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VENDOR DATA

FOR

MAGELLAN 1

OPERATION

AND

MAINTENANCE

MANUAL

July 16, 1998

L3F INDUSTRIES
2110 Belgrave Avenue
Huntington Park, CA 90255
Telephone 323/588-2231
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RACINE®

BOSCH Group

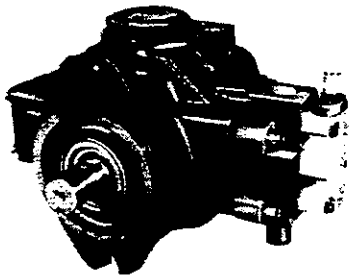
Engineering Data

D330027-3, -42

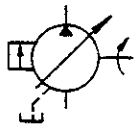
VARIABLE VOLUME VANE PUMPS

MODEL SV-40
MODEL TV-40

FLANGE MOUNTED



inlet 2" SAE 4 Bolt flange
outlet 1¼ SAE 4 Bolt flange
Both flanges: CODE 61



SYMBOL

QUICK REFERENCE CHART

MODEL	GPM @ 100 PSI	MAXIMUM PRESSURE (PSI)	MAXIMUM RPM	PRESSURE COMPENSATING RANGE (PSI)	THEORETICAL DISPLACEMENT IN³/REV	INPUT HP @ MAX PSI & 1800 RPM
SV-40	31 @ 1800 RPM	2000	1800	250-2000	4	41
TV-40	23 @ 1200 RPM	1000	1500	250-1000	4.4	16

STANDARD PUMP — The SV pump is a pressure compensated vane pump and is available in four basic displacements; one, two, four, and eight cubic inches. This bulletin covers the model SV-40 (four cubic inch displacement) and a variation of it which is dimensionally the same.

TWINVANE PUMP — The TV-40 (TWINVANE) pump is a standard pump with internal changes which allow it to operate on either high water content fluids (HWCF) or petroleum fluids. It provides an equivalent life on HWCF with only a slight reduction in volumetric and overall efficiency when compared to operation with petroleum oil at the same pressure and rpm.

PUMP MODEL	SERVICE BULLETIN
SV-40	7.50-52 & 62
TV-40	7.52-62
PUMP CONTROLS	7.90-63

FOR REPAIR PARTS, REFER TO THE SERVICE BULLETIN LISTED IN THE TABLE.

A-6-62
AUGUST 1988
HPUS-A[illegible] 303 / 3 U.S. (12.90)

SPECIFICATIONS

STANDARD PUMP

PRESSURE RATING —
SV-40 — 2000 psi (140 bar)

PRESSURE COMPENSATING RANGE —
SV-40 — 250-2000 psi (17-138 bar)

FLOW AT 1800 rpm —
SV-40 — 30 gpm (136/min) at 1900 psi

THEORETICAL DISPLACEMENT —
SV-40 — 4 in³/rev (65.6 ml/rev)

MAXIMUM INLET VACUUM AT SEA LEVEL —
6 in. Hg (152 mm Hg)
3 in. Hg (76 mm Hg) with fluids containing water

MAXIMUM CASE PRESSURE — 10 psi (0.7 bar)
Case drain line should be full intended size (not reduced down). Case pressure spikes can be minimized by using as straight and direct a path to tank as possible. Other drain lines should not be connected to the pump drain line. Always terminate the drain line below the fluid level in the reservoir. Failure to do so will result in loss of pump prime approximately 30 minutes after it is shut down and possible introduction of air into the circuit. Case drain line should be routed to the opposite side of baffle in relation to suction line.

CASE DRAIN FLOW — The values listed below are the average flows which occur only when the pump is compensating. When the pump is not compensating, the values are much lower.

300 in³/min (4.9 l/min) at 1000 psi (69 bar)
400 in³/min (6.6 l/min) at 2000 psi (138 bar)

DRIVE SPEED RANGE — 750-1800 rpm (Consult factory Applications Dept. for higher speeds)

MOUNTING — SAE C 2-Bolt Flange, side or rear ported.

ROTATION — Right hand and left hand rotation is available. Rotation is always determined when viewing the shaft end.

SEALS — Buna N seals are compatible with petroleum oil, water glycol, and water-in-oil emulsion. When using phosphate ester, viton seals must be specified. Viton is compatible with all of the fluids mentioned.

FILTRATION — A 10 micrometre return line filter is recommended for increased pump life. If a suction strainer is used, it should not be finer than 100 mesh (149 micrometre) when using petroleum fluids. The higher specific gravity of fire resistant fluids and the higher vapor pressure of the water containing fluids will aggravate the pump inlet conditions. If a suction strainer is used with these fluids, the mesh must be coarser (60 mesh or 238 micrometre) than what is used with petroleum oil or the surface area increased to reduce the pressure drop. ISO 17/13

OVERHUNG LOAD — Radial and axial forces on the shaft are not recommended. Pump and prime mover should be mounted with shafts inline (coaxial) and connected with a flexible coupling. Consult factory Applications Dept. for applications with overhung load.

FLUID RECOMMENDATIONS — A premium quality hydraul with zinc complex anti-wear additives is highly recom en Refer to RACINE publication S-106, "Petroleum Hydraul Flu for a list of fluids which meet or exceed the RACINE lubric requirements. 2300 SSU CONTINUOUS OK'd BY RO:

Optimum Viscosity at Operating Temperature	200-30 SU (43-65 cSt
Minimum Operating Viscosity	150 S (32 t)
Maximum Operating Viscosity	1000 SUS (215 cSt)
Maximum Start-up Viscosity	4000 JS (864 St)

To compensate for the reduced lubrication values of ever he mium quality water containing fluids (glycols and wa r-i emulsions), it is necessary to limit system pressure an rp the values listed in the table below for an equivalent life.

	Water Glycol	Water- O Emuls n
Maximum Pressure	1000 psi	750 psi
Maximum RPM	1800 rpm	1200 m

Refer to RACINE publication S-107, "Fire Resistant Fluids" further details on fluid selection. Fluid suppliers should he sulted regarding proper fluid maintenance when using fi re ant fluids containing water.

TEMPERATURE — The temperature of the fluid in the rese should not exceed 130°F (54°C). The pump will operate th higher temperatures provided the viscosity of the fluid v the recommended range. Under no circumstances should t temperature exceed 160°F (71°C). When using fire resistant containing water, the fluid temperature should not exc (49°C) to prevent an excessive rate of water evaporatio

SCREW VOLUME CONTROL — The screw volume control adjustable stop which is used to reduce the maximum p mp and is optional. Turning clockwise will reduce the flow proportion to the displacement of the adjusting screw. Dur tial start-up, the flow setting should be at least 30% of the imum pump flow.

SV-40 — 1/4 turn (90°) clockwise will reduce the flov p mately 4 gpm (15.1 l/min) when the pump is dri 1800 rpm.

When a volume control is used to reduce the maximu fl the pump, the horsepower required to drive the pump is reduced. To determine the Input HP, use the following form

$$\text{Input HP} = \frac{\text{gpm x psi}}{1714} + \text{Deadhead HP at the compensat s}$$

MOUNTING POSITION — Pump should be mounted it shaft horizontal. Caution must be exercised to prevent e l t from being applied to the shaft.

SHAFT ALIGNMENT — Shaft alignment should be within 0 total indicator reading. If the shafts are not properly li increased mechanical noise from the unit will result.

START-UP — To insure priming on initial start-up, air in the pump and inlet line must be allowed to escape. If the pump outlet is normally blocked, it must be temporarily vented. This can be accomplished by opening the valve, temporarily cracking a fitting, or installing an air bleed valve (refer to Bulletin J-34).

CONTROL OPTIONS — Many energy saving controls are available in addition to the standard two-stage pressure compensator. Refer to Bulletin A-11 for performance and dimensional data.

COMBINATION MOUNTING — To simplify multi-pump circuits, adaptor kits are available to mount additional pumps in combination on the rear cover of the flange mounted (side ported) pumps. Refer to Bulletin A-14 for horsepower limitations, adaptors available, dimensional data, and How-To-Order.

WEIGHT (Approximate) —
Flange Mounted Pump ..... 105 lbs. (47.2 Kg)
Add for Screw Volume Control ..... 1 lbs. (0.5 Kg)

TWINVANE PUMP

NOTE: All of the specifications for the standard pump also pertain to the TWINVANE pump except those listed below.

PRESSURE RATING —
TV-40 — 1000 psi (69 bar)

PRESSURE COMPENSATING RANGE —
TV-40 — 260-1000 psi (18-69 bar)

FLOW —
23 gpm (100 l/min) at 1200 rpm and 100 psi (7 bar)
28.5 gpm (110 l/min) at 1500 rpm and 100 psi (7 bar)

Because of the low viscosity of HWCF, the internal leakage is greater and will result in a slight reduction in flow in comparison to petroleum oil. Refer to the performance characteristics on page 5.

THEORETICAL DISPLACEMENT —
TV-40 — 4.4 in^3/rev (72 ml/rev)

MAXIMUM INLET VACUUM AT SEA LEVEL —
When using high water content fluids, a positive head is benefical but not necessary. The TV-40 can be used up to 12 inches (30 cm) above the fluid level at altitudes to 2000 feet (610 m) above sea level.

CASE DRAIN FLOW — The value listed below is the average flow which will occur when the pump is compensating at 1000 psi. When the pump is not compensating, the flow is much lower.

2.5 gpm (11.3 l/min) at 1200 rpm (HWCF)

DRIVE SPEED RANGE — 750-1500 rpm

ROTATION — Right hand only. Clockwise when viewing shaft end.

SEALS — Viton seals are standard.

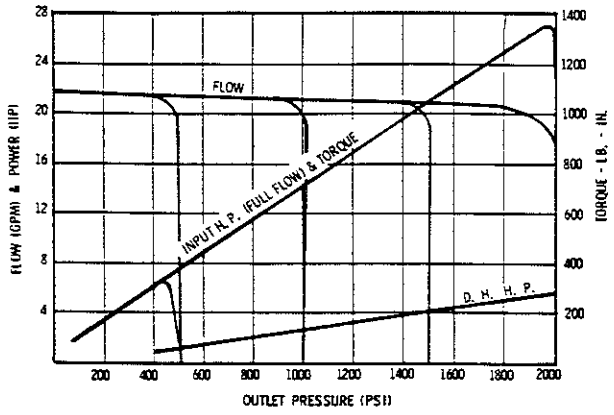
SCREW VOLUME CONTROL — The screw volume control is standard.

FLUID RECOMMENDATIONS — If a high water content fluid is used, please consult the factory Applications Dept. during the fluid selection process for current list of approved fluids. This pump is not compatible with phosphate ester fluids.

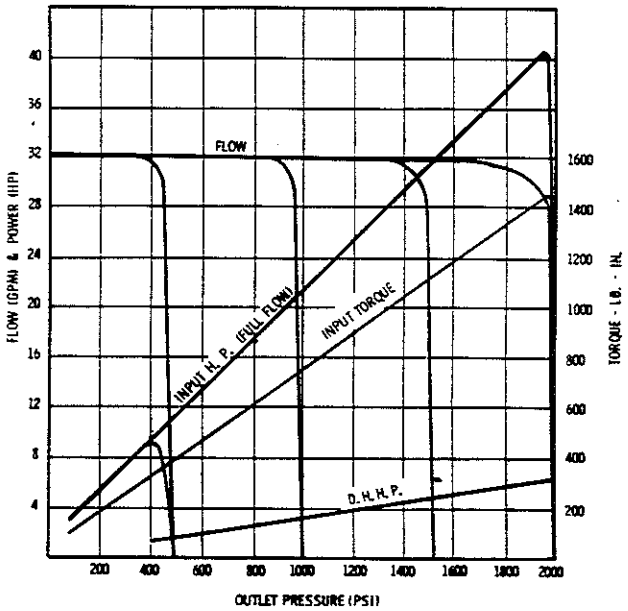
STANDARD PUMP

DATA PLOTTED WITH OIL AT 120°F (49°C)
VISCOSITY @ 120°F = 140 SUS (29.6 cSt)

SV-40 @ 1200 rpm



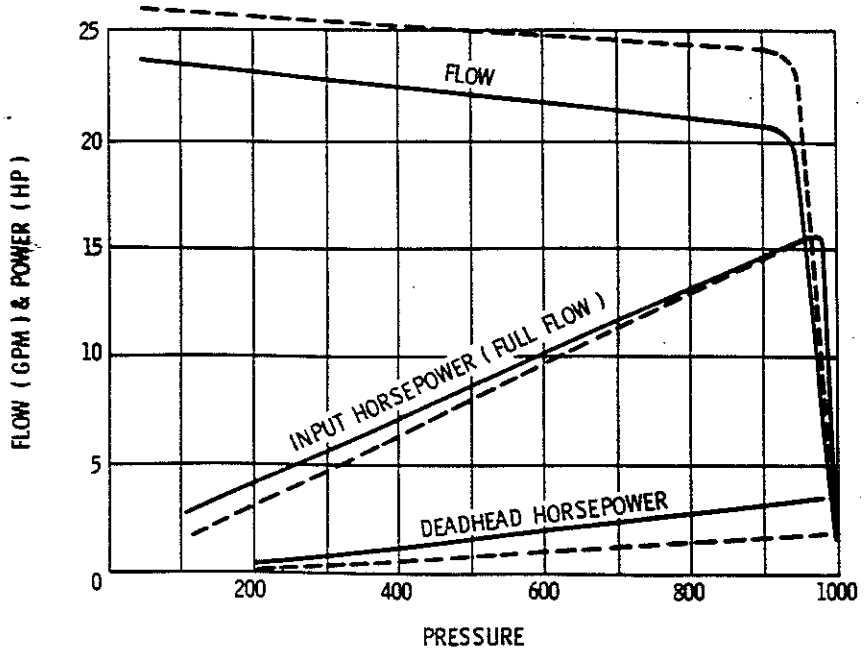
SV-40 @ 1800 rpm



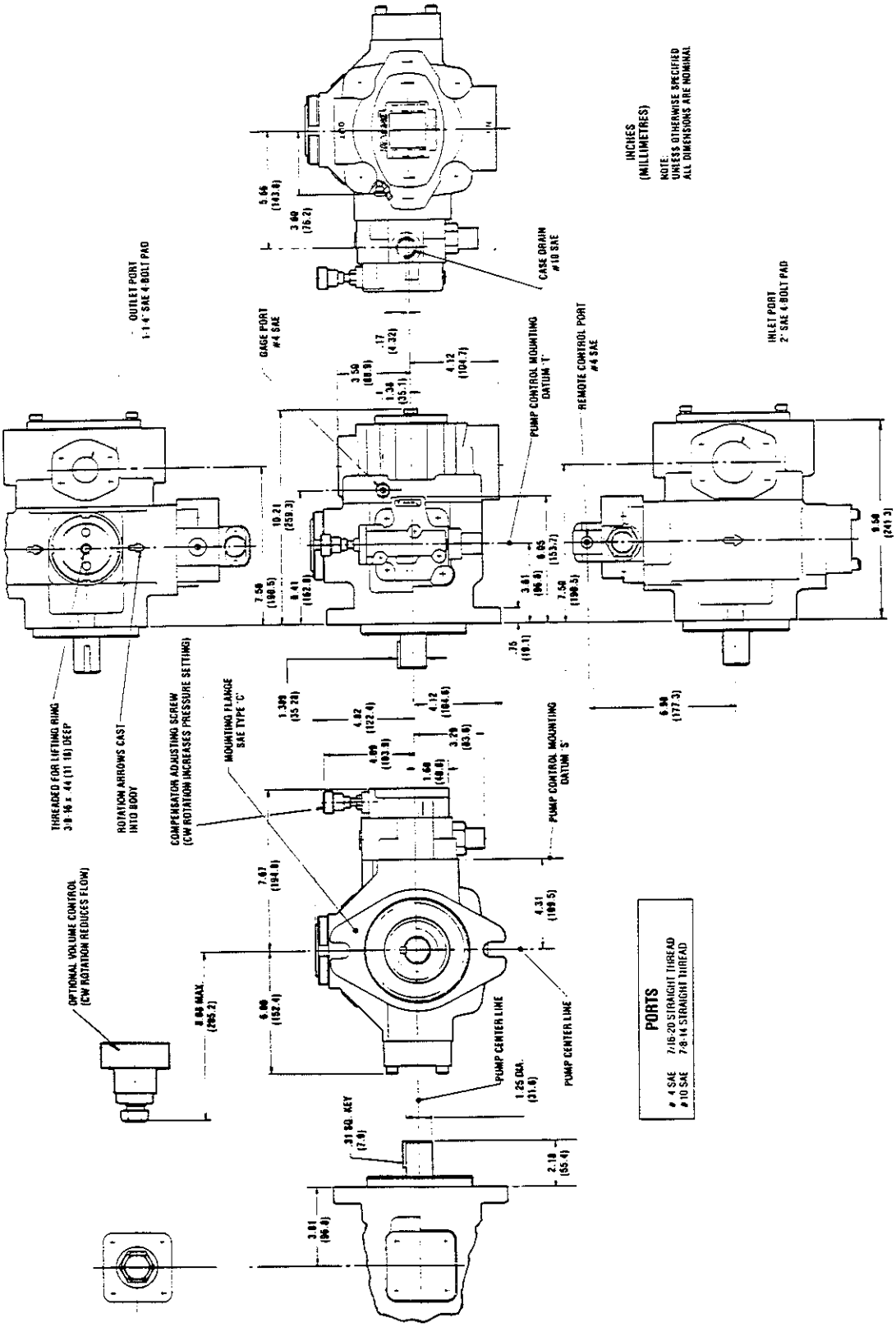
TWINVANE PUMP

[HWCF @ 110°F (43°C)]
[140 SUS (29.6 cSt) @ 120°F (49°C)]

TV-40 @ 1200 rpm



ROTATION → R.H. FLANGE MTD.
SIDE PORTED



Document A-6-62
Ag 988 HAUS-AKT 003
US 12 C

STANDARD PUMP

PSV-PNCO-40HRM-62

CONTROL OPTIONS
- P - STANDARD PRESSURE COMPENSATOR
- *S - SOLENOID TWO-PRESSURE (NORMALLY LOW, ENERGIZE FOR HIGH PRESSURE)
- *H - SOLENOID TWO-PRESSURE (NORMALLY HIGH, ENERGIZE FOR LOW PRESSURE)
- *V - SOLENOID TWO-PRESSURE (NORMALLY VENTED, ENERGIZE FOR HIGH PRESSURE)
- J - HYDRAULIC TWO-PRESSURE (NORMALLY LOW, ENERGIZE FOR HIGH PRESSURE)
- L - LOAD SENSING
- T - TORQUE LIMITING
- K - SINGLE STAGE COMPENSATOR

*Indicate the desired solenoid voltage and frequency at the end of the pump code.

VOLUME CONTROL
- N - NO VOLUME CONTROL
- S - SCREW VOLUME CONTROL

MOUNTING
- C - FLANGE, SIDE PORTED (4 BOLT FLANGE CONNECTIONS)
- R - FLANGE, REAR PORTED (4 BOLT FLANGE CONNECTIONS)

SEALS
- O - BUNA N
- F - VITON

FLOW @ 1800 RPM
40 - 30 GPM @ 900 PSI

PRESSURE RATING
H - 2000 PSI

ROTATION (VIEWING SHAFT END)
- R - RIGHT HAND (CLOCKWISE)
- L - LEFT HAND (COUNTERCLOCKWISE)

SHAFT
M - KEYED SHAFT MEDIUM LENGTH

DESIGN DIGIT
-62

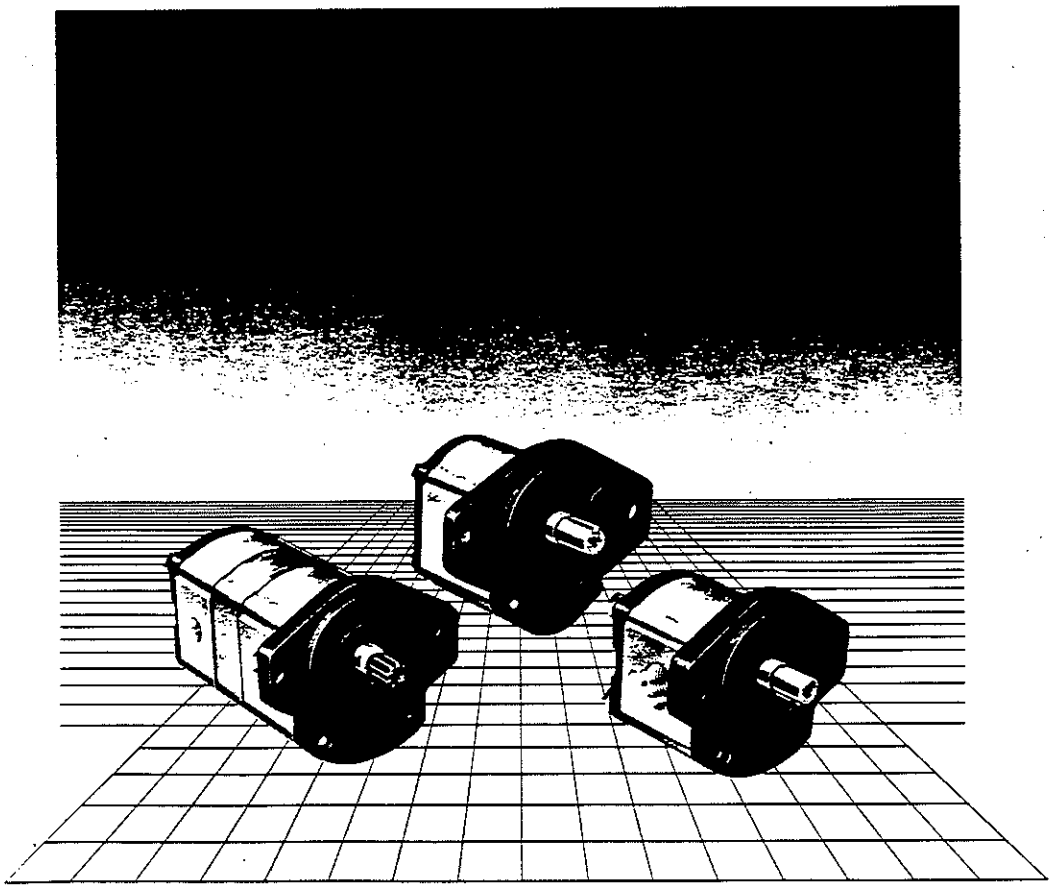
R & T Hydraulics
Bosch
PO Box 2021
Racine WI
53401-2^2
Phone 414-554
Fax 414-554 7

SOLENOID VOLTAGES AVAILABLE
110/115 VAC 50/60 HZ (DUAL FREQUENCY) 220/230 VAC 50/60 HZ (DUAL FREQUENCY) 12 VDC 24 VDC
FOR SOLENOIDS WITH QUICK CONNECT (HIRSCHMANN TYPE) CONSULT FACTORY

To order the lock for the compensator adjusting screw, specify "LOCK" at the end of the code.

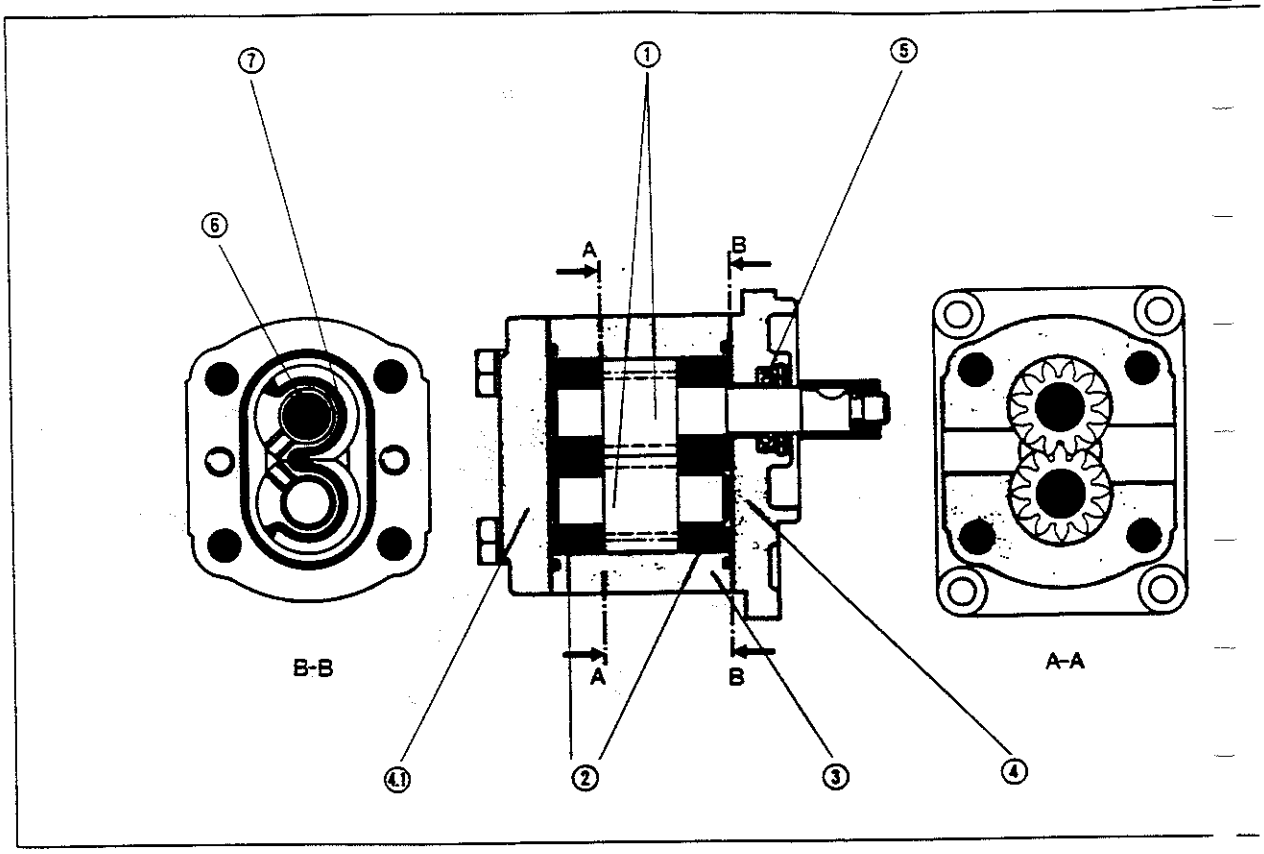
BOSCH

Gear pumps



01

Basic Design



Design Features

The pump consists essentially of a pair of gears ① supported in four bearings ② and the body ③ with front and rear covers ④ and ④①. The drive shaft protrudes from the front cover where it is sealed by the shaft seal ⑤.

The pump body is made of aluminum from an extruded profile section with a high deformation ratio. With this material it is possible to achieve a much higher fatigue strength than, for example, an aluminum die-casting. Cast iron is used for the end covers.

The bearing forces are absorbed by special bearing-bushings with sufficient elasticity to produce surface contact instead of line contact. They also assure good operation under emergency conditions especially at low speed.

The gears have 12 teeth and this keeps both flow pulsation and noise emission to a minimum.

The internal sealing is pressure-sensitive which gives optimum efficiency.

The bearings provide the seal at the ends of the gaps between the teeth which carry the pressurized oil. The sealing zone between the gear teeth and the bearings is controlled by the admission of operating pressure to the rear of the bearings. Special seals ⑦ form the boundary of the zone.

The radial clearance at the tips of the gear teeth is sealed by forcing them against the body.

High Pressure Capability

The Bosch design gear pump incorporates the following features that enable the "F" size pumps to operate continuously at 3600 PSI, intermittently to 4000 PSI.

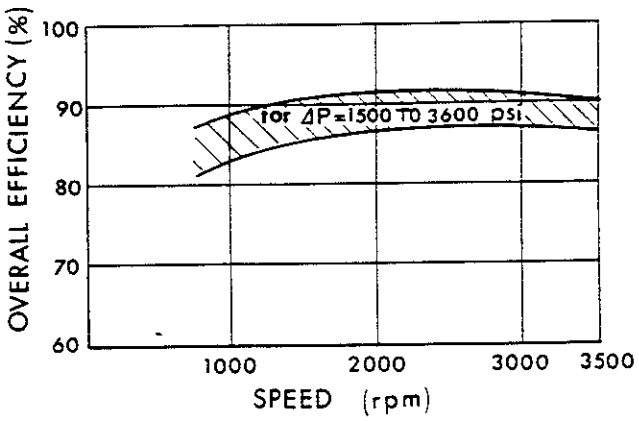
- Precision machining to maintain minimal clearances and the finest finishes.
- Advanced machining process and the twin bushing design maintains precise bearing to gear alignment.
- Minimal pressure build up area near the suction port reduces bearing loads, combined with the benefits of the DU bearings:
  - Long Life
  - Low Friction
  - Wide Temperature Range

Pump Efficiency

The design features contribute to the high pressure capabilities enabling the pumps to maintain high volumetric efficiency.

- Specially designed sealing elements:
  - Reduces seal deformation under pressure and reduces leakage.
  - Fiber-reinforced back-up rings minimize leakage at higher temperatures.
- Pressure loading of the thrust bushings ensures high volumetric efficiency, even when axial forces are applied to the shaft.

At the right is a typical overall efficiency curve of a .69 cu in/rev (11 cc/rev) "F" size pump. The overall efficiency improves with the larger size "G" series.

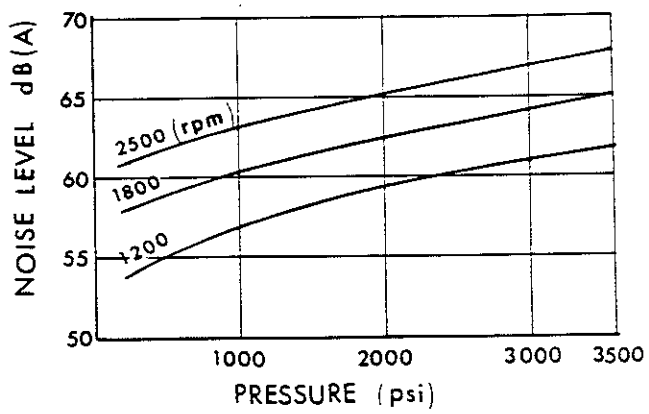


Pump Noise

Special design features have been incorporated to optimize the flow pulsations, pressure reversals, body design, and efficient filling of the pumping chambers (to reduce cavitation). The net results of our efforts is a reduction of noise.

- Lower number of flow pulsations due to a greater number of gear teeth.
- Modified involute gear design and optimized design of the pressure outlet cavity minimizes the number of pressure reversals.
- Cast iron end plates and thicker aluminum extrusion minimizes noise transfer.

The curves at the right show noise levels of a 1 cu in/rev (16 cc/rev) pump at different speeds and pressures (sound levels measuring at a distance of 3.3 ft.)



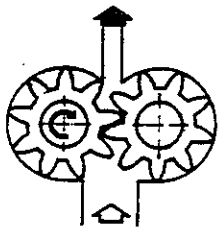
Specifications

General

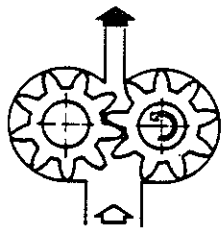
Design	External gear-type pump
Mounting	F Size – SAE A Flange G Size – SAE B Flange
Ports	F Size – SAE straight thread O Ring G Size – SAE 4-bolt flange
Direction of Rotation*	Clockwise or Counter-clockwise. The pump may only be driven in the direction indicated.
Mounting Position	Any
Ambient temperature range	5°F to 140°F
Fluid temperature range	5°F to 180°F
Fluid	Mineral oil based hydraulic fluids
Viscosity	12-800 cs (65-3550 SUS) permitted range 20-100 cs (97-450 SUS) recommended range 2000 cs (8850 SUS) permitted for starting
Filtration	Contamination class 10 to NAS 1638 obtained with filter $B_{25} = 75$

***Definition of direction of rotation**
Always look on the drive shaft.

Note: Dimensional drawings always show clockwise-rotation pumps. On counter-clockwise-rotation pumps the positions of the drive shaft and the suction and delivery ports are different.

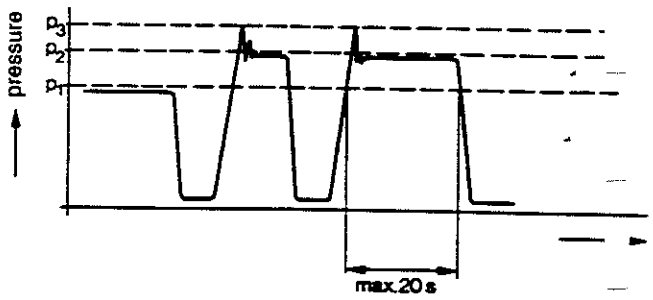


Clockwise rotation



Counter-clockwise rotation

Definitions of pressures

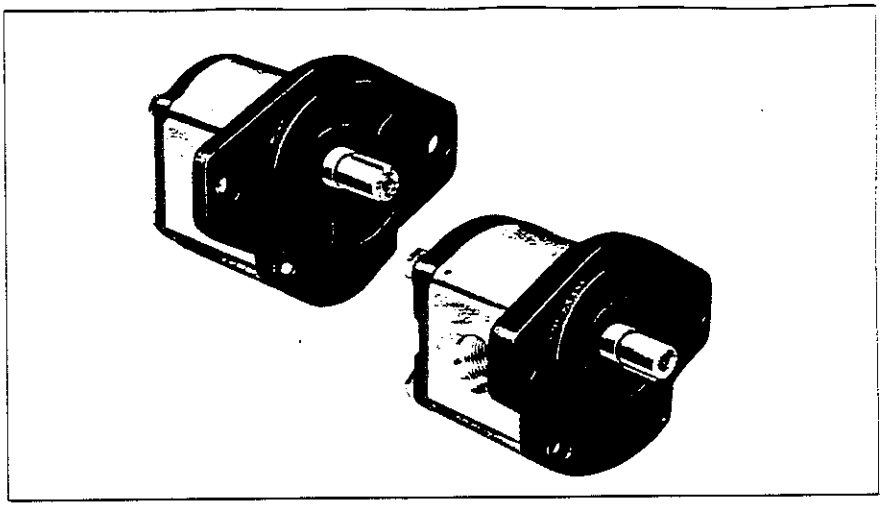


Duration of load

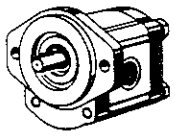
p_1 Max. continuous pressure
p_2 Max. intermittent pressure
p_3 Max. peak pressure

Specifications

F and G

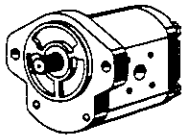


size F



Displacement	in³/rev (cm³/rev)	.24 (4)	.34 (5.5)	.49 (8)	.67 (11)	.85 (14)	.98 (16)	1.16 (19)	1.37 (22.5)
Inlet Pressure		ABSOLUTE Minimum = 9 in Hg; Maximum = 30 psi							
Max. Continuous Pressure P_1	PSI (bar)	3625 (250 bar)						3045 (210)	2610 (180)
Max Intermittent Pressure P_2		4060 (280 bar)						3335 (230)	3045 (210)
Max Peak Pressure P_3		4350 (300 bar)						3625 (250)	3335 (230)
Min. Rotational Speed @ Pressure = 1450 psi (100 bar)	RPM	600	500	500	500	500	500	500	500
1450-2610 psi (100-180 bar)		1200	1200	1000	1000	800	800	800	800
2610-P_2 (180 bar)		1400	1400	1400	1200	1000	1000	1000	1000
Max Rotational Speed @ P_1	RPM	3500			3000	2500	2000	2000	2000
@P_2		4000			3500	3000	3000	3000	2500

size G

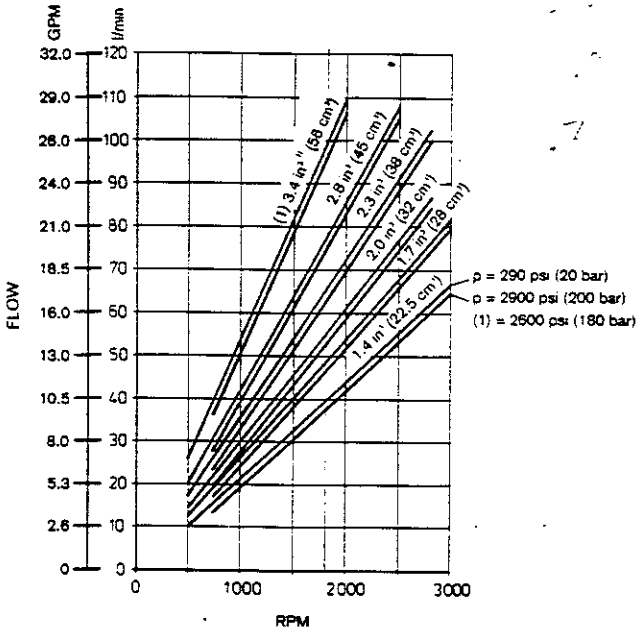


Displacement	in³/rev (cm³/rev)	1.37 (22.5)	1.71 (28)	1.95 (32)	2.32 (38)	2.75 (45)	3.42 (56)
Inlet Pressure		Minimum = 9 in Hg; Maximum = 30 psi					
Max. Continuous Pressure P_1	PSI (bar)	2610 (180 bar)					2175 (150)
Max Intermittent Pressure P_2		3045 (210 bar)					2610 (180)
Max Peak Pressure P_3		3335 (230 bar)					2900 (200)
Min. Rotational Speed @ Pressure = 1740 psi (120 bar)	RPM	500					
1740-2175 psi (120-150)		600					
2175-3045 (150-210)		800					
Max Rotational Speed @ P_1	RPM	2500		2300		2100	1800
@P_2		3000		2800		2600	2300

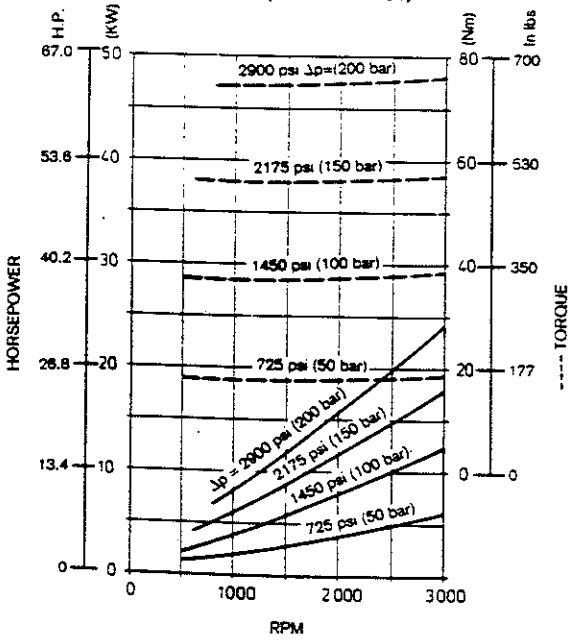
Performance Data

size G

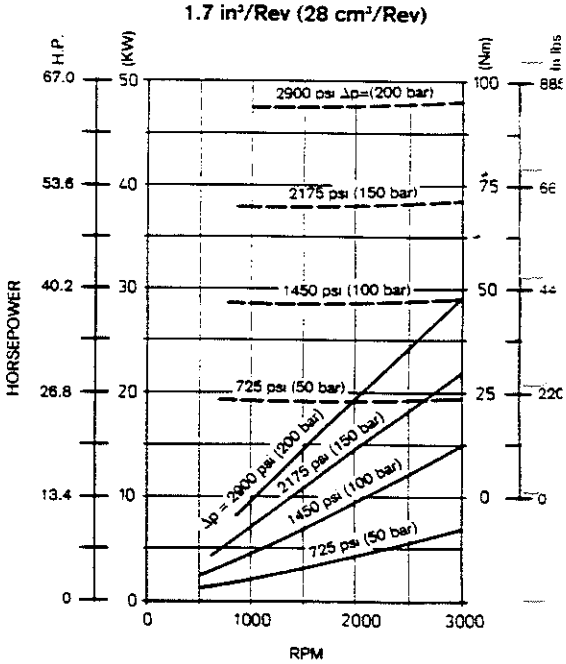
SIZES 1.4 TO 3.4 in³/Rev (22.5 TO 56 cm³/Rev)



1.4 in³/Rev (22.5 cm³/Rev)



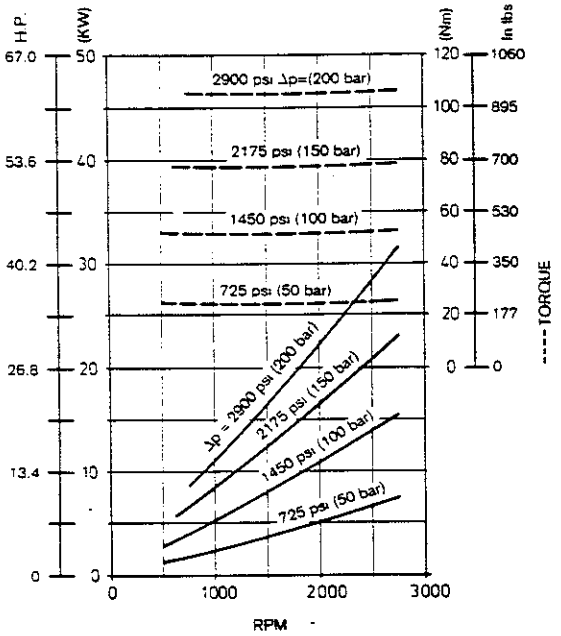
1.7 in³/Rev (28 cm³/Rev)



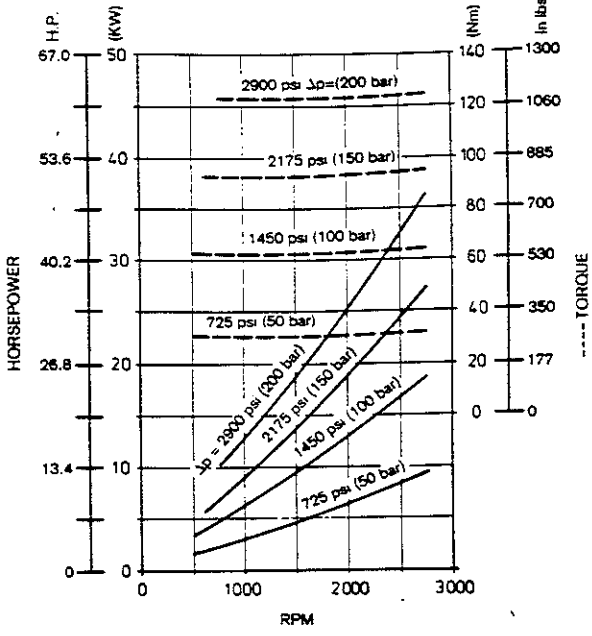
erformance Data

ize G

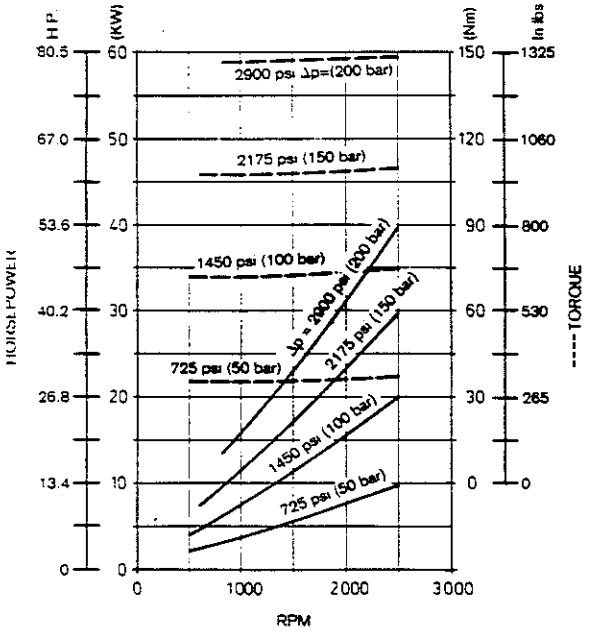
2.0 in³/Rev (32 cm³/Rev)



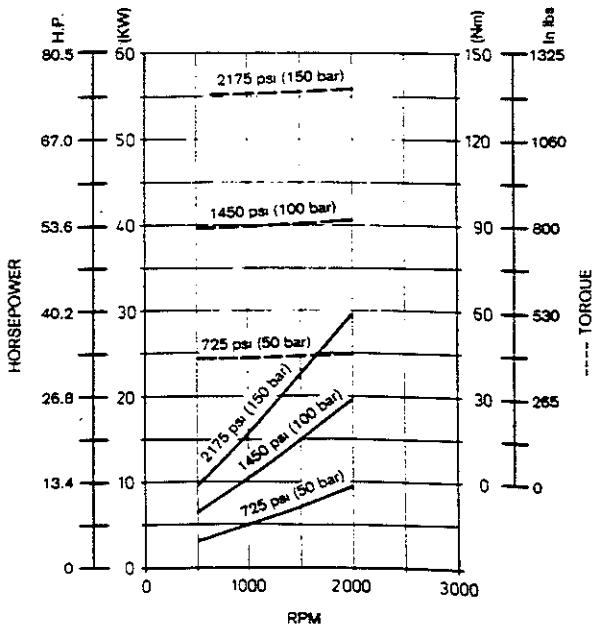
2.3 in³/Rev (38 cm³/Rev)



2.8 in³/Rev (45 cm³/Rev)



3.4 in³/Rev (56 cm³/Rev)



Installation

Installation and commissioning

- Fill the pump with fluid before installing.
- Check the direction of rotation.
- Before installing the pump, clean the pipes thoroughly of all dirt, scale, sand, swarf, etc. Welded pipes in particular must be pickled or flushed out.
- For the first run of the pump it is advisable to disconnect the pump discharge in order to purge the air from the system.
- Cover the shaft seal when spraying or brush-painting the equipment.
- Pay close attention to the specification, especially speeds, pressures and inlet vacuum.

Filter recommendations

By far the largest number of premature failures of gear pumps are due to contaminated fluid.

Since our guarantee does not apply to wear resulting from dirt in the system, we recommend filtering which reduces the size and concentration of the contamination particles to a permitted minimum.

Operating pressure [bar]	>160	<160
Contamination class NAS 1638	9	10
Contamination class ISO 4406	18/15	19/16
Achieved with filter $\beta_x = 75$	20	25

Full-flow filtering is always recommended.

The initial contamination of the flu with which the system is filled mu- n exceed Class 10 to NAS 1638. Pa experience has shown that even brar new fluids often exceed this value. such cases a filler incorporat g special filter should be used.

Multiple Pumps (Tandem)

Gear pumps are well-suited to tandem combinations of pumps in which the drive shaft of the first pump is extended to drive a second pump and sometimes a third pump in the same manner. A coupling is fitted between each pair of pumps. In most cases each pump is isolated from its neighbor, i.e. the suction and delivery ports are separate.

Note: Basically, the specifications for the individual pumps apply, but with certain restrictions:

Max. speed: This is determined by whichever pump has the lowest rated speed.

Pressures: These are restricted by the strength of the drive shaft, the transmissions and the couplings.

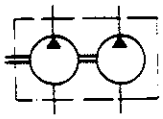
Pressure restrictions

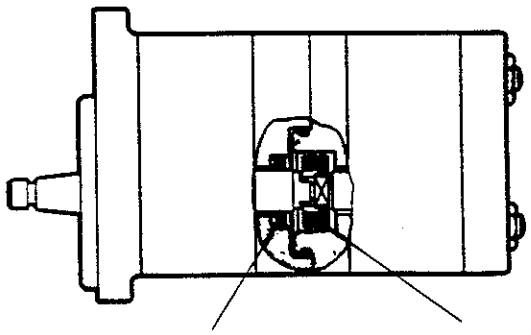
In the case of Size F the cent coupling for the second pum c carry a load of up to M_{max} = 4 b i.e. the pressure restriction for t second pump is as follows:

in^3/rev cc/rev	P_{max} [psi]
.98 - (16)	3335 (230)
1.16 - (19)	2755 (19
1.37 - (22.5)	2320 (16

Combinations

F + F
G + F



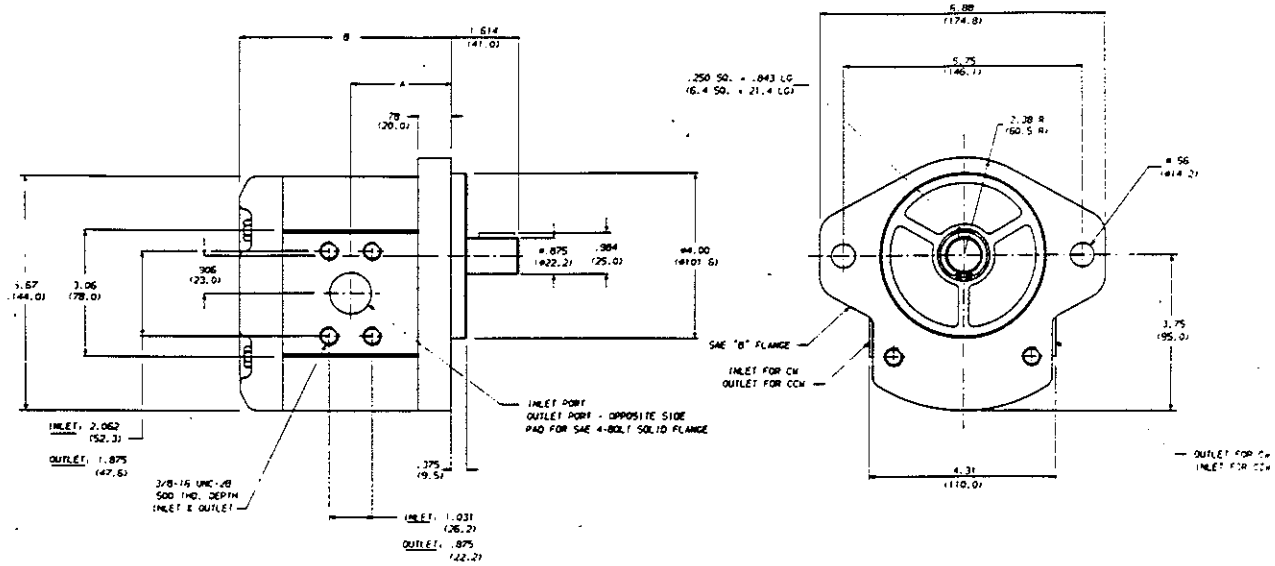


Shaft-seal

Center couplings

DIMENSIONAL DATA

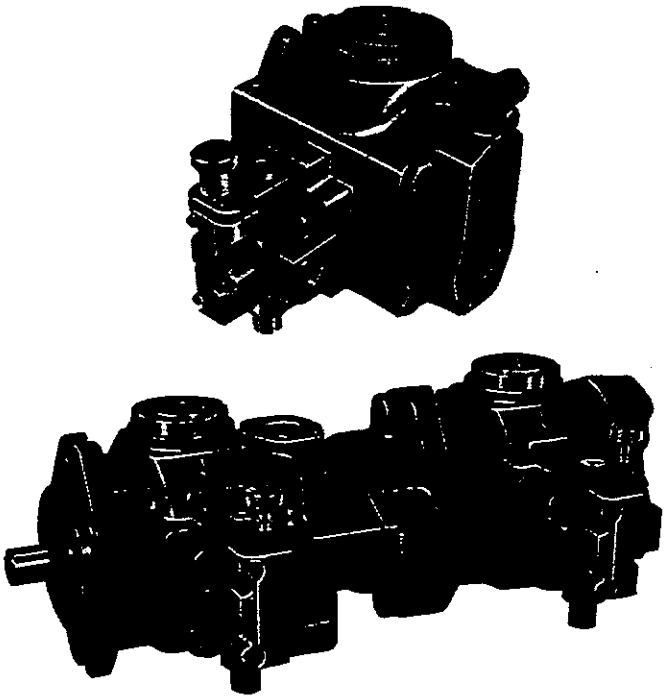
size G
KEYED SHAFT



Code	Theoretical Displacement	Dimension		Port Size UNF-2B		Weight	Part Number	
							CW Rotation	CCW Rotation
HY/ZGS 11/...	in^3/rev (cc/rev)	A in. (mm)	B in. (mm)	Inlet	Outlet	Pounds (kg)	Keyed Shaft	Keyed Shaft
22.5 L/R 408	1.37 (22.5)	2.40 (61.0)	5.07 (128.5)	1" SAE 4 Bolt	3/4" SAE 4 Bolt	19.8 (9.0)	0 510 725 066	0 510 725 366
28 L/R 408	1.71 (28)	2.48 (63)	5.26 (133.7)	1" SAE 4 Bolt	3/4" SAE 4 Bolt	20.2 (9.2)	0 510 725 067	0 510 725 367
32 L/R 408	1.95 (32)	2.54 (64.5)	5.40 (137.2)	1" SAE 4 Bolt	3/4" SAE 4 Bolt	20.7 (9.4)	0 510 725 068	0 510 725 368
38 L/R 408	2.32 (38)	2.62 (66.5)	5.62 (142.6)	1" SAE 4 Bolt	3/4" SAE 4 Bolt	21.3 (9.7)	0 510 725 069	0 510 725 369
45 L/R 408	2.75 (45)	2.74 (69.5)	5.87 (149.2)	1" SAE 4 Bolt	3/4" SAE 4 Bolt	21.8 (9.9)	0 510 725 070	0 510 725 370
56 L/R 408	3.42 (56)	3.04 (77.2)	6.31 (160.2)	1" SAE 4 Bolt	3/4" SAE 4 Bolt	22.9 (10.4)	0 510 825 006	0 510 825 306

BOSCH

REPAIR PARTS



VARIABLE VOLUME SILENTVANE PUMP MODEL SV-40

2000 PSI
30 GPM

FLANGE MOUNTED COMBINATION CAPABILITY

WHEN ORDERING PARTS, FURNISH:

1. COMPLETE CODE NUMBER
2. PARTS REQUIRED
3. SHIPPING INSTRUCTIONS

WRITE FACTORY FOR NEAREST AUTHORIZED PARTS AND SERVICE CENTER.

PUMP CODING

PSV-PNCO-40 HRM-52

- P – PRESSURE COMPENSATOR (STD.)
- L – LOAD SENSING FLOW CONTROL
- T – TORQUE LIMITING CONTROL
- M – MULTIPLE CONTROL (P, L, & T)
- S – SOLENOID TWO PRESSURE CONTROL
- J – HYDRAULIC TWO PRESSURE CONTROL

- N – NO VOLUME CONTROL
- S – SCREW VOLUME CONTROL

- C – FLANGE MOUNTED; FLANGE CONNECTIONS; SIDE PORTED
- R – FLANGE MOUNTED; FLANGE CONNECTIONS; REAR PORTED

- O – BUNA SEALS
- F – VITON SEALS

40 – 30 GPM
FLOW RATE @ 1750 RPM

PRESSURE RATING*
H – 2000 PSI

*These pumps are sound tuneable to any circuit pressure after it has been set. Instructions are on the installation page shipped with each pump. For settings below 400 psi consult the factory.

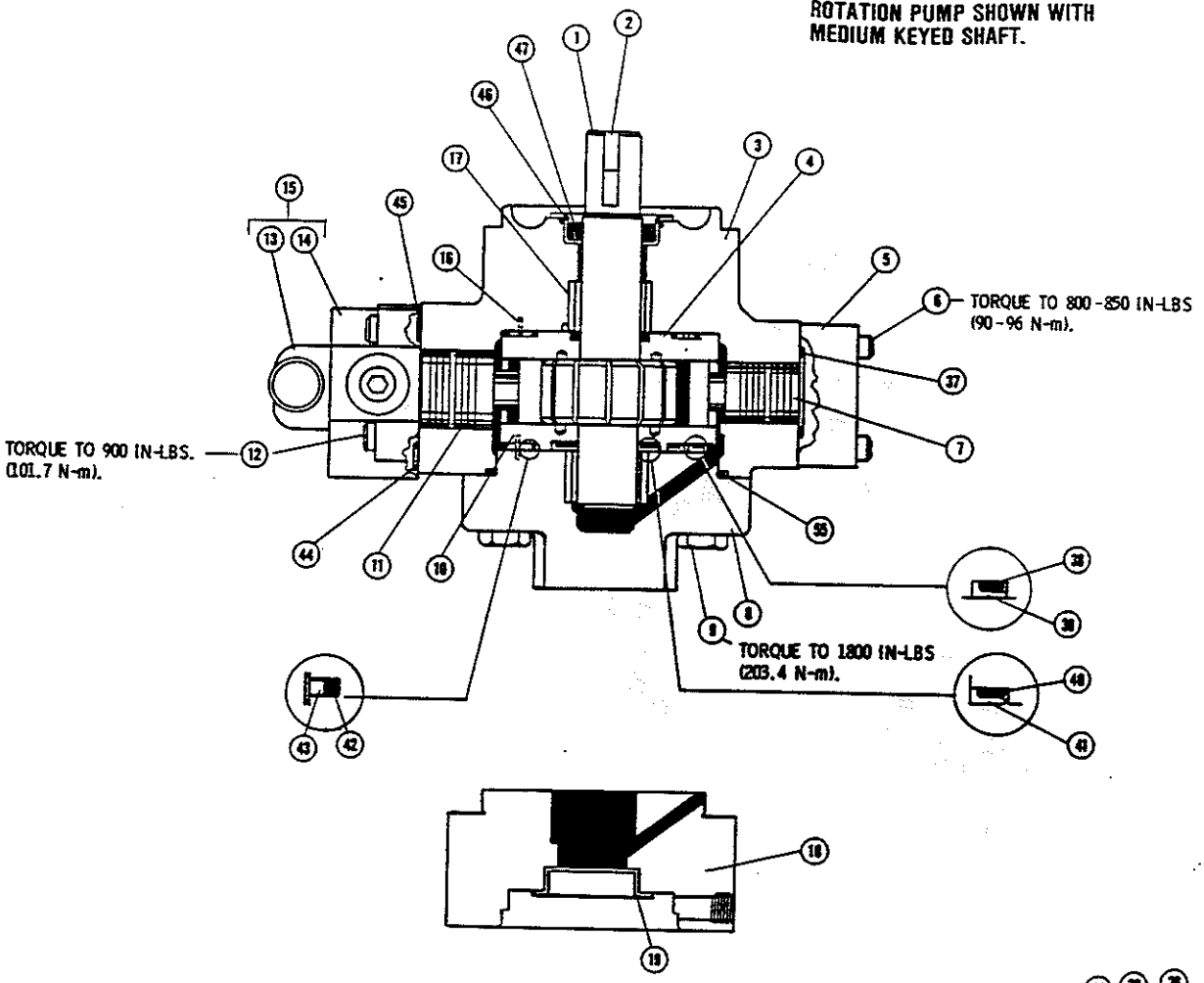
- R – RIGHT HAND ROTATION
- L – LEFT HAND ROTATION

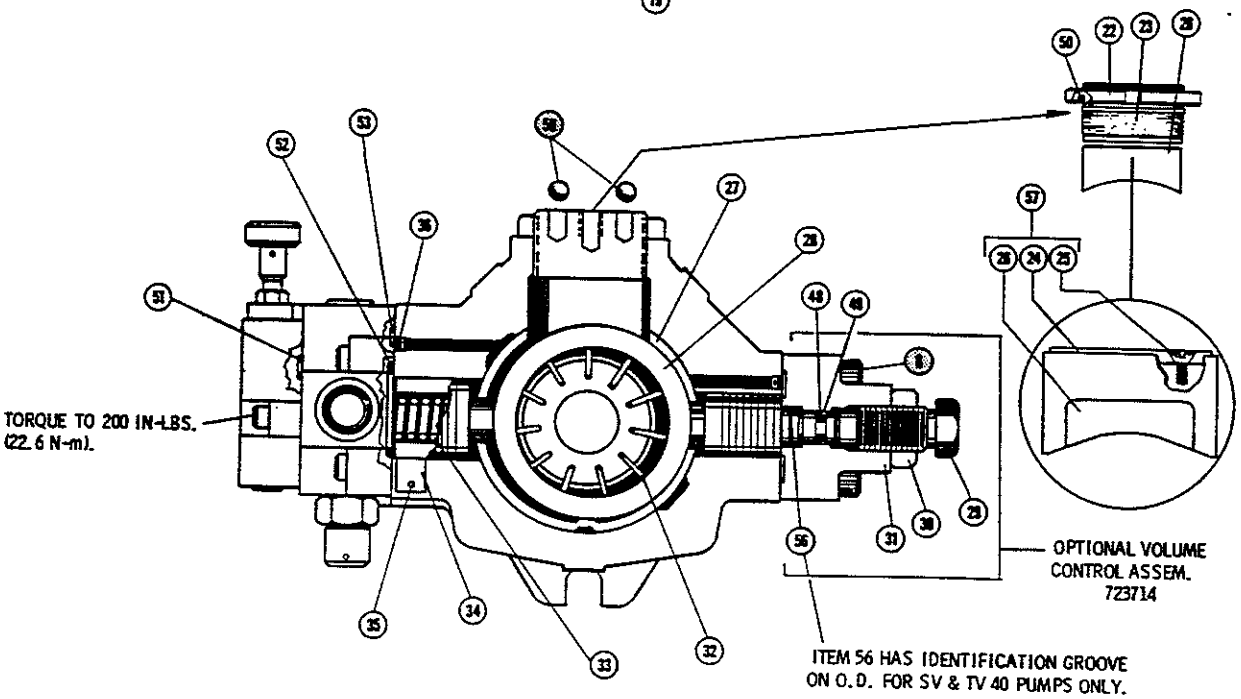
- M – MEDIUM KEYED SHAFT
- T – SPLINE SHAFT
- D – THRU KEYED SHAFT (– 52) (R.H. ROTATION ONLY)

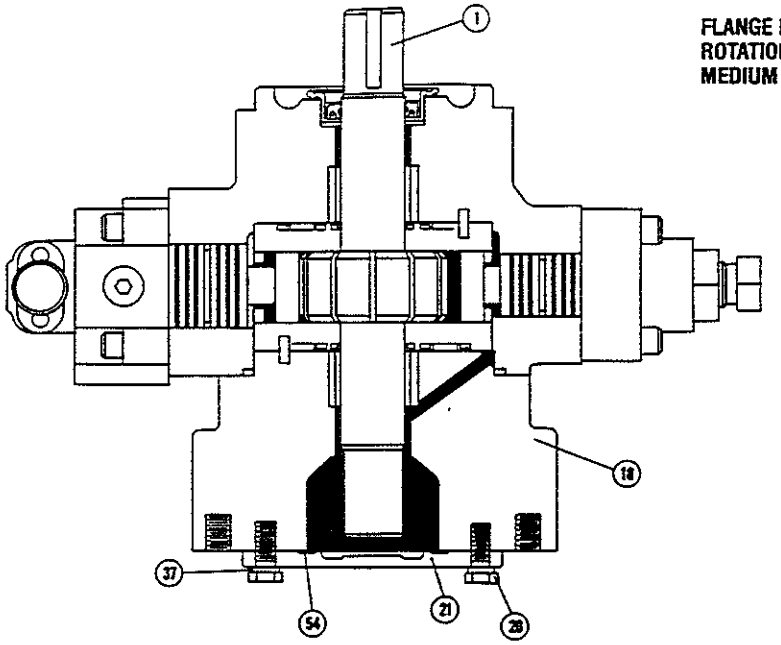
- 50 – ORIGINAL DESIGN
- 51 – 2'ND STAGE UPDATE
- 52 – 1'ST & 2'ND STAGE CHANGES
- 53 – SOL. 2-PRESS. CONTROL CHANGE
- 60 – COMBINATION PUMP
- 61 – 2'ND STAGE UPDATE
- 62 – 1'ST & 2'ND STAGE CHANGES
- 63 – SOL. 2-PRESS. CONTROL CHANGE

For engineering data see Bulletin A-6-50

FLANGE MOUNTED, RIGHT HAND ROTATION PUMP SHOWN WITH MEDIUM KEYED SHAFT.







FLANGE MOUNTED, RIGHT HAND ROTATION PUMP SHOWN WITH MEDIUM COMBINATION SHAFT.

ADAPTOR/COUPLING SYSTEM

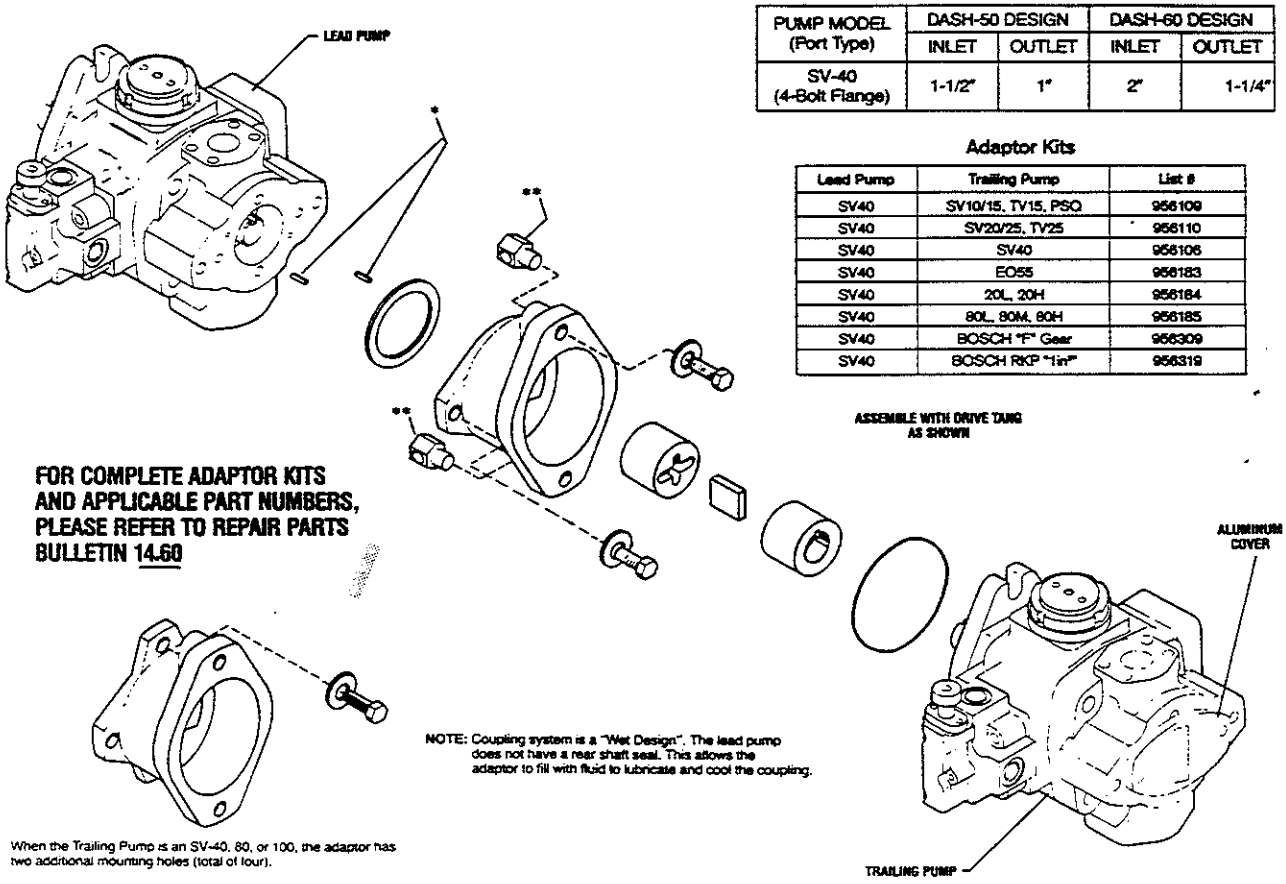
THE DISTANCE FROM THE PUMP MOUNTING FLANGE TO THE CENTER OF THE PORT, INCREASED BY 3/8" (SV-40).

PORT CHANGES
DASH-50 VERSUS DASH-60 DESIGNS

PUMP MODEL (Port Type)	DASH-50 DESIGN		DASH-60 DESIGN	
	INLET	OUTLET	INLET	OUTLET
SV-40 (4-Bolt Flange)	1-1/2"	1"	2"	1-1/4"

Adaptor Kits

Lead Pump	Trailing Pump	List #
SV40	SV10/15, TV15, PSQ	956109
SV40	SV20/25, TV25	956110
SV40	SV40	956106
SV40	EO55	956183
SV40	20L, 20H	956184
SV40	80L, 80M, 80H	956185
SV40	BOSCH "F" Gear	956309
SV40	BOSCH RKP "1in"	956319



FOR COMPLETE ADAPTOR KITS AND APPLICABLE PART NUMBERS, PLEASE REFER TO REPAIR PARTS BULLETIN 14.60

When the Trailing Pump is an SV-40, 80, or 100, the adaptor has two additional mounting holes (total of four).

NOTE: Coupling system is a "Wet Design". The lead pump does not have a rear shaft seal. This allows the adaptor to fill with fluid to lubricate and cool the coupling.

**NOTE: When the weight of the trailing pump(s) exceeds 65 lbs., this part must be used.

*NOTE: Roll pins should be pressed into pump prior to assembly.

Ref. No.	Part No.	Description	Qty.
1	308513	Rotor Shaft, Keyed	1
1	308564	Rotor Shaft, Thru (−52)	1
1	308563	Rotor Shaft, Splined	1
1	308987	Rotor Shaft, Combination Keyed (−62)	1
2	491043	Key	1/2
3	222827	Body, R.H. Rotation	1
3	222826	Body, L.H. Rotation	1
4	222690	Port Plate, R.H. Body, L.H. Cover	1
5	222601	Bias Cover	1
6	408892	Screw, 7/16-14 × 2	4
7	308508	Bias Piston	1
8	222828	Cover, Rear Ported (−52)	1
8	222936	Cover, Rear Ported (−62)	1
9	400758	Screw, 5/8-11 × 2-1/4	4/2
9	400765	Screw, 5/8-11 × 3-1/2 (Side Ported) -52 only	2
10	222692	Port Plate, R.H. Cover, L.H. Body	1
11	308507	Control Piston	1
12	406309	Screw, 7/16-14 × 1-3/4	4
13	956119	2'nd Stage Compensator Assy.	1
14	———	1'st Stage Compensator Assy.	1
15	956132	Standard 2 Stage Compensator	1
16	401717	Roll Pin	4
17	778041	Bearing Assembly	2
18	222830	Cover, Side Ports – Thru Shaft (−52)	1
18	222981	Cover, Side Ports (−62)	1

Ref. No.	Part No.	Description	Qty.
19	491876	Plug	1
19	794289	Plug Assembly (W/O-Ring)	1
20	400721	Screw, 3/8-16 × 7/8	2
21	222975	End Cover	1
22	309062	Lock Nut	1
23	309060	Stationary Block	1
24	309061	SSI Material Disc	1
25	401215	Screw	2
26	228535	Thrust Block	1
27	308780	Spacer Ring	1
28	308511	Pressure Ring	1
29	308412	Adjustment Screw	1
30	401019	Jam Nut	1
31	222600	Body	1
32	778278	Vane Set (308509 - 11 pcs)	1
33	490977	Spring	1
34	491854	Name Plate	1
35	492114	Rivet	2
36	400925	Pipe Plug, 1/16 NPTF	4
56	308506	Piston	1
57	778463	Thrust Block Assembly	1
58	492143	Acetal Ball	2

SEAL KITS

VITON SEALS

Ref. No.	Part No.	Description	Qty.
37	406130	O-Ring, 3/32 × 2-5/16 × 2-1/2	1
38	406703	O-Ring, 1/8 × 4-1/8 × 4-3/8	2
39	491386	Back-Up Ring	2
40	406513	O-Ring, 3/32 × 1-9/16 × 1-3/4	2
41	491385	Back-Up Ring	2
42	491257	O-Ring, 3/32 × 2-1/8 × 2-5/16	2
43	491047	Back-Up Ring	2
44	406565	O-Ring, 1/16 × 7/16 × 9/16	1
45	406265	O-Ring, 1/16 × 3/16 × 5/16	1
46	405422	O-Ring, 1/16 × 2-1/8 × 2-1/4	1/2
47	723650	Shaft Seal Assembly	1/2
48	406518	O-Ring, 3/32 × 9/16 × 3/4	2
49	491354	Back-Up Ring	1
50	405070	O-Ring, 1/8 × 2-3/8 × 2-5/8	1
51	406797	O-Ring, 1/16 × 5/16 × 7/16	3
52	406800	O-Ring, 3/32 × 2-3/16 × 2-3/8	1
53	406636	O-Ring, 3/32 × 3/8 × 9/16	1
54	492568	Gasket	1
55	407150	O-Ring, 1/8 × 5-1/4 × 5-1/2	1

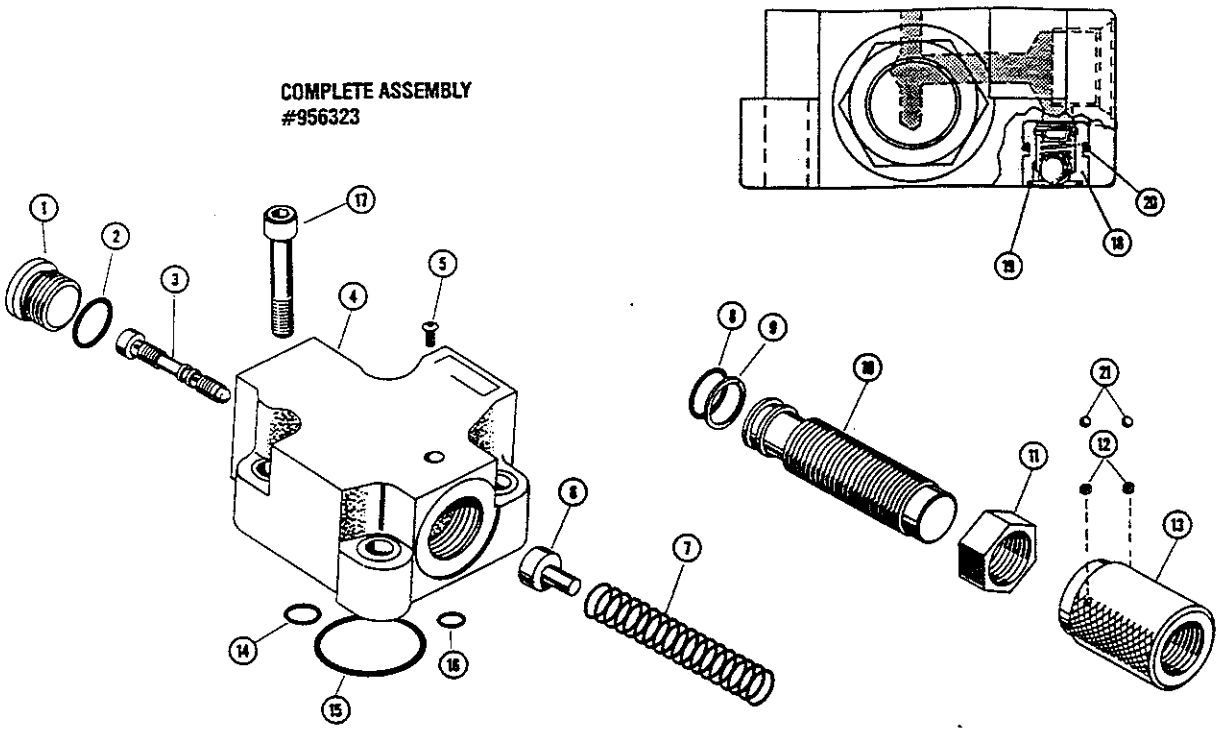
Viton Seal Kits:
Single End Shaft & Combination 723731
Double End Shaft 794117

REPAIR KITS

Description	Kit No.
Single End Shaft Viton	794121
Splined Shaft Viton	794123
Double End Shaft Viton (−52)	794125
Combination Shaft Viton (−62)	794403

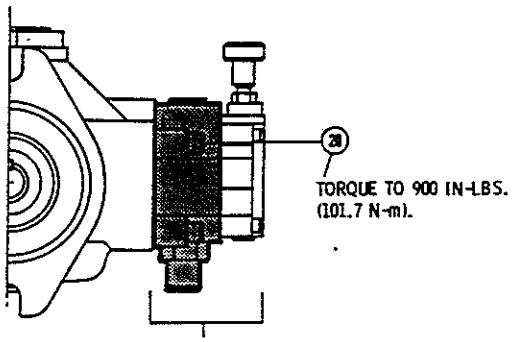
Each kit contains two bearings, one rotor, one set of vanes, one pressure ring, four roll pins, one or two keys, one Seal Kit and two port plates.

COMPLETE ASSEMBLY
#956323



Ref.	List	Description	Qty.
1.	491832	#8 SAE Hollow Plug	1
2.	407139	O-Ring (-908) Viton	1
3.	309298	Spool	1
4.	22311	Body	1
5.	457603	Screw #8-32UNCX.25	1
6.	309299	Spring Seat	1
7.	457642	Spring	1
8.	406707	O-Ring -020 Viton	1
9.	457626	Back-up Ring	1
10.	309300	Adj. Barrel	1
11.	309301	Locknut	1

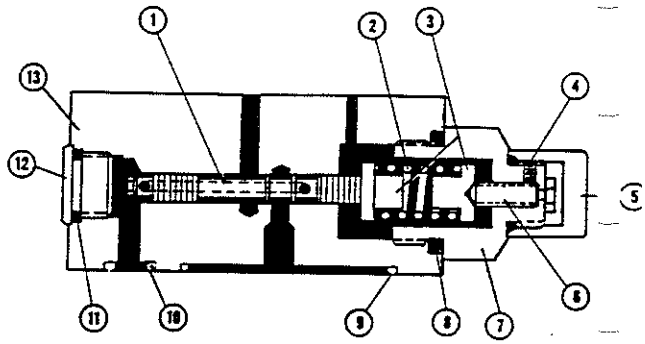
Ref.	List	Description	Qty.
12.	457688	Set Screw 1/4-20x1/8	2
13.	309302	Stop Nut & Knob	1
14.	406636	O-Ring -010 Viton	1
15.	406800	O-Ring -110 Viton	1
16.	406265	O-Ring -008 Viton	2
17.	406309	Mounting Bolts	4
18.	778413	Drain Check Ass.	1
19.	406215	O-Ring -014 Viton	1
20.	406518	O-Ring -113 Viton	2
21.	457689	Acetal Ball Ø 9/64	2



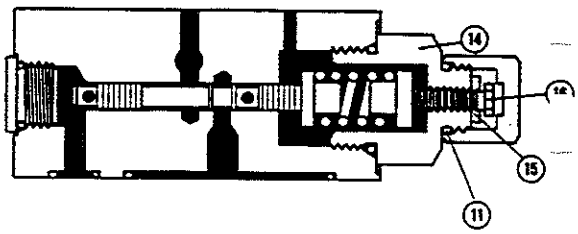
STANDARD TWO-STAGE
PRESSURE COMPENSATOR
956132

NOTE: THE FIRST STAGE CANNOT BE PURCHASED WITHOUT THE SECOND STAGE.

– 51 DESIGN
– 61 DESIGN

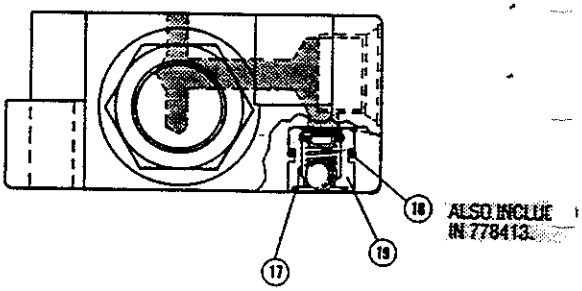


– 52 DESIGN
– 62 DESIGN

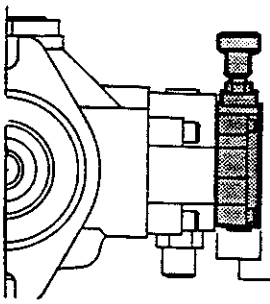


Ref. No.	Part No.	Description	Qty.
1	308747	Spool	1
2	491833	Spring	1
3	308744	Spring Seal	2
4	308637	Set Screw [illegible]	1
5	308936	Safety Cap	1
6	308734	Adjusting Screw [illegible]	1
7	308746	Adaptor [illegible]	1
* 8	407102	O-Ring, #14 SAE (–914)	1
* 9	406800	O-Ring, 3/32 x 2-3/16 x 2-3/8	1
* 10	406636	O-Ring, 3/32 x 5/16 x 7/16	1
* 11	407139	O-Ring, #8 SAE (–906)	2
12	491832	Plug, #8 SAE	1
13	223053	1st Stage Body	1
14	309053	Adaptor	1
15	309049	Jam Nut	1
16	778408	Adjusting Screw w/Lock Nut	1
* 17	406215	O-Ring, 1/16 x 1/2 x 5/8	1
18	406518	O-Ring, 3/32 x 9/16 x 3/4	1
19	778413	Drain Check Assembly	1
20	406309	Screw, 7/16-14 x 1-3/4	4

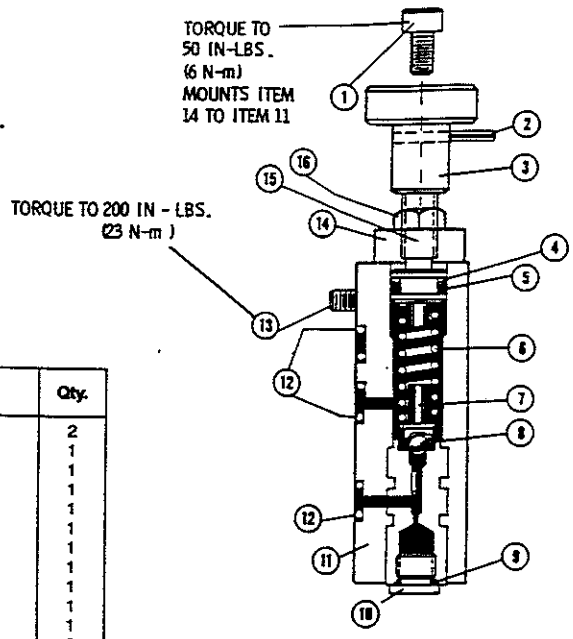
*Included in Seal Kit 778373



ALSO INCLUDE IN 778413.



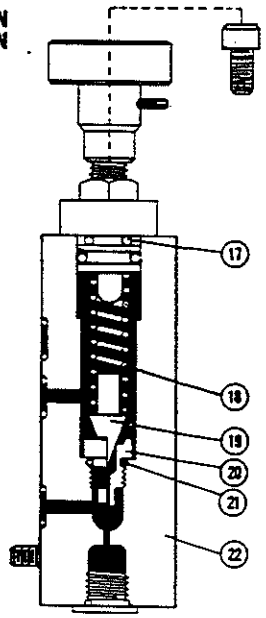
–50 DESIGN



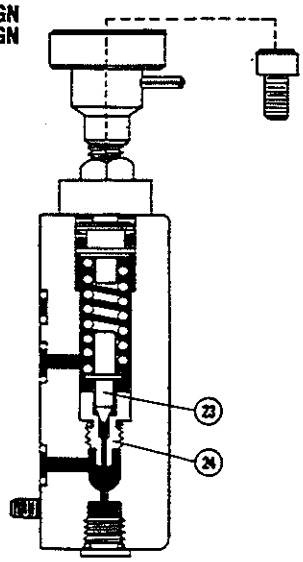
Ref. No.	Part No.	Description	Qty.
1	402396	Screw, #10-24 x 1/2	2
2	401714	Roll Pin	1
3	306730	Knob	1
* 4	490418	Back-Up Ring	1
* 5	406579	O-Ring, 3/32 x 7/16 x 5/8	1
6	406239	Spring Void	1
7	308861	Spring Seat Void	1
8	492209	Tungsten Carbide Ball Void	1
* 9	407141	O-Ring, #4 SAE (-904)	1
10	490708	Plug, #4 SAE	1
11	778313	Body Assembly (-50) Void	1
* 12	406797	O-Ring, 1/16 x 5/16 x 7/16	3
13	400779	Screw, 1/4-20 x 1-1/4	3
14	221777	Retaining Cap	1
15	309029	Adjusting Screw	1
16	401011	Lock Nut	1
* 17	492455	O-Ring, 3/32 x 5/16 x 1/2 (-51/61) Void	1
18	407846	Spring (-51/52 & -61/62)	1
19	307161	Poppet (-51/61 Only) Void	1
20	308012	Seat (-51/61 Only) Void	1
* 21	407123	O-Ring, #3 SAE (-903)	1
22	222982	Body (-51/52 & -61/62)	1
23	309057	Poppet (-52/62 Only)	1
24	778482	(-52/62 Only) Seat w/O-Ring	1

* Included in Seal Kit 723731

–51 DESIGN
–61 DESIGN



–52 DESIGN
–62 DESIGN



START UP PROCEDURES

- Before start-up, make sure that the direction of rotation of the drive corresponds with the arrow direction on the pump body.
- Gear pumps operating at rotational speeds lower than the specified minimum speed must not be subjected to the maximum rated pressure P_1. Consult Bosch for specific applications.
- Before start-up, pumps must be primed with the same oil as used in the installation. The fluid should be filled through the tube connections. If necessary, the pump drive gear should be rotated by hand during priming.
- On initial start-up the pump should be vented by loosening the outlet connection.

SPARE PARTS

Description	Part Number
Buna N Seal Kit: w/shaft seal	1 517 010 150
Buna N Shaft Seal	1 517 283 008
Viton Seal Kit: w/o shaft seal	1 517 010 193
Viton Shaft Seal	1 510 283 018

ONLY PARTS AVAILABLE

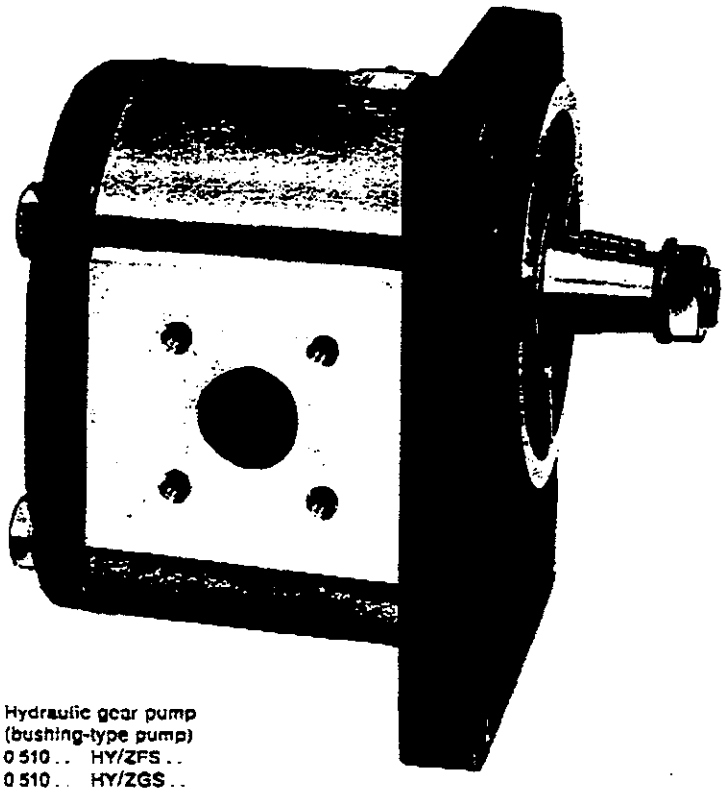
EXAMPLE NOT YOUR PUMP

3. Specifications for dismantling and assembly; list of repair tools.

3.1 General information, to be observed before each repair:

Pumps and motors with damaged or worn glands, gears or casings cannot be repaired, for reasons of tolerance and design.
Service departments only have the possibility of replacing the seals and parts subject to wear (seal elements, see spare parts lists).
After a pump or motor has been taken apart, we advise fitting a new set of seals provided no wear due to dirt or other damage can be identified on the pump.

The difference between pump and motor is slight and no particular attention need be paid to this. It is important when dismantling that the glands, bushings and gears are clearly identified to ensure that the parts are properly reassembled.
When repairing, maximum cleanliness is necessary. The work bench must be kept free of dirt (metal swarf and chips etc.). When dismantling, also ensure that the glands, bushings and gears are not jammed and knocked. The removed parts must be protected from any kind of damage.



Hydraulic gear pump
(bushing-type pump)
0 510 . . HY/ZFS . .
0 510 . . HY/ZGS . .

3.2 Dismantling and assembly specifications for hydraulic gear pump (model S)

3.2.1 Tools and aids:

Tools:

Mounting sleeve	KDEP 2874
Clamping fixture	KDSV 3591
Clamping ring	EFHY 69 (KDHY 4100)
Clamping flange	EFHY 73
Assembly fixture	KDHY 4101

Lubricant:

Consistent grease
Bosch part number 5 700 002 000
is required for filling the cavity at the shaft seal.

Torques:

Casing screws
for HY/ZFS . . . : 40+5 Nm
for HY/ZGS . . . : 50+10 Nm

Use torque wrench!

3.2.2 Changing the direction of rotation:

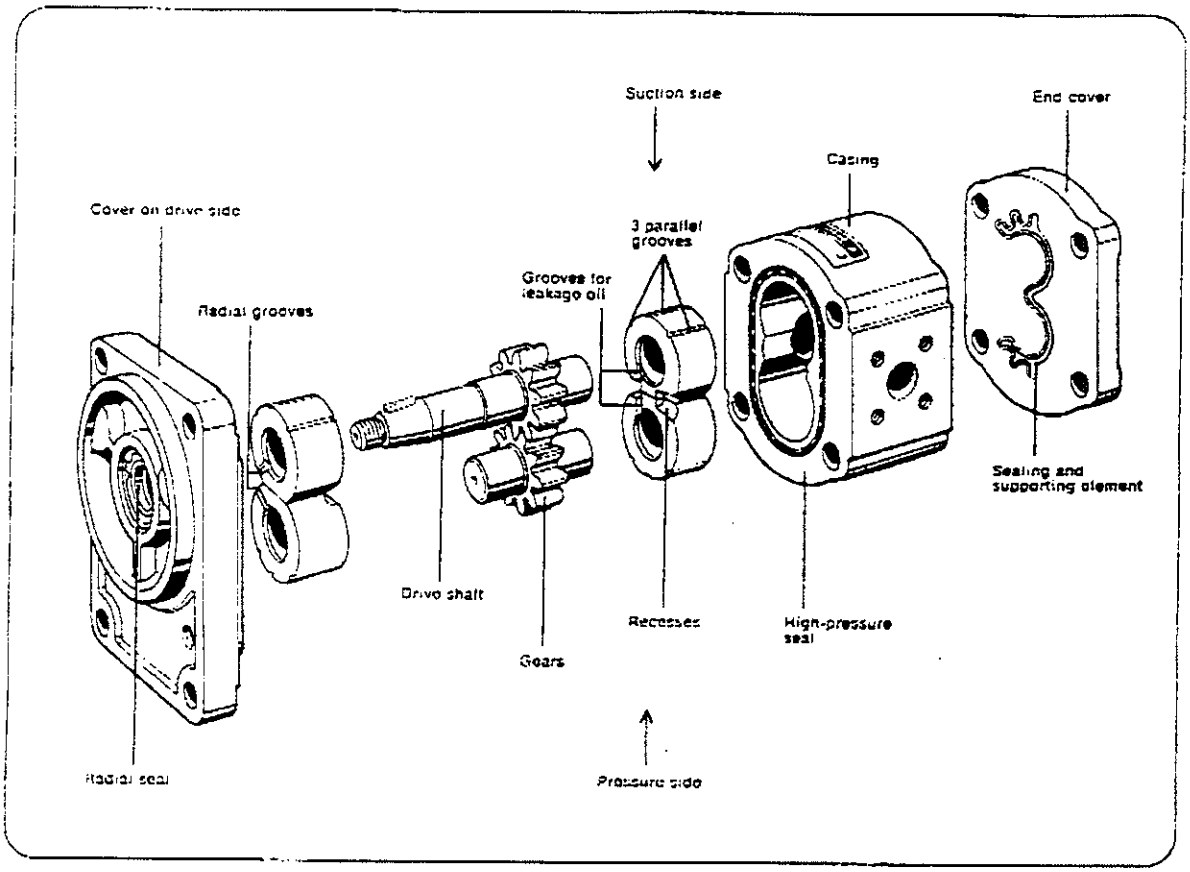
Seal in bearing cover (model up to provisionally FD 423 in the program).

If the seal is contained in the bearing cover, then in bushing-type pumps the direction of rotation of the drive can be changed only on pumps which are still new by exchanging the bearing cover on the drive side

Seal in the bushing (this model was introduced from FD 321).

In bushing-type pumps with the seal in the bushings, the direction of rotation of the drive can be changed only in pumps which are still new by interchanging the two gears and turning the bearing cap on the drive side.

When the direction of rotation has been changed, the Bosch part number on the type plate must be changed accordingly (see HY catalogue or product list).



Design of bushing-type pump
HY/ZFS 1/...
Fig. 12

Scott Follett
telephone (414) 554-8595 x741
fax (414) 554-8103

Bosch

Fax

To:	Craig Leightner	**From:**	Scott Follett
Fax:	(714) 578-2954	**Pages:**	3
Phone:	(714) 578-2940	**Date:**	May 22, 1996
Re:	L&F Industries	**CC:**	

☐ **Urgent** x **For Review** ☐ **Please Comment** ☐ **Please Reply** ☐ **Please Recycle**

• **Comments:**

Craig,

This is in response to the fax sent 16 May 1996.

Again, the required cleanliness level for SV vane pumps is ISO 17/13. The required cleanliness level for gear pumps is ISO 18/15. Of course, if possible, using oil that is even cleaner will increase pump life and improve performance.

There can be no rigid rules defining the maximum levels of water that can be considered acceptable with petroleum oils. Many variables such as fluid type, components involved, speeds, pressures, and operating temperatures must be considered. No one can say absolutely what the maximum water level is. Each case is unique. However, with all that said, generally oils with good anti-rust properties can tolerate up to 0.1% with no particular problems.

Paul Schacht is on the NFPA board as the fluid chemist. His expertise and credentials are recognized throughout the industry. I would recommend that customers discuss each case with him. The customer should also be very leery of any supplier who issue such blanket statements.

One horror story. When I was in the army, a few drops of water (far less than 0.1%) invaded a helicopter tail rotor transmission gear box. The little bit of water was enough to destroy our anode-cathode chip detector and we didn't know it. The chip detector warns pilots of impending catastrophic failure of the tail rotor, but we did not have that until the helicopter went through phase maintenance. So the whole point is, the amount of water permissible in one system could be disastrous in other systems.

Please have the customer call myself or Paul directly. Paul is a great asset.

Thanks,

Scott

FROM LIGHTNING REFERENCE HANDBOOK, 8TH ED

valve opens, all contamination bypasses the filter. Some systems can withstand short term operation with this contamination. On other systems, such as electro-hydraulic servo systems, bypassed contamination may lead to component malfunction.

A low collapse pressure element should never be used in a non-bypass type housing. If sufficient contaminate build-up causes excessive differential pressure, the element may rupture or collapse. When filter elements collapse, large quantities of contamination are immediately induced into the system, with severe problems.

Material Compatibility: The materials which the filter are constructed must be compatible with the hydraulic fluid and operating temperature of the system. Seals, resins and bonding materials must resist degradation in the fluid and at the anticipated fluid temperatures.

Element Construction and Quality: The quality of elements varies considerably between manufacturers. Considerations in construction and quality should include:

- Support of the filter element pleat.
- Bonding or sealing of the filter media to the end caps.
- Consistency of media pore size and hole size per unit area.
- Fiber bonding and the ability to prevent media migration.
- Effective area of the filter media.
- No "pin holes" in the end caps or filter media.

Methods of Filtration (location)

Filters can be placed at various points in the hydraulic system using different circuit configurations as follows:

- Pressure line.
- Return line.
- Suction (intake) line.
- Bypass flow.
- Off-line or recirculating.
- Batch process and reclamation.

Pressure Line: The pressure line filter is placed directly downstream of pumps. Since pumps always produce wear debris, contamination is caught before it is spread to the rest of the system.

Pressure line filtration should be used in electro-hydraulic systems, with servo and proportional valves.

The disadvantage of only using pressure line filtration is that contamination from the reservoir passes through the pump.

Return Line: Return line filtration catches ingressed contamination and wear contaminates from other system components. This type of filtration is generally cost effective due to the low pressure requirements.

A number of considerations should be given to return line filtration, such as the back pressure which the filter applies to the tank or return line of the system. All components must be able to handle the back pressure without malfunctioning.

In addition, when accumulators, or cylinders with a 2:1 c greater differential area are used, the potential for high return surge flows exists. Return filters must be able to handle these flows.

Suction (intake) Line: Suction filters or inlet strainers are generally used to prevent ingestion of large particles, chips or rags into the pump. Some hydrostatic drives only utiliz suction filtration.

Generally when proper filtration is provided, inlet strainers are not required, since the overall cleanliness of the fluid does not contain particulates which can be captured b large mesh strainers.

Bypass Flow: When full flow filtration is not practical, low flow rate bypass filtration can be used. A small portion o the normal system flow is bypassed to a filter. The advan tage is similar to that of off-line filtration.

Off-line or Recirculating: One of the best types of filtration is off-line or recirculating filtration. This is alsc referred to as a "kidney loop". A separate, low flow rate low pressure pump circulates fluid through filters. The main advantage is that continuous, multi-pass filtration occurs. Flow rates are typically lower than full system flow rate and the differential pressure across the filters can be controlled. Excellent cleanliness levels can be achieved with off-line filtration.

In addition to the filters, total fluid conditioning can be accomplished by placing heat exchangers and in-line heaters in a series circuit. Water absorption filters can also be added for removing free water.

Batch Process and Reclamation: When hydraulic fluid is removed from a system, it can either be disposed of or reclaimed. Due to the high cost of disposal, in conjunction with meeting environmental mandates, reclaiming fluids has become more popular.

Fluids which are contaminated with more than 1000 parts per million halogens are considered hazardous waste by the EPA and fluids with concentrations of Arsenic, cadmium, chromium and lead can also be problems. [Refer to ANSI/NFPA T2.13.4, *Recommendations for conservation, maintenance, and disposal of hydraulic fluids — Information Report* for additional information.]

Reclamation generally utilizes a combination of batch processing on fluids, such as centrifuges, vacuum dehydrators and oil polishing filters. Mechanical filtration can be used to remove insoluble contaminates and to neutralize acids.

Additional tests other than particulate count are required to ensure that the viscosity, lubrication and additive properties of the reclaimed fluid are still met.

Fluid Sampling and Testing

Hydraulic fluids should be sampled and tested to ensure contamination and fluid properties are within acceptable levels.

The most current particulate contamination measurement

is performed using SAE J1165, *Reporting Cleanliness Levels of Hydraulic Fluids*. This procedure counts the number of particles above 5 and 15µm and is reported in terms of a range number pair. This range number corresponds to the ISO Solid Contaminant Code. The conversion from older test methods is shown in the Cleanliness Level Correlation Table.

The ISO Code range number is determined by the particle concentration (particles per milliliter). Refer to the ISO Range Table.

CLEANLINESS LEVEL CORRELATION TABLE

ISO Code	Particles per milliliter > 10 µm	ACFTD① Gravimetric Level – mg/L	Mil Std 1246A (1967)	NAS 1638 (1964)	Disavowed "SAE" Level (1963)
26/23	140,000	1,000			
25/23	85,000		1,000		
23/20	14,000	100	700		
21/18	4,500			12	
20/18	2,400		500		
20/17	2,300			11	
20/16	1,400	10			
19/16	1,200			10	
18/15	580			9	6
17/14	280		300	8	5
16/13	140	1		7	4
15/12	70			6	3
14/12	40		200		
14/11	35			5	2
13/10	14	0.1		4	1
12/9	9			3	0
11/8	5			2	
10/8	3		100		
10/7	2.3				
10/6	1.4	0.01			
9/6	1.2			0	
8/5	0.6			00	
7/5	0.3		50	00	
6/3	0.14	0.001			
5/2	0.04		25		
2/.8	0.01		10		

①ACFTD (Air Cleaner Fine Test Dust) — ISO approved test and calibration contaminant.

If a particle count falls between two adjacent particle concentrations, the higher particle concentration is used to formulate the ISO Contaminate Code. The first range number is for the 5µm particle sizes, separated by a slash and the second range number is for the 15µm sizes, such as 19/14. This would indicate up to 5000 particles at 5µm and up to 160 particles at 15µm.

For determining ISO cleanliness codes, a particle counter calibrated to ISO/DIS 4404 must be used.

In the field, however, particle counting can be accomplished by passing a fluid sample through a graduated Millipore filter pad and then counting particles under a microscope, using a special scale. This can be quite a tedious process if an actual particle count is required.

ISO RANGE NUMBER TABLE

Particle Concentration (Particles per milliliter)	Range Number
10,000,000	30
5,000,000	29
2,500,000	28
1,300,000	27
640,000	26
320,000	25
160,000	24
80,000	23
40,000	22
20,000	21
10,000	20
5,000	19
2,500	18
1,300	17
640	16
320	15
160	14
80	13
40	12
20	11
10	10
5	9
2.5	8
1.3	7
0.64	6
0.32	5
0.16	4
0.08	3
0.04	2
0.02	1
0.01	0.9
0.005	0.8
0.0025	0.7

However, by looking at a fluid sample under a microscope, a quick determination can be made if a fluid contamination problem exists.

Prior to performing the particle count, a fluid sample must be taken.

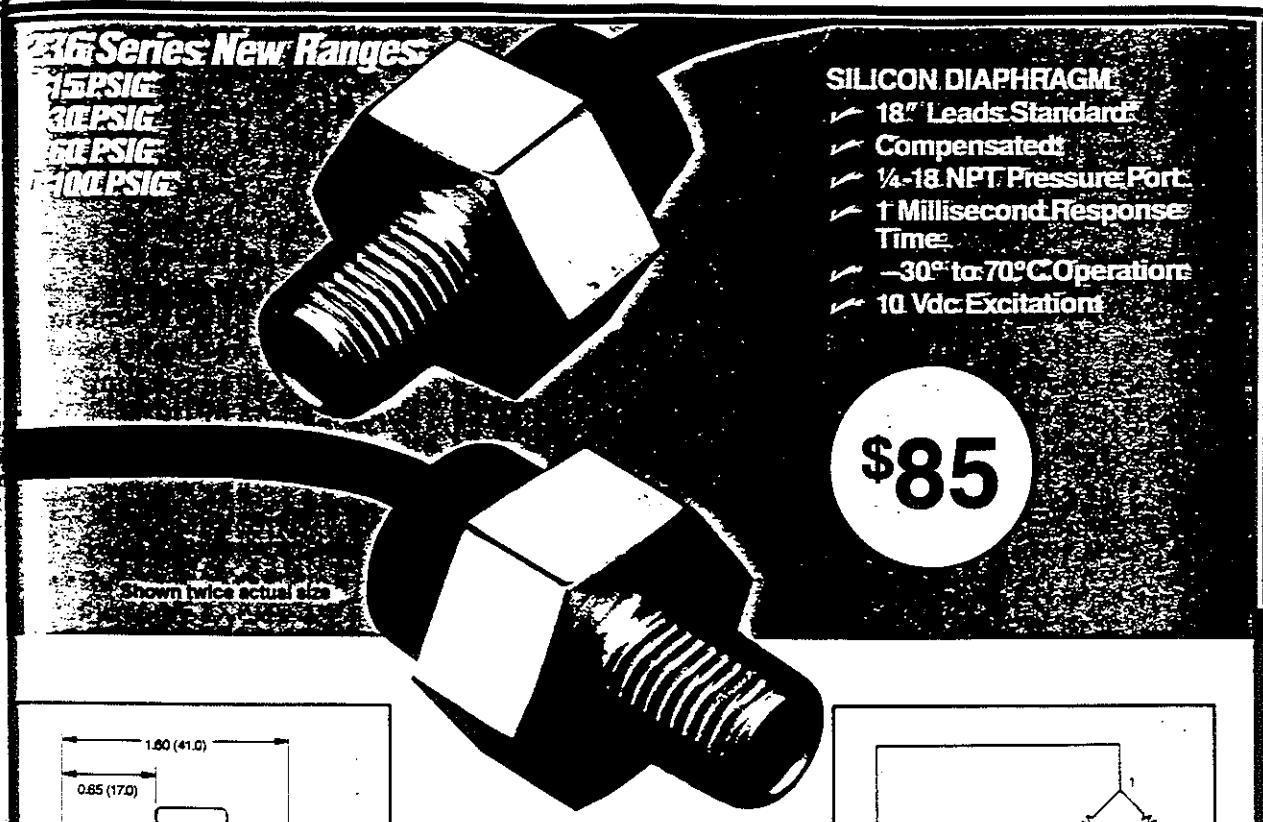
It is important to remember that the size of particles which will be measured cannot be seen by eye. Pre-cleaned and capped sample bottles must be used. The technician should make every attempt to remove any visual contamination from the fluid sample spout with lint-free wipes.

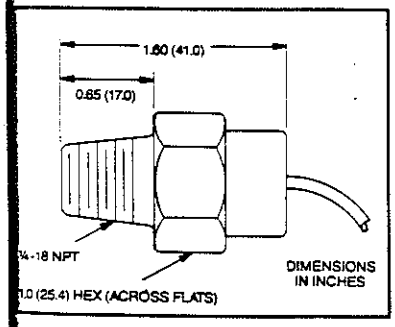
Prior to taking the fluid sample, a small amount of fluid should be run through the sample spout to flush out any contaminates in the tube and particulates which may have accumulated behind the sample valve during operation. When drawing the fluid sample care should be taken not to contact the sample bottle with the sample spout. Sample bottle openings should not be touched or wiped after the sample is taken and immediately recapped. Label the sample with the machine identification, fluid type, test point and sample date.

PX236 ECONOMICAL MILLIVOLT OUTPUT TYPE PRESSURE TRANSDUCER

WITH FULL BRIDGE DESIGN FOR HIGH SENSITIVITY

D330027-8

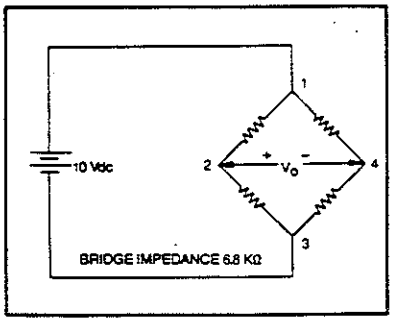




Can be used for vacuum applications

LEADWIRES	
1-Red	V+
2-White	Out+
3-Black	V–
4-Green	Out–

Media Compatability
Limited only to those media which will not attack polyester, silicon borosilicate glass, or epoxy adhesive.



SPECIFICATIONS

Excitation: 10 Vdc, 16 V max. @ 2 mA
Output: See Ranges
Input Impedance: 6.8 K ohm

PERFORMANCE

Linearity: Best Fit Straight Line ±1.5% full scale (±0.5% full scale 100 mV)
Hysteresis & Repeatability: ±0.25% full scale
Zero Balance: ±2 mV
Operable Temperature Range: –22 to 158°F (–30 to 70°C)
Compensated Temperature Range: 32 to 122°F (0 to 50°C)
Thermal Span Effect: ±1.5% full scale
Thermal Zero Effect: .022 mV/°F typ., max. .044 mV/°F
Operable Overpressure: Min. 1.5 x full scale
Response Time: 1 ms

To Order (Specify Model Number)

RANGE	OUTPUT	MODEL	PRICE	COMPATIBLE METER*
0- 5 PSIG	50 mV	PX236-005G V	$85	DP350,DP2000S2,DP41-S
0- 15 PSIG	100 mV	PX236-015G V	85	DP2000S2,DP350,DP41-S
0- 30 PSIG	80 mV	PX236-030G V	85	DP2000P2,DP3002-S,DP41-S
0- 60 PSIG	60 mV	PX236-060G V	85	DP350,DP2000S2,DP41-S
0-100 PSIG	100 mV	PX236-100G V	85	DP350,DP2000S2,DP41-S
0-150 PSIG	60 mV	PX236-150G V	85	DP350,DP2000S3,DP41-S

CONSTRUCTION

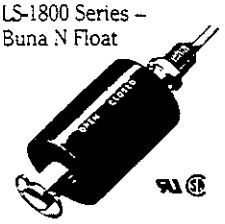
Gage Type: Solid State Piezo-Resistive
Body Material: SS
Diaphragm Material: .10 inch Square Silicon Sensor Chip, .055 in³ volume
Pressure Port: ¼-18 NPT
Electrical Connections: 18", #28 AWG; 4 Conductor Cable
Weight: 56 grams

Large Size – Alloys

LS-1800 and LS-1900 Series are a Step Above Our Plastic Units for Pressure Capabilities

Excellent stability for general use in oils and water.

LS-1800 Series – Buna N Float



LS-1800 Series – Teflon* Float

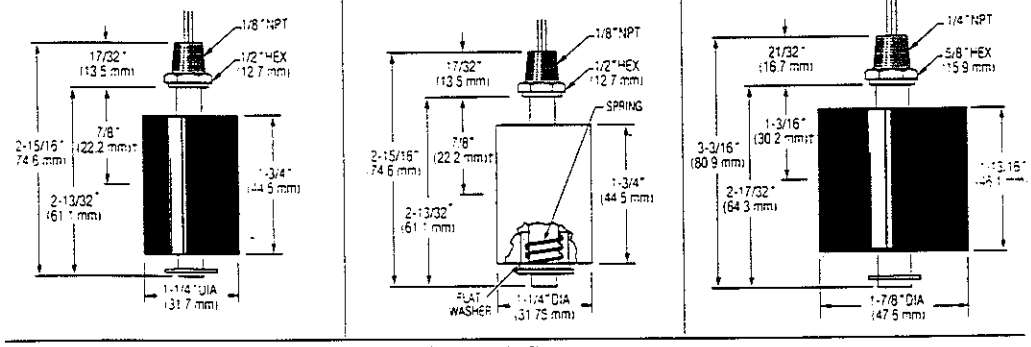
LS-1900 Series – Buna N Float

Intermediate in size. LS-1800 switches provide long life and dependability to meet a broad range of requirements.

With large float displacement, switch withstands rough service; is suitable for high viscosity liquids.

Gems
1710 Sensor Div
1 Cowles Road
Plainville, CT 06062-1198
Tel 860 - 747 - 3000
Fax 860 - 747 - 4244
Catalog 3391

Dimensions



†L_1 = Switch actuation level, nominal (based on a liquid specific gravity of 1.0).

Common Specifications

Electrical Termination: No.18 AWG, 24"L., Polymeric Lead Wires.

Approvals: All Switches on this page are U.L. Recognized – File No. E45168, and are CSA Listed – File No. 30200.

Switch Operation: Selectable, N.O. or N.C., by inverting float on unit stem (except for LS-1800 Series switch with Teflon* float). Units are shipped N.O. unless otherwise specified.

How To Order – Select Part Number based on specifications required.

Series Number	Material: Stem and Mounting	Material: Float	Material: Other Wetted	Min. Liquid Sp. Gr.	Operating Temperature	Pressure, PSI, Max.	Switch* SPST	Part Number
LS-1800	Brass	Buna N	316 Stainless Steel, Hysol	.75	Water: to 180°F (82.2°C) Oil: -40°F to +230°F (-40°C to +110°C)	150	20 VA	01801
							100 VA**	35651
	316 Stainless Steel	Buna N		.75			20 VA	01807
							100 VA**	35657
		Teflon*		.65	-40°F to +250°F (-40°C to +121.1°C)	300	20 VA, N.O.	01811
LS-1900	Brass	Buna N	316 Stainless Steel, Hysol	.55	Water: to 180°F (82.2°C) Oil: -40°F to +230°F (-40°C to +110°C)	150	20 VA	01901
							100 VA**	35676
	316 Stainless Steel			.55			20 VA	01907
							100 VA**	35682

* See "Electrical Data" on Page A-4 for more information.
** 100 VA switches are not U.L. Recognized.

Reservoir Accessories

LHA

Filler Breathers —Bayonet Style

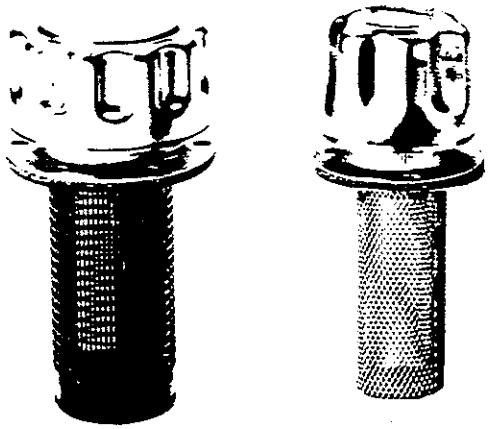
LHA Products Inc
21590 Alexander Road
Cleveland, Ohio 44146
Tel 216-439-7671
Fax 216-439-1230

Document 10/89

ABB/MBB Series

Specifications

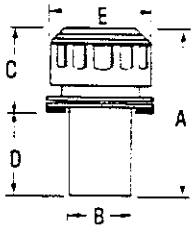
- Chrome plated steel cap
- Air flow to 25cfm
- 30 mesh technopolymer basket
- Self tapping screws for flange mount
- Cork gaskets



Options

- Two cap diameters available
  - — 3 ins (air flows to 25cfm)
  - — 1.8 ins (air flows to 10cfm)
- 10 micron and 40 micron available
- 3", 6", and 8" stainless steel baskets available
- Lockable version available (LT)
- Flip Top version available (non-breathing) (see page 3.07)
- Dipsticks available
- Neoprene gaskets available
- Epoxy weatherproof

Dimensional Details



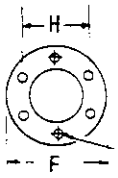
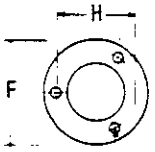


ABB-40N, 10N

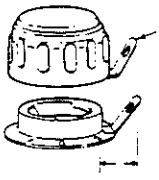


MBB-40, 10

- Steel basket only.

5.5 mm holes

LOCKING TABS (AB and PBB only)



Part Number	Micron Rating	Displacement GPM	Airflow Capacity cfm		A	B	C	D	E	F	H	Screws
ABB-40N	40	192	25	ins.	5.95	1.95	2.25	3.80	3.15	3.25	2.88	No. 10 32 x 1/2
ABB-10N	10	115	15	mm	151	50	57	97	80	83	73	—
MBB-40N	40	72	10	ins.	4.33	1.14	1.70	2.52	1.85	2.0	1.61	—
MBB-10N	10	36	5	mm	110	29	43	64	47	52	41	4.8 x 12

Ordering Information

AB B — 40 N — LT

Product Type	
AB	Standard Air breather
MB	Mini Air breather

Breather Style	
B	Bayonet
BW	Bayonet weatherproof

Micron Rating	
10	10 micron
40	40 micron

*See page 3.08 for information on options.

Options*	
LT	Locking tabs
R	Neoprene gkts.
D	Dipstick
SMB	Side mount

Basket Style*	
N	Standard
S3	3" Stainless Steel
S6	6" Stainless Steel
S8	8" Stainless Steel

ASSEMBLY NUMBER IDENTIFICATION CHART

Symbol No.	Designation	Code	Description
1	STYLE	None H	Standard Model Handwheel Model
2	Valve Series	V	
3	Material	J B S SS	Cast Iron Brass Steel 316 Stainless Steel
4	Connections	None *F	Screw Connection Flange Connection (raised faces, staggered drilling standard; specify if smooth face and/or centered drilling required)
5	Size	-1 -2 -3 -4 -5 -6 -7 -8	¼" Fulflo Catalog FS-390A ⅜" ½" ¾" Phone 513-783-2411 1" Fax 513-783-4983 1¼" 1½" Blanchester, OH 2"
6	O'ring Material	R RV RS RT	Buna O-Ring Cap Seal Standard Viton O-Ring Cap Seal Silicone O-Ring Cap Seal Teflon O-Ring Cap Seal (Standard on VSS Series)
7	Options	SP P	Steel parts (Used on Cast Iron Only) Panel Mount on Handwheel series

EXAMPLES:

VJ-1SPRV

V	J	-1	SP	RV
SERIES	CAST IRON	1/4"	STEEL PARTS	VITON CAP SEAL

HVSF-5RP

H	V	S	F	-5	R	P
HANDWHEEL	SERIES	STEEL	FLANGED	1"	BUNA SEAL	PANEL MOUNT

HOW TO ORDER

Specify:
1. Valve Model Number
2. O-Ring Identification Number
3. Piston Material or Part Number (Hardened or Stainless Steel)
4. Spring Identification Number
5. Spring Pressure Range or Desired Pressure Setting

NOTE:
Stainless steel pistons are supplied on brass valves, unless hardened steel is specified. Hardened steel pistons are supplied on cast iron or steel valves unless stainless steel is specified. Buna O-Rings are supplied as standard unless other material is specified.

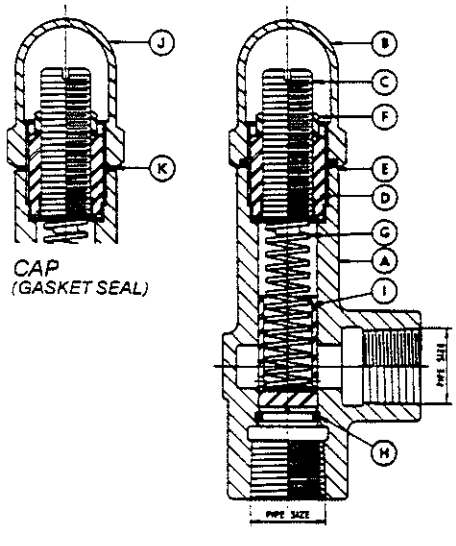
*300# Flange Class Standard (250# Flange Class–Cast Iron Standard)

STANDARD PRESSURE RANGE CHART

Valve Pipe Size	Valve Flange Size	SPRING PRESSURE AND IDENTIFICATION NO.															
		BLACK-AS		RED-US		GREEN-WS		YELLOW-XS		WHITE-YS		BLUE-ZS		PURPLE-TS		BROWN-RS	
		Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
¼"		3	15	7	35	30	100	60	175	150	350	300	500	400	600	550	750
⅜"		3	15	7	35	30	100	60	175	150	350	300	500	400	600	550	750
½"		3	15	7	35	30	100	60	175	150	350	300	500	400	600	550	750
¾"		3	15	7	35	30	100	60	175	150	350	300	500				
1"	1"	3	15	7	35	30	100	60	175	150	350	300	500				
1¼"	1¼"	3	15	7	35	30	100	60	175	150	350	300	500				
1½"	1½"	3	15	7	35	30	100	60	175	150	350	300	500				
2"	2"	3	15	7	35	30	100	60	175	150	350	300	500				

Pressures listed above apply for all ¼" thru 2" relief valves. All Spring Part Nos. ending in "S" are stainless steel.

DIMENSIONS



Valve Size	DIMENSIONS IN INCHES			
	AA	BB	CC	DD
¼"	5 11/32	1 11/32	1 11/32	1 3/8
⅜"	5 11/32	1 11/32	1 11/32	1 3/8
½"	6 3/16	1 13/16	1 13/16	1 13/16
¾"	6 15/16	1 15/16	1 15/16	1 11/16
1"	8 1/32	2 1/32	2 1/32	2 1/16
1¼"	9 3/16	2 5/16	2 5/16	2 1/2
1½"	11 1/16	2 11/16	2 11/16	2 7/8
2"	13	3	3	3 1/4

PARTS LIST

SYM.	NAME	MODEL	VALVE SIZE						
			¼"	⅜"	½"	¾"	1"	1¼"	1½"	2"
A	BODY	VJ, VJ-SP	100	200	300	400	500	600	700	800
		VB	100-B	200-B	300-B	400-B	500-B	600-B	700-B	800-B
		VS	100-S	200-S	300-S	400-S	500-S	600-S	700-S	800-S
		VSS	100-SS	200-SS	300-SS	400-SS	500-SS	600-SS	700-SS	800-SS
B	CAP O-RING SEAL	VJ, VJ-SP	201-SR	201-SR	301-SR	401-R	501-R	601-R	701-R	801-R
		VB	201-BR	201-BR	301-BR	401-BR	501-BR	601-BR	701-BR	801-BR
		VS	201-SR	201-SR	301-SR	401-SR	501-SR	601-SR	701-SR	801-SR
		VSS	201-SSR	201-SSR	301-SSR	401-SSR	501-SSR	601-SSR	701-SSR	801-SSR
C	ADJUSTING SCREW	VJ, VB	202-B	202-B	302-B	402-B	502-B	602-B	702-B	802-B
		VS, VJ-SP	202-S	202-S	302-S	402-S	502-S	602-S	702-S	802-S
		VSS	202-SS	202-SS	302-SS	402-SS	502-SS	602-SS	702-SS	802-SS
D	RETAINER	VJ, VB	203-B	203-B	303-B	403-B	503-B	603-B	703-B	803-B
		VS, VJ-SP	203-S	203-S	303-S	403-S	503-S	603-S	703-S	803-S
		VSS	203-SS	203-SS	303-SS	403-SS	503-SS	603-SS	703-SS	803-SS
E	O-RING †	VJ, VJ-SP, VB, VS	204-*	204-*	304-*	404-*	504-*	604-*	704-*	804-*
		VSS	204-RT	204-RT	304-RT	404-RT	504-RT	604-RT	704-RT	804-RT
F	LOCK NUT	VJ, VJ-SP, VB, VS	205-S	205-S	305-S	405-S	505-S	605-S	705-S	805-S
		VSS	205-SS	205-SS	305-SS	405-SS	505-SS	605-SS	705-SS	805-SS
G	SPRING †	ALL MODELS	207-**	207-**	307-**	407-**	507-**	607-**	707-**	807-**
H	STOP RING	VJ, VB	208-B	208-B	308-B	408-B	508-B	608-B	708-B	808-B
		VS, VJ-SP	208-S	208-S	308-S	408-S	508-S	608-S	708-S	808-S
		VSS	208-SS	208-SS	308-SS	408-SS	508-SS	608-SS	708-SS	808-SS
I	PISTON †	HARDENED STEEL	206	206	306	406	506	606	706	806
		416 STAINLESS STEEL	206-A	206-A	306-A	406-A	506-A	606-A	706-A	806-A
		316 STAINLESS STEEL	206-SS	206-SS	306-SS	406-SS	506-SS	606-SS	706-SS	806-SS
J	CAP (GASKET SEAL)	VJ, VJ-SP	201-S	201-S	301-S	401	501	601	701	801
		VB	201-B	201-B	301-B	401-B	501-B	601-B	701-B	801-B
		VS	201-S	201-S	301-S	401-S	501-S	601-S	701-S	801-S
K	GASKET †	VJ, VB	204	204	304	404	504	604	704	804
		VS, VJ-SP	204-S	204-S	304-S	404-S	504-S	604-S	704-S	804-S

*See o-ring selection chart
**See spring pressure chart
† Recommended spare parts

VALVE SIZING...Use Of Performance Charts

DATA

FULFLO GUIDED PISTON VALVES

The trademark FULFLO expresses the basic principle that the relief valve must have flow capacity equal to that of the pipe lines to which it is connected. The sliding piston concept and internal design contours of FULFLO valves provide unique flow and stability characteristics for reliable performance without chatter.

FULFLO valves are designed to operate reliably at pressures as low as two PSI and as high as 1000 PSI. Higher pressures are accommodated with pilot valve-operated valves. The FULFLO valve reduces velocities through all but the controlling interface of the valve thereby minimizing system power loss.

Unlike ordinary direct acting relief valves, FULFLO guided piston valves are less responsive to transient pressure surges thereby eliminating the tendency to pound, squeal or chatter. Quiet, stable, efficient performance is assured in both load regulation and system protection applications.

FULFLO valves operate effectively with all types of liquids in the full range of viscosities including hydraulic oils, water, solvents and chemicals.

FULFLO valves are not designed to be positive shut off, and will pass a minimal amount of leakage before the set pressure.

FULFLO valves are NOT designed for use with air, gas or steam.

Since the FULFLO relief valve is a flow-modulating device, pressure flow characteristics are completely different from spring loaded poppet or ball check valves. Both types remain substantially tight up to *cracking pressure*. When this pressure is exceeded, the "conventional" valve pops open with a pressure drop at very low flow and an exponential pressure rise as the flow increases.

In contrast the FULFLO valve causes a pressure rise, *over-pressure*, as soon as flow starts; pressure increases almost proportionally with flow. Springs and areas on FULFLO valves are carefully designed to minimize this over-pressure.

Both pressures are important in sizing a valve. *Cracking pressure* must be selected high enough to permit system operation at its maximum rated pressure and flow. *Over-pressure* is limited by the system's capability to withstand the additional pressure and the motor's ability to sustain the pump output at the increased pressure for the required time interval.

The over-pressure to produce a certain flow is a function of valve size and spring constant and can be determined with the aid of the over-pressure charts given for the different valve sizes. The valve performance charts are based on tests made with oil of 150 SSU viscosity at 100°F and may be used with reasonable accuracy within the conventional range of oil viscosities from 100 to 500 SSU. For operation with high viscosity fluids, consult FULFLO's engineering department.

In sizing a valve, the first attempt should be to select a valve equal in size to the pipe to which it is connected. A larger or smaller valve may be used to suit individual requirements, depending on the permissible amount of over-pressure. Assume we have selected a ¾" valve for 17 GPM flow and a cracking pressure of 325 PSI. By referring to the pressure range chart, we find that we may use either a "YS" or a "ZS" spring.

Assuming a "YS" spring, draw a line horizontally at 17 GPM in the ¾" valve chart, to intersect the slanted line marked "YS" and drop a vertical line to the over-pressure scale to read an over-pressure of 44 PSI. The 17 GPM will be discharged at a pressure of 325 + 44 or 369 PSI. The percentage of over-pressure would be 44/325 × 100 or 13.5%.

If a "ZS" spring is used, extend the horizontal line to the "ZS" slope and the over-pressure is 70 PSI. The pressure to pass 17 GPM would be 325 + 70 or 395 PSI and the over-pressure would be 21.5%. If the over-pressure is higher than desired for the particular application, the procedure may be repeated for the next larger size valve.

In some cases, maximum flow through a valve at a given pressure is specified. To determine the cracking pressure, assume a ¾" valve is to pass 12 GPM at 50 PSI. A horizontal line drawn from the 12 GPM capacity to the intersection with the "WS" spring line results in an over-pressure of 14 PSI, therefore the cracking pressure must be 50 — 14 or 36 PSI, and the percentage of over-pressure would be 14/36 × 100 or 38.8%. The use of a "US" spring would produce an over-pressure of only 9 PSI, but the cracking pressure would then be 50 — 9 or 41 PSI, which would exceed the rating of the "US" spring.

For sizing valves for higher viscosity than 500 SSU, the following formula is used:

choose 1¼ valve for nominal viscosity

$$\sqrt[4]{\frac{V2}{V1}} \times \text{area of valve for 150 SSU}$$

$\sqrt[4]{\frac{2300}{150}}(1.244) = 2.42 in^2$ ← AREA NEEDED

V1 = 150 SSU
V2 = higher viscosity

Assume we have the following application,

GPM = 10
Viscosity = 12.000 SSU

2" valve has 3.167 in². Select 2" valve

Normally for 10 GPM a ½" valve would be used. Referring to the orifice area chart on page 9, to find the area of a ½" valve. The area is .305.

$$\sqrt[4]{\frac{12000}{150}} = \sqrt[4]{80} = 2.99$$

for 2" valve apx 10 psi over pressure

2.99 x .305 = .9120 area needed to pass 10 GPM

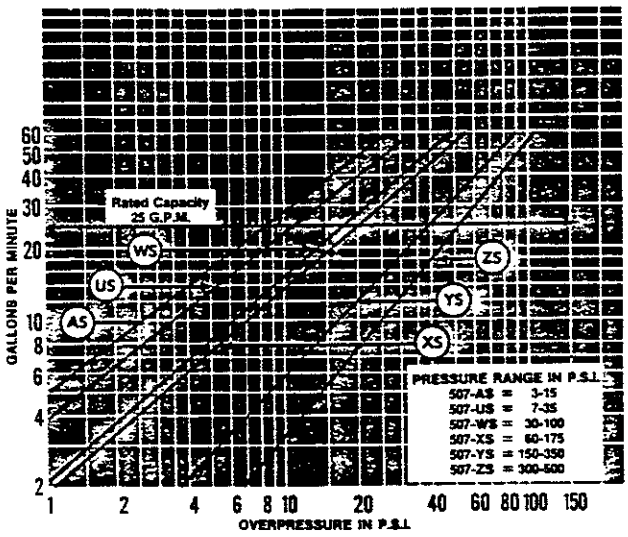
Again referring to the orifice area chart, we find that the area of a 1¼" valve is 1.224. Therefore a 1¼" valve would be used. To find the over-pressure refer to the performance chart for a 1¼" valve.

Performance charts based on actual test results are available on request. For additional information contact THE FULFLO SPECIALTIES CO.

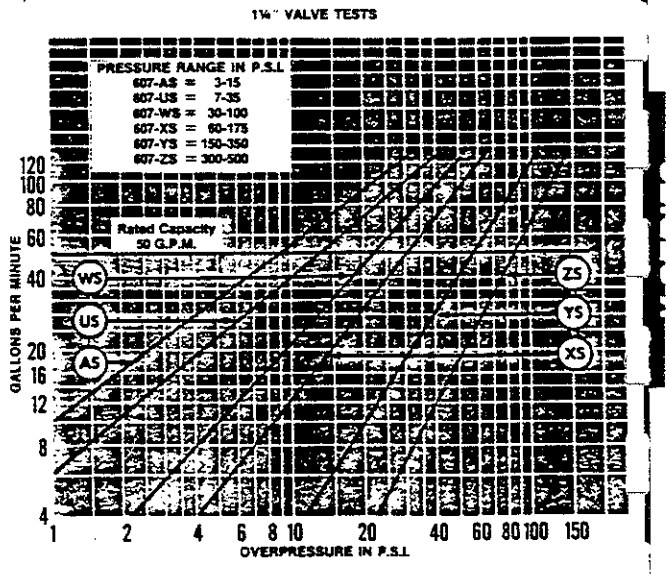
V-SERIES PERFORMANCE CHARTS

All valve tests 110°F. to 120°F. Oil Viscosity 150 S.S.U. at 100°F.

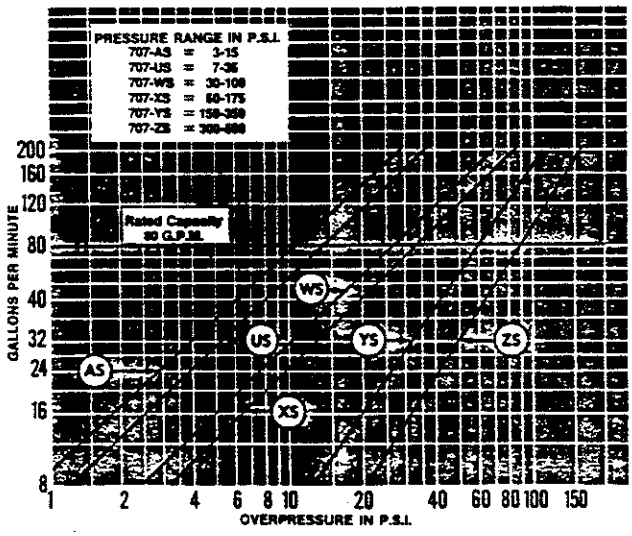
1" VALVE TESTS



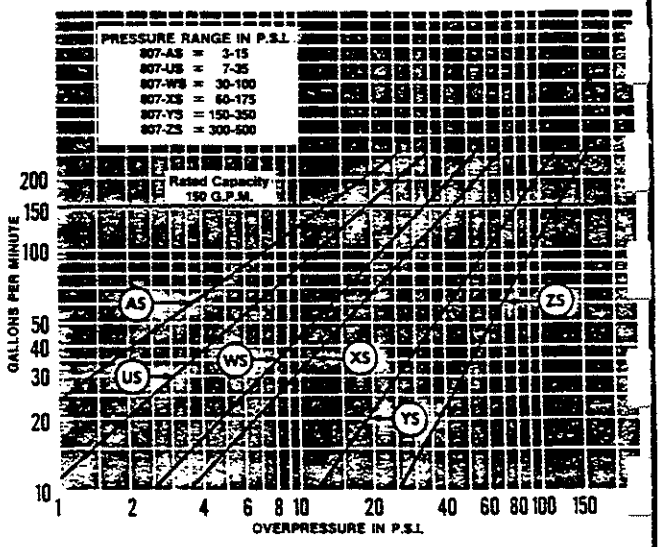
1¼" VALVE TESTS



1½" VALVE TESTS



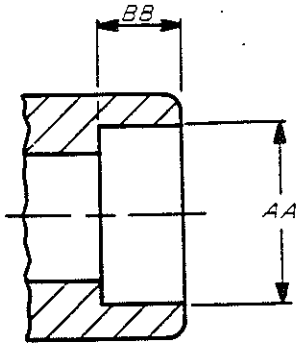
2" VALVE TESTS



SOCKET WELD & STANDARD MATERIALS

SOCKET WELD

VALVE SIZE	MODEL NUMBER		AA		BB
	STEEL	STAINLESS	MIN.	MAX.	
⅜"	SVS-2033	SVSS-2033	.685	.690	.312
½"	SVS-3037	SVSS-3037	.850	.855	.437
¾"	SVS-4038	SVSS-4038	1.060	1.065	.562
1"	SVS-5024	SVSS-5024	1.325	1.330	.625
1¼"	SVS-6058	SVSS-6058	1.670	1.675	.750
1½"	SVS-7067	SVSS-7067	1.910	1.915	.812
2"	SVS-8070	SVSS-8070	2.410	2.415	.875



ASTM/ASME SPECIFICATIONS

Adjusting Screws, Retainers, Stop Rings, Glands, Bonnets
- Brass—ASTM B16
- Steel—ASTM 108-79
- Stainless Steel—ASME SA479 Class 316

Caps
- Cast Iron—401 thru 801 ASTM A 126-42 Class A
- Brass—201-B thru 501-D ASTM B16
- Brass—501B thru 801-B ASME B62
- Steel—All models ASTM 108-79
- Stainless Steel—All models ASME SA479 Class 316

Locknuts
- Steel—ASTM 108-79
- Stainless Steel—ASME SA479 Class 316

Pistons
- Hardened Steel—ASTM 108-79
- 416 Stainless Steel—ASTM A 582 Cond. A
- 316 Stainless Steel—ASME SA 479 Class 316

Bodies
- Cast Iron—ASTM A126-42 Class A
- Brass—ASME B62
- Steel—ASTM A 216 Grade WCB
- Stainless Steel—ASTM A 351 CF8M

Material Codes (Unless Otherwise Specified)
- A —416 Stainless Steel
- CI —Cast Iron (No Part # Suffix)
- B —Brass
- S —Steel
- SS—Stainless Steel

O-RING & PAD MATERIAL SPECIFICATIONS

MATERIAL	SUFFIX CODE	COMPOUND	TEMP. RANGE		ASTM SPEC.
			MIN.	MAX.	
BUNA	R	B 46	-40°F	257°F	D2000
ETHYLENE-PROPYLENE	EPR	E 50	-67°F	302°F	D2000
VITON	RV	V 14	-31°F	437°F	D2000
SILICONE	RS	S 71	-103°F	482°F	D2000
TEFLON	RT	— —	-423°F	500°F	D2000
NEOPRENE	RN	— —	-67°F	284°F	D2000

ORIFICE AREA & PISTON/BODY TOLERANCES

DIMENSIONS IN INCHES

VALVE SIZE	PISTON DIA. ±.000-.0003	AREA IN 2	BODY GO RC 3 FIT	BODY NO GO RC 3 FIT
¼	.4985	.195	.4993	.4999
⅜	.4985	.195	.4993	.4999
½	.6235	.305	.6243	.6249
¾	.7485	.440	.7493	.7499
1	.9985	.783	.9993	1.0003
1¼	1.2485	1.224	1.2495	1.2507
1½	1.4985	1.764	1.4995	1.5007
2	1.9985	3.167	1.9997	2.0011
2½	2.6500	5.515	2.6517	2.6527
3	3.1235	7.663	3.1247	3.1261
4	4.1222	13.346	4.1250	4.1262

SPRING MATERIAL & TEMPERATURE CHART

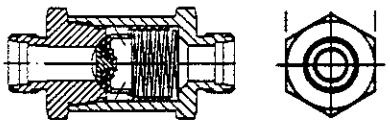
VALVE SIZE	PART NO.	MATERIAL					MAX TEMP.			ASTM SPEC.			
		17-7PHSS	18-8SS	CHR. VANADIUM	OIL TEMP.	MUSIC WIRE	650 F	550 F	425 F / 250 F	313 TYPE 631	A 581 COND. A	A 231	229 / 228
3/8" 1/4"	207-AS		●								●		
	207-US		●						●		●		
	207-WS		●						●		●		
	207-XS		●						●		●		
	207-YS	●					●			●			
	207-ZS	●					●			●			
	207-RS	●					●			●			
	207-TS	●					●			●			
	207-A					●			●				●
	207-U					●			●				●
	207-W				●				●				●
	207-X				●				●				●
	207-Y			●				●				●	
	207-Z			●				●				●	
	207-RS		●				●			●			
	207-TS		●				●			●			
1/2"	307-AS		●				●			●			
	307-US		●				●			●			
	307-WS		●				●			●			
	307-XS	●					●			●			
	307-YS	●					●			●			
	307-ZS	●					●			●			
	307-RS	●					●			●			
	307-TS	●					●			●			
	307-A					●			●				●
	307-U					●			●				●
	307-W				●				●				●
	307-X				●				●				●
	307-Y			●				●				●	
	307-Z			●				●				●	
	307-RS		●				●			●			
	307-TS		●				●			●			
3/4"	407-AS		●				●			●			
	407-US		●				●			●			
	407-WS		●				●			●			
	407-XS	●					●			●			
	407-YS	●					●			●			
	407-ZS	●					●			●			
	407-U					●			●				●
	407-W				●				●				●
	407-X				●				●				●
	407-Y			●				●				●	
	407-Z			●				●				●	
1"	507-AS		●				●			●			
	507-US		●				●			●			
	507-WS		●				●			●			
	507-XS	●					●			●			
	507-YS	●					●			●			
	507-ZS	●					●			●			
	507-A					●			●				●
	507-U					●			●				●
	507-W				●				●				●
	507-X				●				●				●
	507-Y			●				●				●	
	507-Z			●				●				●	
	507-R		●				●			●			

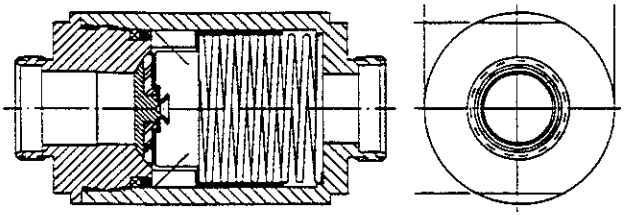
VALVE SIZE	PART NO.	MATERIAL					MAX TEMP.			ASTM SPEC.			
		17-7PHSS	18-8SS	CHR. VANADIUM	OIL TEMP.	MUSIC WIRE	650 F	550 F	425 F / 250 F	313 TYPE 631	A 581 COND. A	A 231	229 / 228
1¼"	607-AS		●				●			●			
	607-US		●				●			●			
	607-WS		●				●			●			
	607-XS	●					●			●			
	607-YS	●					●			●			
	607-ZS	●					●			●			
	607-A					●			●				●
	607-U					●			●				●
	607-W				●				●				●
	607-Y				●				●				●
	607-Z				●				●				●
	607-R			●				●				●	
1½"	707-AS		●				●			●			
	707-US		●				●			●			
	707-WS		●				●			●			
	707-XS	●					●			●			
	707-YS	●					●			●			
	707-ZS	●					●			●			
	707-A					●			●				●
	707-U					●			●				●
	707-W				●				●				●
	707-X				●				●				●
	707-Y				●				●				●
	707-Z				●				●				●
	707-R			●				●				●	
2"	807-AS		●				●			●			
	807-US		●				●			●			
	807-WS		●				●			●			
	807-XS	●					●			●			
	807-YS	●					●			●			
	807-ZS	●					●			●			
	807-A					●			●				●
	807-U					●			●				●
	807-W				●				●				●
	807-X				●				●				●
	807-Y				●				●				●
	807-Z	●					●			●			
2½"	A0960D		●				●			●			
	A0961C			●				●				●	
	A0970D		●				●			●			
	A0971C			●				●				●	
	A0980D		●				●			●			
3"	A1060D		●				●			●			
	A1061C			●				●				●	
	A1070D		●				●			●			
	A1071C			●				●				●	
	A1080D		●				●			●			
4"	A1160D		●				●			●			
	A1170D		●				●			●			
	A1181D		●				●			●			
4" 3" 2½"	A1190D	●					●			●			

TELEDYNE REPUBLIC

Check Valves Type: Free Flow

Catalog Series 480, 490





Features

- Resilient molded seal is permanently locked to poppet which insures zero leakage in high velocity applications.

Teledyne Republic Catalog 119025M
Phone 216-267-2700 Cleveland, OH
Fax 216-267-1918

Berendsen Fluid Power
310-692-6912

Specifications

Service Applications: Pneumatic or hydraulic.

Pressure Range:

Cracking:	2 PSI ±1 Other settings available.
Working:	3,000 PSI
Proof:	4,500 PSI
Burst:	7,500 PSI

Temperature Range:
-65° to 200° F.
Higher temperature limits available.

Sizes:
IPT, EPT: 1/8, 1/4, 3/8, 1/2, 3/4, 1, 1-1/4, 1-1/2, 2.
IST, FLD, FLS: 4, 6, 8, 10, 12, 16, 20, 24, 32.

Type Ports:

NPT:	Pipe threads.
IST:	Internal straight threads (tube connection) O-ring seal.
FLD:	Flared tube connection SAE 37° MS33656 (AND 10056).
FLS:	Flareless tube connection MS33514.

Internal Leakage: Zero.

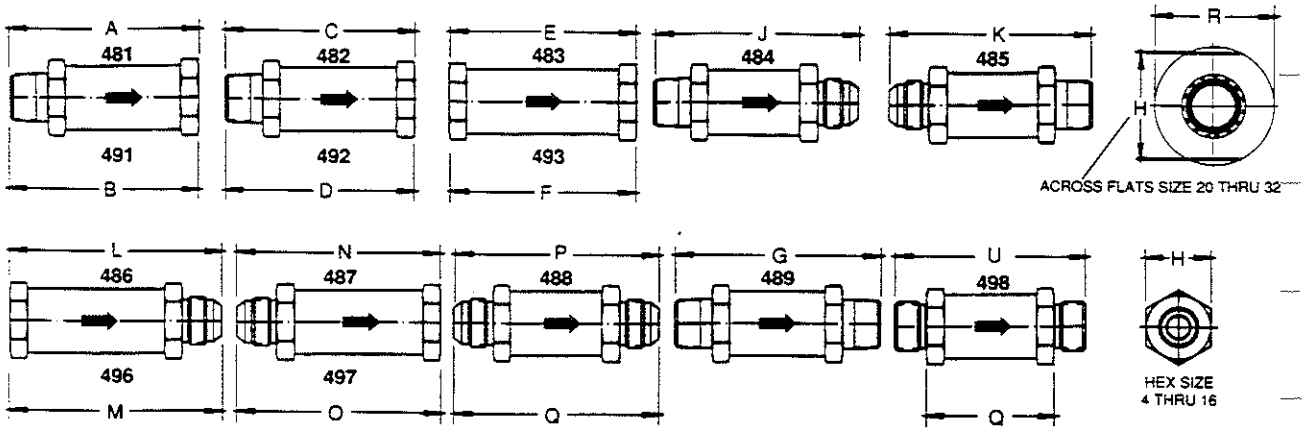
Mounting: Inline.

Materials:

Body and Cap:	Brass, aluminum alloy or 303 stainless steel.
Poppet Body:	304 stainless steel.
Poppet Nose:	303 stainless steel.
Spring:	AMS5688 stainless steel.
O-Ring:	Synthetic rubber.
Molded Seal:	Synthetic rubber.
Back-Up Ring:	Teflon.

Valve Size		Weights (Lbs. Approx.)			CV Factors
Tube	Pipe	Brass	Aluminum Alloy	Stainless Steel	Coefficient of Flow
4	1/8	.12	.06	.12	.75
6	1/4	.37	.12	.37	1.5
8	3/8	.62	.25	.62	4
10	1/2	1.25	.5	1.25	6
12	3/4	1.62	.75	1.62	7.5
16	1	2.5	1.0	2.5	13
20	1-1/4	8.0	2.62	6.25	21
24	1-1/2	12.37	4.25	10.37	30
32	2	18.25	8.5	16.0	55

Dimensions



Valve Size		All Dimensions in Inches																	
Tube	Pipe	A	C	E	J	K	L	N	P	G	B	D	F	M	O	U	Q	Flats H	Round R
4	1/8	2 1/8	1 29/32	1 11/16	2 1/2	2 15/32	2 1/16	2 1/4	2 5/8	2 11/32	2 5/16	2 7/16	2 13/32	2 19/32	2 7/16	2 7/16	1 17/32	3/4	—
6	1/4	2 29/32	2 7/16	2 1/4	3 1/16	3	2 13/32	2 13/16	2 31/32	3 3/32	3	2 17/32	2 7/16	2 1/2	2 27/32	2 51/64	1 55/64	1	—
8	3/8	3 5/64	2 45/64	2 7/16	3 27/64	3 21/64	2 25/32	3 1/16	3 13/32	3 11/32	3 19/64	3 19/64	3 3/8	3 3/8	3 9/32	3 7/32	2 3/32	1 1/4	—
10	1/2	3 25/32	3 9/32	2 15/16	4 1/16	4 1/32	3 7/32	3 11/16	3 31/32	4 1/8	3 25/32	3 13/32	3 1/16	3 11/32	3 23/32	3 45/64	2 29/64	1 1/2	—
12	3/4	4 11/64	3 43/64	3 3/8	4 27/64	4 31/64	3 5/8	4 3/16	4 7/16	4 15/32	4 23/64	3 63/64	3 7/8	3 15/16	4 3/8	4 5/64	2 45/64	1 3/4	—
16	1	4 47/64	4 3/8	3 25/32	5 7/64	5 5/32	4 5/32	4 9/16	4 15/16	5 21/64	4 57/64	4 3/8	3 15/16	4 5/32	4 3/4	4 31/64	3 7/64	2	—
20	1 1/4	6 3/4	5 3/4	5 17/32	6 3/4	6 11/16	5 17/32	6 15/32	6 15/32	6 31/32	6 3/4	5 3/4	5 17/32	5 17/32	6 15/32	5 59/64	4 35/64	2 1/4	2 3/4
24	1 1/2	7 3/8	6 1/2	6 1/8	7 21/32	7 19/32	6 13/32	7 7/32	7 1/2	7 3/4	7 3/8	6 5/8	6 1/4	6 17/32	7 7/32	6 45/64	5 21/64	3 1/8	3 1/2
32	2	8 13/32	7 9/32	7 1/16	8 5/8	8 5/8	7 9/32	8 25/64	8 39/64	8 5/8	8 13/32	7 17/32	7 5/16	7 7/32	8 25/64	7 17/64	5 57/64	4	4 1/2

Interpretation of Valve Number

A — Options
- A: Nuts & Sleeves (for FLD type)

481 — Catalog Number

481 Inlet NPT	Outlet NPT	489 Inlet NPT	Outlet NPT
482 Inlet NPT	Outlet NPT	491 Inlet NPT	Outlet IST
483 Inlet NPT	Outlet NPT	492 Inlet IST	Outlet NPT
484 Inlet NPT	Outlet FLD	493 Inlet IST	Outlet IST
485 Inlet FLD	Outlet NPT	496 Inlet IST	Outlet FLD
486 Inlet NPT	Outlet FLD	497 Inlet FLD	Outlet IST
487 Inlet FLD	Outlet NPT	498 Inlet FLS	Outlet FLS
488 Inlet FLD	Outlet FLD		

-1/8 — Size and Type Ports

4 IST or FLD or FLS	1/8 NPT
6 IST or FLD or FLS	1/4 NPT
8 IST or FLD or FLS	3/8 NPT
10 IST or FLD or FLS	1/2 NPT
12 IST or FLD or FLS	3/4 NPT
16 IST or FLD or FLS	1 NPT
20 IST or FLD or FLS	1-1/4 NPT
24 IST or FLD or FLS	1-1/2 NPT
32 IST or FLD or FLS	2 NPT

B — Materials
- B: Brass
- D: Aluminum Alloy
- SS: Stainless Steel

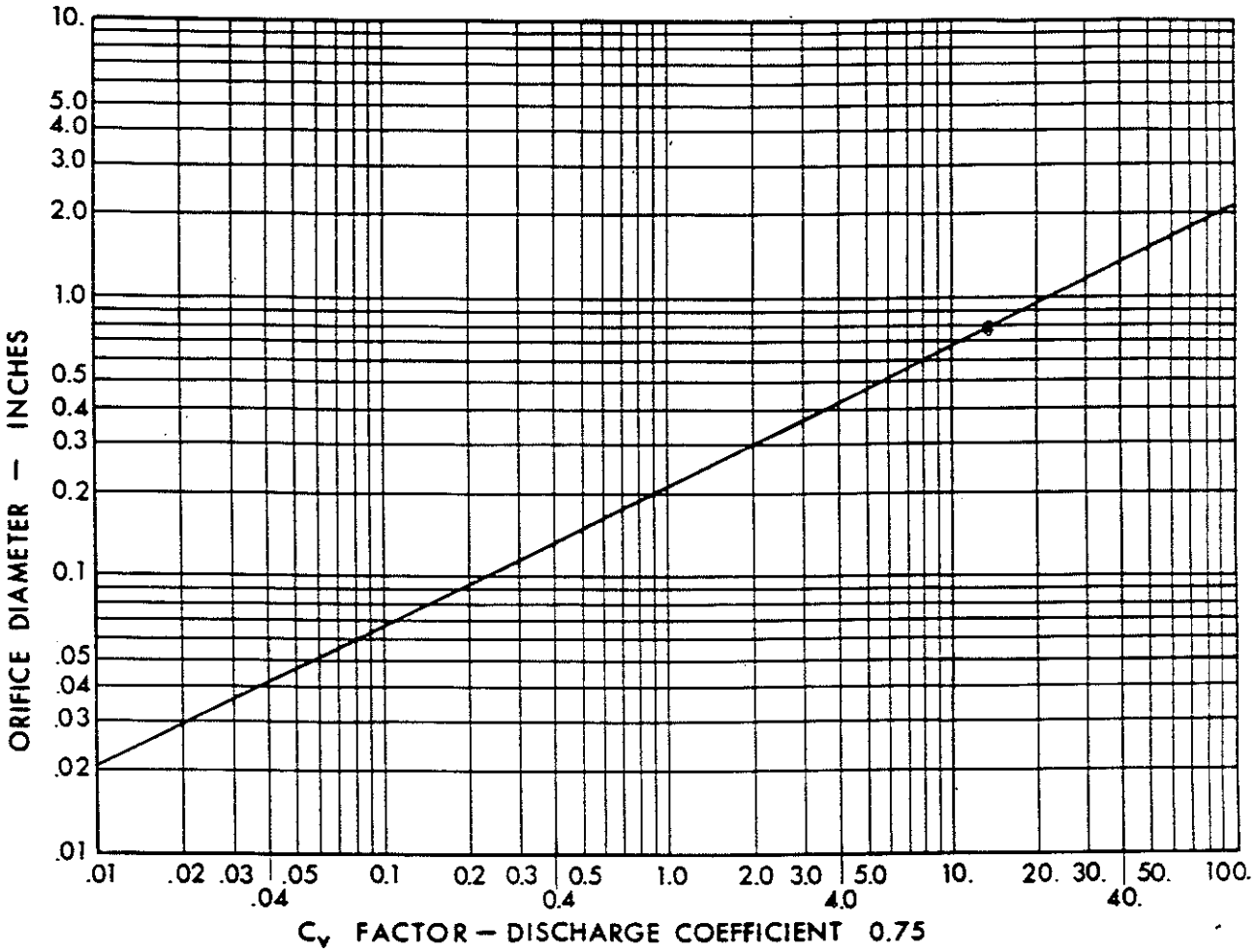
1 — O-Ring Code
- 1: Buna N
- 2: (Commercial) Buna N
- Others Available See O-Ring Code & Media Chart Reference Section

-2 — Cracking Pressure
- 2: 2 PSI ± 1

TELEDYNE REPUBLIC

Reference
Orifice Size and Cv Factor Chart

Media — Hydraulic Oil MIL-H-5606 @ 70° F.



All Republic flow and directional control valves are calibrated for a "Cv Factor" based upon their size and type.

To establish the equivalent orifice diameter for any given Cv Factor:

1. Obtain the Cv Factor from the appropriate data sheet.
2. Find this Factor on the scale at the bottom of the graph.
3. Trace vertically until the line intersects the diagonal line.
4. Read off equivalent orifice size on the vertical scale at left, horizontal to the intersection point.

NOTE: To find Pressure Drop at a specific flow for an equivalent orifice, refer to Orifice Flow Chart on the other side.

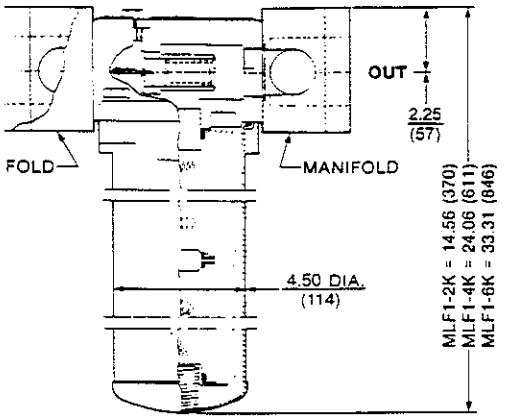
Chart Example
Determine pressure drop (P) for a 8941-1/2HSS2 valve when flowing 10 G.P.M. hydraulic oil. Cv - 1.4.

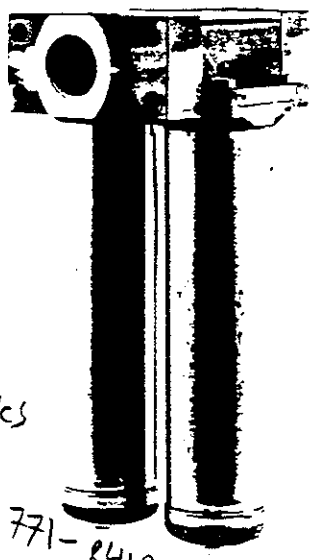
MLF1 (200 GPM / 300 PSI)

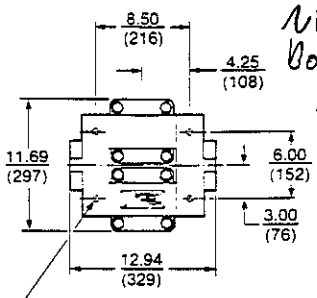
D330027-23, -36, -40

SCHROEDER FILTER

CHILLER







(4) .50-13UNC X 1.00 (25) DP. MTG. HOLES FROM BOTTOM

Schroeder
Nichol Ave
Box 72
McKees Rocks
PA 15136
Tel 412-771-8410
Fax 412-771-1320

000 DENOTES INCHES
(000) DENOTES MILLIMETERS

APPLICATION

Highly efficient filtration to 300 PSI & 200 GPM
Meets Automotive HF4 specification.

FEATURES

Heavy duty filter designed for cyclic operation; P, or F porting; Full range of Dirt Alarms®

Full Range of High Efficiency Elements

Element	Absolute Rating	Beta Ratio			Dirt Holding Capacity (Gm.)
		β_2	β_5	β_{10}	
K3	6.8	28	48	200	54
K10	15.5	--	1.5	10	44
KS.5	<2.0	968	>5000	>5000	35
KS1	<3.0	500	>1000	>3000	57
KS3	3.8	36	292	>3000	59
KS7	9.6	--	5	100	73
KS15	23	--	--	2	79

SPECIFICATIONS

Pressure Rating:
- 300 PSI (20.7 Bar) max. operating
- 1000 PSI (69.0 Bar) min. yield
- Rated Fatigue - see fatigue section, page 59

Maximum Operating Temperature:
- 225°F (107°C)

Bypass Valve Setting:
- Cracking 25 PSI, Full Flow 60 PSI

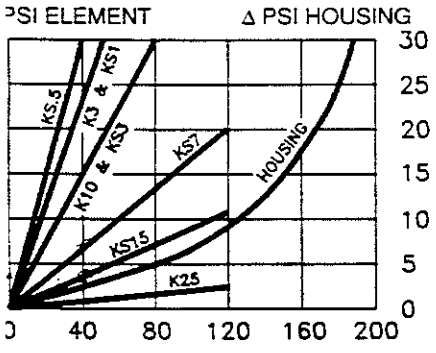
Material:
- Porting Head: Anodized Cast Aluminum
- Element Case: Steel

Compatibility:
- All petroleum based hydraulic fluid. See page 58 for use with other fluids.

Minimum Weight:
- 44.0 LBS. (20.0 Kg.)

Element Change Clearance: 2.00" (51)

PRESSURE DROP



Element Δ P = (Δ P from curve ÷ number of elements) X (SSU viscosity ÷ 150).
Filter Δ P = Housing Δ P + element Δ P.

MODEL NUMBER SELECTION

Filter Series	Number of Elements	Element Model No.	Seal Material	Porting Options	Dirt Alarm - Type
MLF1	2 4 6	K3 K10 K25 ** KS.5 KS1 KS3 KS7 KS15 KM60 KM150	(Omit) = Buna N H = EPR V = Viton	P = 2 1/2" NPTF F = 2 1/2" SAE J518 Split Flange code 61 * * Bolt thread depth 1.19" (30)	D = Pointer MS = Electric Cam Operated

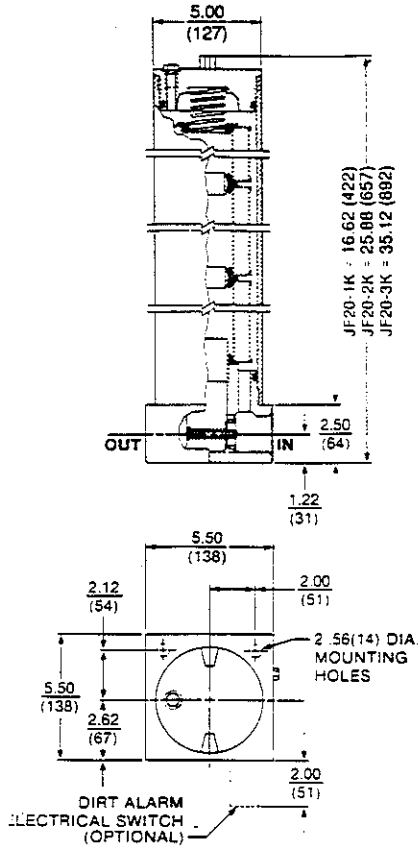
Example: **MLF1-4K10-V-P-MS** = MLF1 filter with four K10 elements, Viton seals, 2 1/2" NPTF ports, electrical switch Dirt Alarm®. ** Available with Buna N seals only.
Additional ordering and PSIΔ information is shown on page 16. Complete Dirt Alarm® details are shown on page 13

MLF1 ELEMENT SELECTION CHART FOR FLOW REQUIREMENT

Pressure	Element Series	Element Model No.	Models shown are based on use of 150 SSU petroleum base hydraulic fluid and include NPTF porting & pointer Dirt Alarm®.		
To 300 PSI	E Media	K3	See KF3 Data Sheet For Flows 0 - 100 GPM	MLF1-4K3-P-D	MLF1-6K3-P-D
		K10		MLF1-4K10-P-D	MLF1-6K10-P-D
		K25		MLF1-4K25-P-D	
	S Media	KS1		MLF1-4KS1-P-D	
		KS3		MLF1-4KS3-P-D	MLF1-6KS3-P-D
		KS7/KS15		MLF1-2KS7(2KS15)-P-D	MLF1-4KS7(4KS15)-P-D
	Flow GPM		0	120 140 160 180	200

JF20 (70 GPM / 2500 PSI)

BRG PUMP



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(000) DENOTES MILLIMETERS

APPLICATION

Highly efficient pressure filtration to 2500 PSI and 70 GPM

FEATURES

Servicing element from top minimizes oil spillage; Available with Dirt Alarm® and Porting; No Element Indicator.

Full Range of High Efficiency Elements

Element	Absolute Rating	Beta Ratio β_2	β_5	β_{10}	Dirt Capacity (G)
K3	6.8	28	48	200	54
K10	15.5	--	1.5	10	44
KS.5	<2.0	968	>5000	>5000	--
KS1	<3.0	500	>1000	>3000	
KS3 & KSX3	3.8	36	292	>3000	
KS7 & KSX7	9.6	--	5	100	73

SPECIFICATIONS

Pressure Rating:
- 2500 PSI (172.4 Bar) max. operating
- 10000 PSI (689.7 Bar) min. yield
- Rated Fatigue - see fatigue section, page 5

Maximum Operating Temperature:
- 225°F (107°C)

Bypass Valve Setting:
- Cracking 30 PSI, Full Flow 45 PSI

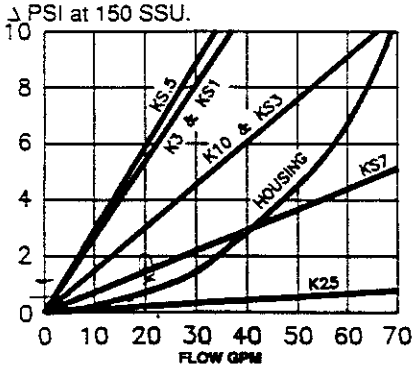
Material:
- Porting Head and Cap: Ductile Iron
- Element Case: Steel

Compatibility:
- All petroleum based hydraulic fluid. See page 58 for use with other fluids.

Minimum Weight:
- 38.7 LBS. (17.3 Kg.)

Element Change Clearance: 8.50" (216)

PRESSURE DROP



Element Δ P = (Δ P from curve ÷ number of elements) X (SSU viscosity ÷ 150).
Filter Δ P = Housing Δ P + element Δ P.

MODEL NUMBER SELECTION

Filter Series	Number of Elements	Element Model No.	Seal Material	Porting Options	Dirt Alarm® Type	No Element Indicator
JF20	1 2 3	K3 K10 K25* KS.5 KS1 KS3 KS7	(Omit) = Buna N H = EPR V = Viton	P = 1 1/4" NPTF S = 1 5/8" - 12 SAE Straight (For Flange Ports See TF50 or KF30)	D = Pointer MS = Electric Cam Operated D5 = Cartridge D5C = Cartridge in Cap Electric Cartridge MS5AC = AC Only MS5DC = DC Only	
JFN20 (Non-bypass Model)		KSX3, KSX7 (3000 PSI Crush Rating)			D5 = Cartridge D5C = Cartridge in Cap Electric Cartridge MS5AC = AC Only MS5DC = DC Only	N/A

Example: **JF20-1K10-V-P-D5** = JF20 filter with one K10 element, Viton seals, 1 1/4" NPTF ports and Cartridge Dirt Alarm®.
* Available with Buna N seals only.
Additional ordering and PSIΔ information is shown on page 16. Complete Dirt Alarm® details are shown on page 13.

JF20 ELEMENT SELECTION CHART FOR FLOW REQUIREMENT

Pressure	Element Series	Element Model No.	Models shown are based on use of 150 SSU petroleum base hydraulic fluid and include SAE straight thread porting & cartridge Dirt Alarm®.
To 2500 PSI	E Media	K3	JF20-1K3-S-D5 / JF20-2K3-S-D5 / JF20-3K3-S-D5
		K10	JF20-1K10-S-D5 / JF20-2K10-S-D5
		K25	JF20-1K25-S-D5
	S Media	KS1	JF20-1KS1-S-D5 / JF20-2KS1-S-D5 / JF20-3KS1-D5
		KS3	JF20-1KS3-S-D5 / JF20-2KS3-S-D5
		KS7	JF20-1KS7-S-D5
Flow GPM			0 10 20 30 40 50 60 70

SUPER CHARGE PUMP

APPLICATION

ghly efficient filtration to 300 PSI & 100 GPM
eets Automotive HF4 specification.

FEATURES

eavy duty filter designed for cyclic operation;
, S, or F porting; Full range of Dirt Alarms®;
vailable with KW water removal element.

Full Range of High Efficiency Elements

Element	Absolute Rating	Beta Ratio			Dirt Holding Capacity (Gm.)
		β_3	β_5	β_{10}	
K3	5.8	28	48	200	54
K10	15.5	--	1.5	10	44
KS.5	<2.0	968	>5000	>5000	35
KS1	<3.0	500	>1000	>3000	57
KS3	3.8	36	292	>3000	59
KS7	9.6	--	5	100	73
KS15	23	--	--	2	79

SPECIFICATIONS

Pressure Rating:
- 300 PSI (20.7 Bar) max. operating
- 1000 PSI (69.0 Bar) min. yield
- Rated Fatigue - see fatigue section, page 59

Maximum Operating Temperature:
- 225°F (107°C)

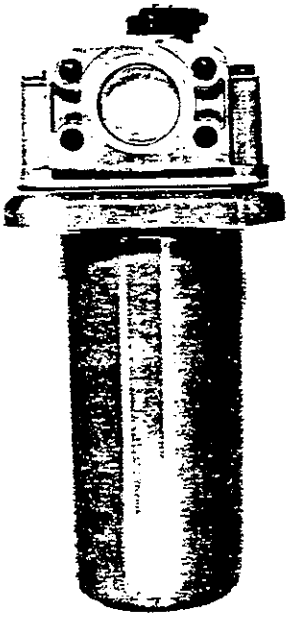
Bypass Valve Setting:
- Cracking 30 PSI, Full Flow 51 PSI

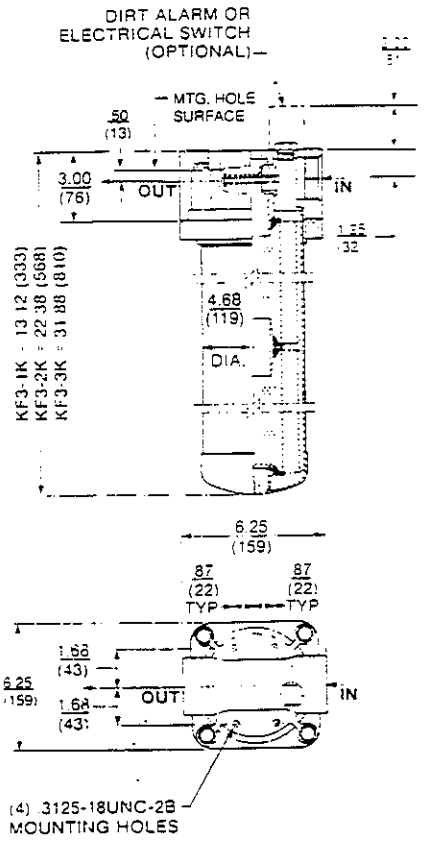
Material:
- Porting Head: Die Cast Aluminum
- Element Case: Steel

Compatibility:
All petroleum based hydraulic fluid.
See page 58 for use with other fluids.

Minimum Weight:
- 12.5 LBS. (6.0 Kg.)

Element Change Clearance: 1.50" (38)





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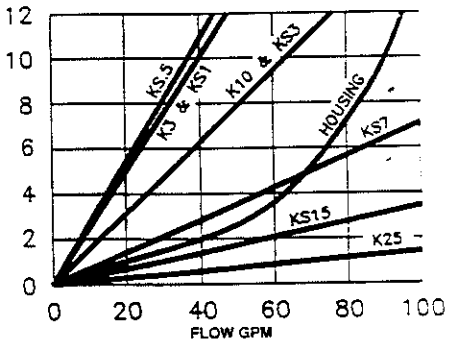
MODEL NUMBER SELECTION

Filter Series	Number of Elements	Element Model No.	Seal Material	Porting Options	Dirt Alarm × Type	No Element Indicator
KF3	1 2 3	K3 K10 K25 ** KS.5 KS1 KS3 KS7 KS15 KW KM10 KM25 KM60	(Omit) = Buna N H = EPR * V = Viton * *When "H", "W", & "V" Seals are Ordered All Alum. Filter Parts are Anodized.	P = 1 1/2" NPTF S = 1 7/8"-12 SAE Straight F = 1 1/2" SAE J518 Split Flange code 61 * * Bolt thread depth .63" (16)	D = Pointer MS = Electric Cam Operated DS = Cartridge Electric Cartridge MS5AC = AC Only MS5DC = DC Only	N

Example: **KF3-1K10-V-P-DS-N** = KF3 filter with single K10 element, Viton seals, 1 1/2" NPTF ports, Cartridge Dirt Alarm× and No Element Indicator. * * Available with Buna N seals only.
Additional ordering and PSIΔ information is shown on page 16. Complete Dirt Alarm× details are shown on page 13.

PRESSURE DROP

Δ PSI at 150 SSU.



Element Δ P = (Δ P from curve - number of elements) X (SSU viscosity ÷ 150)
Filter Δ P = Housing Δ P + element Δ P

KF3 ELEMENT SELECTION CHART FOR FLOW REQUIREMENT

Pressure	Element Series	Element Model No.	Models shown are based on use of 150 SSU petroleum base hydraulic fluid and include SAE straight thread porting & cartridge Dirt Alarm×
To 300 PSI	E Media	K3	KF3-1K3-S-DS · KF3-2K3-S-DS · KF3-3K3-S-DS
		K10	KF3-1K10-S-DS · KF3-2K10-S-DS · KF3-3K10-S-DS
		K25	KF3-1K25-S-DS · KF3-2K25-S-DS
	S Media	KS1	KF3-1KS1-S-DS · KF3-2KS1-S-DS
		KS3	KF3-1KS3-S-DS · KF3-2KS3-S-DS
		KS7 KS15	KF3-1KS7-1KS15-S-DS
Flow GPM			0 · 20 · 40 · 60 · 80 · 100

SCHROEDER CARTRIDGE DIRT ALARMS

Schroeder in-line filters are available with mechanical and electrical cartridge Dirt Alarms. These alarms may also be purchased as separate items.

The mechanical magnetic cartridge shows a *red visual* indicating signal. The electrical magnetic cartridge provides an electrical signal for activating various electric alarm systems or for complete machine shutdown.

The mechanical model has a manual reset button. Once activated, the red signal continues to indicate a bypass or clogged condition, even following equipment shutdown. The signal will not change until it is manually reset.

Like the mechanical model, the new electric model operates in any position and fits any Schroeder filter cartridge port.

As an added feature, the two models are interchangeable. Cartridge dirt alarms are available for all cataloged Schroeder filters except KFX, RT, ST, LRT, and BFT models.

MECHANICAL DIRT ALARMS

D5 — Red Pop Up Visual Indicator
P/N A-LF-2547

D5C — Same as D5 but mounted in Cap
P/N A-LF-2547

D5R — Same as D5 but mounted on opposite side of standard location
P/N A-LF-2547

D8 — Red Pop Up Visual Indicator with Thermal Lock-out
P/N A-LF-3870

D8C — Same as D8 but mounted in Cap
P/N A-LF-3870

D8R — Same as D8 but mounted on opposite side of standard location
P/N A-LF-3870

ELECTRICAL DIRT ALARMS

MS5 — Cartridge Electrical Indicator
P/N A-LF-2548AC
P/N A-LF-2548DC

MS10 — Cartridge Electrical Indicator equipped with DIN Connector
P/N A-LF-2919AC
P/N A-LF-2919DC
MS10C — Same as MS 10 but mounted in cap on top of filter
P/N A-LF-2919AC
P/N A-LF-2919DC

ELECTRICAL DIRT ALARM SPECIFICATIONS			
CODE	TYPE OF CONTACT	ELECTRICAL RATING	CONNECTION
		CONVENTIONAL	
ES	SPDT (BFT)	8 AMPS @ 12 VDC, 1 AMP @ 120 VAC, 4 AMPS @ 24 VDC, .5 AMP @ 240 VAC	Screw Terminal with Rubber Boot
	SPST (All Other In-Tanks)	8 AMPS @ 12 VDC, 1 AMP @ 120 VAC, 4 AMPS @ 24 VDC, .5 AMP @ 240 VAC	Screw Terminal with Rubber Boot
ES1	SPDT	10 AMPS @ 115 VAC	1/2" Conduit, Male
MS	SPDT	15 AMPS @ 125/250 VAC, .5 AMP @ 125 VDC	1/2" Conduit, Female
MS2	SPDT	3 AMPS @ 12 VDC Inductive, 3 AMPS @ 12 VDC Resistance, 10.1 AMPS @ 125/250 VAC	Pigtail
		CARTRIDGE	
MS5AC	Solid State	6 AMPS @ 120 VAC, 3 AMPS @ 240 VAC	3/4" Conduit, Female
MS5DC	Solid State	1 AMP @ 12 VDC, .5 AMP @ 24 VDC	3/4" Conduit, Female
MS10AC	Solid State	6 AMPS @ 120 VAC, 3 AMPS @ 240 VAC	DIN Connector, Male
MS10DC	Solid State	1 AMP @ 12 VDC, .5 AMP @ 24 VDC	DIN Connector, Male
MS11AC	Solid State	6 AMPS @ 120 VAC, 3 AMPS @ 240 VAC	12 Ft. Long STO Cord and Connector
MS11DC	Solid State	1 AMP @ 12 VDC, .5 AMP @ 24 VDC	12 Ft. Long STO Cord and Connector
MS12AC	Solid State	6 AMPS @ 120 VAC, 3 AMPS @ 240 VAC	Brad Harrison Connector
MS12DC	Solid State	1 AMP @ 12 VDC, .5 AMP @ 24 VDC	Brad Harrison Connector

MS11 — Cartridge Electrical Indicator equipped with 12 foot STO weather-proof electrical cable and connector
P/N A-LF-3011AC
P/N A-LF-3011DC

MS12 — Cartridge Electrical Indicator equipped with Brad Harrison Connector
P/N A-LF-4498AC
P/N A-LF-4498DC

RACINE®

BOSCH Group

Distributor: B&T
Bosch
Phone 414-554-7100
Fax 414-554-7117

Engineering Data

D330027-30

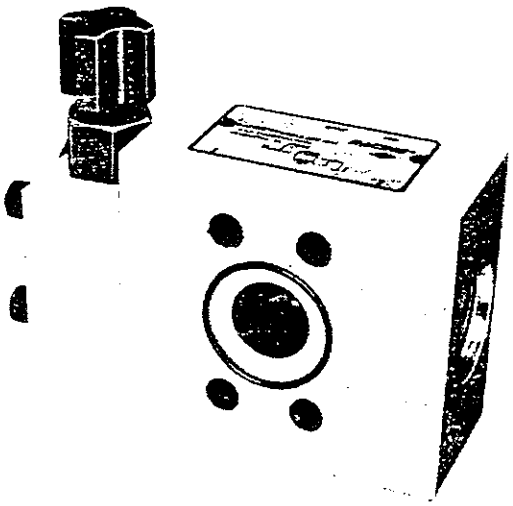
PRESSURE CONTROLS

POPPET RELIEF VALVE

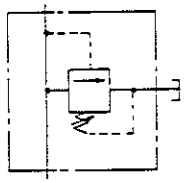
3/4", 1", 1-1/4" & 1-1/2"

5000 PSI 60 & 100 GPM

GASKET MOUNTED (FLOW THRU) SOLENOID CONTROLLED MULTIPLE PRESSURE & VENTING



SYMBOL



SPECIFICATIONS

PRESSURE — 5000 PSI (340 bar)

FLOW RATING — 50 GPM (189 L/MIN) Nominal; 60 GPM (228 L/MIN) Recommended Maximum For: 3/4", 1" & 1-1/4" 3000 PSI, 3/4" & 1" 5000 PSI Size

80 GPM (303 L/MIN) Nominal; 100 GPM (380 L/MIN) Recommended Maximum for 1-1/2" 3000 PSI & 1-1/4" 5000 PSI Size

PRESSURE ADJUSTMENT RANGE — Adjustments range through 3 different spring rates. See "How to Order" section, and curves in the performance section.

REPEATABILITY — ±50 PSI (3.4 bar)

STABILITY — ±25 psi (1.7 bar).

RESPONSE — 20 Milliseconds Average.

SEALS — Viton seals are standard to allow operation with petroleum base fluids and most fire resistant fluids.

ELECTRICAL CONTROL OPTIONS

Solenoid controlled multiple pressure and solenoid venting heads for these relief valves can be found on Catalog page G-34

FLUID RECOMMENDATIONS — Premium grade hydraulic fluid with 60 SUS (10 cSt) to 1000 SUS (216 cSt) viscosity at operating temperature. For detailed fluid information, refer to Racine publication S-106 "Petroleum Hydraulic Fluids", and S-107 "Fire Resistant Fluids".

TEMPERATURE — Under normal conditions of continuous operation, fluid temperature should not exceed 130°F (54°C). In no instance should temperature exceed 160°F (71°C).

MOUNTING POSITION — Not Restricted.

WEIGHT (Approx.) —
3/4", 1" & 1-1/4" ..... 7.5 lbs. (3.4 kg)
1-1/2" ..... 12.1 lbs. (5.5 kg)

LEAKAGE — Not to Exceed 5 CIPM

CONTROL FLOW — On 3/4", 1", 1-1/4" = 115 CIPM
On 1-1/2" = 139 CIPM

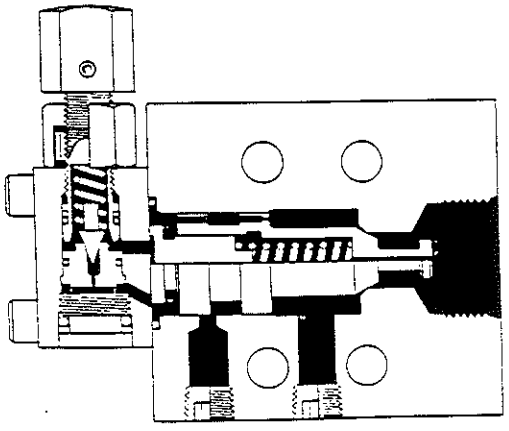
PICTORIAL

"Venting" is accomplished by opening the vent port to-tank through suitable external valving.

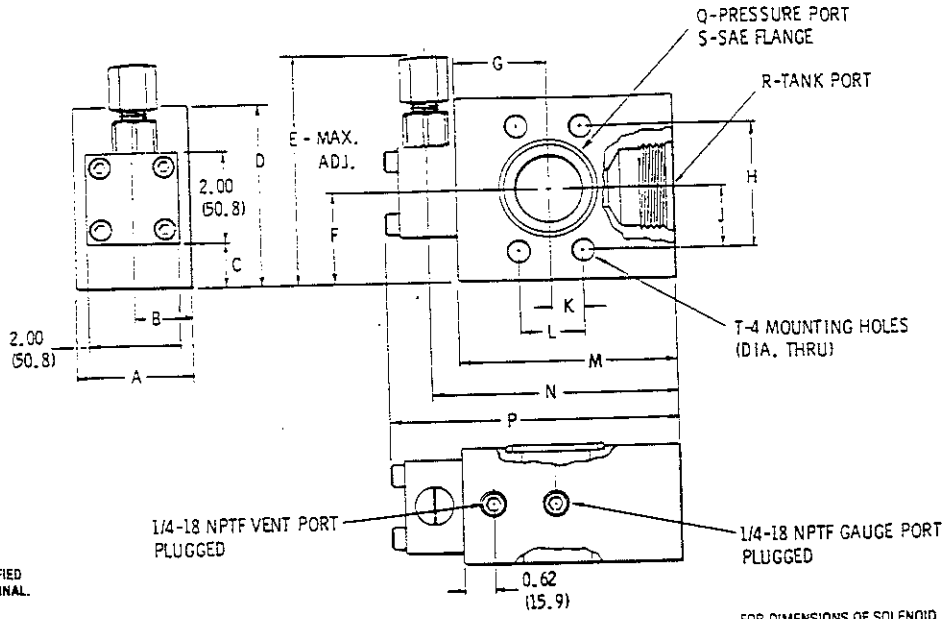
This valve can be remotely controlled. By connecting the inlet of another relief valve to the vent port of the 1-1/4" poppet relief valve* (through suitable external orficing for stability) the pressure setting at which the main poppet opens can be adjusted at the remote relief valve, provided it is set to a lower value than pilot poppet internal setting.

The tank connection should be piped directly to tank to minimize back pressure. Any pressure in the tank line is additive to the pressure setting.

*Recommended orifice size is .040" and available in a 1426-2-040 valve on Catalog page F40.



For Repair Parts See Bulletin 41.30-00



INCHES
(MILLIMETRES)

NOTE:
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE NOMINAL.

FOR DIMENSIONS OF SOLENOID CONTROLLED, MULTIPLE PRESSURE AND SOLENOID VENTING HEADS SEE BULLETIN NO. G-34.

VALVE SIZE	A	B	C	D	E *	F	G	H	J	K	L	M	N	P	Q-PRESS PORT	R-TANK PORT	S-SAE FLG.	T
3/4" (-54) 3000 PSI	2.06 (52.4)	1.06 (27.0)	0.75 (19.1)	3.50 (88.9)	4.62 (117.5)	1.75 (44.5)	1.81 (46.0)	1.875 (47.6)	0.94 (23.8)	0.44 (11.2)	0.875 (22.2)	3.88 (98.4)	4.50 (114.3)	5.44 (138.1)	1/8 C.S. x 1.00 I.D.	16 SAE	3/4"	0.41 (10.4
1" (-56) 3000 PSI	2.06 (52.4)	1.06 (27.0)	0.75 (19.1)	3.50 (88.9)	4.62 (117.5)	1.75 (44.5)	1.81 (46.0)	2.062 (57.37)	1.03 (26.1)	0.52 (13.2)	1.031 (26.1)	3.88 (98.4)	4.50 (114.3)	5.44 (138.1)	1/8 C.S. x 1.31 I.D.	16 SAE	1"	0.41 (10.4
1-1/4"(-58) 3000 PSI	2.06 (52.4)	1.06 (27.0)	0.75 (19.1)	3.50 (88.9)	4.62 (117.5)	1.75 (44.5)	1.81 (46.0)	2.312 (58.72)	1.16 (29.4)	0.59 (14.9)	1.188 (30.17)	3.88 (98.4)	4.50 (114.3)	5.44 (138.1)	1/8 C.S. x 1.50 I.D.	20 SAE	1-1/4"	0.47 (11.9)
1-1/2"(-60) 3000 PSI	2.50 (63.5)	1.25 (31.8)	1.00 (25.4)	4.00 (101.6)	4.88 (123.8)	2.00 (50.8)	2.00 (50.8)	2.75 (69.8)	1.38 (35.05)	0.70 (17.8)	1.406 (35.71)	4.75 (120.7)	5.38 (136.6)	6.31 (160.3)	1/8 C.S. x 1.88 I.D.	24 SAE	1-1/2"	0.53 (13.5)
3/4" (-55) 5000 PSI	2.06 (52.4)	1.06 (27.0)	0.75 (19.1)	3.50 (88.9)	4.62 (117.5)	1.75 (44.5)	1.81 (46.0)	2.00 (50.8)	1.00 (25.4)	0.47 (11.9)	0.937 (23.79)	3.88 (98.4)	4.50 (114.3)	5.44 (138.1)	1/8 C.S. x 1.00 I.D.	20 SAE	3/4"	0.41 (10.4)
1" (-57) 5000 PSI	2.06 (52.4)	1.06 (27.0)	0.75 (19.1)	3.50 (88.9)	4.62 (117.5)	1.75 (44.5)	1.81 (46.0)	2.25 (57.15)	1.12 (28.4)	0.55 (13.9)	1.093 (27.76)	3.88 (98.4)	4.50 (114.3)	5.44 (138.1)	1/8 C.S. x 1.31 I.D.	16 SAE	1"	0.47 (10.
1-1/4"(-59) 5000 PSI	2.50 (63.5)	1.25 (31.8)	1.00 (25.4)	4.00 (101.6)	4.88 (123.8)	2.00 (50.8)	2.00 (50.8)	2.675 (66.67) 2.625 ?	1.31 (33.2)	0.62 (15.7)	1.25 (31.7)	4.75 (120.7)	5.38 (136.6)	6.31 (160.3)	1/8 C.S. x 1.50 I.D.	24 SAE	1-1/4"	0.5 (13.

*LESS KNOB SUBTRACT .55"

various electrical control options.

HOW TO ORDER STANDARD VALVE ONLY

FE1-PREH-G59W

FE1-PB AE-G54W **

DESIGN DIGIT

ADJUSTMENT RANGE*

AE – 100 to 1500 PSI
(EH) – 1500 to 3000 PSI
EK – 1500 to 5000 PSI

FLANGE SIZE

Use the code below with adjustment range AE and EH. Has 3000 psi flange mounting pattern (Code 61).

54 – 3/4" SAE Flange
56 – 1" SAE Flange
58 – 1-1/4" SAE Flange
60 – 1-1/2" SAE Flange

Use the code below with adjustment range EK. Has 6000 psi flange mounting pattern (Code 62).

55 – 3/4" SAE Flange
57 – 1" SAE Flange
(59) – 1-1/4" SAE Flange
61 – 1-1/2" SAE Flange

VENT SPRING

(W) – 65 PSI VENT STD.
S – 25 PSI VENT – Flow is limited to 60 GPM maximum

NOTE: 65 PSI Vent recommended for all normal applications.

NOTE:

For pressure range AE and EH, the SAE 3000 psi flange mounting pattern (Code 61) is used.

For pressure range EK, the SAE 6000 psi flange mounting pattern (Code 62) is used. The 6000 psi rating is for the flange only.

*All springs are capable of 100 PSI min. setting.

MODEL NO.	ADAPTERS USED WITH VALVE SIZE
AD-75-3	3/4" - 3000 PSI FLANGE
AD-100-3	1" - 3000 PSI FLANGE
AD-125-3	1-1/4" - 3000 PSI FLANGE
AD-150-3	1-1/2" - 3000 PSI FLANGE
AD-75-6	3/4" - 6000 PSI FLANGE
AD-100-6	1" - 6000 PSI FLANGE
AD-125-6	1-1/4" - 6000 PSI FLANGE

Bolt Kits to mount the valve & Adapters must be ordered separately.

BOLT KITS FOR ADAPTERS	
BOLT KIT NO.	USED WITH
B-16	1-1/4" 3000 & 1" 6000 PSI FLANGED ADAPTER
B-53	3/4" & 1" 3000 PSI & 3/4" 6000 PSI FLANGED ADAPTER
B-73	1-1/2" 3000 PSI & 1-1/4" 6000 PSI FLANGED ADAPTER

BOLT KITS FOR

Flow thru Relief Valve	Tie Rod Length
3/4" B202 (953697)	3/8-16 × 4.22
1" B-202 (953697)	3/8-16 × 4.22
1-1/4" B-206 (953701)	7/16-14 × 4.38
1-1/2" B-208 (953703)	1/2-13 × 5.16

Combination Check and Relief Valve	(See Page D-34 for Check Valve)
3/4" B-201 (953696)	3/8-16 × 6.72
1" B-204 (953699)	3/8-16 × 7.16
1-1/4" B-207 (953702)	7/16-14 × 7.31
1-1/2" B-210 (953705)	1/2-13 × 9.16

Each bolt kit contains:

4 Tie rods
4 Nuts
4 Lock washers

The only additional hardware needed to mount these valves is a flange and an O-ring for the flange.

See How To Order section of G-34 for proper code using the various electrical control options.

Plateform Mounts

Heavy-Duty Plateform Mount Series

Specifications and Dimensions: Table 1.

Series Number	Part Number Unit weight 2.28 lb.		Max. Axial Rated Load		Axial Spring Rates		Dimensions Under No Load							
							G ❶		I		O ❶		U ❶	
	Square	Holder	lbs.	N	lb/in	N/mm	in	mm	in	mm	in	mm	in	mm
283	283P-120	283PH-120	120	534	480	84.1	.88	22.4	1.25	31.8	3.12	79.2	.50	12.7
	283P-155	283PH-155	155	689	620	108.6	.88	22.4	1.25	31.8	3.12	79.2	.50	12.7
	283P-185	283PH-185	185	823	740	129.6	1.12	28.4	1.50	38.1	3.38	85.9	.50	12.7
	283P-220	283PH-220	220	979	880	154.1	1.12	28.4	1.75	44.5	3.38	85.9	.50	12.7
	283P-250	283PH-250	250	1112	1000	175.1	1.38	35.1	2.00	50.8	3.62	91.9	.50	12.7
	283P-280	283PH-280	280	1245	1120	196.1	1.38	35.1	2.25	57.2	3.62	91.9	.50	12.7
	283P-310	283PH-310	310	1379	1240	217.2	1.62	41.1	2.50	63.5	3.88	98.6	.50	12.7
	283P-400	283PH-400	400	1779	1600	280.2	1.62	41.1	2.50	63.5	3.88	98.6	.50	12.7
	283P-500	283PH-500	500	2224	2000	350.3	1.62	41.1	2.50	63.5	3.88	98.6	.50	12.7
	283P-600	283PH-600	600	2669	2400	420.4	1.62	41.1	2.50	63.5	3.88	98.6	.50	12.7

Notes: Red figures are metric reference.
See page 122 for typical load deflection curve.

Materials: Metal parts are steel except holder which is ductile iron. Flexing elements are specially compounded natural rubber. Metal parts are coated with specially prepared rust preventative for protection during shipment or storage.

❶ Reference dimensions.

Tolerances: xx = ± .03 in (± .762mm)
xxx = ± .015 in (± .381mm)
Bolt holes are + .005 in (.127mm) and − .002 in (.050 mm)

Heavy-Duty Plateform Mount Series

Dimensions: Table 2.

Series Number	Dimensions Under No Load																									
	A ❶		B		C		D +.016" −.005"		E		F		J ❶		K		L ±.016"		M		P ❶		Q		T ❶		V_R ❶	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
283	2.88	73.1	3.25	82.6	2.562	65.1	.516	13.1	.328	8.3	.125	3.2	—	—	6.50	165.1	5.250	133.4	6.01/6.51	155.13	.22	5.6	3.62	91.9	2.75	69.9	2.25	57.2

Notes: Red figures are metric reference.
Customized designs and special elastomer compounds for specific problems are available. These may result in spring rates and dimensions other than shown.

Isolation Performance: See pages 14 and 15 for a step by step method to calculate system natural frequencies and isolation efficiency.
For loads under 120 lbs (534N) use a Standard Plateform Mount.

❶ Reference dimensions.

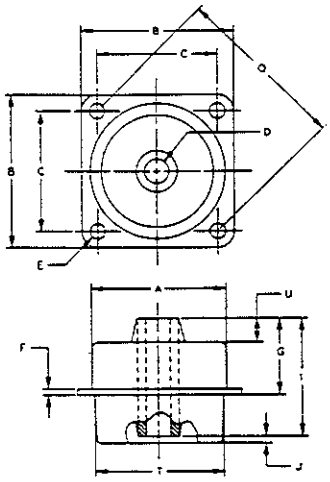
Lord Corporation
Industrial Products Div
1952 West Grandview Blvd
PO Box 10040
Erie, PA 16514-0040

Phone 814-868-5424 or 1800-458-0456
Fax 814-868-3109

Document PC-2201m
1/93-20M

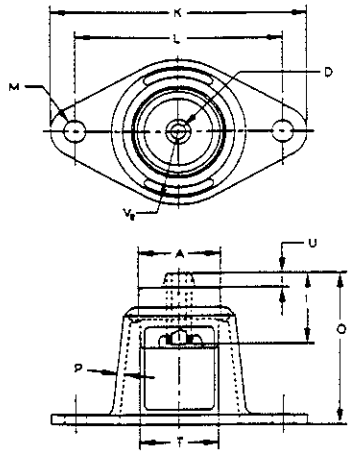
Part Dimension — Square

Figure 1



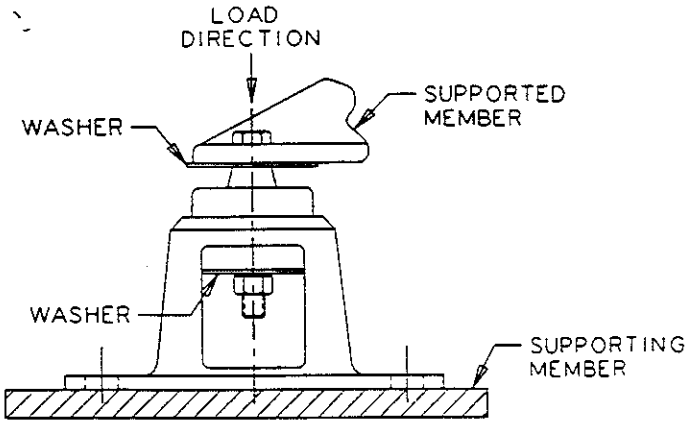
Part Dimension — Holder

Figure 2



Installation View

Figure 3



Heavy-Duty Plateform Mount Series

Snubbing Washer Part Numbers and Dimensions: Table 3.

Series	Washer	O.D.		I.D.		Thk.	
		in	mm	in	mm	in	mm
283	J-2049-4	2.88	73.2	.52	13.2	.125	3.2

Notes: Red figures are metric reference.

SELECTION AND SERVICE GUIDE FOR ELASTOMERS

Common or trade name	Natural rubber	Synthetic natural	Neoprene	Nitrite or Buna N	Silicone
Chemical type	**Natural polyisoprene**	**Isoprene**	**Chloroprene**	**Nitrile butadiene**	**Poly-siloxane**
ASTM D1418 Designation	NR	1R	CR	NBR	MQ, PMQ, VMQ, PVMQ
ASTM D2000/SAE J200 type, class	AA	AA	BC, BE	BF,BG BK, CH	FC, FE, GE
PHYSICAL					
[1]**Density** (gm/cm³)	0.93	0.93	1.24	1.00	1.1 - 1.6
Hardness range (Shore A)	30-100	40-80	40-95	20-90	25-80
Permeability to gases	C	C	B	B-A	D
Electrical resistivity	A	A	C	D-C	A
Odor	B-A	B	C-B	B	B
Taste	C-B	C-B	C-B	C-B	B
Nonstaining	A	A	B-A	C-B	A
Bondability	A	A	A	B-A	B-A
MECHANICAL					
[2]**Tensile strength** (max psi)	4,500	4,000	4,000	3,500	600-1,500
[3]**Abrasion resistance**	A	A	B-A	A	C-B
[4]**Flex resistance**	A	A	B	B	C-B
[5]**Tear resistance**	A	B	B	B	C-B
[6]**Impact resistance**	A	A	B	C	D-C
[7]**Deformation capacity**	A	A	A	B	A
[8]**Elasticity**	A	A	B	B	B-A
[9]**Resilience**	A	A	A	B	D-A
[10, 11]**Creep, stress relaxtion**	A	B	B	B	C-A
THERMAL					
Recommended max temp (°C)	70	70	100	100-125	200-225
[12]**Low-temp stiffening**	B	B	C	C	A
Heat-aging resistance	B-C	B-C	B-A	B	A
Flame resistance	D	D	B-A	D	A
RESISTANCE TO:					
Weather	C-B	C-B	B	C-B	A
Oxygen	B	B	A	B	A
Ozone	C-D	C-D	B	C-D	A
Radiation	B	B	B	B	C-B
Water	A	A	B	A	A
Steam	B	B	B	C-B	C-B
Alkali dil/conc	A/C-B	C-B/C-B	A/A	B/B	A/A
Acid dil/conc	A/C-B	C-B/C-B	A/A	B/B	B/C
[13]**Oil, gasoline, kerosene.**	NR	NR	C	A	D-C
Benzene, tuluol	NR	NR	D	B	NR
[13]**Animal, vegetable oils**	D-B	D-B	B	B	A
Oxygenated solvents	B	B	C	D	B-C
Halogentated solvents	NR	NR	D	C-B	NR
Alcohol	B-A	B	A	C-B	C-B
Synthetic lubes (diester)	NR	NR	D	B-A	NR
Hydraulic fluids					
Silicates	B-A	B-A	B	B	D
Phosphates	B	B	C	D	B

A = Excellent B = Good C = Fair D = Poor NR = Not Recommended

1. The higher the density, the more rubber is required to make a given part. For example, compare neoprene and natural rubber. Even at the same price per pound, neoprene would be more expensive to use.

2. While tensile strength per se is not necessarily important, retention of strength at elevated temperatures suggests retention of other mechanical properties as well.

3. Abrasion-resistance ratings apply to a wide range of temperatures as well as type of abrasion (such as rubbing and impingement).

4. A high resistance to crack-growth indicates good general durability - necessary where physical abuse is expected.

5. Tear resistance, along with crack-growth resistance is desirable where physical abuse is expected.

6. Rubbers that strain-crystallize at extreme deformations are much more durable in impact than those that don't. Low-temperature flexibility also helps improve impact performance.

7. A high deformation capacity usually indicates a high fatigue resistance to flexing.

8. The lower the permanent set, the better the structural integrity and the better the retention of initial dimensions.

9. The higher the resistance, the less the degradative heat buildup in a flexing or dynamic situation.

10. The better the resistance to creep, the longer the life of the part particularly where clearances are to be maintained.

11. Resistance to stress relaxation is essential in seals and other components under steady stress in service.

12. Good low-temperature flexibility is a must for most shock absorbers. The first jolt is critical, regardless of subsequent softness.

13. Resistance to oils and greases is essentially a surface effect; parts with poor resistance to these substances but that have appreciable bulk will not be degraded by such exposure.

Data, courtesy of Lord Corporation, Chemical Products Group, Erie, PA

STANDARD BORE AND KEYWAY COMBINATIONS

MODEL CODE	BORE/KEY CODE	BORE	KEY	100	200	300	400	500	600	700	800	900
M	01203	3/8	3/32	•	•							
M	01403	7/16	3/32	•	•							
M	01404	7/16	1/8	•	•							
M	01604	1/2	1/8	•	•	•						
M	01804	9/16	1/8	•	•	•						
M	02005	5/8	5/32	•	•	•						
M	02006	5/8	3/16	•	•	•	•					
M	02206	11/16	3/16	•	•	•	•					
M	02404	3/4	1/8	•	•	•						
M	02406	3/4	3/16	•	•	•	•	•	•			
M	02806	7/8	3/16	•	•	•	•	•	•			
M	02808	7/8	1/4	•	•	•	•	•	•			
M	03008	15/16	1/4		•	•						
M	10006	1	3/16	•	•	•	•	•	•			
M	10008	1	1/4	•	•	•	•	•	•			
M	10408	1-1/8	1/4	•	•	•	•	•	•			
M	10608	1-3/16	1/4			•		•				
M	10808	1-1/4	1/4		•	•	•	•	•			
M	10810	1-1/4	5/16		•	•	•	•	•	•	•	
M	11210	1-3/8	5/16		•	•	•	•	•	•	•	
M	11212	1-3/8	3/8			•						
M	11412	1-7/16	3/8			•	•	•				
M	11610	1-1/2	5/16				•	•	•			
M	11612	1-1/2	3/8			•	•	•	•	•	•	
M	12012	1-5/8	3/8			•	•	•	•	•	•	
M	12412	1-3/4	3/8				•	•	•	•	•	

MODEL CODE	BORE/KEY CODE	BORE	KEY	100	200	300	400	500	600	700	800	900
M	12414	1-3/4	7/16				•	•	•	•	•	
M	12816	1-7/8	1/2				•	•	•	•	•	•
M	13016	1-15/16	1/2					•	•			
M	20016	2	1/2					•	•	•	•	•
M	20416	2-1/8	1/2					•	•	•	•	•
M	20816	2-1/4	1/2					•	•	•	•	•
M	21220	2-3/8	5/8					•	•	•	•	•
M	21620	2-1/2	5/8						•	•	•	•
M	22020	2-5/8	5/8						•	•	•	•
M	22420	2-3/4	5/8							•	•	•
M	22824	2-7/8	3/4							•	•	•
M	30024	3	3/4								•	•
M	30824	3-1/4	3/4								•	•
M	31228	3-3/8	7/8								•	•
M	31628	3-1/2	7/8								•	•
M	32028	3-5/8	7/8								•	•
M	32428	3-3/4	7/8								•	•
M	32832	3-7/8	1								•	•
M	40032	4	1									•
M	40432	4-1/8	1									•
M	40832	4-1/4	1									•
M	41232	4-3/8	1									•
M	41632	4-1/2	1									•
M	41640	4-1/2	1-1/4									•
M	42040	4-5/8	1-1/4									•
M	42440	4-3/4	1-1/4									•

Shaded Area: AGMA semi-standard bore key combinations.

Part Number Useage: Magnaloy Coupling Hub part numbers may be specified using the following format: Start with letter "M" designating Magnaloy, followed by 3 digit Model Code (100, 200, etc.), then the specific 5 digit Bore Key Code.

Example: Model 500 hub with a 1 3/8 bore and 5/16 keyway would be specified as: M50011210 - No bore hubs are designated as 'R' code, ie: M500R.

BORE TOLERANCES

OVER	INCLUD.	TOLERANCE
—	1	+.0008/+.0003
1	2	+.0013/+.0005
2	3	+.0018/+.0008
3	4	+.0020/+.0010
4	5	+.0023/+.0010

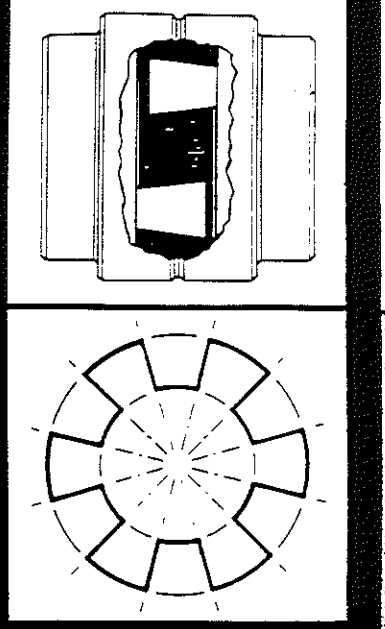
ADDITIONAL COUPLING SPECIFICATIONS

MODEL NUMBER	100	200	300	400	500	600	700	800	900
Maximum Bore	1-1/8	1-3/8	1-5/8	1-7/8	2-3/8	2-5/8	2-7/8	3-7/8	4-3/4
Complete Coupling Apprx. Wght. (Solid Hub)	3/4	1	2	3	4	7	12	18	38
Number of Drive Lugs	3	3	3	3	4	6	6	6	6
Hub Movement for Insert Removal	.74	.74	.75	.98	1.12	1.02	1.50	1.63	2.27
Basic Insert Number	170	270	370	470	570	670	770	870	970

Magnaloy
PO Box 0455
Alpena MI 49707

Tel 517-356-2487
Fax 517-354-4190
Catalog 8511 MPS 9408-12M

"Load-Lock" Design is simple and effective. The drive-lug configuration is tapered from top to base, as are the mating lugs of the opposing coupling hub. Under load, the insert conforms to the tapers, inter-locking the two hubs. This load-lock design protects bearings and equipment by eliminating end thrust in both directions... and it requires only one set-screw in each hub.

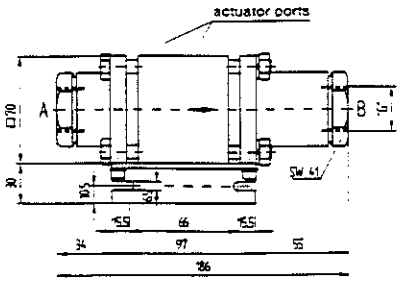


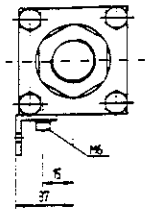
Radial [illegible]

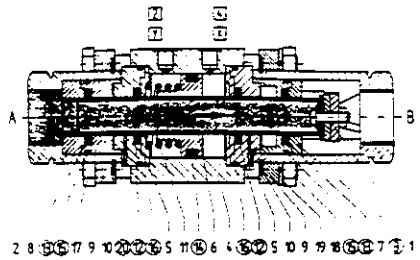
Model Size	Max Bore	Wr^2 lb-ft²	Insert Number	Rated Torque lb-in	Torsional Rigidity lb-in/Deg	Horse Power Rating@ 100 rpm	1200 rpm	1800 rpm
100	1-1/8	.0046	170N	340.7	42	.55	6.5	9.8
			170U	511.0	53	.82	9.8	14.7
			170H	1,022.1	182	1.65	19.8	29.7
200	1-3/8	.0068	270N	398.3	55	.64	7.6	11.5
			270U	597.4	68	.96	11.5	17.2
			270H	1,194.9	234	1.92	23.0	34.5
300	1-5/8	.022	370N	701.4	81	1.12	13.5	20.2
			370U	1,052.1	148	1.68	20.2	30.3
			370H	2,104.2	336	3.36	40.4	60.6
400	1-7/8	.031	470N	1,056.3	138	1.69	20.3	30.4
			470U	1,584.5	310	2.5	30.4	45.6
			470H	3,168.9	488	5.1	60.8	91.3
500	2-3/8	.071	570N	2,194.8	314	3.5	42.1	63.2
			570U	3,292.2	695	5.3	63.2	94.8
			570H	6,584.4	1,571	10.5	126.4	189.6
600	2-5/8	.16	670N	4,946.7	676	7.9	94.9	142.5
			670U	7,420.1	1,510	11.9	142.5	213.7
			670H	14,840.1	2,960	23.7	284.9	427.4
700	2-7/8	.34	770N	11,639.8	1,805	18.6	223.5	335.2
			770U	17,459.7	2,104	27.9	335.2	502.8
			770H	29,099.5		46.5	558.75	838.0
800	3-7/8	.95	870N	21,889.4	3,680	35.0	420.3	630.4
			870U	32,834.1		52.5	630.4	945.6
900	4-3/4	4.20	970N	47,842.3	8,428	76.5	918.6	1,377.9
			970U	71,763.5		114.8	1,377.9	2,066.8

type **VMK 15** 3.K 04.101

function: **NC**
closed when not actuated







SEE SCALED-UP COPY

when ordering spare parts, please provide fabrication number as shown on the valve data plate

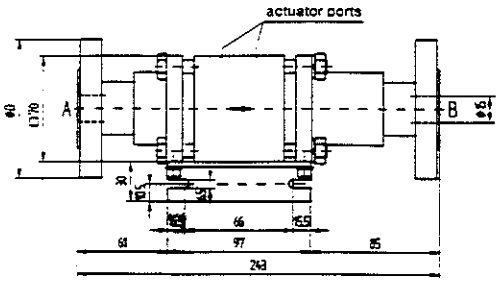
○ items circled are included in spare parts kit

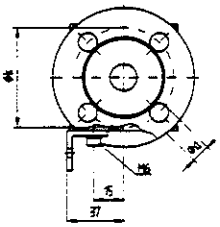
flanges PN	acc. DIN	⌀D	⌀k	⌀d
16	2633	95	65	14
40	2635	95	65	14
100	2637	105	75	14

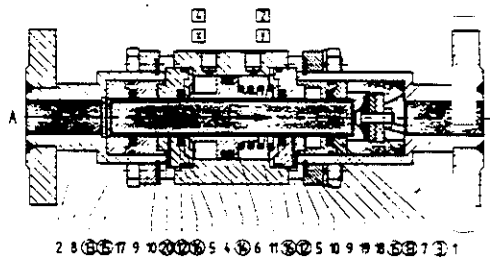
1 connecting port
2 connecting port
(3) valve seat unit
4 valve body
5 gland
6 piston-control tube
7 disc
8 disc
9 retaining ring
10 locking ring
11 return spring
(12) seal (dynamic)
(13) seal (dynamic)
(14) piston seal
(15) o-ring
(16) o-ring
17 hex head bolt
18 hex nut
19 lock washer
(20) gasket

type **VFK 15** 3.K 04.102

function: **NO**
open when not actuated







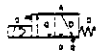
pneumatic actuation


5/2-way-pilot valve
flow rate 700 l/min
pressure range 4–10 bar G1/8"


5/2-way-pilot valve (impulse control)
flow rate 700 l/min
pressure range 4–10 bar G1/8"


5/2-way-pilot valve ISO 1
flow rate 700 l/min
pressure range 4–10 bar G1/8"


5/2-way-pilot valve (impulse control ISO 1)
flow rate 700 l/min
pressure range 4–10 bar G1/8"

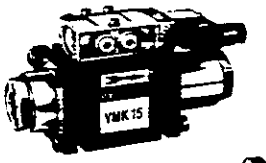

3/2-way-pilot valve main valve monostable
pressure range 4–10 bar with spring return

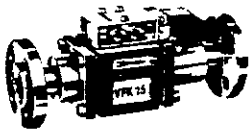
the application-specific layout relating to temperature, pressure conditions, switching behavior, and media (and its consistency) may necessitate relevant modifications to materials used and seal arrangements

co-axial valve

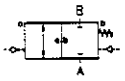
5-VMK 15
5-VFK 15
valve type with pilot valve

type VMK 15 VFK 15

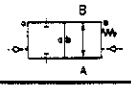




2/2 way valve	**externally controlled**
pressure range	PN 0-100 bar
orifice	DN 15 mm
connection	thread/flange
function	valve normally closed symbol **NC**



valve normally open symbol **NO**



design	pressure balanced, with spring return
body materials	① brass (Ms 58) ② steel, galvanized ③ brass, nickel plated ⑤ without non-ferr. metals ④ steel, nickel plated ⑥ s. s. (316)
valve seat	synthetic resin on metal
seal materials	buna; teflon, viton, neoprene, EPDM

details needed for main valve:
- orifice
- port
- function NC/NO
- operating pressure
- flow rate
- media
- media temperature
- ambient temperature
- type of actuation

details needed for pneumatic actuation:
- nominal voltage
- type of protection
- actuation pressure range min/max
- low wattage coil, actuation p.-range 4-7 bar
- pilot valve type

details needed for hydraulic actuation:
- actuation pressure range min/max
- hydraulic control valve function

general specifications

			options
ports	VMK	threads G 3/8"-G 1"	special threads
	VFK	flanges PN 16/40/100	special flanges
function		NC	NO
pressure range	bar	0-16/0-40/0-64/0-100	>100 bar
flow rate	m^3/h	5.7	
vacuum	leak rate		$<10^{-6}$ mbar/l/s^{-1}
pressure-vacuum	$P_1 \longleftrightarrow P_2$		pressure side max. 100 bar; vacuum side leak rate $<10^{-6}$ mbar/l/s^{-1}
back pressure	$P_2 > P_1$		available (max. 16 bar)
media		gaseous – liquid – highly viscous – gelatinous – pasty – contaminated	
abrasive media			version available
damping	opening / closing	by throttles on pilot valve	
flow direction	A⇔B	as marked	bi-directional upon request
switching cycles	1/min	200	
switching time	ms	opening 50-1000 closing 50-1000	
media temperature	°C	direct mounted pilot valve 60	remote mounted pilot valve outside temperature range of media max. 180 °C
ambient temperature	°C	direct mounted pilot valve 50	
flush ports			available
leak ports			available
limit switches			inductive/mechanical upon request
manual override		via pilot valve	
approvals			LR/GL/WAZ
mounting			mounting bracket/mounting holes
weight	kg	VMK 3.4 VFK 5.0	
additional equipment			upon request

electrical specifications

			options
nominal voltage	U_n	24 V – DC	special voltages upon request
	U_n	230 V 50 Hz – AC	special voltages upon request
power consumption	DC	4.8 watt	2.5 watt
	AC	pick up 11.0 VA holding 8.5 VA	
protection	IP 65 (P 54)	acc. DIN 40 050	
energized duty rating	ED	100 %	
connection	Pg 9	appliance plug socket acc. DIN 43 650, 2 positions × 180°	
additional equipment		illuminated plug, with varistor	
coil		4 positions × 90°	
max. temperatures	media	60 °C	
	ambient	50 °C	
explosion proof		nominal voltage U_n	direct current 24 V DC 3.25 watt; alternating curr. 230 V 50 Hz 2.9 watt
	EEx m II T5	power consumption	

pneumatic specifications

			options
actuation pressure range	bar	4-10	
air consumption	cm^3/stroke	11	
cycle speed		main valve speed variable by throttles on pilot valve	
control		preferably by 5/2-way-pilot valve	
actuator ports	2/4	G 1/8"	G 1/4"

hydraulic specifications

			options
actuation pressure range	bar	10-30/30-60	
by media			upon request
control		preferably by 4/2-way-control valve	
actuator ports	X/Y	G 1/4"	NPT 1/4"

mytech
springer co-ax, Inc.
10 NOELAND AVENUE
PENNDEL, PA 19047-5230
E-MAIL: springer@coaxvalves.com
TEL (800) 757-3725
FAX (888) 757-4060
coax
R.J. SEMOLA

■ specifications not highlighted are standard
specifications highlighted in grey are optional

springer co-ax. inc.

22 April 98

L & F Industries
2110 Belgrave Avenue
Huntington Park, CA 90255
Tel: 213 588 2231
Fax: 213 585 7291
Attn: **Noel Moyer**

QUOTE 4968 KO

Re: **CO-AX™ valve & spare parts**

Hello Noel !
Per our conversation, below is a list of recommended spare parts for the CO-AX™ valves that you have purchased. In addition to the spare parts, we would also suggest to have a complete valve on hand. I have mentioned the Bosch Pilot valve as separate items and not as an assembly.

