 1)

Shut off pressure and electricity to the valve. The valve need not be removed from the line. Remove the sleeve adapter, adapter seal, housing nut, nameplate and housing. If necessary the coil can be removed from the housing. With a Skinner wrench nut, remove the sleeve from the body. Never use a wrench on the sleeve itself. Then remove the spring, plunger, and flange seal from the body.

Disassembly Instructions—Q53-XQ53-Q53A-XQ53A (See Fig. 1)

Follow instructions for V53 etc. To remove piston assembly use a Skinner wrench nut. Remove threaded plug from bottom of valve body. The plug, flange seal and piston may then be removed.

Disassembly Instructions—X53-X53A-X54-X55-X56 (See Fig. 2)

Remove the sleeve adapter and adapter seal from the valve, then remove the nut and cap from the housing assembly. The coil and housing assembly can then be removed from the sleeve assembly. Using a wrench on the hex flange of the sleeve assembly, remove sleeve. Then remove flange seal, spring and plunger assembly from valve body.

Reassembly Instructions—(Figures 1 & 2)

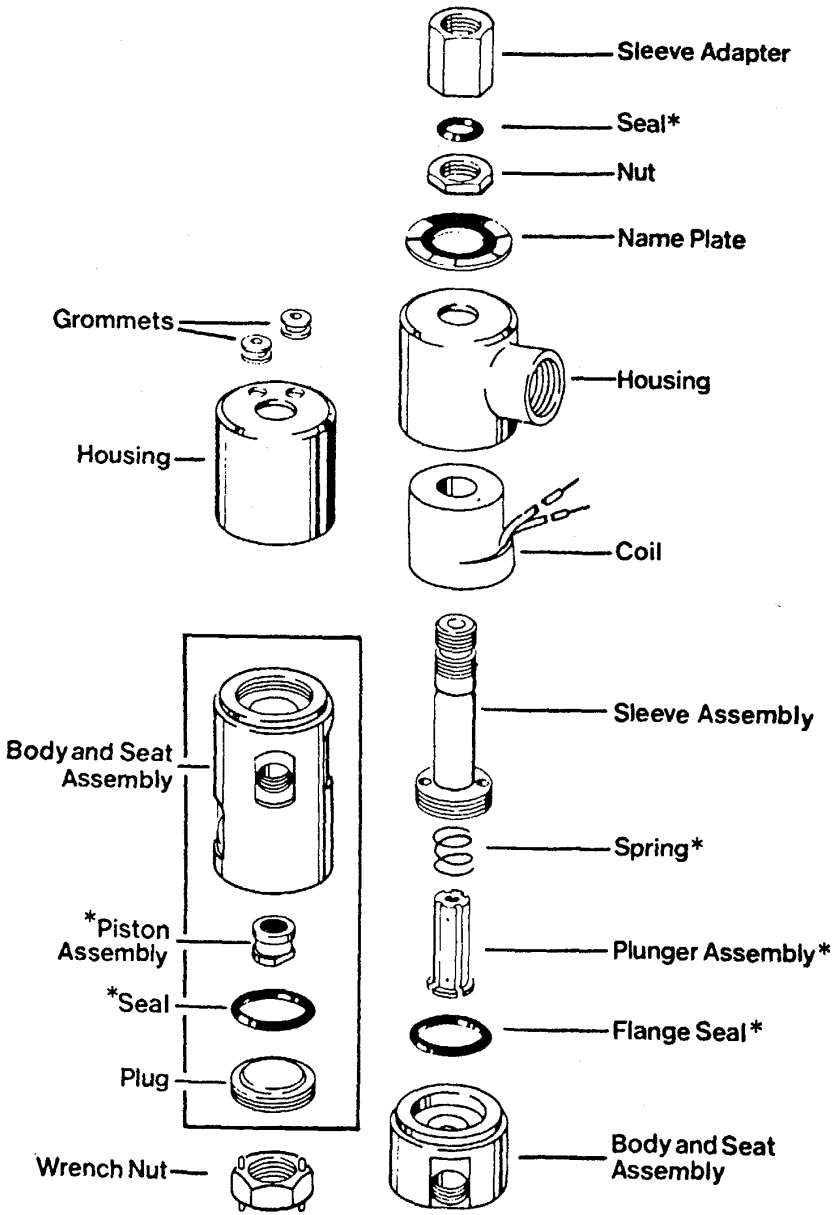
Use mineral oil on the flange seal and place in valve body (omit oil if valve is used on oxygen service or is fitted with ethylene propylene seals). Place plunger and spring in sleeve assembly and with a wrench nut for V5 or wrench for hex flange of X5, fasten to valve body. Apply 135 inch pounds torque.

For Q53-Q53A, XQ53 or XQ53A, place the piston assembly, seal, and plug into the base of the body and secure with a Skinner wrench nut. Apply 135 inch pounds torque.

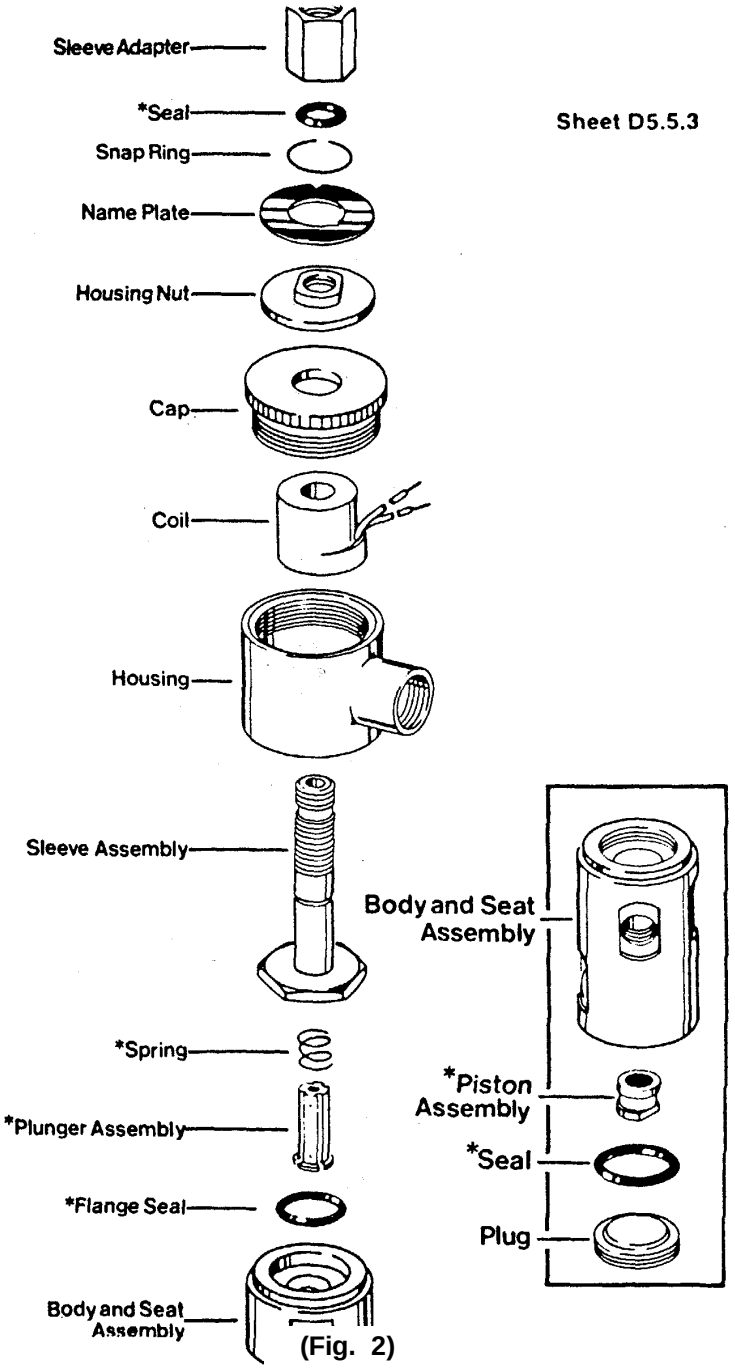
The coil and housing are then assembled, as they were removed. Add nameplate, housing, nut, adapter seal and sleeve adapter. For Explosion Pro, add cover & nut. Torque housing nut to 35 inch pounds. Install nameplate, retaining ring, adapter seal and adapter if so equipped.

Replacement Parts

When ordering replacement parts or parts kits specify valve number and voltage from the nameplate, and describe parts required. Parts kits are available for all catalog valves. Parts included in each kit are marked with an asterisk(*). The plunger assembly and spring are assembled.


Sleeve Adapter
Seal*
Nut
Name Plate
Grommets
Housing
Housing
Coil
Body and Seat Assembly
Sleeve Assembly
Spring*
*Piston Assembly
Plunger Assembly*
*Seal
Flange Seal*
Plug
Body and Seat Assembly
Wrench Nut

(Fig. 1)


Sleeve Adapter
*Seal
Snap Ring
Name Plate
Housing Nut
Cap
Coil
Housing
Sleeve Assembly
*Spring
*Plunger Assembly
*Flange Seal
Body and Seat Assembly
Body and Seat Assembly
*Piston Assembly
*Seal
Plug

(Fig. 2)

MACHINED SURFACE TOLERANCES
FRACTIONAL DIMENSIONS ± 1/64"
DECIMAL DIMENSIONS ± .010 UNLESS
OTHERWISE SPECIFIED

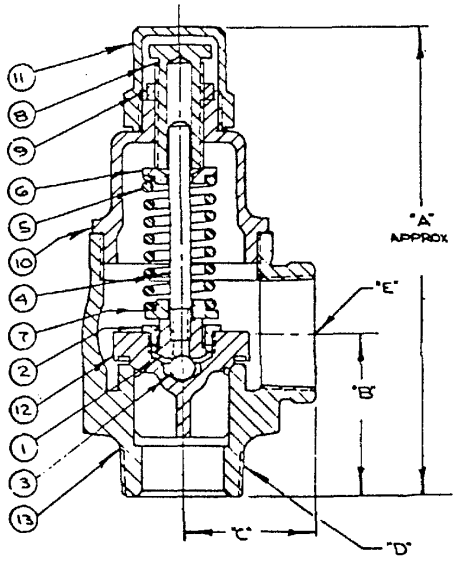
THIS DRAWING AND THE DESIGN THEREON IS THE PROPERTY OF KUNKLE VALVE CO., INC. IT IS NOT TO BE USED FOR COMPETITIVE BIDDING OR MANUFACTURE WITHOUT PERMISSION AND MUST BE RETURNED UPON REQUEST