1) Model **VMK152C1100VTS8B3AXB** 2/2 way CO-AX™ valve
   - 15 mm orifice
   - Normally closed / fail closed
   - Brass construction
   - 0 → 100 bar working pressure (0 → 1500 psi)
   - Viton seals, Teflon seat
   - SAE - 8 port connections (3/4-16)
   - Bosch pilot valve, DIN plug with cable gland
   - 110v AC, 100% ED, IP 65
   - mounting bracket
2) Model **SKVMK152C1100VT** seal kit
   - repair seal kit for the VMK 15 series noted above
3) Model **CTVMK152C1100VT** Piston control tube
   - piston control tube for VMK 15 series noted above
4) Model **0-820-022-997** Bosch direct mounted pilot valve (without coil and speed control mufflers)
5) Model **1-824-201-237** Bosch 110v AC coil for Bosch pilot valve noted in item # 4
6) Model **1-821-201-109** Bosch speed control throttles (mufflers)

Basically, the **Filter, Regulator, Lubricator and Manual shut off valve** are standard items that can be purchased locally if necessary.

Please **reference** the above noted **quote number** with any correspondence. Should you have any further questions, feel free to give us a call. I will send you a hard copy of this information.

Regards, R J Semola R.J.

m-tech
springer co-ax. inc.
P.O. Box 7204 / Penndel, Pennsylvania 19047-7204
10 Noeland Avenue / Penndel, Pennsylvania 19047-5290
Tel (800) 757-3725
Fax (888) 757-4060
Email springer@coaxvalves.com

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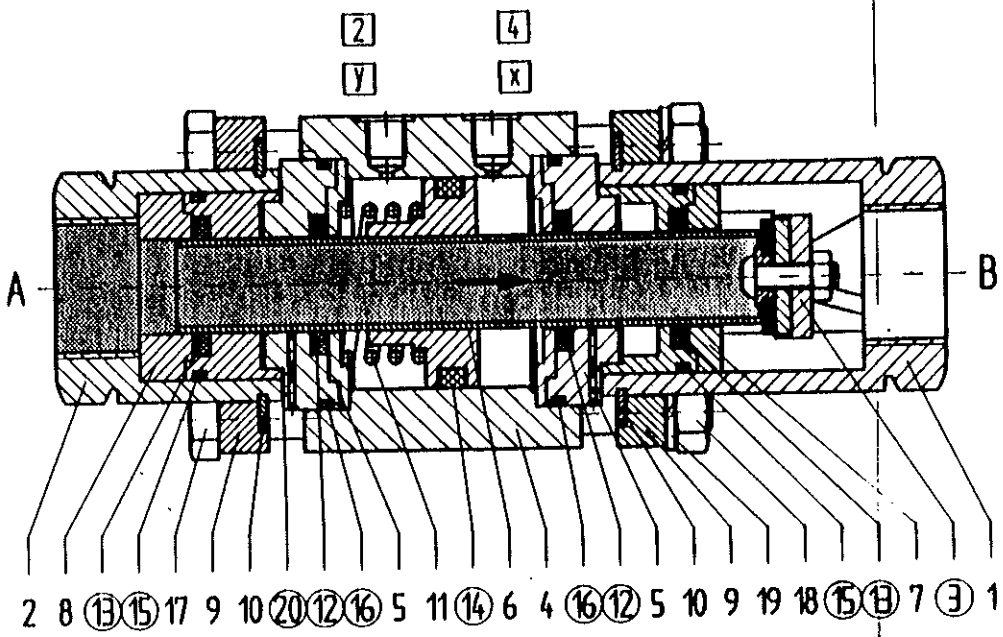
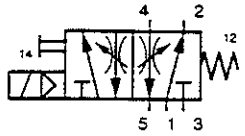
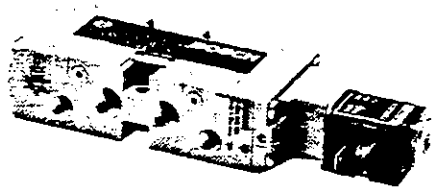


1 connecting port
2 connecting port
(3) valve seat unit
4 valve body

5/2 directional control valve $G^1/_8$ electrically controlled
Pipe and flange connection (2+4)



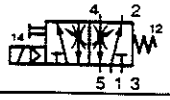


Pipe and flange connection

Characteristics		
General		
Valve type		Spool valve, elastic seal
Mounting		3 plain holes in housing
Connection		$G^1/_8$ with working line 1, 3, 5 Flange with working line 2, 4 M 5 with pilot line 12, 14
Mounting position		Optional
Ambient temperature	$\vartheta_{U\ max.}$	50 °C
Agent temperature	$\vartheta_{M\ max.}$	60 °C
Pneumatic		
Min. working pressure	p_e	2.5 bar
Nominal pressure	p_e	10 bar
Nominal flow	q_v	700 l/min
Electrical		
Power consumption (solenoid)	P_{20}	with AC
		Pick-up power 11 VA
		Holding power 8.5 VA
		with DC 4.8 W
Cyclic duration factor	ED	100 %
Degree of protection as per DIN 40 050		IP 65
Connection		By socket connector Pg 9 Form B (DIN 43 650)

For details regarding conditioning of air, see Section 10

Design
- Suitable for oil-free operation
- With external pilot control, also suitable for vacuum operation
- Housing: glass-fibre reinforced plastic (polyamide)
- Spool operates without overlap
- Valve with elastic sealing (Buna N)
- Change-over valve with spring-actuated return
- Valve with exhaust-air restrictions
- Manual override and exhaust-air restrictions accessible from one side
- Solenoid coil can be turned through 4 x 90°
- Socket connector Form B (DIN 43 650) can be turned through 2 x 180°

Designation	Symbol	kg	Nominal voltage U_n	⊖
5/2 directional control valve $G^1/_8$ electrically controlled, pipe and flange connection		0.260	without solenoid [1]	0 820 022 997

1) Assembly without solenoid cannot be combined with coil of low power rating

Wear-parts kit	1 827 009 388

springer co-ax, inc.

14 April 98

L & F Industries
Tel: 213 588 2231
Fax: 213 585 7291

Attn: **Noel Moyer**

Re: **CO-AX™ valves**

Hello Noel !
Per our conversation, below is the information on the Bosch pilot valve that is installed on the CO-AX™ valves that you have received. Please note that I have given you separate part numbers for all of the components of the pilot valve.

1) Model 0-820-022-997 Bosch direct mount pilot valve (without coil and speed control mufflers)

2) Model 1-824-210-237 Bosch 110v AC coil for Bosch pilot valve noted above

3) Model 1-821-201-109 Bosch speed control throttles (mufflers)

Should you have any further questions or need additional details, feel free to give us a call.

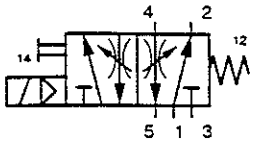
Regards,

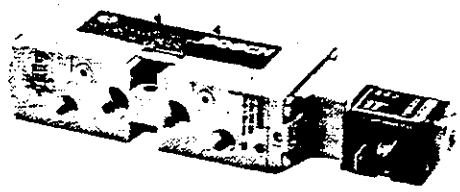
RJ.

R J Semola

m-tech
springer co-ax, inc.
P.O. Box 7204 / Penndel, Pennsylvania 19047-7204
10 Noeland Avenue / Penndel, Pennsylvania 19047-5290
Tel (800) 757-3725
Fax (888) 757-4060
Email springer@coaxvalves.com

5/2 directional control valve $G^1/_8$ electrically controlled
Pipe and flange connection (2+4)



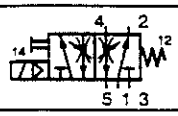


Pipe and flange connection

Characteristics		
General		
Valve type		Spool valve, elastic seal
Mounting		3 plain holes in housing
Connection		$G^1/_8$ with working line 1, 3, 5 Flange with working line 2, 4 M 5 with pilot line 12, 14
Mounting position		Optional
Ambient temperature	$\vartheta_{U\ max.}$	50 °C
Agent temperature	$\vartheta_{M\ max.}$	60 °C
Pneumatic		
Min. working pressure	p_e	2.5 bar
Nominal pressure	p_e	10 bar
Nominal flow	q_v	700 l/min
Electrical		
Power consumption (solenoid)	P_{20}	with AC
		Pick-up power 11 VA
		Holding power 8.5 VA
		with DC 4.8 W
Cyclic duration factor	ED	100 %
Degree of protection as per DIN 40 050		IP 65
Connection		By socket connector Pg 9 Form B (DIN 43 650)

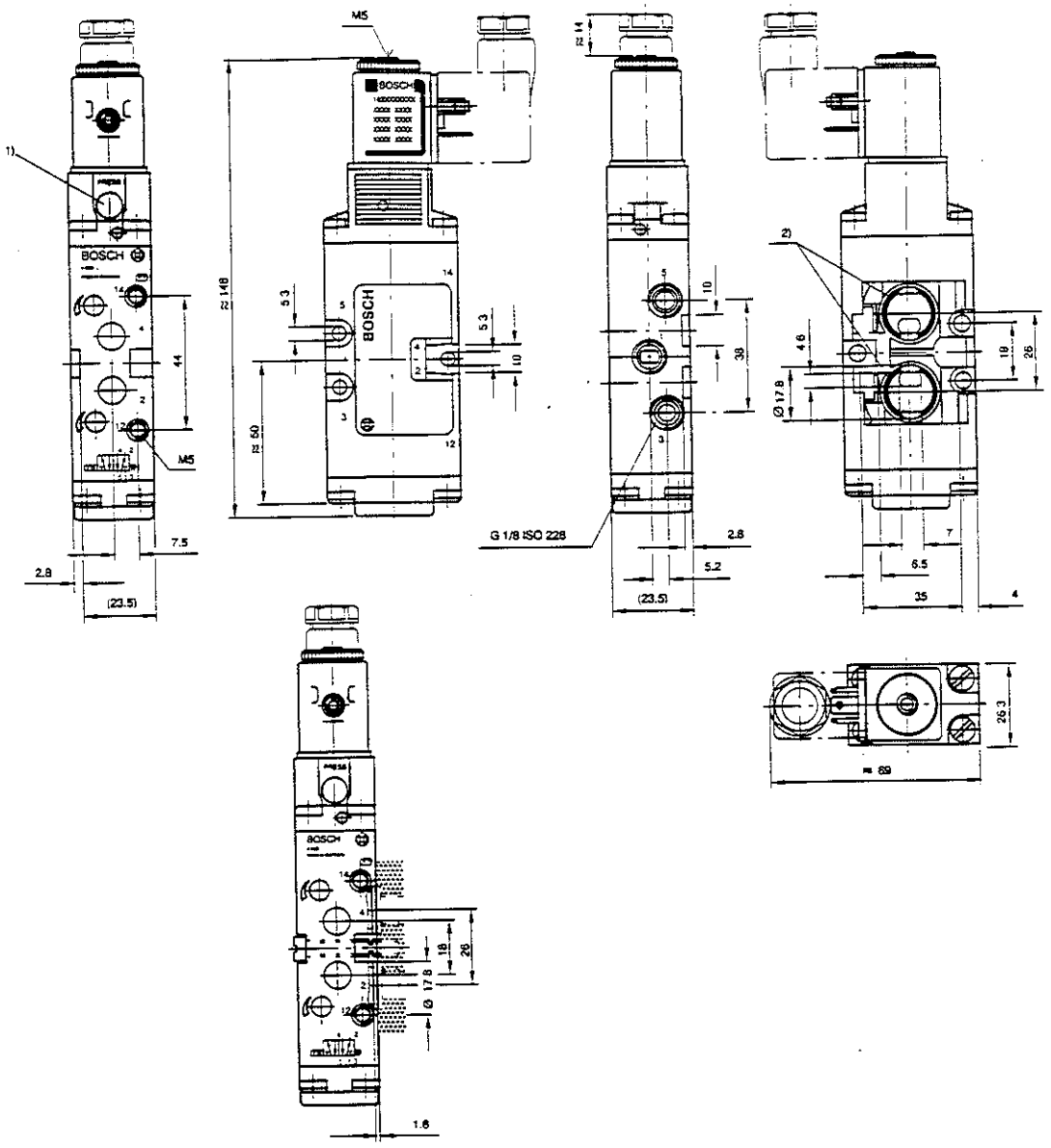
For details regarding conditioning of air, see Section 10

Design
- Suitable for oil-free operation
- With external pilot control, also suitable for vacuum operation
- Housing: glass-fibre reinforced plastic (polyamide)
- Spool operates without overlap
- Valve with elastic sealing (Buna N)
- Change-over valve with spring-actuated return
- Valve with exhaust-air restrictions
- Manual override and exhaust-air restrictions accessible from one side
- Solenoid coil can be turned through 4 x 90°
- Socket connector Form B (DIN 43 650) can be turned through 2 x 180°

Designation	Symbol	kg	Nominal voltage U_n	
5/2 directional control valve $G^1/_8$ electrically controlled, pipe and flange connection		0.260	without solenoid [1]	0 820 022 997

[1] Assembly without solenoid cannot be combined with coil of low power rating

Wear-parts kit	1 827 009 388



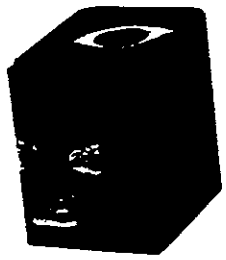
1) Manual override
2) Counter sinking for O ring dia. 14 x 2
(O rings are mounted)

Accessories (order separately)

Designation		⊖
Solenoid coils	230 V 50 Hz	1 824 210 235
	24 V ⎓	1 824 210 243
	24 V 50 Hz	1 824 210 239
	110 V 50 Hz	1 824 210 237
Socket connector Pg 9 Form B (DIN 43 650) black		1 834 484 096
Socket connector with LED Pg 9, Form B (DIN 43 650)	24 V ≡	1 834 484 104
	110–120 V ~	1 834 484 105
	230 V ~	1 834 484 106
Socket connector with cable, Form B, DIN 43 650		1 834 484 148 ... 159

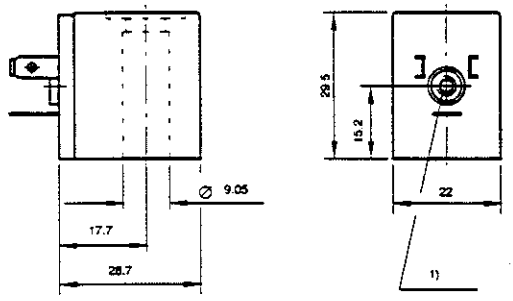
Solenoid with plug connection Form B (DIN 43 650)

For directional control valves
0 820 019 3 ..
0 820 019 6 ..
0 820 022 ...
0 820 023 ...
0 820 034 ...
0 820 035 ...



Characteristics			
Electrical			
Nominal voltage	U_n	See table	
DC power input	P_{20}	4.8 W	2.5 W [1]
AC power input	P_{20}	Pull-in power 11.0 VA Holding power 8.5 VA	
Cyclic duration factor	ED	100%	
Insulation class as per VDE 0580		F	
Degree of protection as per DIN 40 050		IP 65	

Design
- Easy to replace
- In some cases can be used for different voltages
- For socket connector Pg 9, Form B (DIN 43 650)



1) M 3 4.5 mm deep

Nominal voltage U_n (±10%)	Usable with voltages	kg	⊖
240 V 50 Hz	240 V 60 Hz	0.050	1 824 210 234
230 V 50 Hz	230 V 60 Hz 110 V =		1 824 210 235
110 V 50 Hz	110 V 60 Hz 115 V 60 Hz 60 V =		1 824 210 237
42 V 50 Hz	42 V 60 Hz		1 824 210 238
24 V 50 Hz	24 V 60 Hz 12 V =		1 824 210 239
48 V =			1 824 210 241
36 V =			1 824 210 242
24 V =	48 V 50 Hz 48 V 60 Hz		1 824 210 243
24 V = [1]			1 824 210 245

1) Low power input

Compact Controls, Inc.
Hydraulic Cartridges

CP230-1

PRESSURE REDUCING VALVE
(Direct Acting Spool Type)

CARTRIDGES

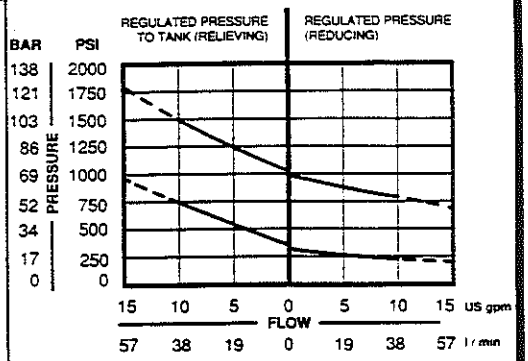
SERIES 10

SPECIFICATIONS

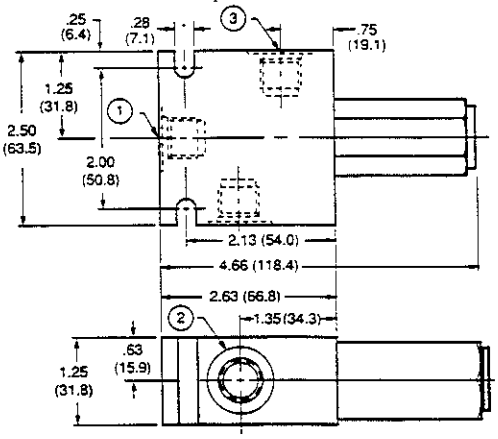
- This cartridge is a direct acting, spool type pressure reducing / relieving valve with internal pilot.
- This valve allows bi-directional flow from (1) to (2) up to the regulated setting. If pressure at (1) exceeds the pressure setting then pressure at (2) is metered off to maintain the regulated setting. If pressure at (1) exceeds the setting then (2) is blocked and (1) is relieved to (3). The valve then performs as a direct acting spool type relief. (3) is vented to tank.
- Valve cartridge is **all** steel construction with precision ground, hardened spool and selectively honed, hardened sleeve to assure low leakage and extended service life.
- Hi-strength aluminum alloy body allows for maximum circuit design flexibility.
- Buna-N seals are standard. Viton is optional (consult factory for other seal compounds).
- Valve rated to 3000 psi (207 bar) working pressure.
- Valve is adjustable to 2400 psi (166 bar).
- Rated flow is 10.0 gpm (37.85 l/m).
- Valve is designed for use with general purpose hydraulic fluids (MIL-H-5606, SAE #10, etc.).
- Cartridge weight .51 lbs (.23 kg).
- Valve cartridge fits Compact Controls Cavity CP10-3.

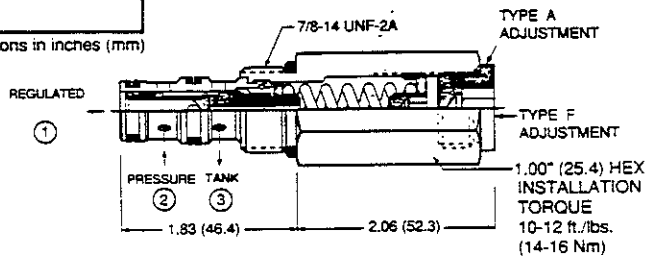
TYPICAL PERFORMANCE

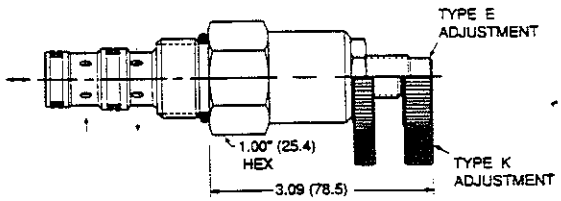
154 SUS (33 cSt) HYD. OIL @ 100° F (38° C)



All dimensions in inches (mm)







ORDERING INFORMATION

CP230 – 1 – B – 0 – A – C – 150

BASIC CARTRIDGE

SEALS

		SEAL KIT
B-BUNA-N	(Std.)	120027
V-VITON	(Opt.)	120028

PORTS

	BODY P/N NO BODY
0 - CARTRIDGE	
3P - 3/8 NPTF	220203
4P - 1/2 NPTF	220204
6S - #6 SAE	220205
8S - #8 SAE	220206
3B - 3/8 BSP	221297
4B - 1/2 BSP	221267

ADJUSTMENT OPTION

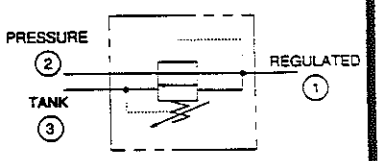
A - INTERNAL ADJUSTMENT
E - EXTERNAL ADJUSTMENT
F - TAMPER RESISTANT
K - KNOB ADJUSTMENT
P - PANEL MOUNT

PRESSURE RANGE

	PSI	BAR
A	50 - 400	(4 - 28)
B	75 - 800	(5 - 55)
C	100 -1400	(7 - 97)
D	500 -2400	(34 - 166)

REGULATED PRESSURE

PSI	BAR
050 = 500	(34)
150 =1500	(103)



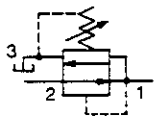
Pressure reducing valves, with or without reverse relief function

E330050-19, E330049-18, E330048-19, E330047-17, E330046-4, E330045-17, E330044-20

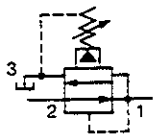
PRV1/2/4-10

Functional symbols

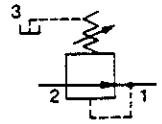
PRV1



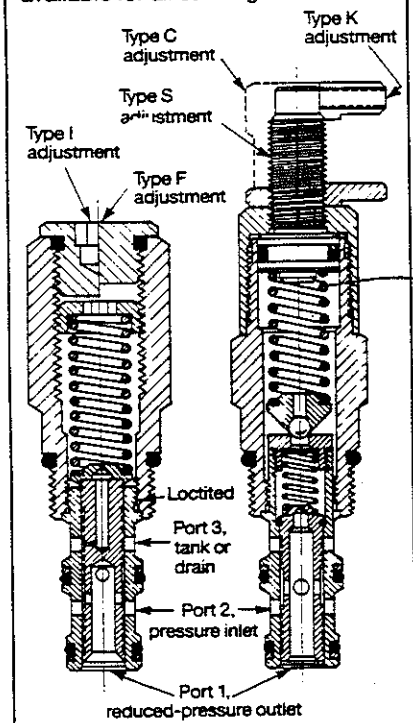
PRV2



PRV4



Typical sections
Adjustment options shown available for all cartridges



PRV1 PRV2
Similar construction for PRV4

Model and ordering code

PRV * -10(V)- * --**/****
1 2 3 4 5 6

1 Type
1, 2 or 4. See "Functional symbols".

2 Fluid compatibility
Blank = Antiwear hydraulic oil
V = As above or with phosphate-ester (not alkyl type)

3 Reduced-pressure adjustment
C = Cap
F = Factory-set
I = Internal
K = Knob
S = Screw

4 Form
0 = Cartridge only

In light-duty housing;
207 bar (3000 psi) max.
6T = With SAE 6 size ports

In NFPA fatigue-rated housing;
207 bar (3000 psi) max.
6H = With SAE 6 size ports
8H = With SAE 8 size ports
2G = With G¼" (BSPF) size ports
3G = With G⅜" (BSPF) size ports

5 Reduced-pressure adjustment range, bar (psi)
At zero flow
PRV1 models
2 = 3,5-13,7 (50-200)
6 = 6,9-41,3 (100-600)
12 = 13,8-82,7 (200-1200)
24 = 27,6-165 (400-2400)

PRV2 models
3 = 3,5-20,7 (50-300)
20 = 6,9-138 (100-2000)
For higher pressure models, consult your local sales engineer.

PRV4 models
2 = 3,5-13,7 (50-200)
4 = 5,2-27,5 (75-400)
06 = 6,9-41,3 (100-600)
12 = 13,8-82,7 (200-1200)
24 = 27,6-165 (400-2400)

6 Factory-set reduced-pressure
Within ranges in 5 above
Blank = Normal factory setting, at approx. mid-range.
User-requested settings in 3,45 bar (50 psi) steps, coded as in following examples:
10 = 68,9 bar (1000 psi)
10.5 = 72,4 bar (1050 psi)
Insert required code when ordering.

Operating data
Performance data is typical with fluid at 28 cSt (132 SUS) and 38°C (100°F)

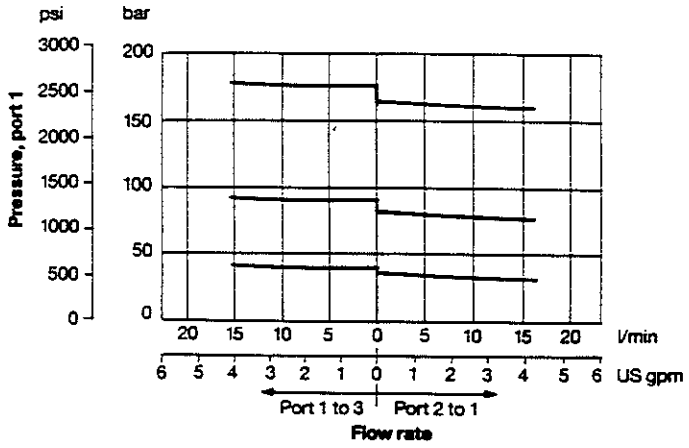
Max. pressure, all ports, cartridge only:	
PRV1 and PRV4	207 bar (3000 psi)
PRV2	207 bar (3000 psi). For higher pressure models, consult your local sales engineer
Rated flow:	
PRV1 and PRV4	15 l/min (4 US gpm)
PRV2	45 l/min (12 US gpm)
Reduced-pressure adjustment range	See "Model code" items 5 and 6 above
Reduced-pressure characteristics	See graphs on next page
Hydraulic fluids, temperature ranges and filtration recommendations	See 2 in "Model code" and also page 259
Installation dimensions, cartridge only	See two pages on
Cavity size	C-10-3. For dimensions see page 240
Mass, cartridge only	0,24 kg (0.54 lb) approx.

Continued on next page

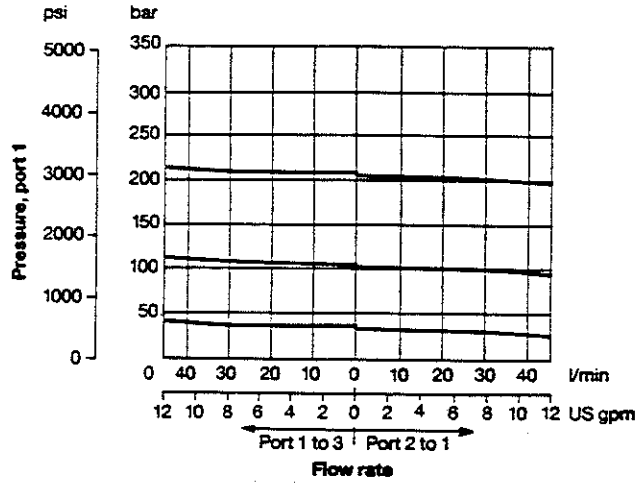
Housing options:	
Standard light-duty type	See page 250
Standard fatigue-rated type	See page 246
Customized types	Consult your local sales engineer
Spare parts	See next page

Reduced-pressure characteristics
Cartridges only

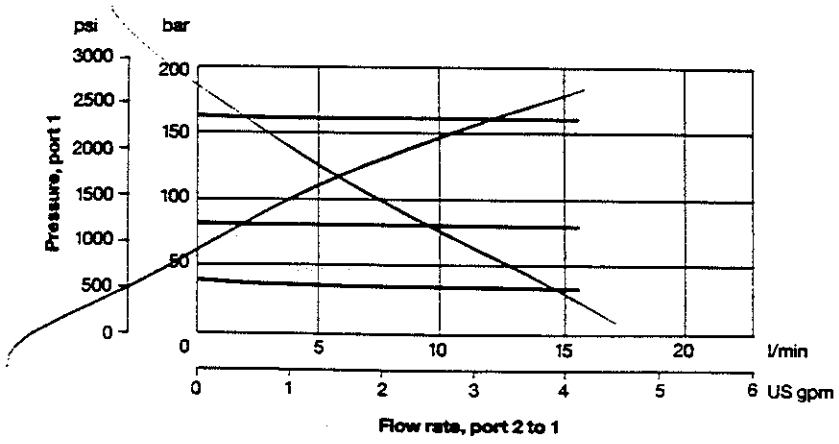
PRV1



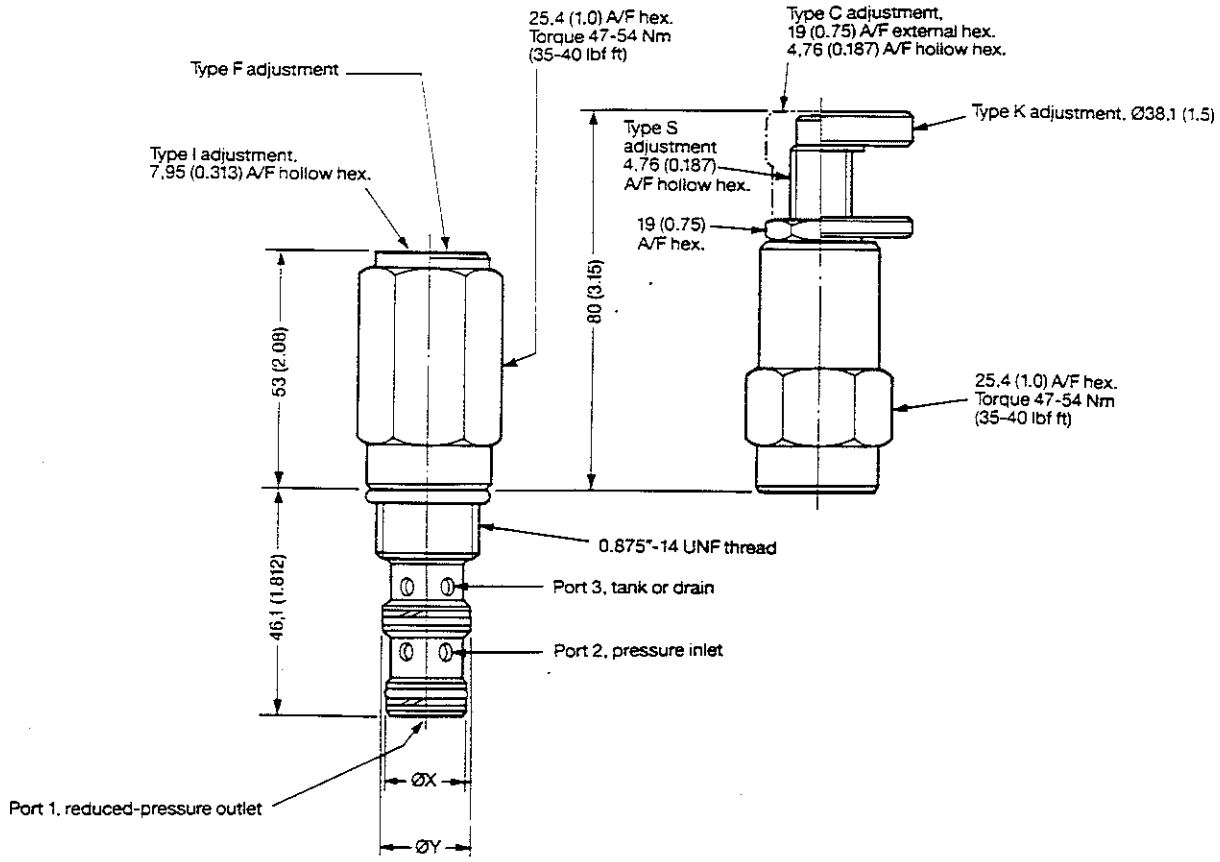
PRV2



PRV4



Installation dimensions in mm (inches)



Model	ØX	ØY
PRV1 & PRV2	15,80 (0.622) 15,75 (0.620)	17,40 (0.685) 17,35 (0.683)
PRV4	15,82 (0.623) 15,80 (0.622)	17,42 (0.686) 17,40 (0.685)

Adjustment options shown available for all cartridges

Spare parts

The only parts available are seal kits comprising external seals and back-up rings for:	Kit no.
PRV*-10-*	SK-10-3
PRV*-10V-*	SK-10V-3

Compact Controls, Inc.
Hydraulic Cartridges

E330050-15, E330049-15,
E330048-16, E330047-14,
E330046-16, E330045-14, E330044-16

CP300-2
FLOW REGULATOR VALVE
(Adjustable Restrictive Type)

CARTRIDGES

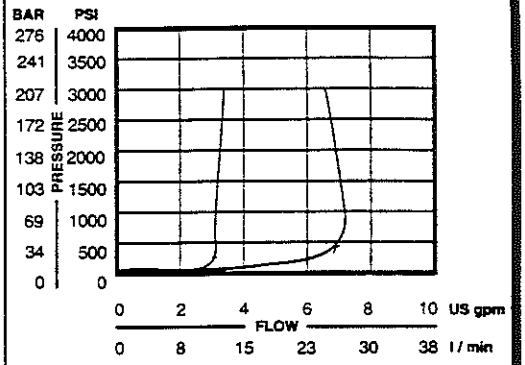
SERIES 10

SPECIFICATIONS

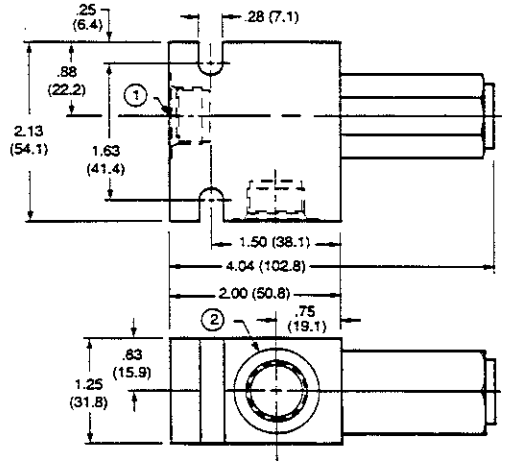
- This cartridge is a limited adjustment, pressure compensated, restrictive flow regulator.
- Valve maintains constant flow out of ② regardless of system pressure. Reverse flow from ② to ① is noncompensated and goes through the control orifice.
- Valve cartridge is **all** steel construction with precision ground spool, honed and hardened sleeve to assure good flow regulation and extended service life.
- Hi-strength aluminum alloy body allows for maximum circuit design flexibility.
- Buna-N seals are standard. Viton is optional (consult factory for other seal compounds).
- Flow adjustment range: +/- 25% of nominal setting.
- Valve rated to 3000 psi (207 bar) working pressure.
- Flow Accuracy: .1 to .49 +/- 20%; .5 to 1.49 +/- 15%; 1.5 to 6.0 +/- 10%
- Valve is designed for use with general purpose hydraulic fluids (MIL-H-5606, SAE #10, etc.).
- Cartridge weight .52 lbs (.24 kg).
- Valve cartridge fits Compact Controls Cavity CP10-2.

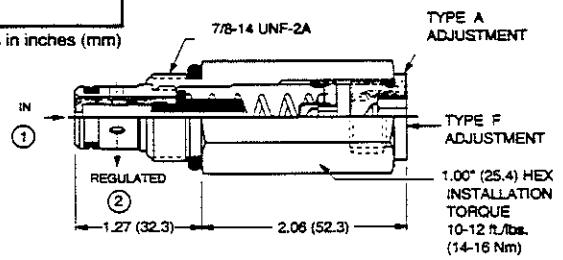
TYPICAL PERFORMANCE

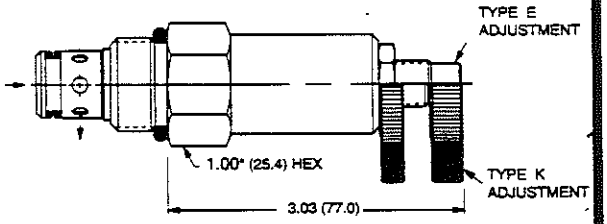
154 SUS (33 cSt) HYD. OIL @ 100° F (38° C)



All dimensions in inches (mm)







ORDERING INFORMATION

CP300 – 2 – B – 0 – A – 2.5

BASIC CARTRIDGE

SEALS

		SEAL KIT
B-BUNA-N	(Std.)	120015
V-VITON	(Opt.)	120016

PORTS

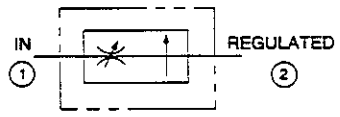
	BODY P/N
0 - CARTRIDGE	NO BODY
3P - 3/8 NPTF	220092
4P - 1/2 NPTF	220124
6S - #6 SAE	220125
8S - #8 SAE	220126
3B - 3/8 BSP	221214
4B - 1/2 BSP	221215

NOMINAL SETTING

gpm	l/m
0.1 = 0.1	(.38)
TO	
6.0 = 6.0	(22.7)

ADJUSTMENT OPTION

A - INTERNAL ADJUSTMENT
E - EXTERNAL ADJUSTMENT
F - TAMPER RESISTANT
K - KNOB ADJUSTMENT
P - PANEL MOUNT



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WILLISTON, VT 05495-1073
PHONE: (802) 863-0085
FAX: (802) 863-1193

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PHONE: (802) 863-0085
FAX: (802) 863-1193

Saycom KS485 installation

RS232 serial port of computer to RS232 side of Saycom. 9 conductors:

	9 pin	25 pin
pin	1	pin 8
	2	3
	3	2
	4	20
	5	7
	6	6
	7	4
	8	5
	9	22

Saycom 485 side to PYX:

Saycom	PYX
pin 2	TX +
pin 3	TX -

Switches on Saycom: 1 off, 2 - 8 on

9 Vdc power supply plugged into Saycom.

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SUPERVISORY SOFTWARE PACKAGE

FOR USE WITH THE FUJI PYX CONTROLLER

/ith the information required to execute the PYX program
:orrectly. Windows uses this file automatically.

:xamples:

<unning the program from the B: disk drive using communications
)ort 2.

:\>B: <Enter> - or - C:\>B:PYX 2 <Enter>
3:\>PYX 2 <Enter>

Running the program from the A: disk drive using communications
)ort 1.

:\>A: <Enter> - or - C:\>A:PYX <Enter>
\:\>PYX <Enter>

PROGRAM OPERATION

)nce the program starts running, it clears the screen and
lisplays the controller's parameters. The program defaults to
station number 1. It reads the parameters from the controller
)nce every 10 seconds and after each time a parameter is
changed. To change a parameter, press any key to get the
)rogram's attention. The program will ask you which option you
/ould like to change. The allowable range is displayed at the
end of the data entry line on the bottom of the screen. Each
)arameter has an option number corresponding to it on the
een. If you enter a option which can not be changed, such as
.CESS VARIABLE, the program will display an error message and
ask you to press any key to continue. Once you have entered
/hich option you want to change, the program will ask you for
:he value for that option. The allowable input range is
lisplayed at the end of the data entry line on the bottom of the
screen. When you are finished using the program, press the
<Esc> key. The program will save all of the controller
)arameters to the non-volatile memory and then return to the
1S-DOS prompt.

If the controller has more parameters than can fit on one
screen, it will use two screens. The current page and the
lumber of pages is displayed in the upper right hand corner of
:he screen. To change the page, press the <Page Up> or <Page
)own> key.

Examples:

Change the station number from 1 to 2.

<Space bar>	To get the programs attention
1 <Enter>	Change option number 1
2 <Enter>	Station number 2

Change the Setpoint Variable to 100.

ace bar>	To get the programs attention
Enter>	Change setpoint variable
100 <Enter>	New value

FILES ON DISKETTE

Filename	Description
READ.ME	This file
PYX.EXE	The PYX program
PYX.BAS	The PYX program turbo basic source code
PYX.PIF	The Windows .PIF file

End of document.

rint this file, use the following command:

COPY DATALOG.TXT PRN <Enter>

X.EXE DATA LOGGING DOCUMENTATION

TRODUCTION

ie PYX program is capable of recording the PV and SV values om the controller to a disk file on a set frequency. The data le is written in a ASCII file format which can be imported ito a spreadsheet program for analysis or graphing.

ONFIGURATION FILE

ie data logging is controlled by a configuration file. The ime of the file is LOG.INI. This file must be present for data ogging to be active. When this file is present, a new menu ption is displayed which allows you to start and stop the data ogging. The LOG.INI file has the following commands and efaults:

```
FILENAME=LOG.TXT
FREQUENCY=60
HEADING=NO
DELIMITER=COMMA
```

ie FILENAME= command controls the name of the file the data is ritten to. If this file exists, the data is appended to the nd of the file. The FREQUENCY= command controls how often the ata is recorded in the file. The value is entered in seconds. ie PYX program rounds this value down to the nearest 10 econds. For example, 26 seconds is rounded down to 20. The llowable range is from 10 to 86400 seconds. The HEADING= ommand controls whether column headings are written into the ata file. Use a value of YES to have the column headings ritten in the file. The DELIMITER command specifies what ASCII haracter is used to seperate the columns of values in the utput file. The DELIMITER command has three possible values: ONE, COMMA and TAB.

here shouldn't be any spaces between the command and the value. f any of the commands are not specified, the default value is sed. The commands may be placed in the file in any order.

UTPUT FILE

data is written to a ASCII file format using the specified delimiter. columns in the output file are as follows:

DATE, TIME, STATION, SV, PV

he DATE is written in MM-DD-YYYY format. The TIME is written

in HH:MM:SS format. The STATION is a number from 1 to 15. SV and PV are recorded as displayed on the controller face plate. (Including the "UUUU" and "LLLL" values. Also "Error" may be written in this field if there is an error communicating with the controller.)

You must make sure that you have sufficient disk space for the output file. Otherwise, the program will record data until the disk is full and then generate an error message. Each reading requires approximately 42 bytes. Taking readings once a minute for an hour requires 2,520 bytes. (42 bytes/min X 60 min/hour = 2,520 bytes/hour) Taking readings every 10 seconds for an hour requires 15,120 bytes. (42 bytes/10 sec X 6 10 sec/min X 60 min/hour = 15,120 bytes/hour)

LOG.BAT

A batch file is also supplied which allows you to continuously record data over extended periods of time. Each time you stop the PYX program, the batch file makes a copy of the data logging output file and then restarts the PYX program. The name of the file is LOG.BAT. The batch file accepts the following parameters:

The communications port the PYX program is to use.
The name of the data logging output file.
The name to copy the output file to.
Whether to clear the output file after making the copy.

For example, to continuously run the PYX program using communications port 2 and copy the output file to LOG.NEW and resetting the output file after the copy, use the following command line:

```
LOG 2 LOG.TXT LOG.NEW CLEAR
```

You could use this batch file to copy the data logging output file to a floppy disk once a day using the following command:

```
LOG 2 LOG.TXT A:\LOG.TXT CLEAR
```

If the fourth parameter is included the file is cleared, if the fourth parameter is omitted, the output file is not reset.

End of document.

To print this file, use the following command:

```
COPY READ.ME PRN <Enter>
```

PYX.EXE DOCUMENTATION

INTRODUCTION

This computer program allows for supervisory control of up to 15 FUJI PYX controllers attached to a computer via an EIA-485 communications line.

MINIMUM SYSTEM CONFIGURATION

IBM PC, XT, AT or true compatibles, 256K RAM free, one communications port, one floppy disk drive, monochrome or color display adapter, MS-DOS or PC-DOS version 2.1 or higher.

PROGRAM EXECUTION

The filename of the program is PYX.EXE. To run the program, place the diskette in the floppy disk drive and change your working directory to that drive. If your disk drive is A:, this is done by typing in A: and pressing <Enter> at the MS-DOS prompt. If your disk drive is B:, this is done by typing in B: and pressing <Enter> at the MS-DOS prompt. To run the program using communications port 1 type in PYX or PYX 1 and press <Enter>. To run the program using communications port 2, 3 or 4 type in PYX 2, PYX 3 or PYX 4 and press <Enter>. If the program runs briefly, prints an error message and returns to the MS-DOS prompt, it is experiencing a communications error. This might be caused by selecting the wrong communications port when running the program or your RS232-RS485 converter is not working properly. To install this program on your hard disk, enter the following commands at the MS-DOS prompt:

```
C:\> C: <Enter>
C:\> CD \ <Enter>
C:\> MD PYX <Enter>
C:\> CD PYX <Enter>
C:\PYX> COPY A:*.* <Enter>
```

These commands install the program on a hard disk C: from floppy disk drive A:. You can substitute your own drive letters and directory name.

The program is MS-Windows compatible and can be run in full screen or windowed mode. To run the program from within Windows use the RUN option of the FILE menu in the Windows Program Manager and enter A:PYX or B:PYX. You can also create a folder and icon for the program using the NEW option of the FILE menu.

A MS-Windows .PIF file is on the disk which supplies Windows

A MS-Windows .PIF file is on the disk which supplies Windows with the information required to execute the PYXS program correctly. Windows uses this file automatically.

Examples:

Running the program from the B: disk drive using communications port 2.

```
C:\>B: <Enter>          - or -          C:\>B:PYXS 2 <Enter>
B:\>PYXS 2 <Enter>
```

Running the program from the A: disk drive using communications port 1.

```
C:\>A: <Enter>          - or -          C:\>A:PYXS <Enter>
A:\>PYXS <Enter>
```

PROGRAM OPERATION

Once the program starts running, it clears the screen and displays PV, SV and the alarm status for the controllers. The program scans the controllers continuously. To change a controller's SV, press any key to get the program's attention. The program will ask you which station number. The allowable range is displayed at the end of the data entry line on the bottom of the screen. Once you have entered the station number, the program will ask for SV. The allowable input range is displayed at the end of the data entry line on the bottom of the screen. When you are finished using the program, press the <Esc> key. The program will return to the MS-DOS prompt.

The alarm status is indicated as shown in the following table:

Indicated	Description
On 12	Both alarms on
On 1	Alarm #1 on
On 2	Alarm #2 on
Off	Both alarms off
"Blank"	The controller does not have alarms

The program reconfigures itself once every 5 minutes. When the program reconfigures, it checks the active status of every station number. You can force the program to reconfigure at any time by pressing the <C> key. It takes 7.5 seconds for the program to reconfigure.

The program also uses a configuration file which allows for the customization of the heading line and the station names. The name of this file is CONFIG.TXT. The format of the file is as follows:

```
0, This is the line displayed on the top of the screen.
1, Station #1 description
2, Station #2 description
3, Station #3 description
...
```

ou are allowed 78 characters on the heading line and 20
iaracters for each of the station descriptions. There should
ily be one comma in each line between the number and the
t. You can use the MS-DOS editor to edit this file.

ILES ON DISKETTE

.lename	Description
EAD.ME	This file
'XS.EXE	The PYXS program
'XS.BAS	The PYXS program turbo basic source code
'XS.PIF	The Windows .PIF file

id of document.

FUJI ELECTRIC

Instruction Manual

RS-485 TRANSMISSION PROTOCOL

(PYX INTERFACE)

INTRODUCTION

1. Scope of this manual

This instruction manual describes the transmission protocol of the Type PYX controller with an RS485 transmission function.

When the PC-9801 series interface board (Type PYX) is used for the transmission between NEC personal computer PC-9801 (and FC-9801) series and PYX, the transmission control has already been realized as a board function. It is therefore, unnecessary for users to be conscious of the transmission protocol described in this instruction manual.

For other cases, prepare a program according to the transmission protocol described in this instruction manual.

2. Related manuals

Refer to the following references as required.

(1) Instruction manual for RS-485 transmission board

(2) Catalogue of fuzzy controller (PYX) (C.NO: 1119)

(3) Instruction manual for fuzzy controller (PYX) (INP-TN1PYX)

CONTENTS

Introduction i

File list iii

I. PYX Transmission protocol specifications 1

1. General 2

2. Transmission specifications 3

3. Transmission information and format 4

3.1 Kinds of message 4

3.2 Formats of messages 5

3.3 Examples of message communication 9

4. Transmission control procedure 16

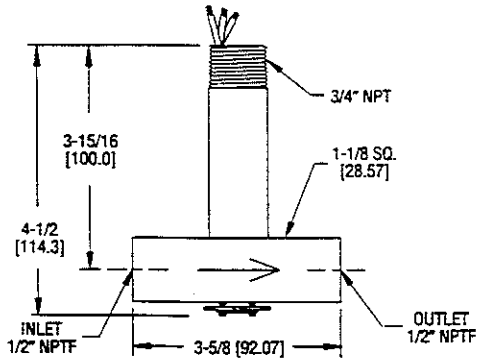
II. File Specifications ((PYX) 17

FILE LIST

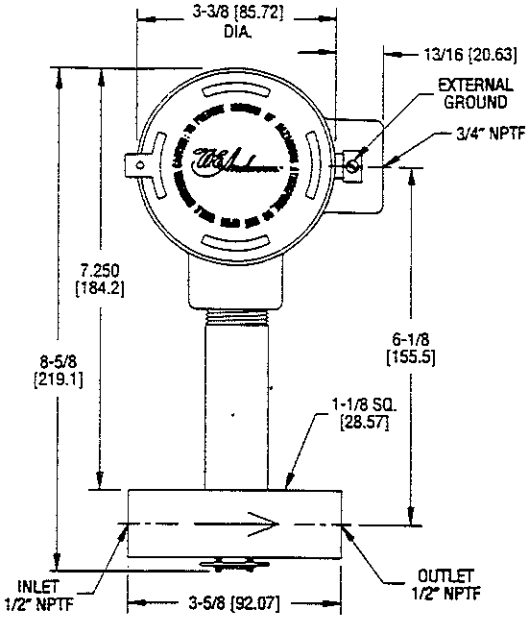
File No.	Name of file	Page
J00	Control command file	19
J01	SV file	20
J02	Second SV file	21
J03	PID/FUZZY parameter file	22
J04	Proportional cycle for output file	25
J05	Rate of digital filter file	26
J06	Input scaling file	27
J07	Input type filter	28
J08	PV offset file	29
J09	Setting value limit file	30
J10	MV limit file	31
J11	Abnormal output file	32
J12	Keylock file	33
J13	Power ON AT command file	34
J14	AT coefficient file	35
J15	Longidutinal limit file	37
J16	RCJ file	39
J17	PILC code file	40
J18	Adjustment value file	41
J19	Monitor file	45
J20	Output monitor file	46
J21	Fault information file	47
J22	Temperature of cold-junction file	48
J23	Parameter for adjustment and test	49
J24	Input terminal board file	51
J25	Control calculation result file	55
J26	Dual calculation output file	56
J27	A/D conversion count value file	57
J28	Station No. file	59
J29	Digital communication form file	60
J30	Alarm parameter file	61
J31	Ramp soak parameter file	66
J32	AO scaling file	70
J33	State of alarm output file	71
J34	Ramp/sok monitor file	72
J35	Heater current file	74
J36	Run monitor command file	75

DIMENSIONS

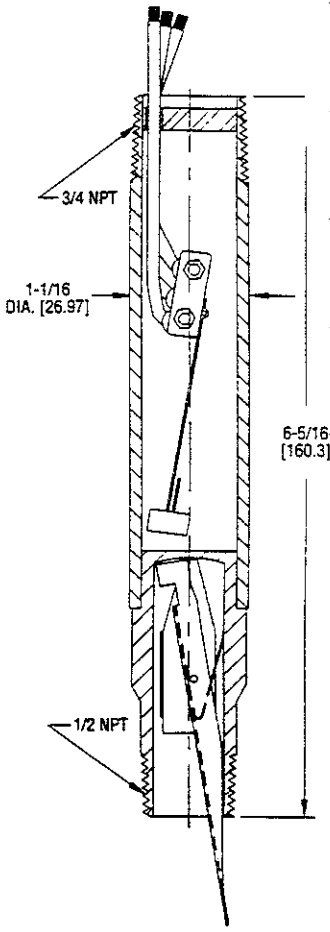
FloTect® Model V6



V6 Low Flow

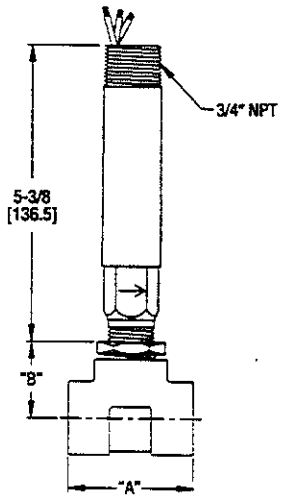


V6 Low Flow with C.S.A., CENELEC Conduit Enclosure

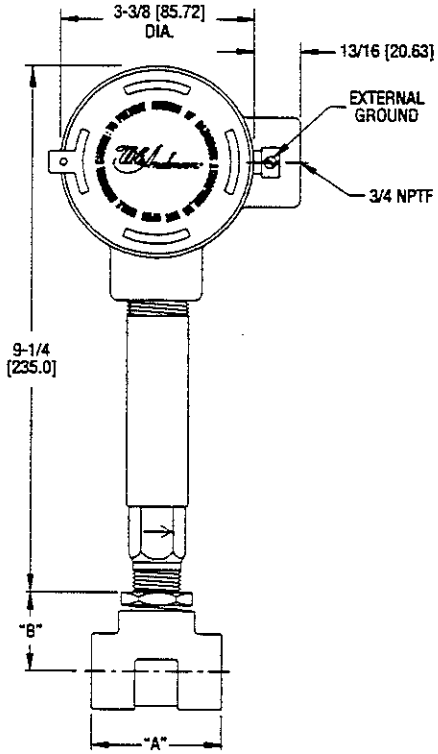


V6 with Field Trimmable Vane

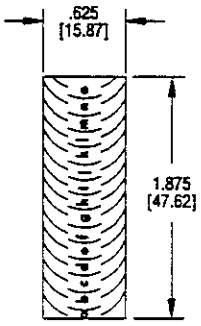
PIPE	BRASS/DUCTILE IRON		FORGED/STAINLESS STEEL		MALLEABLE IRON	
SIZE	DIM. A	DIM. B	DIM. A	DIM. B	DIM. A	DIM. B
1/2"	2-1/4(57)	1-1/8(29)	2-1/4(57)	1-1/8(29)	2-1/2(64)	1-1/4(32)
3/4"	2-3/8(60)	1-1/4(32)	2-5/8(67)	1-7/8(47)	2-5/8(67)	1-3/8(35)
1"	2-1/2(64)	1-3/8(35)	3(76)	2-1/8(54)	2-7/8(73)	1-1/2(38)
1-1/4"	2-5/8(67)	1-1/2(38)	3-1/2(89)	2-1/2(64)	3(76)	1-3/4(44)
1-1/2"	2-7/8(73)	1-5/8(41)	4(102)	2-3/4(70)	3-1/4(83)	1-7/8(48)
2"	3(76)	1-7/8(48)	4-3/4(121)	3-1/8(79)	3-1/2(89)	2-1/8(54)



V6 with Tee



V6 with Tee and C.S.A., CENELEC Conduit Enclosure



Trimmable Vane

V6 With Field Trimmable Vane

Cold Water – Brass or Cast Iron Reducing Tee
Approximate actuation/deactuation flow rates
PM upper, M^3/HR lower

Vane	½" NPT	¾" NPT	1" NPT	1¼" NPT	1½" NPT	2" NPT
Full Size						9.0 8.5 2.0 1.9
A						9.5 9.0 2.2 2.0
B						10.0 9.3 2.3 2.1
C						11.0 10.0 2.5 2.3
D					6.2 5.5 1.4 1.2	12.0 10.0 2.7 2.3
E					7.0 6.5 1.6 1.5	13.0 11.0 3.0 2.5
F				4.3 3.9 1.0 0.9	7.6 7.1 1.7 1.6	14.0 12.0 3.2 2.7
G				4.9 4.4 1.1 1.0	8.0 7.3 1.8 1.7	
H				5.5 5.0 1.2 1.1	9.0 8.2 2.0 1.9	
I			3.5 3.1 0.8 0.7	6.0 5.6 1.4 1.3	10.0 9.0 2.3 2.0	
J			4.0 3.5 0.9 0.8	7.0 6.6 1.6 1.5	13.0 11.0 3.0 2.5	
K			4.6 4.2 1.04 0.95	8.0 7.6 1.8 1.7	15.0 13.0 3.4 3.0	
L		2.6 2.3 0.6 0.5	5.6 5.2 1.3 1.2	10.0 9.0 2.3 2.0		
M	1.6 1.3 0.4 0.3	3.5 3.1 0.8 0.7	6.3 6.1 1.43 1.39	12.0 10.0 2.7 2.3		
N	2.2 1.8 0.5 0.4	4.3 3.8 1.0 0.9	8.0 7.5 1.8 1.7			
O	3.0 2.4 0.7 0.5					

Air – Brass or Cast Iron Reducing Tee
Approximate actuation/deactuation flow rates
SCFM upper, NM^3/M lower

Vane	½" NPT	¾" NPT	1" NPT	1¼" NPT	1½" NPT	2" NPT
Full Size						39.0 37.0 1.10 1.05
A						40.0 38.0 1.13 1.08
B						42.0 40.0 1.19 1.13
C						50.0 44.0 1.42 1.25
D					27.0 25.0 0.76 0.71	55.0 46.0 1.56 1.30
E					30.0 28.0 0.85 0.79	
F				20.0 18.0 0.57 0.51	32.0 30.0 0.91 0.85	
G				21.0 19.0 0.59 0.54	34.0 32.0 0.96 0.91	
H				23.0 21.0 0.65 0.59	37.0 34.0 1.05 0.96	
I			16.0 15.0 0.45 0.42	24.0 22.0 0.68 0.62	39.0 36.0 1.10 1.02	
J			18.0 16.0 0.51 0.45	28.0 25.0 0.79 0.71	51.0 45.0 1.44 1.27	
K			19.0 17.0 0.54 0.48	33.0 30.0 0.93 0.85	69.0 57.0 1.95 1.61	
L		13.0 12.0 0.37 0.34	22.0 20.0 0.62 0.57	38.0 35.0 1.08 0.99		
M	6.4 3.8 0.18 0.11	15.0 14.0 0.42 0.40	25.0 23.0 0.71 0.65	45.0 42.0 1.27 1.19		
N	10.0 7.0 0.28 0.20	20.0 16.0 0.57 0.45	32.0 28.0 0.91 0.79			
O	12.0 9.0 0.34 0.25					

Cold Water – Stainless or Forged Steel Straight Tee and Bushing
Approximate actuation/deactuation flow rates
GPM upper, M^3/HR lower

Vane	½" NPT	¾" NPT	1" NPT	1¼" NPT	1½" NPT	2" NPT
Full Size				5.0 4.5 1.1 1.0	8.5 7.8 1.9 1.8	
A				5.5 5.0 1.2 1.1	9.2 8.6 2.1 2.0	
B				6.2 5.7 1.4 1.3	9.8 9.0 2.2 2.0	
C				6.8 6.3 1.5 1.4	12.0 10.0 2.7 2.3	
D			2.8 2.4 0.6 0.5	8.5 7.8 1.9 1.8	13.0 11.0 3.0 2.5	
E			3.4 3.0 0.8 0.7	10.0 9.2 2.3 2.1		
F			4.0 3.6 0.91 0.82	12.0 10.0 2.7 2.3		
G		2.0 1.5 0.5 0.3	5.0 4.5 1.1 1.0			
H		2.5 2.0 0.6 0.5	6.5 6.1 1.48 1.39			
I		3.5 3.0 0.8 0.7	9.0 8.2 2.0 1.9			
J		7.0 5.5 1.6 1.2				
K		10.0 8.0 2.3 1.8				

Air – Stainless or Forged Steel Straight Tee and Bushing
Approximate actuation/deactuation flow rates
SCFM upper, NM^3/M lower

Vane	½" NPT	¾" NPT	1" NPT	1¼" NPT	1½" NPT	2" NPT
Full Size				21.0 18.0 0.59 0.51	33.0 30.0 0.93 0.85	
A				22.0 20.0 0.62 0.57	39.0 36.0 1.10 1.02	
B				24.0 22.0 0.68 0.62	42.0 38.0 1.19 1.08	
C				28.0 26.0 0.79 0.74	51.0 46.0 1.44 1.30	
D			12.0 10.0 0.34 0.28	33.0 30.0 0.93 0.85	55.0 50.0 1.56 1.42	
E			14.0 12.0 0.40 0.34	37.0 34.0 1.05 0.96		
F			16.0 14.0 0.45 0.40	43.0 40.0 1.22 1.13		
G		8.0 6.5 0.23 0.18	19.0 17.0 0.54 0.48			
H		11.0 10.0 0.31 0.28	26.0 24.0 0.74 0.68			
I		14.0 13.0 0.40 0.37	32.0 30.0 0.91 0.85			
J		27.0 24.0 0.76 0.68				
K		39.0 36.0 1.10 1.02				

ELECTRICAL CONNECTIONS:

Connect wire leads in accordance with local electrical codes and switch action required. N.O. contacts will close and N.C. contacts will open when flow increases to the actuation point. They will return to "normal" condition when flow decreases to the deactuation point. Black = Common, Blue = Normally Open and Red = Normally Closed.

For units supplied with both internal and external grounds, the ground screw inside the housing must be used to ground the control. The external ground screw is for supplementary bonding when allowed or required by local code. Some C.S.A. listed models are furnished with a separate green ground wire. Such units must be equipped with a junction box, not supplied but available on special order.

CENELEC certified models include a junction box. Cable should enter enclosure through an approved EX cable gland, not supplied. Push stripped and tinned leads into appropriate openings in terminal block(s). To connect fine stranded leads or to remove any wire, depress spring release with small screwdriver first.

All wiring, conduit and enclosures must meet applicable codes for hazardous areas. Conduits and enclosures must be properly sealed. For outdoor or other locations where temperatures vary widely, precautions should be taken to prevent condensation inside switch or enclosure. Electrical components must be kept dry at all times. **CAUTION:** To prevent ignition of hazardous atmospheres, disconnect the device from the supply circuit before opening. Keep assembly tightly closed when in use.

V6 With Tee

Cold Water – Factory Installed Tee
Approximate actuation/deactuation flow rates
GPM upper, **M³/HR** lower

1/2" NPT		3/4" NPT		1" NPT		1¼" NPT		1½" NPT		2" NPT	
1.5	1.0	2.0	1.25	3.0	1.75	4.0	3.0	6.0	5.0	10.0	8.5
0.34	0.23	0.45	0.28	0.68	0.40	0.91	0.68	1.36	1.14	2.27	1.93

Air-Factory Installed Tee
Approximate actuation/deactuation flow rates
SCFM upper, **NM³/M** lower

1/2" NPT		3/4" NPT		1" NPT		1¼" NPT		1½" NPT		2" NPT	
6.5	5.0	10.0	8.0	14	12	21	18	33	30	43	36
.18	.14	.28	.23	.40	.34	.59	.51	.93	.85	1.19	1.02

V6 Low Flow, Field Adjustable

Cold Water – Low Flow Models
Approximate actuation/deactuation flow rates
GPM upper, **M³/HR** lower

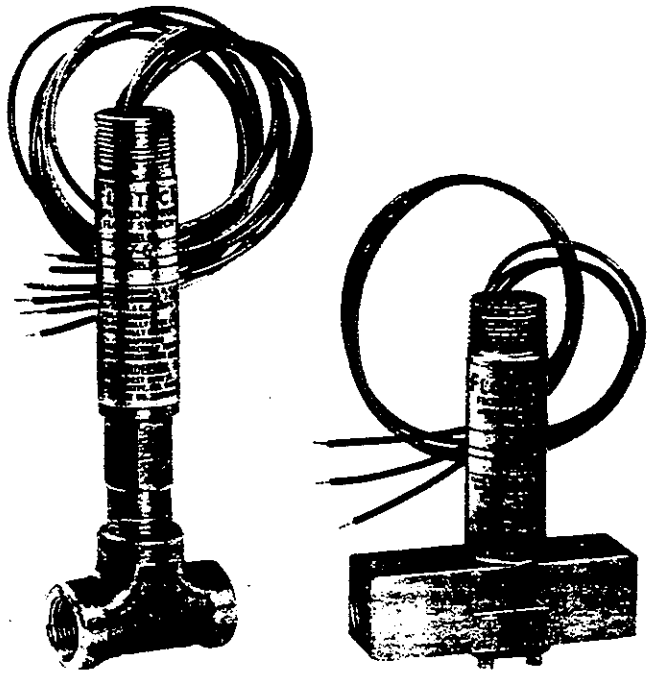
MINIMUM		MAXIMUM	
.04	.03	.75	0.60
.009	.007	0.17	0.14

Air – Low Flow Models
Approximate actuation/deactuation flow rates
SCFM upper, **NM³/M** lower

MINIMUM		MAXIMUM	
.18	.15	2.70	2.0
.005	.004	.08	.06

FLOTECT. MODEL V6 FLOW SWITCH

Installation and Operating Instructions



Explosion-Proof; U.L. and C.S.A. Listed –
Class I, Groups *A, B, C & D
Class II, Groups E, F & G
CENELEC: EExd IIC T6 (T amb=75°C)
*(Group A, stainless steel body only)

PHYSICAL DATA

Maximum Temperature: 220°F (105°C); 400°F (205°C) with high temperature (MT) option – Not U.L., C.S.A. or CENELEC approved.

Maximum Pressure: See chart.

Electrical Ratings: U.L. – 5A @ 125/250 VAC. C.S.A. and CENELEC – 5A @ 125/250 VAC, 5A resistive, 3A inductive @ 30 VDC. Gold contacts (MV option) for dry circuits – 0.1A @ 125 VAC. High temperature (MT) option – 5A @ 125/250 VAC. Not U.L., C.S.A. or CENELEC approved.

Wiring: U.L., C.S.A. models – 18 AWG × 18" (46 cm) length. CENELEC models – terminal block.

Switch Body: Lower housing (wetted), brass or stainless steel. Upper housing, brass or stainless steel.

Vane: Stainless steel.

Pipe Connection: 1/2" – 2" NPT tee standard. 1/2" NPT for Low Flow models and models with field trimmable vane.

Installation: Install in any position with index arrow pointing in direction of flow.

Weight: 2 – 6 lbs. (.9 – 2.7 kg) depending on size and construction.

Options: DPDT relays, custom calibration, Teflon coated wetted parts and more.

The Flotect® Model V6 is an inexpensive, explosion-proof flow switch for use on air, water or other compatible gases and liquids. Three configurations are available – 1. Factory installed in a tee. 2. With a trimmable vane for field adjustment and installation in a suitable tee. 3. Low flow models with an integral tee and adjustable valve. All are available with an optional enclosure which is U.L. and C.S.A. listed, CENELEC approved.

MAXIMUM PRESSURE CHART

MODEL	LOWER HOUSING	TEE	MAXIMUM PRESSURE PSI (KG/CM²)
V6 Low Flow	Brass	Brass	1450 (102)
V6 Low Flow	Stainless Steel	Stainless Steel	1450 (102)
V6	Brass	Brass	250 (17)
V6	Brass	Iron	1000 (70)
V6	Stainless Steel	Iron	1000 (70)
V6	Stainless Steel	Forged Steel	2000 (140)
V6	Stainless Steel	Stainless Steel	2000 (140)

INSTALLATION

Unpack and remove any packing material found inside lower housing or tee.

Switch can be installed in any position but the actuation/deactuation flow rates in the charts are based on horizontal pipe runs and are nominal values. For more precise settings, units can be factory calibrated to specific flow rates.

V6 Models with Tee are supplied in 1/2" – 2" NPT sizes. Install in piping with arrow pointing in direction of flow.

V6 Low Flow Models have 1/2" NPT connections and are field adjustable. Install in piping with arrow pointing in direction of flow. To adjust, loosen the four socket head cap screws on bottom. The adjustment valve rotates 90° between "O" (open) and "C" (closed). See flow charts for approximate ranges. Tighten screws once the required flow rate has been set.

V6 with Field Trimmable Vane. These models enable the installer to choose approximate actuation/deactuation points by trimming the full size vane at appropriate letter-designated marks on a removable template. Flows are defined in the following charts. Note that the charts are based on either brass or cast iron reducing tees or stainless or forged steel straight tees with bushings where necessary. Install in piping with arrow pointing in direction of flow.

When bushings are used, they must be back drilled to allow proper clearance for unrestricted vane travel. Bore the I.D. to 13/16" (20 mm) on 1/2"×3/4" bushings or 1" (25 mm) on larger bushings. The depth of the bore must leave internal threads 9/16" (14 mm) high for proper engagement between the lower housing of the switch and the bushing. Check for proper vane travel and switch operation after installation.

W.E. ANDERSON DIV., DWYER INSTRUMENTS, INC.
P.O. BOX 358, MICHIGAN CITY, INDIANA 46360, U.S.A.
Phone 219/879-8000
Fax 219/872-9057

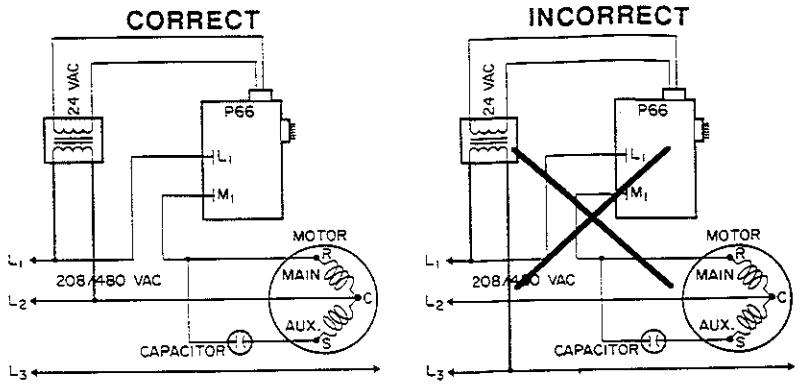


Fig. 4 — Permanent split-capacitor single phase motor connections to the P66 Fan Speed Control when used on three-phase systems. NOTE: The P66 is a single phase control that can only be used with single phase motors. The 24 volt control circuit and the motor must be on the same phase.

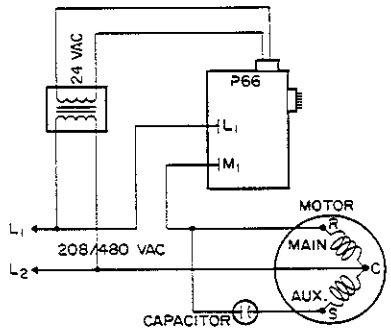


Fig. 5 — Permanent split-capacitor motor connections to the P66 Fan Speed Control.

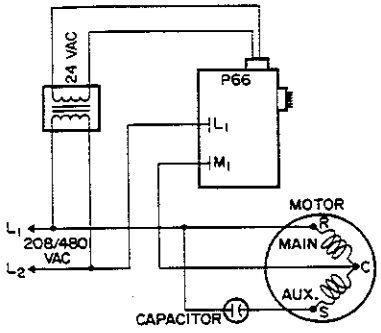


Fig. 6 — Optional wiring diagram for permanent split-capacitor motor connections to the P66 Fan Speed Control.

P66 Specific Model Information

Part Number	Operating Range (PSIG)	Start Voltage (% of Line)	Capillary Length
P66AAB-1	190/250	10	60"
P66AAB-3	180/240	16	60"
P66AAB-4	135/165	10	60"
P66AAB-6	170/230	16	60"
P66AAB-7	80/115	16	60"
P66AAB-9	170/230	40	60"
P66AAB-10	190/250	16	120"
P66AAB-11	140/200	16	60"
P66AAB-12	220/280	16	120"
P66AAB-13	60/90	16	60"
P66AAB-14	220/280	40	120"
P66AAB-15	220/280	16	60"
P66AAD-1✱	160/220	25	60"
P66ABB-21±	220/280	16	120"
P66BAB-1	190/250	10	60"
P66BAB-3	170/230	16	60"
P66BAB-4	190/250	16	120"
P66BAB-5	220/280	16	60"
P66BAD-1✱	160/220	25	60"

NOTES:
✱ 50 Hz
± NEMA 3R enclosure.
P66BAB and P66BAD are dual sensor input.

Litho in U.S.A. 1290-Z

is 80 to 200 PSIG (552 to 1379 kPa) for low pressure models and 140 to 350 PSIG (965 to 2413 kPa) for high pressure models.

The operating range can be adjusted as follows:

1. Locate the adjustment screw on the P66's pressure transducer. The screw can be accessed through the opening in the upper left-hand corner of the control's base. (The second transducer if supplied is located in the lower right-hand corner of the control's base.)

2. Turn the adjustment screw clockwise to increase or counterclockwise to decrease the operating range.

Low Pressure Models (80 to 200 PSIG)
1 turn = approximately ±17 PSIG (117 kPa)

High Pressure Models (140 to 350 PSIG)
1 turn = approximately ±35 PSIG (241 kPa)

CAUTION: Any adjustments should be limited to two full turns in either direction. Over-adjustments may prohibit modulation of the motor and/or cause high head pressures. All pressure adjustments should be verified with the use of refrigerant pressure gages.

Range adjustments made to the P66's pressure transducer(s) will be reflected in the pressure at which the control applies minimum start voltage to the motor. All other adjustments made other than those described above will effect the operation and performance of the control and void any/all warranties.

Checkout Procedure

Before leaving the installation, observe for correct operation through the desired pressure range See the Operation section for a typical operational sequence.

Repairs and Replacement

Field repairs must not be made. For a replacement control contact the Original Equipment Manufacturer or your local Johnson Controls wholesaler.

Trouble Shooting Guide

Refer to the Performance Curve for proper operation.

Problem	Possible Cause	Possible Solution
No fan operation.	Input pressure is below operating range.	No problem, normal operation.
	No 24 volt control voltage.	Check for 24 VAC at control.
		No input pressure to control. alignment. Schrader valve depressor must depress Schrader valve enough to allow pressure into capillary.
	Bad fan motor.	Disconnect power. Place a jumper from L_1 to M_1 and connect power. If fan does not start, motor is bad and should be replaced.
	Pressure transducer problem.	Disconnect 6 pin connector from right side of control. Place a jumper wire between third pin from the top and the bottom pin on the control, not the cable. If fan goes to full speed, check fo input pressure (above). If it has been determine there is adequate pressure, the transducer is bad and the control must be replaced.
Fan stops when pressure reaches the high end of the operating range.	Control is not wired correctly.	See wiring diagrams.
No fan modulation (On-Off operation).	Control is not wired correctly.	See wiring diagrams.
Fan starts at full speed.	Control is not wired correctly.	See wiring diagrams.
Erratic fan operation.	Control is not wired correctly.	Check to see if control voltage (24 VAC) is on same phase as motor.
	Dirty or blocked condenser coil.	Clean condenser coil.
Fan motor is cycling on thermal overload.	Dirty or blocked condenser coil.	Clean condenser coil.
	Wrong motor for fan speed control application.	Replace with motor approved for fan speed control application.

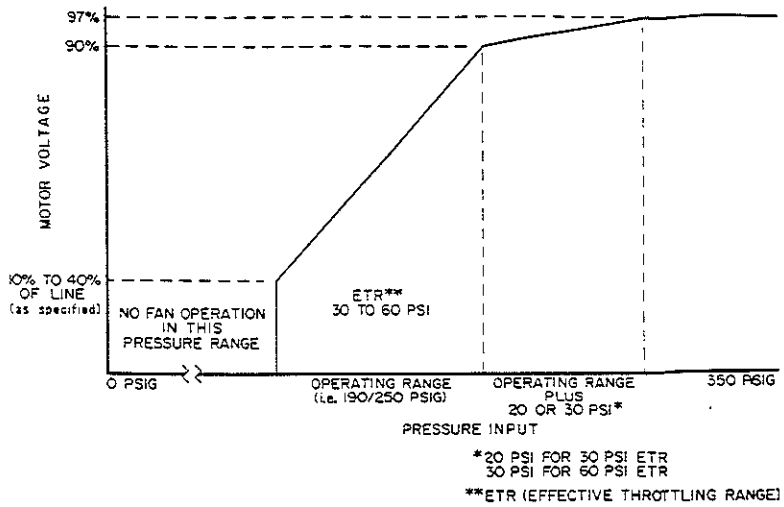


Fig. 2 — P66 performance curve.

air delivery in direct proportion to heat rejection requirements. This allows the refrigeration system to perform efficiently in very low ambient temperatures.

The P66's pressure sensor(s) provide direct response to changes in condenser pressure, regardless of the variations in fan delivery curves. The dual pressure input control selects the pressure input with the highest pressure.

See the chart below for a typical operational sequence for a P66.

Installation

Location

Maintaining operating temperatures within the listed product ratings is necessary for proper operation. The P66 control should be mounted with the cooling fins in a vertical position with no obstruction preventing air flow through the fins. Do not mount the P66 where the control is exposed to an excessive heat source. For maximum ambient temperature ratings refer to the Electrical and Temperature Ratings table.

1. For maximum heat dissipation, locate the P66 where fan air passes through the cooling fins.
2. Locate the P66 so the pressure element(s) inside the base are above the liquid level of the equipment on which the control is being used.
3. Mount the control where it can be conveniently wired to the power supply and the motor.
4. The recommended pressure connection should be in the high pressure vapor line near the condenser inlet (a 60" capillary is standard). Standard models are provided with a Schrader valve depressor in the female flare fitting.
5. Avoid sharp bends or kinks in the capillary tubing.
6. Purge all tubing and lines before connecting the P66.
7. Coil and secure the excess tubing to avoid vibration. Allow some slack in the capillary to avoid "violin string" vibration which can cause the tubing to break. Do not allow the tubing to rub against metal surfaces where friction can damage the capillary.

NOTE: The maximum over pressure of the P66 is 450 PSIG (3103 kPa). The maximum surge pressure is 600 PSIG (4137 kPa). This control must not be used in excess of these limits.

Wiring

CAUTION: Disconnect the power supply before the wiring connections are made to avoid possible electrical shock or damage to the equipment.

Make all wiring connections using copper conductors only. All wiring must be in accordance with the National Electrical Code and local regulations. For maximum electrical rating of the control, see the P66 Electrical and Temperature Ratings table.

CAUTION: The P66 must be grounded to a suitable earth ground.

Adjustments

The throttling range of the P66 is internally fixed and cannot be adjusted. However, the operating range can be increased or decreased within the controls' pressure range. The pressure range

Operational Sequence

Pressure Input	Motor Voltage (VAC, true RMS)
Pressure is between 0 PSIG and the Low End of the Operating Range	0 to 5 volts.
Pressure is at the Low End of the Operating Range	Start Voltage (10% to 40% of line.)
Pressure is in the Operating Range	Motor voltage varies directly with system pressure from start voltage to 90% of line voltage.
Pressure is at the High End of the Operating Range	Output voltage is 90% of line voltage.
Pressure above the Operating Range	A further pressure increase of 20 to 30 PSI will increase motor voltage to at least 97% of the applied voltage

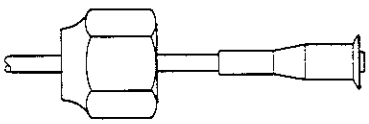


Fig. 3 — Drawing of adapter fitting with depressor.

JOHNSON CONTROLS

Johnson Controls, Inc.
Controls Group
1302 East Monroe Street
Goshen, IN 46526

P66 Series
Electronic Fan Speed Control

Application

The P66 is a pressure actuated electronic motor speed controller. This control can be used with single phase permanent split capacitor and shaded pole motors which are approved by the motor and equipment manufacturer for speed control applications. By directly sensing pressure, this device electronically varies the speed of a fan motor. Controlling head pressure in the condensing section of a refrigeration system is a common application.

Typical applications include:

— Computer room air conditioning.

— Commercial air conditioning.

— Commercial refrigeration.

This control is designed to replace "On/Off" fan cycling controls, multiple speed motors, condenser floodback systems, temperature fan speed control, and modulating louver systems.

All P66 Series electronic fan speed controls are designed for use only as operating controls. Where an operating control failure would result in personal injury and/or loss of property, it is the responsibility of the installer to add devices (safety, limit controls) or systems (alarm, supervisory systems) that protect against, or warn of, control failure.

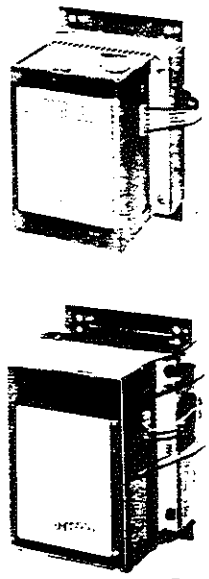


Fig. 1 — P66 Electronic Fan Speed Control. NEMA 1 (top) and NEMA 3R (Rainproof) shown.

CAUTION: The P66 may be used only with single phase motors approved by the manufacturer for speed control applications.

Manufacturers' Sample Specification Description for the P66:

Head Presssure Control — A pressure–actuated condenser motor speed control that allows equipment operation down to ___°F. (–20°F is possible on some equipment.)

Specifications

Product	P66	Electronic Fan Speed Control
Low Pressure Models	**Pressure Range**	80 to 200 PSIG (552 to 1379 kPa)
	Effective Throttling Range (ETR)	30 PSI (207 kPa)
High Pressure Models	**Pressure Range**	140 to 350 PSIG (965 to 2413 kPa)
	Effective Throttling Range (ETR)	60 PSI (414 kPa)
Maximum Overpressure		450 PSIG (3103 kPa)
Maximum Surge Pressure		600 PSIG (4137 kPa)
Control Voltage		24 VAC, 1 VA
Line Voltage Range		187 to 528 VAC
Start Voltage		10% to 40% of Line (OEM Specified)
Construction	**Control Case**	Cold Rolled Steel
	Base and Sensors	Cold Rolled Steel
	Plastic Enclosure	Lexan with Closed Cell Foam Gasket
Enclosure		NEMA 1 and NEMA 3R
Wiring Connections	**Low Voltage**	¼" Quick-Connect (NEMA 1) Two 6" Wire Leads (NEMA 3R)
	Line Voltage	10–32 Screw Terminals
Pressure Connections		60" (1524 mm) Copper Capillary with ¼" (6 mm) Flare Nut and Schrader Valve Depressor is Standard
Mounting		Vertical Only, Two Holes for No. 10 Screws at the Top and Bottom

Electrical and Temperature Ratings

Volts, AC	208	240	277	480
Full Load Amp	8.0	8.0	6.9	4.0
Locked Rotor Amp	16.5	16.5	14.3	10.5
Max. Ambient Temp.	130°F (54°C)	130°F (54°C)	130°F (54°C)	150°F (66°C)
Min. Ambient Temp.	–40°F (–40°C)	–40°F (–40°C)	–40°F (–40°C)	–40°F (–40°C)

Operation

Condensing unit operation and installation determine the overall capability of maintaining a satisfactory pressure by means of fan speed control. Within the operating range, the P66 provides

Maneurop

MT 56 HL

R 22

NOMINAL PERFORMANCE NOTE 1.2

	MODEL	1	3	4
	NOMINAL VOLT	230V 1~	230V 3~	460V 3~
AIR COND. DUTY	Capacity (BTU/h)	56425	56425	56425
	KW motor	6,05	6,05	6,05
	EER BTU/Wh	9,3	9,3	9,3
	Amps	28,00	18,2	8,5
HEAT PUMP DUTY	Capacity (BTU/h)	47100	47100	47100
	KW motor	4,71	4,71	4,71
	EER BTU/Wh	10	10	10
	COP W/W	3,73	3,73	3,73
	Amps	23,3	14,5	6,9
NOTE 3	L.R.A.	146	125	51
	M.C.C.	46	28	13
	R.L.A.	32,9	20	9,3
	M.C.A.	41,1	25	11,6
	Max fuse size	70	45	20

Note :

1) all capacities and power rating have + - 5 % tolerance

2) *Air cond.rating condit.* : tevap = 45°F - tcd = 130°F,
Liquid Temp : 115°F, RGT: 65°F
Energy efficiency ratio EER = $\frac{\text{COOLING CAPACITY}}{\text{POWER INPUT}} = \frac{\text{BTU/H}}{\text{WATTS}}$

Heat pump rating condit. : tevap = 30°F - tcd = 110°F,
Liquid Temp : 95°F, RGT: 50°F,
Coefficient of performance COP = $\frac{\text{HEAT REJECTION}}{\text{POWER INPUT}} = \frac{\text{WATTS}}{\text{WATTS}}$

3) LRA : locked Rotor amp.
MCC : maximum continuous current
RLA : rated load amp = M.C.C. / 1.4
MCA : minimum circuit ampacity (conductor sizing) RLA x 1.25
MFS : maximum fuze size = RLA x 2.25

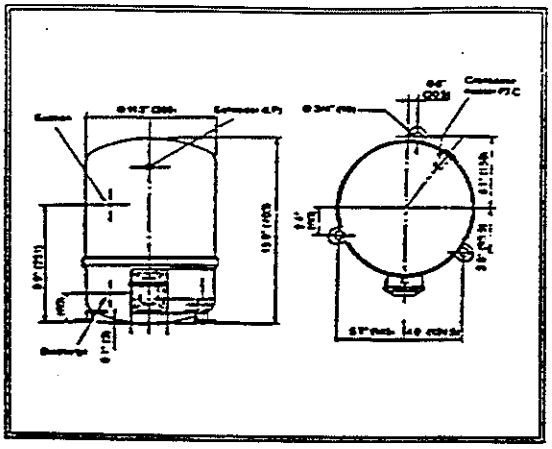
REVISION 1
DECEMBRE 1989

Maneurop

BASE MODEL

MT 56 HL

DIMENSIONS



GENERAL DATA

N° of cyl	2
Bore x stroke	1,875 x 1,062
Displacement CFH at 3500 RPM	712,2
Oil charge (pints)	3,9
Connections rotolock	
Suction (in)	1"3/4
Discharge (in)	1"1/4
Weight (lbs)	75

Compressor protection (internal)
Motor : line break overload
Pressure : high pressure relief valve

MODEL VERSIONS

MODEL VERSION	VERSION VOLTAGE	VOLTAGE RANGE LIMITATION
MT 56 HL 1 B	230 V 1 ~	197 - 253 V
MT 56 HL 3 A	230 V 3 ~	180 - 253 V
MT 56 HL 4	460 V -3 ~	414 - 506 V

SINGLE PHASE DATA

PSC
Run capacitor : 50 MFD

Intended to be applied on systems or units with pressure equalisation and 208 volts minimum at start up.

CSR

Run capacitor : 50 MFD

Start capacitor : 100 MFD

Starting relay : 3 ARR 3J4A4

AGENCY RECOGNITION

UL FILE NO SA 6873	CSA FILE NO LR 84768
MT 56 HL 1 B MT 56 HL 3 A MT 56 HL 4	MT 56 HL 1 B MT 56 HL 3 A MT 56 HL 4

NOMINAL PERFORMANCE AND ELECTRICAL DATA SEE OVERLEAF

c. If flux must be used, take necessary precautions to ensure that the flux does not enter the system.

d. Use damp cloths or other heat absorbent material to ensure that the factory brazed joints on the compressor do not become damaged. If damp cloths are used, take care not to allow moisture to enter the system.

e. Do not overheat brazed joints as excess heat will cause formation of copper oxide on the inside wall of the tubing. Flowing an inert gas through the system, as explained in Step 4, will reduce the possibility of oxidation.

☐ 5. INSTALL FILTER DRIERS. Maneurop recommends the use of the adequate sized liquid and suction line driers anytime a compressor is replaced. If the new compressor is used as a replacement because of a burned compressor, the use of high acid neutralizing filter driers is recommended. For heat pumps, a suction filter drier must be installed between the 4 way valve and the compressor suction inlet. In addition, a two way heat pump liquid line drier must be installed.

☐ 6. CHECK FILTER DRIER FOR CONTAMINATION. If internal contamination is heavy, the suction line filter drier may become clogged and ineffective. Check the pressure drop across the filter drier after approximately 8 hours running time and, if it exceeds 2 psig, replace it.

WARNING: Voltage should not be applied to the compressor with the terminal cover and retainer removed as personal injury could result.

CAUTION: The replacement compressor may become damaged if you fail to check the electrical system against the system manufacturer's service manual and the Maneurop wiring diagrams on Page 2 before startup.

☐ 7. CHECK THE ELECTRICAL SYSTEM. BEFORE STARTING THE COMPRESSOR, VERIFY THAT THE ELECTRICAL SYSTEM IS WIRED ACCORDING TO THE COMPRESSOR WIRING DIAGRAMS ON PAGE 2 EXACTLY! VERIFY THAT THE COMPONENTS USED IN THE SYSTEM MATCH THOSE SPECIFIED IN THE COMPRESSOR ELECTRICAL COMPONENT DATA ON PAGE 2. CHECK ALL CONNECTIONS AND TERMINALS TO BE SURE THAT THEY ARE TIGHT.

☐ 8. CHECK SYSTEM FOR LEAKS. After installation is complete and all electrical checks have been made, pressurize the system to 75 psig using R-22 and check for leaks using a halide torch, soap bubbles or an electronic halogen leak detector. When all connections test satisfactorily, release the pressure. When the sound of escaping gas diminishes, proceed with Step 9.

CAUTION: Do not use the Maneurop replacement compressor as an evacuation assist and never apply voltage to a compressor while it is in a vacuum as damage could result to the compressor.

☐ 9. EVACUATE AND CHARGE THE SYSTEM. Begin evacuation using a vacuum pump designed for this purpose, When a vacuum of 1500 microns is reached, remove the pump and pressurize the system to a positive pressure using R-22. Repeat this process two more times but evacuate to 500 microns the last time. Close the valve, remove the pump, and charge the system.

MANEUROP INC.

COMPRESSOR REPLACEMENT CHECKLIST

WARNING: The air conditioning and refrigeration unit is a pressurized system and hazards exist which could result in personal injury. It is therefore recommended that removal and installation of the hermetic compressor be performed by experienced personnel only.

The following instructions include major points of consideration that will ensure proper installation and protect you from possible personal injury. Please use this as a checklist, taking each item in its order before proceeding to the next.

☐ 1. VERIFY PROPER APPLICATION. Verify that the compressor being replaced and the Maneurop compressor have a like capacity for the refrigerant being used and that the voltage and frequency characteristics are the same. Consult your wholesaler if you have any questions about proper compressor application.

WARNING: To avoid electrical shock, power to the compressor should remain off during performance of Steps 2 thru 9.

☐ 2. DETERMINE CAUSE OF INITIAL FAILURE. Determine the cause of the initial compressor failure and make any necessary repairs to the system. If a burnout occured, a system flush to remove contaminants is required.

☐ 3. INSTALL THE NEW COMPRESSOR. Install the new compressor on its base per instructions on page 1. Be sure to use the new mounting grommets that were shipped with the compressor. If the mounting sleeves shipped with the compressor are used, the mounting bolts will bottom out when tight. Use care not to over compress the mounting grommets when the mounting sleeves cannot be used.

WARNING: Never use oxygen to pressurize refrigeration or air conditioning system. Oxygen will explode on contact with oil and could cause personal injury. When using high pressure gas such as nitrogen or CO_2 for this purpose, be sure to use a regulator that can control the pressure down to 1 or 2 psig.

☐ 4. BRAZE ON SUCTION AND DISCHARGE LINES. Flow an inert gas, such as nitrogen or CO_2, through the system at approximately 2 psig. This will reduce the possibility of oxidation inside the tubing. Braze on the suction and discharge lines following the recommendations listed below:

COPPER TUBING: If additional copper tubing is required, use only clean, dehydrated refrigeration grade tubing with sealed ends.

BRAZING ALLOYS: **CAUTION:** Do not use 95/5, 50/50 or 40/60 soft solder for brazing. Use Sil-Phos or Phos Copper, or similar brazing alloys with high tenside strength on copper to copper welds only. Weld steel to copper only with silver brazing alloys.

BRAZING PROCEDURE: To ensure properly brazed joints, Maneurop recommends that the following steps be used:

a. Exercise extreme care when cutting and forming tubes to keep dirt, filings and other contaminants from entering the system.

b. Do not use excessive amounts of brazing alloy as some of the excess may penetrate the joint and enter the system.

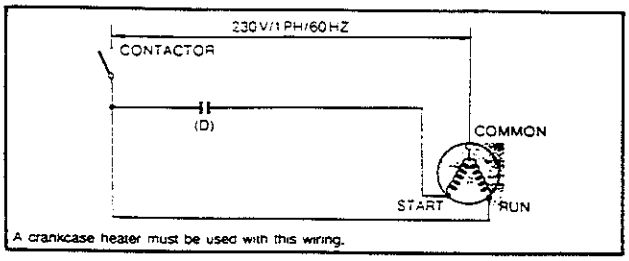
Maneurop Inc.

INSTALLATION INSTRUCTIONS - ELECTRICAL
MT/LT COMPRESSORS

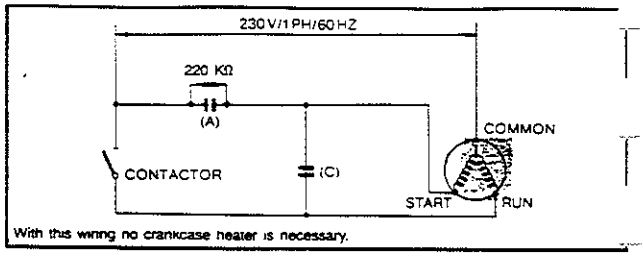
Typical wiring diagrams

SINGLE PHASE (For the nominal system voltage supply of 208 volts, use CSR only)

PSC This system may be used for refrigerant circuits with capillary tube or expansion valve with a bleed port. It is necessary to ensure a pressure equalization at start up. **The electrical supply should not drop to under 208 V.**

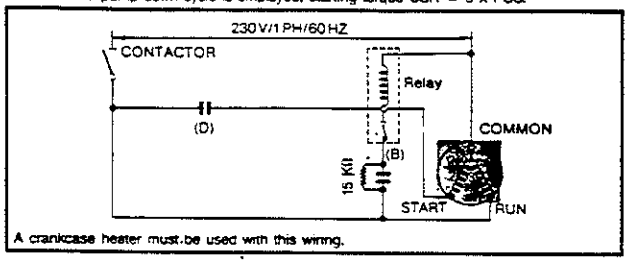


A crankcase heater must be used with this wiring.

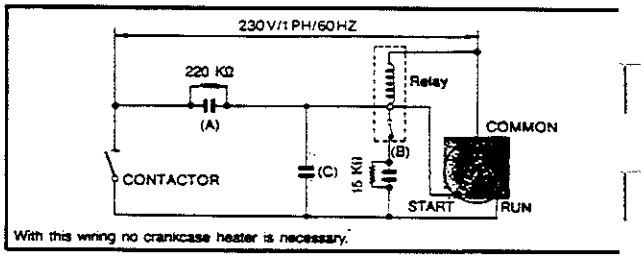


With this wiring no crankcase heater is necessary.

CSR This system may also be used for refrigerant circuits using capillary tube or expansion valve with a bleed port. The pressure difference at start up should not exceed 30 PSI except in the case where a pump down cycle is employed. starting torque CSR = 5 x PSC.

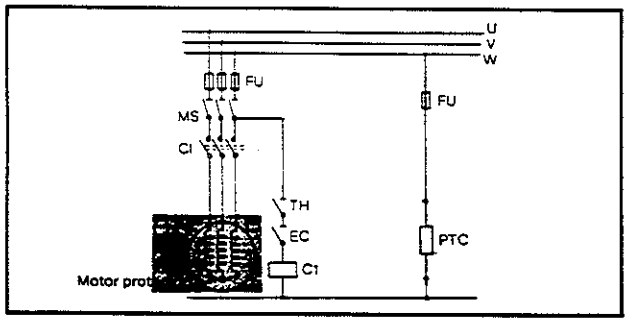


A crankcase heater must be used with this wiring.



With this wiring no crankcase heater is necessary.

THREE PHASE



Selection table capacitors and relays

Compressor model		PSC/CSR Run capacitors (A) MFD	PSC/CSR Run capacitors (C) MFD	PSC/CSR Run capacitors* (D) MFD	CSR only Start capacitors** (B) MFD	CSR only Start relay	*** CSR Kit
	MT 18 JA-1	NA	NA	15	50		CSR0
LT22JEI	MT 22 JC-1	15	20	35	100		CSR
LT28JHI	MT 28 JE-1	25	15	40	135		CSR
	MT 32 JF-1	25	10	35	100	All	CSR
	MT 36 JG-1	30	10	40	100	models	CSR3
LT44MHI	MT 44 HJ-1	30	15	45	135	3ARR3J4A4	CRS4
LT50HPI	MT 50 HK-1	30	15	45	135		CSR
	MT 56 HL-1	30	20	50	200		CSR
	MT 64 HM-1	30	25	55	235		CSR

***Offered as option by Maneurop

Optional

Included in delivery

PTC = Crankcase heater FU = Fuses TH = Thermostat
COMP = Compressor MS = Main switch TR = Transformer
MP = Motor protector CI = Contactor EC = External controls

*Run capacitors 440 volts, minimum 10,000 hours.

**Start capacitors 330 volts.

Starting Frequency: Maximum 12 per hour.
Voltage: Check that supply voltage equals that on nameplate plus or minus allowable tolerence.
Capacitor: Check that all capacitors match the table listing above.

Single phase:
The single phase compressor models are protected internally by a temperature / current sensing bi-metallic cut-out which senses the protector main winding current and start winding current.

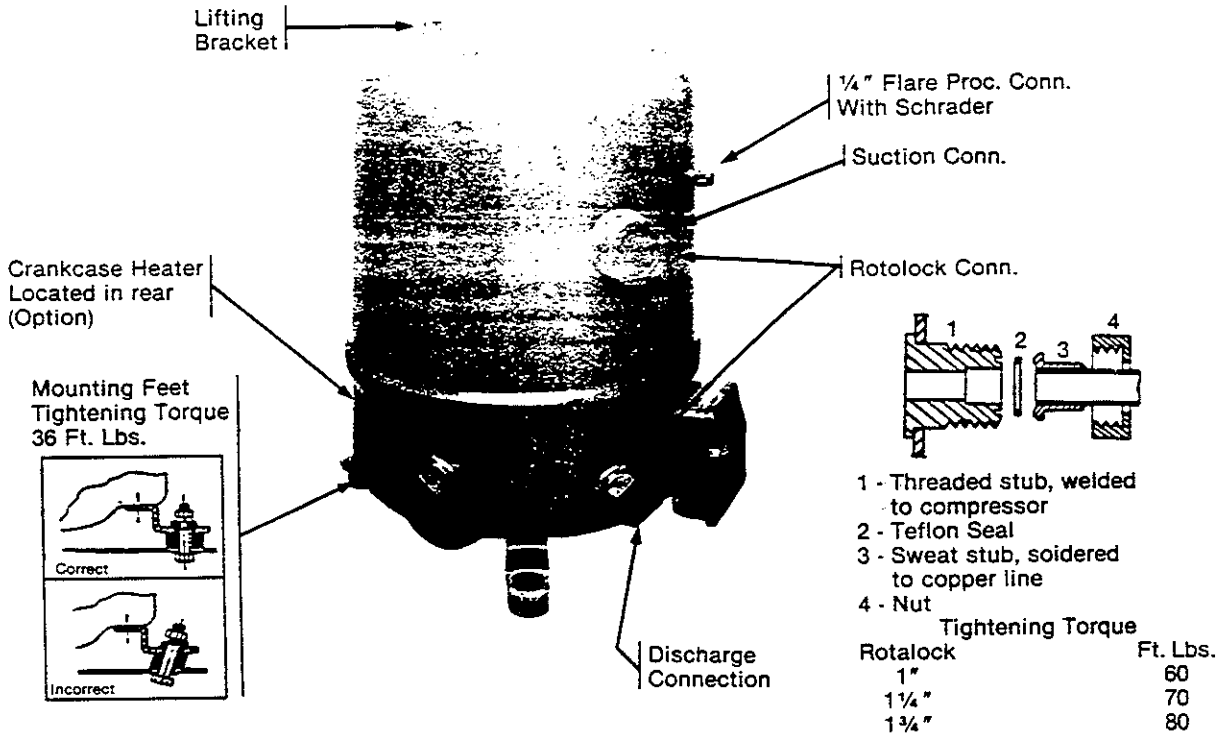
Three phase:
Three phase compressors are protected against excessive motor temperatures and current by means of an internal overload protector (I.O.L.), which is located at the star point of the windings and cuts out all three phases simultaneously via bi-metallic disc.

IMPORTANT:
After the compressor has cut out on I.O.L., the reset time will depend on the location of the compressor. In a warm closed area for exar ple, it can take up to 2-3 hours to cut in, whereas in a ventilated area it would take less than one hour.

Self-Regulating Crankcase Heater - P.T.C.:
All compressors are fitted with PTC sleeve. Voltage is 200-600 volts. Before inserting, it must be coated with heat transfer paste such as Dow Corning #340. After inserting, the plastic bushing is used to hold in place. In removing the ring please use screwdriver, as pulling c the leads may damage the device. The heater is the same for all models with 28 inch model supplied as standard and 48 inch mode as o tion. In operation, as the temperature of the oil drops, the wattage goes up. As the temperature of the oil goes up, the wattage decrease After extended shutdown, allow heater warm-up of 1 hour.

Maneurop Inc.

INSTALLATION INSTRUCTIONS - MECHANICAL
MT/LT COMPRESSORS



1. Mounting grommets (supplied) must be used on compressor.

2. Piping must be made flexible to avoid noise and vibration transmission which leads to stress fractures. Suction lines should always be insulated when there is a possibility of excessive suction gas temperatures returning to the compressor.

3. Refrigerant charge should be limited to 5 lb. per cylinder or it will be necessary to add a suction accumulator or pump down controls.

4. Maneurop White Oil is the only type that can be used. Piping must be designed for proper oil return. Where long lines are required, an oil seperator should be considered especially for R-22. When exceeding 80 ft., additional oil should be added. On sight glass models maintain oil level at ¼ to ¾ level of glass.

5. Maximum temperature on discharge line 1 inch from compressor is 290° F.

Catch-All®

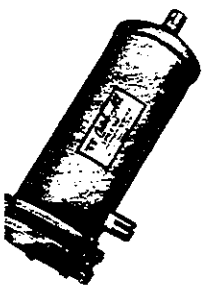
LIQUID LINE RATINGS and SELECTION RECOMMENDATIONS

REFRIGERANT 502

TYPE	SURFACE FILTERING AREA Sq. In.	RATINGS AT ARI STANDARD CONDITIONS: WATER CAPACITY DROPS AT 30 PPM		REFRIGERANT FLOW CAPACITY	SELECTION RECOMMENDATIONS (Tons): REFRIGERATION	AIR CONDITIONING	
		75°F	125°F	Tons at 1 psi	Commercial & Low Temperature Equipment	O.E.M. Self Contained	Field Replacement or Field Build Up Systems
SEALED TYPES							
C-032	9	28	22	0.9	1/4	3/4	1/2
C-032-CAP							
C-032-S							
C-032-F							
C-032-FM							
C-033				2.2			
C-033-S				2.4			
C-052	15	57	52	1.3	1/3	1	3/4
C-052-S							
C-0525-S	15	57	52	1.8	1/3	1½	1
C-053				2.6		2	1
C-053-S				3.9			
C-082	21	94	73	1.3	1/2	1	3/4
C-082-S							
C-0825-S				2.0	3/4	1½	1
C-083	21	94	73	2.9	1	2½	2
C-083-S				3.3			
C-084	21	94	73	4.9	1	4	2
C-084-S				6.0			
C-162	33	167	144	1.3	3/4	2	1
C-1625-S				2.0			
C-163	33	167	144	2.9	2	3	2
C-163-S				3.3			
C-164	33	167	144	6.4	2	5	3
C-164-S				6.9			
C-165	33	167	144	8.7	2	7½	4
C-165-S				10.1			
C-303	53	270	254	2.9	2	4	3
C-304	53	270	254	6.4	3	5	5
C-304-S				6.9			
C-305	53	270	254	9.4	5	7½	5
C-305-S				10.6			
C-307-S	53	270	254	13.7	5	12	7½
C-414	67	355	332	7.2	5	5	5
C-414-S				7.8			
C-415	67	355	332	9.9	7½	7½	5
C-415-S				11.0			
C-417-S	67	355	332	14.0	7½	12	7½
C-419-S				15.3	10	15	12
C-687-S	106	541	507	18.2	10	15	10
C-689-S				20.8		20	
REPLACEABLE CORE TYPES WITH HIGH CAPACITY CORES (RCW-48)							
C-485	64	518	380	9.1	7½	10	7½
C-487				15.0	10	12	10
C-489-G				27.3	10	20	25
C-967	128	1036	760	24.7	15	20	15
C-969				30.5	25	30	25
C-1449	192	1554	1140	37.0	30	35	30
C-14411				43.0	35	40	35
C-19211	256	2072	1520	53.0	50	50	50
C-19213				62.0	55	60	55
C-19217-G				65.0	60	65	60
REPLACEABLE CORE TYPES WITH STANDARD CORES (See Page 14)							
C-R424	67	325	281	7.2	5	7½	7½
C-R425				8.5	5	7½	7½
C-R427				11.7			
C-485	64	162	100	9.1	7½	10	7½
C-487				15.0	10	12	10
C-489-G				27.3	10	20	25
C-967	128	324	200	24.7	15	20	15
C-969				30.5	25	30	25
C-1449	192	486	300	37.0	30	35	30
C-14411				43.0	35	40	35
C-19211	256	648	400	53.0	50	50	50
C-19213				62.0	55	60	55
C-19217-G				65.0	60	65	60
C-30613	294	2610	1770	70.0	70	80	70
C-40017	392	3480	2360	91.0	100	125	100

NOTE: The variation in flow ratings of filter-driers having the same size core and shell is caused by the difference in connection sizes used.

or Suction Line filter-driers
See Page 21



Catch-All®

LIQUID LINE RATINGS and SELECTION RECOMMENDATIONS

REFRIGERANT 22

TYPE	SURFACE FILTERING AREA Sq. In.	RATINGS AT ARI STANDARD CONDITIONS			SELECTION RECOMMENDATIONS (Tons)		
		WATER CAPACITY DROPS AT 60 PPM		REFRIGERANT FLOW CAPACITY	REFRIGERATION	AIR CONDITIONING	
		75°F	125°F	Tons at 1 psi	Commercial & Low Temperature Equipment	O.E.M. Self Contained	Field Replacement or Field Build Up Systems
SEALED TYPES							
C-032	9	26	22	1.4	1/4	1	1/2
C-032-CAP							
C-032-S							
C-032-F							
C-032-FM							
C-033				3.4			
C-033-S				3.7			
C-052	15	57	48	2.0	1/3	1	3/4
C-052-S							
C-0525-S	15	57	48	2.8	1/3	2½	1½
C-053				4.0	1/3	3	2
C-053-S				5.0			
C-082	21	90	75	2.0	1/2	1	1
C-082-S							
C-0825-S				3.0	3/4	2½	1½
C-083	21	90	75	4.4	1	4	2
C-083-S				5.0			
C-084	21	90	75	7.6	1½	5	2
C-084-S				9.3			
C-162	33	144	140	2.0	1½	2	1½
C-1625-S				3.0			
C-163	33	144	140	4.4	2	5	3
C-163-S				5.0			
C-164	33	144	140	9.8	3	7½	5
C-164-S				10.6			
C-165	33	144	140	13.4	3	10	5
C-165-S				15.5			
C-303	53	310	260	4.4	3	5	4
C-304	53	310	260	9.8	5	7½	7½
C-304-S				10.6			
C-305	53	310	260	14.4	5	15	7½
C-305-S				16.3			
C-307-S	53	310	260	21.0	5	20	10
C-414	67	404	338	11.1	5	7½	7½
C-414-S				12.0			
C-415	67	404	338	15.3	7½	15	10
C-415-S				17.0			
C-417-S	67	404	338	21.5	10	20	10
C-419-S				23.5	12	23	15
C-607-S	106	618	518	28.0	15	25	20
C-609-S				32.0		30	
REPLACEABLE CORE TYPES WITH HIGH CAPACITY CORES (RCW-48)							
C-485	64	544	416	14	10	15	10
C-487				23	15	20	15
C-489-G				42	15	30	20
C-967	128	1088	832	38	25	35	25
C-969				47	35	45	35
C-1449	192	1632	1248	57	40	55	40
C-14411				66	50	65	50
C-19211	256	2176	1664	82	70	80	70
C-19213				96	80	100	80
C-19217-G				101	85	100	85
REPLACEABLE CORE TYPES WITH STANDARD CORES (See Page 14)							
C-R424	67	367	288	11	5	7½	5
C-R425				13	7½	15	10
C-R427				18			
C-485	64	245	172	14	10	15	10
C-487				23	15	20	15
C-489-G				42	15	30	20
C-967	128	490	344	38	25	35	25
C-969				47	35	40	35
C-1449	192	735	516	57	40	50	40
C-14411				66	50	60	50
C-19211	256	980	688	82	70	80	70
C-19213				96	80	100	80
C-19217-G				101	85	100	85
C-30013	294	2670	1878	108	100	125	100
C-40017	392	3560	2504	140	130	150	130

NOTE: The variation in flow ratings of filter-driers having the same size core and shell is caused by the difference in connection sizes used.

For Suction L filter-drier: See Page 2

Catch-All®

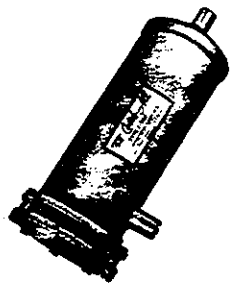
LIQUID LINE RATINGS and SELECTION RECOMMENDATIONS

REFRIGERANT 12

TYPE	SURFACE FILTERING AREA Sq. In.	RATINGS AT ARI STANDARD CONDITIONS			SELECTION RECOMMENDATIONS (Tons)		
		WATER CAPACITY DROPS AT 15 PPM		REFRIGERANT FLOW CAPACITY	REFRIGERATION	AIR CONDITIONING	
		75°F	125°F	Tons at 1 psi	Commercial & Low Temperature Equipment	O.E.M. Self Contained	Field Replacement or Field Build Up Systems
SEALED TYPES							
C-032	9	39	33	1.1	1/4	3/4	1/2
C-032-CAP							
C-032-S							
C-032-F							
C-032-FM							
C-033				2.6			
C-033-S				2.9			
C-052	15	85	74	1.5	1/3	1	3/4
C-052-S							
C-0525-S	15	85	74	2.2	1/3	2	1
C-053				3.0			
C-053-S				4.6			
C-082	21	133	115	1.5	1/2	1	3/4
C-082-S							
C-0825-S				2.3	3/4	2	1½
C-083	21	133	115	3.4	1	3	2
C-083-S				3.9			
C-084	21	133	115	5.9	1½	4	2
C-084-S				7.2			
C-162	33	244	181	1.5	1	2	1
C-1625-S				2.3			
C-163	33	244	181	3.4	2	4	3
C-163-S				3.9			
C-164	33	244	181	7.5	2	5	3
C-164-S				8.2			
C-165	33	244	181	10.3	2	7½	5
C-165-S				11.9			
C-303	53	465	401	3.4	3	4	3
C-304	53	465	401	7.5	3	7½	5
C-304-S				8.2			
C-305	53	465	401	11.1	4	10	7½
C-305-S				12.6			
C-307-S	53	465	401	16.2	5	15	7½
C-414	67	605	525	8.5	5	7½	5
C-414-S				9.2			
C-415	67	605	525	11.8	7½	10	7½
C-415-S				13.1			
C-417-S	67	605	525	16.5	10	15	10
C-419-S				18.1	10	18	12
C-607-S	106	930	802	21.6	15	20	15
C-609-S				24.6		25	
REPLACEABLE CORE TYPES WITH HIGH CAPACITY CORES (RCW-48)							
C-485	64	828	470	10.8	7½	10	7½
C-487				17.7	12	15	12
C-489-G				32.3	12	25	15
C-967	128	1656	940	29.3	20	30	20
C-969				36.2	25	35	25
C-1449	192	2484	1410	43.9	30	40	30
C-14411				50.8	40	50	40
C-19211	256	3312	1880	63.1	50	60	50
C-19213				73.9	60	80	60
C-19217-G				78.0	65	80	65
REPLACEABLE CORE TYPES WITH STANDARD CORES (See Page 14)							
C-R424	67	566	490	8.5	3	5	5
C-R425				10.0	5	10	7½
C-R427				13.9			
C-485	64	590	329	10.8	7½	10	7½
C-487				17.7	12	15	12
C-489-G				32.3	12	25	15
C-967	128	1180	658	29.3	20	20	20
C-969				36.2	25	30	25
C-1449	192	1770	987	43.9	30	40	30
C-14411				50.8	40	50	40
C-19211	256	2360	1316	63.1	50	60	50
C-19213				73.9	60	80	60
C-19217-G				78.0	65	80	65
C-30813	294	4500	2139	83.0	75	100	75
C-40817	392	6000	2852	108.0	110	130	110

NOTE: The variation in flow ratings of filter-driers having the same size core and shell is caused by the difference in connection sizes used.

For Suction Line filter-driers See Page 21



Catch-All®

LIQUID LINE RATINGS and SELECTION RECOMMENDATIONS

U.S. PATENT NUMBER 3,407,617

GENERAL

The selection of a filter-drier for a given application involves such technical factors as: the amount of moisture to be expected in a system — operating temperatures — amount of foreign matter present — allowable pressure drop through the filter-drier — its ability to retain both liquid and solid contaminants, and bursting pressure. Proper evaluation of these factors is necessary for optimum service and economy.

The refrigeration industry has developed a standard for the comparison of filter-driers. However, only two ratings have been published — one for water capacity and one for flow capacity. Until ratings for filtration characteristics, acid removal and other important qualities are established, manufacturers of filter-driers should provide their own test evaluation data and recommendations for various applications. Nevertheless, those who design and service refrigeration systems must make the final choice. As an aid to them, the important factors to be considered for selection purposes are discussed briefly in the following sections.

STANDARD RATINGS ASHRAE-ARI

The American Society of Heating, Refrigerating and Air Conditioning Engineers Standard 63, "Methods of Testing Liquid Line Refrigerant Driers," sets up a test procedure to follow for determining the water capacity and refrigerant flow capacity under certain conditions. The Air Conditioning and Refrigeration Institute subsequently issued ARI Standard 710, which specifies the rating conditions for water capacity, refrigerant flow capacity, and safety requirements.

This Standard is intended to provide ***comparison points only.*** It is a basis for drier evaluation at the specified rating conditions, but does not attempt to govern the performance of a drier over the entire range of possible applications. It serves only to compare driers on their ratings for water capacity, refrigerant flow capacity, and safety requirements.

WATER CAPACITY — is the amount of water (in drops or grams) that a drier will hold at the standard temperatures and equilibrium point dryness (EPD) specified. Twenty drops equal one gram, equal one milliliter or one cubic centimeter.

Equilibrium Point Dryness (EPD) — is used to define the lowest possible water content of a liquid refrigerant attainable by a specific drier at a specific temperature after it has collected a specific quantity of water, when the two have been in contact until an equilibrium between the water in the refrigerant and the water in the drier has been reached. Equilibrium point dryness is expressed in parts per million (ppm) by weight.

REFRIGERANT FLOW CAPACITY — is the maximum flow of liquid refrigerant (in tons) that a drier will pass at a 1 psi pressure drop. The "ton" ratings are based on 86°F. liquid temperature and refrigerant flows of . . .

4.0 lbs. per minute per ton for Refrigerant 12
2.9 lbs. per minute per ton for Refrigerant 22
4.4 lbs. per minute per ton for Refrigerant 502

SAFETY — is based on drier shell bursting pressure. All liquid line driers manufactured under ARI Standard 710 must meet the requirements of Underwriters' Laboratories, Inc., Standard 207, "Refrigerant Containing Components and Accessories, Nonelectrical."

SELECTION

When selecting a filter-drier the following should be considered:

WATER CAPACITY and REFRIGERANT FLOW — comparisons can be made on the basis of ARI Standard data supplied by the manufacturer. ***However, it should be remembered that flow ratings are based on the ideal situation of a completely clean system.*** Flow is reduced as dirt accumulates on the filtering surface.

FILTRATION — Characteristics of a drier are not readily defined or evaluated since a standard does not exist. The ability to filter and ***hold*** foreign matter varies with the brand and type of drier. Until standards are developed, the simplest guide to follow is that filter capacity is proportional to ***filtering area.*** In the tables that follow, the filtering areas of all Catch-All Filter-Driers are tabulated. Filters should be selected with an adequate reserve capacity to allow for the contamination found in most systems.

ACID REMOVAL — is also difficult to measure. There are no standard ratings to follow. However, both laboratory and field tests have demonstrated that the ***Catch-All*** core has far superior acid removal ability — many times that available in other driers.

SPORLAN RECOMMENDATIONS

Sporlan's ***Selection Recommendations*** are based on the technical data currently available and more than forty years of ***field experience*** with molded porous core filter-driers. Satisfactory results will be obtained with the sizes recommended for all normal refrigeration systems. We have considered the difference in requirements for air conditioning and refrigeration applications. Recommendations for these categories are made on pages 6, 7 and 8. Recommendations for suction line use of filter-driers are given on page 21, and a quick reference guide to suction line use is available as Form 40-109.

Drier manufacturers establish ratings for their product, but . . . the final selection of the correct drier should be based on the conditions expected for each job. Consideration should be given to providing extra water capacity and filtering area within economical limits.

FLARING TECHNIQUE — 1) Debur tubing before flaring. 2) Use a drop of oil on the cone of the flaring tool. 3) Place drops of refrigerant oil on the front and back surface of the flare before drawing the nut tight. This allows flare and fitting to mate smoothly. 4) **It is especially important to use oil on joints where both the male and female fittings are copper plated steel. The oil will prevent galling.**

APPLICATION SUGGESTIONS — The Sporlan See•All moisture & liquid indicator should not be used on systems containing **methyl alcohol** or similar liquid dehydrating agents unless an oversize ***Catch-All Filter-Drier*** has been installed previously to remove these additives. Certain colored liquid leak detectors in a system may permanently discolor the element. However, **Dupont Dytel** refrigerant does not cause any problem.

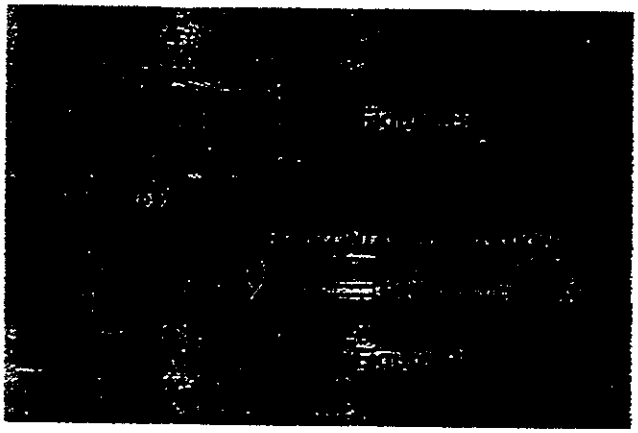
On systems containing an **excessive amount of water,** as a result of a broken condenser or water chiller, do not install the See•All indicator until the Catch-All Filter-Drier or the replaceable cores have been changed several times to reduce the initial high moisture content. Liquid water will dissolve and wash away the color indicator material resulting in a light yellow or white color. This type of damage is permanent — the See•All will no longer change color. If the indicator paper is damaged, it is preferable to change the See•All.

When the See•All is soldered in a **difficult location,** it may be desirable to change only the indicator. This can be done on the newer fused glass models manufactured since 1984. Sporlan kit K-SA-4 consists of a new slotted cylinder and indicator assembly. These parts can be replaced by removing the plug opposite the glass. See Figure-A.

The recommended clean-up procedure **after a hermetic motor burnout** is described completely in Bulletin 40-10. A See•All should be installed after the clean-up procedure is nearly complete (when the Catch-All Filter-Drier is being replaced.)

Do not use See•All indicators at temperatures below −50°F.

BYPASS INSTALLATION — The See•All moisture & liquid indicator may be installed in a bypass to the main liquid line when desired — and must be installed in this manner on lines larger than 2⅛" OD.



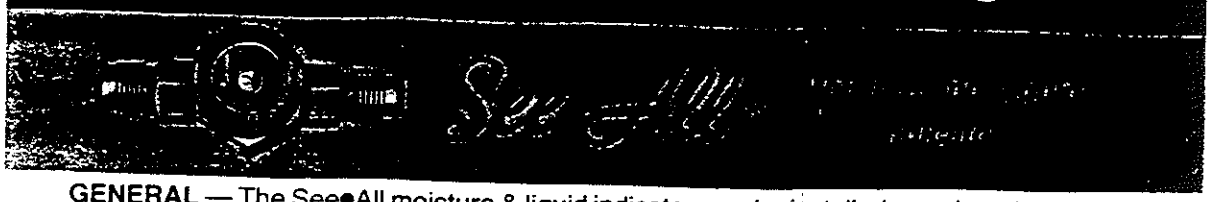
BYPASS INSTALLATION KITS — Are available from your Sporlan Wholesaler. While satisfactory liquid and moisture indication will generally be obtained in any position, preferred methods of installation are shown in Figures B and C.

All Sporlan See•All indicators are suitable for use with the halocarbon Refrigerants, including 11, 12, 22, 113, 114, 134a, 404A, 502, and 507. Listed by **Underwriter's Laboratories, Inc.** and certified by the **Canadian Standards Association** for a working pressure of 500 psi or 3447 kPa (SI units) for Types SA-12 thru SA-19S. The working pressure of Type SA-211 is 460 psi (3171 kPa) and for Types SA-213 and SA-217 the working pressure is 430 psi (2964 kPa).

SPORLAN VALVE COMPANY
206 LANGE DRIVE • WASHINGTON, MO 63090
314-239-1111

 FORM SD-21-500-395

INSTALLATION INSTRUCTIONS



GENERAL — The See•All moisture & liquid indicator may be installed anywhere in the liquid line. When located between the Catch-All Filter-Drier and the expansion device, bubbles indicate a shortage of refrigerant **or** a restriction in the liquid line such as a plugged drier. **Change the Drier When the Color is in Caution or Wet Range.** When received, the indicator may not indicate dry. This in no way affects operation or calibration of the indicator. **The action of the indicator element is completely reversible and will change color whenever the moisture content of the system changes.**

The indicating element may change color rapidly on some installations while others may take a much longer period of time. New systems or systems where the drier has been replaced will cause the indicator to start changing color almost immediately. However, it is recommended that the equipment **operate for 12 hours** to allow the system to reach equilibrium before deciding if the drier should be changed.

The drying of the system should be continued until the indicating element stays **Dark Green.**

The moisture change level of the refrigerant in Parts per Million (PPM) for the various See•All moisture indicator colors is shown below.

MOISTURE CONTENT PPM

for Various Liquid Line Temperatures

Green DRY	Below 5	Below 10	Below 20	Below 30	Below 45	Below 60	Below 50	Below 80	Below 110	Below 10	Below 20	Below 30	Below 15	Below 30
Chartreuse CAUTION	5-15	10-30	20-50	30-90	45-130	60-180	50-200	80-225	110-310	10-45	20-65	30-110	15-90	30-140
Yellow WET	Above 15	Above 30	Above 50	Above 90	Above 130	Above 180	Above 200	Above 225	Above 310	Above 45	Above 65	Above 110	Above 90	Above 140

BRAZING INSTRUCTIONS — See•All moisture & liquid indicators with ¼" through 1⅛" ODF connections are ready for brazing as received. Avoid overheating the body since extreme heat could damage the glass joint. If a wet rag is used it should be wrapped around the fittings and bottom of the body, but not around the top of the See•All body. In this way any moisture inside the See•All will not condense on the cool glass surface and wash away the color indicator material.

The **indicator cartridge** must be removed from the SA-211, SA-213 and SA-217 (1⅜", 1⅝", and 2⅛" line sizes) See•All indicators before brazing into the liquid line. It is shipped hand tight.

All See•All indicators with sweat fittings are suitable for use with any of the **commonly used brazing alloys** including sliver solder, Sil-Fos, Phos-copper, or Sta-Brite.

BRAZING TECHNIQUE — 1) The copper plated steel fittings are clean and ready to braze as received. **Avoid excessive polishing with steel wool** since this may rub off the copper plating and make brazing more difficult. 2) During brazing bleed an inert gas (dry nitrogen or CO_2) through the tubing and See•All. 3) Use a torch that is large enough to rapidly heat the line size being used. 4) Direct the flame away from the See•All body. 5) Perform the brazing as rapidly as possible.

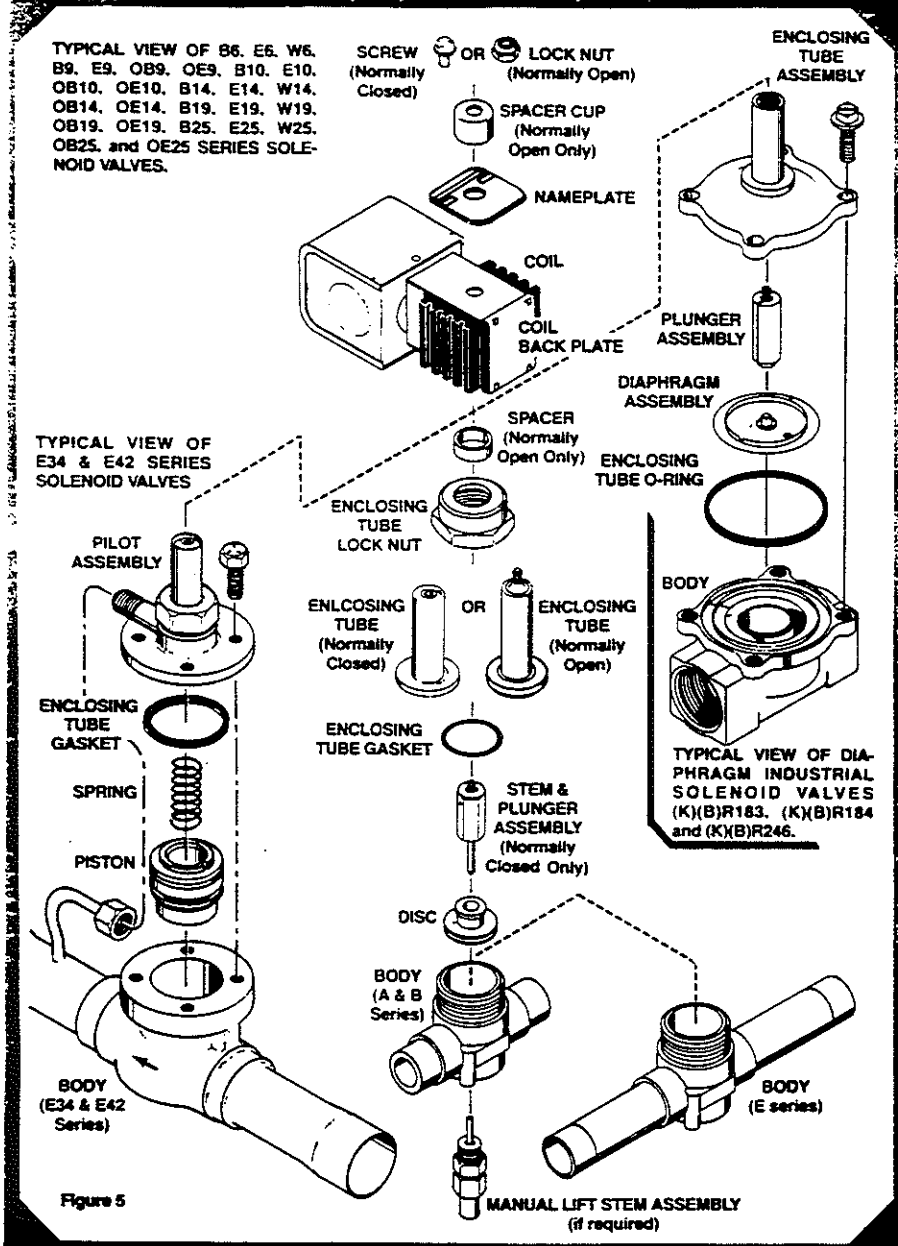


Figure 5

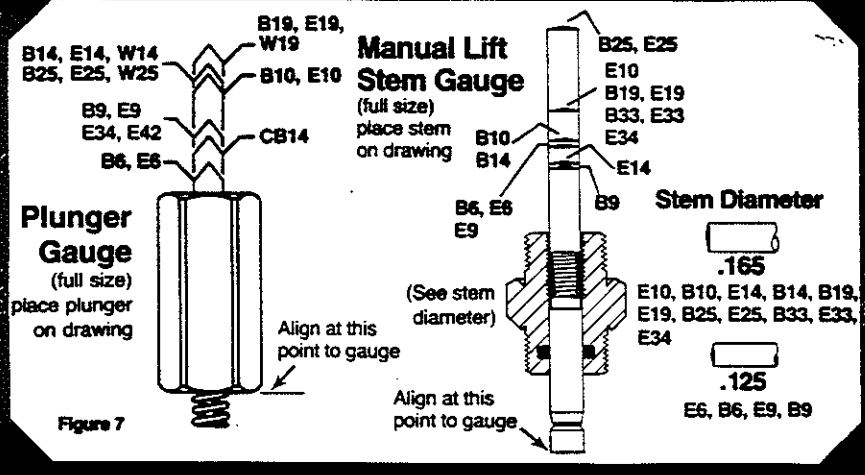
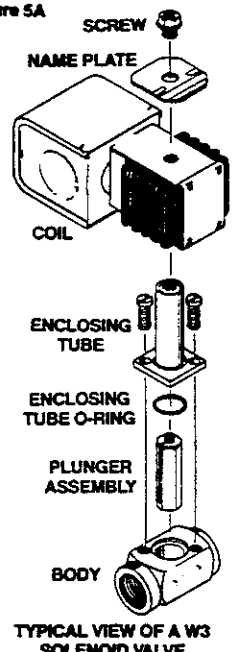


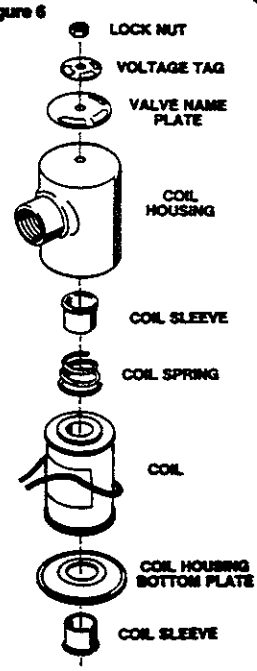
Figure 7

Figure 5A



TYPICAL VIEW OF A W3 SOLENOID VALVE

Figure 6



TYPICAL VIEW OF KC-3 Coil used on valve types: MA5A, MA17A, MA32, MA42 and MA50.

Wiring — Check the electrical specifications of the coil to be sure that they correspond to the available electrical service.

The 1/2" BX conduit connection or junction box on the coil may be rotated to any position by loosening the coil hexscrew. Solenoid valves with four-wire dual voltage coils have a wiring diagram decal, Figure 3, on the coil housing or bracket. This illustrates which wires to connect for either 120, 208 or 240 volt operation. Wiring and fusing (when used) must comply with prevailing local and national wiring codes and ordinances.

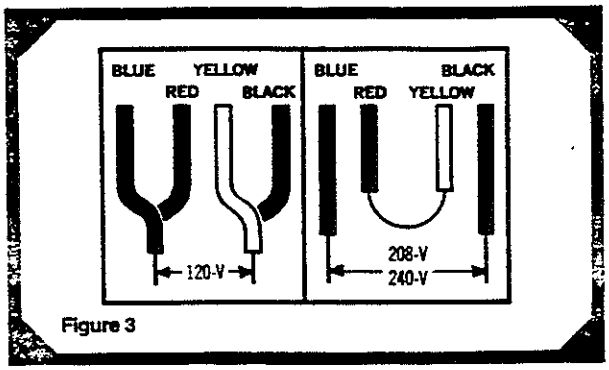


Figure 3

Direct current Valves — A surge protector is supplied with each solenoid valve with a 115 volt DC coil. The surge protector is necessary to absorb the high counter-voltage generated when the circuit is broken, thereby protecting the electrical contacts of the thermostat. It should be wired as shown in Figure 4.

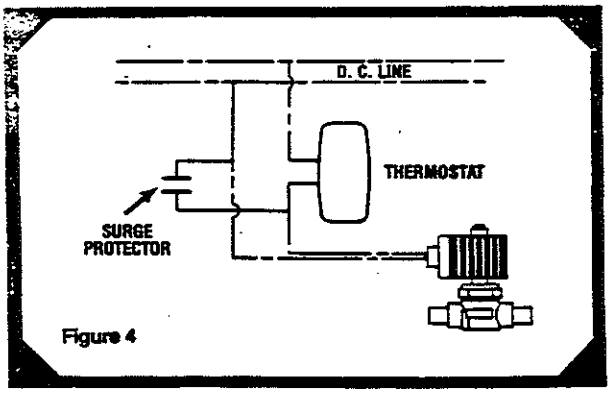


Figure 4

TRANSFORMER SELECTION

MKC-1	1.9	.63	.39	.14	.19	.09	60
MKC-2 OMKC-2	3.1	1.4	.60	.26	.31	.13	100
KC-3	7.9	1.9	1.7	.41	.83	.21	250

SERVICING INSTRUCTIONS

CAUTION—Dangerous hydraulic pressures may develop if a hand valve is installed in the liquid line ahead of the solenoid valve and the hand valve is closed while the solenoid valve is closed. This may cause extrusion of the teflon seat in the disc. Extrusion may cause the valve to fail to open, fail to close and/or have excessive seat leakage. Also the line between these two valves should be pumped down completely before disassembling the solenoid valve for service.

TYPICAL MALFUNCTIONS

There are only three possible malfunctions: 1. Coil burnout. 2. Failure to open. 3. Failure to close. Each is discussed below.

COIL BURNOUT

Coil burnouts are extremely rare unless caused by one of the following:

1. Improper electrical characteristics.
2. Continuous over-voltage, more than 10%.
3. Under-voltage of more than 15%. This applies only if the operating conditions are such that the reduced MOPD causes stalling of the plunger, which results in excessive current draw.
4. Incomplete magnetic circuit due to the omission of parts such as: coil housing, coil sleeves, coil spring, coil housing bottom plate or plunger on the KC model coil and coil yoke, coil backplate or plunger on the MKC molded model coils.
5. Mechanical interference with plunger movement which may be caused by a deformed enclosing tube.
6. Voltage spike.
7. Valve ambient exceeds 120°F.

FAILURE TO OPEN (Normally Closed Types)

1. Coil burned out or an open circuit to coil connections.
2. Improper electrical characteristics.
3. In pilot operated valves, dirt, scale, or sludge may prevent the piston, disc or diaphragm from lifting. This could also be caused by a deformed body.
4. High differential pressure that exceeds the MOPD rating of the valve.
5. Diameter reduction of synthetic seating material in pilot port because of high temperatures and/or pressures, or severe pulsations. Contact Sporlan Valve Co., Washington, Mo.

The problem of dirt can be avoided by installing a Sporlan **Catch-All Filter-Drier** upstream from the solenoid valve. The **Catch-All Filter-Drier** will retain much smaller particles than a conventional strainer.

Use a Sporlan strainer for water applications upstream of every industrial solenoid valve.

FAILURE TO CLOSE

1. Valve is oversized.
2. In pilot operated valves, dirt, scale, or sludge may prevent the piston, disc or diaphragm from closing. This could also be caused by a deformed body.
3. Held open by the manual lift stem.
4. In pilot operated valves only, a damaged pilot port may prevent closing.
5. A floating disc due to severe discharge pulses, contact Sporlan Valve Co., Washington, Mo.
6. Have voltage feedback to the coil after the coil de-energizes.

MISCELLANEOUS

1. **Water Hammer** — Industrial solenoid valves or other quick acting valves may cause water hammer when installed on water lines. If this occurs, it may be minimized by the use of a standpipe installed in the piping near the solenoid valve inlet. Commercially available shock absorbers may also be used to reduce this noise.
2. **AC Hum** — This problem may be caused by a loose coil housing on a KC model coil. On rare occasions this may be caused by loose coil sleeves, in which case deforming them slightly will eliminate the hum. A loose coil hex screw or coil locknut may cause this problem on the MKC molded model coils.

   Foreign material between the magnetic top plug and the plunger in the Types A3, E3, W3, E5, B6, E6, W6, B9, E9, B10, E10, B14, E14, W14, B19, E19, W19, B25, E25, W25, B33, E33, E34 and E42 Series Solenoid valves may cause AC hum also.

On water applications, deposits may accumulate in the valve which could cause AC hum. This may be eliminated by cleaning or flushing the valve.

RECOMMENDED TORQUE (Ft-Lbs)

A3	—	—	—	—	—	2.3	—	—	—	—	—	YES dated 7-86 or later	YES	
E3, E5	—	—	—	—	—	2.3	—	—	—	—	—	YES	YES	
W3		1.5-1.67												
B6, E6, W6	10-15	—	—	—	—	2/3	4.0	—	—	11-12	4.6	YES	YES	
XUP												NO	YES*	
B9, E9, OB9, OE9	15-30	—	—	—	—	2.3	4.0	—	—	11-12	4.6	YES	YES	
XRN												NO	YES*	
B10, E10, OB10, OE10	20-40	—	—	—	—	2.3	4.0	—	—	11-12	4.6	YES	YES	
B14, E14, W14, OB14, OE14														
XRM												NO	YES*	
B19, E19, W19, OB19, OE19	25-45	—	—	—	—	2.3	4.0	—	—	11-12	4-6	YES	YES	
XPO												NO	YES*	
B25, E25, W25	35-60	—	—	—	—	2.3	4.0	—	—	11-12	4.6	YES	YES	
OB25, OE25														
B33	15-30	—	—	—	—	2.3	4.0	8-12	37	11-12	4.6	NO	YES*	
E34									—			YES	YES	
OB33									37			NO	YES*	
OE34									—			YES	YES	
E42, OE42	15-30	—	—	—	—	2.3	4.0	13-20	—	11-12	10-15	YES	YES	
MA5A3	25-50	—	—	—	—	—	4.0	—	24	11-12	10-15	NO	YES	NO
MA17A3		—	—	—	—	—	4.0	—	37	11-12	10-15	NO	YES	NO
MA32	—	—	—	—	—	—	4.0	8-12	74	11-12	10-15	NO	YES	NO
MA42								12-20	74					
MA50								25-35	74					
R183, R184, R246	—	6	—	—	—	2.3	—	—	—	—	—	YES	YES	
8D	10-15	—	35-60	25	—	2.3	—	—	—	—	—	YES	YES	
12D				—	15-18									
16D	30-35	—	***	—	20-24									
10G	10-15	—	35-60	35-60	—									

① Valves with mounting holes use a #8-32 screw torqued not more than 15 in.-lb.
Note: Standard torque charts do not apply. *Coil housing to be no more than 45° from the vertical. **Coil housing must not be below horizontal.
***The 16D pilot assembly is connected to the body with a pipe connection. Apply a light coat of #242 (Blue) Loctite to the male pipe thread and torque to 30-60 ft-lb.

PIPE CONNECTIONS

Types A3, W3, B6, W6, B9, B10, B14, W14, B19, W19, B25, W25, (K)(B)R183, (K)(B)R184, (K)(B)R246 series.

These valves can be installed without disassembly. Avoid excessive amounts of pipe sealing compounds. It will interfere with the valve operation if it comes in contact with the valve's internal parts.

NOTE: When pipe type solenoid valves are installed with pipe to ODF adaptors, the valve must be disassembled prior to brazing the ODF adaptors.

FLANGED CONNECTIONS—PIPE or SOLDER

Solenoid valves with flanged connections may be installed without disassembly. In most cases the flanges are packed disassembled from the valve body. Therefore, they may be installed in the line before the valve is installed. Care must be exercised to be certain that the correct flange is installed on the inlet line in order to properly match the flow direction of the valve. If the valve is installed backwards, it will not function properly.

Types MA5A3, MA17A3, MA32P3, MA42P3, MA50P3

Avoid the use of excessive amounts of pipe sealing compounds. It will interfere with the valve operation if it comes in contact with the valve's internal parts.

Types B33S2, MB33S2, OB33S2, MA42S3, MA50S3

These valves are supplied with a two piece flange assembly, a semi-steel flange ring and a brass solder bushing. The flange should be placed on the pipe before the bushing is soldered or brazed. The soldering discussion given under "Solder Connections" applies for these valves except where the discussion deals with non-flanged valves only.

With Types MA42S3 and MA50S3 care must be exercised to use the correct flange and bushing in order to correspond with its mating flange on the valve for correct flow direction.

These valves have male flange connections on the inlet of the valve; therefore, the flange and bushing for the inlet must be the female pair.

INSTALLATION—ALL VALVES

Mounting — A Type 1216-1 universal mounting bracket, Figure 2, is available, when ordered. It fits all standard Sporlan Solenoid Valves except the Types W3, MA32, B33, E33, E34, E42, MA42, MA50, (K)(B)R183, (K)(B)R184, (K)(B)R246 series and the Type 180 Solenoid Pilot Control. The slots in the bracket will match the tapped holes in the standard solenoid valves so that they may be secured by two screws supplied with the bracket. A locknut is also furnished for use with Types MA5A3 and MA17A3. Both types of installations are shown in Figure 2. The manual lift stem seal cap is replaced after the locknut is tightened against the bracket.

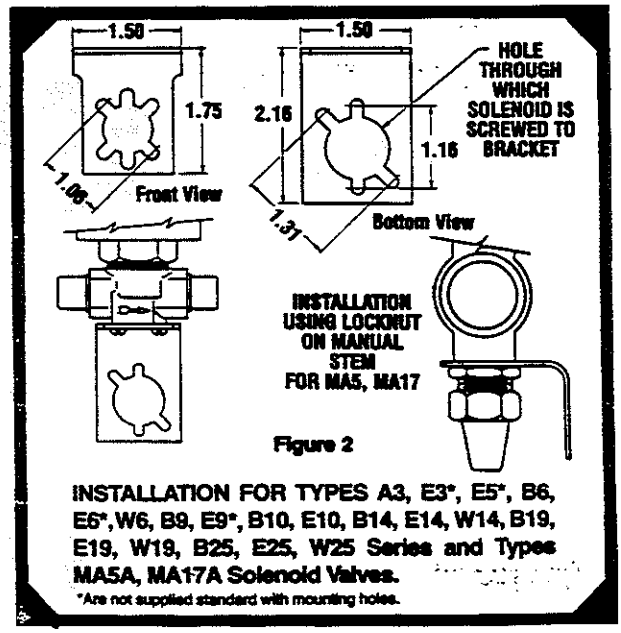


Figure 2

INSTALLATION FOR TYPES A3, E3*, E5*, B6, E6*, W6, B9, E9*, B10, E10, B14, E14, W14, B19, E19, W19, B25, E25, W25 Series and Types MA5A, MA17A Solenoid Valves.

*Are not supplied standard with mounting holes.

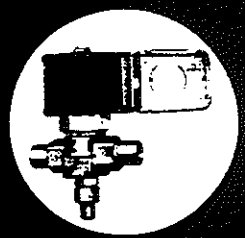
May 1995 / Bulletin 30-11

SPORLAN

SOLENOID VALVES

Installation and Servicing Instructions

NOT FOR USE ON HAZARDOUS OR CORROSIVE FLUIDS



- **The molded MKC-1 coil fits the A3, E3, W3, E5, B6, E6, W6, R183, R184 and R246 series normally closed solenoid valves and all solenoid valves in the field that are equipped with the KC-1 coil.**
- **The OMKC-1 coil fits the XUP series rapid cycle solenoid valves.**
- **The MKC-2 coil fits the B9, E9, B10, E10, B14, E14, W14, B19, E19, W19, B25, E25, W25, B33, E33, E34, E42 series normally closed solenoid valves and the 180 solenoid pilot control . . . and all solenoid valves in the field that are equipped with the old style KC-2 coil.**
- **When changing from the old KC model coils to the current MKC molded model coils, discard the coil housing, coil housing bottom plate, two coil sleeves (not used with KC-1 coil) AND THE SPACER.**
- **The OMKC-2 coil fits the OB9, OE9, OB10, OE10, OB14, OE14, OB19, OE19, OB25, OE25, OB33, OE33, OE34, OE42 series normally open solenoid valves and the XRN, XRM, XPO series rapid cycle solenoid valves.**
- **Other Sporlan Valve products using a molded coil are as follows: MKC-1 — SORIT-12, SORIT-15, SORIT-20, 8D, 12D and 10G. MKC-2 — 16D, DDR-20, SHGB(E)-15, OLDR-15 and OLDR-20. OMKC-2 — LDR-15, LDR-20, XTM and XTO.**

To insure peak performance, solenoid valves must be selected and applied correctly; however, proper installation procedures are equally as important. The following instructions list the essential points for correct installation.

An exploded view of a typical Solenoid Valve is illustrated in Figures 5, 5A and 6, Page 4.

Position — All standard solenoid valves may be mounted horizontal, on its side or in a vertical line with the exception of the following: A3 dated 6-86 or before, MA32, MA42, MA50, MA5A, MA17A, XUP, XRN, XRM and XPO series, which **MUST** be installed in horizontal lines with the coil housing no more than 45° from vertical, see Table on Page 2. The direction of flow is indicated by an **arrow** or the word **IN** on the valve body.

NOTE: Solenoid Valves having a type number starting with the letter "X" are Special Solenoid Valves (non-standard). Contact Sporlan Valve Company, St. Louis if valve mounting is in question.

SOLDER CONNECTIONS

Because of possible damage to valve components due to the high temperatures of soldering and brazing, all Sporlan Solenoid Valves with solder connections are shipped hand-tight to facilitate disassembly with the exception of the following: E Series (Extended End Connections) and Types A3, (M)B33S2, OB33S2, MA42S3 and MA50S3. The following steps outline the recommended procedures to be used when installing these valves.

Soldering Precautions — Solder connections on Sporlan Solenoid Valves are either copper or brass. Any of the commonly used types of solder are satisfactory with these materials. Regardless of the type of solder used, it is important to avoid over-heating the valve.

In all cases it is necessary that the valve be completely disassembled before any heat is applied to the valve body with the exception of the following: E Series (Extended End Connections) and Types A3, (M)B33S2, OB33S2, MA42S3 and MA50S3.

The tip of the soldering torch should be large enough to avoid prolonged heating of the connection during the soldering operation. Overheating can also be minimized by directing the flame away from the valve body.

Type A3S1

1. Remove the coil assembly.
2. Locate the word **IN** or the directional **arrow** on the valve body.
3. Place the valve in the line in the proper direction of flow and solder.
4. Replace the coil assembly and tighten coil hex screw.

Types B6, B9, B10, B14, B19 and B25 Series

1. Remove the coil assembly, enclosing tube and nut, all internal parts, and manual lift stem assembly.
2. Locate the word **IN** or the directional **arrow** on the valve body.
3. Place the valve in the line in the proper direction of flow and solder.

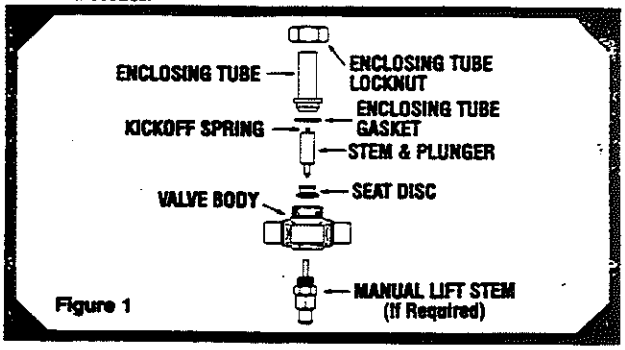


Figure 1

4. Re-assemble as follows, see Figures 1, 5, and 5A:
   a. Place the seat disc into the valve body with the smaller diameter end facing up.
   b. Place the enclosing tube gasket onto the valve body above the threads.
   c. Hold the plunger with one hand so that the pointed end is resting in the pilot port of the disc. Make sure the small spring is in place on the top of the plunger. **(NOTE: Does not apply to normally open and rapid cycle series.)**
   d. With the other hand, place the enclosing tube over the plunger, making sure the enclosing tube gasket is in position.
   e. Replace the enclosing tube locknut and tighten. (See recommended torque in the table below.)
   f. Replace manual lift stem and tighten.
   g. Replace the coil assembly. **(NOTE: For normally open and rapid cycle valves replace spacer and spacer cup with coil assembly.)**

NOTE: Because of the enclosing tube gasket construction, excessive tightening of the enclosing tube locknut is not required. Please observe the torques listed on Page 2.

Types: All E Series (Extended End Connections)

May be brazed into the line without disassembly because the valve contains extended connections. Use caution by placing a wet rag or chills on the extensions at the body to prevent excessive overheating. Follow type A3S1 installation instructions.

9. Now place the spring guide stamping (when used), and spring, in the pin carrier, place the lower spring guide on the opposite end of the spring and screw the bottom cap in place. (Replace the pin guide, spring, and bottom cap assembly together on Type BF/EBF and BS/EBS valves). After screwing bottom cap assembly in place, carefully tighten, preferably with two 10" wrenches, to seal the metal-to-metal knife edge joint. The sealing surfaces should be free of any foreign material or nicks that might prevent a leak-tight joint.

10. On valves with replaceable elements (except Types O, BF/EBF, and BS/EBS), place the pushrods into the body and open the valve several times by pressing down on the pins with a flat metal surface. This will help seat the pin properly.

11. Check the height of the pushrod(s) above the element sealing surface with the pushrod gauge (see Figure 12). The gauge is supplied with internal parts kits or can be obtained at no charge upon request. (Since the internal parts of the Type BF/EBF and BS/EBS valves cannot be replaced, it is not necessary to check the pushrod height of these valves.)

Illustration Showing Use of Gauge

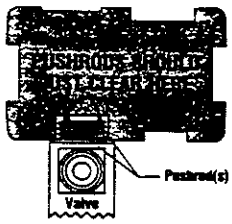


Figure 12

The appropriate gauge numbers for the various TEV's are given in Table 9.

CAUTION: If the element-to-body joint utilizes a gasket, the gasket must be removed before checking pushrod height.

If the pushrod(s) are too long, they must be carefully ground off to the proper length. Clean the pushrod(s) of all dirt and grindings and place them into the body.

12. **ELEMENT REPLACEMENT** — If the element is damaged or has lost its thermostatic charge, replace it with the same type.

To properly replace the element without damaging the element or the valve body on valves which utilize a gasketed joint, be sure only one gasket is used before assembling the element. In assembling gasketed elements held in place by two cap screws, be sure to pull up the cap screws evenly.

On valves which utilize the threaded type of element with metal-to-metal knife edge joints, always use an appropriate wrench (10") on the wrench flats. **DO NOT** use a wrench on the outer welded edge of the element. The sealing surfaces should be free of any foreign materials or nicks that might prevent a leak-tight joint. A few drops of refrigerant oil on the element threads will facilitate easy assembling and removal.

13. Return the superheat spring adjustment to its original position. Replace the seal cap tightly.

TABLE 9

VALVE TYPE①		USE GAUGE NO.
CURRENT	OBSOLETE	
AA(E), LMC-AA(E)	—	1
DA(E), LMC-DA(E)	—	2
PFE or HFE-1½, 3, 4, 5, 8, 12	PFE or HFE-6, 7½, 10, 11	3
PVE or HVE-2½, 5½, 7, 11, 16, 20	PVE or HVE-2, 5, 8, 10, 12, 15, 17, 18	
PDE or HDE-5, 8, 14	PDE or HDE-6, 7½, 9, 12, 13	
PRE or HRE-1½, 4 6½, 9, 12	PRE or HRE-6, 7½, 11, 13	
—	UFE-12, 17	
	UVE-22, 30	
	UDE-15, 21	
	URE-16, 22	
OFE-23, 32, 40	UFE-23	3A
OVE-40, 55, 70	UVE-40	
ODE-28, 40, 50	UDE-28	
ORE-30, 35, 45	URE-30	
All F Models② except FF(E)-⅛, FV(E)-¼, FD(E)-⅛, FR(E)-⅛	—	4
All G Models except GF(E)-⅛, GV(E)-¼, GR(E)-⅛	All Small K Models	5
All X Models	—	
MFE-5, 7½, 11, 13, 15, 20	MFE-12, 17	6
MVE-8, 12, 18, 21, 26, 34	MVE-30	
MDE-6, 9, 13, 15, 18, 25	MDE-14, 20	
MRE-9, 15, 20, 25	—	
KFE or VFE-45, KVE or VVE-70		
KDE or VDE-55, KRE or VRE-50		
MFE-25	MFE-22	7
MVE-42	MVE-40	
MDE-30	MDE-26	
MRE-30	—	
KFE or VFE-35, 55	VFE-50	
KVE or VVE-52, 100	VVE-90	
KDE or VDE-40, 65	VDE-42, 60	
KRE or VRE-38, 70	—	
WFE-80, 110	WFE-75, 100	
WVE-135, 180	—	
WDE-95, 130	WDE-90, 120	
WRE-100, 130	—	
CF(E) or SF(E)-¼, ½ 1, 1½, 2, 2½, 3	R and T Models with 83 Elements	8
CV(E) or SV(E)-½, 1, 1½, 2, 3, 4, 5		
CD(E) or SD(E)-¼, ½ 1, 1½, 2½, 3, 3½		
CR(E) or SR(E)-¼, ½, 1, 1½, 2, 3, 4		
CFE-5, SFE-5, 6	—	8A
CVE-8, SVE-8, 10		
CDE-6, SDE-6, 7		
CRE-6, SRE-6, 7		
OFE-6, 9, 12		
OVE-10, 15, 20		
ODE-7, 11, 14		
ORE-6, 9, 12		
OFE-16, OVE-30 ODE-20, ORE-21③	—	8B

① Type F (internally and externally equalized) valves dated D84 or later, Type S valves dated B69 or later, Type C valves dated C70 or later, and all Type G (externally equalized only) and X valves have packless pushrod construction and internal parts kits are not available for use with them.

② Applies only to Type F valves with a replaceable element.

③ Formerly used the KT-33-8 element and gauge number 33-8 (redesignated 8B). The KT-33-8 element has been replaced by the KT-83.

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FIELD ASSEMBLY INSTRUCTIONS

Sporlan Valves may be opened easily for inspection

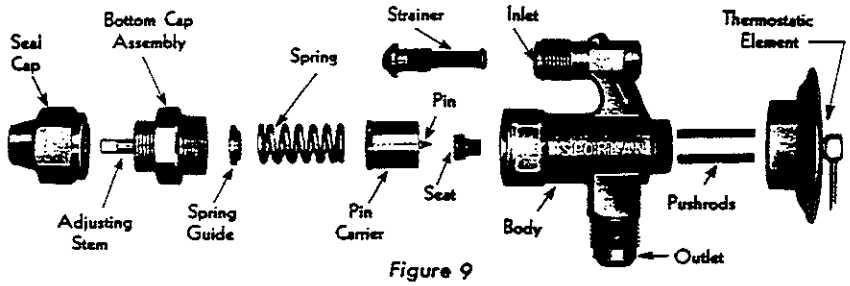


Figure 9

NOTE: These field Assembly Instructions apply in part to all Sporlan TEV's. See Figure-9 for an "exploded" view of those models that can be completely disassembled. When a thermostatic expansion valve is to be disassembled for inspection and cleaning, or for replacement of the thermostatic element or the internal parts, the following information should be reviewed for assistance.

Types F dated approximately C84 or earlier, I, BI, NI, and FB **do not** have replaceable elements nor internal parts kits, but can be disassembled for inspection and cleaning. Type F (internally & externally equalized) dated D84 or later, Type S valves dated B69 or later, Type C valves dated C70 or later, and ALL Type G, X, BF/EBF and BS/EBS valves have packless pushrod construction (externally equalized only) and internal parts are NOT available for use with them. However, their elements can be replaced and they can be disassembled for inspection and cleaning. Due to the single pushrod construction of the Type BF/EBF and BS/EBS valves, only the bottom cap assembly, pin guide, and superheat spring may be removed for inspection and cleaning. Early production of the Type F valve with the replaceable element requires a 15/16" **thin jaw,** open end type element wrench such as a Bonney 1230. Subsequent production of the Type F valve and all Type BF valves require a 1" **thin jaw,** open end type element wrench such as a Bonney 1232. An open end wrench is necessary because of limited space between the body and element of Types F and BF valves. Precautions must be taken in removing the KT-43 element (F) so the element, body, or connections are not damaged by the wrenches.

While standard open end or adjustable wrenches fit the other element sizes, the **thin jaw** type wrenches are also available for the other element sizes: Bonney 1236 (1-1/8") for KT-53 elements, Bonney 1240 (1-1/4") for KT-83 elements, Bonney 1248 for KT-33 elements, and Bonney 1252 for KT-63 & 7 elements.

Replaceable elements and internal parts kits are available for current valves with ***packed*** pushrod construction: Types P, H, M, D, and A.

Replaceable elements for Types O, V, W, and U are also available. However, special field assembly instructions are included with their internal parts kits.

ASSEMBLING INSTRUCTIONS

The following steps are necessary in properly disassembling, inspecting, cleaning, and reassembling a TEV whether the valve is in or out of the refrigerant piping.

1. Before disassembling the valve, be sure the refrigerant pressure in the system has been reduced to a safe level (0 psig).
2. Remove the seal cap and turn the adjustment stem counter-clockwise to relieve the spring force. Count and record the number of turns so adjustment can be returned to its original position.
3. Using appropriate wrenches or a vise to properly suppo the valve body, remove the element (if a replaceable typ the bottom cap assembly, and the internal parts. (On remove the bottom cap, pin guide, and superheat spri on Type BF/EBF and BS/EBS valves. **DO NOT** remove t single pushrod from these valves.)

   CAUTION: Regardless of whether the valve is in t system or in a vise, care must be taken to prevent d torting the body by exerting too much pressure tightening the element or in clamping the body in t vise. Also, do not use a wrench on the outer weld edge of the element.
4. Inspect parts, element, and body for any forei materials or physical damage.
5. On valves with replaceable elements and/or intern parts, replace any items that appear damaged.
6. Clean all parts with solvent, preferably by applyi and then blowing off with clean dry compressed air.

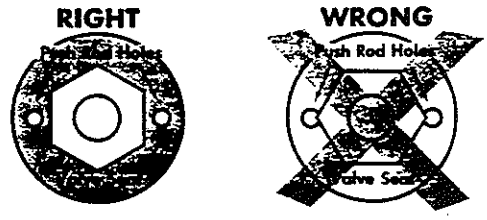
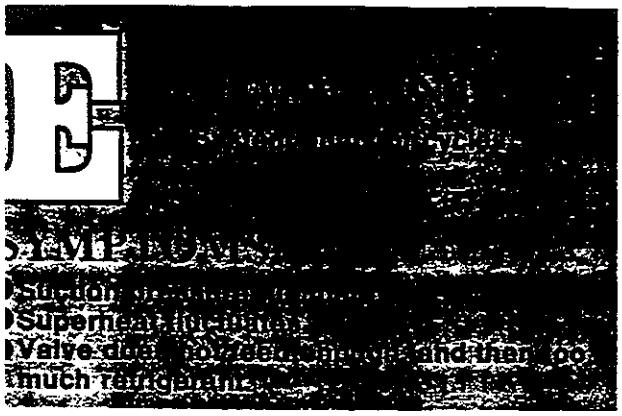


Figure 10

7. To reassemble valves with replaceable seats, screw s into body with a fairly light pressure since it does require a heavy pressure to make this small kn edge joint.

   CAUTION: Be sure hexagon corners of seat do not p trude into pushrod holes (see Figure-10).

   For valves that do not have replaceable elements for Type O valves, place the pushrod(s) into the bc now.
8. Next, slip the pin and carrier (which have been press together at the factory) into the body and tap the p into the seat to form a true seating surface. It is g erally advisable, before tapping these parts togeth to check the concentricity of both the pin and seat engaging the parts by pressing them lightly togetl with one finger and noting that there is no tender to stick together. This should be repeated several tin after rotating the pin carrier a quarter of a turn. assembling valves with port sizes of ¼" and lar which use the flat disc instead of the tapered pin, I **NOT TAP THE DISC AGAINST THE SEAT.**



THE CAUSE MAY BE:

. **SYSTEM CHARACTERISTICS** — Certain design characteristics of the system may have an effect on the system's tendency to hunt or cycle. As an example, after the valve admits refrigerant to the evaporator inlet, there is a time delay before the bulb senses the effect at the evaporator outlet. This time delay is dependent on evaporator length, tube size, and load. Generally, there is more likelihood for hunting to occur when this time interval is long. Other influencing factors are circuit arrangement, load per circuit, and temperature difference.

EMEDY — When hunting is moderate particularly with o floodback, the effect on the system is insignificant nd corrections are not necessary. If hunting is severe vith floodback to the compressor, check the possible remdies shown in Paragraphs below.

. **VALVE SIZE** — An over-sized valve usually aggravates hunting. Carefully check the valve rating considering all the factors affecting its capacity. See Page 14, Bulletin 10-10, or Page 12, Form 10-56.

EMEDY — Replace valve with one correctly sized. On nultiple circuit evaporators using a refrigerant distributor, the capacity of the valve can be reduced, within ertain limits, by installing a smaller distributor nozzle. See Bulletin 20-10.

. **BULB LOCATION** — If the bulb is located in a suction line trap, its temperature will be affected by liquid oil and refrigerant alternately collecting and evaporating at this point. This condition frequently results in severe hunting.

EMEDY — As a temporary measure relocate the bulb way from the trap, and any turbulent areas created by lbows, tees, etc. Also remove the bulb from the air tream or insulate. Re-pipe if necessary. Sometimes anther position around the circumference of the suction ine will minimize hunting.

ollow the Bulb Installation Instructions given on Page for the best thermostatic expansion valve control.

. **REFRIGERANT and LOAD DISTRIBUTION** — In addition to the effects of poor distribution explained in Paragraphs **D-1** and **D-2**, hunting also frequently results. This is caused by liquid refrigerant from the overfed circuits occasionally reaching the bulb of the valve.

EMEDY — Correct the faulty distribution.

---

5. **SUPERHEAT ADJUSTMENT** — All Sporlan thermostatic expansion valves are preset at the factory to give the best performance on the average system. A valve should not be adjusted unnecessarily, but occasionally another setting may prove to be better.

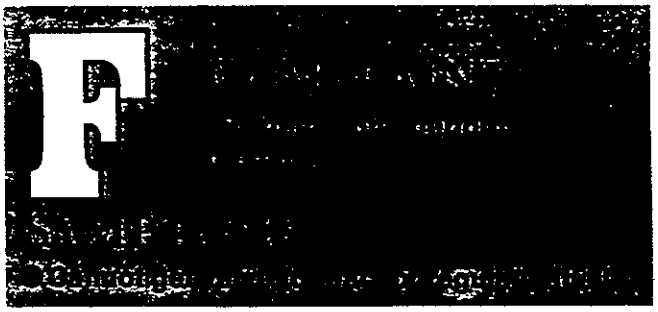
REMEDY — Turn the adjusting stem clockwise a turn at a time. If the hunting stops or is reduced, turn the adjusting stem counter clockwise a turn at a time to obtain the lowest superheat with stable operation.

---

6. **MOISTURE** — As ice forms in a thermostatic expansion valve from excessive moisture, a very erratic hunt may result.

REMEDY — Remove the moisture with the installation of a Sporlan Catch-All Filter-Drier. A safe moisture level can be determined by installing a Sporlan See•All.

★ **When system has some form of capacity reduction — cylinder unloaders or hot gas bypass, a low suction pressure will not exist. Therefore, when checking TEV performance, a better analysis is possible when these devices are locked out or shut off so the suction pressure will respond to variations in load or valve feed.**



THE CAUSE MAY BE:

1. **No refrigerant being fed to evaporator.** See Section **A** on Pages 6 & 7.
2. **Too much refrigerant being fed to evaporator.** See section **B** on Page 8.
3. **Too much refrigerant being fed to evaporator at start-up only.** See Section **C** on Page 9.
4. **Refrigerant control is erratic.** See Section **D** on Page 9.
5. **System is hunting or cycling.** See Section **E** above.
6. **The thermostatic expansion valve has been physically abused in an effort to make the valve work properly.** This is usually the result of a mistaken analysis. It is frequently assumed that if a valve does not feed properly, it is stuck (either opened or closed). Beating the valve body with a hammer will only distort the body and make it impossible for the valve to work once the real cause is determined.

   If a valve "sticks," it is usually due to moisture freezing in the port, dirt and other foreign material restricting or plugging the internal parts, wax forming on the internal parts at low temperatures, or the valve has been physically abused so it **cannot** function.

REMEDY — Inspect the valve and its internal parts, including the inlet strainer. If plugged or restricted in any way, clean the parts thoroughly, oil the parts with a good grade of refrigerant oil, and reassemble the parts. Complete details on this subject are found on Pages 11 and 12.

If the valve is beyond normal cleaning processes, or if it is physically damaged in any way, replace the valve with its proper replacement model.

REMEDY — Keep compressor or suction line warm during the off-cycle. Some compressors are equipped with crankcase heaters for this purpose. Another corrective measure is to install a suction line solenoid valve that is de-energized during the off-cycle.

3. **RESTRICTED or PLUGGED EXTERNAL EQUALIZER** — A momentary flood can occur when the load increases suddenly, such as at start-up because the higher suction pressure cannot reach the underside of the diaphragm and help close the valve. If the pressure under the diaphragm increases due to any pressure leakage around the pushrods, the valve will eventually throttle.

REMEDY — Remove the restriction or plugged portion of the external equalizer.

4. **LIQUID LINE SOLENOID VALVE SEAT LEAK or INTERRUPTED PUMPDOWN** — Liquid refrigerant can continue to feed the TEV and/or remain in evaporator upon shut-down causing flood-back to the compressor upon start-up.

REMEDY — Disassemble and clean solenoid valve and/or replace damaged internal parts if seat leakage is the problem. If the pumpdown cycle isn't completed before the compressor cycles off, or the thermostat calls for cooling and reopens the liquid line solenoid before the evaporator has been properly evacuated, check the low pressure cut-off setting or the electrical controls for possible causes.

5. **ANY ONE or MORE OF THE CAUSES SHOWN in SECTION B on PAGE 8.**

REMEDY — See Section B, Page 8.

THE CAUSE MAY BE:

1. **UNEQUAL CIRCUIT LOADING (Multi-circuit evaporators and parallel evaporators connected to a single refrigerant distributor)** — When each circuit is not subjected to the same heat load, the lightly loaded circuits will allow unevaporated refrigerant or low temperature vapor to enter the suction line and throttle the valve. This will cause normally loaded circuits to be deprived of their share of refrigerant. The net result is a loss of refrigerated evaporator surface.

REMEDY — Make necessary modifications which will low each evaporator circuit to receive the same perc age of the total load. See Bulletin 20-10 for applica information on multi-circuit evaporators using a ref erant distributor.

2. **POOR REFRIGERANT DISTRIBUTION (Multi-cir evaporators and parallel evaporators connectec a single refrigerant distributor)** — If the refriger distribution is faulty, the circuits receiving the lar portion of refrigerant will have the controlling fluence on the thermostatic expansion valve. The sult is the same as in Paragraph 1 above.

REMEDY — Correct refrigerant distribution. See Bull 20-10 for complete information on Refrigerant I tributors.

3. **LOW LOAD** — Low evaporator load may be caused insufficient air over the coil as a result of an unc sized blower, dirty air filters, or an obstruction in air stream. In addition, frost formation on the coil low entering air temperatures will reduce the ev orator load.

REMEDY — Correct the condition responsible.

4. **FLOW FROM ONE COIL AFFECTING THERMOSTA EXPANSION VALVE BULB OF ANOTHER (Multi evaporator systems only)** — The temperature of bulb may be falsely influenced by flow from anot evaporator usually because of incorrect piping.

REMEDY — Correct the piping. See Figure-4, Page 2.

5. **IMPROPER COMPRESSOR-EVAPORATOR BALAN** — If the compressor is too large for the load and ev orator capacity, the low suction pressure which resu will cause poor system performance.

REMEDY — Consult with the manufacturer or consult engineer, or the ASHRAE Equipment Handbook on c ponent balancing. If necessary, change or correct the properly sized component. Hot gas bypass may be u to balance properly.

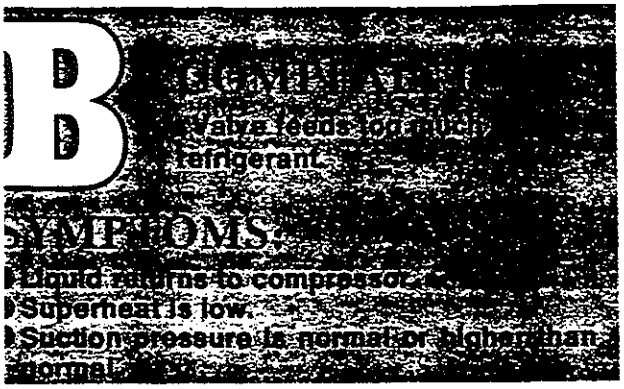
6. **EVAPORATOR OIL-LOGGED** — Poor heat tran occurs and unpredictable performance takes plac erratic performance is observed over a period of ti and other causes are omitted from considerati review the amount of oil in the system. Turbulent c pressor oil level with little or no return to the c pressor sump indicates oil problems.

REMEDY — Remove excessive oil from evaporator connecting piping. Many times the evaporator temp ture will be too low for the oil to be removed. Therefo the system must be allowed to warm sufficiently to get oil to drain. Analyze system components for poss causes of oil problem before restarting the system. C sult with the compressor manufacturer for specific det on their compressor.

★When system has some form of capacity reduction — cylinder unloaders or hot gas bypass, a low suction pressure will not exist. Therefore, w checking TEV performance, a better analysis is possible when these devices are locked out or shut off so the suction pressure will respor variations in load or valve feed.

1. **RESTRICTED, PLUGGED, OR CAPPED EXTERNAL EQUALIZER** — If the pressure under the diaphragm builds up due to pushrod leakage and cannot escape through the external equalizer line, the valve will remain closed.

EMEDY — Check the external equalizer line to be sure is open or not capped.



THE CAUSE MAY BE:

1. **MOISTURE** — Water or a mixture of water and oil frozen in the valve port or working parts of the valve will prevent proper operation. This is the most common source of trouble on thermostatic expansion valves. Since the valve is the first cold spot in the system, moisture will freeze and block the valve open, closed, or any position in between. If the valve is held in the open position by ice, liquid flood-back will occur.

REMEDY — Install a Sporlan Catch-All Filter-Drier in the liquid line for removal of moisture from the refrigerant and oil. See Bulletin 40-10.

For additional protection, install a Sporlan See•All Moisture and Liquid Indicator for a positive indication of when a safe moisture level is reached. See Bulletin 70-10.

2. **DIRT or FOREIGN MATERIAL** — Contaminants such as copper oxide scale, metal chips, oil breakdown sludge, etc. may pass through ordinary strainers and lodge at the thermostatic expansion valve port and prevent the valve from closing.

REMEDY — Disassemble the valve and remove all foreign material from the internal parts. Install a Sporlan Catch-All Filter-Drier in the liquid line. The Catch-All filters out the smallest particles of foreign material that might possibly interfere with the operation of any system component.

3. **EXPANSION VALVE SEAT LEAK** — When the valve port does not seat tightly, refrigerant will pass through during the off-cycle and fill the evaporator with refrigerant. If the seat leak is severe, the valve will feed too much refrigerant during the operating cycle as well. (Not applicable to valves with permanent bleed ports or RPB feature.)

REMEDY — If the valve seat is leaking, a gurgling or hissing sound can usually be heard during the off-cycle. Also, a sight glass or See•All in the liquid line may indicate continued refrigerant flow for a long period after the compressor has stopped. Make certain however, that the bubbles are not the result of ***back-flow*** through a vertical liquid line.

Disassemble the valve to be certain that dirt or foreign material is not responsible (see **B-2**). If the pin and seat are worn or damaged and an internal parts kit is available, replace the parts. When parts are not available, the valve must be replaced.

4. **OVERSIZED VALVE** — Check valve ratings considering all the factors which affect its capacity. See Page 14, Bulletin 10-10, or Page 12, Form 10-56.

REMEDY — Install correctly sized valve.

5. **INCORRECT BULB INSTALLATION** — The bulb should be securely fastened to a straight, clean, section of the suction line using two bulb straps for good thermal contact. Also, the temperature of the bulb should not be influenced by ambient temperature — an external heat source such as a steam pipe or heating coil.

REMEDY — Install bulb correctly. See Installation Instructions, Page 2.

6. **LOW SUPERHEAT ADJUSTMENT**

REMEDY — Turn the adjusting stem clockwise until the correct superheat is indicated. See Page 4.

7. **INCORRECT THERMOSTATIC CHARGE**

REMEDY — Select and install the correct selective charge. See Page 15, Bulletin 10-10, or Page 13, Form 10-56.

8. **INCORRECTLY LOCATED EXTERNAL EQUALIZER**

REMEDY — Relocate external equalizer or connection between evaporator and any temperature or pressure sensitive evaporator control valve near bulb location. See Page 3 for recommendations.

9. **INEFFICIENT COMPRESSOR** — If the compressor is inefficient or for some other reason lacks capacity, the suction pressure will operate higher than normal. This may or may not be accompanied by low superheats.

REMEDY — Consult with compressor manufacturer.

THE CAUSE MAY BE:

1. **REFRIGERANT DRAINAGE** — Drainage of refrigerant from the evaporator (during the off-cycle) when installed at a higher level than the compressor.

REMEDY — Install a trap-riser to top of evaporator or use pump-down control. See Figure-5.

2. **COMPRESSOR or SUCTION LINE IN COLD LOCATION** — During the period when the system is not in operation, liquid refrigerant will condense at the coldest point in the system. Liquid will condense in the compressor or suction line, if they are located in an ambient temperature below that of the evaporator during the off-cycle. Upon re-starting, this liquid will slug the compressor.

glass in the liquid line will show bubbles when the system is short of refrigerant charge. Before adding more refrigerant however, be sure the bubbles are not produced by other causes (See Paragraphs **A-2** and **A-5**).

A lack of refrigerant charge may also be detected by a hissing sound at the thermostatic expansion valve. Some systems not equipped with a liquid line sight glass will have test cocks or other devices for checking the refrigerant level in the receiver.

REMEDY — Add enough refrigerant to obtain desired result.

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5. **GAS IN THE LIQUID LINE** — As explained in Paragraphs **A-2** and **A-4** above liquid line vapor can be produced by a partially plugged strainer or drier and by a shortage of refrigerant charge. In addition, gas in the liquid line can be caused by air or other non-condensable gases in the system or by excessive pressure losses in the liquid line as a result of:

   a. Long or undersized line.

   b. Liquid line vertical lift.

REMEDY — Verify the correct liquid line size for the equivalent length and system tonnage. Consult liquid line sizing data published in many manufacturers' catalogs and in text books. If undersized, repipe with the correct size.

Determine amount of vertical lift, and obtain the resulting pressure loss from Table-2, Page 14, Bulletin 10-10, or Page 12, Form 10-56. From Table-6, Page 16, Bulletin 10-10, or Page 14, Form 10-56 find required subcooling necessary to prevent gasification with the existing pressure losses. Provide the necessary subcooling by using one of the methods described on Page 1.

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6. **MISAPPLICATION OF INTERNALLY EQUALIZED VALVE or INCORRECT LOCATION OF EXTERNAL EQUALIZER** — If the pressure drop through the evaporator exceeds the predetermined values shown in Table-1, Page 9, Bulletin 10-10, or Page 7, Form 10-56, an externally equalized valve must be used. When an externally equalized valve is used, the equalizer connection should be made at a point in the suction line that will reflect the pressure existing in the line at the bulb location.

REMEDY — Replace internally equalized valve with one having an external equalizer.

If external equalizer is installed incorrectly, change to correct location. See Page 3.

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7. **INSUFFICIENT PRESSURE DROP ACROSS VALVE** — One of the factors that influence expansion valve capacity is the pressure drop that exists between the inlet and outlet. Anything contributing to a reduction in this pressure drop will reduce valve capacity. Abnormally low condensing pressures, excessive liquid line pressure losses (even with adequate subcooling), undersized distributor nozzle or distributor tubes may also be responsible for a very low net pressure drop across the valve port.

REMEDY — Remove source of pressure loss, or install valve with adequate capacity at the reduced pressure drop. If inlet pressure to valve is low due to low condensing pressure, raise pressure.

If the refrigerant distributor nozzle is undersized replace with correct size. See Bulletin 20-10.

8. **DEAD THERMOSTATIC ELEMENT or WRONG THE MOSTATIC CHARGE** — If the element has partia or completely lost its thermostatic charge, the val will be unable to feed sufficient refrigerant or will main closed. A wrong charge may cause insufficie feed also.

REMEDY — Replace the element if it is dead. If charge incorrect, replace with proper selective charge — S Pages 3 to 7, Bulletin 10-10; or Pages 1 to 5, Form 10-5

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9. **CHARGE MIGRATION (TYPES P, VGA and CHARGES ONLY)** — In order for valves with the charges to maintain control at the bulb, the bulb mu be kept at a lower temperature than the eleme (diaphragm case). If the thermostatic charge dc migrate to the element because of a lower eleme temperature, the valve will throttle.

DETECTION — Warm the element with a cloth saturated with hot wa If this produces more refrigerant feed and reduces the superh to normal, charge migration is responsible for the starved evapora

— CAUSES —

a. Insufficient pressure drop between the val outlet and bulb location, possibly due to an ov sized distributor nozzle or no nozzle at all.

b. Excessive pushrod leakage, which allows the lea ing refrigerant to cool the diaphragm case bef passing into the equalizer line. This is a rare occ rence and should be carefully checked before arr ing at this conclusion.

c. Cold location of thermostatic expansion valve, condensate drippage on the diaphragm case.

— REMEDIES —

a. Install distributor nozzle correctly sized in accordar with nozzle sizing procedure given in Sporian Bulle 20-10.

b. On valves with packed pushrod construction, remc element and tighten the pushrod packing nuts.

c. Relocate the thermostatic expansion valve away fr cold outlet air, or condensate drippage.

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10. **UNDERSIZED VALVE**

REMEDY — Install valve sized in accordance with pr dure given on Page 14, Bulletin 10-10, or Page 12, F 10-56.

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11. **HIGH SUPERHEAT ADJUSTMENT**

REMEDY — Turn the adjusting stem counter clockw until the correct superheat is indicated.

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12. **FEED-BACK FROM ANOTHER VALVE** — Review structions for Bulb Location, Page 2.

REMEDY — Check the bulb temperature and calculate superheat. If superheat is normal but too little refriger is flowing through the evaporator, check the piping possible refrigerant flow from another evaporator aff ing the bulb. Re-pipe if necessary. See Figure-4.

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13. **HIGH PRESSURE DROP THROUGH EVAPORATC**

REMEDY — Check the pressure at the evaporator ir and outlet with gauges. If pressure difference is grea than the values shown in Table-1, Page 9, Bulletin 10- or Page 7, Form 10-56, use an externally equalized va

How effective the valve performs is easily determined by measuring the superheat as outlined in Figure-8. Observing the frost on the suction line, or considering only the suction pressure may be misleading. **Checking the superheat is the first step in a simple and systematic analysis of thermostatic expansion valve performance.**

- **If not enough refrigerant is being fed to the evaporator—the superheat will be high.**
- **If too much refrigerant is being fed to the evaporator—the superheat will be low.**

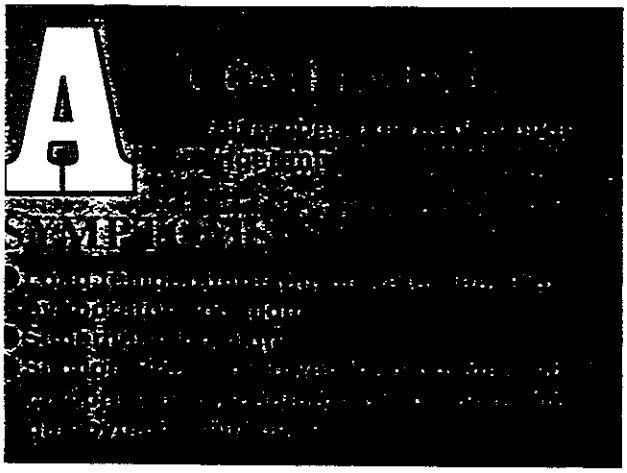
Although these symptoms may be attributed to improper thermostatic expansion valve control, more frequently the origin of the trouble lies elsewhere.

NOTE: Thermostatic expansion valves with permanent bleed ports **(BP)** or Rapid Pressure Balancer **(RPB)** construction are applied on many air conditioning and refrigeration systems by original equipment manufacturers. Each application is tested and approved by the manufacturer. The primary function of these devices is to equalize high-to-low side pressures during the off cycle to assist on start-up of low starting torque compressors.

However, some BP type valves are applied to allow small amounts of liquid refrigerant to pass for compressor motor cooling. The specific function of the feature on a given unit must be determined from the system manufacturer. Once that is determined, it is easier to trouble shoot the system.

The primary cause of difficulty with either the BP or RPB feature is dirt and other foreign materials that restrict or plug them. And if the system purpose intended for either feature is not being satisfied, the valve probably needs cleaning or replacing.

As stated in Bulletin 10-10, the RPB type valve is not to be applied on systems using high starting torque compressors or "hard-start" electrical components, on outdoor coils of heat pumps, or on any refrigeration system, and it should ***not*** be used to replace BP type valves that are applied on those types of systems. On systems other than those described above, the RPB type valve can replace the BP type valve when necessary. Usually it is advisable to replace a valve with one of the same specification unless advised differently. Consult with the system manufacturer for assistance.



THE CAUSE MAY BE:

1. **MOISTURE** — Water or a mixture of water and oil frozen in the valve port or working parts of the valve will prevent proper operation.

   This is a common source of trouble on expansion valves. Since the valve is the first cold spot in the system, moisture will freeze and block the valve open, closed, or any position in between. If the valve is frozen in the intermediate position so that flow is restricted, the superheat will be high.

REMEDY — Install a Sporlan Catch-All Filter-Drier in the liquid line for removal of moisture from the refrigerant and oil. See Bulletin 40-10.

To determine a safe level of moisture in the system, install a Sporlan See-All Moisture and Liquid Indicator. See Bulletin 70-10.

Excessive moisture has a damaging effect on all system components regardless of the evaporating temperature. It must be removed for trouble-free performance.

2. **DIRT or FOREIGN MATERIAL** — Contaminants such as copper oxide scale, metal chips, oil breakdown sludge, etc. will restrict the flow of refrigerant when it collects in strainers or other liquid line accessories. This produces a shortage of refrigerant at the thermostatic expansion valve port. Conventional strainers frequently allow the material to pass through the screen and obstruct the flow at the valve port. If a See-All is installed downstream of the restriction, bubbles will be visible. This should not be confused, however, with a refrigerant shortage or excessive liquid line pressure loss which are also indicated by bubbles in the See-All.

REMEDY — Locate and remove the foreign material creating the restriction. Install a Sporlan Catch-All Filter-Drier to provide effective filtration of the refrigerant. See Bulletin 40-10.

3. **WAX** — Certain systems are contaminated with small amounts of wax which will precipitate at low temperatures in systems with Refrigerants 22 or 502. Since the thermostatic expansion valve represents the first cold point in the refrigeration cycle, wax is most likely to form at the valve port.

   It is sometimes difficult to observe the wax in a valve because it may exist in solid form only at very low temperatures. By the time the valve has been taken apart, the temperature has increased enough to cause the wax to melt and thus become difficult to detect. When wax is suspected, it can usually be detected on the pin and seat by packing the valve in dry ice while disassembling.

REMEDY — Clean the valve with solvent before reassembling the valve. The Sporlan HH style Catch-All Filter-Driers have a special activated charcoal desiccant that is designed to remove wax in the liquid line before it causes trouble. Therefore, use these HH style driers (e.g., C-415-S-HH) on all low temperature systems using Refrigerants 22 or 502 to **prevent** wax problems.

4. **REFRIGERANT SHORTAGE** — See-All or sight

★**When system has some form of capacity reduction — cylinder unloaders or hot gas bypass, a low suction pressure will not exist. Therefore, when checking TEV performance, a better analysis is possible when these devices are locked out or shut off so the suction pressure will respond to variations in load or valve feed.**

2. Temperature Sensitive Evaporator Regulating Valve (CDA Type): the CDA valve is forced into a fully open position first. Then the expansion valve is adjusted to the desired superheat setting at full load condition. Finally, the CDA is set to the desired air temperature. Contact Sporlan Valve Company or the case manufacturer for additional details on setting the CDA.

When the adjustment is completed on the TEV, always tighten the adjusting stem packing nut and replace the seal cap tightly.

Some expansion valves are made ***non-adjustable*** for use on Original Equipment Manufacturers' units. These valves are set at a superheat predetermined by the manufacturers' laboratory tests and cannot be adjusted in the field.

Most ***non-adjustable*** models are modifications of standard adjustable type valves. This is done by using a solid bottom cap instead of one equipped with an adjusting stem and seal cap. These valves can be identified by an **N** preceding the standard valve designation. Adjustable bottom cap assemblies are available for converting most non-adjustable valves to the adjustable type. However, this is rarely required. If symptoms indicate that a valve adjustment is needed, carefully check the other possible causes of incorrect superheat, Pages 6 to 10, before attempting an adjustment.

HOW TO DETERMINE SUPERHEAT CORRECTLY

1. Measure the temperature of the suction line at the point the bulb is clamped.
2. Obtain the suction pressure that exists in the suction line at the bulb location by either of the following methods:
   - **a.** If the valve is externally equalized, a gauge in the external equalizer line will indicate the desired pressure directly and accurately.

   OR

   - **b.** Read the gauge pressure at the suction valve of the compressor. To the pressure add the estimated pressure drop through the suction line between bulb location and compressor suction valve. The sum of the gauge reading and the estimated pressure drop will equal the approximate suction line pressure at the bulb.
3. Convert the pressure obtained in **2a** or **2b** above to saturated evaporator temperature by using a temperature-pressure chart.
4. Subtract the two temperatures obtained in **1** and **3** —the difference is superheat.

Figure-8 illustrates a typical example of superheat measurement on an air conditioning system using Refrigerant-22. The temperature of the suction line at the bulb location is read at 52°F. The suction pressure at the compressor is 66 psig and the estimated suction line pressure drop is 2 psi . . . 66 psig + 2 psig = 68 psig at the bulb, which is equivalent to a 40°F. saturation temperature. 40°F. subtracted from 52°F. = 12°F. superheat.

NOTE: Refrigerated case manufacturers frequently use a "temperature difference" method to approximate superheat. This procedure consists of measuring the temperature of a location on the evaporator which is representative of saturated vapor temperature; and, then subtracting that temperature from the outlet evaporator temperature which is measured at the bulb location.

While this method of reading "superheat" is acceptal on those manufacturer's cases where the pressure dr through the evaporator is low, Sporlan does not recomme the "temperature difference" method for other types systems.

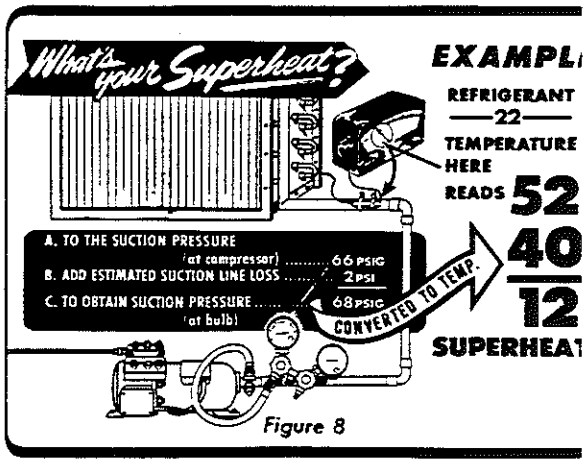


Figure 8

HOW TO CHANGE THE SUPERHEAT SETTIN

To reduce the superheat, turn the adjusting st **COUNTER-CLOCKWISE.** To increase the superheat, tu the adjusting stem **CLOCKWISE.** When adjusting t valve, make no more than one turn of the stem at a ti and observe the change in superheat closely to preve ***over-shooting*** the desired setting. As much as 30 minu may be required for the new balance to take place af an adjustment is made.

If in doubt about the correct superheat setting for a partic lar system, consult the equipment manufacturer. As a ge eral rule, the proper superheat setting will depend on t amount of temperature difference (TD) between refrigera temperature and the temperature of the air or other su stance being cooled. Where high TD's exit, such as on a conditioning applications, the superheat setting can be ma as high as 15°F. without noticeable loss in evaporator capa ity. Where low TD's exist, such as in low temperature blow coil applications, a superheat setting of 10°F. or below usually recommended for maximum evaporator capacity. is these applications that the TEV will more than likely ne to be adjusted.

For the correct valve setting on factory built equipme manufacturers' recommendations should be followe Some manufacturers specify the superheat direct others may recommend valve adjustment to a given su tion pressure at certain operating conditions, or un a certain frost line is observed. Such recommendatio however they are stated, represent the results of exte sive laboratory testing to determine the best possi operation.

FIELD SERVICING

The thermostatic expansion valve is erroneously co sidered by some to be a mysterious and complex devic As a result, many valves are needlessly replaced wh the cause of the system malfunction is not immediate recognized.

Actually the thermostatic expansion valve performs on one very simple function — **it keeps the evaporator su plied with enough refrigerant to satisfy all load con tions.** It is not a temperature control, suction pressu control, a control to vary the compressor's running ti or a humidity control.

Moisture and smaller particles of foreign material are equally harmful to the system and must be removed for peak system performance. Field experience has proven, without a doubt, that most expansion valve failures are due to the presence of dirt, sludge, and moisture in the system. Furthermore, the performance and life of other system components are also seriously affected by these foreign materials. The Sporlan **Catch-All Filter-Drier** removes dirt, moisture, acids, and sludges, and insures the circulation of clean, dry refrigerant through the system at all times.

For all refrigeration and air conditioning applications we recommend that a Sporlan Catch-All Filter-Drier be installed in the liquid line ahead of the thermostatic expansion valve. See Bulletin 40-10 for complete Catch-All specifications.

Further system protection is easily and inexpensively provided with the installation of a Sporlan ***See-All***. The See-All is a combination liquid and moisture indicator that visually indicates if there is a shortage of refrigerant in the liquid line, or if the moisture content of the refrigerant is at a dangerous level. See Bulletin 70-10 for complete See-All specifications.

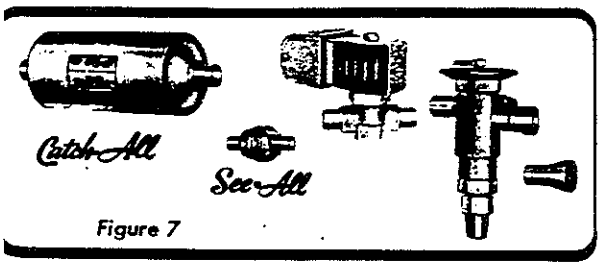


Figure 7

F. TEST PRESSURES and DEHYDRATION TEMPERATURES

For better leak detection an inert ***dry*** gas such as nitrogen or CO_2 may be added to an idle system to supplement the refrigerant pressure.

CAUTION: Inert gases must be added to the system carefully through a pressure regulator. Unregulated gas pressure can seriously damage the system and endanger human life. Never use oxygen or explosive gases.

Excessive low side pressures can shorten the life of the thermostatic expansion valve diaphragm. Table-7 lists the maximum low side test pressure that can safely be applied with the expansion valve connected to the evaporator. These maximum pressures are well above the minimum field leak test pressures for low sides, listed by the ANSI/ASHRAE Standard 15-1978.

Table-7 refers to the maximum low side test pressures which are in contact with the underside of the valve diaphragm. Since only the valve inlet fitting and passages (not the valve diaphragm) are subjected to high side pressures, the valve will withstand any reasonable ***HIGH SIDE TEST PRESSURES*** in excess of the values listed in the ANSI/ASHRAE Standard. The external equalizer line should be disconnected if there is any possibility of exceeding the recommended maximum pressures listed below.

TABLE 7
MAXIMUM LOW SIDE TEST PRESSURES

VALVE TYPE	psig
I, X, Z, NI, F, BF/EBF, G, C, S, BS/EBS, Small O	450
D, P, H, Large O, & U	425
A, M, V, & W	400

If elevated temperatures are used to assist in dehydrating the system, the thermostatic expansion valve should not be exposed to temperatures exceeding those shown in Table-8.

TABLE 8
MAXIMUM DEHYDRATION TEMPERATURES
DEGREES F

REFRIGERANT	THERMOSTATIC CHARGE						
	G and VGA	L	C	Z	X	P Air Conditioning Charge	ZP
12	250	195	190	250	210	250	250
22		**	160	185			
500		**	185	235			
502		**150	150	170			
717 (Ammonia)	†	150	190	235	†	†	†

**Not Available in No. 33 or 63 elements. †Not Available.

Table-8 refers to the maximum dehydration temperatures when the bulb and valve body are subjected to the same temperature. On L, C, Z, and X charges, 250°F. maximum valve body temperature is permissible ***IF THE BULB TEMPERATURE*** does not exceed those shown in the table.

G. EXPANSION VALVE ADJUSTMENT

Each Sporlan Thermostatic Expansion Valve is thoroughly tested and set at the factory before shipment. This factory superheat setting will be correct and no further adjustment is required for the majority of the applications. However, there are many factors which can affect the performance of a thermostatic expansion valve. These factors are independently variable and all of them cannot be compensated for in the design of a valve. When the application or operating conditions require a different valve setting due to one or more of the factors listed below, the valve may be adjusted to obtain the required operating superheat. Therefore, an adjusting stem is provided on all standard valves. The valve should be set with the system as near as possible to design conditions.

Factors which affect valve performance and may make it necessary to adjust the valve are:

1. Low temperature differences (TDs) between the refrigerant and the air
2. TEV bulb location
3. Balance between compressor and evaporator
4. Ratio of load to TEV capacity
5. Condenser capacity
6. Operation of several fixtures on multiple installation
7. Seasonal variation in head pressure caused by extreme changes in ambient air temperature.

NOTE: Valve types, F, BF, EBF, A, M, V, and W have non-rising adjusting stems and a change in adjustment does not change the stem position.

When setting valves on multi-evaporator refrigeration systems with pressure or temperature sensitive evaporator control valves, the following procedure is recommended:

1. Evaporator Pressure Regulating Valve (ORI Type): the ORI valve is set first at the minimum load condition. Then the expansion valve is adjusted, if necessary, to the desired superheat setting while under the normal operating load condition.

contact between the bulb and suction line is essential. The bulb should be securely fastened with two bulb straps to a clean, straight section of the suction line.

Recommended suction line piping usually includes a horizontal line leaving the evaporator to which the thermostatic expansion valve bulb is attached. This line is pitched slightly downward, and when a vertical riser follows, a short trap is placed immediately ahead of the vertical line, see Figure-3. The trap will collect any liquid refrigerant or oil passing through the suction line and prevent it from influencing the bulb temperature.

On multiple evaporator installations the piping should be arranged so that the flow from any valve cannot affect the bulb of another. Approved piping practices including the proper use of traps insures individual control for each valve without the influence of refrigerant and oil flow from other evaporators.

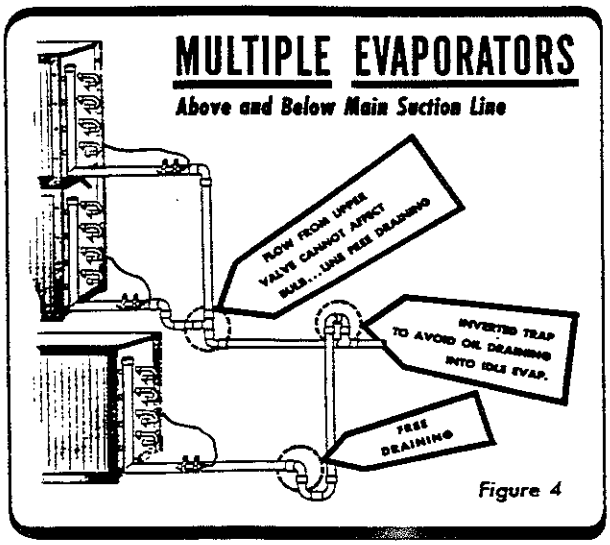


Figure 4

For recommended suction line piping when the compressor is located below the evaporator see Figure-5. The vertical riser extending to the height of the evaporator prevents refrigerant from draining by gravity into the compressor during the off-cycle. When a pumpdown control is used, the suction line may turn immediately down without a trap.

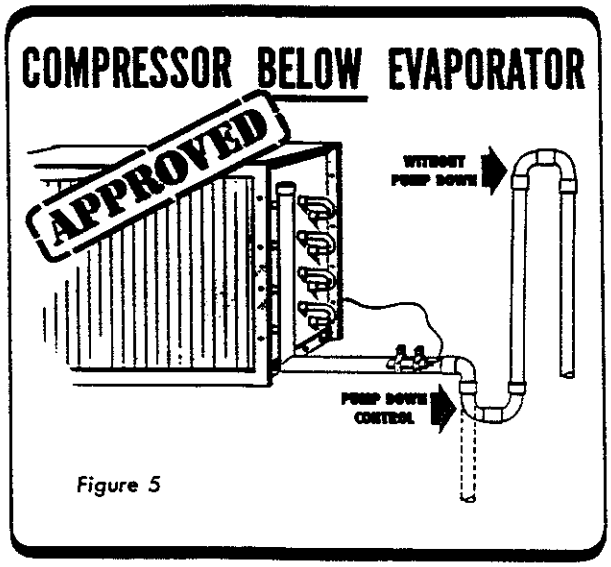


Figure 5

On Commercial and Low Temperature Applications requiring Sporlan Selective Charges C, Z, or X the bulb should be clamped on the suction line at a point whe the bulb temperature will be the same as the evapora temperature during the off-cycle. This will insure tig closing of the valve when the compressor stops. If bu insulation is used on lines operating below 32°F., use no water absorbing insulation to prevent water from fre ing around the bulb.

On brine tanks and water coolers, the bulb should below the liquid surface where it will be at the sa temperature as the evaporator during the off-cycle. Wh locating the bulb in a brine tank, paint it and the capill tubing with pitch or other corrosion resistant paint.

If, for practical reasons, the bulb must be located wh its temperature will be higher than the evaporator d ing the off-cycle, a solenoid valve must be used ahead the thermostatic expansion valve.

On Air Conditioning Applications having thermosta expansion valves equipped with Flow-Master Types VGA or G charged elements, the bulb may be located side or outside the cooled space or duct. The valve bo should not be located in the air stream leaving the ev orator. Avoid locating the bulb in the return air stre unless it is well insulated.

D. EXTERNAL EQUALIZER CONNECTION

For a complete explanation of when an externally equ ized valve should be used refer to Pages 7 to 9, Bulle 10-10, or Pages 5 to 7, Form 10-56. Valves supplied w an external equalizer ***will not operate*** unless this c nection is made.

The equalizer connection should be made at a point th will most accurately reflect the pressure existing in t suction line at the bulb location. See Figure 6. General the connection is immediately downstream of the bu However, equipment manufacturers sometimes loc them in return bends or suction headers that are co patible with their specific design requirements. The diff ence between the pressure at the equalizer connection a the suction pressure at the bulb location should not exce reasonable pressure drop values. The values shown Table 1 on page 9 of Bulletin 10-10, or page 7 of Form 10- can be used as a guide in determining the value.

If any evaporator pressure or temperature control val are located in the suction line at or near the evapora outlet, the equalizer must be connected on the evapora side of these valves.

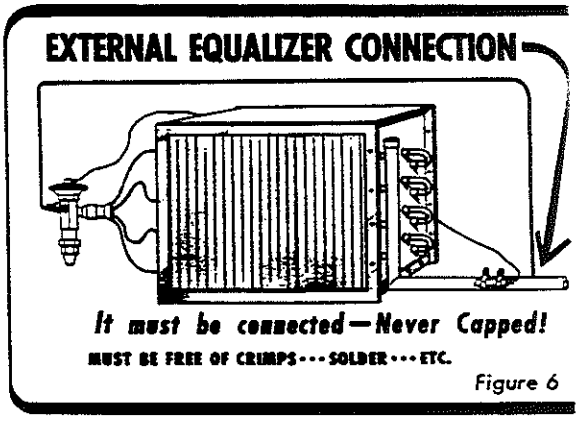


Figure 6

E. DRIERS, STRAINERS, and ACCESSORIE

Most Sporlan thermostatic expansion valves are equip with built-in inlet screens of varying mesh sizes depe ing on the valve size and type. These strainers are ef tive only in removing particles of scale, solder, which could obstruct the closure of the pin and seat.

ing required for systems with excessive vertical lift. The following special devices are the most commonly used methods.

a. Water coils in heat exchange relationship with the liquid line.
b. Separate refrigeration system.
c. Special heat exchanger which uses a portion of the refrigerant to cool the main body of liquid. See Figure-1.

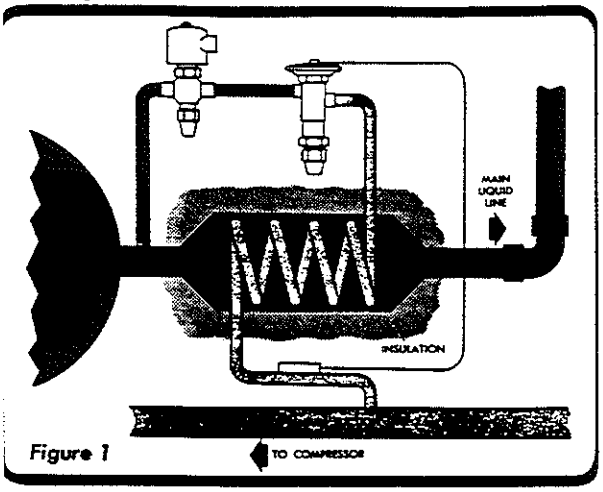


Figure 1

Ordinarily the conventional suction — liquid heat exchanger is installed near the evaporator, where the suction vapor is the coldest, to re-condense any vapor in the liquid line. When the primary purpose of the heat exchanger is to prevent the formation of flash gas — particularly on systems that have a long liquid line or excessive vertical lift — install the heat exchanger near the receiver ***before the vertical lift occurs.*** (This also applies to the special devices described in Method 3). Because vapor in the liquid line considerably increases friction losses, the total pressure drop available across the expansion device on these type of systems is reduced. Also, the suction line and liquid line should be carefully insulated to minimize heat gain if subcooled below ambient temperature.

IMPORTANT — Preventing the formation of vapor in liquid lines having high pressure losses does not eliminate the requirement that an adequate pressure drop must be available across the thermostatic expansion valve. The capacity tables show valve capacities at pressure drops lower than normal. For thermostatic expansion valve application data and capacities at pressure drops below those listed, ***consult Sporlan Valve Company.***

B. SOLDER TECHNIQUE

It is not necessary to disassemble solder type valves such as Types S, P, EBF, EBS and O when soldering to the connecting lines. Any of the commonly used types of solders, e.g., 95-5, Sil-Fos, Easy-Flo, Phos-Copper, Stay Brite 8 or equivalents may be used for copper to copper connections. When soldering a brass refrigerant distributor to the valve, appropriate solders for these connections such as 95-5, Easy-Flo, Stay Brite 8 or equivalents may be used. It is important, however, regardless of the solder used, to direct the flame away from the valve body and avoid excessive heat on the diaphragm, Figure-2. As an extra precaution, a wet cloth may be wrapped around the body and element during the soldering operation.

This precaution will prevent overheating the valve body which could damage the superheat spring and result in floodback problems. In addition, the Type O, BF/EBF, and BS/EBS valve contain synthetic parts which can be damaged due to overheating, resulting in poor valve performance.

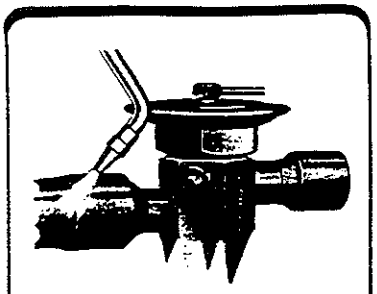


Figure 2

C. BULB LOCATION and INSTALLATION

The location and installation of the bulb is extremely important to the proper performance of the system and care should be taken with its final location.

Accepted principles of good suction line piping should be followed to provide a bulb location that will give the best possible valve control. When system manufacturers have piping recommendations that differ from the general industry recommendations and Sporlan's suggestions shown in this section, those recommendations should be used. When specific recommendations are not available, the suggestions below should be used.

The bulb should be attached to a horizontal suction line at the evaporator outlet (See Figures 3, 4, and 5). If the bulb cannot be located in that manner, it may be located on a ***descending*** vertical line only (as shown in Figure-5 for "pumpdown control"). The bulb should never be located in a trap or downstream of a trap in the suction line. Liquid refrigerant or mixture of liquid refrigerant and oil boiling out of the trap will falsely influence the temperature of the bulb and result in poor valve control.

On suction lines ⅞" OD and larger, the surface temperature may vary slightly around the circumference of the line. On these lines, it is generally recommended that the bulb be installed at 4 or 8 o'clock on the side of the horizontal line, and parallel with respect to the direction of flow. On smaller lines the bulb may be mounted at any point around the circumference, however, locating the bulb on the bottom of the line is not recommended as an oil-refrigerant mixture is generally present at that point. Certain conditions peculiar to a particular system may require a different bulb location than normally recommended. In these cases the proper bulb location may be determined by trial.

For satisfactory expansion valve control, ***good thermal***

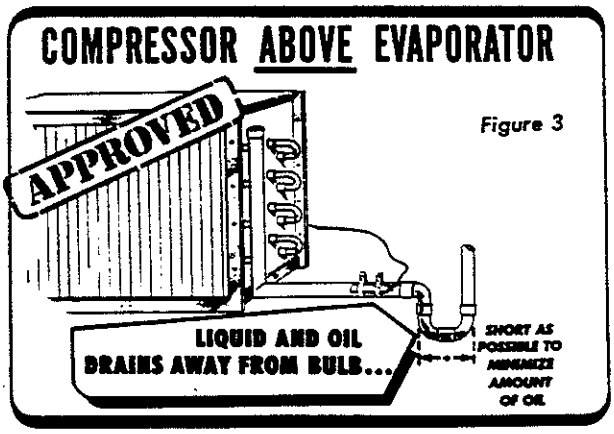


Figure 3

SPORLAN

Thermostatic Expansion Valves

INSTALLATION, FIELD SERVICE & ASSEMB

INSTALLATION

For peak performance, it is important to select a Sporlan thermostatic expansion valve with the correct capacity, selective charge, external or internal equalizer, etc. See Bulletin 10-10 for complete application information. Equally important is the proper installation, which can determine the success or failure of the entire system.

A. VALVE LOCATION

Thermostatic expansion valves may be mounted in any position, but they should be installed as close to the evaporator as possible. If a refrigerant distributor is used with the expansion valve, best performance is obtained if the distributor is mounted directly to the valve outlet. If the distributor cannot be mounted directly to the valve outlet, the distance between the valve outlet and distributor should not exceed 24 inches or refrigerant distribution problems may occur. Also, the tube connecting the valve outlet and distributor can be sized smaller to maintain refrigerant velocity and better distribution. Elbows located between the expansion valve and distributor will hinder proper distribution and therefore, are not recommended.

Best distribution is usually obtained if the expansion valve feeds vertically up or down into the distributor. System manufacturers, however, have successfully applied distributors in other orientations. See Bulletin 20-10 for application and selection information on refrigerant distributors.

While not always convenient nor possible, valve Types BI, F, and O are easier to service if mounted in a vertical and upright position. If mounted in a horizontal position, the internal parts must be carefully reassembled to prevent damage to them. Also, some consideration should be taken in mounting the larger sized expansion valves. They must be adequately supported since system vibration and the weight of the valve may cause valve connections to fracture.

If a hand valve is located on the outlet side of the thermostatic expansion valve it should have a full sized port. No restrictions should appear between the thermostatic expansion valve and evaporator, except a refrigerant distributor if one is used.

Sporlan Thermostatic Expansion Valves having Selective Charges C, Z, L, or X may be installed and operated in most locations. The amount of thermostatic charge and the bulb size are such that the bulb retains control despite a colder valve body or diaphragm case. The exception is when the element is subjected to sub-zero temperatures for extended periods of time during an off-cycle. In this case, start-up may be prolonged until the bulb and element are warmed sufficiently to open the valve.

To minimize the possibility of charge migration, Sporlan Flow-Master P, VGA, or G air condition charges or ZP refrigeration charges should be insta so the diaphragm case is warmer than the bulb. Spe non-condensible charges without MOP and double phragm hydraulic elements with MOP are available system manufacturers to overcome this potential probl

Occasionally, thermostatic expansion valves are loca in corrosive atmospheric conditions that can dam the valve and/or element assembly. Due to this po bility, the valve must be protected with appropr materials to prevent premature failure. Consult spec ists in protective coatings.

PRECAUTIONS — WHEN VALVE IS INSTALLED A CONSIDERABLE HEIGHT ABOVE LIQUID RECEIVE

When the evaporator and thermostatic expansion va are located above the receiver, there is a static press loss in the liquid line. This is due to the weight of column of liquid refrigerant, and this weight may interpreted in terms of pressure loss in pounds per squ inch as shown in Table-2, Page 14, Bulletin 10-10, Page 12, Form 10-56. If the vertical lift is great enou vapor or ***flash gas*** will form in the liquid line causin serious reduction in the capacity of the thermostatic pansion valve.

When an appreciable vertical lift is unavoidable, prec tions should be taken to prevent the accompany pressure loss from producing liquid line vapor. This be accomplished by providing enough subcooling to liquid refrigerant, either in the condenser or after liquid leaves the receiver. Subcooling is determined subtracting the actual liquid temperature from the densing temperature (corresponding to the conden pressure). The required amount of subcooling neces to prevent vapor formation in the liquid line is sh in Table-6, Page 16, Bulletin 10-10, or Page 14, Form 10

Liquid subcooling is provided by the following metho

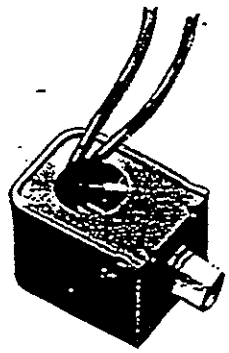
1. **In the condenser**
2. **Suction — liquid heat exchanger**
3. **Special devices**

Method–1 will provide sufficient subcooling for the sim short-coupled system that has only moderate liquid l pressure drop.

Method–2 will usually not provide more than 20°F. s cooling on air conditioning systems operating at norr head pressures. The amount of subcooling will depend the design and size of the heat exchanger and on operating suction and discharge pressures.

Method–3 may be used to provide considerable subc

Bulletin 10-11, May 1990 Supersedes Bulletin 10-11, September 1988; and all prior publications



2 — P100 Pressure Control with conduit cover.

-acting disc and electrical acts reset to their preset ions.

ual Reset Models

manual reset control employs a -acting disc which opens the trical contacts when actuated he pressure sensor. Due to the ation of the disc, the contacts held open until closed by an rnal force from the push button. ause of its link with the pressure, disc will not reset the contacts f the system pressure has fallen predetermined level.

latching mechanism in the P100 vides electrical cutout even if the et button is held fully depressed. s trip free design allows tarting the compressor only when line pressure returns to a determined level.

ptional Constructions

essure Connections

andard 1/4" SAE female flare fitting th internal depressor. Also ailable on quantity orders:

ale Fittings

1/4" — 18 NPT male

1/8" — 27 NPT male

1/4" SAE male flare

Female Fittings

1/8" — 27 NPT female

Braze Fittings

1 1/2" Straight 1/4" diameter tube

As above with 1/4" SAE female flare nut

1 1/2" nibbed tube

1 1/4" Straight 1/4" diameter selective copper plated stainless steel tube with bulge stop.

Capillary Tube Fittings

12", 24" and 36" Straight .093" diameter tube

As above with 1/4" bulbed end

As above with stop

Electrical Terminations

Standard 48" #18 AWG stranded and tinned copper with 600V 105°C PVC 1/16" insulation and 1/2" stripped ends. Available in 6", 12", 18", 24", 30", 36", 42", 48", 60" and 72" lengths with 1/2" stripped ends or 1/4" female quick-connect flag terminals.

Also available without leads, 1/4" male quick-connect terminals (auto reset models only).

Electrical Ratings

Motor Ratings	120 V	240 V
AC Full Load Amp	5.8	2.9
AC Locked Rotor Amp	34.8	15.0
28 VAC/DC, 2 Amp		
Pilot Duty — 375 VA at 120/240/277 VAC		

Differential Selection on Auto Reset Models

Refer to the Pressure Range Chart below for minimum and maximum differentials.

1. Select the desired set point from column (A).
2. Note minimum allowable differential from column (B).
3. Calculate maximum differential; (column (C) X selected set point)
4. The differential must fall between values chosen for steps 2 and 3.

Example

A requirement exists for a pressure control to OPEN at 425 PSIG and CLOSE at 325 PSIG. From the chart:

Pressure Range Differentials and Tolerances

(A) Nominal Set Point PSIG / kPa	(B) Minimum Differential PSI / kPa	(C) Maximum Differential PSI / kPa	Minimum Tolerance* PSI / kPa
20 to 29 / 138 to 200	10 / 69	75%	±3 / ±21
30 to 60 / 207 to 552	15 / 103	70%	±5 / ±34
61 to 160 / 558 to 1103	30 / 207	65%	±5 / ±34
161 to 240 / 1110 to 1655	45 / 310	60%	±7 / ±48
241 to 350 / 1662 to 2413	60 / 414	55%	±10 / ±69
351 to 450 / 2420 to 3103	75 / 517	50%	±10 / ±69
451 to 500 / 3110 to 3448	90 / 621	50%	±15 / ±103

For Nominal Set Point settings less than 20 PSI (138 kPa) or greater than 500 PSI (3448 kPa) contact Application Engineering. The Minimum Tolerance applies to the Nominal Set Point pressure (e.g. 60 ±5 PSI [552±34 kPa]). The Maximum Differential is a percentage of Nominal Set Point.
*At room ambient temperature.