PC NO	NAME	NO REQ	MATERIAL	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"
1	STEM RETAINER	1	BRASS	A57911.001.124	A57911.001.124	A57911.001.124	A57911.001.124	A57911.001.124	A57911.001.124	A57911.001.124	A57911.001.124	A57911.001.124
2	STEM RET LOCKNUT	1	BRASS	A61192.002.124	A61192.002.124	A61192.002.124	A61192.002.124	A61192.002.124	A61192.002.124	A61192.002.124	A61192.002.124	A61192.002.124
3	BALL	1	SST	A57610.003.184	A57610.003.184	A57610.003.184	A57610.003.184	A57610.003.184	A57610.003.184	A57610.003.184	A57610.003.184	A57610.003.184
4	STEM	1	STL CAD PLATE	A61106.045	A61106.045	A61102.045	A61102.045	A61102.045	A61103.045	A61103.045	A61103.045	A61103.045
5	SPRING	1	STL CAD PLATE	B44132 .131	B44132 .131	B44133 .131	B44134 .131	B44135 .131	B44136 .131	B44137 .131	B44138 .131	B44139 .131
6	SPRING PLATE (TOP)	1	STL CAD PLATE	A61810.145	A61810.145	A61810.021.145	A61810.021.145	A61810.021.145	A61810.021.145	A61810.021.145	A61810.021.145	A61810.021.145
7	SPRING PLATE (BTM)	1	STL CAD PLATE	A61870.013.145	A61870.013.145	A61870.011.145	A61870.011.145	A61870.011.145	A61870.012.145	A61870.012.145	A61870.012.145	A61870.012.145
8	PRESSURE SCREW	1	BRASS	A61184.369.124	A61184.369.124	A61184.369.124	A61184.089.124	A61184.089.124	A61184.089.124	A61184.089.124	A61184.089.124	A61184.089.124
9	PRESS SCR LOCKNUT	1	BRASS	A61182.021.124	A61182.021.124	A61182.011.124	A61182.011.124	A61182.011.124	A61182.056.124	A61182.056.124	A61182.056.124	A61182.056.124
10	CAP	1	BRONZE	A29771.001.123	A29771.001.123	A29771.001.123	A29773.001.123	A29773.001.123	A29775.001.123	A29775.001.123	A29775.001.123	A29775.001.123
11	HOOD	1	BRASS	A03610.001.124	A03610.001.124	A03610.001.124	A03610.001.124	A03610.001.124	A03973.001.124	A03973.001.124	A03973.001.124	A03973.001.124
12	DISC	1	[1]	B44134.001.125	B44134.001.125	B41009.001.125	B41298.001.123	B41677.001.123	B41662.001.123	B41663.001.123	B41675.001.123	B41675.001.123
13	BODY (MALE x FE)	1	BRONZE	C1401.004.123	C1401.002.123	C1406.002.123	C1410.002.123	C1411.002.123	C1411A.002.123	C1422.002.123	C1425.002.123	C1427.002.123
	BODY (FE x FE)	1	BRONZE	C1401.010.123	C1401.002.123	C1406.004.123	C1410.004.123	C1411.004.123	C1413.004.123	C1422.004.123	C1425.004.123	C1427.004.123

VALVE DIMENSIONS	DIM	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"
OVERALL HEIGHT	A	3 3/4	3 3/4	4 1/16	5 1/16	7 1/16	9 1/16	10	13"	16"
OUTLET C TO BASE	B	2"	2"	2 1/4	2 3/8	2 1/16	3 1/2	3 5/8	4 3/8	5 3/4
VALVE C TO OUTLET	C	1 5/8	1 5/8	1 7/8	2 1/8	2 1/16	3"	3 1/8	3 7/8	5 1/4
INLET N.P.T.	D	1/2-14	3/4-14	1-11 1/2	1 1/4-11 1/2	1 1/2-11 1/2	2-11 1/2	2 1/2-8	3-8	4-8
OUTLET N.P.T.	E	1/2-14	3/4-14	1-11 1/2	1 1/4-11 1/2	1 1/2-11 1/2	2-11 1/2	2 1/2-8	3-8	4-8

GENERAL NOTES:

1. DISC PC NO 12 SIZES 1/2", 3/4" AND 1" ARE FABRICATED FROM FORGED NAVAL BRASS SIZES 1 1/4" THRU 4" ARE CAST BRONZE.
2. 1/2" SIZE VALVE CAN ALSO BE FURNISHED WITH 1/2"-14 FEMALE N.P.T. OUTLET BODY (MALE x FE) PART NO. C1401.002.123, BODY (FE x FE) PART NO C1401.008.123
3. SERVICE RECOMMENDATION - LIQUID
   MAXIMUM ALLOWABLE SET PRESSURE 300# AT 400°F
4. MAY BE FURNISHED WITH PHOSPHOR BRONZE SPRINGS, DWG 85989-SHT-2



TITLE ASSEMBLY FIG 20

AS TABULATED

10-5-CC

NONE

C3038-B

KUNKLE

MINIATURE REGULATORS

TYPES 361, 363 (Non-Relieving)
TYPES 362, 364 (Relieving)

MAXIMUM INLET: 300 PSI
TEMPERATURE RANGE: 0 - 120°F.

SECTION XVI
KUNKLE VALVES, MINIATURE REGULATORS
AND AIR LINE REGULATORS

INSTALLATION and OPERATING INSTRUCTIONS

INSTALLATION

Before installing, blow out pipe line to remove. scale and other foreign matter. This unit has DRYSEAL pipe threads: use pipe compound or tape sparingly to male threads only. Install regulator in pipe line so that air will flow in direction of arrow stamped on body, install as near as possible to equipment serviced.

REDUCED PRESSURE ADJUSTMENT

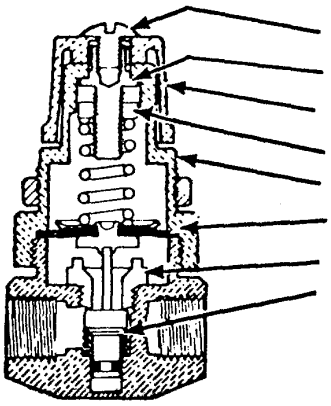
To adjust reduce pressure settings, loosen lock screw in center of knob and turn knob clockwise to increase pressure setting and counter clockwise to lower setting. With relieving-type regulators. the reduced pressure follows adjustment of the screw, with non-relieving regulators adjustment for lower reduced pressure will not be obtained until the reduced pressure system is "bled-off" or until air flow starts.

MAINTENANCE - CLEANING

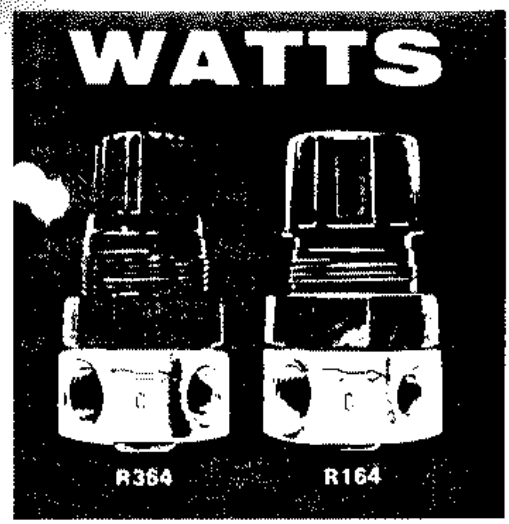
NOTE: To clean, it is not necessary to remove, regulator from line. Refer to drawing as guide in reassembly.

If the air supply is kept clean the regulator should provide long periods of uninterrupted service. Erratic regulator operation or loss of regulation is most always due to dirt in the disc area. To clean, shut off air line pressure and disassemble the regulator. Refer to drawing as a guide to disassembly and subsequent reassembly. Clean parts with denatured alcohol and blow out body with compressed air. When reassembling make sure the seat is firmly in place and that the disc stem fits into center hole of diaphragm: assembly. If diaphragm assembly is replaced make sure disc stem fits into its center hole, tighten bonnet slightly more than hand tight (to 60 inch pounds torque).

REPLACEMENT PARTS
ORDER BY KIT NO.



Part Name	Kit Name	Kit No.
Lock Screw	Spring Cage and Knob Assembly Replacement Kits	CK364Y
Adjusting Screw		
Adjusting Knob		
Nut		
Spring Cage		
Diaphragm Assembly	Repair Kit	
Seat	Relieving	RK364Y
Disc Assembly	Non-Relieving	RK363Y



AIR LINE REGULATORS

MINIATURE SERIES
TYPES R361, R362, R363, R364, R161, R162, R163, R164

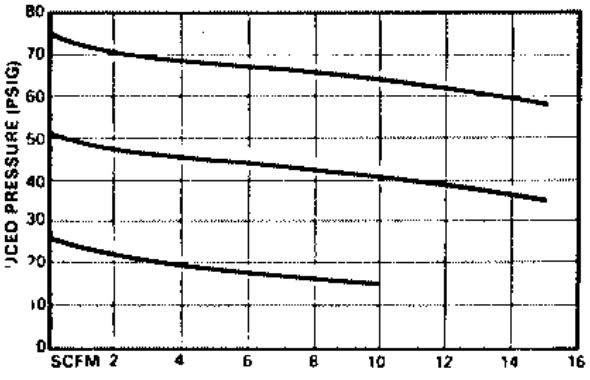
APPLICATIONS

These brass regulators are the perfect choice where a small economical package is required. These air regulators are used extensively on air tools, cylinders, valves, dental hand-pieces, paint sprayers and pressurized tanks where air flows do not exceed 15 SCFM. Similarly, these brass regulators are used on vending, dental and miscellaneous plumbing applications. Both are perfect choices for compact control cabinets and miniaturized circuits. Also, they may be panel mounted through standard 1¼" electrical knock-out. The R364 has a black non-rising adjusting knob, and the R164 has a 3-position tamperproof non-rising adjusting knob, both of which utilize an aluminum mounting nut which enhances the appearance of the most discriminating circuits and panels.