JOHNSON CONTROLS

Johnson Controls, Inc.
Control Products Division
507 East Michigan Street
P.O. Box 423
Milwaukee, WI 53201

Series P100 Encapsulated Pressure Control

Application

The P100 series are encapsulated, nonadjustable, single-pole, single-throw, direct mount pressure controls typically used for low and high pressure cutouts. Applications include:

—Computer Room Air Conditioning

—Commercial Refrigeration Fixtures

—Refrigeration/Air Conditioning Condensers

—Ice Machines

—Food Service Equipment

P100 series controls are available in both automatic and manual reset models. The automatic reset models are available in OPEN HIGH and OPEN LOW configurations. The manual reset controls are available in an OPEN HIGH configuration for high limit applications.

Certain P100 models are supplied as pressure limiting devices for use in refrigeration and air conditioning applications. Contact the Control Products Division, Johnson Controls, Inc. for specific models.

P100 models, other than those specified as pressure limiting devices, are designed for use only as operating controls. Where an operating control failure would result in personal injury and/or loss of property, it is the responsibility of the installer to add devices (safety, limit controls) that protect against, or systems (alarm, supervisory systems) that warn of control failure.

All installations should conform to local building codes.

Features

—Compact size and light weight allow for direct mounting.

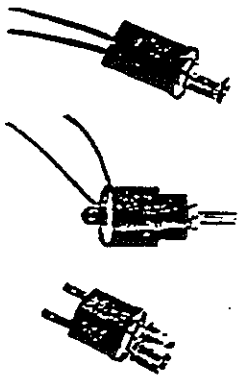


Fig. 1 — P100 Pressure Controls, automatic reset (top), manual reset (center) and automatic reset with 1/4" male quick-connects (bottom).

—Use with all non-corrosive refrigerants.

—¼" female flare fitting with built in Schrader type depressor is standard.

—UL File SA516, Guide SDFY2 and CSA File LR63963, Class 1222 01

—Encapsulated switch, dust tight.

—Trip-free manual reset (manual reset models) . . . contacts cannot be overridden by continued depression of the reset button.

Specifications

Type Number	P100AA	Contacts Open Low
	P100AC	Contacts Open Low, Conduit Cover
	P100CA	Contacts Open High
	P100CC	Contacts Open High, Conduit Cover
	P100DA	Contacts Open High, Manual Reset
	P100DC	Contacts Open High, Manual Reset With Conduit Cover
Short Term Overpressure	20 to 100 PSIG (138 to 690 kPa)	250 PSIG (1724 kPa)
	100 to 500 PSIG (690 to 3448 kPa)	600 PSIG (4137 kPa)
Burst Pressure		3500 PSIG (24,133 kPa)
Design Life	Auto Reset	100,000 Cycles
	Manual Reset	6,000 Cycles
Temperature	Ambient	–20 to 150°F (–29 to 66°C)
	Refrigerant	–65 to 275°F (–54 to 135°C)
Vibration		15 G's Maximum
Range and Differential		See Pressure Range Table
Set Point Tolerances		From ± 3 to ± 25 PSI (± 21 to ± 172 kPa) See Pressure Range Table

General Description

Auto Reset Models

The preset, snap-acting disc utilized in the P100 reverses its shape when pressurized to the selected actuation pressure setting. When the disc snaps, it drives a set of electrical contacts open or closed. When the pressure falls to the deactuation pressure setting, the

F NO.	Name of file	Attribute
J35	Heater current file	Read

1. Outline

This read only file stores a heater current value.

2. Structure

(Offset)	MSB 7	LSB 0
0	Heater current (H)	
	Heater current (L)	

3. Individual contents

MSB	
	Heater current high order byte
	Heater current low order byte (word size)

A heater current value is stored in units of 0.1A.
(No heater current is detectable, if the heater breakage option is not provided).

Ramp/soak state (byte size)

Present running conditions of ramp/soak function are stored by the codes shown in the following table.

Code	Running conditions
0	OFF
1	RUN
2	HOLD
3	*END

F NO.	Name of file	Attribute
J34	Ramp/soak monitor file	Read

1. Outline

This read only file stores data about the program running conditions of ramp/soak function.

2. Structure

(Offset)	MSB 7 — LSB 0
0	Ramp/soak rest time (H)
	Ramp/soak rest time (L)
1	Ramp/soak location
	Ramp/soak state

3. Individual contents

MSB

	Ramp/soak rest time high order byte
	Ramp/soak rest time low order byte (word size)

The program run rest time of ramp/soak function is stored in units of minute.

MSB 7 — LSB 0

	Ramp/soak location (byte size)

The program run location data of ramp/soak function are stored by the codes shown in the following table.

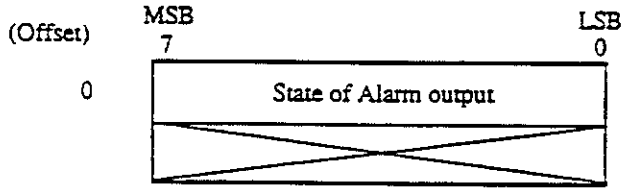
Code	Present position	Code	Present position	Code	Present position
0	Function OFF	4	2nd. soak	8	4th. soak
1	1st. ramp	5	3rd. ramp	9	End
2	1st. sork	6	3rd. soak		
3	2nd. ramp	7	4th. ramp		

F NO.	Name of file	Attribute
J33	State of alarm output file	Read

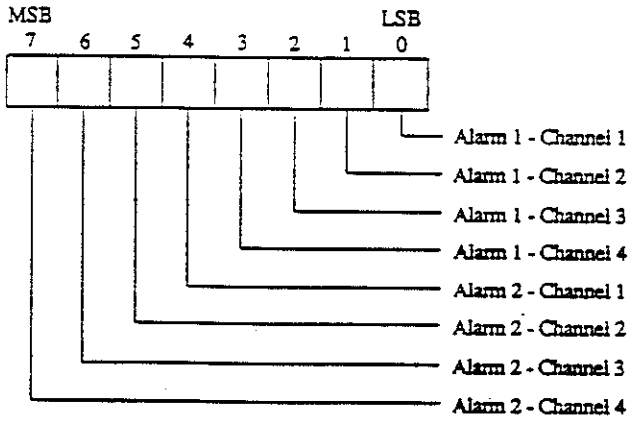
1. Outline

This file stores alarm decision results.

2. Structure



3. Individual contents



Alarm decision result ON : Corresponding bit = 1
OFF : Corresponding bit = 0

F NO.	Name of file	Attribute
J 32	AO scaling file	Read/Write

1. Outline

This file stores auxiliary analog output (AO) parameters.

2. Structure

(Offset)	MSB 7 — LSB 0
0	Lower scale of AO (H)
	Lower scale of AO (L)
1	Upper scale of AO (H)
	Upper scale of AO (L)
2	Kind of AO source

3. Individual contents

MSB

	Lower scale of AO high order byte
	Lower scale of AO low order byte (word size)

A value obtained by converting % value (0 to 100%) of the source corresponding to 1V output of AO into 0 to 10000 is stored. (Setting range: 0 to 10000)

MSB

	Upper scale of AO high order byte
	Upper scale of AO low order byte (word size)

A value obtained by converting % value (0 to 100%) of the source corresponding to 5V output of AO into 0 - 10000 is stored. (Setting range: 0 to 10000)

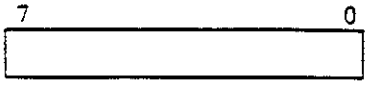
MSB

	AO output source (byte size)

Sources being output to AO are stored by the codes shown in the following table.

Code	Source type
0	Process variables (PV)
1	Setting values (SV)
2	Manipulated variables (MV)

MSB 7 LSB 0

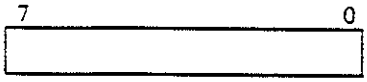


Power ON start command (byte size)

A program can run automatically when turning on the power supply of the main unit.
(Power ON start function)

For turning on and off this function, set the following value to the power ON start command.
(O: Function OFF 1: Function ON)

MSB 7 LSB 0



Ramp/soak command (byte size)

An operation command is given to the ramp/soak function by the codes shown in the following table.

Code	Operation
0	Function OFF
1	RUN
2	HOLD
3	*END

* END (code 3) cannot be written, but it can be read only.

MSB

	Time of 2nd. ramp segment high order byte
	Time of 2nd. ramp segment low order byte (word size)

The time of 2nd. ramp section is stored as a word in units of one minute. (Setting range: 0 to 5999)

MSB

	Time of 2nd. soak segment high order byte
	Time of 2nd. soak segment high order byte

The time of 2nd. soak section is stored as a word in units of one minute. (Setting range: 0 to 5999)

MSB

	Time of 3rd. ramp segment high order byte
	Time of 3rd. ramp segment high order byte

The time of 3rd. ramp section is stored as a word in units of one minute. (Setting range: 0 to 5999)

MSB

	Time of 3rd. soak segment high order byte
	Time of 3rd. soak segment high order byte

The time of 3rd. soak section is stored as a word in units of one minute. (Setting range: 0 to 5999)

MSB

	Time of 4th. ramp segment high order byte
	Time of 4th. ramp segment low order byte (word size)

The time of 4th. ramp section is stored as a word in units of one minute. (Setting range: 0 to 5999)

MSB

	Time of 4th. soak segment high order byte
	Time of 4th. soak segment low order byte (word size)

The time of 4th. soak section is stored as a word in units of one minute. (Setting range: 0 to 5999)

3. Individual contents

MSB

1st. target point [SV] high order byte

1st. target point [SV] low order byte (word size)

A value obtained by representing 1st.1target point value as 0 to 100% to the input range, and then, converting it into 0 to 10000 is stored. (Setting range: 0 to 10000)

MSB

2nd. target point [SV] high order byte

2nd. target point [SV] low order byte (word size)

A value obtained by representing 2nd. target point value as 0 to 100% to the input range, and then, converting it into 0 to 10000 is stored. (Setting range: 0 to 10000)

MSB

3rd. target point [SV] high order byte

3rd. target point [SV] low order byte (word size)

A value obtained by representing 3rd. target point value as 0 to 100% to the input range, and then, converting it into 0 to 10000 is stored. (Setting range: 0 to 10000)

MSB

4th. target point [SV] high order byte

4th. target point [SV] low order byte (word size)

A value obtained by representing 4th. target point value as 0 to 100% to the input range, and then, converting it into 0 to 10000 is stored. (Setting range: 0 to 10000)

MSB

Time of 1st. ramp segment high order byte

Time of 1st. ramp segment low order byte (word size)

The time of 1st. ramp section is stored as a word in units of one minute. (Setting range: 0 to 5999)

MSB

Time of 1st. soak segment high order byte

Time of 1st. soak segment low order byte (word size)

The time of 1st. soak section is stored as a word in units of one minute. (Setting range: 0 to 5999)

F NO.	Name of file	Attribute
J31	Ramp soak parameter file	Read/Write

1. Outline

This file stores ramp/soak function parameters and commands.

2. Structure

(Offset)	MSB 7 — LSB 0
0	1st. target point [SV] (H)
	1st. target point [SV] (L)
1	2nd. target point [SV] (H)
	2nd. target point [SV] (L)
2	3rd. target point [SV] (H)
	3rd. target point [SV] (L)
3	4th. target point [SV] (H)
	4th. target point [SV] (L)
4	Time of 1st. Ramp Segment (H)
	Time of 1st. Ramp Segment (L)
5	Time of 1st. Soak Segment (H)
	Time of 1st. Soak Segment (L)
6	Time of 2nd. Ramp Segment (H)
	Time of 2nd. Ramp Segment (L)
7	Time of 2nd. Soak Segment (H)
	Time of 2nd. Soak Segment (L)
8	Time of 3rd. Ramp Segment (H)
	Time of 3rd. Ramp Segment (L)
9	Time of 3rd. Soak Segment (H)
	Time of 3rd. Soak Segment (L)
10	Time of 4th. Ramp Segment (H)
	Time of 4th. Ramp Segment (L)
11	Time of 4th. Soak Segment (H)
	Time of 4th. Soak Segment (L)
12	Power ON start command
	Ramp/Soak command

MSB

	Setting for alarm 2-2 hysteresis high order byte
	Setting for alarm 2-2 hysteresis low order byte (word size)

A value obtained by representing the hysteresis of channel 2 of alarm 2 as 0 to 100% to the input range value, and then, converting it into 0 to 10000 is stored. (Setting range: 0 to 10000)

MSB

	Setting for alarm 2-3 hysteresis high order byte
	Setting for alarm 2-3 hysteresis low order byte (word size)

A value obtained by representing the hysteresis of channel 3 of alarm 2 as 0 to 100% to the input range value, and then, converting it into 0 to 10000 is stored. (Setting range: 0 to 10000)

MSB

	Setting for alarm 2-2 high order byte
	Setting for alarm 2-2 low order byte (word size)

A value obtained by representing a setting value of channel 2 of alarm 2 as 0 to 100% to the input range in case of an absolute value alarm or to the input range width in case of a deviation alarm, and then converting it into 0 to 10000 is stored. (Setting range: 0 to 10000)

MSB

	Setting for alarm 2-3 high order byte
	Setting for alarm 2-3 low order byte (word size)

A value obtained by representing a setting value of channel 3 of alarm 2 as 0 to 100% to the input range in case of an absolute value alarm or to the input range width in case of a deviation alarm, and then converting it into 0 to 10000 is stored. (Setting range: 0 to 10000)

MSB

	Setting for alarm 1-1 hysteresis high order byte
	Setting for alarm 1-1 hysteresis low order byte (word size)

A value obtained by representing the hysteresis of channel 1 of alarm 1 as 0 to 100% to the input range value, and then, converting it into 0 to 10000 is stored. (Setting range: 0 to 10000)

MSB

	Setting for alarm 1-2 hysteresis high order byte
	Setting for alarm 1-2 hysteresis low order byte (word size)

A value obtained by representing the hysteresis of channel 2 of alarm 1 as 0 to 100% to the input range value, and then, converting it into 0 to 10000 is stored. (Setting range: 0 to 10000)

MSB

	Setting for alarm 1-3 hysteresis high order byte
	Setting for alarm 1-3 hysteresis low order byte (word size)

A value obtained by representing the hysteresis of channel 3 of alarm 1 as 0 to 100% to the input range value, and then, converting it into 0 to 10000 is stored. (Setting range: 0 to 10000)

MSB

	Setting for alarm 2-1 hysteresis high order byte
	Setting for alarm 2-1 hysteresis low order byte (word size)

A value obtained by representing the hysteresis of channel 1 of alarm 2 as 0 to 100% to the input range value, and then, converting it into 0 to 10000 is stored. (Setting range: 0 to 10000)

MSB

	Setting for heater break detection high order byte
	Setting for heater break detection low order byte (word size)

Setting value for heater break detection is stored in units of 0.1A. (Setting range: 10 to 500)

MSB

	Setting for loop break detection high order byte
	Setting for loop break detection low order byte (word size)

Setting value for loop break detection is stored in units of 1 sec. (Setting range: 0 to 5999)

MSB

	Setting for alarm 1-1 high order byte
	Setting for alarm 1-1 low order byte (word size)

A value obtained by representing a setting value of channel 1 of alarm 1 as 0 to 100% to the input range in case of an absolute value alarm or to the input range width in case of a deviation alarm, and then converting it into 0 to 10000 is stored. (Setting range: 0 to 10000)

MSB

	Setting for alarm 1-2 high order byte
	Setting for alarm 1-2 low order byte (word size)

A value obtained by representing a setting value of channel 2 of alarm 1 as 0 to 100% to the input range in case of an absolute value alarm or to the input range width in case of a deviation alarm, and then converting it into 0 to 10000 is stored. (Setting range: 0 to 10000)

MSB

	Setting for alarm 1-3 high order byte
	Setting for alarm 1-3 low order byte (word size)

A value obtained by representing a setting value of channel 3 of alarm 1 as 0 to 100% to the input range in case of an absolute value alarm or to the input range width in case of a deviation alarm, and then converting it into 0 to 10000 is stored. (Setting range: 0 to 10000)

MSB

	Setting for alarm 2-1 high order byte
	Setting for alarm 2-1 low order byte (word size)

A value obtained by representing a setting value of channel 1 of alarm 2 as 0 to 100% to the input range in case of an absolute value alarm or to the input range width in case of a deviation alarm, and then converting it into 0 to 10000 is stored. (Setting range: 0 to 10000)

3. Individual contents

MSB 7 — 4 — 3 — LSB 0

** Alarm 1-4 type	* Alarm 1-3 type
* Alarm 1-2 type	* Alarm 1-1 type

Alarm types of channel 1 to 4 of alarm 1 are set by the codes shown in the following table.

MSB 7 — 4 — 3 — LSB 0

** Alarm 2-4 type	* Alarm 2-3 type
* Alarm 2-2 type	* Alarm 2-1 type

Alarm types of channel 1 to 4 of alarm 2 are set by the codes shown in the following table.

* Alarm types selectable in case of alarms other than alarm 1 - 4/2 - 4

Code	Alarm type
0	No alarm
1	High limit absolute alarm
2	Low limit absolute alarm
3	High limit deviation alarm
4	Low limit deviation alarm
5	High limit deviation alarm (reverse output)
6	Low limit deviation alarm (reverse output)
7	High/low limit deviation alarm
8	High/low limit deviation alarm (reverse output)
9	Low limit absolute alarm (with low limit hold)
A	Low limit deviation alarm (with low limit hold)
B	Low limit deviation (with reverse output and low limit hold)
C	High/low limit deviation alarm (with low limit hold)
D	High/low limit deviation alarm (with reverse output and low limit hold)

** Alarm types selectable in case of alarm 1 - 4/2 - 4 only

Code	Alarm type
0	No alarm
1	Heater break alarm
2	Loop break alarm
3	Heater break alarm + loop break alarm

F NO.	Name of file	Attribute
J30	Alarm parameter file	Read/Write

1. Outline

This file stores the alarm types and setting values.

2. Structure

(Offset)	MSB 7	LSB 0
0	Alarm 1-4 type	Alarm 1-3 type
	Alarm 1-2 type	Alarm 1-1 type
1	Alarm 2-4 type	Alarm 2-3 type
	Alarm 2-2 type	Alarm 2-1 type
2	Setting for Heater Break detection (H)	
	Setting for Heater Break detection (L)	
3	Setting for Loop Break detection (H)	
	Setting for Loop Break detection (L)	
4	Setting for Alarm 1-1 (H)	
	Setting for Alarm 1-1 (L)	
5	Setting for Alarm 1-2 (H)	
	Setting for Alarm 1-2 (L)	
6	Setting for Alarm 1-3 (H)	
	Setting for Alarm 1-3 (L)	
7	Setting for Alarm 2-1 (H)	
	Setting for Alarm 2-1 (L)	
8	Setting for Alarm 2-2 (H)	
	Setting for Alarm 2-2 (L)	
9	Setting for Alarm 2-3 (H)	
	Setting for Alarm 2-3 (L)	
10	Setting for Alarm 1-1 Hysteresis (H)	
	Setting for Alarm 1-1 Hysteresis (L)	
11	Setting for Alarm 1-2 Hysteresis (H)	
	Setting for Alarm 1-2 Hysteresis (L)	
12	Setting for Alarm 1-3 Hysteresis (H)	
	Setting for Alarm 1-3 Hysteresis (L)	
13	Setting for Alarm 2-1 Hysteresis (H)	
	Setting for Alarm 2-1 Hysteresis (L)	
14	Setting for Alarm 2-2 Hysteresis (H)	
	Setting for Alarm 2-2 Hysteresis (L)	
15	Setting for Alarm 2-3 Hysteresis (H)	
	Setting for Alarm 2-3 Hysteresis (L)	

F NO.	Name of file	Attribute
J26	Dual calculation output file	Read

1. Outline

This file stores manipulated variable output 1/2 dual calculation results of MV values of control calculation results.

2. Structure

(Offset)	MSB 7 — LSB 0
0	MV for output 1 (H)
	MV for output 1 (L)
1	MV for output 2 (H)
	MV for output 2 (L)

3. Individual contents

MSB

	MV for output 1 high order byte
	MV for output 1 low order byte (word size)

The values obtained by converting MV outputs 1 (-3% to 103%) of dual calculation results into -300 to 10300 are stored.

MSB

	MV for output 2 high order byte
	MV for output 2 low order byte (word size)

The values obtained by converting MV outputs 2 (-3% to 103%) of dual calculation results into -300 to 10300 are stored.

MSB

Hysteresis high order byte

Hysteresis low order byte (word size)

The values obtained by representing the 2-position action hysteresis as 0 to 100% to the input range width, and then, converting them into 0 to 10000 are stored.

MSB 7 LSB 0

Reverse/normal action (output 1) (byte size)

00H : Normal action
01H : Reverse action

MSB 7 LSB 0

Reverse/normal action (output 2) (byte size)

00H : Normal action
01H : Reverse action

MSB 7 LSB 0

PID/FUZZY selection (byte size)

00H : FUZZY control
01H : PID control

MSB 7 LSB 0

Action when input is abnormal (byte size)

Action when input is abnormal	Output 1	Output 2
0	Control is continued	Control is continued
1	-3.0%	-3.0%
2	103.0%	103.0%
3	-3.0%	103.0%
4	-103.0%	-3.0%

MSB 7 LSB 0

Digital input (byte size)

00H : OFF (open)
01H : ON (close)

MSB

	Dead band/overlap band high order byte
	Dead band/overlap band low order byte (word size)

The values obtained by converting a dead band of -50.0 to 50.0% into -5000 to 5000 are stored.

MSB

	Manual reset.value high order byte
	Manual reset value low order byte (word size)

The values obtained by converting manual reset values of -100.0 to 100.0% into -10000 to 10000 are stored.

MSB

	Low limit setting of MV high order byte
	Low limit setting of MV low order byte (word size)

The values obtained by converting manipulated variable (MV) limit low-limit values of -3.0 to -103% into -300 to 10300 are stored.

MSB

	High limit setting of MV high order byte
	High limit setting of MV low order byte (word size)

The values obtained by converting manipulated variable (MV) limit high limit values of -3.0 to -103% into -300 to 10300 are stored.

MSB

	Cycle of computing high order byte
	Cycle of computing low order byte (word size)

The values obtained by converting cycle of computing of 0.5 to 999.5sec. to 5 to 9995 are stored.

MSB

	Anti-reset wind-up high order byte
	Anti-reset wind-up low order byte (word size)

The values obtained by representing the anti-reset wind-up as 0 to 100% to the input range, and then, converting them into 0 to 10000 are stored.

3. Individual contents

MSB

Measured value (PV) high order byte

Measured value (PV) low order byte (word size)

The values obtained by representing process variables (PV) as 0.00 to 100.00% to the input range, and then, converting them into 0 to 10000 are stored.

MSB

P (Proportional band) high order byte

P (Proportional band) low order byte (word size)

The values obtained by converting P (proportional band) of 0.0 to 999.9% into 0 to 9999 are stored.

MSB

I (Automatic reset time) high order byte

I (Automatic reset time) low order byte (word size)

The values obtained by converting I (automatic reset time) of 0 to 3200sec. into 0 to 32000 are stored.

MSB

D (Rate time) high order byte

D (Rate time) low order byte (word size)

The values obtained by converting D (rate time) of 0.0 to 999.9sec. into 0 to 9999 are stored.

MSB

COOL (Rate of proportional band for output 2) high order byte

COOL (Rate of proportional band for output 2) low order byte (word size)

The values obtained by converting COOL (cooling side proportional band coefficient) of 0.0 to 10.0 into 0 to 100 are stored.

F NO.	Name of file	Attribute
J24	Input terminal board file	Read

1. Outline

This read only input terminal board file stores parameters which serve as control calculation and alarm decision sources.

2. Structure

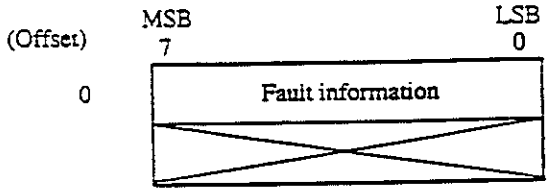
(Offset)	MSB 7 — LSB 0
0	Measured value [PV] (H)
	Measured value [PV] (L)
1	Proportional band (H)
	Proportional band (L)
2	Automatic rest time (H)
	Automatic rest time (L)
3	Rate time (H)
	Rate time (L)
4	Rate of proportional band for output2 (H)
	Rate of proportional band for output2 (L)
5	Dead band/overlap band (H)
	Dead band/overlap band (L)
6	Manual reset value (H)
	Manual reset value (L)
7	Low limit setting of MV (H)
	Low limit setting of MV (L)
8	High limit setting of MV (H)
	High limit setting of MV (L)
9	Cycle of computing (H)
	Cycle of computing (L)
10	Anti-reset wind-up (H)
	Anti-reset wind-up (L)
11	Hys (H)
	Hys (L)
12	
	Reverse/normal action (Output 1)
13	Reverse/normal action (Output 2)
	PID/FUZZY
14	Action when input is abnormal
	Digital input

F NO.	Name of file	Attribute
J21	Fault information file	Read

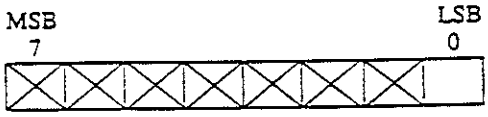
1. Outline

This file stores fault information of the main unit.

2. Structure



3. Individual contents



Fault information (byte size)

bit 7 to 1 === Not used

bit 0 (LSB) === EEP-ROM data breakage information (0: Normal, 1: Broken)

F NO.	Name of file	Attribute
J20	Output monitor file	Read

1. Outline

This read only file stores manipulated variables (MV) being output at present.

2. Structure

(Offset)	MSB 7 — LSB 0
0	MV for output 1 (H)
	MV for output 1 (L)
1	MV for output 2 (H)
	MV for output 2 (L)

3. Individual contents

MSB

MV for output 1 high order byte

MV for output 1 low order byte (word size)

The values obtained by converting output 1 side manipulated variables (MV) of 0 to 100% now being output into 0 to 10000 are stored.

MSB

MV for output 2 high order byte

MV for output 2 low order byte (word size)

The values obtained by converting output 2 side manipulated variables (MV) of 0 to 100% now being output into 0 to 10000 are stored.

F NO.	Name of file	Attribute
J19	Monitor file	Read

1. Outline

This read only file stores set values (SV), process variables (PV), and deviations (DV) being controlled at present.

2. Structure

(Offset)	MSB 7 — LSB 0
0	Measured value (PV) (H)
	Measured value (PV) (L)
1	Setting value (SV) (H)
	Setting value (SV) (L)
2	Deviation value (DV) (H)
	Deviation value (DV) (L)

3. Individual contents

MSB

	Measured value (PV) high order byte
	Measured value (PV) low order byte (word size)

The values obtained by representing present measured value (PV) as 0 to 100% to the input range, and then, converting them into 0 to 10000 are stored.

MSB

	Setting value (SV) high order byte
	Setting value (SV) low order byte (word size)

The values obtained by representing present setting value of SV for control as 0 to 100% to the input range, and then, converting them into 0 to 10000 are stored.

MSB

	Deviation value (DV) high order byte
	Deviation value (DV) low order byte (word size)

The values obtained by representing present deviation value (DV=PV-SV) as 0 to 100% to the input range width, and then, converting them into 0 to 10000 are stored.

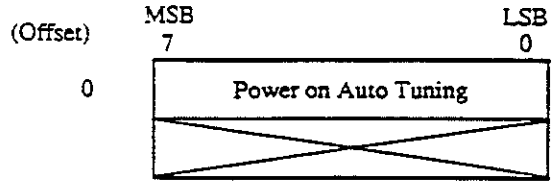
(FTE)

F NO.	Name of file	Attribute
J13	Power ON AT command file	Read/Write

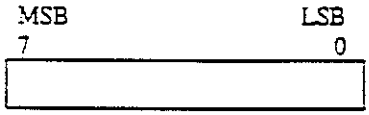
1. Outline

This file stores command for starting the AT (auto tuning) automatically when turning on the power supply.

2. Structure



3. Individual contents



Power ON AT command (byte size)

Auto tuning can be started automatically when turning on the power supply (power ON AT function). This operation can be set by the codes shown in the following table.

Code	Operation
0	AT is not started when turning on the power supply.
1	Normal AT is started when turning on the power supply.
2	Low PV type AT is started when turning on the power supply.

F NO.	Name of file	Attribute
J12	Keylock file	Read/Write

1. Outline

This file stores keylock function parameters.

2. Structure

(Offset)	MSB 7	LSB 0
0	Lock for front operation (H)	
	Lock for front operation (L)	

3. Individual contents

MSB	
	Lock parameter high order byte
	Lock parameter low order byte (word size)

Keylock levels of 0000 to 0003 are stored as they are. The following table shows the details of each level.

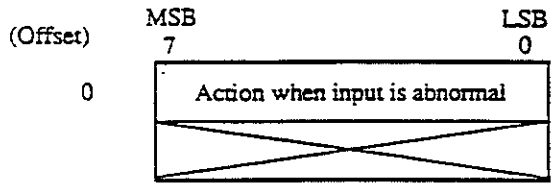
Lock level	Contents
0000	Setting of all parameters is inhibited.
0001	Setting of all parameters other than setting values (SV) is inhibited.
0002	Normal parameters only are settable.
0003	All parameters are settable.

F NO.	Name of file	Attribute
J11	Abnormal output file	Read/Write

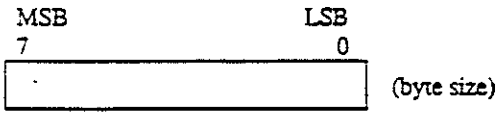
1. Outline

This file is used to designate a manipulated variable (MV) output at an abnormal input or at the end of a ramp soak function (option) program.

2. Structure



3. Individual contents



This file is used to designate a manipulated variable (MV) output at an abnormal output or at the end of a ramp soak function (option) program.

Code	Output 1	Output 2
00H	-3%	-3%
01H	103%	103%
02H	-3%	103%
03H	103%	-3%

F NO.	Name of file	Attribute
J10	MV limit file	Read/Write

1. Outline

This file stores the limit values of manipulated variables (MV).

2. Structure

(Offset)	MSB 7 — LSB 0
0	High limit setting of MV (H)
	High limit setting of MV (L)
1	Low limit setting of MV (H)
	Low limit setting of MV (L)

3. Individual contents

MSB

Manipulated variable (MV) limit high limit value high order byte

Manipulated variable (MV) limit high limit value low order byte (word size)

The values obtained by representing the high limit values of manipulated variable (MV) limit as -3.00 to 103.00% to the input range, and then, converting them into -300 to 10300 are stored.

(Setting range: -300 to 10300)

MSB

Manipulated variable (MV) limit low limit value high order byte

Manipulated variable (MV) limit low limit value low order byte (word size)

The values obtained by representing the low limit values of manipulated variable (MV) limit as -3.00 to 103.00% to the input range, and then, converting them into -300 to 10300 are stored.

(Setting range: -300 to 10300)

F NO.	Name of file	Attribute
J09	Setting value limit file	Read/Write

1. Outline

This file stores the setting value (SV) limit values.

2. Structure

(Offset)	MSB 7 — LSB 0
0	High limit setting of SV (H)
	High limit setting of SV (L)
1	Low limit setting of SV (H)
	Low limit setting of SV (L)

3. Individual contents

MSB

High limit setting of SV high order byte

High limit setting of SV low order byte (word size)

The values obtained by representing the high limit value of SV limit as 0 to 100% to the input range, and then, converting them into 0 to 10000 are stored. (Setting range: 0 to 10000)

MSB

Low limit setting of SV high order byte

Low limit setting of SV low order byte (word size)

The values obtained by representing the low limit value of SV limit as 0 to 100% to the input range, and then, converting them into 0 to 10000 are stored. (Setting range: 0 to 10000)

F NO.	Name of file	Attribute
J08	PV offset file	Read/Write

1. Outline

This file stores PV offset values.

2. Structure

(Offset)	MSB 7	LSB 0
0	PV offset (H)	
	PV offset (L)	

3. Individual contents

MSB		
	PV offset value	high order byte
	PV offset value	low order byte (word size)

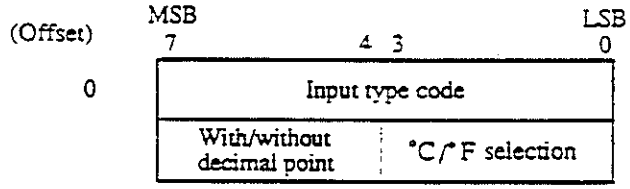
The values obtained by representing the PV offset values as 0 to 100% to the input range width, and then, converting them into 0 to 10000 are stored. (Setting range 0 to 10000)

F NO.	Name of file	Attribute
J07	Input type filter	Read/Write

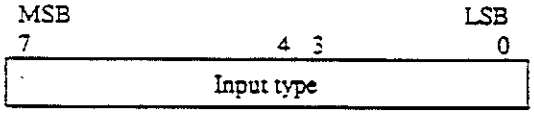
1. Outline

This file stores the input type, input range, whether decimal point is present or not, and °C/°F setting.

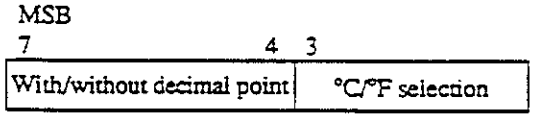
2. Structure



3. Individual contents



An input type code is stored (byte size).



Whether decimal point is present or not and °C/°F selection are set by the codes shown in the following table.

Higher significant 4 bits	0	No decimal point is present.
	1	Indication down to one place of decimals
Lower significant 4 bits	0	°C indication
	1	°F indication

F NO.	Name of file	Attribute
J06	Input scaling file	Read/Write

1. Outline

This file is used for determining the voltage/current input scale.

2. Structure

(Offset)	MSB 7 — LSB 0
0	Lower scale for PV (H)
	Lower scale for PV (L)
1	Upper scale for PV (H)
	Upper scale for PV (L)
2	Decimal point position

3. Individual contents

MSB

Lower scale for PV high order byte
Lower scale for PV low order byte (word size)

The lower scale for PV of -1999 to 9999 is stored as it is. (Setting range: -1999 to 9999)

MSB

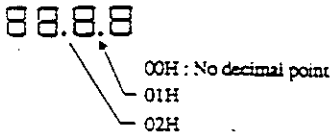
Upper scale for PV high order byte
Upper scale for PV low order byte (word size)

The upper scale for PV of -1999 to 9999 is stored as it is. (Setting range: -1999 to 9999)

MSB

Decimal point position (byte size)

Decimal point position



F NO.	Name of file	Attribute
J05	Rate of digital filter file	Read/Write

1. Outline

This file stores the rate of digital filter.

2. Structure

(Offset)	MSB 7	LSB 0
0	Rate of Digital Filter (H)	
	Rate of Digital Filter (L)	

3. Individual contents

MSB	
	Rate of digital filter high order byte
	Rate of digital filter low order byte (word size)

The values obtained by converting rate of digital filter of 0.0 to 900.0sec. into 0 to 9000 are stored.
(Setting range: 0 to 9000)

F NO.	Name of file	Attribute
J04	Proportional cycle for output file	Read/Write

1. Outline

This file stores the proportional cycle for output data.

2. Structure

(Offset)	MSB 7 — LSB 0
0	Proportional Cycle for Output 1
	Proportional Cycle for Output 2

3. Individual contents

MSB

Proportional Cycle for Output 1 (byte size)

The proportional cycle for output 1 side of 1 to 120sec. is stored as it is. (Setting range: 1 to 120)

MSB

Proportional Cycle for Output 2 (byte size)

The proportional cycle for output 2 side of 1 to 120sec. is stored as it is. (Setting range: 1 to 120)

MSB

	Anti-Reset Wind-up high order byte
	Anti-Reset Wind-up low order byte (word size)

The values obtained by converting the Anti-Reset Wind- up of 0.0 to 100.0% into 0 to 10000 are stored.
(Setting range: 0 to 10000)

MSB

	Manual Reset value high order byte
	Manual Reset value low order byte (word size)

The values obtained by converting manual reset values of -100.0 to 100.0% into -10000 to 10000 are stored.
(Setting range: -10000 to 10000)

MSB

	Cycle of computing high order byte
	Cycle of computing low order byte (word size)

The values obtained by converting the control calculation cycle of 0.5 to 999.5sec. into 5 to 9995 are stored.
(Setting range: 5 to 9995)

MSB

	(Output 1) Reverse/Normal action selection (byte size)

00H : Normal action
01H : Reverse action

MSB

	(Output 2) Reverse/Normal action selection (byte size)

00H : Normal action
01H : Reverse action

3. Individual contents

MSB

P (proportional band) high order byte

P (proportional band) low order byte (word size)

The values obtained by converting P (proportional band) of 0.0 to 999.9% into 0 to 9999 are stored.
(Setting range: 0 to 9999)

MSB

I (integral time) high order byte

I (integral time) low order byte (word size)

The values obtained by converting I (integral time) of 0 to 3200sec. into 0 to 32000 are stored.
(Setting range: 0 to 32000)

MSB

D (derivative time) high order byte

D (derivative time) low order byte (word size)

The values obtained by converting D (derivative time) of 0.0 to 999.9sec. into 0 to 9999 are stored.
(Setting range: 0 to 9999)

MSB

Hysteresis high order byte

Hysteresis low order byte (word size)

The values obtained by representing the 2-position action hysteresis width as 0 to 100% to the input range width, and then, converting them into 0 to 10000 are stored. (Setting range: 0 to 10000)

MSB

2nd output side proportional band coefficient high order byte

2nd output side proportional band coefficient low order byte (word size)

The values obtained by converting the 2nd output side proportional band coefficients of 0.0 to 10.0 into 0 to 100 are stored.
(Setting range: 0 to 100)

MSB

Dead band/Overlapband high order byte

Dead band/Overlapband low order byte (word size)

The values obtained by converting the Dead band/Overlapband of -50 to 50% into -5000 to 5000 are stored.
(Setting range: -5000 to 5000)

F NO.	Name of file	Attribute
J03	PID/FUZZY parameter file	Read/Write

1. Outline

This file stores parameters used for control calculation.

2. Structure

(Offset)	MSB 7 — LSB 0
0	Proportional band (H)
	Proportional band (L)
1	Automatic Reset time (H)
	Automatic Reset time (L)
2	Rate time (H)
	Rate time (L)
3	Hy s (H)
	Hy s (L)
4	Rate of Proportional Band for cooling (H)
	Rate of Proportional Band for cooling (L)
5	Dead band / Overlap band (H)
	Dead band / Overlap (L)
6	Anti-Reset Wind-up (H)
	Anti-Reset Wind-up (L)
7	Manual Reset value (H)
	Manual Reset value (L)
8	Cycle of computing (H)
	Cycle of computing (L)
9	Reverse/Normal action (Output 1)
	Reverse/Normal action (Output 2)

F NO.	Name of file	Attribute
J02	Second SV file	Read/Write

1. Outline

This file stores second setting values used for SV selection (option).

2. Structure

(Offset)	MSB 7	LSB 0
0	Second SV (H)	
	Second SV (L)	

3. Individual contents

MSB	
	Second SV high order byte
	Second SV low order byte (word size)

The values obtained by representing second setting values as 0.00 to 100.00% of the input range (scale), and then, converting them into 0 to 10000 are stored. (Setting range: 0 to 10000)

F NO.	Name of file	Attribute
J01	SV file	Read/Write

1. Outline

This file stores setting values (SV) in local run and manipulated variables (MV) in manual run.

2. Structure

(Offset)	MSB 7 — LSB 0
0	Setting value (H)
	Setting value (L)
1	Manual manipulated variable (H)
	Manual manipulated variable (L)

3. Individual contents

MSB

	Setting value (SV) high order byte
	Setting value (SV) l ow order byte (word size)

The values obtained by representing setting values as 0 to 100% of the input range (scale), and then, converting them into 0 to 10000 are stored. (Setting range: 0 to 10000)

MSB

	Manual manipulated variable high order byte
	Manual manipulated variable low order byte (word size)

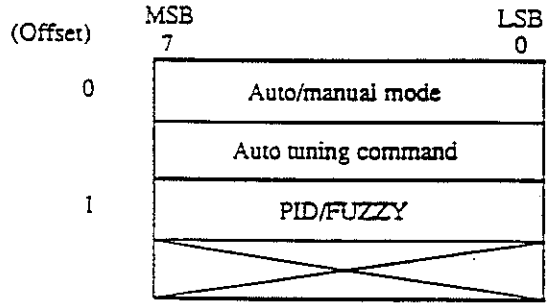
The values obtained by converting manipulated variables (MV) of -3.00 to 103.00% during manual operation into -300 to 10300 are stored. (Setting range: -300 to 10300)

F NO.	Name of file	Attribute
J00	Control command file	Read/Write

1. Outline

This file stores commands to designate the selection of AUTO/MANUAL mode and kinds of control (PID/FUZZY) and the ON/OFF operation of AT (auto tuning).

2. Structure



3. Individual contents

MSB

Auto/manual mode (byte size) selection

00H : AUTO
01H : MANUAL

MSB

Auto tuning command (byte size)

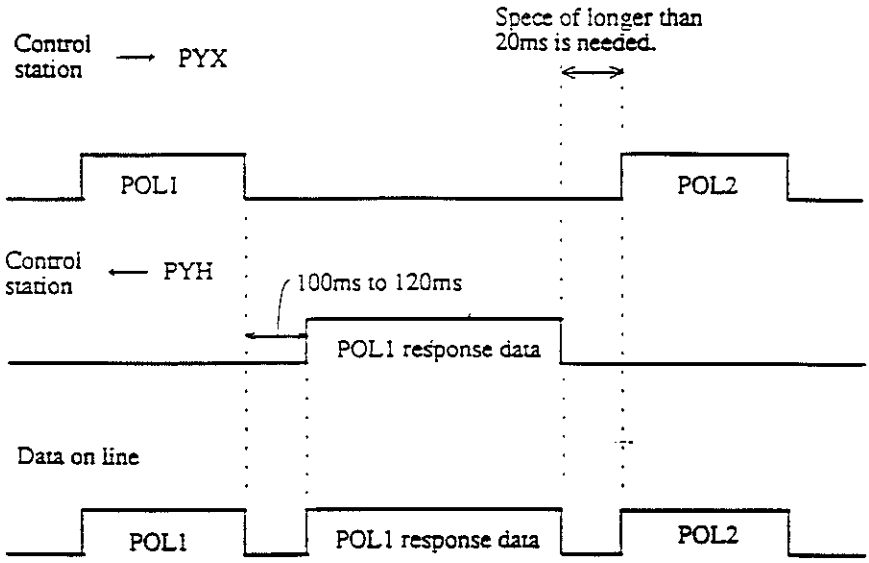
00H : AT (Auto tuning) off
01H : Normal AT
02H : Low PV type AT

MSB

PID/FUZZY (byte size) selection

00H : FUZZY control
01H : PID control

II. File Specification (PYX)


Spece of longer than
20ms is needed.
Control
station
PYX
POL1
POL2
Control
station
PYH
100ms to 120ms
POL1 response data
Data on line
POL1
POL1 response data
POL2

4. Transmission control procedure

In general, the transmission control procedures can be divided into the following three phases.

(1) Data link setup

(2) Data transfer

(3) Data link release

In this transmission system, the data link setup (1) also serves for the data link release (3) of the previous frame.

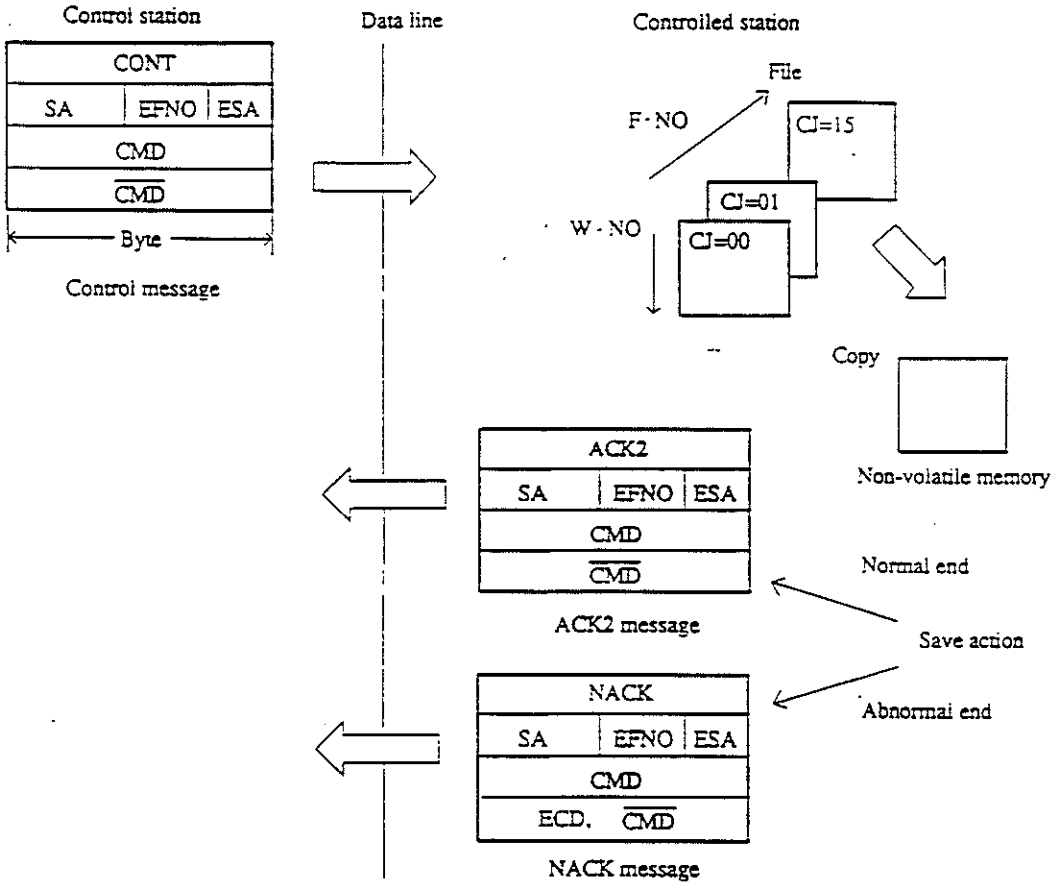
Accordingly, the space between frames must be secured correctly. The time required for spacing the frames is longer than 20msec.

> A polling message or a selecting message from the control station and corresponding response message from the controlled station are called polling frame and selecting frame, respectively.

In other words, when the control station has no received one character data for longer than 20msec on the line, the data link initializes reception based on the judgement that a new frame is started. If the character space becomes 10msec. or longer during the reception (during the transmission from the control station), the controlled station is automatically initialized and all received data are completely cleared. Under the condition of initialized reception, the first character is limited to transmission function words (POL, SEL, CONT), and a series of messages stating with other characters are all neglected.

In the controlled station, when the function words are 'POL' or 'CONT', the header section, or, only 2 words are taken. When the function words are 'SEL', the data (data section) of the data length shown in the header section are taken, while others are all neglected.

(3) Control message



It takes 5 seconds until PYX saves memory data completely after receiving this message.

If the PYX power supply is turned off during this time, memory data are broken to be unemployable.

(4) Others

No response returns, if a transmission function word other than POL code, SEL code, and CONT code is received by the controlled station.

<Sample program>

The selecting message program in example 2 is shown by using BASIC language of the personal computer (PC9801) as follows.

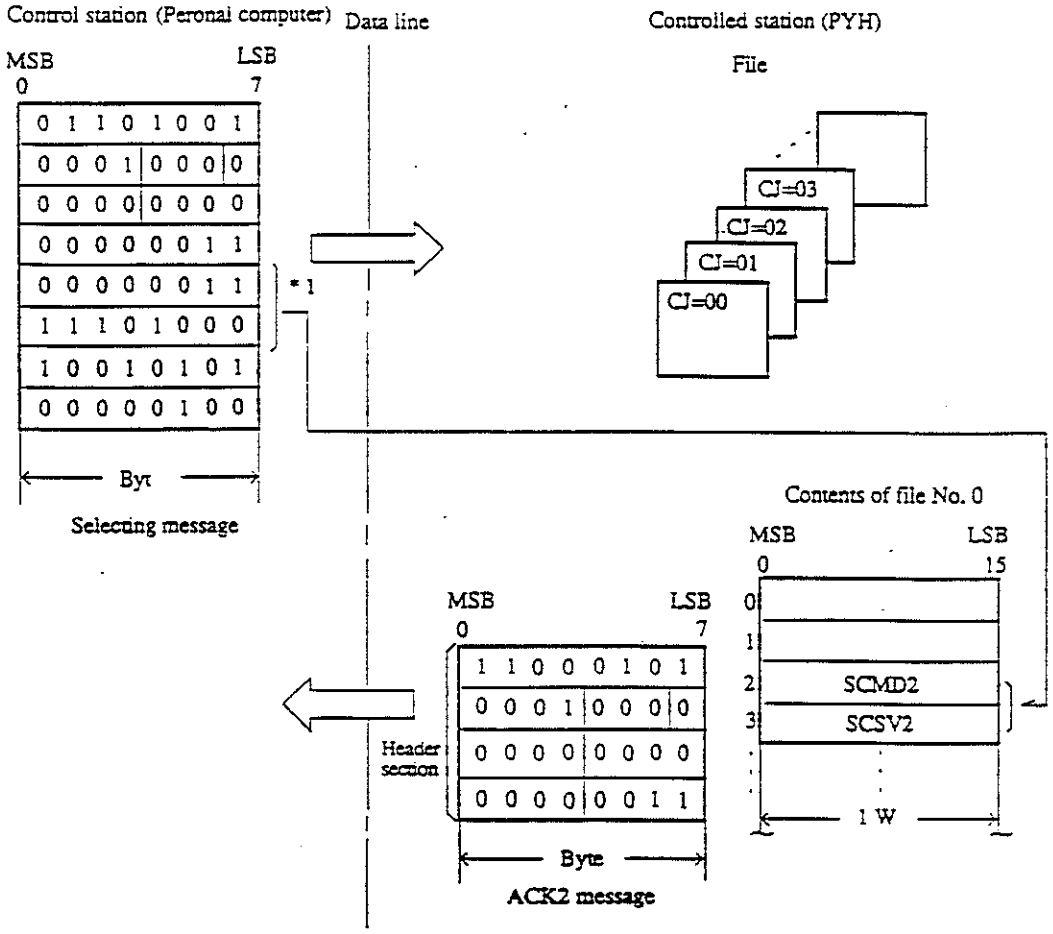
```
10  OPEN "COM1 : 081NN" AS #1

20  PRINT #1, CHRS (&H69) + CHRS (&H10) + CHRS (&H00) + CHRS (&H03) +
    CHRS (&H03) + CHRS (&HE8) + CHRS (&H95) + CHRS (&H04) ;

30  XS = INPUTS (1, #1)

40  PRINT HEXS (ASC (XS))

50  GOTO 30

60  END
```

<After run>

```
RUN

C5

10

00

03
```

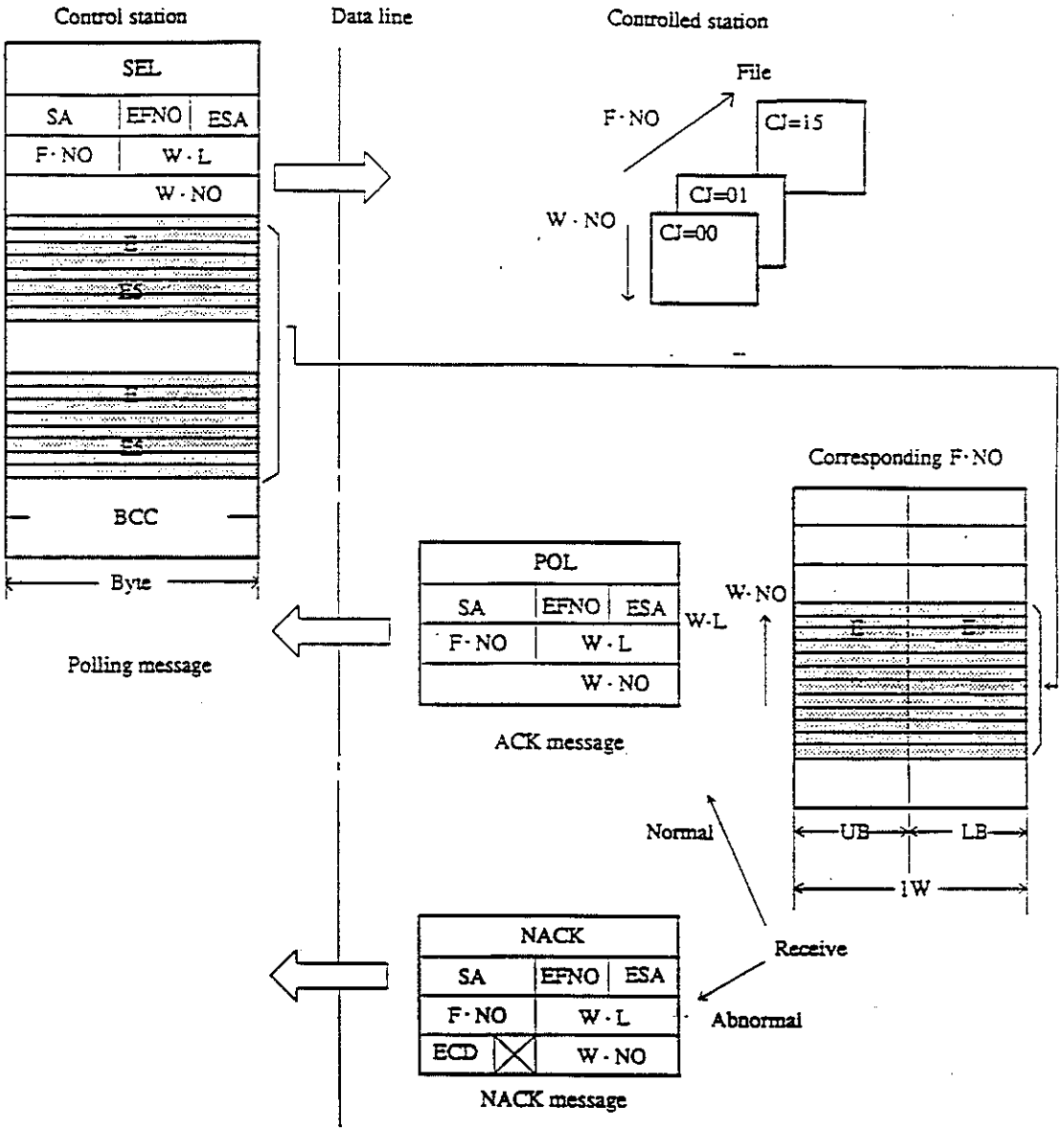
Example 2

Setting (WRITE) of a set value (SV) from the personal computer to station No. 1 microcontroller. Assume that the measuring range of the microcontroller is 0° to 1000°C and the SV is set to 100°C.



* 1 SV is a % value to the measuring range, and 0 to 10000 corresponds to 0 to 100.00%. Since the SV is set to 100°C in the measuring range of 0° to 1000°C in this example, SV is 10%, that is, 1000 (X' 3E8') is stored into the file.

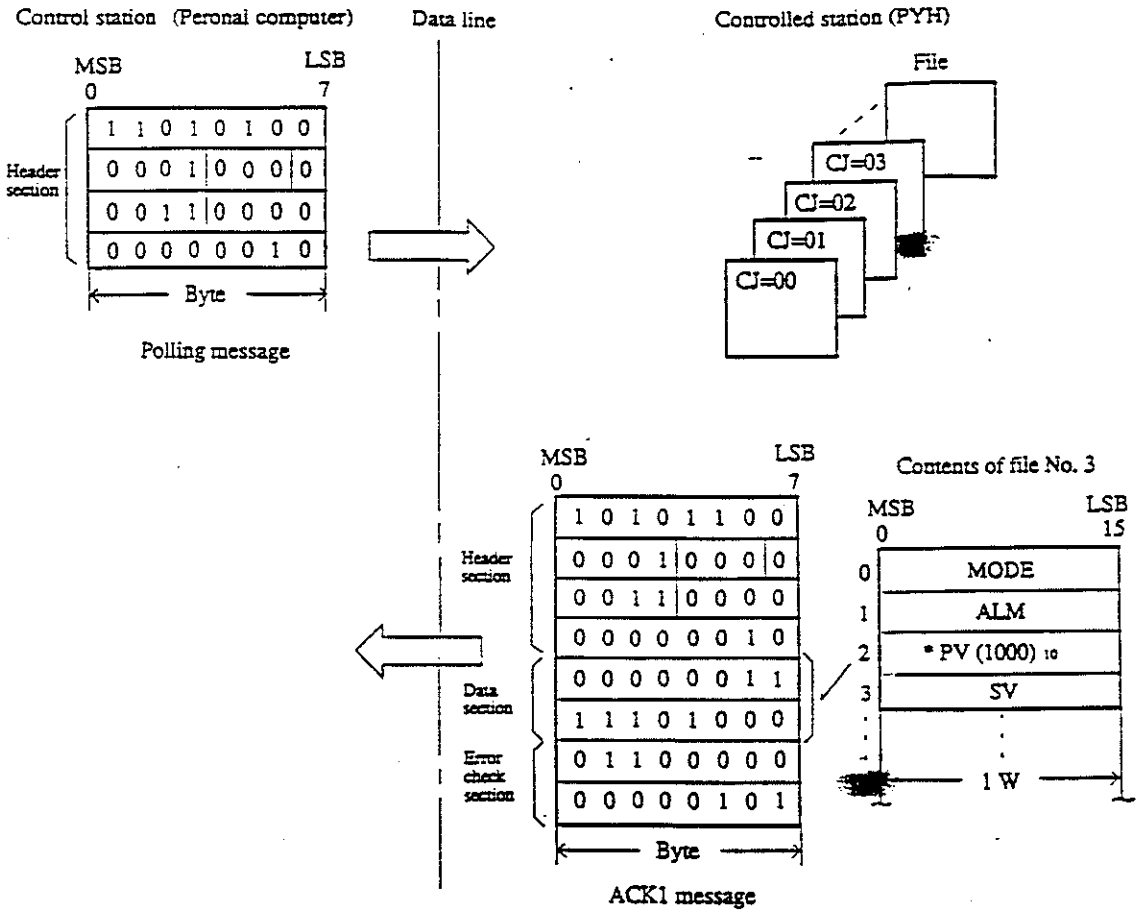
(2) Selecting message



Example 1

Request-to-send (READ) of the present process variable (PV) from the personal computer to station No. 1 microcontroller.

Assume that the measuring range of the microcontroller is 0° to 1000°C and the present process variable (PV) is 100°C.



*1 PV is a % value to the measuring range, and 0 to 10000 corresponds to 0 to 100.00%.
Since PV is 100°C in the measuring range of 0° to 1000°C in this example, PV is 10%, that is, 1000 (X' 3E8') is stored into the file.

<Sample program>

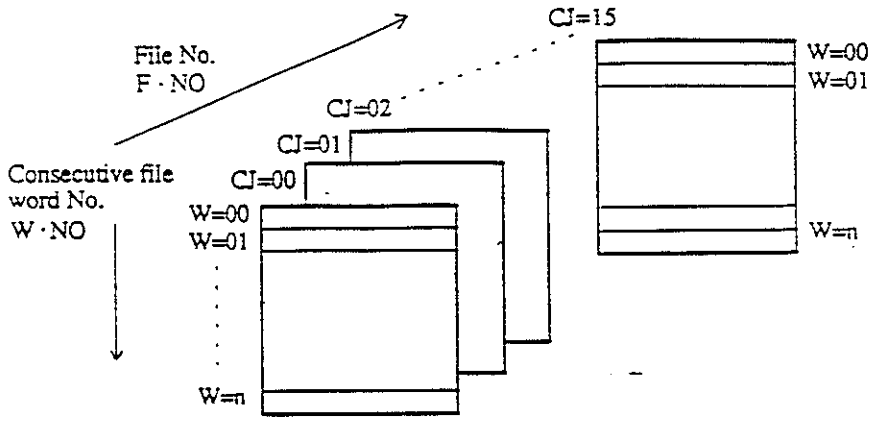
Polling message program in example 1 is shown by using BASIC language of the personal computer (PC9801) as follows.

```
10  OPEN "COM1 : 081NN" AS #1
20  PRINT #1, CHR$ (&HD4) + CHR$ (&H10) + CHR$ (&H30) + CHR$ (&H2);
30  X$ = INPUT$ (1, #1)
40  PRINT HEX$ (ASC (X$))
50  GOTO 30
60  END
```

<After run>

```
RUN
AC
10
30
02
03
E8
60
05
```

Note 1) The controlled station file is composed as shown below.

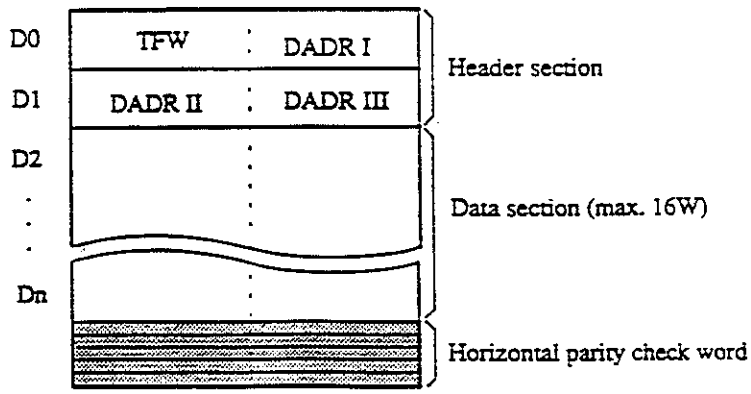


(2) Data section

The data section is composed of data with a word length designated by DADR II W·L of the header section. The 1W data on the transmission line are transmitted in the order of high order byte to low order byte.

(3) Error check section (BCC)

This section is composed of a 1W horizontal parity check word up to the final word of the data section from the header section.



Calculation formula of horizontal parity check word

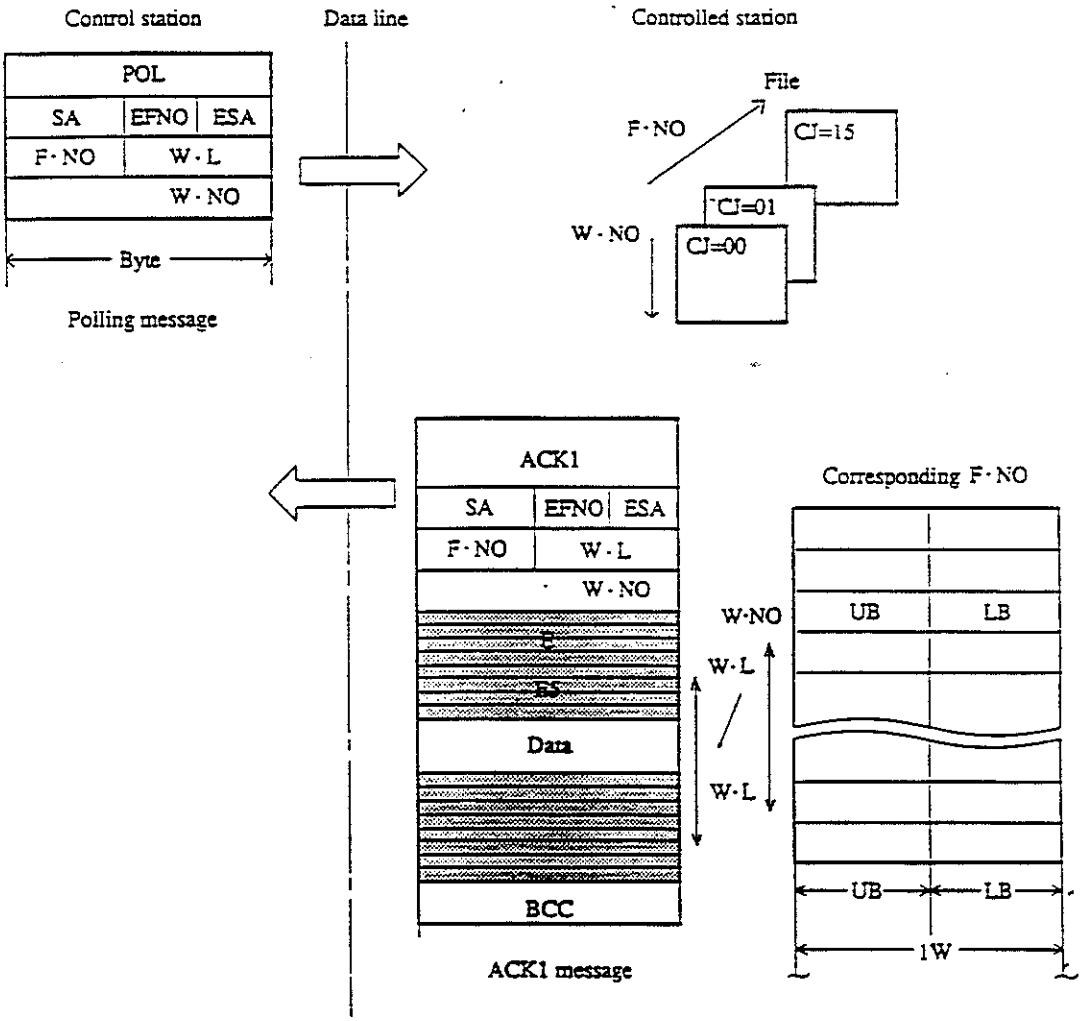
Horizontal parity check word = X' FFF $\forall$ D0 $\forall$ D1 $\forall$ D2 $\forall$ .....$\forall$ Dn

$\forall$ shows the calculation of exclusive-or.

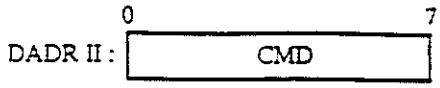
3.3 Examples of message communication

A communication message is described in units of characters (bytes) according to the transmission format.

(1) Polling message

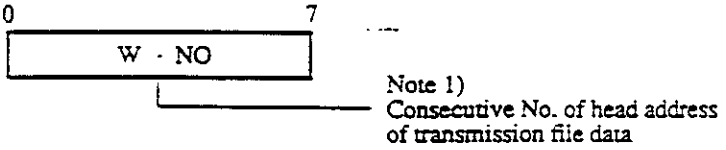


- When the function word is control (CONT), DADR II becomes a code to specify the kinds of specified action.



Specified code X' 1E' only is prepared as CMD for saving various parameters, constants, wafer connection data, and other data into the non-volatile memory.

DADR III : In case where function word is POL, SEL, or ACK1 or ACK2 for selecting



In case where function word is NACK

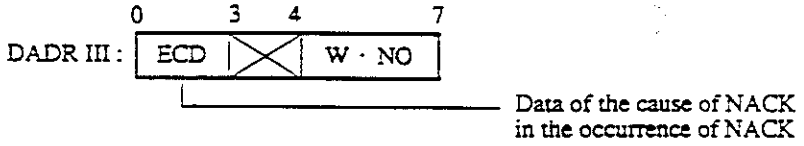
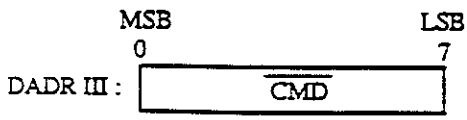


Table 3.2 b Error codes

Error code	Causes of NACK
X' 1'	Access to non-volatile memory is in progress.
X' 2'	Parity or flaming error occurs.
X' 3'	BCC error occurs.
X' 4'	File protect error occurs.
X' 5'	Non-volatile memory write error occurs.

If the function word is control (CONT) or ACK2 to control, error code becomes inverted code X' E1' of CMD.



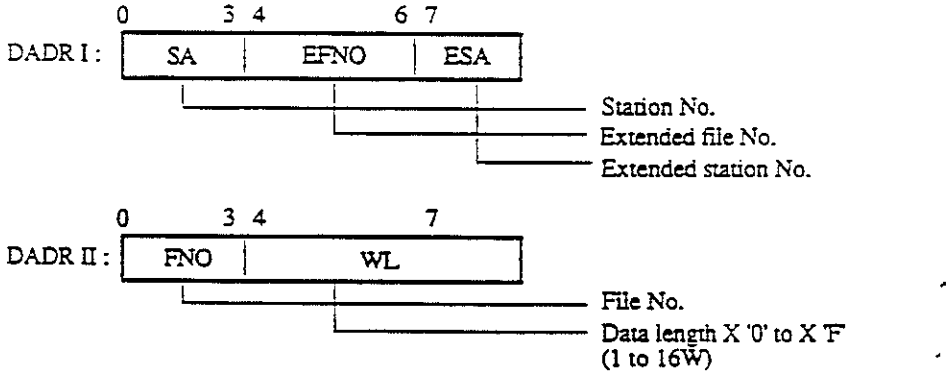
(a) Transmission function words (TFW)

Table 3.2a Transmission function word

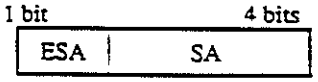
Function word	Symbol	Code	Meaning of function word
Polling	POL	Note 1) X'04'	Code of polling message
Selecting	SEL	X'69'	Code of selecting message
Control	CONT	X'8A'	Code of control message
Acknowledgment 1 (polling response)	ACK1	X'AC'	Code of ACK1 message
Acknowledgment 2 (selecting & control response)	ACK2	X'C5'	Code of ACK2 message
Negative acknowledgment	NACK	X'1B'	Code of NACK message

Note 1): X'**' shows a hexadecimal expression.

(b) Data zone designation

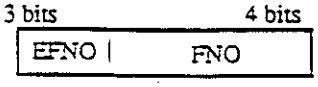


- The station number of each controlled station connected to the line is designated by 5 bits with ESA and SA as shown in the following figure.



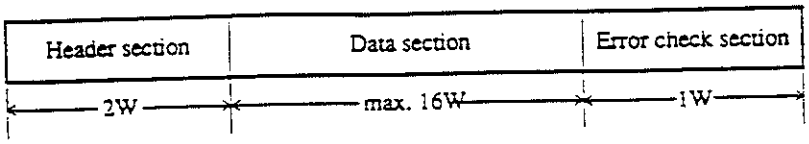
X'01' to X'0F' (Station 1 to 15)

- Transmission destination file No. is also designated by 7 bits with EFNO and FNO.



X'00' to X'7F' (File No. 0 to 127)

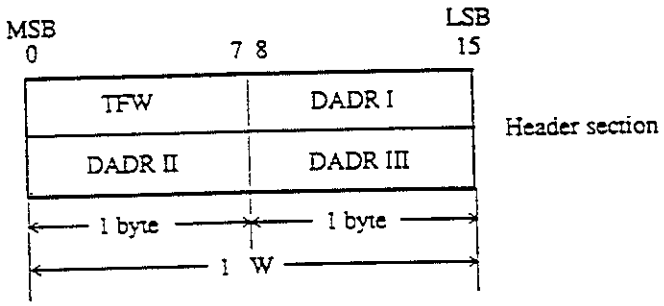
3.2 Formats of message



The selection message and ACK 1 message containing data are composed of the 2W header section, 16W (or less) data section, and 1W error check section respectively as shown in the above format. Other messages without data are composed of a fixed length of 2W header section only.

(1) Header section

The header section is composed of 1 byte transmission function word (TFW) and 3 bytes of data address word, that is, 2W in total.



Elements of the header section are explained in units of byte as follows.

1. General

The PYX transmission protocol is so-called 1:N type transmission system where N (N=15 units) controlled station units are connectable to one control station unit, and PYX acts as a controlled station of this transmission line.

All transmission control is executed under the controlled of the control station and the preferential processing request function from controlled stations is absent to simplify the transmission procedure.

The control station can transmits max. 16W continuous data every transmission unit, and it can refer to (read) and change (write) data about a file area of max. 256W (512 bytes) per controlled station.

Since all the following pieces of information are included, this PYX transmission protocol is easily connectable to the decentralized digital instrumentation.

Since all the following data are included, this system is easily connectable to the decentralized digital instrumentation.

(1) SPC information

(2) DDC (manual operation) information

(3) Monitoring (process, PYH failure information) information

(4) Information on the display and operation of control parameters and running modes

(5) Other pieces of information (operation parameters & industrial values)

L. PYX Transmission Protocol Specifications

KOOLANT KOOLERS, INC.

We thank you for your confidence in our company, displayed by the purchase of a KOOLANT KOOLER. The unit is designed to provide many years of trouble-free service. It has been run-tested in our plant prior to shipping and should not require adjustment or repair when starting. However, should you encounter any difficulty, make sure to refer to the warranty policy and definitely call us before ordering any service repairs. We will provide any practical assistance to assure that the unit meets your requirements. Please take the time to review the start-up and operating instructions. If you have any questions, do not hesitate to call us.

1-800-YOU-KOOL

2625 Emerald Drive • Kalamazoo, Michigan 49001-4542
616-349-6800 • 1-800-YOU-KOOL • Fax 616-349-8951
Manufacturers of Quality Cooling Units Since 1950.

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SECTION I

GENERAL INFORMATION

KOOLANT KOOLERS HAV SERIES

Koolant Koolers systems are designed to maintain the temperature of cooling fluids within a selected temperature range.

Each of our units is tested by simulating the customer's in plant working conditions. This enables Koolant Koolers to calibrate all instrumentation, match actual performance data to customer requirements, and verify that each individual unit will function as specified. You may review the enclosed test sheet.

The units are designed to operate efficiently at the customer's specifications. Due to wide differences in the heat exchange rate at other than the design temperatures, *it is not recommended that the machine be set to operate at temperatures beyond 10 °F above or below the specified temperature range. Consult the factory before any change greater than 10 °F is made since refrigerant pressures need to be monitored to be sure there are no problems.*

Before putting the unit into service, please refer to " INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS ".

The label installed on the outside of the electrical enclosure door specifies the model, serial number, compressor H. P., pump H. P. (if available), voltage, phase, hertz, type of refrigerant and weight and total amps.

Under normal conditions, the start-up procedure can be performed by any plant personnel or maintenance people. It is recommended, however; that any work involving service of the refrigerant system be performed only by a qualified refrigeration service person.

INSTALLATION AND OPERATION

1. Make sure unit is placed in a location where adequate air circulation is provided and allows room for servicing. Do not place on a mezzanine, near a ceiling, or in a enclosed room without consulting factory; because the build-up of high ambient temperatures could cause compressor damage. As a general guideline, keep the unit at least 3 ft. away from the walls and allow at least 8 ft. clearance above the unit. Chillers provided with the squirrel cage blower type condensers can be ducted for heat reclaim or outdoor exhaust.

Keep in mind that in order to provide the highest possible pump pressure and minimize the line loss to ambient, it is necessary to locate the unit as near as possible to the equipment to be cooled.

2. Connect the coolant lines to the proper pipes marked "FLUID IN" and "FLUID OUT". Make sure that the flow of fluid to and from the unit can not be shut off or blocked while the chiller is in operation, and the pipe size is large enough to match pump flow conditions. To give good service, the chiller should be connected into the lines delivering clean coolant. Plugging of the heat exchanger by solids is not covered by the warranty.

3. It is a requirement for units equipped with water cooled condensers to be supplied with either tower, ground or city water.

When using tower water (at 85°F maximum) provide 3 GPM for every 12,000 BTU/HR chiller capacity. For city or ground water the requirement is 65°F maximum or below and 1.5 GPM for every 12,000 BTU/HR chiller capacity.

Note: 1 ton of chiller capacity equals 12,000 BTU/HR.

For additional information, consult the factory.

4. Check voltage to make sure it matches your power.

5. Connect power leads to main disconnect. Wiring should match chiller disconnect size and power requirements in accordance with local codes.

6. On models 12,000 and larger, the refrigerant is stored and isolated during shipping to prevent loss in case of shipping damage. These models will have three or four service valves marked with red tags, two on the compressor, one on the discharge side of the condenser; and if equipped, a fourth valve will be located on the inlet to the condenser.

Valves marked with red tags must be backseated (remove cap and turn valve stem counter-clockwise until snug) to allow refrigerant to enter the system. If refrigerant loss is detected while opening valves, immediately close them and call for assistance.

INSTALLATION AND OPERATION

7. If the unit is equipped with a reservoir, there are two types:

A. A cylindrical galvanized tank for pressurized systems supplied with a pressure reducing valve and a 1/2" make-up line that should be connected to the city water supply.

B. A rectangular steel tank designed to be used with oil or water/glycol solution. This tank should be filled to the proper level as indicated on the sight glass (between the two black markers).

8. Turn disconnect switch to the "ON" position and leave unit energized for at least 8 hours, to allow crankcase heater in the compressor to vaporize any liquid refrigerant that may have mixed with the oil. This applies only if the unit is equipped with a crankcase heater.

9. Turn the control switch to the "ON" position, if equipped. The circulating pump should start.

A. Check the pump to make sure the direction of rotation agrees with the arrow. On single phase models (115 or 230 volts) the direction would be correct when unit leaves the factory and need not be checked.

B. If the rotation is incorrect, switch any two primary incoming leads. The direction can be observed by viewing the motor shaft between the motor and the pump, by removing the steel plug at the end of the motor housing or by observing the fan on a TEFC motor.

On "A" models (HAV, SAV, HAW, SAW, etc.) that utilize customer pumps, the fluid flow can be started. If a grinding, turning or machining coolant is circulated throughout the heat exchanger, make sure that good filtration is provided to prevent the blockage of the heat exchanger. A blocked heat exchanger is not covered by the manufacturer's warranty.

10. Most of our units are provided with a flow switch to insure that the fluid flow is established before the refrigeration unit can operate. Also when cooling water, it minimizes the potential for water expansion damage from freezing.

11. Continue circulating the pump for about five minutes to allow any air in the system to be vented. On cylindrical galvanized tanks, an air eliminator will vent the air and close off when the tank is full. Open tanks (rectangular type) will vent through the tank itself.

12. The compressor will now start if the fluid temperature is higher than the set point on the temperature controller.

INSTALLATION AND OPERATION

13. On models furnished with a heating function, the heater energizes with the fall of the temperature in the fluid.

14. The temperature controller can normally be adjusted up or down 10° F. Beyond this range, adjustments may have to be made or damage to the refrigeration system may result. For water systems, set point must not be adjusted below 45 °F without consulting the factory.

SECTION III

MAINTENANCE

CONDENSERS

In order for the refrigeration system to perform to its rated capacity, it is very important to keep the condensing temperature from getting too hot. This usually happens when the condenser is not kept properly cleaned.

Air cooled condensers: Units with air cooled condensers are supplied with cleanable aluminum air filters, and it is very important that they be cleaned as necessary to maintain good air flow. Failing to do so will result in poor unit performance and possible compressor damage.

Water cooled condensers: Units with water cooled condensers are supplied with the shell and tube (cleanable) type condenser. The end cover plates are removable for easy inspection and cleaning. The water bypass tubes can be cleaned by rodding out or using wire brushes specially design for this purpose.

CLEANABLE HEAT EXCHANGERS

Units equipped with the cleanable heat exchanger type are supplied with pressure gauges on the IN and OUT fluid ports, and they should be monitored for an increase in the pressure differential. We are expecting a normal pressure drop of 7 to 10 PSID, should this differential increase to 20 PSID; the heat exchanger is getting plugged and it will require service. (See special insert for instructions for service)

ELECTRIC MOTORS

Maintenance for electric motors is required only when these motors are furnished with grease fittings so they can be greased. If this is the situation, we recommend greasing every 6 months.

Maintenance as you can see is minimal, but should you have a problem or situation not being described above, please call our service department for assistance at **1-800-YOU-KOOL.**

SERVICE DIAGNOSIS GUIDE

SYMPTOMS	POSSIBLE CAUSE
Selector switch is in the "ON" position and the pump will not start.	1. Open disconnect switch. 2. Blown fuse. 3. Tripped starter overloads.
Pump is rotating but no pressure is established.	1. Improper rotation. 2. No water in the reservoir. 3. Valves not open. 4. No back pressure. 5. Pump suction blocked. 6. Pump seal leaking.
Pump runs properly, temperature rises, but compressor does not start.	1. Compressor is not being energized. (Refer to COMPRESSOR SYMPTOMS) 2. Flow switch (if equipped)not activated.
Fluid flow fault (if equipped).	1. Pump not working (refer to PUMP SYMPTOMS). 2. System not completely filled. 3. Air in the system. 4. Flow switch paddle stuck.
Temperature controller is indicating a fault or has no indication at all.	1. Faulty contacts on the relays. 2. Sensor problem. 3. Supply voltage missing.
Thermostat (if equipped) will not call for cooling.	1. Out of calibration. 2. Defective.
Compressor hums, but will not start.	1. Low line voltage. 2. Shorted or grounded motor windings. 3. Internal compressor damage. 4. Improperly wired.
Compressor will not run, does not try to start (no hum).	1. Power circuit open due to blown fuse, tripped overload circuit, or open disconnect switch. 2. Compressor motor protector open. 3. Open thermostat or temperature control. 4. Burned motor windings - open circuit. 5. Loss of refrigerant charge. 6. Refrigerant liquid solenoid valve (if equipped) not working.

SYMPTOMS	POSSIBLE CAUSE
Compressor starts, but trips on overload protector.	1. Excessive suction or discharge pressure. 2. Low line voltage. 3. Defective overload protector. 4. Tight bearings or mechanical damage in compressor. 5. Shorted or grounded motor windings.
Unit short cycles.	1. Shortage of refrigerant. 2. Refrigerant liquid solenoid valve (if equipped) leaking. 3. Discharge valve leaking. 4. Defective expansion valve.
High refrigerant pressure fault.	1. Refrigerant overcharge. 2. Dirty condenser. 3. Malfunction of condenser fan (air cooled). 4. Excessive air temperature entering condenser.
Low refrigerant pressure fault.	1. Low ambient temperatures (air cooled). 2. Refrigerant leak. 3. Lack of coolant flow through the heat exchanger. 4. Liquid line solenoid valve not opening (if equipped). 5. Expansion valve stuck or lost bulbwell charge (check cap tube).
Lube protector fault (if equipped).	1. Low of oil from compressor due to: (a) Oil trapping in system. (b) Compressor short cycling. (c) Insufficient oil in system. (d) Operation at excessively low suction pressure. 2. Excessive liquid refrigerant returning to compressor. 3. Malfunctioning oil pump.
Fluid temperature too cold or tripped out on freezestat (if equipped).	1. Operating temperature setting is too low. 2. Faulty temperature controller. 3. Defective temperature controller sensor. 4. Refrigerant liquid solenoid valve (if equipped) leaking.

SECTION V

TEST SPECIFICATIONS

SERIAL # 10709
MODEL: HAV5000-SO

DATE: 2/4/97
INVENTORY # 716005000956
TESTED BY: RICK

OPERATING TEMP.	65°F	AMBIENT TEMP.	65-70 °F
FLUID REQ'D	Oil	FLUID TEMP. IN	70.30°F
REFRIG. TYPE	R-22	FLUID TEMP. OUT	62.30°F
LBS/OZS OF REFRIG.	9LBS.	DELTA TEMP.	08.00°F

AMBIENT TEMP. RANGE -10 TO 100°F

	HEAD PRESS. RANGE	HEAD PRESS. ACTUAL	SUCTION PRESS. RANGE	SUCTION PRESS. ACTUAL	BTU/HR RATED	BTU/HR ACTUAL	ENG. OK'D
COMP. 1	190-300	210	70-80	50	58,000	43,680	D.M.
COMP. 2							

	SUPERHEAT RANGE	SUPERHEAT ACTUAL	COMP. OIL PRESS. RANGE	COMP. OIL PRESS. ACTUAL	COMP. OIL TRIP TIME	ENG. OK'D
COMP. 1	15-20	7-18				D.M.
COMP. 2						

	LOW PRESS. SET IN/OUT	LOW PRESS. ACTUAL IN/OUT	HIGH PRESS. SET IN/OUT	HIGH PRESS. ACTUAL IN/OUT
COMP. 1	50/25	50/25	/410	/410
COMP. 2				

	TEMP. SET ON/OFF	TEMP. ACTUAL ON/OFF	WATER REG. VALVE 1 SHUT OFF PRESS. SET/ACTUAL	WATER REG. VALVE 2 SHUT OFF PRESS. SET/ACTUAL
COMP. 1	65/62	65/62		
COMP. 2				

SECTION V

TEST SPECIFICATIONS (continued)

	RLA	L1	L2	L3	OVERLOAD SIZE/SETTING
COMP. 1	9.3	6.5	7.0	6.7	/9.3
COMP. 2					

	RLA	SERVICE FACTOR	S.F. AMPS	L1	L2	L3	OVERLOAD SETTING	REQ'D FLOW GPM	ACTUAL FLOW GPM	REQ'D/ ACTUAL PRESS. PSI
PUMP 1								25	26	
PUMP 2										
PUMP 3										
PUMP 4										

	RLA	L1	L2	L3	OVERLOAD SIZE/ SETTING	SET PRESS. IN/OUT	ACTUAL PRESS. IN/OUT
FAN 1	1.6	.7	1.0	.7			
FAN 2	1.6	.7	1.0	.7			
FAN 3							
FAN 4							
FAN 5							
FAN 6							
FAN 7							
FAN 8							

	RLA	L1	L2	L3	SET TEMP. ON/OFF	ACTUAL TEMP. ON/OFF
HEATER 1						
HEATER 2						
HOT GAS 1					64.5/65.7	64.5/65.6
HOT GAS 2						

PARTS LIST
KOOLANT KOOLER MODEL HAV5000-SO
SERIAL NO. 10709

NO	ID/DESCRIPTION	K.K.PART#	QTY	TYPE
001	HAV5000-SO 460/3/60 OIL 65 DEG F	0716005000956		STOCK
010	18-7/8" X 44-7/8" X 1" INDUSTRIAL AIR FILTER W/ LIFT UP TAB RESEARCH PRODUCTS FITS HAV 3-6 TON, HCV 3-6 -FILT	4311844	2.00	PC
011	PA-L733 GREY PAINT PRIMER EGYPTIAN LACQUER OR EQUIVALENT	4508024	0.50	GAL
012	F77W100 WHITE SANDS QUICK-DRY PAINT SHERWIN WILLIAMS	4508000	0.50	GAL
013	HAV5000-ST LAYOUT	0403291	1.00	PC
014	HAV5000 SHTMTL * USE WITH 2 @ 4311844 * 18.875 X 44.875 AIR FILTER * FOR CLEANABLE AND NONCLEANABLE * SIDES ARE 48" TALL BEFORE BENDING * * STANDARD SHEET METAL * *	0402433	1.00	ASSEM
001	18 GA. CRS 48 X 120 SHEET METAL COMMERCIAL QUALITY, OILED 80.0 LBS/SHEET	9511800	93.00	LB
002	12 GA. HR 48 X 120 SHEET METAL HR PICKLED AND OILED 175.0 LBS/SHT	9501200	70.00	LB
015	S-3-SS-120-31-7-16-T-7-9-1983 HEATEX KOOLANT KOOLERS	2063108	1.00	PC
016	**HAV5000-SO MCHNCL**		**406510**	
001	1-1/2 SCH 40 STD BLACK PIPE (21 FT. LENGTHS)	7012801	6.00	FT
002	1-1/2 150# UNION (BLACK)	7012401	1.00	PC
003	RB1033303 (RB1033302) RTD SENSOR 3 WIRE 100 OHM, WITH 1/8 NPT BRAZED SS FITTING ON ONE SIDE,1/2"PROBE W/ JACKETED LEADS, COLD END CRIMP AND SPRING STRAIN RELIEF W/ DRAIN WIRE GROUNDED TO FITTING (OLD NUMBER RB1033301) OR EQUIVALENT	3832105	1.00	PC
004	V6EPB-SS60 FLOW SWITCH DWYERS S.S. BODY;SPDT;LESS TEE W/TRIMMABLE VANE; VANE TAGGED W/MEASUREMENTS (FOR 2" PIPE W/ VANE TEMPLATE)	3849001	1.00	PC
005	1-1/2 MPT X 1-1/2 HOSEBARB (BLACK)	7012902	2.00	PC
006	1-1/2" GOODYEAR ORTAC HOSE 250PSI	4410004	2.00	FT
007	HAV5000-SO REFRIG	0605526	1.00	ASSEM
001	P66AAB-10 FAN SPEED CTRL PRESSURE SWITCH PENN 190/250 PSIG OPER RGE	3646016	1.00	PC
002	MT56HL-4A MANEUROP COMPRESSOR 1 3/4 SUCTION 1 1/4 DISCHARGE 460/3/60	1440056	1.00	PC
003	1/2" SWEAT ANGLE VALVE WITH ACCESS PORT	3980001	1.00	PC
004	6804505 V07 MANEUROP SERVICE VALVE 1-3/4 R X 7/8 S	1446005	1.00	PC

PARTS LIST
KOOLANT KOOLER MODEL HAV5000-SO
SERIAL NO. 10709

005	6804502 V09 MANEUROP SERVICE VALVE 1-1/4 R X 5/8 S	1446006	1.00 PC
006	7303507 CRANKCASE HEATER 48" WITH MA10109 PTC HEATER STOPPING RING MANEUROP 27W OR EQUIVALENT	1445001	1.00 PC
007	C-164S FILTER-DRYER SPORLAN	2730004	1.00 PC
008	SA-14S SIGHT GLASS SPORLAN 1/2"ODF	2720003	1.00 PC
009	VAF-8 VIBRATION ABSORBER PACKLESS 7/8 X 11 1/2 (UL P-8) OR EQUIVALENT	2980008	1.00 PC
010	E9S240 SOLENOID VALVE SPORLAN	2710005	2.00 PC
011	MKC-2 120V 50-60 HZ SOLENOID COIL KIT SPORLAN	2710097	2.00 PC
012	SVE-5-CP85 EXPANSION VALVE EXTERNALLY EQUALIZED SPORLAN	2760045	1.00 PC
013	P100DA-13D HIGH PRESSURE SWITCH CUT OUT 410 PSI MANUAL RESET ENCAPSULATED WITH A 9' CORD JOHNSON CONTROLS OR EQUIVALENT	3640007	1.00 PC
014	P100AA-33D LOW PRESSURE SWITCH IN 50 OUT 25 AUTO RESET ENCAPSULATED WITH A 9' CORD JOHNSON CONTROLS OR EQUIVALENT	3641002	1.00 PC
015	****** USE SUBSTITUTE 0606588 ***** VARIABLE SPEED MOTOR (FASCO) FAN ASSEMBLY - 16" OUTDOOR V SPEED ********** * * * * * **********	0606495	2.00 ASSEM
016	3/8 MPT FUSE PLUG 3NP210 (210 F) OR EQUIVALENT	1438020	1.00 PC
017	3/5 TON SLANT CONDENSING COIL DR#971606D000, MOD#3CY1003C,34"X34"	1413015	1.00 PC
018	R-22 REFRIGERANT 125 LB CYLINDER 1 PC = 125 LBS OF REFRIGERANT	2990013	9.00 LB
017	**HAV5000 460/3/60 EBOX**		**406511**
001	U09301 MIDGET/CC END BARRIER GOULD OR EQUIVALENT	3501053	2.00 PC
002	30X20X8 NEMA 12 SINGLE DOOR ENCLS.	3445030	1.00 PC
003	30 X 20 SUB PLATE	3418301	1.00 PC
004	NSC-28H4-0800 TRANSFORMER-375VA DONGAN	3842375	1.00 PC
005	194R-NJ030P34ER1 FUSED DISCONNECT SWITCH (A-B) 1 AMP TO 30 AMP FUSES OR EQUIVALENT	3110003	1.00 PC
006	30350 FUSE BLOCK GOULD; ADDER HOLDS TRM, ATQ, ATDR 0-30 AMPS 600 VOLTS OR EQUIVALENT	3501051	4.00 PC
007	ATQ-3 FUSE GOULD	3500130	2.00 PC
008	AJT15 FUSE GOULD OR EQUIVALENT	3500909	3.00 PC

PARTS LIST
KOOLANT KOOLER MODEL HAV5000-SO
SERIAL NO. 10709

009	TRM-2 FUSE GOULD OR EQUIVALENT	3500020	1.00 PC
010	800EP-SM32 3-POS. SELECTOR SWITCH (A-B)	3121053	1.00 PC
011	800E-3LX20 2 N.O. CONTACTS 3 ACROSS COMPLETE LATCH ALLEN-BRADLEY	3121087	1.00 PC
012	800EP-PL4 RED PILOT LIGHT (A-B) OPTICALLY ENHANCED LENS	3120032	1.00 PC
013	800EP-PL3 GREEN PILOT LIGHT (A-B) OPTICALLY ENHANCED LENS	3120031	1.00 PC
014	800E-3TL5 TRANSFORMER MODULE(A-B)	3120043	2.00 PC
015	RG1986-6-12 ELCU (REPLACES A-600) SURGE SUPPRESSOR GALCO OR EQUIVALENT	3849051	3.00 PC
016	100-A12ND3 CONTACTOR (A-B)	3100020	1.00 PC
017	193-A1F1 OVERLD RELAY 3.7-12.0 AMP (A-B) FITS CONTACTOR M05-A30 OR EQUIVALENT	3103404	1.00 PC
018	PYX4MAY1-200RF TEMPERATURE CONTROL 1/16 DIN/RTD/RELAY/ALARM/485 INCLUDING SOFTWARE FUJI	3864900	1.00 PC
019	D-AH2001A ELECTRIC HEATER HOFFMAN 200 WATT 115/1/50-60 1.7 AMP 4 LBS	3499999	1.00 PC
020	1492-EB3 END BARRIER (A-B) OR EQUIVALENT	3123086	1.00 PC
021	1492-W4 TERMINAL BLOCK (A-B) OR EQUIVALENT	3123021	19.00 PC
022	1492-WG10 GROUNDING BLOCK (A-B) OR EQUIVALENT	3123017	1.00 PC
023	ICM-175 BYPASS TIMER ICM TERM 1-2 LOAD,2-3 INPUT (REPLACES 32395 MARS ON 5/10/95) ICM PRODUCT CODE GKSOOC2X100P	3813401	1.00 PC
024	7.5 MICROFARAD CAPACITOR 370V	3899600	2.00 PC
025	A-PWK53NFSS STAINLESS WINDOW KIT	3464098	1.00 PC
026	TRM-4 FUSE GOULD	3500040	1.00 PC
027	DRM DIN RAIL ADAPTOR GOULD FOR 303 SERIES MIDGET & CC FUSE BLK	3501050	4.00 PC
028	DFC3M MIDGET/CC FUSE PULLER GOULD OR EQUIVALENT	3501052	4.00 PC
029	CABLE W/ DATA CONVERTER #RSFCLC RS232 TO RS 485 CONVERTER FUJI	3864901	1.00 PC
030	KIM 43005-3 POWER FACTOR 5KVAR 460V 6 AMP W/LIGHTS ZUCKER	3863001	1.00 PC

DU PONT

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

NAME
FREON* 22 Fluorocarbon

FORMULA
$CHClF_2$

MANUFACTURER/DISTRIBUTOR
E. I. du Pont de Nemours & Co. (Inc.)

ADDRESS
Wilmington, DE 19898

CHEMICAL FAMILY
Halogenated Hydrocarbon

TSCA INVENTORY STATUS
Reported/Included

SARA/TITLE III STATUS
See ADDITIONAL INFORMATION Section

PRODUCT INFORMATION PHONE
(800) 441-9450

MEDICAL EMERGENCY PHONE
(800) 441-3637

TRANSPORTATION EMERGENCY PHONE
CHEMTREC (800) 424-9300

PHYSICAL DATA

BOILING POINT
-40.8°C (-41.4°F)

LIQUID DENSITY
1.194 g/cc at 25°C (77°F)

VAPOR DENSITY (Air = 1)
3.03 at 25°C (77°F)

pH INFORMATION
Neutral

FORM
Liquefied gas

COLOR
Colorless

PERCENT VOLATILE BY VOLUME
100

VAPOR PRESSURE
151 psia at 25°C (77°F)

SOLUBILITY IN WATER
0.30% by wt. at 25°C (77°F)

EVAPORATION RATE (CCl_4 = 1)
>1

APPEARANCE
Clear

ODOR
Slight ethereal

*Registered U.S. Pat. & Tm. Office, Du Pont Company. FREON[R] 22 Fluorocarbon is made only by Du Pont.

ALTH HAZARD INFORMATION

PRINCIPAL HEALTH HAZARDS (Including Significant Routes, Effects, Symptoms of Overexposure, and Medical Conditions Aggravated by Exposure)

Inhalation of high concentrations of vapor is harmful and may cause heart irregularities, unconsciousness, or death. Intentional misuse can be fatal. Vapor reduces oxygen available for breathing and is heavier than air. Liquid contact can cause frostbite.

Inhalation 4-hour LC_{50}: 220,000 ppm in rats

The compound is untested for skin and eye irritancy, and is untested for animal sensitization. Toxicity described in animals exposed by inhalation to concentrations ranging from 5% to 70% include effects on the central nervous system, liver, lungs, kidneys, spleen; cardiac sensitization; decreased body weight gain; and partial anesthesia. In chronic inhalation studies, FC-22 produced a small, but statistically significant, increase of tumors in male rats, but not female rats or male or female mice, at a concentration of 50,000 ppm (v/v). In the same studies, no carcinogenic effects were seen in either species at concentrations of 10,000 ppm or 1000 ppm (v/v). FC-22 was mutagenic in bacterial cell cultures but not mammalian cell cultures, and was not mutagenic in whole animal assays. A slight, but significant, increase in developmental toxicity (eye malformations, decreased fetal weights) has been observed in the offspring of rats exposed to high concentrations (50,000 ppm) of FC-22, a concentration which was also maternally toxic; no effects on the fetus or the maternal rats were seen at 1000 or 100 ppm. Developmental toxicity studies in rabbits at 50,000, 1000 and 100 ppm FC-22 were negative. Studies of the effects of FC-22 on male reproductive performance have been negative. Specific studies to evaluate the effect on female reproductive performance have not been conducted, however, limited information obtained from studies on developmental toxicity do not indicate adverse effects on female reproductive performance at concentrations up to 50,000 ppm (v/v).

Human health effects of overexposure to the vapors by inhalation may include temporary nervous system depression with anaesthetic effects such as dizziness, headache, confusion, incoordination, and loss of consciousness. Higher exposures to the vapors may cause temporary alteration of the heart's electrical activity with irregular pulse, palpitations, or inadequate circulation; or fatality from gross overexposure. Skin contact with the liquid may cause frostbite.

Individuals with preexisting diseases of the central nervous or cardiovascular system may have increased susceptibility to the toxicity of excessive exposures.

CARCINOGENICITY

Not listed as a carcinogen by IARC, NTP, OSHA, or ACGIH. But see Principal Health Hazards Section above.

EXPOSURE LIMITS

PEL (OSHA):	1000 ppm, 3500 mg/m^3
TLV* (ACGIH):	1000 ppm, 3500 mg/m^3
AEL (Du Pont):	1000 ppm

*TLV is a registered trademark of the American Conference of Governmental Industrial Hygienists.

SHIPPING INFORMATION

DOT (172.101)

PROPER SHIPPING NAME
Chlorodifluoromethane

HAZARD CLASS
Nonflammable Gas

UN NO.
1018

DOT LABEL
Nonflammable Gas

DOT PLACARD
Nonflammable Gas

DOT/IMO (172.102)

PROPER SHIPPING NAME
Chlorodifluoromethane

HAZARD CLASS
Nonflammable Gas, 2.2

UN NO.
1018

IMO/ICAO LABEL
Nonflammable Gas

SHIPPING CONTAINERS
Cylinders, tank trucks, tank cars.

ADDITIONAL INFORMATION

STORAGE CONDITIONS
Clean, dry area. Do not heat above 125°F.

NPCA-HMIS RATINGS

Health	1
Flammability	0
Reactivity	1
Personal Protection	-

Personal Protection rating to be supplied by user depending on use conditions.

SARA/TITLE III HAZARD CATEGORIES AND LISTS

Product Hazard Categories:

Chronic Health	-	No
Acute Health	-	Yes
Fire Hazard	-	No
Pressure Hazard	-	Yes
Reactivity Hazard	-	No

Lists:

Extremely Hazardous Substance	-	No
CERCLA Hazardous Substance	-	No
Toxic Chemicals	-	No

DATE OF LATEST REVISION/REVIEW: 5/89

PERSON RESPONSIBLE FOR MSDS:
K. P. BROWN
Du Pont Company
Chemicals & Pigments Department
Chestnut Run Plaza
P.O. Box 80709
Wilmington, DE 19880-0709
(302) 999-5072

KOOLANT KOOLERS, INC.

WARRANTY PROCEDURES

OUR WARRANTY POLICY IS AS FOLLOWS:

WARRANTY WORK:

Before doing any work on a chiller covered under warranty, the customer is to call Koolant Koolers, Inc., **(1-800-YOU-KOOL)** and explain the problem to one of our engineers, who can then determine the best course of action. Koolant Koolers, Inc., will not be obligated to pay for warranty service performed without our prior approval.

If it proves necessary to call in a service person, we require an estimate of the labor charges prior to the service work being performed.

It is the responsibility of the service company to enclose a service report with each invoice. Koolant Koolers will not honor invoices that do not include a service report. Both the service report and the invoice are to include the serial number and model number of the chiller on which the warranty work has been performed.

Koolant Koolers, Inc., will not honor invoices for work done by two or more people at a time, or for overtime labor charges. If the customer requests work which falls into either of these categories, the customer is responsible for the extra charges incurred.

WARRANTY PARTS:

When it is necessary for Koolant Koolers, Inc., to replace parts which are under warranty, we require a purchase order from the customer to cover both the cost of the parts(s) and the freight charges. We will then invoice the customer for that amount. A returned good's authorization number will be issued, on which the defective parts may be returned, freight prepaid. When we receive the defective parts, we will issue a credit for the full amount of the invoice.

PLEASE NOTE: While Koolant Koolers, Inc., is willing to pay freight charges one way, we are not responsible for special freight charges such as next day service, Saturday delivery, etc. If the customer requests one of the special services, the customer is responsible for the charges incurred.

KOOLANT KOOLERS, INC.
WARRANTY

COVERING LABOR AND PARTS FOR ONE YEAR
UNDER THE TERMS AND CONDITIONS AS DESCRIBED BELOW

We agree that the apparatus manufactured by Koolant Koolers, Inc. will be free from defects in material and workmanship - under normal use, service, and proper installation - for a period of one year from the date of original installation or 18 months from the date of shipment from our factory, whichever date may occur first, and that our obligation under this agreement is limited solely to repair or replacement at our options, in our factory or in the field with our approval, within said warranty period. If the unit is returned to our factory, it must be returned freight prepaid, with prior approval and having obtained a returned goods authorization number, to Koolant Koolers, Inc., where we will make any needed repairs at no charge to the customer if the damage is determined not to be the fault of the customer. We will then return the unit freight prepaid; in other words we will be responsible for one leg of the transportation costs. **THIS AGREEMENT TO REPAIR OR REPLACE DEFECTIVE PARTS IS EXPRESSLY IN LIEU OF AND IS HEREBY A DISCLAIMER OF ALL OTHER WARRANTIES, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABITLTY AND FITNESS FOR A PARTICULAR PURPOSE, AS WELL AS ANY OTHER IMPLIED WARRANTIES, IN LAW OR EQUITY, AND OF ALL OTHER OBLIGATIONS OR LIABILITIES ON OUR PART. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION HEREOF.** We neither assume nor authorize any person to assume for us any liability or obligations in connection with sale of our apparatus, except said repair or replacement of the defective part as set forth above. Our liability does not include any labor charges for replacement of parts, adjustments, repairs, or any other work done outside our factory without our approval. Our liability does not include any consequential or resulting damage to persons, property, equipment, goods, merchandise, profits, good will or reputation arising out of any defect in or failure of our apparatus. Our obligation to repair or replace does not apply to any apparatus which has been repaired or altered outside of our factory in any way, or which has been subject to negligence, to misuse, or to pressure outside of stated limits. On parts not of our manufacture such as motors, controls, etc., we extend only the same warranties given by the seller. Our agreement herein applies only to the original purchaser and does not extend, expressly or by implication, to any other person or persons. Nothing in these warranty provisions will impose any liability or obligation of any type, nature or description upon Koolant Koolers, Inc. if Koolant Koolers, Inc. has not received payment in full for the apparatus in question. All stated warranty policies are limited to sales and ultimate shipment of equipment within the continental U.S. only. Shipments to other states or countries must be handled on an individual basis.

DELIVERY

We will make every effort to ship by the quoted date, but failure to do so for any cause whatsoever will not give the buyer the right to cancel the order or hold Koolant Koolers, Inc. responsible for any damages resulting from the inability to deliver within the time stated.

KOOLANT KOOLERS, INC.

We thank you for your confidence in our company, displayed by the purchase of a **KOOLANT KOOLER.** The unit is designed to provide many years of trouble-free service. It has been run-tested in our plant prior to shipping and should not require adjustment or repair when starting. **However, should you encounter any difficulty, make sure to refer to the warranty policy and definitely call us before ordering any service repairs.** We will provide any practical assistance to assure that the unit meets your requirements. Please take the time to review the start-up and operating instructions. If you have any questions, do not hesitate to call us.

1-800-YOU-KOOL

This manual is for Serial Number 8472.

2625 Emerald Drive Kalamazoo, Michigan 49001-4542
616-349-6800 1-800-YOU-KOOL Fax 616-349-8951
Manufacturers of Quality Cooling Units Since 1950.

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SECTION I

GENERAL INFORMATION

KOOLANT KOOLER HAV5000-ST

Koolant Koolers systems are designed to maintain the temperature of cooling fluids within a selected temperature range.

Each of our units is tested by simulating the customer's in plant working conditions. This enables Koolant Koolers to calibrate all instrumentation, match actual performance data to customer requirements, and verify that each individual unit will function as specified. You may review the enclosed test sheet.

The units are designed to operate efficiently at the customer's specifications. Due to wide differences in the heat exchange rate at other than the design temperatures, it is not recommended that the machine be set to operate at temperatures beyond 10 °F above or below the specified temperature.

NOTE: Consult the factory before any change is made beyond the 10° F since refrigerant pressures need to be monitored to be sure there are no problems.

Before putting the unit into service, please refer to " INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS.

The label installed on the outside of the electrical enclosure door specifies the model, serial number, compressor H. P., pump H. P. (if available), voltage, phase, hertz, type of refrigerant and weight and total amps.

Under normal conditions, the start-up procedure can be performed by any plant personnel or maintenance people. It is recommended, however; that any work involving service of the refrigerant system be performed only by a qualified refrigeration service person.

SECTION II

INSTALLATION AND OPERATION

1. Make sure unit is placed in a location where adequate air circulation is provided and allows room for servicing. Do not place in a mezzanine, near a ceiling, or in a enclosed room without consulting factory; because the build-up of high ambient temperatures could cause compressor damage. As a general guideline, keep the unit at least 3 ft. away from the walls and allow at least 8 ft. clearance above the unit. Chillers provided with the squirrel cage blower type condensers can be ducted for heat reclaim or outdoor exhaust.

Keep in mind that in order to provide the highest possible pump pressure and minimize the line loss to ambient, it is necessary to locate the unit as near as possible to the equipment to be cooled.

2. Connect the coolant lines to the proper pipes marked "FLUID IN" and "FLUID OUT". Make sure that the flow of fluid to and from the unit can not be shut off or blocked while the chiller is in operation, and the pipe size is large enough to match pump flow conditions. To give good service, the chiller should be connected into the lines delivering clean coolant. Plugging of the heat exchanger by solids is not covered by the warranty.

3. It is a requirement for units equipped with water cooled condensers to be supplied with either tower, ground or city water.

When using tower water (at 85°F maximum) provide 3 GPM for every 12,000 BTU/HR chiller capacity. For city or ground water the requirement is 65°F maximum or below and 1.5 GPM for every 12,000 BTU/HR chiller capacity.

Note: 1 ton of chiller capacity equals 12,000 BTU/HR.

For additional information, consult the factory.

4. Check voltage to make sure it matches your power.

5. Connect power leads to main disconnect. Wiring should match chiller disconnect size and power requirements in accordance with local codes.

6. On models 12,000 and larger, the refrigerant is stored and isolated in the receiver during shipping to prevent loss in case of shipping damage. These models will have three or four service valves with white caps, two on the compressor, one on the discharge side of the receiver; and if equipped, a fourth valve will be located on the inlet to the receiver.

White caps must be removed and the refrigerant valves back-seated (turned counter-clockwise until snug) to allow refrigerant to enter the system. If refrigerant loss is detected while opening valves, immediately close them and call for assistance.

7. If the unit is equipped with a reservoir, there are two types:

A. A cylindrical galvanized tank for pressurized systems supplied with a pressure reducing valve and a 1/2" make-up line that should be connected to the city water supply.

B. A rectangular steel tank designed to be used with oil or water/glycol solution. This tank should be filled to the proper level as indicated on the sight glass (between the two black markers).

8. Turn disconnect switch to the "ON" position and leave unit energized for at least 8 hours, to allow crankcase heater in the compressor to vaporize any liquid refrigerant that may have mixed with the oil. This applies only if the unit is equipped with a crankcase heater.

9. Turn the control switch to the "ON" position, if equipped. The circulating pump should start.

A. Check the pump to make sure the direction of rotation agrees with the arrow. On single phase models (115 or 230 volts) the direction would be correct when unit leaves the factory and need not be checked.

B. If the rotation is incorrect, switch any two primary incoming leads. The direction can be observed by viewing the motor shaft between the motor and the pump, by removing the steel plug at the end of the motor housing or by observing the fan on a TEFC motor.

On AV and HAV models that utilize customer pumps, the fluid flow can be started. If a grinding, turning or machining coolant is circulated throughout the heat exchanger, make sure that good filtration is provided to prevent the blockage of the heat exchanger. A blocked heat exchanger is not covered by the manufacturer's warranty.

10. Most of our units are provided with a flow switch to insure that the fluid flow is established before the refrigeration unit can operate. Also when cooling water, it minimizes the potential for water expansion damage from freezing.

11. Continue circulating the pump for about five minutes to allow any air in the system to be vented. On cylindrical galvanized tanks, an air eliminator will vent the air and close off when the tank is full. Open tanks (rectangular type) will vent through the tank itself.

12. The compressor will now start if the fluid temperature is higher than the set point on the temperature controller.

13. On models furnished with a heating function, the heater energizes with the fall of the temperature in the fluid.

14. The temperature controller can normally be adjusted up or down 10° F. Beyond this range, adjustments may have to be made or damage to the refrigeration system may result. For water systems, set point must not be adjusted below 45 °F without consulting the factory.

SECTION III

MAINTENANCE

CONDENSERS

In order for the refrigeration system to perform to its rated capacity, it is very important to keep the condensing temperature from getting too hot. This usually happens when the condenser is not kept properly cleaned.

Air cooled condensers: Units with air cooled condensers are supplied with cleanable aluminum air filters, and it is very important that they be cleaned as necessary to maintain good air flow. Failing to do so will result in poor unit performance and possible compressor damage.

Water cooled condensers: Units with water cooled condensers are supplied with the shell and tube (cleanable) type condenser. The end cover plates are removable for easy inspection and cleaning. The water bypass tubes can be cleaned by rodding out or using wire brushes specially design for this purpose.

CLEANABLE HEAT EXCHANGERS

Units equipped with the cleanable heat exchanger type are supplied with pressure gauges on the IN and OUT fluid ports, and they should be monitored for an increase in the pressure differential. We are expecting a normal pressure drop of 7 to 10 PSID, should this differential be increased up to 20 PSID; it will mean the heat exchanger is getting plugged and it will require to be serviced. (See special insert for instructions for service)

ELECTRIC MOTORS

Maintenance for electric motors is required only when these motors are furnished with 9 service ports so they can be greased. If this is the situation, we recommend greasing every 6 months.

Maintenance as you can see is minimal, but should you have a problem or situation not being described above, please call our service department for assistance at **1-800-YOU-KOOL.**

SECTION IV

SERVICE DIAGNOSIS GUIDE

SYMPTOMS	POSSIBLE CAUSE
Selector switch is in the "ON" position and the pump will not start.	1. Open disconnect switch. 2. Blown fuse. 3. Tripped starter overloads.
Pump is rotating but no pressure is established.	1. Improper rotation. 2. No water in the reservoir. 3. Valves not open. 4. No back pressure. 5. Pump suction blocked. 6. Pump seal leaking.
Pump runs properly, temperature rises, but compressor does not start.	1. Compressor is not being energized. (Refer to COMPRESSOR SYMPTOMS) 2. Flow switch (if equipped)not activated.
Fluid flow fault (if equipped).	1. Pump not working (refer to PUMP SYMPTOMS). 2. System not completely filled. 3. Air in the system. 4. Flow switch paddle stuck.
Temperature controller is indicating a fault or has no indication at all.	1. Faulty contacts on the relays. 2. Sensor problem. 3. Supply voltage missing.
Thermostat (if equipped) will not call for cooling.	1. Out of calibration. 2. Defective.
Compressor hums, but will not start.	1. Low line voltage. 2. Shorted or grounded motor windings. 3. Internal compressor damage. 4. Improperly wired.
Compressor will not run, does not try to start (no hum).	1. Power circuit open due to blown fuse, tripped overload circuit, or open disconnect switch. 2. Compressor motor protector open. 3. Open thermostat or temperature control. 4. Burned motor windings - open circuit. 5. Loss of refrigerant charge. 6. Refrigerant liquid solenoid valve (if equipped) not working.

SYMPTOMS	POSSIBLE CAUSE
Compressor starts, but trips on overload protector.	1. Excessive suction or discharge pressure. 2. Low line voltage. 3. Defective overload protector. 4. Tight bearings or mechanical damage in compressor. 5. Shorted or grounded motor windings.
Unit short cycles.	1. Shortage of refrigerant. 2. Refrigerant liquid solenoid valve (if equipped) leaking. 3. Discharge valve leaking. 4. Defective expansion valve.
High refrigerant pressure fault.	1. Refrigerant overcharge. 2. Dirty condenser. 3. Malfunction of condenser fan (air cooled). 4. Excessive air temperature entering condenser.
Low refrigerant pressure fault.	1. Low ambient temperatures (air cooled). 2. Refrigerant leak. 3. Lack of coolant flow through the heat exchanger. 4. Liquid line solenoid valve not opening (if equipped). 5. Expansion valve stuck or lost bulbwell charge (check cap tube).
Lube protector fault (if equipped).	1. Low of oil from compressor due to: (a) Oil trapping in system. (b) Compressor short cycling. (c) Insufficient oil in system. (d) Operation at excessively low suction pressure. 2. Excessive liquid refrigerant returning to compressor. 3. Malfunctioning oil pump.
Fluid temperature too cold or tripped out on freezestat (if equipped).	1. Operating temperature setting is too low. 2. Faulty temperature controller. 3. Defective temperature controller sensor. 4. Refrigerant liquid solenoid valve (if equipped) leaking.

SECTION V

TEST SPECIFICATIONS

SERIAL # 8472
CUSTOMER: L & F INDUSTRIES
MODEL: HAV5000-ST

DATE: 12/12/94
INVENTORY # 716005000990
TESTED BY: MARV

OPERATING TEMP. 65°F
FLUID REQ'D Oil
REFRIG. TYPE R-22
LBS/OZS OF REFRIG. 9LBS.

AMBIENT TEMP. 65 °F
FLUID TEMP. IN 66.00°F
FLUID TEMP. OUT 58.00°F
DELTA TEMP. 08.00°F

	HEAD PRESS. RANGE	HEAD PRESS. ACTUAL	SUCTION PRESS. RANGE	SUCTION PRESS. ACTUAL	BTU/HR RATED	BTU/HR ACTUAL	ENG. OK'D
COMP. 1	200-300	190	70-80	65-70	58,000	58,800	
COMP. 2							

	SUPERHEAT RANGE	SUPERHEAT ACTUAL	COMP. OIL PRESS. RANGE	COMP. OIL PRESS. ACTUAL	COMP. OIL TRIP TIME	ENG. OK'D
COMP. 1	15-20	17				
COMP. 2						

	LOW PRESS. SET IN/OUT	LOW PRESS. ACTUAL IN/OUT	HIGH PRESS. SET IN/OUT	HIGH PRESS. ACTUAL IN/OUT
COMP. 1	50/25	50/25	/410	/410
COMP. 2				

	TEMP. SET ON/OFF	TEMP. ACTUAL ON/OFF	WATER REG. VALVE 1 SHUT OFF PRESS. SET/ACTUAL	WATER REG. VALVE 2 SHUT OFF PRESS. SET/ACTUAL
COMP. 1	65/62	65/62		
COMP. 2				

PARTS LIST
KOOLANT KOOLER MODEL HAV5000-ST
SERIAL NO.8472

NO	ID/DESCRIPTION	K.K.PART#	QTY	TYPE
001	HAV5000-ST 460/3/60 OIL 65 DEG F	0716005000990		STOCK
002	HAV5000-ST ENGINEER	0604238	1.00	ASSEM
003	18-7/8" X 44-7/8" X 1" INDUSTRIAL AIR FILTER W/ LIFT UP TAB RESEARCH PRODUCTS FITS HAV 3 AND 5 TON	4311844	2.00	PC
004	PA-L733 GREY PAINT PRIMER EGYPTIAN LACQUER	4508024	0.00	GAL
005	F77W100 WHITE SANDS QUICK-DRY PAINT SHERWIN WILLIAMS	4508000	0.00	GAL
006	HAV5000-ST LAYOUT	0403291	1.00	PC
007	HAV5000-ST SHTMTL	0402433	1.00	ASSEM
002	18 GA. CRS 48 X 120 SHEET METAL COMMERCIAL QUALITY, OILED 80.0 LBS/SHEET	9511800	93.00	LB
003	12 GA. HR 48 X 120 SHEET METAL HR PICKLED AND OILED 175.0 LBS/SHEET	9501200	70.00	ASSEM
008	S-3-S-120-31-7-16-T-7-7-1983 HEATEX KOOLANT KOOLERS	2063107	1.00	ASSEM
002	6-3/4" OD X 1/4" DOM MECH. TUBING	9011561	29.50	IN
003	2 FULL COUPLING (BLACK)	7016201	2.00	PC
004	1/2-13 X 2-1/2 HEX HEAD CAP SCREW	7750202	16.00	PC
005	120 HOLE STEEL DIFFUSER/ENDCAP FOR 6" SHELL HEAT EXCHANGER MILLED FROM INV.# 2360103 8 HOLES DRILLED FOR TIE BOLTS PRINT# 300697	2360303	1.00	PC
006	120 HOLE STEEL TUBE SHEET FOR 6" SHELL HEAT EXCHANGER DRILLED FROM INV.# 2360103 PRINT# 200820	2360401	2.00	PC
007	120 HOLE STEEL RETURN/ENDCAP FOR 6" SHELL HEAT EXCHANGER MILLED FROM INV.# 2360103 8 HOLES DRILLED FOR TIE BOLTS PRINT# 300697	2360503	1.00	PC
008	BAFFLE FOR 120 TUBE 6" SHELL HE 18 GA. SHEET STEEL INV. #9511810 HOLE PATTERN ON PRINT #200820	2360601	7.00	PC
009	GASKET FOR 6" SHELL HEAT EXCHANGER NEOPRENE INV. #2310704	2360704	2.00	PC
010	1/2 HEX NUTS	7754000	16.00	PC
011	1/2 LOC WASHER	7755222	16.00	PC
012	3/8 OD X 20 GA. (.035") WALL HYDRAULIC SEAMLESS TUBING	9020001	310.00	FT
009	**HAV5000-ST PIPING**	**403292**		
002	1-1/2 150# UNION (BLACK)	7012401	2.00	PC

SECTION V

TEST SPECIFICATIONS (continued)

	RLA	L1	L2	L3	OVERLOAD SIZE/SETTING
COMP. 1	9.3	5.9	6.4	6.2	NA/9.3
COMP. 2					

	RLA	SERVICE FACTOR	S.F. AMPS	L1	L2	L3	OVERLOAD SETTING	REQ'D FLOW GPM	ACTUAL FLOW GPM	REQ'D/ ACTUAL HEAD PRESS.
PUMP 1									35	
PUMP 2										
PUMP 3										
PUMP 4										

	RLA	L1	L2	L3	OVERLOAD SIZE/ SETTING	SET PRESS. IN/OUT	ACTUAL PRESS. IN/OUT
FAN 1	.85	.9	.8		NA/NA		
FAN 2	.85	.8	.8		NA/NA		
FAN 3							
FAN 4							
FAN 5							
FAN 6							
FAN 7							
FAN 8							

	RLA	L1	L2	L3	SET TEMP. ON/OFF	ACTUAL TEMP. ON/OFF
HEATER 1						
HEATER 2						
HOT GAS 1						64/65
HOT GAS 2						

PARTS LIST
KOOLANT KOOLER MODEL HAV5000-ST
SERIAL NO.8472

003	RB1033301 RTD SENSOR GORDON 3 WIRE 100 OHM, WITH 1/8 NPT BRAZED SS FITTING ON ONE SIDE, 1/2" PROBE LENGTH W/ JACKETED LEADS COLD END CRIMP AND SPRING STRAIN RELIEF	3832105	1.00	PC
004	V6EPB-SS60 FLOW SWITCH DWYERS S.S. BODY;SPDT;LESS TEE W/TRIMMABLE VANE; VANE TAGGED W/MEASUREMENTS (FOR 2" PIPE W/ VANE TEMPLET)	3849001	1.00	PC
005	1-1/2 SCH 40 STD BLACK PIPE (21 FT. LENGTHS)	7012801	6.00	FT
010	HAV5000-ST REFRIGERATION	0604236	1.00	ASSEM
002	MT56HL-4A MANEUROP COMPRESSOR 1 3/4 SUCTION 1 1/4 DISCHARGE 460/3/60	1440056	1.00	PC
003	7701003 MOUNTING KIT MANEUROP FOR 2 CYLINDER COMPRESSORS	1444002	1.00	PC
004	6804505 V07 MANEUROP SERVICE VALVE 1-3/4 R X 7/8 S	1446005	1.00	PC
005	6804502 V09 MANEUROP SERVICE VALVE 1-1/4 R X 5/8 S	1446006	1.00	PC
006	7303507 CRANKCASE HEATER 48" WITH MA10109 PTC HEATER STOPPING RING MANEUROP 27W	1445001	1.00	PC
007	C-164S FILTER-DRYER SPORLAN	2730004	1.00	PC
008	SA-14S SIGHT GLASS SPORLAN	2720003	1.00	PC
009	VAF-8 VIBRATION ABSORBER PACKLESS 7/8 X 11 1/2 (UL P-8)	2980008	1.00	PC
010	E9S240 SOLENOID VALVE SPORLAN	2710005	2.00	PC
011	MKC-2 120V 50-60 HZ SOLENOID COIL KIT SPORLAN	2710097	2.00	PC
012	SVE-5-CP85 EXPANSION VALVE EXTERNALLY EQUALIZED SPORLAN	2760045	1.00	PC
013	P100DA-13C HIGH PRESSURE SWITCH CUT OUT 410 PSI MANUAL RESET W/ 9' CORD (**REPLACES P100DA-1C**) JOHNSON CONTROLS	3640007	1.00	PC
014	P100AA-33D LOW PRESSURE SWITCH CUT IN 50 CUT OUT 25 W/ 9' CORD JOHNSON CONTROLS ****THIS WILL REPLACE P100AA-12D***	3641002	1.00	PC
015	16" FAN VENTURII DWG #101084 MEMPHIS METAL 18 GA STEEL	4504000	2.00	PC
016	FH1054 1/2 HP MOTOR A.O. SMITH 460/1/60 1625/2 SPD-RPM FOR VARIABLE SPEED APPLICATIONS REQUIRES 7.5mfd RUN CAPACITOR	4091122	2.00	PC
017	F05E06-1630 X 1/2 CW PHILLIPS (LAU) FAN BLADE LAU #609312-01	4500002	2.00	PC

PARTS LIST
KOOLANT KOOLER MODEL HAV5000-ST
SERIAL NO.8472

018	16" FAN GUARD-MOUNT DWG#101312 (3") 1/2" RADIUS BENDS; 5 GA MAIN WIRE UNIVERSAL WIRE COMPANY	4507002	2.00	PC
019	16" FAN GUARD-FULL DWG #101312 (3") 1/2" RADIUS BENDS; 5 GA MAIN WIRE UNIVERSAL WIRE COMPANY	4507006	2.00	PC
020	3/8 MPT FUSE PLUG 3NP210 (210 F)	1438020	1.00	PC
021	3/5 TON SLANT CONDENSING COIL DR # 971606D000, MOD # 3CY1003C 34" X 34"	1413015	1.00	PC
022	7831 1/2" SWEAT ANGLE VALVE WITH ACCESS PORT HENRY	3980001	1.00	PC
023	P66AAB-9 FAN SPEED CTRL PRESSURE SWITCH PENN	3646009	1.00	PC
011	**HAV5000 460/3/60 EBOX**	**403293**		
002	A30C20BLP HOFFMAN BOX	3417310	1.00	PC
003	A30P20 HOFFMAN PANEL	3418301	1.00	PC
004	NSC-28H4-0800 TRANSFORMER-375VA DONGAN	3842375	1.00	PC
005	194R-NJ030P34ER1 FUSED DISCONNECT SWITCH (A-B)	3110003	1.00	PC
006	DF6-AB10 FUSED TERMINAL BLOCK, TELE 20 AMP/500VAC FUSE BLOCK, 1 POLE	3025000	4.00	PC
007	ATQ-3 FUSE GOULD	3500130	2.00	PC
008	AJT15 FUSE GOULD	3500909	3.00	PC
009	TRM-2 FUSE GOULD	3500020	1.00	PC
010	800EP-SM32 3-POS. SELECTOR SWITCH (A-B)	3121053	1.00	PC
011	800E-4LX20 2 N.O. CONTACT BLOCK (A-B)	3121054	1.00	PC
012	800EP-P4 RED PILOT LIGHT (A-B)	3120022	1.00	PC
013	800EP-P3 GREEN PILOT LIGHT (A-B)	3120021	1.00	PC
014	800E-4TL5 TRANSFORMER MODULE (A-B)	3120023	2.00	ASSEM
015	RG1986-6-12 ELCU (REPLACES A-600) GALCO	3849051	3.00	PC
016	100-A12ND3 CONTACTOR (A-B)	3100020	1.00	PC
017	193-BSC10 OVERLOAD RELAY 6.0-10.0A (A-B)	3103006	1.00	PC
018	PYX4MAY1-200RF TEMPERATURE CONTROL 1/16 DIN/RTD/RELAY/ALARM/485 INCLUDING SOFTWARE FUJI	3864900	1.00	PC
019	D-AH2001A ELECTRIC HEATER HOFFMAN 200 WATT 115/1/50-60 1.7 AMP 4 LBS	3499999	1.00	PC
020	1492-EB3 TERMINAL BLOCK END BARRIER ALLEN-BRADLEY	3123086	1.00	PC
021	1492-W4 ALLEN-BRADLEY TERMINAL BLOCK:25A/POLE; #28-#12 AWG WIRE	3123021	19.00	PC
022	1492-WG10 GROUND BLOCK 50A/POLE;#18-#8 WIRE ALLEN-BRADLEY	3123017	1.00	PC

PARTS LIST
KOOLANT KOOLER MODEL HAV5000-ST
SERIAL NO.8472

023	685744-32395 SOLID STATE BY PASS TIMER (MARS)	3813401	1.00	PC
024	7.5 MICROFARAD CAPACITOR	3899600	2.00	PC
025	A-PWK53NFSS STAINLESS WINDOW KIT	3464098	1.00	PC
026	TRM-4 FUSE GOULD	3500040	1.00	PC
012	HAV5000 460/3/60 WIRE	0604237	1.00	ASSEM
002	CABLE W/ DATA CONVERTER #RSFCLC RS232 TO RS 485 CONVERTER FUJI	3864901	1.00	PC
003	543VLM POWER FACTOR CORRECTION ZUCKER	3863010	1.00	PC
013	HAV5000-ST TEST	0604239	1.00	ASSEM
002	R-22 REFRIGERANT 125 LB CYLINDER	2990013	9.00	LB

DU PONT

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

NAME
FREON* 22 Fluorocarbon

FORMULA
$CHClF_2$

MANUFACTURER/DISTRIBUTOR
E. I. du Pont de Nemours & Co. (Inc.)

ADDRESS
Wilmington, DE 19898

CHEMICAL FAMILY
Halogenated Hydrocarbon

TSCA INVENTORY STATUS
Reported/Included

SARA/TITLE III STATUS
See ADDITIONAL INFORMATION Section

PRODUCT INFORMATION PHONE
(800) 441-9450

MEDICAL EMERGENCY PHONE
(800) 441-3637

TRANSPORTATION EMERGENCY PHONE
CHEMTREC (800) 424-9300

PHYSICAL DATA

BOILING POINT
-40.8°C (-41.4°F)

LIQUID DENSITY
1.194 g/cc at 25°C (77°F)

VAPOR DENSITY (Air = 1)
3.03 at 25°C (77°F)

pH INFORMATION
Neutral

FORM
Liquefied gas

COLOR
Colorless

PERCENT VOLATILE BY VOLUME
100

VAPOR PRESSURE
151 psia at 25°C (77°F)

SOLUBILITY IN WATER
0.30% by wt. at 25°C (77°F)

EVAPORATION RATE (CCl_4 = 1)
>1

APPEARANCE
Clear

ODOR
Slight ethereal

*Registered U.S. Pat. & Tm. Office, Du Pont Company. FREON^R 22 Fluorocarbon is made only by Du Pont.

HAZARDOUS COMPONENTS

MATERIAL(S)	CAS NO.	APPROXIMATE %
Methane, Chlorodifluoro (FREON^{R} 22)	75-45-6	100

HAZARDOUS REACTIVITY

STABILITY
Material is stable. However, avoid open flames and high temperatures.

INCOMPATIBILITY
Alkali or alkaline earth metals—powdered Al, Zn, Be, etc.

DECOMPOSITION
FREON^{R} 22 Fluorocarbon can be decomposed by high temperatures (open flames, glowing metal surfaces, etc.) forming hydrochloric and hydrofluoric acids—possibly carbonyl halides.

POLYMERIZATION
Will not occur.

FIRE AND EXPLOSION DATA

FLASH POINT
None METHOD TOC

FLAMMABLE LIMITS IN AIR, % BY VOL.
LOWER Not applicable
UPPER Not applicable

AUTOIGNITION TEMPERATURE
Not available.

AUTODECOMPOSITION TEMPERATURE
632°C (1170°F)

FIRE AND EXPLOSION HAZARDS
Other burning material may cause FREON^{R} 22 Fluorocarbon to burn weakly. Use water spray or fog to cool containers. Cylinders are equipped with pressure and temperature relief devices but may rupture under fire conditions. Decomposition may occur.

EXTINGUISHING MEDIA
As appropriate for combustibles in area. Extinguishant for other burning material in area is sufficient to stop burning.

SPECIAL FIREFIGHTING INSTRUCTIONS
Self-contained breathing apparatus (SCBA) is required if cylinders rupture or contents are released under fire conditions.

ALTH HAZARD INFORMATION

PRINCIPAL HEALTH HAZARDS (Including Significant Routes, Effects, Symptoms of Overexposure, and Medical Conditions Aggravated by Exposure)

Inhalation of high concentrations of vapor is harmful and may cause heart irregularities, unconsciousness, or death. Intentional misuse can be fatal. Vapor reduces oxygen available for breathing and is heavier than air. Liquid contact can cause frostbite.

Inhalation 4-hour LC_{50}: 220,000 ppm in rats

The compound is untested for skin and eye irritancy, and is untested for animal sensitization. Toxicity described in animals exposed by inhalation to concentrations ranging from 5% to 70% include effects on the central nervous system, liver, lungs, kidneys, spleen; cardiac sensitization; decreased body weight gain; and partial anesthesia. In chronic inhalation studies, FC-22 produced a small, but statistically significant, increase of tumors in male rats, but not female rats or male or female mice, at a concentration of 50,000 ppm (v/v). In the same studies, no carcinogenic effects were seen in either species at concentrations of 10,000 ppm or 1000 ppm (v/v). FC-22 was mutagenic in bacterial cell cultures but not mammalian cell cultures, and was not mutagenic in whole animal assays. A slight, but significant, increase in developmental toxicity (eye malformations, decreased fetal weights) has been observed in the offspring of rats exposed to high concentrations (50,000 ppm) of FC-22, a concentration which was also maternally toxic; no effects on the fetus or the maternal rats were seen at 1000 or 100 ppm. Developmental toxicity studies in rabbits at 50,000, 1000 and 100 ppm FC-22 were negative. Studies of the effects of FC-22 on male reproductive performance have been negative. Specific studies to evaluate the effect on female reproductive performance have not been conducted, however, limited information obtained from studies on developmental toxicity do not indicate adverse effects on female reproductive performance at concentrations up to 50,000 ppm (v/v).

Human health effects of overexposure to the vapors by inhalation may include temporary nervous system depression with anaesthetic effects such as dizziness, headache, confusion, incoordination, and loss of consciousness. Higher exposures to the vapors may cause temporary alteration of the heart's electrical activity with irregular pulse, palpitations, or inadequate circulation; or fatality from gross overexposure. Skin contact with the liquid may cause frostbite.

Individuals with preexisting diseases of the central nervous or cardiovascular system may have increased susceptibility to the toxicity of excessive exposures.

CARCINOGENICITY

Not listed as a carcinogen by IARC, NTP, OSHA, or ACGIH. But see Principal Health Hazards Section above.

EXPOSURE LIMITS

PEL (OSHA):	1000 ppm, 3500 mg/m^3
TLV* (ACGIH):	1000 ppm, 3500 mg/m^3
AEL (Du Pont):	1000 ppm

*LV is a registered trademark of the American Conference of Governmental Industrial Hygienists.

HEALTH HAZARD INFORMATION (cont'd)

SAFETY PRECAUTIONS

Avoid breathing vapors and liquid contact with skin or eyes. Use with sufficient ventilation to keep employee exposure below recommended limits.

FIRST AID

IF LARGE CONCENTRATIONS ARE INHALED: Immediately remove to fresh air. Keep persons calm. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

IN CASE OF SKIN CONTACT: Flush with water. Treat for frostbite if necessary.

IN CASE OF EYE CONTACT: Immediately flush eyes with plenty of water. Call a physician.

IF SWALLOWED: Ingestion is not considered a potential route of exposure.

NOTE TO PHYSICIANS: Because of possible disturbances of cardiac rhythm, catecholamine drugs, such as epinephrine, should be used with special caution in situations of emergency life support.

PROTECTION INFORMATION

GENERALLY APPLICABLE CONTROL MEASURES

Normal ventilation for standard manufacturing procedures is generally adequate. Local exhaust should be used when large amounts are released. Mechanical ventilation should be used in low places.

PERSONAL PROTECTIVE EQUIPMENT

Lined butyl gloves and chemical splash goggles should be used when handling liquid. Under normal manufacturing conditions, no respiratory protection is required when using this product. Self-contained breathing apparatus (SCBA) is required if a large release occurs.

DISPOSAL INFORMATION

SPILL, LEAK OR RELEASE

Ventilate area—especially low places where heavy vapors might collect. Remove open flames. Use self-contained breathing apparatus (SCBA) for large spills or releases.

WASTE DISPOSAL

Reclaim by distillation. Comply with Federal, State and local regulations.

HIPPING INFORMATION

DOT (172.101)

PROPER SHIPPING NAME
Chlorodifluoromethane

HAZARD CLASS
Nonflammable Gas

UN NO.
1018

DOT LABEL
Nonflammable Gas

DOT PLACARD
Nonflammable Gas

DOT/IMO (172.102)

PROPER SHIPPING NAME
Chlorodifluoromethane

HAZARD CLASS
Nonflammable Gas, 2.2

UN NO.
1018

IMO/ICAO LABEL
Nonflammable Gas

SHIPPING CONTAINERS
Cylinders, tank trucks, tank cars.

DDITIONAL INFORMATION

STORAGE CONDITIONS
Clean, dry area. Do not heat above 125°F.

NPCA-HMIS RATINGS

Health	1
Flammability	0
Reactivity	1
Personal Protection	-

Personal Protection rating to be supplied by user depending on use conditions.

SARA/TITLE III HAZARD CATEGORIES AND LISTS

Product Hazard Categories:

Chronic Health	-	No
Acute Health	-	Yes
Fire Hazard	-	No
Pressure Hazard	-	Yes
Reactivity Hazard	-	No

Lists:

Extremely Hazardous Substance	-	No
CERCLA Hazardous Substance	-	No
Toxic Chemicals	-	No

)ATE OF LATEST REVISION/REVIEW: 5/89
'ERSON RESPONSIBLE FOR MSDS:

K. P. BROWN
Du Pont Company
Chemicals & Pigments Department
Chestnut Run Plaza
P.O. Box 80709
Wilmington, DE 19880-0709
(302) 999-5072

KOOLANT KOOLERS, INC.

WARRANTY PROCEDURES

Our warranty policy is as follows:

Warranty Work:

Before doing any work on a chiller covered under warranty, the customer is to call Koolant Koolers and explain the problem to one our engineers, who can then determine the best course of action. Koolant Koolers will not be obligated to pay for warranty service performed without our prior approval.

If it proves necessary to call in a service person, we require an estimate of the labor charges prior to the service work being performed.

It is the responsibility of the service company to enclose a service report with each invoice. Koolant Koolers will not honor invoices which do not include a service report. Both the service report and the invoice are to include the serial number and model number of the chiller on which the warranty work has been performed.

Koolant Koolers will not honor invoices for work done by two or more people at a time, or for overtime labor charges. If the customer requests work which falls into either of these categories, the customer is responsible for the extra charges incurred.

Warranty Parts:

When it is necessary for Koolant Koolers to replace parts which are under warranty, we require a purchase order from the customer to cover both the cost of the part(s) and the freight charges. We will then invoice the customer for that amount. A returned goods authorization number will be issued, on which the defective parts may be returned, freight prepaid. When we receive the defective parts, we will issue a credit for the full amount of the invoice.

PLEASE NOTE: While Koolant Koolers is willing to pay freight charges one way, we are not responsible for special freight charges such as next day service, Saturday delivery, etc. If the customer requests one of the special services, the customer is responsible for the charges incurred.

2625 Emerald Drive Kalamazoo, Michigan 49001-4542
616-349-6800 1-800-YOU-KOOL Fax 616-349-8951
Manufacturers of Quality Cooling Units Since 1950.

KOOLANT KOOLERS, INC.

LIMITED WARRANTY

COVERING LABOR FOR THIRTY DAYS AND PARTS FOR ONE YEAR

AS DESCRIBED BELOW

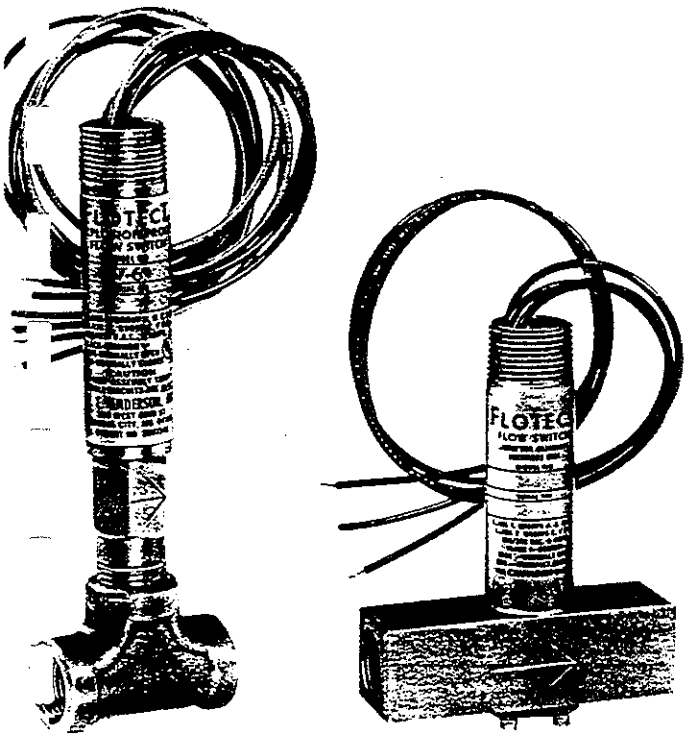
We agree that the apparatus manufactured by Koolant Koolers, Inc. will be free from defects in material and workmanship - under normal use, service, and proper installation - for a period of one year from the date of original installation or 18 months from the date of shipment from our factory, whichever date may occur first, and that our obligation under this agreement is limited solely to the supply of replacement parts in the field, with our approval, within said warranty period. Should a failure occur after a 30 day period and before the warranty has expired, the unit can be returned freight prepaid, with prior approval and having obtained a returned goods authorization number, to Koolant Koolers, Inc., where we will make any needed repairs at no charge to the customer if the damage is determined not to be the fault of the customer. We will then return the unit freight prepaid; in other words we will be responsible for one leg of the transportation costs. **THIS AGREEMENT TO REPAIR OR REPLACE DEFECTIVE PARTS IS EXPRESSLY IN LIEU OF AND IS HEREBY A DISCLAIMER OF ALL OTHER WARRANTIES, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AS WELL AS ANY OTHER IMPLIED WARRANTIES, IN LAW OR EQUITY, AND OF ALL OTHER OBLIGATIONS OR LIABILITIES ON OUR PART. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION HEREOF.** We neither assume nor authorize any person to assume for us any liability or obligation in connection with the sale of our apparatus, except said repair or replacement of the defective part as set forth above. Our liability does not include any labor charges for replacement of parts, adjustments, repairs, or any other work done outside our factory without our approval. Our liability does not include any consequential or resulting damage to persons, property, equipment, goods, merchandise, profits, good will or reputation arising out of any defect in or failure of our apparatus. Our obligation to repair or replace does not apply to any apparatus which has been repaired or altered outside of our factory in any way, or which has been subject to negligence, to misuse, or to pressure outside of stated limits. On parts not of our manufacture such as motors, controls, etc., we extend only the same warranties given by the seller. Our agreement herein applies only to the original purchaser and does not extend, expressly or by implication, to any other person or persons. Nothing in these warranty provisions will impose any liability or obligation of any type, nature or description upon Koolant Koolers, Inc. if Koolant Koolers, Inc. has not received payment in full for the apparatus in question. All stated warranty policies are limited to sales and ultimate shipment of equipment within the continental U.S. only. Shipments to other states or countries must be handled on an individual basis.

DELIVERY

We will make every effort to ship by the quoted date, but failure to do so for any cause whatsoever will not give the buyer the right to cancel the order or hold Koolant Koolers, Inc. responsible for any damages resulting from the inability to deliver within the time stated.

FLOTECT® MODEL V6 FLOW SWITCH

Installation and Operating Instructions



Explosion-Proof; U.L. and C.S.A. Listed –
Class I, Groups *A, B, C & D
Class II, Groups E, F & G
CENELEC: EExd IIC T6 (T amb=75°C)
*(Group A, stainless steel body only)

PHYSICAL DATA

Maximum Temperature: 220°F (105°C); 400°F (205°C) with high temperature (MT) option – Not U.L., C.S.A. or CENELEC approved.

Maximum Pressure: See chart.

Electrical Ratings: U.L. – 5A @ 125/250 VAC. C.S.A. and CENELEC – 5A @ 125/250 VAC, 5A resistive, 3A inductive @ 30 VDC. Gold contacts (MV option) for dry circuits – 0.1A @ 125 VAC. High temperature (MT) option – 5A @ 125/250 VAC. Not U.L., C.S.A. or CENELEC approved.

Wiring: U.L., C.S.A. models – 18 AWG × 18" (46 cm) length. CENELEC models – terminal block.

Switch Body: Lower housing (wetted), brass or stainless steel. Upper housing, brass or stainless steel.

Vane: Stainless steel.

Pipe Connection: 1/2" – 2" NPT tee standard. 1/2" NPT for Low Flow models and models with field trimmable vane.

Installation: Install in any position with index arrow pointing in direction of flow.

Weight: 2 – 6 lbs. (.9 – 2.7 kg) depending on size and construction.

Options: DPDT relays, custom calibration, Teflon coated wetted parts and more.

MAXIMUM PRESSURE CHART

MODEL	LOWER HOUSING	TEE	MAXIMUM PRESSURE PSI (KG/CM²)
V6 Low Flow	Brass	Brass	1450 (102)
V6 Low Flow	Stainless Steel	Stainless Steel	1450 (102)
V6	Brass	Brass	250 (17)
V6	Brass	Iron	1000 (70)
V6	Stainless Steel	Iron	1000 (70)
V6	Stainless Steel	Forged Steel	2000 (140)
V6	Stainless Steel	Stainless Steel	2000 (140)

ne-Flotect® Model V6 is an inexpensive, explosion-proof flow
vit i for use on air, water or other compatible gases and liquids.
are configurations are available – 1. Factory installed in a tee.
With a trimmable vane for field adjustment and installation in a
uitable tee. 3. Low flow models with an integral tee and
dju able valve. All are available with an optional enclosure which
U.L and C.S.A. listed, CENELEC approved.

NSTALLATION

npack and remove any packing material found inside lower
ousing or tee.

wi h can be installed in any position but the actuation/deactua-
on ..ow rates in the charts are based on horizontal pipe runs and
re nominal values. For more precise settings, units can be factory
alibrated to specific flow rates.

'6 odels with Tee are supplied in 1/2" – 2" NPT sizes. Install in
iping with arrow pointing in direction of flow.

'6 Low Flow Models have 1/2" NPT connections and are field
dju table. Install in piping with arrow pointing in direction of flow.
o a just, loosen the four socket head cap screws on bottom. The
justment valve rotates 90° between "O" (open) and "C"
sed). See flow charts for approximate ranges. Tighten screws
nc the required flow rate has been set.

V6 with Field Trimmable Vane. These models enable the installer to choose approximate actuation/deactuation points by trimming the full size vane at appropriate letter-designated marks on a removable template. Flows are defined in the following charts. Note that the charts are based on either brass or cast iron reducing tees or stainless or forged steel straight tees with bushings where necessary. Install in piping with arrow pointing in direction of flow.

When bushings are used, they must be back drilled to allow proper clearance for unrestricted vane travel. Bore the I.D. to 13/16" (20 mm) on 1/2"×3/4" bushings or 1" (25 mm) on larger bushings. The depth of the bore must leave internal threads 9/16" (14 mm) high for proper engagement between the lower housing of the switch and the bushing. Check for proper vane travel and switch operation after installation.

W.E. ANDERSON DIV., DWYER INSTRUMENTS, INC.
P. O. BOX 358 • MICHIGAN CITY, INDIANA 46360, U.S.A.
Telephone 219/879-8000
Fax 219/872-9057

ELECTRICAL CONNECTIONS:

Connect wire leads in accordance with local electrical codes and switch action required. N.O. contacts will close and N.C. contacts will open when flow increases to the actuation point. They will return to "normal" condition when flow decreases to the deactuation point. Black = Common, Blue = Normally Open and Red = Normally Closed.

For units supplied with both internal and external grounds, the ground screw inside the housing must be used to ground the control. The external ground screw is for supplementary bonding when allowed or required by local code. Some C.S.A. listed models are furnished with a separate green ground wire. Such units must be equipped with a junction box, not supplied but available on special order.

CENELEC certified models include a junction box. Cable should enter enclosure through an approved EX cable gland, not supplied. Push stripped and tinned leads into appropriate openings in terminal block(s). To connect fine stranded leads or to remove any wire, depress spring release with small screwdriver first.

All wiring, conduit and enclosures must meet applicable codes for hazardous areas. Conduits and enclosures must be properly sealed. For outdoor or other locations where temperatures vary widely, precautions should be taken to prevent condensation inside switch or enclosure. Electrical components must be kept dry at all times. **CAUTION:** To prevent ignition of hazardous atmospheres, disconnect the device from the supply circuit before opening. Keep assembly tightly closed when in use.

V6 With Tee

Cold Water – Factory Installed Tee
Approximate actuation/deactuation flow rates
GPM upper, **M³/HR** lower

1/2" NPT		3/4" NPT		1" NPT		1¼" NPT		1½" NPT		2" NPT	
1.5	1.0	2.0	1.25	3.0	1.75	4.0	3.0	6.0	5.0	10.0	8.5
0.34	0.23	0.45	0.28	0.68	0.40	0.91	0.68	1.36	1.14	2.27	1.93

Air-Factory Installed Tee
Approximate actuation/deactuation flow rates
SCFM upper, **NM³/M** lower

1/2" NPT		3/4" NPT		1" NPT		1¼" NPT		1½" NPT		2" NPT	
6.5	5.0	10.0	8.0	14	12	21	18	33	30	43	36
.18	.14	.28	.23	.40	.34	.59	.51	.93	.85	1.19	1.02

V6 Low Flow, Field Adjustable

Cold Water – Low Flow Models
Approximate actuation/deactuation flow rates
GPM upper, **M³/HR** lower

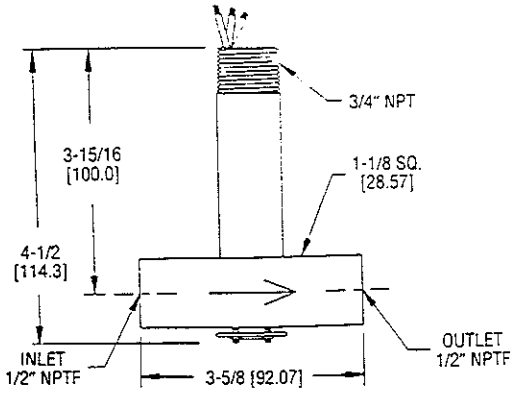
MINIMUM		MAXIMUM	
.04	.03	.75	0.60
.009	.007	0.17	0.14

Air – Low Flow Models
Approximate actuation/deactuation flow rates
SCFM upper, **NM³/M** lower

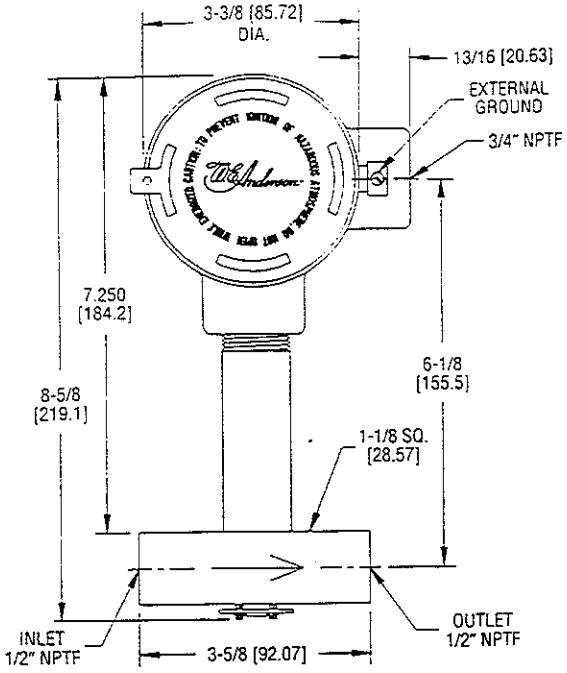
MINIMUM		MAXIMUM	
.18	.15	2.70	2.0
.005	.004	.08	.06

DIMENSIONS

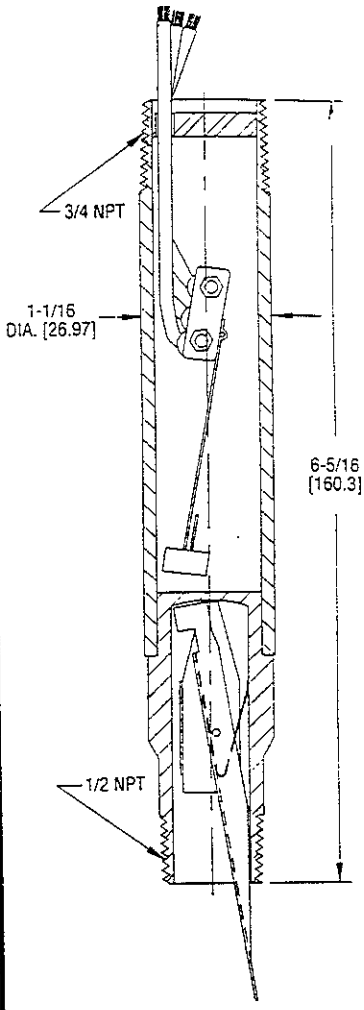
FloTect® Model V6



V6 Low Flow

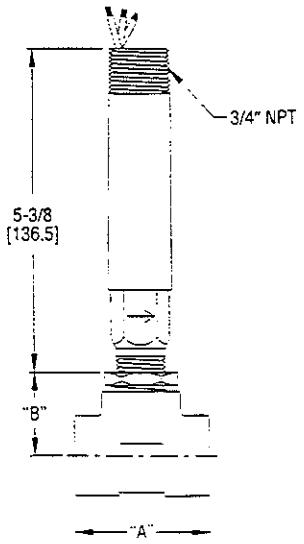


V6 Low Flow with C.S.A., CENELEC Conduit Enclosure

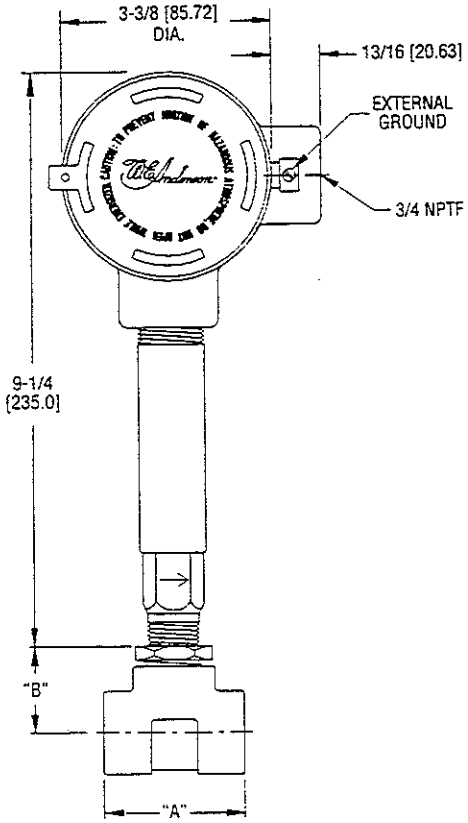


V6 with Field Trimmable Vane

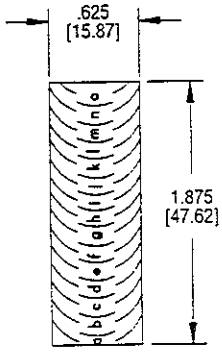
PIPE SIZE	BRASS/DUCTILE IRON		FORGED/STAINLESS STEEL		MALLEABLE IRON	
	DIM. A	DIM. B	DIM. A	DIM. B	DIM. A	DIM. B
1/2"	2-1/4(57)	1-1/8(29)	2-1/4(57)	1-1/8(29)	2-1/2(64)	1-1/4(32)
3/4"	2-3/8(60)	1-1/4(32)	2-5/8(67)	1-7/8(47)	2-5/8(67)	1-3/8(35)
1"	2-1/2(64)	1-3/8(35)	3(76)	2-1/8(54)	2-7/8(73)	1-1/2(38)
1-1/4"	2-5/8(67)	1-1/2(38)	3-1/2(89)	2-1/2(64)	3(76)	1-3/4(44)
1-1/2"	2-7/8(73)	1-5/8(41)	4(102)	2-3/4(70)	3-1/4(83)	1-7/8(48)
2"	3(76)	1-7/8(48)	4-3/4(121)	3-1/8(79)	3-1/2(89)	2-1/8(54)



V6 with Tee



V6 with Tee and C.S.A., CENELEC Conduit Enclosure



Trimmable Vane

W.E. ANDERSON DIV. DWYER INSTRUMENTS, INC.
P.O. Box 358
Michigan City, IN 46360
Phone: 219/879-8000
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FR 82-440805-00
Printed in U.S.A. 1/94

V6 With Field Trimmable Vane

Cold Water – Brass or Cast Iron Reducing Tee
Approximate actuation/deactuation flow rates
GPM upper, M³/HR lower

Vane	½" NPT	¾" NPT	1" NPT	1¼" NPT	1½" NPT	2" NPT
Full Size						9.0 8.5 2.0 1.9
A						9.5 9.0 2.2 2.0
B						10.0 9.3 2.3 2.1
C						11.0 10.0 2.5 2.3
D					6.2 5.5 1.4 1.2	12.0 10.0 2.7 2.3
E					7.0 6.5 1.6 1.5	13.0 11.0 3.0 2.5
F				4.3 3.9 1.0 0.9	7.6 7.1 1.7 1.6	14.0 12.0 3.2 2.7
G				4.9 4.4 1.1 1.0	8.0 7.3 1.8 1.7	
H				5.5 5.0 1.2 1.1	9.0 8.2 2.0 1.9	
I			3.5 3.1 0.8 0.7	6.0 5.6 1.4 1.3	10.0 9.0 2.3 2.0	
J			4.0 3.5 0.9 0.8	7.0 6.6 1.6 1.5	13.0 11.0 3.0 2.5	
K			4.6 4.2 1.04 0.95	8.0 7.6 1.8 1.7	15.0 13.0 3.4 3.0	
L		2.6 2.3 0.6 0.5	5.6 5.2 1.3 1.2	10.0 9.0 2.3 2.0		
M	1.6 1.3 0.4 0.3	3.5 3.1 0.8 0.7	6.3 6.1 1.43 1.39	12.0 10.0 2.7 2.3		
N	2.2 1.8 0.5 0.4	4.3 3.8 1.0 0.9	8.0 7.5 1.8 1.7			
O	3.0 2.4 0.7 0.5					

Air – Brass or Cast Iron Reducing Tee
Approximate actuation/deactuation flow rates
SCFM upper, NM³/M lower

Vane	½" NPT	¾" NPT	1" NPT	1¼" NPT	1½" NPT	2" NPT
Full Size						39.0 37.0 1.10 1.05
A						40.0 38.0 1.13 1.08
B						42.0 40.0 1.19 1.13
C						50.0 44.0 1.42 1.25
D					27.0 25.0 0.76 0.71	55.0 46.0 1.56 1.30
E					30.0 28.0 0.85 0.79	
F				20.0 18.0 0.57 0.51	32.0 30.0 0.91 0.85	
G				21.0 19.0 0.59 0.54	34.0 32.0 0.96 0.91	
H				23.0 21.0 0.65 0.59	37.0 34.0 1.05 0.96	
I			16.0 15.0 0.45 0.42	24.0 22.0 0.68 0.62	39.0 36.0 1.10 1.02	
J			18.0 16.0 0.51 0.45	28.0 25.0 0.79 0.71	51.0 45.0 1.44 1.27	
K			19.0 17.0 0.54 0.48	33.0 30.0 0.93 0.85	69.0 57.0 1.95 1.61	
L		13.0 12.0 0.37 0.34	22.0 20.0 0.62 0.57	38.0 35.0 1.08 0.99		
M	6.4 3.8 0.18 0.11	15.0 14.0 0.42 0.40	25.0 23.0 0.71 0.65	45.0 42.0 1.27 1.19		
N	10.0 7.0 0.28 0.20	20.0 16.0 0.57 0.45	32.0 28.0 0.91 0.79			
O	12.0 9.0 0.34 0.25					

Cold Water – Stainless or Forged Steel Straight Tee and Bushing
Approximate actuation/deactuation flow rates
GPM upper, M³/HR lower

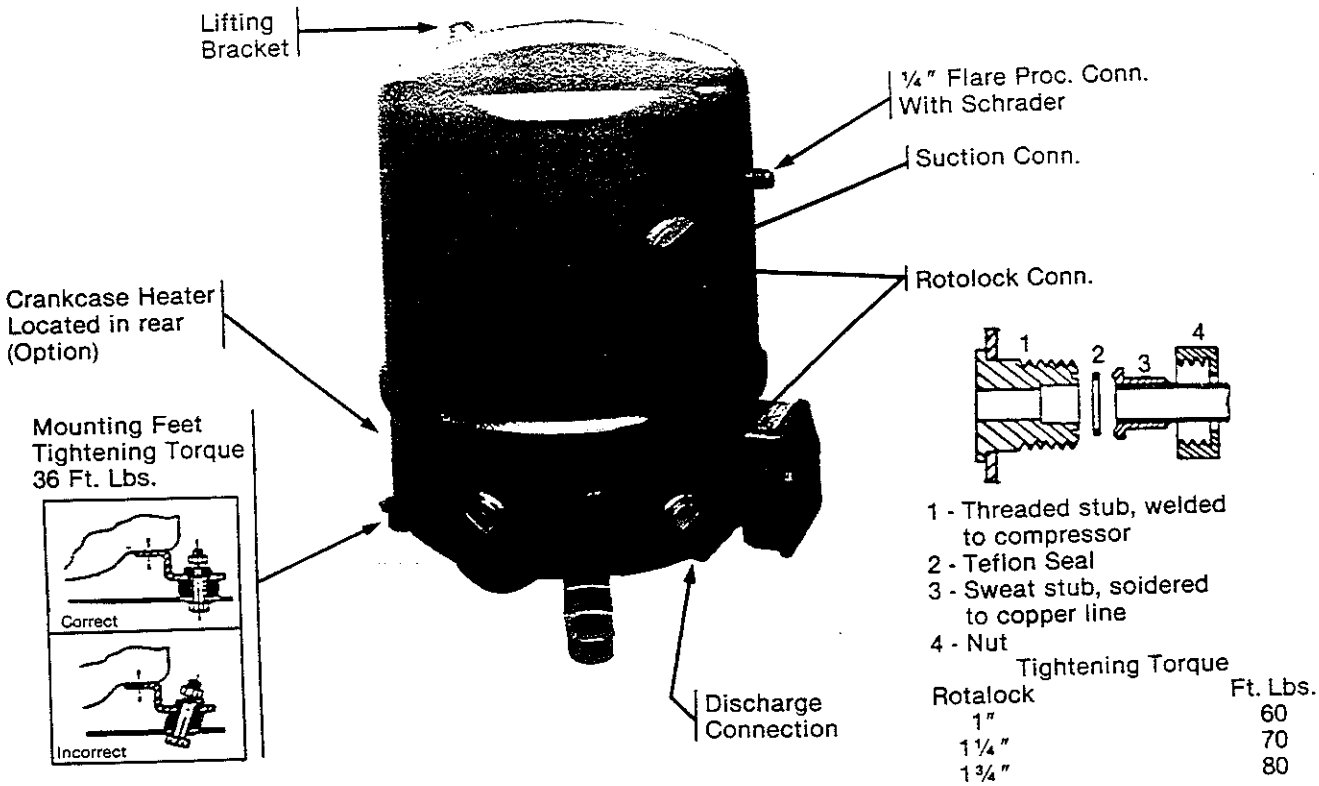
Vane	½" NPT	¾" NPT	1" NPT	1¼" NPT	1½" NPT	2" NPT
Full Size				5.0 4.5 1.1 1.0	8.5 7.8 1.9 1.8	
A				5.5 5.0 1.2 1.1	9.2 8.6 2.1 2.0	
B				6.2 5.7 1.4 1.3	9.8 9.0 2.2 2.0	
C				6.8 6.3 1.5 1.4	12.0 10.0 2.7 2.3	
D			2.8 2.4 0.6 0.5	8.5 7.8 1.9 1.8	13.0 11.0 3.0 2.5	
E			3.4 3.0 0.8 0.7	10.0 9.2 2.3 2.1		
F			4.0 3.6 0.91 0.82	12.0 10.0 2.7 2.3		
G		2.0 1.5 0.5 0.3	5.0 4.5 1.1 1.0			
H		2.5 2.0 0.6 0.5	6.5 6.1 1.48 1.39			
I		3.5 3.0 0.8 0.7	9.0 8.2 2.0 1.9			
J		7.0 5.5 1.6 1.2				
K		10.0 8.0 2.3 1.8				

Air – Stainless or Forged Steel Straight Tee and Bushing
Approximate actuation/deactuation flow rates
SCFM upper, NM³/M lower

Vane	½" NPT	¾" NPT	1" NPT	1¼" NPT	1½" NPT	2" NPT
Full Size				21.0 18.0 0.59 0.51	33.0 30.0 0.93 0.85	
A				22.0 20.0 0.62 0.57	39.0 36.0 1.10 1.02	
B				24.0 22.0 0.68 0.62	42.0 38.0 1.19 1.08	
C				28.0 26.0 0.79 0.74	51.0 46.0 1.44 1.30	
D			12.0 10.0 0.34 0.28	33.0 30.0 0.93 0.85	55.0 50.0 1.56 1.42	
E			14.0 12.0 0.40 0.34	37.0 34.0 1.05 0.96		
F			16.0 14.0 0.45 0.40	43.0 40.0 1.22 1.13		
G		8.0 6.5 0.23 0.18	19.0 17.0 0.54 0.48			
H		11.0 10.0 0.31 0.28	26.0 24.0 0.74 0.68			
I		14.0 13.0 0.40 0.37	32.0 30.0 0.91 0.85			
J		27.0 24.0 0.76 0.68				
K		39.0 36.0 1.10 1.02				

Maneurop Inc.

INSTALLATION INSTRUCTIONS - MECHANICAL
MT/LT COMPRESSORS



1. Mounting grommets (supplied) must be used on compressor.
2. Piping must be made flexible to avoid noise and vibration transmission which leads to stress fractures. Suction lines should always be insulated when there is a possibility of excessive suction gas temperatures returning to the compressor.
3. Refrigerant charge should be limited to 5 lb. per cylinder or it will be necessary to add a suction accumulator or pump down controls.
4. Maneurop White Oil is the only type that can be used. Piping must be designed for proper oil return. Where long lines are required, an oil seperator should be considered especially for R-22. When exceeding 80 ft., additional oil should be added. On sight glass models maintain oil level at ¼ to ¾ level of glass.
5. Maximum temperature on discharge line 1 inch from compressor is 290° F.

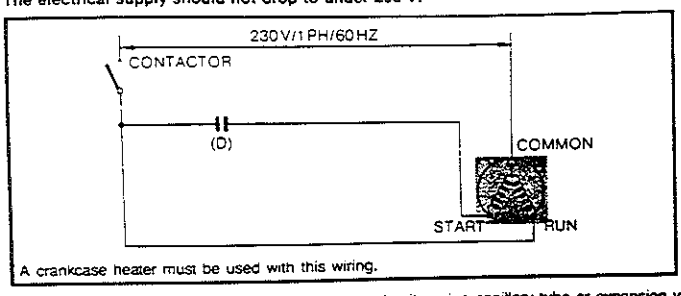
Maneurop Inc.

INSTALLATION INSTRUCTIONS - ELECTRICAL
MT/LT COMPRESSORS

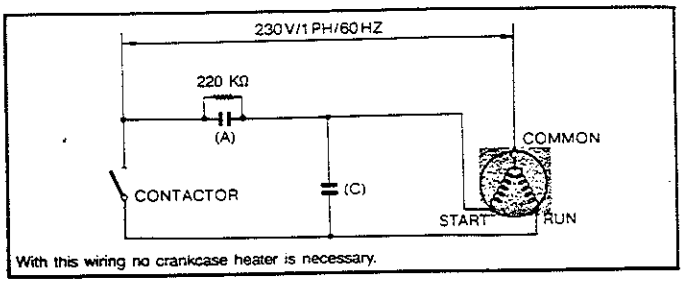
Typical wiring diagrams

SINGLE PHASE (For the nominal system voltage supply of 208 volts, use CSR only)

PSC This system may be used for refrigerant circuits with capillary tube or expansion valve with a bleed port. It is necessary to ensure a pressure equalization at start up. The electrical supply should not drop to under 208 V.

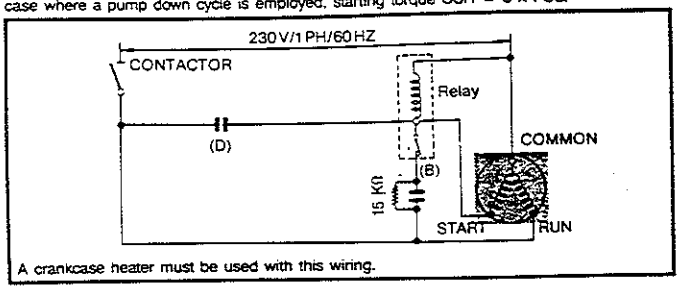


A crankcase heater must be used with this wiring.

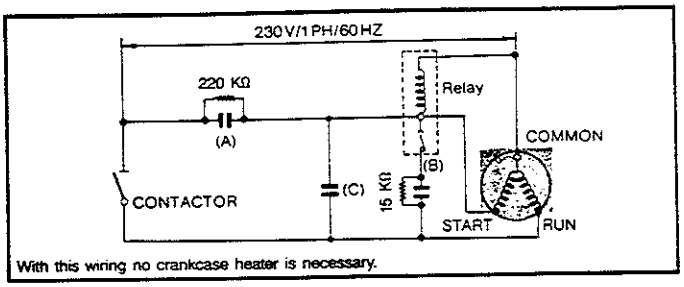


With this wiring no crankcase heater is necessary.

CSR This system may also be used for refrigerant circuits using capillary tube or expansion valve with a bleed port. The pressure difference at start up should not exceed 30 PSI except in the case where a pump down cycle is employed, starting torque CSR = 5 x PSC.

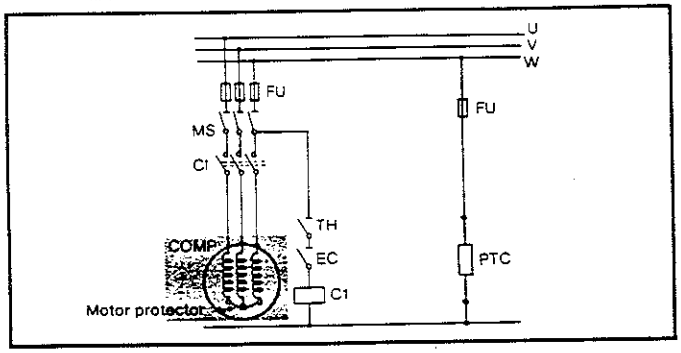


A crankcase heater must be used with this wiring.



With this wiring no crankcase heater is necessary.

THREE PHASE



Selection table capacitors and relays

Compressor model		PSC/CSR Run capacitors (A) MFD	PSC/CSR Run capacitors (C) MFD	PSC/CSR Run capacitors* (D) MFD	CSR only Start capacitors** (B) MFD	CSR only Start relay	*** CSR Kit
	MT 18 JA-1	NA	NA	15	50		CSR0
LT22JEI	MT 22 JC-1	15	20	35	100		CSR1
LT28JHI	MT 28 JE-1	25	15	40	135		CSR2
	MT 32 JF-1	25	10	35	100	All	CSR1
	MT 36 JG-1	30	10	40	100	models	CSR3
LT44MMI	MT 44 HJ-1	30	15	45	135	3ARR3J4A4	CRS4
LT50HPI	MT 50 HK-1	30	15	45	135		CSR4
	MT 56 HL-1	30	20	50	200		CSR5
	MT 64 HM-1	30	25	55	235		CSR6

***Offered as option by Maneurop

Optional

Included in delivery

PTC = Crankcase heater
COMP = Compressor
MP = Motor protector
FU = Fuses
MS = Main switch
CI = Contactor
TH = Thermostat
TR = Transformer
EC = External controls

*Run capacitors 440 volts, minimum 10,000 hours.

**Start capacitors 330 volts.

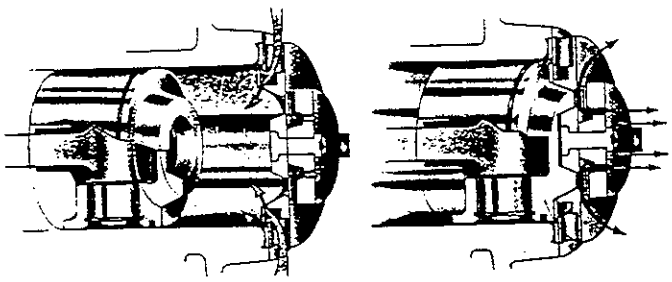
Starting Frequency: Maximum 12 per hour.
Voltage: Check that supply voltage equals that on nameplate plus or minus allowable tolerence.
Capacitor: Check that all capacitors match the table listing above.

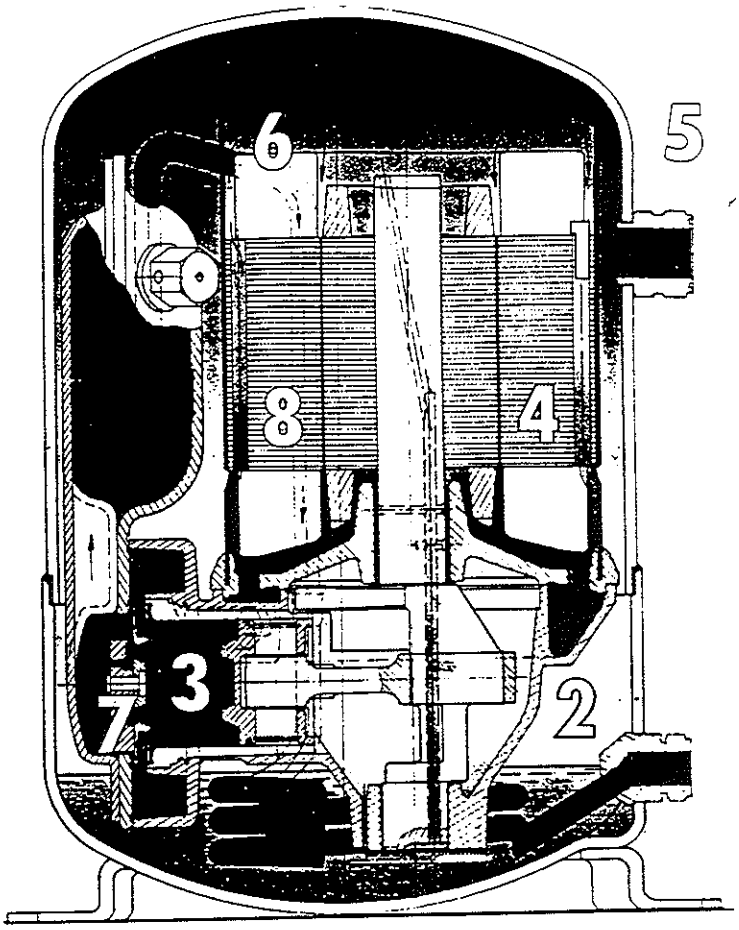
Single phase:
The single phase compressor models are protected internally by a temperature / current sensing bi-metallic cut-out which senses the protector main winding current and start winding current.

Three phase:
Three phase compressors are protected against excessive motor temperatures and current by means of an internal overload protector (I.O.L), which is located at the star point of the windings and cuts out all three phases simultaneously via a bi-metallic disc.

IMPORTANT:
After the compressor has cut out on I.O.L., the reset time will depend on the location of the compressor. In a warm closed area for example, it can take up to 2-3 hours to cut in, whereas in a ventilated area it would take less than one hour.

Self-Regulating Crankcase Heater - P.T.C.:
All compressors are fitted with PTC sleeve. Voltage is 200-600 volts. Before inserting, it must be coated with heat transfer paste such Dow Corning #340. After inserting, the plastic bushing is used to hold in place. In removing the ring please use screwdriver, as pulling on the leads may damage the device. The heater is the same for all models with 28 inch model supplied as standard and 48 inch mode as option. In operation, as the temperature of the oil drops, the wattage goes up. As the temperature of the oil goes up, the wattage decreases. After extended shutdown, allow heater warm-up of 1 hour.

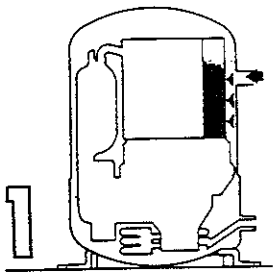




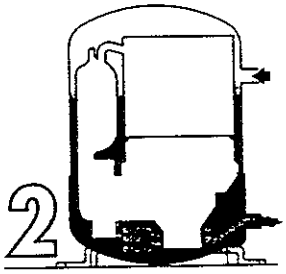
The Maneurop compressor

The Maneurop compressors have been specially designed for applications where high compression ratios and large variations in temperatures are encountered. All the components used are of very high quality and precision to assure a reliable long life product. This compressor design is the only one to have a 100% suction gas cooled motor as a result of the special motor housing. The internal motor protection, the high efficiency circular valve plates, the high torque motor – all combine to offer numerous advantages.

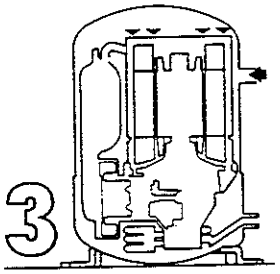
Compressor design features



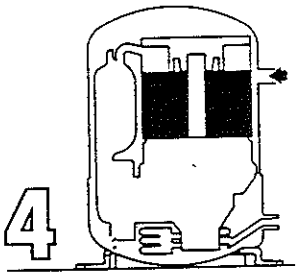
Motor winding shielded



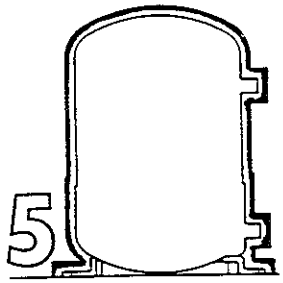
Tolerant to liquid slugging



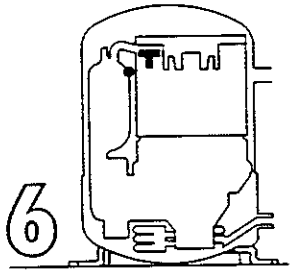
Low heat losses



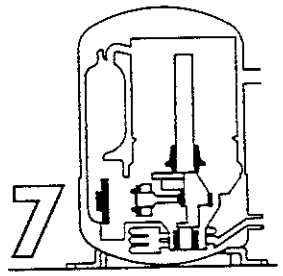
100% gas cooled motor



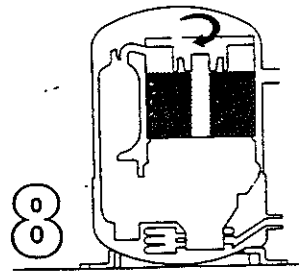
Compressor insulation is allowed



Internal motor protection and pressure relief valve



High compression ratios up to 12.1



High starting torque

Compressor code

Example : **MT 64 HM 3**

- MT → series
- 64 → or HP × 10
- HM → displacement code
- 3 → motor code

Max. evaporating temperature	+ 60°F	+ 15°C
Max. condensing temperature	+ 150°F	+ 65°C
Max. ambient temperature	+ 140°F	+ 60°C

Model specifications and capacities (ari conditions)

Model	Nom. rating HP	Nb of cyl.	Displacement		Oil charge pints	Weight lbs	Air conditioning*			Heat pump**				
			Cu in /rev	CFH			Capacity BTU/H	Power input KW	EER	Capacity BTU/H	Power input KW	EER	Heating capacity W	COP
MT 18 JA	1.8	1	1.84	223.6	1.8	49	16400	1.8	9.1	12835	1.38	9.3	4885	3.54
MT 22 JC	2.2	1	2.32	281.9	1.8	49	22000	2.27	9.7	18200	1.82	10.0	6795	3.73
MT 28 JE	2.8	1	2.93	356.1	1.8	53	30250	3.05	9.9	26320	2.46	10.7	9665	3.93
MT 32 JF	3.2	1	3.28	398.6	1.8	56	33025	3.58	9.2	27360	2.88	9.5	10350	3.60
MT 36 JG	3.6	1	3.69	448.4	1.8	57	38000	4.04	9.4	32320	3.2	10.1	12035	3.76
MT 40 JH	4.0	1	4.14	503.1	1.8	59	43250	4.60	9.4	35040	3.65	9.6	13220	3.62
MT 44 HJ	4.4	2	4.65	565.1	3.9	83	45200	4.65	9.7	37000	3.7	10.0	13815	3.73
MT 50 HK	5.0	2	5.22	634.4	3.9	85	50500	5.15	9.8	40590	4.1	9.9	15195	3.71
MT 56 HL	5.6	2	5.86	712.2	3.9	86	56425	6.05	9.3	47100	4.71	10.0	17585	3.73
MT 64 HM	6.4	2	6.57	798.4	3.9	88	64825	6.75	9.6	53065	5.36	9.9	19865	3.70
MT 72 HN	7.2	2	7.38	896.9	3.9	88	70150	7.54	9.3	58215	5.88	9.9	21790	3.71
MT 80 HP	8.0	2	8.28	1006.3	3.9	91	80050	8.52	9.4	66400	6.64	10.0	24790	3.73
MT 100 HS	10.0	4	10.45	1270.0	8	144	95850	9.583	10.0	79255	7.77	10.2	29440	3.79
MT 125 HU	12.5	4	13.14	1596.9	8	150	124650	12.8	9.7	104750	10.17	10.3	38820	3.82
MT 160 HW	16.0	4	16.56	2012.5	8	163	156800	16.0	9.8	130995	12.78	10.25	48605	3.80

* Evap. temp : 45°F / Cond. temp. : 130°F / Liq. temp. : 115°F / RGT : 65°F
** Evap. temp. : 30°F / Cond. temp. : 110°F / Liq. temp. : 95°F / RGT : 50°F

Technical specifications

Motor code	LRA			MCC			RLA*			Refrigerant line connections			
	1 230 V 1 PH	3** 230 V 3 PH	4 460 V 3 PH	1 230 V 1 PH	3** 230 V 3 PH	4 460 V 3 PH	1 230 V 1 PH	3** 230 V 3 PH	4 460 V 3 PH	Solder sleeves		Shut off valves (accessories)	
Voltage mini / maxi	197 V / 253 V	180 V / 253 V	414 V / 506 V	197 V / 253 V	180 V / 253 V	414 V / 506 V	197 V / 253 V	180 V / 253 V	414 V / 506 V	Suction DIA	Discharge DIA	Suction DIA	Discharge DIA
MT 18 JA	36	40	14.5	13	9	4.5	8.5	5.5	3	1/2"	3/8"	1/2"	3/8"
MT 22 JC	56	40	14.5	17	11	4.5	10	6.5	3.5	1 : 5/8"	1 : 1/2"	1/2"	3/8"
MT 28 JE	73	58	19.5	25	17	5.3	13.5	9.5	4.5	1/2"	3/8"	1/2"	3/8"
MT 32 JF	74	58	25	26	20	5.9	16	10.5	5	5/8"	1/2"	5/8"	1/2"
MT 36 JG	98	75	33	30	22	9	20.5	12	6	5/8"	1/2"	5/8"	1/2"
MT 40 JH		92	40		20	10		16.5	6.5	5/8"	1/2"	5/8"	1/2"
MT 44 HJ	103	100	47	34	22	10	21.5	14	7	7/8"	3/4"	7/8"	3/4"
MT 50 HK	143	117	51	37	23	12	24	17.5	7.5	7/8"	3/4"	7/8"	3/4"
MT 56 HL	146	125	51	46	26	13	28	18	8.5	7/8"	3/4"	7/8"	3/4"
MT 64 HM	148	128	63	53	31	15	31	19.5	10	7/8"	3/4"	7/8"	3/4"
MT 72 HN		128	71		30	15		22	11	7/8"	3/4"	7/8"	3/4"
MT 80 HP		155	69		47	23		25	12	1 1/8"	3/4"	1 1/8"	3/4"
MT 100 HS		157	79		43	22		28.5	14	1 1/8"	3/4"	1 1/8"	7/8"
MT 125 HU		210	105		63	27		35.5	17	1 1/8"	3/4"	1 1/8"	7/8"
MT 160 HW		259	130		70	36		43.5	21	1 1/8"	3/4"	1 1/8"	7/8"

* ARI conditions (air conditioning) : Evap. temp. : 45°F / Cond. temp. : 130°F / Liq. temp. 115°F / RGT : 65°F
** For MT 32-72-100-125-160 min. voltage : 197 V.
\ = locked rotor amp. / MCC = cut-out current of the internal motor protection. / RLA = rated load amp.

MANEUROP INC.

COMPRESSOR REPLACEMENT CHECKLIST

WARNING: The air conditioning and refrigeration unit is a pressurized system and hazards exist which could result in personal injury. It is therefore recommended that removal and installation of the hermetic compressor be performed by experienced personnel only.

The following instructions include major points of consideration that will ensure proper installation and protect you from possible personal injury. Please use this as a checklist, taking each item in its order before proceeding to the next.

☐ 1. VERIFY PROPER APPLICATION. Verify that the compressor being replaced and the Maneurop compressor have a like capacity for the refrigerant being used and that the voltage and frequency characteristics are the same. Consult your wholesaler if you have any questions about proper compressor application.

WARNING: To avoid electrical shock, power to the compressor should remain off during performance of Steps 2 thru 9.

☐ 2. DETERMINE CAUSE OF INITIAL FAILURE. Determine the cause of the initial compressor failure and make any necessary repairs to the system. If a burnout occured, a system flush to remove contaminants is required.

☐ 3. INSTALL THE NEW COMPRESSOR. Install the new compressor on its base per instructions on page 1. Be sure to use the new mounting grommets that were shipped with the compressor. If the mounting sleeves shipped with the compressor are used, the mounting bolts will bottom out when tight. Use care not to over compress the mounting grommets when the mounting sleeves cannot be used.

WARNING: Never use oxygen to pressurize refrigeration or air conditioning system. Oxygen will explode on contact with oil and could cause personal injury. When using high pressure gas such as nitrogen or CO_2 for this purpose, be sure to use a regulator that can control the pressure down to 1 or 2 psig.

☐ 4. BRAZE ON SUCTION AND DISCHARGE LINES. Flow an inert gas, such as nitrogen or CO_2, through the system at approximately 2 psig. This will reduce the possibility of oxidation inside the tubing. Braze on the suction and discharge lines following the recommendations listed below:

COPPER TUBING: If additional copper tubing is required, use only clean, dehydrated refrigeration grade tubing with sealed ends.

BRAZING ALLOYS: **CAUTION:** <u>Do not use 95/5, 50/50 or 40/60 soft solder for brazing.</u> Use Sil-Phos or Phos Copper, or similar brazing alloys with high tenside strength on copper to copper welds only. Weld steel to copper only with silver brazing alloys.

BRAZING PROCEDURE: To ensure properly brazed joints, Maneurop recommends that the following steps be used:

a. Exercise extreme care when cutting and forming tubes to keep dirt, filings and other contaminants from entering the system.

b. Do not use excessive amounts of brazing alloy as some of the excess may penetrate the joint and enter the system.

c. If flux must be used, take necessary precautions to ensure that the flux does not enter the system.

d. Use damp cloths or other heat absorbent material to ensure that the factory brazed joints on the compressor do not become damaged. If damp cloths are used, take care not to allow moisture to enter the system.

e. Do not overheat brazed joints as excess heat will cause formation of copper oxide on the inside wall of the tubing. Flowing an inert gas through the system, as explained in Step 4, will reduce the possibility of oxidation.

☐ 5. INSTALL FILTER DRIERS. Maneurop recommends the use of the adequate sized liquid and suction line driers anytime a compressor is replaced. If the new compressor is used as a replacement because of a burned compressor, the use of high acid neutralizing filter driers is recommended. For heat pumps, a suction filter drier must be installed between the 4 way valve and the compressor suction inlet. In addition, a two way heat pump liquid line drier must be installed.

☐ 6. CHECK FILTER DRIER FOR CONTAMINATION. If internal contamination is heavy, the suction line filter drier may become clogged and ineffective. Check the pressure drop across the filter drier after approximately 8 hours running time and, if it exceeds 2 psig, replace it.

WARNING: Voltage should not be applied to the compressor with the terminal cover and retainer removed as personal injury could result.

CAUTION: The replacement compressor may become damaged if you fail to check the electrical system against the system manufacturer's service manual and the Maneurop wiring diagrams on Page 2 before startup.

☐ 7. CHECK THE ELECTRICAL SYSTEM. BEFORE STARTING THE COMPRESSOR, VERIFY THAT THE ELECTRICAL SYSTEM IS WIRED ACCORDING TO THE COMPRESSOR WIRING DIAGRAMS ON PAGE 2 EXACTLY! VERIFY THAT THE COMPONENTS USED IN THE SYSTEM MATCH THOSE SPECIFIED IN THE COMPRESSOR ELECTRICAL COMPONENT DATA ON PAGE 2. CHECK ALL CONNECTIONS AND TERMINALS TO BE SURE THAT THEY ARE TIGHT.

☐ 8. CHECK SYSTEM FOR LEAKS. After installation is complete and all electrical checks have been made, pressurize the system to 75 psig using R-22 and check for leaks using a halide torch, soap bubbles or an electronic halogen leak detector. When all connections test satisfactorily, release the pressure. When the sound of escaping gas diminishes, proceed with Step 9.

CAUTION: Do not use the Maneurop replacement compressor as an evacuation assist and never apply voltage to a compressor while it is in a vacuum as damage could result to the compressor.

☐ 9. EVACUATE AND CHARGE THE SYSTEM. Begin evacuation using a vacuum pump designed for this purpose, When a vacuum of 1500 microns is reached, remove the pump and pressurize the system to a positive pressure using R-22. Repeat this process two more times but evacuate to 500 microns the last time. Close the valve, remove the pump, and charge the system.

Catch-All®

LIQUID LINE RATINGS and SELECTION RECOMMENDATIONS

U.S. PATENT NUMBER 3,407,617

GENERAL

The selection of a filter-drier for a given application involves such technical factors as: the amount of moisture to be expected in a system — operating temperatures — amount of foreign matter present — allowable pressure drop through the filter-drier — its ability to retain both liquid and solid contaminants, and bursting pressure. Proper evaluation of these factors is necessary for optimum service and economy.

The refrigeration industry has developed a standard for the comparison of filter-driers. However, only two ratings have been published — one for water capacity and one for flow capacity. Until ratings for filtration characteristics, acid removal and other important qualities are established, manufacturers of filter-driers should provide their own test evaluation data and recommendations for various applications. Nevertheless, those who design and service refrigeration systems must make the final choice. As an aid to them, the important factors to be considered for selection purposes are discussed briefly in the following sections.

STANDARD RATINGS ASHRAE-ARI

The American Society of Heating, Refrigerating and Air Conditioning Engineers Standard 63, "Methods of Testing Liquid Line Refrigerant Driers," sets up a test procedure to follow for determining the water capacity and refrigerant flow capacity under certain conditions. The Air Conditioning and Refrigeration Institute subsequently issued ARI Standard 710, which specifies the rating conditions for water capacity, refrigerant flow capacity, and safety requirements.

This Standard is intended to provide ***comparison points only.*** It is a basis for drier evaluation at the specified rating conditions, but does not attempt to govern the performance of a drier over the entire range of possible applications. It serves only to compare driers on their ratings for water capacity, refrigerant flow capacity, and safety requirements.

WATER CAPACITY — is the amount of water (in drops or grams) that a drier will hold at the standard temperatures and equilibrium point dryness (EPD) specified. Twenty drops equal one gram, equal one milliliter or one cubic centimeter.

Equilibrium Point Dryness (EPD) — is used to define the lowest possible water content of a liquid refrigerant attainable by a specific drier at a specific temperature after it has collected a specific quantity of water, when the two have been in contact until an equilibrium between the water in the refrigerant and the water in the drier has been reached. Equilibrium point dryness is expressed in parts per million (ppm) by weight.

REFRIGERANT FLOW CAPACITY — is the maximum flow of liquid refrigerant (in tons) that a drier will pass at a 1 psi pressure drop. The "ton" ratings are based on 86°F. liquid temperature and refrigerant flows of . . .

4.0 lbs. per minute per ton for Refrigerant 12
2.9 lbs. per minute per ton for Refrigerant 22
4.4 lbs. per minute per ton for Refrigerant 502

SAFETY — is based on drier shell bursting pressure. All liquid line driers manufactured under ARI Standard 710 must meet the requirements of Underwriters' Laboratories, Inc., Standard 207, "Refrigerant Containing Components and Accessories, Nonelectrical."

SELECTION

When selecting a filter-drier the following should be considered:

WATER CAPACITY and REFRIGERANT FLOW — comparisons can be made on the basis of ARI Standard data supplied by the manufacturer. ***However, it should be remembered that flow ratings are based on the ideal situation of a completely clean system.*** Flow is reduced as dirt accumulates on the filtering surface.

FILTRATION — Characteristics of a drier are not readily defined or evaluated since a standard does not exist. The ability to filter and ***hold*** foreign matter varies with the brand and type of drier. Until standards are developed, the simplest guide to follow is that filter capacity is proportional to ***filtering area***. In the tables that follow, the filtering areas of all Catch-All Filter-Driers are tabulated. Filters should be selected with an adequate reserve capacity to allow for the contamination found in most systems.

ACID REMOVAL — is also difficult to measure. There are no standard ratings to follow. However, both laboratory and field tests have demonstrated that the ***Catch-All*** core has far superior acid removal ability — many times that available in other driers.

SPORLAN RECOMMENDATIONS

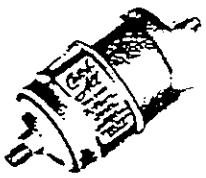
Sporlan's ***Selection Recommendations*** are based on the technical data currently available and more than forty years of ***field experience*** with molded porous core filter-driers. Satisfactory results will be obtained with the sizes recommended for all normal refrigeration systems. We have considered the difference in requirements for air conditioning and refrigeration applications. Recommendations for these categories are made on pages 6, 7 and 8. Recommendations for suction line use of filter-driers are given on page 21, and a quick reference guide to suction line use is available as Form 40-109.

Drier manufacturers establish ratings for their product, but . . . the final selection of the correct drier should be based on the conditions expected for each job. Consideration should be given to providing extra water capacity and filtering area within economical limits.

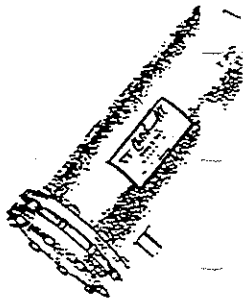
Catch-All®

PERFORMANCE SPECIFICATIONS

TYPE	REFRIGERANT FLOW CAPACITY Tons at 1 psi			DESICCANT VOLUME Cu. In.	② SURFACE FILTERING AREA Sq. In.	① RATINGS AT ARI STANDARD CONDITIONS — WATER CAPACITY — DROPS					
						Refrigerant 12 15 PPM		Refrigerant 22 60 PPM		Refrigerant 502 30 PPM	
	12	22	502			75°F	125°F	75°F	125°F	75°F	125°F
SEALED TYPES											
C-032	1.1	1.4	0.9	3	9	39	33	26	22	28	22
C-032-CAP											
C-032-S											
C-032-F											
C-032-FM											
C-033	2.6	3.4	2.2								
C-033-S	2.9	3.7	2.4								
C-052	1.5	2.0	1.3	5	15	85	74	57	48	57	52
C-052-S											
C-0525-S	2.2	2.8	1.8								
C-053	3.0	4.0	2.6								
C-053-S	4.6	6.0	3.9								
C-082	1.5	2.0	1.3	9	21	133	115	90	75	94	73
C-082-S											
C-0825-S	2.3	3.0	2.0								
C-083	3.4	4.4	2.9								
C-083-S	3.9	5.0	3.3								
C-084	5.9	7.6	4.9								
C-084-S	7.2	9.3	6.0								
C-162	1.5	2.0	1.3	16	33	244	181	144	140	167	144
C-162S-S	2.3	3.0	2.0								
C-163	3.4	4.4	2.9								
C-163-S	3.9	5.0	3.3								
C-164	7.5	9.8	6.4								
C-164-S	8.2	10.6	6.9								
C-165	10.3	13.4	8.7								
C-165-S	11.9	15.5	10.1								
C-303	3.4	4.4	2.9	30	53	465	401	310	260	270	254
C-304	7.5	9.8	6.4								
C-304-S	8.2	10.6	6.9								
C-305	11.1	14.4	9.4								
C-305-S	12.6	16.3	10.6								
C-307-S	16.2	21.0	13.7								
C-414	8.5	11.1	7.2	41	67	605	525	404	338	355	332
C-414-S	9.2	12.0	7.8								
C-415	11.8	15.3	9.9								
C-415-S	13.1	17.0	11.0								
C-417-S	16.5	21.5	14.0								
C-419-S	18.1	23.5	15.3								
C-607-S	21.6	28.0	18.2	60	106	930	802	618	518	541	507
C-609-S	24.6	32.0	20.8								
REPLACEABLE CORE TYPES WITH HIGH CAPACITY CORES (RCW-48)											
C-485	10.8	14.0	9.1	48	64	828	470	544	416	518	380
C-487	17.7	23.0	15.0								
C-489-G	32.3	42.0	27.3								
C-967	29.3	38.0	24.7	96	128	1656	940	1088	832	1036	760
C-969	36.2	47.0	30.5								
C-1449	43.9	57.0	37.0	144	192	2484	1410	1632	1248	1554	1140
C-14411	50.8	66.0	43.0								
C-19211	63.1	82.0	53.0	192	256	3312	1880	2176	1664	2072	1520
C-19213	73.9	96.0	62.0								
C-19217-G	78.0	101.0	65.0								
REPLACEABLE CORE TYPES WITH STANDARD CORES (See Page 12)											
C-R424	8.5	11.0	7.2	41	67	566	490	367	282	325	281
C-R425	10.0	13.0	8.5								
C-R427	13.9	18.0	11.7								
C-485	10.8	14.0	9.1	48	64	590	329	245	172	162	100
C-487	17.7	23.0	15.0								
C-489-G	32.3	42.0	27.3								
C-967	29.3	38.0	24.7	96	128	1180	658	490	344	324	200
C-969	36.2	47.0	30.5								
C-1449	43.9	57.0	37.0	144	192	1770	987	735	516	486	300
C-14411	50.8	66.0	43.0								
C-19211	63.1	82.0	53.0	192	256	2360	1316	980	688	648	400
C-19213	73.9	96.0	62.0								
C-19217-G	78.0	101.0	65.0								
C-30013	83.0	108.0	70.0	300	294	4500	2139	2670	1878	2610	1770
C-40017	108.0	140.0	91.0	400	392	6000	2852	3560	2504	3480	2360



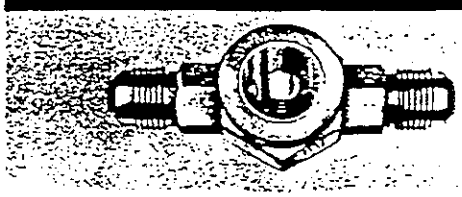
For a Simplified "Quick Selecti Guide" request Form 40-109



① 20 drops = 1 gram = 1 cc ② The filtration area is equal to the core surface area plus the large internal surface available for depth filtration.

NOTE: The variation in flow ratings of filter-driers having the same size core and shell is caused by the difference in connection sizes used.

INSTALLATION INSTRUCTIONS



See•All® Moisture and Liquid Indicator

GENERAL — The See•All moisture & liquid indicator may be installed anywhere in the liquid line. When located between the Catch-All Filter-Drier and the expansion device, bubbles indicate a shortage of refrigerant or a restriction in the liquid line such as a plugged drier. **Change the Drier When the Color is in Caution or Wet Range.** When received, the indicator may not indicate dry. This in no way affects operation or calibration of the indicator. **The action of the indicator element is completely reversible and will change color whenever the moisture content of the system changes.**

The indicating element may change color rapidly on some installations while others may take a much longer period of time. New systems or systems where the drier has been replaced will cause the indicator to start changing color almost immediately. However, it is recommended that the equipment operate for 12 hours to allow the system to reach equilibrium before deciding if the drier should be changed.

The drying of the system should be continued until the indicating element stays Dark Green.

The moisture change level of the refrigerant in Parts per Million (PPM) for the various See•All moisture indicator colors is shown below.

MOISTURE CONTENT PPM for Various Liquid Line Temperatures

See•All Shows	Liquid Line Temp. ➡	Refrigerants 11 & 12			Refrigerant 22			Refrigerants 502, 113 & 114		
		75°	100°	125°	75°	100°	125°	75°	100°	125°
Green DRY		Below 5	Below 10	Below 20	Below 30	Below 45	Below 60	Below 10	Below 20	Below 30
Chartreuse CAUTION		5-15	10-30	20-50	30-90	45-130	60-180	10-45	20-65	30-110
Yellow WET		Above 15	Above 30	Above 50	Above 90	Above 130	Above 180	Above 45	Above 65	Above 110

BRAZING INSTRUCTIONS — See•All moisture & liquid indicators with ¼" through 1⅛" ODF connections are ready for brazing as received. Avoid overheating the body since extreme heat could damage the glass joint. If a wet rag is used it should be wrapped around the fittings and bottom of the body, but not around the top of the See•All body. In this way any moisture inside the See•All will not condense on the cool glass surface and wash away the color indicator material.

The indicator cartridge must be removed from the SA-211, SA-213 and SA-217 (1⅜", 1⅝", and 2⅛" line sizes) See•All indicators before brazing into the liquid line. It is shipped hand tight.

All See•All indicators with sweat fittings are suitable for use with any of the commonly used brazing alloys including sliver solder, Sil-Fos, Phos-copper, or Sta-Brite.

BRAZING TECHNIQUE — 1) The copper plated steel fittings are clean and ready to braze as received. Avoid excessive polishing with steel wool since this may rub off the copper plating and make brazing more difficult. 2) During brazing bleed an inert gas (dry nitrogen or CO_2) through the tubing and See•All. 3) Use a torch that is large enough to rapidly heat the line size being used. 4) Direct the flame away from the See•All body. 5) Perform the brazing as rapidly as possible

FLARING TECHNIQUE — 1) Debur tubing before flaring. 2) Use a drop of oil on the cone of the flaring tool. 3) Place drops of refrigerant oil on the front and back surface of the flare before drawing the nut tight. This allows flare and fitting to mate smoothly. 4) **It is especially important to use oil on joints where both the male and female fittings are copper plated steel. The oil will prevent galling.**

APPLICATION SUGGESTIONS — The Sporlan See•All moisture & liquid indicator should not be used on systems containing **methyl alcohol** or similar liquid dehydrating agents unless an oversize ***Catch-All Filter-Drier*** has been installed previously to remove these additives. Certain colored liquid leak detectors in a system may permanently discolor the element. However, **Dupont Dytel** refrigerant does not cause any problem.

On systems containing an **excessive amount of water,** as a result of a broken condenser or water chiller, do not install the See•All indicator until the Catch-All Filter-Drier or the replaceable cores have been changed several times to reduce the initial high moisture content. Liquid water will dissolve and wash away the color indicator material resulting in a light yellow or white color. This type of damage is permanent — the See•All will no longer change color. If the indicator paper is damaged, it is preferable to change the See•All.

When the See•All is soldered in a **difficult location,** it may be desirable to change only the indicator. This can be done on the newer fused glass models by installing **K-SA-2 replacement parts kit** (thru the removable plug opposite the glass). See Figure-A.

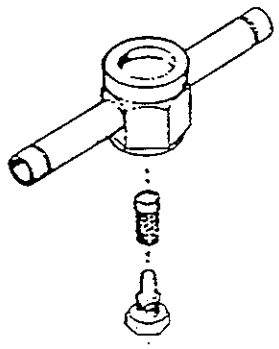


Figure-A

The recommended clean-up procedure after a hermetic motor burnout is described completely in Bulletin 40-10. A See•All should be installed after the clean-up procedure is nearly complete (when the Catch-All Filter-Drier is being replaced.)

Do not use See•All indicators at temperatures below −50°F.

BYPASS INSTALLATION — The See•All moisture & liquid indicator may be installed in a bypass to the main liquid line when desired — and must be installed in this manner on lines larger than 2⅛" OD.

BYPASS INSTALLATION KITS — Are available from your Sporlan Wholesaler. While satisfactory liquid and moisture indication will generally be obtained in any position, preferred methods of installation are shown in Figures B and C.

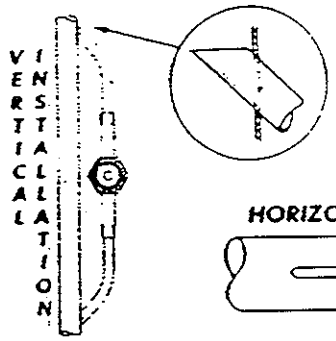


Figure-B

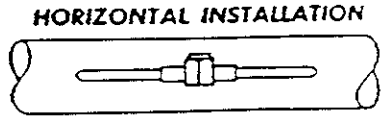


Figure-C

All Sporlan See•All indicators are suitable for use with the halocarbon Refrigerants, including 11, 12, 22, 113, 114, 500 and 502. Listed by **Underwriter's Laboratories, Inc.** and certified by the **Canadian Standards Association** for a working pressure of 500 psi or 3447 kPa (SI units) for Types SA-12 thru SA-19S. The working pressure of Type SA-211 is 460 psi (3171 kPa) and for Types SA-213 and SA-217 the working pressure is 430 psi (2964 kPa).

SPORLAN VALVE COMPANY
7525 SUSSEX AVENUE ST. LOUIS, MO 63143
FAX: 314-647-1714 TELEX: 044-873
PHONE 314-647-2775

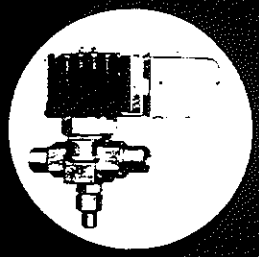
 FORM SD-21 250-489

SPORLAN

SOLENOID VALVES

Installation and Servicing Instructions

NOT FOR USE ON HAZARDOUS OR CORROSIVE FLUIDS



- The molded MKC-1 coil fits the A3, E3, W3, E5, B6, E6, W6, R183, R184 and R246 series normally closed solenoid valves and all solenoid valves in the field that are equipped with the KC-1 coil.
- The OMKC-1 coil fits the XUP series rapid cycle solenoid valves.
- The MKC-2 coil fits the B9, E9, B10, E10, B14, E14, W14, B19, E19, W19, B25, E25, W25, B33, E33, E34, E42 series normally closed solenoid valves and the 180 solenoid pilot control . . . and all solenoid valves in the field that are equipped with the old style KC-2 coil.
- When changing from the old KC model coils to the current MKC molded model coils, discard the coil housing, coil housing bottom plate, two coil sleeves (not used with KC-1 coil) AND THE SPACER.
- The OMKC-2 coil fits the OB9, OE9, OB10, OE10, OB14, OE14, OB19, OE19, OB25, OE25, OB33, OE33, OE34, OE42 series normally open solenoid valves and the XRN, XRM, XPO series rapid cycle solenoid valves.
- Other Sporlan Valve products using a molded coil are as follows:
  MKC-1 — SORIT-12, SORIT-15, SORIT-20, 8D, 12D and 10G.
  MKC-2 — 16D, DDR-20, SHGB(E)-15, OLDR-15 and OLDR-20.
  OMKC-2 — LDR-15, LDR-20, XTM and XTO.

To insure peak performance, solenoid valves must be selected and applied correctly; however, proper installation procedures are equally as important. The following instructions list the essential points for correct installation.

An exploded view of a typical Solenoid Valve is illustrated in Figures 5, 5A and 6, Page 4.

Position — All standard solenoid valves may be mounted horizontal, on its side or in a vertical line with the exception of the following: A3 dated 6-86 or before, MA32, MA42, MA50, MA5A, MA17A, XUP, XRN, XRM and XPO series, which **MUST** be installed in horizontal lines with the coil housing no more than 45° from vertical, see Table on Page 2. The direction of flow is indicated by an **arrow** or the word **IN** on the valve body.

NOTE: Solenoid Valves having a type number starting with the letter "X" are Special Solenoid Valves (non-standard). Contact Sporlan Valve Company, St. Louis if valve mounting is in question.

SOLDER CONNECTIONS

Because of possible damage to valve components due to the high temperatures of soldering and brazing, all Sporlan Solenoid Valves with solder connections are shipped hand-tight to facilitate disassembly with the exception of the following: E Series (Extended End Connections) and Types A3, (M)B33S2, OB33S2, MA42S3 and MA50S3. The following steps outline the recommended procedures to be used when installing these valves.

Soldering Precautions — Solder connections on Sporlan Solenoid Valves are either copper or brass. Any of the commonly used types of solder are satisfactory with these materials. Regardless of the type of solder used, it is important to avoid over-heating the valve.

In all cases it is necessary that the valve be completely disassembled before any heat is applied to the valve body with the exception of the following: E Series (Extended End Connections) and Types A3, (M)B33S2, OB33S2, MA42S3 and MA50S3.

The tip of the soldering torch should be large enough to avoid prolonged heating of the connection during the soldering operation. Overheating can also be minimized by directing the flame away from the valve body.

Type A3S1

1. Remove the coil assembly.
2. Locate the word **IN** or the directional **arrow** on the valve body.
3. Place the valve in the line in the proper direction of flow and solder.
4. Replace the coil assembly and tighten coil hex screw.

Types B6, B9, B10, B14, B19 and B25 Series

1. Remove the coil assembly, enclosing tube and nut, all internal parts, and manual lift stem assembly.
2. Locate the word **IN** or the directional **arrow** on the valve body.
3. Place the valve in the line in the proper direction of flow and solder.

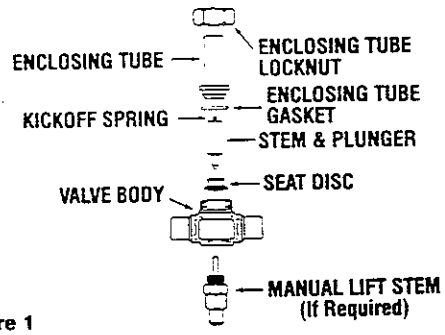


Figure 1

4. Re-assemble as follows, see Figures 1, 5, and 5A:
   a. Place the seat disc into the valve body with the smaller diameter end facing up.
   b. Place the enclosing tube gasket onto the valve body above the threads.
   c. Hold the plunger with one hand so that the pointed end is resting in the pilot port of the disc. Make sure the small spring is in place on the top of the plunger. **(NOTE: Does not apply to normally open and rapid cycle series.)**
   d. With the other hand, place the enclosing tube over the plunger, making sure the enclosing tube gasket is in position.
   e. Replace the enclosing tube locknut and tighten. (See recommended torque in the table below.)
   f. Replace manual lift stem and tighten.
   g. Replace the coil assembly. **(NOTE: For normally open and rapid cycle valves replace spacer and spacer cup with coil assembly.)**

NOTE: Because of the enclosing tube gasket construction, excessive tightening of the enclosing tube locknut is not required. Please observe the torques listed on Page 2.

Types: All E Series (Extended End Connections)

May be brazed into the line without disassembly because the valve contains extended connections. Use caution by placing a wet rag or chills on the extensions at the body to prevent excessive overheating.

RECOMMENDED TORQUE (Ft-Lbs)

VALVE SERIES	ENCLOSING TUBE LOCKNUT	ENCLOSING TUBE SCREWS	PILOT VALVE ASSEMBLY LOCKNUT	LOWER BODY LOCKNUT	BODY FLANGE CAP SCREW	COIL SCREW	COIL LOCKNUT	FLANGE PLATE BOLTS	FLANGE CONNECTION BOLTS	MANUAL LIFT STEM ASSEMBLY	SEAL CAP	VALVE MOUNTING POSITION		
												**VERTICAL LINE	HORIZONTAL LINE	**ON SIDE
A3	—	—	—	—	—	2.3	—	—	—	—	—	YES dated 7-86 or later	YES	
E3, E5	—	—	—	—	—	2.3	—	—	—	—	—	YES	YES	
W3		1.5-1.67												
B6, E6, W6	10-15	—	—	—	—	2.3	4.0	—	—	11-12	4.6	YES	YES	
XUP												NO	YES*	
B9, E9, OB9, OE9	15-30	—	—	—	—	2.3	4.0	—	—	11-12	4.6	YES	YES	
XRN												NO	YES*	
B10, E10, OB10, OE10	20-40	—	—	—	—	2.3	4.0	—	—	11-12	4.6	YES	YES	
B14, E14, W14, OB14, OE14														
XRM												NO	YES*	
B19, E19, W19, OB19, OE19	25-45	—	—	—	—	2.3	4.0	—	—	11-12	4-6	YES	YES	
XPO												NO	YES*	
B25, E25, W25	35-60	—	—	—	—	2.3	4.0	—	—	11-12	4.6	YES	YES	
OB25, OE25														
B33	15-30	—	—	—	—	2.3	4.0	8-12	37	11-12	4.6	NO	YES*	
E34									—			YES	YES	
OB33									37			NO	YES*	
OE34									—			YES	YES	
E42, OE42	15-30	—	—	—	—	2.3	4.0	13-20	—	11-12	10-15	YES	YES	
MA5A3	25-50	—	—	—	—	—	4.0	—	24	11-12	10-15	NO	YES	NO
MA17A3		—	—	—	—	—	4.0	—	37	11-12	10-15	NO	YES	NO
MA32	—	—	—	—	—	—	4.0	8-12	74	11-12	10-15	NO	YES	NO
MA42								12-20	74					
MA50								25-35	74					
R183, R184, R246	—	6	—	—	—	2.3	—	—	—	—	—	YES	YES	
8D	10-15	—	35-60	25	—	2.3	—	—	—	—	—	YES	YES	
12D				—	15-18									
16D	30-35	—	—	—	20-24									
10G	10-15	—	35-60	35-60	—									

Note: Standard torque charts do not apply.

*Coil housing to be no more than 45° from the vertical.

**Coil housing must not be below horizontal.

PIPE CONNECTIONS

Types A3, W3, B6, W6, B9, B10, B14, W14, B19, W19, B25, W25, (K)(B)R183, (K)(B)R184, (K)(B)R246 series.

These valves can be installed without disassembly. Avoid excessive amounts of pipe sealing compounds. It will interfere with the valve operation if it comes in contact with the valve's internal parts.

NOTE: When pipe type solenoid valves are installed with pipe to ODF adaptors, the valve must be disassembled prior to brazing the ODF adaptors.

FLANGED CONNECTIONS—PIPE or SOLDER

Solenoid valves with flanged connections may be installed without disassembly. In most cases the flanges are packed disassembled from the valve body. Therefore, they may be installed in the line before the valve is installed. Care must be exercised to be certain that the correct flange is installed on the inlet line in order to properly match the flow direction of the valve. If the valve is installed backwards, it will not function properly.

Types MA5A3, MA17A3, MA32P3, MA42P3, MA50P3

Avoid the use of excessive amounts of pipe sealing compounds. It will interfere with the valve operation if it comes in contact with the valve's internal parts.

Types B33S2, MB33S2, OB33S2, MA42S3, MA50S3

These valves are supplied with a two piece flange assembly, a semi-steel flange ring and a brass solder bushing. The flange should be placed on the pipe before the bushing is soldered or brazed. The soldering discussion given under "Solder Connections" applies for these valves except where the discussion deals with non-flanged valves only.

With Types MA42S3 and MA50S3 care must be exercised to use the correct flange and bushing in order to correspond with its mating flange on the valve for correct flow direction.

These valves have male flange connections on the inlet of the valve; therefore, the flange and bushing for the inlet must be the female pair.

INSTALLATION—ALL VALVES

Mounting — A Type 1216-1 universal mounting bracket, Figure 2, is available, when ordered. It fits all standard Sporlan Solenoid Valves except the Types W3, MA32, B33, E33, E34, E42, MA42, MA50, (K)(B)R183, (K)(B)R184, (K)(B)R246 series and the Type 180 Solenoid Pilot Control. The slots in the bracket will match the tapped holes in the standard solenoid valves so that they may be secured by two screws supplied with the bracket. A locknut is also furnished for use with Types MA5A3 and MA17A3. Both types of installations are shown in Figure 2. The manual lift stem seal cap is replaced after the locknut is tightened against the bracket.

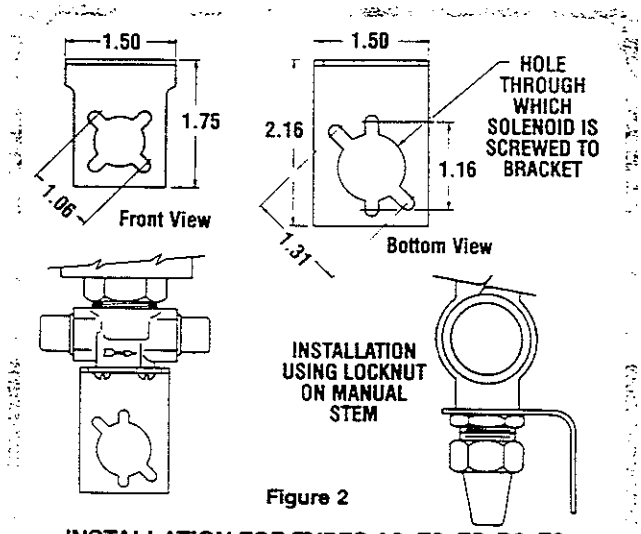


Figure 2

INSTALLATION FOR TYPES A3, E3, E5, B6, E6, W6, B9, E9, B10, E10, B14, E14, W14, B19, E19, W19, B25, E25, W25 Series and Types MA5A, MA17A Solenoid Valves.

Wiring — Check the electrical specifications of the coil to be sure that they correspond to the available electrical service.

The 1/2" BX conduit connection or junction box on the coil may be rotated to any position by loosening the coil hexscrew. Solenoid valves with four-wire dual voltage coils have a wiring diagram decal, Figure 3, on the coil housing or bracket. This illustrates which wires to connect for either 120, 208 or 240 volt operation. Wiring and fusing (when used) must comply with prevailing local and national wiring codes and ordinances.

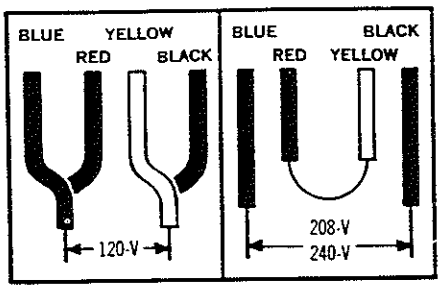


Figure 3

Direct current Valves — A surge protector is supplied with each solenoid valve with a 115 volt DC coil. The surge protector is necessary to absorb the high counter-voltage generated when the circuit is broken, thereby protecting the electrical contacts of the thermostat. It should be wired as shown in Figure 4.

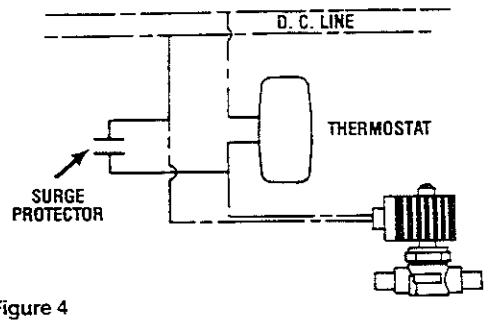


Figure 4

TRANSFORMER SELECTION

COIL KIT	24v/50-60c		120v/50-60c		240v/50-60c		Transformer Rating Volt-Amperes
	Current Amperes		Current Amperes		Current Amperes		For 100% of rated MOPD of Valve
	In-rush	Holding	In-rush	Holding	In-rush	Holding	
MKC-1	1.9	.63	.39	.14	.19	.09	60
MKC-2 OMKC-2	3.1	1.4	.60	.26	.31	.13	100
KC-3	7.9	1.9	1.7	.41	.83	.21	250

SERVICING INSTRUCTIONS

CAUTION—Dangerous hydraulic pressures may develop if a hand valve is installed in the liquid line ahead of the solenoid valve and the hand valve is closed while the solenoid valve is closed. This may cause extrusion of the teflon seat in the disc. Extrusion may cause the valve to fail to open, fail to close and/or have excessive seat leakage. Also the line between these two valves should be pumped down completely before disassembling the solenoid valve for service.

TYPICAL MALFUNCTIONS

There are only three possible malfunctions: 1. Coil burnout. 2. Failure to open. 3. Failure to close. Each is discussed below.

COIL BURNOUT

Coil burnouts are extremely rare unless caused by one of the following:

1. Improper electrical characteristics.
2. Continuous over-voltage, more than 10%.
3. Under-voltage of more than 15%. This applies only if the operating conditions are such that the reduced MOPD causes stalling of the plunger, which results in excessive current draw.
4. Incomplete magnetic circuit due to the omission of parts such as: coil housing, coil sleeves, coil spring, coil housing bottom plate or plunger on the KC model coil and coil yoke, coil backplate or plunger on the MKC molded model coils.
5. Mechanical interference with plunger movement which may be caused by a deformed enclosing tube.

FAILURE TO OPEN (Normally Closed Types)

1. Coil burned out or an open circuit to coil connections.
2. Improper electrical characteristics.
3. In pilot operated valves, dirt, scale, or sludge may prevent the piston, disc or diaphragm from lifting. This could also be caused by a deformed body.
4. High differential pressure that exceeds the MOPD rating of the valve.
5. Diameter reduction of synthetic seating material in pilot port because of high temperatures and/or pressures, or severe pulsations. Contact Sporlan Valve Co., St. Louis, Mo.

The problem of dirt can be avoided by installing a Sporlan **Catch-All Filter-Drier** upstream from the solenoid valve. The **Catch-All Filter-Drier** will retain much smaller particles than a conventional strainer.

Use a Sporlan strainer for water applications upstream of every industrial solenoid valve.

FAILURE TO CLOSE

1. In pilot operated valves, dirt, scale, or sludge may prevent the piston, disc or diaphragm from closing. This could also be caused by a deformed body.
2. Held open by the manual lift stem.
3. In pilot operated valves only, a damaged pilot port may prevent closing.
4. A floating disc due to severe discharge pulses, contact Sporlan Valve Co., St. Louis, Mo.
5. Have voltage feedback to the coil after the coil de-energizes.

MISCELLANEOUS

1. **Water Hammer** — Industrial solenoid valves or other quick acting valves may cause water hammer when installed on water lines. If this occurs, it may be minimized by the use of a standpipe installed in the piping near the solenoid valve inlet. Commercially available shock absorbers may also be used to reduce this noise.
2. **AC Hum** — This problem may be caused by a loose coil housing on a KC model coil. On rare occasions this may be caused by loose coil sleeves, in which case deforming them slightly will eliminate the hum. A loose coil hex screw or coil locknut may cause this problem on the MKC molded model coils.

   Foreign material between the magnetic top plug and the plunger in the Types A3, E3, W3, E5, B6, E6, W6, B9, E9, B10, E10, B14, E14, W14, B19, E19, W19, B25, E25, W25, B33, E33, E34 and E42 Series Solenoid valves may cause AC hum also.

On water applications, deposits may accumulate in the valve which could cause AC hum. This may be eliminated by cleaning or flushing the valve.

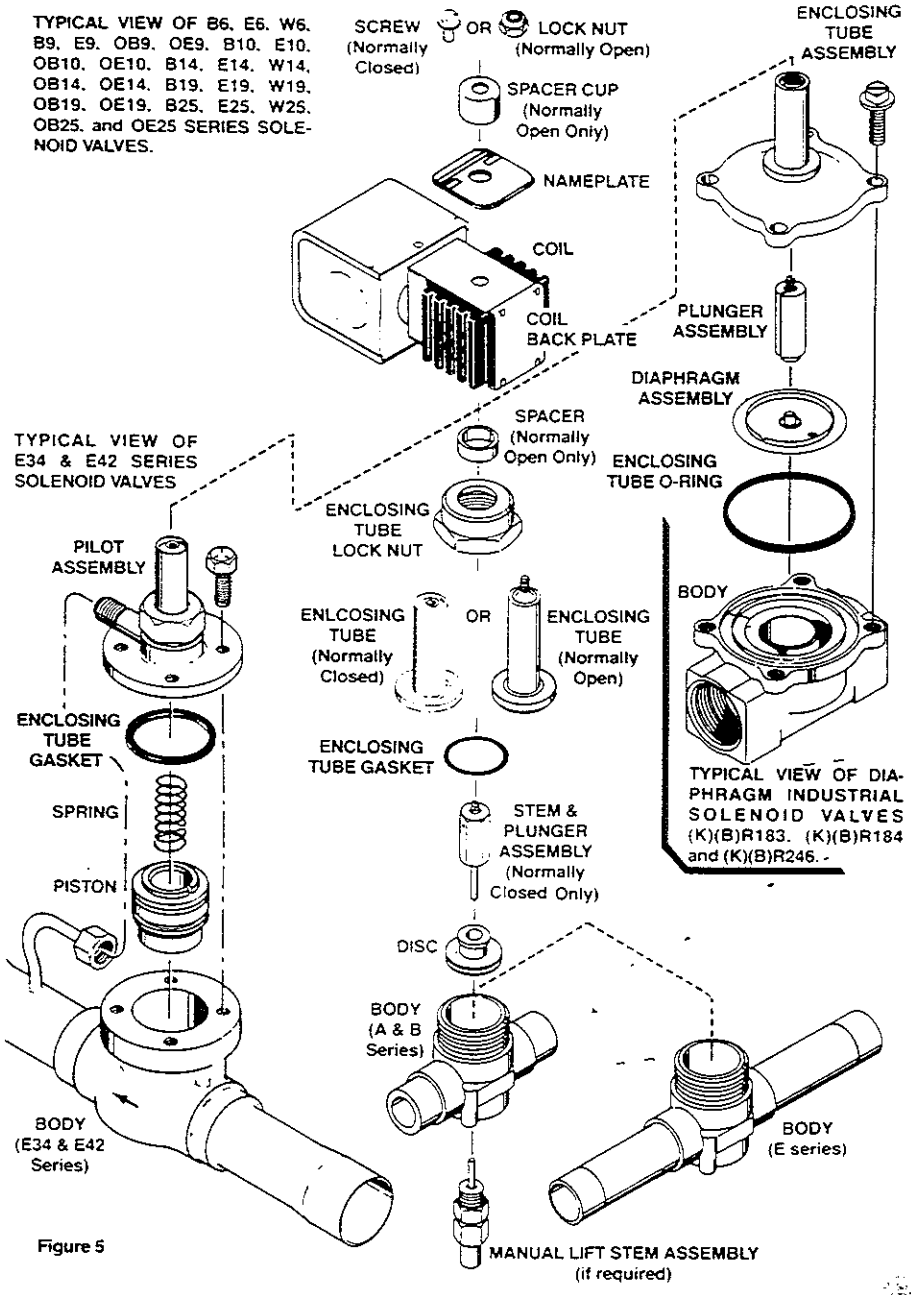
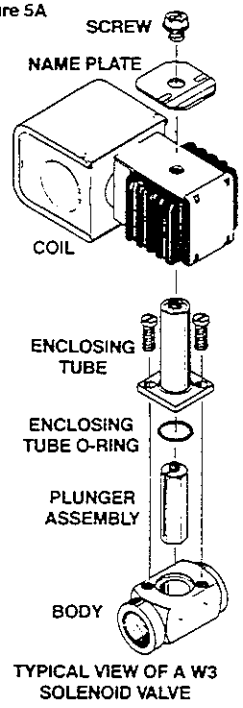


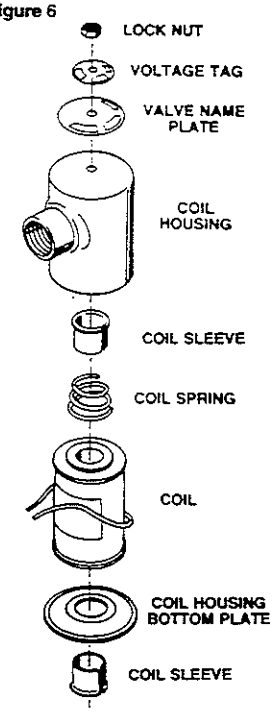
Figure 5

Figure 5A



TYPICAL VIEW OF A W3 SOLENOID VALVE

Figure 6



TYPICAL VIEW OF KC-3 Coil used on valve types: MA5A, MA17A, MA32, MA42 and MA50.

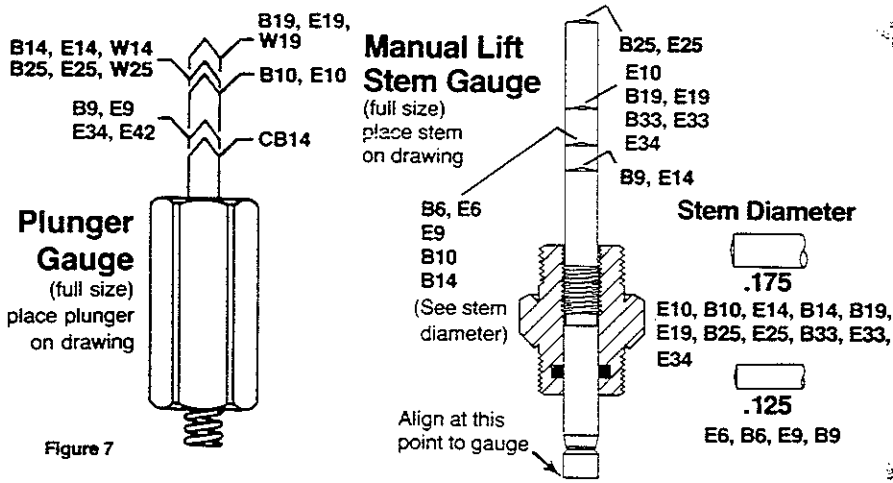


Figure 7

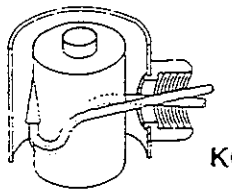
Figure 7 contains a full size plunger gauge, and a manual lift stem gauge for easy identification of parts. Be sure to gauge from the end of the manual lift stem. Do not gauge from the packing gland assembly.

For installation and service instructions on Three-Way Heat Reclaim Valves Type 8D, 12D & 16D, request Form SD-114.

SPORLAN VALVE COMPANY
7525 SUSSEX AVENUE ST. LOUIS, MO 63143
FAX: 314-647-1714 TELEX: 044-872
PHONE: 314-647-2775

COIL INSTALLATION

n replacing a KC-3 or KC-12 solenoid coil, care should ıken to prevent damage to the coil leads. The following ches illustrate the proper method of installation with e wrapped around the coil. One on each side for single coils and two on each side for dual voltage coils.



CUT-A-WAY SIDE VIEW

KC-3

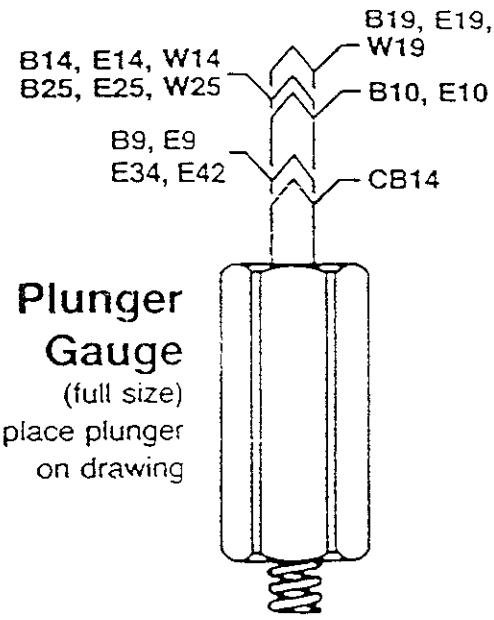
CUT-A-WAY TOP VIEW

COILS and INTERNAL PARTS KITS for CURRENT and OBSOLETE VALVE TYPES

VALVE SERIES	REPLACEMENT COIL KIT NUMBER	INTERNAL PARTS KIT NUMBER
10	MKC-2	None
A3, E3	MKC-1	
E5		
A6		No longer available
B6, MB6, E6, ME6		KS-B6/E6
14	MKC-2	None
A9		No longer available
B9, MB9, E9, ME9		KS-B9/E9
089, 0E9	OMKC-2	KS-089/0E9
A10, MA10	MKC-2	KS-A10
B10, MB10, E10, ME10		KS-B10/E10
0B10, 0E10	OMKC-2	KS-0B10/0E10
20	KC-12	KS-20
73		KS-73
A14, MA14	MKC-2	No longer available
B14, MB14, E14, ME14		KS-B14/E14
0B14, 0E14	OMKC-2	KS-0B14/0E14
43	KC-3 or HKC-3	No longer available
A17, MA17		KS-MA17A/A17A
B19, MB19, E19, ME19	MKC-2	KS-B19/E19
0B19, 0E19	OMKC-2	KS-0B19/0E19
53	KC-3 or HKC-3	No longer available
A24, MA24		
B25, MB25, E25, ME25	MKC-2	KS-B25/E25
0B25, 0E25	OMKC-2	KS-0B25/0E25
90, 9001, 9005	KC-3 or HKC-3	KS-MA32
MA32, B32, MB32		
C32, MC32		
B33, MB33, E33, ME33	MKC-2	KS-B33 E33
EB33, EMB33		
E34, ME34		KS-E34
0E34	OMKC-2	KS-0E34
0B33, E0B33, 0E33	OMKC-2	KS-0B33/0E33
100	KC-3 or HKC-3	KS-MA42
MA42, EMB42		
E42, ME42	MKC-2	KS-E42
0E42	OMKC-2	KS-0E42
110	KC-3 or HKC-3	KS-MA50
MA50		
35		KS-MA5
MA5A3		
83		KS-MA17A
MA17A3		
W3	MKC-1	KS-W3
W6		KS-W6
W7	MKC-2	KS-W7
W14		KS-W14
W19		KS-W19
W25		KS-W25
(K)R183	MKC-1	KS-R18
(K)R184		
(K)R246		KS-R24
(K)BR183		KS-BR18
(K)BR184		
(K)BR246		KS-BR24
XRN	OMKC-2	KS-XRN
XRM		KS-XRM
XPO		KS-XPO
XUP	OMKC-1	KS-XUP

NOTE: The KC-43 coil kit has been renumbered and is now designated as the KC-3 coil kit. The two coils are identical.

1. KS-B6 kits may be used in A6 series valves, but KS-A6 kits should not be used in B6 series valves.

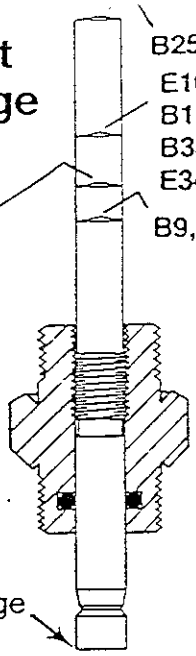


Plunger Gauge

(full size)
place plunger
on drawing

Manual Lift Stem Gauge

(full size)
place stem
on drawing



Stem Diameter

.175

E10, B10, E14, B14, B19, E19, B25, E25, B33, E33, E34

.125

E6, B6, E9, B9

Listed by Underwriters' Laboratories, Inc.
Guide-YIOZ File No. MH4576

Listed by Canadian Standards Association
Guide-440-A-O File No. 19953

GENERAL PURPOSE SOLENOID VALVES

Basic Valve Type	Ambient Temp. Rating (°F)	Fluid Temp. Rating (°F)	Approved Fluids
A3, E3	120	240	1
E5	120	240	1
B6, E6	120	240	1
B9, C9, E9	120	240	1
B10, E10	120	240	1
B14, E14	120	240	1
B19, E19	120	240	1
B25, E25	120	240	1
MA32	70	77	1, 2
B33	120	240	4
E33	120	240	4
E34	120	240	4
E42	120	240	4
MA42	70	77	2, 4
MA50	70	77	2, 4
MA5A	70	77	2
MA17A	70	77	2
R18	120	240	5
R24	120	240	5
W3, RW3	120	240	5

Basic Valve Type	Ambient Temp. Rating (°F)	Fluid Temp. Rating (°F)	Approved Fluids
SHG8-15	120	240	6
SORT-12,15,20	120	240	6
8D	120	240	6
12D	120	240	6
16D	120	240	6
10G	120	240	6
18D	120	240	3, 4
XIF-1	190	65	3
XNL-1	120	240	1
XOB-1, 2	120	240	1
XOE	120	240	1
XS8	120	240	1
XNP	120	240	1
XNQ	120	240	1
XPN	120	240	1
XRN	120	240	1
XRM	120	240	1
XPO	120	240	1
XUP	120	240	1

APPROVED FLUIDS —
1 — All Halogenated Refrigerants Dry Air Water and Brine
2 — Ammonia and Dry Air
3 — Water
4 — All Halogenated Refrigerants and Dry Air
5 — Dry Air Water and Steam
6 — All Halogenated Refrigerants

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SPORLAN

Thermostatic Expansion Valves

INSTALLATION, FIELD SERVICE & ASSEMBLY

INSTALLATION

For peak performance, it is important to select a Sporlan thermostatic expansion valve with the correct capacity, selective charge, external or internal equalizer, etc. See Bulletin 10-10 for complete application information. Equally important is the proper installation, which can determine the success or failure of the entire system.

A. VALVE LOCATION

Thermostatic expansion valves may be mounted in any position, but they should be installed as close to the evaporator as possible. If a refrigerant distributor is used with the expansion valve, best performance is obtained if the distributor is mounted directly to the valve outlet. If the distributor cannot be mounted directly to the valve outlet, the distance between the valve outlet and distributor should not exceed 24 inches or refrigerant distribution problems may occur. Also, the tube connecting the valve outlet and distributor can be sized smaller to maintain refrigerant velocity and better distribution. Elbows located between the expansion valve and distributor will hinder proper distribution and therefore, are not recommended.

Best distribution is usually obtained if the expansion valve feeds vertically up or down into the distributor. System manufacturers, however, have successfully applied distributors in other orientations. See Bulletin 20-10 for application and selection information on refrigerant distributors.

While not always convenient nor possible, valve Types BI, F, and O are easier to service if mounted in a vertical and upright position. If mounted in a horizontal position, the internal parts must be carefully reassembled to prevent damage to them. Also, some consideration should be taken in mounting the larger sized expansion valves. They must be adequately supported since system vibration and the weight of the valve may cause valve connections to fracture.

If a hand valve is located on the outlet side of the thermostatic expansion valve it should have a full sized port. No restrictions should appear between the thermostatic expansion valve and evaporator, except a refrigerant distributor if one is used.

Sporlan Thermostatic Expansion Valves having Selective Charges C, Z, L, or X may be installed and operated in most locations. The amount of thermostatic charge and the bulb size are such that the bulb retains control despite a colder valve body or diaphragm case. The exception is when the element is subjected to sub-zero temperatures for extended periods of time during an off-cycle. In this case, start-up may be prolonged until the bulb and element are warmed sufficiently to open the valve.

To minimize the possibility of charge migration, the Sporlan Flow-Master P, VGA, or G air conditioning charges or ZP refrigeration charges should be installed so the diaphragm case is warmer than the bulb. Special non-condensible charges without MOP and double diaphragm hydraulic elements with MOP are available for system manufacturers to overcome this potential problem.

Occasionally, thermostatic expansion valves are located in corrosive atmospheric conditions that can damage the valve and/or element assembly. Due to this possibility, the valve must be protected with appropriate materials to prevent premature failure. Consult specialists in protective coatings.

PRECAUTIONS — WHEN VALVE IS INSTALLED AT CONSIDERABLE HEIGHT ABOVE LIQUID RECEIVER

When the evaporator and thermostatic expansion valve are located above the receiver, there is a static pressure loss in the liquid line. This is due to the weight of the column of liquid refrigerant, and this weight may be interpreted in terms of pressure loss in pounds per square inch as shown in Table-2, Page 14, Bulletin 10-10, or Page 12, Form 10-56. If the vertical lift is great enough, vapor or ***flash gas*** will form in the liquid line causing a serious reduction in the capacity of the thermostatic expansion valve.

When an appreciable vertical lift is unavoidable, precautions should be taken to prevent the accompanying pressure loss from producing liquid line vapor. This can be accomplished by providing enough subcooling to the liquid refrigerant, either in the condenser or after the liquid leaves the receiver. Subcooling is determined by subtracting the actual liquid temperature from the condensing temperature (corresponding to the condensing pressure). The required amount of subcooling necessary to prevent vapor formation in the liquid line is shown in Table-6, Page 16, Bulletin 10-10, or Page 14, Form 10-56.

Liquid subcooling is provided by the following methods:

1. **In the condenser**
2. **Suction — liquid heat exchanger**
3. **Special devices**

Method–1 will provide sufficient subcooling for the simple short-coupled system that has only moderate liquid line pressure drop.

Method–2 will usually not provide more than 20°F. subcooling on air conditioning systems operating at normal head pressures. The amount of subcooling will depend on the design and size of the heat exchanger and on the operating suction and discharge pressures.

Method–3 may be used to provide considerable subcool-

Bulletin 10-11, May 1990 Supersedes Bulletin 10-11, September 1988; and all prior publications

ing required for systems with excessive vertical lift. The following special devices are the most commonly used methods.

a. Water coils in heat exchange relationship with the liquid line.
b. Separate refrigeration system.
c. Special heat exchanger which uses a portion of the refrigerant to cool the main body of liquid. See Figure-1.

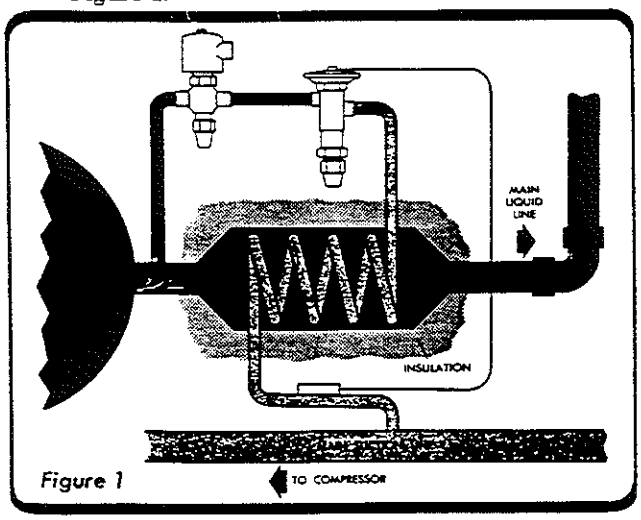


Figure 1

Ordinarily the conventional suction — liquid heat exchanger is installed near the evaporator, where the suction vapor is the coldest, to re-condense any vapor in the liquid line. When the primary purpose of the heat exchanger is to prevent the formation of flash gas — particularly on systems that have a long liquid line or excessive vertical lift — install the heat exchanger near the receiver ***before the vertical lift occurs.*** (This also applies to the special devices described in Method 3). Because vapor in the liquid line considerably increases friction losses, the total pressure drop available across the expansion device on these type of systems is reduced. Also, the suction line and liquid line should be carefully insulated to minimize heat gain if subcooled below ambient temperature.

IMPORTANT — Preventing the formation of vapor in liquid lines having high pressure losses does not eliminate the requirement that an adequate pressure drop must be available across the thermostatic expansion valve. The capacity tables show valve capacities at pressure drops lower than normal. For thermostatic expansion valve application data and capacities at pressure drops below those listed, ***consult Sporlan Valve Company.***

B. SOLDER TECHNIQUE

It is not necessary to disassemble solder type valves such as Types S, P, EBF, EBS and O when soldering to the connecting lines. Any of the commonly used types of solders, e.g., 95-5, Sil-Fos, Easy-Flo, Phos-Copper, Stay Brite 8 or equivalents may be used for copper to copper connections. When soldering a brass refrigerant distributor to the valve, appropriate solders for these connections such as 95-5, Easy-Flo, Stay Brite 8 or equivalents may be used. It is important, however, regardless of the solder used, to direct the flame away from the valve body and avoid excessive heat on the diaphragm, Figure-2. As an extra precaution, a wet cloth may be wrapped around the body and element during the soldering operation.

This precaution will prevent overheating the valve body which could damage the superheat spring and result in floodback problems. In addition, the Type O, BF/EBF, and BS/EBS valve contain synthetic parts which can be damaged due to overheating, resulting in poor valve performance.

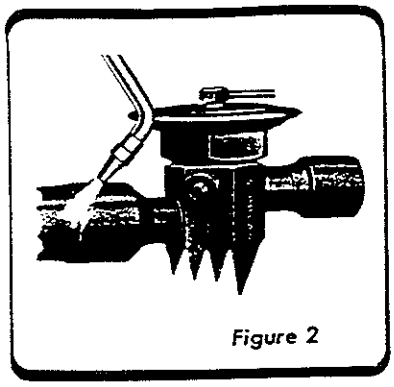


Figure 2

C. BULB LOCATION and INSTALLATION

The location and installation of the bulb is extremely important to the proper performance of the system and care should be taken with its final location.

Accepted principles of good suction line piping should be followed to provide a bulb location that will give the best possible valve control. When system manufacturers have piping recommendations that differ from the general industry recommendations and Sporlan's suggestions shown in this section, those recommendations should be used. When specific recommendations are not available, the suggestions below should be used.

The bulb should be attached to a horizontal suction line at the evaporator outlet (See Figures 3, 4, and 5). If the bulb cannot be located in that manner, it may be located on a ***descending*** vertical line only (as shown in Figure-5 for "pumpdown control"). The bulb should never be located in a trap or downstream of a trap in the suction line. Liquid refrigerant or mixture of liquid refrigerant and oil boiling out of the trap will falsely influence the temperature of the bulb and result in poor valve control.

On suction lines ⅞" OD and larger, the surface temperature may vary slightly around the circumference of the line. On these lines, it is generally recommended that the bulb be installed at 4 or 8 o'clock on the side of the horizontal line, and parallel with respect to the direction of flow. On smaller lines the bulb may be mounted at any point around the circumference, however, locating the bulb on the bottom of the line is not recommended as an oil-refrigerant mixture is generally present at that point. Certain conditions peculiar to a particular system may require a different bulb location than normally recommended. In these cases the proper bulb location may be determined by trial.

For satisfactory expansion valve control, ***good thermal***

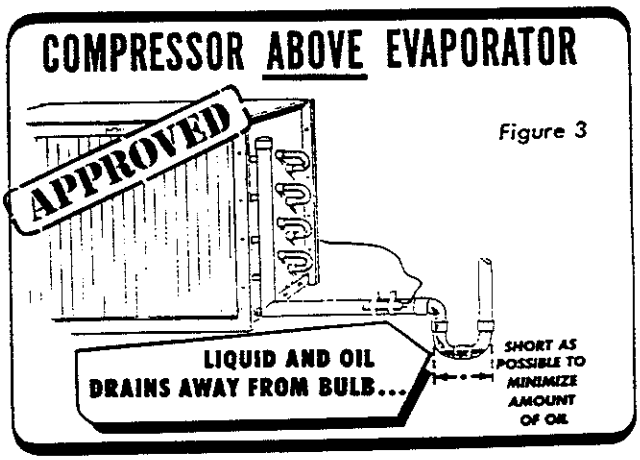


Figure 3

contact between the bulb and suction line is essential. The bulb should be securely fastened with two bulb straps to a clean, straight section of the suction line.

Recommended suction line piping usually includes a horizontal line leaving the evaporator to which the thermostatic expansion valve bulb is attached. This line is pitched slightly downward, and when a vertical riser follows, a short trap is placed immediately ahead of the vertical line, see Figure-3. The trap will collect any liquid refrigerant or oil passing through the suction line and prevent it from influencing the bulb temperature.

On multiple evaporator installations the piping should be arranged so that the flow from any valve cannot affect the bulb of another. Approved piping practices including the proper use of traps insures individual control for each valve without the influence of refrigerant and oil flow from other evaporators.

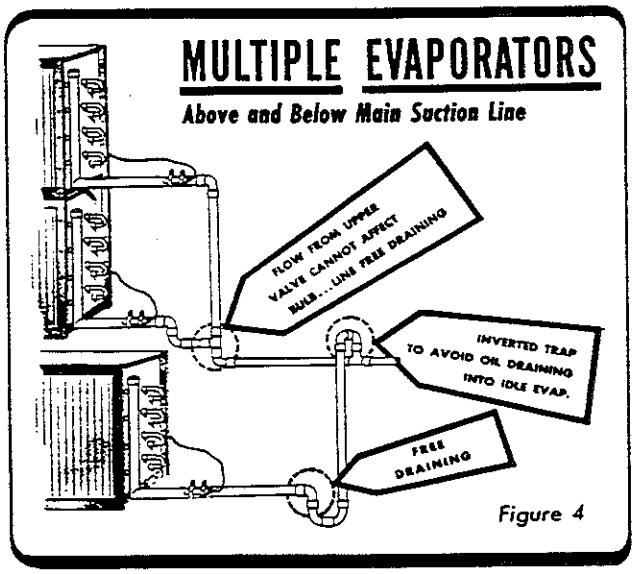


Figure 4

For recommended suction line piping when the compressor is located below the evaporator see Figure-5. The vertical riser extending to the height of the evaporator prevents refrigerant from draining by gravity into the compressor during the off-cycle. When a pumpdown control is used, the suction line may turn immediately down without a trap.

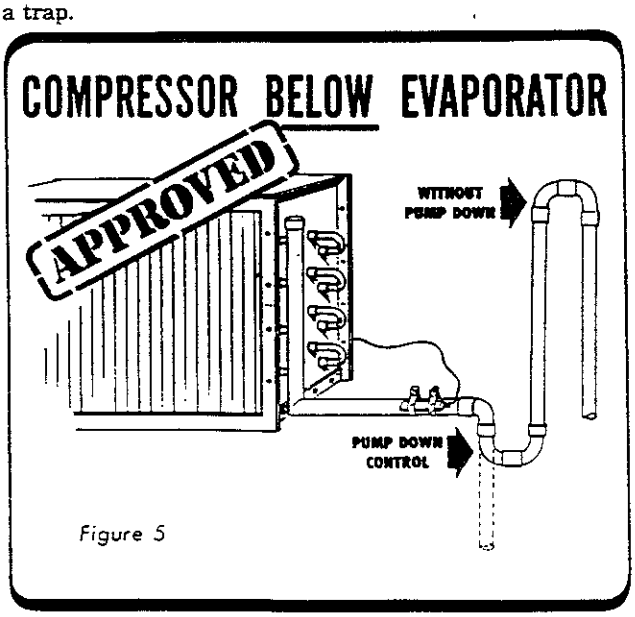


Figure 5

On Commercial and Low Temperature Applications requiring Sporlan Selective Charges C, Z, or X the bulb should be clamped on the suction line at a point where the bulb temperature will be the same as the evaporator temperature during the off-cycle. This will insure tight closing of the valve when the compressor stops. If bulb insulation is used on lines operating below 32°F., use non-water absorbing insulation to prevent water from freezing around the bulb.

On brine tanks and water coolers, the bulb should be below the liquid surface where it will be at the same temperature as the evaporator during the off-cycle. When locating the bulb in a brine tank, paint it and the capillary tubing with pitch or other corrosion resistant paint.

If, for practical reasons, the bulb must be located where its temperature will be higher than the evaporator during the off-cycle, a solenoid valve must be used ahead of the thermostatic expansion valve.

On Air Conditioning Applications having thermostatic expansion valves equipped with Flow-Master Types P, VGA or G charged elements, the bulb may be located inside or outside the cooled space or duct. The valve body should not be located in the air stream leaving the evaporator. Avoid locating the bulb in the return air stream unless it is well insulated.

D. EXTERNAL EQUALIZER CONNECTION

For a complete explanation of when an externally equalized valve should be used refer to Pages 7 to 9, Bulletin 10-10, or Pages 5 to 7, Form 10-56. Valves supplied with an external equalizer ***will not operate*** unless this connection is made.

The equalizer connection should be made at a point that will most accurately reflect the pressure existing in the suction line at the bulb location. See Figure 6. Generally, the connection is immediately downstream of the bulb. However, equipment manufacturers sometimes locate them in return bends or suction headers that are compatible with their specific design requirements. The difference between the pressure at the equalizer connection and the suction pressure at the bulb location should not exceed reasonable pressure drop values. The values shown in Table 1 on page 9 of Bulletin 10-10, or page 7 of Form 10-56 can be used as a guide in determining the value.

If any evaporator pressure or temperature control valves are located in the suction line at or near the evaporator outlet, the equalizer must be connected on the evaporator side of these valves.

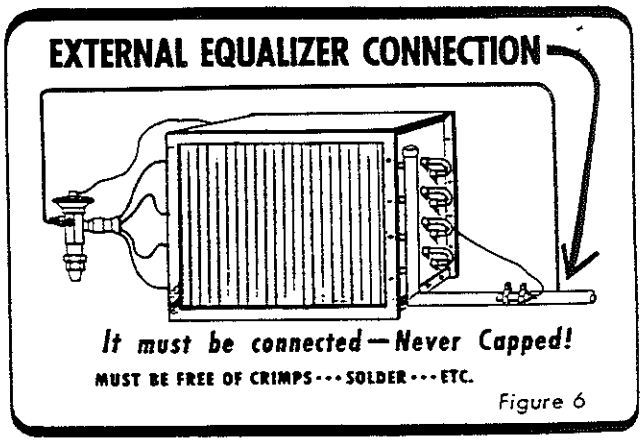


Figure 6

E. DRIERS, STRAINERS, and ACCESSORIES

Most Sporlan thermostatic expansion valves are equipped with built-in inlet screens of varying mesh sizes depending on the valve size and type. These strainers are effective only in removing particles of scale, solder, etc. which could obstruct the closure of the pin and seat.

Moisture and smaller particles of foreign material are equally harmful to the system and must be removed for peak system performance. Field experience has proven, without a doubt, that most expansion valve failures are due to the presence of dirt, sludge, and moisture in the system. Furthermore, the performance and life of other system components are also seriously affected by these foreign materials. The Sporlan **Catch-All Filter-Drier** removes dirt, moisture, acids, and sludges, and insures the circulation of clean, dry refrigerant through the system at all times.

For all refrigeration and air conditioning applications we recommend that a Sporlan Catch-All Filter-Drier be installed in the liquid line ahead of the thermostatic expansion valve. See Bulletin 40-10 for complete Catch-All specifications.

Further system protection is easily and inexpensively provided with the installation of a Sporlan ***See•All***. The See•All is a combination liquid and moisture indicator that visually indicates if there is a shortage of refrigerant in the liquid line, or if the moisture content of the refrigerant is at a dangerous level. See Bulletin 70-10 for complete See•All specifications.

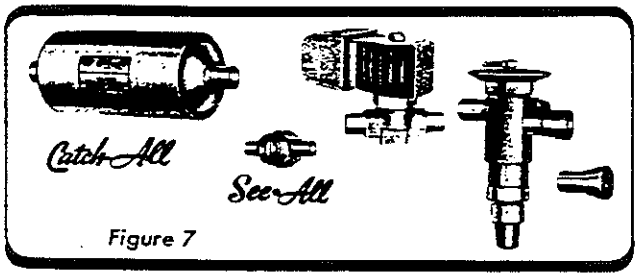


Figure 7

F. TEST PRESSURES and DEHYDRATION TEMPERATURES

For better leak detection an inert ***dry*** gas such as nitrogen or CO_2 may be added to an idle system to supplement the refrigerant pressure.

CAUTION: Inert gases must be added to the system carefully through a pressure regulator. Unregulated gas pressure can seriously damage the system and endanger human life. Never use oxygen or explosive gases.

Excessive low side pressures can shorten the life of the thermostatic expansion valve diaphragm. Table-7 lists the maximum low side test pressure that can safely be applied with the expansion valve connected to the evaporator. These maximum pressures are well above the minimum field leak test pressures for low sides, listed by the ANSI/ASHRAE Standard 15-1978.

Table-7 refers to the maximum low side test pressures which are in contact with the underside of the valve diaphragm. Since only the valve inlet fitting and passages (not the valve diaphragm) are subjected to high side pressures, the valve will withstand any reasonable ***HIGH SIDE TEST PRESSURES*** in excess of the values listed in the ANSI/ASHRAE Standard. The external equalizer line should be disconnected if there is any possibility of exceeding the recommended maximum pressures listed below.

TABLE 7
MAXIMUM LOW SIDE TEST PRESSURES

VALVE TYPE	psig
I, X, Z, NI, F, BF/EBF, G, C, S, BS/EBS, Small 0	450
D, P, H, Large 0, & U	425
A, M, V, & W	400

If elevated temperatures are used to assist in dehydrating the system, the thermostatic expansion valve should not be exposed to temperatures exceeding those shown in Table-8.

TABLE 8
MAXIMUM DEHYDRATION TEMPERATURES
DEGREES F

REFRIGERANT	THERMOSTATIC CHARGE						
	G and VGA	L	C	Z	X	P Air Conditioning Charge	ZP
12	250	195	190	250	210	250	250
22		**	160	185			
500		**	185	235			
502		**150	150	170			
717 (Ammonia)	†	150	190	235	†	†	†

**Not Available in No. 33 or 63 elements. †Not Available.

Table-8 refers to the maximum dehydration temperatures when the bulb and valve body are subjected to the same temperature. On L, C, Z, and X charges, 250°F. maximum valve body temperature is permissible ***IF THE BULB TEMPERATURE*** does not exceed those shown in the table.

G. EXPANSION VALVE ADJUSTMENT

Each Sporlan Thermostatic Expansion Valve is thoroughly tested and set at the factory before shipment. This factory superheat setting will be correct and no further adjustment is required for the majority of the applications. However, there are many factors which can affect the performance of a thermostatic expansion valve. These factors are independently variable and all of them cannot be compensated for in the design of a valve. When the application or operating conditions require a different valve setting due to one or more of the factors listed below, the valve may be adjusted to obtain the required operating superheat. Therefore, an adjusting stem is provided on all standard valves. The valve should be set with the system as near as possible to design conditions.

Factors which affect valve performance and may make it necessary to adjust the valve are:

1. Low temperature differences (TDs) between the refrigerant and the air
2. TEV bulb location
3. Balance between compressor and evaporator
4. Ratio of load to TEV capacity
5. Condenser capacity
6. Operation of several fixtures on multiple installation
7. Seasonal variation in head pressure caused by extreme changes in ambient air temperature.

NOTE: Valve types, F, BF, EBF, A, M, V, and W have non-rising adjusting stems and a change in adjustment does not change the stem position.

When setting valves on multi-evaporator refrigeration systems with pressure or temperature sensitive evaporator control valves, the following procedure is recommended:

1. Evaporator Pressure Regulating Valve (ORI Type): the ORI valve is set first at the minimum load condition. Then the expansion valve is adjusted, if necessary, to the desired superheat setting while under the normal operating load condition.

2. Temperature Sensitive Evaporator Regulating Valve (CDA Type): the CDA valve is forced into a fully open position first. Then the expansion valve is adjusted to the desired superheat setting at full load condition. Finally, the CDA is set to the desired air temperature. Contact Sporlan Valve Company or the case manufacturer for additional details on setting the CDA.

When the adjustment is completed on the TEV, always tighten the adjusting stem packing nut and replace the seal cap tightly.

Some expansion valves are made ***non-adjustable*** for use on Original Equipment Manufacturers' units. These valves are set at a superheat predetermined by the manufacturers' laboratory tests and cannot be adjusted in the field.

Most ***non-adjustable*** models are modifications of standard adjustable type valves. This is done by using a solid bottom cap instead of one equipped with an adjusting stem and seal cap. These valves can be identified by an **N** preceding the standard valve designation. Adjustable bottom cap assemblies are available for converting most non-adjustable valves to the adjustable type. However, this is rarely required. If symptoms indicate that a valve adjustment is needed, carefully check the other possible causes of incorrect superheat, Pages 6 to 10, before attempting an adjustment.

HOW TO DETERMINE SUPERHEAT CORRECTLY

1. Measure the temperature of the suction line at the point the bulb is clamped.
2. Obtain the suction pressure that exists in the suction line at the bulb location by either of the following methods:
   - **a.** If the valve is externally equalized, a gauge in the external equalizer line will indicate the desired pressure directly and accurately.

   OR

   - **b.** Read the gauge pressure at the suction valve of the compressor. To the pressure add the estimated pressure drop through the suction line between bulb location and compressor suction valve. The sum of the gauge reading and the estimated pressure drop will equal the approximate suction line pressure at the bulb.
3. Convert the pressure obtained in **2a** or **2b** above to saturated evaporator temperature by using a temperature-pressure chart.
4. Subtract the two temperatures obtained in **1** and **3** —the difference is superheat.

Figure-8 illustrates a typical example of superheat measurement on an air conditioning system using Refrigerant-22. The temperature of the suction line at the bulb location is read at 52°F. The suction pressure at the compressor is 66 psig and the estimated suction line pressure drop is 2 psi . . . 66 psig + 2 psig = 68 psig at the bulb, which is equivalent to a 40°F. saturation temperature. 40°F. subtracted from 52°F. = 12°F. superheat.

NOTE: Refrigerated case manufacturers frequently use a "temperature difference" method to approximate superheat. This procedure consists of measuring the temperature of a location on the evaporator which is representative of saturated vapor temperature; and, then subtracting that temperature from the outlet evaporator temperature which is measured at the bulb location.

While this method of reading "superheat" is acceptable on those manufacturer's cases where the pressure drop through the evaporator is low, Sporlan does not recommend the "temperature difference" method for other types of systems.

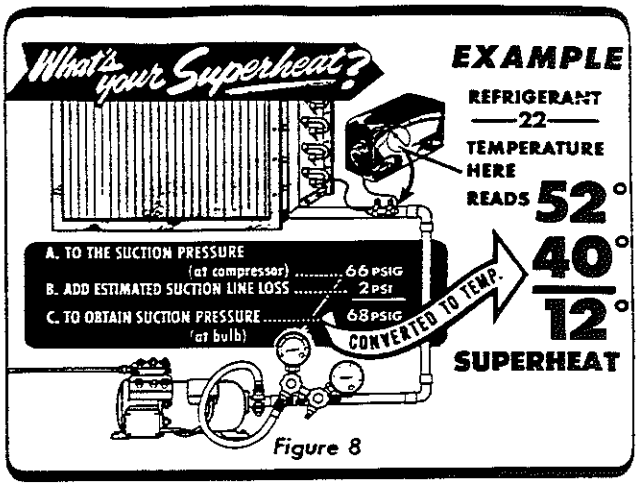


Figure 8

HOW TO CHANGE THE SUPERHEAT SETTING

To reduce the superheat, turn the adjusting stem **COUNTER-CLOCKWISE.** To increase the superheat, turn the adjusting stem **CLOCKWISE.** When adjusting the valve, make no more than one turn of the stem at a time and observe the change in superheat closely to prevent ***over-shooting*** the desired setting. As much as 30 minutes may be required for the new balance to take place after an adjustment is made.

If in doubt about the correct superheat setting for a particular system, consult the equipment manufacturer. As a general rule, the proper superheat setting will depend on the amount of temperature difference (TD) between refrigerant temperature and the temperature of the air or other substance being cooled. Where high TD's exit, such as on air conditioning applications, the superheat setting can be made as high as 15°F. without noticeable loss in evaporator capacity. Where low TD's exist, such as in low temperature blower coil applications, a superheat setting of 10°F. or below is usually recommended for maximum evaporator capacity. It is these applications that the TEV will more than likely need to be adjusted.

For the correct valve setting on factory built equipment, manufacturers' recommendations should be followed. Some manufacturers specify the superheat directly; others may recommend valve adjustment to a given suction pressure at certain operating conditions, or until a certain frost line is observed. Such recommendations, however they are stated, represent the results of extensive laboratory testing to determine the best possible operation.

FIELD SERVICING

The thermostatic expansion valve is erroneously considered by some to be a mysterious and complex device. As a result, many valves are needlessly replaced when the cause of the system malfunction is not immediately recognized.

Actually the thermostatic expansion valve performs only one very simple function — **it keeps the evaporator supplied with enough refrigerant to satisfy all load conditions.** It is not a temperature control, suction pressure control, a control to vary the compressor's running time or a humidity control.

How effective the valve performs is easily determined by measuring the superheat as outlined in Figure-8. Observing the frost on the suction line, or considering only the suction pressure may be misleading. **Checking the superheat is the first step in a simple and systematic analysis of thermostatic expansion valve performance.**

- **If not enough refrigerant is being fed to the evaporator—the superheat will be high.**
- **If too much refrigerant is being fed to the evaporator—the superheat will be low.**

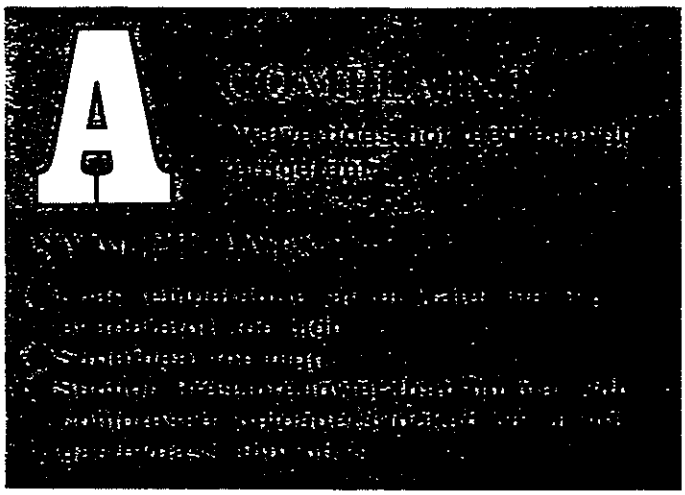
Although these symptoms may be attributed to improper thermostatic expansion valve control, more frequently the origin of the trouble lies elsewhere.

NOTE: Thermostatic expansion valves with permanent bleed ports **(BP)** or Rapid Pressure Balancer **(RPB)** construction are applied on many air conditioning and refrigeration systems by original equipment manufacturers. Each application is tested and approved by the manufacturer. The primary function of these devices is to equalize high-to-low side pressures during the off cycle to assist on start-up of low starting torque compressors.

However, some BP type valves are applied to allow small amounts of liquid refrigerant to pass for compressor motor cooling. The specific function of the feature on a given unit must be determined from the system manufacturer. Once that is determined, it is easier to trouble shoot the system.

The primary cause of difficulty with either the BP or RPB feature is dirt and other foreign materials that restrict or plug them. And if the system purpose intended for either feature is not being satisfied, the valve probably needs cleaning or replacing.

As stated in Bulletin 10-10, the RPB type valve is not to be applied on systems using high starting torque compressors or "hard-start" electrical components, on outdoor coils of heat pumps, or on any refrigeration system, and it should ***not*** be used to replace BP type valves that are applied on those types of systems. On systems other than those described above, the RPB type valve can replace the BP type valve when necessary. Usually it is advisable to replace a valve with one of the same specification unless advised differently. Consult with the system manufacturer for assistance.



THE CAUSE MAY BE:

1. **MOISTURE** — Water or a mixture of water and oil frozen in the valve port or working parts of the valve will prevent proper operation.

   This is a common source of trouble on expansion valves. Since the valve is the first cold spot in the system, moisture will freeze and block the valve open, closed, or any position in between. If the valve is frozen in the intermediate position so that flow is restricted, the superheat will be high.

REMEDY — Install a Sporlan Catch-All Filter-Drier in the liquid line for removal of moisture from the refrigerant and oil. See Bulletin 40-10.

To determine a safe level of moisture in the system, install a Sporlan See•All Moisture and Liquid Indicator. See Bulletin 70-10.

Excessive moisture has a damaging effect on all system components regardless of the evaporating temperature. It must be removed for trouble-free performance.

2. **DIRT or FOREIGN MATERIAL** — Contaminants such as copper oxide scale, metal chips, oil breakdown sludge, etc. will restrict the flow of refrigerant when it collects in strainers or other liquid line accessories. This produces a shortage of refrigerant at the thermostatic expansion valve port. Conventional strainers frequently allow the material to pass through the screen and obstruct the flow at the valve port. If a See•All is installed downstream of the restriction, bubbles will be visible. This should not be confused, however, with a refrigerant shortage or excessive liquid line pressure loss which are also indicated by bubbles in the See•All.

REMEDY — Locate and remove the foreign material creating the restriction. Install a Sporlan Catch-All Filter-Drier to provide effective filtration of the refrigerant. See Bulletin 40-10.

3. **WAX** — Certain systems are contaminated with small amounts of wax which will precipitate at low temperatures in systems with Refrigerants 22 or 502. Since the thermostatic expansion valve represents the first cold point in the refrigeration cycle, wax is most likely to form at the valve port.

   It is sometimes difficult to observe the wax in a valve because it may exist in solid form only at very low temperatures. By the time the valve has been taken apart, the temperature has increased enough to cause the wax to melt and thus become difficult to detect. When wax is suspected, it can usually be detected on the pin and seat by packing the valve in dry ice while disassembling.

REMEDY — Clean the valve with solvent before reassembling the valve. The Sporlan HH style Catch-All Filter-Driers have a special activated charcoal desiccant that is designed to remove wax in the liquid line before it causes trouble. Therefore, use these HH style driers (e.g., C-415-S-HH) on all low temperature systems using Refrigerants 22 or 502 to prevent wax problems.

4. **REFRIGERANT SHORTAGE** — See•All or sight

★**When system has some form of capacity reduction — cylinder unloaders or hot gas bypass, a low suction pressure will not exist. Therefore, when checking TEV performance, a better analysis is possible when these devices are locked out or shut off so the suction pressure will respond to variations in load or valve feed.**

glass in the liquid line will show bubbles when the system is short of refrigerant charge. Before adding more refrigerant however, be sure the bubbles are not produced by other causes (See Paragraphs **A-2** and **A-5**).

A lack of refrigerant charge may also be detected by a hissing sound at the thermostatic expansion valve. Some systems not equipped with a liquid line sight glass will have test cocks or other devices for checking the refrigerant level in the receiver.

REMEDY — Add enough refrigerant to obtain desired result.

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5. **GAS IN THE LIQUID LINE** — As explained in Paragraphs **A-2** and **A-4** above liquid line vapor can be produced by a partially plugged strainer or drier and by a shortage of refrigerant charge. In addition, gas in the liquid line can be caused by air or other non-condensable gases in the system or by excessive pressure losses in the liquid line as a result of:

   a. Long or undersized line.

   b. Liquid line vertical lift.

REMEDY — Verify the correct liquid line size for the equivalent length and system tonnage. Consult liquid line sizing data published in many manufacturers' catalogs and in text books. If undersized, repipe with the correct size.

Determine amount of vertical lift, and obtain the resulting pressure loss from Table-2, Page 14, Bulletin 10-10, or Page 12, Form 10-56. From Table-6, Page 16, Bulletin 10-10, or Page 14, Form 10-56 find required subcooling necessary to prevent gasification with the existing pressure losses. Provide the necessary subcooling by using one of the methods described on Page 1.

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6. **MISAPPLICATION OF INTERNALLY EQUALIZED VALVE or INCORRECT LOCATION OF EXTERNAL EQUALIZER** — If the pressure drop through the evaporator exceeds the predetermined values shown in Table-1, Page 9, Bulletin 10-10, or Page 7, Form 10-56, an externally equalized valve must be used. When an externally equalized valve is used, the equalizer connection should be made at a point in the suction line that will reflect the pressure existing in the line at the bulb location.

REMEDY — Replace internally equalized valve with one having an external equalizer.

If external equalizer is installed incorrectly, change to correct location. See Page 3.

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7. **INSUFFICIENT PRESSURE DROP ACROSS VALVE** — One of the factors that influence expansion valve capacity is the pressure drop that exists between the inlet and outlet. Anything contributing to a reduction in this pressure drop will reduce valve capacity. Abnormally low condensing pressures, excessive liquid line pressure losses (even with adequate subcooling), undersized distributor nozzle or distributor tubes may also be responsible for a very low net pressure drop across the valve port.

REMEDY — Remove source of pressure loss, or install valve with adequate capacity at the reduced pressure drop. If inlet pressure to valve is low due to low condensing pressure, raise pressure.

If the refrigerant distributor nozzle is undersized replace with correct size. See Bulletin 20-10.

8. **DEAD THERMOSTATIC ELEMENT or WRONG THERMOSTATIC CHARGE** — If the element has partially or completely lost its thermostatic charge, the valve will be unable to feed sufficient refrigerant or will remain closed. A wrong charge may cause insufficient feed also.

REMEDY — Replace the element if it is dead. If charge is incorrect, replace with proper selective charge — See Pages 3 to 7, Bulletin 10-10; or Pages 1 to 5, Form 10-56.

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9. **CHARGE MIGRATION (TYPES P, VGA and G CHARGES ONLY)** — In order for valves with these charges to maintain control at the bulb, the bulb must be kept at a lower temperature than the element (diaphragm case). If the thermostatic charge does migrate to the element because of a lower element temperature, the valve will throttle.

DETECTION — Warm the element with a cloth saturated with hot water. If this produces more refrigerant feed and reduces the superheat to normal, charge migration is responsible for the starved evaporator.

— CAUSES —

   a. Insufficient pressure drop between the valve outlet and bulb location, possibly due to an oversized distributor nozzle or no nozzle at all.

   b. Excessive pushrod leakage, which allows the leaking refrigerant to cool the diaphragm case before passing into the equalizer line. This is a rare occurrence and should be carefully checked before arriving at this conclusion.

   c. Cold location of thermostatic expansion valve, or condensate drippage on the diaphragm case.

— REMEDIES —

a. Install distributor nozzle correctly sized in accordance with nozzle sizing procedure given in Sporlan Bulletin 20-10.

b. On valves with packed pushrod construction, remove element and tighten the pushrod packing nuts.

c. Relocate the thermostatic expansion valve away from cold outlet air, or condensate drippage.

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10. **UNDERSIZED VALVE**

REMEDY — Install valve sized in accordance with procedure given on Page 14, Bulletin 10-10, or Page 12, Form 10-56.

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11. **HIGH SUPERHEAT ADJUSTMENT**

REMEDY — Turn the adjusting stem counter clockwise until the correct superheat is indicated.

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12. **FEED-BACK FROM ANOTHER VALVE** — Review instructions for Bulb Location, Page 2.

REMEDY — Check the bulb temperature and calculate the superheat. If superheat is normal but too little refrigerant is flowing through the evaporator, check the piping for possible refrigerant flow from another evaporator affecting the bulb. Re-pipe if necessary. See Figure-4.

13. **HIGH PRESSURE DROP THROUGH EVAPORATOR**

REMEDY — Check the pressure at the evaporator inlet and outlet with gauges. If pressure difference is greater than the values shown in Table-1, Page 9, Bulletin 10-10, or Page 7, Form 10-56, use an externally equalized valve.

14. **RESTRICTED, PLUGGED, OR CAPPED EXTERNAL EQUALIZER** — If the pressure under the diaphragm builds up due to pushrod leakage and cannot escape through the external equalizer line, the valve will remain closed.

REMEDY — Check the external equalizer line to be sure it is open or not capped.

THE CAUSE MAY BE:

1. **MOISTURE** — Water or a mixture of water and oil frozen in the valve port or working parts of the valve will prevent proper operation. This is the most common source of trouble on thermostatic expansion valves. Since the valve is the first cold spot in the system, moisture will freeze and block the valve open, closed, or any position in between. If the valve is held in the open position by ice, liquid flood-back will occur.

REMEDY — Install a Sporlan Catch-All Filter-Drier in the liquid line for removal of moisture from the refrigerant and oil. See Bulletin 40-10.

For additional protection, install a Sporlan See•All Moisture and Liquid Indicator for a positive indication of when a safe moisture level is reached. See Bulletin 70-10.

2. **DIRT or FOREIGN MATERIAL** — Contaminants such as copper oxide scale, metal chips, oil breakdown sludge, etc. may pass through ordinary strainers and lodge at the thermostatic expansion valve port and prevent the valve from closing.

REMEDY — Disassemble the valve and remove all foreign material from the internal parts. Install a Sporlan Catch-All Filter-Drier in the liquid line. The Catch-All filters out the smallest particles of foreign material that might possibly interfere with the operation of any system component.

3. **EXPANSION VALVE SEAT LEAK** — When the valve port does not seat tightly, refrigerant will pass through during the off-cycle and fill the evaporator with refrigerant. If the seat leak is severe, the valve will feed too much refrigerant during the operating cycle as well. (Not applicable to valves with permanent bleed ports or RPB feature.)

REMEDY — If the valve seat is leaking, a gurgling or hissing sound can usually be heard during the off-cycle. Also, a sight glass or See•All in the liquid line may indicate continued refrigerant flow for a long period after the compressor has stopped. Make certain however, that the bubbles are not the result of ***back-flow*** through a vertical liquid line.

Disassemble the valve to be certain that dirt or foreign material is not responsible (see **B-2**). If the pin and seat are worn or damaged and an internal parts kit is available, replace the parts. When parts are not available, the valve must be replaced.

4. **OVERSIZED VALVE** — Check valve ratings considering all the factors which affect its capacity. See Page 14, Bulletin 10-10, or Page 12, Form 10-56.

REMEDY — Install correctly sized valve.

5. **INCORRECT BULB INSTALLATION** — The bulb should be securely fastened to a straight, clean, section of the suction line using two bulb straps for good thermal contact. Also, the temperature of the bulb should not be influenced by ambient temperature — an external heat source such as a steam pipe or heating coil.

REMEDY — Install bulb correctly. See Installation Instructions, Page 2.

6. **LOW SUPERHEAT ADJUSTMENT**

REMEDY — Turn the adjusting stem clockwise until the correct superheat is indicated. See Page 4.

7. **INCORRECT THERMOSTATIC CHARGE**

REMEDY — Select and install the correct selective charge. See Page 15, Bulletin 10-10, or Page 13, Form 10-56.

8. **INCORRECTLY LOCATED EXTERNAL EQUALIZER**

REMEDY — Relocate external equalizer or connection between evaporator and any temperature or pressure sensitive evaporator control valve near bulb location. See Page 3 for recommendations.

9. **INEFFICIENT COMPRESSOR** — If the compressor is inefficient or for some other reason lacks capacity, the suction pressure will operate higher than normal. This may or may not be accompanied by low superheats.

REMEDY — Consult with compressor manufacturer.

THE CAUSE MAY BE:

1. **REFRIGERANT DRAINAGE** — Drainage of refrigerant from the evaporator (during the off-cycle) when installed at a higher level than the compressor.

REMEDY — Install a trap-riser to top of evaporator or use pump-down control. See Figure-5.

2. **COMPRESSOR or SUCTION LINE IN COLD LOCATION** — During the period when the system is not in operation, liquid refrigerant will condense at the coldest point in the system. Liquid will condense in the compressor or suction line, if they are located in an ambient temperature below that of the evaporator during the off-cycle. Upon re-starting, this liquid will slug the compressor.

REMEDY — Keep compressor or suction line warm during the off-cycle. Some compressors are equipped with crankcase heaters for this purpose. Another corrective measure is to install a suction line solenoid valve that is de-energized during the off-cycle.

3. **RESTRICTED or PLUGGED EXTERNAL EQUALIZER** — A momentary flood can occur when the load increases suddenly, such as at start-up because the higher suction pressure cannot reach the underside of the diaphragm and help close the valve. If the pressure under the diaphragm increases due to any pressure leakage around the pushrods, the valve will eventually throttle.

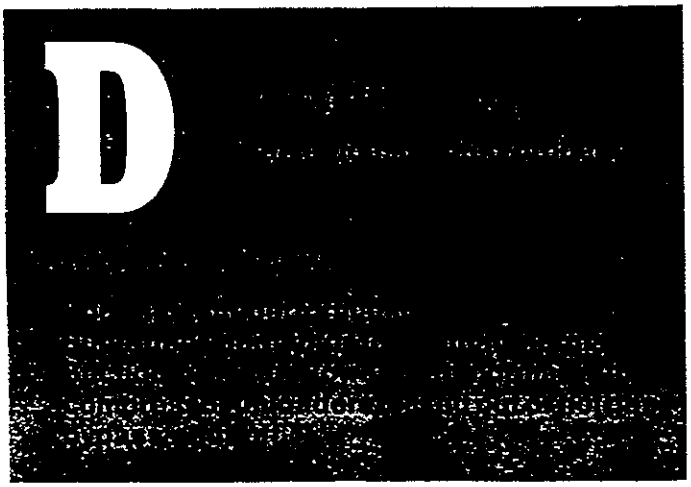
REMEDY — Remove the restriction or plugged portion of the external equalizer.

4. **LIQUID LINE SOLENOID VALVE SEAT LEAK or INTERRUPTED PUMPDOWN** — Liquid refrigerant can continue to feed the TEV and/or remain in evaporator upon shut-down causing flood-back to the compressor upon start-up.

REMEDY — Disassemble and clean solenoid valve and/or replace damaged internal parts if seat leakage is the problem. If the pumpdown cycle isn't completed before the compressor cycles off, or the thermostat calls for cooling and reopens the liquid line solenoid before the evaporator has been properly evacuated, check the low pressure cut-off setting or the electrical controls for possible causes.

5. **ANY ONE or MORE OF THE CAUSES SHOWN in SECTION B on PAGE 8.**

REMEDY — See Section **B**, Page 8.



THE CAUSE MAY BE:

1. **UNEQUAL CIRCUIT LOADING (Multi-circuit evaporators and parallel evaporators connected to a single refrigerant distributor)** — When each circuit is not subjected to the same heat load, the lightly loaded circuits will allow unevaporated refrigerant or low temperature vapor to enter the suction line and throttle the valve. This will cause normally loaded circuits to be deprived of their share of refrigerant. The net result is a loss of refrigerated evaporator surface.

REMEDY — Make necessary modifications which will allow each evaporator circuit to receive the same percentage of the total load. See Bulletin 20-10 for application information on multi-circuit evaporators using a refrigerant distributor.

2. **POOR REFRIGERANT DISTRIBUTION (Multi-circuit evaporators and parallel evaporators connected to a single refrigerant distributor)** — If the refrigerant distribution is faulty, the circuits receiving the largest portion of refrigerant will have the controlling influence on the thermostatic expansion valve. The result is the same as in Paragraph 1 above.

REMEDY — Correct refrigerant distribution. See Bulletin 20-10 for complete information on Refrigerant Distributors.

3. **LOW LOAD** — Low evaporator load may be caused by insufficient air over the coil as a result of an undersized blower, dirty air filters, or an obstruction in the air stream. In addition, frost formation on the coil or low entering air temperatures will reduce the evaporator load.

REMEDY — Correct the condition responsible.

4. **FLOW FROM ONE COIL AFFECTING THERMOSTATIC EXPANSION VALVE BULB OF ANOTHER (Multiple evaporator systems only)** — The temperature of the bulb may be falsely influenced by flow from another evaporator usually because of incorrect piping.

REMEDY — Correct the piping. See Figure-4, Page 2.

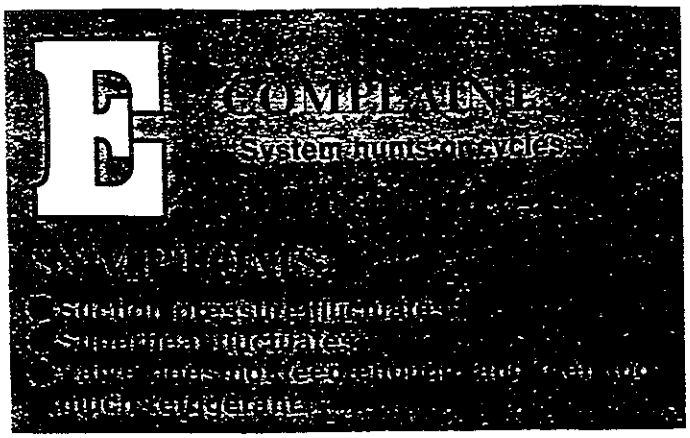
5. **IMPROPER COMPRESSOR-EVAPORATOR BALANCE** — If the compressor is too large for the load and evaporator capacity, the low suction pressure which results will cause poor system performance.

REMEDY — Consult with the manufacturer or consulting engineer, or the ASHRAE Equipment Handbook on component balancing. If necessary, change or correct the improperly sized component. Hot gas bypass may be used to balance properly.

6. **EVAPORATOR OIL-LOGGED** — Poor heat transfer occurs and unpredictable performance takes place. If erratic performance is observed over a period of time, and other causes are omitted from consideration, review the amount of oil in the system. Turbulent compressor oil level with little or no return to the compressor sump indicates oil problems.

REMEDY — Remove excessive oil from evaporator and connecting piping. Many times the evaporator temperature will be too low for the oil to be removed. Therefore, the system must be allowed to warm sufficiently to get cold oil to drain. Analyze system components for possible causes of oil problem before restarting the system. Consult with the compressor manufacturer for specific details on their compressor.

★**When system has some form of capacity reduction — cylinder unloaders or hot gas bypass, a low suction pressure will not exist. Therefore, when checking TEV performance, a better analysis is possible when these devices are locked out or shut off so the suction pressure will respond to variations in load or valve feed.**



THE CAUSE MAY BE:

1. **SYSTEM CHARACTERISTICS** — Certain design characteristics of the system may have an effect on the system's tendency to hunt or cycle. As an example, after the valve admits refrigerant to the evaporator inlet, there is a time delay before the bulb senses the effect at the evaporator outlet. This time delay is dependent on evaporator length, tube size, and load. Generally, there is more likelihood for hunting to occur when this time interval is long. Other influencing factors are circuit arrangement, load per circuit, and temperature difference.

REMEDY — When hunting is moderate particularly with no floodback, the effect on the system is insignificant and corrections are not necessary. If hunting is severe with floodback to the compressor, check the possible remedies shown in Paragraphs below.

2. **VALVE SIZE** — An over-sized valve usually aggravates hunting. Carefully check the valve rating considering all the factors affecting its capacity. See Page 14, Bulletin 10-10, or Page 12, Form 10-56.

REMEDY — Replace valve with one correctly sized. On multiple circuit evaporators using a refrigerant distributor, the capacity of the valve can be reduced, within certain limits, by installing a smaller distributor nozzle. See Bulletin 20-10.

3. **BULB LOCATION** — If the bulb is located in a suction line trap, its temperature will be affected by liquid oil and refrigerant alternately collecting and evaporating at this point. This condition frequently results in severe hunting.

REMEDY — As a temporary measure relocate the bulb away from the trap, and any turbulent areas created by elbows, tees, etc. Also remove the bulb from the air stream or insulate. Re-pipe if necessary. Sometimes another position around the circumference of the suction line will minimize hunting.

Follow the Bulb Installation Instructions given on Page 2 for the best thermostatic expansion valve control.

4. **REFRIGERANT and LOAD DISTRIBUTION** — In addition to the effects of poor distribution explained in Paragraphs **D-1** and **D-2**, hunting also frequently results. This is caused by liquid refrigerant from the overfed circuits occasionally reaching the bulb of the valve.

REMEDY — Correct the faulty distribution.

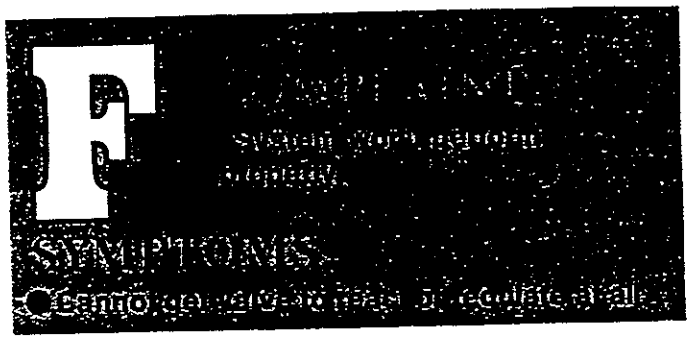
5. **SUPERHEAT ADJUSTMENT** — All Sporlan thermostatic expansion valves are preset at the factory to give the best performance on the average system. A valve should not be adjusted unnecessarily, but occasionally another setting may prove to be better.

REMEDY — Turn the adjusting stem clockwise a turn at a time. If the hunting stops or is reduced, turn the adjusting stem counter clockwise a turn at a time to obtain the lowest superheat with stable operation.

6. **MOISTURE** — As ice forms in a thermostatic expansion valve from excessive moisture, a very erratic hunt may result.

REMEDY — Remove the moisture with the installation of a Sporlan Catch-All Filter-Drier. A safe moisture level can be determined by installing a Sporlan See•All.

★ **When system has some form of capacity reduction — cylinder unloaders or hot gas bypass, a low suction pressure will not exist. Therefore, when checking TEV performance, a better analysis is possible when these devices are locked out or shut off so the suction pressure will respond to variations in load or valve feed.**



THE CAUSE MAY BE:

1. **No refrigerant being fed to evaporator.** See Section **A** on Pages 6 & 7.
2. **Too much refrigerant being fed to evaporator.** See section **B** on Page 8.
3. **Too much refrigerant being fed to evaporator at start-up only.** See Section **C** on Page 9.
4. **Refrigerant control is erratic.** See Section **D** on Page 9.
5. **System is hunting or cycling.** See Section **E** above.
6. **The thermostatic expansion valve has been physically abused in an effort to make the valve work properly.** This is usually the result of a mistaken analysis. It is frequently assumed that if a valve does not feed properly, it is stuck (either opened or closed). Beating the valve body with a hammer will only distort the body and make it impossible for the valve to work once the real cause is determined.

   If a valve "sticks," it is usually due to moisture freezing in the port, dirt and other foreign material restricting or plugging the internal parts, wax forming on the internal parts at low temperatures, or the valve has been physically abused so it **cannot** function.

REMEDY — Inspect the valve and its internal parts, including the inlet strainer. If plugged or restricted in any way, clean the parts thoroughly, oil the parts with a good grade of refrigerant oil, and reassemble the parts. Complete details on this subject are found on Pages 11 and 12.

If the valve is beyond normal cleaning processes, or if it is physically damaged in any way, replace the valve with its proper replacement model.

FIELD ASSEMBLY INSTRUCTIONS

Sporlan Valves may be opened easily for inspection

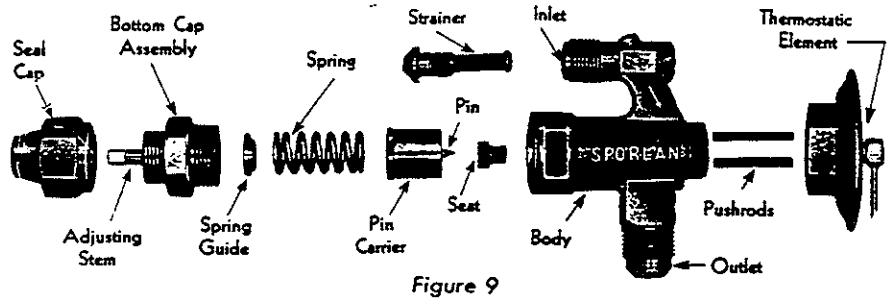


Figure 9

NOTE: These field Assembly Instructions apply in part to all Sporlan TEV's. See Figure-9 for an "exploded" view of those models that can be completely disassembled. When a thermostatic expansion valve is to be disassembled for inspection and cleaning, or for replacement of the thermostatic element or the internal parts, the following information should be reviewed for assistance.

Types F dated approximately C84 or earlier, I, BI, NI, and FB **do not** have replaceable elements nor internal parts kits, but can be disassembled for inspection and cleaning. Type F (internally & externally equalized) dated D84 or later, Type S valves dated B69 or later, Type C valves dated C70 or later, and ALL Type G, X, BF/EBF and BS/EBS valves have packless pushrod construction (externally equalized only) and internal parts are NOT available for use with them. However, their elements can be replaced and they can be disassembled for inspection and cleaning. Due to the single pushrod construction of the Type BF/EBF and BS/EBS valves, only the bottom cap assembly, pin guide, and superheat spring may be removed for inspection and cleaning. Early production of the Type F valve with the replaceable element requires a 15/16" **thin jaw,** open end type element wrench such as a Bonney 1230. Subsequent production of the Type F valve and all Type BF valves require a 1" **thin jaw,** open end type element wrench such as a Bonney 1232. An open end wrench is necessary because of limited space between the body and element of Types F and BF valves. Precautions must be taken in removing the KT-43 element (F) so the element, body, or connections are not damaged by the wrenches.

While standard open end or adjustable wrenches fit the other element sizes, the **thin jaw** type wrenches are also available for the other element sizes: Bonney 1236 (1-1/8") for KT-53 elements, Bonney 1240 (1-1/4") for KT-83 elements, Bonney 1248 for KT-33 elements, and Bonney 1252 for KT-63 & 7 elements.

Replaceable elements and internal parts kits are available for current valves with ***packed*** pushrod construction: Types P, H, M, D, and A.

Replaceable elements for Types O, V, W, and U are also available. However, special field assembly instructions are included with their internal parts kits.

ASSEMBLING INSTRUCTIONS

The following steps are necessary in properly disassembling, inspecting, cleaning, and reassembling a TEV whether the valve is in or out of the refrigerant piping.

1. Before disassembling the valve, be sure the refrigerant pressure in the system has been reduced to a safe level (0 psig).
2. Remove the seal cap and turn the adjustment stem counter-clockwise to relieve the spring force. Count and record the number of turns so adjustment can be returned to its original position.
3. Using appropriate wrenches or a vise to properly support the valve body, remove the element (if a replaceable type), the bottom cap assembly, and the internal parts. (Only remove the bottom cap, pin guide, and superheat spring on Type BF/EBF and BS/EBS valves. **DO NOT** remove the single pushrod from these valves.)

   CAUTION: Regardless of whether the valve is in the system or in a vise, care must be taken to prevent distorting the body by exerting too much pressure in tightening the element or in clamping the body in the vise. Also, do not use a wrench on the outer welded edge of the element.
4. Inspect parts, element, and body for any foreign materials or physical damage.
5. On valves with replaceable elements and/or internal parts, replace any items that appear damaged.
6. Clean all parts with solvent, preferably by applying and then blowing off with clean dry compressed air.

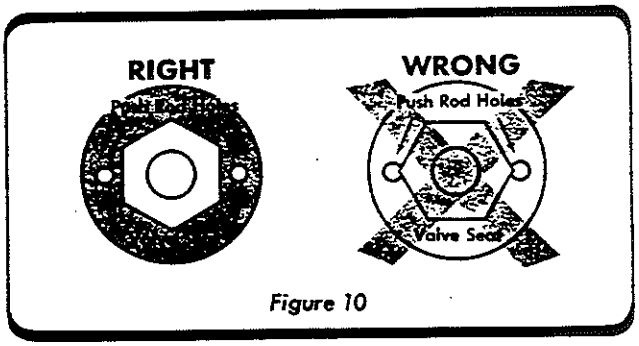


Figure 10

7. To reassemble valves with replaceable seats, screw seat into body with a fairly light pressure since it does not require a heavy pressure to make this small knife-edge joint.

   CAUTION: Be sure hexagon corners of seat do not protrude into pushrod holes (see Figure-10).

   For valves that do not have replaceable elements or for Type O valves, place the pushrod(s) into the body now.
8. Next, slip the pin and carrier (which have been pressed together at the factory) into the body and tap the pin into the seat to form a true seating surface. It is generally advisable, before tapping these parts together, to check the concentricity of both the pin and seat by engaging the parts by pressing them lightly together with one finger and noting that there is no tendency to stick together. This should be repeated several times after rotating the pin carrier a quarter of a turn. In assembling valves with port sizes of ¼" and larger which use the flat disc instead of the tapered pin, **DO NOT TAP THE DISC AGAINST THE SEAT.**

9. Now place the spring guide stamping (when used), and spring, in the pin carrier, place the lower spring guide on the opposite end of the spring and screw the bottom cap in place. (Replace the pin guide, spring, and bottom cap assembly together on Type BF/EBF and BS/EBS valves). After screwing bottom cap assembly in place, carefully tighten, preferably with two 10" wrenches, to seal the metal-to-metal knife edge joint. The sealing surfaces should be free of any foreign material or nicks that might prevent a leak-tight joint.

10. On valves with replaceable elements (except Types O, BF/EBF, and BS/EBS), place the pushrods into the body and open the valve several times by pressing down on the pins with a flat metal surface. This will help seat the pin properly.

11. Check the height of the pushrod(s) above the element sealing surface with the pushrod gauge (see Figure 12). The gauge is supplied with internal parts kits or can be obtained at no charge upon request. (Since the internal parts of the Type BF/EBF and BS/EBS valves cannot be replaced, it is not necessary to check the pushrod height of these valves.)

Illustration Showing Use of Gauge

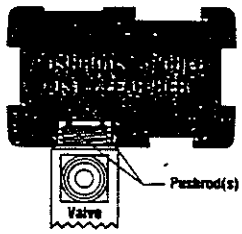


Figure 12

The appropriate gauge numbers for the various TEV's are given in Table 9.

CAUTION: If the element-to-body joint utilizes a gasket, the gasket must be removed before checking pushrod height.

If the pushrod(s) are too long, they must be carefully ground off to the proper length. Clean the pushrod(s) of all dirt and grindings and place them into the body.

12. **ELEMENT REPLACEMENT** — If the element is damaged or has lost its thermostatic charge, replace it with the same type.

To properly replace the element without damaging the element or the valve body on valves which utilize a gasketed joint, be sure only one gasket is used before assembling the element. In assembling gasketed elements held in place by two cap screws, be sure to pull up the cap screws evenly.

On valves which utilize the threaded type of element with metal-to-metal knife edge joints, always use an appropriate wrench (10") on the wrench flats. **DO NOT** use a wrench on the outer welded edge of the element. The sealing surfaces should be free of any foreign materials or nicks that might prevent a leak-tight joint. A few drops of refrigerant oil on the element threads will facilitate easy assembling and removal.

13. Return the superheat spring adjustment to its original position. Replace the seal cap tightly.

TABLE 9

VALVE TYPE①		USE GAUGE NO.
CURRENT	OBSOLETE	
AA(E), LMC-AA(E)	—	1
DA(E), LMC-DA(E)	—	2
PFE or HFE-1½, 3, 4, 5, 8, 12	PFE or HFE-6, 7½, 10, 11	3
PVE or HVE-2½, 5½, 7, 11, 16, 20	PVE or HVE-2, 5, 8, 10, 12, 15, 17, 18	
PDE or HDE-5, 8, 14	PDE or HDE-6, 7½, 9, 12, 13	
PRE or HRE-1½, 4 6½, 9, 12	PRE or HRE-6, 7½, 11, 13	
—	UFE-12, 17	
	UVE-22, 30	
	UDE-15, 21	
	URE-16, 22	
OFE-23, 32, 40	UFE-23	3A
OVE-40, 55, 70	UVE-40	
ODE-28, 40, 50	UDE-28	
ORE-30, 35, 45	URE-30	
All F Models② except FF(E)-1/8, FV(E)-1/4, FD(E)-1/8, FR(E)-1/8	—	4
All G Models except GF(E)-¼, GV(E)-¼, GR(E)-⅛	All Small K Models	5
All X Models	—	
MFE-5, 7½, 11, 13, 15, 20	MFE-12, 17	6
MVE-8, 12, 18, 21, 26, 34	MVE-30	
MDE-6, 9, 13, 15, 18, 25	MDE-14, 20	
MRE-9, 15, 20, 25	—	
KFE or VFE-45, KVE or VVE-70		
KDE or VDE-55, KRE or VRE-50		
MFE-25	MFE-22	7
MVE-42	MVE-40	
MDE-30	MDE-26	
MRE-30	—	
KFE or VFE-35, 55	VFE-50	
KVE or VVE-52, 100	VVE-90	
KDE or VDE-40, 65	VDE-42, 60	
KRE or VRE-38, 70	—	
WFE-80, 110	WFE-75, 100	
WVE-135, 180	—	
WDE-95, 130	WDE-90, 120	
WRE-100, 130	—	
CF(E) or SF(E)-¼, ½ 1, 1½, 2, 2½, 3	R and T Models with 83 Elements	8
CV(E) or SV(E)-½, 1, 1½, 2, 3, 4, 5		
CD(E) or SD(E)-¼, ½ 1, 1½, 2½, 3, 3½		
CR(E) or SR(E)-¼, ½, 1, 1½, 2, 3, 4		
CFE-5, SFE-5, 6	—	8A
CVE-8, SVE-8, 10		
CDE-6, SDE-6, 7		
CRE-6, SRE-6, 7		
OFE-6, 9, 12		
OVE-10, 15, 20		
ODE-7, 11, 14		
ORE-6, 9, 12		
OFE-16, OVE-30 ODE-20, ORE-21③	—	8B

① Type F (internally and externally equalized) valves dated D84 or later Type S valves dated B69 or later, Type C valves dated C70 or later, and all Type G (externally equalized only) and X valves have packless pushrod construction and internal parts kits are not available for use with them.

② Applies only to Type F valves with a replaceable element.

③ Formerly used the KT-33-8 element and gauge number 33-8 (redesignated 8B). The KT-33-8 element has been replaced by the KT-83.

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Catalog Section P
Series P100
Bulletin No. 4917
Supersedes New

FAN 125

JOHNSON CONTROLS

Johnson Controls, Inc.
Control Products Division

507 East Michigan Street
P.O. Box 423
Milwaukee, WI 53201

Series P100
Encapsulated Pressure Control

Application

The P100 series are encapsulated, nonadjustable, single-pole, single-throw, direct mount pressure controls typically used for low and high pressure cutouts. Applications include:

—Computer Room Air Conditioning

—Commercial Refrigeration Fixtures

—Refrigeration/Air Conditioning Condensers

—Ice Machines

—Food Service Equipment

P100 series controls are available in both automatic and manual reset models. The automatic reset models are available in OPEN HIGH and OPEN LOW configurations. The manual reset controls are available in an OPEN HIGH configuration for high limit applications.

Certain P100 models are supplied as pressure limiting devices for use in refrigeration and air conditioning applications. Contact the Control Products Division, Johnson Controls, Inc. for specific models.

P100 models, other than those specified as pressure limiting devices, are designed for use only as operating controls. Where an operating control failure would result in personal injury and/or loss of property, it is the responsibility of the installer to add devices (safety, limit controls) that protect against, or systems (alarm, supervisory systems) that warn of control failure.

All installations should conform to local building codes.

Features

—Compact size and light weight allow for direct mounting.

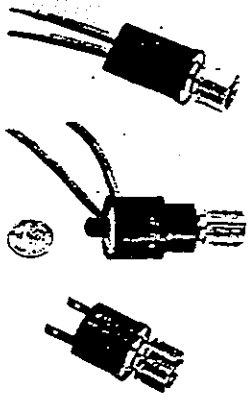


Fig. 1 — P100 Pressure Controls, automatic reset (top), manual reset (center) and automatic reset with 1/4" male quick-connects (bottom).

—Use with all non-corrosive refrigerants.

—¼" female flare fitting with built in Schrader type depressor is standard.

—UL File SA516, Guide SDFY2 and CSA File LR63963, Class 1222 01.

—Encapsulated switch, dust tight.

—Trip-free manual reset (manual reset models) . . . contacts cannot be overridden by continued depression of the reset button.

Specifications

Type Number	P100AA	Contacts Open Low
	P100AC	Contacts Open Low, Conduit Cover
	P100CA	Contacts Open High
	P100CC	Contacts Open High, Conduit Cover
	P100DA	Contacts Open High, Manual Reset
	P100DC	Contacts Open High, Manual Reset With Conduit Cover
Short Term Overpressure	20 to 100 PSIG (138 to 690 kPa)	250 PSIG (1724 kPa)
	100 to 500 PSIG (690 to 3448 kPa)	600 PSIG (4137 kPa)
Burst Pressure		3500 PSIG (24,133 kPa)
Design Life	Auto Reset	100,000 Cycles
	Manual Reset	6,000 Cycles
Temperature	Ambient	-20 to 150°F (-29 to 66°C)
	Refrigerant	-65 to 275°F (-54 to 135°C)
Vibration		15 G's Maximum
Range and Differential		See Presssure Range Table
Set Point Tolerances		From ±3 to ±25 PSI (±21 to ±172 kPa) See Pressure Range Table

General Description

Auto Reset Models

The preset, snap-acting disc utilized in the P100 reverses its shape when pressurized to the selected actuation pressure setting. When the disc snaps, it drives a set of electrical contacts open or closed. When the pressure falls to the deactuation pressure setting, the

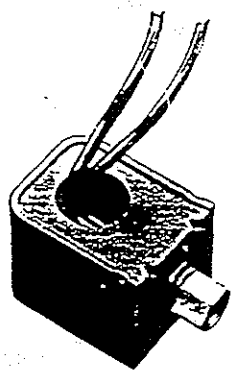


Fig. 2 — P100 Pressure Control with conduit cover.

snap-acting disc and electrical contacts reset to their preset positions.

Manual Reset Models

The manual reset control employs a snap-acting disc which opens the electrical contacts when actuated by the pressure sensor. Due to the formation of the disc, the contacts are held open until closed by an external force from the push button. Because of its link with the pressure, the disc will not reset the contacts until the system pressure has fallen to a predetermined level.

The latching mechanism in the P100 provides electrical cutout even if the reset button is held fully depressed. This trip free design allows restarting the compressor only when the line pressure returns to a predetermined level.

Optional Constructions

Pressure Connections

Standard ¼" SAE female flare fitting with internal depressor. Also available on quantity orders:

Male Fittings

¼" — 18 NPT male

⅛" — 27 NPT male

¼" SAE male flare

Female Fittings

⅛" — 27 NPT female

Braze Fittings

1 ½" Straight ¼" diameter tube

As above with ¼" SAE female flare nut

1 ½" nibbed tube

1 ¼" Straight ¼" diameter selective copper plated stainless steel tube with bulge stop.

Capillary Tube Fittings

12", 24" and 36" Straight .093" diameter tube

As above with ¼" bulbed end

As above with stop

Electrical Terminations

Standard 48" #18 AWG stranded and tinned copper with 600V 105°C PVC 1/16" insulation and ½" stripped ends. Available in 6", 12", 18", 24", 30", 36", 42", 48", 60" and 72" lengths with ½" stripped ends or ¼" female quick-connect flag terminals.

Also available without leads, ¼" male quick-connect terminals (auto reset models only).

Electrical Ratings

Motor Ratings	120 V	240 V
AC Full Load Amp	5.8	2.9
AC Locked Rotor Amp	34.8	15.0
28 VAC/DC, 2 Amp		
Pilot Duty—375 VA at 120/240/277 VAC		

Differential Selection on Auto Reset Models

Refer to the Pressure Range Chart below for minimum and maximum differentials.

1. Select the desired set point from column (A).
2. Note minimum allowable differential from column (B).
3. Calculate maximum differential; (column (C) X selected set point)
4. The differential must fall between values chosen for steps 2 and 3.

Example

A requirement exists for a pressure control to OPEN at 425 PSIG and CLOSE at 325 PSIG. From the chart:

Pressure Range Differentials and Tolerances

(A) Nominal Set Point PSIG / kPa	(B) Minimum Differential PSI / kPa	(C) Maximum Differential PSI / kPa	Minimum Tolerance* PSI / kPa
20 to 29 / 138 to 200	10 / 69	75%	±3 / ±21
30 to 80 / 207 to 552	15 / 103	70%	±5 / ±34
81 to 160 / 558 to 1103	30 / 207	65%	±5 / ±34
161 to 240 / 1110 to 1655	45 / 310	60%	±7 / ±48
241 to 350 / 1662 to 2413	60 / 414	55%	±10 / ±69
351 to 450 / 2420 to 3103	75 / 517	50%	±10 / ±69
451 to 500 / 3110 to 3448	90 / 621	50%	±15 / ±103

For Nominal Set Point settings less than 20 PSI (138 kPa) or greater than 500 PSI (3448 kPa) contact Application Engineering. The Minimum Tolerance applies to the Nominal Set Point pressure (e.g. 80 ± 5 PSI [552 ± 34 kPa]). The Maximum Differential is a percentage of Nominal Set Point.
*At room ambient temperature.

GENERAL INFORMATION

KOOLANT KOOLER AF/HAF,WX/HWX, and AV/HAV MODELS
HCW, HCR, HCO, HAW, HAR, HAO, HWV, HWW, HWR, HWO
SAV, SAW, SAR, SAO, SWV, SWW, SWR, SWO

Koolant Koolers are designed specifically to maintain the temperature of liquids within a selected temperature range.

The units are designed to operate efficiently at the original design temperature specified and therefore, due to wide differences in the heat exchange rate at other than the design temperatures, it is not recommended that the machine be set to operate at temperatures beyond 10°F above or below the specified temperature.

NOTE: Extra adjustment in the operating temperature can be tolerated on specific cases; however, it is recommended that the factory be consulted and that the refrigerant pressures be monitored to be sure there are no problems before any change in operating temperature beyond the 10°F range.

Each Koolant Kooler is tested at the factory under conditions duplicating those supplied as specification with the customer order. You may review the enclosed test sheet to see the results.

When the unit is operating properly the temperature drop across the heat exchanger should be in the range of 6 to 12°F.

In operations where the possibility of coolant contamination such as cutting, grinding, reaming, and honing exists, the coolant must be properly filtered to prevent the plugging of the heat exchanger with particles or solids. Blockage of the heat exchanger does void the warranty.

Before putting the machine into service, carefully read and follow the instructions as outlined and labeled: "INSTALLATION, OPERATING AND SERVICE INSTRUCTIONS."

Be sure to follow the instructions in sequence.

The serial label, installed on the outside of the electrical enclosure door, specifies the operating voltage, phase, and Hz of the power supply required. Also, the full load amperage draw is stamped on the label so that the proper line capacity can be determined. The refrigerant type and full charge amount is also noted on this label.

Under normal circumstances, the start-up procedure can be performed by any plant personnel or maintenance people. It is recommended, however, that any work involving service of the refrigerant system be performed only by a qualified refrigeration service person having the required gauges and equipment for this type of work.

Section VI is the TEST SPECIFICATIONS which gives complete test information such as: high and low side normal pressures, coolant operating temperature, coolant flow in GPM, and other pertinent data to serve as a guide to any refrigeration service person who may work on the equipment.

Section VII is the PARTS LIST. It includes all controls and components used in assembly on the machine, all of which are available from Koolant Koolers and which, in most cases, may be available locally to expedite replacement if needed.

The following blue prints are provided in the back pocket of the manual: electrical diagram, plumbing and refrigeration schematic. Study these for operation sequence.

SECTION II

INSTALLATION AND OPERATION

1. Inspect the Koolant Kooler for damage done in shipping and report any damage to the transportation company.

2. Place the machine as near as possible to the equipment to be cooled. This will provide the highest possible pump pressure and minimize the line loss to ambient.

   Make sure the unit is placed in a location where good air circulation is provided, also allowing room for servicing. Do not place on a mezzanine, near a ceiling, or in an enclosed room. The build-up of high ambient temperatures can cause compressor damage. Units provided with the squirrel cage blower-type condensers can be ducted for heat reclaim or outdoor exhaust.

3. Connect the coolant lines to the proper pipes marked "FLUID IN" and "FLUID OUT". Use two wrenches so that you put no strain on the internal piping of the unit. Make sure that the flow of fluid to and from the unit can not be shut off or blocked while the Kooler is in operation. On AF and HAF Models, make sure that the coolant gravity feeds to the inlet line. To give good service, the Kooler should be connected into the lines delivering clean coolant. Plugging of the heat exchanger by solids is not covered by the warranty.

4. On units with water cooled condensers, the water lines must be connected to the condenser inlet and outlet. In plants with tower water, provide 3 GPM/12,000 BTU/hr chiller capacity, and if using city or ground water 65^{0}F or below, use 1.5 GPM/12,000 BTU/hr chiller capacity.

5. Check the voltage on the name plate to make sure it matches your power.

6. Connect the power leads to L_1, L_2, and L_3 (L_3 only on three phase models.) Turn the selector switch to the "OFF" position. If the "ON/OFF" push buttons are used, it will automatically be in the "OFF" position.

7. On AF and WX models 5000 and larger, the freon is stored in the receiver during shipping to prevent loss in case of shipping damage. These models will have 3 white caps; two on the compressor and one on the discharge of the receiver. These must be removed and the refrigerant valves back-seated (turned counter-clockwise until snug) to allow refrigerant to enter the system. If loss is detected while opening valves, immediately close them and call for assistance.

8. There are three types of reservoirs on HCC, HWX, and WX Models:

   A. A cylindrical galvanized tank has a pressure reducing valve and a 1/2" makeup line that should be connected to the city water supply.

B. A rectangular steel tank is designed for use with oil or water/glycol solution. This tank should be manually filled to the proper levels as indicated on the sight glass.

C. A rectangular stainless tank is designed to maintain rust-free water. It can be manually filled through the sight glass or it can be connected to the 1/2" female fill port which has a float valve connected to the inside of the reservoir. This is factory-set to maintain the proper level; however, it may require additional adjustment due to wear or shipping.

9. Turn on the main power to the unit. If the unit is furnished with a disconnect switch, turn or switch the disconnect to the "ON" position. The unit should stay in this position for eight hours so that the crankcase heater will vaporize any liquid freon that may have mixed with the oil. Anytime the chiller power is shut down for 1/2 hour or more, this step should be repeated.

10. A. Turn the thermostat to the highest setting (this will prevent the compressor from starting).

B. On AF and HAF models that utilize customer pumps, the fluid flow can be started. If a grinding, turning, or machining coolant is circulated throughout the heat exchanger, make sure that good filtration is provided to prevent the blockage of the heat exchanger. A blocked heat exchanger is not covered by the manufacturer's warranty.

11. On units designed for cooling water or a water soluble solution, a flow switch is provided to insure that the fluid flow is established before the refrigeration unit can operate. This minimizes the potential for water expansion damage from freezing.

12. Turn the control switch to the "ON" position. The circulating pump should start.

13. Check the pump to make sure the direction of rotation agrees with the arrow. On single phase models (115 or 230 volt) the direction will be correct when air leaves the factory and need not be checked.

14. If the rotation is incorrect, switch any two primary incoming leads. the direction can be observed by viewing the motor shaft between the motor and the pump, by removing the steel plug at the end of the motor housing, or by observing the fan on a TEFC motor. The plug can be pried off with a screwdriver and a light tap.

15. Continue circulating the pump for about five minutes to allow any air in the system to be vented. On cylindrical galvanized tanks, an air eliminator will vent the air and then close off when the tank is full. Rectangular tanks will vent through the tank.

16. Turn the thermostat setting to the desired operating setting. The compressor will now start if the fluid temperature is higher than the set point.

17. On AF/WX and HAF/HWX. . H models (heating), the heater energizes with the fall of the temperature in the reservoir.

18. On WX/HWX models, a bypass valve is mounted between the evaporator and the reservoir. This is designed so that the flow through the reservoir can be adjusted to balance the system flow. It should not be completely closed or the stabilizing effect of the reservoir will be lost. Throttling toward the closed position will build system pressure.

19. The thermostat can normally be adjusted up or down $10^{o}F$. Beyond this range, adjustments may have to be made or damage to the refrigeration system may result.

SECTION III

MAINTENANCE

Any refrigeration system depends upon the condensing temperature of the refrigeration being maintained at or below the maximum temperature in order to perform to its rated capacity.

Each Koolant Kooler is provided with a condenser of ample capacity to meet the system requirement at 90-95°F ambient. However, the condenser capacity is assured only if the condenser is maintained in a clean condition so that a good heat exchange is maintained. Therefore, it is imperative that the condenser be cleaned at regular intervals.

Air Cooled Condensers: A good method of cleaning is to blow out the tube and fin area with compressed air as often as necessary to keep it free of accumulated dust and oil. Air filters must be cleaned as necessary to maintain air flow.

Water Cooled Condenser: The water cooled condensers incorporated in all water cooled Koolant Koolers are of the shell and tube (cleanable) type. The end cover plates are removable for easy inspection and cleaning. The water bypass tubes can be cleaned by rodding out or using wire brushes that are designed for this purpose.

Koolant Kooler models with a CL in the model number have evaporators with sides that are removable for cleaning the swarf from the heat exchangers. Only the tie bolts on the side channels should be loosened or removed. Do not loosen the freon passage head bolts.

Other than the above, no special maintenance should be required. However, it is good practice to occasionally monitor the refrigerant sight glass and the oil level sight glass in the compressor crankcase.

The oil level should be approximately in the center of the sight glass.

The refrigerant sight glass will indicate frothing or bubbling if the refrigerant is below the normal charge.

Koolant Koolers, Inc. stands ready at all times to assist with any field problems. Calls to the factory will be given prompt attention. If at all possible, please have the serial number and model of your unit available. This will aid us in helping you.

SECTION IV

SERVICE DIAGNOSIS GUIDE (continued)

SYMPTOMS	POSSIBLE CAUSE
Compressor will not run, does not try to start (no hum).	1. Power circuit open due to blown fuse, tripped overload circuit, or open disconnect switch. 2. Compressor motor protector open. 3. Open thermostat or temperature control. 4. Burned motor windings - open circuit. 5. Loss of refrigerant charge. 6. Refrigerant liquid solenoid valve (if equipped) not working.
Compressor starts, but trips on overload protector.	1. Excessive suction or discharge pressure. 2. Low line voltage. 3. Defective overload protector. 4. Tight bearings or mechanical damage in compressor. 5. Shorted or grounded motor windings.
Unit short cycles.	1. Shortage of refrigerant. 2. Refrigerant liquid solenoid valve (if equipped) leaking. 3. Discharge valve leaking. 4. Defective expansion valve.
High refrigerant pressure fault.	1. Refrigerant overcharge. 2. Dirty condenser. 3. Malfunction of condenser fan (air cooled). 4. Restricted water flow (water cooled). 5. Excessive air temperature entering condenser.
Low refrigerant pressure fault.	1. Low ambient temperatures (air cooled). 2. Refrigerant leak. 3. Lack of coolant flow through the heat exchanger. 4. Liquid line solenoid valve not opening (if equipped). 5. Expansion valve stuck or lost bulbwell charge (check cap tube).

SECTION IV

SERVICE DIAGNOSIS GUIDE

SYMPTOMS	POSSIBLE CAUSE
Selector switch is in the "ON" position and the pump will not start.	1. Open disconnect switch. 2. Blown fuse. 3. Tripped starter overloads.
Pump is rotating, but no pressure is established.	1. Improper rotation. 2. No water in the reservoir. 3. Valves not open. 4. No back pressure. 5. Pump suction blocked. 6. Pump seal leaking.
Pump runs properly, temperature rises but compressor does not start.	1. Compressor is not being energized. (Refer to COMPRESSOR SYMPTOMS.) 2. Flow switch (if equipped) not activated.
Fluid flow fault (if equipped).	1. Pump not working (refer to PUMP SYMPTOMS). 2. System not completely filled. 3. Air in the system. 4. Flow switch paddle stuck.
Temperature controller is indicating a fault or has no indication at all.	1. Faulty contacts on the relays. 2. Sensor problem. 3. Supply voltage missing.
Thermostat (if equipped) will not call for cooling.	1. Out of calibration. 2. Defective.
Compressor hums, but will not start.	1. Low line voltage. 2. Shorted or grounded motor windings. 3. Internal compressor damage. 4. Improperly wired.

SECTION IV

SERVICE DIAGNOSIS GUIDE (continued)

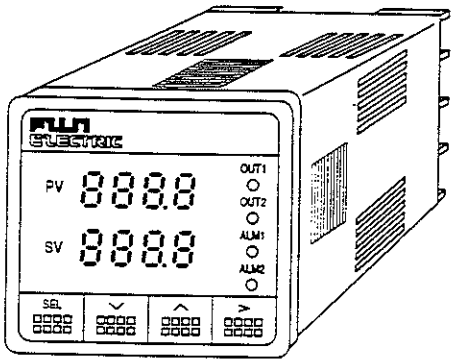
SYMPTOMS	POSSIBLE CAUSE
Lube protector fault (if equipped).	1. Loss of oil from compressor due to: (a) Oil trapping in system (b) Compressor short cycling (c) Insufficient oil in system (d) Operation at excessively low suction pressure 2. Excessive liquid refrigerant returning to compressor. 3. Malfunctioning oil pump.
Fluid temperature too cold or tripped out on freezestat (if equipped).	1. Operating temperature setting is too low. 2. Faulty temperature controller. 3. Defective temperature controller sensor. 4. Refrigerant liquid solenoid valve (if equipped) leaking.

FUJI ELECTRIC

Instruction Manual

FUZZY CONTROLLER X

Type: PYX



Fuji Electric Co.,Ltd.

INP-TN1PYXb-E

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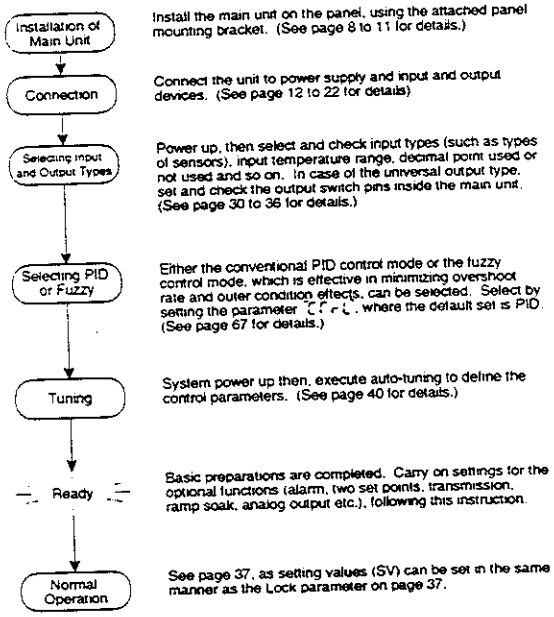
I. PREPARING THE OPERATION

We thank you for the purchase of this PYX (Fuzzy Temperature Controller).
Employing FUZZY LOGIC the PYX virtually eliminates system overshoot and effectively suppresses fluctuation of the process variable due to external disturbances.
Please read this manual, when programed and operated within the guidelines setforth in this manual, your PYX controller will give you years of precise, reliable control.

* E.U. indicates Engineering Units.

1. THE BASIC INSTALLATION PROCEDURE

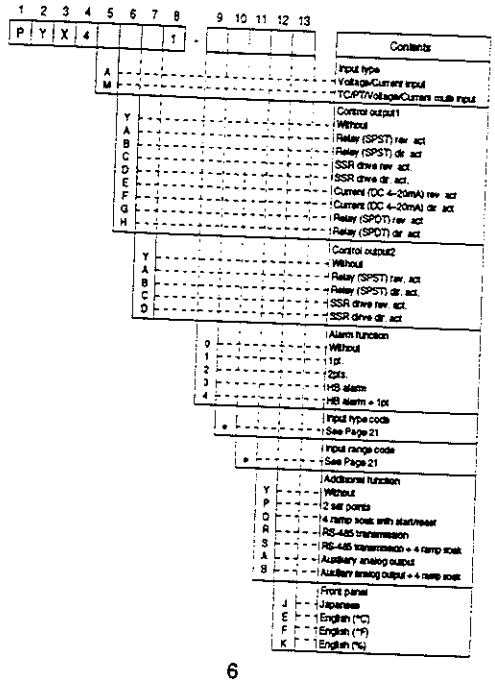
Is given here as to the basic flow from the installation to operate the PYX. For detailed description of each step, see the pages correspondent. See the section "Operation Procedure" on the pages 26 to 29 for calls and changes the specific parameter.



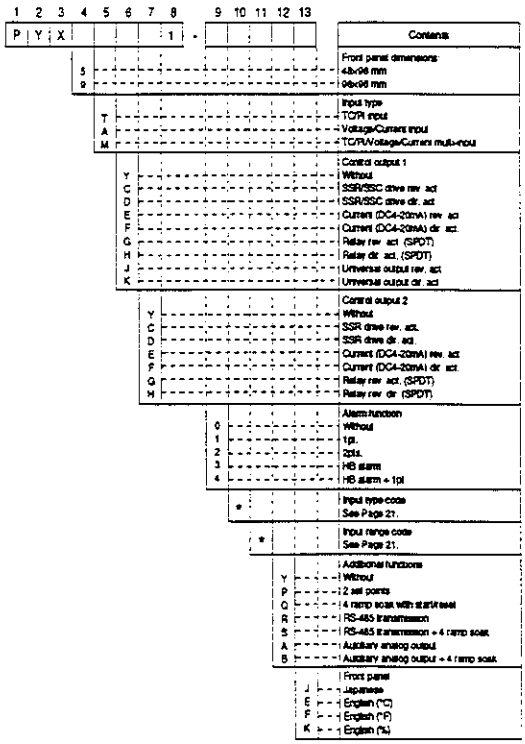
2. CHECK OF SPECIFICATIONS

Please make sure that specifications of this product is according with your request. The product specifications are provided on the main unit as model configuration following.

2.1 PYX4 MODEL CONFIGURATION



2.2 PYX5/9 MODEL CONFIGURATION



3. ACCESSORIES

In addition to the main unit, the following accessories are shipping in the same package.

Accessories	Quat.
Instruction manual (this manual) (INP-TN1PYX-E)	1
Panel mounting bracket set	1
Current input resistance (250Ω) * Not delivered for TC/PT input type	1

* Suffix means revision control

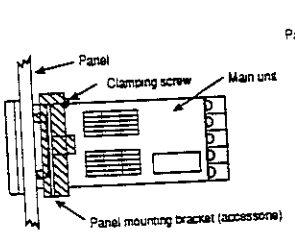
4. INSTALLATION

4.1 INSTALLATION PLACE

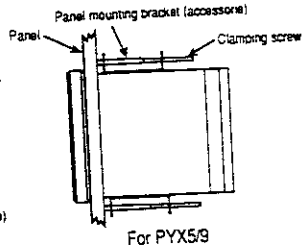
Please verify if where the controller is mounted there is no:

(1) splash of water.
(2) mechanical vibration.
(3) extreme temperature
(4) no corrosive gases.
(5) dust or oil smoke.
(6) electric noise.

4.2 INSTALLATION PROCEDURE



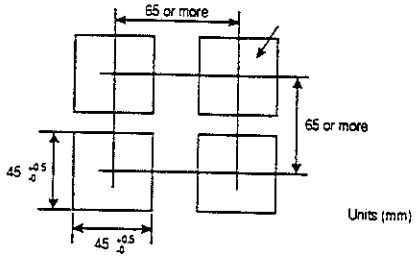
For PYX4



For PYX5/9

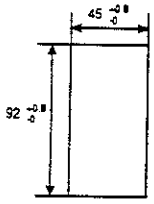
- For PYX4
  Slide the enclosed plastic panel mounting bracket (shipped with every PYX4) up the back of the controller until it makes contact with the back of the panel. Push the mounting bracket until the tabs seat themselves in the molded tab ridges, located on the front of the controller's outer case. Tighten the two screw on the mounting bracket for added pressure; do not use excessive force.
- For PYX5/9
  The mounting bracket's tabs fit into the two holes on both the top and bottom of the controller's outer case. With an instrument screwdriver, turn the screw in the mounting bracket until the end of it touches the back of the panel. Do this to both brackets. Making sure that the face of the controller is flush and straight, tighten both mounting bracket screws. Your controller should now be firmly set. If the controller is still loose, tighten the mounting bracket screw a little more. Do not use excessive force.

4.3 PANEL CUT DIMENSIONS

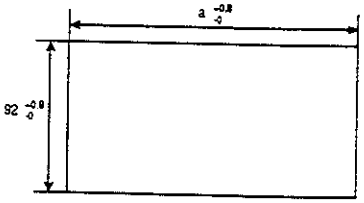


For PYX4

When mounting one unit



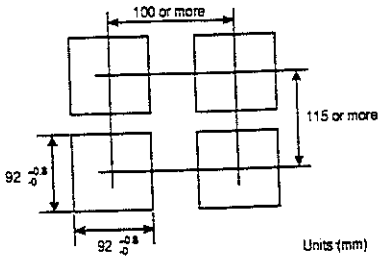
When mounting multiple n units (2 ≤ n ≤ 6)



Units	2	3	4	5	6
a	93	141	189	237	285

Units (mm)

For PYX5

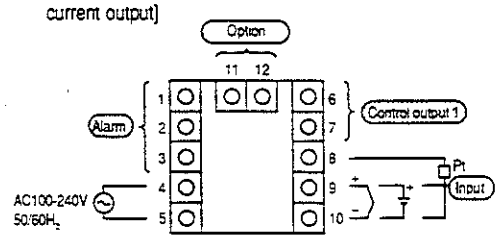


For PYX9

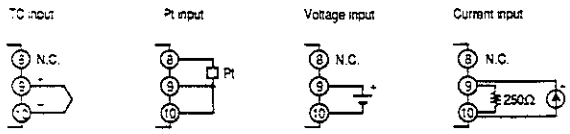
5. WIRING

5.1 PYX4 WIRING DIAGRAM

[When the output 1 is relay (SPST) output, SSR drive output or current output]

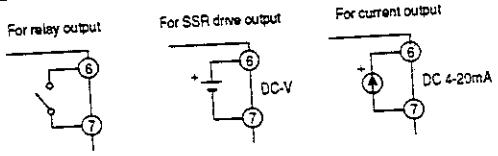


Input



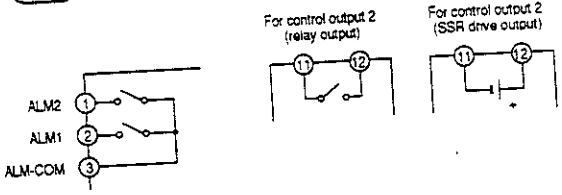
NOTE: • *For current input (4-20mA), use the accessorie resistance (250Ω).*
• *Make sure that the setting pin is in the appropriate position according to page 33.*

Control output 1

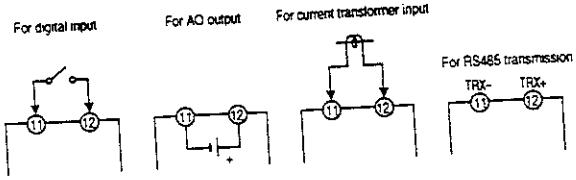


Alarm

Option

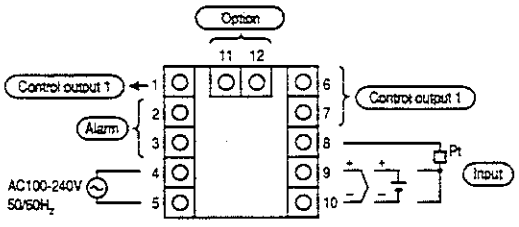


NOTE: Only ALM 1 is available in the case of the digital output type.

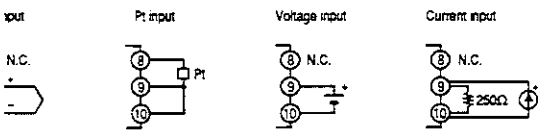


5.2 *PYX4 WIRING DIAGRAM*

[When the output 1 is relay (SPDT) output]



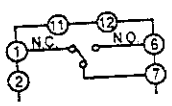
Input



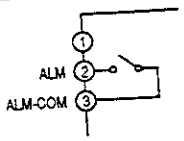
NOTE: • *For current input (4-20mA), use the accessorie resistance (250Ω).*

• *Make sure that the setting pin is in the appropriate position according to page 33.*

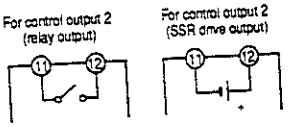
Control output 1

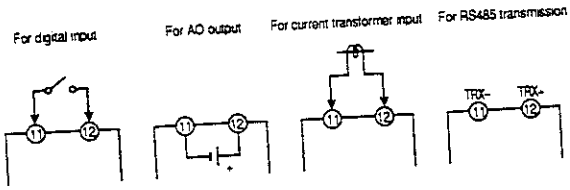


Alarm



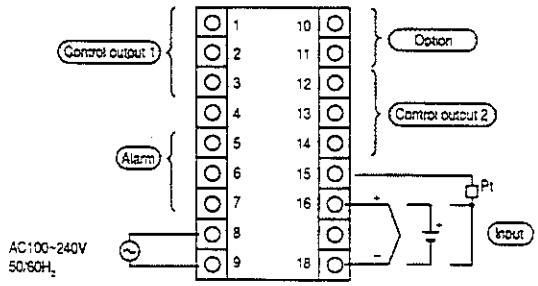
Option



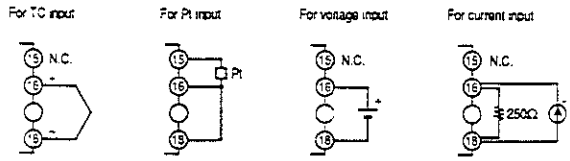


5.3 PYX5/9 WIRING DIAGRAM

(Not universal output)



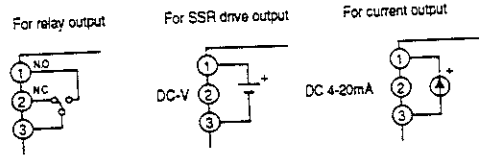
Output



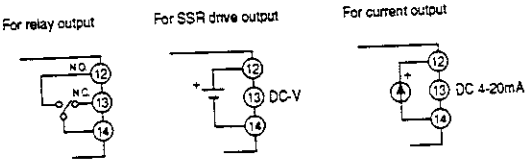
NOTE: • *For current input (4-20mA), use the accessorie resistance (250Ω).*

• *In the case of multi-input, make sure that the setting pin is in the appropriate position according to page 33.*

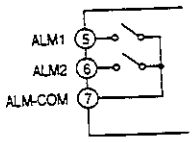
Control output 1



Control output 2

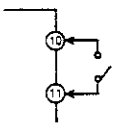


Alarm

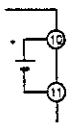


Option

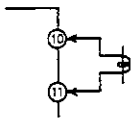
· digital input



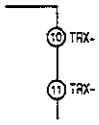
For AO output



For current transformer input

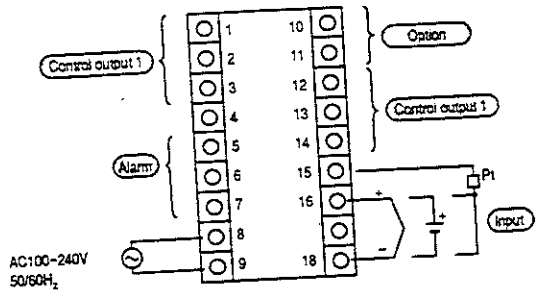


For RS485 transmission



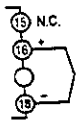
5.4 PYX5/9 WIRING DIAGRAM

(universal output)

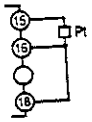


Input

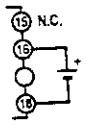
For TC input



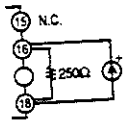
For Pt input



For voltage input



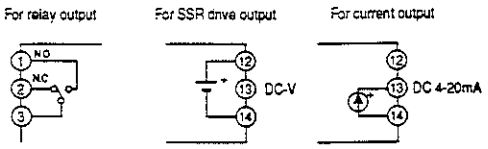
For current input



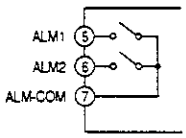
NOTE: • *For current input (4-20mA), use the accessorie resistance (250Ω).*

• *In the case of multi-input, make sure that the setting pin is in the appropriate position according to page 33.*

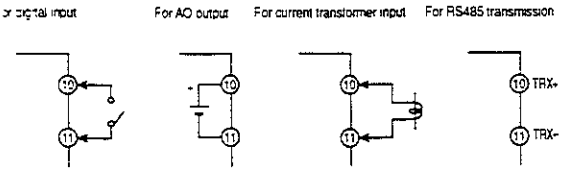
Control output 1



Alarm



Option



5.5 NOTES

Connection:

- This product not provide power switch and fuse, then if necessary is recommended the external installation.
- Use designated compensating wire in the case of thermo-couple input.
- Use wire with line resistance lower that 10 Ω for thermoresistance input.
- To avoid noise induction to input wires separate from the power and output wires also connected to your controller.
- In case of model equipped with heater break alarms, the power supply used should be the same for the PYX and Heater.
- Use shielded wires for input wires. Keep them away from output wires.

Noise:

- Take the following measures when there is serious noise induction in the external wiring: When using a contactor as a load on digital output such as relay contact output and alarm output, supplement a serge absorber to the coil side of the contactor.
  Z-Trap (ENB461D-14A for AC220V) manufactured by Fuji Electric
- In the case of noise induction from the power supply, the use of an insulated transformer and a noise filter is recommended.
  Noise Filter (ZMB22R5-11) manufactured by TDK
- It is efficacious against noise induction to twist the power wires.

Connection of Load Circuit:

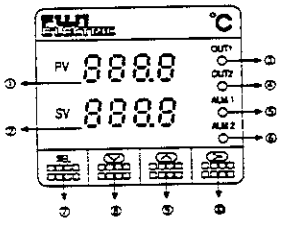
- When the frequency of operation is rather high, in the case of proportional operation for instance, maximum load with respect to the capacity of the output relay will result in shorter life. Use an auxiliary relay in such a case. Type SSR is recommended.

  electromagnetic switch: proportion cycle 20 sec. and above
  SSR: proportion cycle 2 sec. and above (approximately)

  contact output life: mechanical: 10 million times (no load)
  electrical: 100 thousand times (nominal load)

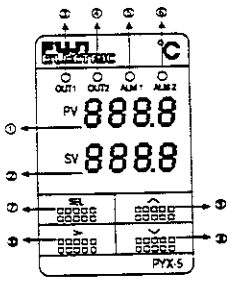
- Relay contacts will be worn out with time. After certain period has passed, locking (a phenomenon in which a contact cannot be released once switched on) may happen. It is advisable to provide an external safety device to protect the system just in case locking happens.

II. FRONT PANEL LAYOUT

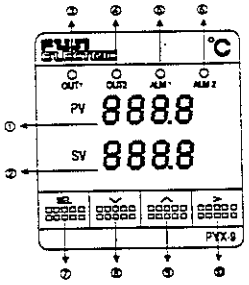


PYX4

① PV value display
② Set point value display
③ Control output 1 monitor lamp
④ Control output 2 monitor lamp
⑤ Alarm 1 lamp
⑥ Alarm 2 lamp
⑦ SELECT/Registration
⑧ DOWN key
⑨ UP key
⑩ CARRIAGE/Registration



PYX5



PYX9

① PV value display

PV 8888

Displays the measured value, as well as the failure information. When more than one failure occurs simultaneously, the failure information of the highest priority alone will be displayed.

Display	Meaning	Priority
FAIL	Main unit failure	High
Hbrk	Heater disconnected	
LPbr	Control loop failure	Low

② Set point value display

SV 8888

Displays the set point value.

(During auto-tuning or manual operation, the display of "TUNE" or "ONOF" and set point value alternate.)

③ Control output-1 monitor lamp

Output 1 ○

Lights when Output 1 is ON. (it does not light for the current output type.)

④ Control output 2 monitor lamp

Output 2 ○

Lights when Output 2 is ON. (it does not light for the single output type).

⑤ Alarm-1 monitor lamp

ALM 1 ○

Lights when the alarm-1 relay operates

⑥ Alarm 2 monitor lamp

ALM 2 ○

Lights when the alarm-2 relay operates

⑦ SELECT/Registration

Used to switch from the operation mode to parameter setting mode, to select parameters, and to Registration set values.

Keeping pressing this key for about 3 sec switches between the operation mode and parameter setting mode.

⑧ DOWN key

Used to select parameters and to decrease set values.

Continuing to press this key results in auto-repeat.

⑨ UP key

Used to select parameters and to increase set values.

Continuing to press this key results in auto-repeat.

⑩ CARRIAGE/Registration

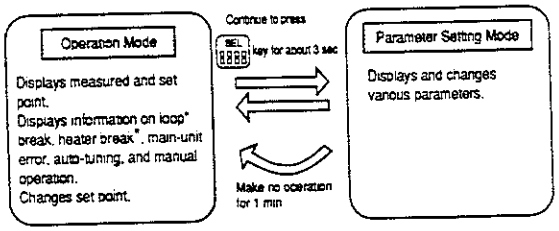
Used for preset value digit carrying or for preset value Registration.

III. OPERATION PROCEDURE

1. OPERATION MODE/PARAMETER SETTING MODE

The operation of this device includes **the Operation Mode** where measured and set values are displayed and **the Parameter Setting Mode** where various parameters are set.

To switch between **the operation** and **parameter setting modes**, continue to press the SEL key for about 3 sec.

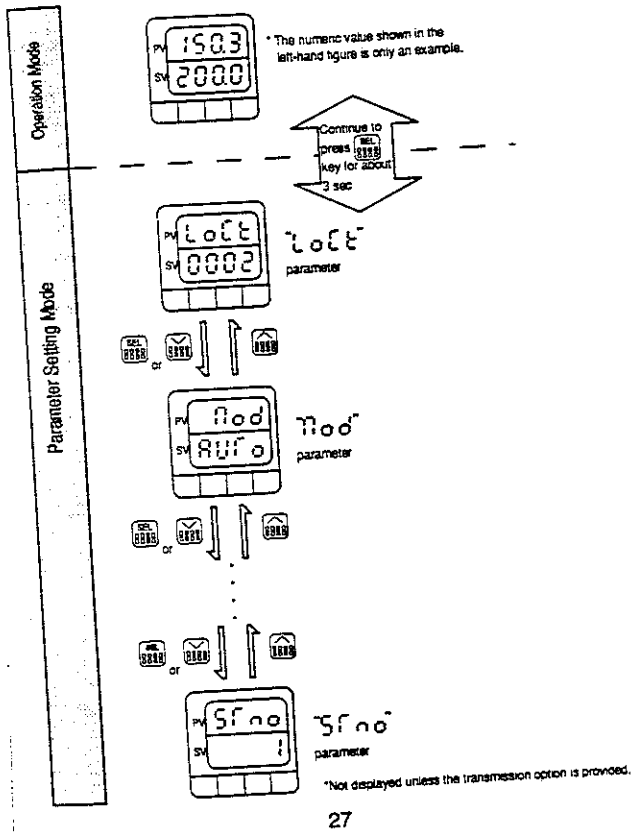


* indicates an option.

2. VIEWING PARAMETERS

1. Enter the parameter setting mode. (continue to press SEL key for about 3 sec)
2. Display the target parameter with the SEL, ▽, or △ key.

NOTES: No parameter is displayed if its parameter lock setting is illegal or if its corresponding option has been mounted in the system.



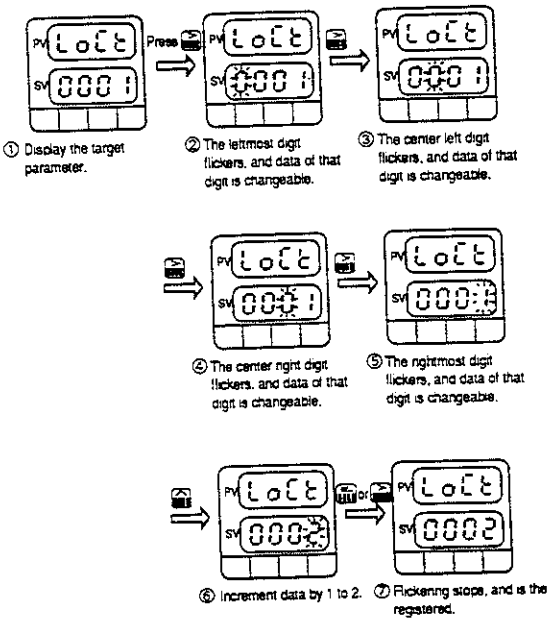
3. CHANGING PARAMETERS

1. Display the parameter to be set (to be changed) on the screen, as described in the Section 2. "Viewing Parameter" (page 26).
2. Select the digit to be set (to be changed), with the key (the selected digit flickers).
3. Set (to be changed) the data with the and keys.
4. Press the key, or repeat pressing the key until it stops flickering (the set (changed) data is registered).

NOTES: If no operation is made for about one minute during data setting (changing), control automatically returns to the operation mode. The data being changed (set) at this time is invalidated.

Example

<<Changing "Lock" from 1 to 2>>



① Display the target parameter.

② The leftmost digit flickers, and data of that digit is changeable.

③ The center left digit flickers, and data of that digit is changeable.

④ The center right digit flickers, and data of that digit is changeable.

⑤ The rightmost digit flickers, and data of that digit is changeable.

⑥ Increment data by 1 to 2.

⑦ Flickering stops, and is the registered.

SETTING INPUT AND OUTPUT TYPES

r completing wiring, make sure that the measured value is of the right
before operating the device.

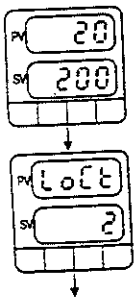
Parameter to be used

Changing input — PVT

ting the input type (PVT)

efers to setting the input type (range), presence or absence of decimal-
nt, and units of display (°C/°F).

tting procedure

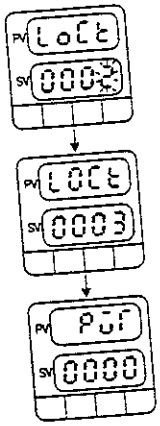


1. Turn the power of PYX (LEDs go on after a few sec).

2. Continue to press the SET key for about 3 sec (parameter LoCt is displayed).

   At that time, if "3" is displayed steps 3 and 4 need not be executed.

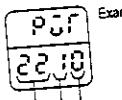
3. Press the ▷ key 4 times (the right most digit flickers).



4. Change the lower display to "0003" with the ▷ and ▽ keys, and stop flickering and register the value with the SET and △ keys.

5. Repeat pressing the SET key until parameter "PVT" is displayed.

6. Set parameter "PVT" to the desired specifications following.



Example: Setting of K thermocouple for 0.0-400.0 °C range

Display unit
0 | C display
1 | F display

Decimal point display
0 | No decimal point
1 | 0.1 C/ F display

Input type code

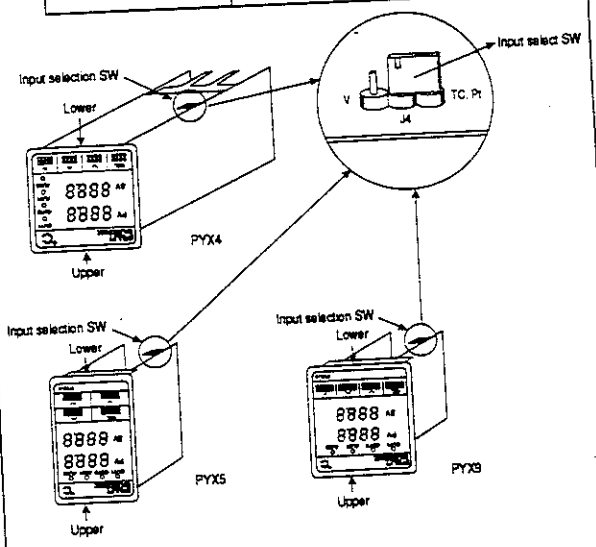
Input signal and measurement range

Input signal		Input type code	Measurement range (°C)	Measurement range (°F)	0.1°C display	0.1°F display
Thermo-resistance JIS	Pt100	00	0~150°C	32~302°F	O	O
	Pt100	01	0~300°C	32~572°F	O	O
	Pt100	02	0~500°C	32~932°F	O	O
	Pt100	03	0~600°C	32~1112°F	O	×
	Pt100	04	-50~100°C	-58~212°F	O	O
	Pt100	05	-100~200°C	-148~392°F	O	O
	Pt100	06	-150~600°C	-238~1112°F	O	×
	Pt100	07	-150~650°C	-238~1562°F	O	×
Thermo-resistance old JIS	JPt100	10	0~150°C	32~302°F	O	O
	JPt100	11	0~300°C	32~572°F	O	O
	JPt100	12	0~500°C	32~932°F	O	O
	JPt100	13	0~600°C	32~1112°F	O	×
	JPt100	14	-50~100°C	-58~212°F	O	O
	JPt100	15	-100~200°C	-148~392°F	O	O
	JPt100	16	-150~600°C	-238~1112°F	O	×
Thermo-couple	J	20	0~400°C	32~752°F	O	O
	J	21	0~800°C	32~1472°F	O	×
	K	22	0~400°C	32~752°F	O	O
	K	23	0~800°C	32~1472°F	O	×
	K	24	0~1200°C	32~2192°F	×	×
	R	25	0~1600°C	32~2912°F	×	×
	B	26	0~1800°C	32~3272°F	×	×
	T	27	-199.9~200°C	-328~392°F	O	×
	T	28	-150~400°C	-238~752°F	O	×
	E	29	0~800°C	32~1472°F	O	×
	E	2A	-199.9~800°C	-328~1472°F	O	×
	S	2B	0~1600°C	32~2912°F	×	×
	N	2C	0~1300°C	32~2372°F	×	×
	U	2D	-199.9~400°C	-328~752°F	O	×
	WRe5-26	2E	0~2300°C	32~4172°F	×	×
	PL-II	2F	0~1300°C	32~2372°F	×	×
Power supply voltage	DC1-5V	40	-1999 to 9999 (Possible scaling range)		O: Enabled ×: Disabled	
	DC0-5V	41				
Power supply current	DC4-20mA	40*	* For current input, mount the 250Ω resistance on input terminals, and apply the 1-5V voltage input.			

NOTES: •The 0.1°C/F display is impossible for all over the 1000°C/F span.

NOTES: Make sure to switch the input selection SW referencing the following table when changing the type of input by changing the parameter "PVT".

Switching from Pt or TC input to voltage/current input	Re-position the input switch pin on "V" side.
Switching from voltage/current input to Pt/TC input	Re-position the input switch pin on Pt/TC side.
Other types of switching	Input pin re-positioning is not necessary.



Parameter to be used

Changing scale (voltage/current input)

P.SC / P.SB / P.Sd

If it is used for voltage or current input, input scaling is possible.

Input scaling

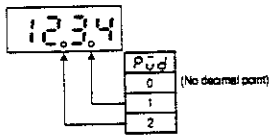
Engineering dimensions can be set to voltage or current input.

Setting procedure

P.SC (maximum value on scale): Engineering value equivalent to the 100% input is set (-1999 ~ 9999).

P.SB (minimum value on scale): Engineering value equivalent to the 0% input is set (-1999 ~ 9999).

P.Sd (decimal-point location): Decimal point location is set (see below). (0 ~ 2)



NOTES: When setting the scale, set it so that the difference between P.SC and P.SB (span) does not exceed 9999. The following condition must always be satisfied when setting is made: P.SC is larger than P.SB.

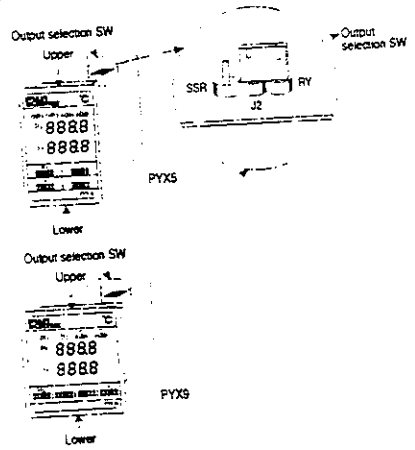
Parameter to be used

Changing output (universal output)

none

In case of the universal output type, the type of the control output 1 can be selected from the relay (SPDT) output, the SSR drive output and the current (4-20mA) output. Follow the table below when switching.

Desire type of control output 1	Switching
Relay (SPDT) output	Switch the pin "J2" in the figure below to the "RY" position.
SSR drive output	Switch the pin "J2" in the figure below to the "SSR" position.
Current (4-20mA) output	No switching required.



NOTES:

1. *The output terminal for each output type is independent in the case of the universal output. Make sure that connections are properly made according to the page 20.*
2. *The current (4-20mA) output is made regardless of the position of the switching pin "J2" in the case of the universal output. However, only one type of output can be concurrently used among the relay output, the SSR drive output and the current output.*

V. FUNCTIONS

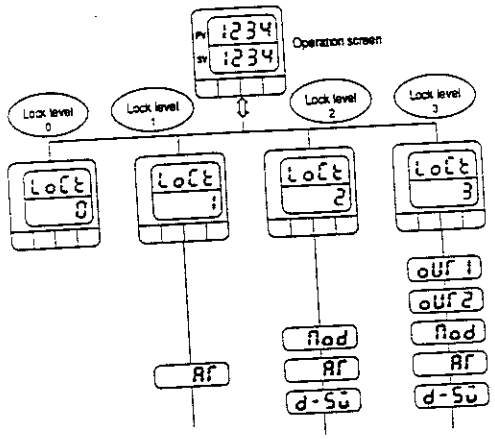
Parameter to be used

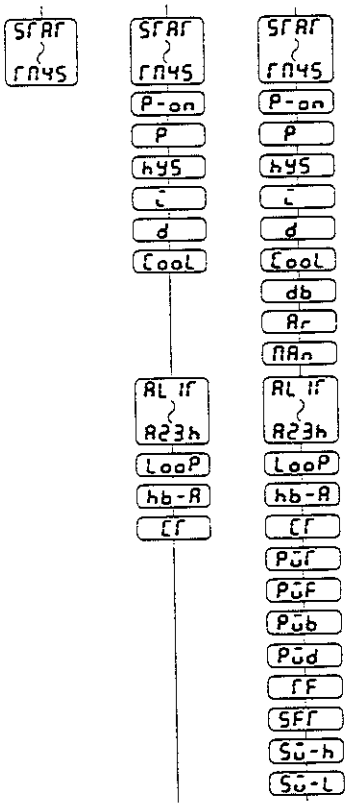
Lock — LoCt

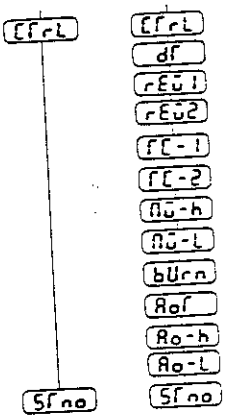
The lock function is to suppress display of those parameters which are not used frequently in normal operations, and thereby to prevent parameter miss-settings.

There are four lock levels: 0 to 3. Parameters corresponding to each lock level are displayed. Setting the lock level to 0 disables changing of all parameters other than "LoCt".

<Parameters for each lock level>







NOTE: Some parameters may not be displayed, depending upon the option composition.

Lock level	Use
0	(Setting of no parameter allowed) Use this level to lock all parameters.
1	(Setting of only set point allowed) Use this level when no parameter other than the set point is changed.
2	(Setting of normally set parameters allowed) Use this when normal parameters are set or changed.
3	(Setting of all parameters allowed) Use this when the set-up parameters are set or changed.

Parameter to be used

Auto-tuning — AT

Autotuning function

This is the function implemented by the controller itself to automatically perform ON/OFF control, identify the process, and determine control constants (P, I, D, Cool, Ar).

Operating procedure

AT (Autotuning Command)

Setting	Operation
oFF	Provides normal control.
on (Standard type)	Perform auto-tuning while targeting the present [set point value (SV)].
Lo (Low PV type)	Performs auto-tuning while targeting the present [set point value (SV) - 10%FS].

(Autotuning command) Setting "on" or "Lo" in the autotuning command starts autotuning (during autotuning, "TUnE" and the set value alternate in display on the run screen). Autotuning terminates automatically.

Supplementary descriptions

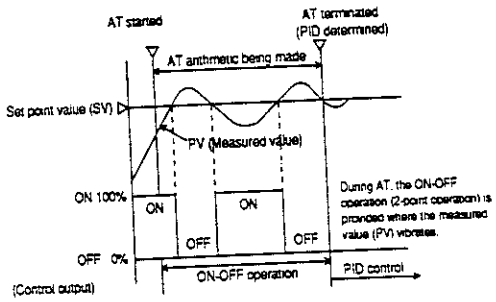
1. There are two types of auto-tuning (AT): ① Standard type (including over-shoot) and ② Low PV type (suppressing overshoot).

   Type ① is the system in which the measured value (PV) exceeds the set point value (SV) (overshoot) during autotuning. Use this type where overshoot is permitted.

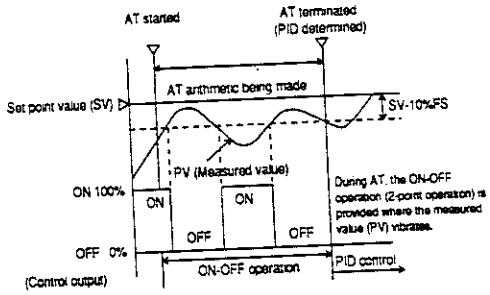
   Type ② is the system in which ON-OFF control is provided by centering upon the value 10% (/full-scale) lower than the set point value (SV). Use this type where overshoot is to be suppressed.

For single output

① Standard type (including overshoot)

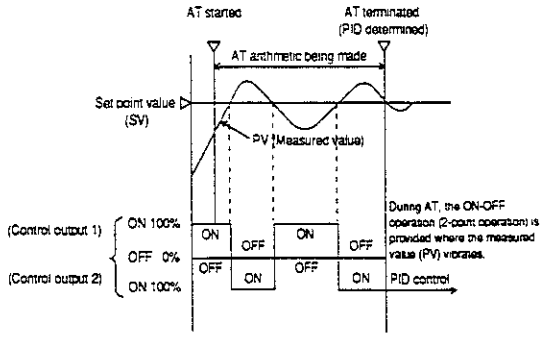


② Low PV type (suppressing overshoot)

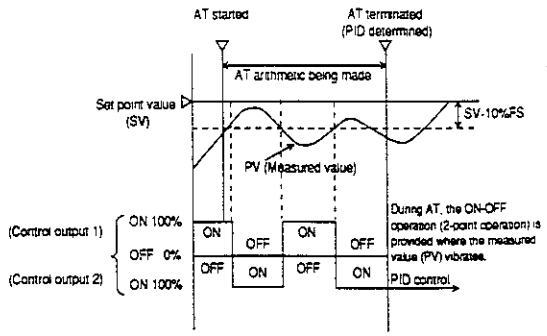


For dual output

① Standard type (including overshoot)



② Low PV type (suppressing overshoot)



NOTES

1. *Avoid applying the auto-tuning to the following processes.*
   - *(a) The process must not be disturbed due to temporary ON-OFF control output from PYX.*
   - *(b) Process featuring very quick response such as pressure/flow rate process.*
   - *(c) Process where overshoot must not be generated*
2. *Auto-tuning cannot be executed under the following conditions. If the auto-tuning is already being executed, stop it.*
   - *(a) Manual operation*
   - *(b) Measured value (PV) error occurring*
   - *(c) Set point changed during auto-tuning*
   - *(d) Auto-tuning not terminated within 12 hours*
3. *Do not execute auto-tuning when the ramp soak function is being used (i.e. when the parameter "Pro U" is not "oFF"), since it may result in incorrect tuning.*
4. *When the operation condition is changed, restart the auto-tuning*
5. *When the auto-tuning terminates abnormally, the PID value takes the value prior to auto-tuning, in such cases as abnormal termination of auto-tuning. The same applies when the auto-tuning command is switched to "oFF" during auto-tuning.*

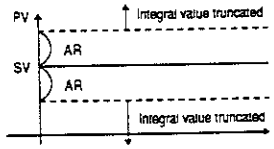
Parameter to be used

Control function — P/I/d/Ar/MAn /hYS/CooL/db

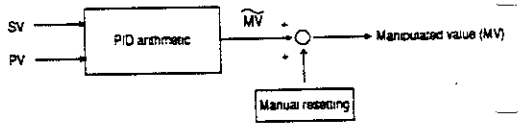
1. Normal PID control

P	(Proportional band)	Set the proportional band using the ratio (%) with respect to the input full scale (0.0-999.9%). Setting P to 0.0 provides the 2-point (ON-OFF) control. The 2-point control is not available in the fuzzy control mode. This parameter is automatically set with auto-tuning.
I	(Integral time)	Set the integral time in sec units (0-3200 sec). Setting I to 0 provides no integral operation. This parameter is automatically set with auto-tuning.
d	(Derivative time)	Set the derivative time in 0.1-sec units (0.0-999.9 sec). Setting d to 0.0 provides no derivative operation. This parameter is automatically set with auto-tuning.

Ar	(Anti-reset wind up)	When control operation involves integral operation, the initial over-integral causes overshoot to occu Overshoot is prevented by limiting the integral range. Set setting value (SV) high and low limits with engineering units. (0~100%FS E.U.) This parameter is automatically set by executing auto-tuning.



MAn	(Manual resetting value)	When control includes only the P operation, it generates offset. To eliminate this, add the manual resetting value to the manipulated value (MV). (-100.0~100.0%)

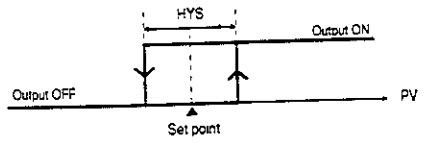


2. 2-POINT (ON-OFF) CONTROL

When PID control is specified as the control type, setting P to 0.0 provides the 2-point (ON-OFF) control operation.

hYS (2-point operation hysteresis)

Set the 2-point operation hysteresis with engineering values. (0~100% FS D.E.U.)



3. FUZZY CONTROL

Employing Fuzzy Logic control eliminates system overshoot and effectively suppresses fluction of the process variable due to external disturbances. See the section describing control type setting (page67).

NOTES

1. *The dual output type does not allow use of fuzzy control.*
2. *Though the fuzzy control also requires setting of parameters P, I, and D, these values can be set to those being used in PID control. Auto tuning is also available.*

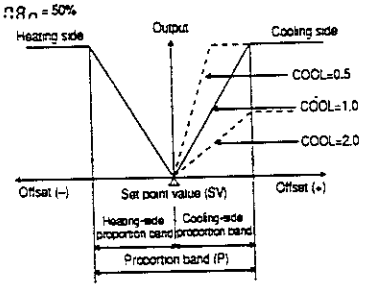
4. DUAL CONTROL

* This function is an option.

If the process heats itself, cooling control is needed in addition to heating control. The dual control is used for control of that process.

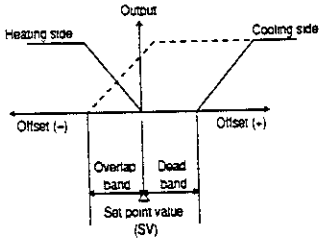
CooL (Cooling-side proportional band coefficient)

Set the cooling-side proportion band coefficient (0.1~10.0). This parameter is automatically set with auto-tuning.



db (Dead/overlap band)

Used to separate (dead) and overlap the heating and cooling side output as shown in the figure below (-50 ~ +50%)



Alarm

Parameter to be used

AL 1F/AL2F
AL 1:1/AL 12/AL 13/AL2 1/AL22/AL23
A 1:1h/A 12h/A 13h/A2 1h/A22h/A23h
LooP/hb-A/CC

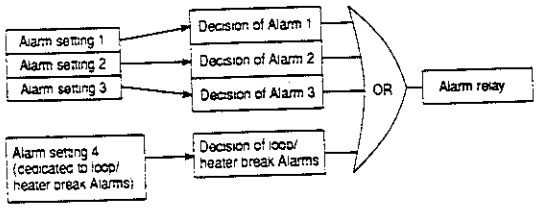
* This function is an option.

This device provides the multi-alarm function (option) that allows simultaneous detection of a maximum of 4 types of alarming.

Multi-alarming

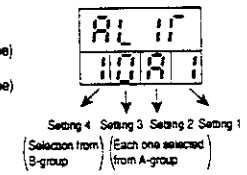
It allows a maximum of 4 types of alarm settings (among which, one is dedicated to loop/heater disconnection), detects those types of alarm individually, and makes logical OR before outputing it to the alarm relay.

(Multi-alarm)



Operation procedure

AL 1F (Alarm-1 type)
AL 2F (Alarm-2 type)



* For the setting in the above figure, the result of ORing of the heater break alarm "holding"-featured low-limit deviation alarm, and high-limit absolute alarm is output.

Set one type code in each digit (settings 1 to 4). When a code that is not in the table is specified, it will be regarded as "no alarm (code: 0)".

(A-group alarm)

Code	Type	
0	No alarm	No alarm used
1	High limit absolute value	PV, Alarm Set point
2	Low limit absolute value	PV, Alarm Set point
9	Low limit absolute value with holding feature	PV, Alarm Set point
3	High limit deviation	Alarm Set point, PV, Set point
4	Low limit deviation	Alarm Set point, P, Set point
A	Low limit deviation with holding feature	Alarm Set point, P, Set point
5	High limit deviation (inverted)	Alarm Set point, PV, Set point
6	Low limit deviation (inverted)	Alarm Set point, P, Set point
B	Low limit deviation (inverted) with holding feature	Alarm Set point, P, Set point
7	High/low limit deviation	Alarm Set point, PV, Set point
C	High/low limit deviation with holding feature	Alarm Set point, PV, Set point
8	High/low limit deviation (inverted)	Alarm Set point, P
D	High/low limit deviation (inverted) with holding feature	Alarm Set point, P

(B-group alarm)

Code	Type
0	No alarm
1	Heater break detection
2	Loop break detection
3	Heater break detection + Loop break detection

NOTES: Any code setting does not result in heater break detection unless the heater break option is provided.

AL 11 (alarm 1 - set point 1) Sets the value for alarm.

AL 12 (alarm 1 - set point 2)

AL 13 (alarm 1 - set point 3)

AL21 (alarm 2 - set point 1)

AL22 (alarm 2 - set point 2)

AL23 (alarm 2 - set point 3)

A11h (alarm 1-hysteresis 1) Sets the hysteresis for alarm.

A12h (alarm 1-hysteresis 2)

A13h (alarm 1-hysteresis 3)

A21h (alarm 2-hysteresis 1)

A22h (alarm 2-hysteresis 2)

A23h (alarm 2-hysteresis 3)

LooP (loop break detection time)

The loop break detection time is set in minutes and seconds. By setting 00.00, the alarm will turned ON only at an abnormal input (overrange/ underrange, burn-out etc.). (00.00 -99.59)

hb-A (heater break detection current value)

The heater break detecton current value is set in the unit of ampere. (1-50A)

CT (heater current value)

Displays the current in the heater. This parameter cannot be changed. (0-50A)

Supplementary descriptions

1. If during normal operation, the output (MV value) to switch to less 0% or more 100%, and the input (PV value) not moved more than ±3%FS elapsed the time defined in "LooP" parameter, then the "LPbr" message will appear and loop break alarm turns ON.
2. This device provides the heater current monitor function (for only the heater break option-fitted type). The current value is displayed in parameter "CT". This can be used as reference when determining the heater break detection current value.
3. The heater current measured value is read only when the control output-1 relay is on. When that relay is off, the value at the point immediately before the relay is set off is retained.

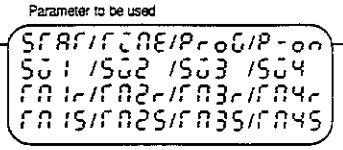
4. Detection of the heater current requires the following current transformer (to be purchased separately).

Heater current value	Types
For 1~30A	CTL-6-SF
For 20~50A	CTL-12-S36-8F

5. Heater break alarm is not available in the following cases.
   1) Control output 1 is SSR drive output or current output.
   2) Control output 1 is relay (1c contact) output and the heater is ON on the contact N.C. (normally close) side.
   3) The output proportion cycle time of control output 1 is lower than 20 seconds.

Parameter to be used

Ramp soak

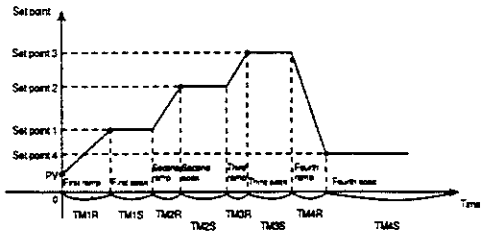


* This function is an option.

Ramp soak function

Function to automatically change the set point value (SV) with elapsing of time, in accordance with the preset pattern, as shown below. This device allows a maximum of 4 ramp soak programs.
The first ramp starts at the value measured immediately before the program is executed (PV).

After the program ends, the manipulate value is output according to ("bUrn") setting. If you want to continue the control with the setting value (SV) immediately prior to the end of the program, set the parameter "bUrn" to 0 (control continue). Note that, with this setting, the control will be continued even if abnormal input takes place.



Ramp---- Region in which the SP changes toward the target value
Soak---- Region in which the SP keeps unchanged at the target value.

Powering on can automatically trigger the program run (power-on start function). External contact signals (option) also run the program (start/reset).

Operating procedure

PrOG (ramp soak command) Switches the program operation modes.

oFF	Local operation
rUn	Program run
hoLd	Program temporary halt

P-on (power-on start command) Set this to determine whether the power-on start should be made. (Yes/No)

SU1 (first-ramp target value) Sets the target value (SV) during each ramp. (0~100%FS E.U.)

SU2 (second-ramp target value)

SU3 (third-ramp target value)

SU4 (fourth-ramp target value)

rN1r (first ramp segment time) Sets the duration (in hours and minutes) of each time segment

rN1S (first soak segment time)

rN2r (second ramp segment time)

rN2S (second soak segment time)

rN3r (third ramp segment time)

rN3S (third soak segment time)

rN4r (fourth ramp segment time)

rN4S (fourth soak segment time)

rTnE (time for rest of the program) The time for rest of the program is displayed as follows. This parameter cannot be set.

When the time for rest is 100 hours or more: "100.h" (example: for 100 hours)

When the time for rest is less than 100 hours: "99.59" (example: for 99 hours and 59 min)

SrAr (present point of program) It displays the program run status as shown in the following table. This parameter cannot be set.

"oFF"	Stop	"3-rP"	Third ramp running
"1-rP"	First ramp running	"3-St"	Third soak running
"1-St"	First soak running	"4-rP"	Fourth ramp running
"2-rP"	Second ramp running	"4-St"	Fourth soak running
"2-St"	Second soak running	"End"	Program end

When using the start/reset function, connect an external terminal with reference to the section "5. Wiring" starting on the page 12. The operations will be as follows. External contact input takes place at the time when the contact status (ON/OFF) changes (edge detection).

External contact (digital input DI)	Operation
ON → OFF	Program stops. "oFF"
OFF → ON	Program runs. "run"

NOTE:

1. *Do not use the auto-tuning function while the ramp soak function is ON ("Pro5" is not "oFF").*
2. *The ramp soak command "Pro5" will be set off, once the power supply is switched "oFF".*

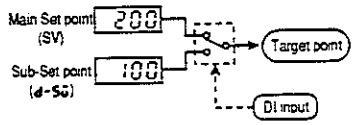
Parameter to be used

Two set-points — d-S5

* This function is an option.

Two setpoints

Changes setpoint with external contact input (Digital Input). See "5. Connection" starting on the page 12 for connection of an external contact.



Operating procedure

d-S5 (sub-set point)

Set the sub-Set point in parameter "d-S5". The target value is the sub-Set point value while DI input is on and, while it is off, the main Set point value is the target value.

Target value	Main Set point	Sub-Set point	Main Set point
DI input	OFF	ON	OFF

Parameter to be used

Analog output (AO) — AoF / Ao-h / Ao-L

* This function is an option.

AO output function

Function to externally output the PV, SV, or MV value with DC1~5V signals. AO output can be scaled.

Operating procedure

AoF (AO output type)

Set the parameter "Ao-F" to the desired output signal type.

PV	Measured Value
SV	Setting Value
MV	Manipulated Value

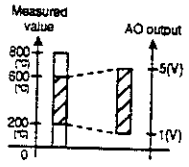
Ao-h (scale high limit)

Ao-L (scale low limit)

Set the parameters "Ao-h" and "Ao-L" to the signal type values (%) corresponding to the 5V and 1V output respectively of AO. (Percentage against the input range is set when the signal type is PV or SV, the % value with respect to the input range is set.)

Example: Input.... K thermocouple, 0 ~ 800°C range

1~5V signals are to be output when PV values are at 200 - 600°C.



AO signal type . . . PV value
600°C → 75% of input range
200°C → 25% of input range

(Setting)

AoF ··· PV
Ao-h ··· 75.0%
Ao-L ··· 25.0%

Parameter to be used

Digital output — SFno

* This function is an option.

Digital transmission function

Using the RS-485 communication, this function allows remote control for parameter settings and process monitoring. This employs the multi-drop system, and allows connection of a maximum of 15 units. The communication protocol conforms to the Fuji Electric CC data line protocol. For details, refer to the Fuji Electric PYX Transmission Protocol Specifications (TN508165-E).

Operating procedure

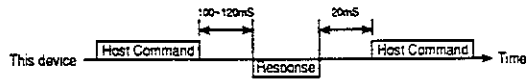
SFno (station No.) Set the station number (1~15).

Perform transmission in accordance with the PYX Transmission Protocol Specifications. The available commands are for polling (parameter read), selecting (parameter write) and control (parameter save). Communication settings are fixed as described below. Make sure that the host side has the same settings.

- Transmission signal RS-485
- Transmission rate ..... 9600 bps
- Parity ..... Odd
- Stop bit ..... 1 bit

NOTES:

1. *For the control (parameter save) operation, a maximum of 5 sec is required for the interval from receiving a command to completing the operation.* ***Before ending of that interval, never turn the power for this device off*** *(otherwise, the memory contents are destroyed and disabled).*
2. *This unit requires a time length of 100 to 120mS as the interval from completing reception of a command from the host before returning the response. It also requires 20mS before it is able to receive the next command after completing a reply.*



Parameter to be used

Manual operation — **Mod /Set Point value (MV)**

Manual mode

Direct manipulation

Operating procedure

Mod (control mode) — Switches the control mode

AUT o	Automatic control
MAn	Manual control

(During manual mode, the Set point value and "MAn" alternate in display on the Run screen.)

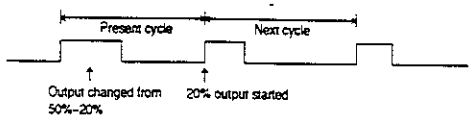
Set point value [8888] — Set the manipulated variable to be output in "%" units into the SP field of the operation screen. (-3.0-103.0%)

Supplementary descriptions

1. The normal PID or fuzzy control status is called the auto mode ("AUT o"), and manual operation status is referred to as the manual mode ("MAn").

NOTE:

1. *For the dual control type, the manual control mode is not available.*
2. *Though the display of manual output can be set in 0.1% unit, the actual output resolution is 1%.*
3. *Autotuning cannot be executed in the manual mode.*
4. Power supply is off during manual operation, the value of "MAn" becomes 0.0%.
5. When the manipulated variable is changed during manual operation, the proportion cycle being output at that changing point is followed by the next proportion cycle which starts the actual output of changed MV.



Parameter to be used

Output monitoring — oUT 1/oUT 2

Output monitor function

Numerically displays the MV being output.

Operating procedure

oUT 1 (MV for output1)	The currently output value of single-output or dual-output heating-side MV is displayed in percent. (-3.0 to 103.0%)
oUT 2 (MV for output2)	The currently output value of dual-output cooling-side MV is displayed in percent. (-3.0 to 103.0%)

NOTES:

1. *Neither* oUT 1 *nor* oUT 2 *can be set.*
2. oUT 2 *is not displayed with the single-output type.*

VI. SET-UP PARAMETER

Parameter to be used

Input filter — FF

Input filter

When a PV value becomes unstable due to effects of noise, the filter helps suppress the unstable status.

Setting procedure

FF	(input filter constant)	Set the filter time constant in sec units (0.0 ~ 900.0 (sec)).

FF=0, input filter function is not active.

The filter effects increase as this setting becomes larger, and decrease as it becomes smaller.

Smaller ←	Time constant	→ Larger
Faster ←	Response	→ Slower
Little ←	Effect	→ Great

Parameter to be used

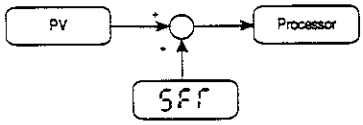
PV shift SFT

PV shift

Shifts the PV. Use this function when the PV is to be adjusted according to a recorder or an indication instrument, or when the sensor is not in the right position and therefore the PV must be adjusted.

Setting procedure

SFT (PV shift value) Set the shift value to be added to PV. (-50 ~ 50%FS E.U.)



Parameter to be used

Control type CTRL

Control type

In addition to **PID control**, this device is fitted with the **fuzzy control** suitable for suppressing overshoot. One of the two can be selected as the control type.

Setting procedure

CTRL (control type) Select the control type.

PID	PID control
FUZY	Fuzzy control

NOTES:

1. *When control is made with the fuzzy, the PID parameter must be set as with PID control. However, it need not be tuned particularly for the fuzzy. (The values are allowed to be the same as those for PID control.)*
2. *The fuzzy control mode also allows use of the autotuning function.*
3. *Fuzzy control cannot be used in the dual output type.*
4. *The two-set-point function is not available in the fuzzy control mode.*

Parameter to be used

Output setting in input abnormal

bUrn

Input abnormal-time output

In the event of an input PV error (e.g. thermocouple burn-out, sensor disconnection or short-circuit, over-input, under-input etc.), or after the ramp soak function (option) program ends, the value specified in advance as the parameter "bUrn" is out put as the manipulated value.

Setting procedure

bUrn (input abnormal-time output selection code)

Set the code number (0 ~ 4) by referencing the following table.

Code No.	Control output 1	Control output 2
0	Going on control	Going on control
1	-3%	-3%
2	103%	103%
3	-3%	103%
4	103%	-3%

Supplement:

1. *Set the parameter bUrn to "0" when the control is desired to be continued after the ramp soak function (option) program terminates, with the set value prior to the program termination.*

NOTES:

1. *The parameter "bUrn" specifies only one type of output for both cases of abnormal input and program end. In other words, the same operation will be made after an input error and after the program ends.*

Parameter to be used

Output limits

OU-H/OU-L

Output limit

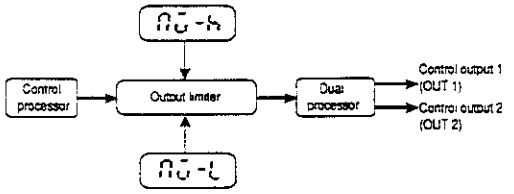
Function to limit the manipulated variable. Used to limit the output range to favor conditions of the process or operation terminal.

Setting procedure

OU-H (MV high limit)

OU-L (MV low limit)

Set the manipulated-variable high and low limits (-3.0 ~ 103.0%).



NOTES 1: Setting must always be made to satisfy the condition of OU-H > OU-L.

2: Limiting is not valid during manual operation.

3: Auto-tuning provides the 0-100% range output regardless of limiting.

4: The limiter is not valid for the 2 point (ON/OFF) control.

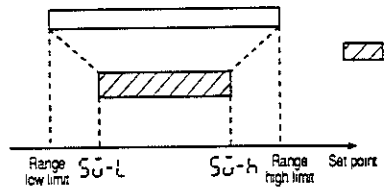
5: The loop break detection cannot be performed when "OU-L" exceeds 100.0% or does not reach 0.0%.

Parameter to be used

Set point vlaue limits — SU-H/SU-L

Set point limit

Function to limit the range in which Set point can be set.



Setting procedure

SU-H (Set point high limit)

SU-L (Set point low limit)

Set the Set point high and low limits within the input scale 0 ~ 100% range. (0 ~ 100%FS E.U.)

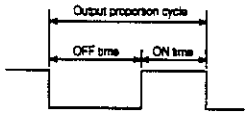
NOTES: Setting must be made to satisfy the condition of SU-H > SU-L.

Parameter to be used

Output cycle time — rC-1/rC-2

Output proportion cycle time

The relay/SSR drive output delivers the manipulated variable (0 ~ 100%) as the proportion of output-off time and output-on time. The sum of output-on time and output-off time lengths, that is the on/off cycle time is called the output proportion cycle time.



Setting procedure

rC-1 (Output 1 side proportion cycle time)

The output proportion cycle time is set in sec units (1 ~ 120 sec).

rC-2 (Output 2 side proportion cycle time)

Normally the following output proportion cycle time values must be specified.

Relay output	20 seconds
SSR drive output	2 seconds

Supplement:

1. *"rC-1" and "rC-2" are not displayed in the case of current output.*
2. *"rC-2" is not displayed in the case of single output type.*

Parameter to be used

Direct/reverse control action — rEU 1/rEU2

Selecting direct/reverse operation

Selects the direct operation mode (cooling control) or the reverse operation mode (heating control).

Setting

rEU1 (operation on the control output 1 side)
Set the operation modes for control 1 and 2 as indicated below.

rEU2 (operation on the control output 2 side)

rEU	Reverse operation (heating control)
norn	Direct operation (cooling control)

NOTE:

1. *rEU2 is not displayed in the case of single output type.*

Parameter to be used

Control processing cycle time — dT

Control processing cycle time

This function is not supported now.

Please set 0.5 sec. to "dT" parameter.

Cf. Dellivery value of "dT" parameter is 0.5 sec..

APPENDIX

1. ERROR MESSAGES

Display	Cause	Control output
UUUU	1. Thermocouple sensor burn out 2. Thermoresistance sensor disconnection 3. Input exceeding 105% of the input range	The value preset in parameter "bUrn" is output. For details, see "Output setting in input abnormal" on page 68.
LLLL	1. Thermoresistance sensor disconnection 2. Thermoresistance sensor short-circuit 3. Input under -5% of the input range	
HbrE	1. Heater disconnection	Going on control
EPbr	1. Control loop error (cause not specifically determined)	
ERLr	1. Memory data destroyed	Going on control

If display indicates an error, remove its cause as soon as possible.

2. POWER FAILURE

a) Operation of this device is not affected in case of instantaneous power failure with a duration of 20ms or less.

b) In case of power failure with a duration of 20ms or more, operation is made in the same manner as when re-powering on is made.

3. SPECIFICATIONS

- Input block

Indication accuracy	• Thermocouple input ±0.5%FS±1digit±1 (at 23°C) * B thermocouple 0 ~ 400°C ±5% R thermocouple 0 ~ 500°C ±1%	
	• Thermoresistance input ±0.5%FS±1digit (at 23°C)	
	• Voltage input, current input (externally mounted resistance use) ±0.5%FS±1digit (at 23°C)	
Temperature drift	• ±0.3%FS/10°C	
Reference contact temperature compensation adjustment	• ±1.0°C	
Time indication range (ramp/soak function)	0 hour 0 min - 799 hours	
Input sampling cycle time	• 500msec	
Input impedance	• Thermocouple:	1MΩ or above
	• Current input:	externally mounted resistance of 250Ω
	• Voltage input:	1MΩ or above
Allowable signal source resistance	• Thermocouple:	250Ω or below
	• Voltage input:	1kΩ or below
Allowable wiring resistance	• Thermoresistance:	10Ω or below (for one wire)

- Output block

Control output	• Relay contact output	
	Proportion cycle time:	20 ~ 120sec
	Contact structure:	SPST, SPDT
	Contact capacity: (Standard load)	AC220V/DC30V 3A (resistance load) AC220V/DC30V 1A (inductive load)
	Minimum switching current:	100mA (DC24V)
	Mechanical life:	20 million cycles or more
	Electrical life:	100 thousand cycles or more (Standard load)
	• Voltage pulse output (SSR/SSC drive output)	
	Proportion cycle time:	1 ~ 120sec
	ON voltage:	DC9V ~ 24V
	OFF voltage:	DC0.5V or below
	Maximum current:	DC20mA
	Load resistance:	600Ω or above
	• Current output (DC4 ~ 20mA)	
	Ensured output range:	DC3.52mA ~ 20.48mA (-3 ~ 103%)
	Accuracy:	±5%FS
	Linearity:	±2%FS
	Resolution:	1.0%FS
	Follow-up speed:	2 sec or below
	Load resistance:	600Ω or below

- Display block

Display system	• 7-segment, 4-digit × 2-stage, red, green

- Power supply block
  - Power supply voltage: AC100 ~ 240V, Free power supply
  - Power supply voltage variation: within -15% ~ +10%
  - Power supply frequency: 50/60Hz (±5%)
  - Power consumption: AC100V: 10VA or below
    AC220V: 15VA or below
- External dimensions: (W × H × D) mm:
  48 × 48×120.5 (PYX4)
  48 × 96×112 (PYX5)
  96 × 96×112 (PYX9)
- Weight: Approx. 200g (PYX4)
  Approx. 300g (PYX5)
  Approx. 400g (PYX9)
- Mounting method: Panel-installed type
- External terminals: screw terminals M3.5
- Ambient temperature: -10 ~ 50°C
- Ambient humidity: 90%RH or below (no condensation)
- Warm up: 2 hours or above
- Insulation resistance: DC500V, 20MΩ or above
- Control function (PID or fuzzy control selectable)
  Basic PID type (Position type)
  - Proportional band (P): 0.0 ~ 999.9%, P=0 ON/OFF control
  - Integration time (I): 0 ~ 3200 sec, I=0 integration off
  - Derivative time (D): 0 ~ 999.9 sec, D=0 derivative off

  Fuzzy control
- Digital filter
  - First-order time-lag filter
  - 0.0 ~ 900.0 sec, Set resolution 0.1 sec (0: OFF)
- PV input compensation: • PV shift (±50%FS)
- Over-range, under-range: • Outside the range of -5 ~ 105%

- Alarm output (ALM1, ALM2 option)
  - Output update cycle time: 500msec
  - Relay contact output ×2-pts SPST contact

  Contact capacity (Standard load): AC220V/DC30V 1A (resistance load)
  AC220V/DC30V 0.3A (inductive load)
  Minimum switching current: 100mA (DC24V)
  Mechanical life: 12 million cycles (200 times/min.)
  Electrical life: 100 thousand cycles (Standard load, 20 times/min.)
- Loop break alarm output (Option)
  - Output update cycle time: 500msec
  - Alarm setting range: 0.0 ~ 99 min 59 sec
  - Relay contact output: Alarm relay also used for this
- Heater break alarm input signal (option)

  1 ~ 30A: CT (CTL-6-SF)
  20 ~ 50A: CT (CTL-12-S36-8F) used

  *However, the output proportion cycle time must be 20 sec or above.
- Heater break alarm output (option)
  - Output update cycle time: 500msec
  - Alarm setting range: 1 ~ 50A
  - The alarm output relay is also used for this output.

- Ramp/soak function (option)
  - Program pattern count: 1 pattern
  - Number of ramps/soaks per pattern: Maximum of 4
  - Memory backup: EEP-ROM
  - OFF/run by digital input possible (only when start/reset option is provided)
- Auxiliary analog output (option)
  - Number of channels: 1
  - Output type: DC1 ~ 5V
    - Ensured output range: DC0.88V ~ 5.12V (-3 ~ 103%)
    - Accuracy: ±0.5%FS
    - Ripple voltage: P-P 1.0%FS or below (50Hz or below)
    - Temperature drift: ±0.3%FS/10°C
    - Load resistance: 500kΩ or above
  - Attached function: scaling function
  - Output update cycle time: 500msec
- Digital input (Input by contact)
  DC15V~21V 5mA
- Transmission function (option)
  RS-485 (2-wire system)
  - Transmission system: Half-duplex, bit serial
  - Synchronous system: start-stop synchronization
  - Coding: data length 8-bit Parity odd
  - Transmission rate: 9600BPS
  - Number of units connectible: 15 units
  - Transmission distance: 500m

4. TROUBLESHOOTING

Phenomenon	Possible cause	User response
Required parameter not displayed	• Wrong lock level is specified.	• Set the right lock level. (See Page 37~39.)
Set point not changed	• Set point limits not correct • Ramp/soak command set to other than oFF (for the type with the ramp/soak function)	• Set the correct Set point limits. (See Page 70.) • Set the ramp/soak command to oFF. (See Page 53~56.)
Setting of alarm not displayed	• Alarm type set to "No alarm" (Code: 0)	• Set the alarm type to be set. (See Page 48~52.)
"tPbr" display flickering	• Input error • Heater break • Control loop illegally connected	• Check the input or sensor connection and input switch pin setting (for multi-input type). (See Page 12~22, 33.) • Replace the heater. • Set the correct control loop.
"FRLr" display flickering	EEP-ROM data destroyed	• Replace the main unit.
"UUUU" or "LLLL" display output	• Input error • Input switch pin illegally set (for multi-input type)	• Check the input or sensor connection. (See Page 12~22.) • Set the input switch pin correctly. (See Page 33.)
"----" displayed	• Input value incapable of being displayed in four digits	• Make sure the input is appropriate.

Phenomenon	Possible cause	User response
Autotuning not available	• Input error • Ramp/soak command set to other than "oFF" • Manual run being performed • Set point changed during autotuning • Because of the too slow process, autotuning is not terminated within 12 hours.	• Check whether the input is normal. (See page 12-22, 33.) • Set the ramp/soak command to "oFF" during autotuning. (See page 53-56.) • Switch the manual run mode to the automatic run mode. (See page 62.) • Do not change the Set point value during autotuning. • Autotuning is not available. Perform manual tuning. (See page 44-47.)
"CF" Set point not raised (for the type fitted with heater break alarming)	• The control output relay has been switched on not long enough. • Output proportion cycle time too short	• If the control output relay does not get triggered at least 1 sec after powering on, the correct heater current value cannot be detected. (See page 51.) • Set the output proportion cycle time of "CC - 1" to 20 sec or more. (See page 71.)
Loop break detection not available	• Output limit setting is illegal	• Loop break detection is not available when "OU - H" is smaller than 100.0 or "OU - L" is larger than 0.0. (See page 69.)
Digital transmission not properly performed	• Host-side setting is wrong. • Station number is wrong. • Polarity of transmission connection is wrong.	• Give the right transmission setting to the host. (See page 60.) • Set the right station number. (See page 60.) • Check if the transmission connection are all right. (See pages 12-22.)

5. PARAMETER LIST

Display	Name		Lock level	Description	Initial value during shipment	Remarks
LoCk	LOCK	Lock level	0	Parameter locking (setting range: 0 - 3)	2	
oUT 1	OUT1	Control output 1 output value	3	No setting (display range: -3.0 - 103.0%)	-	
oUT 2	OUT2	Control output 2 output value	3	No setting (display range: -3.0 - 103.0%)	-	Not displayed unless correct output 2 is provided
Mod	MOD	Control mode	2	Setting: "AUTO" Mode: Auto; "MAn" Mode: Manual	"AUTo"	
AT	AT	Autotuning command	1	Setting: "oFF" Autotuning: Stop; "on" Normal autotuning; "Lo" Low-PV type autotuning	"oFF"	
d-SU	D-SV	Sub-Set point	2	2-setting function sub-set point (setting range: 0 - 100%FS E.U.)	0%FS E.U.	Not displayed unless the 2-setting function is provided
STAT	STAT	Ramp/soak present point	1	Ramp/soak proceeding status is displayed with a symbol. No setting (display: OFF/1-RP/1-SK/2-RP/2-SK/3-RP/3-SK/4-RP/4-SK/END)	-	Not displayed unless the ramp soak function is provided.
TIME	TIME	Ramp/soak remaining-operation time	1	The ramp/soak proceeding status is displayed with the time for remaining operation. When the time for remaining operation exceeds 100 hours, the hours display of "xxxH" is made. When the time is under 100 hours, the hour/min display of "xx.xx" is made. No setting.	-	

* See page 37~39 for lock level.

* E.U.: Engineering Units
* D.E.U. : Deviation engineering Units

Display	Name		Lock level	Description	Initial value during shipment	Remarks
ProG	PROG	Ramp/soak command	1	Setting: "oFF" – Operation: Function OFF; "rUn" – Run; "hoLd" – Temporary stop	"oFF"	
Sv 1	SV-1	First target value	1	First-ramp target value (setting range:0~100%FS E.U.)	0%FS E.U.	
tm1r	TM1R	First ramp time	1	First-ramp segment time (hour/min) (setting range:00.00~99.59)	00.00	
tm1S	TM1S	First soak time	1	First-soak segment time (hour/min) (setting range:00.00~99.59)	00.00	
Sv2	SV-2	Second target value	1	Second-ramp target value (setting range:0~100%FS E.U.)	0%FS E.U.	
tm2r	TM2R	Second ramp time	1	Second-ramp segment time (hour/min) (setting range:00.00~99.59)	00.00	Not displayed unless the ramp/soak function is provided
tm2S	TM2S	Second soak time	1	Second-soak segment time (hour/min) (setting range:00.00~99.59)	00.00	
Sv3	SV-3	Third target value	1	Third-ramp target value (setting range:0~100%FS E.U.)	0%FS E.U.	
tm3r	TM3R	Third ramp time	1	Third-ramp segment time (hour/min) (setting range:00.00~99.59)	00.00	
tm3S	TM3S	Third soak time	1	Third soak segment time (hour/min) (setting range 00.00~99.59)	00.00	
Sv4	SV-4	Fourth target value	1	Fourth-ramp target value (setting range:0~100%FS E.U.)	0%FS E.U.	
tm4r	TM4R	Fourth ramp time	1	Fourth-ramp segment time (hour/min) (setting range:00.00~99.59)	00.00	
tm4S	TM4S	Fourth soak time	1	Fourth-soak segment time (hour/min) (setting range:00.00~99.59)	00.00	
P-on	P-ON	Power-on start	2	Ramp/soak power-on start command (setting range:NO/YES)	NO	
P	P	Proportional band	2	setting range:0.0~999.9%	5.0	'0' for ON-OFF control

Display	Name		Lock level	Description	Initial value during shipment	Remarks
hYS	HYS	2-point operation hysteresis	2	(setting range:0~100%FS D.E.U.)	0.5%FS D.E.U.	Not displayed except when P = 0
i	I	Integration time	2	(setting range:0~3200sec)	240	At '0' integration operation turns off
d	D	Derivative time	2	(setting range:0.0~999.9sec)	60.0?	At 0 derivative operation turns off.
CooL	COOL	Control output 2 proportional band coefficient	2	Control output 2 proportional band coefficiency. '0' for 2-point operation (setting range: 0.0~10.0)	1.0	Not displayed unless control output 2 is provided.
db	DB	Dead band	3	Control output 2 shift value (setting range:-50~50%)	0.0	
Ar	AR	Anti-resetting wind up	3	The integration range is set (setting range: 0.0~100.0% D.E.U.)	100% FS D.E.U.	
MAn	MAN	Manual resetting value	3	MV shift (setting range:-100.0~100.0%)	0.0	
AL1T	AL1T	Types of alarm-1	2	Four-digit setting: Dedicated to cooling/heater disconnection, 1-3 type, 1-2 type, 1-1 type	0003 1000 for the HB fitted	Not displayed unless alarm 1 is provided.
AL11	AL11	Alarm 1-1 Set point	2	Set point of Alarm 1-1 (setting range: 0~100%FS E.U.)	[illegible]	Not displayed when alarm 1 is not provided and when setting is not made for alarm 1-1
A11h	A11H	Alarm 1-1 hysteresis	3	Hysteresis for alarm 1-1 (setting range: 0~100%FS D.E.U.)	0.5%FS D.E.U.	

Display	Name		Lock level	Description	Initial value during shipment	Remarks
AL 12	AL12	Alarm 1-2 Set point	2	Alarm 1-2 Set point (setting range 0~100%FS E.U.)	0%FS E.U	Not displayed when alarm 1 is not provided, or when setting is not made for alarm 1-2
A 12h	A12H	Alarm 1-2 hysteresis	3	Alarm 1-2 hysteresis (setting range 0~100%FS D.E.U.)	0.5%FS D.E.U	
AL 13	AL13	Alarm 1-3 Set point	2	Alarm 1-3 Set point (setting range 0~100%FS E.U.)	0%FS E.U	Not displayed when alarm 1 is not provided, or when setting is not made for alarm 1-3
A 13h	AL13H	Alarm 1-3 hysteresis	3	Alarm 1-3 hysteresis (setting range 0~100% FS D.E.U.)	0.5%FS D.E.U	
AL2T	AL2T	Type of alarm 2	2	[illegible] 2-3 type, 2-2 type, 2-1 type	[illegible]	Not displayed unless alarm 2 is provided
AL 21	AL21	Alarm 2-1 Set point	2	Set point of alarm 2-1 (setting range: 0~100%FS E.U.)	[illegible]	Not displayed when alarm 2 is not provided, and when setting is not made for alarm 2-1 and alarm 2
A21h	A21H	Alarm 2-1 hysteresis	3	Hysteresis for alarm 2-1 (setting range: 0~100%FS D.E.U.)	0.5%FS D.E.U	
AL22	AL22	Alarm 2-2 Set point	2	Alarm 2-2 Set point (setting range 0~100%FS E.U.)	0%FS E.U	Not displayed when alarm 2 is not provided or when setting is not made for alarm 2-2
A22h	A22H	Alarm 2-2 hysteresis	3	Alarm 2-2 hysteresis (setting range: 0~100%FS D.E.U.)	0.5%FS D.E.U	

Display	Name		Lock level	Description	Initial value during shipment	Remarks
AL23	AL23	Alarm 2-3 Set point	2	Alarm 2-3 Set point (setting range: 0~100FS E.U.)	0%FS E.U	Not displayed when alarm 2 is not provided or when setting is not made for alarm 2-3
A23h	AL23H	Alarm 2-3 hysteresis	3	Alarm 2-3 hysteresis (setting range: 0~100FS D.E.U.)	0.5%FS D.E.U	
LooP	Loop	Loop break alarm Set point	2	Loop break alarm detection time (min/sec) (setting range. 00.00~99.59)	00.00	Not displayed unless alarming is provided
hb-A	HB-A	Heater break alarm Set point	2	Heater break alarm detection current (setting range: 1~50A)	50A	Not displayed unless heater break alarming is provided
CT	CT	Heater current	2	Heater current monitor No setting (display range: 0~50A)	-	
PUT	PVT	PV type	3	Input type, presence or absence of decimal point, and°C/°F specified. Display: 2 2 1 0 — input type; presence or absence of decimal point; °C/°F	2200 unless otherwise specified (K thermo-couple, 0~400°C)	
PUF	PVF	Full scale	3	Scaling full scale (setting range.-1999~9999)	1000	[Displayed only in the voltage or current input mode]
PUb	PVB	Base scale	3	Scaling base scale (setting range -1999~9999)	0	
PUd	PVD	Scaling decimal-point location	3	Scaling decimal-point location. Display: 1 2. 3. 4 — "2", "1", "0":none	1	
TF	TF	Input filter	3	Input filter time constant Setting 0.0 turns the filter off (setting range: 0.0~900.0sec)	5.0	

Display	Name		Lock level	Description	Initial value during shipment	Remarks
SFT	SFT	PV shift	3	PV shift value (setting range: -50~50%FS D.E.U.)	0%FS (D.E.U.)	
SV-H	SV-H	Set point high limit	3	Set point high limit (setting range:0~100%FS E.U.)	100%FS	
SV-L	SV-L	Set point low limit	3	Set point low limit (setting range:0~100%FS E.U.)	0%FS E.U.	
CTRL	CTRL	Control operation system	2	Control operation algorithm selected (setting range: PID/FUZY)	PID	
dT	DT	Control operation cycle time	3		1.5 sec	
REV1	REV1	Control output 1 direct/reverse operation selection	3	(Setting range: REV/NORM)		
REV2	REV2	Control output 2 direct/reverse operation selection	3	(Setting range: REV/NORM)		Not displayed when control output 2 is not provided.
TC-1	TC-1	Control output 1 output operation cycle time	3	(Setting range: 1~120 sec)	Relay output: 20 sec SSR drive: 2 sec	Not displayed when output 1 is 4 - 20mA.
TC-2	TC-2	Control output 2 output operation cycle time	3	(Setting range: 1~120 sec)	Relay output: 20 sec SSR drive: 2 sec	Not displayed when 4 - 20mA output or without control output 2.

Display	Name		Lock level	Description	Initial value during shipment	Remarks
MV-H	MV-H	MV high limit	3	(setting range: -3.0~103.0%)	100.0%	
MV-L	MV-L	MV low limit	3	(setting range: -3.0~103.0%)	0.0%	
BURN	BURN	Output setting in input abnormal	3	Setting: 0 — Output 1: Control in control / Output 2: Control in control 1 — -3.0% / -3.0% 2 — 103.0% / 103.0% 3 — -3.0% / 103.0% 4 — 103.0% / -3.0%	-	
AOT	AOT	AO output type	3	Setting: PV — AO source: PV SV — SV MV — MV	PV	Not displayed unless AO is provided
AO-H	AO-H	AO scaling full scale	3	AO output scaling full scale (setting range: 0.0~100.0%)	100.0%	
AO-L	AO-L	AO scaling base scale	3	AO output scaling base scale (setting range: 0.0~100.0%)	0.0%	
STNO	STNO	Station no	2	Transmission originating station number (setting range: 1~15)	-	Not displayed unless transmission is provided

Fuji Electric Co.,Ltd.
New Yurakucho Bldg. 12-1 Yurakucho 1-chome,
Chiyoda-ku, Tokyo, 100 Japan
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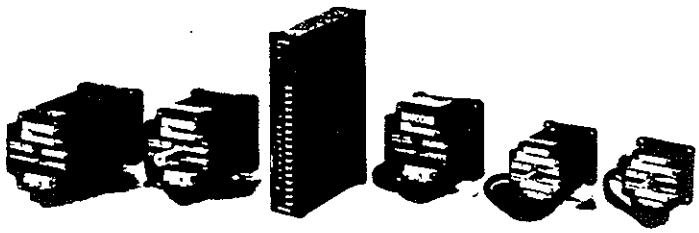
UPS 52 PULSTAR V SERIES
5-Phase Stepping Motors and Drivers* *High Torque Version*

A New Generation of High Performance 5-Phase Stepping Motor/Driver Package.

- Very High Torque in a Compact Package.
- 500 (Full) / 1000 (Half) Mechanical Steps per Revolution.
- Virtually No Low Speed Resonance.
- Unit Includes Motor & Driver with Built-in Power Supply.
- Motor & Driver Are Perfectly Matched Unit (No Adjustments Necessary).
- Many Other Beneficial Features.



* Protected by US/Intl. Patents

UPS 52 Series **(A) after the unit # denotes single shaft configuration. (B) after the unit # denotes thru-shaft configuration.**

MOTOR SIZE (mm)	MOTOR AND DRIVER COMBINATION UNIT #	MAX. HOLDING TORQUE oz-in (kg-cm)	ROTOR INERTIA oz-in² (g cm²)	STEP ANGLE FULL/HALF	PHASE CURRENT (A)	MOTOR WEIGHT oz (kg)	DRIVER TYPE	MOTOR TYPE
23 (60)	UPS52-564 (A)(B)	58.3 (4.2)	0.87 (175)	0.72°/0.36°	1.4	17.6 (0.5)	UPS52	PF 564 (A)(B)
	UPS52-566 (A)(B)	115.3 (8.3)	1.4 (280)	0.72°/0.36°	1.4	26.4 (0.75)	UPS52	PF 566 (A)(B)
	UPS52-569 (A)(B)	230.5 (16.6)	2.8 (560)	0.72°/0.36°	1.4	45.8 (1.3)	UPS52	PF 569 (A)(B)
34 (85)	UPS52-596 (A)(B)	291.6 (20.9)	7.0 (1400)	0.72°/0.36°	1.4	52.9 (1.5)	UPS52	PF 596 (A)(B)
	UPS52-599 (A)(B)	568 (40.9)	13.5 (2700)	0.72°/0.36°	1.4	88.2 (2.5)	UPS52	PF 599 (A)(B)
	UPS52-5913(A)(B)	873.5 (62.9)	20 (4000)	0.72°/0.36°	1.4	123.4 (3.5)	UPS52	PF 5913 (A)(B)

Other Specifications

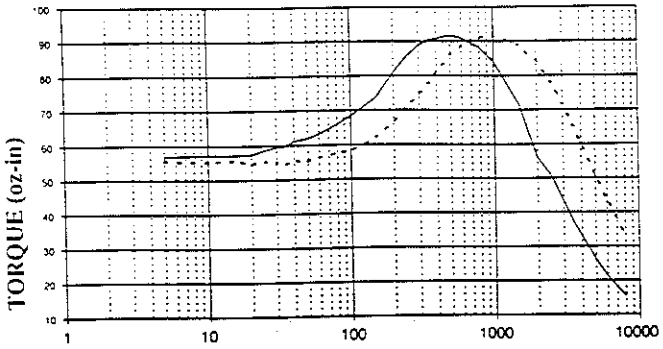
Motor

Step Angle Accuracy	± 3 min.
Shaft Radial Play	0.025 mm max. / load 0.5 Kg
Shaft Axial Play	0.075 mm max. / load 1 Kg
Dielectric Strength	No abnormality detected after the application of 0.5KV at 50Hz between motor windings and frame for duration of one minute.
Insulation Class	Class B
Insulation Resistance	100M ohms or better with 500V potential applied between motor windings and frame at normal ambient temperature and humidity.
Operating Environment Temperature	0°C ~ +50°C

Driver

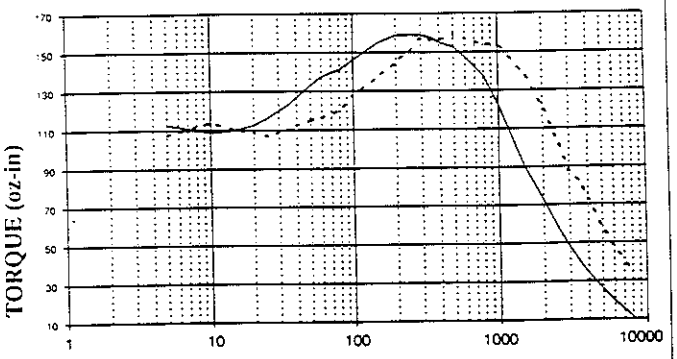
	UPS 52
Drive Type	Star Bi-Polar, Constant Current Chopper
Power Requirements	115 ~ 120V AC. 50/60 Hz
Power Consumption	4 Amp Max.
Built In Functions	Auto current reduction at stand still. Current off. Excitation timing signal output. Driver overheat warning signal output.
Input Pulse Types	STEP and DIRECTION or CW/CCW signal (selectable). All opto isolated. Voltage H = 4 ~ 5V, L = 0 ~ 0.5V. Resistance 220 ohms.
Dielectric Strength	No abnormality detected after the application of AC 1KV between case and power input terminals, case and signal I/O terminals, signal I/O terminals and power input terminals for duration of one minute.
Insulation Resistance	100M ohms or better with 500V potential applied between case and power input terminals and signal I/O terminals.
Operating Environment Temperature	0°C ~ + 40°C

UPS52-564



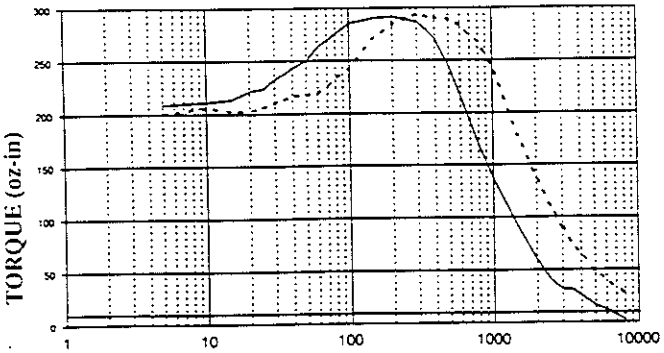
PULSE RATE (PPS) X 10

UPS52-566



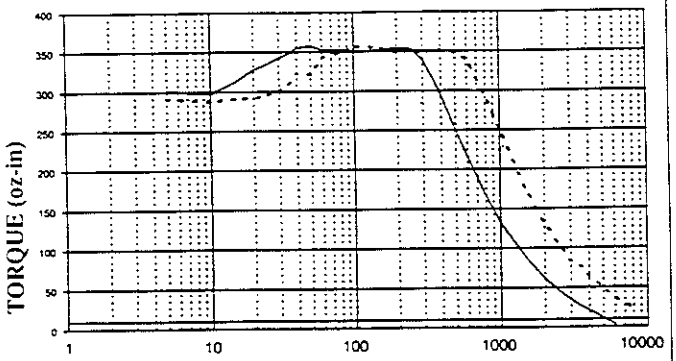
PULSE RATE (PPS) X 10

UPS52-569



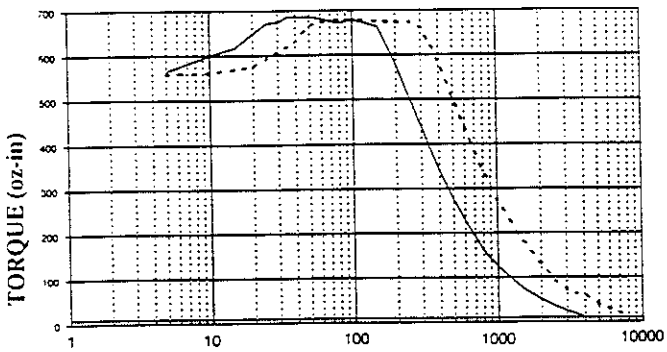
PULSE RATE (PPS) X 10

UPS52-596



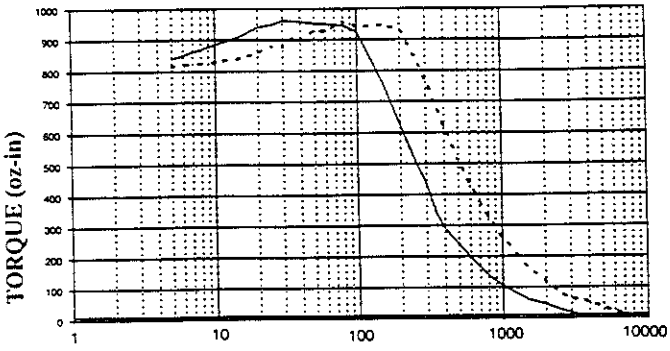
PULSE RATE (PPS) X 10

UPS52-599



PULSE RATE (PPS) X 10

UPS52-5913

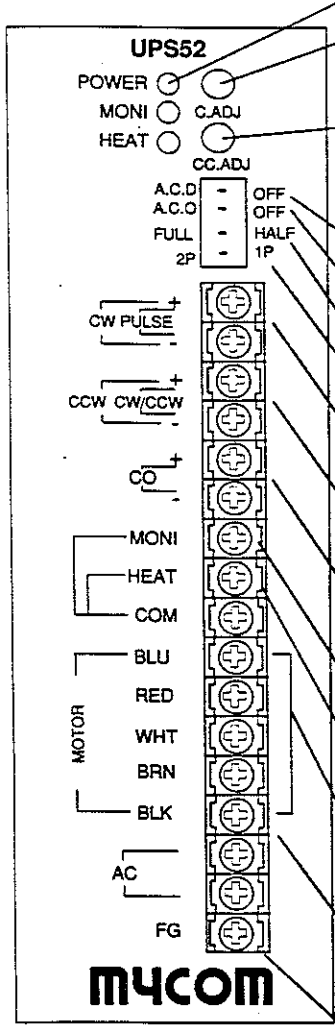


PULSE RATE (PPS) X 10

———— FULL STEP

- - - - - - - - - - - HALF STEP

UPS52 Driver Functions



Power indicator LED

Current Adjust (Motor run current adjustment)
Each driver is pre-adjusted for the applicable motor included with a package. This adjustment **should not be changed** unless a lower current level setting is absolutely needed in order to reduce motor torque and motor/drive heat generation.

CC. Adjust (motor standstill current cutback adjustment)
UPS52 drivers are equipped with an auto-current cutback feature when the motor is at stand still (idle) to reduce motor heat buildup when not running.
Adjustable range is from 20% to 90% of motor run current value which is set by C.ADJ pot. Clockwise rotation of this pot increases motor standing current, and counterclockwise reduces motor standing current. Factory set value is 50%. If motor holding torque at stand still is not needed, this pot may be set at the lowest value (fully counter clockwise) to minimize motor heating. This function is activated 200mS after the motor stops.

Automatic current reduction (current cutback) switch
When this switch is in OFF position, current cutback function is disabled.

Automatic current off.
When this switch is in the ON position and the onboard temperature sensor reaches 158°F (70°C) the driver will automatically cut all current to motor. The OFF position will disable this function.

Step angle selector (Full step = 0.72° Half step = 0.36°)

Input pulse selector.
1P = STEP/DIRECTION Mode 2P = CW/CCW Mode

CW step input terminal (5V negative logic)
(Low or 0V to 0.5V = ON, Hi or 4V to 5V = OFF) Pulse input for CW motor rotation.
When step and direction mode selected, this terminal accepts the STEP input.

CCW step input terminal (5V negative logic)
(Low or 0V to 0.5V = ON, Hi or 4V to 5V = OFF) Pulse input for CCW motor rotation.
When step and direction mode selected, this terminal accepts the DIRECTION input.

Motor current shutoff signal input terminal (5V negative logic)
Motor winding current turn-off signal input. When this input terminal is kept ON, the driver will output no motor current. CAUTION: The motor will produce no holding torque.

Excitation timing ZERO output terminal
This terminal provides opto isolated open collector output for excitation timing origin (step #0) of the motor. A green LED indicator which will light when this terminal turns on is provided for visual timing representation.

Driver overheat alarm output terminal
This terminal provides opto isolated open collector output for driver overheat conditions when the onboard temperature sensor detects the driver's heat sink temperature to exceed 158°F (70°C).

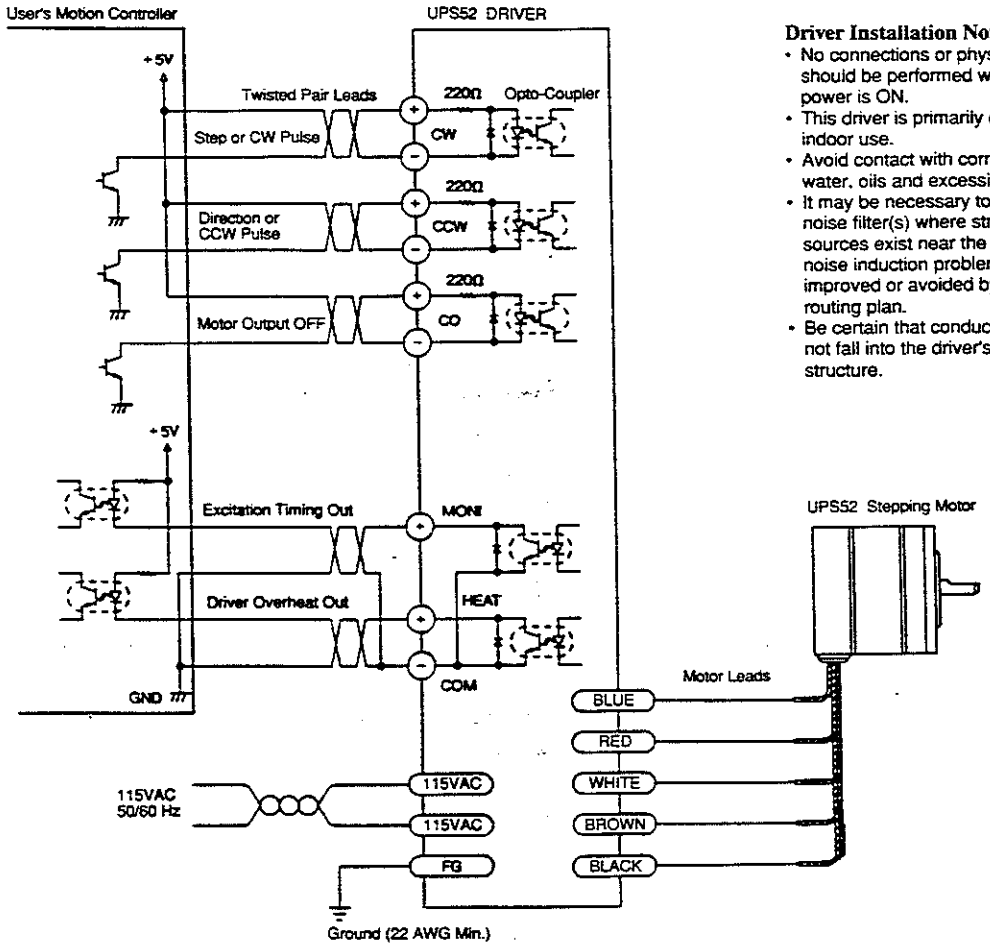
Motor lead terminals (Motor power outputs)
Connect color coded motor leads to these terminals.

AC power input terminal
Connect 115V (nominal) AC (50/60Hz) line power to these terminals. Use 20 AWG or larger leads for connections.

Frame Ground
Connect to system ground point.

CAUTION: TO AVOID INJURY BY ELECTRICAL SHOCK & DAMAGE, DO NOT TOUCH MOTOR LEAD TERMINALS WHEN THE POWER IS ON! MAXIMUM MOTOR CHOPPING VOLTAGE WILL APPROACH 140VDC. NO CONNECTION CHANGES MAY BE MADE WHILE THE DRIVE POWER IS ON. HAZARDOUS VOLTAGES MAY BE PRESENT AT THESE TERMINALS. IF THE MOTOR OUTPUTS ARE SHORT CIRCUITED, SERIOUS DAMAGE TO THE DRIVER WILL RESULT. THIS WILL NOT BE COVERED UNDER WARRANTY, AND WILL VOID REMAINDER OF THE ORIGINAL PRODUCT WARRANTY. IF MOTOR LEAD TO TERMINAL CONNECTION IS TO BE MADE VIA A CONNECTOR SET, DO NOT USE MALE CONNECTORS OF ANY TYPE TO TERMINATE DRIVER OUTPUTS TO THE MOTOR. ALWAYS USE FEMALE CONNECTOR ON DRIVER OUTPUT SIDE TO AVOID POSSIBLE SHORT CIRCUIT ACCIDENTS.

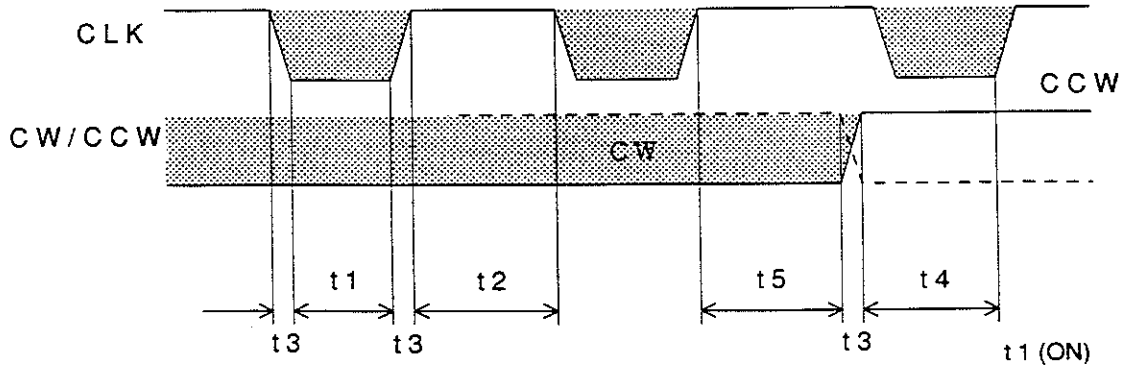
Connections



Driver Installation Notes

- No connections or physical installation should be performed while the driver power is ON.
- This driver is primarily designed for indoor use.
- Avoid contact with corrosive materials, water, oils and excessive dust.
- It may be necessary to install a line noise filter(s) where strong noise sources exist near the driver. The line noise induction problems may be improved or avoided by a careful wire routing plan.
- Be certain that conductive particles do not fall into the driver's internal structure.

Input Pulse Waveform



t1 (ON)	≧ 6μs
t2 (OFF)	≧ 10μs
t3	≦ 2μs
t4	≧ 20μs
t5	≧ 24μs

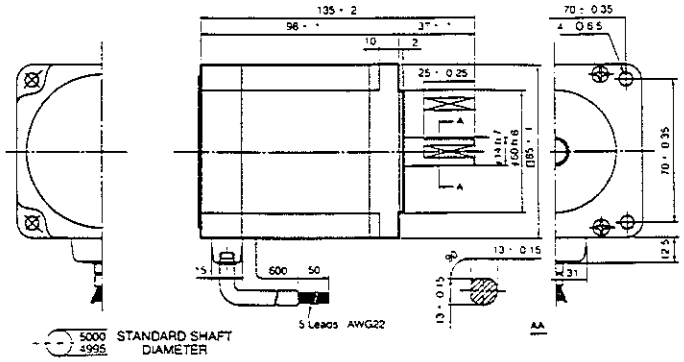
1. Input voltage: High = 4V to 5V, Low = 0V to 0.5V
2. Required input pulse characteristics
   Pulse duty: 50% or less, Width: 6 micro sec. or more, Rise/Fall time: 2 micro sec. or less.
3. If the input voltage exceeds 5V, use a series resistor of an appropriate value to limit the current flow through the opto-coupler LED to 15mA.

UPS 52 Series Motor Dimensions

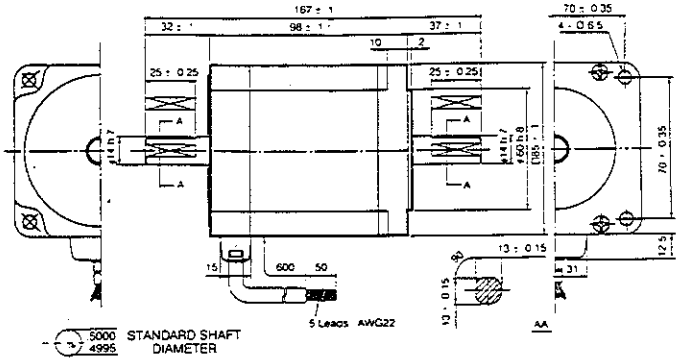
Unit: (mm)

All dimensions are shown in millimeters. To obtain inch equivalents, divide given number by 25.4 (ex. 85 mm ÷ 25.4 = 3.346 in.)

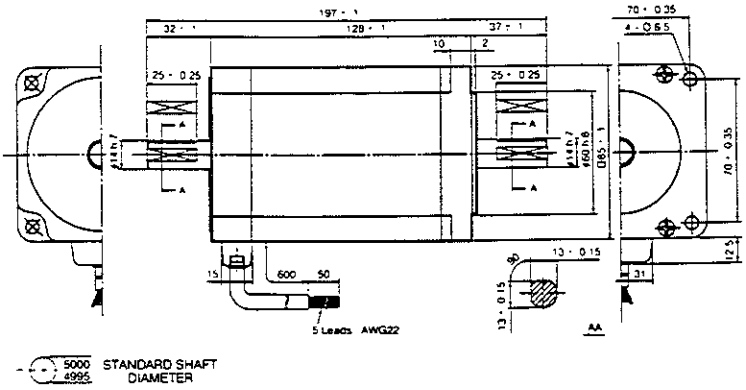
UPS52-599A (Single Shaft)



UPS52-599B (Through Shaft)

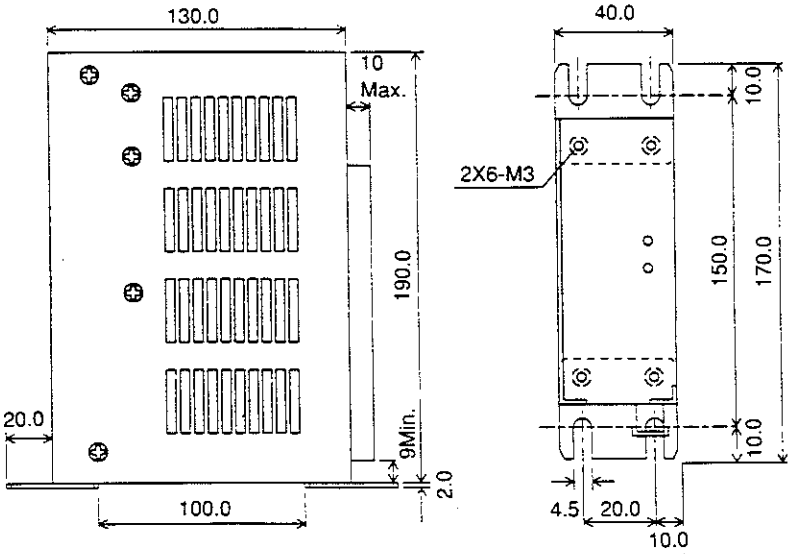


UPS52-5913B (Through Shaft)



UPS 52 Driver Dimensions

Unit: (mm)



DRIVER WEIGHT: 2 lb (0.9kg)

A MANUFACTURER OF MOTION CONTROL & FUZZY CONTROL SYSTEMS

Standard shafts available for all 5-phase motors.

D330005/006-2

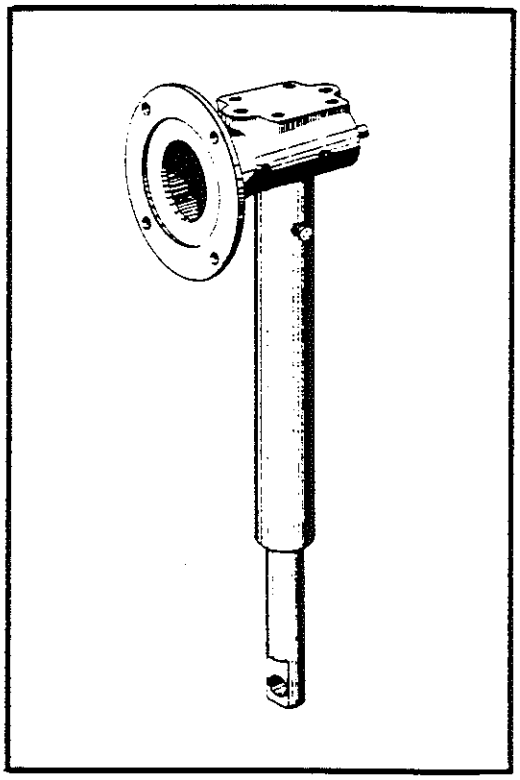
Duff-Norton®

INSTALLATION, OPERATING AND MAINTENANCE INSTRUCTIONS

WITH PARTS LIST

PUBLICATION PART NO. SK-2463-22

MODULAR ACTUATORS



TRANSLATING TUBE ACTUATORS MODEL NUMBERS
M-2464
M-2465

ROTATING SCREW ACTUATORS MODEL NUMBERS
M-2462
M-2463

IMPORTANT — CAUTION

This manual contains important information for the correct installation, operation and maintenance of the equipment described herein. All persons involved in such installation, operation, and maintenance should be thoroughly familar with the contents. To safeguard against the possibility of personal injury or property damage, follow the recommendations and instructions of this manual and keep it for further reference.

WARNING

The equipment shown in this manual is intended for industrial use only and should not be used to lift, support, or otherwise transport people.

Duff-Norton

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SECTION I

INTRODUCTION

1-1. General

This manual provides instructions for the installation, operation, and maintenance of the Duff-Norton® Modular Actuator. It includes proper procedures for the disassembly, cleaning, inspection, rebuilding, lubrication, and assembly of the actuator. To ensure efficient and long, satisfactory use of this unit, read and understand the information herein, and follow the instructions closely.

1-2. Intended Use

The Duff-Norton® Modular Actuators described and illustrated in this manual are intended for industrial use only and should not be used to lift, transport, or otherwise support people.

1-3. Safety Considerations

1. Avoid touching the exterior surfaces of the actuator. Surface temperatures may reach 230°F during prolonged use.
2. Make certain that the electric motor used conforms to the requirements of the actuator.

1-4. Unwarranted Applications

CAUTION

These actuators are not recommended or warranted for use in applications involving the following activities or conditions:

1. Lifting, supporting, or positioning of people where a malfunction might result in bodily injury.
2. Side loading or binding of the actuator. (See Paragraph 4-1, "Improper Loading".)

NOTE

If in doubt about the suitability of the actuator for your application, consult the Duff-Norton Engineering Department.