FEATURES

1. Rugged brass body.
2. Oversize orifices and unbalanced disc construction.
3. Three position, tamperproof adjusting knob (R164 series).
4. Non-rising adjustment knobs.
5. Full flow gauge ports.
6. Separate bottom plug for easy servicing.

FLOW CURVE — 100 PSIG Supply



TYPICAL RELIEF CHARACTERISTICS
R364-R164 MINIMUM OVERPRESSURE FOR ACTUATION 8 PSI
RELIEF CAPACITY AT 15 PSI OVERPRESSURE 2 SCFM

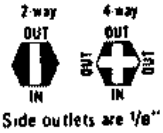
MATERIALS OF CONSTRUCTION

Body – Brass • Spring cage and knob – Acetyl resin • Disc and diaphragm – Buna N • Stem and bottom spring – Stainless steel.

SIZES – NUMBERS

SIZE	AIR REGULATOR NUMBER				REGULATOR			
	NON RELIEVING		RELIEVING		NON RELIEVING		RELIEVING	
	2 Way	4 Way	2 Way	4 Way	2 Way	4 Way	2 Way	4 Way
⅛	R361 1	R363 1	R362 1	R364 1	R161 1	R163 1	R162 1	R164 1
¼	R361 2	R363 2	R362 2	R364 2	R161 2	R163 2	R162 2	R164 2

TOP VIEW



Side outlets are ⅛"

PRESSURE – TEMPERATURE

Maximum supply pressure 300 PSI
Operating temperature range 40°F to 120°F

REDUCED PRESSURE RANGE

Available in Three Ranges:

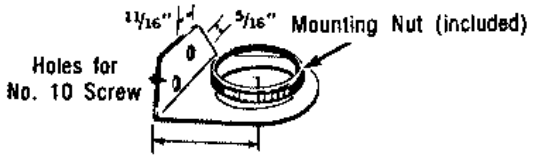
0-25 PSI
0-60 PSI
0-125 PSI

Unless otherwise specified, standard 0-125 PSI range will be supplied.

ACCESSORIES & OPTIONS

Panel Mount – Specify suffix "P". (Panel mounting hole diameter 1¼".)

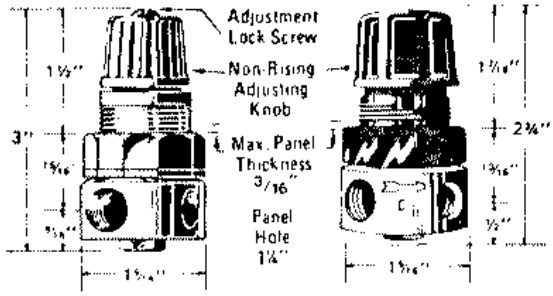
Bracket Mount – Specify No. SA161X57.



Distance from center of regulator to rear wall of bracket 1¼".

Pressure Gauge – Specify suffix "G". (1½" Dial ⅛" back connected.)

DIMENSIONS – WEIGHTS



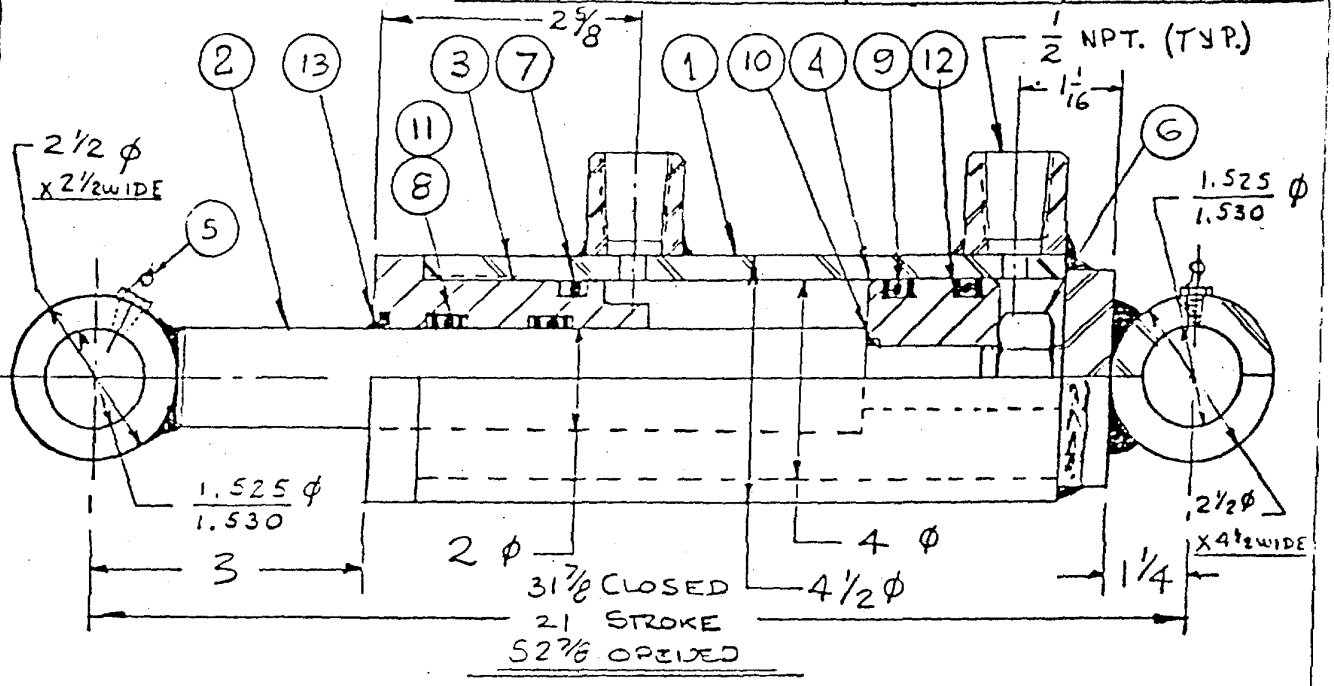
TYPE R364
WEIGHT ½ lb.

TYPE R164
WEIGHT ½ lb.

Section XVII
CYLINDER PARTS LIST

ITEM # 7 TO 13
FOR SEAL KIT ONLY
ORDERING NO
MK-760072

DESCRIPTION	PART NO	QTY	ITEM
TUBE	2401331	1	1
SHAFT	2403212	1	2
HEAD	2105063	1	3
PISTON	2106094	1	4
GREASE FITTING	———	2	5
NUT	———	1	6
O-RING	BUNA	1	7
" "	"	2	8
" "	"	2	9
" "	"	1	10
BACK-UP-RING	URETH	4	11
" " "	"	4	12
WIPER	"	1	13
			14



MODEL : # SM2-21-4-21

VERINS EN 3 POINTS 4"

REV.	DESCRIPTION	DATE	PAR PY	APP CHK'D

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SI NON SPECIFIEE
LES LIMITES DIMENSIONNELLES DES SURFACES FINIES DEVRONT ETRE :
FRACTIONNELLE ± 1/64 DECIMALE ± .01
ANGULAIRE ± 1/4° SOUDURE ± 1/32

UNLESS OTHERWISE SPECIFIED
DIMENSIONAL LIMITS
ON FINISHED SURFACE ARE TO BE
FRACTIONAL ± 1/64 DECIMAL ± .01
ANGULAR ± 1/4° WELDING ± 1/32

MAILHOT HYDRAULIQUE INC.
St-Jacques, P. Qué.

DESSINE PAR DRAWN BY A.D. DATE 1-9-81
VERIFIE PAR CHECKED BY JD ECHELLE SCALE NA

TITRE PART LIST FOR CYLINDER
TITLE 4 BORE x 21 STROKE.

NO DESSIN A-TOIE-49-8105
DRAWING NB

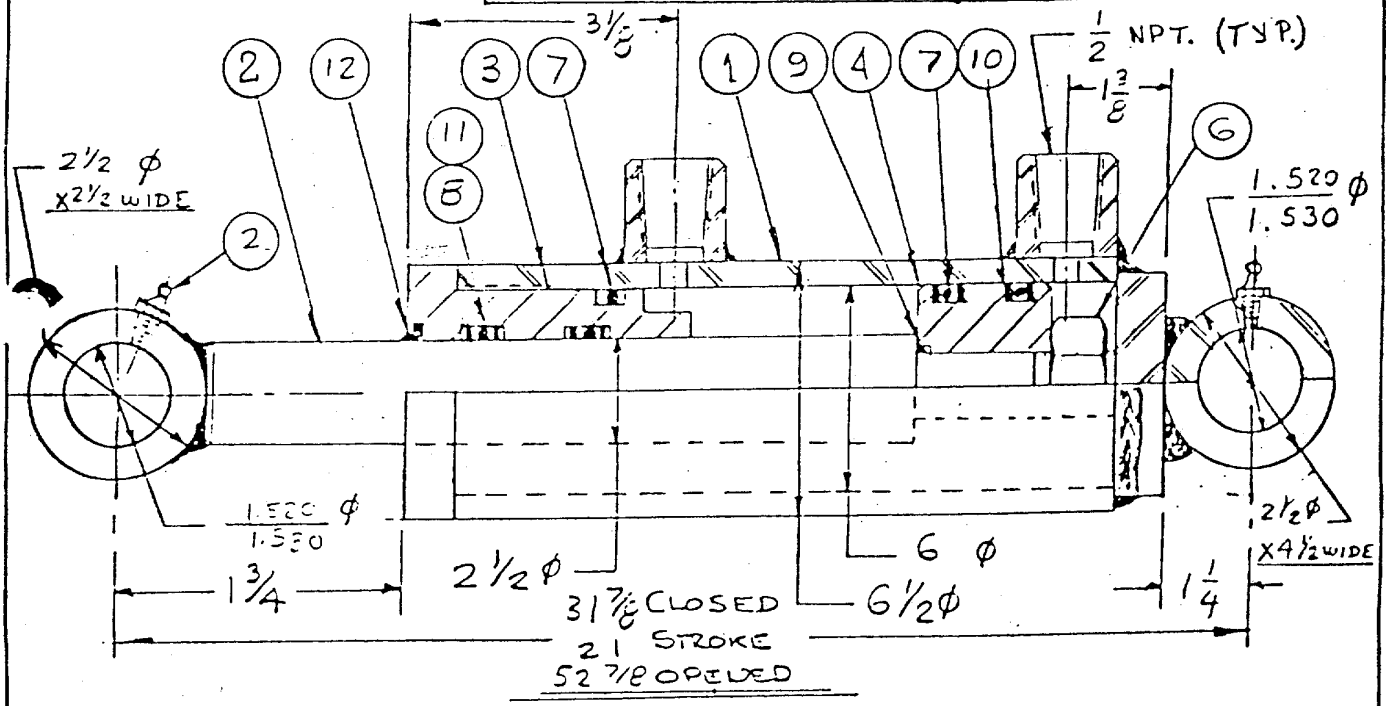
NO DESSIN D'ASSEMBLAGE T-018
ASSEMBLY DRAWING NB