1-5. Warranty and Warranty Repair

Subject to the conditions stated herein, Duff-Norton will repair or replace, without charge, any parts proven to Duff-Norton's satisfaction to have been defective in material or workmanship. Claims must be made within one year after date of shipment. Duff-Norton will not repair or replace any parts that become inoperative because of improper maintenance, eccentric loading, overloading, chemical or abrasive action, excessive heat, or other abuse.

Equipment and accessories not of Duff-Norton's manufacture are warranted only to the extent that they are warranted by the manufacturer, and only if the claimed defect arose during normal use, applications and service. Equipment which has been altered or modified by anyone without Duff-Norton's authorization is not warranted by Duff-Norton. EXCEPT AS STATED HEREIN, DUFF-NORTON MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

If you have any questions concerning warranty repair, please consult a Duff-Norton Warehouse and Customer Service Center for the name and address of your nearest Duff-Norton actuator warranty repair facility.

Authorization for return must be granted by the Duff-Norton Company before any equipment may be returned for inspection or warranty repair.

SECTION II

INSTALLATION

Duff-Norton's Modular Actuator is designed to be a versatile piece of equipment which can be used in many different applications; consequently, installation procedures will vary widely with customer requirements.

2-1. Motor Installation

The Modular Actuator is designed to accept a standard NEMA 56 frame electric motor with C-face mounting, to be supplied by the customer. For instructions on installing the motor on the actuator, see Paragraph 5-5, steps 19-21 (these steps apply to both Rotating Screw and Translating Tube actuators).

2-2. Installation of the Actuator

The actuator has two bolt patterns for convenient attachment of the actuator to the application: both the two-hole pattern ($^{17}/_{32}$-inch unthreaded holes 4 inches apart) and the four-hole pattern ($\frac{1}{2}$-20 threaded holes on a 2.55 inch square) can be used to bolt the actuator to a wide variety of mounting points; the four-hole pattern will also accept standard hydraulic type end fittings.

The lifting nut (on Rotating Screw actuators) and the clevis end (on Translating Tube actuators) must be restrained against rotation in order for the actuator to lift its load.

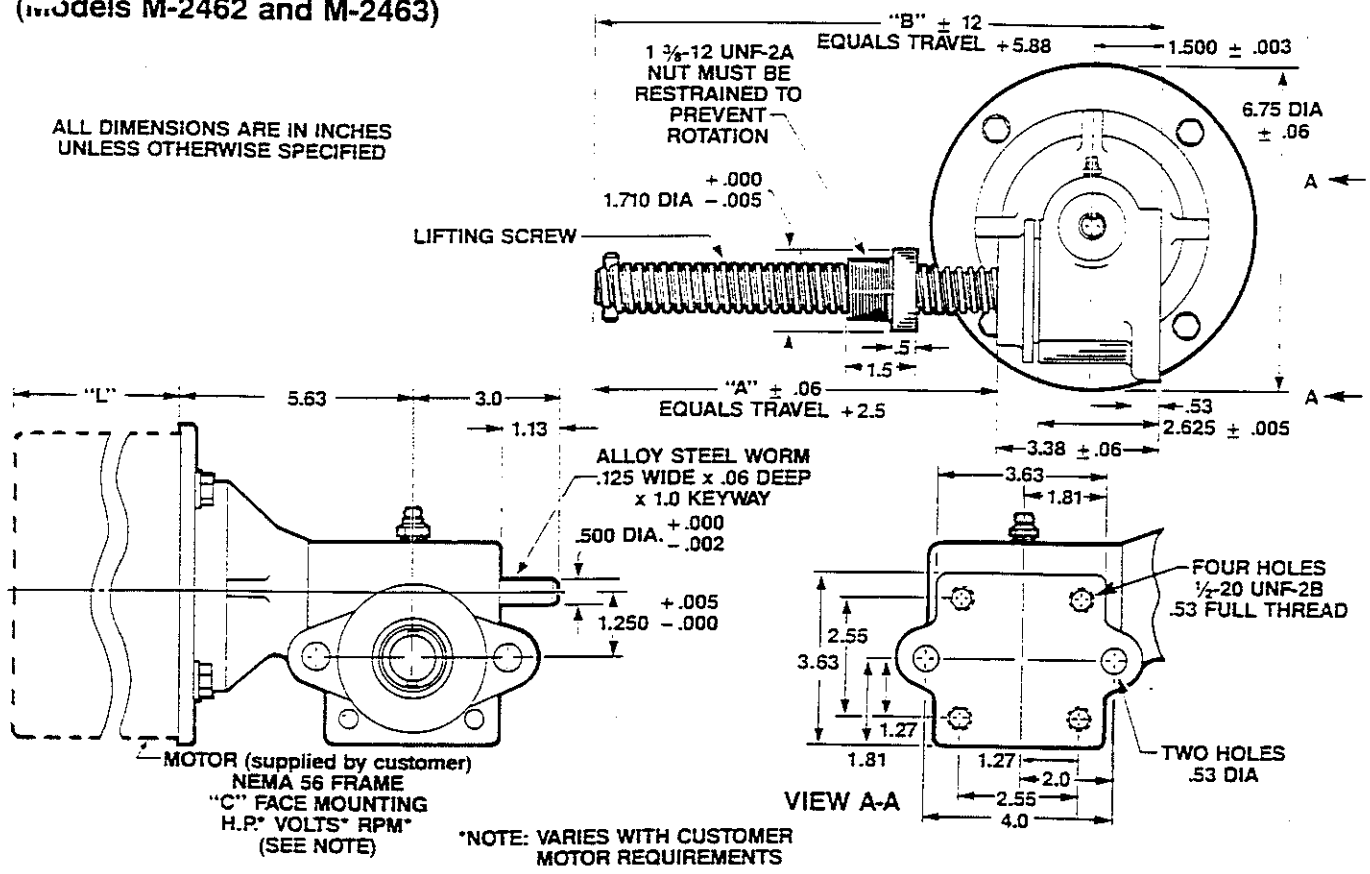
2-3. Limit Switches

Duff-Norton recommends that limit switches be incorporated in the installation to prevent overtravel of the actuator in either direction and to protect the actuator against internal jamming. Duff-Norton limit switches to fit this actuator are available at additional cost.

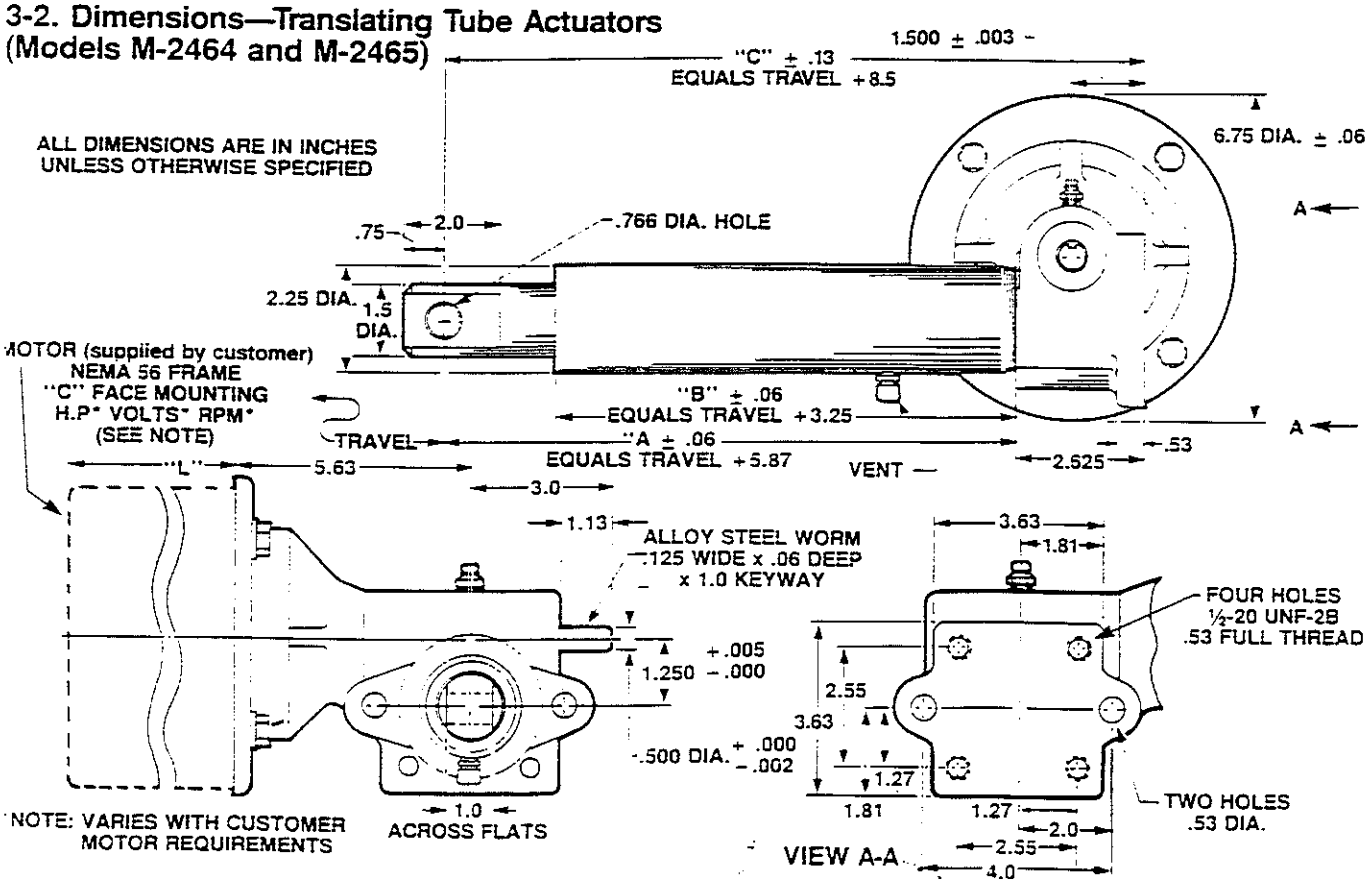
SECTION III

DIMENSIONS AND SPECIFICATIONS

Dimensions—Rotating Screw Actuators (Models M-2462 and M-2463)



3-2. Dimensions—Translating Tube Actuators (Models M-2464 and M-2465)



3-3. SPECIFICATIONS

Model No.	Screw Dia.	Turns of Worm/1" Travel		Torque lb/in @ 1000 lb Load		Motor RPM	Rated Load						Lifting Speed in/min	
		Ratio		Ratio			⅓ hp Motor		½ hp Motor		¾ hp Motor		Ratio	
		5:1	20:1	5:1	20:1		Ratio		Ratio		Ratio			
							5:1	20:1	5:1	20:1	5:1	20:1	5:1	20:1
M-2462 M-2464	.875 Dia. Acme .25 Pitch R.H. Double	10	40	39	18	1725	300	700	500	1000	700	1500	170	43
						1140	450	1000	700	1500	1100	2000	114	28
M-2463 M-2465	1.0 Dia. Acme .25 Pitch R.H. Single	20	80	29	14	1725	400	900	600	1400	900	2000	86	21
						1140	600	1400	900	2000	1400	2000	57	14

NOTE: 1. Models M-2462 and M-2464 are self-lowering and a motor brake should be used.
2. Models M-2463 and M-2465 may drift 0.75 in (20:1 ratio) to 2.0 in (5:1 ratio) when the motor is shut off. If this is undesirable, a motor brake should be used.

SECTION IV

OPERATION, MAINTENANCE, AND INSPECTION

4-1. Improper Loading

WARNING

The actuator must NOT be subjected to side loading or binding (i.e., a bending moment across the actuator) at any point in its travel. It is the responsibility of the installer to ensure that the mounting points cannot transmit such loading to the actuator anywhere between full retraction and full extension. Failure to observe this warning will void the warranty on the actuator.

4-2. Clevis Pins

The axes of the clevis pins should be parallel so that the actuator can pivot without binding. A few drops of oil should be applied to the clevis pins on installation and periodically thereafter.

4-3. Lubrication

When lubricating this actuator, use only Alvania EPl grease from Shell Oil Company.

The actuator should be lubricated periodically (see NOTE under Paragraph 4-4, "Inspection"), using the grease fitting. On Rotating Screw actuators, the lifting screw and nut can be lubricated by painting a light coat of grease on the screw at a point that passes through the nut. To lubricate the lifting screw and nut on a Translating Tube actuator, first loosen the set screws and unscrew the outer tube from the housing to expose the lifting screw threads.

The actuator should be disassembled, cleaned, inspected, and relubricated after 500,000 inches of travel under normal conditions, or earlier if the need is indicated by inspection or by a squealing from the lifting screw and nut area. Follow the instructions in Section V to overhaul the actuator.

4-4. Inspection

The actuator should be inspected periodically (see NOTE below), with attention given to the following items:

1. Clevis ends for wear, cracks, distortion, or other degradation or damage.
2. Loose bolts, screws, or other hardware on the actuator or its mounting points.
3. Limit switches (if so equipped) for proper setting and operation.
4. Lifting screw, lifting nut, and gear set for excessive wear or lack of lubrication (see instructions under Paragraph 4-3, "Lubrication").

Any of the above deficiencies should be corrected before the actuator is returned to service.

NOTE

Periodic Inspection and Lubrication: The exact periods for inspection and lubrication of the actuator cannot be predetermined because of the many variables involved, such as frequency of operation, type and magnitude of loading, and operational environment. Determination should be based on the user's experience. It is recommended that the user begin with a weekly inspection, extending the inspection period to monthly, quarterly, or annually, based on his weekly experience.

SECTION V

DISASSEMBLY AND ASSEMBLY

5-1. Lubricant

When rebuilding this actuator, use only Alvania EPl grease from Shell Oil Company.

5-2. Required Tools

A bearing puller and press, a soft jaw table clamp, and common hand tools are required for proper disassembly and assembly of the actuator.

5-3. General Procedures

Duff-Norton recommends following these procedures during disassembly and assembly of the actuator:

1. Tag critical parts to facilitate reassembly.
2. Mark mating surfaces to ensure proper meshing.
3. Clean and lubricate parts as required.
4. Replace all seals at time of rebuild.

5. Replace any screws, washers, and other small common parts that are damaged in any way.

4. Disassembly—Rotating Screw Actuators (Models M-2462 and M-2463)

Disassemble the Duff-Norton® Rotating Screw Modular Actuator as follows, referring to Figure 6-1 on page 10. Read the instructions thoroughly before disassembling the actuator.

NOTE

For disassembly procedures for Translating Tube actuators, see Paragraph 5-6.

NOTE

Disassembly should be undertaken on a clean cloth.

1. Remove the four cap screws (B) with lock washers (F) that attach the motor (A) to the shell (9) flange, and remove the motor from the shell. Half the flexible coupling (5a) will come with the motor shaft, and the other half (5a) will remain on the worm shaft (4). The flexible spider (5b) may stay with either half of the coupling.
2. Remove the set screw (5c) from the motor half of the coupling (5a), and remove the coupling half and the key (E) from the motor shaft.
3. Remove the pipe plug (7) and the grease fitting (8) from the shell (9).
4. Remove the set screw (5c) from the worm half of the coupling (5a) by inserting the set screw wrench through the pipe plug hole.
5. Remove the coupling half (5a) and the key (18) from the worm shaft (4).

When disassembling an actuator equipped with limit switches, follow steps 6 and 7 below. If the actuator is not equipped with limit switches, proceed directly to step 8.

6. Remove the two socket head cap screws (28) and the one long hex head cap screw (26) from the limit switch adapter (29), and remove the limit switch box (D) from the limit switch adapter.
7. Remove the two half dog point sets screws (30) from the shell (9) and remove the limit switch adapter (29) from the shell (see NOTE below).

NOTE

It may be necessary to use heat to overcome the adhesive in order to remove the limit switch adapter from the shell.

8. Remove the two set screws (10) from the shell (9), and unscrew the shell cap (19) from the shell.
9. Remove the shell cap, lifting screw, bearing, and gear assembly from the shell (9).
10. Remove the retaining ring (1) from the shell (9).
11. Remove the worm (4) by pressing on the motor end of the worm shaft. The worm bearing (2) next to the retaining ring (1) groove will be driven out by the worm. The other worm bearing (2) should remain in the shell until the load bearing cup (13) has been removed.
12. Press the worm bearing (2) off the worm (4).
13. Remove the load bearing cup (13) out of the shell (9).
14. Remove the remaining worm bearing (2) from the shel (9).
15. Clamp the lifting screw (17) in a vise, using soft jaws to prevent damage to the screw.
16. Remove the lock nut (12), and remove the gear (14), key (18), and spacer (15) from the lifting screw (17).
17. Remove the shell cap (19) and lifting nut (20) from the lifting screw (17).
18. Remove the stop pin (16) from the lifting screw (17) if necessary.
19. Remove the two load bearing cones (13) from the gear (14).

Disassembly of the actuator is now complete.

5-5. Assembly—Rotating Screw Actuators (Models M-2462 and M-2463)

Assemble the Duff-Norton® Rotating Screw Modular Actuator as follows, referring to Figure 6-1 on page 10. Read the instructions thoroughly before assembling the actuator

NOTE

For assembly procedures for Translating Tube actuators, see Paragraph 5-7.

NOTE

Be sure all parts are clean and dry before assembling the actuator.

1. Assemble one load bearing cup (13) into the shell (9), and the other load bearing cup into the shell cap (19).
2. Assemble one worm bearing (2) into the motor mounting flange end of the shell (9) (see **NOTE** below).

NOTE

The bearing must be installed from the opposite end of the shell.

3. Notice that one end of the worm (4) has a hole in the center of the shaft, and one end does not. Press the remaining worm bearing (2) on to the end of the shaft WITH the hole.
4. Assemble the worm (4) into the shell (9) and worm bearing (2), and then install the retaining ring (1) in the shell.
5. Grease the two load bearing cones (13) and install them on the worm gear (14) bearing journals.
6. Install the stop pin (16) in the end of the lifting screw (17), taking care to center the pin in the screw.
7. Screw the lifting nut (20) on to the lifting screw (5) with the flange end away from the stop pin (16).
8. Slide the shell cap and bearing cup assembly over the lifting screw threads, with the bearing cup (13) facing the turned end of the lifting screw.
9. Slip the spacer (15) over the end of the lifting screw (17), with the flange toward the screw thread.
10. Install the key (18) in the keyway in the lifting screw (17).

11. Slide the gear and load bearing cone assembly over the end of the lifting screw (17).
12. Thread the lock nut (12) on to the end of the lifting screw (17). Clamp the lifting screw between soft jaws in a vise, and tighten the lock nut to 30 ft-lb.
13. Install the lifting screw, shell cap, and gear assembly in the shell (9), taking care to mesh the gear teeth and the worm properly.
14. Pack the gear housing with Shell Alvania EPl grease.
15. Coat the shell cap (19) threads with aluminum antiseize compound. Thread the shell cap into the shell (9), and torque it to 40 ft-lb. Spot drill the shell cap thread O.D. in two places, and install the two set screws (10). Tighten the set screws to hold the shell cap in place.
16. Install the key (6) in the end of the worm (4) shaft on the flange side of the shell (9), and slide a coupling half (5a) onto the worm shaft. The inside face of the coupling should be flush with the worm shaft end. Tighten the coupling set screw (5c) against the key by inserting the set screw wrench through the ⅛-inch pipe tap hole in the shell.
17. Install the pipe plug (7).
18. Install the grease fitting (8).
19. Install the key (E) in the motor shaft and slide the second coupling half (5a) on to the motor shaft, with the inside face of the coupling flush with the end of the motor shaft. Tighten the coupling set screw against the key to lock it in place.
20. Assemble the flexible spider (5b) on to the motor coupling half (5c).
21. Align the motor coupling half (5a) with the worm coupling half (5a) and assemble the motor (A) to the shell (9), aligning the holes in the flange with the tapped holes in the face of the motor. Make sure that the motor is centered in the counterbore, and then install and tighten the four ⅜-16 × ⅞ inch hex head cap screws (B) with lock washers (F) that attach the motor to the flange. Turn the worm shaft extension by hand to be certain that there is no binding of the motor and the actuator.

This completes the assembly procedures for actuators not equipped with limit switches. When assembling an actuator equipped with limit switches, continue with the instructions below.

22. Apply two or three drops of Loc-Tite No. 35 Extra Strength Retaining Ring Compound to the shell bore.

If a new (replacement) limit switch adapter is being installed, follow steps 23 and 24 below. If a used (previously spot drilled) adapter is being installed, proceed directly to step 25.

23. Install the limit switch adapter (29) in the shell (9), making sure that the adapter bottoms out against the retaining ring (1). Orient the four tapped holes in the limit switch adapter to line up with the four motor mounting holes in the housing flange.
24. Spot drill the limit switch adapter (29) in two places and install the two half dog point set screws (30). Proceed directly to step 27.
25. Install the limit switch adapter (29) in the shell (9), aligning the spot drilled holes in the adapter with the tapped holes in the shell.
26. Install the two half dog point set screws (30).
27. Aligning the slot in the limit switch worm shaft with the pin in the actuator worm, install the limit switch box on the adapter (29) in the desired position.

Assembly of the actuator is now complete.

5-6. Disassembly—Translating Tube Actuators (Models M-2464 and M-2465)

Disassemble the Duff-Norton® Translating Tube Modular Actuator as follows, referring to Figure 6-2 on page 11. Read the instructions thoroughly before disassembling the actuator.

NOTE

For disassembly procedures for the Rotating Screw actuators, see Paragraph 5-4.

NOTE

Disassembly should be undertaken on a clean cloth.

1. Remove the four cap screws (B) with lock washers (F) that attach the motor (A) to the shell (9) flange, and remove the motor from the shell. Half the flexible coupling (5a) will come with the motor shaft, and the other half (5a) will remain on the worm shaft (4). The flexible spider (5b) may stay with either half of the coupling.
2. Remove the set screw (5c) from the motor half of the coupling (5a), and remove the coupling half and the key (E) from the motor shaft.
3. Remove the pipe plug (7) and the grease fitting (8) from the shell (9).
4. Remove the set screw (5c) from the worm half of the coupling (5a) by inserting the set screw wrench through the pipe plug hole.
5. Remove the coupling half (5a) and the key (6) from the worm shaft (4).

When disassembling an actuator equipped with limit switches, follow steps 6 and 7 below. If the actuator is not equipped with limit switches, proceed directly to step 8.

6. Remove the two socket head cap screws (28) and the one long hex head cap screw (26) from the limit switch adapter (29), and remove the limit switch box (D) from the limit switch adapter.
7. Remove the two half dog point set screws (30) from the shell (9) and remove the limit switch adapter (29) from the shell (see **NOTE** below).

NOTE

It may be necessary to use heat to overcome the adhesive in order to remove the adapter from the shell.

8. Remove the two set screws (10) from the shell (9), and remove the outer tube (24) by first unscrewing it from the shell and then sliding it off over the translating tube.
9. Remove the translating tube, lifting screw, bearing, and gear assembly from the shell (9).

10. Remove the retaining ring (1) from the shell (9).
11. Remove the worm (4) by pressing on the motor end of the worm shaft. The worm bearing (2) next to the retaining ring (1) groove in the shell (9) will be driven out by the worm. The other worm bearing (2) should remain in the shell until the load bearing cup (13) has been removed.
12. Press the worm bearing (2) off the worm (4).
13. Remove the load bearing cup (13) out of the shell (9).
14. Remove the remaining worm bearing (2) from the shell (9).
15. Remove the remaining load bearing cup (13) from the outer tube (24).
16. Remove the wiper scraper seal (22) from the outer tube (24), and if necessary press the guide bushing (23) out of the outer tube.
17. Clamp the lifting screw (17) in a vise, using soft jaws to prevent damage to the screw.
18. Remove the lock nut (12), and remove the gear (14), key (18), and spacer (15) from the lifting screw (17).
19. Remove the two load bearing cones (13) from the gear (14).
20. Screw the lifting screw (17) into the translating tube until the screw bottoms out and cannot rotate farther, or until the screw thread becomes disengaged from the lifting nut (19) thread.

    Drive the four pins (20) just far enough into the lifting nut (19) to clear the translating tube wall; then remove the translating tube from the nut.
22. Remove the lifting screw (17) from the lifting nut (19).
23. Remove the four pins (20) by pressing each one the rest of the way through the lifting nut wall.
24. Remove the stop pin (16) from the lifting screw (17) if necessary.

Disassembly of the actuator is now complete.

5-7. Assembly—Translating Tube Actuators (Models M-2464 and M-2465)

Assemble the Duff-Norton® Translating Tube Modular Actuator as follows, referring to Figure 6-2 on page 11. Read the instructions thoroughly before assembling the actuator.

NOTE

For assembly procedures for Rotating Screw actuators, see Paragraph 5-5.

NOTE

Be sure all parts are clean and dry before assembling the actuator.

1. Assemble a load bearing cup (13) into the shell (9).
2. Assemble one worm bearing (2) into the motor mounting flange end of the shell (9) (see **NOTE** below).

NOTE

The bearing must be installed from the opposite end of the shell.

3. Notice that one end of the worm (4) has a hole in the center of the shaft, and one end does not. Press the remaining worm bearing (2) on to the end of the shaft WITH the hole.
4. Assemble the worm (4) into the shell (9) and worm bearing (2), and then install the retaining ring (1) in the shell.
5. Install the guide bushing (23) and the wiper scraper seal (22) in the end of the outer tube (24) opposite the threaded end.
6. Install a load bearing cup (13) in the threaded end of the outer tube (24).
7. Grease the two load bearing cones (13) and install them on the worm gear (14) bearing journals.
8. Install the stop pin (16) in the end of the lifting screw (17), taking care to center the pin in the screw.
9. Screw the lifting nut (19) on to the lifting screw (17) with the flange end away from the stop pin (16).
10. Fill the translating tube (16) approximately half full of Shell Alvania EP1 grease.
11. Slide the translating tube and clevis end assembly over the lifting screw (17) and on to the lifting nut (19), lining the four holes in the translating tube up with the four holes in the lifting nut (19).
12. Press the four pins (20) into place (see **CAUTION** below).

CAUTION

The pins should end up extending $\frac{1}{32}$ inch beyond the O.D. of the translating tube, and must NOT jam against the O.D. of the lifting screw thread. If the pins are pressed too far into the lifting nut, they will bind against the lifting screw thread, perhaps damaging the screw surface.

NOTE

The lifting nut should now rotate freely on the lifting screw. If the nut does not rotate freely on the screw, follow steps 21-24 under Paragraph 5-6, "Disassembly", and then resume "Assembly" at step 9.

13. Slip the spacer (15) over the end of the lifting screw (17) with the flange toward the lifting screw shoulder.
14. Install the key (18) in the keyway in the lifting screw (17).
15. Slide the gear and load bearing cone assembly over the end of the lifting screw (17).
16. Thread the lock nut (12) on to the end of the lifting screw (17). Clamp the lifting screw between soft jaws in a vise and tighten the lock nut to 30 ft-lb.
17. Install the lifting screw, translating tube, and gear assembly in the shell (9), taking care to mesh the gear teeth and the worm properly.
18. Pack the gear housing with Shell Alvania EP1 grease.
19. Make sure that a load bearing cup (13) has been installed in the end of the outer tube (24) (see step 6). Lightly grease the O.D. of the translating tube assembly, and slide the outer tube over the translating tube, threaded end first.
20. Thread the outer tube (24) into the shell (9), and tighten it to 40 ft-lb. Spot drill the outer tube thread in two places.

and install and tighten the two set screws (10) to hold the outer tube in place.

21. Install the key (6) in the end of the worm (4) shaft on the flange side of the shell, and slide a coupling half (5a) on to the worm shaft. The inside face of the coupling should be flush with the worm shaft end. Tighten the coupling set screw (5c) against the key by inserting the set screw wrench through the ⅛-inch pipe tap hole in the shell.
22. Install the pipe plug (7).
23. Install the grease fitting (8).
24. Install the key (E) in the motor shaft and slide the second coupling half (5a) on to the motor shaft, with the inside face of the coupling flush with the end of the motor shaft. Tighten the coupling set screw against the key to lock it in place.
25. Assemble the flexible spider (5b) on to the motor coupling half (5c).
26. Align the motor coupling half (5a) with the worm coupling half (5a) and assemble the motor to the shell (9), aligning the holes of the flange with the tapped holes in the face of the motor. Make sure that the motor is centered in the counterbore, and then install and tighten the four ⅜-16 x ⅞ inch hex head cap screws (B) with lock washers (F) that attach the motor to the flange. Turn the worm shaft extension by hand to be certain that there is no binding of the motor and the actuator.

This completes the assembly procedures for actuators not equipped with limit switches. When assembling an actuator equipped with limit switches, continue with the instructions below.

27. Apply two or three drops of Loc-Tite No. 35 Extra Strength Retaining Ring Compound to the shell bore.

If a new (replacement) limit switch adapter is being installed, follow steps 28 and 29 below. If a used (previously spot drilled) adapter is being installed, proceed directly to step 30.

28. Install the limit switch adapter (29) in the shell (9), making sure that the adapter bottoms out against the retaining ring (1). Orient the four tapped holes in the limit switch adapter to line up with the four motor mounting holes in the housing flange.
29. Spot drill the adapter (29) in two places and install the two half dog point set screws (30). Proceed directly to step 32.
30. Install the limit switch adapter (29) in the shell, aligning the spot drilled holes in the adapter with the tapped holes in the shell.
31. Install the two half dog point set screws (30).
32. Aligning the slot in the limit switch worm shaft with the pin in the actuator worm, install the limit switch box on the adapter (29) in the desired position.

Assembly of the actuator is now complete.

SECTION VI

ILLUSTRATED PARTS LIST

6-1. General

This section contains exploded illustrations of Duff-Norton® Rotating Screw and Translating Tube Modular Actuators. The numbers adjacent to each of the parts on the illustrations is the index number. On the parts listed below, these numbers are keyed to the individual part names.

6-2. PARTS LIST FOR ROTATING SCREW ACTUATORS (Models M-2462 and M-2463)

INDEX NO. Figure 6-1	PART NAME	QTY. REQ.	PART NUMBER
1	Retaining Ring	1	SK-2501-11
2	Worm Bearing	2	SK-2501-10
3	Spring Pin (Worm)	1	S-50-26
4	Worm 5:1 Ratio	1	SK-2465-43
	20:1 Ratio	1	SK-2465-53
5**	Flexible Coupling	1	SK-2465-21
6	Key	1	S-10-2
7	Pipe Plug	1	S-25-13
8	Grease Fitting	1	SK-974-32
9	Shell	1	SK-2465-1
10	Set Screw	2	S-7-10
11	Decal	1	SK-2433-19
12	Lock Nut	1	H-3966-P
13	Load Bearing	2	SK-2501-9

INDEX NO. Figure 6-1	PART NAME	QTY. REQ.	PART NUMBER
14	Worm Gear 5:1 Ratio	1	SK-3502-4
	20:1Ratio	1	SK-2502-14
15	Spacer	1	SK-2465-17
16	Pin (Stop)	1	H-5122-P
17	Screw (M-2463)	1	SK-2465-5-*
	Screw (M-2462)	1	SK-2464-5-*
18	Key (Screw)	1	S-10-72
19	Shell Cap (M-2463)	1	SK-2463-2
	Shell Cap (M-2462)	1	SK-2462-2
20	Lifting Nut (M-2463)	1	SK-2463-6
	Lifting Nut (M-2462)	1	SK-2462-6
26	Hex Hd. Cap Screw	1	S-44-157
27	Lock Washer	3	H-4084-P
28	Soc. Hd. Cap Screw	2	H-2201
29	Limit Switch Adapter	1	SK-2465-11
30	Set Screws	2	S-52-1

* This No. is equal to travel plus 1
** 5a - coupling body
5b - spider
5c - set screw

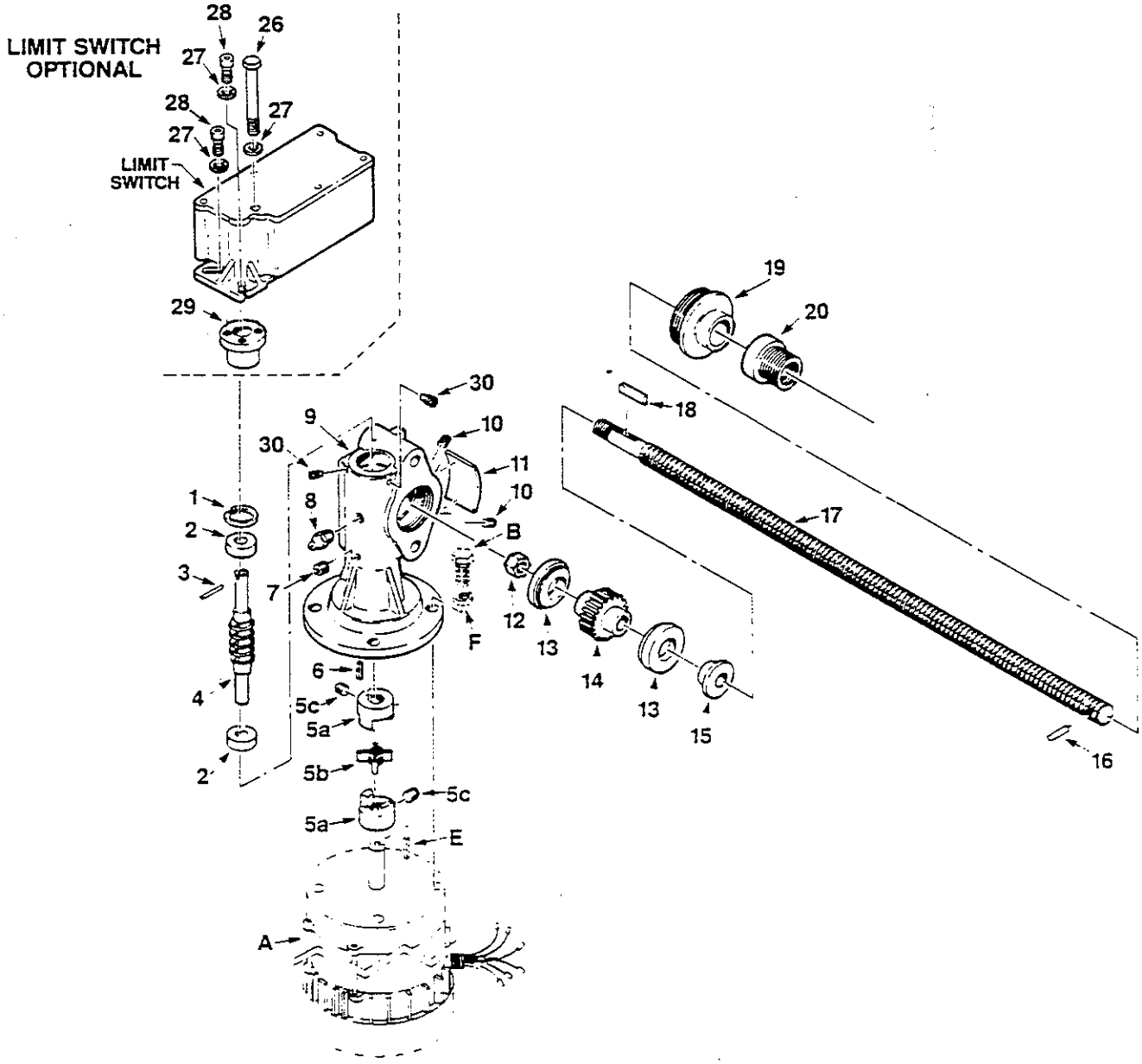


FIGURE 6-1. EXPLODED ILLUSTRATION ROTATING SCREW MODULAR ACTUATORS MODELS M-2462 AND M-2463

6-3. PARTS LIST FOR TRANSLATING TUBE ACTUATORS (MODELS M-2464 and M-2465)

INDEX NO. Figure 6-2	PART NAME	QTY. REQ.	PART NUMBER
1	Retaining Ring	1	SK-2501-11
2	Worm Bearing	2	SK-2501-10
3	Spring Pin (Worm)	1	S-50-26
4	Worm 5:1 Ratio	1	SK-2465-43
	20:1 Ratio	1	SK-2465-53
5**	Flexible Coupling	1	SK-2465-21
6	Key	1	S-10-2
7	Pipe Plug	1	S-25-13
8	Grease Fitting	1	SK-974-32
9	Shell	1	SK-2465-1
10	Set Screw	2	S-7-10
11	Decal	1	SK-2433-19
12	Lock Nut	1	H-3966-P
13	Load Bearing	2	SK-2501-9
14	Worm Gear 5:1 Ratio	1	SK-3502-4
	20:1 Ratio	1	SK-2502-14
15	Spacer	1	SK-2465-17

INDEX NO. Figure 6-2	PART NAME	QTY. REQ.	PART NUMBER
16	Pin (Stop)	1	H-5122-P
17	Screw (M-2465)	1	SK-2465-5-*
	Screw (M-2464)	1	SK-2464-5-*
18	Key (Screw)	1	S-10-72
19	Lifting Nut (M-2465)	1	SK-2465-15
	Lifting Nut (M-2464)	1	SK-2415-15
20	Pin (Nut)	4	H-5164
21	Tube & Clevis Sub-Assembly	1	SK-6415-109-*A
22	Wiper-Scraper Seal	1	SK-6415-16
23.	Guide Bushing	1	SK-6415-23
24	Outer Tube	1	SK-6415-111-*
25	Air Vent	1	SK-2015-218
26	Hex Hd. Cap Screw	1	S-44-157
27	Lock Washer	3	H-4084 P
28	Soc. Hd. Cap Screw	2	H-2201
29	Limit Switch Adapter	1	SK-2465-11
30	Set Screws	2	S-52-1

* This Nut is equal to travel
** 5a - coupling hous
5b - spider
5c - set screw

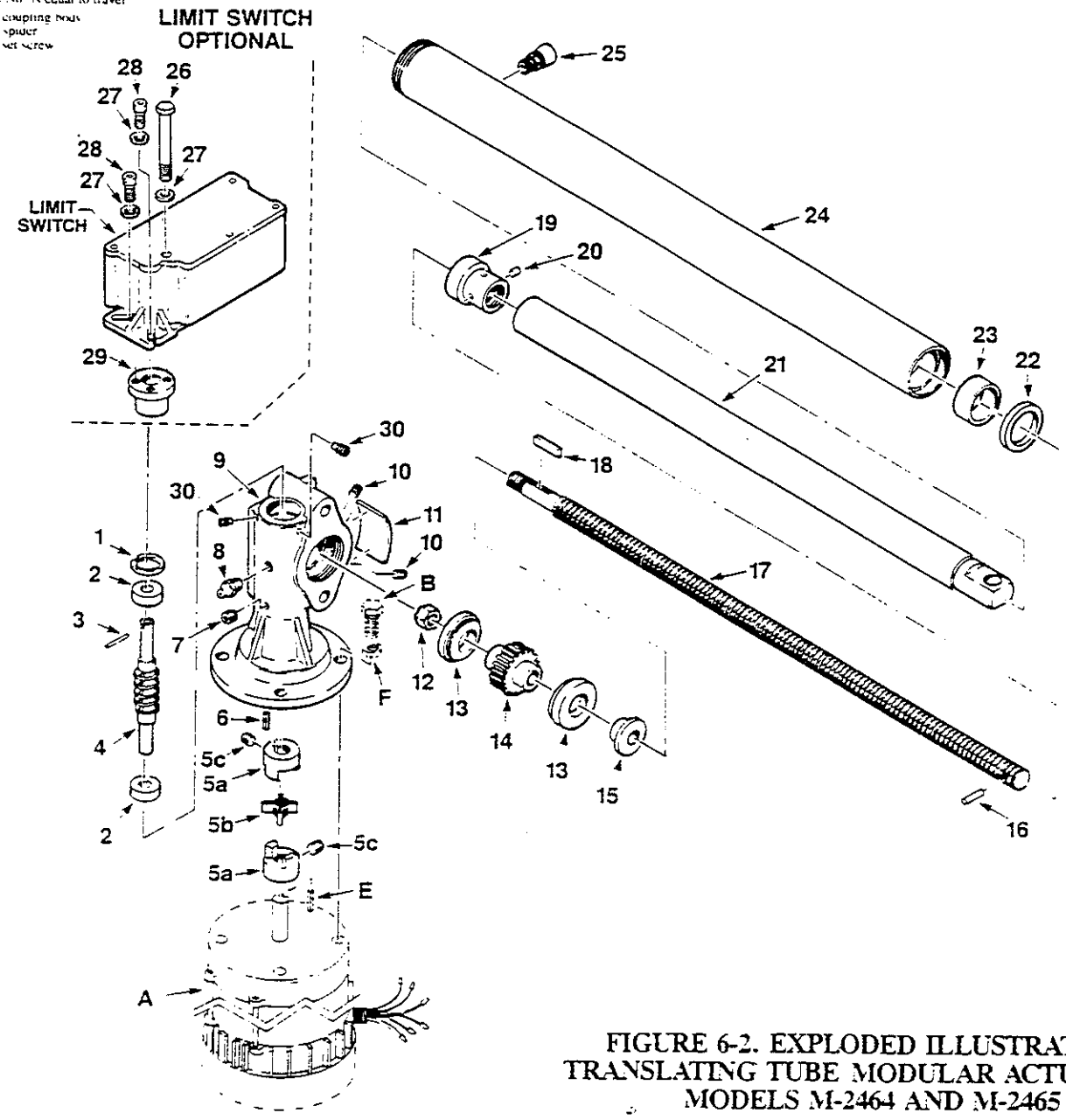
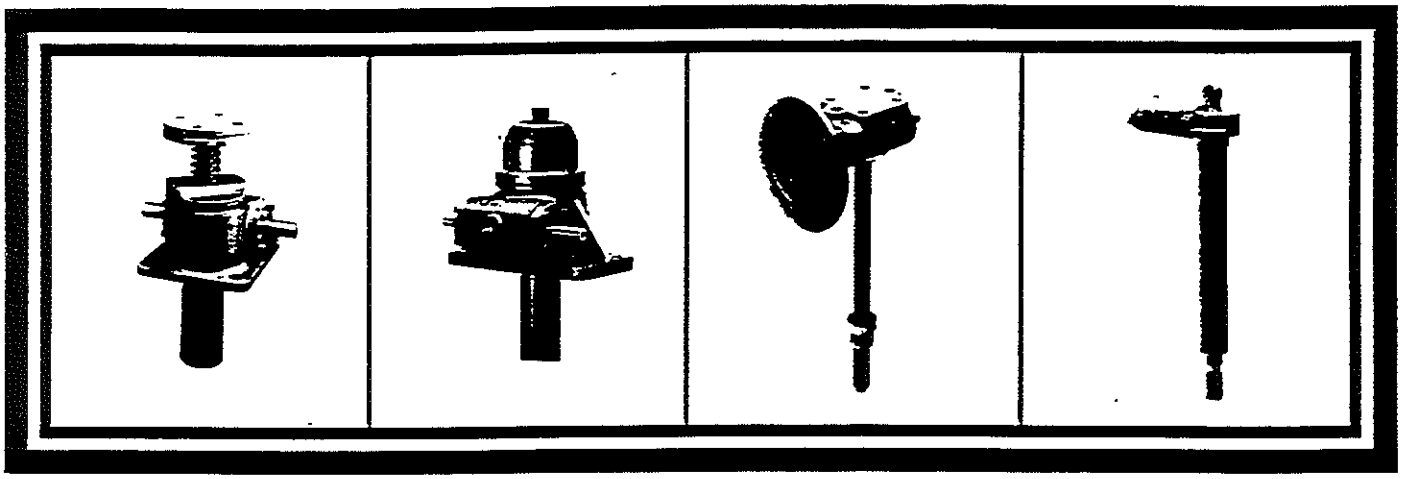


FIGURE 6-2. EXPLODED ILLUSTRATION
TRANSLATING TUBE MODULAR ACTUATORS
MODELS M-2464 AND M-2465

DUFF-NORTON OFFERS A COMPLETE LINE OF MECHANICAL AND ELECTROMECHANICAL ACTUATORS FOR PRECISE POSITIONING OF LOADS UP TO 250 TONS

For reliable motion - in-line or through an arc - Duff-Norton has the right actuator to put your designs in motion. You can select from a comprehensive line of machine screw, ball screw, high-duty cycle, electro-mechanical and modular models to solve your design and production problems.

Duff-Norton® actuators are easy to specify, install and operate. Compact and self-contained, they do not require bothersome selection of individual components nor the attendant maintenance of leaky hydraulic hoses, valves or couplings. They provide many options in meeting a wide range of lifting, pushing, pulling and tensioning requirements.



Machine Screw Actuators. Capacities from ¼ to 250 tons. Worm gear ratios from 5:1 to 50:1. More than 200 standard combinations to choose. Can be operated manually or by gear motor. Used to push, pull, apply pressure, or as linear actuators. Holds loads without creep, when not subject to vibration.

Ball Screw Actuators. Capacities from ½ to 50 tons. Ball bearing screw and nut design reduces friction, increases efficiency as much as 70%. Permits linear motion up to 300 in/min @ 1800 rpm worm shaft speed. Available in 40 standard models. Multiple units may be synchronized for uniform raises to 10 feet.

Modular Actuators Capacities to 2,000 pounds depending on actuator gear ratio and motor horsepower. Engineered for 56 frame motor. C face mounting. Choice of 5:1 or 20:1 gear ratios in rotating screw or translating tube models. Travel lengths to 24 inches. Lift speeds to 170 inches per minute.

Electromechanical Actuators Capacities to ¾ ton. Choice of 115 VAC or 12 VDC motors for indoor or outdoor applications. Standard raises from 3"to 24". Speeds to 145 in/min. All components sealed in a corrosion-resistant, aluminum alloy die-cast housing. Fully adjustable limit switches available on some models.

For more information on these or other Duff-Norton actuators, ask you local distributor or Duff-Norton District Sales Manager for Catalog 172. Or write factory.

WARNING: The equipment shown in this manual is intended for industrial use only and should not be used to lift, support, or otherwise transport people unless you have a written statement from Duff-Norton Company which authorizes the specific actuator unit, as used in your application, as suitable for moving people.

AVAILABLE FROM YOUR LOCAL DUFF-NORTON® ACTUATOR DISTRIBUTOR:

Duff-Norton

P.O. Box 7010
Charlotte, NC 28241-7010

Customer Service (704) 588-2720
Parts Service (704) 588-2323
FAX (704) 588-1994
Telex 575188

Printed in USA

200 SK2463-22?12-9

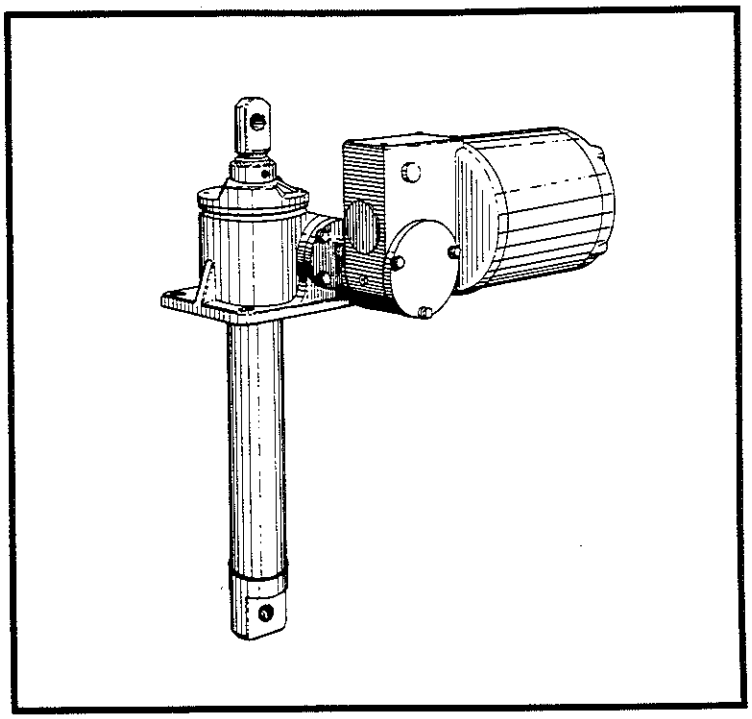
Duff-Norton®

OPERATING, INSPECTION AND MAINTENANCE INSTRUCTIONS

WITH PARTS LIST

PUBLICATION PART NO. SK-2428

MAXI-PAC™ MECHANICAL ACTUATORS



2700 SERIES

IMPORTANT — CAUTION

This manual contains important information for the correct installation, operation and maintenance of the equipment described herein. All persons involved in such installation, operation, and maintenance should be thoroughly familar with the contents. To safeguard against the possibility of personal injury or property damage, follow the recommendations and instructions of this manual and keep it for further reference.

WARNING

The equipment shown in this manual is intended for industrial use only and should not be used to lift, support, or to suspend unattended loads over people.

Duff-Norton

GENERAL

This manual contains instructions for maintenance of the Worm Gear Jactuator unit. It contains descriptions of and procedures for disassembly, cleaning, inspection, rebuild and assembly of the Jactuator unit.

In order to insure that the jacks give good service over a period of years, the following precautions should be taken.

1. Select a jack that has a rated capacity greater than the maximum load that may be imposed on it.

2. The structure on which the jacks are mounted should have ample strength to carry the maximum load, and should be rigid enough to prevent undue deflection or distortion of the jack supporting members.

3. It is essential that the jacks are carefully aligned during installation so that the lifting screws are perfectly plumb and the connecting shafts are exactly in line with the worm shafts. After the jacks, shafting, gear boxes, etc., are coupled together, it should be possible to turn the main drive shaft by hand. If there are no signs of binding or misalignment, the jacking system is then ready for normal operation.

4. The worm gear jacks should have a greater raise than is needed in the actual installation. Should it be necessary to operate the jacks at the extreme limits of travel, it should be done cautiously.

   CAUTION: Do not allow jack travel to go beyond catalog closed height of jack or serious damage to internal jack mechanism may result. Refer to table of specifications for closed height of respective units.

5. The lifting screw should not be permitted to accumulate dust and grit on the threads. If possible, lifting screws should be returned to closed position when not in use.

6. When using a 2700 Series Jactuator unit a periodic check of backlash of the lifting screw thread is recommended to check wear of the worm gear internal threads. The normal backlash on a new unit of this type is approximately .010 inch. Backlash of 50% or more of the thread thickness indicates the need to replace the worm gear.

7. Unless otherwise specified, Jactuator units and gear boxes are shipped packed with grease which should be sufficient for one month of normal operation. For normal operation the Jactuator units and gear boxes should be lubricated about once a month, using one of the following Extreme Pressure greases or their equivalent:

Socony Mobile Oil Co.	Mobilplex E.P. #1
Texaco	Texaco E.P. #1
Gulf Oil Corp.	Gulf Crown E.P. #1
Shell Oil Co.	Shell Alvania E.P. #1

For severe service conditions, the Jactuator unit should be lubricated more frequently using one of the above greases (daily to weekly depending on conditions.) If duty is heavy, an automatic lubrication system is strongly recommended. If ambient temperatures exceed 200°F, consult lubricant manufacturers.

The Worm Gear Jactuator units shown in this catalog are intended for industrial use only and should not be used to lift, support, or otherwise transport human cargo unless you have a written statement from Duff Norton that the specific Jactuator unit as used in your application is suitable for lifting human cargo.

NOTE: For loads of from 25% to 100% of jack capacity, torque requirements are approximately proportioned to the load.

SPECIFICATIONS

Model No.	Type	Rated Lifting Capacity (lbs.)	Maximum Raise at Rated Capacity* (in.)	Lifting Speed (in./min.) Single-Speed Motor	Diameter of Lifting Screw (in.)	Maximum Bending Moment (in.-lbs.)	Minimum Closed Height (in.)	Base Size (in.)	Weight** with 6-in. Raise (lbs.)	Weight for each addl. 1-in. Raise (lbs.)
M-2704	Translating Screw, Inverted	3,000 5,000	65 50	18 9	1½ .375 Pitch Square	4,000	2½	6x8	77	.85
M-2705	Translating Screw, Upright	3,000 5,000	65 50	18 9	1½ .375 Pitch Square	4,000	7	6x8	77	.85
CCM-2705***	Double-Clevis Mount	3,000 5,000	30 30	18 9	1½ .375 Pitch Square	4,000	10 + Raise (Pin to Pin)	6x8	79	1.0
M-2709	Translating Screw, Upright	5,200 9,200	84 65	6 3	2 .500 Pitch Square	9,600	2¾	7½x8¾	94	1.4
M-2710	Translating Screw, Upright	5,200 9,200	84 65	6 3	2 .500 Pitch Square	9,600	8¼	7½x8¾	94	1.4
CCM-2710***	Double-Clevis Mount	5,200 9,200	36 36	6 3	2 .500 Pitch Square	9,600	11¾ + Raise (Pin to Pin)	7½x8¾	96	1.6

*Maximum raise at rated lifting capacity, based on column strength of screw.
**Total weight depends on total raise.
***Raises shown are maximum for compression loads regardless of how light load may be.

For CCM-2705: Max. raise at 3,000 lb. rating (compression) = 30"
Max. raise at 5,000 lb. rating (compression) = 21"
For CCM-2710: Max. raise at 5,200 lb. rating (compression) = 36"
Max. raise at 9,200 lb. rating (compression) = 27"

SECTION I – TRANSMISSION

DISASSEMBLY (See Figure 1)

1. Remove the four machine screws (8) from cover plate (9) and remove plate and gasket (10). Disconnect lead wires and identify for later reassembly.

2. Remove four cap screws (10) and lockwashers (14) from end of motor and remove motor. (See Figure 3)

3. Remove three cap screws (16) and lockwashers (17) from end cap (15) and remove cap and gasket (13).

   NOTE: It will probably be necessary to tap around cap with a hammer or pry with a screwdriver to remove it. Also, note that the bearing will remain on the worm shaft.

4. Remove three cap screws (16) and lockwashers (17) and slip transmission housing assembly off of jack worm shaft. With a suitable gear puller, remove bearing (14) from end of jack worm shaft.

5. Remove retaining ring (1) from housing (7) and retaining ring (2) from worm (4).

6. To remove the worm (4) and bearings (3) and (5), tap gently against the side of the worm thread with a brass drift pin. The worm and both bearings should come out together.

   NOTE: Do not strike very hard. This would separate bearing (5) from worm (4) and a small gear puller would be necessary to remove it from housing.

   After removal of the worm assembly from the housing, remove bearing (3) and bearing (5) from worm (4).

   NOTE: Use a rubber hammer to tap against bearings for removal from worm.

7. Remove plug (6) from worm (4).

   NOTE: The above parts should be identified and set aside for later reassembly.

CLEANING

1. Use degreasing solvent, paint thinner or dry cleaning solvent to remove grease or oil from all parts.

   CAUTION: Remove grease from unit and do not reuse old grease.

   WARNING: Provide adequate ventilation during the use of cleaning agents; avoid prolonged breathing of fumes and contact with skin.

2. Use clean water or a soap solution of 1/4 pound of soap chips to one gallon of hot water for general cleaning of painted surfaces.

3. Dry parts thoroughly with moisture-free compressed air.

NOTE: Before installing new parts, remove any rust preventative, protection grease, etc.

INSPECTION (See Figure 1)

1. Make a visual inspection of housing (7) for broken, cracked or distorted areas. Check threads of all bores for burrs or broken threads.

2. Check worm (4) for burrs or scratches on working or mating surfaces.

3. Check fit of spline in worm (4) and motor shaft. If fits are excessively loose, replace parts as required.

4. Check bearings (3), (5), and (14) for seizure, galling, or play and replace parts as required.

5. Check small common components: (screws, washers, retaining rings, etc.) and replace parts as required.

ASSEMBLY (See Figure 1)

1. Use just a drop of Loctite on drive in plug (6) and drive into worm (4) until seated.

2. a. Slip bearing (5) and bearing (3) onto worm (4) making sure that bearing (3) is on end with retaining ring groove. Slip this assembly into housing (7). When bearing (3) slips into bore, bearing (5) will be lined up for assembly. Use a suitable arbor (such as a piece of tubing and gently tap bearings into place. Tap against bearing (3) until seated and retaining ring groove can be seen. Assemble retaining ring (2) onto worm.

NOTE: Tap gently bearing (3) again with an arbor to make sure that retaining ring is seated in groove.

b. Assemble retaining ring (1) into housing (7).

NOTE: Tap gently bearing (3) again with an arbor to make sure that retaining ring is seated in groove. Worm should turn freely by hand after these steps have been taken.

3. Assemble transmission housing onto jack adapter flange using three cap screws (16), three lockwashers (17) and one gasket (13) (Angle shown in Figure 1 does not illustrate these seven items.)

NOTE: It will probably be necessary to turn the housing a little for ease of assembly. Take care when assembling gasket since the three holes are not 120° apart and damage to the gasket could result.

4. Slip bearing (14) onto jack worm shaft.

NOTE: Tap gently to make sure bearing is seated against shoulder on worm.

5. Assemble end cap (15) and gasket (13) with three cap screws (16) and lockwashers (17).

6. Assemble motor onto housing with four cap screws and lockwashers.

NOTE: Make sure that all leads are through hole in housing so they will not be pinched by motor and housing. Connect motor leads as necessary.

7. Assemble the cover plate (9) and gasket (10) with four machine screws (8).

NOTE: It will be necessary to replace decal on gasket if gasket is replaced.

FIG. NO.	PART NAME	NO. REQ.
1	Ring, Retaining (Housing)	1
2	Ring, Retaining (Worm)	1
3	Bearing, (Worm)	1
4	Worm	1
5	Bearing (Housing)	1
6	Plug, Drive-In	1
7	Housing, Gear	1
8	Screw, Machine	4
9	Plate, Cover	1
10	Gasket, Cover Plate	1
11	Plug, Pipe	2
12	Fitting, Grease	1
13	Gasket, End Cap (one not shown)	2
14	Bearing, End Cap	1
15	Cap, End	1
16	Screw, Cap (three not shown)	6
17	Washer, Lock (three not shown)	6

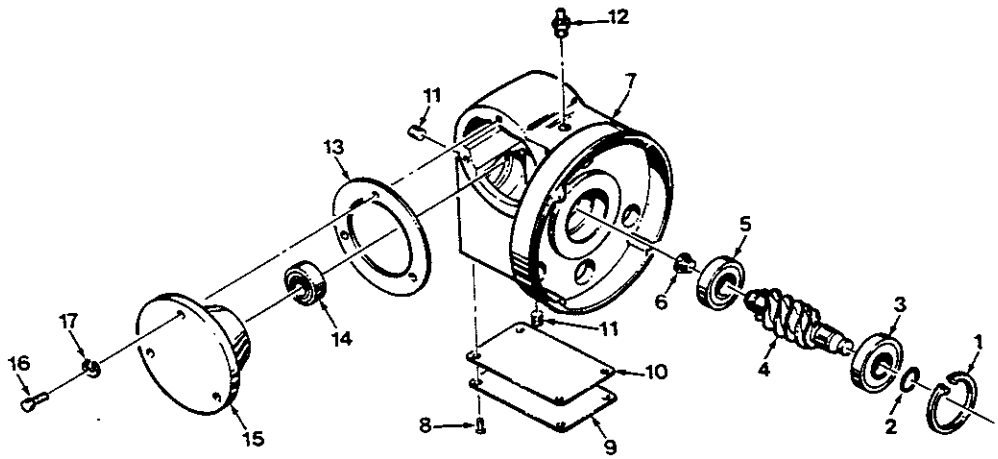


FIGURE 1. TRANSMISSION

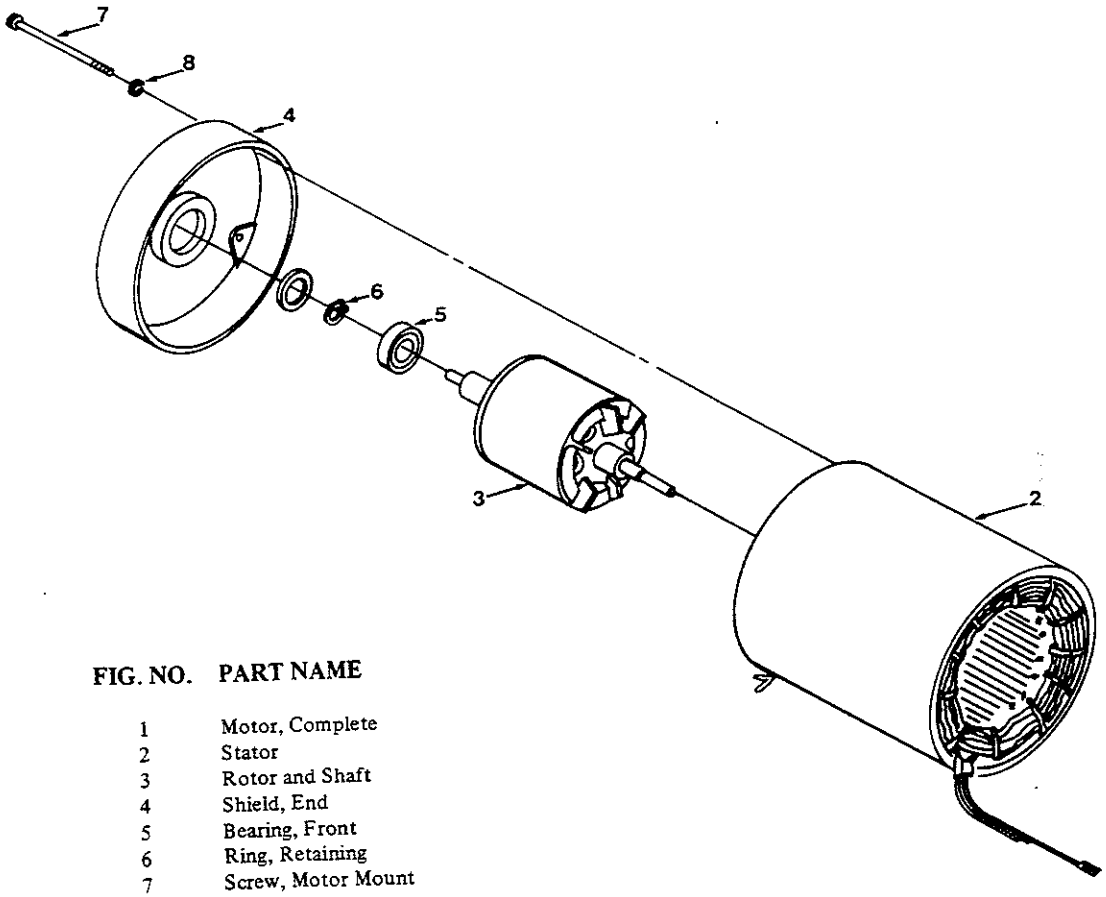


FIG. NO.	PART NAME
1	Motor, Complete
2	Stator
3	Rotor and Shaft
4	Shield, End
5	Bearing, Front
6	Ring, Retaining
7	Screw, Motor Mount
8	Lock Washer

FIGURE 2. MOTOR PARTS – SINGLE SPEED

SECTION II – JACK

GENERAL REBUILD PROCEDURE

1. Tag critical parts to facilitate reassembly.
2. Mark mating surfaces to insure proper meshing.
3. Clean and lubricate parts as required.
4. All seals must be replaced at time of rebuild.
5. All screws, washers and other small common parts must be replaced if mutilated in any way.
6. Replace damaged or frozen lubrication fittings with new fittings.

TOOLS REQUIRED

Bearing puller or press and common hand tools.

DISASSEMBLY (See Figure 3)

1. Remove retaining ring (21), worm gear (22), woodruff key (23), (and remaining retaining ring (21) from worm shaft on 5 ton jack only.)
2. Remove four cap screws (9) and lockwashers (10) from flange adapter (8) and from flange (11) and remove adapter and flange.

   NOTE: Take care not to loosen flange shims (12).
3. With a lead mallet, tap worm shaft back into jack housing until worm drops free inside of shell.
4. Remove bottom pipe (4) from shell (3) (upright models), or from shell cap (2) (inverted models).
5. Loosen two set screws (20) and remove stop nut (19) from end of lifting screw (5).
6. Loosen and remove two set screws (1) in shell cap (2) and remove cap from shell (3).

   NOTE: It may be necessary to break shell cap loose with a hammer.
7. Lift the worm so that the worm threads do not interfere with the worm gear threads. Then grasp the lifting screw (5) and pull the screw, worm gear (6), top load bearing (7), and shell cap (2) from the jack housing.
8. Unscrew worm gear (6) from lifting screw (5) and slip off the shell cap (2).
9. Remove top load bearing (7), which may be attached to either the shell cap (2) or worm gear (6).

   CAUTION: Use only a wooden mallet to tap bearings loose.
10. Remove bottom load bearing (7) which may be attached to either the shell (3) or worm gear (6).
11. Press oil seal (13) out of flange (11).
12. Remove worm (14) and bearing (15) sub assembly from jack housing.

*13. Remove worm bearings (15) from worm (14) with a bearing puller or press.

   **NOTE: This step will not be necessary if worm and worm bearings are not damaged.*

14. If jack is keyed, remove cap screw and lockwasher from shell cap and tap key out of keyway.

CLEANING

1. Use degreasing solvent, paint thinner or dry cleaning solvent to remove grease or oil from all parts.

   CAUTION: Remove grease from unit and do not reuse old grease.

   WARNING: Provide adequate ventilation during the use of cleaning agents; avoid prolonged breathing of fumes and contact with skin.
2. Use clean water or a soap solution of 1/4 pound of soap chips to one gallon of hot water for general cleaning of painted surfaces.
3. Dry parts thoroughly with moisture-free compressed air.

   NOTE: Before installing new parts, remove any rust preventative, protection grease, etc.

INSPECTION (See Figure 3)

1. Make a visual inspection of shell (3) for broken, cracked or distorted areas. Check threads of all bores for burrs or broken threads.

2. Check shell cap (2), bottom pipe (4), lifting screw (5), and worm gear (6) for burrs or scratches on working or mating surfaces.

3. Check fit between lifting screw thread and internal thread in worm gear. If fit is excessively loose, replace worm gear or lifting screw as required.

4. Check fit of worm gear (22), woodruff key (23) and worm (14) and replace as necessary.

5. Check bearings (7) and (15) for seizure, galling or play and replace as required.

6. Check small common components (screws, retaining rings, etc.) and replace as required.

ASSEMBLY (See Figure 3)

1. Press worm bearing cones (15) onto worm shaft (14) making sure that bearing cone is seated properly against shoulder.

   NOTE: Taper roller bearings are used; the small end of the cone should point to the worm end.

2. Position worm shaft (14) in shell (3).

   NOTE: Taper roller bearings are used; tap worm bearing cups (15) into place in shell and assemble bearings.

3. Press oil seal (13) into worm flange (11).

   NOTE: The sealing element should point inward.

4. Position flange adapter (8) with shim (12), (one only), and bolt in place with four cap screws (9) and lockwashers (10).

5. Position flange (11) with two shims (12) and bolt in place with four cap screws (9) and lockwashers (10).

6. Assemble one retaining ring (21) onto worm (14), put woodruff key (23) into place and slip worm gear (22) onto worm shaft. On 5 ton jack, assemble other retaining ring (21) on to shaft.

7. Position bottom load bearing (7) into shell (3).

8. Install worm gear (6) in shell (3).

   CAUTION: Strike each end of worm shaft sharply with a wooden mallet to seat bearing properly. Recheck flange bolts for tightness. Worm should turn freely with minimum drag and end play. If too much end play is present remove shims as required. If worm does not turn freely, add shims as required.

9. Install top load bearing (7) on worm gear (6).

10. Install shell cap (2) and screw down until tight.

    NOTE: Shell cap does not have to bear down against top of shell, there will usually be a gap. This will put a drag on worm. If worm is too hard to turn, back off slightly on shell cap.

11. Spot-drill and lock set screws (1) in place.

    NOTE: If new parts have been installed, it may be necessary to respot holes for these screws.

12. Fill housing fully with grease.

13. Brush lifting screw (5) with a light film of grease and install in jack.

    NOTE: If lifting screw (5) has been replaced, the stop ring (24) will have to be assembled onto the screw before assembly. On inverted models only, install guide bushing (16) and stake threads on inside and outside of jack housing. Then install lifting screw (5).

14. Assemble stop nut (19) onto lifting screw (5) and retighten set screws (20).

15. Screw bottom pipe (4) into shell (3) (upright models) or into shell cap (2) (inverted models).

16. If jack is keyed, line up keyway and install key in shell cap (2) and bolt in place.

17. Operate unit to insure proper functioning of all components prior to final assembly with transmission and motor (See figures 1 & 2).

FIG. NO.	PART NAME	NO. REQ.	FIG. NO.	PART NAME	NO. REQ.
1	Screw, Set	2	14	Worm	1
2	Cap, Shell	1	15	Bearing, Worm	2
3	Shell, Jactuator	1	16	Bushing, Guide (Inverted Models only)	1
4	Pipe, Bottom	1	17	Fitting, Grease	1
5	Screw Assembly, Lifting	1	18	Nameplate	1
6	Worm Gear	1	19	Stop Nut, Bottom	1
7	Bearing, Load	2	20	Screw, Set	2
8	Flange, Adaptor	1	21	Ring, Retaining	2
9	Screw, Cap	8	22	Worm Gear, Worm Shaft	1
10	Washer, Lock	8	23	Key, Woodruff	1
11	Flange, Worm	1	24	Stop Ring, Top	1
12	Shim, Flange	3	25	Spring Pin, Stop Ring	1
13	Seal, Oil	1			

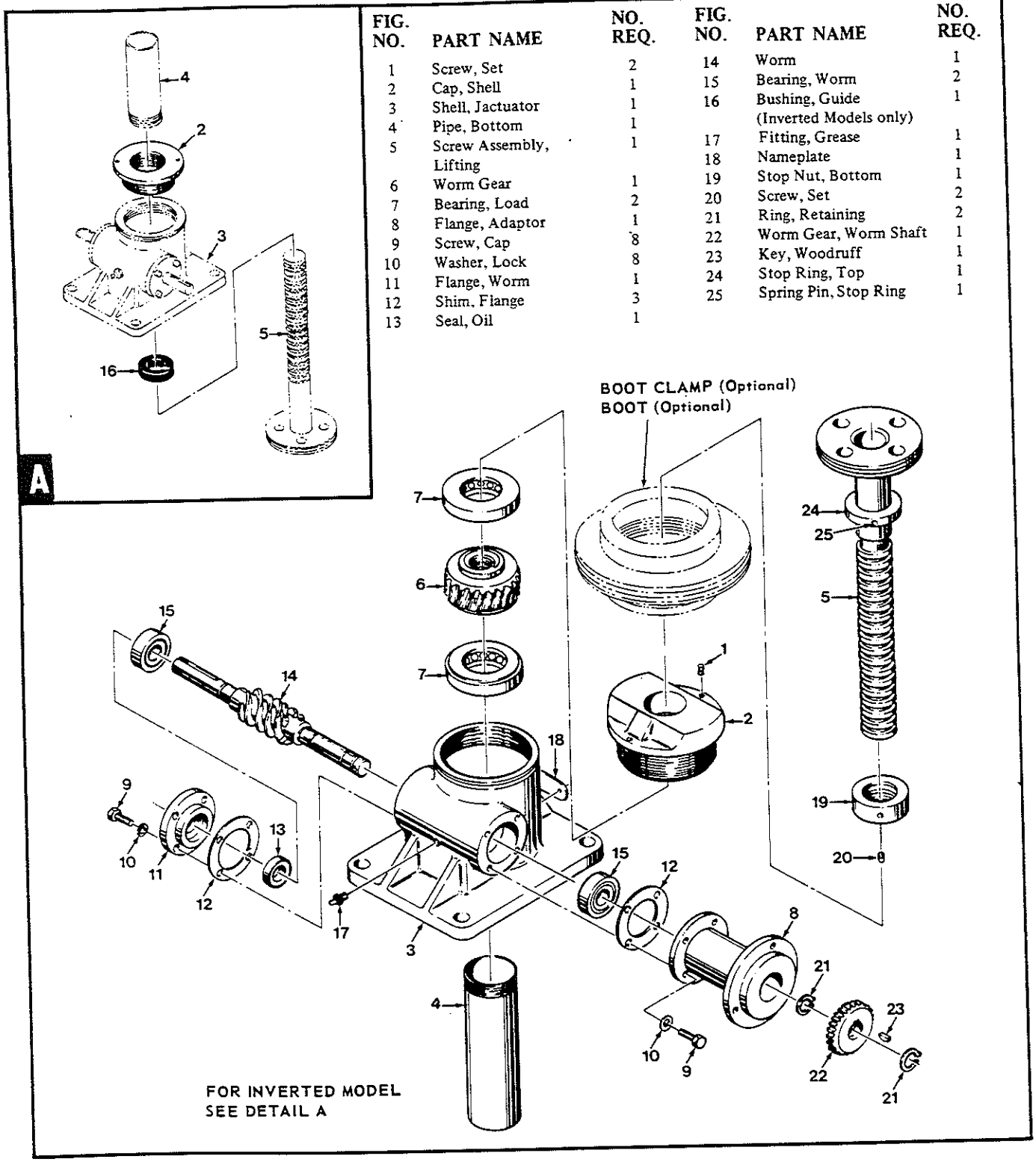


FIGURE 3. JACK

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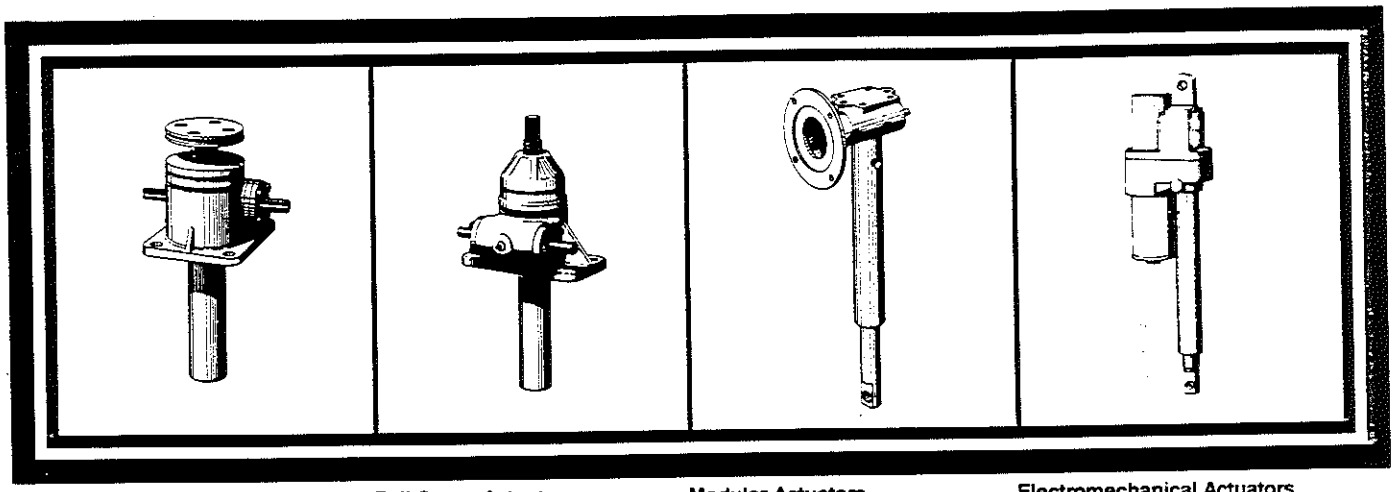

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Electromechanical Actuators. Capacities to ¾ ton. Choice of 115 VAC or 12 VDC motors for indoor or outdoor applications. Standard raises from 3" to 24". Speeds to 145 in/min. All components sealed in a corrosion-resistant, aluminum alloy die-cast housing. Fully-adjustable limit switches available on some models.

For more information on these or other Duff-Norton® actuators, ask your local distributor or Duff-Norton District Sales Manager for Catalog 172. Or write factory.

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AVAILABLE FROM YOUR LOCAL ACTUATOR DISTRIBUTOR:

Duff-Norton
P.O. Box 7010
CHARLOTTE, NC 28241-7010

Phone (704) 588-4610
FAX (704) 588-1994
Telex 575188

Duff-Norton Manufactures:
Duff-Norton® Actuators • Mechanical Jacks • Rotary Unions® • Coffing® Hoists
Duff Lynx® Hoists and Pullers

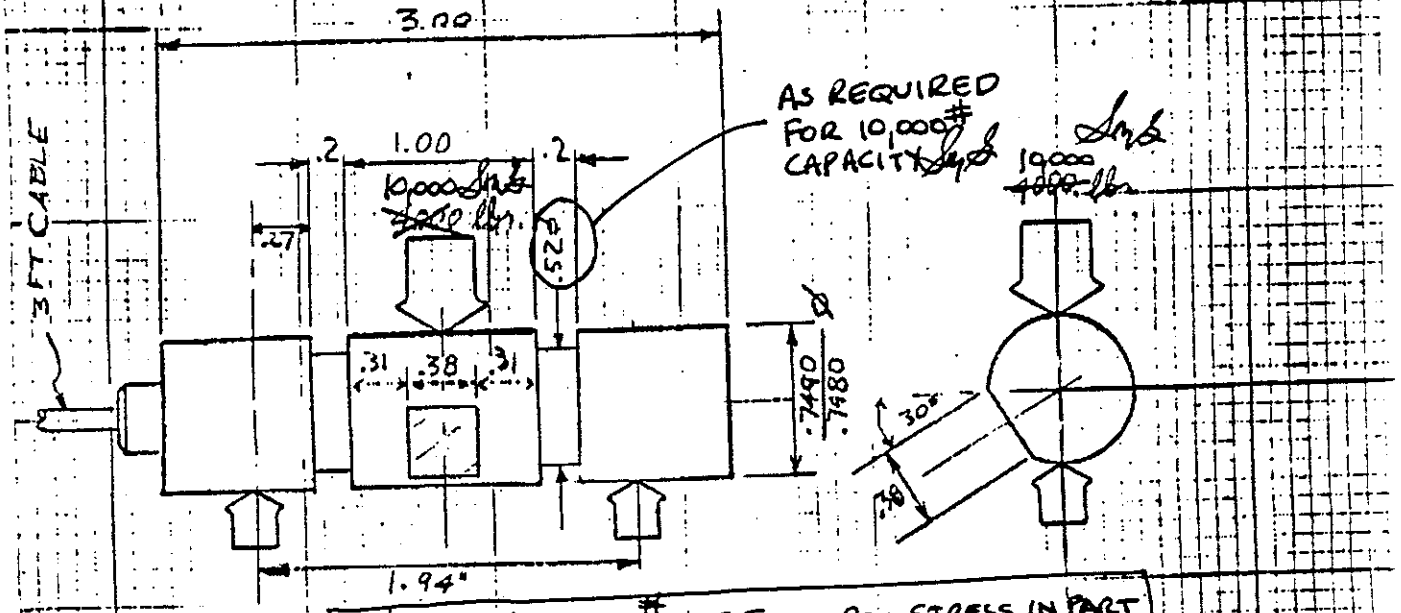
Printed in USA

500/SK-2428/6-90

BY _____ DATE _____ SUBJECT _____ E330005/006-6

CHKD. BY _____ DATE 8/11/93 Parallel Eng.

IF CONNECTOR IS SUPPLIED, PLEASE FURNISH BOTH HALVES OF CONNECTOR.



W/A.L. 6/11/96: 6K 75,000 PSI STRESS IN PART
UNIT ENDED UP BEING "6,000# CAP." 120,000 Y.S.
NOTE - F.S. = 2.46 ON YIELD @ 3900#

SPECIFICATIONS

OUTPUT RESISTANCE:	350 OHMS (NOMINAL) ~~200 OHMS FOR 20,000 lbs and larger~~
INPUT RESISTANCE:	350 OHMS (NOMINAL) ~~200 OHMS FOR 20,000 lbs and larger~~
EXCITATION:	10 VDC or AC
SENSITIVITY:	NOM. 2 MV/V AT CAPACITY
NON-LINEARITY:	±0.15% F.S.
HYSTERSIS:	±0.15% F.S.
COMPENSATED TEMP. RANGE:	15° F - 150° F
SAFE OVERLOAD:	150% RATED CAPACITY
ULTIMATE OVERLOAD:	250% RATED CAPACITY
ZERO BALANCE:	BETTER THAN 1% F.S.

Steve Bennett 8-27-93

APPROVED BY: DATE:

A. L. DESIGN INC.

TOLERANCES		ALD-SP-SHEAR PIN-930811	HEAT TREAT TO 44 ROCKWELL "C"	MATERIAL: 17-4PH S.S.
FRACTIONS	+/-1/16	CAP = ~~20000~~ lbs. ≅ 10,000 lbs.	DSGND BY	ENGR.
.XX	+/-.01		CHK BY	DWN BY
.XXX	+/-.001	DATE: AUG 11, 1993	DRWG NO. 930811	SCALE 1:1
ANGLES	+/-½°			

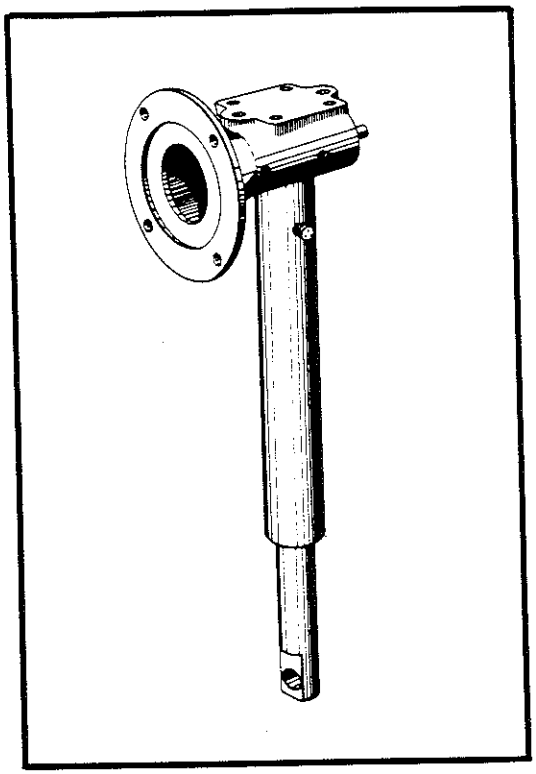
Duff-Norton®

INSTALLATION, OPERATING AND MAINTENANCE INSTRUCTIONS

WITH PARTS LIST

PUBLICATION PART NO. SK-2463-22

MODULAR ACTUATORS



TRANSLATING TUBE ACTUATORS MODEL NUMBERS
M-2464
M-2465

ROTATING SCREW ACTUATORS MODEL NUMBERS
M-2462
M-2463

IMPORTANT — CAUTION

This manual contains important information for the correct installation, operation and maintenance of the equipment described herein. All persons involved in such installation, operation, and maintenance should be thoroughly familar with the contents. To safeguard against the possibility of personal injury or property damage, follow the recommendations and instructions of this manual and keep it for further reference.

⚠ WARNING

The equipment shown in this manual is intended for industrial use only and should not be used to lift, support, or otherwise transport people.

Duff-Norton

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SECTION I

INTRODUCTION

1-1. General

This manual provides instructions for the installation, operation, and maintenance of the Duff-Norton® Modular Actuator. It includes proper procedures for the disassembly, cleaning, inspection, rebuilding, lubrication, and assembly of the actuator. To ensure efficient and long, satisfactory use of this unit, read and understand the information herein, and follow the instructions closely.

1-2. Intended Use

The Duff-Norton® Modular Actuators described and illustrated in this manual are intended for industrial use only and should not be used to lift, transport, or otherwise support people.

1-3. Safety Considerations

1. Avoid touching the exterior surfaces of the actuator. Surface temperatures may reach 230°F during prolonged use.
2. Make certain that the electric motor used conforms to the requirements of the actuator.

1-4. Unwarranted Applications

CAUTION

These actuators are not recommended or warranted for use in applications involving the following activities or conditions:

1. Lifting, supporting, or positioning of people where a malfunction might result in bodily injury.
2. Side loading or binding of the actuator. (See Paragraph 4-1, "Improper Loading".)

NOTE

If in doubt about the suitability of the actuator for your application, consult the Duff-Norton Engineering Department.

1-5. Warranty and Warranty Repair

Subject to the conditions stated herein, Duff-Norton will repair or replace, without charge, any parts proven to Duff-Norton's satisfaction to have been defective in material or workmanship. Claims must be made within one year after date of shipment. Duff-Norton will not repair or replace any parts that become inoperative because of improper maintenance, eccentric loading, overloading, chemical or abrasive action, excessive heat, or other abuse.

Equipment and accessories not of Duff-Norton's manufacture are warranted only to the extent that they are warranted by the manufacturer, and only if the claimed defect arose during normal use, applications and service. Equipment which has been altered or modified by anyone without Duff-Norton's authorization is not warranted by Duff-Norton. EXCEPT AS STATED HEREIN, DUFF-NORTON MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

If you have any questions concerning warranty repair, please consult a Duff-Norton Warehouse and Customer Service Center for the name and address of your nearest Duff-Norton actuator warranty repair facility.

Authorization for return must be granted by the Duff-Norton Company before any equipment may be returned for inspection or warranty repair.

SECTION II

INSTALLATION

Duff-Norton's Modular Actuator is designed to be a versatile piece of equipment which can be used in many different applications; consequently, installation procedures will vary widely with customer requirements.

2-1. Motor Installation

The Modular Actuator is designed to accept a standard NEMA 56 frame electric motor with C-face mounting, to be supplied by the customer. For instructions on installing the motor on the actuator, see Paragraph 5-5, steps 19-21 (these steps apply to both Rotating Screw and Translating Tube actuators).

2-2. Installation of the Actuator

The actuator has two bolt patterns for convenient attachment of the actuator to the application: both the two-hole pattern ($17/32$-inch unthreaded holes 4 inches apart) and the four-hole pattern ($1/2$-20 threaded holes on a 2.55 inch square) can be used to bolt the actuator to a wide variety of mounting points; the four-hole pattern will also accept standard hydraulic type end fittings.

The lifting nut (on Rotating Screw actuators) and the clevis end (on Translating Tube actuators) must be restrained against rotation in order for the actuator to lift its load.

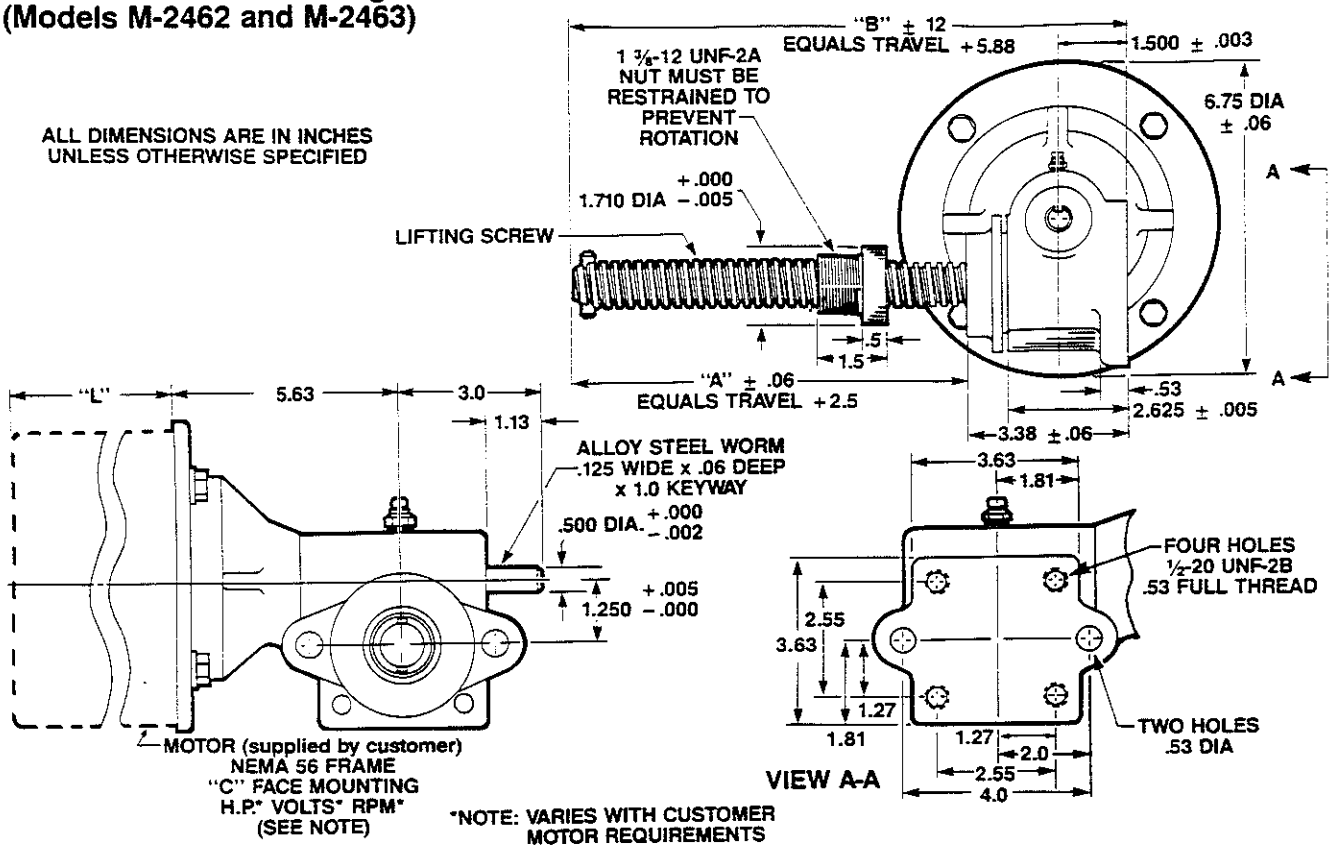
2-3. Limit Switches

Duff-Norton recommends that limit switches be incorporated in the installation to prevent overtravel of the actuator in either direction and to protect the actuator against internal jamming. Duff-Norton limit switches to fit this actuator are available at additional cost.

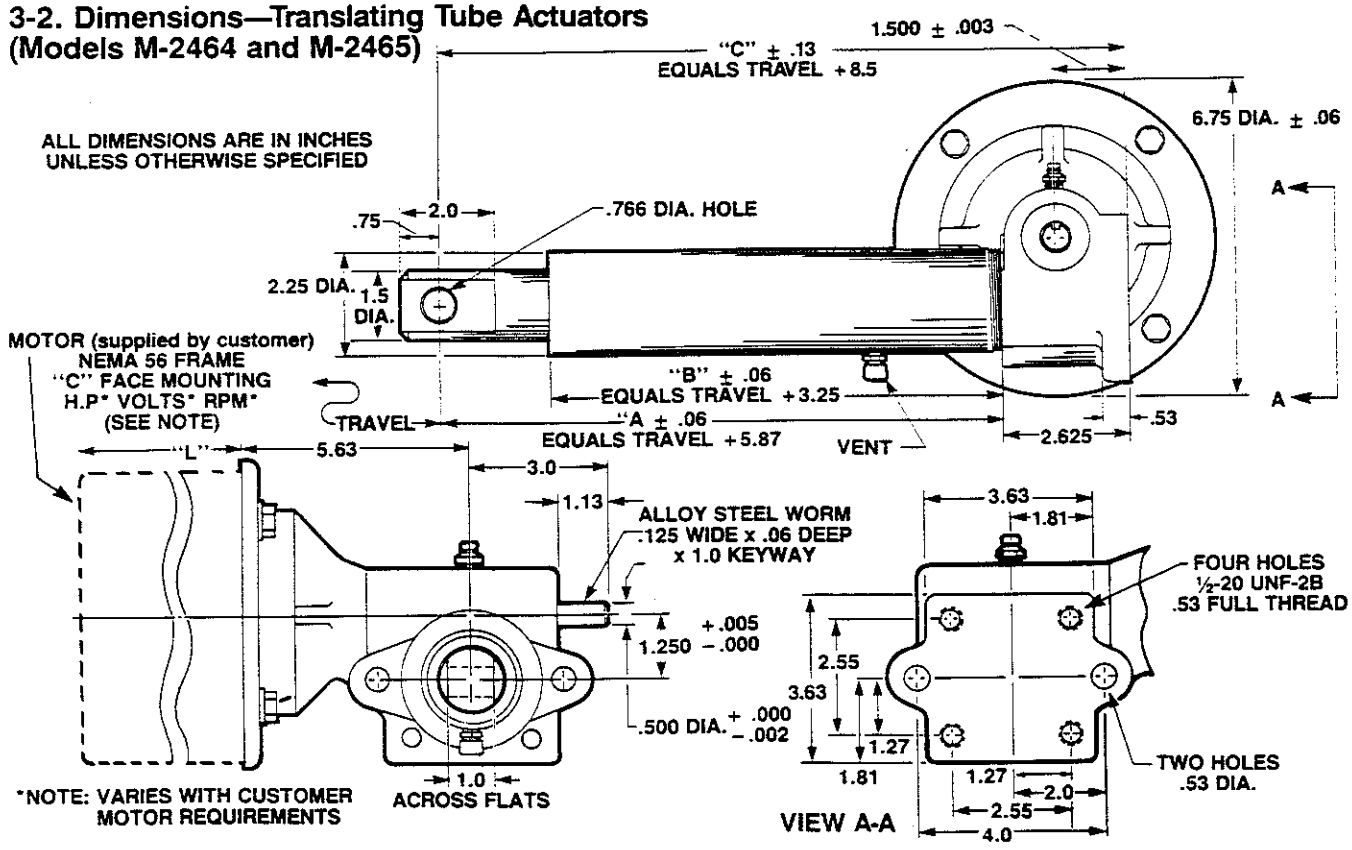
SECTION III

DIMENSIONS AND SPECIFICATIONS

3-1. Dimensions—Rotating Screw Actuators (Models M-2462 and M-2463)



3-2. Dimensions—Translating Tube Actuators (Models M-2464 and M-2465)



3-3. SPECIFICATIONS

Model No.	Screw Dia.	Turns of Worm/1" Travel		Torque lb/in @ 1000 lb Load		Motor RPM	Rated Load						Lifting Speed in/min	
		Ratio		Ratio			⅓ hp Motor		½ hp Motor		¾ hp Motor		Ratio	
							Ratio		Ratio		Ratio			
		5:1	20:1	5:1	20:1		5:1	20:1	5:1	20:1	5:1	20:1	5:1	20:1
M-2462 M-2464	.875 Dia. Acme .25 Pitch R.H. Double	10	40	39	18	1725	300	700	500	1000	700	1500	170	43
						1140	450	1000	700	1500	1100	2000	114	28
M-2463 M-2465	1.0 Dia. Acme .25 Pitch R.H. Single	20	80	29	14	1725	400	900	600	1400	900	2000	86	21
						1140	600	1400	900	2000	1400	2000	57	14

NOTE: 1. Models M-2462 and M-2464 are self-lowering and a motor brake should be used.
2. Models M-2463 and M-2465 may drift 0.75 in (20:1 ratio) to 2.0 in (5:1 ratio) when the motor is shut off. If this is undesirable, a motor brake should be used.

SECTION IV

OPERATION, MAINTENANCE, AND INSPECTION

4-1. Improper Loading

WARNING

The actuator must NOT be subjected to side loading or binding (i.e., a bending moment across the actuator) at any point in its travel. It is the responsibility of the installer to ensure that the mounting points cannot transmit such loading to the actuator anywhere between full retraction and full extension. Failure to observe this warning will void the warranty on the actuator.

4-2. Clevis Pins

The axes of the clevis pins should be parallel so that the actuator can pivot without binding. A few drops of oil should be applied to the clevis pins on installation and periodically thereafter.

4-3. Lubrication

When lubricating this actuator, use only Alvania EPl grease from Shell Oil Company.

The actuator should be lubricated periodically (see **NOTE** under Paragraph 4-4, "Inspection"), using the grease fitting. On Rotating Screw actuators, the lifting screw and nut can be lubricated by painting a light coat of grease on the screw at a point that passes through the nut. To lubricate the lifting screw and nut on a Translating Tube actuator, first loosen the set screws and unscrew the outer tube from the housing to expose the lifting screw threads.

The actuator should be disassembled, cleaned, inspected, and relubricated after 500,000 inches of travel under normal conditions, or earlier if the need is indicated by inspection or by a squealing from the lifting screw and nut area. Follow the instructions in Section V to overhaul the actuator.

4-4. Inspection

The actuator should be inspected periodically (see **NOTE** below), with attention given to the following items:

1. Clevis ends for wear, cracks, distortion, or other degradation or damage.
2. Loose bolts, screws, or other hardware on the actuator or its mounting points.
3. Limit switches (if so equipped) for proper setting and operation.
4. Lifting screw, lifting nut, and gear set for excessive wear or lack of lubrication (see instructions under Paragraph 4-3, "Lubrication").

Any of the above deficiencies should be corrected before the actuator is returned to service.

NOTE

Periodic Inspection and Lubrication: The exact periods for inspection and lubrication of the actuator cannot be predetermined because of the many variables involved, such as frequency of operation, type and magnitude of loading, and operational environment. Determination should be based on the user's experience. It is recommended that the user begin with a weekly inspection, extending the inspection period to monthly, quarterly, or annually, based on his weekly experience.

SECTION V

DISASSEMBLY AND ASSEMBLY

5-1. Lubricant

When rebuilding this actuator, use only Alvania EPl grease from Shell Oil Company.

5-2. Required Tools

A bearing puller and press, a soft jaw table clamp, and common hand tools are required for proper disassembly and assembly of the actuator.

5-3. General Procedures

Duff-Norton recommends following these procedures during disassembly and assembly of the actuator:

1. Tag critical parts to facilitate reassembly.
2. Mark mating surfaces to ensure proper meshing.
3. Clean and lubricate parts as required.
4. Replace all seals at time of rebuild.

5. Replace any screws, washers, and other small common parts that are damaged in any way.

5-4. Disassembly—Rotating Screw Actuators (Models M-2462 and M-2463)

Disassemble the Duff-Norton® Rotating Screw Modular Actuator as follows, referring to Figure 6-1 on page 10. Read the instructions thoroughly before disassembling the actuator.

NOTE

For disassembly procedures for Translating Tube actuators, see Paragraph 5-6.

NOTE

Disassembly should be undertaken on a clean cloth.

1. Remove the four cap screws (B) with lock washers (F) that attach the motor (A) to the shell (9) flange, and remove the motor from the shell. Half the flexible coupling (5a) will come with the motor shaft, and the other half (5a) will remain on the worm shaft (4). The flexible spider (5b) may stay with either half of the coupling.
2. Remove the set screw (5c) from the motor half of the coupling (5a), and remove the coupling half and the key (E) from the motor shaft.
3. Remove the pipe plug (7) and the grease fitting (8) from the shell (9).
4. Remove the set screw (5c) from the worm half of the coupling (5a) by inserting the set screw wrench through the pipe plug hole.
5. Remove the coupling half (5a) and the key (18) from the worm shaft (4).

When disassembling an actuator equipped with limit switches, follow steps 6 and 7 below. If the actuator is not equipped with limit switches, proceed directly to step 8.

6. Remove the two socket head cap screws (28) and the one long hex head cap screw (26) from the limit switch adapter (29), and remove the limit switch box (D) from the limit switch adapter.
7. Remove the two half dog point sets screws (30) from the shell (9) and remove the limit switch adapter (29) from the shell (see NOTE below).

NOTE

It may be necessary to use heat to overcome the adhesive in order to remove the limit switch adapter from the shell.

8. Remove the two set screws (10) from the shell (9), and unscrew the shell cap (19) from the shell.
9. Remove the shell cap, lifting screw, bearing, and gear assembly from the shell (9).
10. Remove the retaining ring (1) from the shell (9).
11. Remove the worm (4) by pressing on the motor end of the worm shaft. The worm bearing (2) next to the retaining ring (1) groove will be driven out by the worm. The other worm bearing (2) should remain in the shell until the load bearing cup (13) has been removed.
12. Press the worm bearing (2) off the worm (4).
13. Remove the load bearing cup (13) out of the shell (9).
14. Remove the remaining worm bearing (2) from the shell (9).
15. Clamp the lifting screw (17) in a vise, using soft jaws to prevent damage to the screw.
16. Remove the lock nut (12), and remove the gear (14), key (18), and spacer (15) from the lifting screw (17).
17. Remove the shell cap (19) and lifting nut (20) from the lifting screw (17).
18. Remove the stop pin (16) from the lifting screw (17) if necessary.
19. Remove the two load bearing cones (13) from the gear (14).

Disassembly of the actuator is now complete.

5-5. Assembly—Rotating Screw Actuators (Models M-2462 and M-2463)

Assemble the Duff-Norton® Rotating Screw Modular Actuator as follows, referring to Figure 6-1 on page 10. Read the instructions thoroughly before assembling the actuator.

NOTE

For assembly procedures for Translating Tube actuators, see Paragraph 5-7.

NOTE

Be sure all parts are clean and dry before assembling the actuator.

1. Assemble one load bearing cup (13) into the shell (9), and the other load bearing cup into the shell cap (19).
2. Assemble one worm bearing (2) into the motor mounting flange end of the shell (9) (see **NOTE** below).

NOTE

The bearing must be installed from the opposite end of the shell.

3. Notice that one end of the worm (4) has a hole in the center of the shaft, and one end does not. Press the remaining worm bearing (2) on to the end of the shaft WITH the hole.
4. Assemble the worm (4) into the shell (9) and worm bearing (2), and then install the retaining ring (1) in the shell.
5. Grease the two load bearing cones (13) and install them on the worm gear (14) bearing journals.
6. Install the stop pin (16) in the end of the lifting screw (17), taking care to center the pin in the screw.
7. Screw the lifting nut (20) on to the lifting screw (5) with the flange end away from the stop pin (16).
8. Slide the shell cap and bearing cup assembly over the lifting screw threads, with the bearing cup (13) facing the turned end of the lifting screw.
9. Slip the spacer (15) over the end of the lifting screw (17), with the flange toward the screw thread.
10. Install the key (18) in the keyway in the lifting screw (17).

11. Slide the gear and load bearing cone assembly over the end of the lifting screw (17).
12. Thread the lock nut (12) on to the end of the lifting screw (17). Clamp the lifting screw between soft jaws in a vise, and tighten the lock nut to 30 ft-lb.
13. Install the lifting screw, shell cap, and gear assembly in the shell (9), taking care to mesh the gear teeth and the worm properly.
14. Pack the gear housing with Shell Alvania EPl grease.
15. Coat the shell cap (19) threads with aluminum antiseize compound. Thread the shell cap into the shell (9), and torque it to 40 ft-lb. Spot drill the shell cap thread O.D. in two places, and install the two set screws (10). Tighten the set screws to hold the shell cap in place.
16. Install the key (6) in the end of the worm (4) shaft on the flange side of the shell (9), and slide a coupling half (5a) onto the worm shaft. The inside face of the coupling should be flush with the worm shaft end. Tighten the coupling set screw (5c) against the key by inserting the set screw wrench through the ⅛-inch pipe tap hole in the shell.
17. Install the pipe plug (7).
18. Install the grease fitting (8).
19. Install the key (E) in the motor shaft and slide the second coupling half (5a) on to the motor shaft, with the inside face of the coupling flush with the end of the motor shaft. Tighten the coupling set screw against the key to lock it in place.
20. Assemble the flexible spider (5b) on to the motor coupling half (5c).
21. Align the motor coupling half (5a) with the worm coupling half (5a) and assemble the motor (A) to the shell (9), aligning the holes in the flange with the tapped holes in the face of the motor. Make sure that the motor is centered in the counterbore, and then install and tighten the four ⅜-16 × ⅞ inch hex head cap screws (B) with lock washers (F) that attach the motor to the flange. Turn the worm shaft extension by hand to be certain that there is no binding of the motor and the actuator.

This completes the assembly procedures for actuators not equipped with limit switches. When assembling an actuator equipped with limit switches, continue with the instructions below.

22. Apply two or three drops of Loc-Tite No. 35 Extra Strength Retaining Ring Compound to the shell bore.

If a new (replacement) limit switch adapter is being installed, follow steps 23 and 24 below. If a used (previously spot drilled) adapter is being installed, proceed directly to step 25.

23. Install the limit switch adapter (29) in the shell (9), making sure that the adapter bottoms out against the retaining ring (I). Orient the four tapped holes in the limit switch adapter to line up with the four motor mounting holes in the housing flange.
24. Spot drill the limit switch adapter (29) in two places and install the two half dog point set screws (30). Proceed directly to step 27.
25. Install the limit switch adapter (29) in the shell (9), aligning the spot drilled holes in the adapter with the tapped holes in the shell.
26. Install the two half dog point set screws (30).
27. Aligning the slot in the limit switch worm shaft with the pin in the actuator worm, install the limit switch box on the adapter (29) in the desired position.

Assembly of the actuator is now complete.

5-6. Disassembly—Translating Tube Actuators (Models M-2464 and M-2465)

Disassemble the Duff-Norton® Translating Tube Modular Actuator as follows, referring to Figure 6-2 on page 11. Read the instructions thoroughly before disassembling the actuator.

NOTE

For disassembly procedures for the Rotating Screw actuators, see Paragraph 5-4.

NOTE

Disassembly should be undertaken on a clean cloth.

1. Remove the four cap screws (B) with lock washers (F) that attach the motor (A) to the shell (9) flange, and remove the motor from the shell. Half the flexible coupling (5a) will come with the motor shaft, and the other half (5a) will remain on the worm shaft (4). The flexible spider (5b) may stay with either half of the coupling.
2. Remove the set screw (5c) from the motor half of the coupling (5a), and remove the coupling half and the key (E) from the motor shaft.
3. Remove the pipe plug (7) and the grease fitting (8) from the shell (9).
4. Remove the set screw (5c) from the worm half of the coupling (5a) by inserting the set screw wrench through the pipe plug hole.
5. Remove the coupling half (5a) and the key (6) from the worm shaft (4).

When disassembling an actuator equipped with limit switches, follow steps 6 and 7 below. If the actuator is not equipped with limit switches, proceed directly to step 8.

6. Remove the two socket head cap screws (28) and the one long hex head cap screw (26) from the limit switch adapter (29), and remove the limit switch box (D) from the limit switch adapter.
7. Remove the two half dog point set screws (30) from the shell (9) and remove the limit switch adapter (29) from the shell (see **NOTE** below).

NOTE

It may be necessary to use heat to overcome the adhesive in order to remove the adapter from the shell.

8. Remove the two set screws (10) from the shell (9), and remove the outer tube (24) by first unscrewing it from the shell and then sliding it off over the translating tube.
9. Remove the translating tube, lifting screw, bearing, and gear assembly from the shell (9).

10. Remove the retaining ring (1) from the shell (9).
11. Remove the worm (4) by pressing on the motor end of the worm shaft. The worm bearing (2) next to the retaining ring (1) groove in the shell (9) will be driven out by the worm. The other worm bearing (2) should remain in the shell until the load bearing cup (13) has been removed.
12. Press the worm bearing (2) off the worm (4).
13. Remove the load bearing cup (13) out of the shell (9).
14. Remove the remaining worm bearing (2) from the shell (9).
15. Remove the remaining load bearing cup (13) from the outer tube (24).
16. Remove the wiper scraper seal (22) from the outer tube (24), and if necessary press the guide bushing (23) out of the outer tube.
17. Clamp the lifting screw (17) in a vise, using soft jaws to prevent damage to the screw.
18. Remove the lock nut (12), and remove the gear (14), key (18), and spacer (15) from the lifting screw (17).
19. Remove the two load bearing cones (13) from the gear (14).
20. Screw the lifting screw (17) into the translating tube until the screw bottoms out and cannot rotate farther, or until the screw thread becomes disengaged from the lifting nut (19) thread.
21. Drive the four pins (20) just far enough into the lifting nut (19) to clear the translating tube wall; then remove the translating tube from the nut.
22. Remove the lifting screw (17) from the lifting nut (19).
23. Remove the four pins (20) by pressing each one the rest of the way through the lifting nut wall.
24. Remove the stop pin (16) from the lifting screw (17) if necessary.

Disassembly of the actuator is now complete.

5-7. Assembly—Translating Tube Actuators (Models M-2464 and M-2465)

Assemble the Duff-Norton® Translating Tube Modular Actuator as follows, referring to Figure 6-2 on page 11. Read the instructions thoroughly before assembling the actuator.

NOTE

For assembly procedures for Rotating Screw actuators, see Paragraph 5-5.

NOTE

Be sure all parts are clean and dry before assembling the actuator.

1. Assemble a load bearing cup (13) into the shell (9).
2. Assemble one worm bearing (2) into the motor mounting flange end of the shell (9) (see **NOTE** below).

NOTE

The bearing must be installed from the opposite end of the shell.

3. Notice that one end of the worm (4) has a hole in the center of the shaft, and one end does not. Press the remaining worm bearing (2) on to the end of the shaft WITH the hole.
4. Assemble the worm (4) into the shell (9) and worm bearing (2), and then install the retaining ring (1) in the shell.
5. Install the guide bushing (23) and the wiper scraper seal (22) in the end of the outer tube (24) opposite the threaded end.
6. Install a load bearing cup (13) in the threaded end of the outer tube (24).
7. Grease the two load bearing cones (13) and install them on the worm gear (14) bearing journals.
8. Install the stop pin (16) in the end of the lifting screw (17), taking care to center the pin in the screw.
9. Screw the lifting nut (19) on to the lifting screw (17) with the flange end away from the stop pin (16).
10. Fill the translating tube (16) approximately half full of Shell Alvania EPl grease.
11. Slide the translating tube and clevis end assembly over the lifting screw (17) and on to the lifting nut (19), lining the four holes in the translating tube up with the four holes in the lifting nut (19).
12. Press the four pins (20) into place (see **CAUTION** below).

CAUTION

The pins should end up extending $\frac{1}{32}$ inch beyond the O.D. of the translating tube, and must NOT jam against the O.D. of the lifting screw thread. If the pins are pressed too far into the lifting nut, they will bind against the lifting screw thread, perhaps damaging the screw surface.

NOTE

The lifting nut should now rotate freely on the lifting screw. If the nut does not rotate freely on the screw, follow steps 21-24 under Paragraph 5-6, "Disassembly", and then resume "Assembly" at step 9.

13. Slip the spacer (15) over the end of the lifting screw (17), with the flange toward the lifting screw shoulder.
14. Install the key (18) in the keyway in the lifting screw (17).
15. Slide the gear and load bearing cone assembly over the end of the lifting screw (17).
16. Thread the lock nut (12) on to the end of the lifting screw (17). Clamp the lifting screw between soft jaws in a vise, and tighten the lock nut to 30 ft-lb.
17. Install the lifting screw, translating tube, and gear assembly in the shell (9), taking care to mesh the gear teeth and the worm properly.
18. Pack the gear housing with Shell Alvania EPl grease.
19. Make sure that a load bearing cup (13) has been installed in the end of the outer tube (24) (see step 6). Lightly grease the O.D. of the translating tube assembly, and slide the outer tube over the translating tube, threaded end first.
20. Thread the outer tube (24) into the shell (9), and tighten it to 40 ft-lb. Spot drill the outer tube thread in two places,

and install and tighten the two set screws (10) to hold the outer tube in place.

21. Install the key (6) in the end of the worm (4) shaft on the flange side of the shell, and slide a coupling half (5a) on to the worm shaft. The inside face of the coupling should be flush with the worm shaft end. Tighten the coupling set screw (5c) against the key by inserting the set screw wrench through the ⅛-inch pipe tap hole in the shell.
22. Install the pipe plug (7).
23. Install the grease fitting (8).
24. Install the key (E) in the motor shaft and slide the second coupling half (5a) on to the motor shaft, with the inside face of the coupling flush with the end of the motor shaft. Tighten the coupling set screw against the key to lock it in place.
25. Assemble the flexible spider (5b) on to the motor coupling half (5c).
26. Align the motor coupling half (5a) with the worm coupling half (5a) and assemble the motor to the shell (9), aligning the holes of the flange with the tapped holes in the face of the motor. Make sure that the motor is centered in the counterbore, and then install and tighten the four ⅜-16 x ⅞ inch hex head cap screws (B) with lock washers (F) that attach the motor to the flange. Turn the worm shaft extension by hand to be certain that there is no binding of the motor and the actuator.

This completes the assembly procedures for actuators not equipped with limit switches. When assembling an actuator equipped with limit switches, continue with the instructions below.

27. Apply two or three drops of Loc-Tite No. 35 Extra Strength Retaining Ring Compound to the shell bore.

If a new (replacement) limit switch adapter is being installed, follow steps 28 and 29 below. If a used (previously spot drilled) adapter is being installed, proceed directly to step 30.

28. Install the limit switch adapter (29) in the shell (9), making sure that the adapter bottoms out against the retaining ring (1). Orient the four tapped holes in the limit switch adapter to line up with the four motor mounting holes in the housing flange.
29. Spot drill the adapter (29) in two places and install the two half dog point set screws (30). Proceed directly to step 32.
30. Install the limit switch adapter (29) in the shell, aligning the spot drilled holes in the adapter with the tapped holes in the shell.
31. Install the two half dog point set screws (30).
32. Aligning the slot in the limit switch worm shaft with the pin in the actuator worm, install the limit switch box on the adapter (29) in the desired position.

Assembly of the actuator is now complete.

SECTION VI

ILLUSTRATED PARTS LIST

6-1. General

This section contains exploded illustrations of Duff-Norton® Rotating Screw and Translating Tube Modular Actuators. The numbers adjacent to each of the parts on the illustrations is the index number. On the parts listed below, these numbers are keyed to the individual part names.

6-2. PARTS LIST FOR ROTATING SCREW ACTUATORS (Models M-2462 and M-2463)

INDEX NO. Figure 6-1	PART NAME	QTY. REQ.	PART NUMBER
1	Retaining Ring	1	SK-2501-11
2	Worm Bearing	2	SK-2501-10
3	Spring Pin (Worm)	1	S-50-26
4	Worm 5:1 Ratio	1	SK-2465-43
	20:1 Ratio	1	SK-2465-53
5**	Flexible Coupling	1	SK-2465-21
6	Key	1	S-10-2
7	Pipe Plug	1	S-25-13
8	Grease Fitting	1	SK-974-32
9	Shell	1	SK-2465-1
10	Set Screw	2	S-7-10
11	Decal	1	SK-2433-19
12	Lock Nut	1	H-3966-P
13	Load Bearing	2	SK-2501-9

INDEX NO. Figure 6-1	PART NAME	QTY. REQ.	PART NUMBER
14	Worm Gear 5:1 Ratio	1	SK-3502-4
	20:1Ratio	1	SK-2502-14
15	Spacer	1	SK-2465-17
16	Pin (Stop)	1	H-5122-P
17	Screw (M-2463)	1	SK-2465-5-*
	Screw (M-2462)	1	SK-2464-5-*
18	Key (Screw)	1	S-10-72
19	Shell Cap (M-2463)	1	SK-2463-2
	Shell Cap (M-2462)	1	SK-2462-2
20	Lifting Nut (M-2463)	1	SK-2463-6
	Lifting Nut (M-2462)	1	SK-2462-6
26	Hex Hd. Cap Screw	1	S-44-157
27	Lock Washer	3	H-4084-P
28	Soc. Hd. Cap Screw	2	H-2201
29	Limit Switch Adapter	1	SK-2465-11
30	Set Screws	2	S-52-1

* This No. is equal to travel plus 1.
** 5a - coupling body
5b - spider
5c - set screw

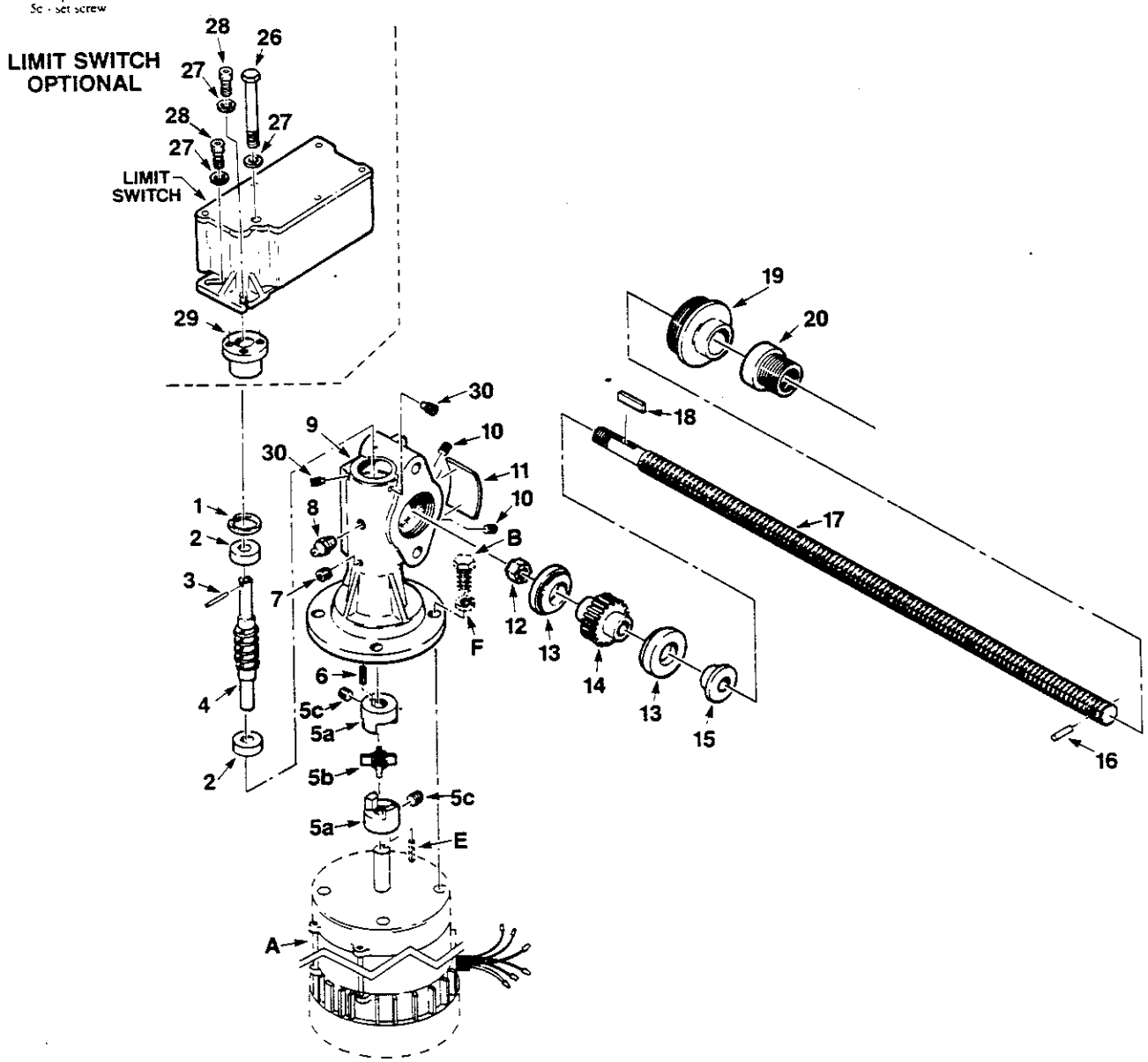


FIGURE 6-1. EXPLODED ILLUSTRATION ROTATING SCREW MODULAR ACTUATORS MODELS M-2462 AND M-2463

6-3. PARTS LIST FOR TRANSLATING TUBE ACTUATORS (MODELS M-2464 and M-2465)

INDEX NO. Figure 6-2	PART NAME	QTY. REQ.	PART NUMBER
1	Retaining Ring	1	SK-2501-11
2	Worm Bearing	2	SK-2501-10
3	Spring Pin (Worm)	1	S-50-26
4	Worm 5:1 Ratio	1	SK-2465-43
	20:1 Ratio	1	SK-2465-53
5**	Flexible Coupling	1	SK-2465-21
6	Key	1	S-10-2
7	Pipe Plug	1	S-25-13
8	Grease Fitting	1	SK-974-32
9	Shell	1	SK-2465-1
10	Set Screw	2	S-7-10
11	Decal	1	SK-2433-19
12	Lock Nut	1	H-3966-P
13	Load Bearing	2	SK-2501-9
14	Worm Gear 5:1 Ratio	1	SK-3502-4
	20:1 Ratio	1	SK-2502-14
15	Spacer	1	SK-2465-17

INDEX NO. Figure 6-2	PART NAME	QTY. REQ.	PART NUMBER
16	Pin (Stop)	1	H-5122-P
17	Screw (M-2465)	1	SK-2465-5-*
	Screw (M-2464)	1	SK-2464-5-*
18	Key (Screw)	1	S-10-72
19	Lifting Nut (M-2465)	1	SK-2465-15
	Lifting Nut (M-2464)	1	SK-2415-15
20	Pin (Nut)	4	H-5164
21	Tube & Clevis Sub-Assembly	1	SK-6415-109-*A
22	Wiper-Scraper Seal	1	SK-6415-16
23	Guide Bushing	1	SK-6415-23
24	Outer Tube	1	SK-6415-111-*
25	Air Vent	1	SK-2015-218
26	Hex Hd. Cap Screw	1	S-44-157
27	Lock Washer	3	H-4084 P
28	Soc. Hd. Cap Screw	2	H-2201
29	Limit Switch Adapter	1	SK-2465-11
30	Set Screws	2	S-52-1

* This No. is equal to travel
** 5a - coupling hub
5b - spider
5c - set screw

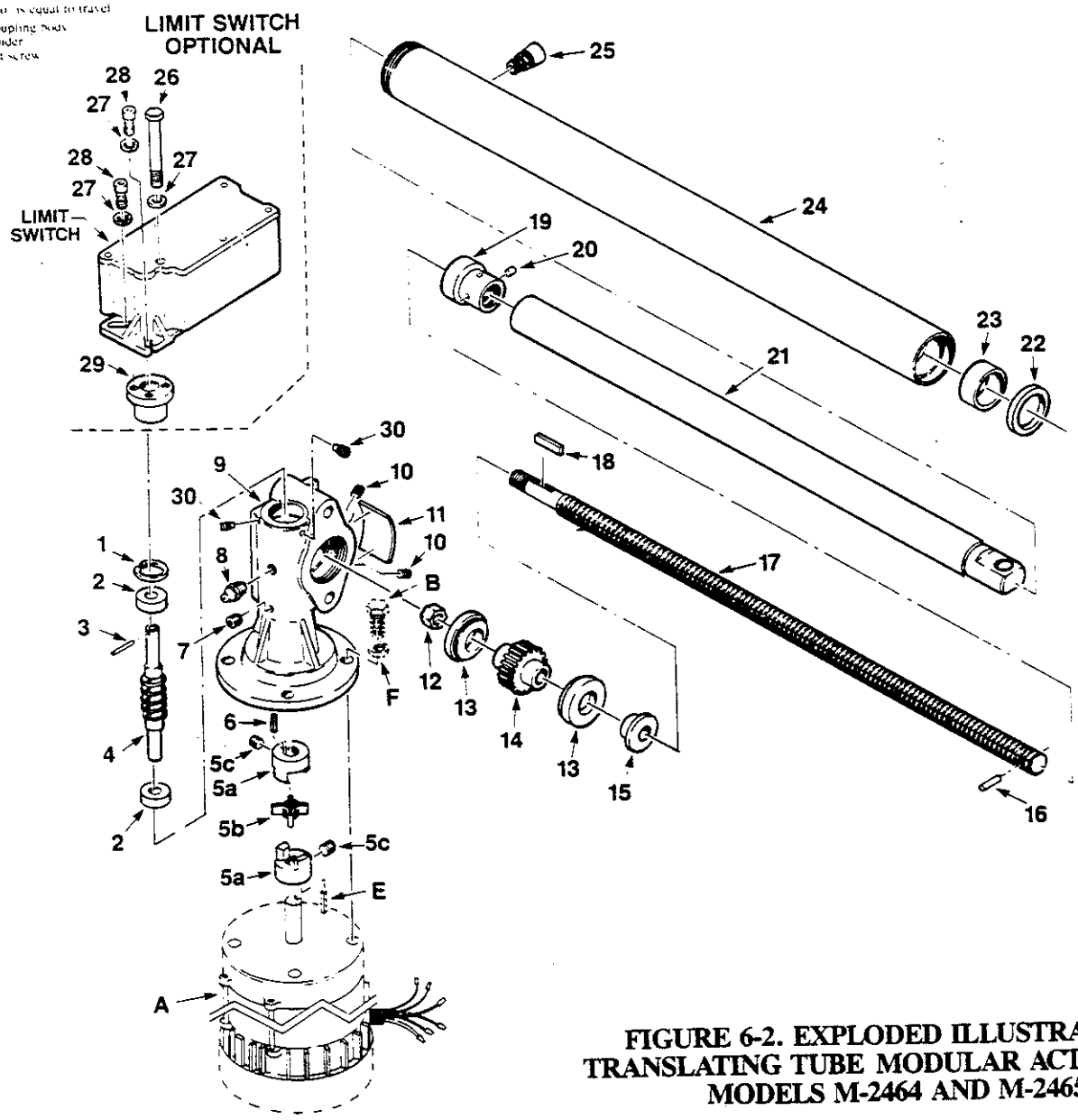
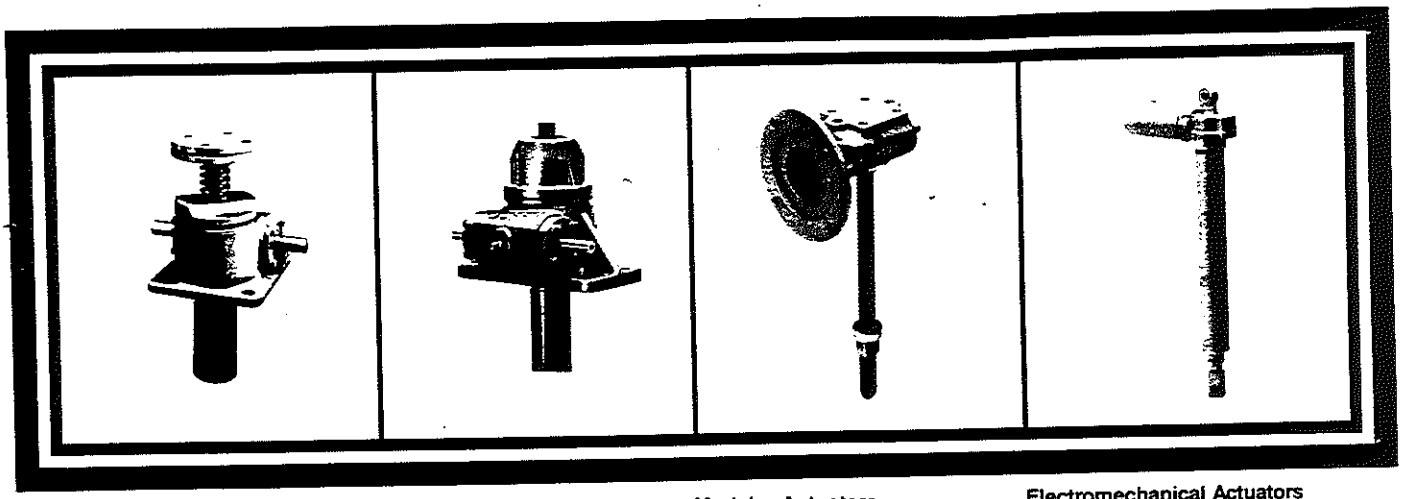


FIGURE 6-2. EXPLODED ILLUSTRATION TRANSLATING TUBE MODULAR ACTUATORS MODELS M-2464 AND M-2465

DUFF-NORTON OFFERS A COMPLETE LINE OF MECHANICAL AND ELECTROMECHANICAL ACTUATORS FOR PRECISE POSITIONING OF LOADS UP TO 250 TONS

For reliable motion - in-line or through an arc - Duff-Norton has the right actuator to put your designs in motion. You can select from a comprehensive line of machine screw, ball screw, high-duty cycle, electro-mechanical and modular models to solve your design and production problems.

Duff-Norton® actuators are easy to specify, install and operate. Compact and self-contained, they do not require bothersome selection of individual components nor the attendant maintenance of leaky hydraulic hoses, valves or couplings. They provide many options in meeting a wide range of lifting, pushing, pulling and tensioning requirements.



Machine Screw Actuators. Capacities from ¼ to 250 tons. Worm gear ratios from 5:1 to 50:1. More than 200 standard combinations to choose. Can be operated manually or by gear motor. Used to push, pull, apply pressure, or as linear actuators. Holds loads without creep, when not subject to vibration.

Ball Screw Actuators. Capacities from ½ to 50 tons. Ball bearing screw and nut design reduces friction, increases efficiency as much as 70%. Permits linear motion up to 300 in/min @ 1800 rpm worm shaft speed. Available in 40 standard models. Multiple units may be synchronized for uniform raises to 10 feet.

Modular Actuators Capacities to 2,000 pounds depending on actuator gear ratio and motor horsepower. Engineered for 56 frame motor, C face mounting. Choice of 5:1 or 20:1 gear ratios in rotating screw or translating tube models. Travel lengths to 24 inches. Lift speeds to 170 inches per minute.

Electromechanical Actuators Capacities to ¾ ton. Choice of 115 VAC or 12 VDC motors for indoor or outdoor applications. Standard raises from 3"to 24". Speeds to 145 in/min. All components sealed in a corrosion-resistant, aluminum alloy die-cast housing. Fully adjustable limit switches available on some models.

For more information on these or other Duff-Norton actuators, ask you local distributor or Duff-Norton District Sales Manager for Catalog 172. Or write factory.

WARNING: The equipment shown in this manual is intended for industrial use only and should not be used to lift, support, or otherwise transport people unless you have a written statement from Duff-Norton Company which authorizes the specific actuator unit, as used in your application, as suitable for moving people.

AVAILABLE FROM YOUR LOCAL DUFF-NORTON® ACTUATOR DISTRIBUTOR:

Duff-Norton

P.O. Box 7010
Charlotte, NC 28241-7010

Customer Service (704) 588-2720
Parts Service (704) 588-2323
FAX (704) 588-1994
Telex 575188

Printed in USA

500\SK2463-22\3-96

ROCKFORD MANUFACTURING GROUP

ROCKFORD MANUFACTURING GROUP, INC.

14343 Industrial Parkway • South Beloit, IL 61080
Phone: 815/624-2500 • Fax: 815/624-7254

PTD
POWER TRANSMISSION DIVISION

F-165-2

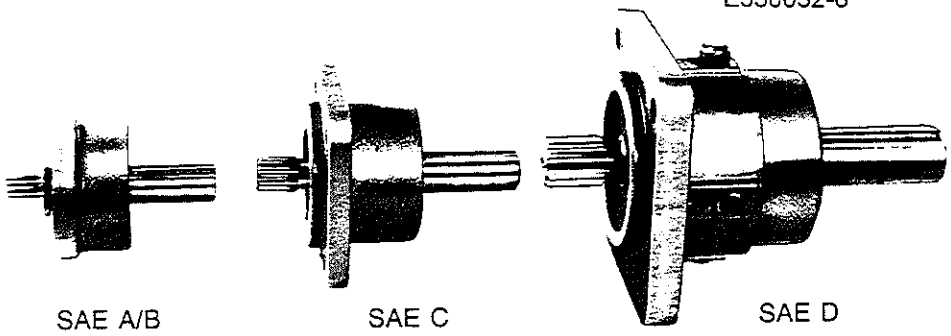
Input Shaft Assemblies

Furnished with pre-heat-treated 4140 shafting, these input shaft assemblies are primarily intended to:

1. Permit easy adaptation of standard electric motors to gear reducers and clutches which normally interface only with hydraulic motors.
2. Permit the adaptation of belts and pulleys (instead of direct "plug in" hydraulic motors).

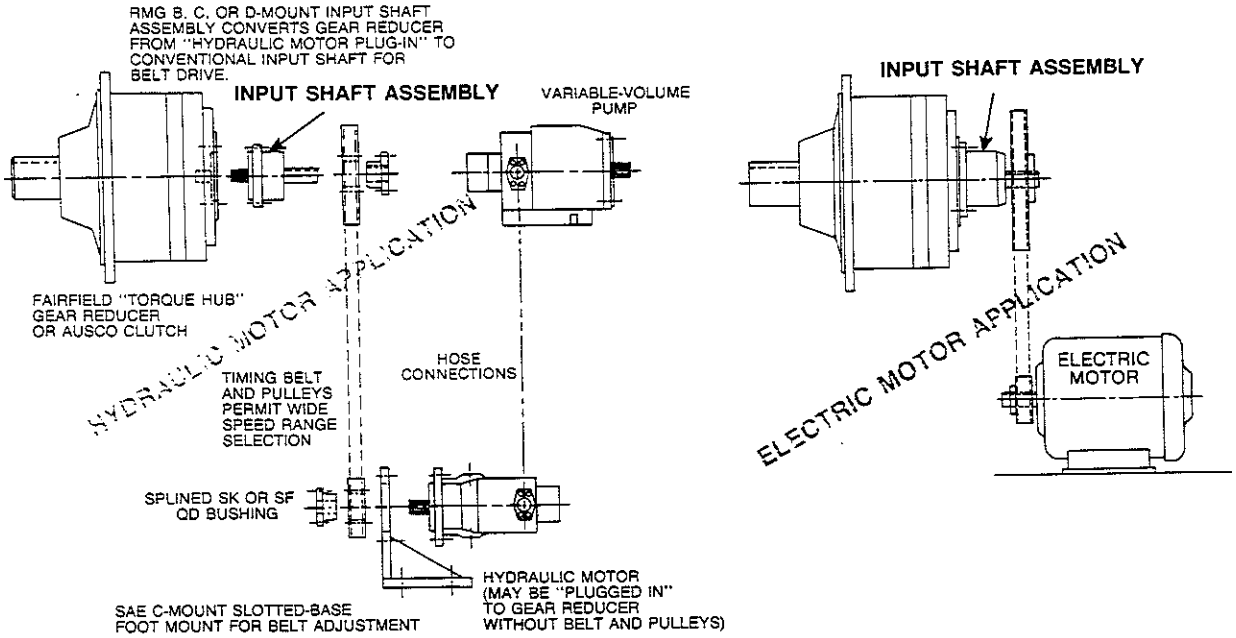
The use of belts and pulleys (on either hydraulic motors or electric motors) with Fairfield Torque Hubs or Ausco clutches can often solve space problems. Additionally, by being able to belt drive the transmission equipment, it is possible to enjoy a wider selection of reduction ratios, speed values, and service factors.

E330032-8



SAE A/B SAE C SAE D

Material certification furnished on request.



Most Fairfield and Ausco transmission equipment is installed with the axis horizontal. When this equipment is installed with the axis VERTICAL and the input shaft assembly ABOVE the gear reducer or clutch, special provisions must be made for lubrication. Contact RMG factory office for details.

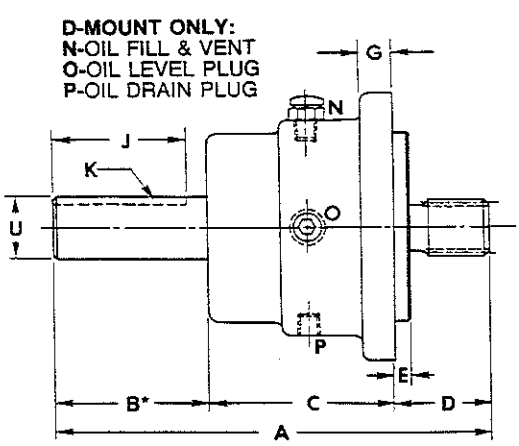
Table 1 **CONDENSED SPECIFICATIONS AND DISTRIBUTOR LIST PRICES**

MOUNT	ASSEMBLY NUMBER	SPLINE	INPUT SHAFT DIA.	NET WEIGHT	DISTRIBUTOR LIST PRICE — FOB ROCKFORD, ILLINOIS				
					1	2 - 4	5 - 9	10 - 24	25+
SAE A	D0200.01	9 TEETH 16/32 PITCH	1.125" 1/4 KEY	5.5 lb	**$ 236**	**$ 212**	**$ 193**	**$ 179**	**$ 170**
SAE B	D0159	13 TEETH 16/32 PITCH	1.375" 5/16 KEY	11.5 lb	**$ 268**	**$ 241**	**$ 220**	**$ 204**	**$ 193**
SAE C	D0266 D0266.02	14 TEETH 12/24 PITCH	1.500" 3/8 KEY	19.0 lb	**$ 360** $ 696	**$ 324** $ 626	**$ 295** $ 570	**$ 274** $ 529	**$ 259** $ 501
SAE D	D1311 D1311.07	13 TEETH 8/16 PITCH	2.000" 1/2 KEY	52.5 lb	**$1232** $1650	**$1109** $1485	**$1010** $1353	**$ 936** $1254	**$ 887** $1188

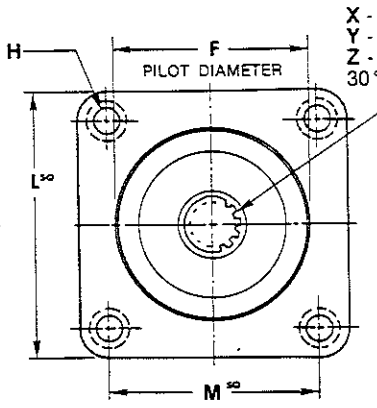
1. **BOLD FACE LIST PRICES APPLY TO STOCK SUPER-STANDARD ASSEMBLIES WHICH USE SKF BALL BEARINGS LISTED IN TABLE 3 AND WHICH PROVIDE THE OVERHUNG LOAD RATINGS LISTED IN TABLE 3.**
2. Light face list prices apply to non-stock assemblies which use spherical roller bearings offering higher overhung load ratings. See footnote under Table 3.
3. **ALL PRICES SUBJECT TO PREVAILING TRADE DISCOUNT OR PRICE MULTIPLIER.**

REVISED 6/1/95

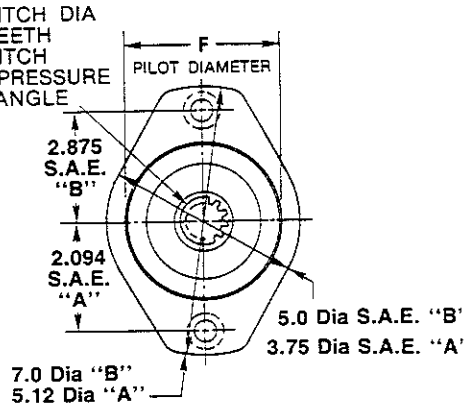
Dimensions and OHL Ratings



*SPECIAL SHAFT LENGTHS AVAILABLE



4-HOLE C-D-MOUNT



2-HOLE A & B-MOUNT

Table 2

MOUNT	A	B	C	D	E	F	G	H	J	K-Keyway	L	M	U	X	Y	Z
A	5.75	2.25	2.31	1.18	.25	3.250 / 3.248	.50	17/32	1.88	1/8 x 1/4	5.12	—	1.125 / 1.124	.5625	9	16/32
B	6.85	2.94	2.34	1.56	.312	4.000 / 3.998	.50	17/32	1.75	5/32 x 5/16	7.00	—	1.375 / 1.374	.813	13	16/32
C	9.21	3.66	3.52	2.03	.38	5.000 / 4.998	.62	17/32	2.38	3/16 x 3/8	5.75	4.50	1.500 / 1.499	1.167	14	12/24
D	13.75	4.84	5.91	3.00	.43	6.000 / 5.998	1.00	13/16	4.25	1/4 x 1/2	8.50	6.36	2.000 / 1.999	1.625	13	8/16

All dimensions are in inches and are subject to change without notice. Please request certified dimensional prints for certified applications.

Table 3

PERMISSABLE OVERHUNG LOAD RATINGS — POUNDS

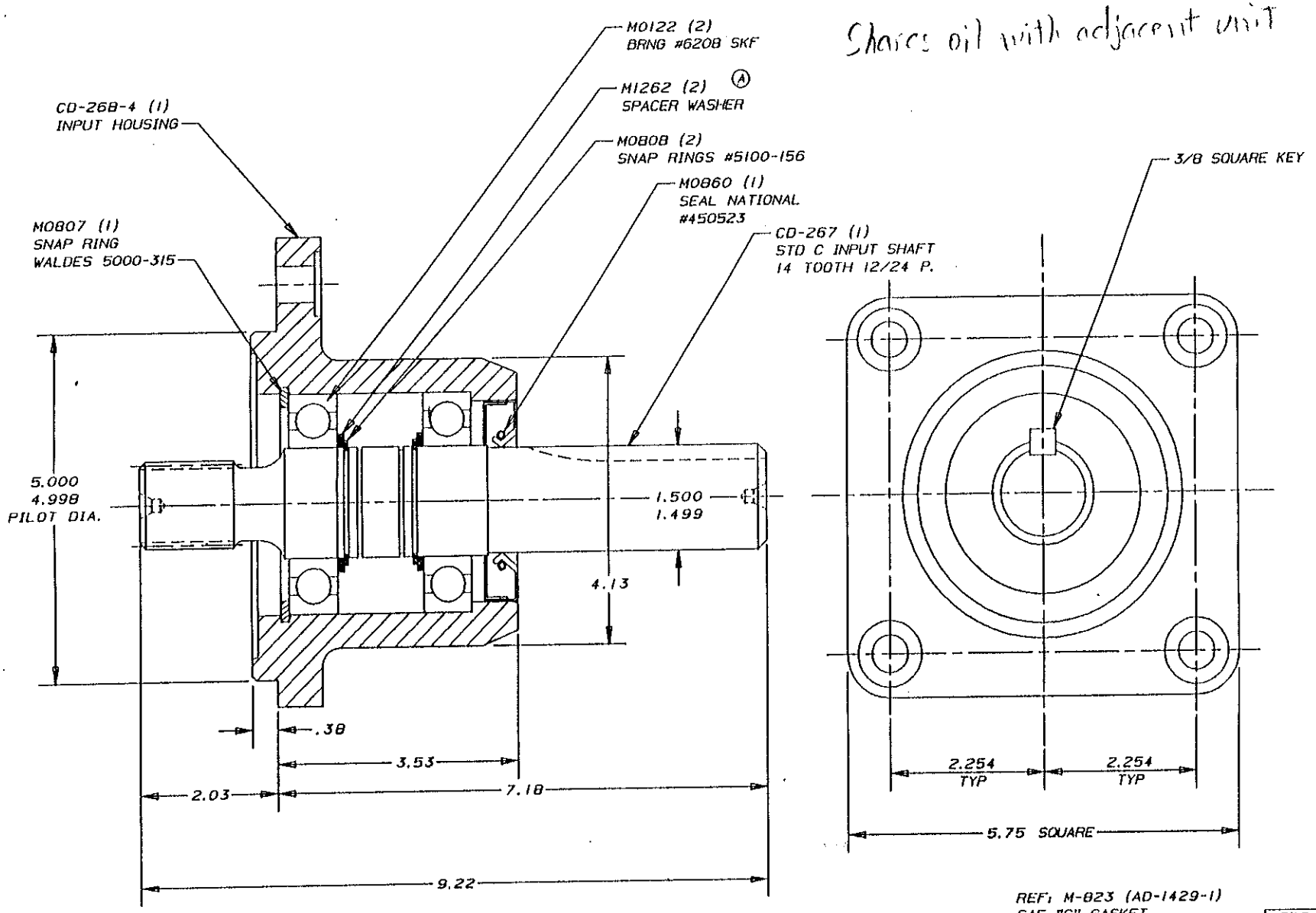
SHAFT ASSEMBLY	B-10 HOURS	REVOLUTIONS PER MINUTE					
		500	1000	1500	2000	2500	3000
S.A.E. A-MOUNT DØ200.01 #6206 BEARINGS	200	946	725	643	577	532	473
	500	681	541	480	431	406	379
	1000	549	431	379	341	321	304
	1960	437	344	304	275	254	243
	3000	379	299	262	240	221	210
	4100	341	270	237	216	198	187
	5100	318	250	218	200	185	174
S.A.E. B-MOUNT DØ159 #6207 BEARINGS	200	1076	825	731	657	605	538
	500	775	615	545	490	461	430
	1000	625	490	430	387	365	346
	1960	497	391	346	312	289	277
	3000	430	339	298	273	251	239
	4100	387	307	269	245	225	213
	5100	362	285	248	228	210	198
S.A.E. C-MOUNT DØ266 #6208 BEARINGS	200	1565	1199	1063	955	880	782
	500	1127	894	794	713	671	626
	1000	909	713	626	563	531	503
	1960	722	569	503	454	420	402
	3000	626	494	433	397	366	348
	4100	563	447	391	357	327	310
	5100	526	414	361	331	306	287
S.A.E. D-MOUNT D1311 #311 BEARINGS	200	5232	4007	3554	3192	2943	2616
	500	3767	2990	2653	2384	2242	2093
	1000	3038	2384	2093	1883	1777	1682
	1960	2415	1902	1682	1519	1405	1345
	3000	2093	1652	1449	1326	1223	1162
	4100	1883	1495	1308	1192	1095	1035
	5100	1760	1385	1207	1108	1023	961

REVISED 6/1/95

1. Maximum rated rpm: 5000 for A, B and C-Mount; 3600 rpm for D-Mount.
2. Load ratings shown above are the maximum allowed at the mid-point of the input shaft extension and are based on the allowable radial load (ar location relative to the mid-point of the shaft) of the bearings when operating at the various speeds shown at the expected B-10 life expectanc
3. C-Mount overhung load ratings can be INCREASED 150% when assemblies are provided with spherical roller bearings—at the list prices show in light face on Table 1.
4. D-Mount overhung load ratings can be INCREASED 200% when assemblies are provided with spherical roller bearings—at the list prices show in light face on Table 1.
5. A or B-Mount assemblies are not available with spherical roller bearings.
6. Load ratings shown above can be used with timing belts with a 1.0 service factor. If V-belts are used, DIVIDE the load ratings shown above by 1.

CD-266

Shares oil with adjacent unit



REF: M-823 (AD-1429-1)
SAE "C" GASKET

AD-270 SPACER REMOVED 3-28-88 LSS
SNAP RINGS MOVED TO BETWEEN BEARINGS
CD-268-4 WAS CD-268; M-860 WAS M-806 11-9-84; LSS

A	REDRAWN IN CAD 1262 WASHERS ADDED	LSS	4-4-91 4-4-91	

UNLESS OTHERWISE SPECIFIED, BREAK ALL CORNERS .03
(X.XXX±.010)(X.XX±.020)(X.X OR FRAC.± 1/16)(ANGLES ± 1/2°)

title STD "C" INPUT ASSY

ASSEM. MODEL

DRN. LSS MAT'L. D

DATE 4-1-91 STK. SIZE

SCALE 1/1 FINISH D

HEAT TREAT D

DO NOT SCALE DRAWING

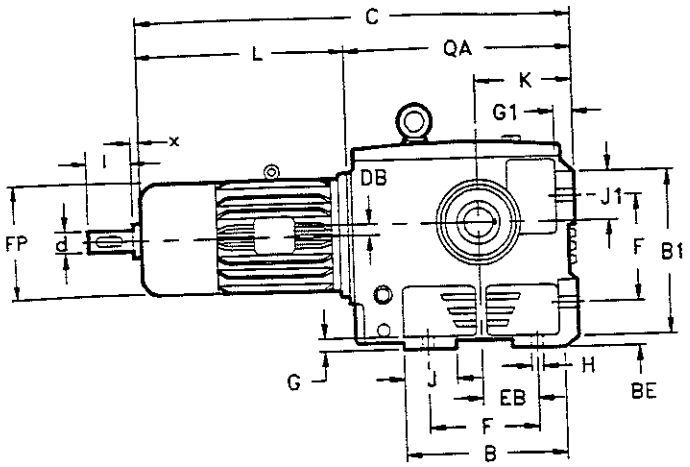
RMG ROCKFORD MANUFACTURING GROUP

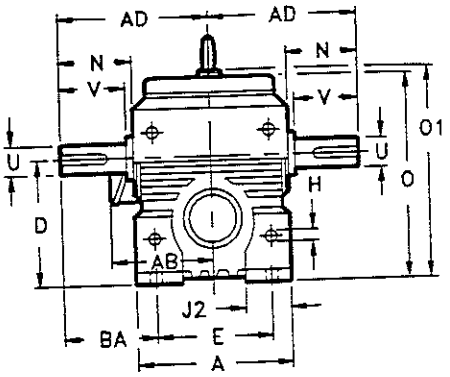
SHEET 1 OF 2

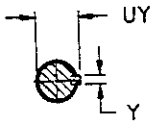
CD 6

FILE NUMBER
0026600A

E330032-21







UNIT SIZE	A	AD	B	BA	BE	B1
SK12063L-90S/4-BRE/HL-WE	5.43	5.66	5.51	3.50	1.38	5.51

D	DB	E	EB	F	G	G1	H	J
4.41	0.51	4.33	1.77	3.94	0.63	0.63	0.43	1.57

J1	J2	K	N	QA	O	O1	U	UY
1.57	1.42	3.15	2.95	7.87	7.17	7.40	1.250	1.36

KEY	V	Y	AB	FP	C	L
1/4x1/4x2-1/4 (2)	2.75	0.250	6.02	7.13	22.6	14.76

d	x	l
14mm	0.24	1.18

RATIO: 49.88:1 MTG: B3 OUTPUT TORQUE: 2069 LB IN OUTPUT SPEED: 35 RPM

MOTOR DATA: 1.50HP @ 1715RPM, 230/460V, 3PH, 60HZ

SPECIAL: MOTOR WITH EXTENDED SHAFT AND HAND RELEASE BRAKE, DBL. EXTENDED O/P SHAFT

Scale: None Dimensions in inches

NORD GEAR CORPORATION
800 NORD DRIVE
P.O. BOX 367
WAUNAKEE, WI 53597-0367
PHONE (608) 849-7300
FAX (608) 849-7367

	DATE	NAME
DRAWN	8/21/95	MBI
CHECKED		
CERTIFIED	8/22/95	TB

U TOLERANCE:
DIA. TO 1.750 +.0000 -.0005
DIA. OVER 1.875 +.0000 -.0010

CUSTOMER L&F INDUSTRIES
NORD ORDER NO. 950817128
CUSTOMER'S ID 15948-83281-B

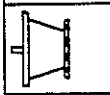
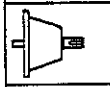
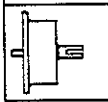
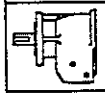
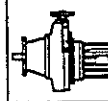
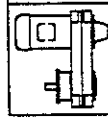
Unicase Helical Worm Gearmotor

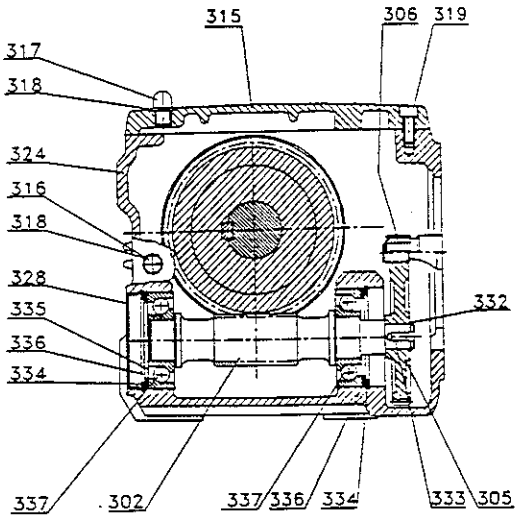
CA 1610-35

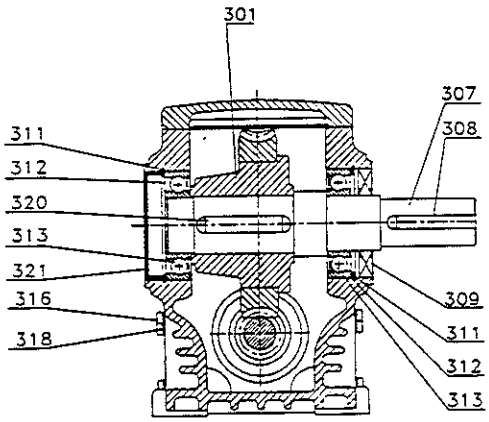
PARTS LIST

UNICASE - HELICAL WORM REDUCER
FRAME SIZE: SK12063V
FOOT MOUNT

PARTS LIST NO.
610100

REDUCER INPUT MODULES	
	*INTEGRAL MOTOR*
	*C-FACE OR IEC MOTOR INPUT ADAPTER*
	*INPUT HOUSING*
	*FLANGED INPUT HOUSING FOR P-MOUNT, SCOOP MOUNT*
	*MULTISTAGE GEARING, LOW OUTPUT SPEEDS*
	*NORDISC, ADJ. SPEED FRICTION DISC DRIV.*
	*TITAN, ADJ. SPEED BELT-DRIVE U OR Z-FLOW*





ITEM	PART NAME	DESCRIPTION	PART NO.	QTY
301	WORM WHEEL	CONTACT	FACTORY	1
302	WORM PINION	CONTACT	FACTORY	1
305	INPUT GEAR	CONTACT	FACTORY	1
306	INPUT PINION	CONTACT	FACTORY	1
307	OUTPUT SHAFT	1.25x2.75 in.	161030000	1
308	OUTPUT KEY	1/4x1/4x2 1/4 in.	126004180	1
309	OIL SEAL	35x72x12ASmm	25035160	1
311	SNAP RING	72x2.5mm int.	27307200	2
312	SHIM	56x72x0.1mm	29105612	2
312	SHIM	56x72x0.3mm	29105652	2
313	BEARING (BALL)	6207Z	24620710	2
315	INSPECTION COVER		61018000	1
316	DRAIN PLUG	M10x1.0mm	22110003	6
317	AUTO VENT	M10x1.0mm	22010005	1

ITEM	PART NAME	DESCRIPTION	PART NO	QTY
318	GASKET	10x13.5x1.0mm	25310130	7
319	SOCKET HEAD BOLT	M8x16mm	22108160	6
320	KEY (HARDENED)	10x8x50mm	26105000	1
321	SEAL PLUG	72x9mm	25807201	1
324	HOUSING (FOOTED)	SK12063V	61010000	1
328	SEAL PLUG	52x10mm	25805200	1
332	SNAP RING	16x1.0mm ext.	27201600	1
333	KEY (HARDENED)	5x5x14mm	26050145	1
334	SNAP RING	52x2.0mm int.	27305200	2
335	SHIM	42x52x0.1mm	29104211	2
335	SHIM	42x52x0.3mm	29104251	2
336	SPACER	42x52x2.5mm	27804200	2
337	BEARING (ANG.CONT.)	7304B	24730400	2

CONTACT FACTORY: THIS APPLIES TO PARTS WHERE A VARIETY OF SIZES ARE AVIILABLE.

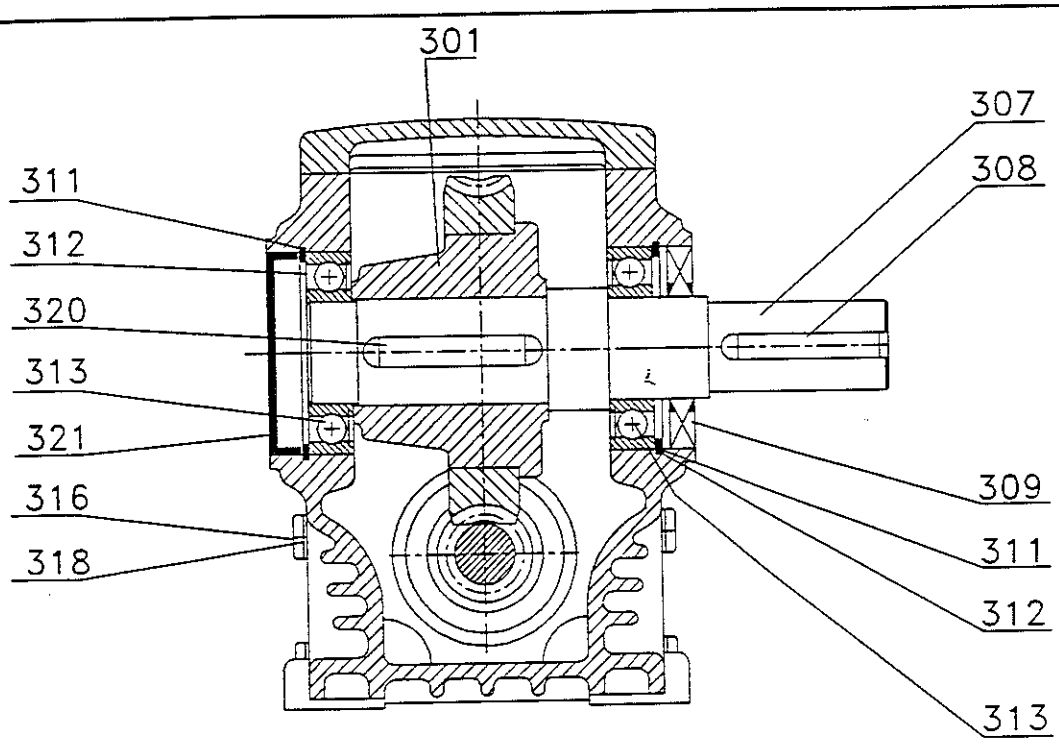
NORD GEAR CORPORATION
800 NORD DRIVE
WAUNAKEE, WI 53597
TELEPHONE: (608) 849-7300
TELEFAX: (608) 849-7367

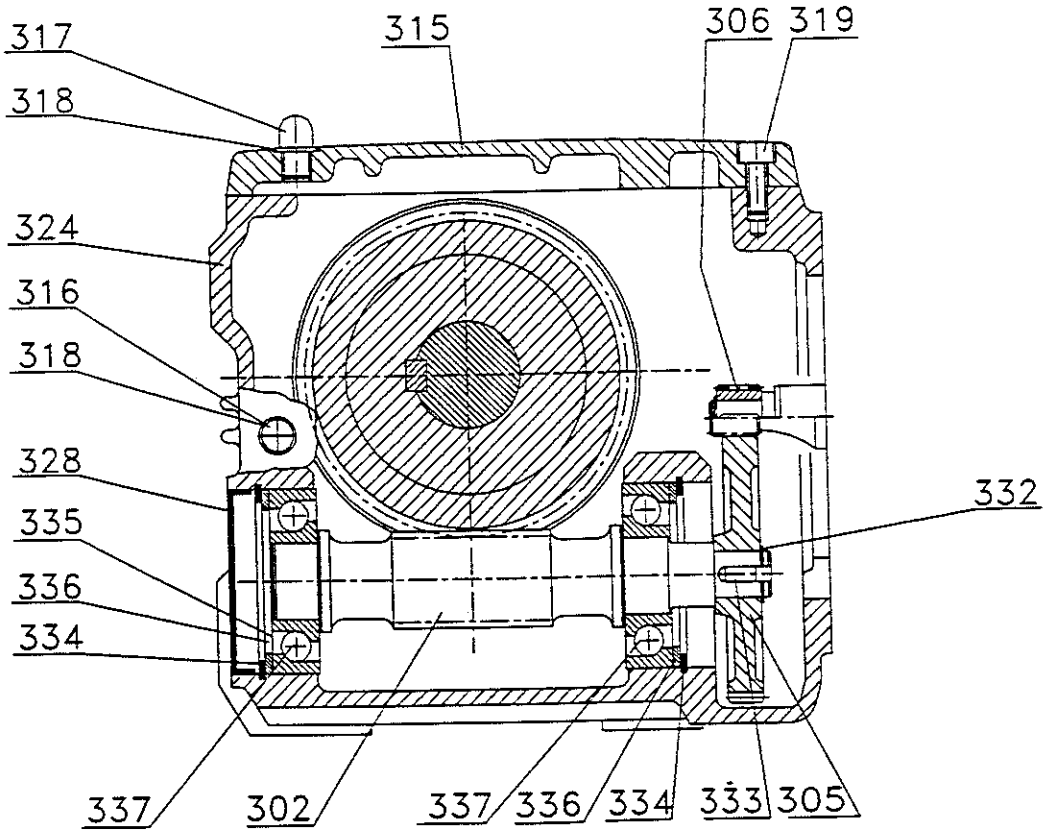
IMPORTANT: *WHEN ORDERING PARTS SUPPLY NAMEPLATE DATA:*
1. SERIAL NUMBER
2. FRAME SIZE
3. RATIO

PARTS LIST - ENLARGED

SUPPORT DOCUMENT
FRAME SIZE: SK12063V

REF. PARTLIST #
610100





This support document is generated to assist in the selection of parts and to identify the parts during disassembly/assembly of the unit. For part numbers see appropriate partslist.

Unicase™ - Helical Worm Gearmotors

Constant Speed

Selections

1.5 HP INPUT

OUTPUT SPEED (rpm)	EXACT RATIO	OUTPUT TORQUE (LB.IN)	SERVICE FACTOR	MODEL GEAR MOTOR UNIT FRAME
210	8.17	396	1.7	SK02050-90S4
182	9.41	456	1.6	SK02050-90S4
147	11.63	558	1.4	SK02050-90S4
102	16.86	771	1.2	SK02050-90S4
88	19.42	889	1.1	SK02050-90S4
77	22.32	1021	1.6	SK12063-90S4
68	25.15	1151	1.5	SK12063-90S4
60	28.61	1293	1.4	SK12063-90S4
49	34.89	1558	1.2	SK12063-90S4
44	38.92	1631	1.2	SK12063-90S4
39	43.86	1813	1.1	SK12063-90S4
34	49.88	2062	1.0	SK12063-90S4
33	52.03	2208	1.9	SK12080-90S4
29	58.27	2473	1.7	SK12080-90S4
26	66.44	2783	1.6	SK12080-90S4
22	78.91	3262	1.4	SK12080-90S4
18	94.35	3277	1.3	SK12080-90S4
16	106.08	3625	1.2	SK12080-90S4
14	123.42	4150	1.1	SK12080-90S4
12	138.21	4571	1.1	SK12080-90S4
10	165.50	5656	1.8	SK32100-90S4
9.3	183.50	6170	1.7	SK32100-90S4
7.1	241.50	7721	1.4	SK32100-90S4
6.9	247.69	8465	2.4	SK42125-90S4
5.1	337.46	10975	2.0	SK42125-90S4
3.8	446.50	14029	1.6	SK42125-90S4
2.8	611.00	18188	1.3	SK42125-90S4
2.2	794.58	23214	1.1	SK43125-90S4

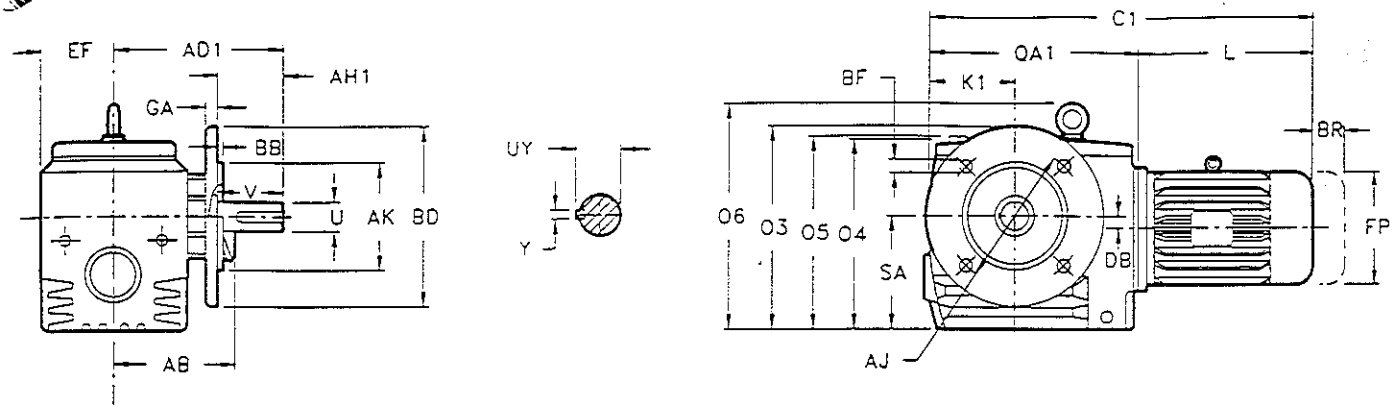
SK12063VL-90S-BRE/HL/WE

SK12063L-90S/4 BRE/HL/WE

Unicase - Helical Worm Gearmotor
Flange Mounted

Dimensions

SIZES SK02050VF — SK42125VF



GEAR REDUCER DIMENSIONS

SIZE	AD1	AH1	AJ	AK	BB	BD	BF	DB	EF	GA	K1
SK 02050VF	5.47	2.12	5.12	4.331	0.16	6.30	0.35	0.30	2.48	0.39	3.15
SK 12063VF	6.53	2.75	6.50	5.118	0.16	7.87	0.43	0.51	2.76	0.47	3.94
SK 12080VF	7.24	2.75	6.50	5.118	0.16	7.87	0.43	0.75	3.11	0.47	3.98
SK 32100VF	9.09	3.50	8.46	7.087	0.16	9.84	0.55	0.94	3.78	0.63	4.92
SK 42125VF	11.86	4.50	11.81	9.843	0.20	13.78	0.71	1.54	4.69	0.79	6.89

SIZE	O3	O4	O5	O6	QA1	SA	U	OUTPUT SHAFT KEY	UY	V	Y
SK 02050VF	7.01	6.65	6.93	-	7.48	3.86	1.000	1/4 x 1/4 x 1 5/8	1.11	2.12	0.250
SK 12063VF	8.62	7.60	7.83	-	8.70	4.69	1.250	1/4 x 1/4 x 2 1/4	1.36	2.75	0.250
SK 12080VF	9.69	9.92	9.88	11.30	9.53	5.75	1.375	5/16 x 5/16 x 2 1/8	1.51	2.75	0.312
SK 32100VF	12.09	12.28	12.24	14.06	11.34	7.17	1.875	1/2 x 1/2 x 2 3/4	2.09	3.50	0.500
SK 42125VF	15.63	14.88	15.67	18.11	14.84	8.74	2.375	5/8 x 5/8 x 3 1/2	2.65	4.50	0.625

MOTOR DIMENSIONS - INTEGRAL MOUNTED TEFC MOTORS

				SK02050VF		SK12063VF		SK12080VF		SK32100VF		SK42125VF	
MOTOR	AB	BR	FP	C1	L	C1	L	C1	L	C1	L	C1	L
63L	4.45	2.36	5.12	16.4	8.9	16.8	8.9	18.5	8.9				
71S & 71L	4.92	2.67	5.71	17.2	9.8	18.5	9.8	19.3	9.8				
80S & 80L	5.39	2.64	6.38	18.2	10.7	19.4	10.7	20.2	10.7	21.8	10.5		
90S & 90L	5.79	2.95	7.13	19.7	12.2	20.9	12.2	21.7	12.2	23.3	12.0	27.1	12.3
100L/40	6.22	3.54	7.99					24.1	14.6	25.7	14.4	28.4	13.6
132S	7.72	4.80	10.47							29.3	18.0	32.0	17.2
132M	7.72	4.80	10.47									32.0	17.2
160M	9.41	5.12	12.60									35.5	20.7

Dimension in inches
U tolerance

Diameters to 1.750	+.0000 -.0005
Diameters over 1.875	+.0000 -.0010

Dimensions subject to change

AK tolerance

9" Diameters	+.0005 -.0005
Diameters over 9"	+.0000 -.0015

Dimensional Certification **Nord Gear**

NORD shop order #: _____

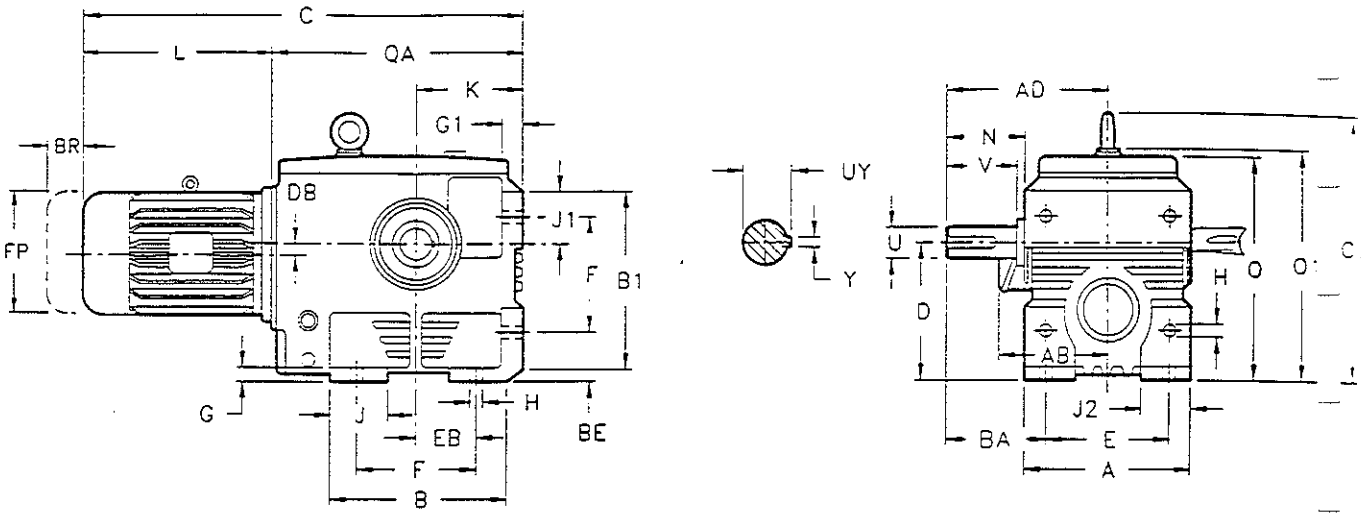
Model # _____ Certified by: _____

Customer name: _____ Customer P.O.#: _____

Unicase - Helical Worm Gearmotor
Foot Mounted

Dimensions

SIZES SK02050V — SK42125V



2.95
4.41
3.15

GEAR REDUCER DIMENSIONS

SIZE	A	AD	B	BA	BE	B1	D	DB	E	EB	F	G	G1	H
SK02050V	4.80	4.68	4.72	2.71	1.38	4.49	3.94	0.30	3.94	1.38	3.15	0.55	0.55	0.43
SK12063V	5.43	5.66	5.51	3.50	1.38	5.51	4.41	0.51	4.33	1.77	3.94	0.63	0.63	0.43
SK12080V	6.30	6.29	7.01	3.73	1.57	6.69	5.51	0.75	5.12	2.36	5.12	0.79	0.79	0.55
SK32100V	7.48	7.63	7.28	4.68	2.76	7.20	7.09	0.94	5.91	2.95	5.31	1.10	0.98	0.71
SK42125V	9.84	9.81	9.53	5.88	3.23	9.45	8.86	1.54	7.87	3.62	7.09	1.34	1.18	0.87

SIZE	J	J1	J2	K	N	O	O1	O2	QA	U	OUTPUT SHAFT KEY	UY	V	Y
SK02050V	1.38	1.34	1.34	2.95	2.28	6.26	6.50	-	7.28	1.000	1/4 x 1/4 x 1 5/8	1.11	2.12	0.250
SK12063V	1.57	1.57	1.42	3.15	2.95	7.17	7.40	-	7.87	1.250	1/4 x 1/4 x 2 1/4	1.36	2.75	0.250
SK12080V	1.57	1.57	1.57	3.94	2.99	8.94	8.98	10.31	9.49	1.375	5/16 x 5/16 x 2 1/8	1.51	2.75	0.313
SK32100V	1.96	1.89	1.96	4.92	3.70	11.34	11.38	13.15	11.34	1.875	1/2 x 1/2 x 2 3/4	2.09	3.50	0.500
SK42125V	2.76	2.36	2.36	5.91	4.69	13.70	14.49	16.93	13.86	2.375	5/8 x 5/8 x 3 1/2	2.65	4.50	0.625

MOTOR DIMENSIONS - INTEGRAL MOUNTED TEFC MOTORS

				SK02050V		SK12063V		SK12080V		SK32100V		SK42125V	
MOTOR	AB	BR	FP	C	L	C	L	C	L	C	L	C	L
63L	4.45	2.36	5.12	16.2	8.9	16.8	8.9	18.4	8.9				
71S & 71L	4.92	2.67	5.71	17.0	9.8	17.6	9.8	19.3	9.8				
80S & 80L	5.39	2.64	6.38	18.0	10.7	18.6	10.7	20.2	10.7	21.8	10.5		
90S & 90L	5.79	2.95	7.13	19.5	12.2	20.1	12.2	21.7	12.2	23.3	12.0	26.1	12.3
100L/40	6.22	3.54	7.99					24.1	14.6	25.7	14.4	27.4	13.6
132S	7.72	4.80	10.47							29.3	18.0	31.1	17.2
132M	7.72	4.80	10.47									31.1	17.2
160M	9.41	5.12	12.60									34.5	20.7

Dimension in inches
U tolerance

Diameters to 1.750 +.0000 -.0005
Diameters over 1.875 +.0000 -.0010

Dimensions subject to change

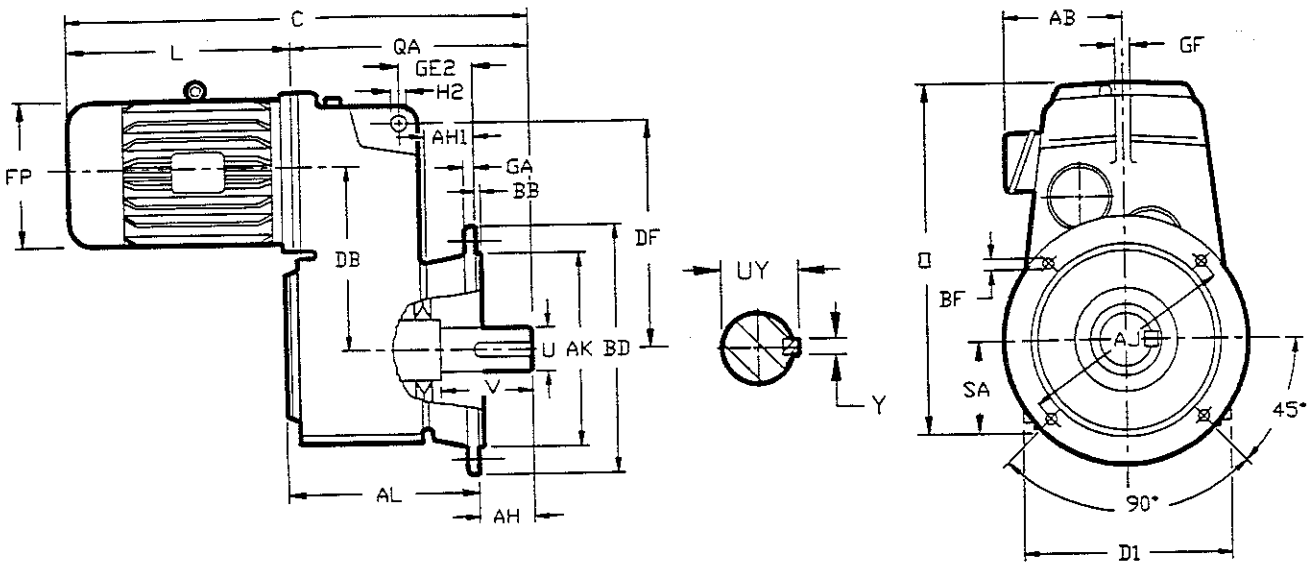
Dimensional Certification **Nord Gear**

NORD shop order #: _____

Model # _____ Certified by: _____

Customer name: _____ Customer P.O.#: _____

E330032-17



UNIT SIZE	AH	AH1	AJ	AK	AL	BB	BD
SK4282VF-180 M/4	2.62	2.09	10.43	9.055	8.78	0.16	11.81

BF	D1	DB	DF	GA	GE2	GF	H2	□
0.55	10.04	8.11	11.06	0.79	3.27	0.87	0.87	17.87

SA	U	UY	V	Y	C	QA	OUTPUT KEY
4.84	2.250	2.47	4.00	0.500	31.8	11.44	1/2x1/2x3-1/4

AB	FP	L
12.2	9.21	20.4

TORQUE: 14445 In.Lb. RATIO: 12.68:1 MTG: H1 SPEED: 138 RPM

MOTOR: 25.0 HP @ 1745 RPM, 230/460 V, 3 PH, 60 HZ

SPECIAL FEATURES: -

Scale: None Dimensions in inches

NORD GEAR CORPORATION
800 NORD DRIVE
P.O. BOX 367
WAUNAKEE, WI 53597-0367
PHONE (608) 849-7300
FAX (608) 849-7367

	DATE	NAME
DRAWN	8/21/95	MBI
CHECKED		
CERTIFIED	8/22/95	JB

AK Tolerances:
Diameters to 9.00 +.0000 -.0005
Diameters over 9.00 +.0000 -.0015
U Tolerance:
Diameters over 1.75 +.0000 -.0010

CUSTOMER L&F INDUSTRIES
NORD ORDER NO. 950817132
CUSTOMER'S ID 15948-83281-A

UNICASE-CLINCHER HELICAL Gearmotor

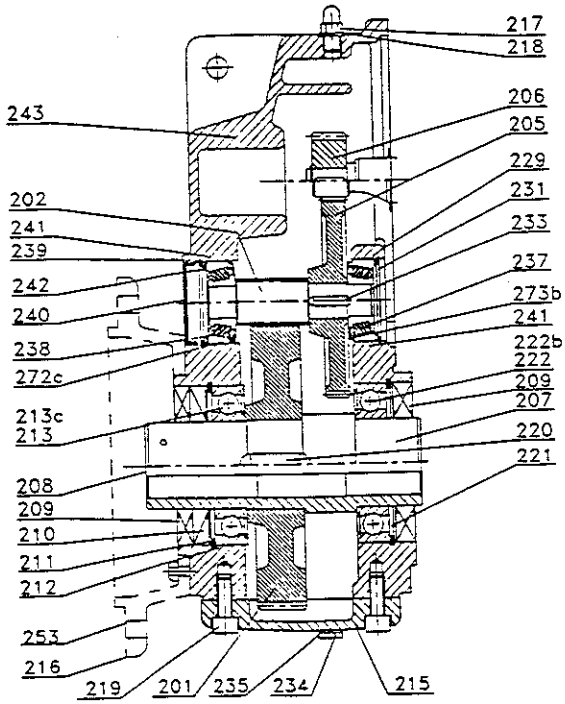
CA 1842-74

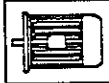
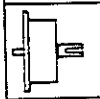
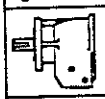
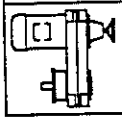
PARTS LIST

UNICASE - CLINCHER HELICAL REDUCER
FRAME SIZE: SK4282A, SK4282AF

PARTS LIST NO.

842100



REDUCER INPUT MODULES	
	*INTEGRAL MOTOR*
	*C-FACE OR IEC MOTOR INPUT ADAPTER*
	*INPUT HOUSING*
	*FLANGED INPUT HOUSING FOR P-MOUNT, SCOOP MOUNT*
	*MULTISIAGE GEARING, LOW OUTPUT SPEEDS*
	*NORDISC, ADJ. SPEED FRICTION DISC DRIVE*
	*TITAN, ADJ. SPEED BELT-DRIVE U OR Z-FLOW*

ITEM	PART NAME	DESCRIPTION	PART NO.	QTY
201	OUTPUT GEAR	CONTACT	FACTORY	1
202	OUTPUT PINION	CONTACT	FACTORY	1
205	INPUT GEAR	CONTACT	FACTORY	1
206	INPUT PINION/SHAFT	CONTACT	FACTORY	1
207	OUTPUT SHAFT	HOLLOW SHAFT	184237040	1
208	OUTPUT KEY	1/2x1/4x3 1/2	126001050	2
209	OIL SEAL	70x125x12ASmm	25070090	2
210	OIL SEAL	70x125x12A mm	25070100	1
211	SNAP RING	125x4.0mm int.	27312500	1
212	SHIM	100x125x.1mm	29110012	2
212	SHIM	100x125x.3mm	29110052	2
213	BEARING (BALL)	6214	24621400	1
213c	BEARING (BALL)	6214Z	24621410	1
215	INSPECTION COVER		84218000	1
216	BOLT ON FLANGE	300mm	84214000	1
217	AUTO VENT	M12x1.5mm	22012005	1
218	GASKET	12x15.5x1.5mm	25312150	1
219	SOCKET HEAD BOLT	M12x25mm	22112250	6
220	KEY (HARDENED)	20x12x36mm	26200365	1

ITEM	PART NAME	DESCRIPTION	PART NO.	QTY
221	SNAP RING	125x4.0mm int.	27312500	1
222	BEARING (BALL)	6214	24621400	1
222b	BEARING (BALL)	6214Z	24621410	1
229	SPACER	50x62x3.0mm	27805000	1
231	SNAP RING	62x2mm int.	27306200	1
233	KEY (HARDENED)	8x7x28mm	26080285	1
234	DRAIN PLUG	M12x1.5mm	22112003	2
235	GASKET	12x15.5x1.5mm	25312150	2
237	BEARING (TAPER ROLLER)	32305	24323050	1
238	BEARING (TAPER ROLLER)	32305	24323050	1
239	SNAP RING	62x2mm int.	27306200	1
240	SEAL PLUG	62x8mm	25806200	1
241	SHIM	50x62x.1mm	29105011	2
241	SHIM	50x62x.3mm	29105051	2
242	SPACER	50x62x3.0mm	27805000	1
243	HOUSING	SK4282	84211000	1
253	SOCKET HEAD BOLT	M12x35mm	22112350	6
272c	NILOS RING	32305AV	25423051	1
273b	NILOS RING	32305AV	25423051	1

b. LIMITED TO UNITS MOUNTED WITH O/P SHAFT IN VERTICAL DOWN POSITION.
c: LIMITED TO UNITS MOUNTED WITH O/P SHAFT IN VERTICAL UP POSITION.

CONTACT FACTORY: THIS APPLIES TO PARTS WHERE A VARIETY OF SIZES ARE AVIILABLE.

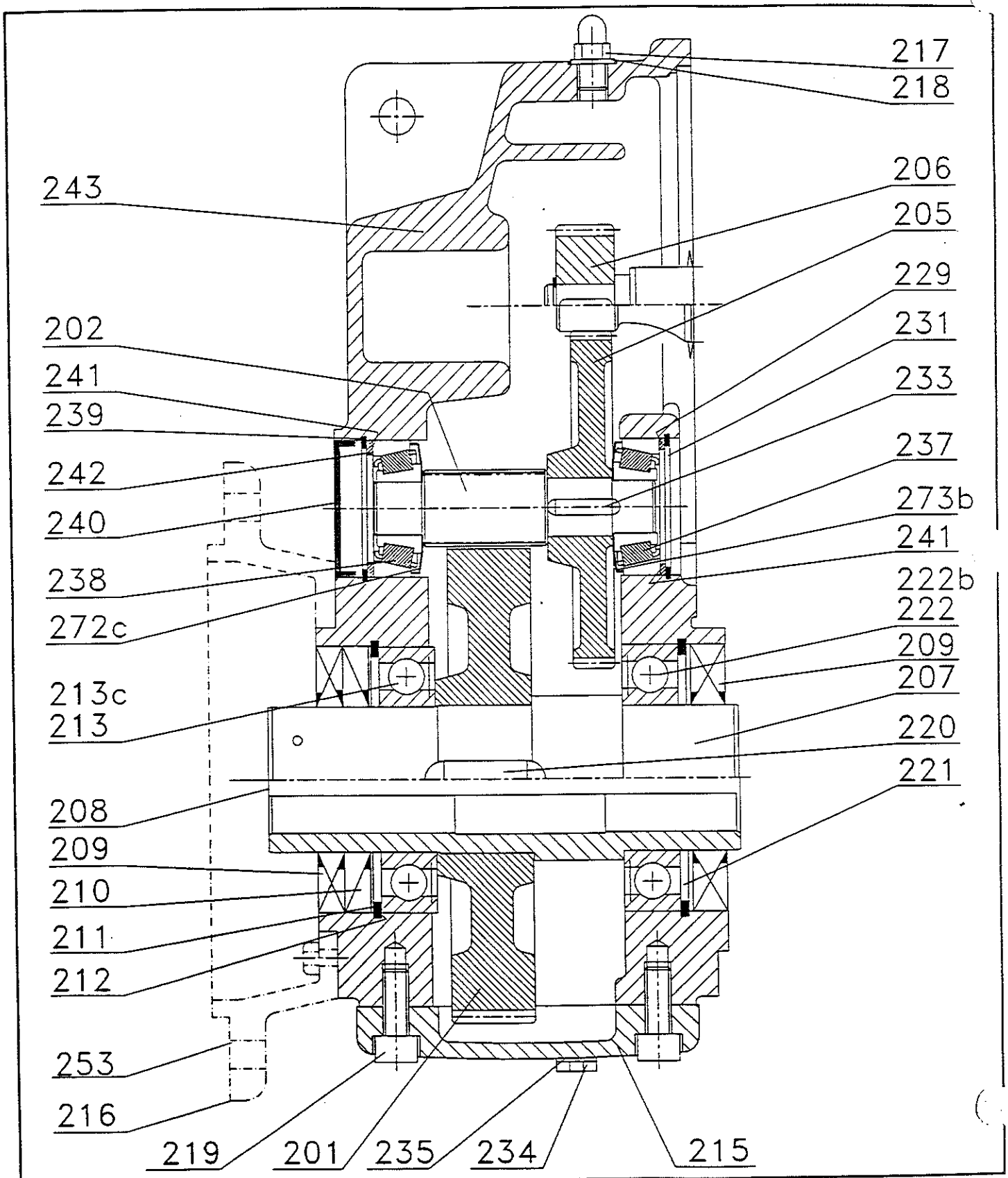
NORD GEAR CORPORATION
800 NORD DRIVE
WAUNAKEE, WI 53597
TELEPHONE: (608) 849-7300
TELEFAX: (608) 849-7367

IMPORTANT: *WHEN ORDERING PARTS SUPPLY NAMEPLATE DATA:*
1. SERIAL NUMBER
2. FRAME SIZE
3. RATIO

PARTS LIST - ENLARGED

SUPPORT DOCUMENT
SK4282A, SK4282AF

REF. PARTLIST #
842100

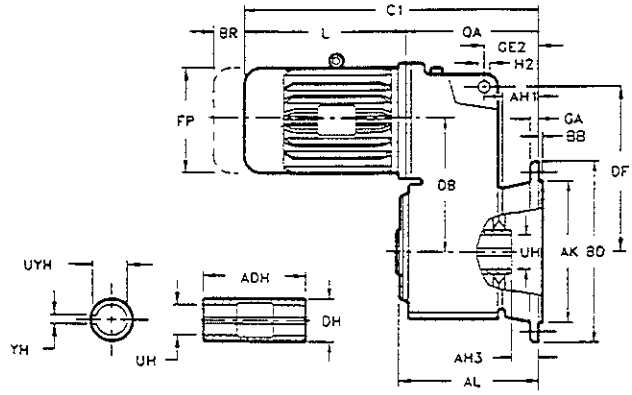


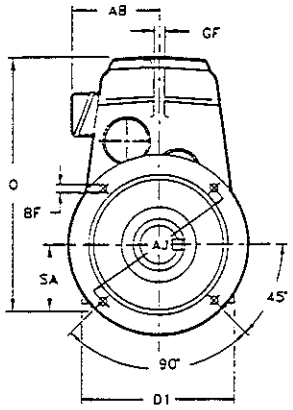
This support document is generated to assist in the selection of parts and to identify the parts during disassembly/assembly of the unit. For part numbers see appropriate partslist.

Unicase - Clincher Helical Gearmotor
Hollow Output Shaft - Flange Mounted

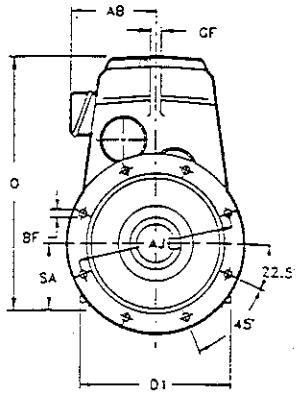
Dimension

SIZES SK1282AF — SK9282AF





SK1282AF — SK6282AF



SK7282AF — SK9282AF

GEAR REDUCER DIMENSIONS

SIZE	ADH	AH1	AH3	AJ	AK	AL	BB	BD	BF	D1	DB	DF	DH	GA	GE2	GF	H2	O	SA	UH	HOLLOW SHAFT KEY	UYH	YH
SK1282AF	5.39	1.77	0.51	6.50	5.118	5.79	0.14	7.87	0.43	6.22	4.80	6.50	1.77	0.47	2.44	0.55	0.43	10.98	3.03	1.188	3/8 x 1/4 x 4 1/2	1.28	0.380
SK2282AF	6.02	2.05	0.83	8.46	7.087	6.53	0.16	9.84	0.55	7.48	5.79	8.31	1.97	0.63	2.88	0.63	0.55	13.27	3.54	1.437	3/8 x 1/4 x 5	1.54	0.380
SK3282AF	7.40	2.09	1.02	10.43	9.055	8.19	0.16	11.81	0.55	8.90	7.01	9.84	2.17	0.79	3.11	0.71	0.55	15.24	4.21	1.625	1/2 x 1/4 x 6	1.71	0.500
SK4282AF	8.39	2.09	0.67	10.43	9.055	8.78	0.16	11.81	0.55	10.04	8.11	11.06	2.76	0.79	3.27	0.87	0.87	17.87	4.84	2.062	1/2 x 1/4 x 7	2.16	0.500
SK5282AF	9.96	2.24	0.67	11.81	9.843	10.35	0.20	13.78	0.71	12.05	9.88	13.43	3.35	0.79	3.66	1.10	0.87	20.75	5.75	2.438	5/8 x 3/8 x 8 1/2	2.59	0.630
SK6282AF	12.60	2.36	0.39	13.78	11.811	12.68	0.20	15.75	0.71	13.78	11.06	14.06	3.94	0.79	4.35	1.38	1.02	22.87	6.77	2.750	3/4 x 3/8 x 11	2.89	0.750
SK7282AF	13.39	2.44	0.59	15.75	13.780	13.74	0.20	17.72	0.71	16.14	12.44	15.71	4.33	0.87	4.53	1.57	1.02	25.51	7.76	3.188	1 x 1/2 x 12	3.36	1.000
SK8282AF	15.59	2.44	0.47	19.69	17.717	15.79	0.20	21.65	0.71	18.50	14.17	17.72	5.12	1.10	4.92	1.97	1.22	29.49	8.86	4.062	1 x 1/2 x 14	4.25	1.000
SK9282AF	18.31	3.15	0.83	23.62	21.654	18.74	0.39	25.98	0.87	24.02	18.27	22.99	6.30	1.26	5.90	2.17	1.22	37.56	11.61	4.750	1 1/4 x 1/2 x 16	4.92	1.250

TEFC MOTOR DIMENSIONS

				SK1282AF			SK2282AF			SK3282AF			SK4282AF		
MOTOR	AB	BR	FP	C1	L	QA	C1	L	QA	C1	L	QA	C1	L	QA
63L	4.45	2.40	5.12	14.49	8.94	5.55									
71S & L	4.92	2.67	5.71	15.31	9.76	5.55	16.30	9.76	6.54						
80S & L	5.39	2.64	6.38	16.26	10.71	5.55	17.01	10.47	6.54	17.99	10.47	7.52			
90S & L	5.79	2.95	7.13	17.76	12.20	5.55	18.50	11.97	6.54	19.49	11.97	7.52	21.10	12.28	8.82
100L/40	6.22	3.54	7.99	19.76	14.21	5.55	20.91	14.37	6.54	21.89	14.37	7.52	22.40	13.58	8.82
132S & M	7.72	4.80	10.47							25.51	17.20	7.52	26.02	17.20	8.82
160M	10.24	5.12	12.60										28.11	19.29	8.82

All Dimensions in inches
Dimensions subject to change

UH Tolerances:

All Diameters +.001 -.000

AK tolerances:

9" Diameters and below +.0000 -.0005

Diameters over 9" +.0000 -.0015

				SK5282AF			SK6282AF			SK7282AF			SK8282AF			SK9282AF		
MOTOR	AB	BR	FP	C1	L	QA	C1	L	QA	C1	L	QA	C1	L	QA	C1	L	QA
90S & L	5.79	2.95	7.13	21.85	12.28	9.57												
100L/40	6.22	3.54	7.99	23.15	13.58	9.57	25.75	12.87	12.87									
132S & M	7.72	4.80	10.47	26.77	17.20	9.57	29.92	17.05	12.87	30.55	17.05	13.50	32.28	17.05	15.24			
160M	10.24	5.12	12.60	28.86	19.29	9.57	32.17	19.29	12.87	32.80	19.29	13.50	34.53	19.29	15.24			
160L	10.24	5.12	12.60	30.63	21.06	9.57	33.94	21.06	12.87	34.57	21.06	13.50	34.53	19.29	15.24			
180M	11.89	5.71	14.41	31.06	21.50	9.57	34.37	21.50	12.87	35.00	21.50	13.50	36.73	21.50	15.24	38.58	21.50	17.08
180L	11.89	5.71	14.41	32.60	23.03	9.57	35.91	23.03	12.87	36.54	23.03	13.50	38.27	23.03	15.24	40.11	23.03	17.08
200L	13.15	6.89	16.26				38.46	25.59	12.87	39.09	25.59	13.50	40.83	25.59	15.24	42.67	25.59	17.08
225S	14.57	7.87	18.11							39.69	26.18	13.50	41.42	26.18	15.24	43.26	26.18	17.08
225M	14.57	7.87	18.11							40.67	27.17	13.50	42.40	27.17	15.24	44.25	27.17	17.08
250M	14.57	-	18.11										44.33	28.50	15.83	46.17	28.50	17.67
280S	19.61	-	20.24										49.09	33.27	15.83	50.94	33.27	17.67
280M	20.43	-	22.13													53.30	35.63	17.67
315S	24.96	-	22.13													54.28	36.61	17.67

Dimensional Certification **Nord Gear**

NORD shop order #: _____

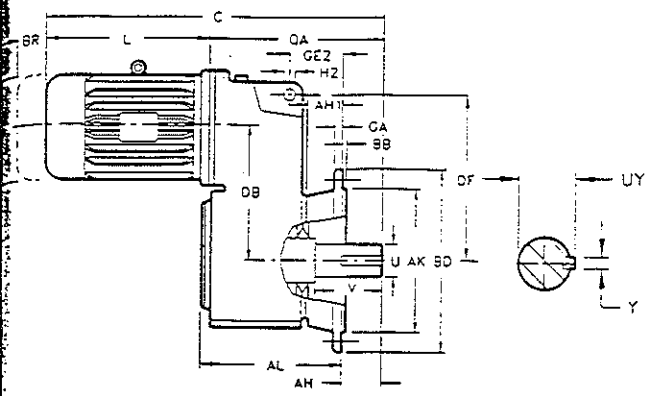
Model # _____ Certified by: _____

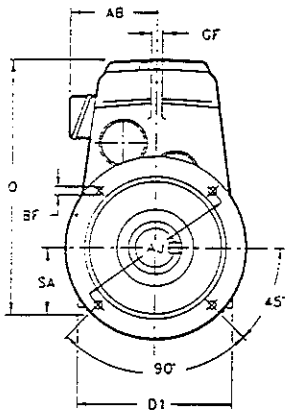
Customer name: _____ Customer P.O.#: _____

Unicase - Clincher Helical Gearmotor
Solid Output Shaft - Flange Mount

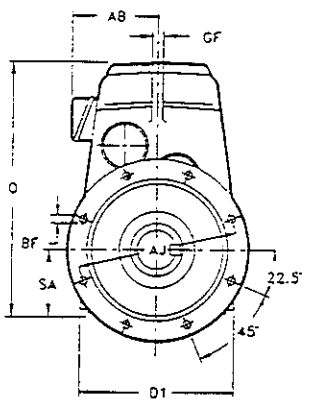
Dimensions

SIZES SK1282VF — SK9282VF





SK1282VF — SK6282VF



SK7282VF — SK9282VF

GEAR REDUCER DIMENSIONS

SIZE	AH	AH1	AJ	AK	AL	BB	BD	BF	D1	DB	DF	GA	GE2	GF	H2	O	SA	U	OUTPUT SHAFT KEY	UY	V	Y
X1282VF	1.65	1.77	6.50	5.118	5.79	0.14	7.87	0.43	6.22	4.80	6.50	0.47	2.44	0.55	0.43	10.98	3.03	1.250	1/4 x 1/4 x 2 1/4	1.36	2.75	0.250
X2282VF	1.37	2.05	8.46	7.087	6.53	0.16	9.84	0.55	7.48	5.79	8.31	0.63	2.88	0.63	0.55	13.27	3.54	1.375	5/16 x 5/16 x 2 1/8	1.51	2.75	0.312
X3282VF	1.93	2.09	10.43	9.055	8.19	0.16	11.81	0.55	8.90	7.01	9.84	0.79	3.11	0.71	0.55	15.24	4.21	1.875	1/2 x 1/2 x 2 3/4	2.09	3.50	0.500
X4282VF	2.62	2.09	10.43	9.055	8.78	0.16	11.81	0.55	10.04	8.11	11.06	0.79	3.27	0.87	0.87	17.87	4.84	2.250	1/2 x 1/2 x 3 1/4	2.47	4.00	0.500
[illegible]282VF	3.43	2.24	11.81	9.843	10.35	0.20	13.78	0.71	12.05	9.88	13.43	0.79	3.66	1.10	0.87	20.75	5.75	2.500	5/8 x 5/8 x 4	2.77	5.00	0.625
[illegible]282VF	3.93	2.36	13.78	11.811	12.68	0.20	15.75	0.71	13.78	11.06	14.06	0.79	4.35	1.38	1.02	22.87	6.77	3.000	3/4 x 3/4 x 4 1/2	3.33	5.50	0.750
X7282VF	4.98	2.44	15.75	13.780	13.74	0.20	17.72	0.71	16.14	12.44	15.71	0.87	4.53	1.57	1.02	25.51	7.76	3.500	7/8 x 7/8 x 5 1/2	3.88	6.75	0.875
X8282VF	6.85	2.44	19.69	17.717	15.79	0.20	21.65	0.71	18.50	14.17	17.72	1.10	4.92	1.97	1.22	29.49	8.86	4.250	1 x 1 x 7 1/4	4.69	8.50	1.000
X9282VF	7.64	3.15	23.62	21.654	18.74	0.39	25.98	0.87	24.02	18.27	22.99	1.26	5.90	2.17	1.22	37.56	11.61	5.250	1 1/4 x 1 1/4 x 8 3/4	5.80	9.84	1.250

VF Solid Shaft

AF Hollow Shaft

- H1 Mounting

SK 4282 VF

Shaft U Tolerances:

.750" Diameter and below +.0000 -.0005

Diameters over 1.750" +.0000 -.0010

AK Tolerances:

9" Diameter and below +.0000 -.0005

Diameters over 9" +.0000 -.0015

All Dimensions in inches
Dimensions subject to change

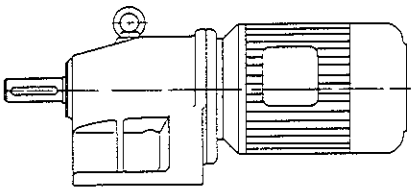
Dimensional Certification — **Nord Gear**

NORD shop order #: _____

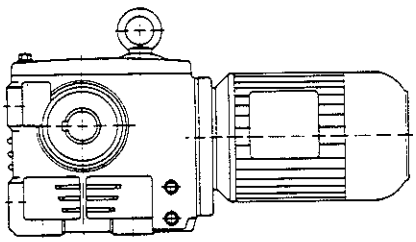
Model # _____ Certified by: _____

Customer name: _____ Customer P.O.#: _____

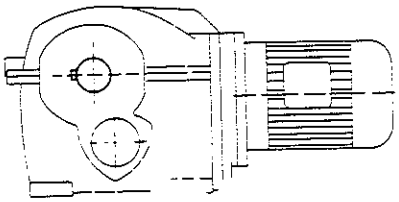
OPERATING & MAINTENANCE INSTRUCTIONS



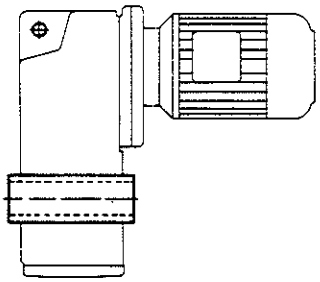
HELICAL



HELICAL-WORM



BEVEL-HELICAL



SHAFT MOUNT

NORD GEAR CORPORATION
800 Nord Drive
P.O. Box 367
Waunakee, WI 53597-0367

Phone (608)849-7300
TWX 910-286-2704
FAX 608-849-7367

318-618/93

INSTALLATION

The gearmotor or reducer should be mounted on a structure with enough rigidity to prevent vibration or flexture caused by dynamic loading. The mounting surface should be flat so stresses are not introduced during assembly of the unit on the structure. Externally mounted gears, sprockets and sheaves should be carefully aligned to prevent stresses caused by poorly aligned members.

If a coupling is used it should be a flexible coupling and the halves should be aligned in accordance with the coupling manufacturer's recommendations.

When mounting anything on the shaft of the gear unit the member should be heated if possible to make assembly easier.

Gears, sprockets or sheaves should be mounted as close to the gear housing as possible. Coupling guards should be provided by the customer.

ELECTRICAL CONNECTIONS

Check the motor nameplate to verify the phase, hertz and voltage agrees with the available power supply. Connection should conform to local codes. A connection diagram for the motor is located inside the conduit box and on the motor nameplate. The motor starter should incorporate an overload protector.

START-UP

All units are lubricated before shipment. The breather is plugged for shipment. Before start-up or prolonged storage remove the plastic wick from the breather. The lubricant level should be checked with the unit mounted in it's correct operating position. Lubricant should be added or removed to bring it to the correct level. The catalog for the gear unit shows the oil level for various mounting positions.

MAINTENANCE
A. MOTOR

During maintenance, inspect the fan guard and remove any accumulated debris from under it and around the motor and gear. Motor bearings are greased during assembly. For re-lubrication the following suggestions are offered:

HOURS OF SERVICE PER YEAR	HP RANGE	SUGGESTED RELUBE INTERVAL
5,000	¼ to 7½ 10 to 40 50 to 150	5 years 3 years 1 year
CONTINUOUS Normal Application	¼ to 7½ 10 to 40 50 to 150	2 years 1 year 9 months
SEASONAL SERVICE Motor is idle for 6 months or more	All	1 year (beginning of season)
CONTINUOUS High ambients, dirty or moist locations, high vibrations, or where shaft is hot (pumps—fans).	¼ to 40 50 to 190	6 months 3 months

Use high quality ball bearing grease. Use consistency of grease suitable for class of insulation stamped on nameplate as follows:

INSULATION CLASS	CONSISTENCY	TYPE	TYPICAL	FRAME TYPE
A & B	#2	Lithium Base	Shell Alvania Grease R 3	215 T & smaller
A & B	Medium	Polyurea	Shell Dolium Grease R	254T & larger
F & H	Medium	Polyurea	Shell Dolium Grease R	All

Procedure:

If motor is equipped with Alemite fitting, clean tip of fitting and apply grease gun. Use 1 to 2 full strokes on motors in NEMA 215 frame and smaller. Use 2 to 3 strokes on NEMA 254 through NEMA 365 frame. Use 3 to 4 strokes on NEMA 404 frames and larger. On motors having drain plugs, remove grease drain plug and operate motor for 20 minutes before replacing drain plug.

On motors equipped with slotted head grease screw, remove screw and apply grease tube to hole. Insert 3 to 3 inch length of grease string into each hole on motors in NEMA 215 frame and smaller. Insert 3 to 5 inch length on larger motors. Motors having grease drain plugs, remove plug and operate motor 20 minutes before replacing drain plug.

Caution: Keep grease clean. Lubricate motors at standstill. Remove and replace drain plugs at standstill. Do not mix petroleum grease and silicone grease in motor bearings.

B. GEARS

Gear units should have the oil changed every 10,000 hours or 2 years. If synthetic lubricant is used it should be changed every 20,000 hours or 4 years. For adverse operating conditions the interval should be shorter. DO NOT MIX SYNTHETIC & MINERAL BASE OILS. Units should be checked periodically for increased noise, surface temperature, vibration, shaft movement & amperage draw. Units with inspection covers should not be operated with the inspection cover removed.

The table below offers suggestions on the viscosity & manufacturers of recommended lubricants.

VISCOSITY RANGE FOR AGMA LUBRICANTS

RUST AND OXIDATION INHIBITED GEAR OILS	VISCOSITY RANGE ‡	EQUIVALENT ISO GRADE ◄	EXTREME PRESSURE GEAR LUBRICANTS ‡‡	VISCOSITIES OF FORMER AGMA SYSTEM ◄◄
AGMA Lubricant No.	mm²/s (cSt) at 40 °C		AGMA Lubricant No.	SSU at 100 °F
1	41.4 to 50.6	46		193 to 235
2	61.2 to 74.8	68	2 EP	284 to 347
3	90 to 110	100	3 EP	417 to 510
4	135 to 165	150	4 EP	626 to 765
5	198 to 242	220	5 EP	918 to 1122
6	288 to 352	320	6 EP	1335 to 1632
7 Comp	414 to 506	460	7 EP	1919 to 2346
8 Comp	612 to 748	680	8 EP	2837 to 3467
8A Comp	900 to 1100	1000	8A EP	4171 to 5098

NOTE: **Viscosity ranges for AGMA lubricant numbers will henceforth be identical to those of ASTM 2422.**

‡ "Viscosity System for Industrial Fluid Lubricants", ASTM 2422. Also British Standards Institute, B.S. 4231.

◄ "Industrial Liquid Lubricants—ISO Viscosity Classification." International Standard, ISO 3448.

‡‡ AGMA 250.03, May, 1972 and AGMA 251.02, November, 1974.

◄◄ Oils marked Comp are compounded with 3% to 10% fatty or synthetic fatty oils.

RECOMMENDED LUBRICANTS FOR HELICAL & BEVEL-HELICAL GEARING

Type of Lubricant	Ambient Temperature Range (°F)	kin Viscosity (cSt) at 40°C (mm 2/S)	Viscosity SUS 175 100°F	AGMA Lubricant No.	ISO Grade	AMOCO	CHEVRON	EXXON	MOBIL	SHELL	TEXACO
Oil	15 to 125	198 to 242	900 to 1100	5EP	220EP	AMOGEAR EP220	NL GEAR Compound 220	SPARTAN EP220	Mobil Gear 630	Omala Oil 220	Meropa 220
	-10 to +75°	90 to 765	465 to 165	3-4EP	100-150EP	AMOGEAR EP150	NL GEAR Compound 150	SPARTAN EP 150	Mobil 629	Omala Oil 100	Meropa 150
	Below 10°‡‡	15 to 680	135 to 165	—	—	—	E.P. Hydraulic Oil 22	UNIVIS J13	Mobil D.T.E. 11	—	Texamatic Fluid 9226 or Texamatic Type F
Oil— Synthetic	-40° to 175°‡ **	—	90 to 4000	—	—	—	—	—	Mobil SHC 629 or 634	—	Synstar GL75W-140
Fluid Grease	5° to 120°	—	—	—	—	—	—	—	—	—	MARKFAK 00

For bearings not lubricated in oil bath use a lithium base bearing grease, NLGI #2 or #3
‡ Ambient temperatures below -20°F and above 140°F require special oil seals
‡‡ Consult with Nord Gear Corporation for these applications
Bold ambient temperature indicates factory filled

Actual capacity should be established by opening the oil level plug and filling until oil runs out of the oil level hole.

RECOMMENDED LUBRICANTS FOR HELICAL-WORM GEARING

TYPE OF LUBRICANT	AMBIENT TEMP RANGE °F	KIN VISCOSITY (cSt) AT 40°C (mm 2/S)	VISCOSITY SUS 175 100°F	ISO GRADE	MOBIL	TEXACO
Oil Synthetic	-40° to 175°‡	198 to 352	900 to 1600	220	Glygoyle 30	Synstar GL75W 140

For bearings not lubricated in oil bath use a lithium base bearing grease, NLGI #2 or #3
‡Ambient temperatures below 0°F and above 100°F require special oil seals
Consult NORD GEAR CORPORATION for these applications

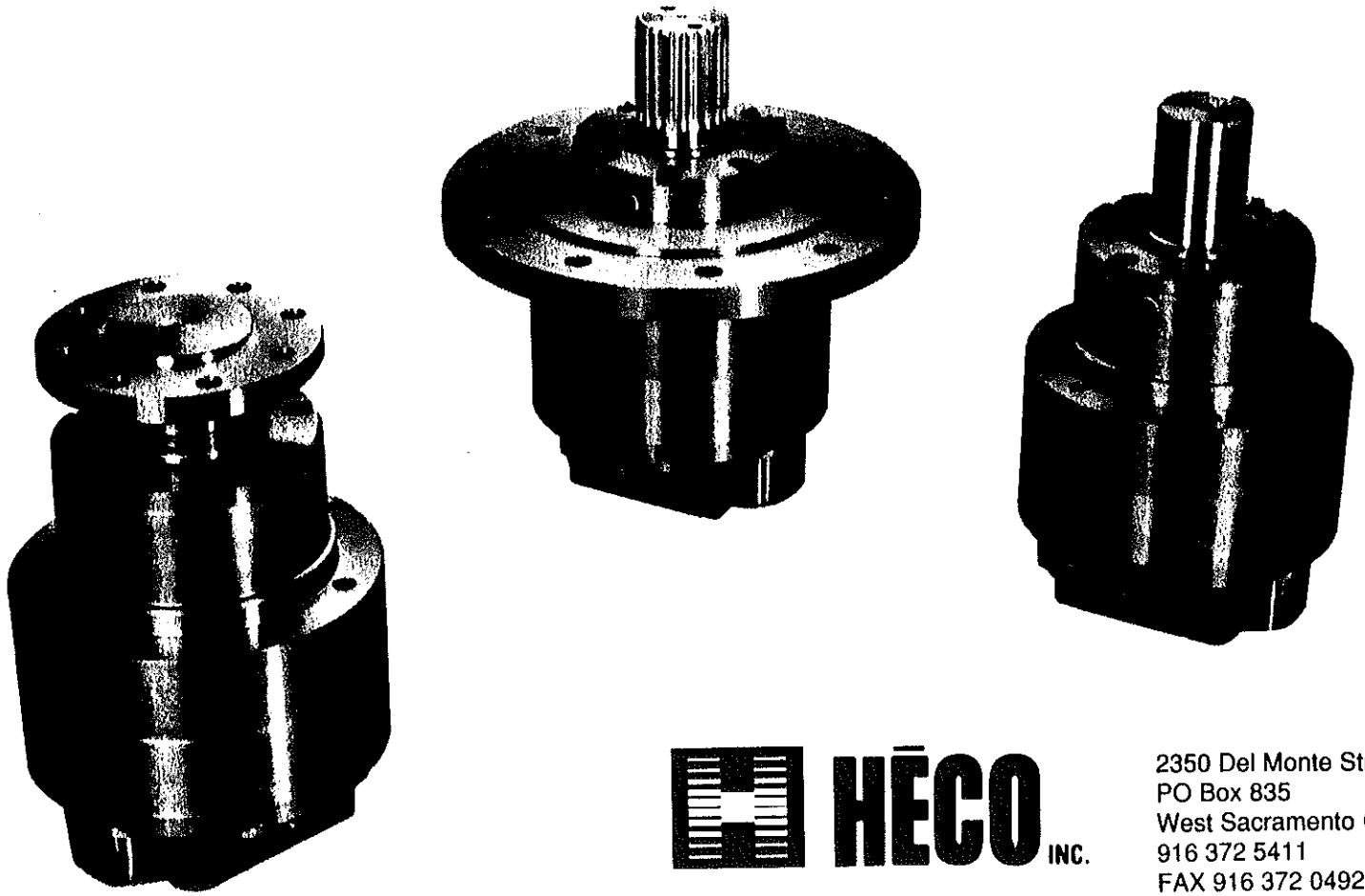
STORAGE

Units shipped from Nord are intended to be used within 30 days after receipt and presumed to be stored indoors in a heated building. If you intend storing units under adverse conditions or for a long period of time special storage precautions will be necessary.

1. Store in a sheltered area away from chemical vapors or steam.
2. Cover.
3. Do not store in sunlight or near high heat.
4. Remove plastic wick from breather.
5. Spray oil on exposed shafts & seals. Remove oil on start-up.
6. Rotate output shaft 360° every 3-4 weeks.

Model 20 & 20D

Parts and Lubrication Information



HECO INC.

2350 Del Monte Street
PO Box 835
West Sacramento CA 95691
916 372 5411
FAX 916 372 0492
Telex 377309

E330032-7

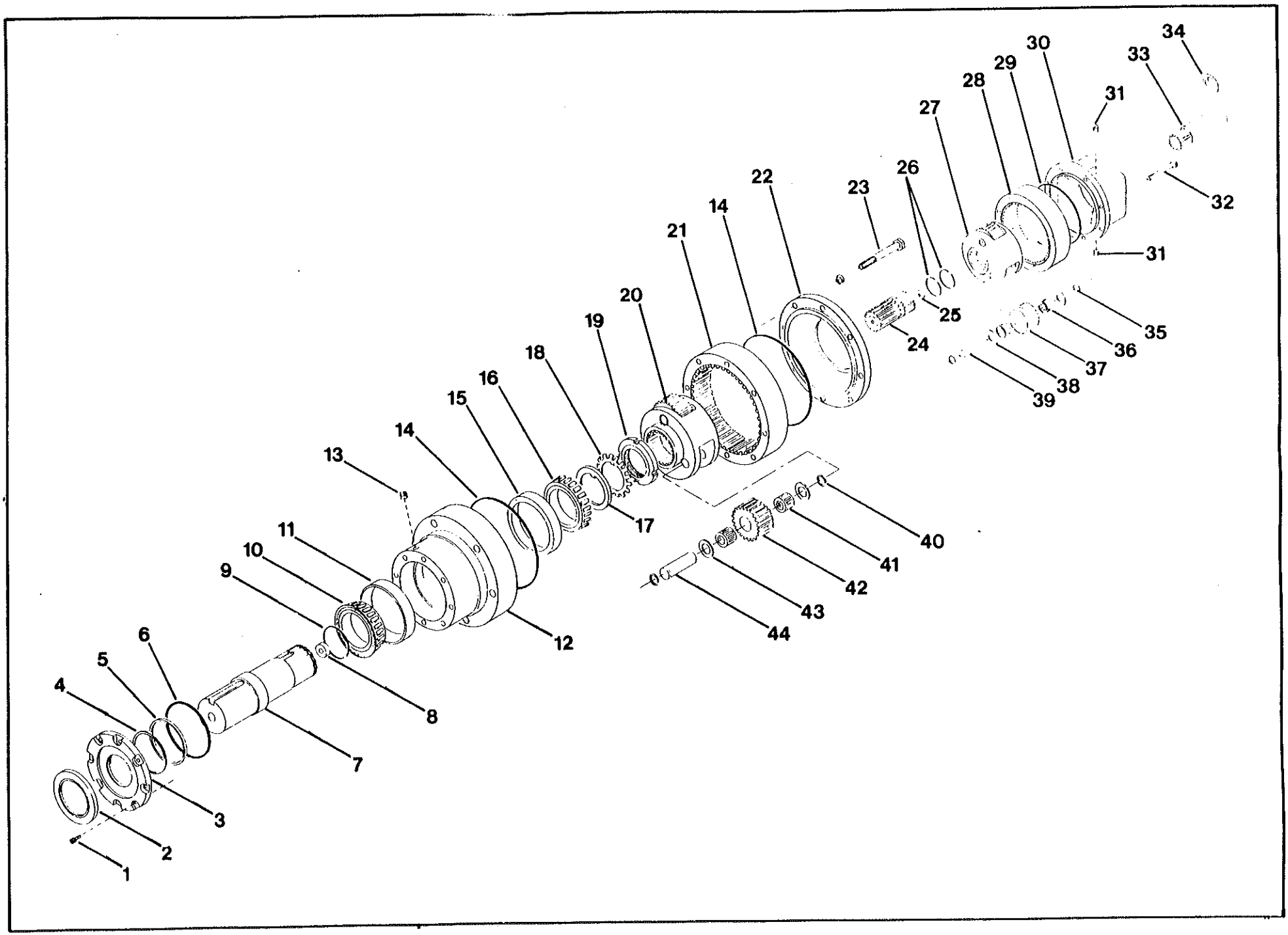
Model 20 & 20D

ITEM #	PART #	DESCRIPTION	QTY/ASSY
1.	151110	Cap Screw	8
2.	201500	Shaft Seal — 2 Design (Not Available in Viton)	1
3.		Seal Carrier	1
	200640	Standard	
	200650	High Pressure	
* 4.	201190	Backup Ring (Not Used on High Pressure Seal)	1
* 5.	201170	Quad Ring	1
	201175	Quad Ring Viton	
	201220	High Pressure Lip Seal	
* 6.	201160	O Ring	1
	201150	O Ring Viton	
7.		Output Shaft	1
	200440	2.750" Straight Keyed	
	200210	3.375" Straight Keyed	
	200570	23T 8/16 Spline	
	200530	8-Hole Flange	
8.	150152	Thrust Plug	1
9.	200110	Retaining Ring	1
10.	201210	Cone - CF Housing	2
	201560	Cone - FF Housing	
11.	201120	Cup - CF Housing	2
	201550	Cup - FF Housing	
12.	200200	CF Housing	1
	200560	FF Housing	
13.	201100	Pipe Plug	1
* 14.	201010	O Ring	2
	201015	O Ring Viton	
15.	201120	Cup	2
16.	201210	Cone	2
17.	201280	Keyed Washer	1
18.	201060	Lock Washer	1
19.	201070	Lock Nut	1
20.	200050	Planet Carrier	1
21.		Internal Gear	1
D	**200190**	**31.2:1**	
	200190	6:1	
D	**200040**	**24.96:1**	
	200040	4.8:1	
22.		Motor Adapter	1
	200240	SAE C 2/4-Bolt	
	200701	Modified SAE A 4-Bolt	
	200300	**Transition Plate**	1
23.	201090	Bolt — Motor Adapter/Transition Plate	8
24.		Sun Gear Kit (Input Shaft Adapter)	1
	20F	6:1 Char-Lynn 4000 Bearingless	
	20G	6:1 Char-Lynn 6000 Bearingless	
	2016	6:1 14T 12/24 Spline	
	2014	4.8:1 14T 12/24 Spline	
D	**200320**	**31.2:1 Intermediate Gear**	1
D	**200330**	**24.96:1 Intermediate Gear**	1
25	150	ust P	

ITEM #	PART #	DESCRIPTION	QTY/ASSY
D 26.	**150110**	**Retaining Ring**	**2**
D 27.	**150040**	**Planet Carrier**	**1**
D 28.	**150030**	**Internal Gear**	**1**
*** D 29.**	**151020**	**O Ring**	**2**
	151025	**O Ring Viton**	
D 30.		**Motor Adapter**	**1**
D	**152050**	**SAE A 2-Bolt**	
D	**150640**	**SAE B 2-Bolt**	
D	**150180**	**SAE B 4-Bolt**	
D	**152090**	**SAE C 2/4-Bolt**	
D	**150901**	**Modified SAE A 4-Bolt**	
D 31.	**151290**	**Pipe Plug**	**2**
	201100	Pipe Plug	2
D 32.	**151100**	**Bolt**	**8**
	151080	**Stud — SAE C 2/4-Bolt Only**	**8**
	151090	**Nut — SAE C 2/4-Bolt Only**	**8**
D 33.		**Sun Gear Kit (Input Shaft Adapter)** (See Separate Sheet for Kit Parts)	**1**
	16B	**7/8" — 13T Spline**	
	16C	**1" — 15T Spline**	
	16D	**1" Straight Keyed**	
	16E	**Char-Lynn 2000 Bearingless**	
	16F	**Char-Lynn 4000 Bearingless**	
	16H	**1 1/4" Straight Keyed**	
	16I	**1 1/4" — 14T Spline**	
	16M	**1" SAE 6B Spline**	
	16O	**7/8" Straight Keyed**	
	16P	**1 1/8" Straight Keyed**	
D 35.	**151070**	**Retaining Ring**	**6**
D 36.	**151130**	**Planet Bearing**	**6**
D 37.	**150050**	**Planet Gear**	**3**
D 38.	**151120**	**Thrust Washer**	**6**
D 39.	**150080**	**Planet Pin**	**3**
40.	201050	Retaining Ring	6
41.	201110	Planet Bearing	6
42.		Planet Gear	3
D	**200180**	**31.2:1**	
	200180	6:1	
D	**200080**	**24.96:1**	
	200080	4.8:1	
43.	201150	Thrust Washer	6
44.	200100	Planet Pin	3
		(See Parts Price List for Motor Bolt and Seal Kit Prices.)	
	209320	Seal Kit — Buna	
	209330	Seal Kit — Viton	
	209350	Seal Kit — High Pressure	
D	**209500**	**Seal Kit Double Reduction — Buna**	
D	**209550**	**Seal Kit Double Reduction — Viton**	
D	**209750**	**Seal Kit Double Red. — High Pressure**	

* Items which are included in Seal Kits

Item odel ly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LUBRICATION INSTRUCTIONS

HECO planetary speed reducers may be lubricated as a self-contained unit (standard hydraulic motor), or as an integral part of the hydraulic system (bearingless motor).

In applications where the speed reducer is lubricated as a self-contained, horizontal unit, it is recommended that the unit be half-filled with EP (1) oil (see chart for amount and proper grade gear oil). Self-contained, vertical installations (output shaft down) require the unit to be filled to the center line of the upper planetary gear train. For self-contained vertical installations (output shaft up) consult HECO. When installed as a self-contained unit, ensure adequate ventilation is provided to allow for lubricant expansion.

The oil should be changed after the first 50 hours and 100 hours of operation, and every 1000 hours thereafter. Oil should be drained while the unit is at operating temperature. The unit should be cleaned with flushing oil (use of solvents should be avoided). NOTE: The importance of a thorough gear case cleaning with flushing oil during the first lubricant change cannot be overemphasized. If the maximum oil operating temperature is exceeded, change oil immediately.

In applications where the speed reducer is lubricated by oil flow from the bearingless hydraulic motor, a petroleum based hydraulic oil with EP(1) additives should be used. Ensure that a minimum oil flow of 2 GPM is maintained, a separate case drain line should be connected directly from the top of the reducer (ensure the reducer remains full) to the oil reservoir.

For maximum cooling and lubrication the case drain should be connected to the drain port at the opposite end of the reducer from the hydraulic motor. Reducer case pressure must not exceed 20 PSI with the standard shaft seal or 50 PSI with the optionally available high pressure seal installed.

(1) Extreme Pressure Lubricants — These lubricants are petroleum base liquids with chemical additives, such as, sulfur phosphorous or similar materials or soluble compounds which produce a protective film to withstand high pressures.

	HORIZONTAL OPERATION (1/2 FULL)	TOTAL CAPACITY
Model 16	20 oz. (6 dl.)	40 oz. (12 dl.)
Model 20	50 oz. (15 dl.)	105 oz. (31 dl.)
Model 20D	50 oz. (15 dl.)	105 oz. (31 dl.)
Model 50	100 oz. (30 dl.)	200 oz. (60 dl.)
Model 50D	85 oz. (25 dl.)	170 oz. (50 dl.)
Model 52D	85 oz. (25 dl.)	170 oz. (50 dl.)
Model 52T	115 oz. (34 dl.)	230 oz. (68 dl.)

OIL GRADE — Single Reduction (RPM Out)
0-25 RPM — AGMA #5
25-100 RPM — AGMA #3
100-200 RPM — AGMA #1
200 + — Consult HECO

OIL GRADE — Double Reduction (RPM Out)
0-40 RPM — AGMA #5
40-60 RPM — AGMA #1
60 + — Consult HECO

MAXIMUM OIL TEMPERATURE
140°F (60°C) continuous
170°F (76°C) intermittent
Consult HECO for higher temperatures

INDUSTRIES
245-A Tank Farm Road • San Luis Obispo, CA 93401
Tel (805) 782-8080 • Fax (805) 782-8090

Heco Gear Reducers
Mirror Cart Drive Wheels

CAUTION:

UNIT MUST BE FILLED WITH PROPER TYPE AND AMOUNT OF LUBRICATION BEFORE START UP — **SEE BOTH SIDES**

Lubrication Instructions

	HORIZONTAL OPERATION (1/2 FULL)	TOTAL CAPACITY
Model 16	20 oz. (6 dl.)	40 oz. (12 dl.)
Model 20	50 oz. (15 dl.)	105 oz. (31 dl.)
Model 20D	50 oz. (15 dl.)	105 oz. (31 dl.)
Model 50	100 oz. (30 dl.)	200 oz. (60 dl.)
Model 50D	85 oz. (25 dl.)	170 oz. (50 dl.)
Model 52D	85 oz. (25 dl.)	170 oz. (50 dl.)
Model 52T	115 oz. (34 dl.)	230 oz. (68 dl.)

CAUTION:

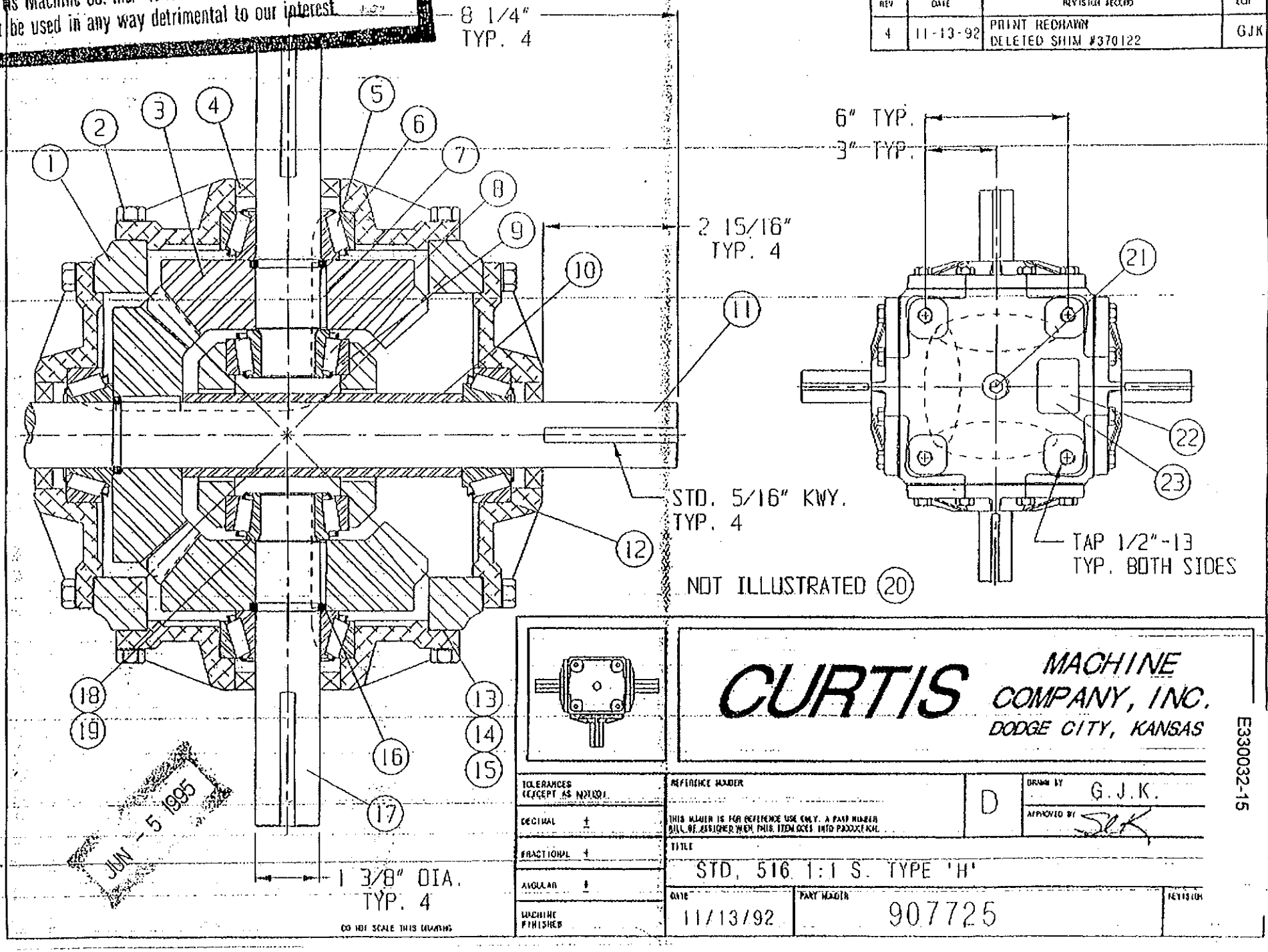
UNIT MUST BE FILLED WITH PROPER TYPE AND AMOUNT OF LUBRICATION BEFORE START UP — **SEE BOTH SIDES**

OIL GRADE — Single Reduction (RPM Out)
0-25 RPM — AGMA #5
25-100 RPM — AGMA #3
100-200 RPM — AGMA #1
200 + — Consult HECO

OIL GRADE — Double Reduction (RPM Out)
0-40 RPM — AGMA #5
40-60 RPM — AGMA #1
60+ — Consult HECO

MAXIMUM OIL TEMPERATURE
140°F (60°C) continuous
170°F (76°C) intermittent
Consult HECO for higher temperatures

REV	DATE	REVISION RECORD	ECO
4	11-13-92	PRINT REDRAWN DELETED SHIM #370122	GJK



DO NOT SCALE THIS DRAWING

CURTIS MACHINE COMPANY, INC.
DODGE CITY, KANSAS

E330032-15

TOLERANCES EXCEPT AS NOTED:
DECIMAL ±
FRACTIONAL ±
ANGULAR ±
MACHINE FINISHES

REFERENCE NUMBER

THIS NUMBER IS FOR REFERENCE USE ONLY. A PART NUMBER WILL BE ASSIGNED WHEN THIS ITEM GOES INTO PRODUCTION.

D

DRAWN BY G.J.K.

APPROVED BY

TITLE
STD. 516 1:1 S. TYPE 'H'

DATE 11/13/92

PART NUMBER 907725

REVISION

BILL OF MATERIAL

DET	PART NUMBER	QTY	DESCRIPTION
1	000828	1	HOUSING
2	410134	32	SEMS CAP SCREW
3	100677	3	GEAR
4	300178	4	SEAL
5	151175	4	BEARING CONE
6	151167	4	BEARING CUP
7	600155	3	KEY
8	150037	2	BEARING CONE
9	150029	2	BEARING CUP
10	450114	1	SPACER
11	200295	1	THRU SHAFT
12	051769	4	CAP
13	390161	VAR	GASKET (.015)
14	390179	VAR	GASKET (.010)
15	390229	VAR	GASKET (.003)
16	620070	3	RETAINING RING
17	200006	2	PINION SHAFT
18	370148	VAR	SHIM (.010)
19	370130	VAR	SHIM (.005)
20	410027	1	PIPE PLUG (SOLID)
21	410035	1	PIPE PLUG (VENTED)
22	800573	1	I.D. TAG
23	802876	1	I.D. TAG COVER

DET	PART NUMBER	QTY	DESCRIPTION

NOTES:

I.D. TAG INFORMATION:

MODEL NO. 516
TYPE H
RATIO 1:1
CURTIS NO. 907725-4
CUSTOMER NO.
DATE (today's no. day yr.)

JUN - 5 1995

CURTIS MACHINE COMPANY, INC.
DODGE CITY, KANSAS

REFERENCE NUMBER

THIS NUMBER IS FOR REFERENCE USE ONLY. A PART NUMBER WILL BE ASSIGNED WHEN THIS ITEM GOES INTO PRODUCTION.

DRAWN BY G.J.K.

APPROVED BY SK

TITLE STD 516 1:1 S TYPE (H)

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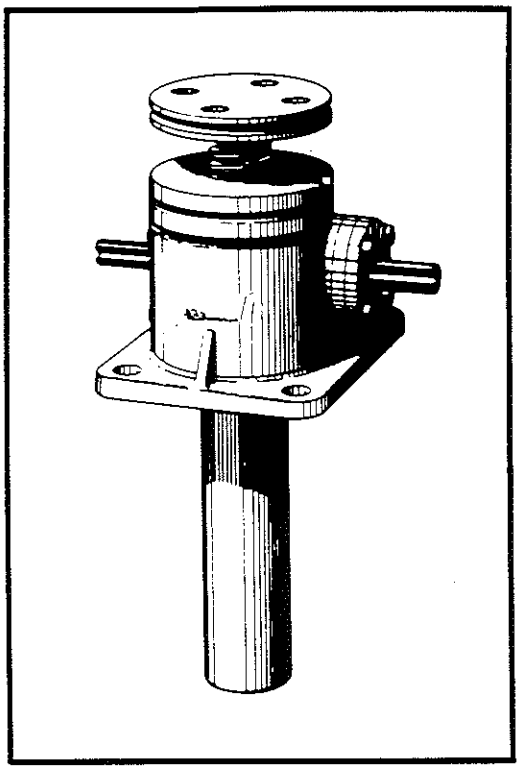
Duff-Norton®

MAINTENANCE INSTRUCTIONS

WITH PARTS LIST

PUBLICATION PART NO. SK-2389

MACHINE SCREW ACTUATORS



SERIES
1800
9000
4800
9400

IMPORTANT — CAUTION

This manual contains important information for the correct installation, operation and maintenance of the equipment described herein. All persons involved in such installation, operation, and maintenance should be thoroughly familar with the contents. To safeguard against the possibility of personal injury or property damage, follow the recommendations and instructions of this manual and keep it for further reference.

WARNING

The equipment shown in this manual is intended for industrial use only and should not be used to lift, support, or otherwise transport people.

Duff-Norton

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SECTION I

GENERAL INFORMATION

1-1. General

This manual contains maintenance instructions for Duff-Norton® 1800, 9000, 4800 and 9400 machine screw actuators. It describes and details procedures for disassembly, cleaning, inspection, rebuilding and assembly of these actuators.

1-2. Industrial Use Only

The machine screw actuators described and illustrated in this manual are intended for industrial use only and should not be used to lift, support or otherwise transport people unless you have a written statement from Duff-Norton Company which authorizes the specific actuator unit, as used in your application, as suitable for moving people.

1-3. Specifications

TABLE 1. 1800 AND 9000 SERIES

Actuator Number		Upright / Inverted	1802 & 9002 / 1801 & 9001	9005 / 9004	9010 / 9009	9015 / 9014	9020 / 9019	9025 / 9024	9035 / 9034	1850 / 1849	1899 / 1898	18150 / 18149
Rated Load (tons)			2	5	10	15	20	25	35	50	100	150
Diameter of Lifting Screw (inches)			1 .250 Pitch Acme	1½ .375 Pitch Acme	2 .500 Pitch Acme	2¼ .500 Pitch Acme	2½ .500 Pitch Acme	3⅜ .666 Pitch Acme	3¾ .666 Pitch Acme	4½ .666 Pitch Square	6 .750 Pitch Square	7 1.000 Pitch Square
Closed Height ** (in)			5¼	7	7¼	8	9¼	11	12	13	24	24
Base Size (in)			3½ × 7 4⅛ × 6¼	6 × 8	7½ × 8¾	7¾ × 9¼	8¼ × 11	10¼ × 13¾	10¼ × 15½	9¾ × 19¾	20¾ × 24½	20¾ × 24½
Worm Gear Ratios	Std. Ratio		6:1	6:1	8:1	8:1	8:1	10⅔:1	10⅔:1	10⅔:1	12:1	12:1
	Optional		24:1	24:1	24:1	24:1	24:1	32:1	32:1	32:1	36:1	36:1
Turns of Worm for 1" Raise	Std. Ratio		24	16	16	16	16	16	16	16	16	12
	Optional		96	64	48	48	48	48	48	48	48	36
Maximum H.P. Per Actuator	Std. Ratio		2	4	5	5	5	8	8	15	25	25
	Optional		½	¾	1½	1½	1½	2½	2½	6	11	11
Torque at Full Load* (in-lbs)	Std. Ratio		120	450	950	1,430	2,050	3,360	4,600	7,500	16,000	28,100
	Optional		50	185	490	820	1,170	1,900	2,750	4,200	8,600	15,500
Actuator Efficiency Rating (%)	Std. Ratio		23.2	22.1	22.0	20.2	18.8	16.4	15.2	13.8	13.0	14.1
	Optional		13.3	12.1	14.0	12.9	20.2	9.2	8.5	8.3	8.0	8.6
Weight with Base Size of 6" (lb)			17	35	52	66	93	181	240	410	1,200	1,350
Weight For Each Additional 1" Raise (lb)			.33	.85	1.4	1.5	2.6	3.5	4.1	5.5	9.0	12.6

* For loads of from 25% to 100% of Actuator load rating. Torque requirements are approximately proportional to the load.

** Closed heights are for standard upright models and may vary with different screw ends, inverted models or when bellows boot is used.

TABLE 2. 4800 AND 9400 SERIES

Actuator No.		4802 & 9402	9405	9410	9415	9420	9425	9435	4850	4899	48150
Rated Load (tons)		2	5	10	15	20	25	35	50	100	150
Torque at Full Load (in-lbs)	Std. Ratio	135	500	1045	1573	2255	3700	5060	8250	17600	30900
	Optional	55	205	540	905	1290	2090	3025	4620	9460	17050
Actuator Efficiency Rating %		20.9 11.9	19.9 10.9	19.8 12.6	18.0 11.7	16.9 10.8	14.8 8.3	13.7 7.7	12.4 7.3	11.7 7.2	12.7 7.7
Closed Height (in)		5¼	7	7¼	8	9¼	12	13	14	26½	26¼
Weight with Base Raise of 6 " (lb)		18	37	55	70	101	197	250	440	1325	1475

NOTE: Additional specifications are same as for Series 1800 and 9000. See Table 1

TABLE 3. DECIMAL RATIOS

Actuator No.	Upright	1802 & 9002	9005	9010	9015	9020	9025
	Inverted	1801 & 9001	9004	9009	9014	9019	9024
Rated Load (tons)		2	5	10	15	20	25
Lifting Screw		1 " Dia. .250 Pitch Acme	1½ " Dia. .250 Pitch Acme	2 " Dia. .250 Pitch Acme	2¼ " Dia. .250 Pitch Acme	2½ " Dia. .250 Pitch Acme	3⅜ " Dia. .320 Pitch Square
Worm Gear Ratio		25:1	25:1	25:1	25:1	25:1	32:1
Turns of Worm for 1 " Raise		100	100	100	100	100	100
Torque at Full Load (in-lbs)		48	175	270	640	925	1500
Actuator Efficiency Rating %		13.2	9.1	8.6	7.5	6.9	5.3
Maximum H.P per Actuator		½	¾	1½	1½	1½	2½

NOTE All other data for these models same as shown in Table 1

1-4. Important Precautions

In order to ensure that Duff-Norton® machine screw actuators provide good service over a period of years the following precautions should be taken:

1. Select an actuator that has a load rating greater than the maximum load that may be imposed on it.
2. The structure on which the actuators are mounted should have ample strength to carry the maximum load, and should be rigid enough to prevent undue deflection or distortion of the actuator supporting members.
3. It is essential that the actuators be carefully aligned during installation so that the lifting screws are perfectly plumb and the connecting shafts are exactly in line with the worm shafts. After the actuators, shafting, gear boxes, etc., are coupled together, it should be possible to turn the main drive shaft by hand. If there are no signs of binding or misalignment, the actuator system is then ready for normal operation.
4. Machine screw actuators should have a greater raise than is needed in the actual installation. Should it be necessary to operate these actuators at the extreme limits of travel, it should be done cautiously.

CAUTION

Do not allow actuator travel to go beyond specified (catalog) closed height, or serious damage to internal mechanism may result. Refer to table of specifications (par. 1-3) for closed heights of respective units.

5. The worm shaft speed for these actuators should not exceed 500 RPM for heavy loads, 1200 RPM for light loads of one-fourth (or less) of the actuator load rating.
6. The lifting screw should not be permitted to accumulate dust and grit on the threads. If possible, lifting screws should be returned to closed position when not in use.

CAUTION

Where lifting screws are not protected from airborne dirt, dust, etc., bellows boots should be used. Inspect frequently at regular intervals to be certain that a lubricating film is present. Lifting screws should never be run dry.

7. When using an 1800 or 9000 Series Actuator, a periodic check of backlash of the lifting screw thread is recommended to check wear of the worm gear internal threads. The normal backlash on a new unit of this type is approximately .010 inch. **Backlash of 50% or more of the thread thickness indicates the need to replace the worm gear.**

   The 4800 and 9400 Series Anti-backlash Actuators are designed to be adjusted for minimum backlash, approximately .002 inch. The worm gear and anti-backlash nut are manufactured to have a clearance between their surfaces of ½ the thread thickness. **When adjustments have been made to the point where all this clearance is gone, 50% of the thread thickness is gone and replacement is necessary.** (See page 5, paragraph 2-8 for a detailed explanation of how the anti-backlash nut functions.)

NOTE

For loads of from 25% to 100% of actuator capacity, torque requirements are approximately proportioned to the load, except for very light loads.

8. The lubrication procedures for normal and severe service conditions, as described in Section II, paragraph 2-1, should be closely followed.

1-5. Warranty and Warranty Repair

Subject to the conditions stated herein, Duff-Norton will repair or replace, without charge, any parts proven to Duff-Norton's satisfaction to have been defective in material or workmanship. Claims must be made within one year after date of shipment. Duff-Norton will not repair or replace any parts that become inoperative because of improper maintenance, eccentric loading, overloading, chemical or abrasive action, excessive heat, or other abuse.

Equipment and accessories not of Duff-Norton's manufacture are warranted only to the extent that they are warranted

the manufacturer, and only if the claimed defect arose during normal use, applications and service. Equipment which has been altered or modified by anyone without Duff-Norton's authorization is not warranted by Duff-Norton.

EXCEPT AS STATED HEREIN, DUFF-NORTON MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

If you have any questions concerning warranty repair, please contact a convenient Duff-Norton Warehouse and Customer Service Center.

Authorization for return must be received from the Duff-Norton Company before returning any equipment for inspection or warranty repair.

SECTION II

MAINTENANCE

2-1. Lubrication

Unless otherwise specified, actuators and gear boxes are shipped packed with grease which should be sufficient for one month of normal operation. For normal operation, the actuator and gear boxes should be lubricated once a month using one of the following Extreme Pressure greases or their equivalent:

Socony Mobile Oil Co.	Mobilplex E.P. #1
Texaco	Texaco E.P. #1
Gulf Oil Corp.	Gulf Crown E.P. #1
Shell Oil Co.	Shell Alvania E.P. #1

For severe service conditions, the actuators should be lubricated more frequently using one of the above greases (daily to weekly depending on conditions). If duty is heavy, an automatic lubrication system is strongly recommended. If ambient temperatures exceed 200 °F, consult lubricant manufacturers.

CAUTION

Where lifting screws are not protected from airborne dirt, dust, etc., bellows boots should be used. Inspect frequently at regular intervals to be certain that a lubricating film is present. Lifting screws should never be run dry.

2-2. Rebuild Procedure

Duff-Norton recommends the following procedures for disassembly and disassembly of machine screw actuators.

1. Tag critical parts to facilitate reassembly.
2. Mark mating surfaces to ensure proper meshing.
3. Clean and lubricate all parts as required.
4. All seals must be replaced when rebuilding.
5. All screws, washers and other small common parts must be replaced if damaged in any way.
6. Replace damaged or frozen lubrication fittings with new ones.

2-3. Required Tools

A bearing puller or press and common hand tools are necessary for proper assembly and disassembly.

2-4. Disassembly (Refer to Figure 3-1)

1. Remove lifting screw (5) from actuator.
2. Remove bottom pipe (4) from shell (3) (upright models) or shell cap (2) (inverted models) or base plate as applicable.
3. **FOR ALL MODELS EXCEPT 100 AND 150-TON—** Loosen and remove set screws (1) in cap (2) and remove cap from shell (3).

   FOR 100 AND 150-TON MODELS— Loosen the lock screw in the shell and unscrew (counterclockwise) the base plate from the shell.

   NOTE

   It may be necessary to break shell cap or base plate loose with a hammer.

4. Remove gear (6A) or worm gear and nut assembly (6B) from shell (3).

   NOTE

   To facilitate removal of the gear from the shell on models with 50-ton or higher load ratings, partially reassemble the lifting screw into the worm gear (or worm gear and nut assembly) and use a hoist or pulley block to lift on the screw.

5. Remove top load bearing (7) which may be attached to either shell cap (2) or worm gear (6A) or anti-backlash nut.

   CAUTION

   Use only a wooden mallet to tap bearings loose.

6. Remove bottom load bearing (8) which may be attached to either the shell (3) (base plate for 100 and 150-ton models) or worm gear (6A).
7. Remove four cap screws (9) from each of the two worm flanges (11) and remove flanges.

   NOTE

   Take care not to lose the flange shims (12).

8. Press oil seal (13) out of flange (11).
9. Remove worm (14) and worm bearings (15) from shell (3) by striking one end of worm with a wooden or lead mallet.
10. Remove worm bearings (15) from worm (14) with bearing puller or press. (NOTE: This step will not be necessary if worm and worm bearings are not damaged.)
11. If actuator is keyed, remove screw in shell cap (shell on 100 and 150-ton models) and tap key out of keyway.

2-5. Cleaning

1. Use degreasing solvent to remove grease or oil from all parts.

CAUTION

Remove grease from unit and do not reuse old grease.

WARNING

Provide adequate ventilation during the use of cleaning agents; avoid prolonged breathing of fumes and contact with skin.

2. Use clean hot water or a soap solution for general cleaning of painted surfaces.
3. Dry parts thoroughly after cleaning.

NOTE

Before installing new parts, remove any rust preventive, protection grease, etc.

2-6. Inspection (Refer to Figure 3-1)

1. Make a visual inspection of shell (3) for broken, cracked or distorted areas. Check threads of all bores for burrs or broken threads.
2. Check shell cap (2), base plate, bottom pipe (4), lifting screw (5), worm gear (6A) or worm gear and nut assembly (6B) for burrs or scratches on their working or mating surfaces.
3. Check fit between lifting screw thread and internal thread in worm gear. If fit is excessively loose, replace worm gear or lifting screw as required. Replace worm gear and nut assembly as a set (4800 and 9400 Series).
4. Check small common components (screws, etc.) and replace as required.
5. Check bearings (7), (8) and (15) for seizure, galling or play and replace as required.

2-7. Assembly (Refer to Figure 3-1)

1. Press worm bearings (15) onto worm shaft (14) making sure that bearings are seated properly against shoulder.

NOTE

When tapered roller bearings are used, the small end of the cone should point to the worm end.

2. Position worm shaft end (14) in shell (3).

NOTE

If tapered roller bearings are used, tap worm bearing cups into place in the shell.

3. Press oil seals (13) into worm flange (11).

NOTE

The sealing element should point inward.

4. Position worm flanges (11) with shims (12) and bolt in place.
5. Position bottom load bearing (8) (bearing cup on 5-ton and 35-ton models, top load bearing on 100 and 150-ton models) in shell (3).

5a. **On 5-ton and 35-ton models**, press load bearing cones onto worm gear (6A) or worm gear nut assembly (6B). Small end of bearing cone should face away from gear teeth.

6. Install worm gear (6A) or worm gear and nut assembly (6B) in shell (3).

CAUTION

Strike each end of worm shaft sharply with a wooden mallet to seat bearing properly. Recheck flange bolts for tightness. Worm should turn freely with minimum drag and end play. If too much end play is present, remove shims as required. If worm does not turn freely, add shims as required.

7. Install top load bearing (7) (bottom load bearing (8) for 100 and 150-ton models) on worm gear (6A) or worm gear and nut assembly (6B).
8. Fill housing fully with grease.
9. **FOR ALL MODELS EXCEPT 100 AND 150-TON—** Install shell cap (2) and screw down until tight.

NOTE

Shell cap flange does not necessarily have to bear against top of shell, there will usually be a gap. This will put a slight drag on worm. If worm is hard to turn, back off slightly on shell cap.

FOR ALL 100 AND 150-TON MODELS— Install base plate and screw down base plate until tight.

NOTE

This should put a slight drag on the worm. If the worm is hard to turn, back off slightly on the base plate. Be sure base plate does not project past base surface of housing.

10. Lock shell cap in place with set screws (lock screw on 100 and 150-ton models).

NOTE

If new parts have been installed, it may be necessary to respot holes for these screws.

11. **FOR ALL MODELS EXCEPT 100 AND 150-TON—** Screw bottom pipe (4) into shell (3) (upright models) or into shell cap (2) (inverted models).

FOR 100 AND 150-TON MODELS— Screw bottom pipe into base plate (upright models) or into shell (inverted models).

12. Brush lifting screw (5) with a light film of grease and install in actuator. On inverted models, install guide bushing (16) and then install lifting screw (5).
13. If actuator is keyed, install key in shell cap (2) (shell for 100 and 150-ton models) and bolt in place.
14. Operate unit to ensure proper functioning of all components prior to reinstallation.

2-8. Anti-Backlash Nut Function

As shown in Figure 2-1, the worm gear (2) and anti-backlash nut (3) are pinned together with guide pins. The threads in the anti-backlash nut work in opposition to the threads in the worm gear as they engage the threads of the lifting screw (1). Adjustment of backlash is made by running down

the shell cap of the actuator. This forces the anti-backlash nut threads into closer contact, reducing clearance and thus reducing backlash.

9. Anti-Backlash Nut Adjustment

1. To minimize backlash remove the two set screws (4) and tighten down on shell cap until the desired backlash is obtained. Spot drill top of shell through set screw holes, then replace set screws and tighten to prevent shell cap backing off.

   To avoid binding and excessive wear, do not adjust lifting screw backlash to less than 0.002 inch.

2. The clearance (A) designed into the worm gear and anti-backlash nut set is one-half the thread thickness. When adjustments have been made to use all this clearance replace the worm gear and anti-backlash nut as a set.

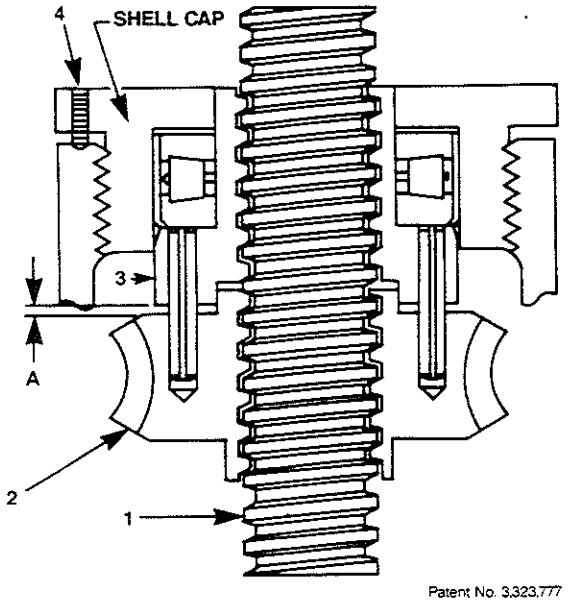


FIGURE 2-1. ANTI-BACKLASH NUT ADJUSTMENT

SECTION III

ILLUSTRATED PARTS LIST

3-1. General

This section contains an exploded illustration of the 1800, 9000, 4800 and 9400 Series machine screw actuator. The number adjacent to each part on the illustration is the index number. Keyed to this index number on the parts list is the part name.

When ordering parts be sure to include:

1. The nameplate model of your unit.
2. Index number and name of part.

3-2. PARTS LIST FOR 1800, 9000, 4800 and 9400 SERIES MACHINE SCREW ACTUATORS

INDEX NO.	PART NAME	QTY. REQ.
1	Screw, Set (All models except 100 and 150-ton)	2
2	Cap, Shell (All models except 100 and 150-ton)	1
3	Shell, Actuator	1
4	Pipe, Bottom	1
5	Screw Assembly, Lifting	1
6A	Worm Gear	1
6B	Worm Gear and Anti-backlash Nut Assembly (Mfg'd and sold in sets only)	1
7	Bearing, Top Load	1
8	Bearing, Bottom Load	1
9	Screw, Cap	8
10	Washer, Lock	8
11	Flange, Worm	2
12	Shim, Flange	2
13	Seal, Oil	2
14	Worm	1
15	Bearing, Worm	2
16	Bushing, Guide (inverted model only)	1
18	Nameplate	1
19	Screw, Lock (100 and 150-ton only)	1*
20	Plate, Base (100 and 150-ton only)	1*

*Not shown

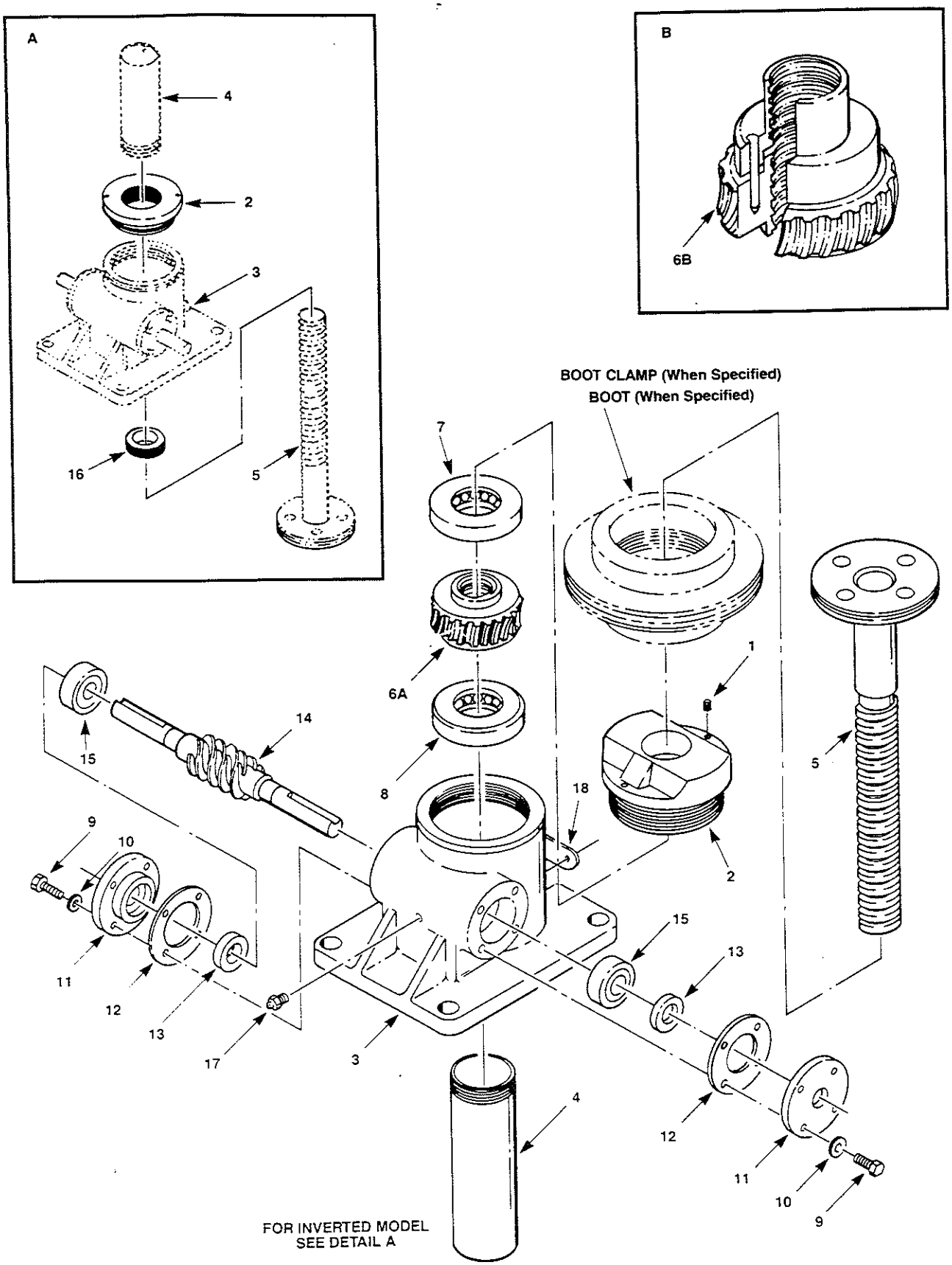
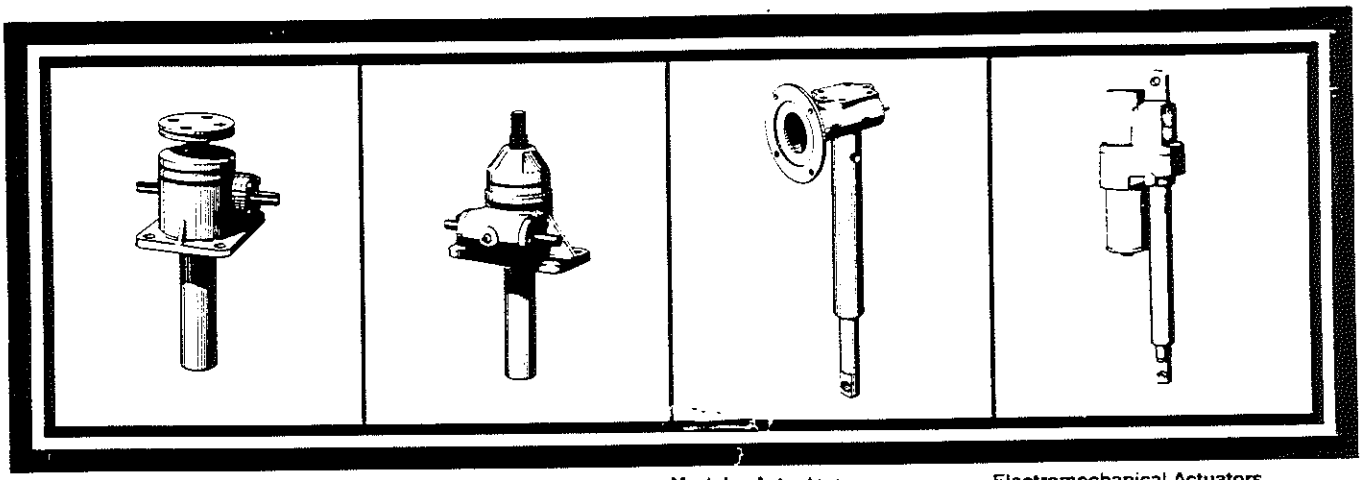


FIGURE 3-1. EXPLODED ILLUSTRATION 1800, 9000, 4800 and 9400 SERIES MACHINE SCREW ACTUATORS.

DUFF-NORTON OFFERS A COMPLETE LINE OF MECHANICAL AND ELECTROMECHANICAL ACTUATORS FOR PRECISE POSITIONING OF LOADS UP TO 250 TONS.

For reliable motion — in-line or through an arc — Duff-Norton has the right actuator to put your designs in motion. You can select from a comprehensive line of machine screw, ball screw, high-duty cycle, electromechanical and modular models to solve your design and production problems.

Duff-Norton™ actuators are easy to specify, install and operate. Compact and self-contained, they do not require bothersome selection of individual components nor the attendant maintenance of leaky hydraulic hoses, valves or couplings. They provide many options in meeting a wide range of lifting, pushing, pulling and tensioning requirements.



Machine Screw Actuators. Capacities from ¼ to 250 tons Worm gear ratios from 5:1 to 50:1. More than 200 standard combinations to choose. Can be operated manually or by gear motor. Used to push, pull, apply pressure, or as linear actuators. Hold loads indefinitely without creep, when not subject to vibration.

Ball Screw Actuators. Capacities from ½ to 50 tons Ball bearing screw and nut design reduces friction, increases efficiency as much as 70%. Permits linear motion up to 300 in/min @ 1800 rpm worm shaft speed. Available in 40 standard models. Multiple units may be synchronized for uniform raises to 10 feet.

Modular Actuators. Capacities to 2,000 pounds depending on actuator gear ratio and motor horsepower. Engineered for 56 frame motor, C face mounting. Choice of 5:1 or 20:1 gear ratios in rotating screw or translating tube models. Travel lengths to 24 inches. Lift speeds to 170 inches per minute.

Electromechanical Actuators. Capacities to ¾ ton. Choice of 115 VAC or 12 VDC motors for indoor or outdoor applications. Standard raises from 3" to 24". Speeds to 145 in/min. All components sealed in a corrosion-resistant, aluminum alloy die-cast housing. Fully-adjustable limit switches available on some models.

For more information on these or other Duff-Norton™ actuators, ask your local distributor or Duff-Norton District Sales Manager for Catalog 172. Or write factory.

WARNING: The equipment shown in this manual is intended for industrial use only and should not be used to lift, support, or otherwise transport people unless you have a written statement from Duff-Norton Company which authorizes the specific actuator unit, as used in your application, as suitable for moving people.

AVAILABLE FROM YOUR LOCAL ACTUATOR DISTRIBUTOR:

Duff-Norton

P.O. Box 7010
Charlotte, NC 28241-7010

Customer Service (800) 477-5002
FAX (704) 588-1994

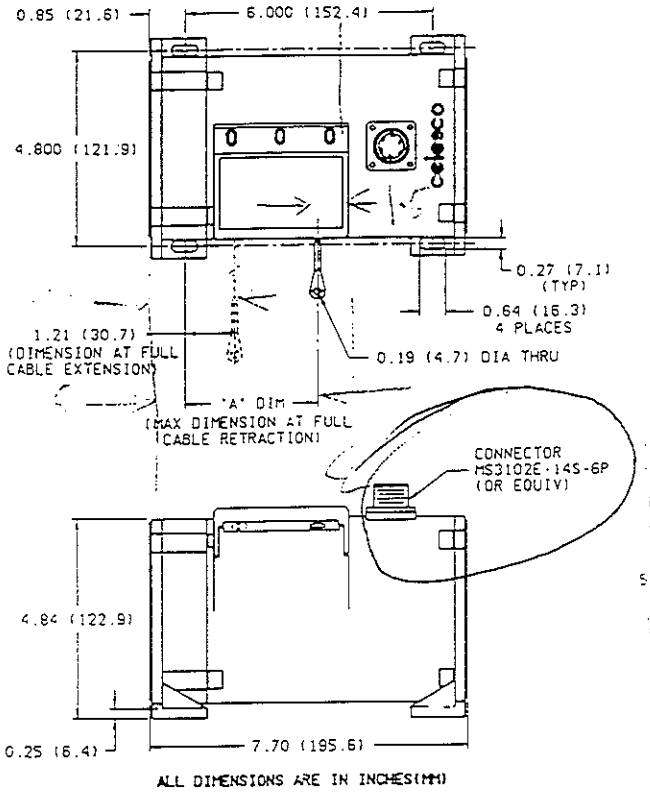
Duff-Norton Manufactures:
Duff-Norton™ Actuators • Mechanical Jacks • Rotary Unions™ • Coffing™ Hoists
Duff Lynx™ Hoists and Pullers

Printed in USA

4M/SK2389/1-95

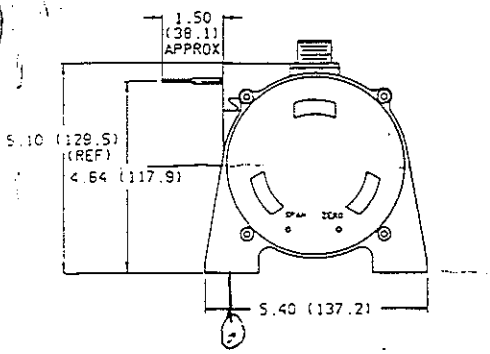
20 Medium to Long Range / Industrial Grade - 4...20 mA Output

E330051/052-12



"A" Dimension

English Range (in.)	0.024" dia. cable	0.047" dia. cable	Metric Range (mm)	0.61mm dia. cable	1.19mm dia. cable
75	1.35"	1.50"	2500	34.5mm	38.2mm
100	1.40"	1.60"	3750	35.7mm	40.7mm
150	1.50"	1.80"	5000	38.2mm	45.6mm
200	1.60"	1.99"	6250	40.6mm	50.5mm
250	1.70"	2.19"	7500	43.2mm	55.6mm
300	1.80"	2.38"	8750	45.7mm	60.5mm
350	1.90"	2.58"	10000	48.2mm	65.5mm
400	2.00"	n/a	11250	50.8mm	n/a
450	2.10"	n/a	12500	53.3mm	n/a
500	2.20"	n/a	13750	55.9mm	n/a
550	2.30"	n/a	15000	58.4mm	n/a



Ordering Information / Model Number:

PT9420 - ____ - ____ - 1__ 0

full stroke range
- 0 0 7 5 = 75 inches
- 0 1 0 0 = 100 inches
- 0 1 5 0 = 150 inches
- 0 2 0 0 = 200 inches
- 0 2 5 0 = 250 inches
- 0 3 0 0 = 300 inches
- 0 3 5 0 = 350 inches
- 0 4 0 0 = 400 inches
- 0 4 5 0 = 450 inches
- 0 5 0 0 = 500 inches
- 0 5 5 0 = 550 inches

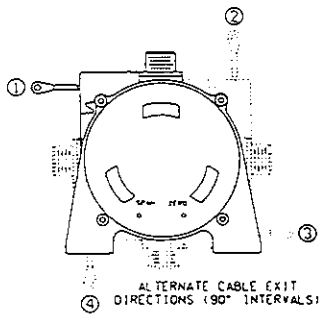
construction / cable tension
- 1 = aluminum - standard
- 2 = aluminum - increased
- 3 = stainless steel - standard
- 4 = stainless steel - increased

cable diameter
- 1 = 0.024 in.
- 2 = 0.047 in.--*up to 400 in. F.S.*

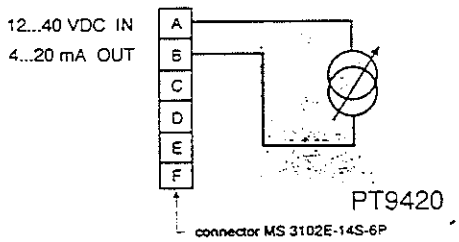
electrical connection
- 1 = 6-pin connector
- 2 = 10 ft. waterproof cable

output
- 1 = 4-20 mA standard
- 2 = 4-20 mA reversed

cable exit
- 1...4 = *see below*



Electrical:



celesco

SCO TRANSDUCER PRODUCTS 7800 Deering Avenue Canoga Park, CA 91309 Tel: (800) 423-5483 Fax: (818) 340-1175

PMS 5.18.94

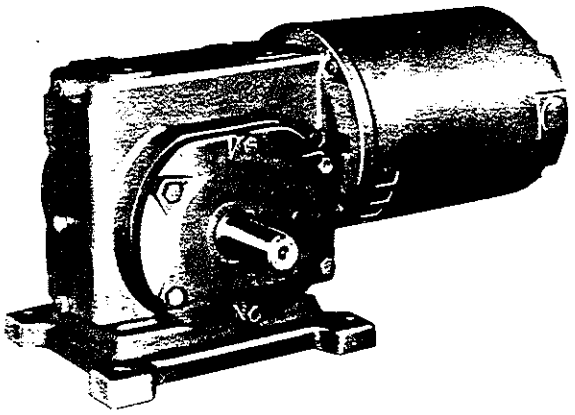
E330051/052-7

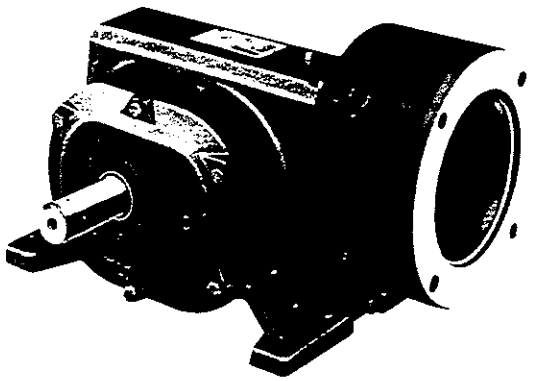
INSTRUCTION MANUAL FOR RIGHT ANGLE

- MASTER® XL Gearmotors
- MASTER® XL C-Face Reducers

(Three Piece Coupled)

For Sizes 12, 16, 21, 28





WARNING: Because of the possible danger to person(s) or property from accidents which may result from the improper use of products, it is important that correct procedures be followed. Products must be used in accordance with the engineering information specified in the catalog. Proper installation, maintenance and operation procedures must be observed. The instructions in the instruction manuals must be followed. Inspections should be made as necessary to assure safe operation under prevailing conditions. Proper guards and other suitable safety devices or procedures as may be desirable or as may be specified in safety codes should be provided, and are neither provided by Reliance Electric Industrial Company nor are the responsibility of Reliance Electric Industrial Company. This unit and its associated equipment must be installed, adjusted and maintained by qualified personnel who are familiar with the construction and operation of all equipment in the system and the potential hazards involved. When risk to persons or property may be involved, a holding device must be an integral part of the driven equipment beyond the speed reducer output shaft.

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DANGER

Only qualified personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, and/or service this equipment. Read and understand this manual in its entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

GENERAL INFORMATION

The MASTER right angle gear product line is composed of two basic reducers.

1. THE GEARMOTOR—uses a partial motor direct connected to the reducer input shaft by means of a semirigid coupling.
2. THE C-FACE REDUCER—utilizes a standard C-face motor, adapter and flexible coupling, connecting to the reducer.

Gearing is designed with a steel worm, integral to the input shaft, mating with a bronze worm gear. The second stage gears where used are helical, cut from steel, shaved to close tolerances and then case hardened.

The single reduction and combination gearmotor is designed with ball bearings on input shafts and tapered roller bearings on intermediate and final output shaft.

WARRANTY

This equipment is warranted under Reliance's published "Standard Terms and Conditions of Sale of Electrical Apparatus."

Parts, service, and repairs, in or out of warranty may be arranged through any Reliance Authorized Service Shop, Distributor, or District Sales Office.

Damage in shipment, abuse, misuse, applicable maintenance and repair and periodic adjustments, as required, are not part of this warranty.

STANDARD TERMS & CONDITIONS OF SALE

Company expressly warrants the equipment manufactured by it as set forth herein. Company makes no other warranties, either express or implied (including without limitation warranties as to mechantability or fitness for a particular purpose).

WARRANTY

CAUTION: SERVICE AND REPAIR UNDER WARRANTY SHOULD BE PERFORMED ONLY BY A DODGE AUTHORIZED SERVICE SHOP. CALL WARRANTY ADMINISTRATION AT 812-378-2416 FOR THE NEAREST LOCATION.

MASTER XL gear units are warranted under DODGE "Standard Conditions for Sale."

Warranty claims on any such apparatus must be submitted to the company within one year from date of installation or within three years from the date of manufacture, whichever comes first. The Seller's warranty applies insofar as the equipment is operated within the rating and service conditions for which it was specifically sold. The warranty does not extend to failures induced by misuse, improper storage or handling, abuse or misapplication.

For warranty service, contact the nearest DODGE Sales Office or Authorized Distributor or call Warranty Administration at 812-378-2416.

SERVICE FACTOR

Load conditions must be in accordance with service factor as listed on the nameplate. Refer to the DODGE Gear catalog or AMGA published ratings for definition of service conditions.

INSTALLATION

The gear unit must be mounted on a sturdy base of sufficient strength to prevent distortion due to applied loads. To prevent the introduction of additional stresses in the gear unit, the base must be flat and any uneveness must be compensated for by the insertion of shims between the base and the feet of the gearcase. Hex head bolts of proper diameter and grade, together with flat washers, should be used to mount the gear unit to its base.

DANGER

THE USER IS RESPONSIBLE FOR CONFORMING WITH THE NATIONAL ELECTRICAL CODE AND ALL OTHER APPLICABLE LOCAL CODES. WIRING PRACTICES, GROUNDING, DISCONNECTS AND OVERCURRENT PROTECTION ARE OF PARTICULAR IMPORTANCE. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

ROTATION

WARNING

TO ENSURE THAT DRIVE IS NOT UNEXPECTEDLY STARTED, TURN OFF AND LOCK OUT OR TAG POWER SOURCE BEFORE PROCEEDING. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

To reverse the direction of rotation of a 3-phase A-C gearmotor, interchange any two of the lines going to the motor. If it is a 2-phase gearmotor, interchange the wires of one phase. Four-wire, 2-phase gearmotors have lead marking conforming to NEMA Standards.

D-C gearmotors may be reversed by interchanging the armature leads, (A1 and A2 at the motor). In all cases connection diagrams are furnished with the motors.

LUBRICATION FITTINGS AND PLUGS

This gearcase has been lubricated at the factory for only one mounting position. Before starting, check the mounting position diagrams on pages 5 through 8 to make sure that the oil level plug and oil level are in the correct location for which the unit is to be operated. This is extremely important, as insufficient lubricant will damage gears and bearings in a very short time. If any change is necessary, the vent plug must be relocated above the new oil level. When the unit is to be mounted in a position other than those shown in the diagrams, consult the factory.

Units mounted with output shafts in the vertical position require street ells to raise the oil level to the top edge of the bronze worm gear. On some sizes this street ell is shipped separately to avoid breakage in transit. The location for the street ell is indicated by an instruction tag wired to a throwaway plug (a throwaway plug can be recognized by the cross-drilled hole in the head of the plug). Before putting unit into operation turn the unit up so that oil will not drain out when the throwaway plug is removed. Remove and discard the throwaway plug and install the street ell in a vertical position as indicated on the mounting position diagrams on pages 5 through 8. The unit is factory-filled with the proper amount of lubricant to bring the oil level to the top of the street ell.

On some mounting positions zerk fittings are provided for grease lubricating bearings located above the operating oil level. Lubricate with a good grade of roller bearing grease when changing gear lubricant at the recommended change interval. Texaco Marfak No.3 is a suitable grease. Do not overlubricate grease-packed bearings.

Single reduction worm gear units for output shaft down mounting have one pipe-tapped hole in the center of the closed bearing housing. Combination units for output shaft down mounting have two pipe-tapped holes in line, one in the center of the output shaft, and one in the center of the second stage pinion shaft. Units are shipped from the factory with throwaway plugs in these tapped holes (a throwaway plug can be recognized by the cross-drilled hole in the head of the plug). Before putting units into operation remove and discard the throwaway plugs and install the zerk fittings.

Flanged units for the flange/output shaft up mounting have two pipe-tapped holes in the side of the flanged bearing housing. One of these holes is for a zerk fitting. Its location can be recognized by the throwaway plug. Remove and discard the throwaway plug and install the zerk fitting.

CAUTION

PROPER OPERATION OF THIS UNIT REQUIRES VENTING. REPLACE THE THROW AWAY PLUG WITH VENT PROVIDED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN DAMAGE TO, OR DESTRUCTION OF, THE EQUIPMENT.

Vent plug locations can be recognized by a throwaway plug. The vent plug is wired to the throwaway plug to avoid mistaking it for a zerk location. The vent plug is designed to prevent dirt and water from entering the gearcase and also to release air pressure caused by heat generated in the case. Without proper air venting the increase in pressure may force lubricant through the oil seals and result in oil leakage and damage to the unit. Do not restrict the operation of the vent with paint or other obstructions.

NOTE: Standard vents are spring loaded which open at approximately .50 P.S.I. If sight gauges are installed on a gear unit, the vent must be a type which is open continously.

OPERATING TEMPERATURES

Heating is a natural characteristic of right angle gear units with a worm gear set. A maximum gearcase sump temperature approaching 200°F. is not uncommon for units operating in normal ambient temperatures. When operated at the rated capacity, no damage will result from this temperature, as this was taken into consideration in the design of the gearcase and the selection of the lubricant. The proper lubricant must be selected for the operating ambient temperature range, with seasonal changes in lubricant viscosity grade whenever necessary. Output speeds above 300 RPM may require a lighter viscosity grade of lubricant. Select the lubricant from the proper column on page 3. Lubricants other than those listed should not be used without specific factory approval as performance or gear life may be adversely affected.

MAINTENANCE

Gearmotors and reducers are accurately adjusted and tested at the factory. Care must be taken when the gear-case is disassembled and reassembled. This should be done according to this manual or by an authorized service station as damage to internal parts may result if done improperly.

Whenever a partial motor is assembled to the gearcase of a gearmotor type unit, the spline on the reducer input shaft must be lubricated with a molydisulfide-type lubricant, preferably Mobiltemp No. 78 grease.

Whenever a C-face motor is assembled to a C-face type reducer, care must be taken to ensure that the flexible coupling hub on the motorshaft is spaced properly. See diagram on page 10 of this manual.

Lubrication is extremely important for satisfactory operation. The proper oil level must be maintained in the gearcase at all times. The correct level is indicated by the red head pipe plug. Frequent inspections with the unit not running (preferably when warm), should be made by removing the plug to see that the level is being maintained. If low, (without replacing oil level plug), add lubricant through one of the proper holes until it comes out the oil level hole. Replace the oil level plug securely.

The satisfactory performance of gears and bearings in gearmotors and reducers depends on clean lubricant, free from dust, grit, sludge, and moisture. Depending on operating conditions, the lubricant will eventually become contaminated and should be replaced periodically. When first put into operation, the lubricant in new gearcases becomes contaminated with grit and metal particles from the run-in period.

Lubricant should be drained, the gearcase flushed with mineral spirits and refilled after the first 250 hours of operation; then every 1500 hours or six months thereafter, whichever occurs first. (Normal operation is running 16 hours per day in 80°F. ambient). More frequent oil changes may be necessary when running continuously at high temperatures. Use only recommended lubricants as listed in the table. on page 3.

NOTE: If Mobil SHC-629 or SHC-634 are used for normal operation (viscosity group 318.62), the time for changing the lubricant may be extended. Drain, flush, and refill after the first 1500 hours of operation; then every 5000 hours thereafter. (SHC is a registered trademark of the Mobil Corporation).

APPROVED LUBRICANTS VS. AMBIENT CONDITIONS:

AMBIENT TEMPERATURE	LUBRICANT VISCOSITY GROUP VS. OUTPUTSHAFT SPEED				
	UP TO 300 RPM			OVER 300 RPM	
-65°F. TO 0°F. -45°F. TO +20°F. -5°F. TO +55°F. +15°F. TO +110°F. +100°F. TO +165°F.	318.59 318.60 318.61 318.62 318.63			318.59 318.60 318.62 318.63	
VISCOSITY GROUP	**318.59**	**318.60**	**318.61**	**318.62**	**318.63**
AMOCO OIL COMPANY AMOCO PERMAGEAR AMOCO				EP460 WORM GEAR OIL	
ATLANTIC RICHFIELD ARCO MINERAL GEAR OIL S.A.E.			90	140	
CARR OIL COMPANY LUB 733				EP140	
DARMEX INDUSTRIAL CORP. GEAR BOX OIL				DX-9140	
DUBOIS CHEMICAL CO. E.G.O.			EP90	EP140	
EXXON CYLESSTIC				TK460	
FISKE BROTHERS LUBRIPLATE APG			90	140	
GULF OIL COMPANY TRANSGEAR LUBE			EP90	EP140	
E.F. HOUGHTON CO. MP GEAR OIL			90	140	
KEYSTONE LUBE CO.				WG-A	
MOBIL OIL CORP. SHC-600 SERIES SHC-600 SERIES AVREX MOBILFLUID CYLINDER OIL EXTRA HECLA	904	423	SHC-629*	SHC-629* SHC-634 600W	SHC-634* SUPER CYLINDER
PHILLIPS PETROLEUM PHILUBE			90	140	
SHELL OIL CO. AEROSHELL FLUID	4	5-L			
TEXACO VANGUARD				460	
ULTRACHEM. INC. CHEMLUBE				140*	
ISO OR A.G.M.A. VISCOSITY GRADE	ISO 15	ISO 46 AGMA 1	ISO 320 AGMA 5	ISO 460 AGMA 7	ISO 680 AGMA 8

*Viscosity of these oils is actually less than the listed ISO or A.G.M.A. grade.

RECOMMENDED LUBRICANTS

It is impossible to select one gear lubricant of petroleum origin which is usable over a wide range of temperatures, such as minus (-)65°F. to plus (+)165°F., as is required for some installations. When such conditions are encountered it is necessary to change the lubricant depending on the ambient (surrounding air) temperature at the time of operation. Use lubricants of the proper viscosity group as outlined in the previous table.

Note 1. Lubricants shipped in the gearcase from the factory are viscosity group 318.62 oils for standard ambient conditions and continuous duty.

Note 2. If a USDA-H1 food grade lubricant is desired, Chevron FM lubricating oil 460X may be used in ambient temperatures of +15°F. to +110°F. Chevron FM lubricating oil is available as a factory fill, but if it becomes necessary to install this oil in the field by draining a gearcase which contains our standard non-food grade lubricnat the gearcase must be flushed thoroughly before installing the new oil.

Do not operate gear unit in ambient temperatures below -65°F. nor above +165°F. For temperatures below -10°F. special oil seals are required and bearings in the gearcase must be packed with Aeroshell 7 grease instead of Marfak No. 3.

All group 318.63 lubricants, except Mobil SHC-634 must be changed after 300 hours of high temperature operation. Mobil SHC-634 must be changed after 1500 hours of high temperature operation. When changing oil from one viscosity group to another, flush the gearcase with mineral spirits before installing the new oil.

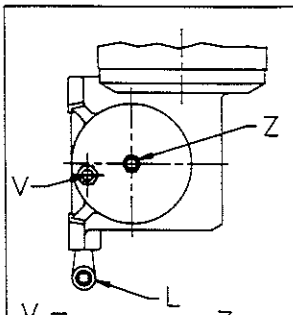
FOR INTERMITTENT DUTY IN A WIDE TEMPERATURE RANGE

(Defined as not over 50% duty nor more than 30-minute operation continuously).

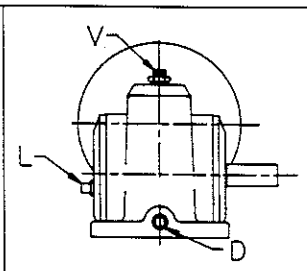
AMBIENT TEMPERATURE			VISCOSITY GROUP
-65°F.	to	+10°F.	318.59
-20°F.	to	+50°F.	318.60
+15°F.	to	+110°F.	318.62
+80°F.	to	+165°F.	318.63

FOOT MOUNTED UNITS

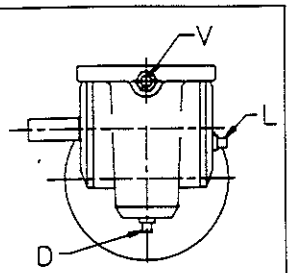
SINGLE REDUCTION WORM UNITS



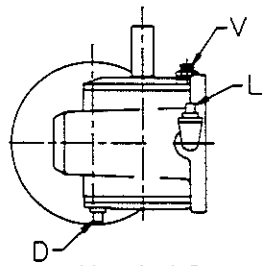
K2 & L4



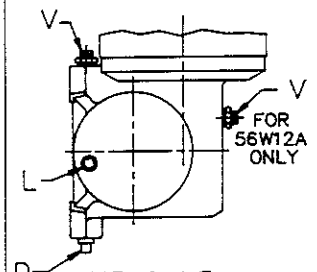
K1 & L1



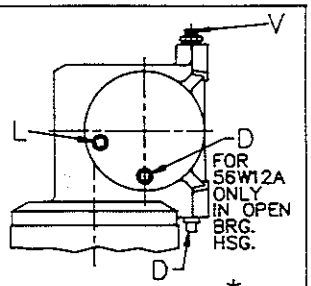
K3 & L3*



K4 & L2

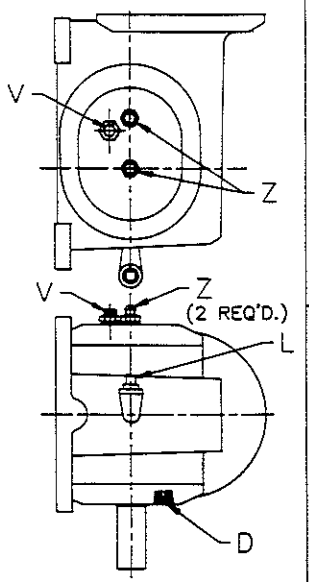


K5 & L5

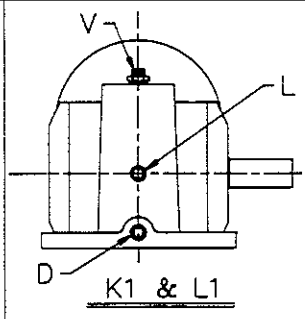


K6 & L6*

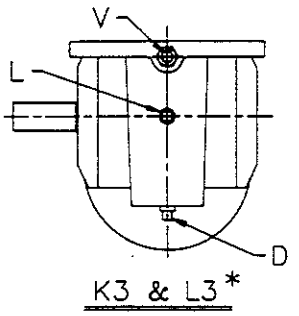
COMBINATION UNITS



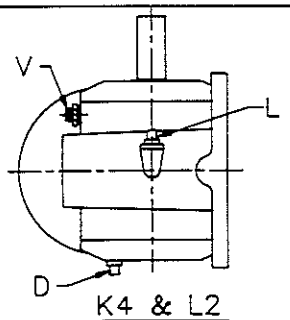
K2 & L4



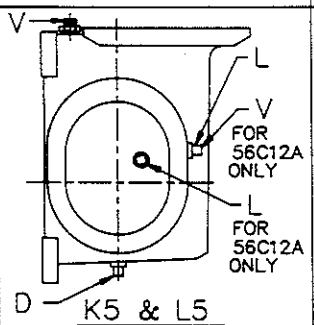
K1 & L1



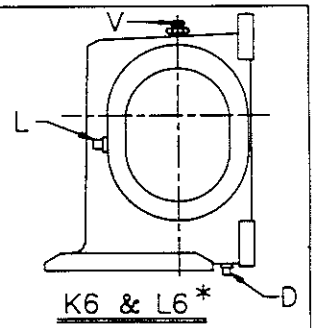
K3 & L3*



K4 & L2



K5 & L5



K6 & L6*

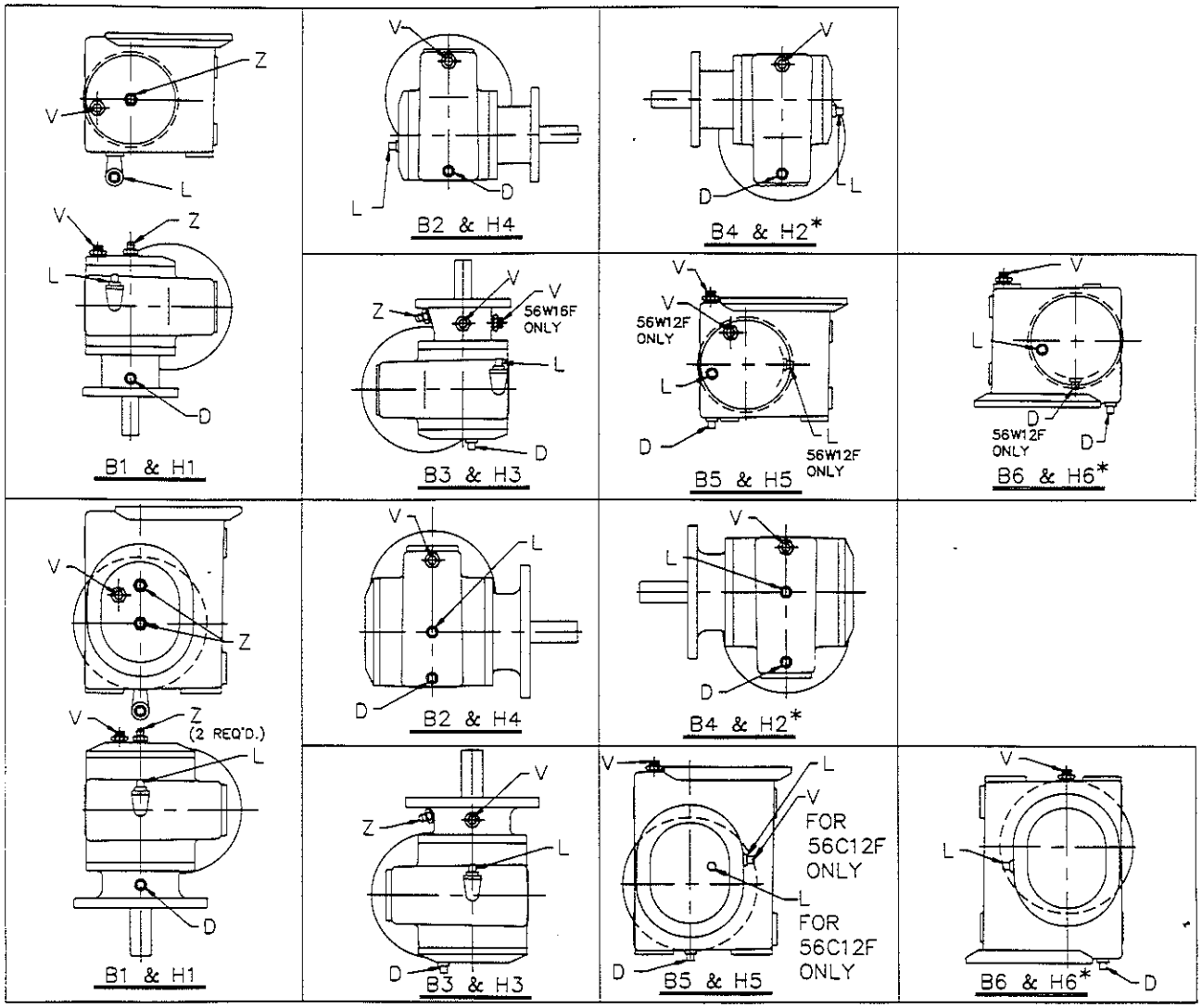
* MOUNTING POSITIONS NOT RECOMMENDED

V = VENT PLUG D = DRAIN PLUG
L = OIL LEVEL PLUG Z = ZERK FITTING

FLANGE MOUNTED UNITS

SINGLE REDUCTION WORM UNITS

COMBINATION UNITS

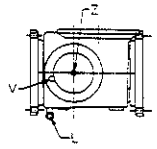


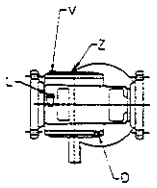
* MOUNTING POSITIONS NOT RECOMMENDED

V = VENT PLUG D = DRAIN PLUG
L = OIL LEVEL PLUG Z = ZERK FITTING

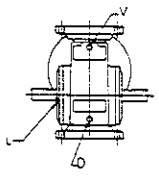
MULTI-MOUNT UNITS

SINGLE REDUCTION WORM UNITS

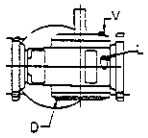




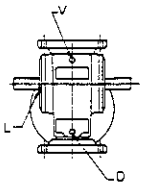
POSITIONS
K2, L4, A2, E4



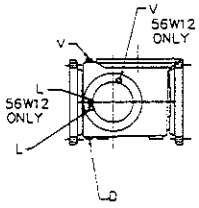
POSITIONS
K1, L1, A3, E3



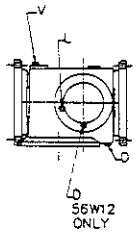
POSITIONS
K4, L2, A4, E2



POSITIONS
K3, L3, A1, E1*

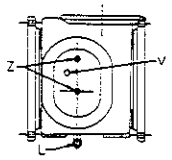


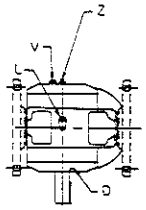
POSITION 5



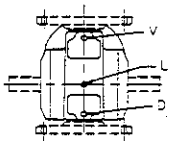
POSITION 6*

COMBINATION UNITS

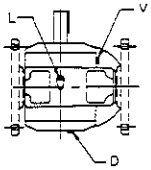




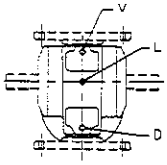
POSITIONS
K2, L4, A2, E4



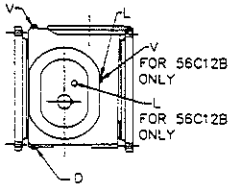
POSITIONS
K1, L1, A3, E3



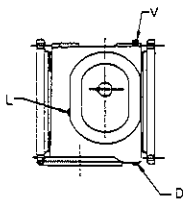
POSITIONS
K4, L2, A4, E2



POSITIONS
K3, L3, A1, E1*



POSITION 5



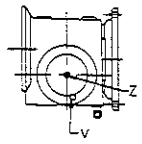
POSITION 6*

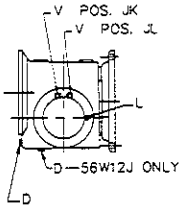
* MOUNTING POSITIONS NOT RECOMMENDED

V = VENT PLUG D = DRAIN PLUG
L = OIL LEVEL PLUG Z = ZERK FITTING

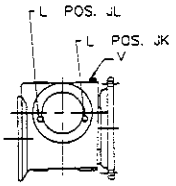
J-MOUNT UNITS

SINGLE REDUCTION WORM UNITS

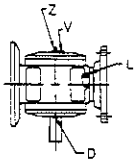




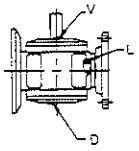
POSITION JK1 & JL1



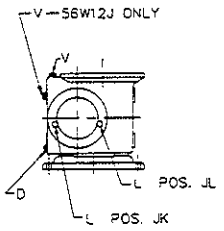
POSITION JK3 & JL3*



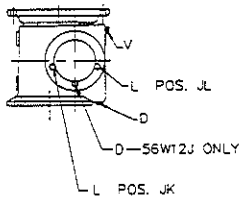
POSITION JK2 & JL4



POSITION JK4 & JL2

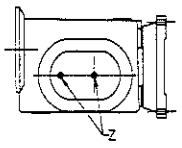


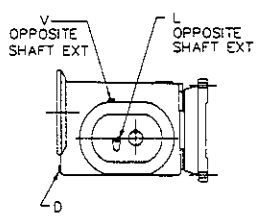
POSITION JK5 & JL5



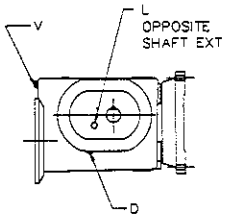
POSITION JK6 & JL6*

COMBINATION UNITS

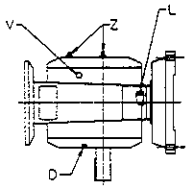




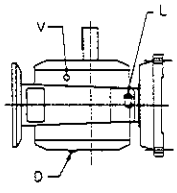
POSITIONS
JK1 & JL1



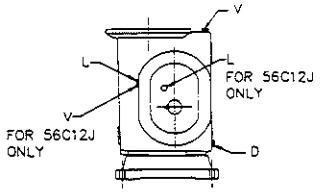
POSITIONS
JK3 &JL3*



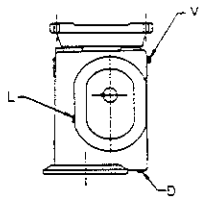
POSITIONS
JK2 & JL4



POSITIONS
JL2 & JK4



POSITIONS
JK5 & JL5



POSTIONS
JK6 & JL6*

* MOUNTING POSITIONS NOT RECOMMENDED

V = VENT PLUG D = DRAIN PLUG
L = OIL LEVEL PLUG Z = ZERK FITTING

REMOVAL AND REPLACEMENT OF MOTOR

DANGER

TO ENSURE THAT DRIVE IS NOT UNEXPECTEDLY STARTED, TURN OFF AND LOCK OUT OR TAG POWER SOURCE BEFORE PROCEEDING. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

WARNING

EQUIPMENT BEING REMOVED MAY BE TOO HEAVY TO CONTROL MANUALLY. SUPPORT IT BY EXTERNAL MEANS. FAILURE TO OBSERVE THE PRECAUTIONS COULD RESULT IN BODILY INJURY.

For the Gearmotor Configuration:

1. Disconnect all electrical wire and conduit.
2. Remove the four motor bolts (6).
3. Tap the side of the end shield (3) to loosen and remove.
4. Remove stator and frame assembly (4).
5. Rotor and shaft assembly (5) will now slide off of the splined input shaft. Be careful to not lose the coupling spring (8) which is in the coupling bore.
6. The semirigid coupling in gearmotors requires a small amount of Mobil-Temp 78 lubricant added to the splines.
7. After other repairs are made to the reducer the motor can be assembled in reverse order.

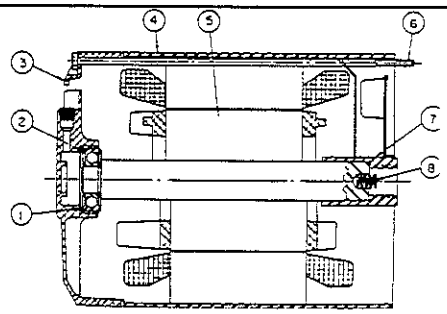
Whenever a partial motor is assembled to the gearcase of a gearmotor-type unit, the spline on the reducer input shaft must be lubricated with a molydisulfide-type lubricant, preferably Mobil Temp No.78 grease.

WARNING

TO ENSURE THAT DRIVE IS NOT UNEXPECTEDLY STARTED, TURN OFF AND LOCK OUT OR TAG POWER SOURCE BEFORE PROCEEDING. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

For the C-face Configuration:

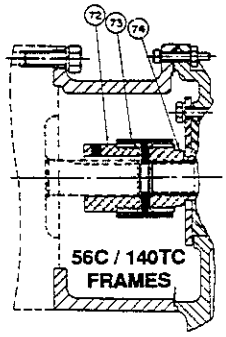
1. Disconnect all electrical wire and conduit.
2. Remove four motor mounting bolts (76).
3. Pull motor from reducer.
4. Remove flexible coupling hub from motor shaft.
5. Refer to applicable motor instruction manual if further disassembly if required.
6. Whenever a C-face motor is assembled to a C-face-type reducer, care must be taken to ensure that the flexible coupling hub on the motorshaft is spaced properly. See diagram on page 10 of this manual.
7. After other repairs are made, the motor can be assembled in reverse order.

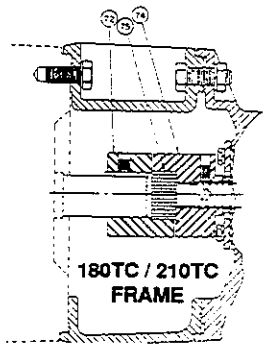


PARTIAL MOTOR USED ON GEARMOTORS

MOTOR PARTS IDENTIFICATION

1. Thrust Spring
2. Ball Bearing
3. F.E. Shield
4. Stator and Frame
5. Rotor
6. Motor Bolts
7. Motor Shaft and Semi-Rigid Coupling Assembly
8. Spring (Coupling)
72. Half Coupling for Motor Shaft
73. & 75. Coupling Sleeve or Spider
74. Half Coupling for Reducer Input Shaft
76. Motor Mounting Bolts





MOTOR ADAPTER USED ON C-FACE REDUCERS

INSTALLATION OF MOTOR FOR THE C-FACE CONFIGURATION

WARNING

TO ENSURE THAT DRIVE IS NOT UNEXPECTEDLY STARTED, TURN OFF AND LOCK OUT OR TAG POWER SOURCE BEFORE PROCEEDING. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

When the C-face MASTER Speed Reducer is recieved the adapter is bolted to the gearcase. The flexible coupling assembly and bolts for attaching the motor to the adapter are packaged separately. To assemble the C-face motor to the C-face reducer proceed as follows:

MOTOR FRAMES 48Y, 56C AND 140TC

Shown in figure 1 below is the C-FACE ASSEMBLY for mounting Nema C-face motor frames 48Y, 56C, and 140TC.

1. Locate motor coupling hub A on the motor shaft as shown in Figure 2 below. Once located, tighten coupling hub set screw.
2. Slip reducer coupling hub C on reducer input shaft until it shoulders on the reducer seal sleeve as shown in Figure 1.
3. Slip coupling sleeve B over reducer coupling hub C until shouldered.
4. Guide motor shaft coupling hub A into the coupling sleeve as shown in Figure 1.
5. Rotate motor to line up C-face tapped holes with bolt holes on the adapter; insert bolts, and tighten securely.

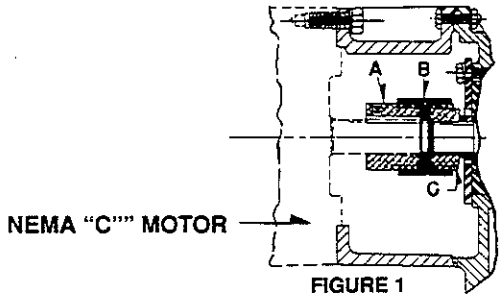


FIGURE 1

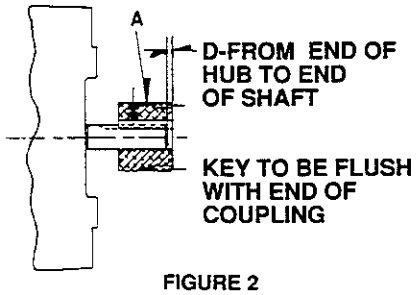
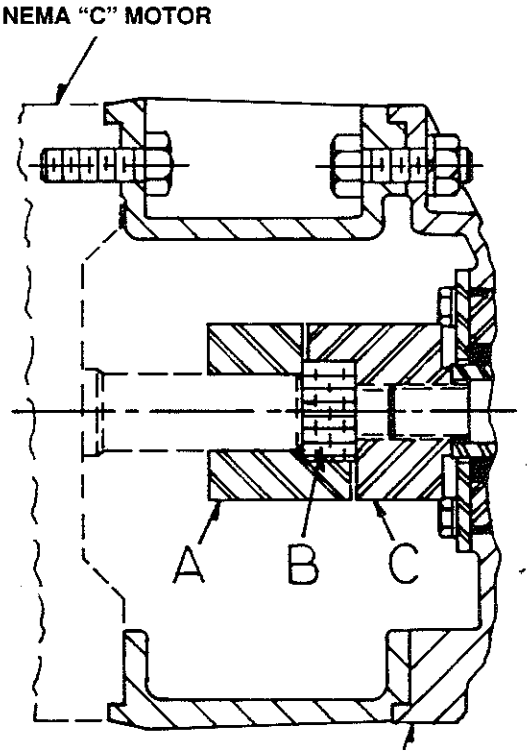


FIGURE 2

MOTOR FRAMES 180TC-210TC

Shown in the figure below is the C-face assembly for mounting Nema C-face motor frames 180TC and 210TC.

1. Slip reducer coupling hub C on the reducer input shaft until it shoulders on the reducer seal sleeve. Once located, tighten set screws.
2. Slip motor coupling hub A on motor shaft till the end of the motor shaft is flush with the inner face of the coupling hub. Once located, tighten set screws.
3. Slip coupling spider onto reducing coupling hub C.
4. Guide motor shaft with coupling hub A into spider as shown below.
5. Rotate motor to line up C-face tapped holes with bolt holes on adapter; insert bolts, and tighten securely.



MASTER GEAR REDUCER

LUBRICATION AND MAINTENANCE

The C-face MASTER speed reducer flexible coupling is lubrication free and requires no maintenance.

"C" FACE FR.	D
56 FR. OR 48 FR. WITH 56 FR. "C" FACE	1/8
140TC	1/8

INSTRUCTIONS FOR THE DISASSEMBLY AND REASSEMBLY OF SINGLE REDUCTION GEARMOTORS AND REDUCERS

WARNING

TO ENSURE THAT DRIVE IS NOT UNEXPECTEDLY STARTED, TURN OFF AND LOCK OUT OR TAG POWER SOURCE BEFORE PROCEEDINGS. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

WARNING

EQUIPMENT BEING REMOVED MAY BE TOO HEAVY TO CONTROL MANUALLY. SUPPORT IT BY EXTERNAL MEANS. FAILURE TO OBSERVE THE PRECAUTIONS COULD RESULT IN BODILY INJURY.

Gearmotors and reducers are accurately adjusted and tested at the factory. Care must be taken when the gearcase is disassembled and reassembled. This should be done according to this manual or by an authorized service station as damage to internal parts may result if done improperly.

Remove motor if complete disassembly is to be made. (See page 9.)

1. Remove the drain plug and drain oil from gearcase.
2. Remove screws holding the bearing housing (8), tap housing to loosen at the gasketed joint, then remove from the gearcase. (6)
3. Lift out the output shaft assembly (17) which includes bronze worm gear.
4. To remove input shaft (46), remove seal clamp screws. Pull input worm shaft assembly including seal (4) and bearings (5A-B) from gearcase.

NOTE: The input shaft oil seal in the gearmotor was an assembly in early manufacture held together with a lockring. Once removed it cannot be reused. In present design, the seal and sleeve are separate items and individually removable. Because of the bearing lockring (48), the seal assembly (4) and bearing (5A) cannot be removed at the same time.

5. All parts and castings should now be cleaned and inspected for possible replacement. If bearing or gears are to be replaced, a suitable set of bearing pullers or an arbor press must be utilized.

NOTE: Shimming of the tapered roller bearings and centering of the worm gear on the output shaft is accomplished by placing shims (14) behind the bearing cups (31A or 31B) and shifting as needed. If bearings, gears, collar, or output shaft have not been changed, then reshimming should not be necessary; but a check for end play or preload should be made.

6. A new seal sleeve (16) should be installed on the output shaft (where applicable). Some sealer should first be applied on the shaft at the sleeve location. Do not use so much that it gets on the sleeve O.D. or seal lip, as this will result in seal leakage.
7. Reassemble by installing closed bearing housing (45) and gasket using sealer on this gasket, then insert the output shaft assembly (17) into the gearcase. Install open bearing housing gasket without using sealer, bearing housing (8), and screws.
8. Check ouput shaft for looseness or preloading of the bearing. It is recommended that bearing be shimmed to .000" to .003" end play.
9. Again, remove the bearing housing screws, bearing housing (8), and output shaft assembly (17) and put to one side.
10. New input worm shaft bearings (5A-B) should now be pressed into place. The Tru-Arc lockring (48) is placed between the bearing (5A) and oil seal (4) to accept one-way thrust.
11. First apply a small amount of sealer around the shaft at the sleeve location, then press seal sleeve into place. Do not get sealer on the sleeve O.D. or seal lip.
12. Install the input shaft assembly (46) in the gearcase (6). Install the oil seal assembly (4), seal clamp (3), and screws. The input shaft should turn freely but have no end movement other than bearing internal clearance.
13. In order to check gear centering or alignment, you must "blue" the gears. Apply Prussian Blue lightly but evenly to six (6) teeth of the bronze gear (47). Install the output shaft and the gear assembly into the gearcase so that the gears do not mesh to the teeth coated with Prussian Blue. Install gasket, without using sealer, bearing housing (8), and secure with several screws.
14. Rotate input shaft (46) to provide one-half of a revolution of the bronze gear in one direction through the "blued area," then in the opposite direction again through the "blued area." This will provide marks of contact on both sides of the gear teeth (47).
15. Remove bearing housing screws, bearing housing (8), and output shaft assembly. You can now see if worm gear is centered by means of contact pattern.
16. If the tooth contact pattern shows an off centered condition, it means that the output assembly needs to be moved in the direction where contact shows heaviest. This is accomplished by removing the required amount of bearing shims (14) from under the bearing cup on the side where contact is heaviest, then placing them under the opposite bearing cup.

17. Reassemble and follow steps 13 thru 16 until the gears are centered properly, washing and re-bluing each time.

18. Install new output shaft seal (15) after its O.D. is coated lightly with sealer. Take a tube of proper dimensions so as to be able to press or tap the seal squarely into place in the bearing housing (8) flush with the casting face. DO NOT cock or bend. Install open bearing housing.

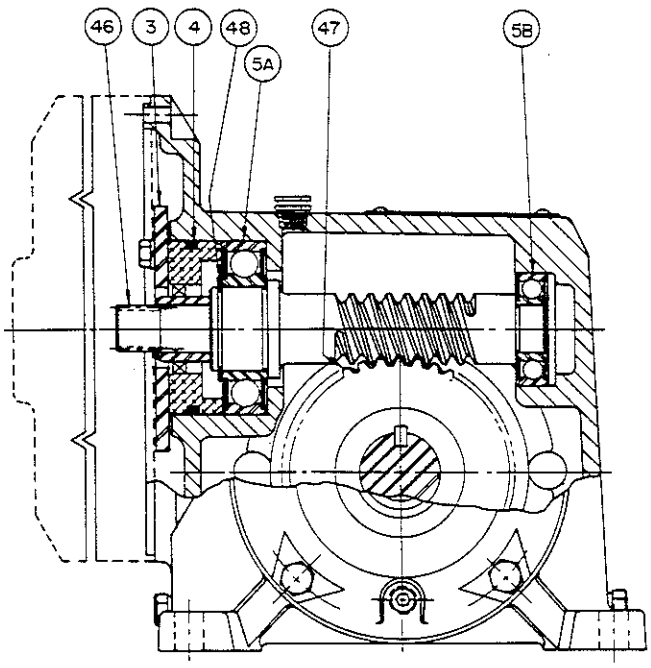
19. Bearings being set properly and gears aligned correctly, sealer can now be applied to gasket. Sealer should also be applied to all threads on screws, plugs, etc.

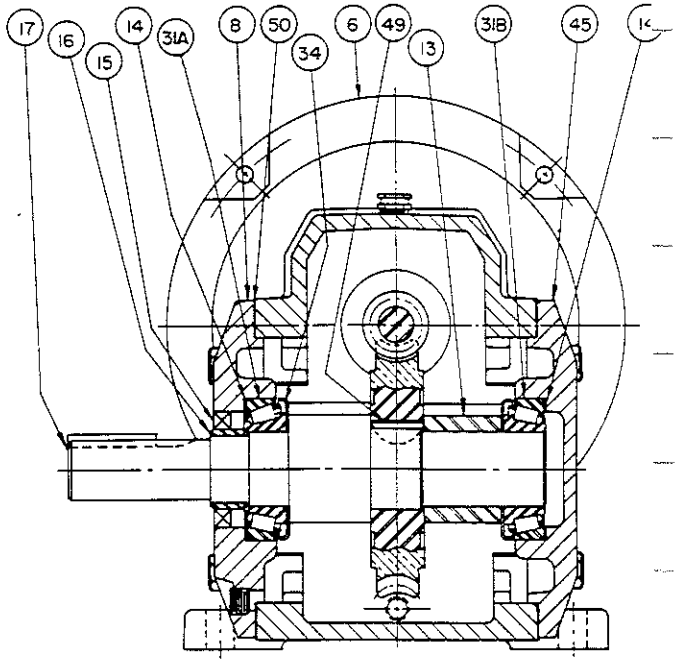
20. Install vent plugs in correct location. Fill the gearcase with the proper lubricant to the correct oil level for test.

21. If the unit is a gearmotor, check motor shaft bearings, replacing if necessary. Pack the semirigid steel coupling with Mobil-Temp 78 lubricant prior to installing the drive motor. Reinstall motor to gearbox, see motor disassembly and reassembly directions.

22. Test unit for performance.

RIGHT ANGLE—SINGLE REDUCTION





Ref. No.	Part Description	Unit Qty.	Part Numbers ■			
			W12	W16	W21	W28
3	Oil Seal Clamp	1	411625-12A	411625-03A	411625-04A	411625-08A
*4	Oil Seal Assembly (1)	1	411620-01F	411620-04F	411620-06F	411620-17F
*5a	Bearing	1	79147-02K	79147-02AD	79147-02AL	79147-03V
*5b	Bearing	1	79147-02B	79147-02K	79147-02K	79147-02P
6	Gear Case	1	79029-10A	79027-04A	86852-02A	86864-02A
8	Bearing Housing—Open	1	602020-10A	602022-03A	602035-02A	602075-02A
13	Spacer—Worm Gear	1	411622-07A	411622-10A	411622-12B	411622-16A
14	Shims	—	411623-01E	411623-01E	411623-01Y	411623-02A
*15	Oil Seal (1)	1	411627-01AL	411627-01AL	411627-01AM	411627-01A
*16	Oil Seal Sleeve (1)	1	411621-09A	411621-09A	411621-10A	411621-15D
17	Output Shaft	1	602026-11A	602027-01A	602040-01A	602040-05A
*31a	Bearing	1	411626-01BE	411626-01C	411626-01A	411626-01R
*31b	Bearing	1	411626-01D	411626-01C	411626-01A	411626-01R
34	Grease Retainer—When Req'd.	2	411624-01Y	411624-01C	411624-01E	411624-01R
45	Bearing Housing—Closed	1	602020-04A	602022-04A	602035-04A	602075-04A
*46	Worm Shaft	1	SEE GEAR CHART PAGE 21			
*47	Worm Gear	1				
48	Lock Ring	1	0082P001	053594	056044	411637-02A
49	Key—Worm Gear	1	411688-10A	411688-10B	053180	050999
*50	Gasket (1)	2	602028-01B	602028-01A	602028-01C	602028-12A
	Oil Seal & Gasket Kit	1	79019-38AA	79019-38AC	79019-38AE	79019-38AG

(1) Can use oil seal & gasket kit

* Recommended spare parts

■ Note: These part numbers apply to standard units only.

For part numbers not shown, contact Renewal Parts Customer Service (803) 297-4160 FAX: 803-281-2364

CHANGING THE OUTPUT SHAFT OF THE SINGLE REDUCTION UNIT FROM K-1 MOUNTING TO L-1 MOUNTING (AND VICE-VERSA)

See Page 13 for illustration.

1. Loosen the open bearing housing bolts.
2. Place the reducer, open bearing housing (8) up, over a clean container to catch oil.
3. Remove the bearing housing bolts. Use a hammer and a soft punch to rotate the bearing housing around the output shaft. This will shear the bearing housing gearcase seal.
4. Remove the open bearing housing (8).
5. Lift out the output shaft assembly (17) which includes the bronze worm gear (47), turn the gearcase over, and drain the oil into the container.
6. Remove the output shaft seal (15), taking care not to damage the machined bore in the bearing housing. Discard the old seal.
7. Remove the closed bearing housing (45) in the same manner used to remove open bearing housing (8).
8. Remove the roller bearing cups and shims from both bearing housing bores and switch them. (Place the cups and shims from the closed bearing housing into the bore of the open bearing housing and the cups and shims from the open bearing housing into the bore of the closed bearing housing.)

   A stiff wire hook worked evenly around the bearing cups will assist their removal. Avoid cocking and jamming the cups in their bores.
9. Centering the bronze worm gear:
   Worm gear sets must be properly adjusted or "centered" so the worm is contacting the center of the tooth on the worm gear. Failure to make this adjustment can cause reduced efficiency and life of the gearset, overheating, and tooth breakage.
10. Install the closed bearing housing — apply sealer to the gasket (if so equipped). Sealer should also be applied to all threads on screws, plugs, etc. If your unit did not come equipped with gaskets, apply a 1/16" bead of Loctite #515 sealant around the bearing housing tenon and set the bearing housing in place. Tighten the bearing housing bolts to the torques shown on page 20. Lay the unit on a workbench with the closed bearing housing down.

    Proceed with the gear centering as follows:
11. Apply Prussian blue lightly, but evenly, to both sides of five adjacent teeth on the bronze worm gear on the output shaft assembly.
12. Install the output shaft assembly into the gearcase so that the gears mesh with the uncoated teeth. Install the open bearing housing and secure with two screws at diagonal corners.
13. Rotate the input shaft so the "blued" teeth are rotated through the gear mesh. Then rotate in the opposite direction to bring the outer side of the "blued" teeth through the gear mesh. Marks of contact will be made by the worm in the bluing on the worm gear teeth.

    The input shaft may be rotated by:

    A) Gearmotors — Manually rotating the motor fan or brake shaft, when the motor is so equipped.

    B) C-face reducers — rotating the input shaft (46) by means of:

       I. A splined adaptor rotated by an inpact wrench.
       II. Manually rotating the motor fan or brake shaft, when the motor is so equipped.
14. Remove the open bearing housing and output shaft assembly. Examine the contact pattern on the blued teeth of the bronze worm gear.
15. If the contact pattern is off center, the output shaft assembly must be moved in the direction where contact shows the heaviest. This is accomplished by removing shims from beneath the bearing cup on the side where the contact is heaviest and placing them under the opposite bearing cup.
16. Repeat steps 10 through 14, cleaning and rebuilding each time, until the contact pattern is in the center of the bronze worm gear.
17. With gears properly centered, the gearbox can be closed up, and sealer applied to the gaskets (if so equipped). Sealer should also be applied to all threads on screws, plugs, etc. If your unit did not come equipped with gaskets, apply a 1/16" bead of Loctite #515 sealant around the bearing housing tenon and set the bearing housing in place. Tighten the bearing housing mounting bolts to the torques shown on page 20.
18. Lubricate the seal sleeve on the output shaft liberally with SHC-629 oil or other lube. Coat the seal bore in the bearing housing with a thin layer of Loctite #515 sealant. Install a new seal, taking care not to cut the lip or pop the seal spring out of position. Suitable sleeve-type seal tools should be used. Seat the seal flush with the outside of the bearing housing.
19. Fill the gearcase with the proper amount of lubricant from the list on page 3. Apply sealant to the fill plug and tighten securely.
20. Test unit for performance.

INSTRUCTIONS FOR DISASSEMBLY AND REASSEMBLY OF COMBINATION GEARMOTORS AND REDUCERS

WARNING

TO ENSURE THAT DRIVE IS NOT UNEXPECTEDLY STARTED, TURN OFF AND LOCK OUT OR TAG POWER SOURCE BEFORE PROCEEDING. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

WARNING

EQUIPMENT BEING REMOVED MAY BE TOO HEAVY TO CONTROL MANUALLY. SUPPORT IT BY EXTERNAL MEANS. FAILURE TO OBSERVE THE PRECAUTIONS COULD RESULT IN BODILY INJURY.

Gearmotors and reducers are accurately adjusted and tested at the factory. Care must be taken when the gearcase is disassembled and reassembled. This should be done accordingly to this manual or by an authorized service station as damaged to internal parts may result if done improperly.

*The removal and replacement of motor (See page 9).

1. Remove the drain plug and drain all oil from the gearcase.
2. Remove the screws holding the **closed** bearing housing (45) and tap with a mallet to loosen at the gasketed joint, then remove bearing housing.
3. Lift the output shaft assembly (17) with gear (20) from gearcase (6). Be careful, do not damage the gear teeth. At this time, the intermediate countershaft (19) with bronze worm gear (47) may also be removed.
4. Remove the screws holding the **open** bearing housing (8). Tap housing with a mallet to loosen the gasket joint, then remove.
5. Remove the seal clamp screws and the seal clamp (3) at the input shaft (46). Pull the input worm shaft assembly complete with seal (4) and bearings (5A & B) out of the gearcase.

NOTE: The input shaft oil seal in the gearmotor was an assembly in early manufacture, held together with a lockring. Once removed, it cannot be re-used. In present design, the seal and sleeve are separate items and individually removable. Because of bearing lockring (48), the input seal assembly (4) and bearing (5A) in gearmotors cannot be removed at the same time.

6. All parts and castings should be cleaned and inspected for possible replacement. If bearings or gears are to be replaced, a suitable set of bearing pullers or an arbor press should be utilized.

NOTE: The shimming of roller bearings on intermediate shaft (19) and output shaft (17), also centering of the bronze worm gear (47) is done by means of steel shims placed behind the roller bearing cups in the bearing housing bores, shifting as necessary from one side to the other. If bearings, gears, collars, and shaft are not to be changed, no re-shimming is necessary; but a check for end play or preload should be made.

7. If necessary, install new bearings on input shaft (46) and put lockring (48) in place. Place some sealer on the shaft where seal sleeve will go. Do not add so much as to get on seal or outside of sleeve. Press on seal sleeve. Shim to .000" to .003" end play.
8. Place input shaft assembly into gear housing with balance of seal assembly amd O-rings. Install clamp and screws. Check for pre-load or end play.
9. Install open bearing housing gasket, **open** bearing housing (8), and secure with screws. DO NOT put lip seal in at this time.
10. Install the intermediate counter shaft (19) with bronze worm gear (47). Place closed bearing housing gasket, closed bearing housing (45) on the gearcase and secure with screws.

NOTE: To check for looseness or pre-loading of bearings on the intermediate shaft, a tapped hole is provided in the end of the shaft (19), and bearing housing (8). This hole is located underneath the 1/8" pipe plug in the open bearing housing. Insert 1/4" x 20 bolt (long enough to be gripped) into the tapped hole in the shaft (19) to check for looseness or preloading of the intermediate shaft (19). If the bearings are loose, then shims are required. Place shims behind the bearing cups. If preloaded, remove those necessary. Shim to .000" to .003" end play.

NOTE: If new intermediate shaft or output shaft bearing or gears are used, proceed as follows:

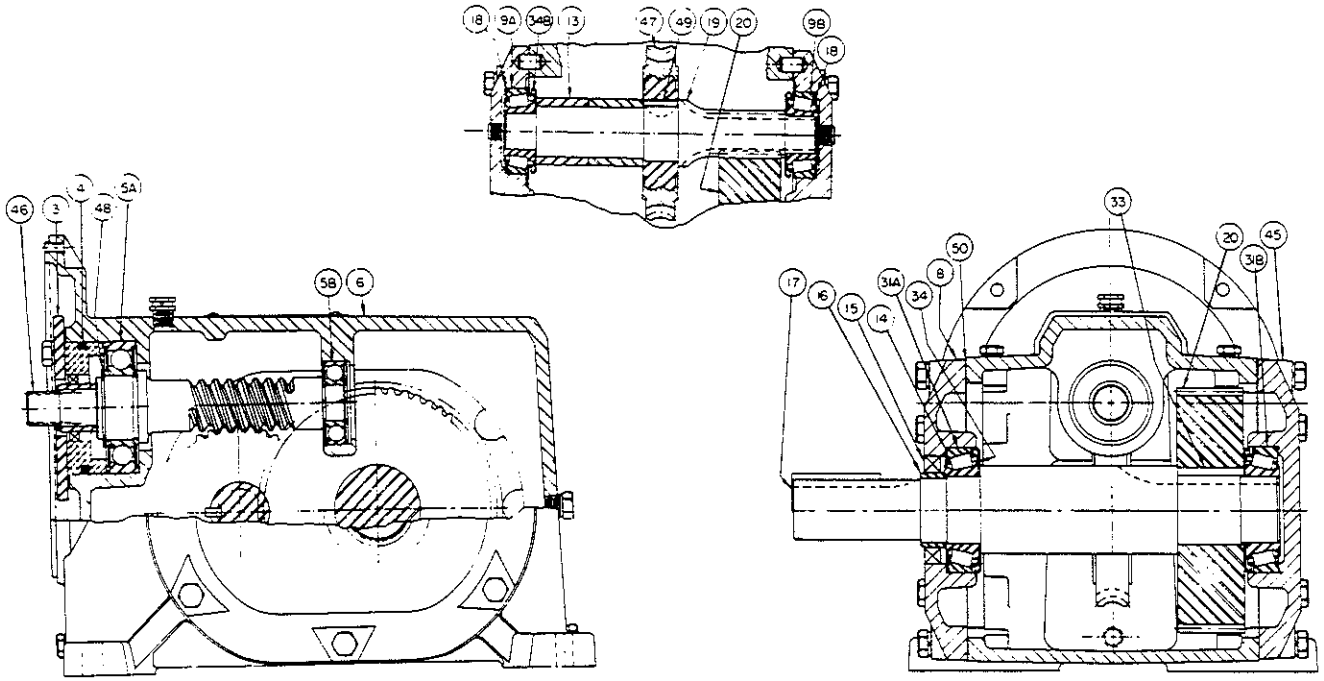
11. Remove the **closed** bearing housing (45), lift out the intermediate shaft assembly (19). Apply Prussian Blue to six (6) teeth of the bronze gear (47). Install the intermediate shaft assembly back into gearcase so that the gears do not mesh in the area that has been coated with Prussian Blue. Install gasket without using sealer, closed bearing housing and secure all screws.
12. By rotating the input worm shaft (46) in one direction through the "blued area" (then in the opposite direction again through the "blued area") you will get a mark of contact on both sides of the gear teeth (47).
13. Remove the **closed** bearing housing screws, bearing housing (45), and intermediate shaft assembly (19). You can now see if the worm gear is centered by means of a contact pattern. If the tooth contact shows an off centered condition, it means that the assembly needs to be moved. This is accomplished by removing the required amount of bearing shims from behind the bearing cup on the side where contact is heaviest, placing them underneath the bearing cup in the opposite side. Re-blue, reassemble, and check again.

14. With the intermediate worm gear shaft set up properly, the final output shaft (17) with gear (20) can now be installed and checked. Remove the closed bearing housing screws and bearing housing (45). Lift out the intermediate shaft assembly (19) with worm gear (47).
15. Install a new seal sleeve (16) (where applicable) on the final output shaft (17) after placing a small amount of sealer around the shaft at sleeve location.
16. With worm gear (47) and shaft (19) removed, place the output shaft assembly (17) into the gearcase—shaft protruding through the open bearing housing (8). Replace the closed bearing housing gasket, without sealer, closed bearing housing (45) and secure all screws. Check the shaft (17) for looseness or preloading of bearings. If additional shims are required, they should be placed behind the bearing cup (31A or 31B) in the open bearing housing (8). If preloaded, remove those necessary. Shim to .000" to .003" end play.
17. Remove the closed bearing housing and install the intermediate counter shaft and worm gear assembly (19) (leaving final stage gear and output shaft still in place), apply sealer to the gasket area—replace and secure with screws.
18. Remove the open bearing housing, apply sealer to the gasket area, replace and secure with screws.
19. Install a new ouput shaft seal (15), after coating O.D. of seal lightly with sealer. Using a tube of the same dimensions as the lip seal housing, tap or press the seal squarely into place in the bearing housing, flush with the casting face. Do not cock or bend.
20. Install a vent plug in the proper location. Fill the gear case with the proper lubricant to the correct oil level and test.

NOTE: Pack the motor shaft steel coupling with Mobil Temp 78 lubricant prior to installing the drive motor to gear case (refer to Page 10).

21. If the unit is a gearmotor, check motor shaft bearing, replacing if necessary. Slide the splined coupling end of motor shaft on to the splined worm shaft, making sure that the coil spring is still properly in place in the coupling.
22. Place motor frame and stator over the rotor with thru bolts in place. Do not damage stator winding.
23. Check motor end cover to be sure that any thrust springs or shims are properly in place, add a small amount of good bearing lube and place end cover over bearing and into place on the frame.
24. Add nuts to all four (4) thru bolts and tighten evenly.
25. Test unit for performance.

RIGHT ANGLE COMBINATION



CHANGING THE OUTPUT SHAFT OF THE DOUBLE REDUCTION UNIT FROM K-1 MOUNTING TO L-1 MOUNTING (AND VICE-VERSA)

See Page 16 for illustration.

1. Loosen the open bearing housing bolts.
2. Place the reducer, open bearing housing (8) up, over a clean container to catch oil.
3. Remove the bearing housing bolts. Use a hammer and a soft punch to break the bearing housing loose from the gearecase. This will shear the bearing housing/gearcase sealed joint..
4. Remove the open bearing housing (8).
5. Lift out the output shaft assembly (17) which includes the bronze worm gear (47), turn the gearcase over, and drain the oil into the container.
6. Remove the output shaft seal (15), taking care not to damage the machined bore in the bearing housing. Discard the old seal.
7. Remove the closed bearing housing (45) in the same manner used to remove open bearing housing (8).
8. Remove the roller bearing cups and shims from both bearing housing bores and switch them. (Place the cups and shims from the closed bearing housing into the bore of the open bearing housing and the cups and shims from the open bearing housing into the bore of the closed bearing housing.)

   A stiff wire hook worked evenly around the bearing cups will assist their removal. Avoid cocking and jamming the cups in their bores.
9. Centering the bronze worm gear:
   Worm gear sets must be properly adjusted or "centered" so the worm is contacting the center of the tooth on the worm gear. Failure to make this adjustment can cause reduced efficiency and life of the gearset, overheating, and tooth breakage.
10. Install the closed bearing housing — apply sealer to the gasket (if so equipped). Sealer should also be applied to all threads on screws, plugs, etc. If your unit did not come equipped with gaskets, apply a $^{1}/_{16}$" bead of Loctite #515 sealant around the bearing housing tenon and set the bearing housing in place. Tighten the bearing housing bolts to the torques shown on page 20. Lay the unit on a workbench with the closed bearing housing down.

    Proceed with the gear centering as follows:
11. Apply Prussian blue lightly, but evenly, to both sides of five adjacent teeth on the bronze worm gear on the output shaft assembly.
12. Install the output shaft assembly into the gearcase so that the gears mesh with the uncoated teeth. Install the open bearing housing and secure with two screws at diagonal corners.
13. Rotate the input shaft so the "blued" teeth are rotated through the gear mesh. Then rotate in the opposite direction to bring the outer side of the "blued" teeth through the gear mesh. Marks of contact will be made by the worm in the bluing on the worm gear teeth.

    The input shaft may be rotated by:

    A) Gearmotors — Manually rotating the motor fan or brake shaft, when the motor is so equipped.

    B) C-face reducers — rotating the input shaft (46) by means of:

       I. A splined adaptor rotated by an inpact wrench.
       II. Manually rotating the motor fan or brake shaft, when the motor is so equipped.
14. Remove the open bearing housing and pinion shaft assembly. Examine the contact pattern on the blued teeth of the bronze worm gear.
15. If the contact pattern is off center, the pinion shaft assembly must be moved in the direction where contact shows the heaviest. This is accomplished by removing shims from beneath the bearing cup on the side where the contact is heaviest and placing them under the opposite bearing cup.
16. Repeat steps 10 through 14, cleaning and rebuilding each time, until the contact pattern is in the center of the bronze worm gear.
17. With gears properly centered, install the output shaft assembly and close up the gearbox. Apply sealer to the gasket (if so equipped). Sealer should also be applied to all threads on screws, plugs, etc. If your unit did not come equipped with gaskets, apply a bead of Loctite #515 sealant around the bearing housing machined face and set the bearing housing in place. Tighten the bearing housing mounting bolts to the torques shown on page 20.
18. Lubricate the seal sleeve on the output shaft liberally with SHC-629 oil or other lube. Coat the seal bore in the bearing housing with a thin layer of Loctite #515 sealant. Install a new seal, taking care not to cut the lip or pop the seal spring out of position. Suitable sleeve-type seal tools should be used. Seat the seal flush with the outside of the bearing housing.
19. Fill the gearcase with the proper amount of lubricant from the list on page 3. Apply sealant to the fill plug and tighten securely.
20. Test unit for performance.

RIGHT ANGLE COMBINATION

Ref. No.		Unit Qty.	Part Numbers ■			
			C12	C16	C21	C28
3	Oil Seal Clamp	1	411625-12A	411625-03A	411625-04A	411625-08A
*4	Oil Seal Assembly	1	411620-01F	411620-04F	411620-06F	411620-17F
*5a	Bearing	1	79147-02K	79147-02AD	79147-02AL	79147-03V
*5b	Bearing	1	79147-02B	79147-02K	79147-02K	79147-02P
6	Gear Case	1	79029-10A	86850-04A	86854-02A	86866-02A
8	Bearing Housing—Open	1	79031-03A	79033-03A	79036-02A	79061-02A
*9a	Bearing	1	411626-01D	411626-01E	411626-01B	411626-01AC
*9b	Bearing	1	411626-01D	411626-01E	411626-01B	411626-01AC
13	Spacer	—	411622-07B	411622-10T	411622-29A	411622-15B
14	Shims	—	411623-01E	411623-01Y	411623-02A	411623-03A
*15	Oil Seal (1)	1	411627-01AL	411627-01AM	411627-01A	411627-01D
*16	Oil Seal Sleeve (1)	1	411621-09A	411621-10A	411621-15B	411621-18A
17	Output Shaft	1	602026-02A	602027-02A	602040-02A	602040-06A
18	Shims	—	411623-01A	411623-01AD	411623-01E	411623-02AA
*19	Pinion Shaft	1	SEE GEAR CHART PAGE 22			
20	Gear, Driven	1				
*31a	Bearing	1	411626-01C	411626-01A	411626-01R	411626-01AB
*31b	Bearing	1	411626-01C	411626-01A	411626-01R	411626-01AB
33	Key-Gear	1	055037	055668	053552	055157
34	Grease Retainer—When Req'd.	2	411624-01C	411624-01E	411624-01R	411624-01X
34b	Grease Retainer—When Req'd.	2	411624-01A	411624-01D	411624-01B	411624-01W
45	Bearing Housing — Closed	1	79031-04A	79033-04-A	79036-04A	79061-04A
*46	Worm Shaft	1	SEE GEAR CHART PAGE 22			
*47	Worm Gear	1				
48	Lock Ring	1	0082P001	053594	056044	411637-02A
49	Key—Worm Gear	1	411688-10A	411688-10B	053180	050999
*50	Gasket (1)	2	602028-03A	602028-04A	602028-02A	602028-13A
	Oil Seal & Gasket Kit	1	79019-38AB	79019-38AD	79019-38F	79019-38AH

(1) Can use oil seal & gasket kit

* Recommended spare parts

■ Note: These part numbers apply to standard units only.

For part numbers not shown, contact Renewal Parts Customer Service (803) 297-4160 FAX: 803-281-2364

LONG-TERM STORAGE GUIDELINES FOR GEAR REDUCERS

Care must be taken to ensure that gear reducers are placed in service in the best possible condition. During periods of long storage (six months or longer) special procedures must be followed which will protect the reducer and make certain that it will be in good condition when ready to be put into service.

By taking special precautions, problems such as seal leakage and reducer failure due to lack of lubrication, improper lubrication quantity, or contamination can be avoided. The following precautions will protect reducers during periods of long-term storage:

A. Preparation:

1. Select a clean, dry, protected storage area free of vibration and temperature extremes. Set the drive level on its feet with no load on either the input or output shafts. Block as needed to keep weight off the motor fan shroud and motor conduit box (if unit has a motor).
2. Fill the gearbox to the highest designated oil level with a recommended lubricant blended with 2% by volume of Daubert Chemical Co. Nox-Rust VCI-105 Oil. Do not fill the gearbox completely full of oil. Expansion space is needed to avoid pressurizing the gearbox during temperature variations. Rotate the input at least 60 revolutions to ensure a full distribution of the lubricant.
3. Replace the gearbox vent plug with a solid pipe plug. Wire or tie the vent plug to the gearbox to prevent losing it.
4. All condensate drains and breathers (on motors so equipped) are to be fully operable to allow breathing through points other than bearing fits. Remove the consensate drain plugs located in the motor end shield. Position the motor so the drain is at its lowest point. Totally enclosed fan cooled XT motors are equipped with automatic drains which should be left in place.

5. All units equipped with heaters must have the heaters connected and operational if the storage conditions are in any way like anticipated service conditions.

6. Motor windings are to be checked with a megohmmeter when the equipment is put into storage. The resistance must be recorded and saved for future reference. See "To Put The Stored Unit Into Service" for the megohmmeter check required upon removal from storage.

7. Apply a thick coating of chassis-type grease, Cosmoline or equivalent protective coating *(Daubert Chemical Co. Nox-Rust X-110 is a suitable coating) on a unpainted surfaces including threads, bores, keyways and shafts.

8. Apply a thick coating of chassis-type grease to all exposed shaft seals.

9. If the unit must be stored outdoors or in damp or unheated areas indoors, cover the entire exterior with a rust preventive. Seal the unit in a mositure proof container or in an envelope of heavy polyethylene film with a dessicant inside. Shade the enclosure from direct sunlight.

10. Rotate the input shaft at least 60 revolutions once a month to redistribute the lubricant and to prevent brinelling of bearings and drying of seals.

11. Instructions manuals and tags are paper and must be kept dry. Remove these documents and store them in a safe, dry place for future refernce at start up.

B. To Put the Stored Unit into Service:

1. Remove all protective coatings added for storage.

2. Drain and refill the gearbox with a recommended type and amount of lubricant. Regreaseable assemblies and bearings must be purged and filled with new grease.

3. Install the vent and oil level plugs in the proper locations for the mounting position to be used. Check the motor condensate drain locations to assure the motors will drain properly when mounted in the proposed position. Rotate the motor on the gearhead and rotate the motor end shields on the motor frame if necessary to get the drains in the proper positions.

4. Check all hardware for proper tightness.

5. If the gear unit has been stored for more than three years or in an area with high ambient temperatures, the oil seals must be replaced before being put into service.

6. Check the motor stator insulation resistance with a megohmmeter. Resistance less than one megohm or less than 50% of the resistance reading taken when the motor was put into storage (whichever is the higher resistance), requires the motor winding to be dried in one of the two ways described below. If drying does not restore the winding insulation resistance to the values listed above, the motor must be repaired or rewound.

DANGER

SUBSEQUENT STEPS REQUIRE ROTATING PARTS AND/OR ELECTRICAL CIRCUITS TO BE EXPOSED. STAY CLEAR IF UNIT MUST BE RUNNING OR DISCONNECT AND LOCKOUT OR TAG POWER SOURCE IF CONTACT MUST BE MADE. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

a. Remove the motor from the reducer. Place the motor in a ventilated oven at not more than 90 degrees Celsius (194 degrees F.) Check the insulation resistance every 30 minutes. Bake until the resistance becomes constant.

b. Lock the motor rotor. Insert a thermocouple in the winding or set up to measure rise by resistance. Apply low voltage. Gradually increase the current through the winding until the winding temperature reaches 90 degrees Celsius (194 degrees F.). Do not exceed this temperature. Check the winding insulation resistance with a megohmmeter. Repeat if necessary. After drying, briefly run the motor not connected to any load to further dry the motor and to check the bearings for noise and smooth operation.

7. When stored motors are found to be wet, a more detailed inspection should be made by removing the motor end shields and visually inspecting for water in the grease or rust on the bearings. If either is found, replace the bearings, clean the end shields thoroughly and relubricate.

***NOTE:** Daubert Nox-Rust VCI-105 Oil and Nox-Rust X-110 Protective Coating can be procured in bulk quantity from:

Daubert Chemical Company, Inc.
4700 S. Central Ave.
Chicago, Illinois 60638
Telephone (708) 496-7350

or in 5 gallon pails from their distributor:

Rock Island Lubricants and Chemicals
1320 First Street
Rock Island, Illinois 61204-5015
Telephone (309) 788-5631

HARDWARE TORQUES

TORQUES FOR GEARCASE BOLTS (GRADE 5 HEX HEAD SCREWS)

Case Size	Bearing Housing Screws		Bearing Clamp Screws	
	Screw Size	Torque (Lb. In.)	Screw Size	Torque (Lb. In.)
W12 C12	1/4 - 20	75	#10-32	36
W16 C16	1/4 - 20	75	1/4-20	75
W21 C21 W28 C28	5/16-18	156	1/4-20	75

TORQUES FOR NEMA C-FACE BOLTS (GRADE 5 HEX HEAD SCREWS)

Motor Frame Size vs. Case Size	C-face Adaptor to Gearcase		Motor to C-face Screws	
	Screw Size	Torque (Lb. In.)	Screw Size	Torque (Lb. In.)
56C 140TC vs. 12-16 21-28	3/8 - 16	276	#10-32	36
180TC 210TC vs. 21-28	1/2 - 13	660	1/2-13	660

TORQUES FOR SETSCREWS WHICH ATTACH COUPLING HUBS TO C-FACE MOTORSHAFTS AND TO SPLINED INPUT SHAFT OF GEARCASE

Motor Frame Size vs. Case Size	Screw Size	Torque (Lb. In.)
56C & 140TC vs. 12-16-21-28 Motor Hub	1/4-20	50
180TC 21TC vs. 21-28 Motor Hub	5/16-18	96
180TC 210TC vs. 21-28 Splined Shaft Gearcase Hub	3/8-16	180

TORQUES FOR PARTIAL GEARMOTOR MOUNTING HARDWARE

Motor Frame Size	Thread Size	Torque (Lb. In.)
56P 140P	#10-32 Thru Bolt	23 23
180TY 210TY	1/2-13 Stud	420

TORQUES FOR GEARCASE BOLTS TO ATTACH BOLT-ON BASE AND J-MOUNT BASE TO GEARCASE (SOCKET HEAD CAP SCREWS)

Case Size	Screw Size	Torque (Lb. In.)
W12 C12 W16 C16	3/8-16	545
W21 C21 W28 C28J	1/2-13	1300

TORQUES FOR PIPE PLUGS

Case Size	Plug Size	Torque (Lb. In.)
W12 C12	1/8-27 NPT	100
W16 C16	1/4-18 NPT	200
W21 C21 W28 C28	3/8-18 NPT	400

WORM GEAR CHARTS

Right Angle Single Reduction Size WG/WM12

Ratio	Steel Worm Shaft	Bronze Worm Gear	
		Dbl. Ext. Shaft	Standard
5	602406-02	602411-89	602411-88
7.5	602406-04	602411-19	602411-04
10	602406-05	602411-20	602411-05
12.67	602406-06	602032-60	602032-08
15	602406-87	602411-22	602411-07
18	602406-08	602032-62	602032-10
20	602406-09	602411-24	602411-09
25	602406-10	602032-64	602032-12
30	602406-11	602411-26	602411-11
40	602406-13	602411-28	602411-13
50	602406-14	602411-29	602411-14
60	602406-15	602411-30	602411-15

Right Angle Single Reduction Size WG/WM16

Ratio	Steel Worm Shaft	Bronze Worm Gear
5	602034-55	602412-02
7.5	602409-04	602412-04
10	602409-05	602412-05
12.67	602409-06	602412-06
15	602409-07	602412-07
18	602409-08	602412-08
20	602409-09	602412-09
25	602409-94	602412-10
30	602409-11	602412-11
40	602409-13	602412-13
50	602409-14	602412-14
60	602409-15	602412-15

Right Angle Single Reduction Size WG/WM21

Ratio	Steel Worm Shaft	Bronze Worm Gear
5	602036-56	602413-02
7.5	602410-04	602413-04
10	602410-05	602413-05
12.67	602036-06	602037-08
15	602410-07	602413-07
18	602410-08	602037-10
20	602410-09	602037-11
25	602410-10	602037-12
30	602410-11	602413-11
40	602410-13	602413-13
50	602410-14	602413-14
60	602430-08	602413-15

Right Angle Single Reduction Size WG/WM28

Ratio	Steel Worm Shaft	Bronze Worm Gear
5	602076-56	602077-67
7.5	602076-32	602077-63
10	602426-02	602424-03
12.67	602076-06	602077-08
15	602426-04	602424-04
18	602076-08	602077-10
20	602426-06	602424-05
25	602076-10	602077-12
30	602076-11	602077-13
40	602426-08	602424-07
50	602426-09	602424-08

COMBINATION GEAR CHARTS

Right Angle Combination Size CG/CM12

Ratio	First Stage Worm		Second Stage — Helical	
	Worm Shaft	Worm Gear	Driver	Driven
20	602406-02	602411-88	602024-02	602029-02
25	602406-02	602411-88	602024-03	602029-03
30	602406-04	602411-04	602024-02	602029-02
36	602406-04	602411-04	602024-03	602029-03
40	602406-05	602411-05	602024-02	602029-02
50	602406-06	602032-08	602024-02	602029-02
60	602406-06	602032-08	602024-03	602029-03
70	602406-87	602411-07	602024-03	602029-03
86	602406-08	602032-10	602024-03	602029-03
101	602406-10	602032-12	602024-02	602029-02
121	602406-11	602411-11	602024-02	602029-02
144	602406-11	602411-11	602024-03	602029-03
162	602406-13	602411-13	602024-02	602029-02
192	602406-13	602411-13	602024-03	602029-03
240	602406-14	602411-14	602024-03	602029-03
288	602406-15	602411-15	602024-03	602029-03
336	602406-16	602032-18	602024-03	602029-03

Right Angle Combination Size CG/CM16

Ratio	First Stage Worm		Second Stage — Helical	
	Worm Shaft	Worm Gear	Driver	Driven
20	602034-55	602412-02	602025-09	602030-02
25	602034-55	602412-02	602025-10	602030-03
30	602409-04	602412-04	602025-09	602030-02
36	602409-04	602412-04	602025-10	602030-03
40	602409-05	602412-05	602025-09	602030-02
50	602409-06	602412-06	602025-09	602030-02
60	602409-06	602412-06	602025-10	602030-03
70	602409-07	602412-07	602025-10	602030-03
86	602409-08	602412-08	602025-10	602030-03
101	602409-94	602412-10	602025-09	602030-02
121	602409-11	602412-11	602025-09	602030-02
144	602409-11	602412-11	602025-10	602030-03
162	602409-13	602412-13	602025-09	602030-02
192	602409-13	602412-13	602025-10	602030-03
240	602409-14	602412-14	602025-10	602030-03
288	602409-15	602412-15	602025-10	602030-03

Right Angle Combination Size CG/CM21

Ratio	First Stage Worm		Second Stage — Helical	
	Worm Shaft	Worm Gear	Driver	Driven
20	602036-56	602413-02	602038-02	602039-02
25	602036-56	602413-02	602038-03	602039-03
30	602410-04	602413-04	602038-02	602039-02
36	602410-04	602413-04	602038-03	602039-03
40	602410-05	602413-05	602038-02	602039-02
50	602036-06	602037-08	602038-02	602039-02
60	602036-06	602037-08	602038-03	602039-03
70	602410-07	602413-07	602038-03	602039-03
86	602410-08	602037-10	602038-03	602039-03
101	602410-10	602037-12	602038-02	602039-02
121	602410-11	602413-11	602038-02	602039-02
144	602410-11	602413-11	602038-03	602039-03
162	602410-13	602413-13	602038-02	602039-02
192	602410-13	602413-13	602038-03	602039-03
240	602410-14	602413-14	602038-03	602039-03
288	602430-08	602413-15	602038-03	602039-03

Right Angle Combination Size CG/CM28

Ratio	First Stage Worm		Second Stage — Helical	
	Worm Shaft	Worm Gear	Driver	Driven
10	602076-56	602077-67	602078-12	602079-05
12.7	602076-56	602077-67	602078-14	602079-06
15	602076-32	602077-63	602078-12	602079-05
18	602076-32	602077-63	602078-14	602079-06
20	602076-56	602077-67	602078-02	602079-02
25	602076-56	602077-67	602078-03	602079-03
30	602076-32	602077-63	602078-02	602079-02
36	602076-32	602077-63	602078-03	602079-03
40	602426-02	602424-03	602078-02	602079-02
50	602076-06	602077-08	602078-02	602079-02
60	602076-06	602077-08	602078-03	602079-03
70	602426-04	602424-04	602078-03	602079-03
86	602076-08	602077-10	602078-03	602079-03
101	602076-10	602077-12	602078-02	602079-02
121	602076-11	602077-13	602078-02	602079-02
144	602076-11	602077-13	602078-03	602079-03
162	602426-08	602424-07	602078-02	602079-02
192	602426-08	602424-07	602078-03	602079-03
240	602426-09	602424-08	602078-03	602079-03

RENEWAL PARTS

CONTACT YOUR NEAREST RELIANCE PARTS DISTRIBUTOR IN THE YELLOW PAGES UNDER THE HEADINGS SPEED REDUCERS, POWER TRANSMISSION EQUIPMENT, OR VARIABLE SPEED DRIVES.

OR

CONTACT DODGE-MASTER-REEVES RENEWAL PARTS QUOTATIONS FOR ASSISTANCE AT PHONE NUMBER 1-803-297-4160 OR FAX NO. 1-803-281-2364. IDENTIFICATION NUMBER FROM UNIT NAMEPLATE WILL BE REQUIRED FOR PARTS ASSISTANCE.

SERVICE ENGINEERS

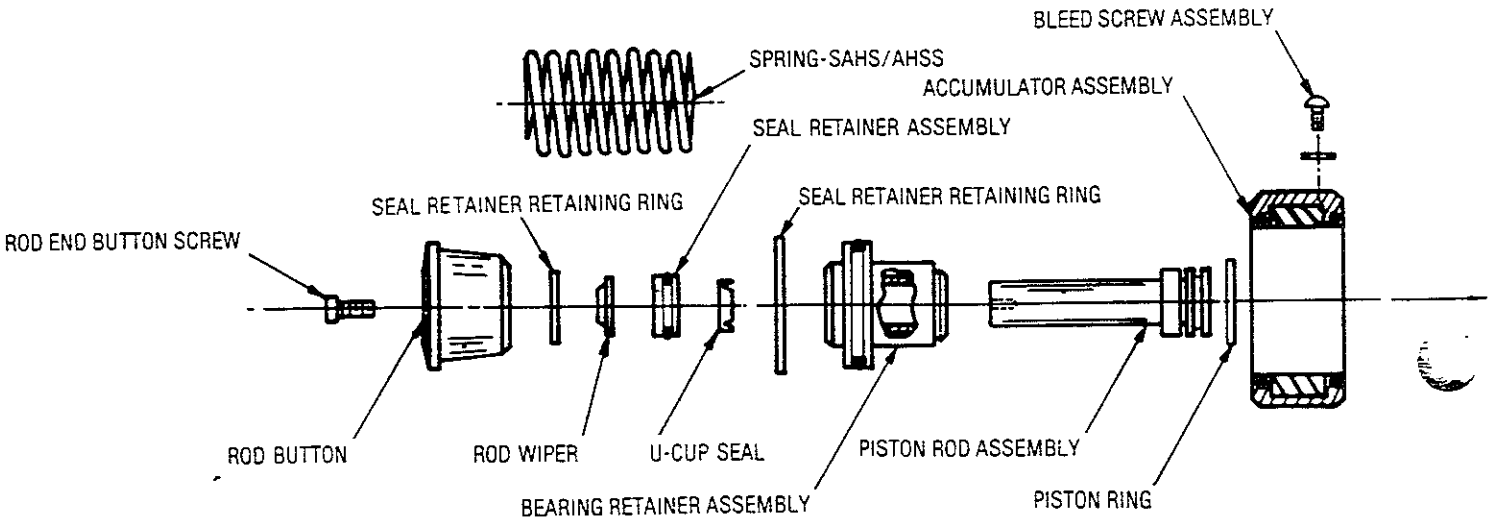
FOR RATES AND AVAILABILITY OF SERVICES CALL 1-812-378-2416.

Disassembly Instructions ACE 2 and 3 Bore

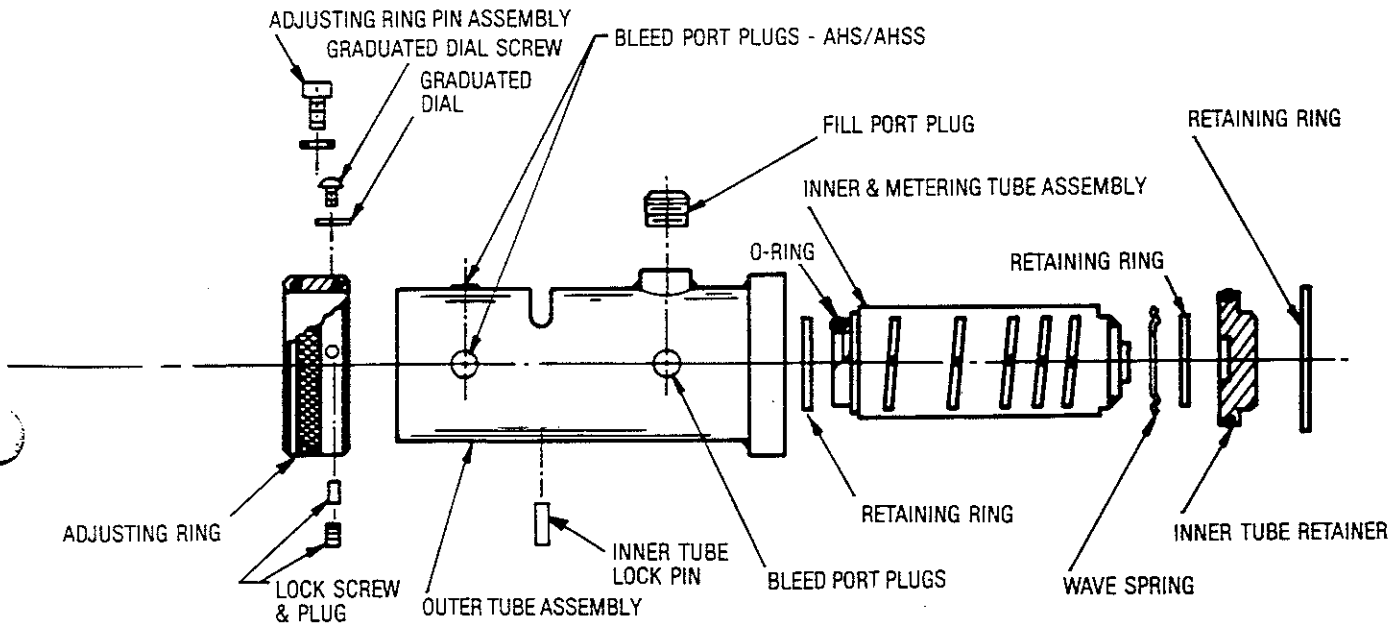
1. Drain all the oil from the shock absorber.
2. Remove the rod end button if the unit has one. Put the button in a vise (DO NOT PUT THE PISTON ROD IN A VISE) and loosen the button screw 2 or 3 turns. Insert a punch *in* the hex pocket *in* the screw and drive the rod out of the button.
3. Remove the seal retainer retaining ring and charge the unit to 80 psi. The seal retainer assembly will pop out of the bearing assembly. (Caution: The piston rod will extend rapidly.)
4. Remove the accumulator screw (if applicable) and pull the accumulator off the end of the shock absorber. Remove the bleeder screws if there is no accumulator.
5. Remove the graduated dial, then the lock screw.
6. Remove the adjusting ring screw (under the acorn nut on the 3 bore) and pull the adjusting ring off the end of the shock absorber.
7. Remove retaining rings from both ends of the shock absorber.
8. Remove the inner tube pin. (This is a straight pin in 2 bore models and screwed in place in 3 bore models.)
9. Using the piston rod as a ram, push the inner tube retainer, as well as the inner and metering tube assembly, out of the shock absorber.
10. Put the rod back into the bearing assembly and pull the bearing assembly out of the shock absorber. Use the rod as the bearing assembly puller.
11. Remove the retaining rings and wave spring from the inner tube and slide the metering tube off the inner tube.
12. Remove and discard all seals.
13. Inspect and replace all worn or damaged parts.

Assembly Instructions ACE 2 and 3 Bore

1. Thoroughly clean all parts and assemble the seals on their respective parts. Lubricate *all* seals and parts generously.
2. Put one retaining ring on the inner tube at the closed end. Install the wave spring next to this ring — towards the open end of the inner tube. Slide the metering tube over the inner tube, resting the metering tube on top of the wave spring. Make sure the holes in the inner tube are all visible through the slots in the metering tube. Push down on the metering tube (against the wave spring) and install the second retaining ring on the inner tube, effectively trapping the metering tube in position.
3. Put the piston rod through the bearing and, using the rod as an assembly tool, put the bearing into the outer tube assembly. Install at the flange end (for a front flange mounting) or at the other end (for all other mountings).
4. Remove the piston rod from the bearing assembly and install in the inner tube. Use care when compressing the piston ring to enter the inner tube. Place the piston ring joint 180° away from the holes in the inner tube.
5. Make sure the O-ring to be trapped between bearing assembly and inner tube is in its proper location.



6. Take the inner and metering tube assembly (with the piston already installed) and insert into the outer tube assembly. Push the rod through the bearing assembly.
7. Set the outer tube assembly down on its side with the rod pointing away from you and the slot to the left. This will position the proper inner tube pin hole near the top of the outer tube assembly.
8. With the inner tube pin hole visible in the wide slot of the metering tube, rotate the inner tube and metering tube assembly until the pin holes in the outer tube and inner tube line up. Install the inner tube pin. (This is a screw-type pin in the 3 bore.)
9. Stand the outer tube assembly up on the edge of a bench, with piston rod vertical (rod down). Be careful the bearing assembly does not come out. Be sure the inner tube pin stays in place in 2 bore models.
10. Push the inner tube retainer into the outer tube assembly. Tap lightly to line up the pilot on the inner tube and the inner tube retainer.
11. Install the retaining ring to hold the inner tube retainer in place.
12. Stand the assembly up on the inner tube retainer and push the bearing assembly all the way into the outer tube assembly.
13. Install the retaining ring to hold the bearing assembly in place. This will require light tapping to compress the O-ring trapped between the bearing assembly and the inner tube.
14. Slide the adjusting ring over the outer tube assembly. The lock screw hole should be away from the flange on 3 bore models. On 2 bore models, the lock screw hole should be towards the flange. Line up the adjusting ring screw hole with the slot in the outer tube assembly. Rotate the adjusting ring to line up the screw hole with the mating hole in the metering tube.
15. Insert the adjusting ring screw through the adjusting ring into the metering tube. Rotate the adjusting ring one way and then the other whi looking in the fill port to be sure the metering rotates in both directions. Install the acorn nut lock washer on 3 bore models.
16. On self-contained models, slide the accumulat over the outer tube assembly. Align the hole ir accumulator with the bleed screw hole in the outer tube, then install the accumulator screw hold the accumulator in place.
17. Install all bleeder screws and seals.
18. Push the seal retainer assembly over the end the rod with the U-cup facing the bearing assembly. Push the seal retainer assembly intc the bearing assembly and install the retaining to hold it in place.
19. Install the rod end button (and spring, if applicable) by putting the button in a vise and usi the button screw to draw the rod into the buttc (this is a press fit). DO NOT PUT THE ROD IN VISE.
20. Install the graduated dial. The numbers should right side up when the shock absorber is on its side and the rod is towards you on 2 bore moc They should be right side up when the shock a sorber is on its side and the rod is away from on 3 bore models.
21. Charge the shock absorber to 50 psi and submerge in water to check for cut O-rings anc other leaks. Rotate the adjusting ring while the unit is submerged, and charged.
22. The shock absorber is now ready to be filled with oil. See filling and bleeding instructions on page 22.



Approved Oils for Use with ACE Shock Absorbers

ACE RECOMMENDS:

Through an extensive testing and research program on oils versus orifice profile, conclusive data was obtained to recommend the following oils to be used in all Adjust-A-Shocks:

Standard Oil, Division of American Oil Company
- American Industrial Oil #46 (formerly was American #21)
*- Amoco - Dexron A.T.F. Fluid

Texaco, Inc.
- Texaco Regal 46 (R & 0)

Equivalent Oils:

ACE Controls has solicited recommended equivalent oils to the above products. The following oils have been recommended by various oil companies and industrial firms:

1. Cities Service Oil Company—Citgo Pacemaker #20 (7)
2. Humble Oil and Refining Company—Nuto #48
3. Mobil Oil Company—Vactra Medium
*4. Mobile Oil Company—Mobil A.T.F. Fluid
5. Phillips 66—Magnus—8124
**6. Shell Oil Company—Telius #46 (was #29)
**7. Esso International, Div. of Standard Oil New Jersey—Nuto #48
8. American Motors Corporation—American Industrial Oil #46 (formerly was American #21)
9. Chrysler Corporation—NP 6200 Medium
10. Ford Motor Company—6C2B
11. General Motors Corporation—WEL #34
**12. G.E. Silicone Fluid—SF-96-50
13. Gulf—Harmony #47
***14. Fyrquel #220 (formerly Cellulube)
***15. Houghto Safe—1120—E.F. Houghton & Co.
***16. Pyrogard 53—Mobil Oil Co.
***17. Pydraul F-9—Monsanto Chemical Co.

* *Available in most service stations*
** *Internationally available*
*** *To be used with Viton Seals*

Not all industrial oils perform satisfactorily as industrial shock absorber fluids. Satisfactory fluids are distinguished by properties such as: high viscosity index; high shear stability; anti-foam agents; rust and oxidation inhibitors. The following general specifications for shock absorber fluids should also be adhered to for satisfactory performance:

1. Viscosity range (SUS @ 100°F)—180 to 210
2. Aniline point (°F)—190 to 220
3. Should be compatible with Nitrile Rubber, Polyurethane and Bronze.

NOTE: These oils are listed for the individual users' selection only. Because of the different processing by manufacturers, mixing of dissimilar brands is not recommended. Where there is a question on any oil, please contact the factory.

illing and Bleeding Instructions
CE 1/2 Bore thru 3 Bore

LLING AND BLEEDING

s best to pre-fill shock absorbers at a bench away m the work station whenever possible. Conditions in eas where shock absorbers are installed normally ike proper filling and bleeding extremely difficult.

. AA and SA models (Primary Series) and AHS and AHSS (Standard Series) models connected to an air-oil tank must have all air pressure to the tank shut *off* and the tank fill plug removed — SLOWLY — to permit any trapped air to escape.

. A and NA models (Primary Series) and SAHS and AAHS models (Standard Series) are pre-filled at the factory. If re-filling is required, this is easily accomplished by an air-oil tank or stand pipe as shown in fig. 1 and fig. 2.

. Fill the tank (or stand pipe) to the proper level with American Industrial Oil #46, or any ACE approved oil.

. Turn the adjusting ring to the highest setting and push the rod all the way in, then pull it all the way out. Repeat ten times. Make sure oil flows out of the tank (or stand pipe) into the shock absorber, being careful not to admit air. After the tenth cycle, push the rod all the way in, turn the adjusting ring to "O" and fill the tank or stand pipe with oil again.

. Remove the bleed screw and place a finger over the opening to meter the oil flow out.

. While the oil is flowing out the bleed port, pull the rod out slowly so as not to suck air or oil back into the bleed port. This can best be done by constantly rotating the piston rod clockwise, then counterclockwise, while pulling the rod out slowly. CAUTION...Be sure to keep the air-oil tank or stand pipe full of oil.

. With the dial still at "O", replace the bleed screw and impact the end of the piston rod with the palm of your hand. You should not feel more than 1/16 inch of movement. If a mushy action results there is still air in the shock absorber and steps 4, 5 and 6 should be repeated.

FIG. 1

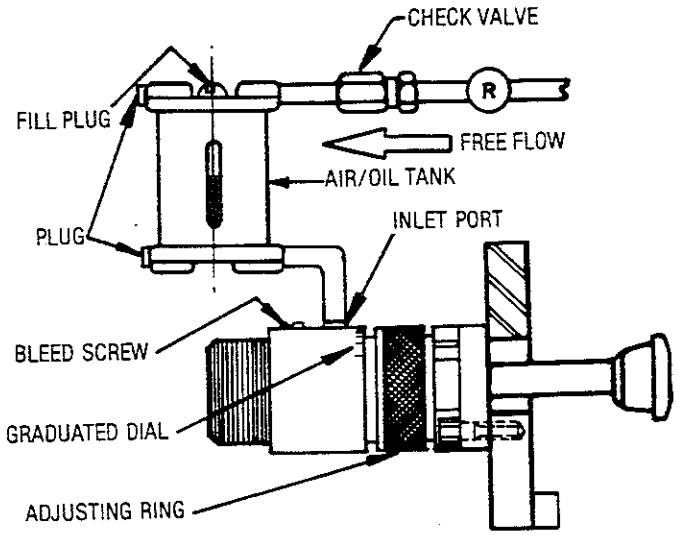
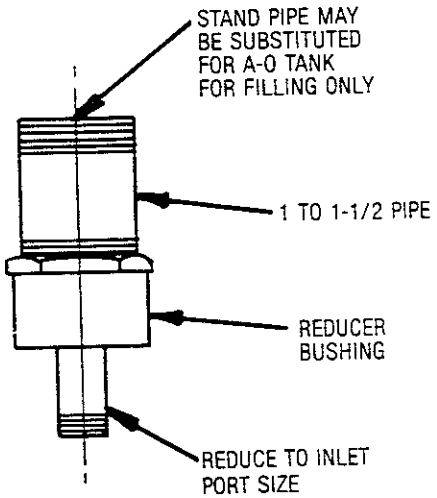
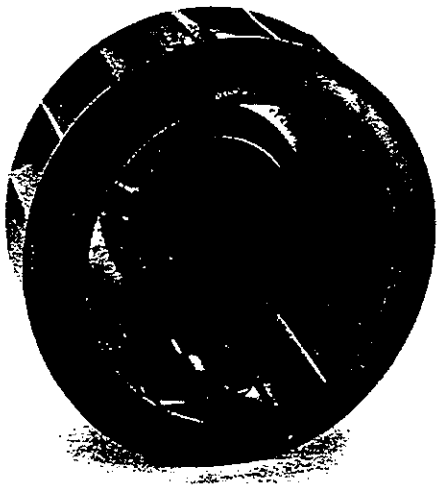
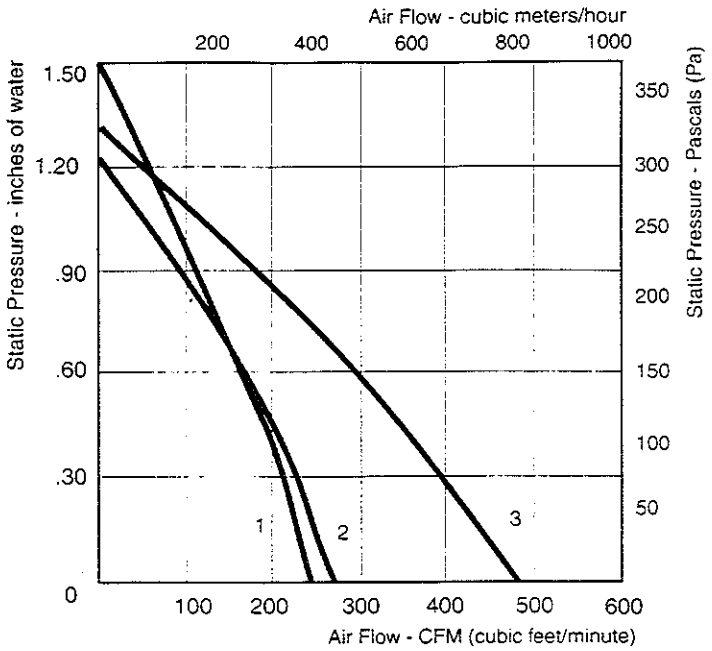


FIG. 2



180, 190 and 220Ø (7.1", 7.5" and 8.7" Ø)
Brushless DC Backward Curved Impellers





Curve Number	Part Number	Volts	Wheel Dia (in)	CFM @ 0"	dBA	Watts	Wgt. (lbs.)	Temp. Max. °C	Impeller Material
1	**R2G180-AB51-12**	24	7.1	247	60	65	1.9	60	Plastic
2	**R3G190-AE21-01**	24	7.5	277	66	81	3.6	65	Plastic
2	**R3G190-AE09-10**	48	7.5	260	58	67	5.6	60	Galv.Steel
3	**R3G220-AA17-12**	24	8.7	477	69	65	4.5	60	Plastic
3	**R3G220-AA23-12**	48	8.7	477	69	62	4.5	60	Plastic

Speed control by voltage typical range: +15% and – 30%.

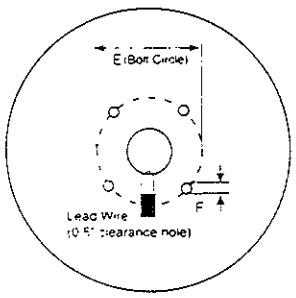
Impeller Dimensions [Inches (mm)]

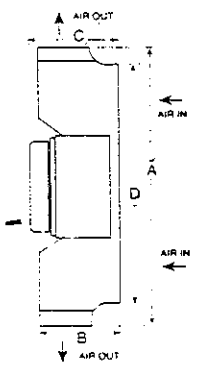
Type	A	B	C	D	E	F	Holes
R3G180-AT	7.1 (180)	3.1 (78)	3.3 (84.5)	5.2 (132)	2.3 (58)	M4	4 x 90°
R3G190-AE*	7.5 (190)	2.5 (62.5)	2.8 (72)	5.2 (131)	2.3 (58)	M4	4 x 90°
R3G220-AA**	8.7 (220)	2.5 (63)	3.228 (82)	6.3 (159)	2.3 (58)	M4	4 x 90°

* Motor extends beyond inlet .323" (8mm)

** Motor extends beyond inlet .248" (6.3mm)

MOUNT DETAIL

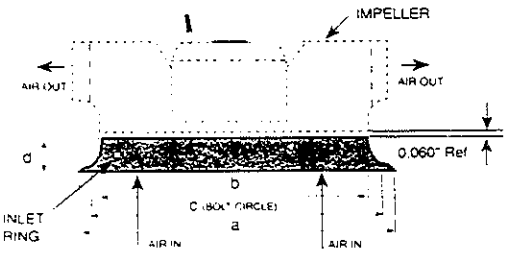




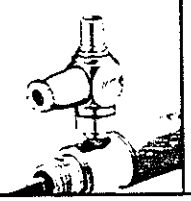
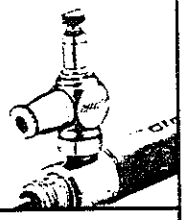
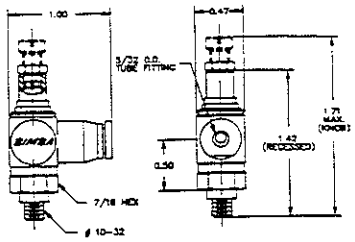
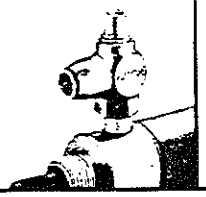
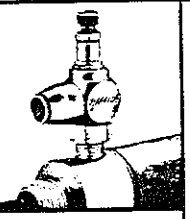
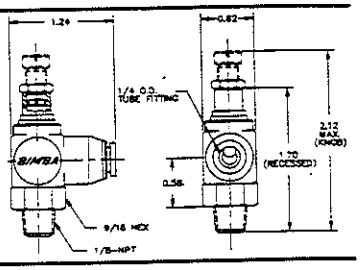
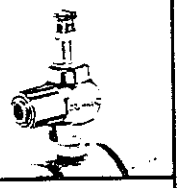
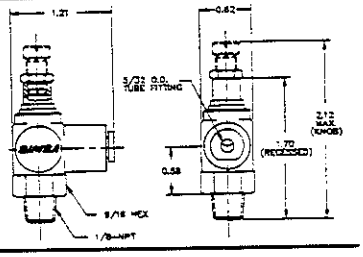
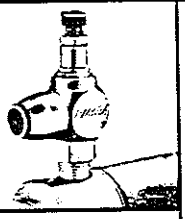
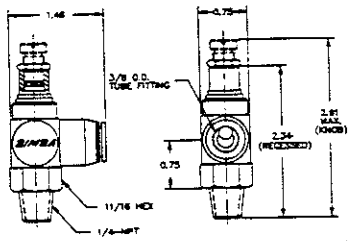
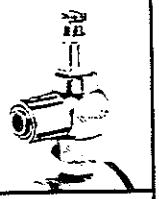
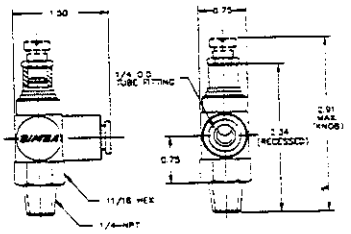
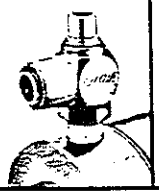
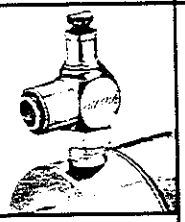
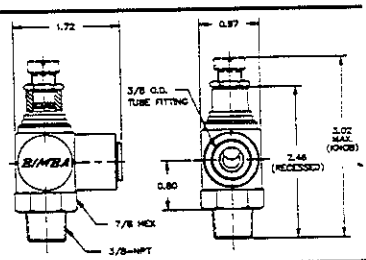
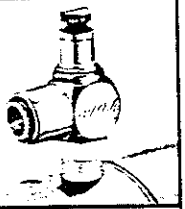
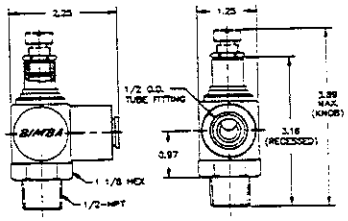
NOTE: Wiring connection: Red = +; Blue = –

Inlet Rings are recommended

Type	Inlet Ring #	a	b	c	d	Hole Dia.	Holes
R3G180-AT	9576-2-4013	6.7 (170)	4.9 (125.5)	6.2 (158)	.6 (14)	.2 (4.5)	4 x 90
R3G190-AE	9576-2-4013	6.7 (170)	4.9 (125.5)	6.2 (158)	.6 (14)	.2 (4.5)	4 x 90
R3G220-AA	9609-2-4013	9.9 (252)	6.1 (155)	9.7 (245)	.6-551 (14)	.2 (4.5)	4 x 90



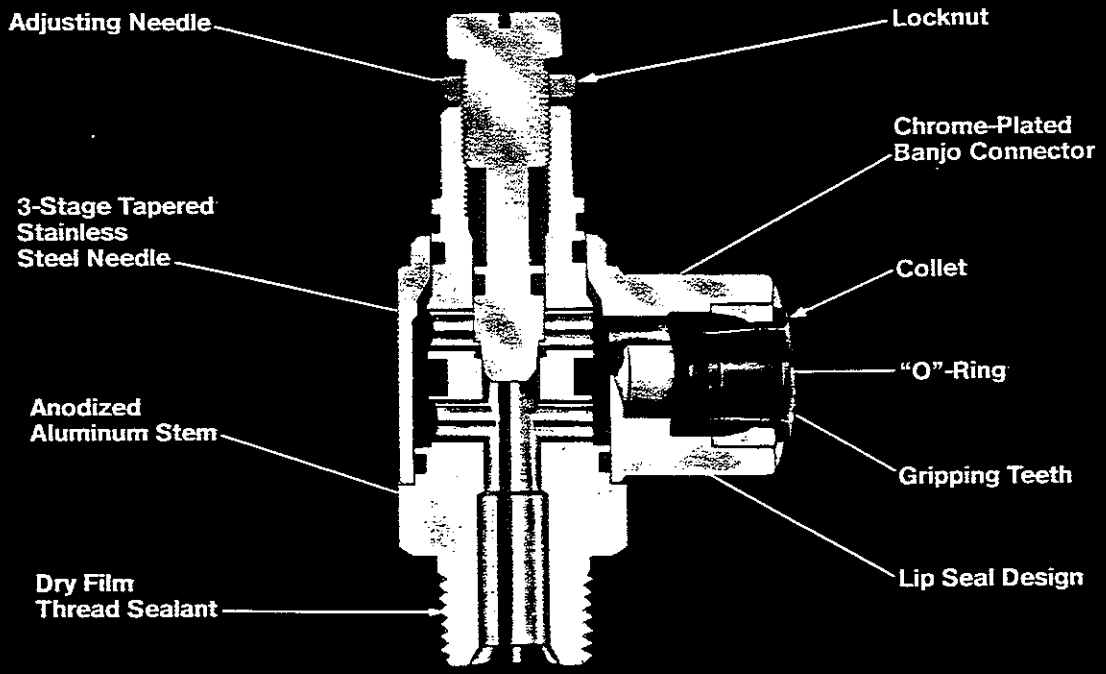
BIMBA QUIK-FLO™ FLOW CONTROL

MODEL AND PRICE		DIMENSIONS
FQP1 $9.50 	**FQP1K** $10.95 	For 5/16", 7/16", 9/16" bore sizes 
For 10-32 Port and 5/32" O.D. Tubing		
FQP2 $11.30 	**FQP2K** $12.95 	For 3/4", 7/8", 1 1/16", 1 1/4", 1 1/2" bore sizes 
For 1/8 Port and 1/4" O.D. Tubing		
FQP21 $11.30 	**FQP21K** $12.95 	For 3/4", 7/8", 1 1/16", 1 1/4", 1 1/2" bore sizes 
For 1/8 Port and 5/32" O.D. Tubing		
FQP4 $14.50 	**FQP4K** $16.60 	For 1 3/4", 2", 2 1/2" bore sizes 
For 1/4 Port and 3/8" O.D. Tubing		
FQP44 $14.50 	**FQP44K** $16.60 	For 1 3/4", 2", 2 1/2" bore sizes 
For 1/4 Port and 1/4" O.D. Tubing		
FQP6 $17.95 	**FQP6K** $20.40 	For 3" bore size 
For 3/8 Port and 3/8" O.D. Tubing		
FQP8 $23.45 	**FQP8K** $26.20 	
For 1/2" Port and 1/2" O.D. Tubing		

*List Price Mounted Each Cylinder Port
May be ordered as a separate item for the same price.

D330040-18

BIMBA QUIK-FLO® FLOW CONTROL



Bimba Quik-Flo® Flow Control provides improved, reliable control for pneumatic cylinders and rotary actuators, and streamlines the design and assembly of pneumatic components. Simply push the tubing in – stainless steel gripping teeth inside the plastic collet securely hold the tubing, and the "O"-ring provides a secure seal. To remove, just press in the collet and pull out the tubing.

- Banjo swivels 360° – simplifies plumbing, avoids line kinks, minimizes space.
- Adjusting needle – recessed to prevent tampering, or knob with locknut for secure adjustment.
- Unique 3-stage tapered needle – precise control, eliminates damage if needle bottoms out.
- Lip seal design – precise control with maximum free flow.
- Dry film thread sealant – labor-saving, no-leak seal.
- Integral fitting – reduces parts and labor, streamlines appearance.
- Collet design – easy to connect and disassemble, no tools needed.
- "O"-ring design – 100% free flow through the tubing, secure seal.

TECHNICAL SPECIFICATIONS

Maximum Operating Pressure: 150 PSI Air Only
Operating Temperature Range: 14°F to 167°F (−25°C to +75°C)
Sizes: 10/32, 1/8, 1/4, 3/8 and 1/2 Ports
Materials:
- Banjo Connector: Chrome-plated Zinc Die Cast
- Banjo Retaining Ring: Zinc-plated Steel
- Stem: High-strength Anodized Aluminum Alloy
- Adjusting Needle: Stainless Steel
- "O"-Rings and Lip Seal: Buna N
- Collet: Acetal Copolymer
- Gripping Teeth: Stainless Steel
- Collet Retainer for FQP21, FQP44, FQP6 and FQP8 series: Brass
- Locknut: Chrome-plated Brass

Tube Types: All plastic tubing, including nylon and polyethylene

REPORT ID: ENI900 PRODUCT INQUIRY RUNTIME 05/04/98 AT 11:15:42

PROD SPEC # REV STAT TDR # P/R ESPEC: 25WGW004 RATING: 001
25E158W004 - PRD/L 0135666 N MSPEC: 25E158 LY: 25LYE158
DESC: MTR. K16AB 208-230/460VAC CREATED: 11/17/1997
CAT #: PROD CODE: AC MOTOR PLT: CK EFF: 11/21/1997
TYPE: 2516M ENCLOSURE: TENV POLES: 04 CLASS CODE: CUSTOM
FRAME: 42C MOUNTING: F1 EXT CD: CD0005 ROTATION: R
INERTIA: BASE: RG INT CD:
LEADS: 9#18 INSUL CLASS: F
CUSTOMER CATALOG #: CUSTOMER PART #:
PROPRIETARY: N NON-PROPRIETARY, BUT DESIGNED FOR (SEE CUST #)
REPLACED BY:

NAMEPLATE: NP0868

001	CAT.NO.					
002	SPEC.	25E158W004				
003	RATING	40C AMB-CONT				
004	FRAME	42C		SER.	DATE CODE	
005	HP	1/8 TE				
006	VOLTS	208-230/460				
007	AMPS	.95-.86/.43				
008	RPM	1725				
009	HZ	60		PH	3	* CLASS F
010	RATIO					
011	R.P.M.			TORQ/IN LB		

CUST #	NAME	CUST #	NAME	CUST #	NAME
030052	SUPERIOR ELEC MTR				

NO-LOAD TESTS / LOCKED ROTOR TESTS

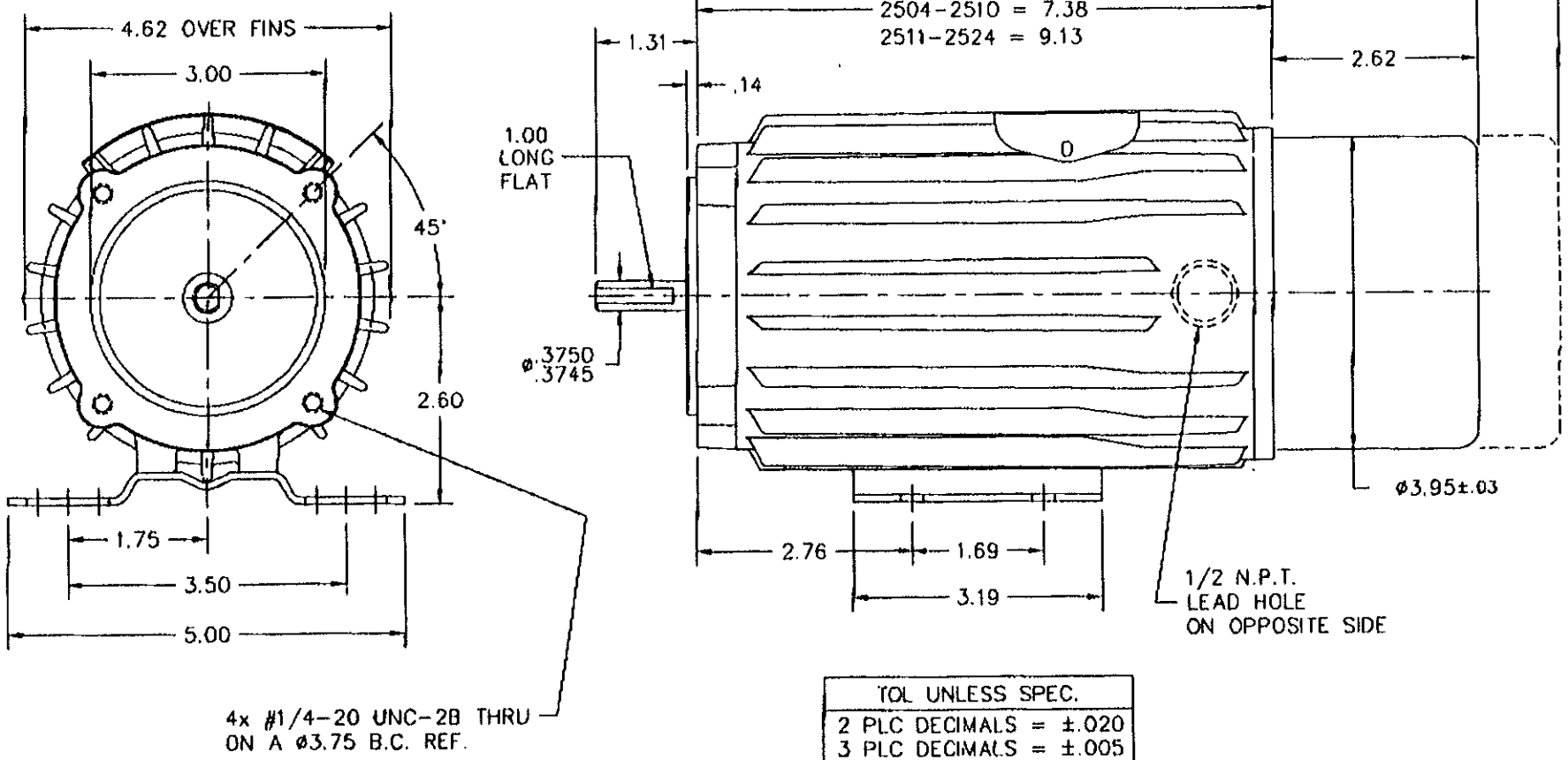
TEST	VLTS	HZ	AMPS	WATTS	TEST	VLTS	HZ	AMPS	TORQUE
NLHV	460	60	.360-.440	44-54					

******** END OF PRINT ********

AC MOTOR WITH MODIFICATIONS
FOR MIRROR COVER

BALDOR # MVM3458B
WITH BRAKE
LOCKED ROTOR TORQUE OF 2.2 FT*LB

E330041-5



TOL UNLESS SPEC.
2 PLC DECIMALS = ±.020
3 PLC DECIMALS = ±.005
ANG=±.5° RADII=±.015

CUST. NAME:			CERTIFIED BY		TORQUE		INSUL	AMB
H.P.	DUTY	TYPE	R.P.M.	VOLTS	ENCL	PHASE	FREQ	FRAME
REMARKS:								
REV:	-	NEW						

SCALE: -	BY: JD	REVISED: 11/18/97
FILE: CKA00007730		TDR: 0135666

25E158

BALDOR ELECTRIC Co.

LAYOUT DRAWING, 25 C-FACE WITH BRAKE

25E158

SOM

E330041-1

L & F INDUSTRIES

INSTALLATION DRAWING
BILL OF MATERIALS
& MAINTENANCE INSTRUCTIONS

GEARBOX TYPE:

PG0164PS 1722 H71

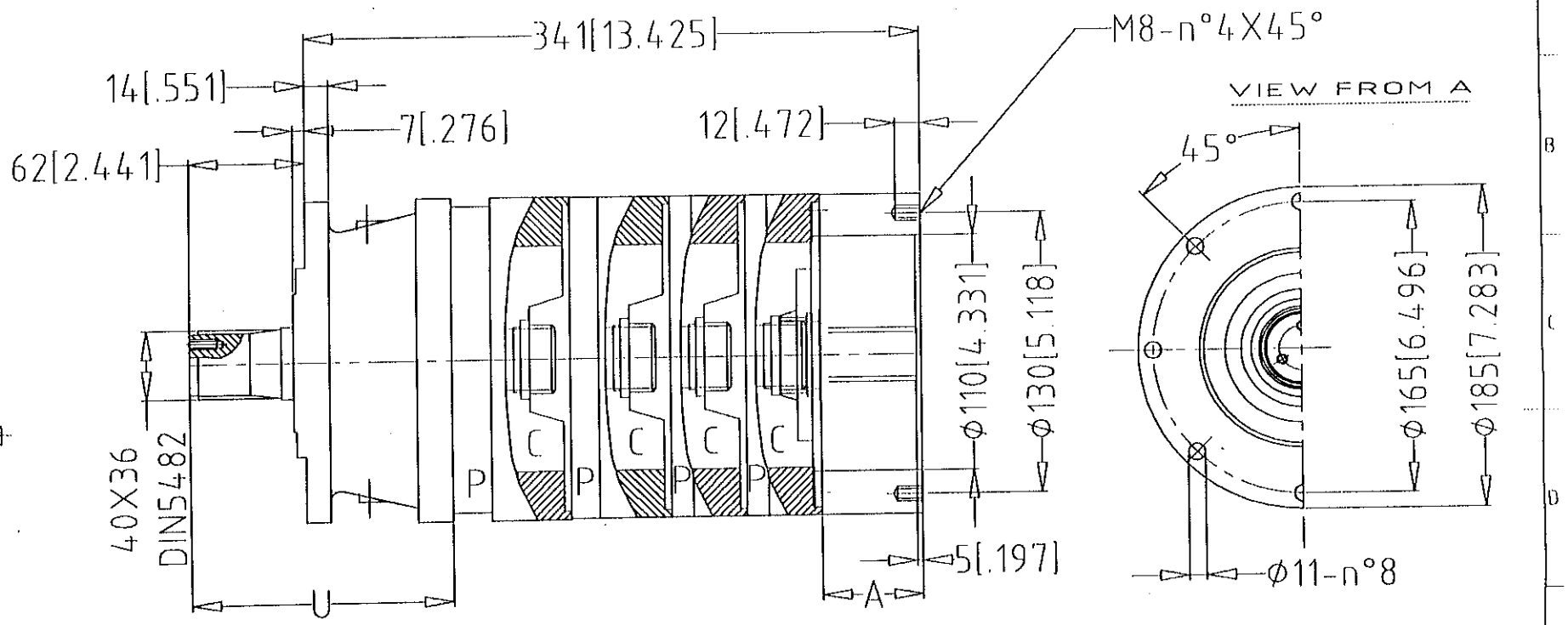
PO #: 14253-83281

NORTH AMERICAN HYDRAULICS, INC.

BATON ROUGE, LA	HOUSTON, TX	SACRAMENTO, CA	KERRVILLE, TX
PHONE: (504) 751-0500	(713) 460-2139	(707) 446-8500	(830) 792-3726
FAX: (504) 751-0610	(713) 460-0502	(707) 446-7717	(830) 792-3726

SPECIALIZING IN LOW SPEED, HIGH TORQUE DRIVES

RevNo	Revision note	Date	Signature	Checked



A	1	INPUT ASSEMBLY: H71	4702 011 006
P	2	PLANETARY ASSEMBLY:EP100/6.75	4708.023 100
P	1	PLANETARY ASSEMBLY: EP160/6.75	4710.522 100
C	4	CONNECTION FLANGE: CF100/160	4708.500 300
P	1	PLANETARY ASSEMBLY: EP160/5.6	4710.523 100
U	1	OUTPUT ASSEMBLY: US160PS	4708.504.000
Itemref	Quantity	Title/Name, designation, material, dimension etc	Part No./Reference

Designed by	Checked by	Approved by - date	Filename	Date	Scale
DENNIS BUQUET			0164PS117.DWG	98.05.19	NONE

SOM
PLANETARY GEARBOXES

NORTH AMERICAN HYDRAULICS, INC.
BATON ROUGE,LA-USA PHONE: 504/751-0500

PG0164PS 1722 H71

L & F INDUSTRIES

Edition	Sheet
	1/1

SOM

NORTH AMERICAN HYDRAULICS, INC.

Technical Data Sheet

Gearbox Type: PG0164PS 1722 H71

Actual Ratio = 1722.2625:1

Pursuant to L&F purchase order number: 14253-83281

This NAHI Technical Data Sheet is intended only as a reference tool. NAHI reserves all right to alter products and specifications without notice.

HORSEPOWER RATING: These reference power values are assuming 68°F, 1500 rpms, continuous duty, and horizontal mounting. Where actual horsepower exceeds the thermal rating, external cooling is required. For specific details and restrictions, consult the Product Design Guide.

- **Mechanical:** 1.7 Hp
- **Thermal:** 2 Hp

OUTPUT TORQUE: The *continuous torque* value reflects the maximum value of stress on the gears according to the international standards **ISO 6336**. The *peak torque* value reflects that amount that can be transmitted in a short duration without causing permanent structural damage to the internal components.

- **Continuous Torque:** 892 lb-ft
- **Peak Torque:** 1785 lb-ft

MAXIMUM SPEED: This is the maximum intermittent speed allowed. For continuous duty or greater speeds, consult your **NAHI** representative.

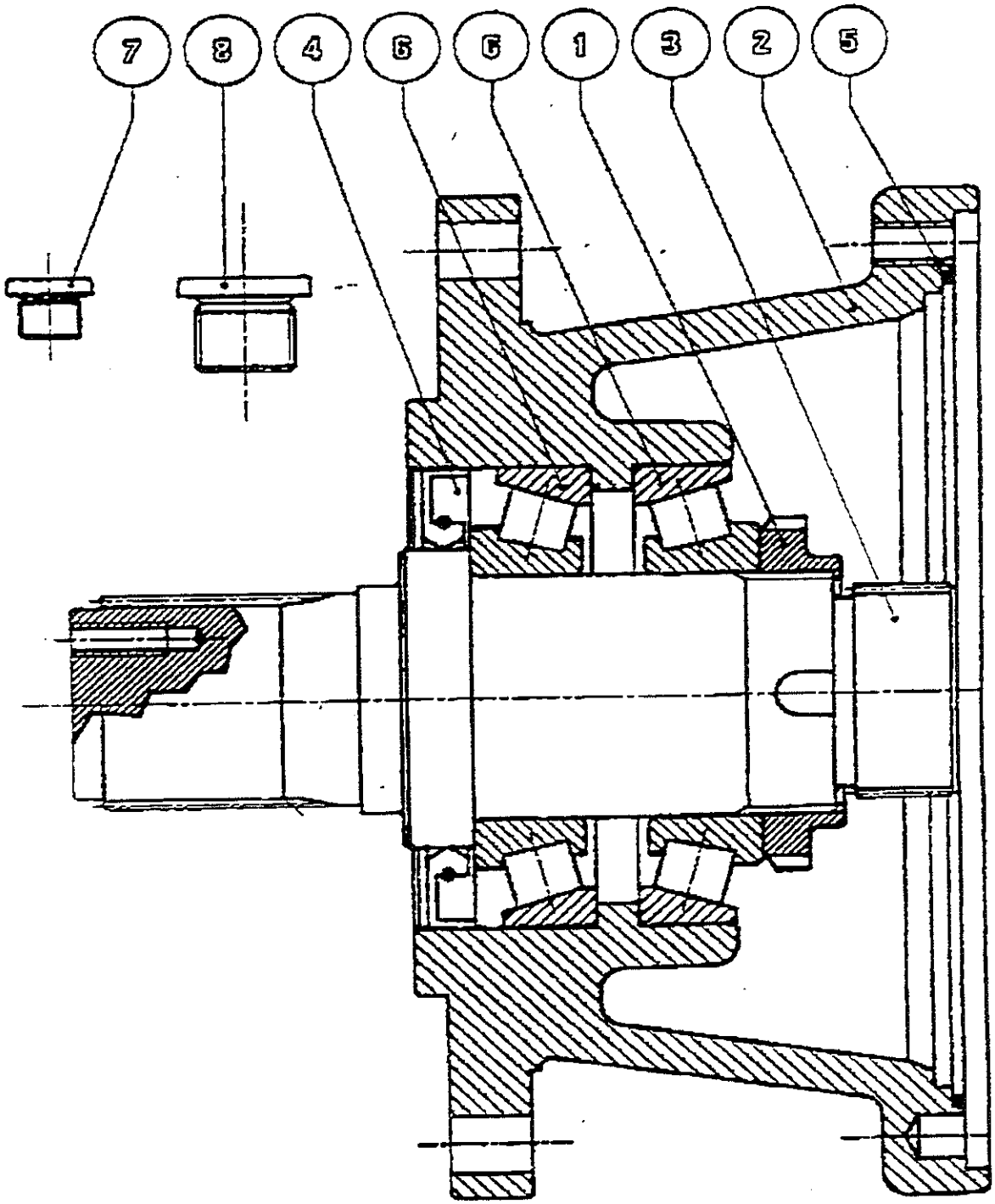
- **Input speed:** 2800 rpms
- **Output speed:** 1.6 rpms

PRESSURE VENTING: A vent plug with a built-in check valve is provided to protect shaft seals from over-pressure. This vent must be situated as to remain at the highest point of the gearbox at all times, to prevent oil spillage.

- **Check valve setting:** 3 psi

SOM
Reggio Emilia — Italy

DESCRIZIONE	CODICE
USCITA MOTO PS PG100	4708.504.000
DISEGN COMPLESSIVO	DATA: 7-9-92 / RIFERIMENTO: U 6



SOM s.r.l. VIA PRATI VECCHI 7 42025 CAVRIAGO(RE) TEL.0522/942794 FAX.0522/942586

SOM S.p.A.

ITEM : PS OUTPUT STEP 100

CODE : 4708.504.000

POS.	PART NO.	QTY	DESCRIPTION
1	1281.010.041	1	ring nut M45x1.5
2	1708.015.002	1	output housing
3	1708.232.042	1	output shaft
4	9020.412.000	1	oil seal 55x85x8
5	9030.235.101	1	O-ring 3600
6	9110.355.001	2	taper roller bearing 30209
7	9510.018.061	1	plug 1/8"G DIN908
8	9510.107.000	2	plug 3/8"G DIN908 NA41/A

uscite/708504

SOM
Reggio Emilia — Italy

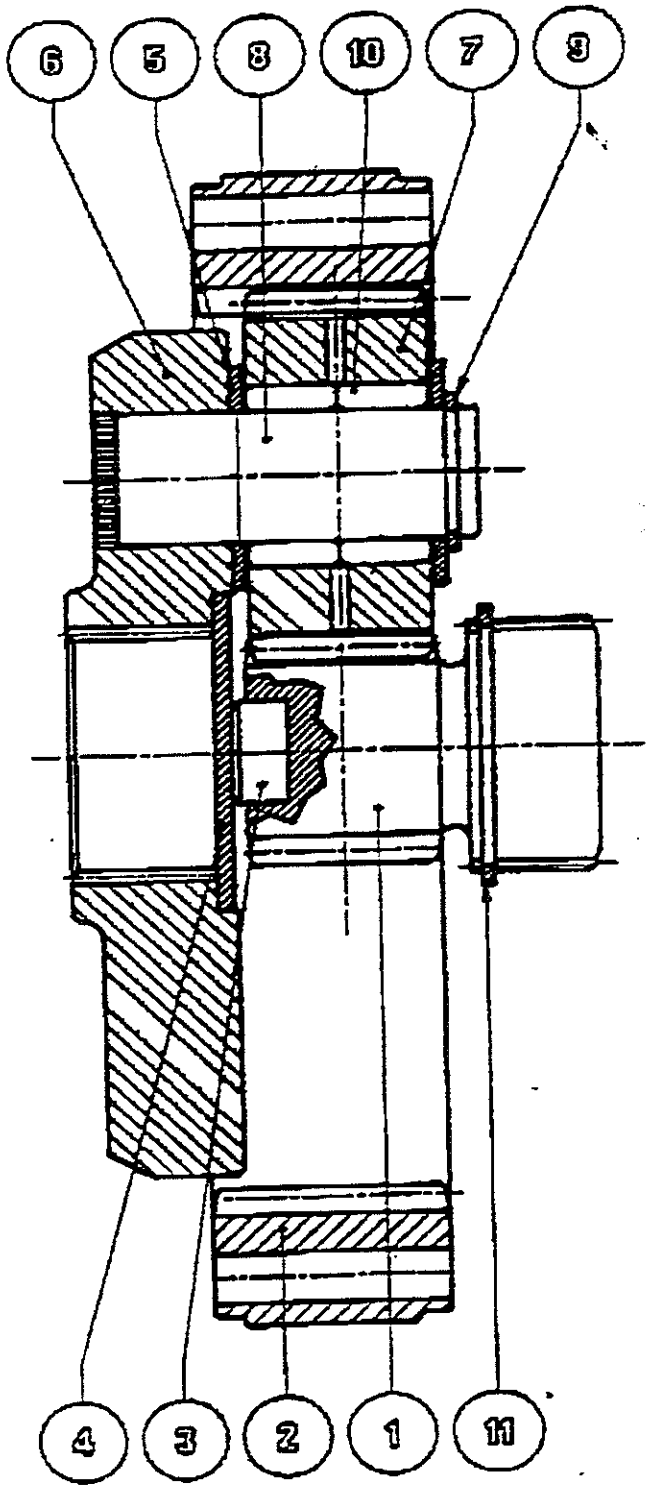
DESCRIZIONE: EPICICLO M R5.6 DS20 PG160

CODICE: 4710.522.100

DATA: 7-9-92

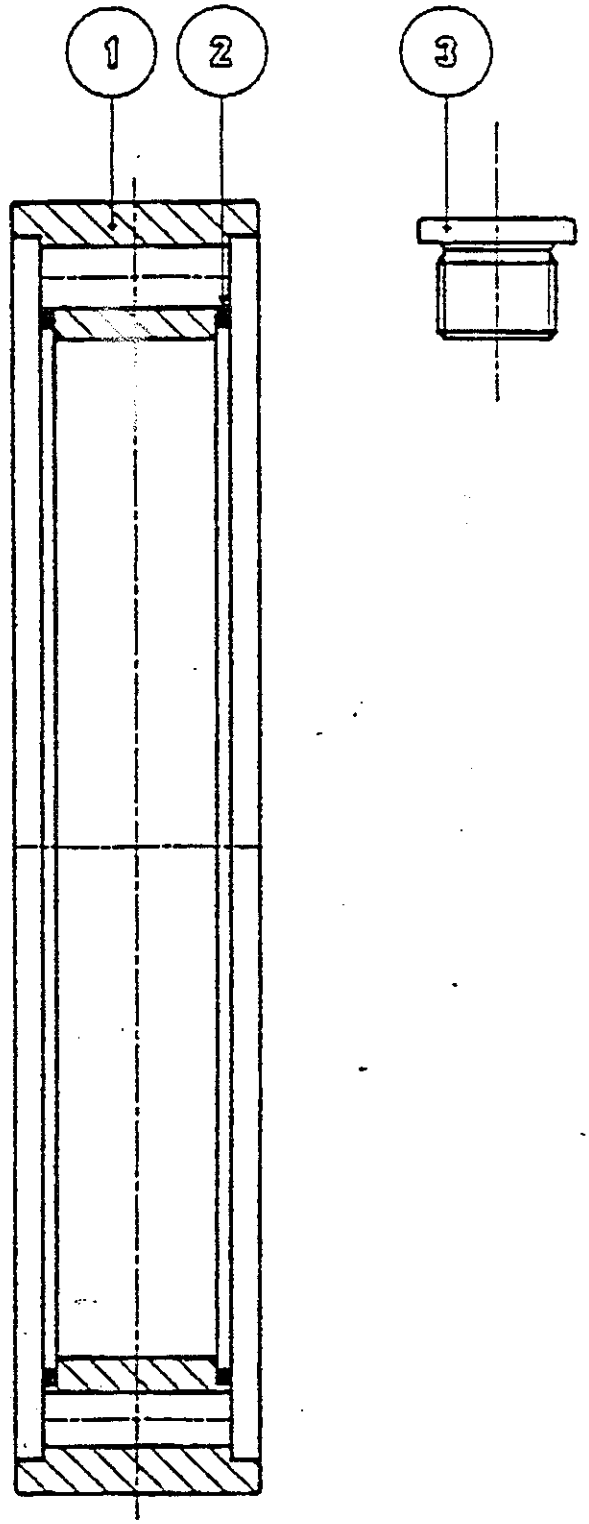
RIFERIMENTO: P_{10}

DISEGNO COMPLESSIVO



SOM s.p.a. LA PRAT VECCHI 37 42025 CAVRIAGO(RE) TEL.0522/942784 FAX.0522/942566

SOM Reggio Emilia — Italy	DESCRIZIONE CONNESSIONE 100/100	CODICE 4708.500.300	
	DISEGNO COMPLESSIVO	DATA 16-3-92	RIFERIMEN C_8



SOM s.p.a. 42100 REGGIO EMILIA(ITALY)—VIA BARILLI5—TEL.0522/921406—49746 FAX 0522/517781

DESCRIZIONE:

CONNESSIONE 100/100 CODICE: 4708.500.300

POSIZ.	CODICE	Q.TA'	DESCRIZIONE
1	1708.011.001	1	SCATOLA CONNESSIONE STADI
2	9030.235.101	2	ANELLO OR 3600
3	9510.107.000	2	TAPPO 3/8G DIN 908

SOM

Reggio Emilia — Italy

DESCRIZIONE

EPICICLO M R6.75 DS20 PG160

CODICE

4710.523.100

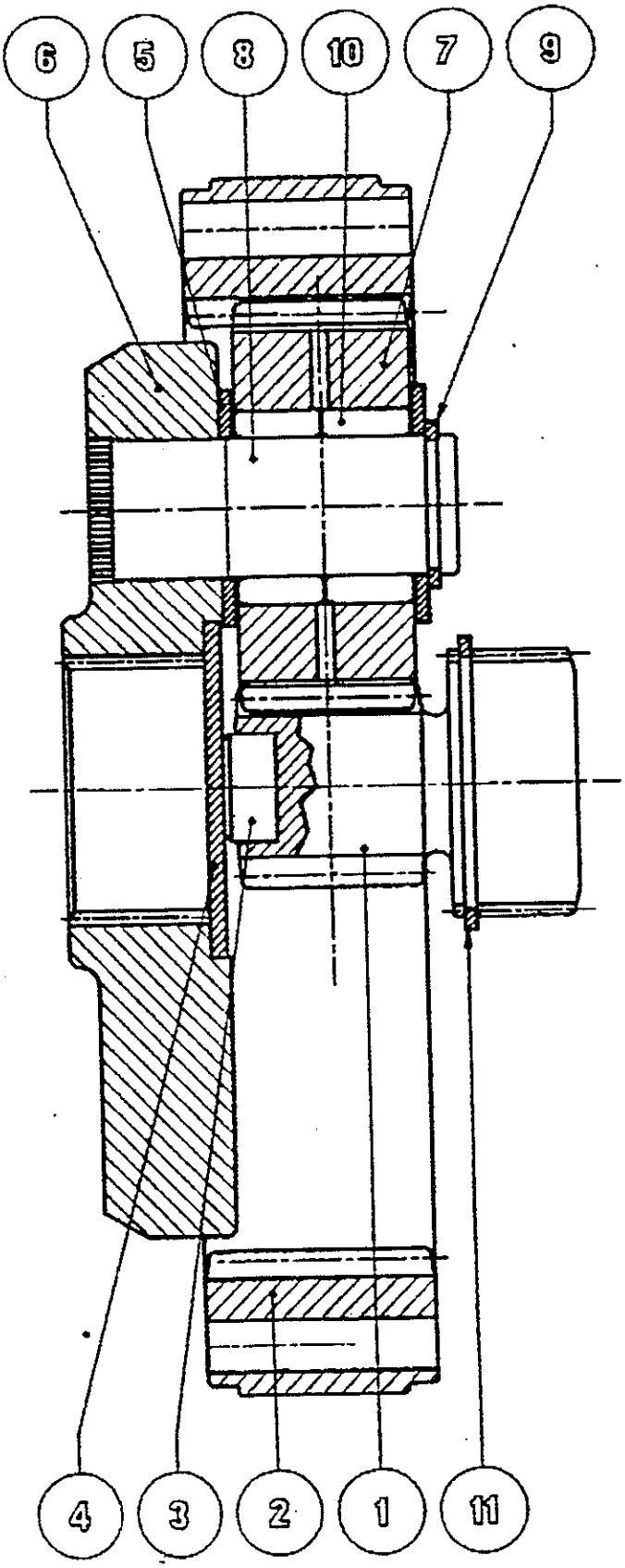
DISEGNO COMPLESSIVO

DATA

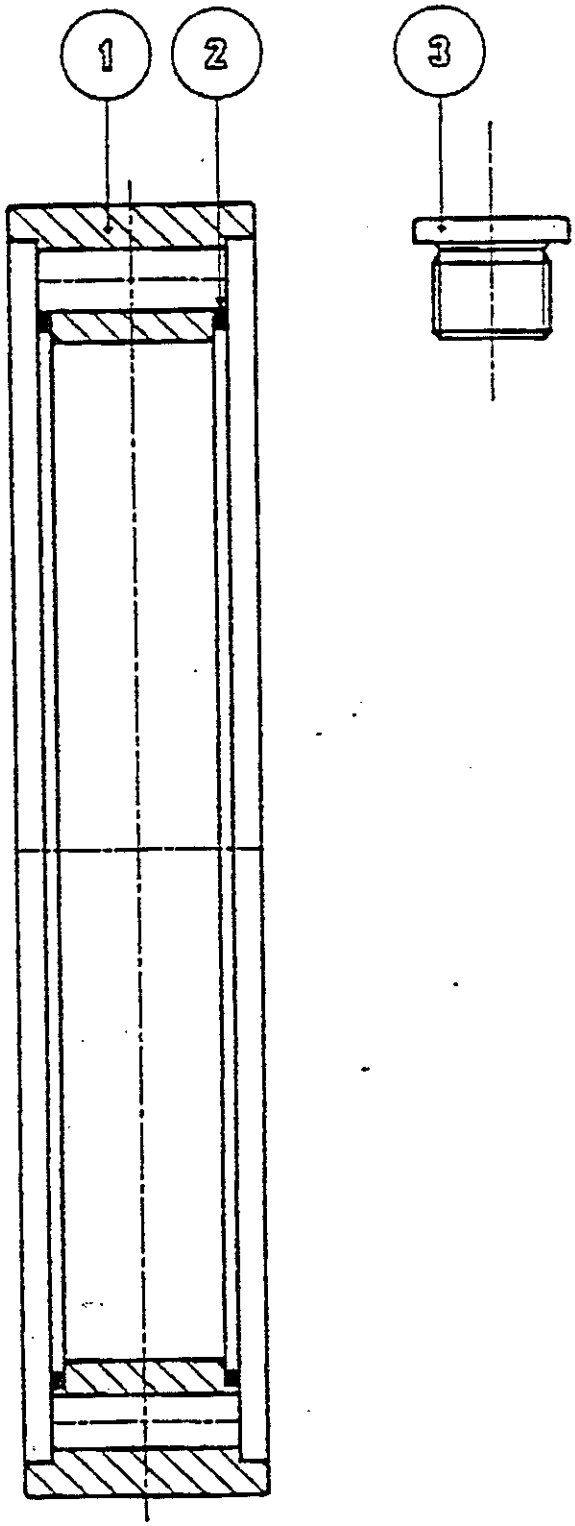
21-6-93

RIFERIMENTO

P



SOM Reggio Emilia — Italy	DESCRIZIONE	CODICE
	CONNESSIONE 100/100	4708.500.300
	DISEGNO COMPLESSIVO	DATA: 16-3-92 — RIFERIMENTO: C_8



SOM s.p.a. 42100 REGGIO EMILIA(ITALY)—VIA BARILLI—TEL.0522/921406—49748 TAX 0522/511781

DESCRIZIONE:

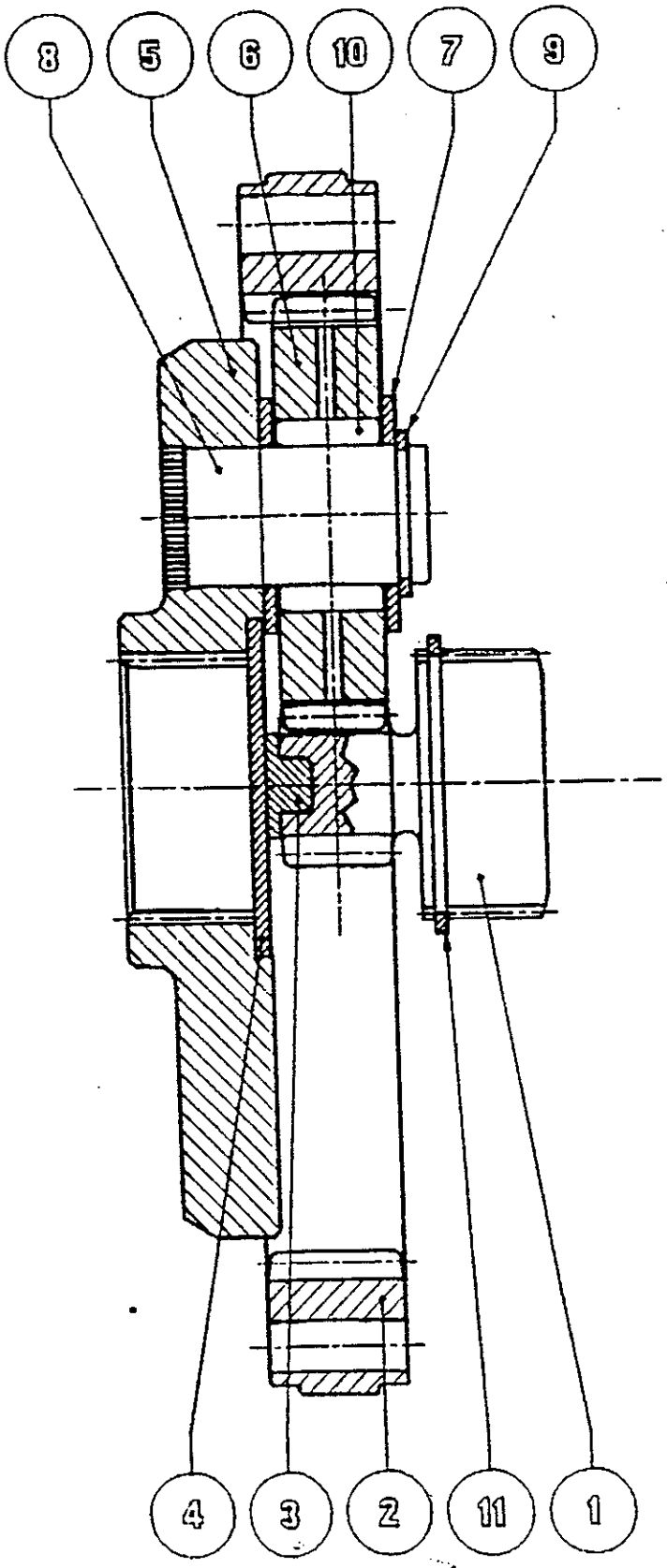
CONNESSIONE 100/100 CODICE: 4708.500.300

POSIZ.	CODICE	Q.TA'	DESCRIZIONE
1	1708.011.001	1	SCATOLA CONNESSIONE STAOI
2	9030.235.101	2	ANELLO OR 3600
3	9510.107.000	2	TAPPO 3/8G DIN 908

SOM

Reggio Emilia — Italy

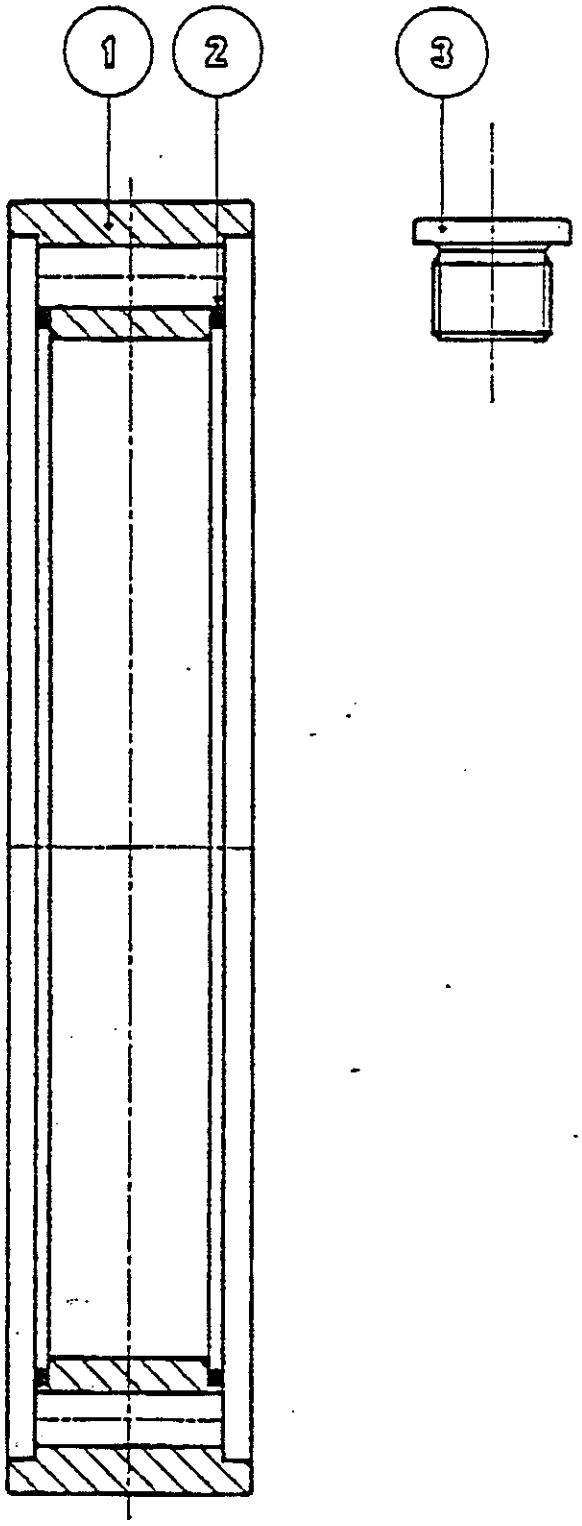
EPICICLO M R6.75 DS20 PG100	4708.023.100	
DISEGNO COMPLESSIVO	DATA 6-9-93	RIFERIMENTO P_8



SOM

Reggio Emilia — Italy

DESCRIZIONE	CODICE	
CONNESSIONE 100-100	4708.500.300	
DISEGNO COMPLESSIVO	DATA 16-3-92	RIFERIMENTO C_8



SOM s.p.a. 42100 REGGIO EMILIA(ITALY)—VIA BARILLI5—TEL.0522/921466—49746 FAX 0522/517781

DESCRIZIONE:

CONNESSIONE 100/100 CODICE: 4708.500.300

POSIZ.	CODICE	Q.TA'	DESCRIZIONE
1	1708.011.001	1	SCATOLA CONNESSIONE STADI
2	9030.235.101	2	ANELLO OR 3600
3	9510.107.000	2	TAPPO 3/8G DIN 908

SOM

Reggio Emilia — Italy

EPICICLO M R6.75 DS20 PG100	4708.023.100
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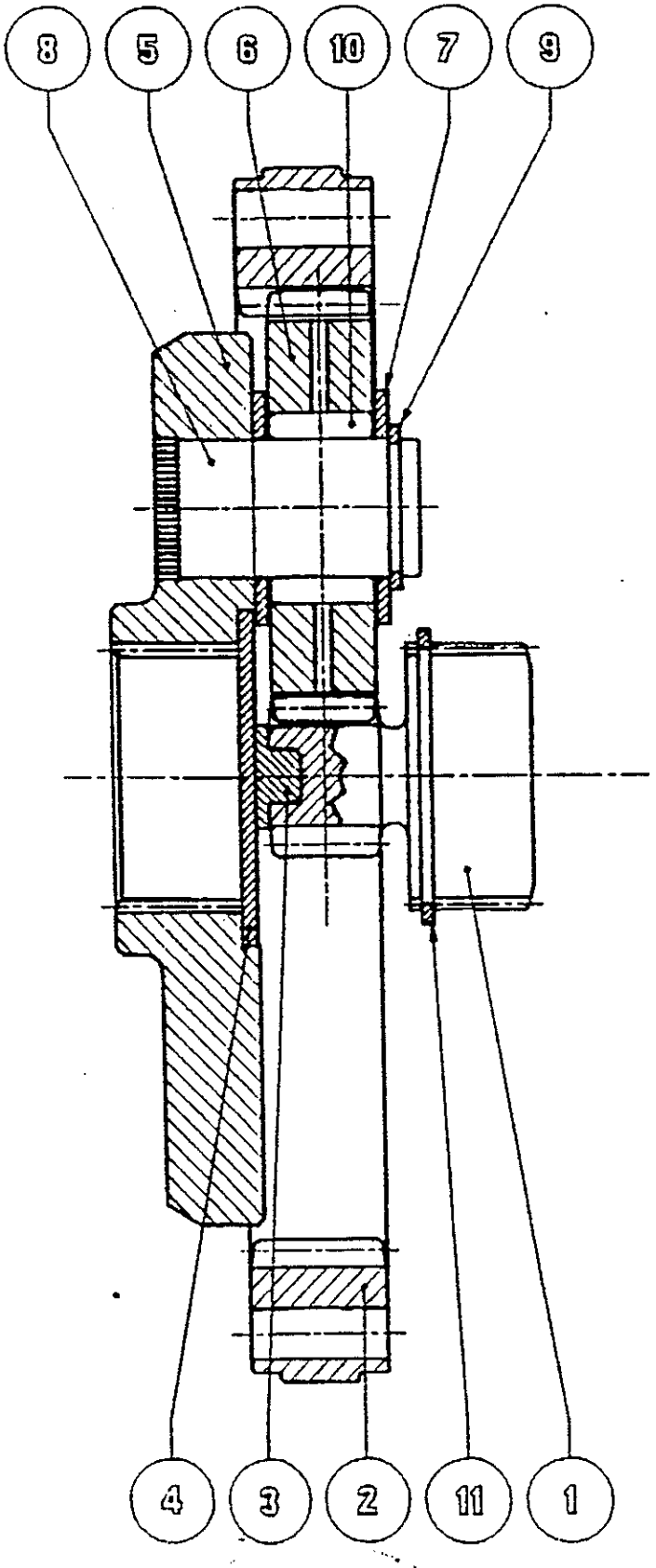
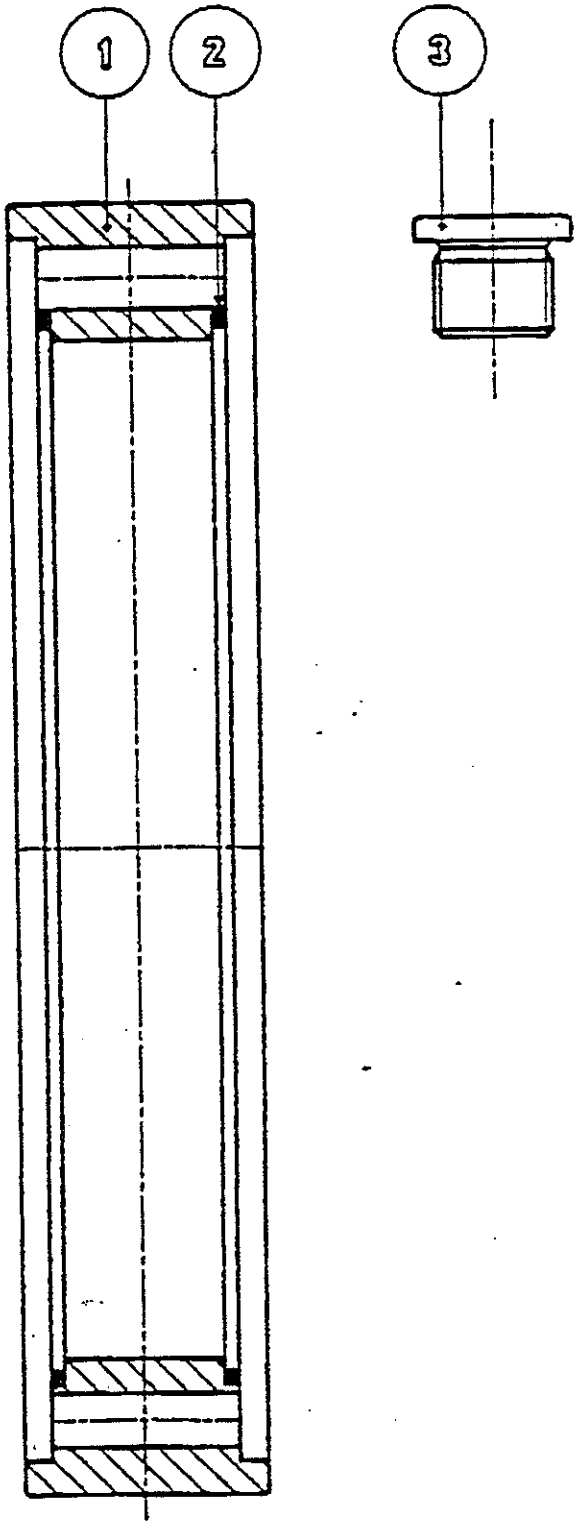


SOM Reggio Emilia — Italy	DESCRIZIONE	CODICE	
	CONNESSIONE 100-100	4708.500.300	
	DISEGNO COMPLESSIVO	DATA 16-3-92	RIFERIMENTO G_8



SOM s.p.a. 42100 REGGIO EMILIA(ITALY)—VIA BARILLI5—TEL.0522/921466—49746 FAX 0522/517781

DESCRIZIONE:

CONNESSIONE 100/100 CODICE: 4708.500.300

POSIZ.	CODICE	Q.TA'	DESCRIZIONE
1	1708.011.001	1	SCATOLA CONNESSIONE STADI
2	9030.235.101	2	ANELLO OR 3600
3	9510.107.000	2	TAPPO 3/8G DIN 908

SOM

Reggio Emilia — Italy

DESCRIZIONE	CODICE	
ACC ENT H71	4702.011.006	
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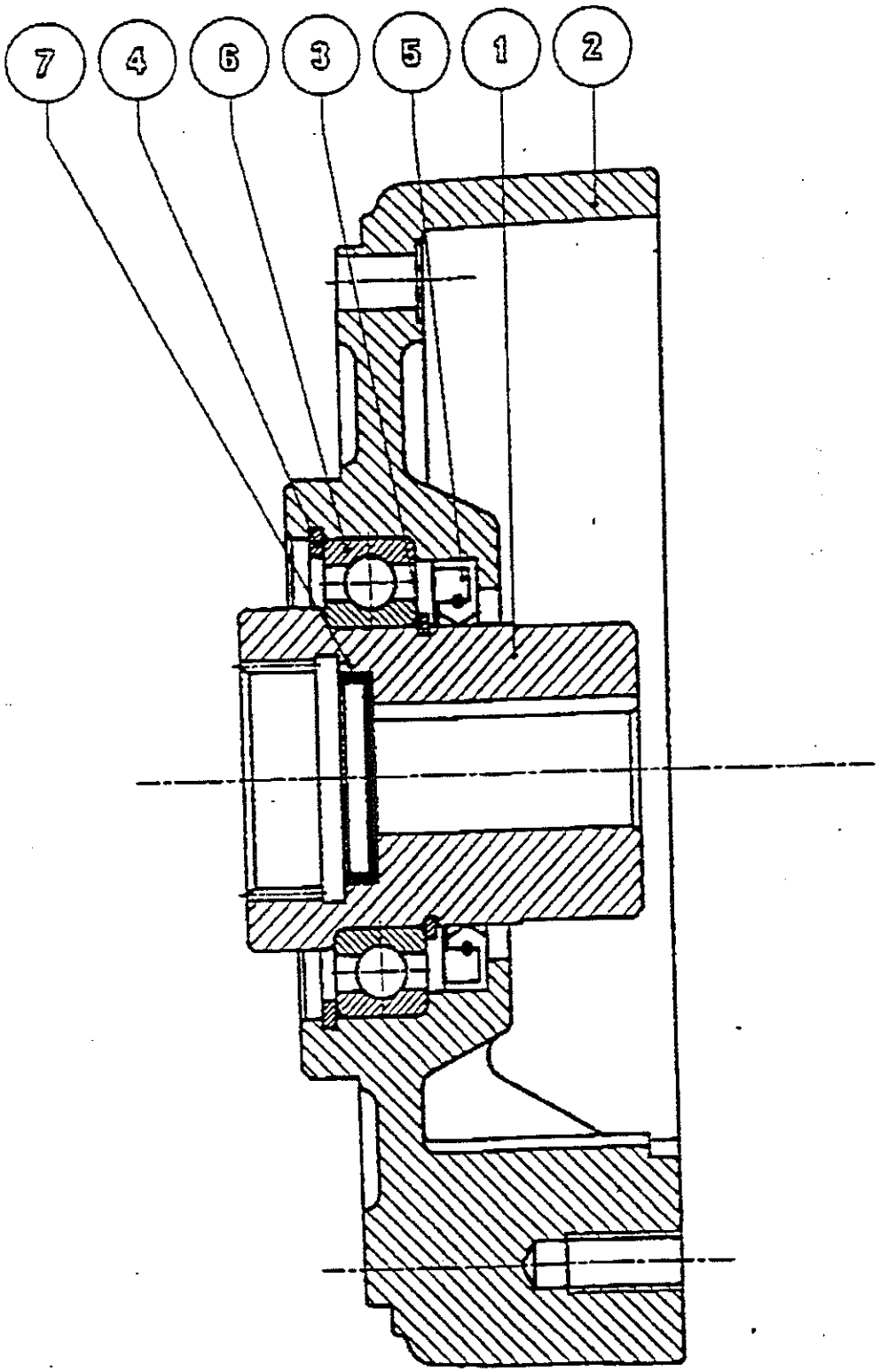


SOM s.r.l. 42100 REGGIO EMILIA(ITALY)—VIA BARILLI,5—TEL.0522/921466—48746 FAX 0522/517781

INSTALLATION - MAINTENANCE - LUBRICATION

GENERAL MOUNTING AND MAINTENANCE INSTRUCTIONS

*In order to ensure proper running and long life, the planetary unit must be mounted correctly. Always ensure that all mounting faces are flat and that the axis of the holes for spigot, which must have a tolerance **H8**, are perpendicular to the mounting face.*
*To fasten the unit use bolt and nuts of class **8.8** specification and tighten them at **70%** of their yield point making sure that all the fixing holes on the flanges are used.*

We recommed to protect the gear units mounted in open air from bad weather by treating them with anticorrosive agents and to protect the oil seals with water-repellent grease.