K•Σ CRYSTALLINE'B

Section XVII
CYLINDER PARTS LIST

ITEM # 7 TO 12
FOR SEAL KIT ONLY
ORDERING NO
MK-8138

TUBE	2401147	1	1
SHAFT	2403103	1	2
HEAD	2105057	1	3
PISTON	2106036	1	4
GREASE FITTING	———	2	5
NUT	———	1	6
O-RING	BUNA	3	7
" "	"	2	8
" "	"	1	9
BACK-UP-RING	URETH.	4	10
" " "	"	4	11
WIPER	"	1	12
			13
			14



MODEL : # SM2-21-6-21

REV.	DESCRIPTION	DATE	PAR BY	APP CHK'D

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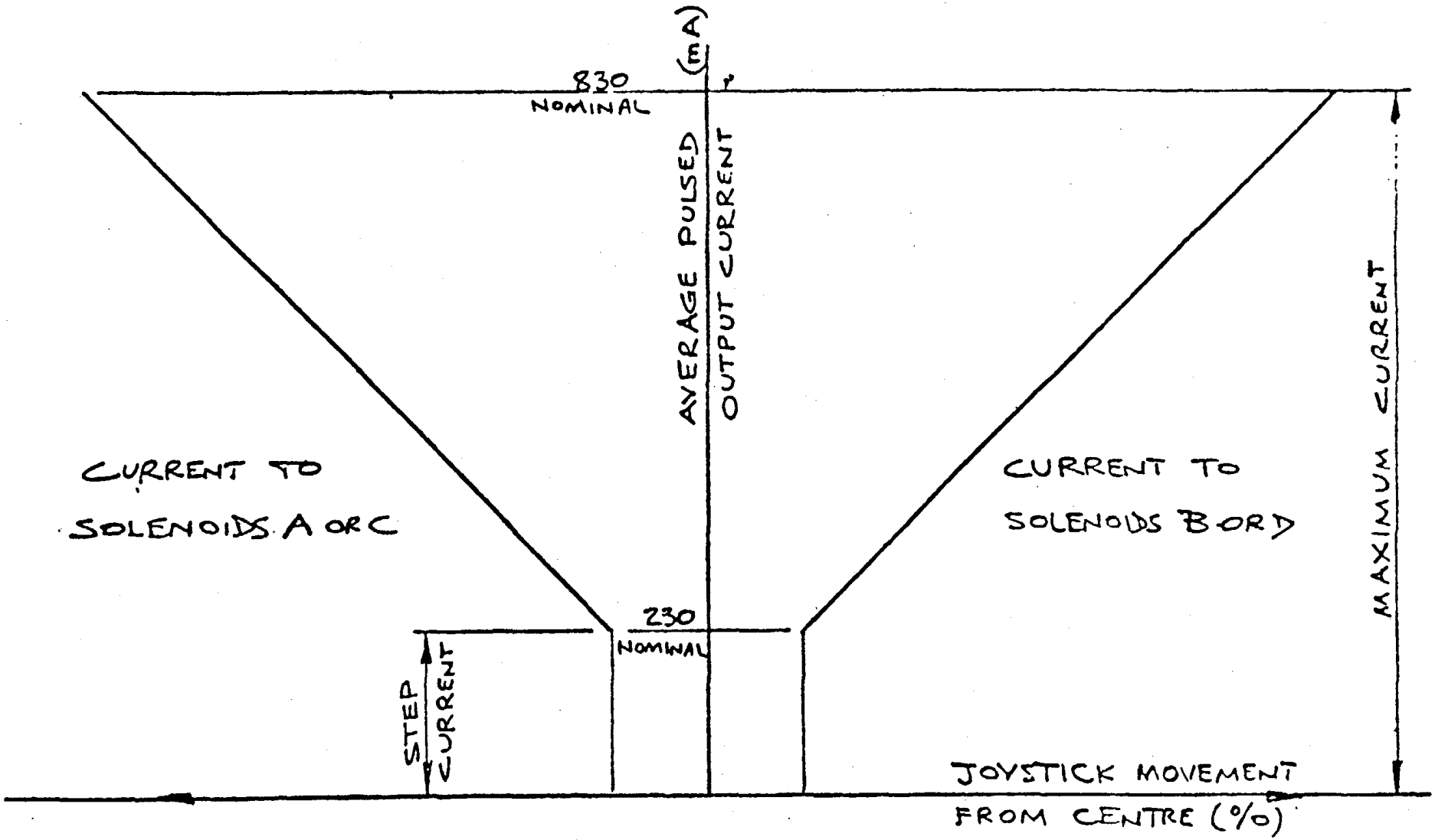
SI NON SPECIFIEE
LES LIMITES DIMENSIONNELLES DES SURFACES FINIES DEVRONT ETRE
FRACTIONNELLE ± 1/64 DECIMALE ± .001
ANGULAIRE ± 1/4° SOUDURE ± 1/32

UNLESS OTHERWISE SPECIFIED
DIMENSIONAL LIMITS
ON FINISHED SURFACE ARE TO BE
FRACTIONAL ± 1/64 DECIMAL ± .001
ANGULAR ± 1/4° WELDING ± 1/32

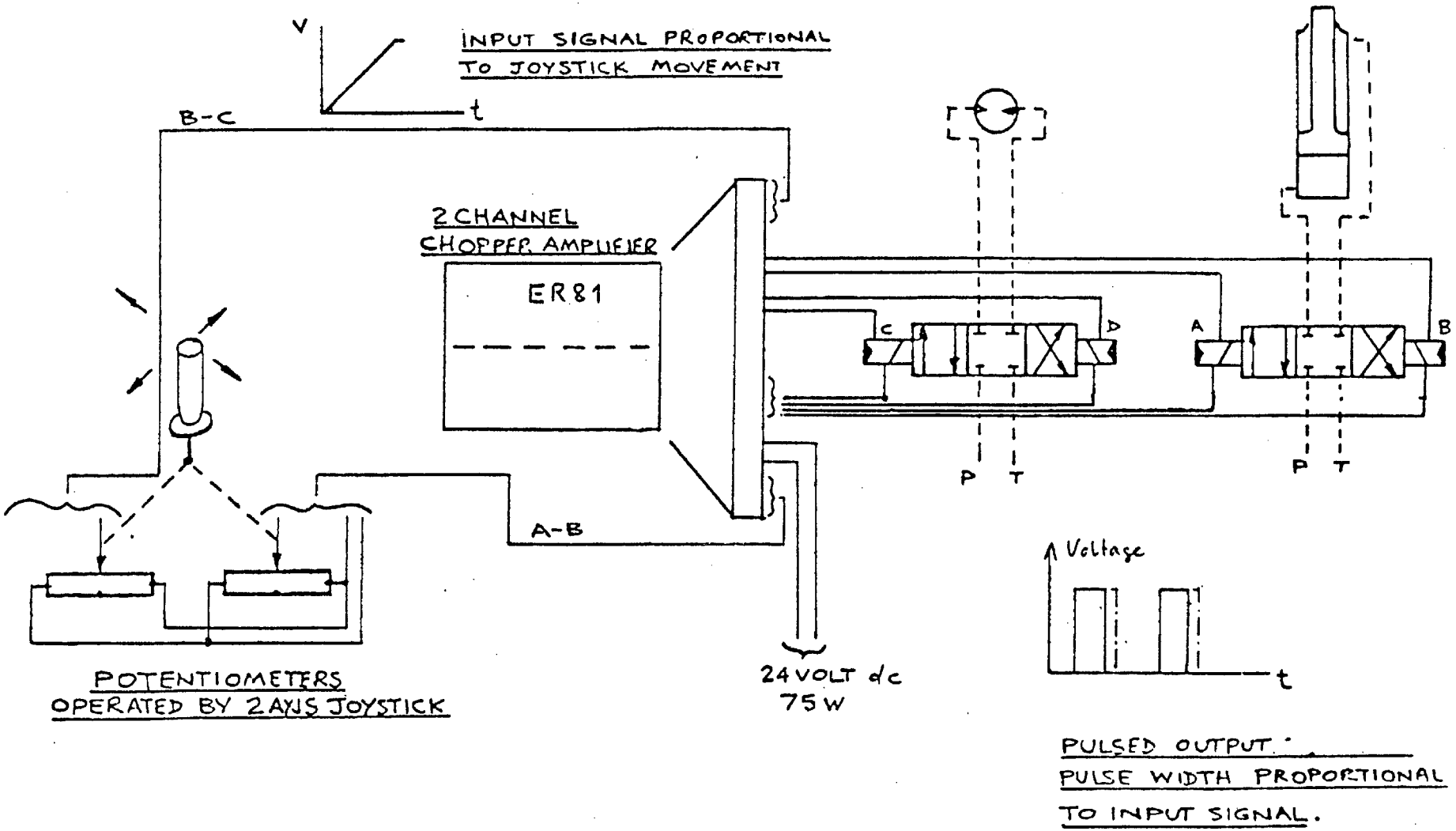
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St-Jacques, P. Qué.