In operations in which there could be malfunctions due to accidental overloading a mechanical or hydraulic safety device must be used in order to safeguard the transmission.

The assembly of the gear unit to the motors, electric ot hydraulic, is usually done by means of direct flanges when no particularly critical conditions exist which could cause damage after installation.
*In connection with this, where the installation of heavy motors (over **Kg 100**) is required, please get in touch with our Technical-Commercial Service Department, to evaluate the proper mounting position. In alternative, we suggest to separately mount the two units and to connect them by means of a coupling or pulley.*

UNITS WITH FLANGE CLAMPING OR WITHOUT FLANGE MOUNTING

PLANETARY UNITS WITH MALE OUTPUT SHAFT (M-P)

*For these units, when the loads are **50%** greater than the ones indicated in the single product technical card, we suggest the use of both spigots on the side flange. In all other cases, especially when toothed pinions are mounted, both spigots on splined output shafts must be used.*
*In applications where heavy external load conditions simultaneously acting on the output and input exist, please contact our **Technical-Commercial Service Department**.*

PLANETARY UNITS WITH FEMALE OUTPUT SHAFT (F)

These planetary units cannot accept external loads in any direction. Therefore always ensure that the shaft is concentric and in-line with the axis of the driven shaft.

FOOT MOUNTED PLANETARY UNITS (CPC)

The fastening conditions with respect to the concentricy and alignment as discussed in the beginning of this section, apply also to these units.
Ensure that the unit is properly aligned with the machine to be operated. Should you have any doubts about the outcome of this operation, connect a flexible coupling between the planetary unit and the machine.
Ensure that the mounted gear unit is not subject to vibrations.

REDUCTION GEARS FOR SHAFT MOUNTING (FS)

Before installing these planetary units, you must prepare the torque arm by respecting the minimum lengths as shown on the drawing for each single unit. Furthermore, we recommend to cushion the reaction constraint using rubber elements and/or shock absorbers.
For a correct application in case of particular mounting conditions due to the use of very heavy motors or to heavy radial load on the input, please contact our Technical-Commercial Service Department. These particular load conditions, together with the rotation reaction torque, could cosiderably reduce the lifetime of the bearings, and compromise the tightening of the shrink disc or affecting the shaft resistance.
Before tightening the shrink disc, properly degrease the internal surface of the planetary unit shaft and its coupling male shaft. Then proceed to tighten the screws in a gradual and uniform manner without discontinuance.
To remove the unit, gradually, unscrew the screws in the same order that you fasten them; i.e., without discontinuance. We advise to give each screw one third turn during the first loosening sequence in order to avoid possible misalignments.
Then proceed to completely unfasten the unit, always in a gradual manner without completely removing the screw from the threads.
*We suggest to use tolerance H6 for the male shafts to be connected to the **SOM** units.*

*Generally, **SOM** planetary units are supplied without lubricant*

LUBRICATION

A correct lubrication is required for the proper running of the planetary units.
We thus recommend the following to conditions to be met during the installation:

- Make sure that all plugs are correctly mounted with respect to the installation position specified in the order and according to the instructions in Chapter 8. MOUNTING POSITIONS.

- **Horizontally mounted** units must be filled up to the central line regardless of a linear or angular configuration. To visually check the oil level, unscrew the plug located just above the center line.

- In case of **right angle**, the bevel gear is connected in such a way that the oil is circulating freely; we suggest to carry out the filling operation on both ends but not simultaneously and while the unit is on the ground, in accordance with the correct mounting position. This procedure would speed up the operation and would ensure that the correct quantity of oil is introduced regardless of how long it would take for the oil to go from one chamber to the other.

- Particular attention should be paid to **vertically mounted** units which must be completely filled by means of elbows and extensions supplied with the unit. For these positions we recommend the use of an expansion tank which is supplied upon request. This tank must be positioned above the highest point of the planetary unit and is designed to collect possible oil expansions or to ensure that the units mounted in difficult-to-reach places get filled up.

- Brakes and assembled motor connections form a separate chamber from the planetary unit thus you need to fill them up separately, see Chapter 6.3 BRAKES.

- Units running on continuous duty are subject to overheating due to the high quantity of oil. If this is the case, we recommend using an oil with a lower viscosity.

Please note that the oil quantities shown in the catalogue are approximate and are subject to changes caused by the planetary unit configuration: ratios, brake, motor connections and output adapters.
During normal running, the temperature of the outer casing should not exceed **80°C**.
Should the temperature exceed 80°C then contact the **SOM** Technical-Commercial Service Department.

OIL CHANGES

- The first oil change should be done after **100 working hours.**

- Subsequent oil changes should take place after **2000 hours** or at least once a year.

- In order to avoid sludge deposits, change the oil whilst the gear unit is still warm.

- Clean all plugs.

- For an effective oil change, the unit should be flushed through with a liquid detergent recommended by the lubricant supplier.

- Check periodically for oil leaks and the oil level while the unit is idling. If needed, top up the unit with the same type of oil.
  Attention: if the quantity of oil used during topping up is greater than **10** percent of the oil capacity then check again for leaks.

LUBRICANT

SOM recommends using **EP** additive oil with anti-foaming properties. In case the planetary unit is subject to severe temperature changes, we advice the use of **EP** additive synthetic oil (such as **"Shell" Tivela Oil WB** or **Mobile SHC 630**) with a minimum viscosity index of 165 and a viscosity of **(VG 150-220) ISO 3448**.
In this regard, Table No 4 shows some types of commercially available oils that meet the lubrication requirements according to the different environment temperatures.

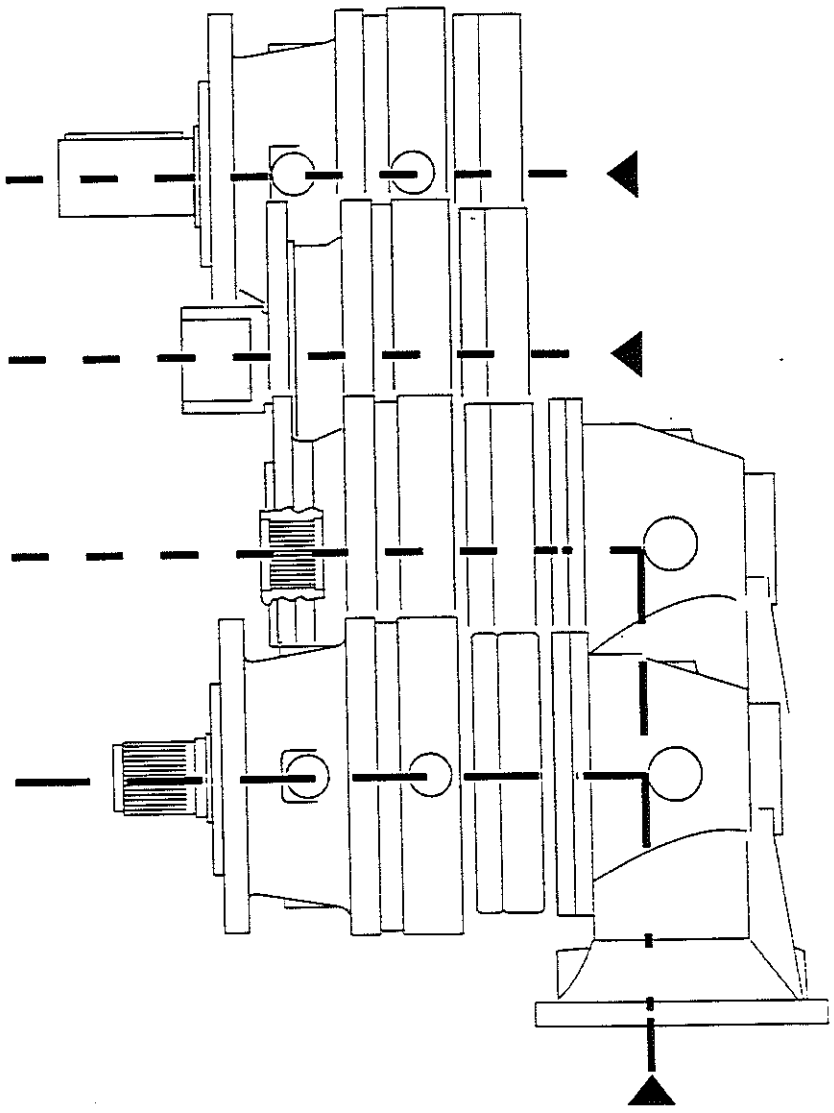
Generally, **SOM** planetary units are supplied without lubricant

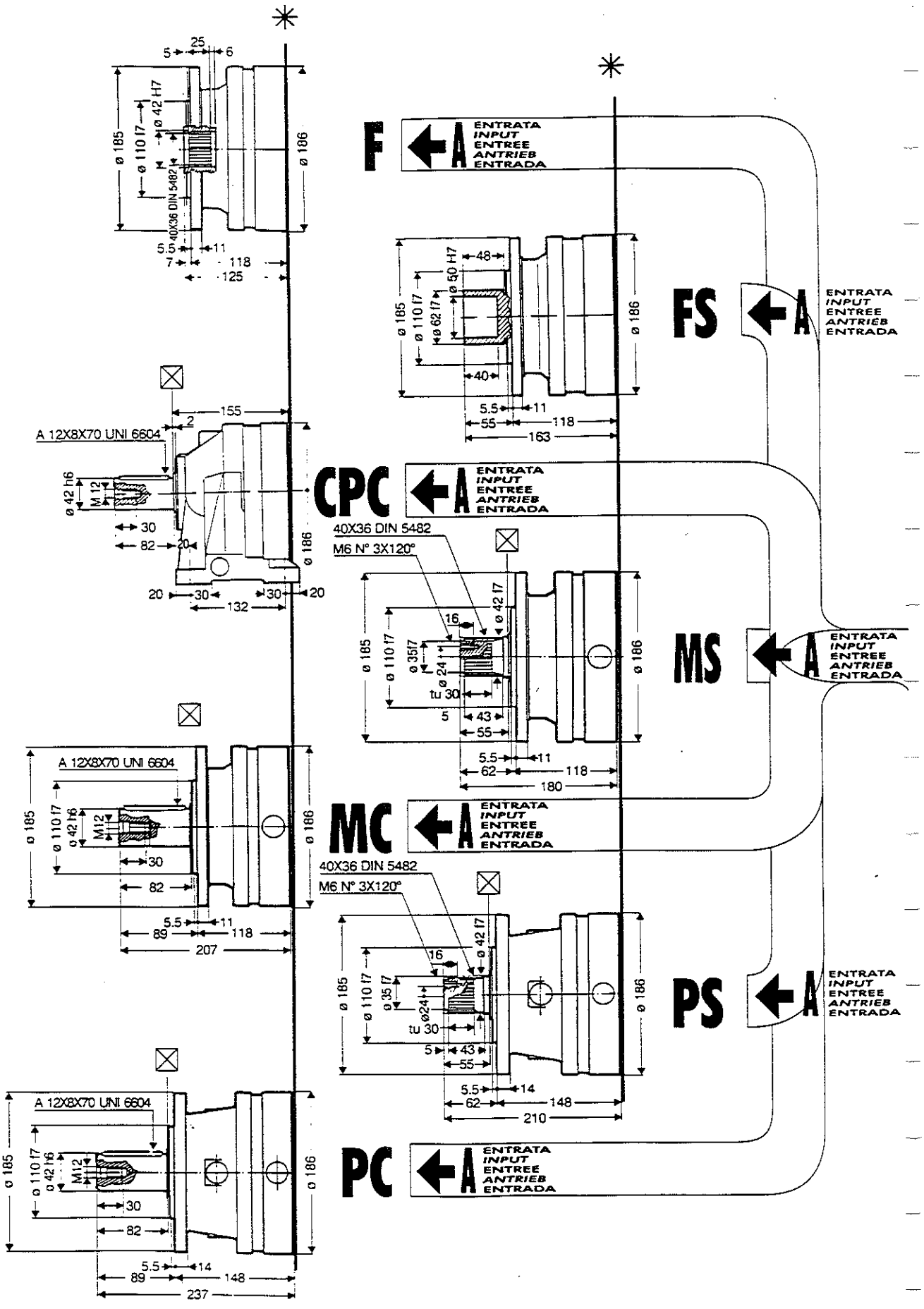
SOM

PLANETARY REDUCTION UNITS

PG160

161-162-163-164




F
ENTRATA
INPUT
ENTREE
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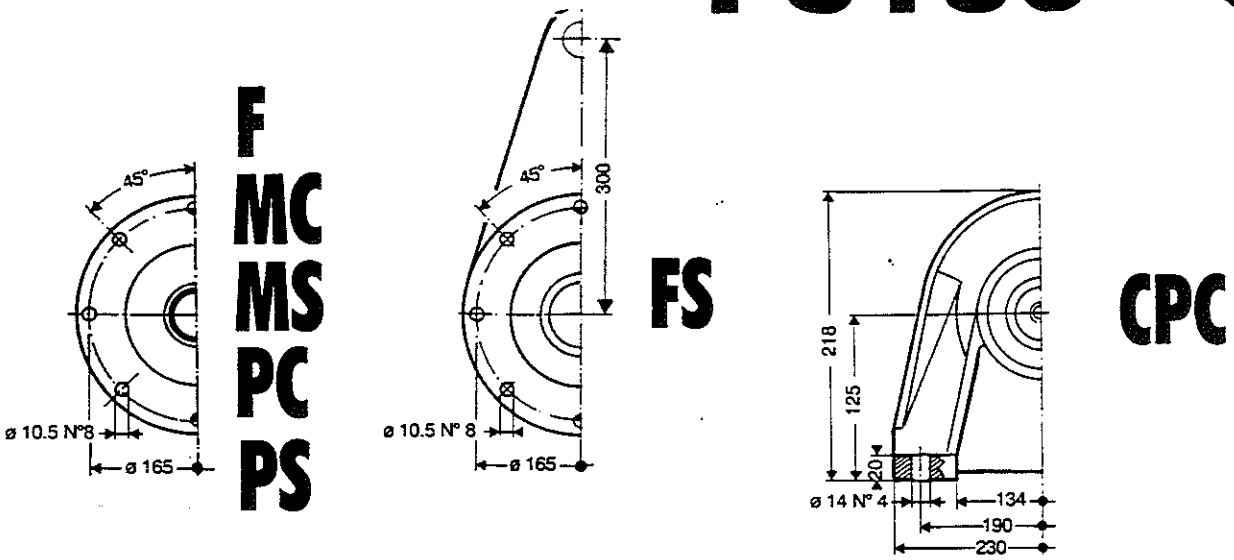
A 12X8X70 UNI 6604
40X36 DIN 5482
M6 N° 3X120°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MC
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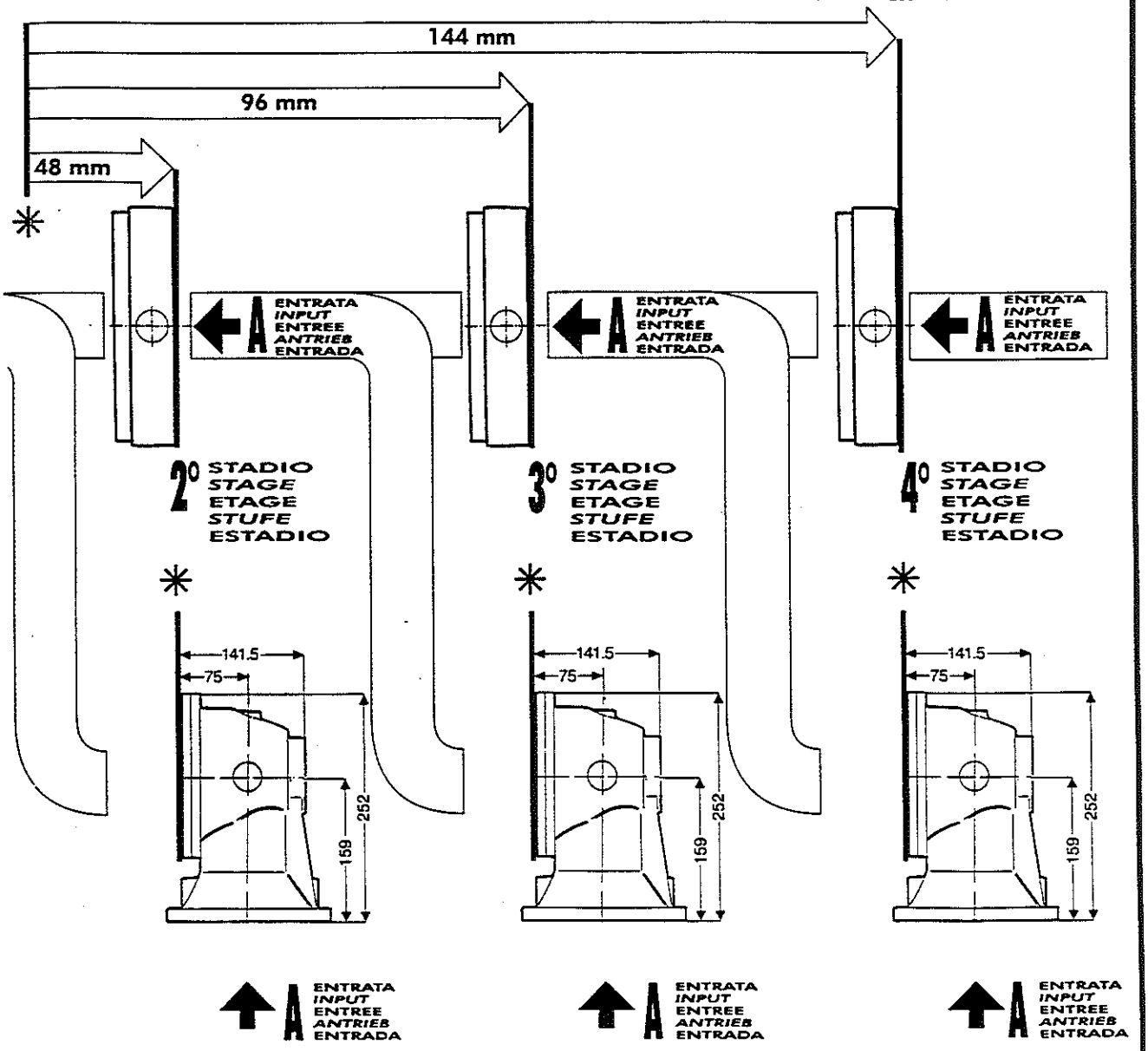
PC
PS
45°
ø 10.5 N°8
ø 165
FS
300
CPC
218
125
20
ø 14 N° 4
134
190
230


144 mm
96 mm
48 mm
ENTRATA
INPUT
ENTREE
ANTRIEB
ENTRADA
2° STADIO
STAGE
ETAGE
STUFE
ESTADIO
3° STADIO
STAGE
ETAGE
STUFE
ESTADIO
4° STADIO
STAGE
ETAGE
STUFE
ESTADIO
141.5
75
159
252

PG 161			PG 162			PG 163			PG 164			PGA 162			PGA 163			PGA 164		
n max 2800 r.p.m.			n max 2800 r.p.m			n max 2800 r.p.m.			n max 2800 r.p.m.			n max 2800 r.p.m			n max 2800 r.p.m			n max 2800 r.p.m		
Pt (kW) 12			Pt (kW) 8			Pt (kW) 5			Pt (kW) 1.5			Pt (kW) 8			Pt (kW) 5			Pt (kW) 1.5		
i	M_c daNm	M max daNm	i	M_c daNm	M max daNm	i	M_c daNm	M max daNm	i	M_c daNm	M max daNm	i	M_c daNm	M max daNm	i	M_c daNm	M max daNm	i	M_c daNm	M max daNm
3.55	170	340	12.6	170	340	54.1	170	340	337.3	170	340	10.4	170	340	37.0	170	340	131.8	170	340
4.28	170	340	15.2	170	340	65.3	170	340	365.7	170	340	12.5	170	340	44.6	170	340	158.9	170	340
5.60	121	242	19.9	170	340	70.7	170	340	396.4	170	340	16.4	121	242	53.8	170	340	191.5	170	340
6.75	100	200	23.9	170	340	78.7	170	340	440.8	170	340	19.7	100	200	58.4	170	340	207.6	170	340
			28.9	170	340	85.3	170	340	477.8	170	340				70.3	170	340	230.8	170	340
			31.3	121	242	102.8	170	340	531.3	170	340				84.8	170	340	260.1	170	340
			37.8	121	242	111.5	170	340	575.9	170	340				91.9	121	242	301.7	170	340
			45.5	100	200	134.3	170	340	624.4	170	340				110.8	121	242	327.0	170	340
			58.5	100	200	161.9	170	340	694.2	170	340				133.6	100	200	363.6	170	340
						172.5	170	340	752.6	170	340				171.5	100	200	394.2	170	340
						207.9	170	340	836.8	170	340							475.1	170	340
						211.6	121	242	907.1	170	340							515.3	121	242
						255.1	121	242	966.3	170	340							572.7	170	340
						271.7	121	242	1093.4	170	340							610.1	170	340
						307.5	100	200	1144.5	170	340							735.4	170	340
						327.5	121	242	1185.4	121	242							797.2	121	242
						394.8	100	200	1318.0	170	340							960.9	121	242
									1428.8	121	242							1158.2	100	200
									1692.3	170	340							1233.7	121	242
									3422.1	100	200							1487.1	100	200

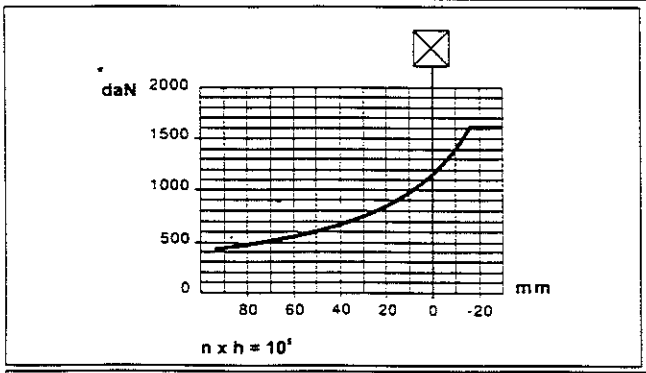
MODELLO - *MODEL* - MODÈLE - *MODELL* - MODELO		PG 161			PG 162			PG 163			PG 164			PGA 162			PGA 163			PGA 164					
Tipo uscita - *Output type* - Type de sortie - *Ausgangstyp* - Tipo de salida		M	F	P	M	F	P	M	F	P	M	F	P	M	F	P	M	F	P	M	F	P	M	F	F
Peso - *Weight* - Poids - *Gewicht* - Peso	Kg	15	13	17	21	19	23	27	25	29	33	31	35	30	28	32	35	34	38	42	40	44	-	-	-
Olio - *Oil* - Huile - *Öl* - Aceite	Orizz. - *Hor* - Hor - *waager* - Hor	0.5	0.5	0.6	0.8	0.7	0.8	1.0	0.9	1.0	1.2	1.1	1.2	2.1	2.0	2.4	2.3	2.2	2.6	2.5	2.4	2.8	-	-	-
Lt	Vert. - *Ver* - Vert. - *senkr* - Vert	1.2	1.0	1.2	1.6	1.4	1.6	2.0	1.8	2.0	2.4	2.2	2.4	4.2	4.0	4.8	4.6	4.4	5.2	5.0	4.8	5.6	-	-	-

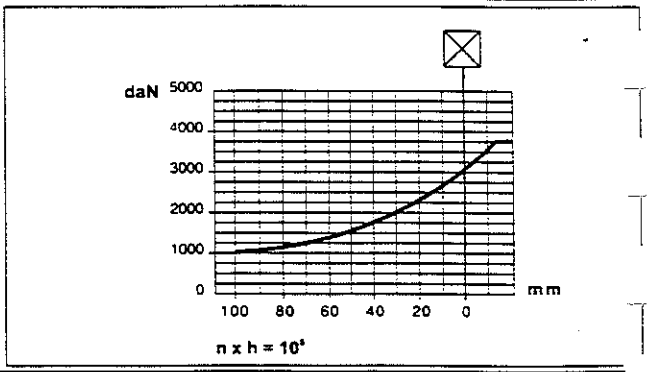
TABELLA CARICHI ESTERNI SULL'ALBERO DI USCITA - *LOADS ON OUTPUT SHAFT* - CHARGES SUR L'ARBRE DE SORTIE - *TABELLE DER BELASTUNGEN IM ABTRIEB* - TABLA CARGOS EXTERNOS SOBRA L'EYE DE SALIDA

Valido per versioni di uscita tipo **M**
For output types "type" M
Valable pour versions de la sortie type **M**
Gültig bei Abtriebswellen typ M
Válido para typos de salida tipo **M**

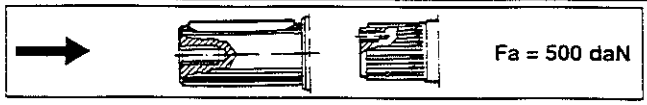
Valido per versioni di uscita tipo **P - (CPC*)**
For output types "type" P - (CPC)*
Valable pour versions de la sortie type **P - (CPC*)**
Gültig bei Abtriebswellen typ P - (CPC)*
Válido para typos de salida tipo **P - (CPC*)**

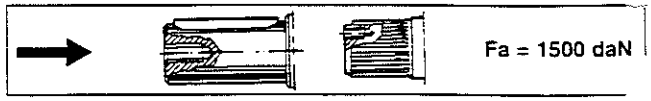
CARICHI RADIALI (FR) *RADIAL LOADS (FR)* CHARGES RADIALES (FR) *RADIALBELASTUNGEN (FR)* CARGO RADIALES (FR)



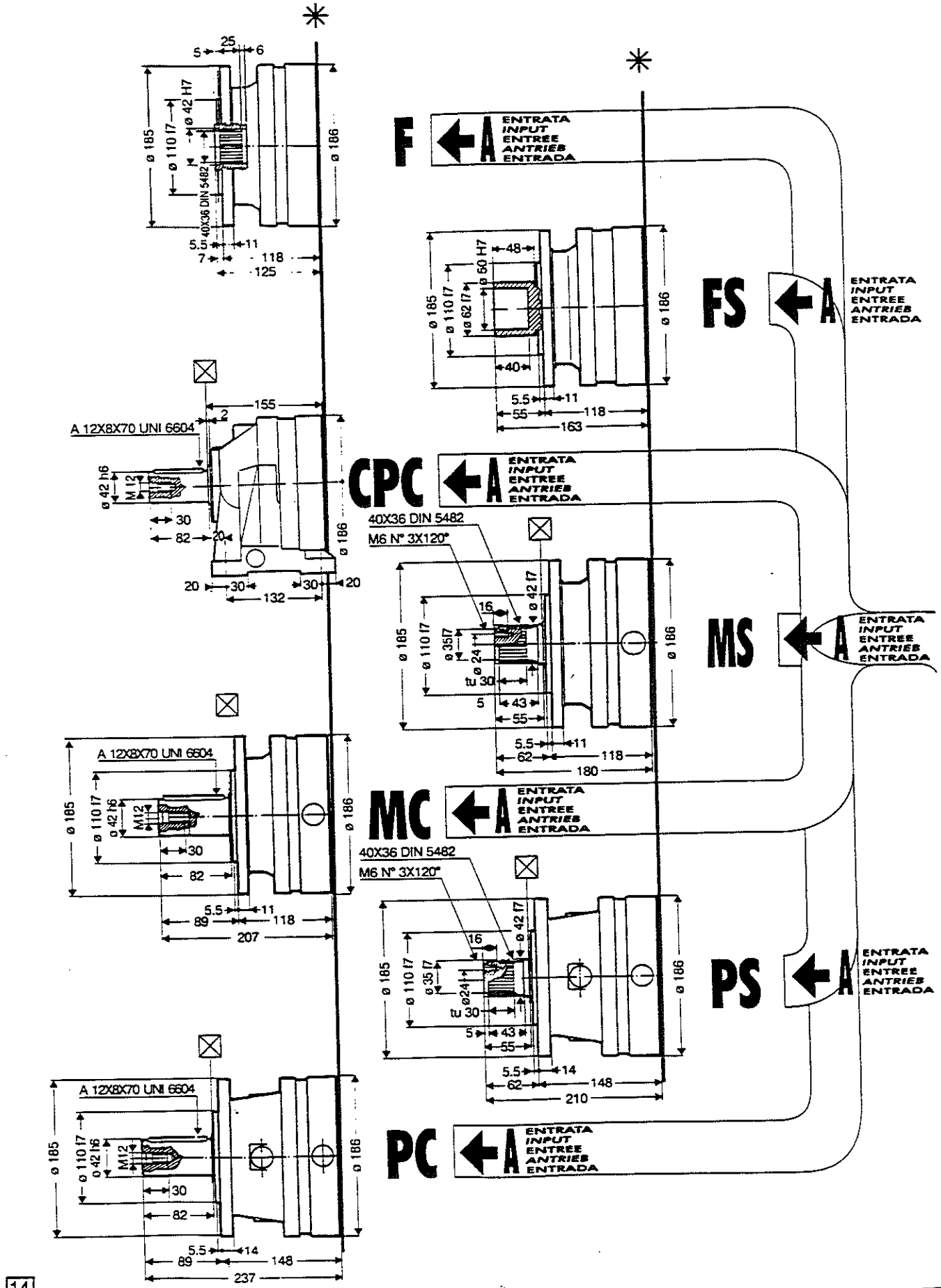


CARICHI ASSIALI *AXIAL LOADS* CHARGE AXIALE *AXIALBELASTUNGEN* CARGOS AXIALES





* Per i supporti di uscita **CPC** i valori dei carichi radiali vanno ridotti del **25%** - *As regards CPC output supports radial load values must be decreased by 25%* - En ce qui concerne les supports de sortie **CPC** les valeurs des charges radiales doivent être reduites de **25%** - *Für den Abtrieb CPC sind die Werte der Radialbelastungen um 25% zu reduzieren* - Para los soportes de salida **CPC** los valores de las cargas radiales deben ser reducidos **25%**


F
ENTRATA
INPUT
ENTREE
ANTRIEB
ENTRADA
FS
CPC
MS
MC
PS
PC
A 12X8X70 UNI 6604
40X36 DIN 5482
M6 N° 3X120°

NORTH AMERICAN HYDRAULICS INC.
11549 SUNBELT COURT
BATON ROUGE , LOUISIANA 70809
PHONE (504) 751-0500 FAX (504) 751-0610

ATTENTION : NOEL MOYER

DATE : 05 / 21 / 98

COMPANY : L & F INDUSTRIES

FROM : J .NESWADI

SUBJECT : SOM GEARBOX MOUNTINGS

PAGE : 1 OF 2

NOEL ,,

ATTACHED IS THE EXPANDED PAGE OUT OF SOM'S DESIGN MANUAL WHICH DEPICTS THE VARIOUS MOUNTING OPTIONS AND WHERE THE POSITION OF THE VENT AND SIGHT LEVEL PLUGS NEED TO BE ..

HOPE THIS HELPS !!

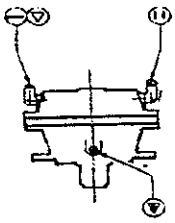
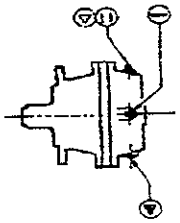
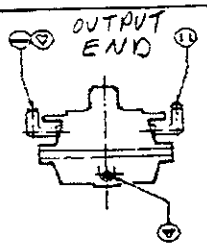
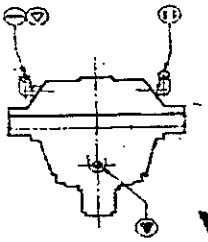
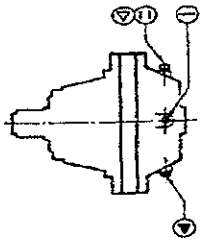
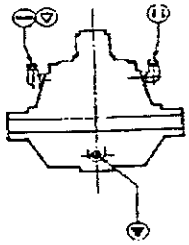
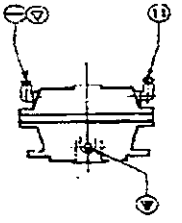
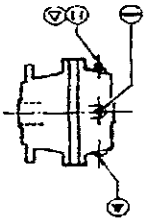
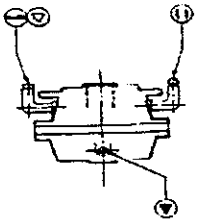
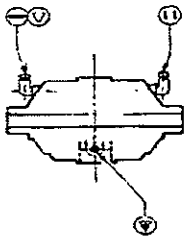
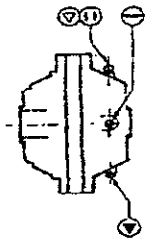
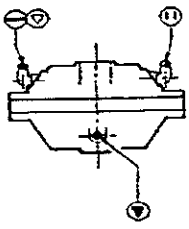
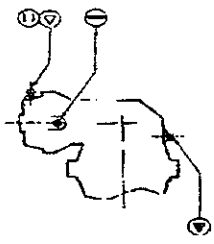
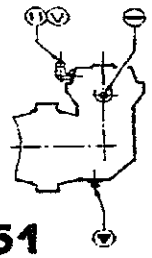
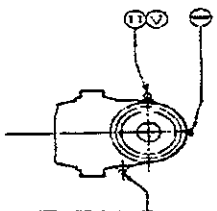
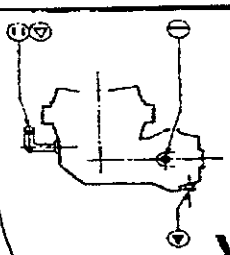
BEST REGARDS

JOHN

CC :: KENT STRAND

USE POSITION V3
FOR ZENUTH POINTING

Tipi di fissaggio dei riduttori

VERTICALE *VERTICAL*	ORIZZONTALE *HORIZONTAL*	VERTICALE *VERTICAL*
 **V1**	 **B5**	 **V3**
 **V1**	 **B5**	 **V3**
 **V1**	 **B5**	 **V3**
 **V1**	 **B5**	 **V3**
 **V15**	 **B51**  **B55**  **B53**	 **V35**

(11) TAPPO SFIATO - *BREATHER PLUG* (⊖) TAPPO LIVELLO - *LEVEL PLUG*
(▽) TAPPO CARICO - *FILLING PLUG* (▼) TAPPO SCARICO - *DRAIN PLUG*

Tabella 6 - *Table 6*

Pelli

LUBRIFICANTE *LUBRICANT* LUBRIFIANT *SCHMIERSTOFF* LUBRICANTE	SCELTA DEL LUBRIFICANTE IN FUNZIONE DELLA TEMPERATURA AMBIENTE *LUBRICANT SELECTION ACCORDING TO ENVIRONMENT* CHOIX DU LUBRIFIANT EN FONCTION DE LA TEMPERATURE AMBIANTE *DIE WAHL DES SCHMIERSTOFFS HÄNGT VON DER RAUMTEMPERATUR AB* ELECCIÓN DEL LUBRICANTE EN FUNCIÓN DE LA TEMPERATURA AMBIENTE			
	-20°C / +5°C - IV 95	+5°C / +40°C - IV 95	+40°C / +55°C - IV 95	-30°C / +65°C - IV 165
ISO 3448	VG 100	VG 150	VG 320	VG 150-200
AGIP	Blasia 100	Blasia 150	Blasia 320	Blasia S 220
ARAL	Degol BG 100	Degol BG 150	Degol BG 320	Degol GS 220
BP MACH	GR XP 100	GR XP 150	GR XP 320	Enersyn HTX 220
CASTROL	Alpha SP 100	Alpha SP 150	Alpha 320	Alpha SN 150
CHEVRON	non leaded gear compound 100	non leaded gear compound 150	non leaded gear compound 320	
ESSO	Spartan EP 100	Spartan EP 150	Spartan EP 320	
Q8	Goya 100	Goya 150	Goya 320	El Greco 228
I.P.	Mellana 100	Mellana 150	Mellana 320	Telesia Oil 150
MOBIL		Mobilgear 629	Mobilgear 632	Glygoyle 22 Glygoyle 30 SHC 630
SHELL	Omala oil 100	Omala oil 150	Omala oil 320	Tivela Oil SA
TOTAL	Carter EP 100 N	Carter EP 150	Carter EP 320 N	
KLUEBER	Lamora 100	Lamora 150	Lamora 320	Synteso D 220 EP
ELF	Reductelf SP 100	Reductelf SP 150	Reductelf SP 320	Elf ORITIS 125 MS Elf Syntherma P 30
FINA	Giran 100	Giran 150	Giran 320	Giran 22

Tabella N° 4 - *Table No. 4* - Tableau N° 4 - *Tabelle Nr. 4* - Tabla N° 4

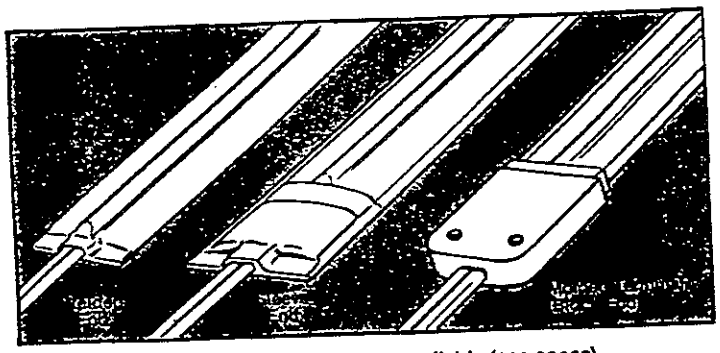
E330041-25

PRESS-AT-ANY-POINT TAPESWITCH CONTROFLEX® RIBBON SWITCH SPECIFICATIONS

INTRODUCTION:

CONTROFLEX® Ribbon Switches are normally open momentary contactors for sensing, control, or other low power duty. These ribbon switches offer PRESS-AT-ANY-POINT actuation, and they are SELF-BOTTOMING. They eliminate linkages, mountings, and interfaces required by other sensing switches.

A wide range of pressure sensitivities, sheathing materials, switch lengths, end terminating seals, exterior colors, and lead wire combinations let CONTROFLEX® switches adapt to most applications. Nominal sensitivities of 40 oz. (11N), 12 oz. (3N), and 8 oz. (2N), are standard. Several models have substantial moisture and chemical resistance. Design life is several millions of cycles at any point. All switches are tested for insulation breakdown, for operation, and are visually inspected for defects.

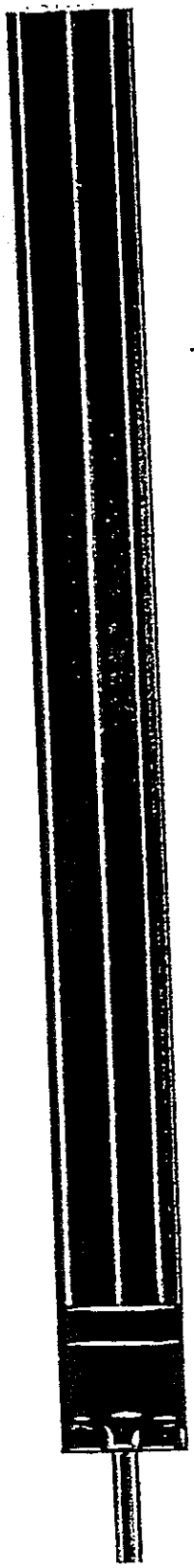


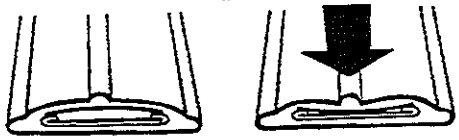
Ribbon Switch end styles available (see specs)

GENERAL INFORMATION:

Detailed specifications for standard CONTROFLEX® Ribbon Switches are listed on the following pages. A general line product brochure and price lists are available on request.

Available options, including our popular FAIL-SAFE circuitry, are listed with the specifications. Do-it-yourself kits comprising the switches in this specification list are available in 50 foot (15.2m) rolls or larger coils to allow virtually any length to be field fabricated.





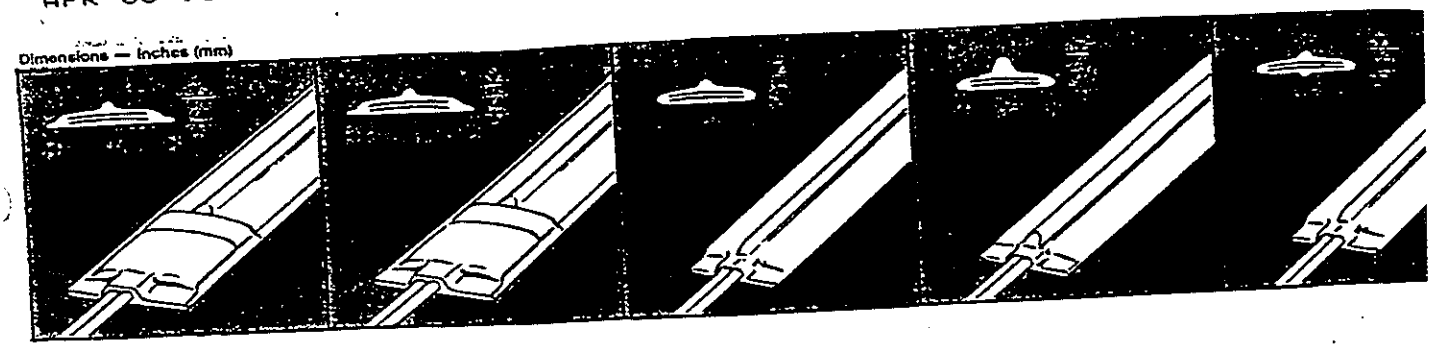
CONTROFLEX® Ribbon Switches are the essence of simplicity and reliability. Fundamentals of their construction, shown above, consist of a bottom metallic strip conductor separated by an insulating strip from an upper metallic strip conductor, all in an insulating housing. Simple pressure completes electrical contact.

TYPICAL APPLICATIONS

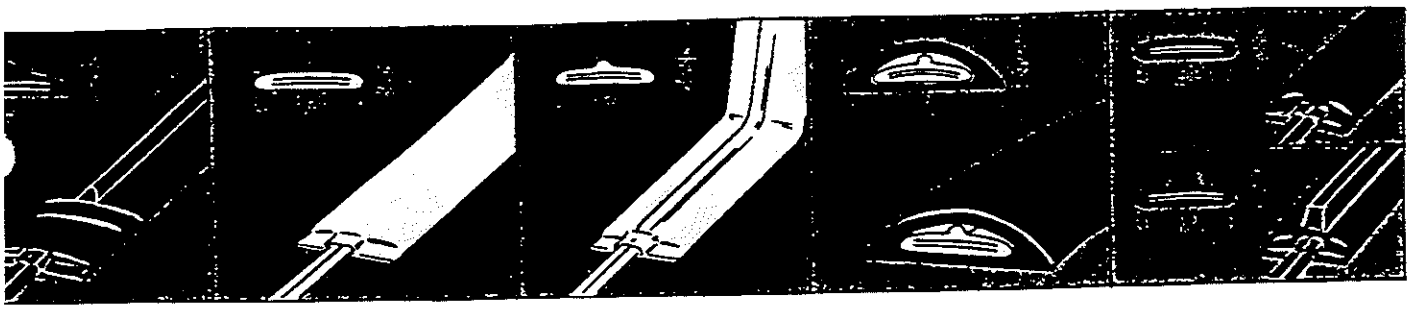
Among literally thousands of applications for ribbon switches are:

- Automated assembly line shutdown
- Machine operation sensing
- Public transit vehicle annunciator
- Movable library shelf sensor
- Emergency stops
- Automatic parts shelf sensors
- Automatic filing system sensors
- Machine emergency stop switch
- Entrance signalling
- Pedestrian counting
- Protection of safes
- Invalid call switch
- Attic hatch protection
- Holdup alarm switch
- Money tray alarm
- Wall partition or fence alarm
- Bedroom light switch
- Pulpit or stage signaling
- Customer sequencing counter
- Sports touch-pad timer
- Sports position sensing
- Vehicle traffic counting
- Bank teller alarm
- Automobile seat sensor
- Foot treadle activation
- Robot arm position sensing
- Perimeter or door intrusion sensing
- Assembly line item counting
- Medical patient motion sensing
- Object removal sensing
- Door opening or closing sensing

Dimensions — inches (mm)



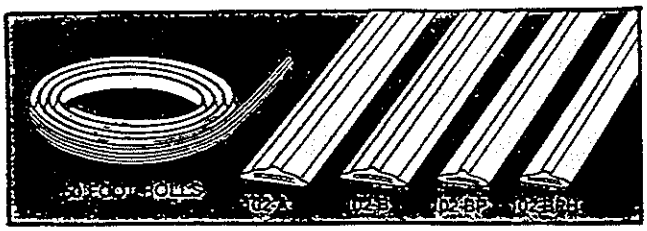
Product	CONTROFLEX® RIBBON SWITCH	CONTROFLEX® RIBBON SWITCH	CONTROFLEX® RIBBON SWITCH	HIGH BEAD CONTROFLEX® RIBBON SWITCH	CONTROFLEX® STA STEEL RIBBON SWI
Part Number	131-A (Sleeve end) 131-AMT (Block end)	101-B (Sleeve end) 101-BMT (Block end)	121-BP (Welded end only)	141-BPH (Welded end only) 102-BPH	191-S (Welded end o
Exterior Shell - Color	PVC - Light Grey	PVC - Yellow or Black	PVC - Light Green	PVC - White or Red	PVC - Beige
Features	General purpose switch for foot, hand or mechanical activation. Bends without shorting. At bend sensitivity is decreased.	Medium sensitivity general purpose switch. Switch may be bent sharply without shorting. Sensitivity at bend is not decreased. Applications include signaling along conveyors, machines, signaling inside vehicles.	Most sensitive switch. Use exposed or under cover in machine or innovative applications. More sensitive and smaller cross section.	Similar to **121-BP** but with high actuating bead. Prominent bead makes the style suitable for basic leading edge safety switches either covered or uncovered.	All stainless steel co makes this switch id some severe enviror applications. Cannot be bent shar been used for under application.
Mounting Recommendations	By holes in block ends, Channel **#106**, or **DA-12** double adhesive tape.	By holes in block ends. Channel **#106**, or **DA-12** double adhesive tape.	Channel **#104**, or **DA-32** double adhesive tape.	Channel **#104**, or **DA-32** double adhesive tape.	DA-32 double adhe
Standard Switch Lengths (in 1 ft. increments)	1 ft. to 10 ft. (.3m to 3.0m)	1 ft. to 10 ft. (.3m to 3.0m)	1 ft. to 10 ft. (.3m to 3.0m)	1 ft. to 10 ft. (.3m to 3.0m)	1 ft. to 10 ft. (.3m t
Lead Wire Size & Length	AWG #18, 18" (460mm)	AWG #18, 18" (460mm)	AWG #22, 18" (460mm)	AWG #22, 18" (460mm)	AWG #22, 18" (46
Weight	.8 oz./ft. (74.6 g/m)	.8 oz./ft. (74.6 g/m)	.7 oz./ft. (65.2 g/m)	.8 oz./ft. (74.6 g/m)	.5 oz./ft. (465 g/m
Actuation Force (nominal)	40 oz. (11N)	12 oz. (3N)	8 oz. (2N)	8 oz. (2N)	12 oz. (3N)
Bending Radius	1 in. (25mm)	< 1/8" (3mm)	< 1/8" (3mm)	< 1/8" (3mm)	Do not bend
Dielectric Resistance	1000 VAC for 2 minutes	1000 VAC for 2 minutes	1000 VAC for 2 minutes	1000 VAC for 2 minutes	1000 VAC for 2 n
Chemical/Moisture Resistance	Good	Good	Good	Good	Good
Recommended Voltage & Current	28 VAC or VDC @ 2A	28 VAC or VDC @ 2A	28 VAC or VDC @ 2A	28 VAC or VDC @ 2A	28 VAC or VDC
Contact Rating	140 VAC @ 1A	140 VAC @ 1A	140 VAC @ 1A	140 VAC @ 1A	140 VAC @ 1A
Operating Temperature Range	0°F to 120°F (-18°C to 50°C)	0°F to 120°F (-18°C to 50°C)	0°F to 120°F (-18°C to 50°C)	0°F to 120°F (-18°C to 50°C)	0°F to 120°F (-18
Design Life	Over 3x10⁶ actuations	Over 3x10⁶ actuations	Over 3x10⁶ actuations	Over 3x10⁶ actuations	Over 3x10⁶ ac
Options	Non-standard switch lengths. Non-standard lead lengths. Air Leak test. FAIL-SAFE Leads. Adhesive backing. Moisture trap.	Non-standard switch lengths. Non-standard lead lengths. Air Leak test. FAIL-SAFE Leads. Adhesive backing. Moisture trap. Interconnect joint.	Non-standard switch lengths. Non-standard lead lengths. Air Leak test. FAIL-SAFE Leads. Adhesive backing. Moisture trap. Interconnect joint.	Non-standard switch lengths. Non-standard lead lengths. Air Leak test. FAIL-SAFE Leads. Adhesive backing. Interconnect joint. Several optional bead	Non-standard lengths. Non- lead lengths. test. FAIL-SAF Leads. Adhesi Moisture trap. Interconnect jc



ROFLEX® T SWITCH	CONTROFLEX® WINDOW SILL ALARM SWITCH	CONTROFLEX® FLEX ACTION RIBBON SWITCH	CONTROFLEX® SERPENTINE RIBBON SWITCH	CONTROFLEX® NEOPRENE RIBBON SWITCHES
(Sleeve end only)	151-BBW (Welded end only)	180 (Welded end only)	161-FS (Welded end only)	107-LS (Welded end only) 107-RS (Welded end only)
Black	PVC - White	PVC - Red	EPDM - Black	Neoprene - Black
cement switch for road switch. Specify length. Can be used nporary instrumenta- ap counter in bicycle etc. Super moisture ant switch with special UN lead and in-line ure trap.	Low profile, very sensitive switch. Lead wire both ends for easy series connection of multiple windows, or FAIL-SAFE connection. Protects open or closed windows. May be covered to further conceal or protect.	Patented design has snap action which operates when either flexed at any point or squeezed - or a combination of both. Many inventive uses in sensing, detection, counting, etc.	Designed for foot activation. Rugged rubber sheath encases special ribbon switch. May be curved while flat on floor in 30" (762mm) radii. Use for emergency shutdown switch, foot operator, etc. Replacement inserts available.	These switches provide improved resistance to moisture and chemical attack and are normally used under an additional cover. 107-LS-flat top - no actuating bead. 107-RS - has raised actuating bead on top.
in RBMA, or fasten to adbed with 6" (152mm) duct tape.	DA-32 double adhesive tape.	DA-32 double adhesive tape at fixed end.	Floor tile mastic.	DA-32 double adhesive tape, or contact cement.
10 ft. (.3m to 3.0m)	1 ft. to 10 ft. (.3m to 3.0m)	1 ft. to 10 ft. (.3m to 3.0m)	1 ft. to 10 ft. (.3m to 3.0m)	1 ft. to 10 ft. (.3m to 3.0m)
#18 stranded to #20 , 10 ft. (3.05m)	AWG #22 (each end) 12" (305mm)	AWG #22, 18" (460mm)	AWG #18, 6 ft. (1.8 m)	AWG #18 Neoprene Jacketed, 4 ft. (1.22 m)
/ft. (74.6 g/m)	.7 oz./ft. (65.2 g/m)	.7 oz./ft. (65.2 g/m)	5 oz./ft. (465 g/m)	107-LS-.9 oz./ft. (83.7 g/m) 107-RS-1 oz./ft. (93.0 g/m)
z. (11N)	8 oz. (2N)	8 oz. (2N)	80 oz. (22N)	8 oz. (2N)
. (50mm)	< 1/8" (3mm)	15° maximum	Do not bend	1/2" (12mm)
VAC for 2 minutes	1000 VAC for 2 minutes	1000 VAC for 2 minutes	1000 VAC for 2 minutes	1000 VAC for 2 minutes
l	Good	Good	Good	Excellent
AC or VDC @ 2A	28 VAC or VDC @ 2A	28 VAC or VDC @ 2A	28 VAC or VDC @ 2A	28 VAC or VDC @ 2A
/AC @ 1A	140 VAC @ 1A	140 VAC @ 1A	140 VAC @ 1A	140 VAC @ 1A
o 120°F (-18°C to 50°C)	0°F to 120°F (-18°C to 50°C)	0°F to 120°F (-18°C to 50°C)	0°F to 120°F (-18°C to 50°C)	-20°F to 140°F (-29°C to 60°C)
10^6 actuations	Over $3x10^6$ actuations	Over $3x10^6$ actuations	Over $3x10^6$ actuations	Over $3x10^6$ actuations
standard switch ths. Non-standard lengths. Air Leak FAIL-SAFE s 170-IS TEMPORARY D SWITCH. Same as S, but without ture trap.	Non-standard switch lengths. Non-standard lead lengths. Air Leak test.	Non-standard switch lengths. Non-standard lead lengths. Air Leak test. FAIL-SAFE leads. Moisture trap. 180-S (Orange color) Similar to 180 but more	Non-standard switch lengths. Non-standard lead lengths. Air Leak test. FAIL-SAFE leads. Moisture trap.	Non-standard switch lengths. Non-standard lead lengths. Air Leak test. FAIL-SAFE leads. Moisture trap. Interconnect joint.

RIBBON SWITCH ACCESSORIES

Dimensions — Inches (mm)



DO-IT-YOURSELF SWITCH MATERIAL, 50 FT. (15.2m) ROLLS

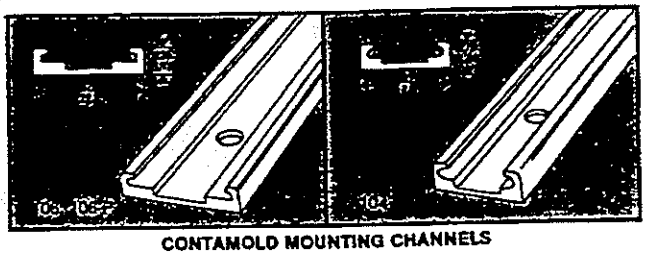
Can be cut to any length with sharp conventional shears. Use Terminals #103. Seal with Tapeswitch Sealant #105A. Longer lengths available on special order.
Fasten to clean dry surface with DA-12/32 Tape or for permanent mounting, use Channel #106 or Channel #104. Factory installed adhesive backing available.

102-A - Same material and specifications as 131-A. Use Terminal Set #103-A. Channel #106. Adhesive Tape DA-12.

102-B - Same material and specifications as 101-B. Use Terminal Set #103-B. Channel #106. Adhesive Tape DA-12.

102-BP - Same material and specifications as 121-BP. Use Terminal Set #103-BP. Channel #104. Adhesive Tape DA-32.

102-BPH - Same material and specifications as 141-BPH. Use Terminal Set #103-BPH. Channel #104. Adhesive Tape DA-32.



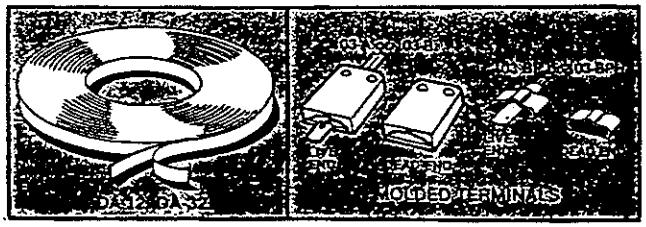
CONTAMOLD MOUNTING CHANNELS

106, 106P CONTAMOLD MOUNTING CHANNEL - 106 is Aluminum extrusion. Designed for CONTROFLEX® styles 131A, 131-AMT, 101-B, 101BMT, 102A and 102-B. Switches may be rolled into channel or slid from end. Pre-punched for 106-S screws on 7 inch (178mm) centers. Standard lengths 3 ft. (.9m) and 6 ft. (1.8m). (12 ft. (3.6m) lengths available in quantity). Wt: 6 ft. (1.8m): 10 oz. (1.28 kg.)

106-P is plastic extrusion. Conforms more easily to curved surfaces. Wt. 6 ft. (1.8m): 7 oz. (.20 kg).

104 - CONTAMOLD MOUNTING CHANNEL FOR BP - Aluminum. Designed for CONTROFLEX® style 141-BPH. (Also fits style 121-BP. Switch slides in from an end. Holes for rivets or 106-S screws. Standard lengths: 3 ft. (.9m) and 6 ft. (1.8m). (12 ft.(3.6m) lengths available in quantity. Wt: 6 ft.(1.8m): 10 oz. (1.28 kg).

NOTE: ALL CONTAMOLD Channels available with factory installed adhesive backing to simplify positioning.



DOUBLE ADHESIVE MOUNTING STRIP FOR TAPESWITCHES - Special, newly available 1/32 inch (.8mm) thick adhesive mount for TAPESWITCH CONTROFLEX® ribbon switches. Will not leach plasticizers. Recommended for indoor use.

DA-12 - 3/4" (15.2mm) wide, 50' (15m) long. Use with A & B style switches.
DA-32 - 9/16" (14.3mm) wide, 50' (15m) long. Use with all other styles.

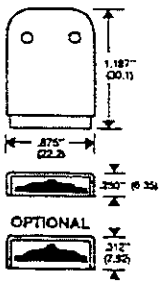
For heavy use (industrial, vehicle, etc.) Mounting Channels #104 and #106 are recommended.

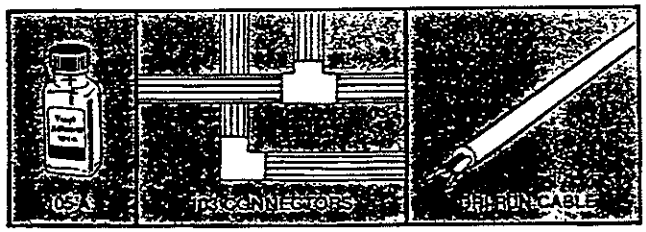
MOLDED TERMINALS - Block End

103-A - Grey Set, 103-B - Yellow or Black Set.
103-BP - Light Green Set, 103-BPH - White or Red Set.

Neat appearance, quick connecting closure with lead wire. Each set includes one dead end and one live end with tongue connector. 18" (460mm) lead wire is attached to the live end. Seal with TAPESWITCH #105A Adhesive/sealant.

No soldering needed. Simply slip tongue connector into the TAPESWITCH.





105-A VINYL ADHESIVE (Clear) - Bonds terminals and switch. Quick drying time. Solvent weld bond achieved. Used to fasten PVC to PVC. Coat switch and terminal piece, slide together and hold in place with tape strips until firm. Available in 1 oz. (.03 kg) and 4 oz. (11 kg) containers. 1 oz. is enought to bond 20 terminals.

103-TA - Grey 'T', 103-TB - Yellow or Black "T"
103-LA - Grey 'L', 103-LB - Yellow or Black "L"

These 'T' and 'L' fittings connect switch styles A or B using self-contained laminar tongue connectors. Seal with TAPESWITCH #105A Adhesive. Allows Do-It-Yourself construction of most rectangular patterns.

DRI-RUN MOISTURE RESISTANT CABLE - Custom extruded vinyl cable is designed without fibrous cloth fillers which tend to wick moisture along the cable. The "all solid" design is rugged, and gives longer switch life in most environments.

#18 AWG, 2 conductor cable available in Black or Grey.

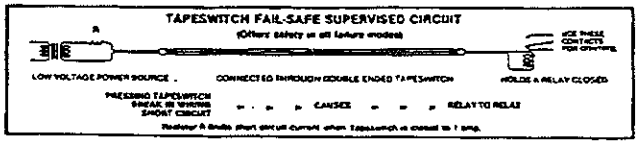
Also available are individual lengths, custom terminated with a moisture excluding water trap.

Switches normally in ground contact are provided with custom DRI-RUN moisture resistant cables. For wet areas, custom Moisture Trap fittings available. Use low voltage (32 Volts or less) in all ground contact, or wet area applications.

All operating force ratings are nominal, based on force applied with a 4.5mm rod. Total operating force increases with contact area. Ribbon Switch styles sense force up to 30 degrees off Dead Center. Operating force requirements increase at very low temperatures, except LS/RS styles.

Factory installed self-adhesive backing and foam tapes available to position and hold switch. For heavy commerial, vehicle, or industrial use, extruded mounting channels are available.

TAPESWITCH FAIL-SAFE supervised control circuit provides positive indication of normal operation, sensing switch failure, broken connections, or loss of power. Use for all Industrial Safety Circuits, or critical alarm circuits. See diagram below.



Tapeswitch CORPORATION
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Basic Switches
Environment Sealed

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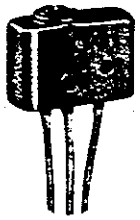
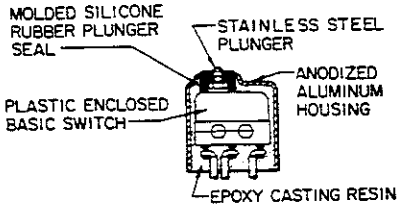




GENERAL INFORMATION

SE and XE switches are the smallest environment-sealed switches offered by MICRO SWITCH. Both types enclose basic switches within a corrosion resistant aluminum housing to seal precision switch contacts from contamination. SE switches include a SM basic switch, and XE switches include the smaller SX basic switch.

Switches held depressed for extended periods of time at temperature extremes may experience retarded plunger return upon deactuation. Where such a condition exists in the application, contact the 800 number for special designs that are available.

FEATURES

- Watertight seal per enclosure design symbol 3, MIL-S-8805
- Power load switching capability up to 7 amps
- Temperature tolerance up to +221°F (105°C)
- High temperature construction for use to +300°F (149°C)
- Several auxiliary actuators
- Choice of termination
- Military standard construction with listings qualified to MIL-S-8805
- All 4SE switches are UL recognized and CSA certified
- 4XE switches are UL recognized

ELECTRICAL RATINGS

Circuitry	Electrical Rating Code	
Single-Pole Double-Throw	**A** 5 amps res., 3 amps ind., (sea level), 5 amps res., 2.5 amps ind., (50,000 feet) 28 vdc. 5 amps res., 5 amps ind., 125 or 250 vac, 60 Hz.	**D** UL Rating 7 amps, 250 vac 60 Hz
	B UL and CSA Rating 5 amps, 250 vac, 60 Hz	**E** 7 amps res., 4 amps ind., (sea level), 7 amps res., 2.5 amps ind., (50,000 feet), 28 vdc.
	C 7 amps res., 4 amps ind., (sea level), 7 amps res., 2.5 amps ind., (50,000 feet), 28 vdc. 7 amps res., 4 amps ind., (sea level), 115 vac, 400 Hz	**R** 1 amp res., 0.50 amp ind., 28 vdc.

Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position

SE SWITCHES ORDER GUIDE

Catalog Listing	Recommended For	Electrical Rating Code	Characteristics					
			O.F. Newtons ounces	R.F. min. Newtons ounces	P.T. max. mm inches	O.T. min. mm inches	D.T. max. mm inches	O.P. mm inches
1SE1	Most applications	A	1,39-4,73 **5-17**	1,11 **4**	1,27 **.050**	0,08 **.003**	0,1 **.004**	10.8 **.425**
1SE2	SPST — Normally-closed	A	1,39-4,73 **5-17**	1,11 **4**	1,27 **.050**	0,08 **.003**	0,1 **.004**	10.8 **.425**
1SE3	SPST — Normally-open	A	1,39-4,73 **5-17**	1,11 **4**	1,27 **.050**	0,08 **.003**	0,1 **.004**	10.8 **.425**
4SE1	UL and CSA listing and UL and CSA listed lead wire	B	1,39-4,73 **5-17**	1,11 **4**	1,27 **.050**	0,08 **.003**	0,1 **.004**	10.8 **.425**
5SE1	Oil resistant Fluorosilicone seal	A	1,39-4,73 **5-17**	1,11 **4**	1,27 **.050**	0,08 **.003**	0,1 **.004**	10.8 **.425**
7SE1	Lower force	A	1,11-2,22 **4-8**	0,56 **2**	1,27 **.050**	0,08 **.003**	0,1 **.004**	10.8 **.425**
12SE4-T	High return force	A	1,39-5,28 **5-19**	1,11 **4**	1,27 **.050**	0,08 **.003**	0,1 **.004**	10.8 **.425**
1SE1-T	For customer leading	A	1,39-4,73 **5-17**	1,11 **4**	1,27 **.050**	0,08 **.003**	0,1 **.004**	10.8 **.425**

1 foot leads (other lengths available)

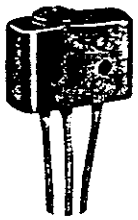


Fig. 1

Fig. 2

Basic Switches
Environment Sealed

Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position

AUXILIARY ACTUATORS FOR SE SWITCHES ORDER GUIDE
(Switches are not included with actuators)


Fig. 3


Fig. 4


Fig. 5


Fig. 6


Fig. 7

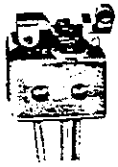


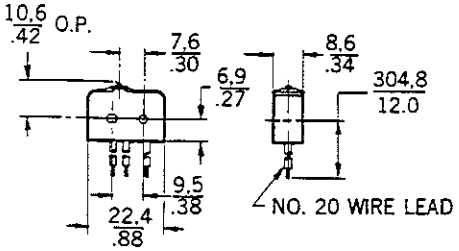
Fig. 8

Catalog Listing	Description	Actuator Length A mm inches	Characteristics measured with actuators mounted to a 1SE1						
			O.F. max. Newtons ounces	R.F. min. Newtons ounces	P.T. approx. mm inches	O.T. min. mm inches	D.T. max. mm inches	O.P. mm inches	F.P. mm inches
JE-1	Straight leaf (mounting hardware included)	16,8 .66	3,34 12	0,56 2	3,81 .150	0,38 .015	0,64 .025	11,2 .440	15±0,76 .590±.030
JE-4	Roller leaf. Roller turned 90° to switch axis (mounting hardware included).	16,8 .66	3,34 12	0,56 2	3,81 .150	0,38 .015	0,64 .025	16,3 .640	20,1 .790 approx.
JE-5	Roller leaf (mounting hardware included)	14,2 .560	3,34 12	0,56 2	3,81 .150	0,38 .015	0,64 .025	16,3 .640	20,1±0,76 .790±.030
JE-17	Roller leaf. Reversed position (mounting hardware included)	14,2 .560	3,34 12	0,56 2	3,81 .150	0,38 .015	0,64 .025	16,3 .640	20,1±0,76 .790±.030
JE-21	Roller lever	13,7 .540	1,67 6	0,28 1	2,54 .100	0,25 .010	0,41 .016	16,3 .640	18,8±0,76 .740±.030
JE-22	Tandem Roller Lever	17,8 .700	4,73 17	1,11 4	2,54 .100	0,15 .006	0,3 .012	16,8±1,3 .660±.050	19,3±1,3 .760±.050

Environment Sealed

MOUNTING DIMENSIONS (For reference only)

SE ENVIRONMENT PROOF SWITCHES



MOUNTING HOLES WILL ACCEPT PINS OR SCREWS OF 22,1/.087 MAX DIA

Fig. 1

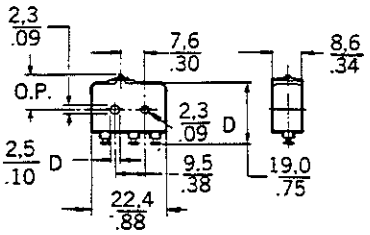
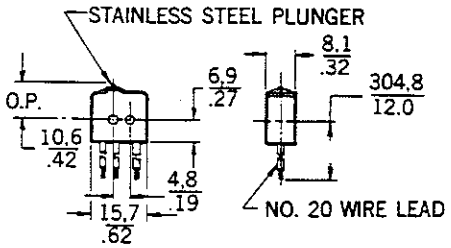


Fig. 2

XE ENVIRONMENT PROOF SWITCHES



MOUNTING HOLES WILL ACCEPT PINS OR SCREWS OF 22,1/.087 MAX DIA

Fig. 9

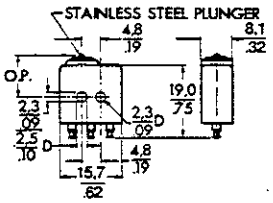


Fig. 10

Dimensions shown are for reference only. For actual dimensions, contact the 800 number.

AUXILIARY ACTUATORS

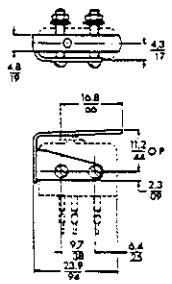


Fig. 3

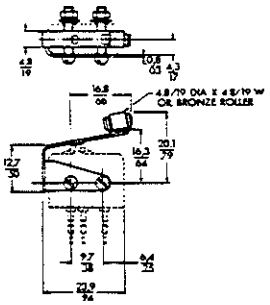


Fig. 4

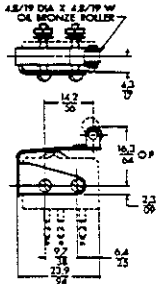


Fig. 5

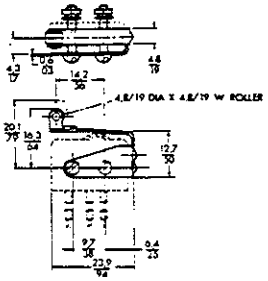


Fig. 6

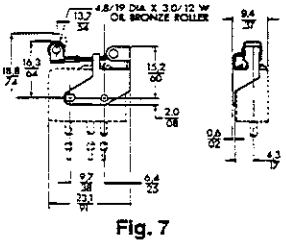


Fig. 7

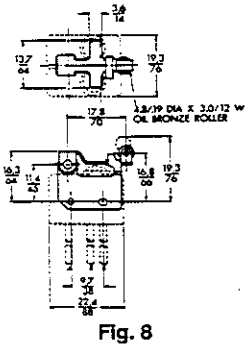


Fig. 8

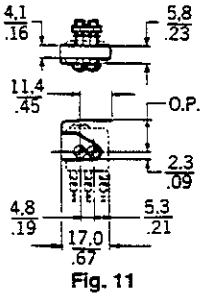


Fig. 11

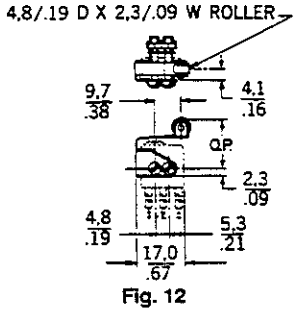
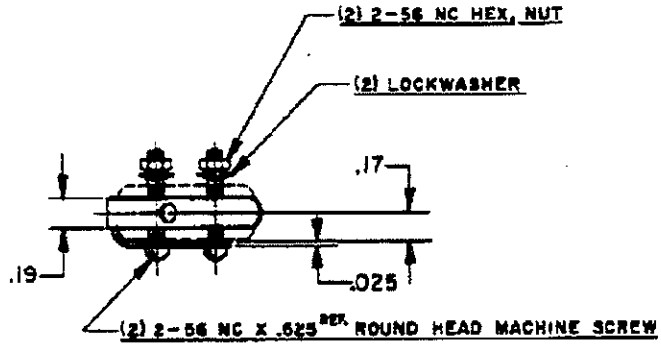


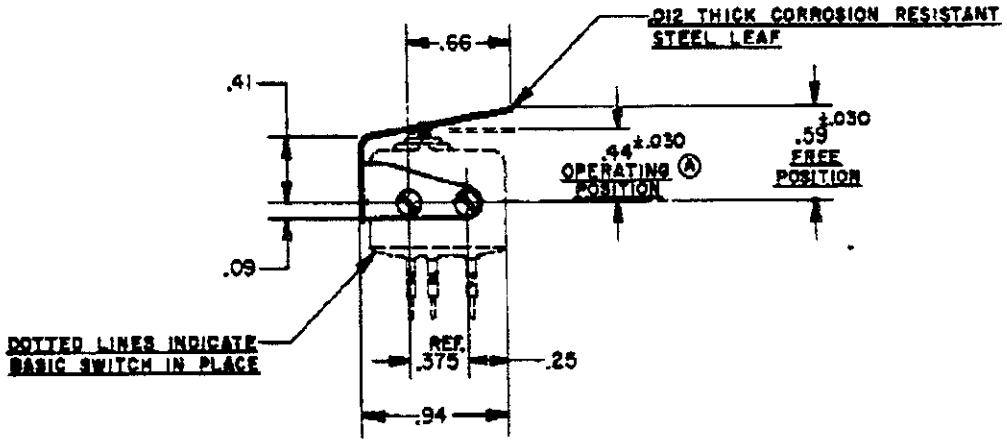
Fig. 12

MICRO SWITCH
A DIVISION OF HONEYWELL
FED MFR CODE 91929

ACTUATOR-SWITCH

CATALOG LISTING
JE-1





NOTE -
1- SCREWS, NUTS, AND LOCKWASHERS FURNISHED UNASSEMBLED.

CHARACTERISTICS (WITH ISEI) Ⓐ	ELECTRICAL DATA	
OPERATING FORCE - - - - - - 12 OZ. MAX.	CONTACT ARRANGEMENT	BREAK DISTANCE
RELEASE FORCE - - - - - - - - 2 OZ. MIN.		
DIFFERENTIAL TRAVEL - - - - - .025 MAX.		
OVERTRAVEL - - - - - - - - - - .015 MIN.		

SCALE - FULL
DO NOT SCALE PRINT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ARE

ONE PLACE	(.0)	±.030
TWO PLACE	(.00)	±.010
THREE PLACE	(.000)	±.005
ANGLES		±

WEIGHT

DRAWN N.H.L. 9 MAY '55 CHECK CHECK

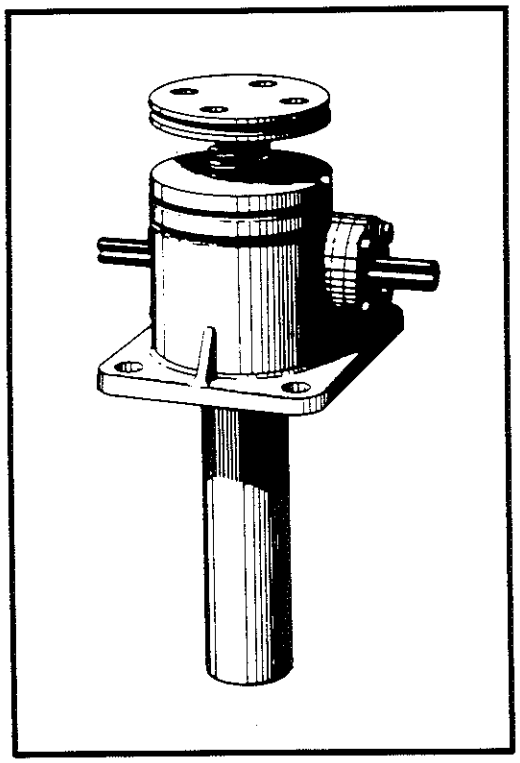
D330266 D330061-1
D330051/052-6 D330095-7

Duff-Norton®

MAINTENANCE INSTRUCTIONS WITH PARTS LIST

MACHINE SCREW ACTUATORS

PUBLICATION PART NO. SK-2389



SERIES
1800
9000
4800
9400

IMPORTANT — CAUTION

This manual contains important information for the correct installation, operation and maintenance of the equipment described herein. All persons involved in such installation, operation, and maintenance should be thoroughly familar with the contents. To safeguard against the possibility of personal injury or property damage, follow the recommendations and instructions of this manual and keep it for further reference.

⚠WARNING

The equipment shown in this manual is intended for industrial use only and should not be used to lift, support, or otherwise transport people.

Duff-Norton

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SECTION I

GENERAL INFORMATION

1-1. General

This manual contains maintenance instructions for Duff-Norton® 1800, 9000, 4800 and 9400 machine screw actuators. It describes and details procedures for disassembly, cleaning, inspection, rebuilding and assembly of these actuators.

1-2. Industrial Use Only

The machine screw actuators described and illustrated in this manual are intended for industrial use only and should not be used to lift, support or otherwise transport people unless you have a written statement from Duff-Norton Company which authorizes the specific actuator unit, as used in your application, as suitable for moving people.

1-3. Specifications

TABLE 1. 1800 AND 9000 SERIES

Actuator Number	Upright / Inverted	1802 & 9002 / 1801 & 9001	9005 / 9004	9010 / 9009	9015 / 9014	9020 / 9019	9025 / 9024	9035 / 9034	1850 / 1849	1899 / 1898	18150 / 18149
Rated Load (tons)		2	5	10	15	20	25	35	50	100	150
Diameter of Lifting Screw (inches)		1 .250 Pitch Acme	1 1/2 .375 Pitch Acme	2 .500 Pitch Acme	2 1/4 .500 Pitch Acme	2 1/2 .500 Pitch Acme	3 3/8 .666 Pitch Acme	3 3/4 .666 Pitch Acme	4 1/2 .666 Pitch Square	6 .750 Pitch Square	7 1.000 Pitch Square
Closed Height ** (in)		5 1/4	7	7 1/4	8	9 1/4	11	12	13	24	24
Base Size (in)		3 1/2 × 7 4 1/8 × 6 1/4	6 × 8	7 1/2 × 8 3/4	7 3/4 × 9 1/4	8 1/4 × 11	10 1/4 × 13 3/4	10 1/4 × 15 1/2	9 3/4 × 19 3/4	20 3/4 × 24 1/2	20 3/4 × 24 1/2
Worm Gear Ratios	Std. Ratio	6:1	6:1	8:1	8:1	8:1	10⅔:1	10⅔:1	10⅔:1	12:1	12:1
	Optional	24:1	24:1	24:1	24:1	24:1	32:1	32:1	32:1	36:1	36:1
Turns of Worm For 1" Raise	Std. Ratio	24	16	16	16	16	16	16	16	16	12
	Optional	96	64	48	48	48	48	48	48	48	36
Maximum H.P. Per Actuator	Std. Ratio	2	4	5	5	5	8	8	15	25	25
	Optional	½	¾	1½	1½	1½	2½	2½	6	11	11
Torque at Full Load* (in-lbs)	Std. Ratio	120	450	950	1,430	2,050	3,360	4,600	7,500	16,000	28,100
	Optional	50	185	490	820	1,170	1,900	2,750	4,200	8,600	15,500
Actuator Efficiency Rating (%)	Std. Ratio	23.2	22.1	22.0	20.2	18.8	16.4	15.2	13.8	13.0	14.1
	Optional	13.3	12.1	14.0	12.9	20.2	9.2	8.5	8.3	8.0	8.6
Weight with Base Raise of 6" (lb)		17	35	52	66	93	181	240	410	1,200	1,350
Weight For Each Additional 1" Raise (lb)		.33	.85	1.4	1.5	2.6	3.5	4.1	5.5	9.0	12.6

* For loads of from 25% to 100% of Actuator load rating. Torque requirements are approximately proportional to the load.

**Closed heights are for standard upright models and may vary with different screw ends, inverted models, or when bellows boot is used.

TABLE 2. 4800 AND 9400 SERIES

Actuator No.		4802 & 9402	9405	9410	9415	9420	9425	9435	4850	4899	48150
Rated Load (tons)		2	5	10	15	20	25	35	50	100	150
Torque at Full Load (in-lbs)	Std. Ratio	135	500	1045	1573	2255	3700	5060	8250	17600	30900
	Optional	55	205	540	905	1290	2090	3025	4620	9460	17050
Actuator Efficiency Rating %		20.9 11.9	19.9 10.9	19.8 12.6	18.0 11.7	16.9 10.8	14.8 8.3	13.7 7.7	12.4 7.3	11.7 7.2	12.7 7.7
Closed Height (in)		5¼	7	7¼	8	9¼	12	13	14	26½	26¼
Weight with Base Raise of 6 " (lb)		18	37	55	70	101	197	250	440	1325	1475

NOTE: Additional specifications are same as for Series 1800 and 9000. See Table 1.

TABLE 3. DECIMAL RATIOS

Actuator No.	Upright	1802 & 9002	9005	9010	9015	9020	9025
	Inverted	1801 & 9001	9004	9009	9014	9019	9024
Rated Load (tons)		2	5	10	15	20	25
Lifting Screw		1 " Dia. .250 Pitch Acme	1½" Dia. .250 Pitch Acme	2 " Dia. .250 Pitch Acme	2¼" Dia. .250 Pitch Acme	2½" Dia. .250 Pitch Acme	3⅜" Dia. .320 Pitch Square
Worm Gear Ratio		25:1	25:1	25:1	25:1	25:1	32:1
Turns of Worm for 1 " Raise		100	100	100	100	100	100
Torque at Full Load (in-lbs)		48	175	270	640	925	1500
Actuator Efficiency Rating %		13.2	9.1	8.6	7.5	6.9	5.3
Maximum H.P per Actuator		½	¾	1½	1½	1½	2½

NOTE: All other data for these models same as shown in Table 1.

1-4. Important Precautions

In order to ensure that Duff-Norton® machine screw actuators provide good service over a period of years the following precautions should be taken:

1. Select an actuator that has a load rating greater than the maximum load that may be imposed on it.
2. The structure on which the actuators are mounted should have ample strength to carry the maximum load, and should be rigid enough to prevent undue deflection or distortion of the actuator supporting members.
3. It is essential that the actuators be carefully aligned during installation so that the lifting screws are perfectly plumb and the connecting shafts are exactly in line with the worm shafts. After the actuators, shafting, gear boxes, etc., are coupled together, it should be possible to turn the main drive shaft by hand. If there are no signs of binding or misalignment, the actuator system is then ready for normal operation.
4. Machine screw actuators should have a greater raise than is needed in the actual installation. Should it be necessary to operate these actuators at the extreme limits of travel, it should be done cautiously.

CAUTION

Do not allow actuator travel to go beyond specified (catalog) closed height, or serious damage to internal mechanism may result. Refer to table of specifications (par. 1-3) for closed heights of respective units.

5. The worm shaft speed for these actuators should not exceed 500 RPM for heavy loads, 1200 RPM for light loads of one-fourth (or less) of the actuator load rating.
6. The lifting screw should not be permitted to accumulate dust and grit on the threads. If possible, lifting screws should be returned to closed position when not in use.

CAUTION

Where lifting screws are not protected from airborne dirt, dust, etc., bellows boots should be used. Inspect frequently at regular intervals to be certain that a lubricating film is present. Lifting screws should never be run dry.

7. When using an 1800 or 9000 Series Actuator, a periodic check of backlash of the lifting screw thread is recommended to check wear of the worm gear internal threads. The normal backlash on a new unit of this type is approximately .010 inch. **Backlash of 50% or more of the thread thickness indicates the need to replace the worm gear.**

   The 4800 and 9400 Series Anti-backlash Actuators are designed to be adjusted for minimum backlash, approximately .002 inch. The worm gear and anti-backlash nut are manufactured to have a clearance between their surfaces of ½ the thread thickness. **When adjustments have been made to the point where all this clearance is gone, 50% of the thread thickness is gone and replacement is necessary.** (See page 5, paragraph 2-8 for a detailed explanation of how the anti-backlash nut functions.)

NOTE

For loads of from 25% to 100% of actuator capacity, torque requirements are approximately proportioned to the load, except for very light loads.

8. The lubrication procedures for normal and severe service conditions, as described in Section II, paragraph 2-1, should be closely followed.

1-5. Warranty and Warranty Repair

Subject to the conditions stated herein, Duff-Norton will repair or replace, without charge, any parts proven to Duff-Norton's satisfaction to have been defective in material or workmanship. Claims must be made within one year after date of shipment. Duff-Norton will not repair or replace any parts that become inoperative because of improper maintenance, eccentric loading, overloading, chemical or abrasive action, excessive heat, or other abuse.

Equipment and accessories not of Duff-Norton's manufacture are warranted only to the extent that they are warranted

by the manufacturer, and only if the claimed defect arose during normal use, applications and service. Equipment which has been altered or modified by anyone without Duff-Norton's authorization is not warranted by Duff-Norton. EXCEPT AS STATED HEREIN, DUFF-NORTON MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

If you have any questions concerning warranty repair, please contact a convenient Duff-Norton Warehouse and Customer Service Center.

Authorization for return must be received from the Duff-Norton Company before returning any equipment for inspection or warranty repair.

SECTION II

MAINTENANCE

2-1. Lubrication

Unless otherwise specified, actuators and gear boxes are shipped packed with grease which should be sufficient for one month of normal operation. For normal operation, the actuator and gear boxes should be lubricated once a month using one of the following Extreme Pressure greases or their equivalent:

Socony Mobile Oil Co.	Mobilplex E.P. #1
Texaco	Texaco E.P. #1
Gulf Oil Corp.	Gulf Crown E.P. #1
Shell Oil Co.	Shell Alvania E.P. #1

For severe service conditions, the actuators should be lubricated more frequently using one of the above greases (daily to weekly depending on conditions). If duty is heavy, an automatic lubrication system is strongly recommended. If ambient temperatures exceed 200 °F, consult lubricant manufacturers.

CAUTION

Where lifting screws are not protected from airborne dirt, dust, etc., bellows boots should be used. Inspect frequently at regular intervals to be certain that a lubricating film is present. Lifting screws should never be run dry.

2-2. Rebuild Procedure

Duff-Norton recommends the following procedures for assembly and disassembly of machine screw actuators.

1. Tag critical parts to facilitate reassembly.
2. Mark mating surfaces to ensure proper meshing.
3. Clean and lubricate all parts as required.
4. All seals must be replaced when rebuilding.
5. All screws, washers and other small common parts must be replaced if damaged in any way.
6. Replace damaged or frozen lubrication fittings with new ones.

2-3. Required Tools

A bearing puller or press and common hand tools are necessary for proper assembly and disassembly.

2-4. Disassembly (Refer to Figure 3-1)

1. Remove lifting screw (5) from actuator.
2. Remove bottom pipe (4) from shell (3) (upright models) or shell cap (2) (inverted models) or base plate as applicable.
3. **FOR ALL MODELS EXCEPT 100 AND 150-TON—** Loosen and remove set screws (1) in cap (2) and remove cap from shell (3).

   FOR 100 AND 150-TON MODELS— Loosen the lock screw in the shell and unscrew (counterclockwise) the base plate from the shell.

   NOTE

   It may be necessary to break shell cap or base plate loose with a hammer.
4. Remove gear (6A) or worm gear and nut assembly (6B) from shell (3).

   NOTE

   To facilitate removal of the gear from the shell on models with 50-ton or higher load ratings, partially reassemble the lifting screw into the worm gear (or worm gear and nut assembly) and use a hoist or pulley block to lift on the screw.
5. Remove top load bearing (7) which may be attached to either shell cap (2) or worm gear (6A) or anti-backlash nut.

   CAUTION

   Use only a wooden mallet to tap bearings loose.
6. Remove bottom load bearing (8) which may be attached to either the shell (3) (base plate for 100 and 150-ton models) or worm gear (6A).
7. Remove four cap screws (9) from each of the two worm flanges (11) and remove flanges.

   NOTE

   Take care not to lose the flange shims (12).
8. Press oil seal (13) out of flange (11).
9. Remove worm (14) and worm bearings (15) from shell (3) by striking one end of worm with a wooden or lead mallet.
10. Remove worm bearings (15) from worm (14) with bearing puller or press. (**NOTE**: This step will not be necessary if worm and worm bearings are not damaged.)
11. If actuator is keyed, remove screw in shell cap (shell on 100 and 150-ton models) and tap key out of keyway.

2-5. Cleaning

1. Use degreasing solvent to remove grease or oil from all parts.

CAUTION

Remove grease from unit and do not reuse old grease.

WARNING

Provide adequate ventilation during the use of cleaning agents; avoid prolonged breathing of fumes and contact with skin.

2. Use clean hot water or a soap solution for general cleaning of painted surfaces.
3. Dry parts thoroughly after cleaning.

NOTE

Before installing new parts, remove any rust preventive, protection grease, etc.

2-6. Inspection (Refer to Figure 3-1)

1. Make a visual inspection of shell (3) for broken, cracked or distorted areas. Check threads of all bores for burrs or broken threads.
2. Check shell cap (2), base plate, bottom pipe (4), lifting screw (5), worm gear (6A) or worm gear and nut assembly (6B) for burrs or scratches on their working or mating surfaces.
3. Check fit between lifting screw thread and internal thread in worm gear. If fit is excessively loose, replace worm gear or lifting screw as required. Replace worm gear and nut assembly as a set (4800 and 9400 Series).
4. Check small common components (screws, etc.) and replace as required.
5. Check bearings (7), (8) and (15) for seizure, galling or play and replace as required.

2-7. Assembly (Refer to Figure 3-1)

1. Press worm bearings (15) onto worm shaft (14) making sure that bearings are seated properly against shoulder.

NOTE

When tapered roller bearings are used, the small end of the cone should point to the worm end.

2. Position worm shaft end (14) in shell (3).

NOTE

If tapered roller bearings are used, tap worm bearing cups into place in the shell.

3. Press oil seals (13) into worm flange (11).

NOTE

The sealing element should point inward.

4. Position worm flanges (11) with shims (12) and bolt in place.
5. Position bottom load bearing (8) (bearing cup on 5-ton and 35-ton models, top load bearing on 100 and 150-ton models) in shell (3).

5a. **On 5-ton and 35-ton models**, press load bearing cones onto worm gear (6A) or worm gear nut assembly (6B). Small end of bearing cone should face away from gear teeth.

6. Install worm gear (6A) or worm gear and nut assembly (6B) in shell (3).

CAUTION

Strike each end of worm shaft sharply with a wooden mallet to seat bearing properly. Recheck flange bolts for tightness. Worm should turn freely with minimum drag and end play. If too much end play is present, remove shims as required. If worm does not turn freely, add shims as required.

7. Install top load bearing (7) (bottom load bearing (8) for 100 and 150-ton models) on worm gear (6A) or worm gear and nut assembly (6B).
8. Fill housing fully with grease.
9. **FOR ALL MODELS EXCEPT 100 AND 150-TON—** Install shell cap (2) and screw down until tight.

NOTE

Shell cap flange does not necessarily have to bear against top of shell, there will usually be a gap. This will put a slight drag on worm. If worm is hard to turn, back off slightly on shell cap.

FOR ALL 100 AND 150-TON MODELS— Install base plate and screw down base plate until tight.

NOTE

This should put a slight drag on the worm. If the worm is hard to turn, back off slightly on the base plate. Be sure base plate does not project past base surface of housing.

10. Lock shell cap in place with set screws (lock screw on 100 and 150-ton models).

NOTE

If new parts have been installed, it may be necessary to respot holes for these screws.

11. **FOR ALL MODELS EXCEPT 100 AND 150-TON—** Screw bottom pipe (4) into shell (3) (upright models) or into shell cap (2) (inverted models).

FOR 100 AND 150-TON MODELS— Screw bottom pipe into base plate (upright models) or into shell (inverted models).

12. Brush lifting screw (5) with a light film of grease and install in actuator. On inverted models, install guide bushing (16) and then install lifting screw (5).
13. If actuator is keyed, install key in shell cap (2) (shell for 100 and 150-ton models) and bolt in place.
14. Operate unit to ensure proper functioning of all components prior to reinstallation.

2-8. Anti-Backlash Nut Function

As shown in Figure 2-1, the worm gear (2) and anti-backlash nut (3) are pinned together with guide pins. The threads in the anti-backlash nut work in opposition to the threads in the worm gear as they engage the threads of the lifting screw (1). Adjustment of backlash is made by running down

on the shell cap of the actuator. This forces the anti-backlash nut threads into closer contact, reducing clearance and thus reducing backlash.

2-9. Anti-Backlash Nut Adjustment

1. To minimize backlash remove the two set screws (4) and tighten down on shell cap until the desired backlash is obtained. Spot drill top of shell through set screw holes, then replace set screws and tighten to prevent shell cap backing off.
2. To avoid binding and excessive wear, do not adjust lifting screw backlash to less than 0.002 inch.
3. The clearance (A) designed into the worm gear and anti-backlash nut set is one-half the thread thickness. When adjustments have been made to use all this clearance replace the worm gear and anti-backlash nut as a set.

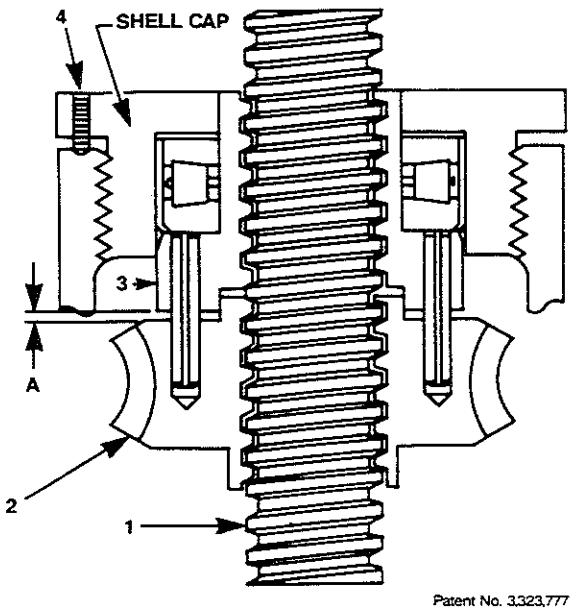


FIGURE 2-1. ANTI-BACKLASH NUT ADJUSTMENT

SECTION III

ILLUSTRATED PARTS LIST

3-1. General

This section contains an exploded illustration of the 1800, 9000, 4800 and 9400 Series machine screw actuator. The number adjacent to each part on the illustration is the index number. Keyed to this index number on the parts list is the part name.

When ordering parts be sure to include:

1. The nameplate model of your unit.
2. Index number and name of part.

3-2. PARTS LIST FOR 1800, 9000, 4800 and 9400 SERIES MACHINE SCREW ACTUATORS

INDEX NO.	PART NAME	QTY. REQ.
1	Screw, Set (All models except 100 and 150-ton)	2
2	Cap, Shell (All models except 100 and 150-ton)	1
3	Shell, Actuator	1
4	Pipe, Bottom	1
5	Screw Assembly, Lifting	1
6A	Worm Gear	1
6B	Worm Gear and Anti-backlash Nut Assembly (Mfg'd and sold in sets only)	1
7	Bearing, Top Load	1
8	Bearing, Bottom Load	1
9	Screw, Cap	8
10	Washer, Lock	8
11	Flange, Worm	2
12	Shim, Flange	2
13	Seal, Oil	2
14	Worm	1
15	Bearing, Worm	2
16	Bushing, Guide (inverted model only)	1
18	Nameplate	1
19	Screw, Lock (100 and 150-ton only)	1*
20	Plate, Base (100 and 150-ton only)	1*

*Not shown.

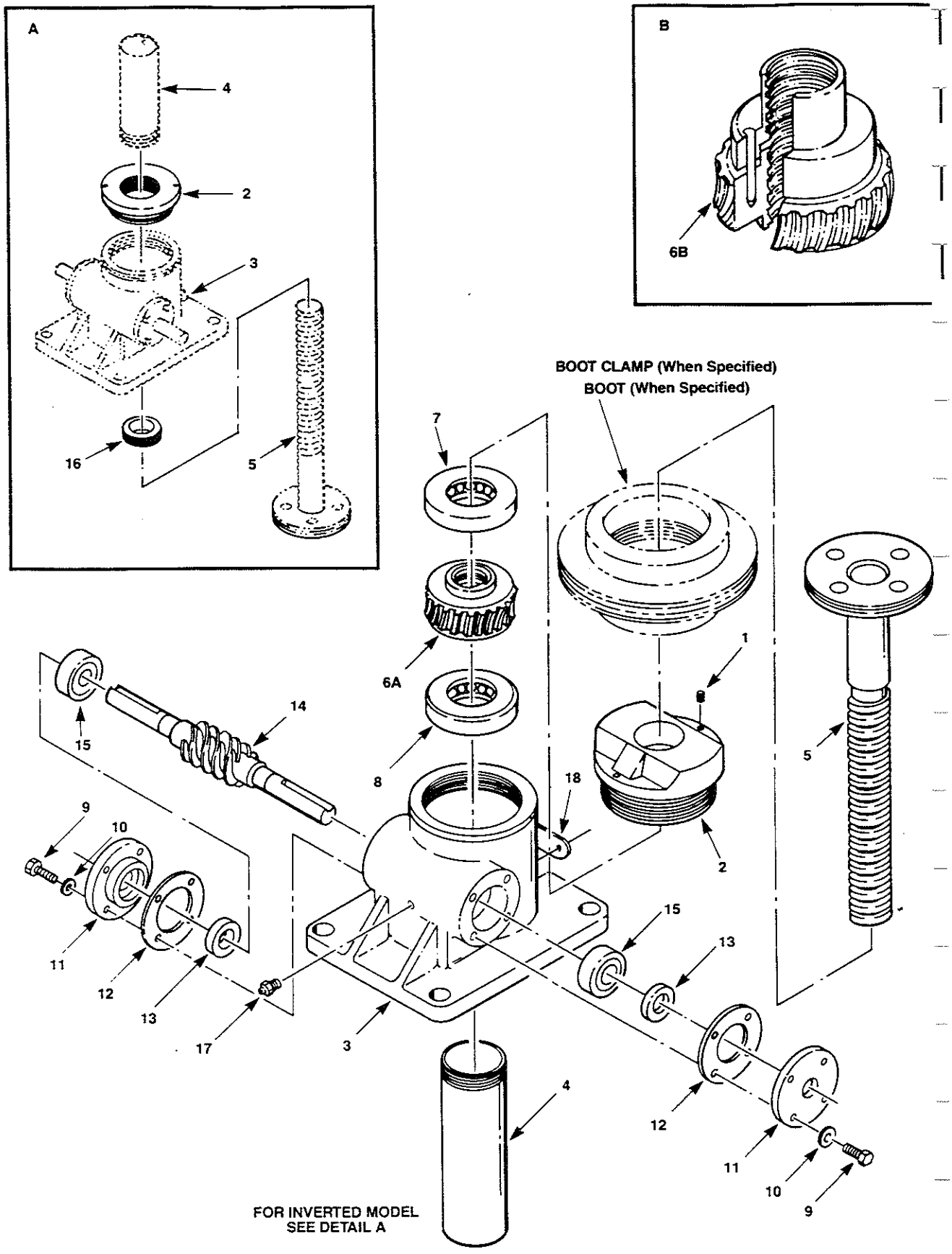
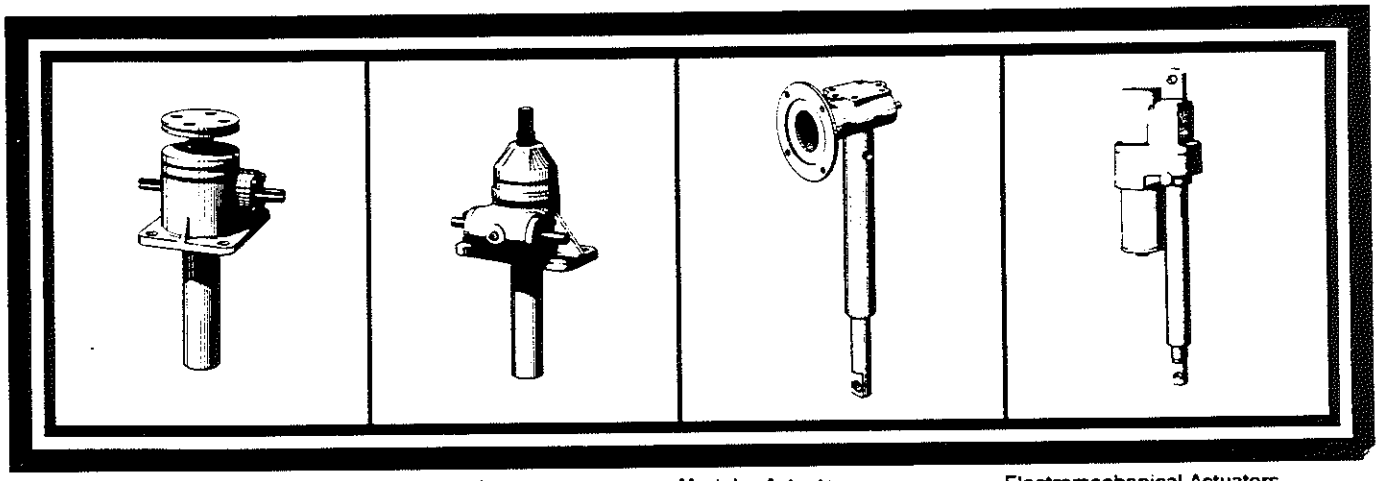


FIGURE 3-1. EXPLODED ILLUSTRATION 1800, 9000, 4800 and 9400 SERIES MACHINE SCREW ACTUATORS.

DUFF-NORTON OFFERS A COMPLETE LINE OF MECHANICAL AND ELECTROMECHANICAL ACTUATORS FOR PRECISE POSITIONING OF LOADS UP TO 250 TONS.

For reliable motion — in-line or through an arc — Duff-Norton has the right actuator to put your designs in motion. You can select from a comprehensive line of machine screw, ball screw, high-duty cycle, electromechanical and modular models to solve your design and production problems.

Duff-Norton® actuators are easy to specify, install and operate. Compact and self-contained, they do not require bothersome selection of individual components nor the attendant maintenance of leaky hydraulic hoses, valves or couplings. They provide many options in meeting a wide range of lifting, pushing, pulling and tensioning requirements.



Machine Screw Actuators. Capacities from 1/4 to 250 tons. Worm gear ratios from 5:1 to 50:1. More than 200 standard combinations to choose. Can be operated manually or by gear motor. Used to push, pull, apply pressure, or as linear actuators. Hold loads indefinitely without creep, when not subject to vibration.

Ball Screw Actuators. Capacities from 1/2 to 50 tons. Ball bearing screw and nut design reduces friction, increases efficiency as much as 70%. Permits linear motion up to 300 in/min @ 1800 rpm worm shaft speed. Available in 40 standard models. Multiple units may be synchronized for uniform raises to 10 feet.

Modular Actuators. Capacities to 2,000 pounds depending on actuator gear ratio and motor horsepower. Engineered for 56 frame motor, C face mounting. Choice of 5:1 or 20:1 gear ratios in rotating screw or translating tube models. Travel lengths to 24 inches. Lift speeds to 170 inches per minute.

Electromechanical Actuators. Capacities to 3/4 ton. Choice of 115 VAC or 12 VDC motors for indoor or outdoor applications. Standard raises from 3" to 24". Speeds to 145 in/min. All components sealed in a corrosion-resistant, aluminum alloy die-cast housing. Fully-adjustable limit switches available on some models.

For more information on these or other Duff-Norton® actuators, ask your local distributor or Duff-Norton District Sales Manager for Catalog 172. Or write factory.

WARNING: The equipment shown in this manual is intended for industrial use only and should not be used to lift, support, or otherwise transport people unless you have a written statement from Duff-Norton Company which authorizes the specific actuator unit, as used in your application, as suitable for moving people.

AVAILABLE FROM YOUR LOCAL ACTUATOR DISTRIBUTOR:

Duff-Norton

P.O. Box 7010
Charlotte, NC 28241-7010

Customer Service (800) 477-5002
FAX (704) 588-1994

Duff-Norton Manufactures
Duff-Norton® Actuators • Mechanical Jacks • Rotary Unions® • Coffing® Hoists
Duff Lynx® Hoists and Pullers

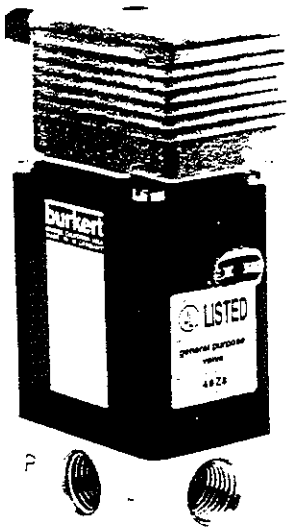
Printed in USA

4M\SK2389\5-97

Burkert
andard program

3/2-WAY SOLENOID VALVE FOR NEUTRAL LIQUID AND GASEOUS MEDIA 1/4 NPT

E330067/068-9



Burkert 3/2-way Solenoid valve type 330

Direct-acting valve, with epoxy-encapsulated coil, ported version, with lockable manual override. Flow medium separated from the magnetic system by a hermetically sealing diaphragm. Brass or stainless steel body and seat, Viton seal material, temperature range 14°F to 194°F, for neutral media such as compressed air, natural gas, water, hydraulic oil, oils and fats with no additives (max. viscosity approx. 4X10⁻⁴FT²/SEC). Electrical connection by cable plug (see next page).

Technical data

Mounting position	*any (preferably with solenoid systems upright)*
Max. ambient temp.	*130°F*
Voltage tolerance	*±10%*
Power consumption (in warm state)	*AC30VA (inrush) 15VA/8W (hold), DC8W*
Opening time (ms)	*AC/8-15, DC/10-20*
Closing time (ms)	*AC/8-15, DC/10-20*

Times measured at outlet A from switching on until pressure rise of 90% or drop to 10% at a working pressure of 85PSI.

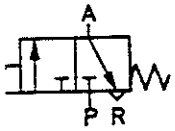
Cycling rate	*approx. 1000 c.p.m.*
Duty cycle	*continuous (100%)*

Approval Code

CSA+UL	*= U*
CSA+UR	*= R*
CSA	*= C*
CSA+UL+FM	*= Z*

FM approved
NONINCENDIVE FOR
HAZARDOUS LOCATIONS
CLASS I DIV. 2 GROUP A,B,C,D
CLASS II DIV. 2 GROUP F,G
CLASS III DIVISION 1 AND 2
OPERATION TEMPERATURE T4A

peration C



? way valve, normally closed. ıen de-energized, Outlet A ırmally vented.

dering Key

ındard Coil Voltages
DC 24/60
DC 120/60
240/60

Ordering

The part number explanation follows. Insert the required voltage into the part number from the table below.

330 - C - 1/8 - F - BR - 1/4 - * - 08 - U - H - 000

- 000 — OPTIONAL FEATURES (024=STAINLESS STEEL BODY) (047=VACUUM VERSION W STAINLESS STEEL BODY) (872=VACUUM VERSION WITH BRASS BODY)
- H — ELECTRICAL CONNECTION (E=SPADE CONNECTION) (H=PLUG REQ'D FOR UL LISTED VALVE)
- U — APPROVAL CODE (R=UL COMPONENT RECOGNIZED) (U=UL LISTED)
- 08 — COIL WATT RATING
- * — COIL VOLTAGE (SEE STANDARD COIL VOLTAGES)
- 1/4 — PORT CONNECTION
- BR — BODY MATERIAL (BR=BRASS, SS=STAINLESS STEEL)
- F — SEAL MATERIAL (F=VITON)
- 1/8 — ORIFICE DIAMETER
- C — VALVE OPERATION
- 330 — VALVE TYPE

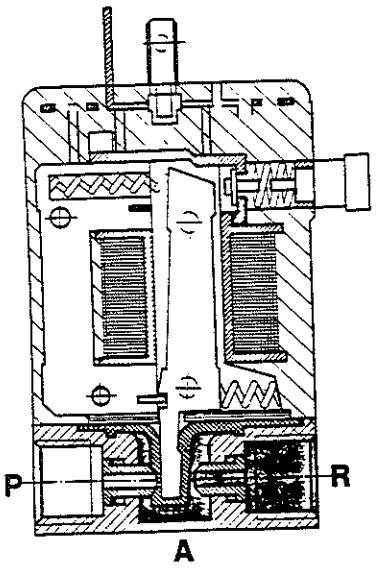
Orifice Diameter (IN)	Cv - Rating[1] Water (GPM)	Cv - Rating[1] Air (SCFM)[2]	Port Connection (NPT)	Pressure Range (PSI)	Weight (LBS)	Body Material	Part Number
5/64	0.13	4.2	1/4	0-170	0.88	BR	
						SS	
1/8	0.27	8.8	1/4	0-140	0.88	BR	
						SS	
5/32	0.33	11.4	1/4	0-70	0.88	BR	
						SS	

Flow rate values for DC are ·duced by 20%

2) Measured with 85 PSI upstream pressure and 15 PSI pressure drop across valve at a temperature of 68°F.

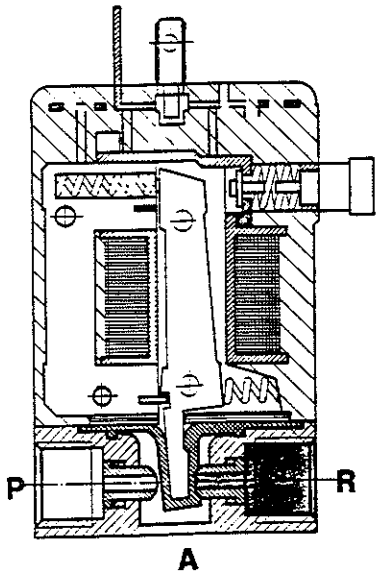
For specialized versions see Burkert main catalog data sheet type 330/331.

Operating Principle



Closed Position:

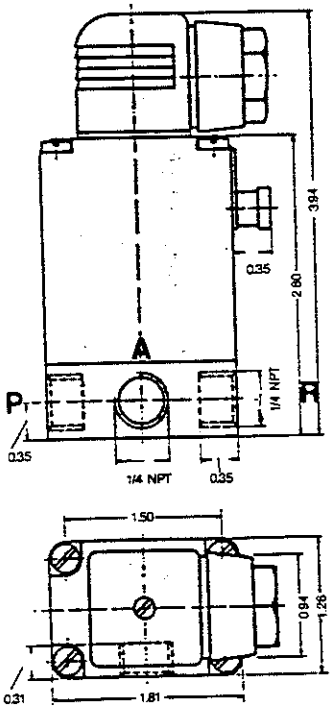
The diaphragm is so designed that it acts as a valve seal. When the coil is de-energized, the outlet port A is connected to the venting port R. The pressure outlet P is kept closed against the medium pressure by spring action.



Open position:

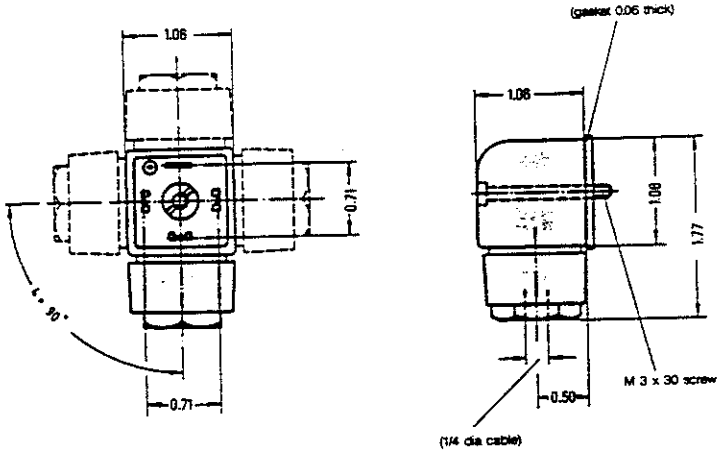
When energized, the solenoid closes the venting port with magnetic force. The outlet port A is pressurized.

Dimensions

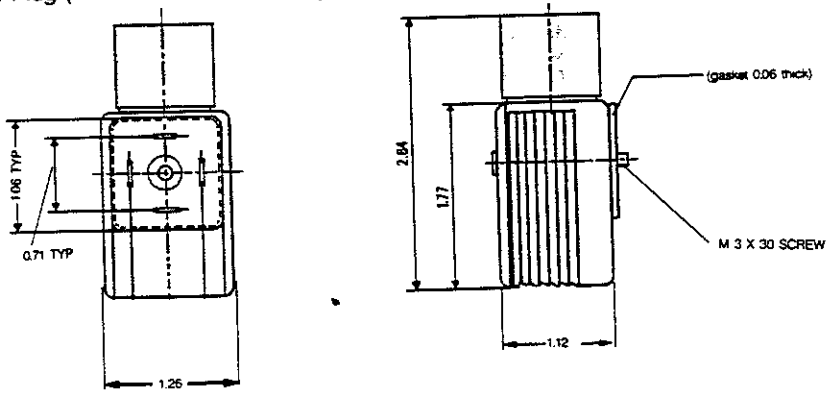


Cable plug

F plug (P/N A-1050-S001-021-00) not included with valve, order as separate item.



H Plug (P/N A-1053-S001-031-00) Included with all UL Listed valves



We reserve the right to make technical changes.

HEIDENHAIN

E330078/079-2

Betriebsanleitung
Operating Instructions

EXE 610C
EXE 611
EXE 612

4/94

Technische Beschreibung/Lieferumfang

Die EXE 61x ist eine Interpolations- und Digitalisierungs-Elektronik in einem robusten Gußgehäuse. Sie eignet sich zum Anschluß an HEIDENHAIN-Längen- und Winkelmeßsysteme mit sinusförmigen Stromsignalen (7 μA_{SS} bis 16 μA_{SS}). Je nach Ausführung der EXE werden die Meßsystem-Signale 5- oder 10fach interpoliert und digitalisiert.
Die Ausgangssignale der EXE haben TTL-Pegel.

Lieferumfang
- EXE (siehe Typenschild)
- Betriebsanleitung

Stecker und Kabel
- siehe „Kabelübersicht"

Zubehör für Justage und Service (separat zu bestellen)
- Adapter Nr. 19, Id.-Nr. 110 257 ZZ

Technical Description/Items Supplied

The EXE 61x is an interpolation and digitizing electronics unit in a sturdy cast-metal housing. It is suited for use with HEIDENHAIN linear and angle encoders that provide sinusoidal current signals (7 μA_{PP} to 16 μA_{PP}). Depending on the version, the EXE interpolates the encoder signals 5-, or 10-fold and then digitizes them.
The output signals of the EXE have TTL levels

Items Supplied
- EXE *(see ID label)*
- *Operating Instructions*

Connectors and Cable
- *See "Cable Overview"*

Accessories for Adjustment and Service (must be ordered separately)
- *Adapter No. 19, Id.-Nr. 110 257 ZZ*

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2 Lieferumfang
4 EXE 61x – Übersicht
5 Mechanischer Anbau
7 Elektrischer Anschluß
8 Kabelübersicht
9 Stromversorgung

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10 Pinbelegung
11 Prüfen der Eingangssignale

EXE-Ausgangssignale TTL
12 Beschreibung
15 Pinbelegung
16 Folge-Elektronik

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16 *Subsequent Electronics*

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18 *EXE 610 C/EXE 611*
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Status and Warning Indicators
21 *EXE 611*

Typ ***Model***	**Interpolation** ***Interpolation***	**Taktfrequenz f_T** ***Clock frequency f_T***	**Eingangsfrequenz f_i** ***Input frequency f_i***	**Min. Flankenabstand a** ***Min. edge separation a***
EXE 610 C	einstellbar: 5fach *selectable: 5-fold*	2 MHz	50 kHz 25 kHz 12,5 kHz 6,25 kHz	1 µs 2 µs 4 µs 8 µs
	10fach 10-fold		50 kHz 25 kHz 12,5 kHz 6,25 kHz	0,5 µs 1 µs 2 µs 4 µs
EXE 611 mit Diagnoseanzeigen *with Status and Warning Indicators*	siehe EXE 610 C *see EXE 610 C*			
EXE 612	einstellbar: 5fach *selectable: 5-fold*	8 MHz	100 kHz 100 kHz 50 kHz 25 kHz	0,25 µs 0,5 µs 1 µs 2 µs
	10fach 10-fold		100 kHz 100 kHz 50 kHz 25 kHz	0,125 µs 0,25 µs 0,5 µs 1 µs

Mechanischer Anbau

Den Anbauort richtig wählen

➤ Abstand der EXE und der signalführenden Kabel zu Störquellen einhalten:
- mindestens 20 cm zu Netzleitungen, Schaltnetzteilen, Schützen, Motoren, Magnetventilen und deren Zuleitungen,
- mindestens 10 cm zu störsignalführenden Kabeln,
- in metallischen Kabelschächten ist eine geerdete Zwischenwand erforderlich.

➤ Biegeradien der Signalkabel einhalten:

Kabel-Durchmesser	**Zulässiger Biegeradius für Wechselbiegung**	**einmalige Biegung**
6 mm	R > 75 mm	R > 20 mm
8 mm	R > 100 mm	R > 40 mm

Mechanische Kennwerte

Masse	ca. 0,7 kg
Schutzart	IP 65 (EN 60 529)
Arbeitstemperatur	0 bis 70 °C
Lagertemperatur	–30 bis 70 °C
Vibration (55 bis 2000 Hz)	≤ 10 m/s² (DIN IEC 68-2-6)
Schock (11 ms)	≤ 300 m/s² (DIN IEC 68-2-27)

Mounting

Select the proper mounting location

➤ *Ensure that the EXE and its signal cables are located at the proper distances from sources of interference:*
- *at least 20 cm from power cords, switch-mode power supplies, contactors, motors, solenoid valves and their supply leads,*
- *at least 10 cm from cables transmitting spurious signals,*
- *in metal cable ducts, a grounded partition is necessary.*

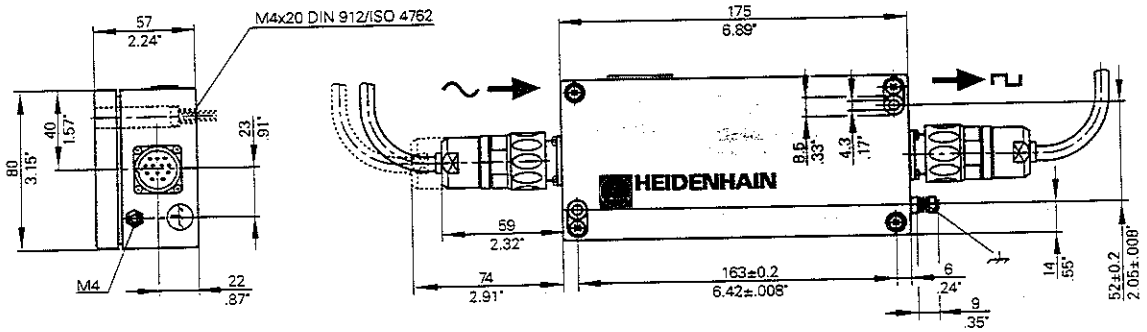
➤ *Comply with the specified bending radii for signal cable:*

Cable diameter	***Permissible bending radius for frequent flexing***	***rigid configuration***
6 mm (.24 in.)	*R > 75 mm (3 in.)*	*R > 20 mm (.8 in.)*
8 mm (.31 in.)	*R > 100 mm (4 in.)*	*R > 40 mm (1.6 in.)*

Mechanical Data

Weight	*Approximately 0.7 kg*
Protection	*IP 65 (IEC 529)*
Operating temperature	*0 to 70 °C (32 to 158 °F)*
Storage temperature	*–30 to 80 °C (–22 to 176 °F)*
Vibration *(55 to 2000 Hz)*	*≤ 10 m/s² (DIN IEC 68-2-6)*
Shock *(11 ms)*	*≤ 300 m/s² (DIN IEC 68-2-27)*

DIN ISO 8015
ISO 2768 - m H



➤ Die EXE mit zwei Befestigungsschrauben M4 x 20 DIN 912 montieren.

➤ *Mount the EXE with two mounting screws M4 x 20 ISO 4762.*

Elektrischer Anschluß

Gefahr für interne Bauteile!
Steckverbindungen nur bei ausgeschaltetem Gerät herstellen oder lösen!

Die richtigen Kabel verwenden:

- ➤ Meßsysteme und EXE nur mit HEIDENHAIN-Kabeln verbinden, um die Qualität der Meßsystem-Signale zu gewährleisten.
- ➤ Es wird empfohlen, EXE und Folge-Elektronik ebenfalls mit HEIDENHAIN-Kabeln zu verbinden. Steckerbelegung siehe Kapitel „EXE-Ausgangssignale".
- ➤ Maximale Kabellängen einhalten:

Meßsystem zur	
EXE 610 C/EXE 611	30 m ($I_{Meßsystem} \leq 120$ mA)
EXE 612	max. 10 m
EXE zur Folge-Elektronik	50 m bei empfohlener Eingangsschaltung der Folge-Elektronik. Die Höhe der Versorgungsspannung – meßbar am Kabelende über die Sensorleitung – muß dabei eingehalten werden. **EXE 612:** 20 m bei minimalem Flankenabstand $a_{min} = 0{,}125$ µs

Erdung und Schirmung

Die Kabelschirme, die metallischen Gehäuse der Meßsysteme, EXE und Steuerung müssen gleiches Potential aufweisen.

- ➤ EXE erden; dazu Kupferleitung (Ø ≥ 6 mm²) an ⏚ (M4-Gewinde) festschrauben und erden.
- ➤ Schirmung der Signalkabel direkt und großflächig auf die Gehäuse der Steckverbinder führen.

Electrical Connection

Potential damage to internal parts!
Do not engage or disengage connections unless the power is off!

Use the proper cable:

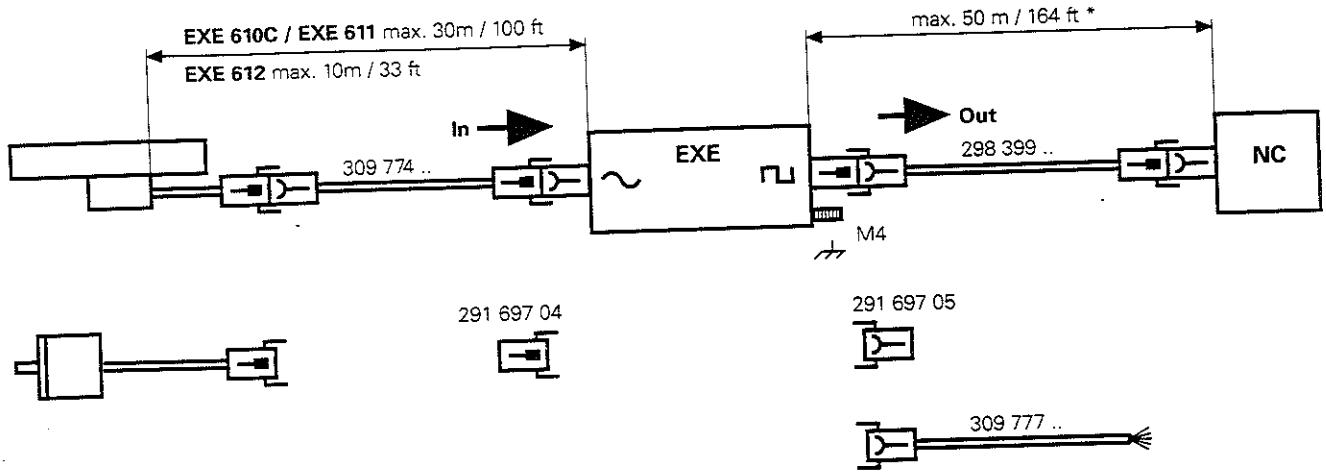
- ➤ *Connect the encoders to the EXE only with HEIDENHAIN cable to guarantee the quality of the encoder signals.*
- ➤ *We also recommend using HEIDENHAIN cable to connect the EXE to the subsequent electronics. For the pin layout, see the chapter "EXE Output Signals".*
- ➤ *Do not exceed the maximum cable lengths:*

Encoder to	
EXE 610 C/EXE 611	*30 m ($I_{encoder} \leq 120$ mA) (100 ft)*
EXE 612	*max. 10 m (32.8 ft)*
EXE to subsequent electronics	*50 m (164 ft) with recommended input circuitry of the subsequent electronics. Be sure that the supply voltage level – measured at the cable end over the sensor line – is maintained.* ***EXE 612:*** *20 m (66 ft) with minimum edge separation $a_{min} = 0.125$ µs*

Grounding and shielding

The cable shielding and the metal housings of the encoders, EXE and the control must all have the same potential.

- ➤ *Ground the EXE by screwing a grounded copper lead (dia. ≥ 6 mm²) onto ⏚ (M4 thread).*
- ➤ *Connect the shields so that they are short and provide maximum contact on the connector housings.*



*mit Differenz-Leitungsempfänger am Eingang der Folge-Elektronik
EXE 612: max. 20 m bei minimalem Flankenabstand a_{min} = 0,125 µs

**With differential line receiver at the input of the subsequent electronics*
EXE 612: *max. 20 m (66 ft) with minimum edge separation a_{min} = 0.125 µs*

Stromversorgung

Die EXE wird über Pin 10 (0 V) und Pin 12 (5 V) des 12poligen Ausgangskabels versorgt.

Spannung Stabilisierte Gleichspannung
5 V ± 5 %

Stromaufnahme Elektronik der EXE (ohne Lampenstrom und ohne Ausgangsbelastung):
EXE 610 C typ. 65 mA, max. 100 mA
EXE 612 typ. 65 mA, max. 100 mA
EXE 611 typ. 90 mA, max. 140 mA
Erhöhung der Stromaufnahme mit empfohlener Ausgangsbeschaltung:
ΔI = max. 80 mA
Lichtquelle des Meßsystems:
siehe Daten des Meßsystems

Gefahr für interne Bauteile!
Die Spannung externer Stromkreise muß einer "Funktionskleinspannung mit sicherer Trennung" nach EN 50 178 entsprechen!

Power Supply

The EXE is connected to the power supply on pin 10 (0 V) and pin 12 (5 V) of the 12-lead output cable.

Voltage *Regulated direct current*
5 V ± 5 %

Current consumption *Electronicsof the EXE (without lamp current or output load)*
EXE 610 C *typ. 65 mA, max. 100 mA*
EXE 612 *typ. 65 mA, max. 100 mA*
EXE 611 *typ. 90 mA, max. 140 mA*
Increase in current consumption with recommended output circuitry:
ΔI = max. 80 mA
Encoder light source:
see encoder spedifications

Potential damage to components!
Voltage sources for external circuits must conform to low voltage with reliable separation according to EN 50 178!

EXE-Eingangssignale ∿

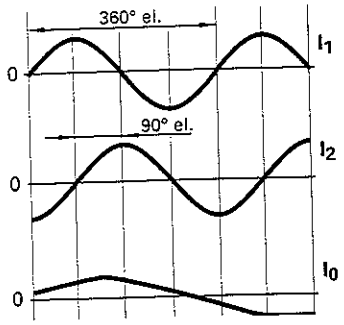
Sinusförmige Inkrementalsignale I_1 und I_2 mit 90° el. Phasenversatz

Signalpegel bei Last 1 kΩ
I_1, I_2: 7 bis 16 μA_{SS}
I_0: 2 bis 8,5 µA (Nutzanteil)

Eingangsfrequenz f_i siehe „Übersicht" und „EXE-Einstellungen"

Stromaufnahme der angeschlossenen Meßsysteme max. 250 mA

Pinbelegung
9polige Flanschdosen für sinusförmige Eingangssignale
(Farbangaben gelten für HEIDENHAIN-Kabel)



EXE *Input Signals* ∿

Sinusoidal incremental signals I_1 and I_2 with 90° el. phase shift

Signal levels *with 1 kΩ load*
I_1, I_2: *7 to 16 μA_{PP}*
I_0: *2 to 8.5 µA (usable component)*

Input frequency f_i *See "Overview" and "EXE Settings"*

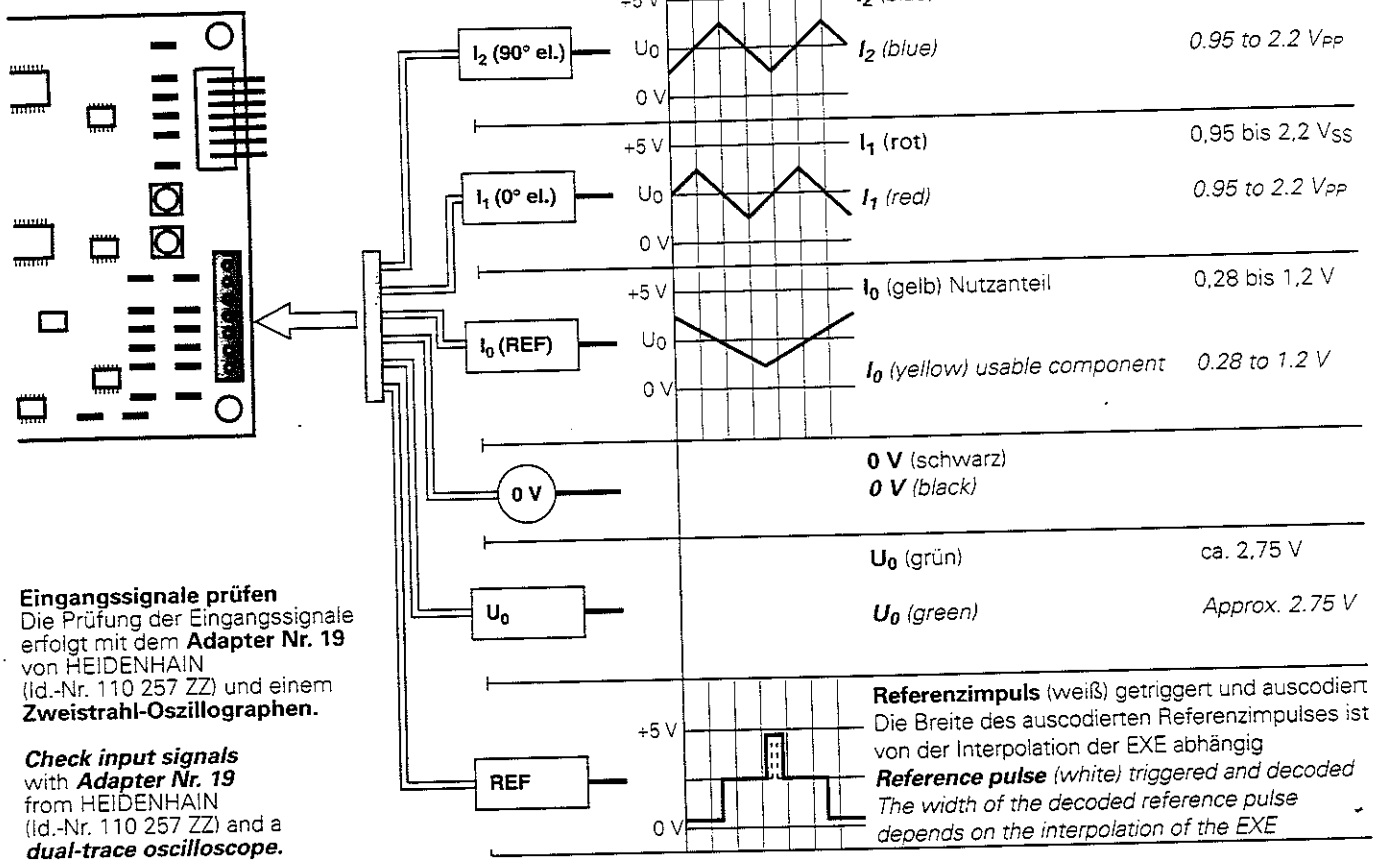
Current consumption of connected encoders *max. 250 mA*

Pin layout
9-pin flange sockets for sinusoidal input signals (colors specified as they apply to HEIDENHAIN cable)

Pin	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9***
Signal	I_{1+}	I_{1-}	+ 5 V	0 V	I_{2+}	I_{2-}	I_{0+}	I_{0-}	Schirm *shield*
Farbe ***Color***	grün *green*	gelb *yellow*	braun *brown*	weiß *white*	blau *blue*	rot *red*	grau *gray*	rosa *pink*	/

* innerer Schirm am Pin 9, äußerer Schirm am Steckergehäuse

** Internal shield on pin 9, external shield on connector housing*



Eingangssignale prüfen
Die Prüfung der Eingangssignale erfolgt mit dem **Adapter Nr. 19** von HEIDENHAIN (Id.-Nr. 110 257 ZZ) und einem **Zweistrahl-Oszillographen.**

Check input signals
with ***Adapter Nr. 19***
from HEIDENHAIN
(Id.-Nr. 110 257 ZZ) and a
dual-trace oscilloscope.

EXE-Ausgangssignale TTL

Inkrementalsignale: Getaktete Rechteckimpulsfolgen U_{a1} und U_{a2} mit 90° el. Phasenversatz, sowie deren invertierte Impulsfolgen $\overline{U_{a1}}$ und $\overline{U_{a2}}$ (nach RS-422).

Min. Flankenabstand a_{min} } siehe
Min. Impulsbreite b_{min} } Einstellunger

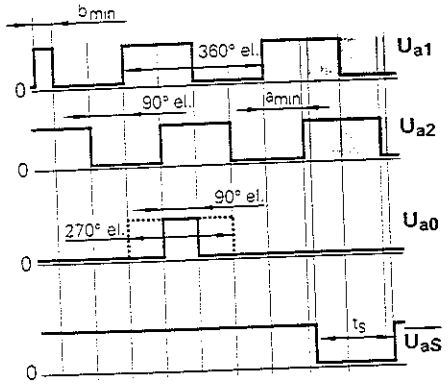
Referenzimpuls: Rechteckimpuls U_{a0} sowie dessen invertierter Impuls $\overline{U_{a0}}$

Breite 90° el. (Standard);
auf 270° el. umschaltbar

Störungssignal: Rechteckimpuls $\overline{U_{aS}}$

Dauer $t_s \geq 20$ ms
Max. Ansprechdauer nach dem Einschalten: 0,5 s.

Die Ausgänge für U_{a1}, U_{a2} sowie $\overline{U_{a1}}$, $\overline{U_{a2}}$ können bei $\overline{U_{aS}}$ = Low hochohmig geschaltet werden (Three State). Standard-Einstellung: Three State nicht aktiv.



EXE Output Signals (TTL)

Incremental signals: *Square-wave pulse trains U_{a1} and U_{a2} with 90 el. phase shift, plus their inverted pulse trains $\overline{U_{a1}}$ and $\overline{U_{a2}}$ (according to RS-422).*

Min. edge separation a_{min} } *See*
Min. pulse width b_{min} } *"Settings"*

Reference pulse: *Square-wave pulse U_{a0} and its inverted pulse $\overline{U_{a0}}$*

Width *90° el. (standard); switchable to 270° el.*

Fault detection signal: *Square-wave pulse $\overline{U_{aS}}$*

Duration $t_s \geq 20$ ms
Max. response duration after switch-on: 0.5 s.

With $\overline{U_{aS}}$ = low (tristate), the outputs U_{a1}, U_{a2} and $\overline{U_{a1}}$, $\overline{U_{a2}}$ can be switched to high impedance. Standard setting: tristate inactive.

EXE-Ausgangssignale TTL

Die Ausgangssignale werden kontinuierlich ausgegeben und sind – bezogen auf die Eingangssignale – wegproportional. Die auftretende Signallaufzeit zwischen EXE-Ein- und Ausgang ist abhängig vom eingestellten Flankenabstand und liegt bei der EXE 610 C/EXE 611 zwischen 6 µs und 17 µs, bei der EXE 612 zwischen 3 µs und 5 µs.

EXE Output Signals (TTL)

The output signals are transmitted continuously and are path-proportional relative to the input signals. The signal transit time from the EXE input to output depends on the selected edge separation. With the EXE 610 C/EXE 611 it is between 6 µs and 17 µs, with the EXE 612 it is between 3 µs and 5 µs.

EXE-Ausgangssignale TTL

Signalpegel

$U_{High} \geq 2{,}5$ V bei $-I_{High} \leq 20$ mA
$U_{Low} \leq 0{,}5$ V bei $I_{Low} \leq 20$ mA

Belastbarkeit

$-I_{High} \leq 20$ mA
$I_{Low} \leq 20$ mA
$C_{Load} \leq 1000$ pF gegen 0 V

Kurzschlußfestigkeit

Kurzschluß aller Ausgänge gegen 0 V kurzfristig zulässig.

Schaltzeiten

Bei Kabellänge = 1 m und empfohlener Eingangsschaltung der Folge-Elektronik:
Anstiegszeit t_+ = typ. 20 ns, max. 30 ns
Abfallzeit t_- = typ. 20 ns, max. 30 ns

EXE Output Signals (TTL)

Signal levels

$U_{High} \geq 2.5$ V at $-I_{High} \leq 20$ mA
$U_{Low} \leq 0.5$ V at $I_{Low} \leq 20$ mA

Load capacity

$-I_{High} \leq 20$ mA
$I_{Low} \leq 20$ mA
$C_{Load} \leq 1000$ pF against 0 V

Short-circuit stability

Momentary short circuit of all outputs against 0 V permissible.

Switching times

With cable length = 1 meter and the recommended input circuitry of the subsequent electronics:
Rise time t_+ = typ. 20 ns, max. 30 ns
Fall time t_- = typ. 20 ns, max. 30 ns

Pinbelegung
12polige Flanschdose (Stift) für TTL-Ausgangssignale
(Farbangaben gelten für HEIDENHAIN-Kabel)

Pin layout
12-pin flange socket (male) for TTL output signals
(colors specified as they apply to HEIDENHAIN cable)

Pin	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**/**
Signal	$\overline{U_{a2}}$	* Sensor + 5 V	U_{a0}	$\overline{U_{a0}}$	U_{a1}	$\overline{U_{a1}}$	$\overline{U_{aS}}$	U_{a2}	/	U_N* 0 V	* Sensor 0 V	U_P* + 5 V	/
Farbe **Color**	rosa *pink*	blau *blue*	rot *red*	schwarz *black*	braun *brown*	grün *green*	violett *violet*	grau *gray*	/	weiß/ grün *white/ green*	weiß *white*	braun/ grün *brown/ green*	gelb *yellow*

*Die Sensorleitung ist intern mit der Versorgungsleitung verbunden

**The sensor line is connected internally to the supply line*

Zulässige Kabellänge zwischen EXE und Folge-Elektronik

TTL-Ausgang: max. 50 m mit HEIDENHAIN-Kabel [4 (2 x 0,14) + (4 x 0,5)] mm^2 und empfohlener Eingangsschaltung der Folge-Elektronik. Die Höhe der Versorgungsspannung – meßbar am Kabelende über die Sensorleitung – muß dabei eingehalten werden.

EXE 612: max. 20 m bei minimalem Flankenabstand a = 0,125 µs

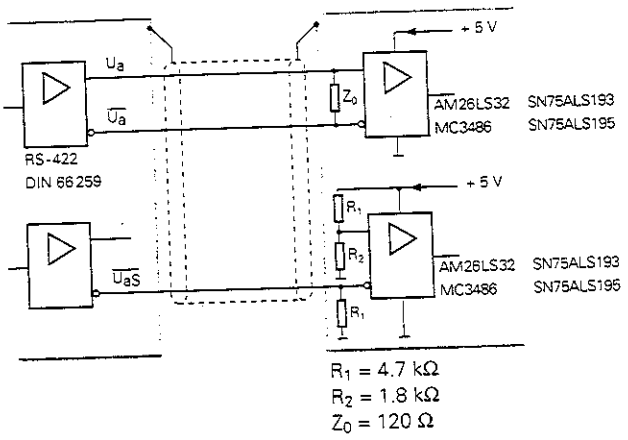
Permissible cable length from EXE to subsequent electronics

TTL output: *Max. 50 m with HEIDENHAIN cable [4 (2 x 0.14) + (4 x 0.5)] mm^2 and recommended input circuitry of the subsequent electronics. Be sure that the supply voltage level – measured at the cable end over the sensor line – is maintained.*

EXE 612: *Max. 20 m (66 ft) with min. edge separation a = 0.125 µs*

Empfohlene Eingangsschaltung der Folge-Elektronik

Recommended input circuitry of subsequent electronics



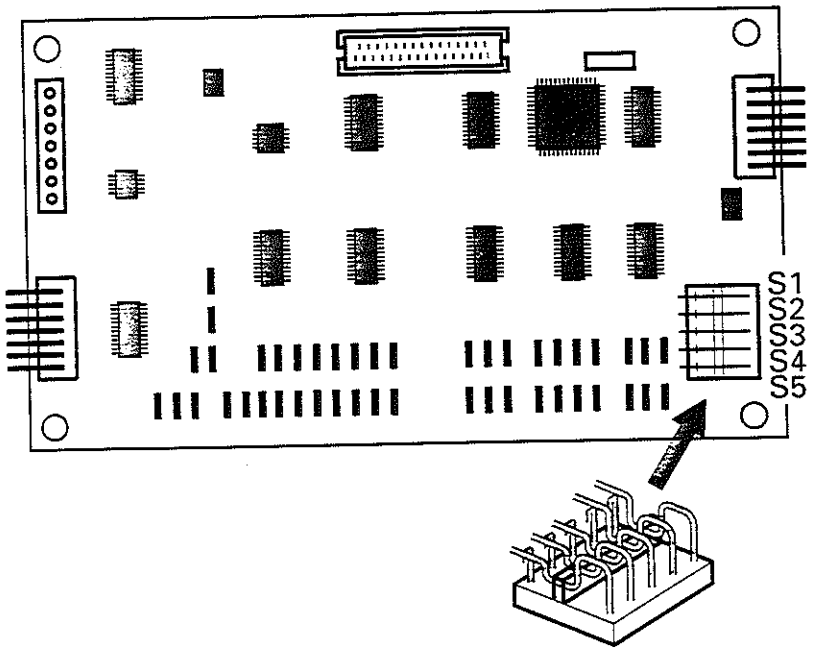
R_1 = 4.7 kΩ
R_2 = 1.8 kΩ
Z_0 = 120 Ω

Minimaler Flankenabstand a_{min}/Minimale Impulsbreite b_{min}
Der minimale Flankenabstand a_{min} ist die kleinste zulässige Zeitspanne zwischen zwei benachbarten Flanken von U_{a1} und U_{a2}. Die minimale Impulsbreite b_{min} ist die kleinste Zeitspanne zwischen zwei benachbarten Flanken auf einer Leitung.
Bei **getakteten** Ausgangssignalen sind a_{min} und b_{min} durch die Taktfrequenz f_T festgelegt. Das Auftreten des minimalen Wertes kann bereits bei annäherndem Stillstand des Meßsystems (z. B. durch Vibration) erfolgen. Im Interesse einer guten Störsicherheit der EXE muß die Eingangsschaltung der Folge-Elektronik unabhängig von der Eingangsfrequenz der EXE die Flankenabstände a_{min} und b_{min} fehlerfrei verarbeiten können. Als Sicherheitszuschlag für Laufzeitunterschiede in der Übertragungsstrecke sollten. je nach Länge des Ausgangskabels mindestens 20 ns + 0,2 ns/m berücksichtigt werden.

Minimum edge separation a_{min}/Minimum pulse width b_{min}
The minimum edge separation a_{min} is the shortest permissible duration between two successive signal edges of U_{a1} and U_{a2}. The minimum pulse width b_{min} is the shortest permissible duration between two successive pulse edges on one line.
*For **clocked** output signals, a_{min} and b_{min} are determined by the clock frequency f_T. A very small a_{min} or b_{min} may occur even when the encoders are nearly motionless, for example as a result of vibration. In order to ensure adequate protection of the EXE from interference, the input circuitry of the subsequent electronics should be able to correctly process a_{min} and b_{min} regardless of the input frequency of the EXE. Depending on the length of the output cable, you should calculate a safety margin of at least 20 ns + 0.2 ns/m for differences in transit time over the transmission distances.*

Auf der Platine befinden sich fünf Schalter.

There are five switches on the circuit board.



Einstellungen EXE 610 C/EXE 611

Settings EXE 610 C/EXE 611

Mit den Schaltern auf der EXE-Platine lassen sich folgende Einstellungen vornehmen:

The switches on the EXE board can be used to make the following settings:

Referenzimpuls-Breite *Reference pulse width*	**Schalter** *Switches* S1
90° el.	o
270° el.	●

Ausgänge: U_{a1}, $\overline{U_{a1}}$, U_{a2}, $\overline{U_{a2}}$ bei $\overline{U_{aS}}$ = low ***Outputs:*** *U_{a1}, $\overline{U_{a1}}$, U_{a2}, $\overline{U_{a2}}$ at $\overline{U_{aS}}$ = low*	**Schalter** *Switches* S2
nicht hochohmig *Low impedance*	O
hochohmig *High impedance*	●

EXE 610 C/EXE 611

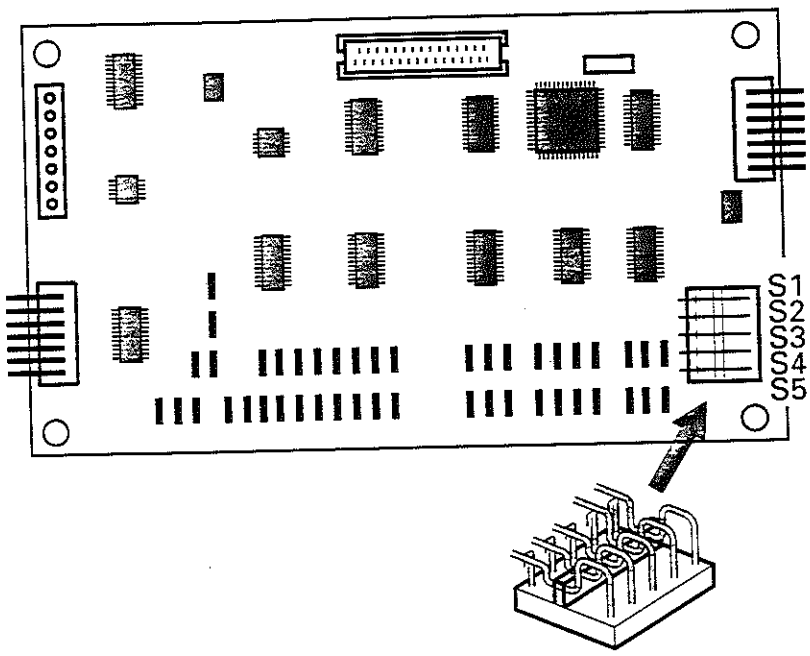
Interpolation ***Interpolation***	**Takt** ***Clock***	**Max. Eingangsfrequenz** ***Max. input frequency***	**Min. Flankenabstand a_{min}** ***Min. edge separation a_{min}***	**Min. Impulsbreite b_{min}** ***Min. pulse width b_{min}***	**Schalter** ***Switches*** S3	S4	S5
5fach *5-fold*	2 MHz	50 kHz	1 µs	0,5 µs	●	●	●
		25 kHz	2 µs	1 µs	O	●	●
		12,5 kHz	4 µs	2 µs	●	O	●
		6,25 kHz	8 µs	4 µs	O	O	●
10fach *10-fold*		50 kHz	0,5 µs	0,5 µs	●	●	O
		25 kHz	1 µs	1 µs	O	●	O
		12,5 kHz	2 µs	2 µs	●	O	O
		6,25 kHz	4 µs	4 µs	O	O	O

O = Schalter offen
● = Schalter geschlossen

O = *Switch open*
● = *Switch closed*

Auf der Platine befinden sich fünf Schalter.

There are five switches on the circuit board.



Einstellungen EXE 612

Mit den Schaltern auf der EXE-Platine lassen sich folgende Einstellungen vornehmen:

Referenzimpuls-Breite *Reference pulse width*	**Schalter** *Switches* S1
90° el.	○
270° el.	●

Settings EXE 612

The switches on the EXE board can be used to make the following settings:

Ausgänge: U_{a1}, $\overline{U_{a1}}$, U_{a2}, $\overline{U_{a2}}$ bei $\overline{U_{aS}}$ = low ***Outputs:*** *U_{a1}, $\overline{U_{a1}}$, U_{a2}, $\overline{U_{a2}}$ at $\overline{U_{aS}}$ = low*	**Schalter** *Switches* S2
nicht hochohmig *Low impedance*	○
hochohmig *High impedance*	●

EXE 612

Interpolation ***Interpolation***	**Takt** ***Clock***	**Max. Eingangsfrequenz** ***Max. input frequency***	**Min. Flankenabstand a_{min}** ***Min. edge separation a_{min}***	**Min. Impulsbreite b_{min}** ***Min. pulse width b_{min}***	**Schalter** *Switches* S3	S4	S5
5fach *5-fold*	8 MHz	100 kHz* 100 kHz 50 kHz 25 kHz	0,25 µs 0,5 µs 1 µs 2 µs	0,125 µs 0,25 µs 0,5 µs 1 µs	● ○ ● ○	● ● ○ ○	● ● ● ●
10fach *10-fold*		100 kHz* 100 kHz 50 kHz 25 kHz	0,125 µs 0,25 µs 0,5 µs 1 µs	0,125 µs 0,25 µs 0,5 µs 1 µs	● ○ ● ○	● ● ○ ○	○ ○ ○ ○

* Bei dieser Einstellung sind Frequenzen von über 100 kHz (bis ca. 180 kHz) möglich. Die max. erreichbare Frequenz hängt jedoch von der -3dB-Grenzfrequenz des jeweiligen Meßsystems ab.

○ = Schalter offen

● = Schalter geschlossen

* With this setting, frequencies over 100 kHz are possible (up to approx. 180 kHz). The max. possible frequency, however, depends on the -3dB cutoff frequency of the encoder.

○ = *Switch open*

● = *Switch closed*

INLAND MOTOR DIVISION Southwest Controls 714 970-5586 KOLLMORGEN CORPORATION

TORQUER CATALOG DATA SHEET

BY: D. Marks DATE: 6/11/84
CHECKED BY: CRW DATE: 6-14-84

MODEL QT-12509

CDE- 12444
ISSUE A
SHEET 1 OF 1

MOTOR SIZE CONSTANTS	UNITS	SYMBOL	VALUE
Peak Torque	lb•ft	T_P	200
Motor Constant	lb•ft/$\sqrt{watt}$	K_M	6.04
Electrical Time Constant	ms	T_E	3.78
Mechanical Time Constant	ms	T_M	5.5
Power Input, Stalled, At Peak Torque (25°C)	watts	P_P	1095
Viscous Damping — Zero Z Source	lb•ft per rad/s	F_O	49.5
Viscous Damping — Inf. Z Source	lb•ft per rad/s	F_I	0.30
Motor Friction Torque	lb•ft	T_F	1.6
Ripple Torque, Ave. to Peak	percent	T_R	2
Ripple Cycles Per Rev.	cycles/rev	–	139
Ultimate Temp. Rise Per Watt	deg C	TPR	0.1
Max. Permissible Winding Temperature	deg C	–	155
Rotor Moment of Inertia	lb•ft•s²	J_M	0.27
Max. Power Rate	lb•ft/s²	$\dot{P}$	1.48×10^5
Max. Theoretical Accel.	rad/s²	αM	740
No Load Speed Theor @ Vp	rad/s	ωNL	4
Motor Weight	lbs	–	67

Slots .
Bars .
Poles .
M.L. Rotor .
M.L. Stator .
ϕ / Pole .
MLT .
Rad. Gap .
No. Brush .
Type Brush .
Brush Area .
Magnet Mat .
Rotor O.D. .
Rotor I.D. .
Stator O.D. .
Stator I.D. .
Overall Width

NOTE:
THESE DATA TO BE BLANKED OUT BEFORE GOING TO A CUSTOMER OR REPRESENTATIVE.

FORM ED-7228/REV. 5-84

WINDING CONSTANTS	UNITS	TOL	SYMBOL	A	B	C	D	E	F	G	H
DC Resistance (25°C)	ohms	±12.5%	R_M	4.50	2.86	1.70					
Volts At Pk. Torque (25°C)	volts	nom	V_P	70.2	56.1	44.4					
Amps At Peak Torque	amps	rated	I_P	15.6	19.6	26.1					
Torque Sensitivity	lb•ft/amp	±10%	K_T	12.8	10.2	7.68					
Back EMF	V per rad/s	±10%	K_B	17.4	13.9	10.4					
Inductance	mH	±30%	L_M	17	11	6.1					

E330083-8

NO.	ECN. NO.	DATE	APP'D	NO.	ECN. NO.	DATE	APP'D	NO.	ECN. NO.	DATE	APP'D
A	64464	5/9/94	REH								

EXE 611 Diagnoseanzeigen

EXE 611 Status and Warning Indicators

Die EXE 611 besitzt sechs Leuchtdioden zur Anzeige folgender Zustände:

The EXE 611 has six LEDs which signal the following states:

Anzeige / *Display*	**Funktion**	***Function***
RI	Eine Referenzmarke wurde überfahren (Mindest-Anzeigedauer ca. 300 ms).	*A reference mark was crossed over (minimum display duration approx. 300 ms).*
Ua0 *	Mindestens ein U_{a0}-Signal wurde ausgegeben.	*At least one U_{a0} signal was output.*
Up *	Versorgungsspannung zu niedrig: < 4,5 V	*Supply voltage too low (less than 4.5 V)*
<5 *	Eingangssignale zu klein: Amplituden < 5 μA_{SS}	*Input signals too weak (amplitudes are under 5 μA_{PP})*
>16 *	Eingangssignale zu groß: Amplituden > 16 μA_{SS}	*Input signals too strong (amplitudes are over 16 μA_{PP})*
fmax *	Der angegebene Positionswert weicht um mehr als ein Viertel der Signalperiode vom Eingangswert ab. Dies wird beim Überschreiten der max. Eingangsfrequenz oder bei scheinbaren Positionssprüngen durch starke Störeinflüsse erreicht. Erfahrungsgemäß führen Störeinflüsse zu keinem Positionsfehler, wenn die Signalamplituden ≥ 5 μA_{SS} sind - trotz Fehlermeldung.	*The indicated position value deviates from the input value by more than one quarter of the signal period. This can occur when the maximum input frequency is exceeded or with apparent position jumps caused by strong interference. Experience has shown that interference does not cause position errors when the signal amplitudes are at least 5 μA_{PP} – even when an error is signalled.*

* Diese Anzeigen werden gespeichert. Das Löschen erfolgt durch Aus-/Einschalten der Versorgungsspannung oder durch kurzzeitigen „Low"-Impuls auf dem Ausgangssignal $\overline{U_{aS}}$.

* *These displays are stored. They can be deleted by switching the power off and then on again, or with a brief LOW pulse on output signal $\overline{U_{aS}}$.*

Angle Encoders

July 1994

DISTRIBUTED & SERVICED BY
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1400 W. Lambert Rd. Unit C
BREA, CA 92621
(310) 905-5342 (310) 905-5346

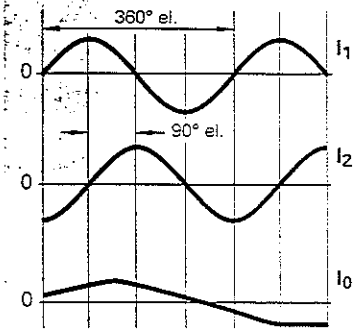
HEIDENHAIN

ROD 700/ROD 700C

Power supply

5 V ± 5 %/max. 90 mA (with no load)
Light source: LED

Output signals



Incremental signals 2 sinusoidal signals I_1 and I_2. I_2 lags I_1 with clockwise rotation (viewed from flange side)

Signal amplitude with 1 kΩ load: I_1 approx. 11 μA_{PP}; I_2 approx. 11 μA_{PP}

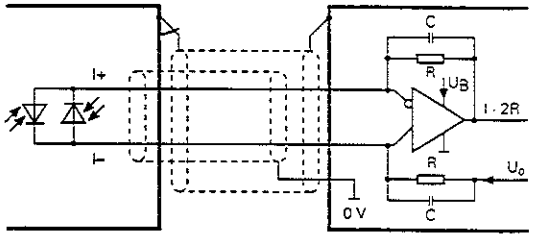
Reference signal

ROD 700 1 signal I_0 per revolution
ROD 700C 36 signals I_0 per revolution with 18000 lines
72 signals I_0 per revolution with 36000 lines

Signal amplitude with 1 kΩ load: I_0 approx. 5.5 µA (usable component)

–3 dB limit frequency ≥ 90 kHz

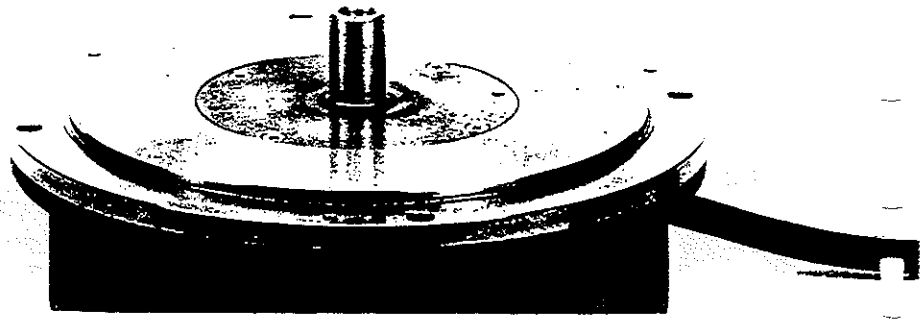
Recommended input circuitry of subsequent electronics



RC 4157
C = 27 pF
R = 100 kΩ ± 2%

$$U_0 = \frac{U_B}{2}$$

Cable length at angle encoder: 1 m (3.3 ft), other lengths upon request
to subsequent electronics: 30 m (100 ft) max., HEIDENHAIN cable [3(2 x 0.14) + (2 x 1)] mm^2



ROD 700

Sturdy die-cast housing
Accuracy ± 2″ with 36000 lines

ROD 700C

Distance-coded reference marks

Measuring step 0.0005°/0.0001°
with 18000/36000 lines after
10-fold/25-fold interpolation

Power supply 5 V

Output signals 2 sinusoidal incremental signals and 1 or 36 or 72 reference mark signals per revolution
External interpolation and digitizing electronics

Standard line counts
ROD 700 18000
ROD 700C 18000/36000

Mechanical Data

Shaft speed		Max. 1000 rpm
Moment of inertia of rotor		$366 \cdot 10^{-6}$ kgm^2
Torque at 20° C (68° F)		≤ 0.012 Nm
Shaft load	Axial Radial	30 N 30 N at shaft end
Weight		Approx. 3.5 kg (7.7 lb)
Protection		IP 64 (IEC 529)
Operating temperature **Storage temperature**		0 to 50° C (32 to 122° F) –30 to 80° C (–22 to 176° F)
Vibration (55 to 500 Hz) **Shock** (6 ms)		≤ 100 m/s^2 (DIN IEC 68-2-6) ≤ 300 m/s^2 (DIN IEC 68-2-27)

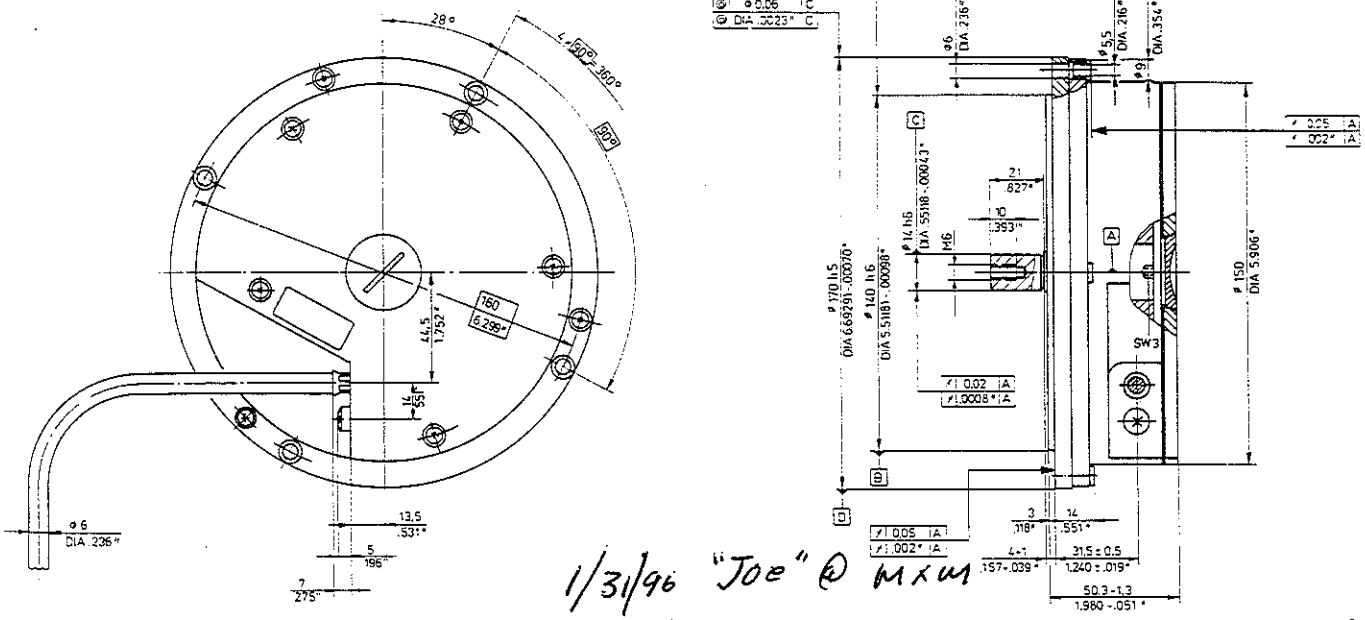
Dave Burgarewicz — Rick Glos
telescope eng.

(408) 519 4206 Vacuum

will run in a Vacuum — good to 10^{-6} torr

Dimensions
in mm/inches

Resolution in ° = $\frac{360}{\text{lines} \times \text{int.} \times 4}$
↑ quad counter



1/31/96 "Joe" @ MXM

ROD 700 w/18000 lines $5057

18000 has .0002° Res.

Interpolators: EXE 602 x5 $393 -
" 610 x10 $490 -
" 650 x25/50 $858 -
" 660 x100 $1072 -

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CARTER PERMANENT MAGNET DC TACH GENERATORS

E330083/084-5

High output models ideal for slow speed applications. Rugged, long life, accurate, low cost.

Today's industrial automation demands product quality, control and performance. Accurate, continuous measurement of rotating and surface speeds can improve your product's quality and lower cost in many applications. Carter DC Tachometer Generators provide a simple and dependable means to obtain your speed measurements. Our Tach Generators deliver higher output voltages for slow speed applications.

Carter PM DC Tach Generators are designed to meet the need for high output DC models for commercial and industrial applications. Rugged in design as well as performance, our tachs deliver outputs from 5 to 60 volts per thousand RPM. Excellent inherent reliability for long life, trouble free service. Carter Tach Generators will help you measure and control your product quality and performance, accurately, dependably, and at low cost.

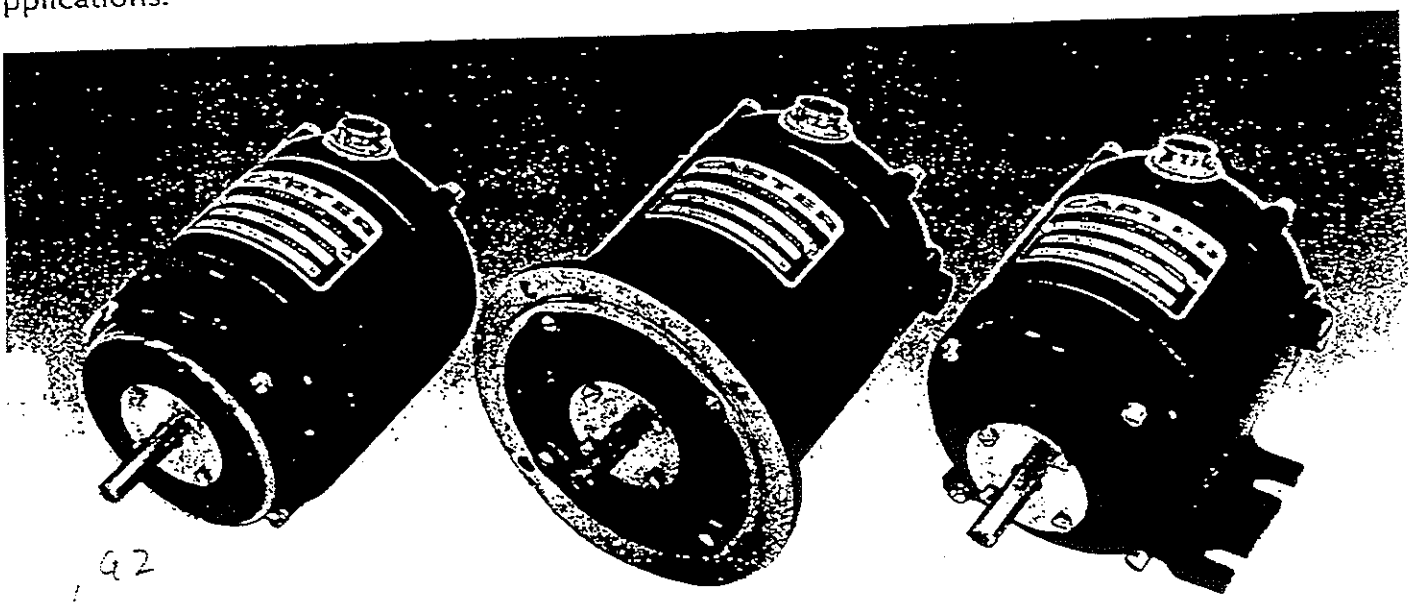

FIG. 12

FIG. 13

FIG. 14

SPECIFICATIONS

Maximum output up to 15 watts capacity at 3600 RPM. Driving torque, 1 oz. in. average. Maximum speed 10,000 RPM or 200 volts with capacitor filter.

Linearity at 25 degrees C, one direction 1%, either direction 3%. Ripple 3% filtered, 5% unfiltered, per IEEE test #251. Temperature range −40 degrees C to +75 degrees C (not temperature compensated.) 2 lead reversible. Continuous duty. Totally enclosed. Electrical and mechanical modifications available per your specifications.

Model Number	DC output Volts per/1000	Mounting	Maximum Speed RPM
CTA60AA	60	base	3000
CTA60BA	60	face	3000
CTA60DA	60	flange	3000
CTA50AA	50	base	4000
CTA50BA	50	face	4000
CTA50DA	50	flange	4000
CTA25AA	25	base	8000
CTA25BA	25	face	8000
CTA25DA	25	flange	8000

OTHER VOLTAGES AVAILABLE ON ORDER

With a Carter PM DC tach coupled directly to the drive source, there is no need to increase shaft speeds with belts or gearing to obtain sufficient output voltage. Gear backlash and accumulated drive errors are eliminated.

CARTER CLASSIC TACH GENERATORS
DIMENSIONS AND WEIGHTS

OUTPUT VOLTS	5 TO 60 PER 1000 RPM
MAXIMUM RPM	10,000 RPM
MAXIMUM POWER OUTPUT	15 WATTS
CTA-AA-BA-DA	4-1/2 LBS. L = 4-1/2 IN.

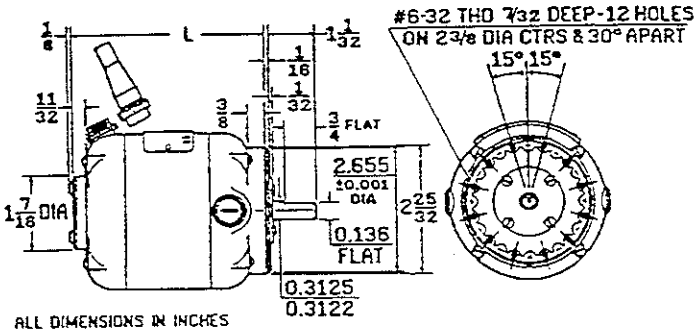

FIG. 12

OUTPUT VOLTS	5 TO 60 PER 1000 RPM
MAXIMUM RPM	10,000 RPM
MAXIMUM POWER OUTPUT	15 WATTS
CTA-AA-BA-DA	4-1/2 LBS. L = 4-13/32 IN.

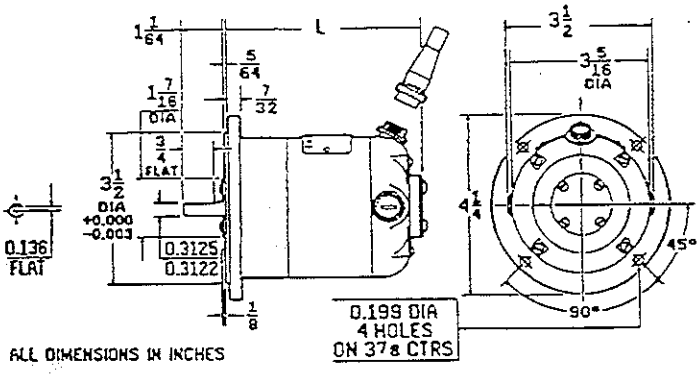

FIG. 13

OUTPUT VOLTS	5 TO 60 PER 1000 RPM
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CTA-AA-BA-DA	4-1/2 LBS. L = 4-1/2 IN.

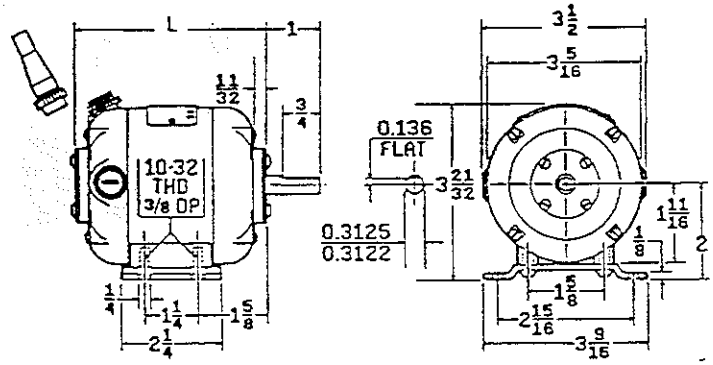

FIG. 14

CONVERSION FACTORS

POWER

HP = TORQUE (LB IN) X SPEED (RPM) ÷ 63025
HP = WATTS ÷ 745.7
WATTS = HP X 745.7

TORQUE

OZ IN = LB FT x 192.0
LB FT = OZ IN ÷ 16 ÷12

SAFETY

"The use of electrical motors and generators like that of all other utilization of concentrated power, is potentially hazardous. The degree of hazard can be greatly reduced by proper design, selection, installationand use, but hazards cannot be completely eliminated. The reduction of hazard is the joint responsibility of the user, the manufacturer of the driven or driving equipment and the manufacturer of the motor or generator"*

Since even well built apparatus can be installed or operated in a hazardous manner it is important that the user observe safety considerations. To protect operating personnel from electrical shocks, fires, or explosions, proper consideration to the use of grounding, thermal and overcurrent protection, and good maintenance procedures should be given.

*Standard publications ANSI CS1-1/NEMA MG-2 • NATIONAL ELECTRICAL MFG. ASSOCIATION • WASHINGTON, D.C.

NORMAL OPERATING CONDITIONS

1) Motors rated for continuous duty, based on 8 hours per day; 5 days per week. Products intended for intermittent duty, should keep the winding temperature within the maximum allowable temperature of the insulation system.
2) Ambient operating temperatures should not exceed 50 degrees C., (104°F). Higher ambient temperatures will shorten motor life.
3) Load — uniform and free from shock or high inertia.
4) Voltage — within 10% of nameplate rating.

CAUTION: The models listed in this catalog are not explosion proof types, and should not be operated in hazardous conditions.

SCOT MOTORPUMP™

J56 & C56 FRAME MOTOR

• INSTALLATION • OPERATION • MAINTENANCE

INCLUDES MECHANICAL SEAL REPLACEMENT

INSPECTION

Check pump for shortage and damage immediately upon arrival. Note damage or shortage on freight bill (bill of lading); immediately file claim with carrier.

EXTERIOR – Pay particular attention to conduit box, external hardware and accessories. Touch up abrasions or scratches with approved paint.

INTERIOR – If extensive or serious external damage is noted, if impeller is damaged (look in ports), or if shaft binds or sticks, disassemble as required to permit internal inspection.

HANDLING

Handle with care. Dropping or jarring can seriously damage motor bearings or break pump parts. Lift with device having capacity for pump weight, and use lifting hooks or eye bolts (if provided) or rig double sling around motor frame and pump casing. Do not use sling through pump motor adapter nor around suction and discharge flanges.

INSTALLATION

Location – Pump location should provide the following:

1. Install as close to suction supply possible.
2. Shortest and most direct suction pipe practical. Suction lift must not exceed limit for pump. NPSH available must equal or exceed pump requirement.
3. Suction port below pumping level to provide priming.
4. Room for inspection and maintenance.
5. Correct power supply to motor; all wiring should meet National Electrical and Local Codes and regulations.
6. If outdoors, protection from the elements, freezing, and water damage due to flooding.

Piping – Suction and discharge gauges are useful to check pump operation and are excellent trouble indicators. Install gauges in the lines if pump ports do not have gauge taps. Observe these precautions when installing piping:

1. Support close to, but independently of pump.
2. Use at least next larger pipe size for suction and discharge.
3. Keep as straight as possible, with few or no bends and fittings.
4. Remove burrs, sharp edges, ream pipe cuts, and make joints air-tight.
5. Don't spring pipe to make connections. Strain must not be transmitted to pump.
6. Allow for pipe expansion with hot fluids; expansion joints are not recommended.

Suction – Size and install suction piping to keep pressure loss at minimum and to provide correct NPSH:

1. The suction pipe should be at least equal in size or preferably one size larger than the suction connection of the pump. If pipe larger than pump suction is used, an eccentric pipe reducer should be used at the pump.
2. Pipe should slope upward to pump, even for horizontal run.
3. Use 45-degree or long-sweep 90-degree elbows.
4. A valve in the suction is necessary only on positive suction head installation and must not be used to throttle the pump. The suction valve should be installed for maintenance purposes only.

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• Cedarburg, WI 53012 • P.O. Box 286 • 414-377-7000 • *FAX 414-377-7330*
FACTORY BRANCHES
• Irvine, CA 92714 • 1881 Kettering • 714-756-8076 • *FAX 714-756-9480*
• Ft. Lauderdale, FL 33315 • 77 SW 20th Street • 305-524-6776 • *FAX 305-764-3361*

SCOT DIVISION OF ARDOX CORP.

61.000.253
MAY 1990

INSTALLATION CONT.

Discharge – Pumps permit discharge port location at any of four positions, 90 degrees apart. Change by removing cover bolts, rotate casing, and replace bolts. Do not slice O-ring or tear fibre gasket. Scot does not recommend bottom vertical discharge due to erratic pump performance. Ensure there is adequate clearance with selected position between wall or tank, motor conduit box, and grease fittings. Casing may extend beyond base or feet.

1. If discharge line is short; size may be same as discharge port; if long, use 1 or 2 sizes larger.
2. For long horizontal runs keep grade as even as possible; avoid high spots and loops. Trapped air will throttle flow and may result in erratic pumping.
3. Install check and gate valves in discharge line; check valve (if used) between pump and gate valve.

OPERATION

Pre-Start – Before initial start of the pump, check as follows:

1. The rotation must be checked upon installation. Close, then break the contacts quickly and observe rotation of the exposed portion of rotating parts. Rotation must agree with the rotation arrow on the motor. For all pumps the standard rotation is counterclockwise when viewed from the suction end. Motor wiring is easily changed in the field by the wiring diagram on the inside of the terminal box cover, or on the motor nameplate.
2. Check voltage, phase, and frequency of line circuit with motor nameplate.
3. Check suction and discharge piping and pressure gauges for proper operation.
4. Assure that pump is full of liquid (primed).

Priming – If pump is installed with a positive head on the suction, prime by opening suction valve and allowing liquid to enter the casing, at the same time venting all air out of the top of the casing.

If pump is installed with a suction lift, priming must be done by other methods, such as foot valves, ejectors, or by manually filling casing and suction line.

CAUTION – DO NOT RUN PUMP DRY HOPING IT WILL SELF-PRIME. Serious damage may result if started dry.

Starting – Proceed as follows to start pump:

1. Close drain valves and valve in discharge line.
2. Open fully all valves in the suction line.
3. Prime the pump. If pump does not prime properly, or loses prime during start-up, shut down and correct condition before repeating procedure.
4. For pumps moving high temperature liquids, open warm-up valve to circulate liquid for preheating. Close valve after pump has warmed up.
5. Start the motor (pump).
6. When pump is operating at full speed, open discharge valve slowly.

Running – Periodically inspect pump while running, but especially after first start and following repair.

1. Check pump and piping for leaks. Repair immediately.
2. Record pressure gauge readings for future reference.
3. Record voltage, amperage per phase, and kw (if an indicating wattmeter is available).
4. Adjust pump output (capacity) ONLY with discharge valve. DO NOT throttle suction line.

Freezing Protection – Protect pumps shut down during freezing conditions by one of the following methods:

1. Drain pump; remove all liquid from the casing.
2. Keep fluid moving in pump and insulate or heat the pump to prevent freezing. If heated, do not let temperature go above 100 to 150 degrees F.
3. Fill pump completely with antifreeze solution.

MAINTENANCE

Cleaning – Remove oil, dust, dirt, water, chemicals from exterior of motor and pump. Keep motor air inlet and outlet open. Blow out interior of open motors with clean compressed air at low pressure. Regularly drain moisture from TEFC motors.

Labeled Motors – It is imperative for repair of a motor with Underwriters' Laboratories label that original clearances be held; that all plugs, screws, other hardware be fastened securely, and that parts replaced be exact duplicates or approved equals. Violation of any of the above invalidates Underwriters' label.

Temperature – Total temperature, not the rise, is the measure of safe operation for a motor. If temperature by thermometer exceeds limits for insulation class, investigate and change operating conditions.

MAINTENANCE CONT.

Lubrication – Pumps should require no maintenance, other than the motor bearings, according to the following instructions:

DOUBLE SHIELDED. When double shielded prelubricated bearings are furnished no lubrication is required for the life of the bearings. Inspect bearings periodically to determine the condition of the grease and replace the bearings if necessary.

SINGLE SHIELDED W/GREASE FITTING PROVISIONS. When single shield bearings are furnished periodic inspection, cleaning and relubrication is required. See motor manufacturer's specific instructions for lubrication.

MECHANICAL SEAL REPLACEMENT

Ⓐ Ⓑ J56 FRAME MOTOR

A) Disassembly:

1. Turn off power.
2. Close suction and discharge valves.
3. Drain system.
4. Remove bolts holding base to foundation
5. Remove casing bolts.
6. Remove motor and rotating element from casing, leaving casing and piping undisturbed.
   Insert a screwdriver in one of the impeller waterway passages and back off the impeller nut as shown in Fig. 1.

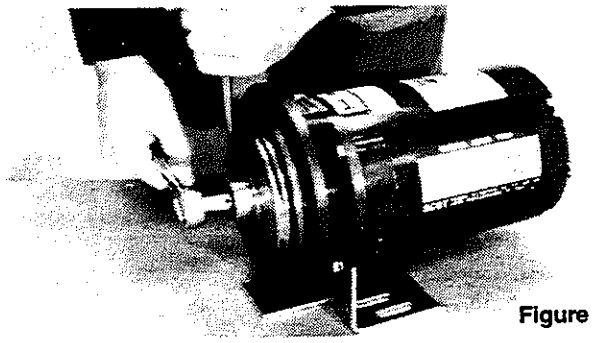


Figure 1

7. Remove motor shaft end cap. Insert a screwdriver in slot of motor shaft. While holding shaft against rotation, unscrew impeller from shaft by turning counterclockwise when facing impeller (Fig. 2).

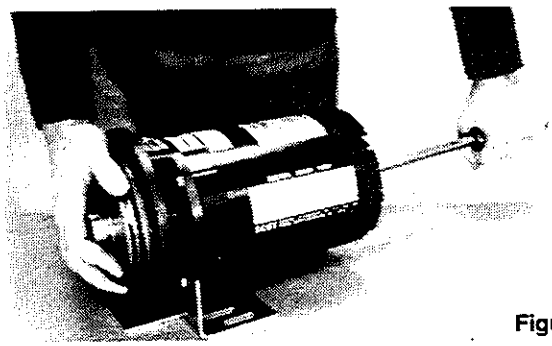


Figure 2

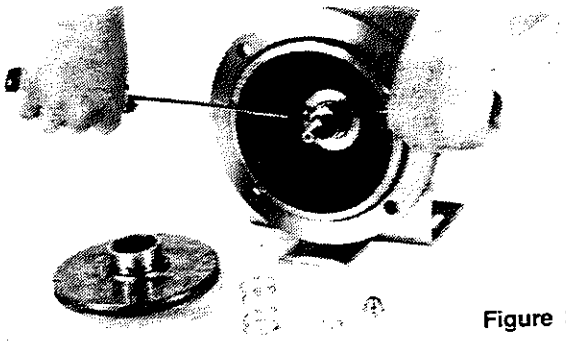


Figure 3

8. Pry off rotating member of mechanical seal from shaft by using two (2) screwdrivers (Fig. 3).
9. Remove bolts holding adapter to motor and take off adapter.
10. Place adapter on a flat surface and push out stationary part of mechanical seal.

B) Reassembly:

1. Clean gasket and flange faces, seal seat cavity and shaft, in particular shaft shoulder fitting against impeller.
2. Lubricate seal seat cavity of adapter and rubber cup or O-ring of stationary seal with soapy water solution. Press the stationary seat in seal seat cavity squarely and evenly. Use caution not to chip or scratch the lapped face of seat.
3. Remount the adapter on motor, making sure the motor shaft does not dislocate or chip the stationary seat of the seal.
4. Apply a soapy water solution to the motor shaft and the rubber bellows of the rotary seal. Set the rotating member of mechanical seal on motor shaft. Be sure the rotating seal face stays in the holding collar during installation. Also take extra care not to chip or scratch the lapped seal faces.
5. Hold shaft against rotation as decribed in paragraph 7 of disassembly procedure, and thread impeller on shaft until it is tight against the shaft shoulder.
6. Replace D-washer and impeller nut holding impeller against rotation as indicated in paragraph 6 of disassembly procedure (3 phase motors only).
7. Remove any burrs caused by screwdriver on the vane of impeller in waterway passage.
8. Replace motor and rotating element in casing. Be sure that any damaged O-ring or gasket is replaced.
9. Tighten casing bolts alternately and evenly.
10. Replace hold-down bolts.
11. Check for free rotation after assembly is completed.
12. Replace motor shaft end cap.
13. Close all drain openings using pipe sealant on threads.
14. Reprime before starting. Do not start until pump is completely filled with water.

MECHANICAL SEAL REPLACEMENT

Ⓥ C56 FRAME MOTOR

A) Disassembly:

1. Follow paragraphs 1 - 6 of instructions for Mechanical Seal Replacement J56 frame.
2. Insert wrench between openings in adapter and place on flats of stub shaft. While holding shaft against rotation, remove the impeller retaining assembly using a 7/16 socket (Fig. 4).

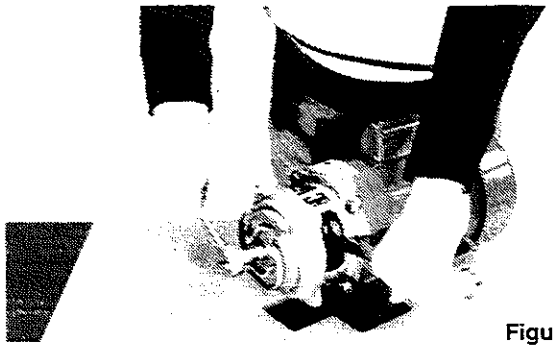


Figure 4

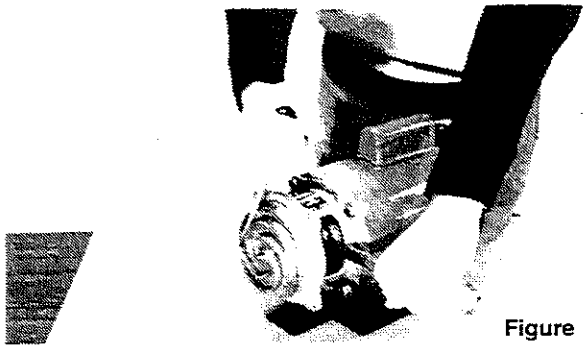


Figure 5

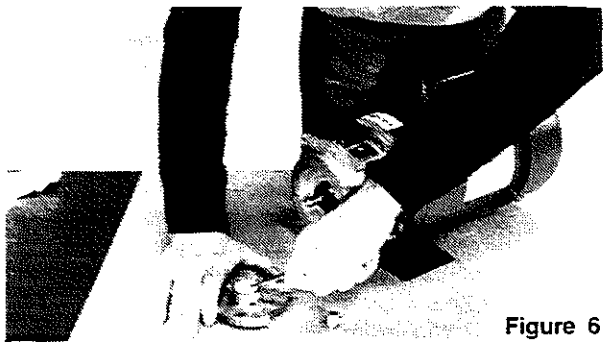


Figure 6

3. Leave the wrench on flats of stub shaft and unscrew the impeller by turning counterclockwise when facing the impeller (Fig. 5).
4. The seat of the seal can now be removed from the impeller (Fig. 6).
5. Disassemble cap screws holding adapter to the motor and remove adapter.
6. Place adapter on a flat surface and push out the mechanical seal head.

B) Reassembly:

1. Clean gasket and flange faces, seal seat cavity, seal head bore and shaft, in particular shaft shoulder fitting against impeller.
2. Lubricate seal seat cavity of impeller and rubber cup or O-ring of seal seat with a soapy water solution. Press the seat in the seal seat cavity squarely and evenly. Use caution not to chip or scratch the lapped face of seat.
3. Apply pipe sealant on outside of the stainless portion of the seal head to ease head into adapter.
4. Install the seal head by pressing on the stainless lip using a 3" long piece of 1¼" PVC pipe.
5. Hold shaft against rotation as discussed in paragraph 3 of disassembly procedure, and thread impeller on shaft until it is tight against the shaft shoulder.
6. Replace impeller retaining assembly holding impeller against rotation as indicated in paragraph 3 of disassembly procedure.
7. Replace motor and rotating element in casing. Be sure that any damaged gasket is replaced.
8. Tighten case nuts alternately and evenly.
9. Replace hold-down bolts.
10. Check for free rotation after assembly is completed.
11. Close all drain openings using pipe sealant on threads.
12. Reprime before starting. Do not start unit until pump is completely filled with water.

WE RECOMMEND STOCKING A SPARE MECHANICAL SEAL OR REPAIR KIT TO ELIMINATE DOWN TIME.

PRESSURE AND TEMPERATURE LIMITATION
STANDARD FITTED PUMPS

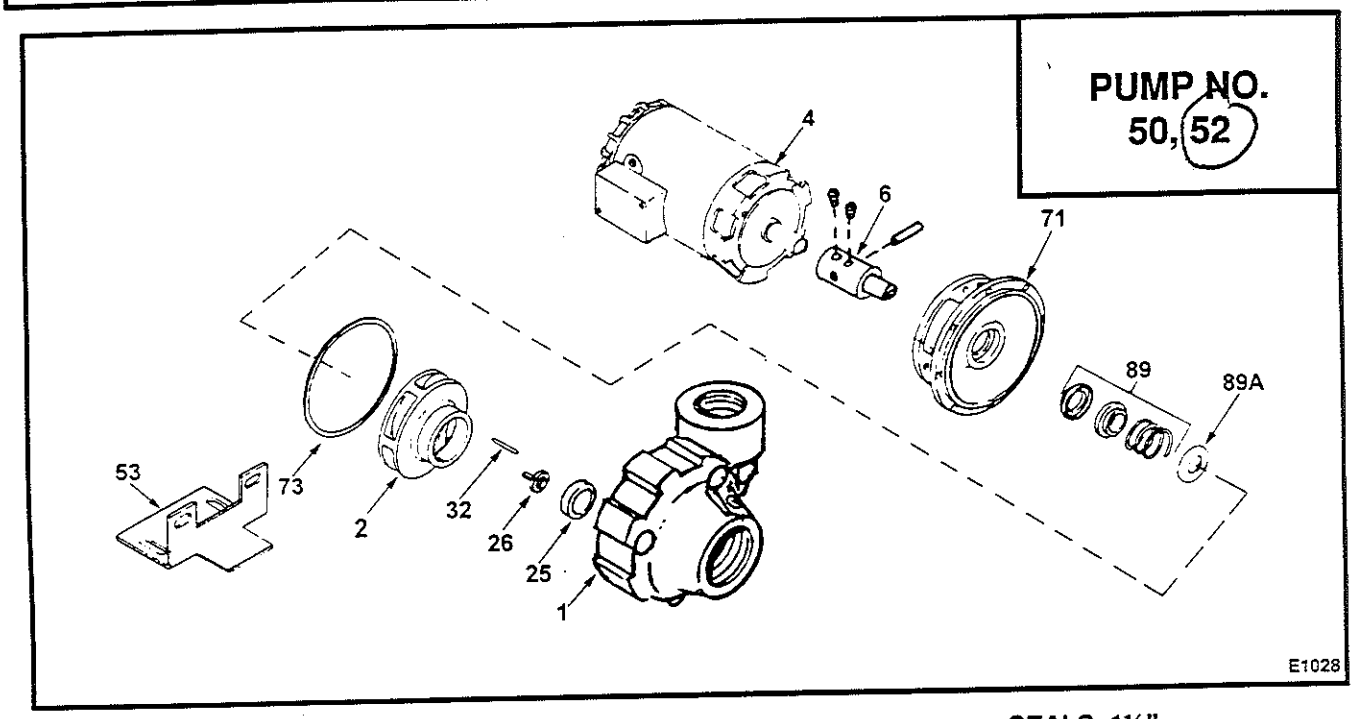
PUMP NO.	PRESSURE		TEMPERATURE	
	STANDARD	OPTIONAL	STANDARD	OPTIONAL
68, 69	75 PSI	N/A	220°F	275°F
51, 61, 74	75 PSI	150 PSI	220°F	275°F
71, 72, 77, 78, 79, 82	75 PSI	N/A	220°F	275°F
11, 13, 60	75 PSI	150 PSI	220°F	275°F
62	165 PSI	165 PSI	220°F	275°F
ALL OTHERS	175 PSI	175 PSI	220°F	275°F

N/A - NOT AVAILABLE

CAUTION

DO NOT ALLOW EITHER THE DISCHARGE PRESSURE OR THE TEMPERATURE OF THE LIQUID TO EXCEED THE LIMITATIONS LISTED ABOVE.

1750 RPM - 6.5" IMPELLER - C56 FRAME - 1/4-3/4 HP



KEY NO.	PART NAME	7.25" FIT PUMP NO. 50, 52
1	CASE	See Chart
2	IMPELLER	See Chart
4	MOTOR C56	See Page 53
+6 •	STUB SHAFT, BRONZE	135.000.165X
--	STUB SHAFT, STAINLESS	135.000.174X
25	WEAR RING	See Chart
26 •	IMPELLER RETAINER	118.000.163B
32 •	KEY	102.000.102
53	BASE	119.000.237D
71	ADAPTER, IRON	132.000.202
--	ADAPTER, BRONZE	132.000.228
73 •	GASKET, CASE	116.000.157
89 •	SEAL 1 1/2"	See Chart
89A •	SEAL RETAINER	104.000.174
--	*REPAIR KITS:	
	BN-CM SEAL	118.000.382
	VN-CM SEAL	118.000.382A
	VN-NR SEAL	118.000.382B
	EPDM-NR	118.000.382C

• DENOTES COMPONENTS INCLUDED IN REPAIR KIT
+ INCLUDES SET SCREWS AND PIN

SEALS 1½"

TYPE 21	
BN-CM	101.000.168
VN-CM	101.000.191
VN-NR	101.000.175
EPDM-NR	101.000.175B

WEAR RINGS

PUMP NO.	BRONZE	STEEL
50	103.000.135	103.000.155
52	103.000.136	103.000.154

*** ALL REPAIR KITS INCLUDE THE BRONZE STUB SHAFT EXCEPT THE VN-CM SEAL, WHICH IS STAINLESS.**

***CASES**

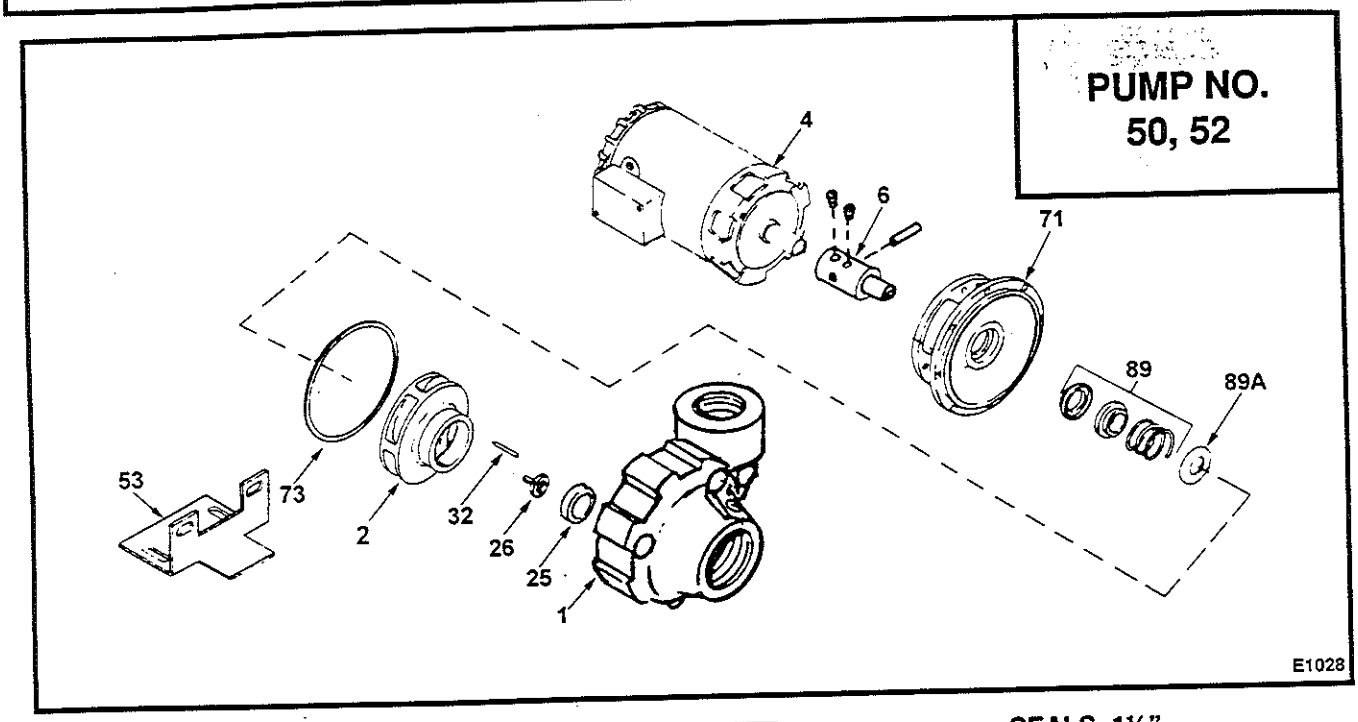
PUMP NO.	SUCT	DISCH	IRON	BRONZE
50	2	1.5	130.000.257X	130.000.272X
52	2.5	2	130.000.219X	130.000.218X

• INCLUDES BRONZE WEAR RING. FOR STEEL WEAR RING, REPLACE SUFFIX "X" WITH "X1".

ENCLOSED IMPELLERS - SPECIFY DIAMETER

7/8" KEYED DESIGN		
PUMP NO.	CONSTRUCTION	
	IRON	BRONZE
50	131.000.832	131.000.829
52	137.000.120	131.000.810

1750 RPM - 6.5" IMPELLER - C56 FRAME - 1/4-3/4 HP



KEY NO.	PART NAME	7.25" FIT PUMP NO. 50, 52
1	CASE	See Chart
2	IMPELLER	See Chart
4	MOTOR C56	See Page 53
+6 •	STUB SHAFT, BRONZE	135.000.165X
--	STUB SHAFT, STAINLESS	135.000.174X
25	WEAR RING	See Chart
26 •	IMPELLER RETAINER	118.000.163B
32 •	KEY	102.000.102
53	BASE	119.000.237D
71	ADAPTER, IRON	132.000.202
--	ADAPTER, BRONZE	132.000.228
73 •	GASKET, CASE	116.000.157
89 •	SEAL 1 1/2"	See Chart
89A •	SEAL RETAINER	104.000.174
--	*REPAIR KITS:	
	BN-CM SEAL	118.000.382
	VN-CM SEAL	118.000.382A
	VN-NR SEAL	118.000.382B
	EPDM-NR	118.000.382C

• DENOTES COMPONENTS INCLUDED IN REPAIR KIT
+ INCLUDES SET SCREWS AND PIN

SEALS 1½"

TYPE 21	
BN-CM	101.000.168
VN-CM	101.000.191
VN-NR	101.000.175
EPDM-NR	101.000.175B

WEAR RINGS

PUMP NO.	BRONZE	STEEL
50	103.000.135	103.000.155
52	103.000.136	103.000.154

*** ALL REPAIR KITS INCLUDE THE BRONZE STUB SHAFT EXCEPT THE VN-CM SEAL, WHICH IS STAINLESS.**

***CASES**

PUMP NO.	SUCT	DISCH	IRON	BRONZE
50	2	1.5	130.000.257X	130.000.272X
52	2.5	2	130.000.219X	130.000.218X

** INCLUDES BRONZE WEAR RING. FOR STEEL WEAR RING, REPLACE SUFFIX "X" WITH "X1".*

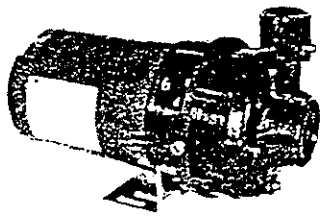
ENCLOSED IMPELLERS - SPECIFY DIAMETER

7/8" KEYED DESIGN		
PUMP NO.	CONSTRUCTION	
	IRON	BRONZE
50	131.000.832	131.000.829
52	137.000.120	131.000.810

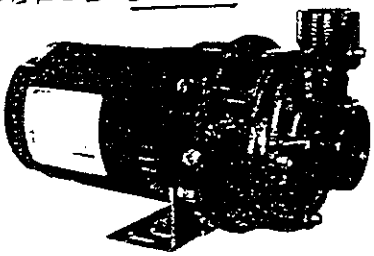
- .33 to 1.5 HP
- 1750 RPM, 60 Hertz
- Capacity to 220 GPM
- 35 Ft. Head
- 5.5" Max. Impeller

E330085-1

5.5" IMPELLER CENTRIFUGAL PUMPS 1750 RPM

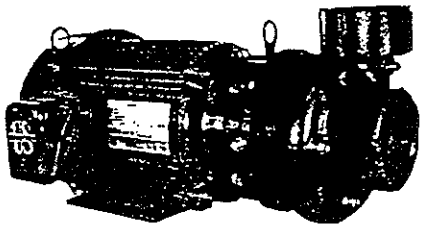


SCOT PUMP - HANDLED BY GRUNDFOS EXCEPT IN CALIF.

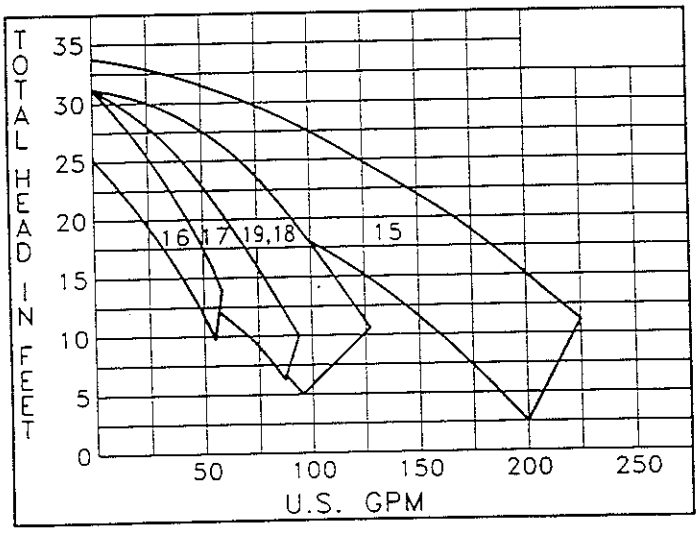


NEW

PURCHASED FROM SCOT FOR MAGELLAN I.



PUMP NO.	SUCTION x DISCHARGE	MOTOR HP RANGE
ENCLOSED IMPELLER		
16	2 X 1.5	.33, .5
17	2 X 2	.5, .75
18	2.5 X 2	.33, .50, .75, 1
15	3 X 3	.75, 1, 1.5
SEMI-OPEN IMPELLER		
19	2.5 X 2	.33, .5, .75, 1



- Maximum Working Pressure, 175 PSI
- Standard fitted, bronze fitted, all bronze & all iron construction
- Type 21 mechanical seal
- Bronze or stainless steel shaft sleeve or stub shaft over carbon steel motor shaft
- Impeller is keyed to shaft and secured by retaining nut

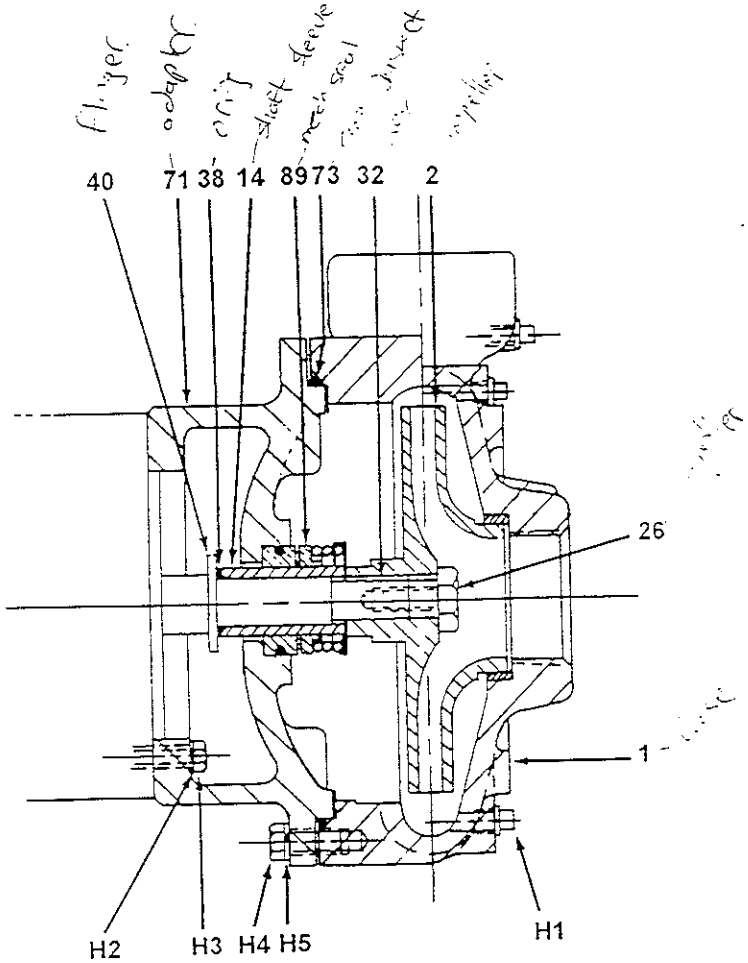
Motor Voltages: 3/60/230/460, 200 or 575V
Motor Enclosures: Dripproof, TEFC, Explosion Proof

5.5" - 1750 RPM
CONSTRUCTION OPTIONS

KEY	PART NAME	STANDARD FITTED	BRONZE FITTED	ALL IRON	ALL BRONZE
1	Case	Iron	Iron	Iron	Bronze
2	Impeller	*SF	Bronze	Iron	Bronze
14	Shaft Sleeve	Bronze	Bronze	Stainless Steel	Bronze
26	Impeller Retaining Assy.	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
32	Key	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
38	Shaft O-Ring	Buna	Buna	Buna	Buna
40	Flinger	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
71	Adapter	Iron	Iron	Iron	Bronze
73	Gasket, Case	O-Ring	O-Ring	O-Ring	O-Ring
89	Mechanical Seal, Type 21	Standard	Standard	Standard	Standard
H1	Plug, Drain	Brass	Brass	Plated Steel	Nylon

*SF = Iron impeller with brass wear ring on eye except pump no. 19 which is bronze.

Pump no. 19 is not available in all bronze construction.



STANDARD MECHANICAL SEAL CONSTRUCTION

Bellows	Buna N
Spring	Stainless Steel
Washer	Carbon
Seat	Ceramic
Cup	Buna N

TO ORDER - SPECIFY

- Pump Number
- Construction *
- Impeller Diameter
- Motor HP, RPM, Phase, Voltage, Frame and Enclosure

* If not specified, pumps will be shipped in Standard Fitted Construction.

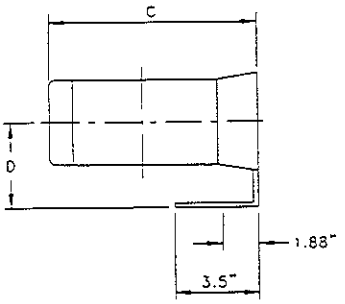
NOTE: Key Nos. H2, H3, H4 and H5 are standard hardware items and may be purchased locally.

5.5" - 1750 RPM

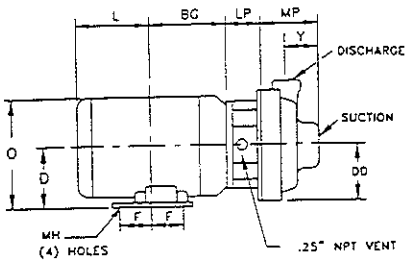
6

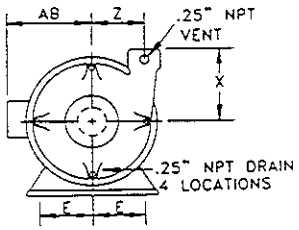
MOTORPUMP™

MOTOR 56C



MOTOR JM





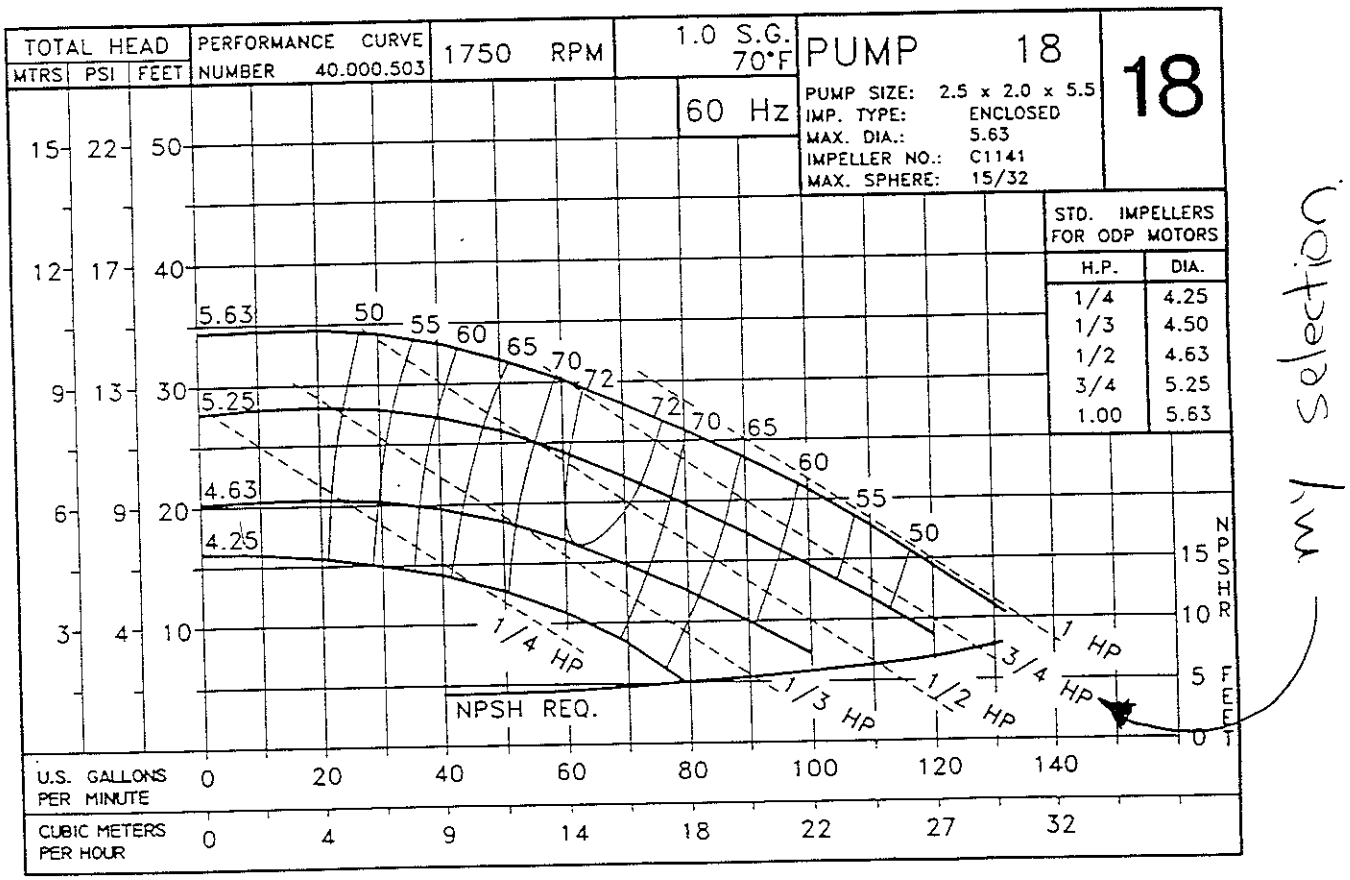
PUMP DIMENSIONS - NPT

PUMP NO.	SUCTION x DISCHARGE (NPT)	LP	X	Y	Z	DD	MP
16	2 X 1.5	2.50	4.75	2.50	3.12	3.87	4.13
17	2 X 2	2.50	5.00	2.63	3.25	3.87	4.31
18	2.5 X 2	2.50	5.00	2.63	3.25	3.87	4.31
19	2.5 X 2	6.76	5.00	3.25	3.25	3.87	4.88
15	3 X 3	2.50	5.75	3.50	3.50	4.25	5.38

MOTOR DIMENSIONS

ODP HP	FRAME	D	E	F	O	AB	BG	L*	C	MH
.25, .33	56C	4.50	2.06	--	--	3.25	--	--	8.00	--
.5	56C	4.50	2.06	--	--	3.25	--	--	8.25	--
.75	56C	4.50	2.06	--	--	3.25	--	--	8.75	--
1	143JM	3.50	2.75	2.50	7.00	5.25	5.38	4.69	--	.34
1.5, 2	145JM	3.50	2.75	2.50	7.00	5.25	5.38	4.69	--	.34

* For TEFC Motors Increase 'L' by approximately 2". L Dimension is not determined by NEMA specifications and therefore may vary slightly depending on motor manufacturer.



My selection

Supplemental Safety Instructions for Baumann Control Valves, Actuators and Positioners E330085-2

Ref P.O.# 21100-8487
Dwg. E330085
Item-2

SAFETY INSTRUCTIONS

INTRODUCTION

Please read these safety warnings, cautions, and instructions carefully before using the product.

These instructions cannot cover every installation and situation. The installation, operation, and maintenance of this product should only be performed by persons who are qualified through training or experience. If you have any questions concerning installation, use, or maintenance of this product, contact your Baumann office or sales representative before proceeding.

INSPECTION AND MAINTENANCE SCHEDULES

All products must be inspected periodically and maintained as needed. The schedule for inspection can only be determined based on the severity of your service conditions. Your installation might also be subject to inspection schedules set by your governmental codes and regulations, industry standards, company standards, or plant standards.

CONTROL VALVES

Installation

⚠ WARNING

•Personal injury or equipment damage caused by sudden release of pressure or bursting of parts may result if the valve assembly is installed where service conditions could exceed the limits given in the product literature, the limits on the appropriate nameplates, or the mating pipe flange rating. Use pressure-relieving devices as required by government or accepted industry codes and good engineering practices. If you cannot determine the ratings and limits for this product, contact your Baumann office or sales representative before proceeding.

•Personal injury could result from packing leakage. The packing might require some readjustment to meet specific service conditions.

⚠ CAUTION

When ordered, the valve configuration and construction materials were selected to meet particular pressure, temperature, pressure drop and controlled fluid conditions. Since some body/trim material combinations are limited in their pressure drop and temperature ranges, do not apply any other conditions to the valve without first contacting your Baumann office or sales representative.

Maintenance

⚠ WARNING

Avoid personal injury or property damage from sudden release of process pressure or uncontrolled movement of parts. Before performing any maintenance operations:

•Disconnect any operating lines providing air pressure, electric power, or a control signal to the actuator. Be sure the actuator cannot suddenly open or close the valve.

•Use bypass valves or completely shut off the process to isolate the valve from process pressure. Relieve process pressure from both sides of the valve. Drain the process media from both sides of the valve.

•Vent the pneumatic actuator loading pressure and relieve any actuator spring precompression.

•Use lock-out procedures to be sure that the above measures stay in effect while you work on the equipment.

•Many valve parts that are moving can injure you by pinching, cutting, or shearing. To help prevent such injury, stay clear of any moving part.

•Never apply pressure to a partially assembled valve.

•To avoid personal injury or property damage caused by uncontrolled movement of a valve bonnet, loosen the bonnet per the following paragraph. Do not remove a stuck bonnet by pulling on it with equipment that can stretch or store energy in any other manner. The sudden release of stored energy can cause uncontrolled movement of the bonnet.