DESSINE PAR DRAWN BY A.D. DATE 1-9-81
VERIFIE PAR CHECKED BY J.D. ECHELLE SCALE 1/4
TITRE Part List For Cylinder
TITLE 6 Bore x 21 Stroke.
NO DESSIN A-T018-49-8107
DRAWING NB
NO DESSIN D'ASSEMBLAGE T-018
ASSEMBLY DRAWING NB

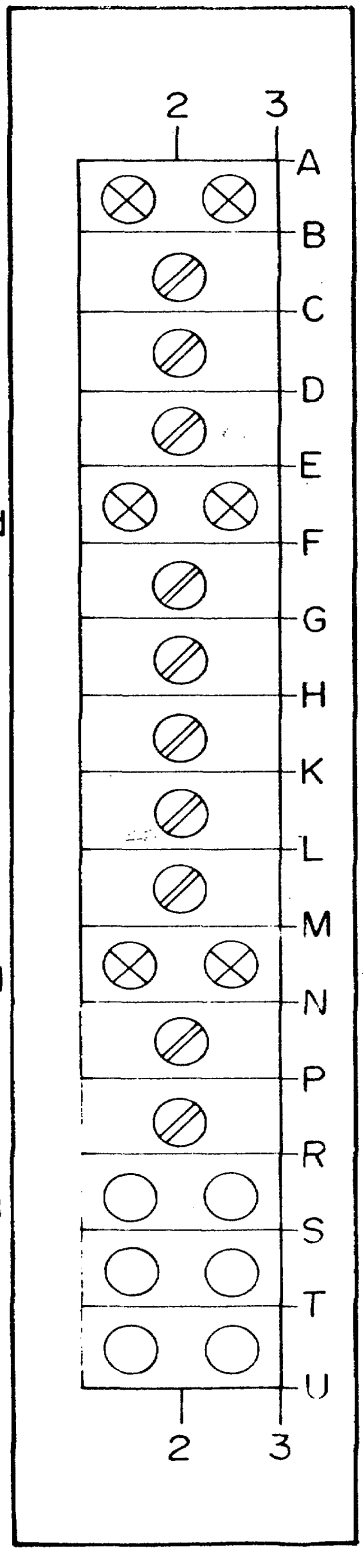
K•E


830
NOMINAL
AVERAGE PULSED (mA)
OUTPUT CURRENT
MAXIMUM CURRENT
CURRENT TO
SOLENOIDS A OR C
CURRENT TO
SOLENOIDS B OR D
230
NOMINAL
STEP
CURRENT
JOYSTICK MOVEMENT
FROM CENTRE (%)

Section XVIII
JOYSTICK TESTING PROCEDURE AND
TECHNICAL INFORMATION BULLETIN



min max



dead man blocked

LED 8 V supply voltage

POT Ram Magnets A and B

POT I MIN Magnet B

POT I MAX Magnet B

ED magnet A controlled

LED Magnet B controlled

POT I MIN Magnet A

POT I MAX Magnet A

POT Ramp Magnets C D

POT I MIN Magnet D

POT I MAX Magnet D

ED magnet C controlled

LED Magnet D controlled

POT I MIN Magnet C

POT I MAX Magnet C

EST jack current Magnets AB

TEST jack Current Magnets CD

jack 8 V

TEST jack 4 V

EST jack dither frequency

TEST jack 0 V

1. FUNCTION DESCRIPTION

Figures 1, 2, and 3 refer.

The Chopper Amplifier processes a demand signal, typically received from a joystick-operated potentiometer, to regulate electric current applied to the solenoids of an electrohydraulic proportional valve.

Each chopper amplifier has two control channels. Each channel will control one valve having two solenoids.

The chopper amplifiers incorporate automatic shut-down (1 per channel) for a faulty load circuit in the event of an electrical short circuit at the load .(solenoid) and in the event of a short circuit at the demand potentiometers..

Red status lights on the front side of the card indicate:

- POWER ON.
- deadman device inhibit.
- output active (each solenoid).

The chopper amplifier produces a pulsed square wave output, the average value of which is proportional to the demand signal voltage magnitude. This system is known as "Pulse Width Modulation".

The actual current through the solenoid is fed back into .a current controller which varies the pulse width so. that the current is independent from temperature-, load or supply voltage-changes.

For a correct operating of the current controller the load must be an inductive load, like the usual proportional solenoids.

A setpoint voltage (normally from the joystick) "'arm" proportional valve solenoid "a" or "b", according to the direction of hydraulic actuator motion required, in response to the movement of the joystick away from its centre position.

When the setpoint voltage exceeds a certain deadband, a step current (Fig. 2, part A) occurs. This step current causes the main spool of the valve to be displaced sufficiently to eliminate the sealing overlap, so that further fractional movement of the joystick connects the hydraulic pump to the load actuator which responds to further joystick movement.

Field Adjustments to each output of the chopper amplifier are:

STEP CURRENT, MAXIMUM CURRENT, PULSE FREQUENCY, RAMP TIME for each channel.

Adjustment procedure is described in section 3.

2. ADJUSTMENT SET-UP

The Chopper Amplifier must be electrically connected per fig. ER 81-60-3P. It is not necessary to have the hydraulic circuit functioning.

Ensure all electrical connections to the chopper amplifier terminals are correct.

A test unit with built-in frequency meter, Ammeters, joystick press-to-test switches or short and open circuit testing and adjustable/stabilized power supply is available from Barmag Hydraulic UK. Instructions for its use are supplied with the test unit. If the test unit is not available the following test equipment/facilities may be used:

Item:	Description:	Quantity:;
1	joystick Barmag part No.	1
2	Frequency meter (25 - 150 Hz) (or oscilloscope)	1
3	Voltmeter (30 V; 1 V range)	1
4	instrument screwdriver	1
5	24 V DC smoothed power supply (75 w)	-
6	switch 1 pole	
7	test plug 2 mm Ø	2

3. ADJUSTMENT PROCEDURE

3.1. General

The general procedure is as follows:

a) Adjust pulse frequency

b) Adjust step currents for each channel

c) Adjust maximum currents for each channel

d) Adjust ramp time for each channel.

Note that the step current may need re-adjustment when the hydraulic system is functioning to take account of tolerances in the hydraulic valve.

The maximum current may be used to control the hydraulic actuator speed, but there are also mechanical adjustments for this on the hydraulic valves. For speed adjustments via chopper amplifier made when the hydraulic system is functioning, it is necessary to ensure the mechanical adjustments are set to maximum speed condition (main spool end stops fully "out").

3.2. Preparations

When the card is supplied with the nominal DC voltage of the used solenoids, the red light (pos. 2) should be on. If not check fuse pos. 23 (4 Amps.) When the deadman switch is open, red light (pos. 1) should also be on. All outputs are inhibited. For further test the deadman switch should be closed continuously. Then the red light (pos. 1) is off.

3.2.1. Pulse Frequency

Adjusted by the trim potentiometer (pos. 24); turns C.W. (RH); increases frequency.

Min. frequency is approx. 50 Hz,
max. frequency is " 150 Hz.

Adjust the pulse frequency which is recommended for the used valve.

3.2.2. Step Current

Adjusted by trim potentiometer:

pos. 4 for solenoid B
" 8 for " A
" 11 for " D
" 15 for " C

Turn C.W. (RH) increases current:

Min. step current approx. 50 mA
max. step current " 450 mA.

3.2.2.1. Connect a voltmeter (range 1 V) to the measuring terminals pos. 22 (-) and pos. 17 (+) for the current to solenoids A and B or to the measuring terminals pos. 22 (-) and pos. 18 for the current to solenoids C and D.

The reading is 0,5 V for a current of 1 A.

3.2.2.2. Operate the joystick slightly away from its centre pos. on one axis until one of the LED's, pos. 6 or 7, and pos. 13 and 14 shows an active output, and keep it steady during the adjustment.

Adjust the current with the corresponding trim potentiometer to get a reading of 0,115 V on the meter (230 mA).

Repeat for the other solenoids.

3.2-3. Maximum Current

Adjusted by the potentiometers pos. 5 for solenoid B
" 9 for " A .
“ 12 for " D
" 16 for " C

Turn C.W. (RH) increases current:

Min. Value approx. 500 mA
max. Value " 1500 mA.

3.2.3.1. Proceed as for 3.2.2.1.

3.2.3.2. Operate the joystick to maximum position on the axis and keep it steady during the adjustment.

Adjust the current with the corresponding trim potentiometers to get a reading of 0,415 V on the meter (830 mA).

Repeat for the other solenoids.

3.2.4. Short Circuit Protection (Load)

The built-in protection circuit switches the output off 'in case of short circuit. The corresponding LED is cut off. If the fault at the output is rectified: , the circuit will work correctly and the LED switches on.

3.2.5 Short and Open Circuit Protection (Joystick)

If there is a short or an open circuit on the leads to the joysticks the protection circuit cuts off the outputs.

During connection work or repair of joystick connections the supply voltage to the card should be switched off. Finally, the deadman switch should be open.

3.2.6. Adjusting the Ramp Time

A separate ramp generator is built-in for each channel. The up and down time of the ramp is the same.

Min. ramp time is approx. 0.15 sec
max. ramp time is " 6 sec.

Turn COW. (RH) increases time.

For solenoids A and B adjust ramp time with potentiometer pos. 3' for solenoids C and D with potentiometer Pos. 10.

TECHNICAL INFORMATION BULLETIN

CHOPPER AMPLIFIER ER 81

2 Channel

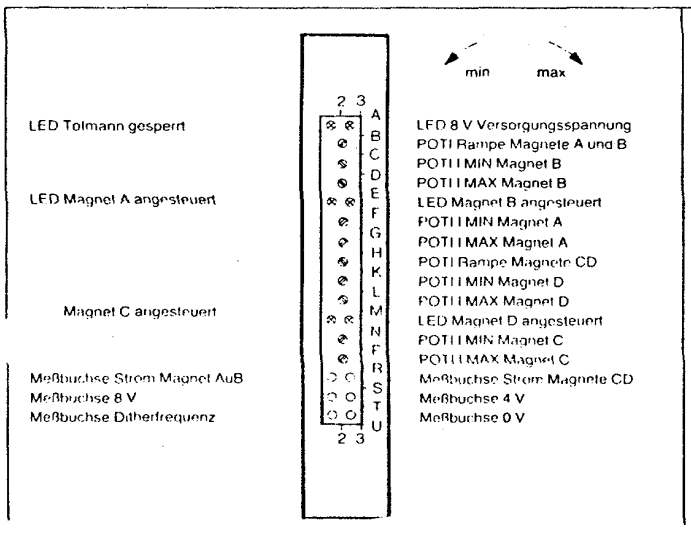
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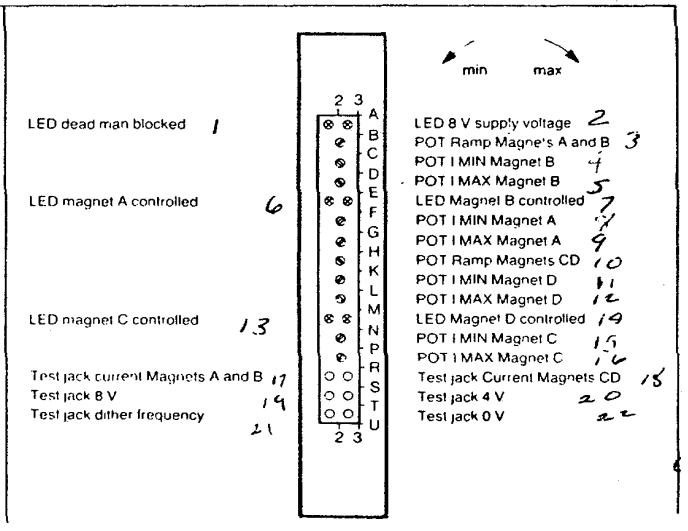
1	FUNCTION DESCRIPTION
2	ADJUSTMENT SET-UP
3	ADJUSTMENT PROCEDURE
Fig. 1	BLOCK DIAGRAM SYSTEM
Fig. 2	CHOPPER AMIPLIFIER
Fig, 3	APPLICATIONS
Fig. 4	OUTPUT CURRENTS

barmag hydraulic

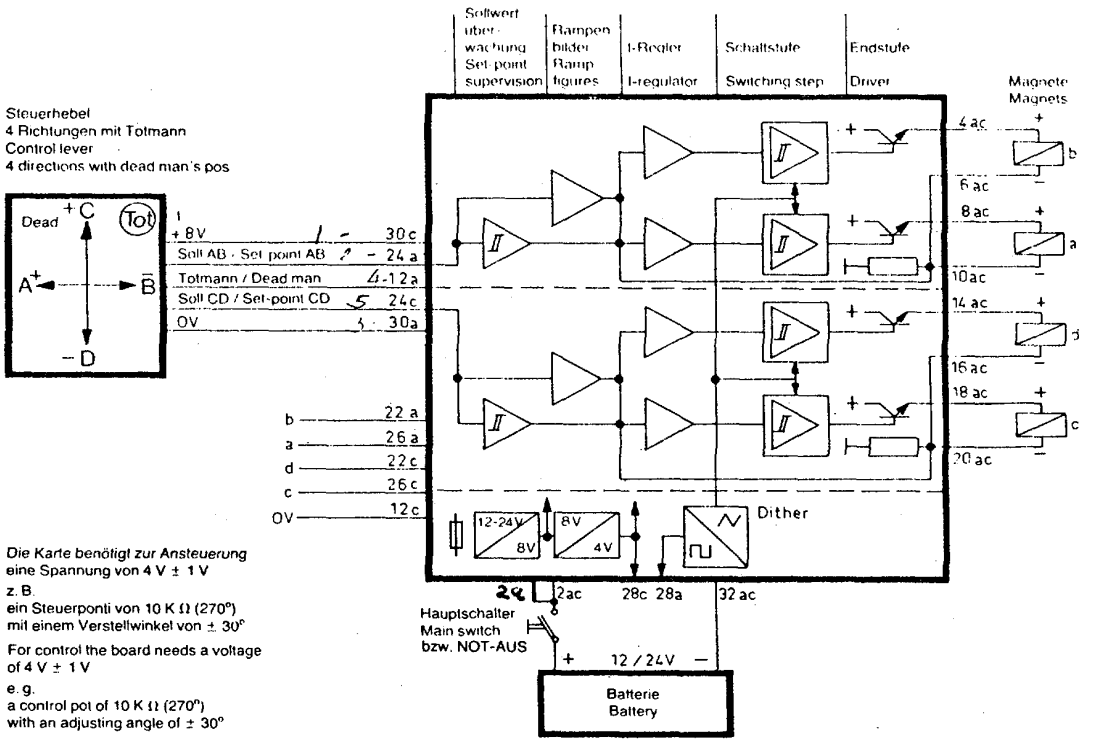
Technische Daten
Technical Data

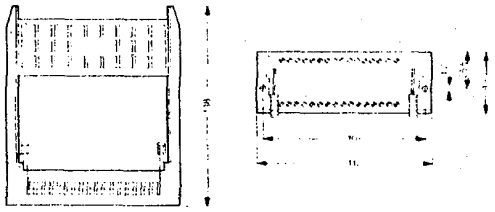
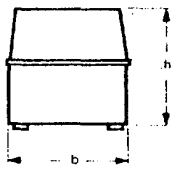
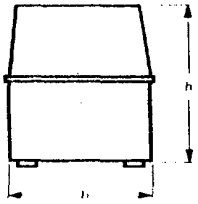
Ventilspannung		Valve voltage		12 V 24 V
zul. Betriebsspannung		Perm. operating voltage		11 V - 30 V
Restwelligkeit		Residual ripple		5 %
interne Spannung		Internal voltage		8 V / ± 4 V
Leistungsaufnahme		Rate of power		max. 80 VA
max. Ausgangsstrom je Magnet		Max. output current per magnet		1,5 A
Eingangswiderstand für Sollwert		Input resistance for set-point value		Ri ~ 50 K Ω
Sicherung träge		Fuse slow		4 A
Feuchtebeanspruchung nach DIN 40040 Betrieb/Lagerung		Moisture demand as per DIN 40040/workshop storage		F / E
Betriebstemperatur		Operating temperature		–30 °C - +60 °C
Lagertemperatur		Storage temperature		–55 °C - +85 °C
Rampenzeiteinstellung für jedes Ventil getrennt		Ramp time adjustment separate for each valve		0,25 - 5 sec.
Ditherfrequenz einstellbar		Dither frequency adjustable		50 - 150 Hz
Eingang für Totmannschalter mit Freigabe bei geschlossenem Schalter		Input for dead man's switch with release with closed switch		
LED Anzeigen	⊗ stabilisierte Spannung 8 V vorhanden	LED indications	⊗ stabilized voltage 8 V available	
	⊗ Totmannschalter nicht geschlossen		⊗ dead man's switch not closed	
	⊗ je Magnet eine Anzeige		⊗ one indication for each magnet	
Prüfstecker in Frontlafel für hochohmige Meßgeräte	– Stromistwert für Magnete A B	Test plug in front panel for high-resistance measuring instruments	– actual current value for magnets A B	1 A ≙ 0,5 V
	– Stromistwert für Magnete C D		– actual current value for magnets C D	1 A ≙ 0,5 V
	– stabilisierte Spannung		– stabilized voltage	8 V
Ri > 10 k Ω	– stabilisierte Spannung	Ri > 10 k Ω	– stabilized voltage	4 V
	– Bezugsspannung		– reference voltage	0 V
	– Ditherfrequenz / Rechteck		– dither frequency / square	8 V
Kartenformat:	Europakarte	Board format:	European format	100 x 160 mm
Steckerleiste:	nach DIN 41612	Plug board:	as per DIN 41612	32-polig / 32 poles



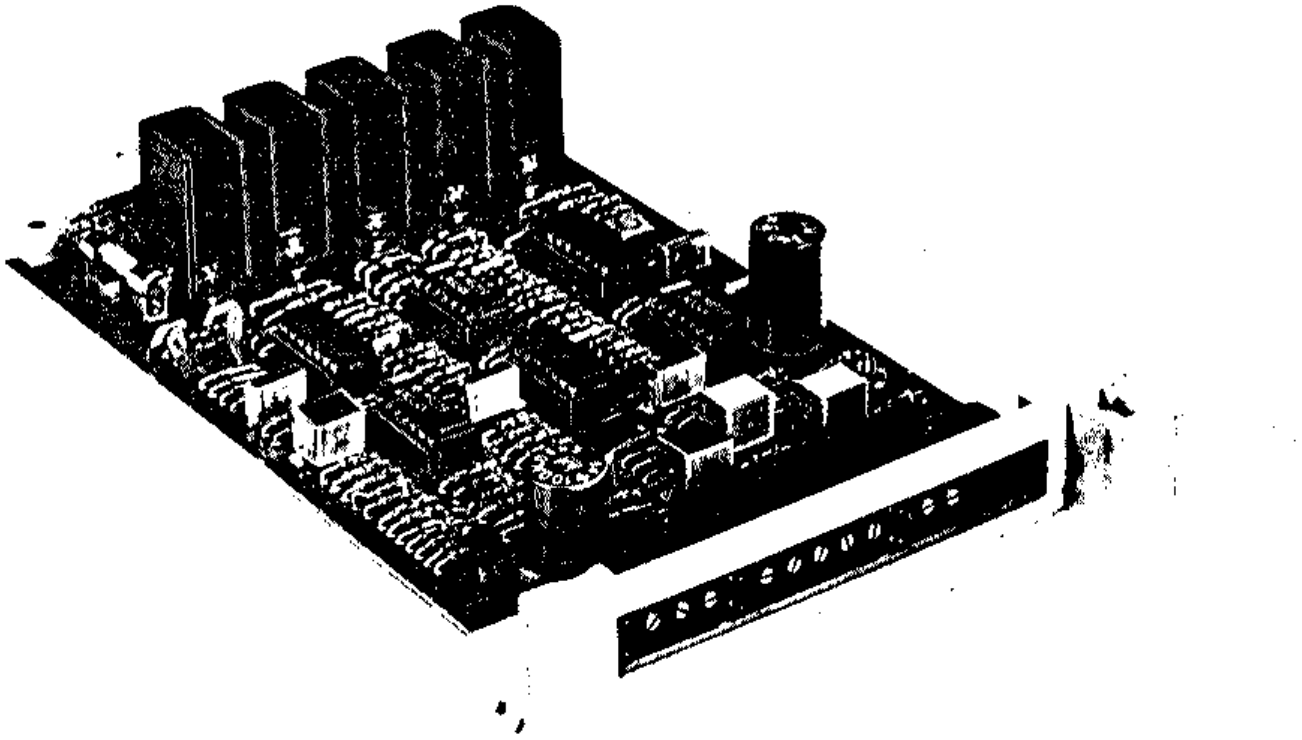


Section XVIII
JOYSTICK TESTING PROCEDURE AND
TECHNICAL INFORMATION BULLETIN



Typenschlüssel / Code			Bestell-Nr. / Order No.
Stromreglerkarte ***Current regulator board***	FE 102.02 FE 102.02	für 2 Ventile for 2 valves	504 302 / 6 504 302 / 6
Kartenhalter **Board holder**			466 933 / 0 466 933 / 0
Gehäuse T 347 für 1 Karte IP 55 *incl. Kartenhalter* **Housing T 347** for 1 board IP 55 incl. board holder		**Maße:** h = 205 mm, b = 140 mm, t = 175 mm **Anschlüsse:** 1 x PG 11, 5 x PG 9 **Dimensions:** h = 205 mm, b = 140 mm, t = 175 mm **Connections:** 1 x PG 11, 5 x PG 9	504 454 / 9 504 454 / 9
Gehäuse CI 4 für 2-4 Karten IP 55 **Housing CI 4** for 2-4 boards IP 55		**Maße:** h = 212 mm, b = 250 mm, t = 360 mm **Dimensions:** h = 212 mm, b = 250 mm, t = 360 mm	504 554 / 1 Gehäuse beinhaltet keine Kartenhalter und Anschlüsse 504 554 / 1 Housing without boards holders and connections

Stromregler ER 81
Current regulator ER 81



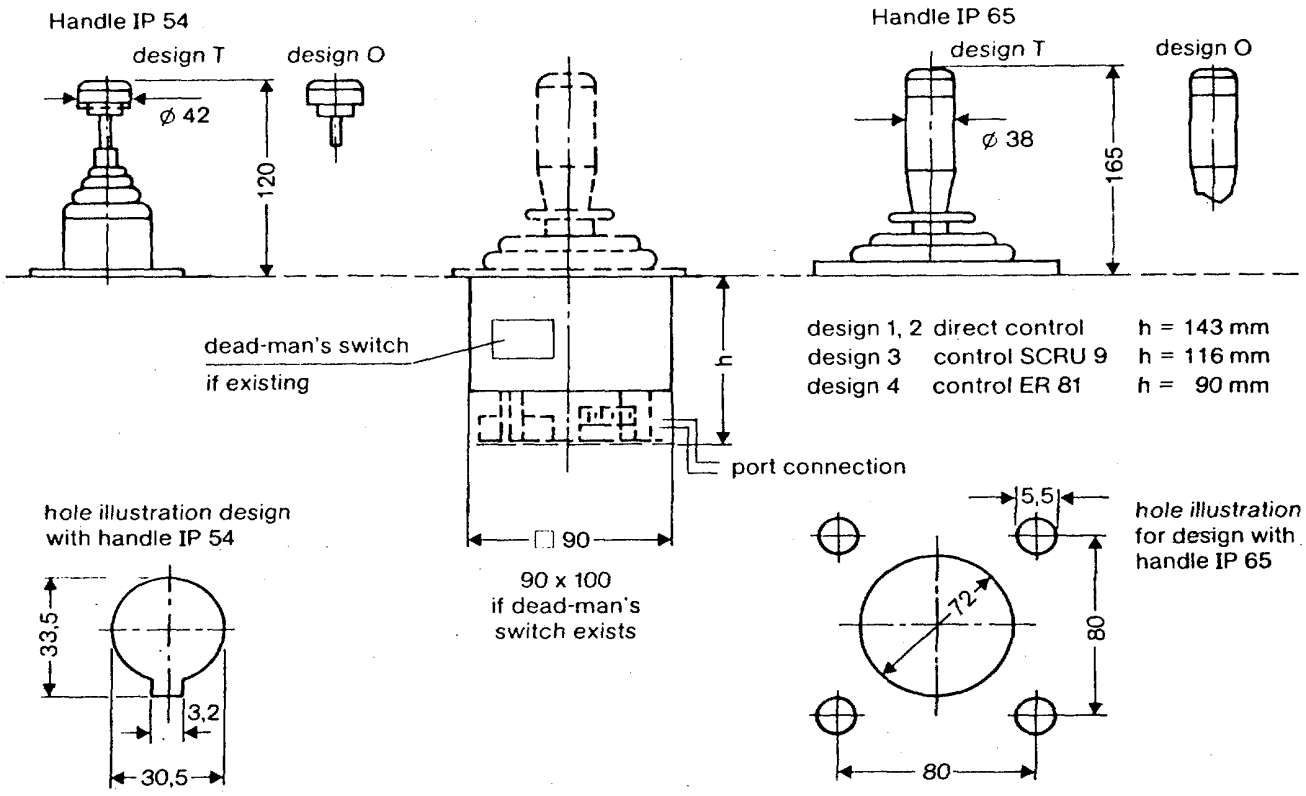
Description

The plug-in current-regulator board ER 81 of European format serves to control 4 proportional magnets or 2 valves as maximum.

The optimally adjusted dither frequency of the pulsed drivers guarantees the low hysteresis of the Barmag proportional valve.

Even under strong fluctuations of ambient temperature and supply voltage, the current regulator board ensures sensitive control. An adjustable ramp allows to limit the adjusting speed of the valve. The different operating stages of the board are signalled by Light emitting diode indication. In case of a short circuit in the magnetic lines, the corresponding output is switched off and released again automatically once the fault has bean cleared. Short circuits on the setpoint side effect the suppression of the output signal. All outputs can be blocked by means of a dead man's switch.

Technical data



servicing life	switching cycles	5×10^5 (design 3 and 4 5×10^6)
insulation class at the front	handle	IP 54
	handle	IP 65
operation angle	from center-position	24°
operating force	[N]	10
weight [e. g. VE 10 KO-4 F] dependent on the design	[kg]	0,9

Subject to technical alterations

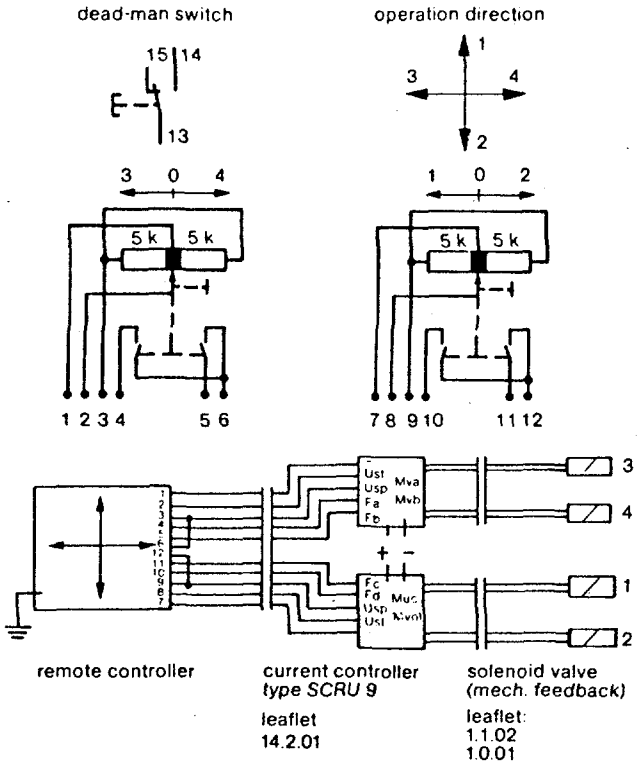
barmag

BARMAG BARMER MASCHINENFABRIK
AKTIENGESELLSCHAFT
5630 Remscheid 11, Postfach 11 02 40, Tel.: (0 21 91) 60 91, Telex 851 3210 · Fax 0 21 91 60 92 04 · Bundesrepublik Deutschland

AMERICAN BARMAG CORPORATION
1101 Westinghouse Boulevard, Charlotte, N.C. 2 82 17, P.O. Box 70 46, Tel.: Area Code 704/5 88 00 72, Telex 810 6 21 04 85 · Fax 001 704 554 01 41 · U.S.A.

BUK BARMAG HYDRAULIC U.K.
Dunbeath Road, Elgin, Swindon SN2 6EA, Wiltshire, Tel : 0793 487414, Telex 444485 · England

Design 3, control SCRU 9



operating voltage	control contacts	potentio-meter	dead-man device	potentiometer resistance	potentiometer performance
V				Ω	W
12, 24	2	1	with / without	2 x 5 kΩ	1,5
	4	2	with / without		

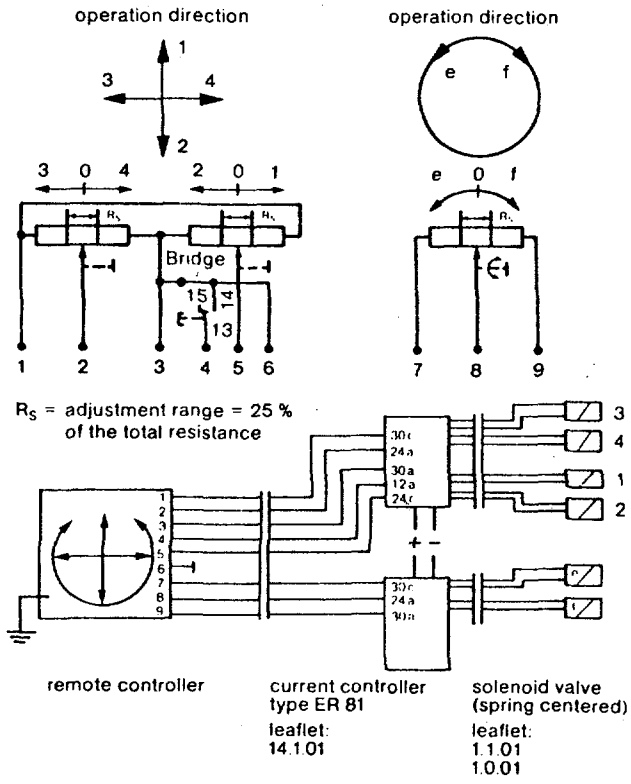
Remote controller for 3 operation directions not available

Applications of design 3:
for exalting controls, control SCRU 9 for proportional valves with mechanical feedback (leaflet 1.1.02)

Advantages:
low hysteresis
no modulation by temperature changes and by fluctuations of the power supply

we recommend the use of shielded cables for a troubleless functioning.

Design 4, control ER 81



operating voltage	control contacts	potentio-meter	dead-man device	potentiometer resistance	potentiometer performance
V				Ω	W
12, 24	–	1	with / without	10-40 kΩ total resistance	1,5
	–	2	with / without		
	–	3	with / without		

At remote controllers for 3 operation directions the dad-man's button is arranged laterally at the handel IP 65.

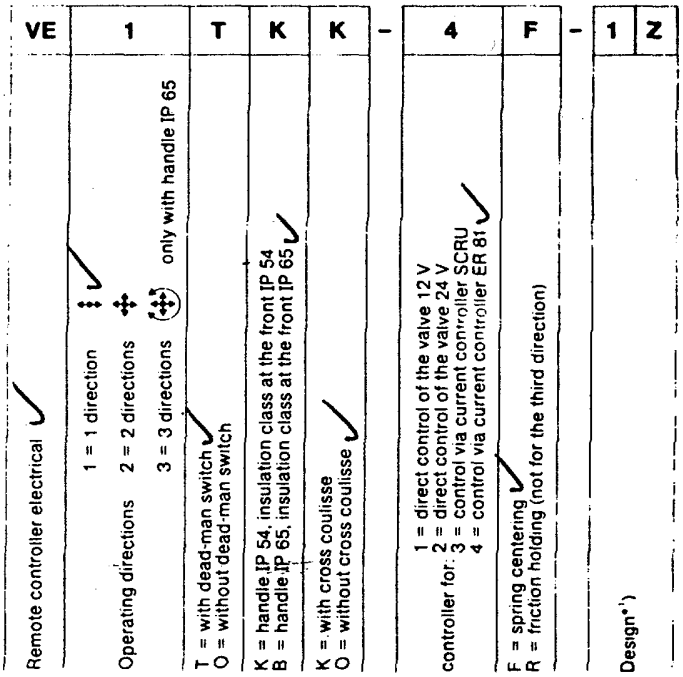
Applications of design 4:
for exalting controls, control ER 81 recommended for proportional valves with barometric feedback, spring centered (leaflet 1.1.01)

Advantages:
low hysteresis
no modulation by temperature changes and by fluctuations of the power supply
compact structure, low weight

we recommend the use of shielded cables for a troubleless fuctioning.

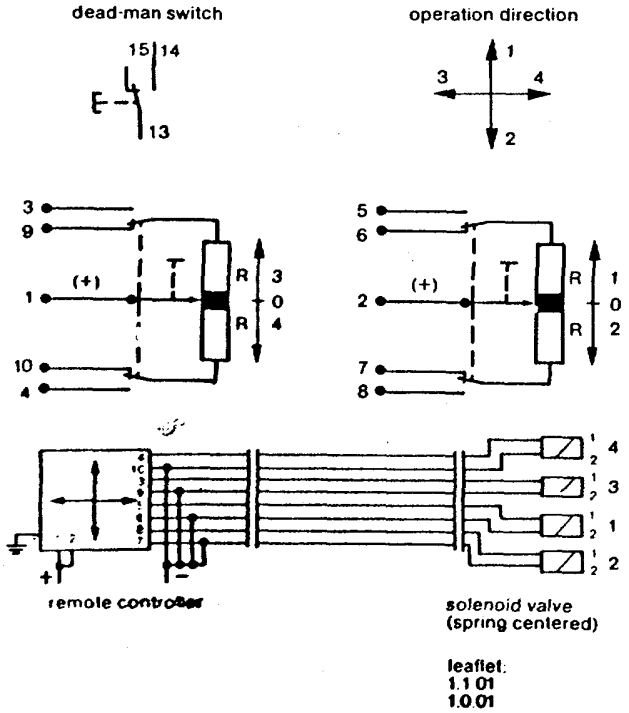
These remote controllers can be used for all electrical Barmag proportional remote-control systems.
For the various system variations only the equipment with potentiometers and switches changes.
The necessary design for each system may be seen from type code.

Type code



*1) 1 Z = Standard ✓
In case of special designs, this nomination changes.
In case of first order, give the whole text.

Design 1, 2, direct control 12 V, 24 V



leaflet:
1.1.01
1.0.01

operating voltage	control contacts	potentio-meter	dead-man device	potentiometer resistance	potentiometer performance
V				Ω	W
12	2	1	with / without	2 x 35 Ω	60
	4	2	with / without		
24	2	1	with / without	2 x 75 Ω	60
	4	2	with / without		

Remote controller for 3 operation directions not available.

Applications of design 1 and 2:
for simple controls. Not recommendable for proportional valves as per leaflet 1.1.02

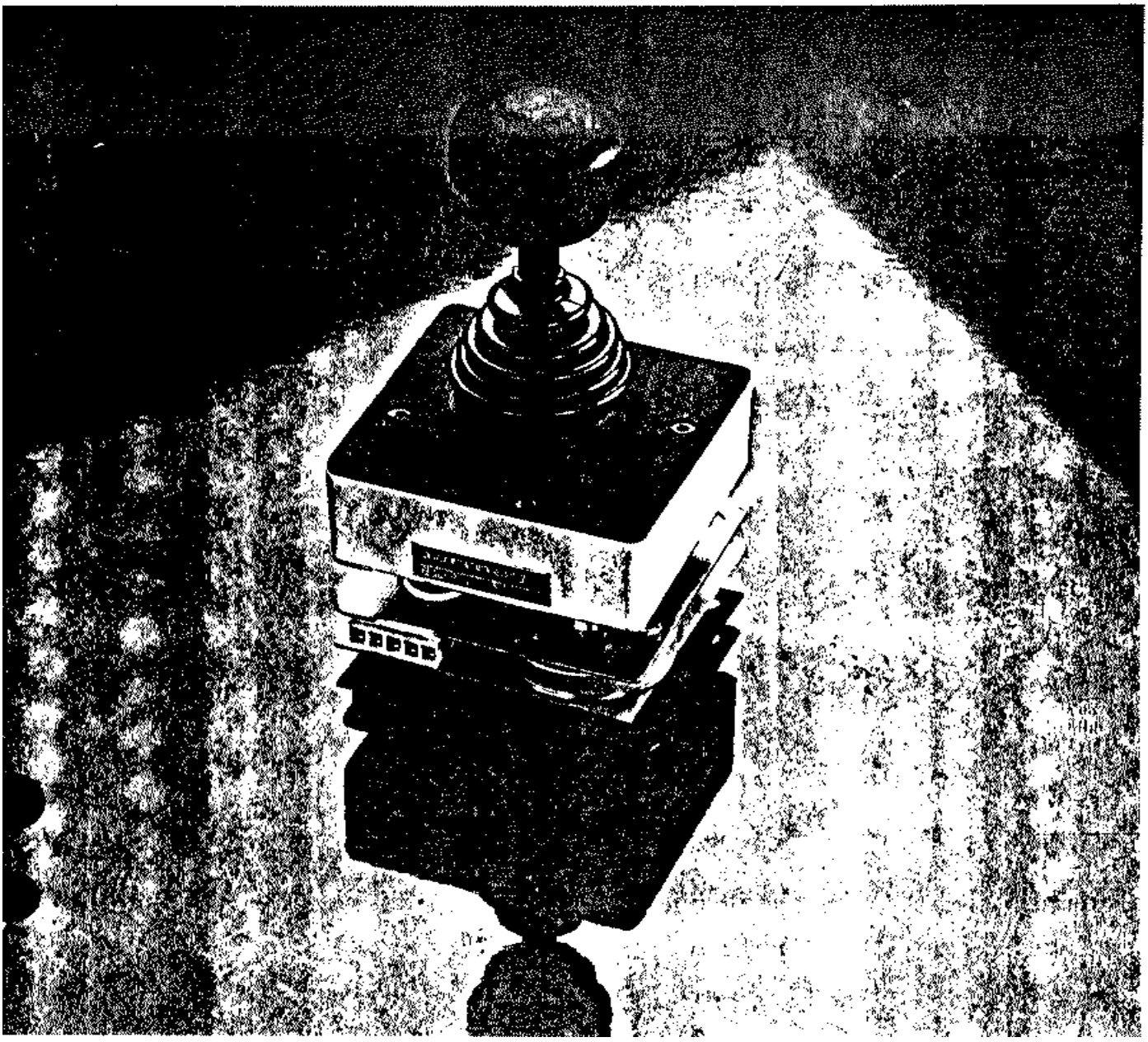
Remote controller

Electrical manually-operated
Installation type
Insulation class at front IP 54 or IP 65

barmag hydraulic

Section XVIII
JOYSTICK TESTING PROCEDURE AND
TECHNICAL INFORMATION BULLETIN

13.1.01



By Order of the Secretary of the Army:

JOHN A. WICKHAM, JR.
General, United States Army
Chief of Staff

Official:

R. L. DILWORTH
Brigadier General, United States Army
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PRINTED NAME, GRADE OR TITLE AND TELEPHONE NUMBER	SIGN HERE

TEAR ALONG PERFORATED LINE

DA FORM 1 JUL 79 **2028-2**

PREVIOUS EDITIONS ARE OBSOLETE.

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 dekagram = 10 grams = .35 ounce
1 hectogram = 10 dekagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	newton-meters	1.356	metric tons	short tons	1.102
pound-inches	newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

PIN: 060751-000