Loosen bonnet nuts approximately 1/8 inch (3 mm). Then loosen the body–to–bonnet gasketed joint by either rocking the bonnet or prying between the bonnet and body. Work the prying tool around the bonnet until the bonnet loosens. If no fluid leaks from the joint, proceed with bonnet removal.

•As you remove parts, such as valve bonnets, other parts, such as stems and plugs can fall from the valve body. To avoid injury from falling parts, be sure to support parts as you diassemble the valve.

ACTUATORS

Installation

⚠ WARNING

To avoid personal injury and property damage caused by bursting of parts and to avoid parts damage, malfunction of control valve, or loss of control of the process caused by excessive pressure, do not exceed the maximum pressures or temperatures for this actuator, as given in the product literature or on the nameplate If you cannot determine the limits for this product, contact your Baumann office or sales representative before proceeding.

24003 Series
3-Way Control Valve Instructions

⚠ WARNING: For Warnings and Cautions refer to Supplemental Safety Instruction No. SSI-1.

INSTALLATION

1. Before installing the valve in the pipeline, thoroughly clean the line of all dirt, welding chips, scale, oil or grease, and other foreign material.
2. Install valve so the controlled fluid will flow through the valve body in the direction required by the application - refer to Bulletin No. 3WY-2.
3. In case of a heat-insulated installation, insulate the valve body only, not the bonnet (8).

AIR PIPING

1. Connect actuating air pressure line to the 1/4" NPT opening in the upper diaphragm case if an air-to-extend actuator (air-to-close action), or in the lower diaphragm case if an air-to-retract actuator (air-to-open action).
2. Use 1/4" OD tubing or equivalent for all air lines. If air line exceeds 25 ft. in length, 3/8" tubing is preferred. Air lines must not leak. Air pressure should not exceed 35 psig.

BODY DISASSEMBLY

CAUTION: To prevent distortion of body and seat hold valve body in vise by ends ONLY!

1. Remove actuator, stem locknuts (27), travel indicator (58), packing nut (20) and yoke drive nut (9) as described in Actuator Instruction No. N32/N54.
2. Unscrew bonnet from valve body.
3. Unscrew lower connection from valve body (1). Inspect mating surfaces of parts.
4. Turn plug and stem assembly (4) out through packing box. Handle carefully to avoid damaging the seating and guiding surfaces. Wipe with a clean soft cloth and examine for wear (see below).
5. To remove seat ring (2), fabricate a special wrench to engage the seat ring lugs. (Seat ring removal tools can also be purchased through your local Baumann Representative.) Clean thoroughly and examine for wear.

LAPPING SEAT

If valve leakage becomes excessive, lapping may be necessary. Replace plug in bonnet and apply a good grade of fine lapping compound at several spots around the plug seating surface. Screw bonnet loosely in the body (less gasket) to serve as a guide during the lapping operation. Excessive lapping will shoulder seat ring and will not improve seating. Clean seats thoroughly after operation.

PACKING

Packing box gland should be held firmly - but not too tightly - against packing (14). If necessary to renew packing, disassemble valve as directed previously, remove locknuts and indicator disk, and TURN plug stem out through packing box. Remove packing box nut and gland and push out old packing by working from underside of bonnet. For braided packing insert new packing rings and stagger each skive cut relative to the adjacent ring to avoid creating a leak path. Compress each ring individually with 5/16" x 3/4" diameter tube using a hammer. Packing follower should be held firmly, not too tightly, against packing rings (14). For v-ring packing carefully insert v-ring packing set and hand tighten packing nut. Use wrench to increase tightness by turning nut an additional 60°.

CAUTION: Over-tightening packing may lock-up valve stem!

REASSEMBLY

Apply stem lubricant on stem and thread sealer to threads of lower connection. Place plug and lower connection in valve body. Replace bonnet with plug in valve. Place actuator yoke over stem. While tilting actuator back, drop yoke drive nut over stem, TURN packing follower over stem threads, drop packing nut over stem, run locknut (27), travel indicator (58), and locknut (27) down as far as possible and counter nuts to lock.
Level actuator over stem, lift plug stem and turn plug stem into actuator stem as far as it will go before adjusting bench range. (See actuator instruction no. N32/N54.)

CAUTION: Do not turn stem while plug is in contact with seat to avoid damage to seating surface.

32in² and 54in² Actuator Instructions

INSTRUCTION NO. N32/N54-4

WARNING: For Warnings and Cautions refer to Supplemental Safety Instruction No. SSI-1.

Baumann 32in² and 54in² spring diaphragm actuators offer a powerful yet compact device to operate control valves, louvers and dampers or mechanical speed adjusting devices. Multiple spring actuators are field reversible without extra parts to provide either air-to-extend (ATE) down or air-to-retract (ATR) up action. They feature exceptionally low hysteresis due to the absence of side loads imposed by unevenness of single coiled springs. Use of multiple springs also offers a substantially lower profile. Materials of construction include epoxy coated steel diaphragm cases and cast iron yoke. All remaining parts are either stainless or zinc plated steel for optimum corrosion resistance.

DESCRIPTION

Actuator spring ranges listed in the table on page 3 are the air pressure range in pounds per square inch (psi) for rated stroke under no load. Air connections are 1/4" NPT and are located in both the upper (44) and lower (43) diaphragm case. Use upper connection for air-to-extend (ATE) actuator and lower connection for air-to-retract (ATR) actuator. Air pressure should not exceed 35 psi. Higher pressures will cause diaphragm leakage.

STROKE ADJUSTMENT

When assembling the actuator to a valve or another device that provides a positive stop in one direction proceed as follows:

1. Refer to the appropriate Baumann Control Valve body assembly instruction bulletin and locate the following items essential for actuator mounting and calibration: stem locknuts (27), travel indicator (58), packing nut (20) and yoke drive nut (9).
2. Place locknuts (27) and travel indicator (58) on valve stem as low as possible and counter the two nuts. This allows rotation of plug stem into the actuator stem (26). Make sure yoke drive nut (9) and packing nut (20) are first placed over stem.
3. Apply approximately 10 psi air pressure to actuator and screw valve stem clockwise into actuator stem (26), until yoke (17) rests firmly on valve bonnet.
4. Tighten yoke drive nut (9).
   a. Air-to-extend (ATE) actuator: Continue to screw valve stem into actuator stem (26) until valve plug is stopped by valve bonnet in the upper stroke position. Apply some air pressure, and turn valve stem one extra full turn, then lock stem position with locknuts. Apply maximum air signal and check if valve plug is fully seated. Calibrate travel indicator scale (56) at this position.

CAUTION: ***If valve plug is not seated properly turn valve stem back out of actuator stem. Never turn valve stem while plug is seated, seating surface will be damaged.***

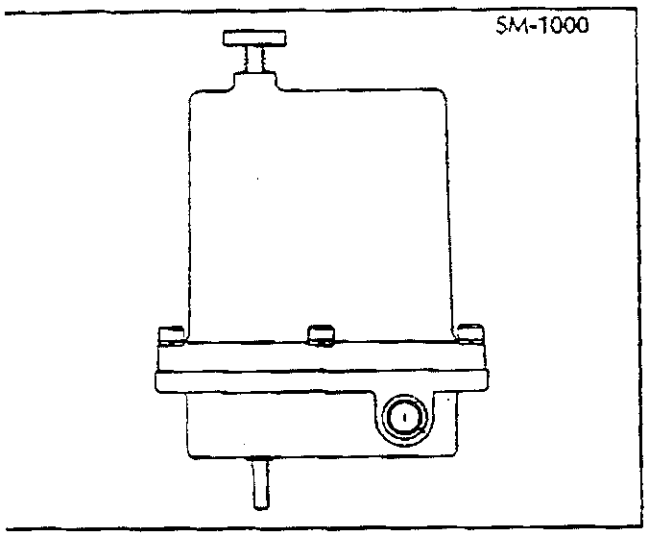
   b. Air-to-retract (ATR) actuator: With 10 psi air signal screw valve stem into actuator stem (26) as far as it will go. Reduce air pressure to zero and slowly turn valve stem back out of actuator stem (26) until valve plug touches the seat. Reapply air signal and turn valve stem 1 to 1-1/2 additional turns out of actuator stem. Lock valve stem in position with locknuts and calibrate travel indicator scale (56) at zero stroke position.

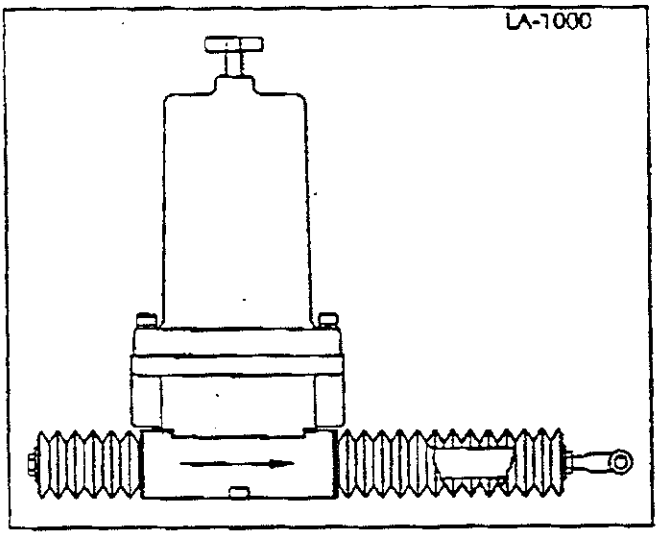
ordan Controls, Inc.

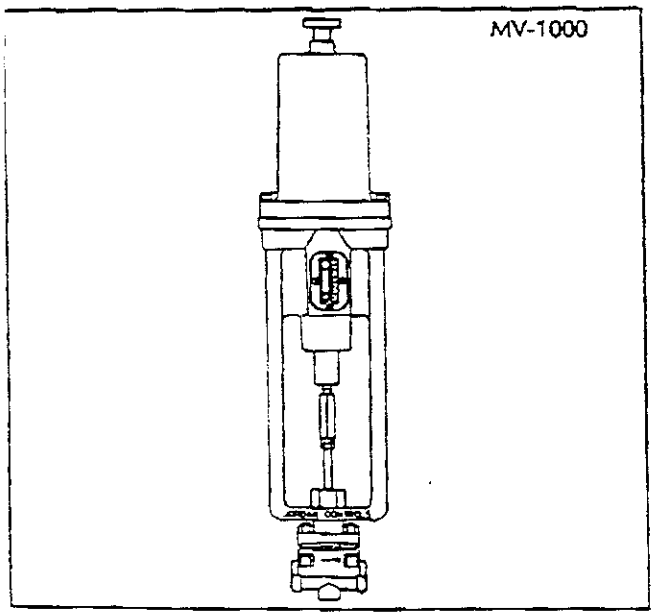
nstruction Manual

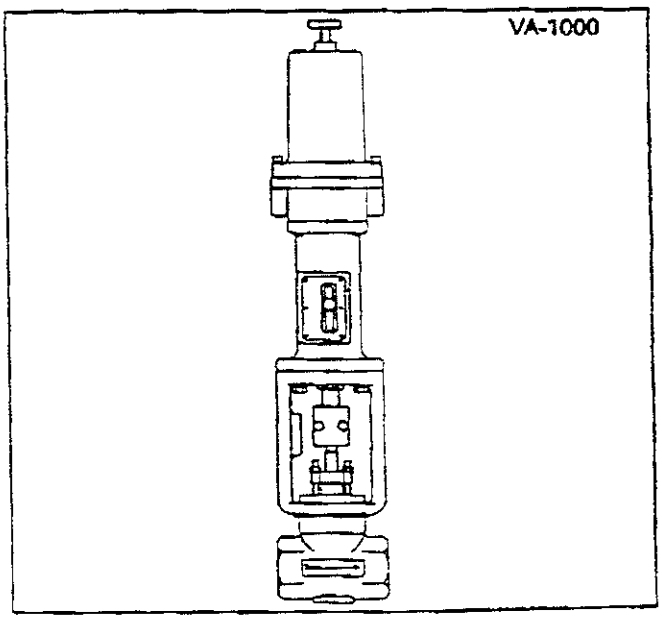
M-0610

1000 Series Electronic Actuators









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ABBREVIATIONS USED IN THIS MANUAL

A	Ampere
ac	Alternating Current
AWG	American Wire Gauge
°C	Degrees Celsius
CW	Clockwise
CCW	Counterclockwise
dc	Direct Current
DEC	Decrease
DIP	Dual Inline Package
ESD	Electro-static Discharge
°F	Degrees Fahrenheit
HP	Horsepower
IN	Inch
INC	Increase
in.lbs.	Inch Pounds
kg	Kilogram
L	Line (power supply)
lbf	Pounds Force
lbs	Pounds
LED	Light Emitting Diode
LOS	Loss of Signal
LS	Limit Switch
mA	Milliamp
mm	Millimeters
-	Negative
N	Newton (force)
N	Neutral (power supply)
Nm	Newton Meter
NPT	National Pipe Thread
PCB	Printed Circuit Board
Pot	Potentiometer
+	Positive
RPM	Revolutions per Minute
SEC	Second
TB	Terminal Strip
Vac	Volts ac
Vdc	Volts dc

GENERAL INFORMATION

INTRODUCTION

Jordan Controls, Inc., designs, manufactures, and tests its products to meet many national and international standards. For these products to operate within their normal specifications, they must be properly installed and maintained. The following instructions must be followed and integrated with your safety program when installing, using, and maintaining Jordan Controls products:

- Read and save all instructions prior to installing, operating, and servicing this product.
- If you do not understand any of the instructions, contact your Jordan Controls representative for clarification.
- Follow all warnings, cautions, and instructions marked on, and supplied with, the product.
- Inform and educate personnel in the proper installation, operation, and maintenance of the product.
- Install equipment as specified in Jordan Controls installation instructions and per applicable local and national codes. Connect all products to the proper electrical sources.
- To ensure proper performance, use qualified personnel to install, operate, update, tune, and maintain the product.
- When replacement parts are required, ensure that the qualified service technician uses replacement parts specified by Jordan Controls. Substitutions may result in fire, electrical shock, other hazards, or improper equipment operation.
- Keep all actuator protective covers in place (except when installing, or when maintenance is being performed by qualified personnel), to prevent electrical shock, personal injury, or damage to the actuator.

WARNING

Before installing the actuator, make sure that it is suitable for the intended application. If you are unsure of the suitability of this equipment for your installation, consult Jordan Controls prior to proceeding.

WARNING - SHOCK HAZARD

Installation and servicing must be performed only by qualified personnel.

WARNING - ELECTROSTATIC DISCHARGE

This electronic control is static-sensitive. To protect the internal components from damage caused by static discharge, never touch the printed circuit cards without being statically protected.

RECEIVING/INSPECTION

Carefully inspect for shipping damage. Damage to the shipping carton is usually a good indication that it has received rough handling. Report all damage immediately to the freight carrier and Jordan Controls, Inc.

Unpack the actuator and information packet—taking care to save the shipping carton and any packing material should return be necessary. Verify that the items on the packing list or bill of lading agree with your own.

STORAGE

If the actuator will not be installed immediately, it should be stored in a clean, dry area where the ambient temperature is not less than -20° F. The actuator should be stored in a non-corrosive environment. The actuator is not sealed to NEMA 4 until the conduit entries are properly connected.

EQUIPMENT RETURN

A **Returned Goods authorization (RG) number** is required to return any equipment for repair. This must be obtained from the Jordan Controls Service Department. (Telephone: 414/461-9200) The equipment must be shipped, freight prepaid, to the following address after the RG number is issued:

Jordan Controls, Inc.
5607 West Douglas Avenue
Milwaukee, Wisconsin 53218
Attn: Service Department

To facilitate quick return and handling of your equipment, include:
RG Number on outside of box
Your Company Name, Contact Person, Phone/Fax number
Address
Repair Purchase Order Number
Brief description of the problem

GENERAL INFORMATION

IDENTIFICATION LABEL

An identification label is attached to each actuator cover. When ordering parts, requesting information or service assistance, please provide all of the label information.

EXAMPLES:

Model Number: SM 1020-A-2-GB-0-0-0

Actuator Series: SM: Rotary LA: Linear MV: Control Valve VA: Control Valve
Force Range: 1010: Low 1020: High
Voltage Input: A: 120/240 Vac D: 28 Vdc (24-36 Vdc for 1010 models, 28-36 Vdc for 1020 models) V: 12-36 Vdc
Stroke Range: SM: 90: 90° to 2 turns 2: 2 to 20 turns LA, MV, VA: Stroke in inches (specify)
Gearbox option, (SM-1020 only) 0: Not required G: Gearbox
Signal Interface Options: 0: Not required *RM: Signal conversion module, Chassis form (shipped loose) *XM: Signal conversion module, mounted *XL: Signal conversion module, shipped loose *3W: 3 wire, 120 or 240 Vac incremental control **2W: 2 wire, dc incremental control
*Battery Back-up Option: 0: Not required B: Supplied
Factory Services: 0: None required CAL: Calibrated for specified rotation or stroke MTD: Mounted to customer-supplied valve or other device J: Mounted to Jordan-supplied valve or other device

*Available on ac-powered units only
**Available on dc-powered units only

GENERAL DESCRIPTION, ACTUATOR

The 1000 series are full-featured actuators offered as a standard package with the capability to accept analog current and voltage control signals. The design provides smooth, highly accurate positioning, with positive position-lock when not in motion. These rugged actuators may be mounted in any position and will withstand the most adverse environmental conditions.

A stepper motor produces torque, which is transmitted to the output shaft through a gear or screw shaft arrangement. This allows the low torque, high speed motor output to be converted to high torque/high thrust, lower speed actuator shaft output motion. The built-in servo drive amplifier controls the stepper motor's speed and direction. It also controls actuator end limits, motor torque, deadband, 4-20 mA transmitter, and electronic auxiliary limit switches.

SIGNAL CONVERSION MODULE OPTION MODEL EC-10797

This option is utilized to accept up to four actuator open collector limit switches as inputs and convert them to four form C relay output contacts. The module can be furnished in chassis form for customer mounting or in an enclosure.

GEARBOX - OPTION (SM-1020 only)

The gearbox is factory installed to the SM-1020 output shaft, to increase the torque output.

BATTERY BACKUP MODULE OPTION MODEL EC-10809 (for 4-20 mA inputs only)

This external option provides battery backup power to the actuator along with a generated 4-20 mA command signal. While ac power is available, the batteries are trickle-charged.

When ac power is lost, the pot adjustable command signal positions the actuator. After completing this positioning sequence, the battery unit enters a power-conserving cycle to extend available battery power. Once ac power is restored, the circuitry resets to automatic control. There is enough reserve power to position the actuator multiple times without a charge period. A fully discharged battery will take 12 to 16 hours to recharge. A battery OK, open transistor, low-level logic output signal is provided to indicate when battery voltage has fallen below operational levels.

INCREMENTAL CONTROL OPTION MODELS EC-10820 AND EC-10821

These integral options allow switched dc or ac line power to position the actuator.

PRODUCT SPECIFICATIONS

ACTUATOR

Electrical

Standard Line Voltage: 120/240 Vac (Slide switch selectable)
Frequency: 50/60 Hz
Optional Line Voltage: 1010D Models - 24-36 Vdc
1020D Models - 28-36 Vdc, 1020V Models - 12-36 Vdc
Power: 1010 Models, 18 VA; 1020 Models, 36 VA
(≤ 0.4A ac models, ≤ 1.5A dc models)
Command Signal Inputs: (DIP switch selectable)
Current: 4-20 mA, 4-12 mA, 12-20 mA
Voltage: 0-5 Vdc, 0-10 Vdc
Incremental: Dry contact closures, one for each direction
Optional Incremental: Switched120 or 240 Vac for ac models, line voltage dc for dc models
Limit Signals:
Internal: Part of servo control
External: Open transistor, low level logic outputs, adjustable over stroke range. 40 Vdc and 40 mA max.
Position Feedback Signal: Isolated 4-20 mA, loop powered with 12-36 Vdc external power supply
Field Wiring Terminations: Barrier terminal block, wire size range 26-14 AWG
Current Limit: (pot-adjustable)
Command Signal Monitor: (current command only)
The 1000 series loss-of-signal circuitry monitors the command signal input. If the command signal is lost, the actuator will either lock in place or drive to the low command position. (DIP switch selectable)

Mechanical

Force: see speed/force curves, pages 15, 18, 20, 22
(pot-adjustable)
Rotation:
SM models without gearbox: 90° to 2 turns or 2 to 20 turns. Infinitely adjustable within either range.
SM models with gearbox: 30° to 153° or 150° to 4.25 turns. Infinitely adjustable within range.
Stroke: (pot-adjustable)
L models: 0.75 to 21 inches (19 to 533.4 mm)
V models: 0.093 to 1.375 inches (2.4 to 34.9 mm)
VA models: 0.34 to1.5 inches (8.6 to 38.1 mm)
All of the above are infinitely adjustable within their range.
Speed: See speed/force curves, pages 15, 18, 20, 22
Output Shaft Motion: All models can go either direction on an increasing command signal. (DIP switch selectable)
Weights: (not including valves or other devices mounted to the actuator)
M-1010: 12 lbs. (5.4 kg)
SM-1020: 16 lbs. (7.3 kg)
SM-1020/gearbox: 19 lbs. (8.6 kg)
L-1020: 16 lbs. (7.3 kg)
V-1010: 12 lbs. (5.4 kg)
MV-1020: 16 lbs. (7.3 kg)
VA-1010: 20 lbs. (9.1 kg)
VA-1020: 24 lbs. (10.9 kg)
Conduit Entry: Two 1/2-14 NPT
Handwheel: Push to engage, spring return upon release (to be used with power off)

Environmental

Temperature Limits: -40° F to 150° F (-40° C to 65° C)
Enclosure: Explosion-proof for Class I, Division 1, Groups C and D; Dust-ignition-proof for Class II, Division 1, Groups E, F, and G. Type 4 (IP65), indoor or outdoor.

Performance

Positioning Accuracy: MV models: ± 0.001 in. (0.025 mm)
All other models 1.5% of full range or better.
Duty Cycle: Unrestricted modulating duty. (Continuous duty)

SIGNAL CONVERSION MODULE OPTION

MODEL EC-10797 (specified as RM, XM, or XL option)

Line Voltage: 120/240 Vac (terminal-selectable)
Frequency: 50/60 Hz
Field Wiring Terminations: Barrier terminal block
Wire size range 26-14 AWG
Signal Inputs: Four open collector limits from actuator
Signal Outputs: Four form C contacts rated 5A resistive at 120/240 Vac; 1/6 hp
Weight: Chassis form: 0.5 lbs. (0.2 kg)
Enclosed form: 3 lbs. (1.4 kg)
Conduit Entry: Two 1/2-14 NPT
Environmental: Enclosed form: same as actuator.

BATTERY BACKUP MODULE OPTION

MODEL EC-10809 (specified as B option)

Line Voltage: 120/240 Vac (terminal-selectable)
Frequency: 50/60 Hz
Field Wiring Terminations: Barrier terminal block
Wire size range 26-14 AWG
Signal Inputs: 4-20 mA (+ only)
Signal Outputs: 4-20 mA (pot-selectable) for desired loss of power positioning of the actuator
Voltage Outputs: 15 and 24 Vdc to power actuator bus
Weight: 3.5 lbs. (1.6 kg)
Conduit Entry: Two 1/2-14 NPT
Consult factory for interconnect wiring requirements
Environmental: (Enclosed form) Same as actuator.

INCREMENTAL CONTROL OPTION

MODEL EC-10820 (specified as 2W option)

Input Voltage - Actuator: 1010 models: 24-36 Vdc, 1020 models: 28-36 Vdc or 12-36 Vdc. With this option, the position command is switched dc power, where polarity reversal causes actuator direction reversal.

INCREMENTAL CONTROL OPTION

MODEL EC-10821 (specified as 3W option)

Input Voltage: (all actuator models) 120 or 240 Vac
With this option, the position command is switched ac power; with one line, plus neutral, resulting in movement of the actuator shaft in one direction and a second line, plus neutral, resulting in shaft movement in the other direction.

SETUP INFORMATION

AMPLIFIER SETUP

WARNING: This setup must be done with power off.

INPUT POWER

If input power is 120 or 240 Vac, the upper pc board slide switch must be placed in the appropriate position. Failure to do this can result in extensive damage. Dc powered units do not have this slide switch (see Figure 2, page 6).

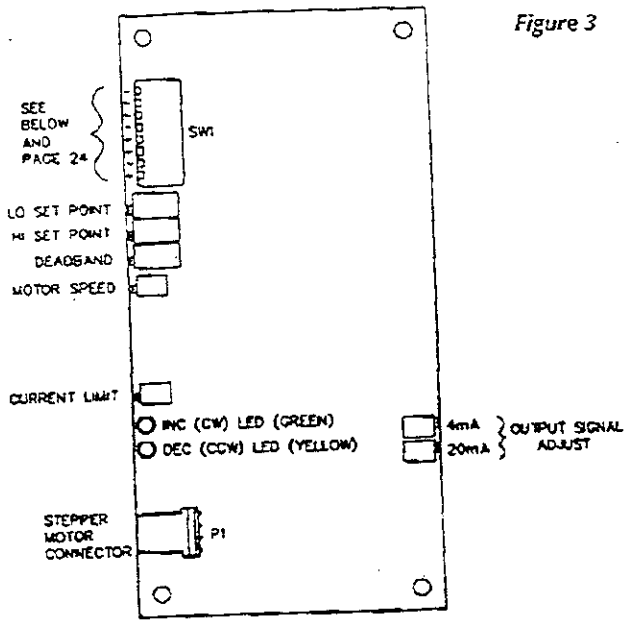
DIP SWITCH SETTINGS

Refer to note below table 1, this page)

1. Command Signal Selection
   A. If command signal is current, set switches as follows:
      4-20 mA - Place DIP switch #1 in its down position
      4-12 mA - Place DIP switch #2 in its down position
      12-20 mA - Place DIP switch #3 in its down position
      Only one of the above DIP switches may be down at one time. Place DIP switch #4 in its up position.
   B. If command signal is voltage, set switches as follows:
      Place DIP switches #1, #2, #3 in their up position.
      Place DIP switch #4 in its down position.
      0-5 Vdc - Place DIP switch #5 in its down position.
      0-10 Vdc - Place DIP switch #5 in its up position.
   C. If command signal is incremental control (contact closures), set all DIP switches in their up position, except #8 must be down, and DIP switch #6 is set per step 2.
2. **Direct or reverse action selection** (see table 2 on page 8, "Switch 6 Position.")
   A. For direct (normal) action, on increasing command signal, place DIP switch #6 as follows:
      For SM-1000 models without gearbox - down
      For SM-1000 models with gearbox - up
      For LA-1000 models - down
      For MV-1000 models - up
      For VA-1000 models - up
      For MC-10796 models -up
   B. For reverse action, place DIP switch #6 in the opposite position. The above reverse action logic carries through for automatic or manual operation.
3. Auto-Manual Selection
   A. Automatic mode - Place DIP switch #7 in its down position. In this mode, the actuator output shaft is positioned in proportion to the command signal.
   B. Manual mode or incremental control mode - Place DIP switch #7 in its up position and **DIP switch #8 in its down position**. In this mode, the actuator output shaft responds to external increase and decrease dry contact closures.
4. Loss of Signal (LOS) Action Selection
   The loss of signal monitors current command signals only. When the signal is lost, DIP switch #8 can be set as follows:
   A. On LOS, actuator stays in last position - Place DIP switch #8 in its up position.
   B. On LOS, actuator goes to its 4 mA postion - Place DIP switch #8 in its down position.

   If the command signal is voltage, and is lost, the actuator will travel to the low command position.

Figure 3



LOWER PC BOARD

TABLE 1

DIP SWITCH SETTINGS		
SWITCH	SWITCH POSITION	FUNCTION
1	DOWN	4-20 mA COMMAND SIGNAL
2	DOWN	4-12 mA COMMAND SIGNAL
3	DOWN	12-20 mA COMMAND SIGNAL
4	UP	CURRENT COMMAND SIGNAL
	DOWN	VOLTAGE COMMAND SIGNAL
5	UP	0-10 Vdc COMMAND SIGNAL
	DOWN	0-5 Vdc COMMAND SIGNAL
6	SEE CHART ON PAGE 8 FOR ACTION	
7	DOWN	AUTO OPERATION
	UP	MANUAL OPERATION
8	UP	LOS PARK IN PLACE
	DOWN	LOS GO TO LO SET

NOTE: This table applies to low level current or voltage command inputs and to incremental (discrete) control. For powered incremental control, see Tables 3-4 on page 24.

INSTALLATION WIRING

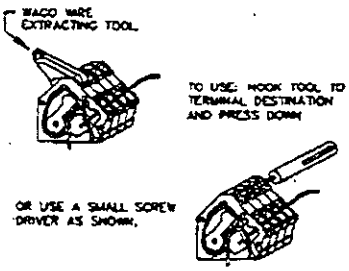
GENERAL

- All wiring should be done in accordance with prevailing codes by qualified personnel.
- Typical wiring diagrams are shown on pages 11-12. Actual wiring should follow the print supplied with the actuator.
- Fusing must be installed in line power, and should be of the slow blow type. Recommend 1 amp for ac input models and 5 amp for dc input models.
- Wiring should be routed to the actuator through one of the two 1/2 inch conduit openings. Generally, one conduit will contain input power and earth ground wires. The other conduit would then contain low level input and output signal wiring.

  After installation, it is recommended that all conduits be sealed to prevent water damage.

  Strip 0.22 inch (5.6mm) of insulation from the wire and insert this bare end into the appropriate terminal location, utilizing an insertion tool or a small screwdriver as shown in Figure 1 below.

Figure 1



Maximum recommended wire size is 14 AWG, and minimum is 26 AWG.

It is recommended that all low level signal wiring be a shielded type with the shield grounded at source common.

WIRING TO TB1

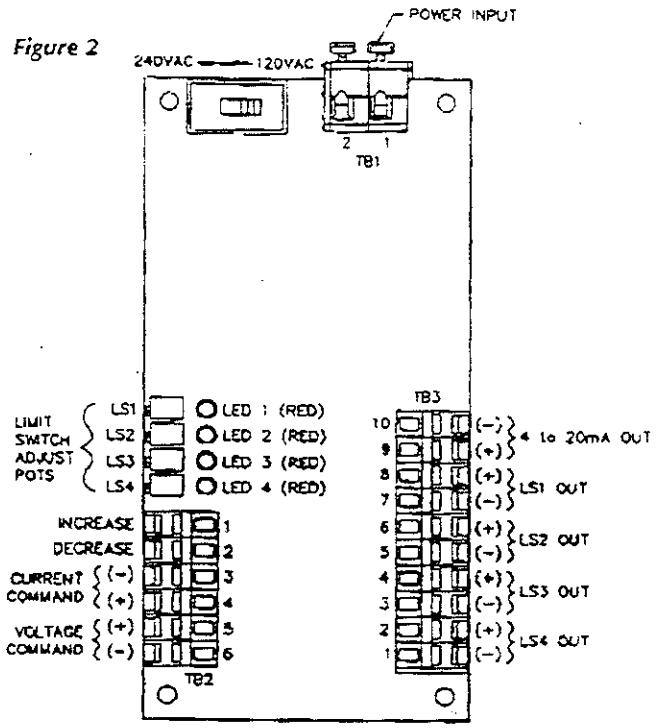
Input power terminates at TB1. For ac models, terminal 1 is hot, and terminal 2 is neutral. For dc models, terminal 1 is positive (+), and terminal 2 is negative (-). Terminal strip tabs are pressed down to insert wires.

WIRING TO TB2

LS1 and LS2 are normally factory-wired by Jordan Controls as end of travel limit switches (see Figure 4). LS1 is at the low command position and LS2 is at the high command position.

Current command (4-12 mA, 12-20 mA, or 4-20 mA) wires terminate at terminal 3 (-) and will be in addition to a wire already there, and to terminal 4 (+). Voltage command (0-5 Vdc or 0-10 Vdc) wiring terminates on terminals 5 (+) and 6 (-).

Figure 2



UPPER PC BOARD

The incoming power supply earth ground should be securely connected to the green ground screw located inside the actuator base between the two conduit entries.

WIRING TO TB3

If LS3 and LS4 are used as auxiliary position limit switches, connection is to terminals 1 through terminal 4. Maximum voltage is 40 Vdc and maximum current is 40 mA.

4-20 mA position feedback signal wires connect to terminals 9 (+) and 10 (-).

Increasing command signal will result in an increasing position feedback signal. Operation of the transmitter requires an external dc power supply in the range of 12 Vdc (minimum) to 36 Vdc (maximum) and a load connected in series with one lead from the power supply. (see figure 4)

$$\frac{\text{Power Supply Voltage} - 8\text{Vdc}}{0.020\text{A}} = \text{load resistance}$$

Example:

$$\frac{24\text{Vdc} - 8\text{Vdc}}{0.020\text{A}} = 800 \text{ ohms maximum load}$$

WIRING TO TB4

This terminal strip is only used on models with 3W option, and is located near the top of the PC board assembly (see Figure 5 on page 11 and Figure 24 on page 24).

NORMAL OUTPUT SHAFT MOTION FOR INCREASING SIGNAL - 1000 SERIES

Table 2

OBSERVATIONS	SM-1000	SM-1000 w/ Gearbox	MV-1000	VA-1000	LA-1000	MC-10796	SWITCH 6 REVERSES?
Standard output shaft motion for increasing signal for this actuator. (Actuator normal.)	CW	CW	Retract	Retract	Extend*	Retract	Yes
Switch 6 position for "actuator" normal operation	Down	Up	Up	Up	Down	Up	-
Stepper motor rotation for increasing signal (looking into motor tailshaft/handknob)	CCW	CW	CW	CW	CCW	CW	Yes
Stepper motor drive LED for increasing signal	Green	Green	Green	Green	Green	Green	No
Stepper motor drive LED for CW motor rotation (looking into motor tailshaft/handknob)	Yellow	Green	Green	Green	Yellow	Green	Yes
LS1 and LS3 trip (LED turns on) as actuator shaft goes:	CCW	CCW	Extend	Extend	Retract	Extend	Yes
LS2 and LS4 trip (LED turns on) as actuator shaft goes:	CW	CW	Retract	Retract	Extend	Retract	Yes
Output shaft movement with CW handwheel rotation	CCW	CW	Retract	Retract	Retract	Retract	No

DIRECTIONAL REFERENCES FOR THE 1000 FAMILY OF ELECTRONIC ACTUATORS

The 1000 family of products use similar servo amplifiers. The 1000 series servo amplifier has directional references: NORMAL/REVERSE, HIGH/LOW, HI/LOW SETPOINTS and INCREASE/DECREASE. These were established during product design and are constant regardless of application.

Jordan Controls has established a standard for actuator output motion for all actuators including the 1000 series. Wiring drawings conform to this standard. For rotary actuators, the actuator will rotate CW (when looking into the shaft) for increasing signal. For globe valve actuators, the actuator will retract for increasing signal. For the LA-1000 series, the shaft extends for increasing signal.

*Extension direction is indicated by an arrow on the rack block.

START-UP INFORMATION

I. START-UP FOR LOW LEVEL CURRENT OR VOLTAGE COMMAND SIGNALS

(See Figure 4, page 10)

1. **Power.** Apply ac or dc power to TB1, as appropriate for the model.
2. **Setpoints.** These are the the end of travel extremes corresponding to the actuator output shaft positions desired for low and high comand signal levels. They are set by the Lo and Hi setpoint pots (25 turn devices).
   A. Set the command signal to Low.
   B. Adjust Lo setpoint pot by turning CCW to move actuator output shaft to desired position. (Turn CW if output shaft is beyond this position.) The Yellow (DEC) LED will illuminate while the actuator is moving toward the Lo setpoint position. Should the Red LED adjacent to LS1 trim pot illuminate before getting to desired position, turn LS1 trim pot several turns CCW and continue to adjust the Lo setpoint pot CCW until the desired setting is obtained. NOTE: The Yellow LED and Red LS1 LED should be off.
   C. Set command signal to high.
   D. Adjust HI setpoint pot by turning CW to move actuator output shaft to desired position. (Turn CCW if output shaft is beyond this position). The Green (INC) LED will illuminate while the actuator is moving toward the Hi setpoint position. Should the Red LED adjacent to LS2 trim pot illuminate before getting to desired position, turn LS2 trim pot several turns CW and continue to adjust the Hi setpoint pot CW until desired setting is obtained. NOTE: The Green LED and Red LS2 LED should be off.
3. **Deadband.** This adjustment establishes the actuator servo sensitivity and is set to tolerate electrical "noise" on the command signal, mechanical instability, backlash, etc. It governs the "tightness" of the operating servo loop.
   A. Adjust the deadband pot (25 turn device) to desired position. CW rotation decreases sensitivity. If the actuator begins to oscillate (Green and Yellow LEDs turn on and off rapidly), turn the deadband pot slowly CW until oscillation stops.
   B. Some interaction will occur, and it is necessary to repeat above steps until both Hi and Lo setpoint desired positions are obtained.
4. **End of Travel Limit Switches.** These are the electronic position limit switches that are set just outside of the low and high command signal level positions. They are set by LS1 and LS2 trim pots (25 turn devices).
   A. Set command signal to low, and adjust LS1 trim pot until its LED just comes on. Note that the Green and Yellow LEDs are also on. This is an indication the limit switch tripped and stopped actuator movement just prior to reaching low command level position.
   B. Turn LS1 trim pot approximately 1/8 turn CW, or just until LS1 LED goes off. The Green and Yellow LEDs will also go off, indicating that the actuator is in correct low command position.
   C. Set command signal to high and adjust LS2 trim pot until its LED just comes on. Note that the Green and Yellow LEDs are also on. This is an indication that the limit switch tripped and stopped actuator movement just prior to reaching high command level position.
   D. Turn LS2 trim pot approximately 1/8 turn CW, or just until LS2 LED goes off. The Green and Yellow LEDs will also go off, indicating that the actuator is in correct high command position.
5. **Speed Adjust.** Actuator output speed is set by the motor speed pot (12 turn device). Adjust the motor speed pot to desired actuator output shaft speed. CW rotation increases speed.

   CAUTION: Speed must be within the limits detailed by the curves on pages 15, 18, 20, 22 of this manual. Choose the curve that applies to your actuator model.
6. **Current Limit.** This governs the torque limit setting for SM-1000 models and the thrust limit setting for all other 1000 series models. It is set by the current limit pot, and must be adjusted to yield an electrical limiting feature. When the motor torque setpoint is exceeded, the actuator will remain in place and can stay in this condition indefinitely without overheating, provided the current limit pot (12 turn device) is adjusted as follows:
   A. With the actuator in motion and operating under full load, slowly turn the current limit pot CCW to reduce motor current. Continue until the actuator begins to stall. At this point, stop turning the current pot CCW. Next, give the current pot one full turn CW.
   B. The current limit adjustment is now complete. Any readjustment of the speed pot will require repeating the above procedure.

   CAUTION: FAILURE TO FOLLOW THIS PROCEDURE WILL RESULT IN PREMATURE FAILURE OF THE UPPER PC BOARD.
7. **Auxilliary Limit Switches.** LS3 and LS4 can be set to open or close anywhere within the actuator range. Adjust LS3 and LS4 trim pots (25 turn devices) to desired "trip" points. The Red LEDs adjacent to LS3 and LS4 indicate their state.
8. **Isolated Position Feedback.** 4-20 mA current feedback signal is taken from the integral feedback pot, and is optically isolated from all other servo electronics. It is calibrated with two 25 turn trim pots.
   A. Set command signal to low.
   B. Adjust 4 mA output signal pot until output is at 4 mA.
   C. Set command signal to high.
   D. Adjust 20 mA output signal pot until output is at 20 mA.
   E. Some interaction will occur, and it is necessary to repeat above steps until no further adjustment is necessary.
   F. The position feedback signal is now calibrated and will be proportional to the actuator output shaft travel.

9. Verify all settings by running the actuator through its travel range several times. Also verify loss of signal action.
10. Transfer to automatic control and observe that operation is proper before leaving the actuator unattended.

II. STARTUP FOR INCREMENTAL (DISCRETE) CONTROL

(See Figure 6 on page 12)

1. Power. Apply ac or dc power to TB1, as appropriate for the model
2. Two isolated, dry contact closures are used to position the actuator. These contacts may be within a remotely located controller or may take the form of external pushbuttons or switches for manual control. NOTE: the Hi and Lo setpoint pots have no influence in this mode.
   A. Adjust LS1 full CW and LS2 full CCW. This will allow for full range of travel.
   B. Close DEC contact. The actuator will move toward the low command position. The Yellow LED comes on.
   C. Set LS1 trim pot so adjacent LS2 Red LED turns off at desired low command position. The Yellow LED will also turn off at this point.
   D. Open DEC contact and close INC contact. The actuator will move toward the high command position. The Green LED comes on.
   E. Set LS2 trim pot so adjacent LS1 Red LED turns off at desired high command position. The Green LED will also turn off at this point.
   F. If reverse action is desired, DIP switch #6 should be moved to its opposite position, and the above steps repeated.
3. **Deadband.** The Deadband pot adjustment has no influence in this mode of operation.
4. **Speed Adjust.** Same procedure as Step 5 above.
5. **Current Limit.** Same procedure as Step 6 above.
6. **Auxilliary Limit Switches.** Same procedure as Step 7 above.
7. **Isolated Position Feedback Signal.** Same procedure as Step 8 above.

III. STARTUP FOR POWERED INCREMENTAL DC CONTROL

(See Figure 5, page 11)

If the actuator is equipped with the 2W option in the model number, the actuator is positioned by switching and reversing the polarity of dc power.

1. Set DIP switches per Table 3, page 24.
2. Adjust LS1 full CW and LS2 full CCW. This will allow for full range of travel.
3. Apply a negative (-) voltage to TB1 terminal 1, and a positive (+) voltage to terminal 2; the actuator will move toward the low command (DEC) position. The Yellow LED comes on.
4. Set LS1 trim pot so adjacent LS1 Red LED turns on at desired low command position. The Green LED will also turn on at this point. When dc power is switched off, all LEDs go off, and the actuator will remain in its last position.
5. Apply a positive (+) voltage to TB1 terminal 1, and a negative (-) voltage to terminal 2; the actuator will move toward the high (INC) comand position. The Green LED comes on.
6. Set LS2 trim pot so adjacent Red LED turns on at desired high command position. The Yellow LED will also turn on at this point. When dc power is switched off, all LEDs go off, and the actuator will remain in its last position.
7. If reverse action is desired, DIP switch #6 should be moved to its opposite position and the above steps repeated.
8. Speed adjust pot, current limit pot, auxilliary limit switch pots, and isolated feedback signal adjustment are the same as that covered in section I, Steps 5 through 8.
9. The Hi and Lo setpoint pots and deadband pot have no influence in this mode.

IV. STARTUP FOR POWERED INCREMENTAL AC CONTROL

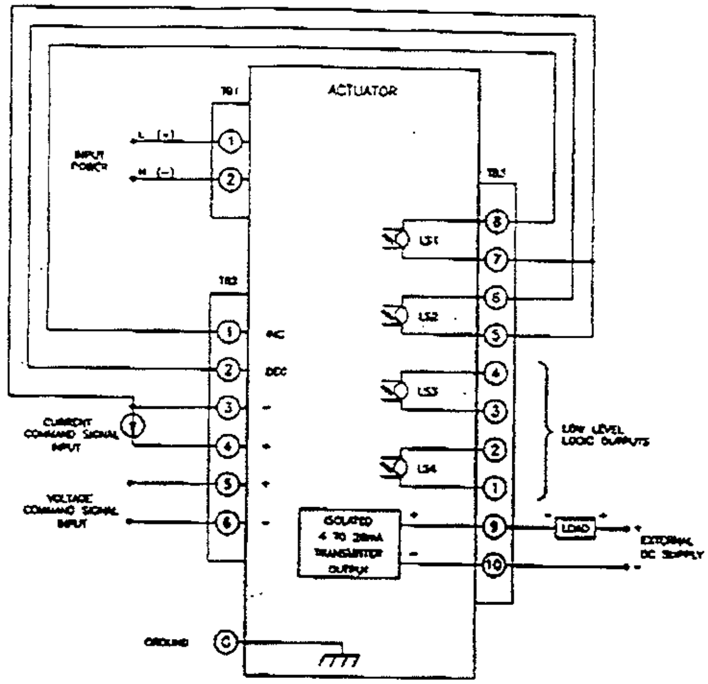
If the actuator is equipped with the 3W option in the model number, the actuator is positioned by applying switched line voltage to TB4. (See wiring on page 11 and TB4 location on page 24)

1. Set DIP switches per Table 4, page 24.
2. Apply ac power to TB1.
3. Adjust LS1 full CW and LS2 full CCW. This will allow for full range of travel.
4. Apply ac line voltage to TB4 terminal 3 (L) and 2 (N). The actuator will move toward the low command (DEC) position. The Yellow LED comes on.
5. Set LS1 trim pot so adjacent Red LED turns off at desired low command position. The Yellow LED will also turn off at this point.
6. Apply ac line voltage to TB4 Terminal 1 (L) and 2 (N). The actuator will move toward the high command (INC) position. The Green LED comes on.
7. Set LS2 trim pot so adjacent Red LED turns off at the desired high command position. The Green LED will also turn off at this point.
8. If reverse action is desired, DIP switch #6 should be moved to its opposite position and the above steps repeated.
9. Speed adjust pot, current limit pot, auxilliary limit switch pots, and isolated feedback signal adjustment are the same as that covered in section I, Steps 5 through 8.
10. The Hi and Lo setpoint pots, and deadband pot have no influence in this mode.

TYPICAL WIRING DIAGRAMS

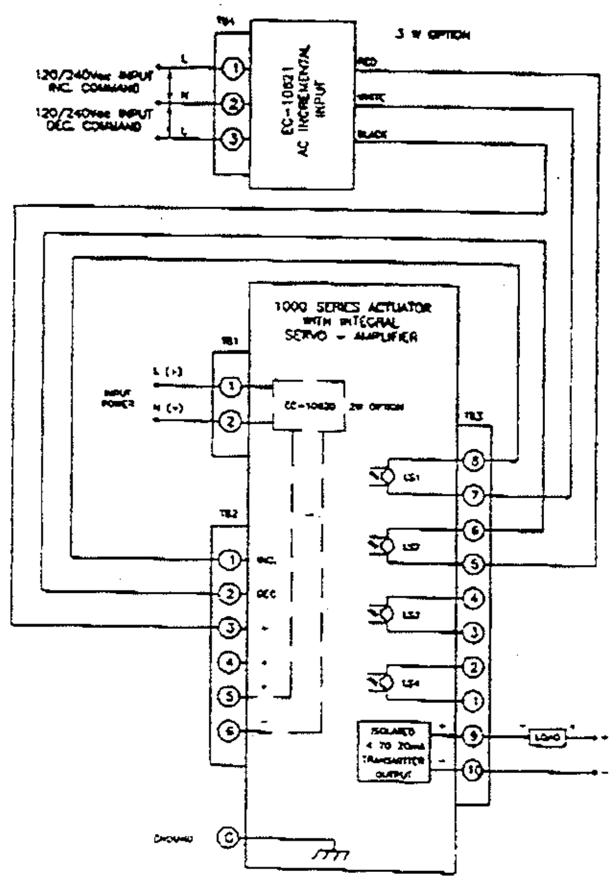
ANALOG COMMAND WITH POSITION LIMITS

Figure 4



POWERED INCREMENTAL CONTROL WITH POSITION LIMITS

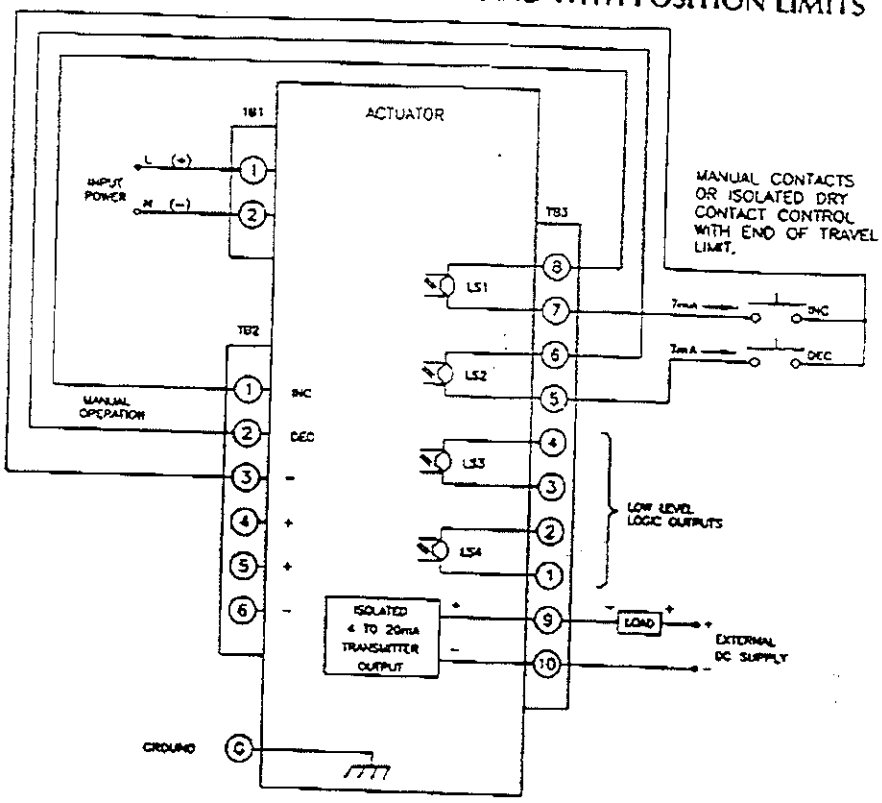
Figure 5



TYPICAL WIRING DIAGRAMS

INCREMENTAL (DISCRETE) COMMAND WITH POSITION LIMITS

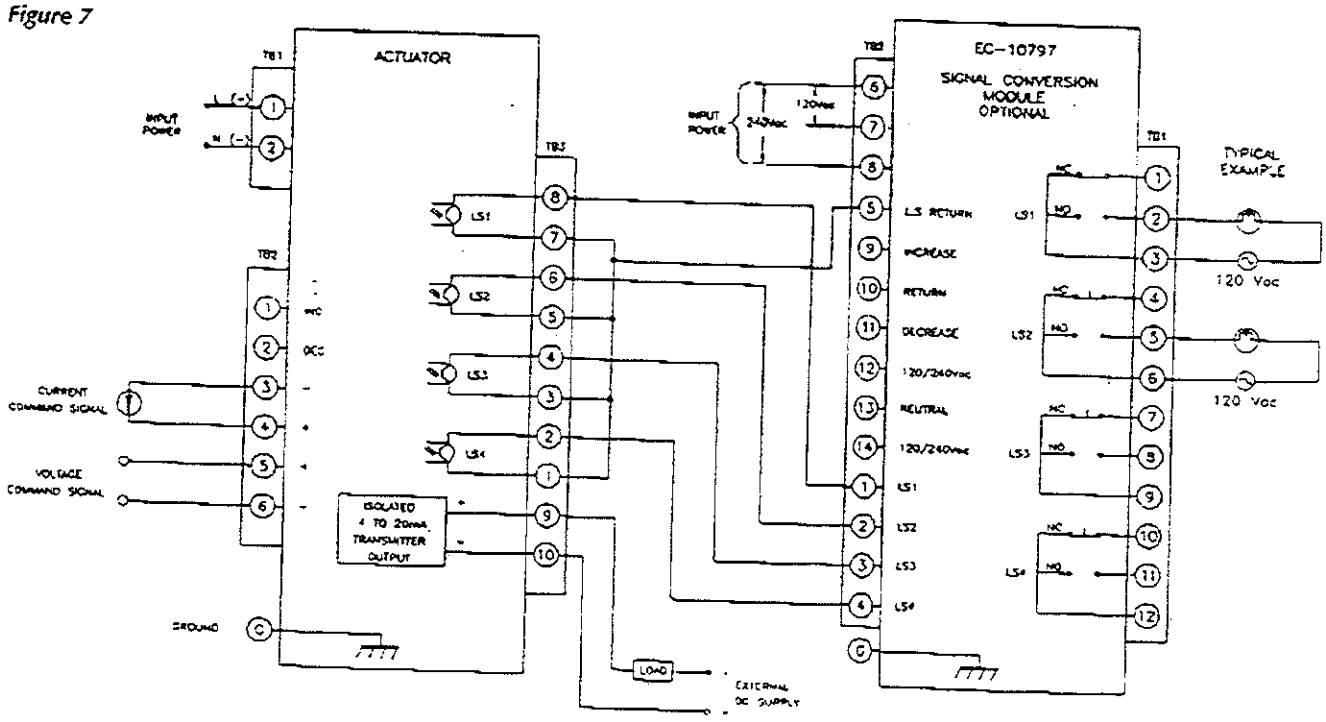
Figure 6



UTILIZING SIGNAL CONVERSION MODULE

FORM C LIMIT SWITCH OUTPUTS

Figure 7

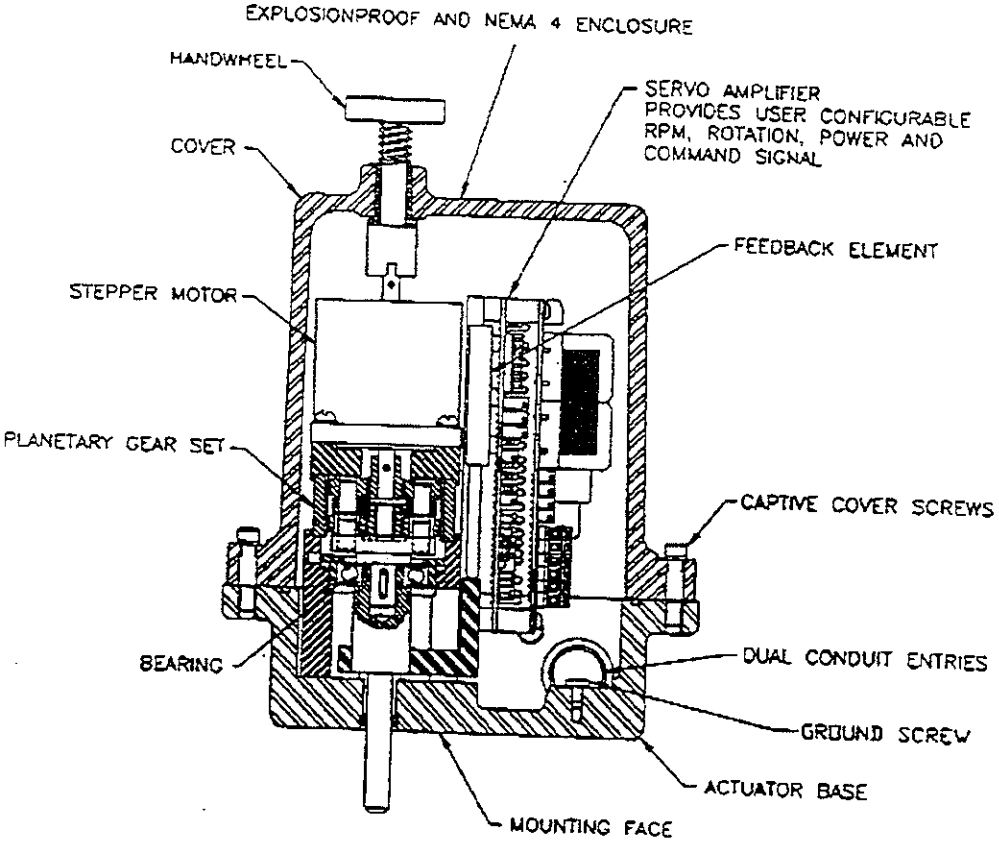


TROUBLESHOOTING GUIDE

TROUBLE	POSSIBLE CAUSE	REMEDY
Can't get full stroke by adjusting setpoint pots.	a. Runs into a mechanical stop. b. LS1 and/or LS2 opens (LED comes on) before reaching desired setpoint.	a. Set stroke within actuator limits. b. Adjust LS1, LS2 and setpoint pots per set-up procedure.
Output shaft goes in opposite direction as desired.	DIP switch #6 is in incorrect position.	Reverse DIP switch #6 position and recalibrate.
No response when in manual mode.	DIP switch #8 is in incorrect position.	Reverse DIP switch #8 position.
Actuator "chatters" and Green & Yellow LEDs go on and off rapidly.	a. Deadband too tight. b. Low speed or current. c. Excessive noise on command signal. d. Command signal shield not grounded, or grounded incorrectly.	a. Turn deadband pot CW to decrease sensitivity until "chattering" stops and Green & Yellow LEDs go off. b. Readjust motor speed and current limit pot. c. Remove noise. d. Ensure shield is grounded at source common only.
Erratic operation.	a. DIP switches set incorrectly. b. Incorrect wiring.	a. Correct settings. b. Correct wiring.
Loss of signal action incorrect. (4-20mA only)	DIP switch # 8 set incorrectly.	Correct DIP switch #8 position.
Transformer on upper PC board seems too warm.	Incorrect setting of speed and current pots.	Reset pots per startup procedure.
Actuator won't run.	a. No power or power out of range. b. Transformer burned out and discolored due to incorrect setting of speed and current pots. c. Transformer burned out due to incorrect setting of slide switch (240 Vac supply and switch set on 120 Vac). d. Transformer connection to PC board broken, due to excessive vibration. e. Slide switch set in 240 Vac position when power is 120 Vac. f. ESD damage to PC boards. g. Incorrect wiring. h. Loss of command signal. i. Excessive side load on output shaft. j. dc input power polarity reversed k. Command signal not received or not in range. l. Actuator mechanically at end of travel. m. External actuated device binding or at its end of travel.	a. Check and restore power or connect to proper power. b. Replace upper PC board and reset speed and current pots. Also recalibrate. c. Replace upper PC board and recalibrate. d. Replace upper PC board and eliminate excessive vibration. Recalibrate. e. Remove power, set slide switch to 120 Vac position and restore power. f. Replace PC board set. g. Correct wiring. h. Restore command signal. i. Eliminate side load. j. Correct wiring. k. Check and correct. l. Recalibrate to bring in mechanical range. m. Eliminate bind or recalibrate.

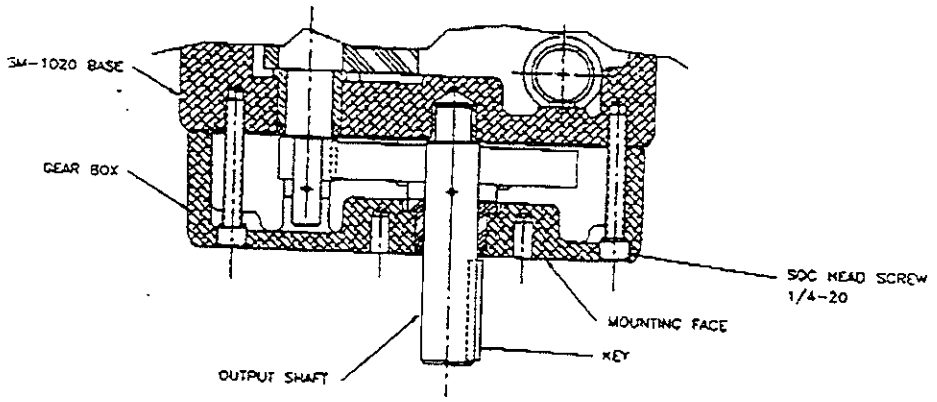
SM-1000 MAJOR COMPONENT IDENTIFICATION

Figure 8



GEARBOX (Optional)

Figure 9



INSTALLATION DIMENSIONS

OPTIONAL SIGNAL CONVERSION MODULE CHASSIS FORM

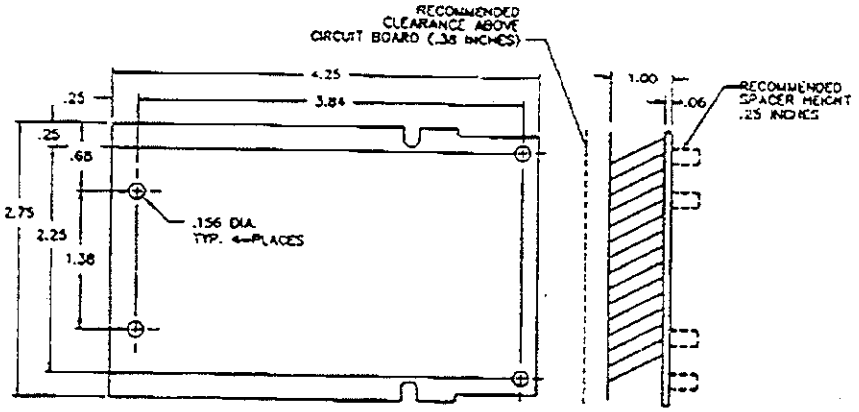
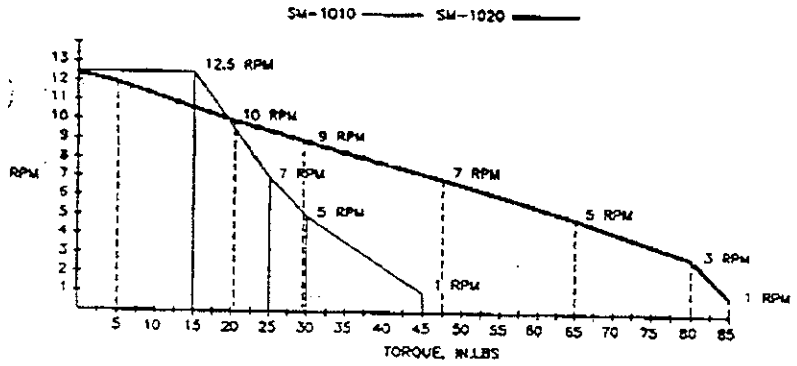


Figure 10

SPEED/TORQUE CURVES

Figure 11



To calculate shift (total stroke) time, use the following formula:

$$\text{Shift time (sec.)} = \frac{\text{maximum revolutions for total range x 60}}{\text{revolutions per minute}}$$

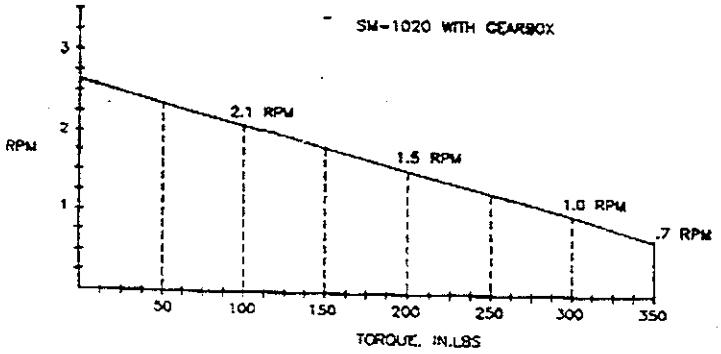
Example: 90° rotation @ 1 rpm, 80 in.lbs. torque

$$\frac{0.25 \times 60}{1} = 15 \text{ sec.}$$

NOTE: At 80 in.lb. maximum speed is 3 rpm, which would give a 5 second shift time for an SM-1020.

CAUTION: On SM-1020V models operating in the 12-23 Vdc input range, maximum output torque is limited to 29 in.lbs. There is no rating change when input voltage is 24 Vdc or greater.

Figure 12

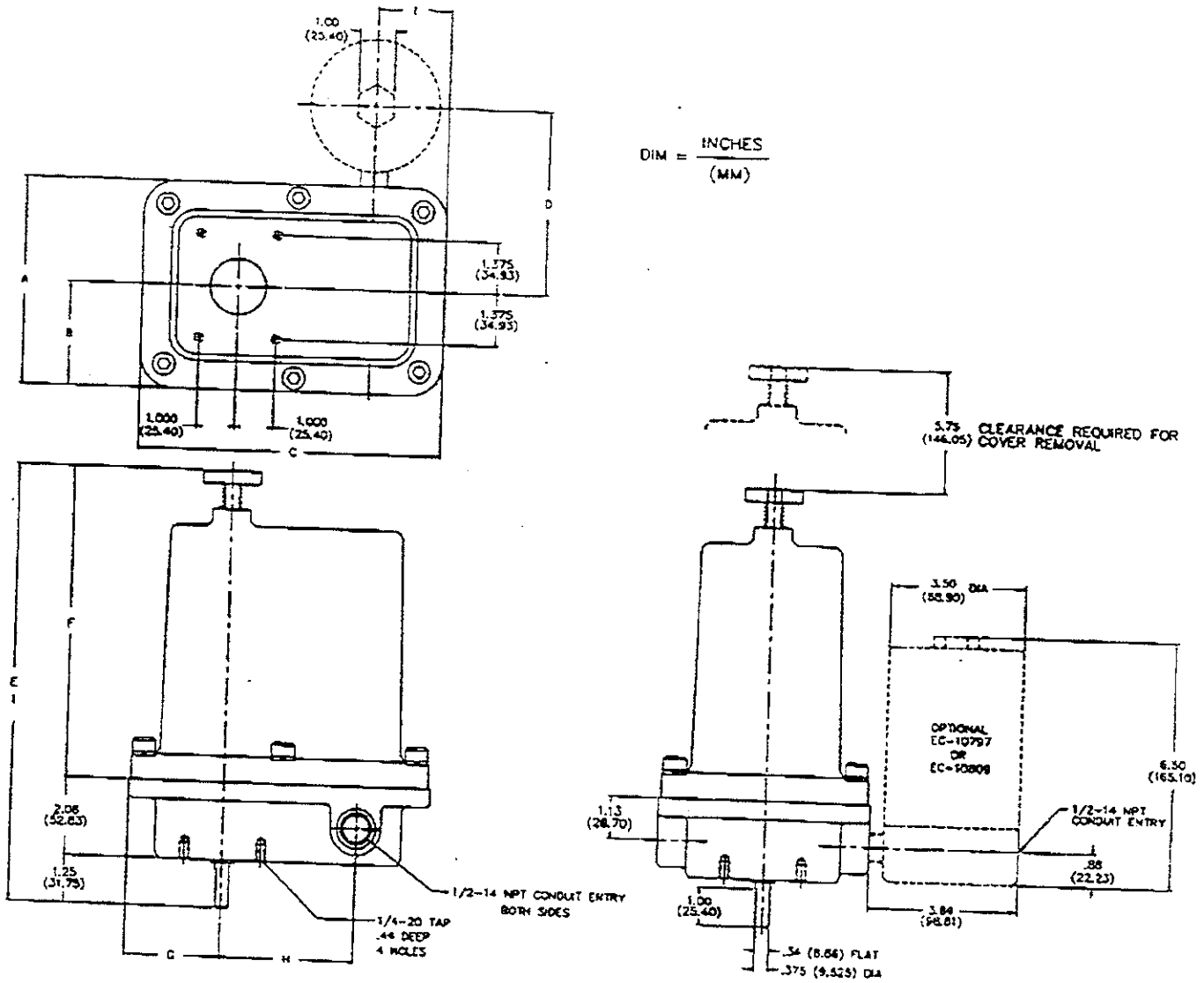


To convert in.lbs. to NM, multiply by 0.113.

CAUTION: On SM-1020V models with gearbox operating in the 12-23 Vdc input range, maximum output torque is limited to 125 in.lbs. There is no rating change when input voltage is 24 Vdc or greater.

SM-1000 INSTALLATION DIMENSIONS

Figure 13

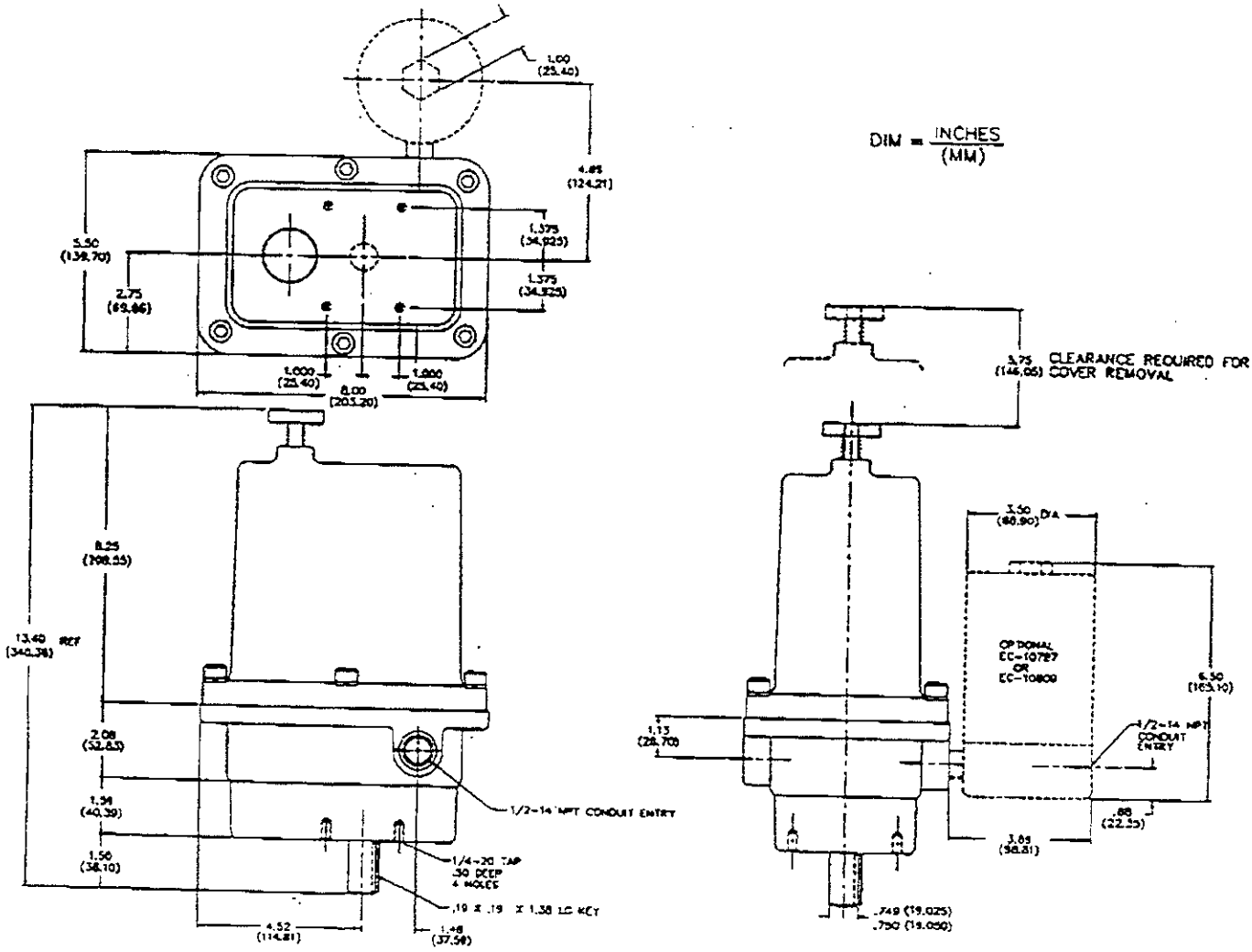


	A	B	C	D	E	F	G	H	I
SM-1010	5.25 (133.35)	2.63 (66.8)	7.13 (181.1)	4.75 (120.65)	10.68 (271.27)	7.35 (186.69)	2.38 (60.45)	3.00 (76.2)	1.75 (44.45)
SM-1020	5.5 (139.7)	2.75 (69.85)	8.00 (203.2)	4.89 (124.21)	11.56 (293.62)	8.25 (209.55)	2.5 (63.5)	3.5 (88.9)	2.00 (50.08)

SM-1000 INSTALLATION DIMENSIONS

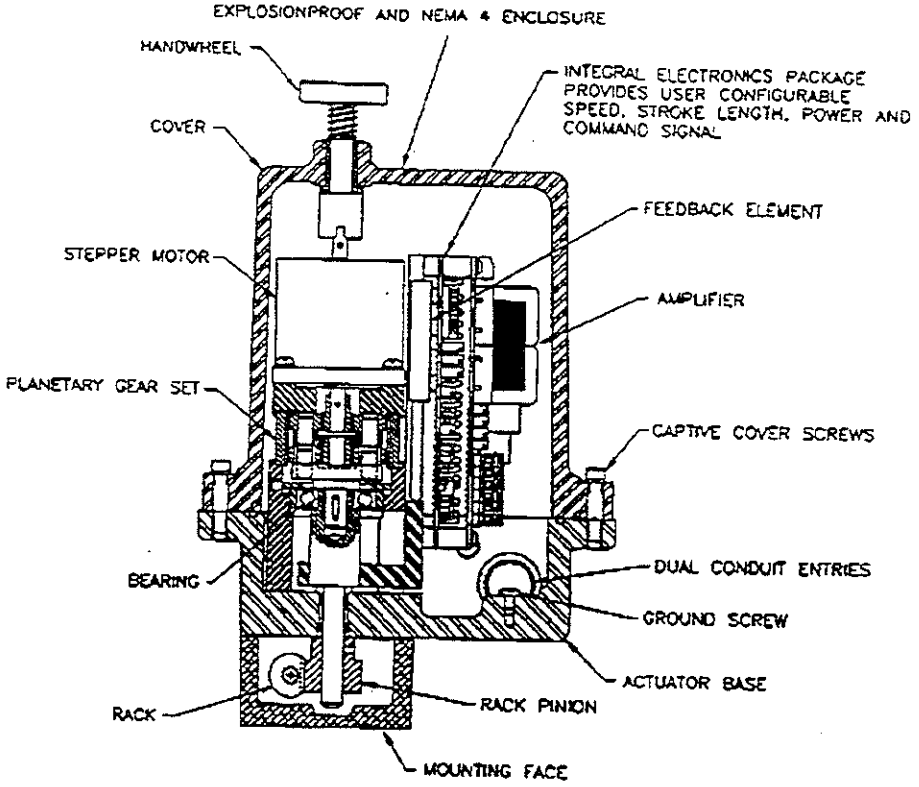
SM-1020 with gearbox

Figure 14



LA-1000 MAJOR COMPONENT IDENTIFICATION

Figure 15



SPEED/THRUST CURVE

To calculate shift (total stroke) time, use the following formula:

$$\text{Shift time (sec.)} = \frac{\text{Total stroke in inches} \times 60}{\text{Stroke rate of actuator in inches per minute}}$$

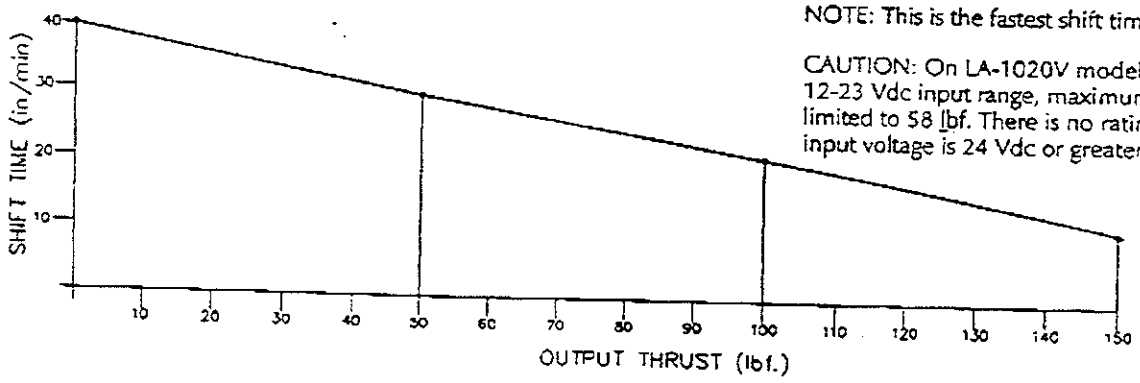
Figure 16

Example: 7 in. stroke, 50 lbf. thrust

$\frac{7 \times 60}{30} = 14$ sec.

NOTE: This is the fastest shift time for this example.

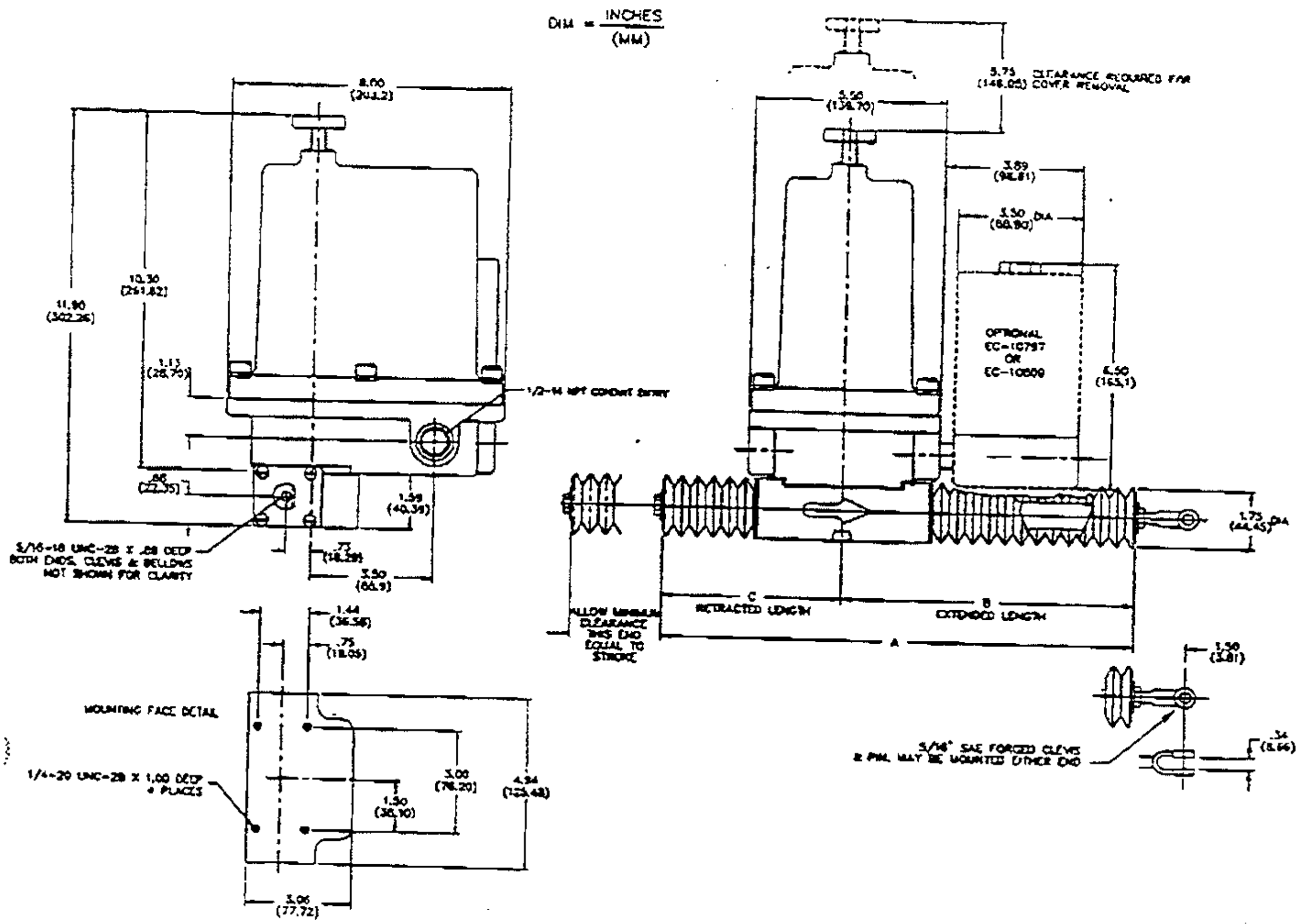
CAUTION: On LA-1020V models operating in the 12-23 Vdc input range, maximum output thrust is limited to 58 lbf. There is no rating change when input voltage is 24 Vdc or greater.



To convert in/min to mm/min, multiply by 25.4
To convert lbf to N, multiply by 4.448

LA-1000 INSTALLATION DIMENSIONS

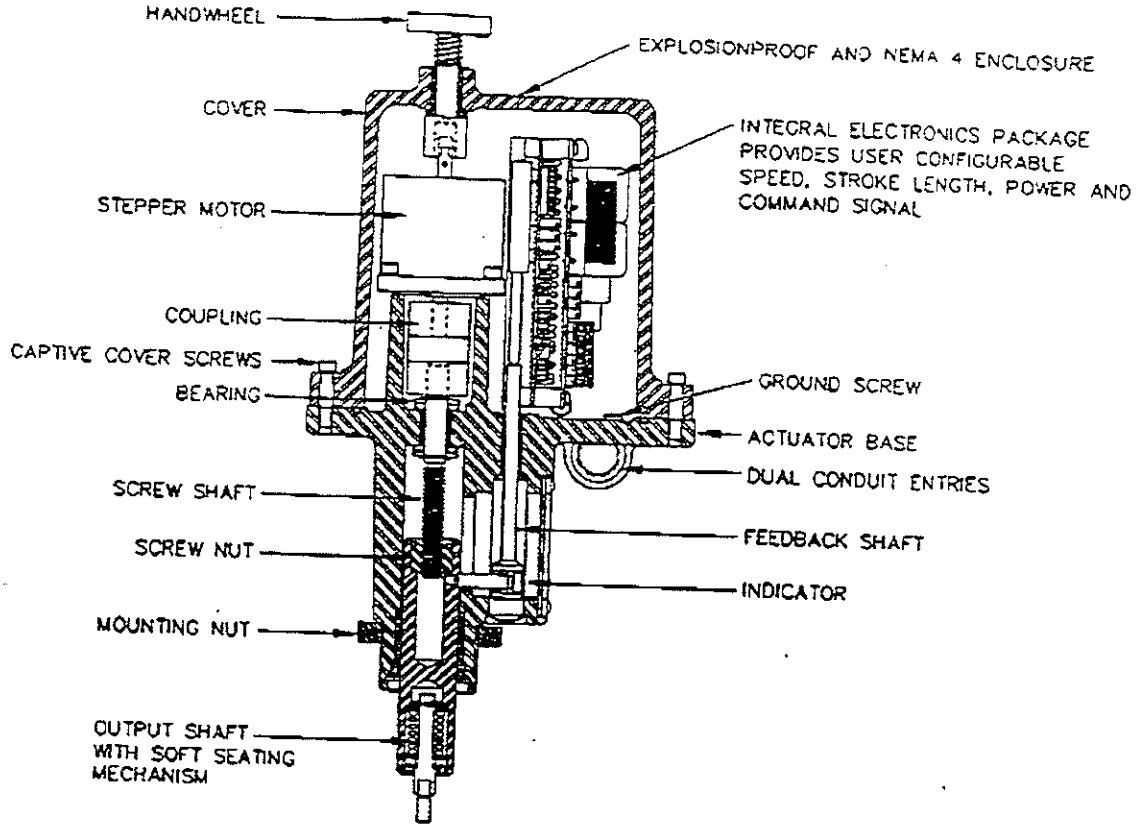
Figure 17



[illegible]	[illegible]	[illegible]	[illegible]
0.35"-3"	12.38 (314.45)	7.69 (195.33)	4.69 (119.13)
3.01"-6"	17.38 (441.45)	11.69 (296.93)	5.69 (144.53)
6.01"-9"	22.38 (568.45)	15.69 (398.53)	6.69 (169.93)
9.01"-12"	27.38 (695.45)	19.69 (500.13)	7.69 (195.33)
12.01"-15"	32.38 (882.45)	23.69 (601.73)	8.69 (220.73)
15.01"-21"	42.38 (1076.45)	31.69 (804.93)	10.69 (271.53)
21.01"-24"	47.38 (1203.45)	35.69 (906.53)	11.69 (296.93)

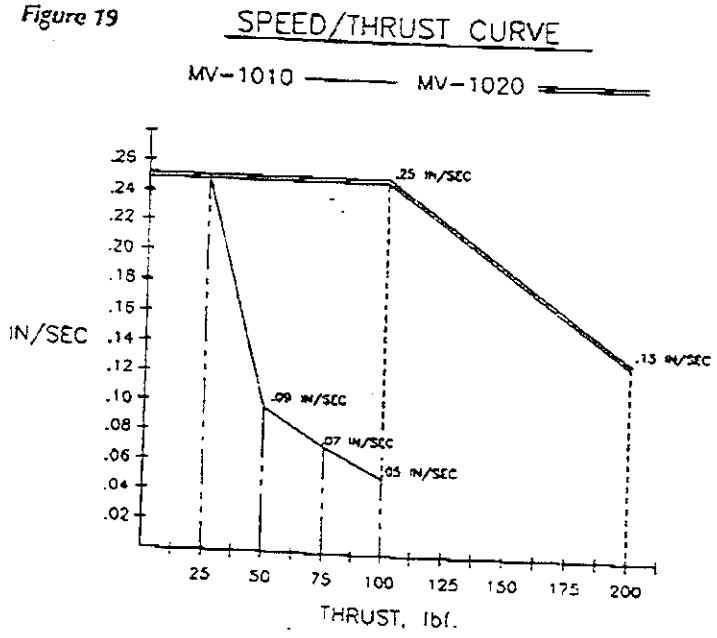
MV-1000 MAJOR COMPONENT IDENTIFICATION

Figure18



SPEED/THRUST CURVE

Figure 19



To calculate shift (total stroke) time, use the following formula:

$$\text{Shift time (sec.)} = \frac{\text{Total stroke in inches}}{\text{Stroke rate of actuator in in./sec.}}$$

Example: 1.25 in. stroke, 150 lbf. thrust

$\frac{1.25}{0.19}$ = 6.6 sec. max

or:

$\frac{1.25}{0.13}$ = 9.6 sec. min.

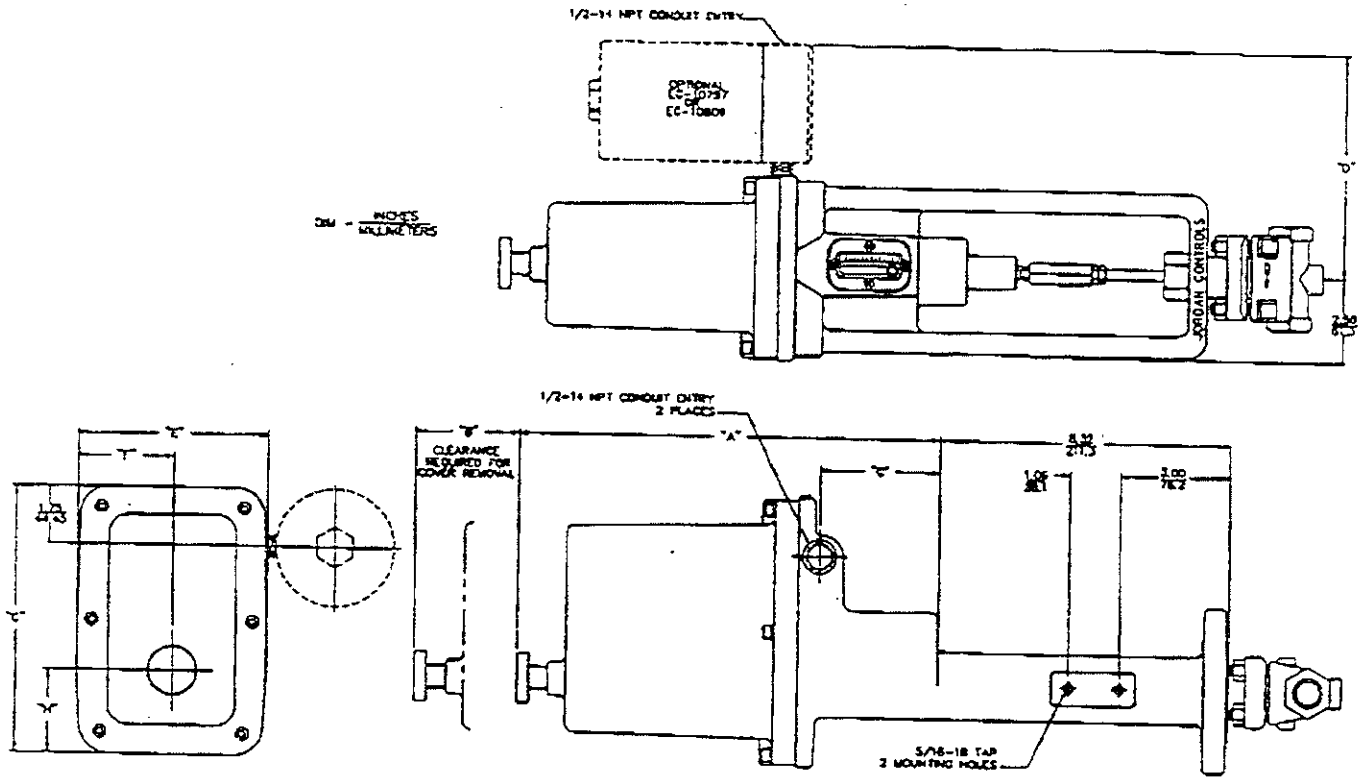
CAUTION: On MV-1020 models operating in the 12-23 Vdc range, maximum output thrust is limited to 60 lbf. There is no rating change when input voltage is 24 Vdc or greater.

To convert lbf. to N, multiply by 4.448

To convert in./sec. to mm/sec., multiply by 25.4

MV-1000 INSTALLATION DIMENSIONS

Figure 20

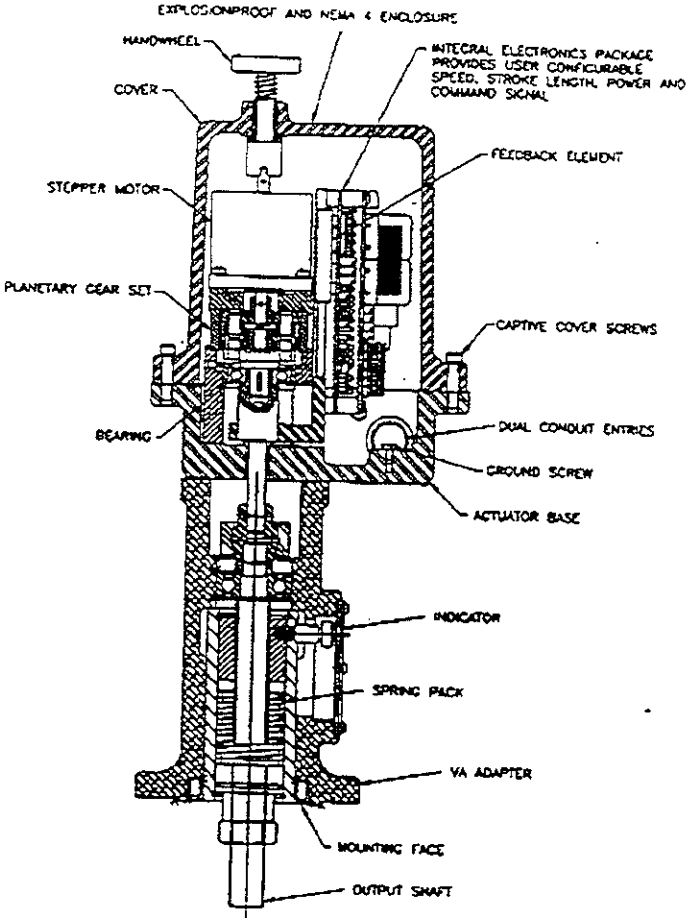


NOTE: Valve shown for reference only

	A	B	C	D	E	F	G	H
MV-1010	11.43 / 290.3	5.25 / 133.4	3.40 / 86.4	6.52 / 165.6	5.39 / 136.9	2.69 / 68.3	7.12 / 180.8	2.37 / 60.2
MV-1020	12.37 / 314.2	6.13 / 155.7	3.53 / 89.7	6.64 / 168.6	5.66 / 143.8	2.83 / 71.9	8.00 / 203.2	2.50 / 63.5

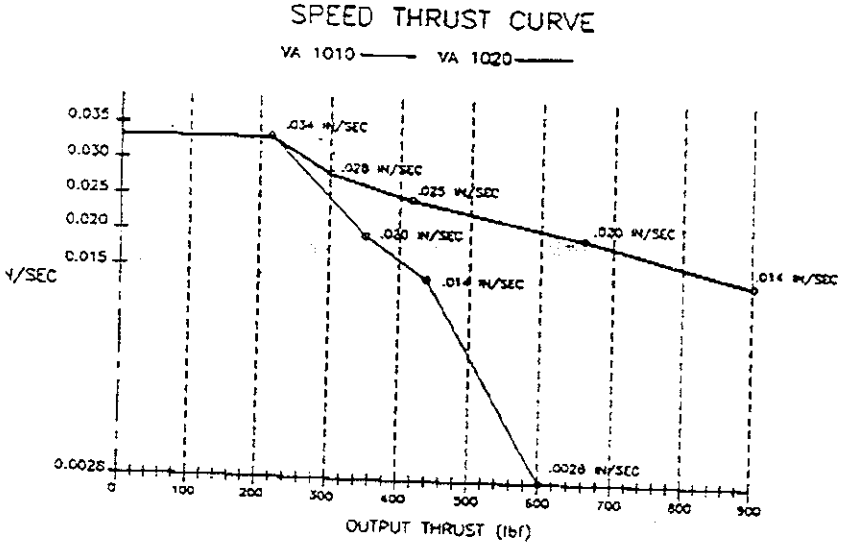
VA-1000 MAJOR COMPONENT IDENTIFICATION

Figure 21



SPEED/THRUST CURVE

Figure 22



To calculate shift (total stroke) time, use the following formula:

$$\text{Shift (sec.)} = \frac{\text{Stroke in inches}}{\text{Stroke rate of actuator in in./sec.}}$$

Example: 0.75 in. stroke, 400 lbf. thrust

$\frac{0.75}{0.25}$ = 30 seconds (VA - 1020)

or:

$\frac{0.75}{0.017}$ = 44.1 seconds (VA - 1010)

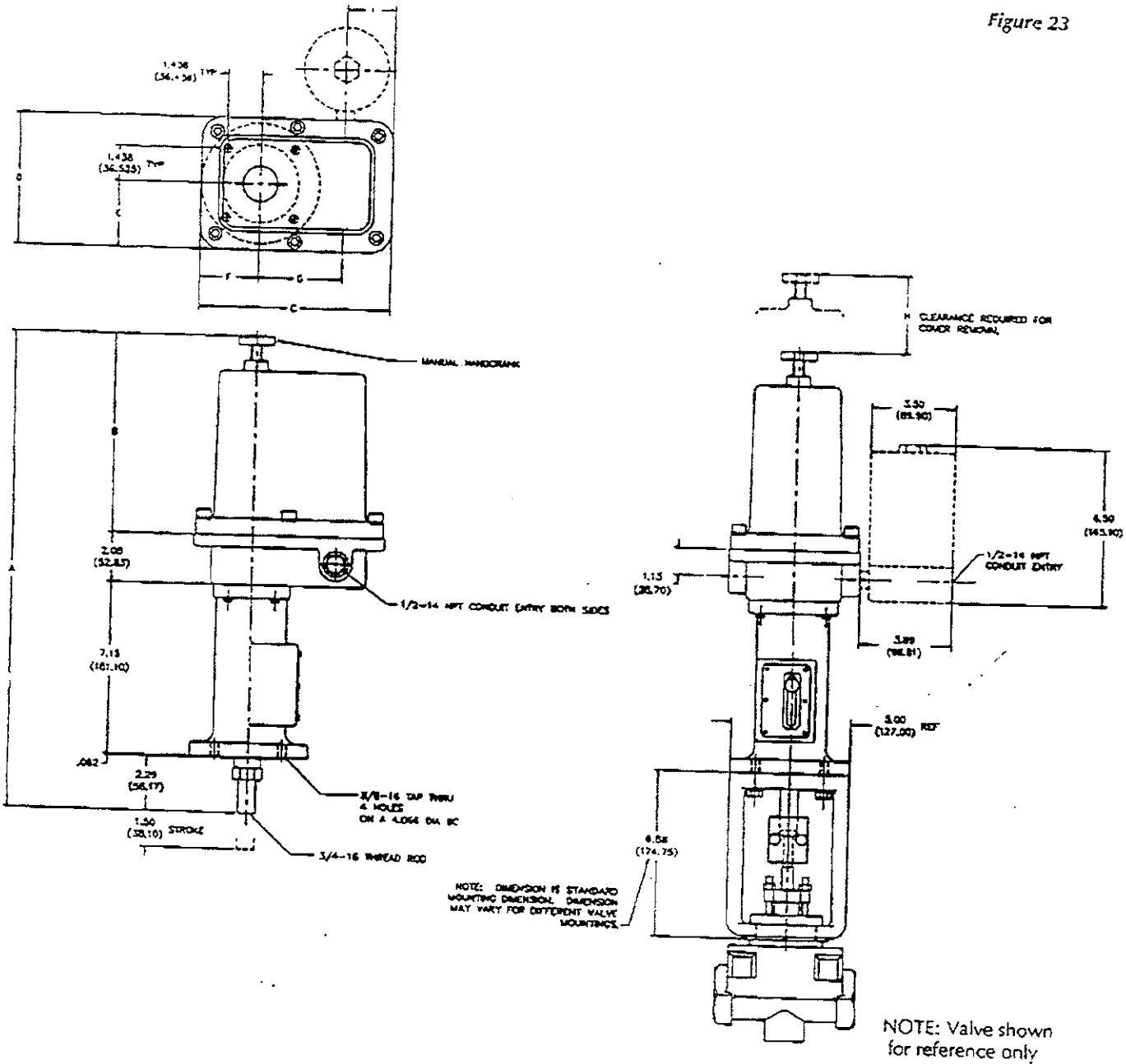
CAUTION: On VA-1020V models operating in the 12-23 Vdc range, output thrust is limited to 423 lbf. There is no rating change when input voltage is 24 Vdc or greater.

To convert lbf. to N, multiply by 4.448

To convert in./sec. to mm/sec. multiply by 25.4.

VA-1000 INSTALLATION DIMENSIONS

Figure 23

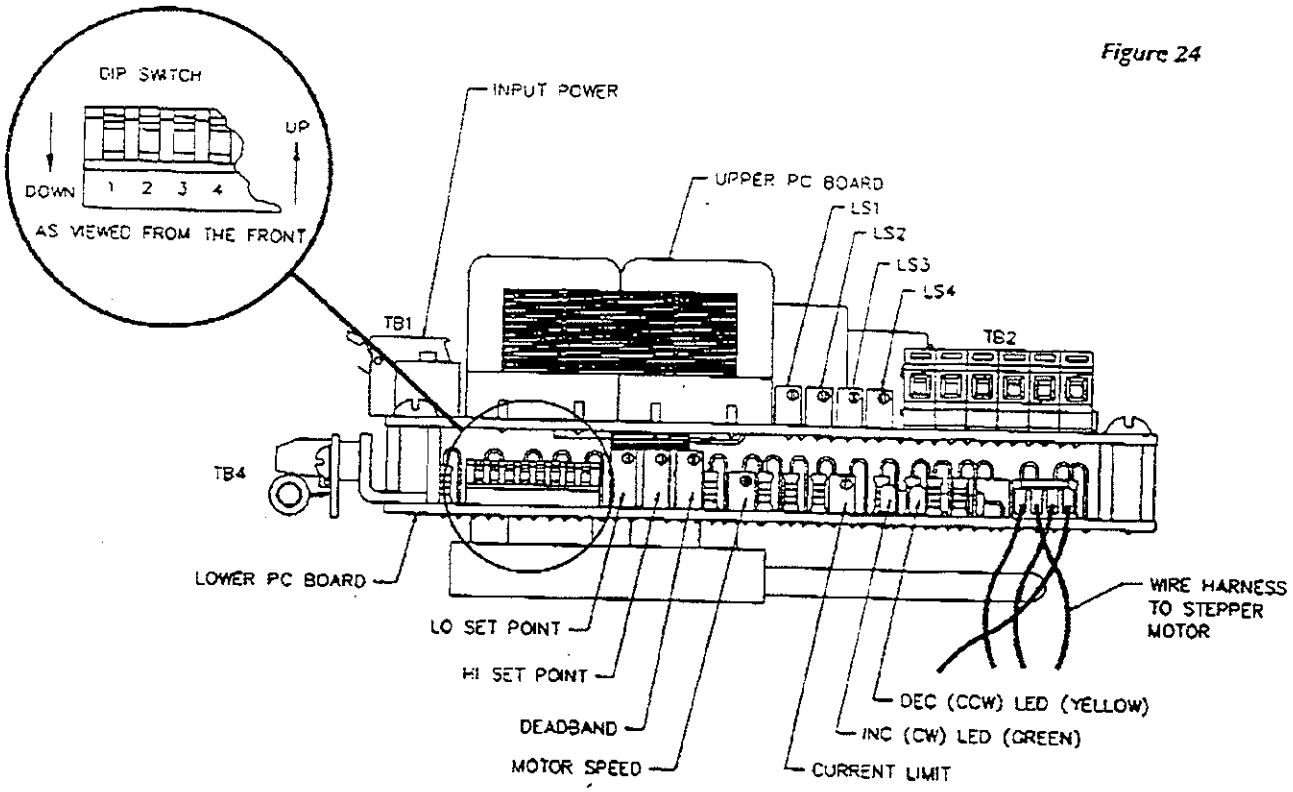


NOTE: Valve shown for reference only

	A	B	C	D	E	F	G	H	L
VA-1010	18.9 (480.06)	7.35 (186.69)	7.13 (181.1)	5.25 (133.35)	2.63 (66.8)	2.38 (60.45)	3.00 (76.20)	5.25 (133.35)	1.75 (44.45)
VA-1020	21.3 (541.02)	8.25 (209.55)	8.00 (203.2)	5.5 (139.7)	2.75 (69.85)	2.5 (63.5)	3.5 (88.9)	5.75 (146.05)	2.00 (50.8)

AMPLIFIER SWITCH, POT & TERMINAL LOCATIONS

Figure 24



POWERED INCREMENTAL CONTROL

TABLE 3 (2W OPTION)

DIP SWITCH SETUP	
SWITCH	SWITCH POSITION
1	UP
2	UP
3	UP
4	DOWN
5	UP
6	SEE TABLE 2, PAGE 12
7	DOWN
8	DOWN

TABLE 4 (3W OPTION)

DIP SWITCH SETUP	
SWITCH	SWITCH POSITION
1	DOWN
2	DOWN
3	DOWN
4	DOWN
5	DOWN
6	SEE TABLE 2, PAGE 12
7	UP
8	DOWN

ordan Controls, Inc.

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Phone: (414) 461-9200
AX: (414) 461-1024
-Mail: jordan@jordancontrols.com

M J-0610 11/96

Jordan CONTROLS

MV/VA-1000 SERIES & MC-10796 START-UP INSTRUCTIONS

OPERATING PARAMETERS (Refer to IM-0610 if your parameters differ)

-120 or 240 Vac input power
-4-20 mA command signal
-Auto operation
-Output shaft retracting on increasing signal
-Stay in last position on loss of command signal.
Refer to backside of this card for component locations.

WIRING (POWER OFF)

1. **INPUT POWER** to TB1 terminals 1 (hot) and 2 (neutral)
2. 4 to 20 mA **COMMAND SIGNAL** to TB2 terminals 4 (+) and 3 (-). Note that a factory installed jumper will also be on terminal 3.
3. 4 to 20 mA **POSITION FEEDBACK SIGNAL**, if used, to TB3 terminals 9 (+) and 10 (-)

SWITCH SETTINGS

4. **INPUT POWER VOLTAGE SELECT SWITCH**

-Select appropriate 120 or 240 Vac switch position

5. **DIP SWITCH** Positions

-Set switches 1 and 7 in down position
-Set switches 2, 3, 4, 5, 6 & 8 in their up positions

START-UP (POWER ON)

6. Under full load, adjust **LO SET POINT POT** as follows:

-Set command signal to 4 mA and let actuator run until it stops
-If LS1 LED comes on now or during next step, turn LS1 pot several turns CCW
-Adjust LO set point pot until desired extend position is obtained

7. Under full load, adjust **HI SET POINT POT** as follows:

-Set command signal to 20 mA and let actuator run until it stops
-If LS2 LED comes on now or during next step, turn LS2 pot several turns CW
-Adjust HI set point pot until desired retract position is obtained.
-Some interaction between LO and HI set point pots may occur and steps 6 and 7 should be repeated until desired rotation corresponding to 4 mA and 20 mA signals is achieved

8. Adjust **DEADBAND POT**

-Turning deadband pot CW decreases sensitivity

9. Adjust **LIMIT SWITCH POTS**

-With command signal at 4 mA, set LS1 pot until adjacent LED comes on, and then back off 1/8 turn so LED goes off
-With command signal set at 20 mA, set LS2 pot until adjacent LED comes on, and then back off 1/8 turn so LED goes off

10. Adjust **MOTOR SPEED POT**

-Turn motor speed pot CW to increase speed

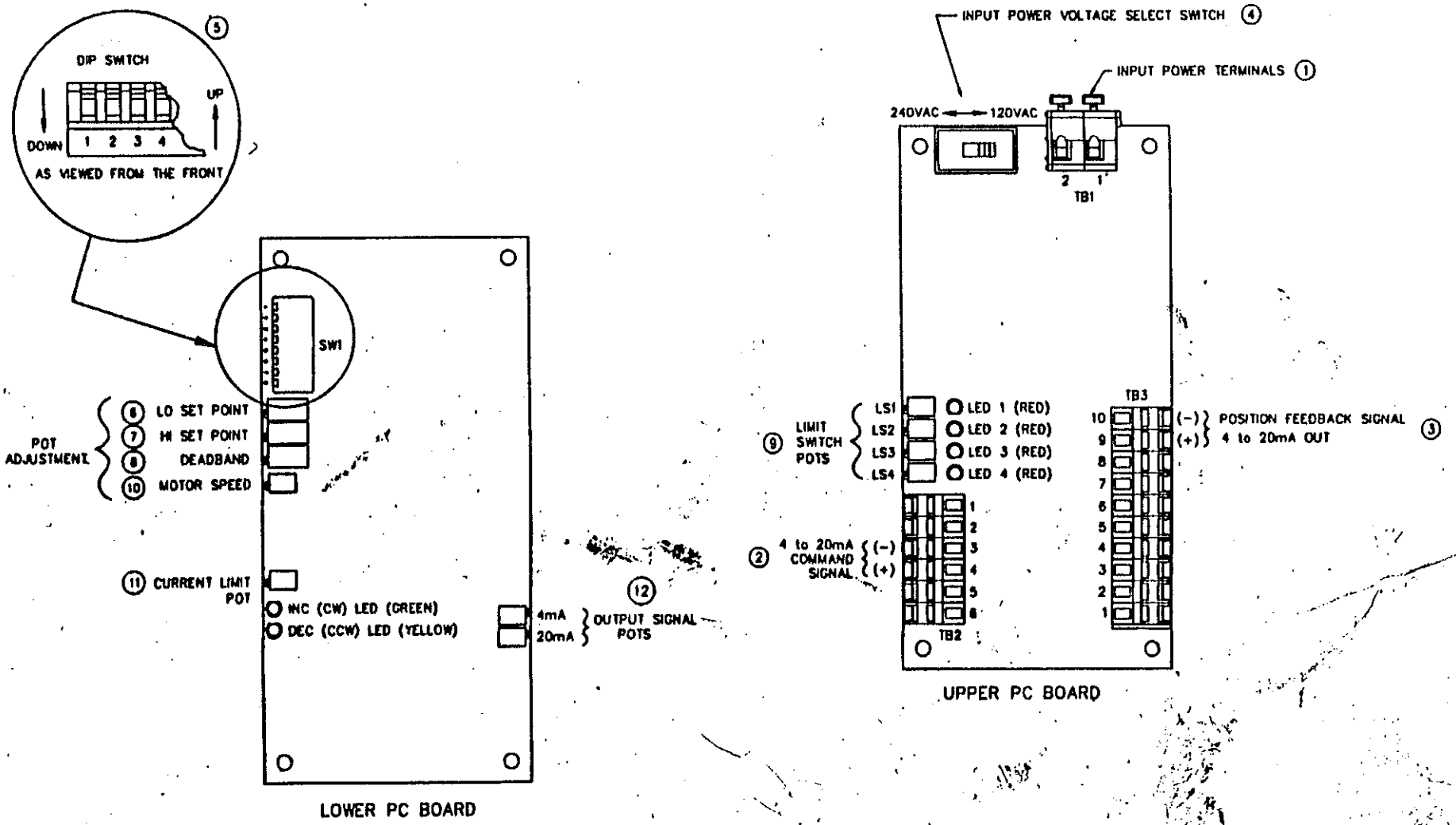
11. Adjust **CURRENT LIMIT POT**

-With unit running under full load, turn current limit pot CCW until actuator stalls, then turn pot one full turn CW
-If actuator speed needs readjustment, the current limit pot adjustment procedure above must be repeated

FAILURE TO FOLLOW STEP 11 IN ITS ENTIRETY WILL RESULT IN PREMATURE FAILURE OF THE ACTUATOR

12. Adjust 4 to 20 mA **OUTPUT SIGNAL POTS**

-With actuator at 4 mA position, adjust 4 mA pot until 4 mA output signal reading obtained
-With actuator at 20 mA position, adjust 20 mA pot until 20 mA output signal is obtained
-Repeat above step until no interaction occurs



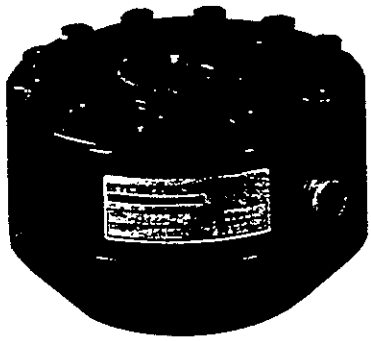
NOTE: Factory wiring between TB2 terminals 1, 2 & 3 and TB3 terminals 5 through 8 will normally be in place and should not be removed.

D330086/087-3

interface

ADVANCED FORCE MEASUREMENT

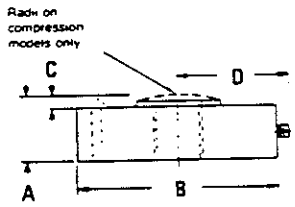
LOW PROFILE™ LOAD CELLS

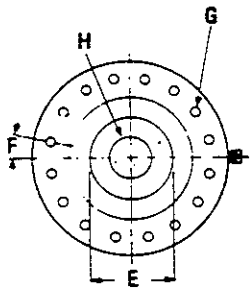


Model 1220AF-25K
Shown with B103 Base

The INTERFACE load cell concept has established new dimensions in every aspect of precision performance:

- COMPACT SIZE
- RESISTANCE TO EXTRANEOUS FORCES
- HIGH OUTPUT
- TRUE LINEARITY
- LONG TERM STABILITY & FATIGUE LIFE
- LOW DEFLECTION
- THERMAL STABILITY
- BAROMETRIC COMPENSATION
- SYMMETRICAL OUTPUT





DIMENSIONAL SPECIFICATIONS

SERIES	Model No.	A±a	B	C	D	E	F	G	H
LOW PROFILE UNIVERSAL TENSION AND COMPRESSION	1010	1.37	4.12	0.12	2.56	1.34	22.5°	9/32 Dia 8 Holes EQ SP . 3.50 B.C	5/8 - 18 UNF-3B
	1020	1.75	6.06	0.12	3.50	2.65(2)	15°	13/32 Dia 12 Holes EQ SP . 5.125 B.C	1 1/4 - 12 UNF-3B
	1032	2.50	8.00	0.25	4.50	3.76	11.25°	17/32 Dia 16 Holes EQ SP 6.500 B.C	1 3/4 - 12 UN-3B
	1040	3.50	11.00	0.50	6.00	4.81	11.25°	11/16 Dia 16 Holes EQ SP 9.00 B.C	2 3/4 - 8 UN-3B
	1110	1.37	4.12	0.12	2.56	1.34	22.5°	9/32 Dia 8 Holes EQ SP . 3.50 B.C	5/8 - 18 UNF-3B
	1120	1.75	6.06	0.12	3.50	2.65(2)	15°	13/32 Dia 12 Holes EQ SP . 5.125 B.C	1 1/4 - 12 UNF-3B
	1132	2.50	8.00	0.25	4.50	3.76	11.25°	17/32 Dia 16 Holes EQ SP . 6.500 B.C	1 3/4 - 12 UN-3B
	1140	3.50	11.00	0.50	6.00	4.81	11.25°	11/16 Dia 16 Holes EQ SP . 9.00 B.C	2 3/4 - 8 UN-3B
	1210	1.37	4.12	0.12	2.56	1.34	22.5°	9/32 Dia 8 Holes EQ SP . 3.50 B.C	5/8 - 18 UNF-3B
	1220	1.75	6.06	0.12	3.50	2.65(2)	15°	13/32 Dia. 12 Holes EQ SP . 5.125 B.C	1 1/4 - 12 UNF-3B
	1232	2.50	8.00	0.25	4.50	3.76	11.25°	17/32 Dia . 16 Holes. EQ SP . 6.500 B.C	1 3/4 - 12 UN-3B
	1240	3.50	11.00	0.50	6.00	4.81	11.25°	11/16 Dia 16 Holes. EQ SP . 9.00 B.C	2 3/4 - 8 UN-3B
LOW PROFILE COMPRESSION (ONLY)	1111	1.37	4.12	0.12	2.56	1.34	22.5°	9/32 Dia . 8 Holes. EQ SP . 3.50 B.C	—
	1121	1.75	6.06	0.12	3.50	2.65(2)	15°	13/32 Dia . 12 Holes EQ SP . 5.125 B.C	—
	1211	1.37	4.12	0.12	2.56	1.34	22.5°	9/32 Dia . 8 Holes. EQ SP . 3.50 B.C	—
	1221	1.75	4.75	0.12	2.87	1.57	45°	11/32 Dia . 4 Holes. EQ SP . 4.00 B.C	—
	1231	2.25	7.50	0.25	4.25	3.12	15°	15/32 Dia . 12 Holes. EQ SP . 6.250 B.C	—
	1241	3.25	8.25	0.25	4.62	3.16	15°	11/16 Dia . 12 Holes. EQ SP . 6.75 B.C	—

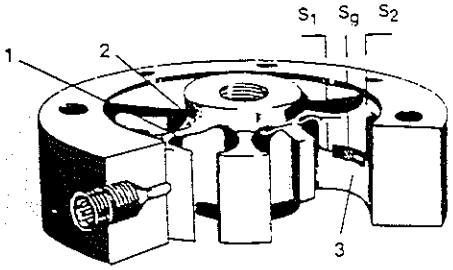
Notes: (1) O.D. of hub is 2.41 on 12.5K range.
(2) O.D. of hub is 2.41 on 25K range.
(3) All 1100 Series models sold with Base Included (See Pg. 3 for base heights.)

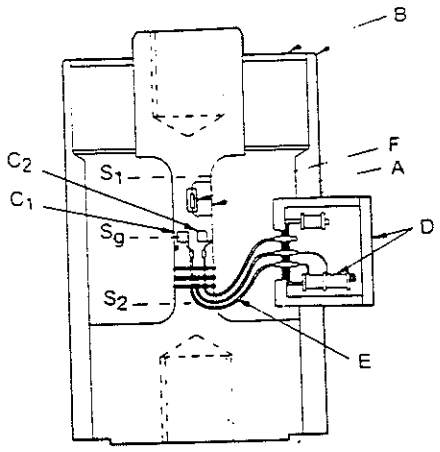
SP?
FRED McGLAUGHLIN
602-948-5555

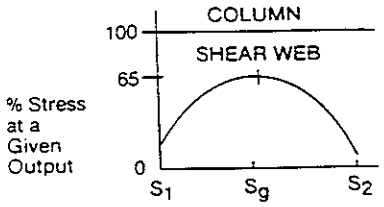
interface LOW PROFILE™ LOAD CELLS

interface

ADVANCED FORCE MEASUREMENT







The perfection of the INTERFACE low profile shear web design load cell has brought new dimensions to the field of force measurement. New dimensions that mean new benefits and broader applications for you.

These improvements and corresponding benefits unique to the **INTERFACE** concept of load cell design can best be demonstrated by comparison to the more familiar column load cell, as illustrated above.

COMPACT SIZE permits smaller, more compact testing machines, portability and allows for weighing systems of substantially smaller dimensions.

Typically, **INTERFACE** low profile load cells are 1" to 3½" in height as compared to typical column heights of 6" to 24".

RESISTANCE TO EXTRANEOUS FORCES (bending, torsion, side loads) produces high fatigue life, permits less stringent mounting alignment and reduces the possibility of reading errors.

The low profile shear web design of the **INTERFACE** load cell (1) has great inherent resistance to extraneous forces. In comparison, the column type load cell (A) has low resistance to bending moments and side loads, necessitating a supporting outer shell and diaphragm system (B).

The diaphragms on the **INTERFACE** load cell (2) are for sealing only and do not absorb bending and side loads.

HIGH OUTPUT is desirable for better resolution and greater reading accuracy.

Column load cells have two arms, of a four-arm bridge, aligned parallel to the load axis and two arms aligned at 90° (C_1 & C_2) to measure poisson strain (approximately 30% of primary strain and opposite sign). The four-arm bridge is 2.6 times the output of a single arm aligned with the principal axis.

The **INTERFACE** shear web design has principal strains of equal magnitude and opposite sign, permitting output of the four-arm bridge (3) to be four times the output of a single arm aligned with the principal stress. This greater efficiency of the shear web, (153% of column type) results in either a higher output for same strain level or lower strain level for the same output.

TRUE LINEARITY is a key factor in simple, accurate readouts.

The **INTERFACE** design with its equal resistance changes in all arms of the Wheatstone bridge is the only condition resulting in inherent true linearity.

The cross sectional area of a column changes with load and is therefore inherently non-linear. This non-linearity may be compensated for by the addition of a semiconductor strain sensitive resistor (F).

LONG TERM STABILITY AND FATIGUE LIFE is vital in fatigue testing, weighing systems, batch plants, and other long term installations. For example, in fatigue testing the load cell must remain accurate through thousands of such tests.

As shown in the above graph, the strain level (S1 to S2) is constant in load cells of column design, placing the entire bridge in the maximum strain field.

INTERFACE's shear webs are contoured in a manner to produce peak strain only under the gage grids. The gage tabs, bridge wiring, and compensation are located in low stress areas. In addition, the gages themselves are constructed of high endurance alloy to specified standards of high accuracy and fatigue operation on a shear web.

LOW DEFLECTION causes less interaction between a specimen and the testing unit producing a higher frequency response in fatigue, shock, and impact testing.

The greater efficiency of the equal arm shear bridge and the small area of the relatively high stress results in high stiffness and low deflection between .001 and .006 inches which is less than one-fourth that in column type load cells.

THERMAL STABILITY with its inherent resistance to wide temperature variations frees force measurements from the laboratory and permits industrial and field usage in a variety of conditions.

Differential expansion in the seals of **INTERFACE** load cells results in forces in a plane perpendicular to the load axis and does not cause measurement error under thermal gradients. In fact, step temperature changes up to 100°F. will cause typical errors less than 0.1% F.S. on 1000 and 1100 series **INTERFACE** cells.

The large deflection of column cells combined with the need for stabilizing diaphragms require output and thermal trim compensation in an external box (D) after the cell is sealed. Leads (E), at least two of which are internal bridge wires, are unsupported and free to vibrate between the coumn and external box. This remote thermal compensation is a prime reason for the strict thermal gradient limits (usually 5°F.) imposed on column load cells.

Another cause of thermal gradient errors in column cells is the supporting shell which forms a parallel load path with the strain gaged column. Temperature variations between this outer case and the sensor column causes unequal expansion, producing loads along the sensitive axis of the cell. Because of the mass involved, substantial measurement errors of long duration are created.

BAROMETRIC COMPENSATION is required for accurate readings under variations in atmospheric pressure.

INTERFACE load cells with their dual diaphragms are innately compensated against barometric pressure when the exterior underside is vented. Most sealed column cells, however, are not so compensated and venting the interior of the cell provides compensation at the expense of the hermetic seal.

SYMMETRICAL OUTPUT for tension and compression measurements is highly desirable for simplified instrumentation and control.

Column cells get longer in tension and shorter in compression, also the cross sectional area decreases in tension and increases in compression. This produces higher bridge sensitivity in tension than in compression.

In comparison, the **INTERFACE** shear web is identically deformed in tension and compression with symmetrical outputs within ±0.1%.

To achieve output symmetry of better than 1.5% in a column load cell, a semiconductor strain sensitive resistor (F) is mounted in the high strain area and placed in series with the bridge excitation. Semiconductors are not normally used in fatigue operations because they have proven to be unreliable.

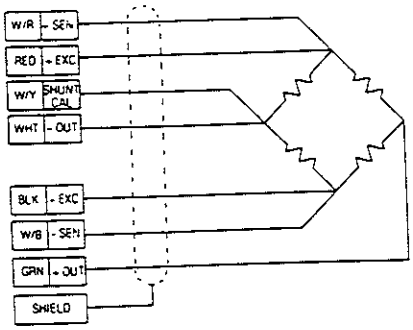
LOW CREEP has been designed into the **INTERFACE** load cells. Guaranteed performance of less than 0.03% of full scale creep in twenty minutes is available at a no charge option on all precision and ultra precision load cells. Should the ultimate in performance be a necessity 0.020% of full scale creep can be provided as an extra cost option.

ELECTRICAL INFORMATION

The standard **INTERFACE** load cell is supplied with a Bendix PC04E-10-6P electrical connector.

At no additional cost, an integral 10 foot, 7 wire, shielded cable (PVC Jacket - AWG22) can be provided. The cable is attached to the cell through a ¼ NPT for conduit connection.

CONNECTOR		CABLE (ALL MODELS)	
PIN	FUNCTION	COLOR	FUNCTION
A	+Excitation	Red	+Excitation
B	+Output (positive reading	Green	+Output
C	−Output for tension)	White	−Output
D	−Excitation	Black	−Excitation
E	No Connection	White/Red	+Sense
F	No Connection	White/Black	−Sense
		White/Yellow	Shunt Cal.
		Shield	No Connection



1. Wire color conforms to ISA S37.8 "Specifications and Tests for Strain Gage Force Transducers" SMA Load Cell Terminology.
2. Lead length effects on the load cell may be eliminated by remote sensing of the bridge voltage at the load cell. This requires two additional leads to the excitation corners of the bridge. These wires are furnished in standard units with cables.

OPTIONS

INTERCONNECTING CABLES

Interconnecting cables are available for use with **INTERFACE** load cells. Cables include a load cell mating connector on one end and pigtailed leads on the other. Standard length is 10 feet.

SYSTEM INTERCONNECT CABLE PART NUMBERS
CC-101-xx* compression upscale
CT-101-xx* tension upscale

*xx indicates length in feet

MATING CONNECTORS

An **INTERFACE** load cell ordered with standard Bendix PC04A-10-6P electrical connectors requires mating connectors PC06W-10-6S which are available as an option.

SHUNT CALIBRATION

A precision fixed resistor (R_{cal}) placed across one leg of a load cell bridge causes an electrical unbalance which may be considered equivalent to a particular value of mechanical load. This "equivalent mechanical input" may be used for setting and checking instrument and/or system calibration without the necessity of applying a known mechanical load.

An R_{cal} value approximating 75% of full scale is recorded and supplied for each low profile load cell. The user may duplicate this output by placing a like value resistor across the indicated terminal of the load cell. **As there are no series temperature sensitive resistors in the load cell circuit, the shunt calibration check may be made at any temperature.**

Other R_{cal} values may be calculated by: $R_{cal} = \frac{25{,}000\ Rb}{KX}$ where

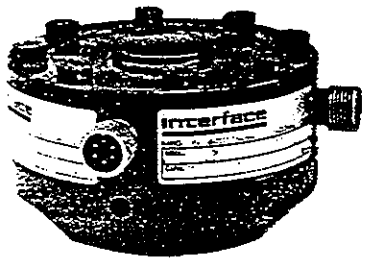
Rb = bridge resistance, X = electrical equivalent, % full scale, K = full scale load cell output in mV/V

MULTIPLE BRIDGE

Certain applications require that several load readings be taken from one transducer. These include: readout and control; multiple control; statistical averaging; redundancy.

INTERFACE load cells are available with as many as four electrically isolated, independent bridges.

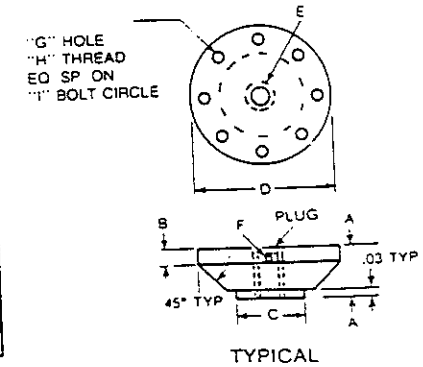
Connector locations for multiple bridges are standard at 90° intervals, but may be optionally located between any two outer rim holes.



BASES

These treated, high strength bases are available in standard sizes. When the base and load cell are ordered together, a plug is supplied in both the cell and the base to prevent damage or errors caused by over-engagement of mating parts. Standard thread "E" is the same as the mating load cell.

BASES ARE RECOMMENDED FOR MOST LOW PROFILE LOAD CELL INSTALLATIONS. A mounting surface that is flat to 0.0002" T.I.R. (total indicator reading) is required, unless base is installed.



TYPICAL

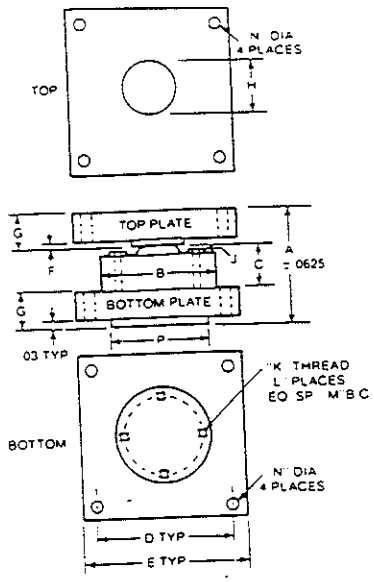
P/N	A	B	C	D	E	F	G	H	I	Wt. lbs.
B101*	1.12	0.50	1.25	4.12	5/8-18	.25	8	1/4-28	3.500	1.75
B102	1.12	0.50	1.25	4.12	5/8-18	.25	8	1/4-28	3.500	4.00
B103	1.75	0.81	2.25	6.06	1 1/4-12	.31	12	3/8-24	5.125	12.00
B104	2.00	1.97	3.00	7.50	1 3/4-12	.31	12	7/16-20	6.250	24.00
B105	3.00	2.97	4.50	11.00	2 3/4-8	.31	16	5/8-18	9.000	78.00
B106	1.25	1.22	2.00	4.75	1/2-20	—	4	5/16-24	4.000	6.00
B108	2.50	2.47	3.00	8.25	3/4-16	—	12	5/8-18	6.750	38.00
B112	2.00	1.97	3.00	8.00	1 3/4-12	—	16	1/2-20	6.500	26.00

*Aluminum — All others are steel.

MOUNTING PLATES

The installation of a compression load cell under a weigh bridge, tank, or other structure, normally requires that mounting plates be used. The bottom plate, ground flat to 0.0002 T.I.R., to mate with the load cell, and fabricated of mild steel, distributes the load over the foundation or supporting structure and provides a prepared surface for the load cell.

The top plate distributes the load to the weighing structure and provides a hard (Rc45) surface for the load button. The top plate will move on the button due to thermal expansion, load shifting, wind loading and other side loads. The high side load capacity of the **INTERFACE** load cell eliminates the requirement for expansion assemblies in most installations. Mounting plates are suitable for compression loads only.



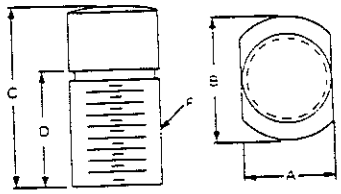
Note: An optional bottom plate with a center steel threaded stud mount is available for applications where it is desired to mount a load cell with base to a bottom plate. To order add a "-3" to model designation, i.e. BP101-3.

P/N	L/C RANGE	A	B	C	D	E	F	G	H	J	K	L	M	N	P
TP-101, BP-101*	1K, 2K	3.62	4.12	1.37	5.0	6	.25	1.12	2.00	1/4-20 x 1 1/2	1/4-20	8	3.50	.56	3.0
TP-101, BP-108	5K, 10K	3.62	4.12	1.37	5.0	6	.25	1.12	2.00	1/4-20 x 1 1/2	1/4-20	8	3.50	.56	3.0
TP-102, BP-102	25K, 50K	4.25	4.75	1.75	5.5	7	.25	1.20	2.25	5/16-18 x 2	5/16-18	4	4.00	.69	3.5
TP-103, BP-103	100K	5.25	7.50	2.25	6.5	8	.25	1.50	2.75	7/16-20 x 2 1/2	7/16-20	12	6.25	.69	4.0
TP-104, BP-104	200K	8.25	8.25	3.25	8.0	10	.37	2.50	4.00	5/8-11 x 3 3/4	5/8-11	12	6.75	.69	8.2

*Aluminum — All others are steel.

LOAD BUTTONS

A load button should be installed in an **INTERFACE** universal load cell if it is used as a compression cell with the load applied by a plate or other flat surface. For compression application only, an **INTERFACE** compression load cell should be specified. Compression load cells are usually smaller, less expensive, and have an integral load button.



P/N	A	B	C	D	F
LB-101	0.94	1.06	1.28	1.00	5/8-18 UNF-3A
LB-102	1.25	1.75	1.56	0.69	1¼-12 UNF-3A
LB-103	1.75	2.50	3.75	2.12	1¾-12 UNF-3A
LB-104	2.75	4.00	5.00	3.12	2¾-8 UNF-3A

STANDARDIZED OUTPUTS

Load cell outputs standardized to within ±0.1% of the nominal mV/V output. Compression cells are standardized in compression and universal cells are standardized in tension. Useful in multiload cell applications such as batch systems and electronic truck scales. An **INTERFACE** base is required for units with standardized outputs.

COUNTERBORED MOUNTING HOLES

All compression and 50K and lower capacity universal low profile load cells are optionally available with counterbored mounting holes for use with socket head cap screw. This provides even lower installed height where space is at a premium. Standard bolt installation torques apply.

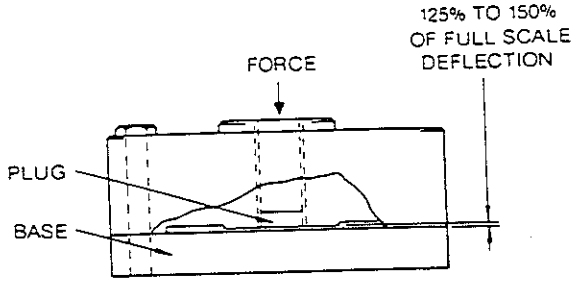
POSITIVE OVERLOAD

The positive overload option is useful when high overloads occur in plications such as: impact or off-center loads on weighing platfor engine malfunctions during rocket or jet engine testing; transi overloads on engine dynamometers.

The unique design of **INTERFACE** load cells allows incorporation simple positive overload stop to protect against overload in comp sion. This stop engages at approximately 125% of cell capacity.

Compression only cells with the overload option may be operate 5 times rated capacity without damage in capacities through 25, pounds. 50,000 pound capacities and larger may be operated to 3 ti rated capacities.

Load cells with positive overload protection must be ordered wit **INTERFACE** installed base.



Center hub deflects under the load until it contacts the base which provides positive overload protection. The center tapped hole is sealed to keep overload surfaces clean.

Interface Load Cell Specifications

SERIES	MODEL	RANGES (lbs.)	Output mV/V	Static Error Band ± % Rated Output (1)	Non-Linearity % Full Scale (2)	Hysteresis % Full Scale (2)	Non-Repeatability % Full Scale (2)	Tens. & Comp. Symmetry. ± % Full Scale	Compensated Temp. Range °f	Weight in Pounds	Temp. Effect on Zero % Full Scale/100°F	Temp. Effect on Sensitivity % Reading/100°F	Safe Overload % Rated Range	Deflection at Rated Range in Inches (5)	Optional Base P/N
FATIGUE—UNIVERSAL Premium materials, special processing and critical inspection and the most advanced concept in design are combined to provide the ultimate fatigue load cell. It will withstand in excess of 100 million fully reversed load cycles without failure.	1010* 1010 1020 1032 1040	500. 1K 2.5K. 5K 12.5K. 25K 50K 100K	1 2 2 2 2	0.05 0.05 0.05 0.05 0.07	0.05	0.02 0.03 0.03 0.03 0.03	0.02	0.1	0° to +150	1½ 3¼ 9½ 26 68	0.08	0.08	300	0.0005 0.001 0.001 0.002 0.003	B101 B102 B103 B112 B105
ULTRA PRECISION—UNIVERSAL The highest accuracy Ultra Precision Load Cell is ideal for calibration systems, thrust measurements, laboratory standards, or any precise requirement. (Includes base installed.)	1110* 1110 1120 1132 1140	1K. 2K 5K. 10K 25K. 50K 100K 200K	2 4 4 4 4	0.02 0.03 0.04 0.06 0.07	0.02 0.03 0.03 0.05 0.05	0.01 0.03 0.03 0.04 0.04	0.01	0.1	0° to +150	3¼ 7¼ 21½ 52 146	0.04	0.08	150	0.002 0.004 0.004 0.006 0.012	B101 B102 B103 B112 B105
ULTRA PRECISION—COMPRESSION - The highest accuracy Ultra Precision load cell in a compression only configuration (Includes base installed.)	1111* 1111 1121	1K. 2K 5K 10K 25K. 50K	2 4 4	0.02 0.03 0.03	0.02 0.03 0.03	0.01 0.03 0.03	0.01	—	0° to +150	3¼ 7¼ 21½	0.04	0.08	150	0.002 0.004 0.004	B101 B102 B103
PRECISION—UNIVERSAL The general purpose Precision series offers low profile, high accuracy, and immunity to extraneous forces for all your requirments	1210* 1210 1220 1232 1240	1K. 2K 5K 10K 25K. 50K 100K 200K	2 4 4 4 4	0 05 0 05 0 05 0 06 0 07	0 05	0.02 0.04 0.04 0.04 0.04	0.02	0.1	+15 to +115	1½ 3¼ 9½ 26 68	0.08	0.08	150	0.001 0.002 0.002 0.003 0.006	B101 B102 B103 B112 B105
PRECISION—COMPRESSION The small, lightweight design makes installation in weighing applications such as scales, tanks, bins and hoppers extremely easy	1211* 1211 1221 1231 1241	1K. 2K 5K. 10K 25K. 50K 100K 200K	2 4 4 4 4	0 04 0 04 0 04 0 04 0 06	0.05	0.02	0.02	—	+15 to +115	1½ 3¼ 6¾ 13½ 40	0.08	0.08	150	0 001 0.002 0.002 0.003 0.004	B101 B102 B106 B104 B108

*Aluminum — All others are steel.

Note 1: Static Error Band (SEB), where shown, is the guaranteed performance specification. Static Error Band is calculated as the best straight line through zero including the effects of non-linearity, hysteresis and non-repeatability. (SMA Load Cell Terminology)

Note 2: Specifications noted are typical values where Static Error Band is shown.

Note 3: All universal low profile cells are normally calibrated in tension only. If compression only or tension and compression calibration is desired, please specify with your order.

Note 4: Output standardized to ±0.1% optionally available. Base required. Input resistance is 350 Ω +10% −1%.

Note 5: Total Deflection, load cell with base, nominally 2x load cell value.

Note 6: Recommended excitation voltage 10VDC. (Max. 20VDC)

Note 7: Useable temperature −65 to +200 range F° for all models.

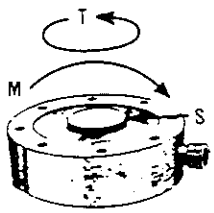
Bridge Input and Output Resistance 350Ω ±1% all series except Note 4.

Zero Balance ±1% Full Scale all series.

Insulation Resistance Bridge to Ground 5000 Megohms all series.

RESISTANCE TO EXTRANEOUS FORCES

The **INTERFACE** low profile design provides optimum resistance to extraneous forces to insure maximum operation life and minimize reading errors. The following chart tabulates maximum allowable extraneous forces that may be applied singularly without electrical or mechanical damage to the cell and the maximum error that can be expected from side forces or bending moments. Several forces can be tolerated simultaneously if the total combined force is not more than 100% of the allowable maximum extraneous force.



SERIES	(S) lbs.	(M) in-lbs.	(T) in-lbs.	Max. Error*
	Side Force (% Rated Range)	Bending (% Rated Range)	Torque (% Rated Range)	Due to S or M
1000	100%	100%	100%	0.1%
1100	50%	50%	50%	0.05%
1132	40%	40%	40%	0.1%
1140	40%	40%	40%	0.1%
1200	40%	40%	40%	0.1%

*Single or A Bridge: Dual Bridge load cells 1010-500, 1K, 2.5K and 1100-1K, 5K meet 1200 Series specifications only.

INSTALLATION INFORMATION

Mechanical installation of an **INTERFACE** load cell is easily accomplished due to its inherent immunity to side loads, bending moments, torques, and thermal gradients. The alignment to the load is not critical, as it is with column type cells, because it measures only the forces perpendicular to the mounting surface and will reject other components and bending moments, up to the limits listed.

The cell should be mounted to the surface with grade 8 bolts. The bolts should be alternately and evenly tightened to the following torques:

Bolt Size	1/4-28	5/16-24	3/8-24	7/16-20	1/2-20	5/8-18
Install Torque (ft. lbs.)	5 (alum. L/C) 10 (steel L/C)	25	45	80	120	250

The load cell should be mounted on a surface which is flat within 0.0002 T.I.R. for universal and for compression cells. This surface can be supplied with a standard **INTERFACE** base, mounting plate, or by Blanchard grinding of your mounting plate. Certified drawings available for use in designing mountings and fixturing.

The mating thread for the load cell should be class 3 fit. The yield strength for a mating grade 8 bolt when engaged one diameter is as follows:

Thread Size	5/8-18	1 1/4-12	1 3/4-12	2 3/4-8
Yield strength x 1000 lbs.	35.8	128.8	251.4	620.4

ORDERING INFORMATION

The **INTERFACE** model numbering system is simple and easily indicates changes from the basic catalog unit. The model number is broken down as shown:

1210	AF	5K
Basic Model	Configuration code (AF represents the standard catalog unit with electrical connector)	Range in lbs. (K=000)

The configuration code is established by **INTERFACE**. Any change in a standard load cell must be identified by a new **INTERFACE** code. The code will guarantee the fabrication and shipment of exactly what was ordered both on the initial order and on follow-up orders.

Please consult our local representative or the factory for special features, quantity purchases, or blanket orders.

WHEN WRITING YOUR SPECIFICATIONS

To assure receiving an **INTERFACE** load cell, list the following specifications in your order:

Output: Table on page 5.
Size: Information from page 1.
Weight: Information from page 5.
Deflection: Table on page 5.
Side load: Information from page 5.
Bending moment: Information from page 5.
Torque: Information from page 5.
Thermal Gradient: Information from page 2.
Symmetrical Output: Table on page 5.
Fatigue Life: 10^8 fully reversed cycles for fatigue series page 5.
Barometric Compensation: Information on page 2.

To best apply the **INTERFACE** load cell to your requirements be sure to specify the required adapters, options or special features such as:

Base
Load Buttons
Multiple Bridge Option
Positive Overload Option
Output Standardization
Mounting Plates

Please request certified drawings before designing mountings or fixtures since dimensions are subject to change.

Warranty: **INTERFACE, INC.'s** standard two-year warranty is applicable to the Low Profile load cell. **INTERFACE, INC.** certifies that its calibration measurements are traceable to the U.S. National Institute of Standards and Technology (NIST).

HOW TO ORDER

Minimum Order Charge: $50.00

Address your order to: **INTERFACE, INC.**
7401 East Butherus Drive, Scottsdale, Arizona 85260
or send to **INTERFACE, INC.** c/o our local representative.

Additional ordering information can be obtained by calling (602) 948-5555 collect, or Telex 825-882.

Standard terms: Net 30 days in U.S. dollars, F.O.B. Scottsdale, Arizona. Prices and specifications subject to change without notice.

D330088-54
D330088-55

UPS 50 BG Series

5-Phase, 5-Lead Stepping Motor / Driver Package With Zero Backlash Cycloidal Ball Reducer

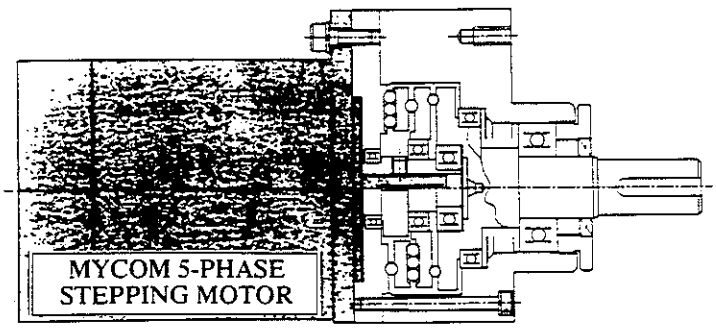
- High precision zero backlash reducers are coupled with the MYCOM STAR BIPOLAR DRIVE* high performance stepping motor/ driver system for quick and easy out-of-the box installation.
- In-line style saves space.
- Over 1,389 oz.-in. running torque at 60 RPM and above.
- Up to 20,000 steps of true resolution (standard ratio).
- ± 15 arc seconds repeatability.
- 5-phase stepping motor sizes from NEMA 17 to Metric 34, final holding torque from 375 oz-in (size 17 motor) to 2,776 oz-in (size 34 motor).
- Highly cost effective.

*Protected by US/Int.. Patents

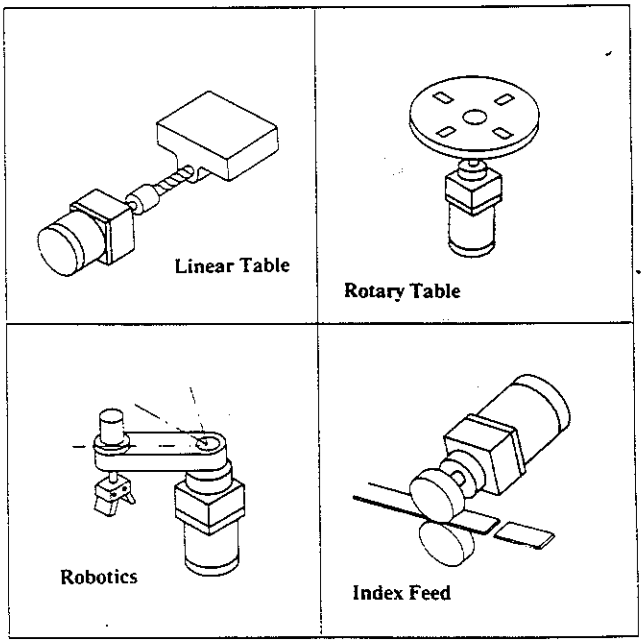
MYCOM's 5-phase stepping motor system has proven its superior capabilities over the standard and microstepped 2-phase motor systems in many recent applications.

Now the powerful 5-phase motors are available with zero backlash cycloidal ball reducers to offer resolution of up to 20,000 highly accurate mechanical steps per revolution, as well as a large gain in maximum running torque from any given motor size.

Coupled with a high performance 5-phase motor, this unit can be implemented to your system to move any given load at a high velocity, unlike any other reduction system to this date.



UPS 50 BG Series Applications



Zero backlash cycloidal ball reducer principles

As shown in Fig.1, a rolling ball is placed between two discs where one of the two is fixed (Disc A), the other (Disc B) giver an orbital rotation with an eccentricity amount of "e", the ball will roll between the two discs scribing a circle with the Diameter "e". Then as shown in Fig.2, when an autorotation of 0 degrees is imparted to Disc B, the ball will start to scribe an epicycloid (outer rotation) trace with an Amplitude "e" on the surface of Disc A, and a hypocyloid (inner rotation) trac of the same amplitude on the Disc B surface.

Operating the above principle in reverse, where the ball's epicycloidal trace and the hypocycloidal trace grooves are cut onto each disc surface with a rolling ball riding in the groove between them (Fig.3), an orbital rotation imparted on Disc B will cause an autorotation on Disc B it'self with the amplitude that is in proportion to the differences in the number of groove lobes between the Disc A and B.

The autorotation motion of Disc B can now be extracted through the output coupling stage which is comprised of two opposing disc surfaces (one on the input side of Disc B and the other on the output disc) each surface having a number of annual grooves radially placed, and a ball rolling in the space between both surface's matching annual grooves.

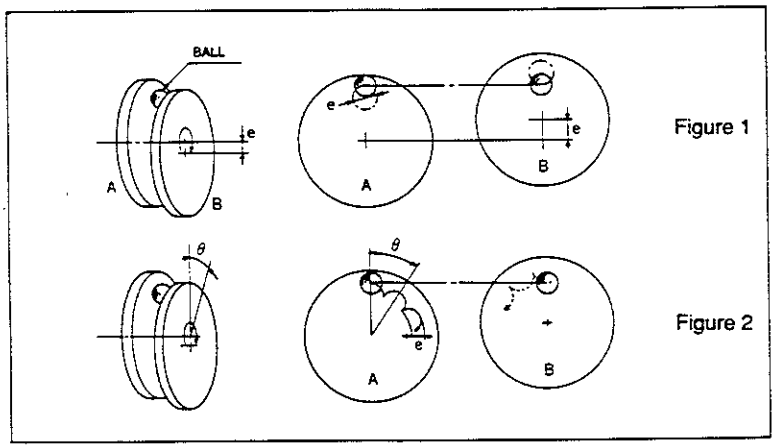
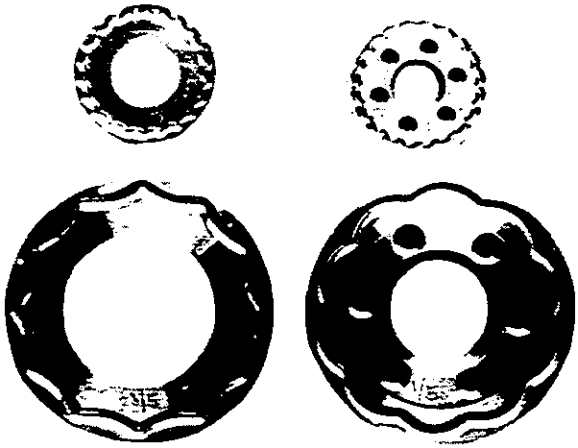


Figure 1

Figure 2



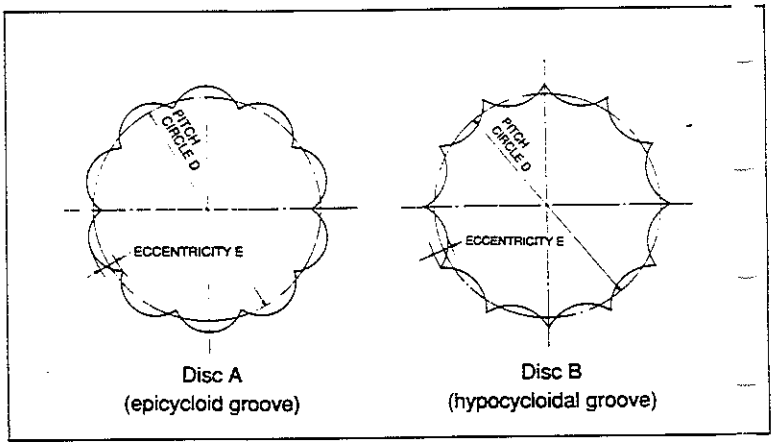


Figure 3

Figure 4

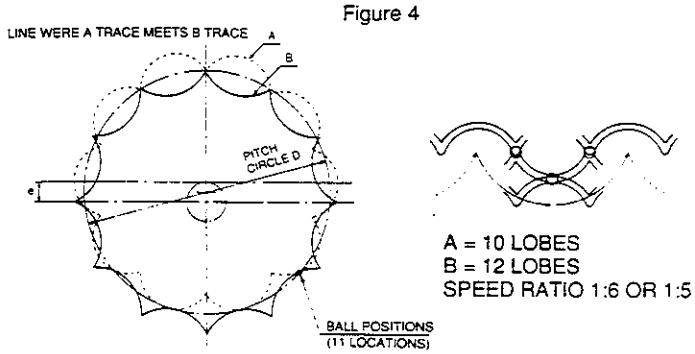
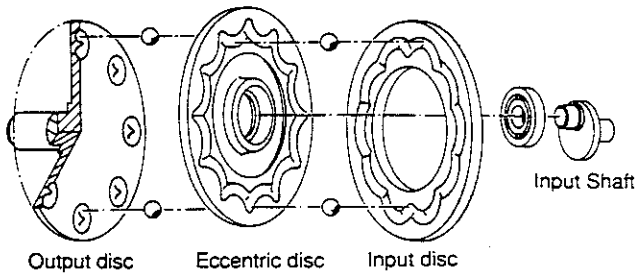


Figure 5



Since there are a number of contacting location points between the epicycloid trace and the hipocycloidal trace as shown in Fig.4, and there is a ball located at each one of the location points, an excellent interlocking ability is inherently evident, giving this system a high level of rigidity. The torque is transmitted and speed reduction is achieved purely through the balls' constant rolling motion and contacts in the grooves. Fig.5 shows the basic construction of a typical ball reducer unit.

Since the main motion transmission bodies are the balls, unlike other gear driven devices, the mechanism backlash can be eliminated by an application of proper thrust preload to the "groove to ball to groove" relationship in the system. The torque to be transmitted through the system and the accuracy margin are evenly distributed to the total number of the balls employed, giving this reducer an incredible transmission strength (5 to 10 times that of a conventional gear based systems per weight) and micron level positioning accuracy for the given size of the unit.

By the virtue of a 100% rolling ball contact mechanism, the ball reducer emits very little noise which is a common annoyance factor with a conventional gear or roller based reducer mechanisms previously available. The high level of efficiency and mechanical longevity is also a notable advantage of this reduction mechanism.

The reduction ratio can be calculated by the following equations.
Number of groove lobes on one disc : N
Number of groove lobes on other disc : N-2

When an orbital motion is imparted on the disc N:
Ratio = 2/N

When an orbital motion is imparted on the disc N-2:
Ratio = 2/N-2

The groove lobe count difference of the two discs is always TWO, and the maximum number of balls can be employed is N-1(balls).

Regarding the system preload –
This reducer mechanism eliminates any backlash through the principle much like that of the precision backlash-free ball screw systems. In order to accomplish this zero backlash, the unit is equipped with an adjustable thrust preload nut located at the output shaft end. At the time of delivery, every unit has been properly adjusted for the maximum preload allowable for the torque rating of a particular motor and reducer combination.

Regarding efficiency –
The standard ball reducer efficiency is 85% to 90%. This value may vary with applied thrust preload.

Regarding vibration –
The reducer generates virtually no buzz type vibration at constant running speeds, and the reducer's primary resonance point is at a very low frequency (about 12 Hz).

UPS50BG Series Stepping Motor

Part number identification & order information

UPS 5X - 5XXX BG - XX

A (Single Shaft)
B (Dual Shaft)

- XX — Reduction ratio
  - 01 = 10 : 1
  - 02 = 20 : 1
- BG — Reducer equipped
- 5XXX — Motor size

NEMA 17	535M	
Metric 23	564	Short
	566	Med
	569	Long
Metric 34	596	Short
	599	Med
	5913	Long

See dimensions for length.

- 5X — Driver type
  - 50 = 115VAC 0.75A/1.4A
  - 500 = 24VDC 0.75A/1.4A

UPS50-59XBG
Size Metric 34

UPS50-59XBG are 5-Phase stepping motor & driver units with integral in-line cycloidal ball reducers. The motor / driver supplied with this package operates with 115VAC power and no external power supply is needed.

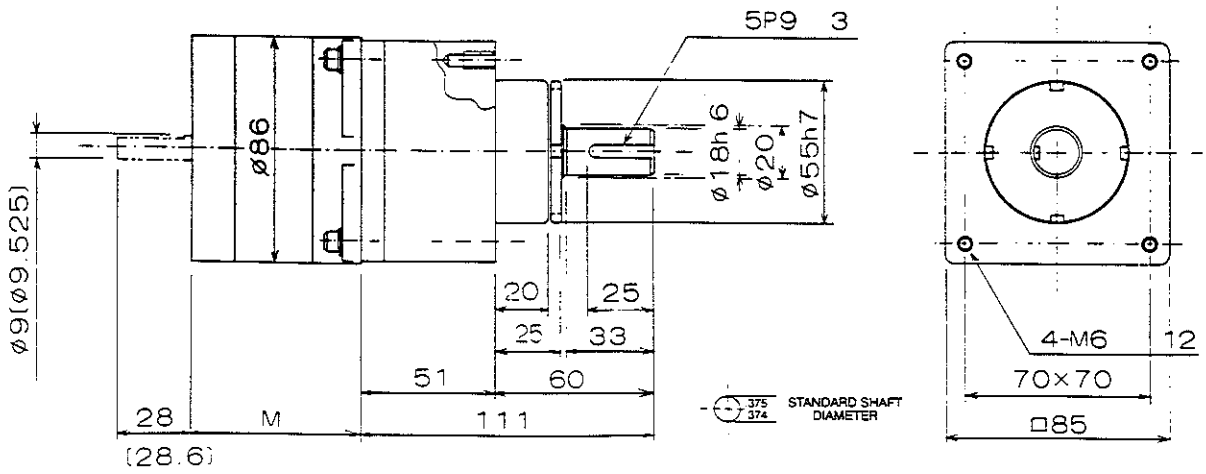
Motors are Metric size 34 configuration 5-Phase motors which offer 500/1000 steps per revolution. When used with 20:1 reduction ratio, the final resolution is 10,000/20,000 steps per revolution of the reducer output shaft. Every step is extremely accurate and highly repeatable with zero backlash.

Driver #	UPS50-130		
Motor #	596 BG	599 BG	5913 BG
Dimension of M (inches)	2.51	3.81	5.11
Reducer Weight (oz.)	38.80	38.80	38.80
Motor Weight (oz.)	52.91	88.18	134.04
Output Torque (oz-in)	97.21 x reduction ratio	194.42 x reduction ratio	388.84 x reduction ratio
Reducer Max. Allowable Torque (oz-in)	2777.48		
Repeatability (arc sec.)	± 15		
Max. hysterisis (arc sec.)	± 20		
Output Shaft Step angle	0.72 / 0.36 deg. x reduction ratio (Full/Half)		
Available Reduction Ratios	10 : 1, 20 : 1 Standard ** Other ratios are available as specially ordered items.		

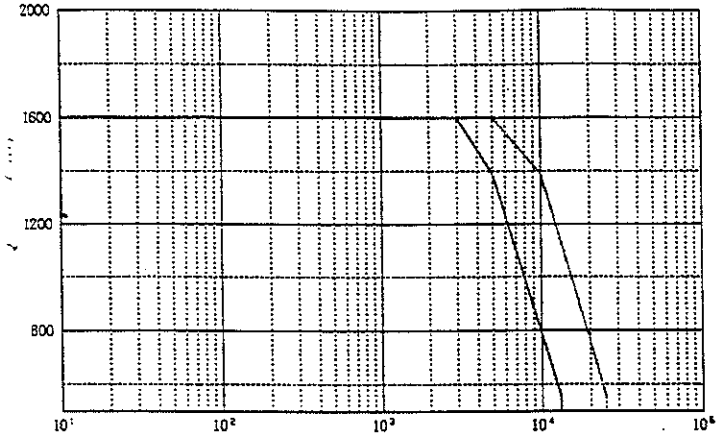
** Non standard ratio configuration requires longer delivery time and variable pricing.

UPS50 BG–59XBG Motor & Reducer Dimensions

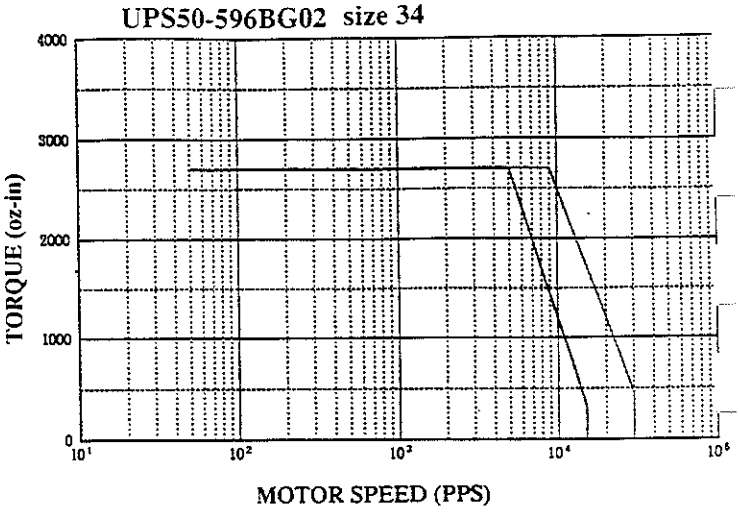
Max. thrust load 60kgf (132.00 lb)
Max. radial load 30kgf (66.00 lb.)



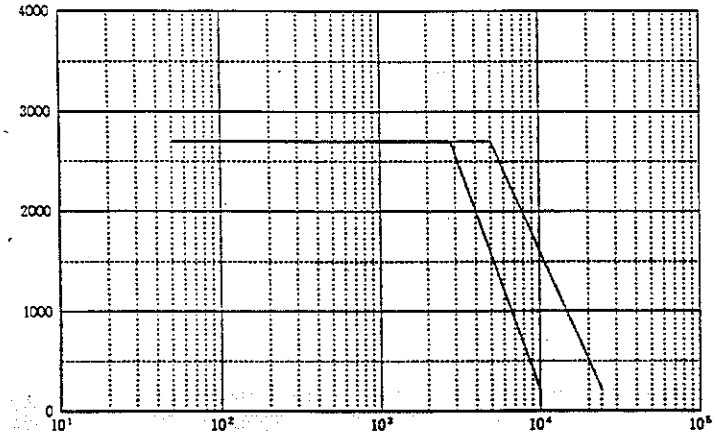
UPS50-596BG01 size 34



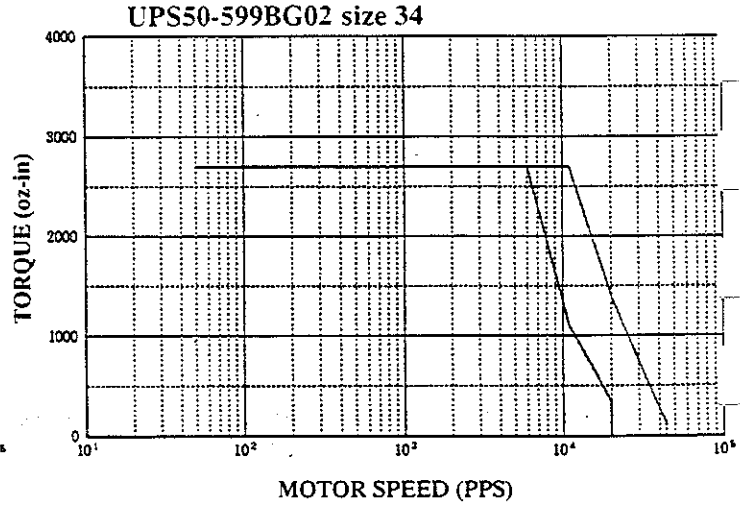
UPS50-596BG02 size 34



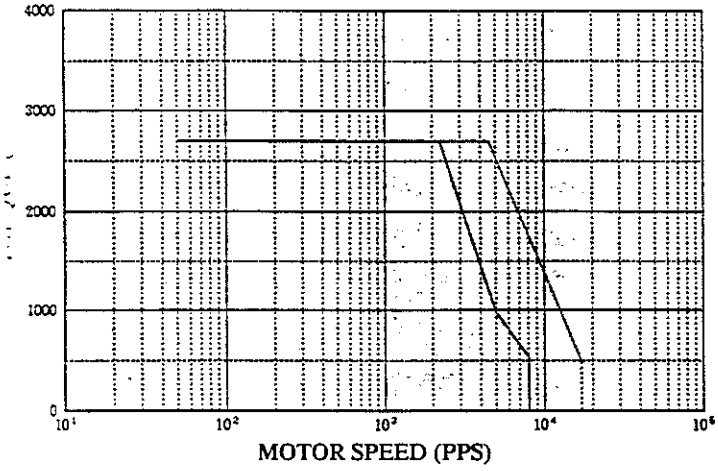
UPS50-599BG01 size 34



UPS50-599BG02 size 34



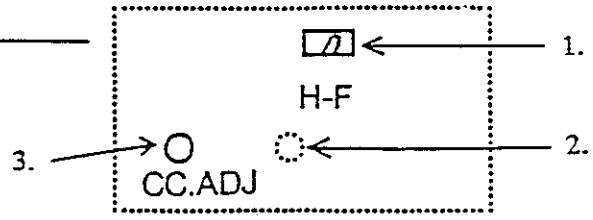
UPS50-5913BG01 size 34



FULL STEP

HALF STEP

UPS50-130 Driver Parameters



Adjustable Parameters Located at top of Driver

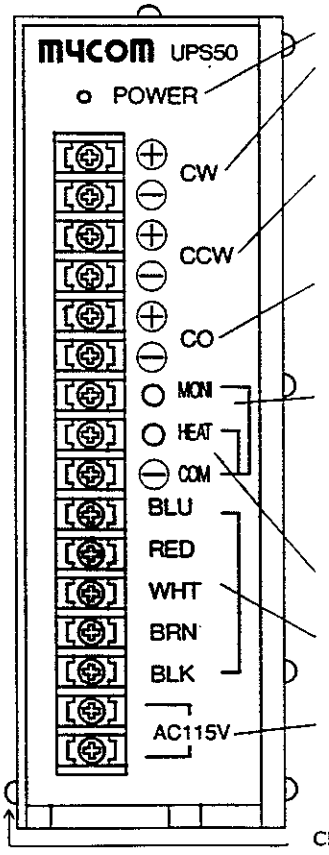
1. Step angle selector switch
   Switch position F for Full step mode (0.72 deg./step).
   Switch position H for Half step mode (0.36 deg./step).

2. C. ADJ. (Motor run current adjustment)
   Each driver is pre-adjusted for the applicable motor included with a package. This adjustment **should not be made** unless a lower current level setting is absolutely needed in order to reduce motor torque and motor/driver heat generation.

   NOTE: Stepping motors should be operated below 212 deg. F. or 100C at the motor casing. Motor case may heat to temperature level under certain running conditions where it could feel too hot to the touch. This will not cause adverse effects to the motor as long as the temperature remains below 212 deg. F or 100C.

3. CC. ADJ (Motor stand still current cutback adjustment)
   UPS50 drivers are equipped with auto-current cutback feature when the motor is at stand still (idle) to reduce motor heat build up when not running.
   Adjustable range is from 20% to 90% of motor run current value which is set by C. ADJ pot. Clockwise turn of this pot increases motor standing current, and counter clockwise reduces motor standing current. Factory set value is 50%. If motor holding torque at stand still is not needed, this pot may be set at the lowest value (fully counter clockwise) to minimize motor heating. This function is activated 200mS after the motor stops. This feature can be disabled by keeping CW input terminal in ON (low) state.

Driver Functions



Power indicator LED

CW step input terminal (5V negative logic)
(Low or 0V to 0.5V = ON, Hi or 4V to 5V = OFF)
Pulse input for CW motor rotation.
When step and direction mode selected, this terminal accepts the STEP input.

CCW step input terminal (5V negative logic)
(Low or 0V to 0.5V = ON, Hi or 4V to 5V = OFF)
Pulse input for CCW motor rotation.
When step and direction mode selected, this terminal accepts the DIRECTION input.

Motor current shutoff signal input terminal (5V negative logic)
Motor winding current turn-off signal input.
When this input terminal is kept ON, the driver will output no motor current.
CAUTION: The motor will produce no holding torque.

Excitation timing ZERO output terminal
This terminal provides opto isolated open collector output for excitation timing origin (step #0) of the motor.
The terminal will turn on once every 10 steps in Full step mode (0.72°/step).
The terminal will turn on once every 20 steps in Half step mode (0.36°/step).
A green LED indicator which will light when this terminal turns on, provided for visual timing representation.

Driver overheat alarm output terminal
This terminal provides opto isolated open collector output for driver overheat condition when the onboard temperature sensor detects the drivers heat sink temperature to exceed 158°F (70°C).

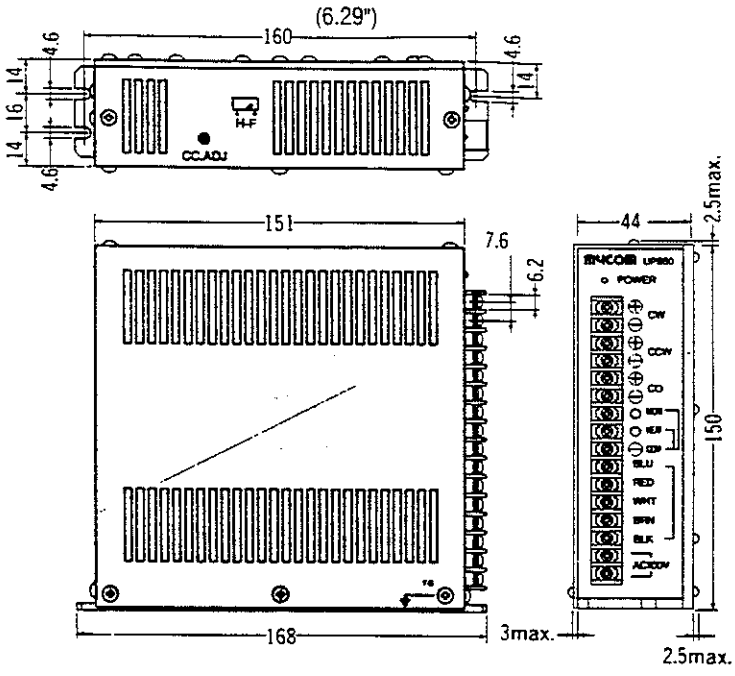
Motor lead terminals (Motor power outputs)
Connect color coded motor leads to these terminals.
* If the motor leads are to be extended, 18 AWG leads or larger are recommended.

AC power input terminal
Connect 115V (nominal) AC (50/60Hz) line power to these terminals.
* Use 20 AWG or larger leads for connections.

Chassis ground screw (side panel at bottom)
Connect to system ground point.

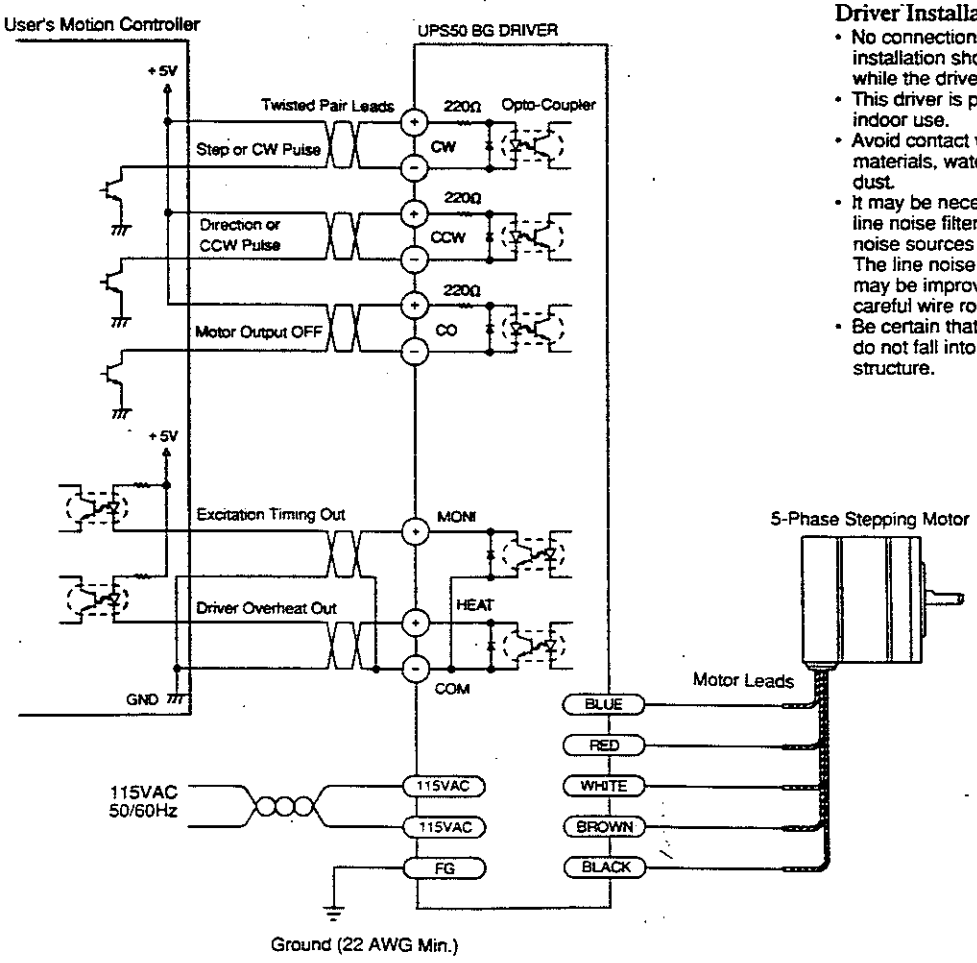
CAUTION: TO AVOID INJURY BY ELECTRICAL SHOCK & DAMAGE DO NOT TOUCH MOTOR LEAD TERMINALS WHEN THE POWER IS ON! MAXIMUM MOTOR CHOPPING VOLTAGE WILL APPROACH 140VDC. NO CONNECTION CHANGES MAY BE MADE WHILE THE DRIVE POWER IS ON. HAZARDOUS VOLTAGES MAY BE PRESENT AT THESE TERMINALS. IF THE MOTOR OUTPUTS ARE SHORT CIRCUITED, SERIOUS DAMAGE TO THE DRIVER WILL RESULT. THIS WILL NOT BE COVERED UNDER WARRANTY, AND WILL VOID REMAINDER OF THE ORIGINAL PRODUCT WARRANTY. IF MOTOR LEAD TO TERMINAL CONNECTION IS TO BE MADE VIA A CONNECTOR SET, DO NOT USE MALE CONNECTORS OF ANY TYPE TO TERMINATE DRIVER OUPUTS TO THE MOTOR. ALWAYS USE FEMALE CONNECTOR ON DRIVER OUTPUT SIDE TO AVOID POSSIBLE SHORT CIRCUIT ACCIDENTS.

UPS50-030 (130) Driver Dimensions (mm)



1mm = .03937 inches

UPS50 Series BG Type Connections

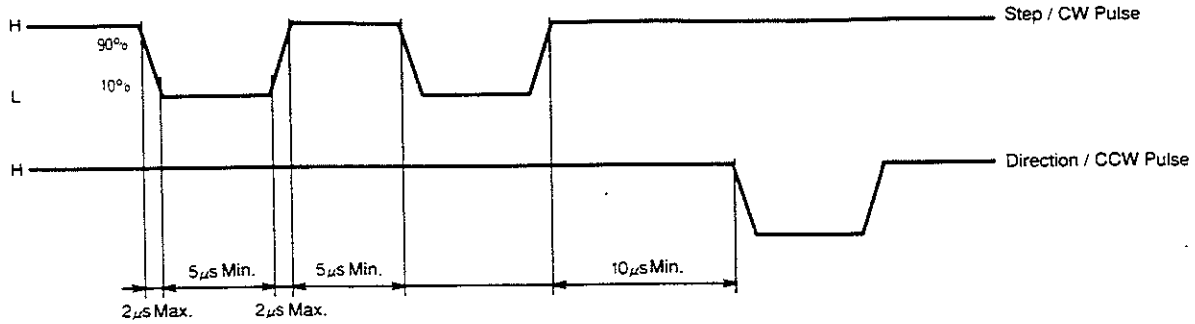


Driver Installation Notes

- No connections or physical installation should be performed while the driver power is ON.
- This driver is primarily designed for indoor use.
- Avoid contact with corrosive materials, water, oils and excessive dust.
- It may be necessary to install DC line noise filter(s) where strong noise sources exist near the driver. The line noise induction problems may be improved or avoided by a careful wire routing plan.
- Be certain that conductive particles do not fall into the driver's internal structure.

Input Signal Timing Data

Input Pulse Waveform



UPS50BG Driver Specifications

	UPS50-030	UPS50-130
Driver Type	Star Bi-Polar, Constant Current Chopper	
Power Requirements	115V ~ 120V AC, 50/60Hz	
Power Consumption	2.0A or less	3.5A or less
Built in Functions	Auto current down at stand still. Current off. Excitation timing signal output. Driver overheat warning signal output.	
Input Pulse Types	STEP and DIRECTION or CW/CCW pulse (selectable). All opto-isolated. Voltage H=4 ~ 5V, L=0 ~ 0.5V. Input resistance 220 ohms.	
Dielectric Strength	No abnormality detected after the application of AC 1KV between case and power input terminals, case and signal I/O terminals, signal I/O terminals and power input terminals for duration of one minute.	
Insulation Resistance	100M ohms or better with 500V potential applied between case and power input terminals and signal I/O terminals.	
Operating Environment Temperature	0°C ~ +40°C	

D330089-13
E330056-2

UPS 50 Series STANDARD TYPE †
5-Phase, 5-Lead Stepping Motors and Drivers *

Sizes 23 and 34

- High torque output in a compact package.
- Extremely smooth operation. – Virtually no low rpm vibration.
- Motor and driver are offered as a perfectly matched pair to ensure the optimum performance.
- Highly cost effective.
- Easy installation with only 5 leads.

* Protected by US/Intl. Patents

UPS 50 Series (A) after the unit # denotes single shaft configuration. (B) after the unit # denotes thru-shaft configuration.

MOTOR SIZE (mm)	MOTOR AND DRIVER COMBINATION UNIT #	MAX. HOLDING TORQUE oz-in (kg-cm)	ROTOR INERTIA oz-in² (g cm²)	STEP ANGLE FULL/HALF	PHASE CURRENT (A)	MOTOR WEIGHT oz (kg)	DRIVER TYPE	MOTOR TYPE
23 (60)	UPS50-564A(B)	31.9 (2.30)	0.54 (100)	0.72/0.36	0.75	17.6 (0.5)	UPS50-030	PS 564A(B)
	UPS50-566A(B)	51.4 (3.77)	1.09 (200)	0.72/0.36	0.75	26.4 (0.75)	UPS50-030	PS 566 A(B)
	UPS50-569A(B)	105.5 (7.60)	2.18 (400)	0.72/0.36	1.4	45.8 (1.3)	UPS50-130	PS 569 A(B)
34 (85)	UPS50-596A(B)	163.9 (11.80)	3.82 (700)	0.72/0.36	1.4	52.9 (1.5)	UPS50-130	PS 596 A(B)
	UPS50-599A(B)	290.2 (20.90)	6.26 (1200)	0.72/0.36	1.4	88.2 (2.5)	UPS50-130	PS 599 A(B)
	UPS50-5913A(B)	527.7 (38.00)	9.48 (1800)	0.72/0.36	1.4	123.4 (3.5)	UPS50-130	PS 5913 A(B)

Other Specifications

Motor

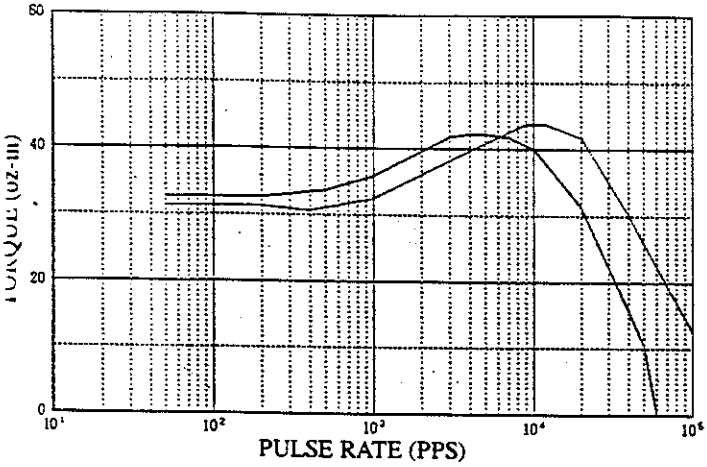
Step Angle Accuracy	± 5 min.
Shaft Radial Play	0.00098 in. max. / 1.1lbs load
Shaft Axial Play	0.00295 in. max. / 2.2lbs load
Dielectric Strength	No abnormality detected after the application of 0.5KV at 50Hz between motor windings and frame for duration of one minute.
Insulation Class	Class B
Insulation Resistance	100M ohms or better with 500V potential applied between motor windings and frame at normal ambient temperature and humidity.
Operating Environment Temperature	0°C ~ +50°C

† UPS50 series size 23 motors are available with a High Resolution Option. The M Type Motors offer 1000 or 2000 steps per revolution for further improved low speed resonance characteristics and absolute positioning accuracy.

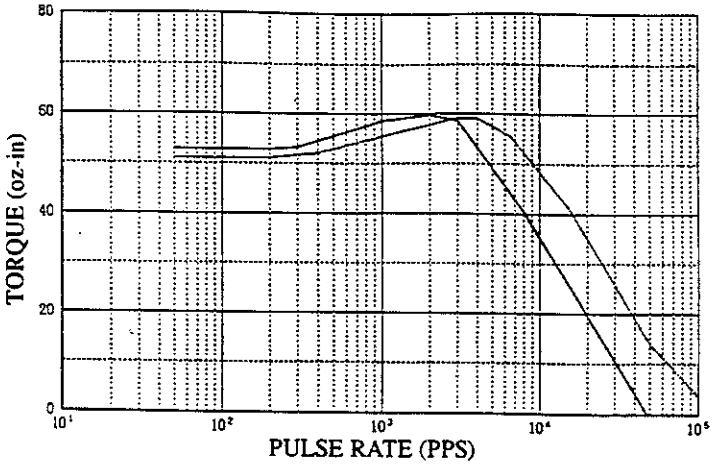
Driver

	UPS50-030	UPS50-130
Drive Type	Star Bi-Polar, Constant Current Chopper	
Power Requirements	115 ~ 120V AC. 50/60 Hz	
Power Consumption	2.0A or less	3.5A or less
Built in Functions	Auto current down at stand still. Current off. Excitation timing signal output. Driver overheat warning signal output.	
Input Pulse Types	STEP and DIRECTION or CW/CCW signal (selectable). All opto isolated. Voltage H=4 ~ 5V, L=0 ~ 0.5V. Resistance 220 ohms.	
Dielectric Strength	No abnormality detected after the application of AC 1KV between case and power input terminals, case and signal I/O terminals, signal I/O terminals and power input terminals for duration of one minute.	
Insulation Resistance	100M ohms or better with 500V potential applied between case and power input terminals and signal I/O terminals.	
Operating Environment Temperature	0°C ~ +40°C	

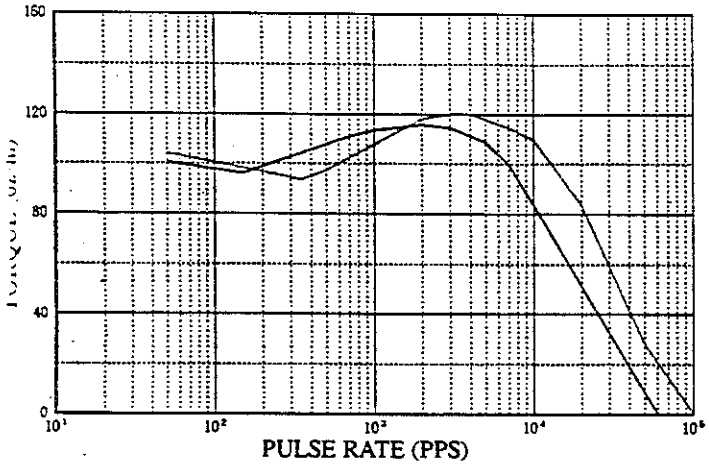
UPS50-564A(B) size 23



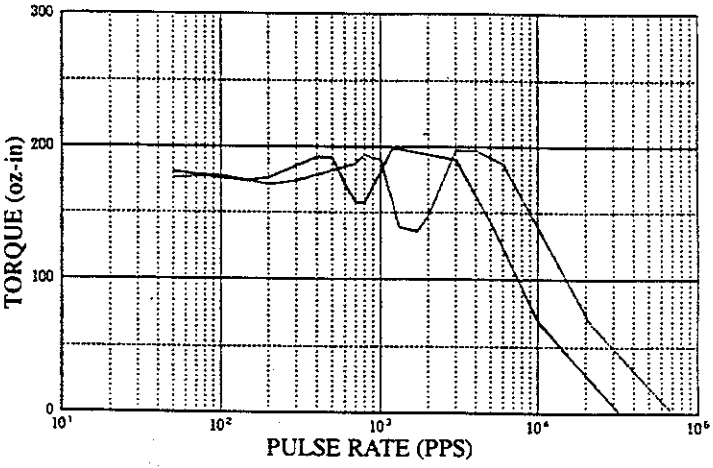
UPS50-566A(B) size 23



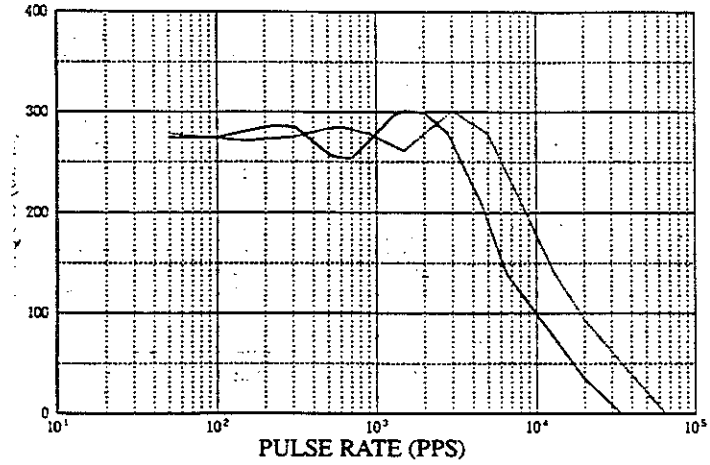
UPS50-569A(B) size 23



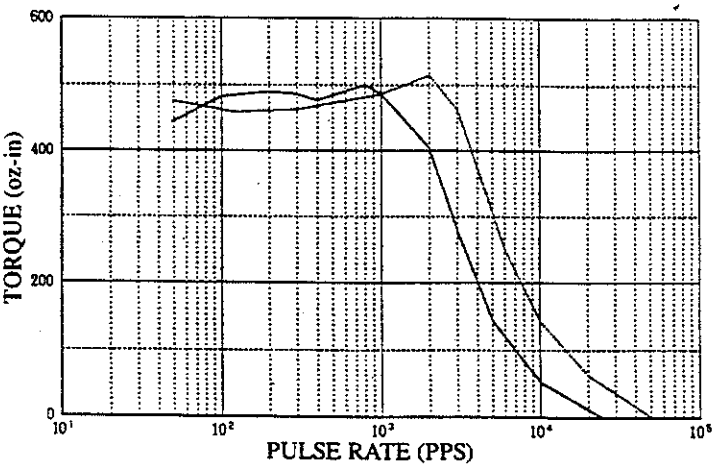
UPS50-596A(B) size 34



UPS50-599A(B) size 34



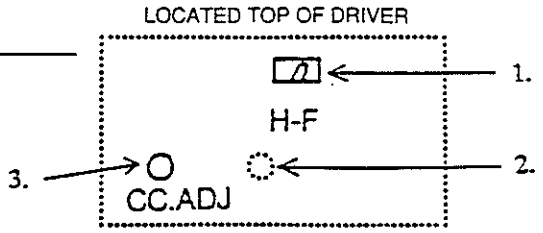
UPS50-5913A(B) size 34



——————— FULL STEP

- - - - - - - - - - - - HALF STEP

UPS50-030 (130) Driver Adjustable Parameters



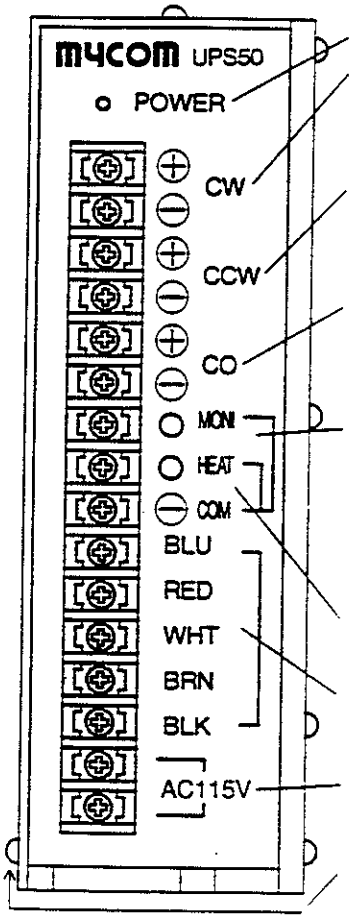
Located at top of Driver

1. Step angle selector switch
   Switch position F for Full step mode (0.72°/step).
   Switch position H for Half step mode (0.36°/step).
2. C. ADJ. (Motor run current adjustment)
   Each driver is pre-adjusted for the applicable motor included with a package. This adjustment **should not be made** unless a lower current level setting is absolutely needed in order to reduce motor torque and motor/drive heat generation.

   NOTE: Stepping motors should be operated below 212°F or 100°C at the motor casing. Motor case may heat to temperature level under certain running conditions where it could feel too hot to the touch. This will not cause adverse effects to the motor as long as the temperature remains below 212°F or 100°C.

3. CC. ADJ (Motor stand still current cutback adjustment)
   UPS50 drivers are equipped with auto-current cutback feature when the motor is at stand still (idle) to reduce motor heat build up when not running.
   Adjustable range is from 20% to 90% of motor run current value which is set by C. ADJ pot. Clockwise turn of this pot increases motor standing current, and counterclockwise reduces motor standing current. Factory set value is 50%. If motor holding torque at stand still is not needed, this pot may be set at the lowest value (fully counter clockwise) to minimize motor heating. This function is activated 200mS after the motor stops. This feature can be disabled by keeping **CW input terminal** in ON (low) state.

UPS50-030 (130) Driver Functions



Power indicator LED

CW step input terminal (5V negative logic)
(Low or 0V to 0.5V = ON, Hi or 4V to 5V = OFF)
Pulse input for CW motor rotation.
When step and direction mode selected, this terminal accepts the STEP input.

CCW step input terminal (5V negative logic)
(Low or 0V to 0.5V = ON, Hi or 4V to 5V = OFF)
Pulse input for CCW motor rotation.
When step and direction mode selected, this terminal accepts the DIRECTION input.

Motor current shutoff signal input terminal (5V negative logic)
Motor winding current turn-off signal input.
When this input terminal is kept ON, the driver will output no motor current.
CAUTION: The motor will produce no holding torque.

Excitation timing ZERO output terminal
This terminal provides opto isolated open collector output for excitation timing origin (step #0) of the motor.
The terminal will turn on once every 10 steps in Full step mode (0.72°/step).
The terminal will turn on once every 20 steps in Half step mode (0.36°/step).
A green LED indicator which will light when this terminal turns on is provided for visual timing representation.

Driver overheat alarm output terminal
This terminal provides opto isolated open collector output for driver overheat condition when the onboard temperature sensor detects the drivers heat sink temperature to exceed 158°F (70°C).

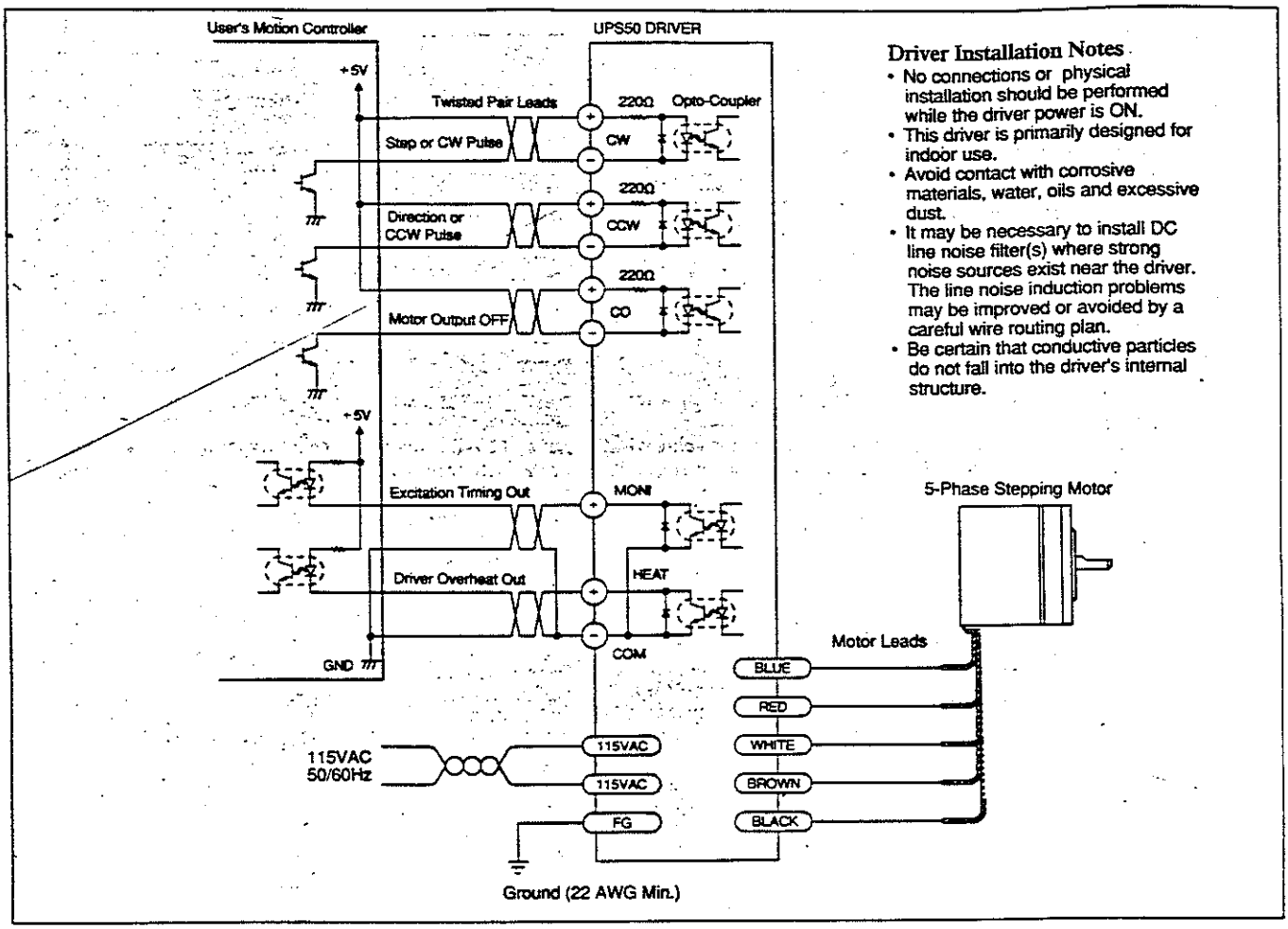
Motor lead terminals (Motor power outputs)
Connect color coded motor leads to these terminals.
* If the motor leads are to be extended, 18 AWG leads or larger are recommended.

AC power input terminal
Connect 115V (nominal) AC (50/60Hz) line power to these terminals.
* Use 20 AWG or larger leads for connections.

Chassis ground screw (side panel at bottom)
Connect to system ground point.

CAUTION: TO AVOID INJURY BY ELECTRICAL SHOCK & DAMAGE DO NOT TOUCH MOTOR LEAD TERMINALS WHEN THE POWER IS ON! MAXIMUM MOTOR CHOPPING VOLTAGE WILL APPROACH 140VDC. NO CONNECTION CHANGES MAY BE MADE WHILE THE DRIVE POWER IS ON. HAZARDOUS VOLTAGES MAY BE PRESENT AT THESE TERMINALS. IF THE MOTOR OUTPUTS ARE SHORT CIRCUITED, SERIOUS DAMAGE TO THE DRIVER WILL RESULT. THIS WILL NOT BE COVERED UNDER WARRANTY, AND WILL VOID REMAINDER OF THE ORIGINAL PRODUCT WARRANTY. IF MOTOR LEAD TO TERMINAL CONNECTION IS TO BE MADE VIA A CONNECTOR SET, DO NOT USE MALE CONNECTORS OF ANY TYPE TO TERMINATE DRIVER OUPUTS TO THE MOTOR. ALWAYS USE FEMALE CONNECTOR ON DRIVER OUTPUT SIDE TO AVOID POSSIBLE SHORT CIRCUIT ACCIDENTS.

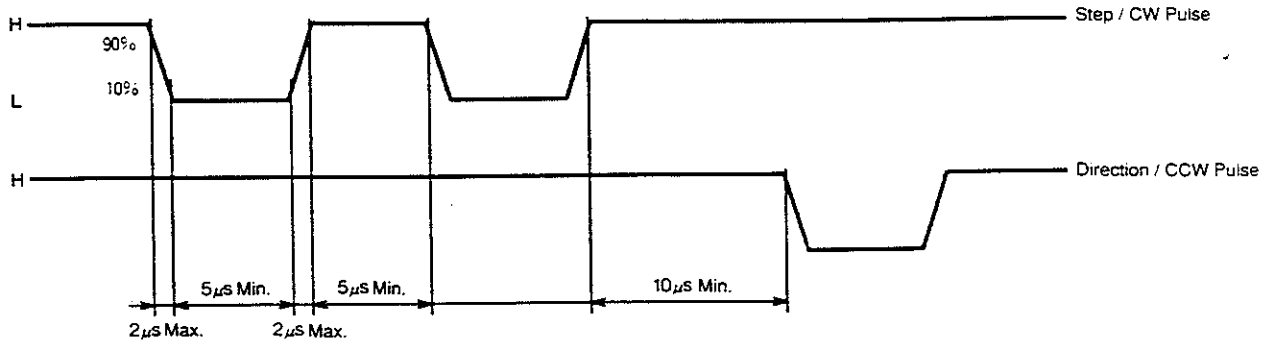
UPS50 Series STANDARD Type Connections



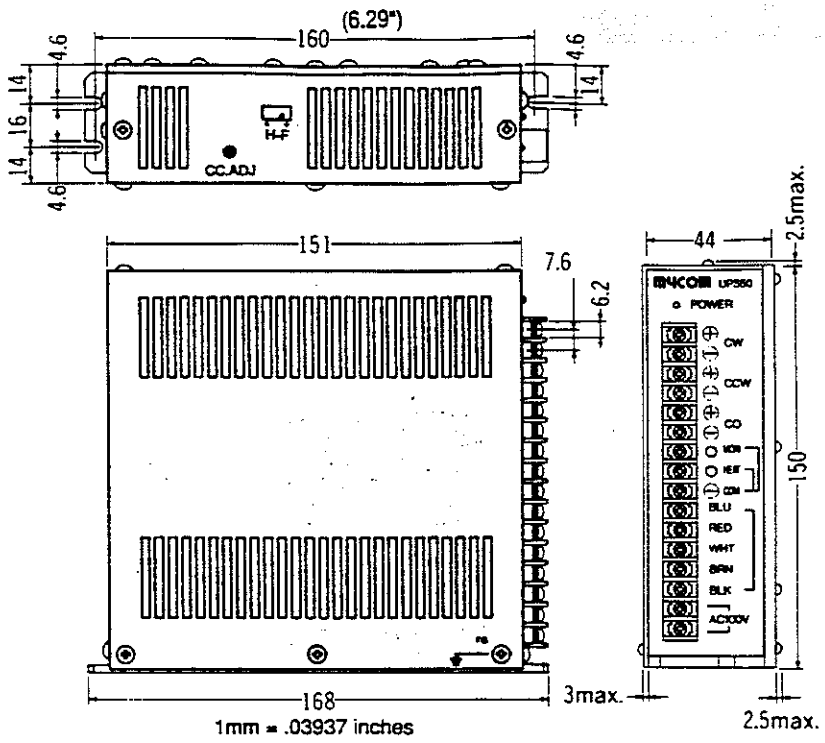
Driver Installation Notes

- No connections or physical installation should be performed while the driver power is ON.
- This driver is primarily designed for indoor use.
- Avoid contact with corrosive materials, water, oils and excessive dust.
- It may be necessary to install DC line noise filter(s) where strong noise sources exist near the driver. The line noise induction problems may be improved or avoided by a careful wire routing plan.
- Be certain that conductive particles do not fall into the driver's internal structure.

Input Pulse Waveform



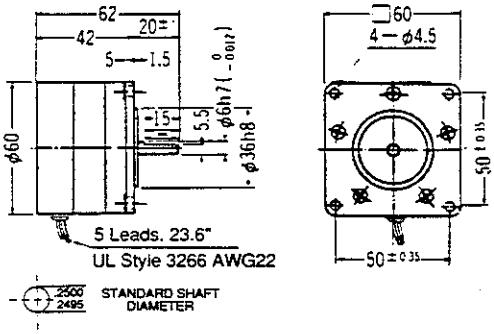
UPS50-030 (130) Driver Dimensions (mm)



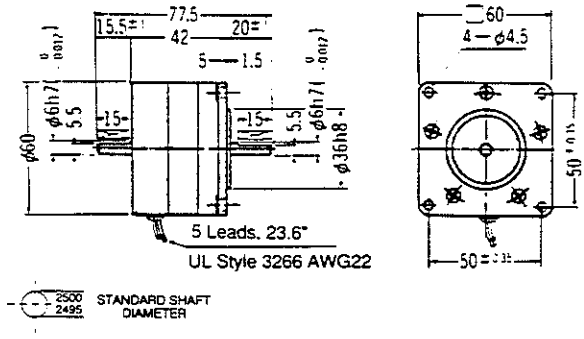
UPS50 Series Standard Type Motor Dimensions

All dimensions are shown in millimeters. To obtain inch equivalent, divide given number by 25.4 (ex. 85mm ÷ 25.4 = 3.346 in.)

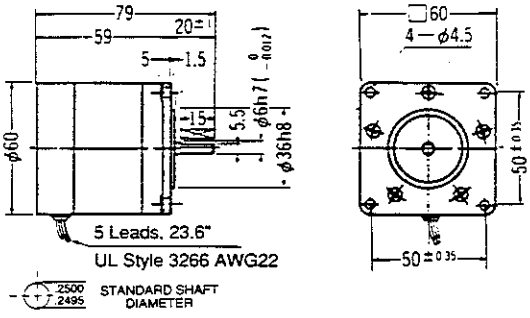
UPS50-564A (Single Shaft)



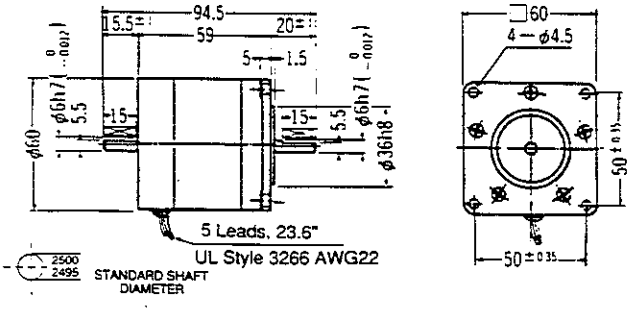
UPS50-564B (Through Shaft)



UPS50-566A (Single Shaft)



UPS50-566B (Through Shaft)

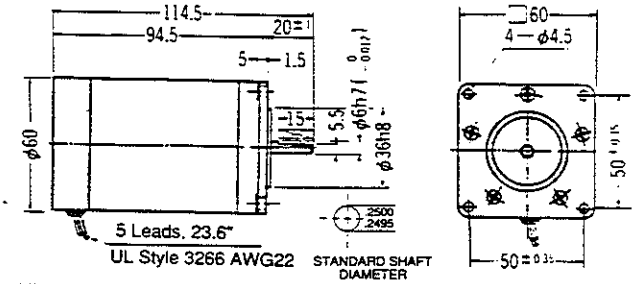


Standard shafts available for all 5-phase motors.

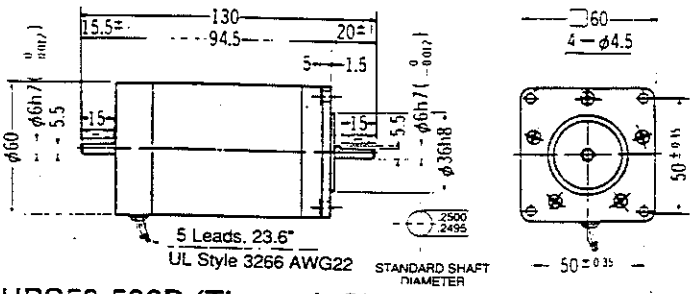
UPS50 Series STANDARD Type Dimensions

All dimensions are shown in millimeters. To obtain inch equivalent, divide given number by 25.4 (ex. 85mm ÷ 25.4 = 3.346 in.)

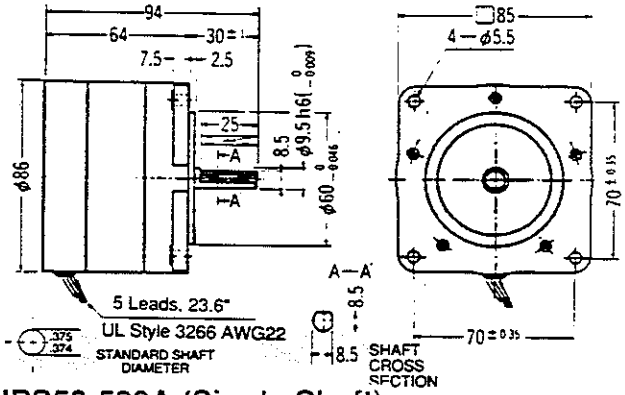
UPS50-569A (Single Shaft)



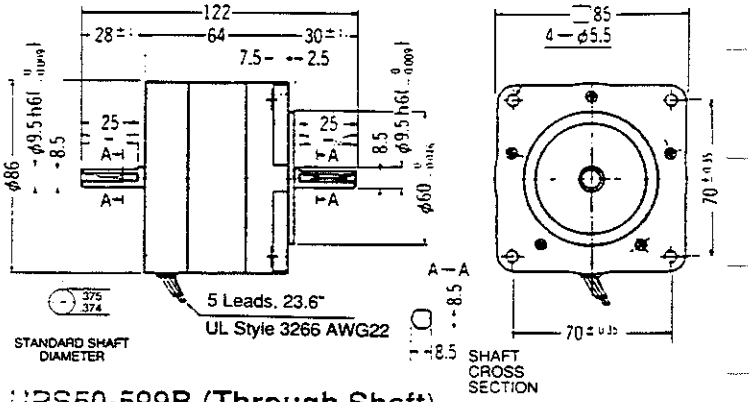
UPS50-569B (Through Shaft)



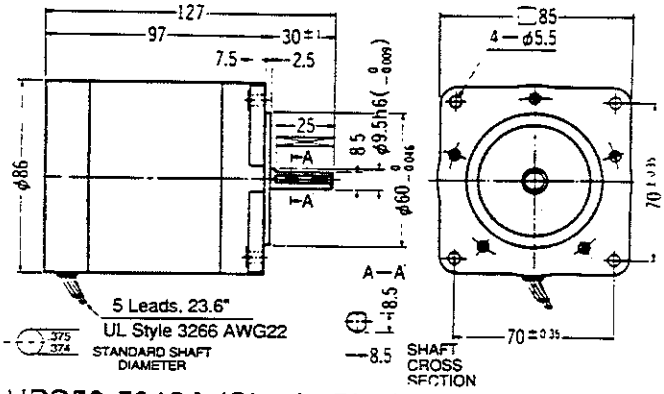
UPS50-596A (Single Shaft)



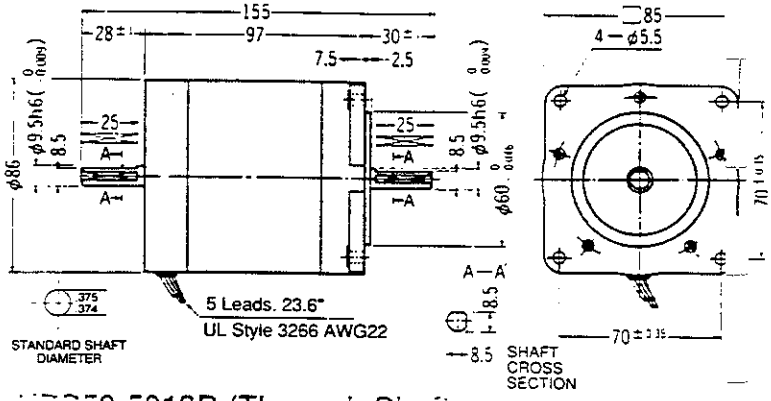
UPS50-596B (Through Shaft)



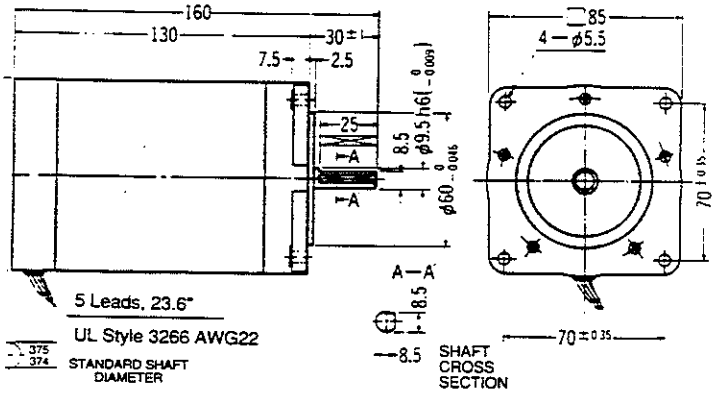
UPS50-599A (Single Shaft)



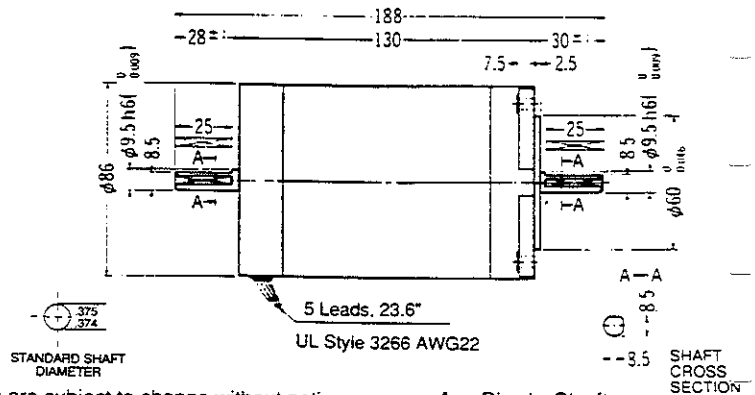
UPS50-599B (Through Shaft)



UPS50-5913A (Single Shaft)



UPS50-5913B (Through Shaft)



Specifications are subject to change without notice.

A = Single Shaft
B = Through Shaft

Standard shafts available for all 5-phase motors.

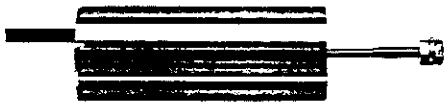
DC-DC Miniature LVDTs

Models MS2 and S2C

MINIATURE DESIGN

COST EFFECTIVE

0.25% NON-LINEARITY



Model MS2 Free Unguided

Model S2C Captive Guided Spring Return

SENSOTEC's Models MS2 (free unguided armature) and S2C (captive guided spring return armature) DC-DC Miniature LVDTs are ideally suited for multi-point applications with space constraints and provide a cost-effective alternative to larger, more expensive units. These models operate with 6 to 12 volt DC power supplies and are compatible with DC data logging equipment used for taking readings from strain gages or other DC operated transducers.

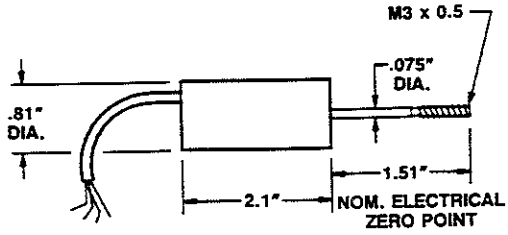
	Model MS2 (Free Unguided) Order Code BY325	Model S2C (Captive Guided Spring Return) Order Code BY322
PERFORMANCE		
Stroke Ranges	+/-.1" to .2"	+/-.1" to .2"
Non-linearity (max)	+/-0.25% F.S.	+/-0.25% F.S.
Output Sensitivity	6.6VDC/in. @ 10V supply	6.6VDC/in. @ 10V supply
Resolution	Infinite	Infinite
ENVIRONMENTAL		
Temperature, Operating	14° F to 122° F	14° F to 122° F
Temperature Effect		
- Zero (max)	.01% F.S./° F	.01% F.S./° F
- Span (max)	.025% Rdg./° F	.025% Rdg./° F
ELECTRICAL		
Element Type	DC-DC LVDT	DC-DC LVDT
Input Supply	6-12VDC @ 50ma	6-12VDC @ 50ma
Unfiltered Output Impedance	100 ohms	100 ohms
Output Load (min.)	20,000 ohms	20,000 ohms
Noise (filtered output)	15mv max peak to peak	30mv max peak to peak
Wiring Code (std)	#32 (See P. 167)	#32 (See P. 167)
Electrical Termination	Multiconductor shielded cable (6 ft.)	Multiconductor shielded cable (6 ft.)
MECHANICAL		
Case Material	Stainless steel	Stainless steel
Probe Material	Stainless steel	Stainless steel
Armature Type	Free unguided	Captive guided spring return
Unit Weight	64 grams	75 grams
Probe Thread	M3 x 0.5	N/A

NOTES *Calibrated at 10VDC. Output will change approximately proportionally to the applied supply voltage. It is therefore important that a stable supply is employed.

Dimensions

Model MS2 (Order Code BY325)

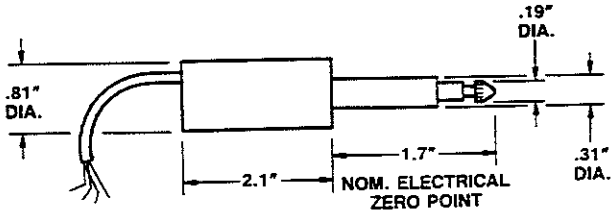
Order Code W/Range	Available Stroke Ranges
BY325HM	+/-.1"
BY325HN	+/-.2"



Model MS2 Free Unguided

Model S2C (Order Code BY322)

Order Code W/Range	Available Stroke Ranges
BY322HM	+/-.1"
BY322HN	+/-.2"



Model S2C Captive Guided Spring Return

ULTRA MOTION 225 East Side Ave. Mattituck, NY 11952 Phone and Fax: 516 298 9179

ACTUATOR USED ON M3 TURRET

INSTRUCTIONS AND OPERATING LIMITATIONS

Tower Series Linear Actuators

Polarity: Red or White lead ( ) unit extends, Red or White lead ( ) unit retracts.

Limit Switches: Units are equipped with externally adjustable limit switches. The limits can be set from the full stroke positions to these positions minus 2 inches on each switch.

When looking at the front face of the unit with the thrust tube below the center line of the unit, the extend limit screw is to the right and the retract limit screw is to the left. Turning the screws clockwise brings the limit switches closer to the front of the unit. Therefore, full stroke is achieved when the extend limit screw is turned fully clockwise and the retract limit screw is turned fully counterclockwise. **Do not force the switches into the travel stops. Stop turning the adjustment screw when resistance is felt.**
IMPORTANT...Adjust the retract switch only when unit is extended to the extend limit switch. Adjust the extend switch only when the unit is retracted to the retract limit switch.

Force Limitations: Push and pull forces are normally limited to 150 lbs. Units can be modified to provide forces to 500 lbs. with a 175 inch travel reduction and reduced cycle life. Units geared for higher speeds cannot achieve high force depending on gear ratio lead screw type and pitch. Consult factory.

Current Limiting: Current limiting should be employed when high gear ratios (no-load speeds below 2"/second) are used to protect equipment in the event of a jam up of driven load.

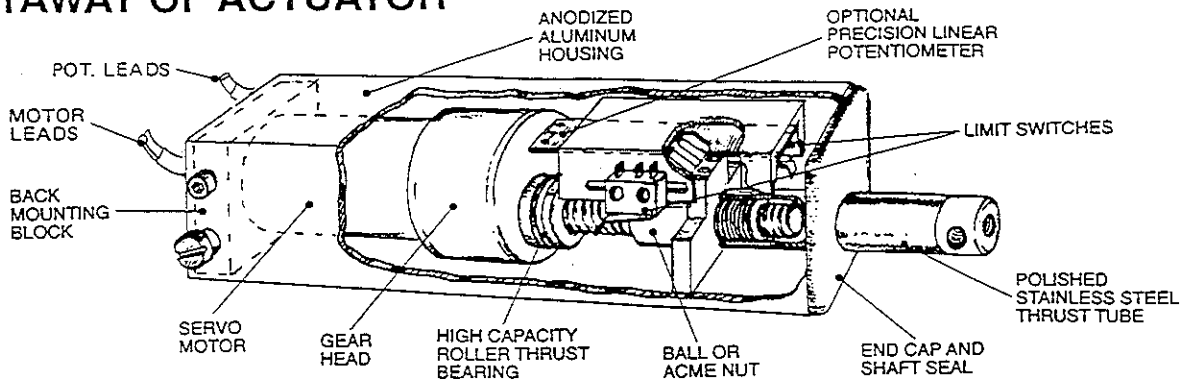
Lubrication: No lubrication is needed.

Motor Brush Life: Brush life varies with load and stop frequency but 1500 to 2000 hours are average.

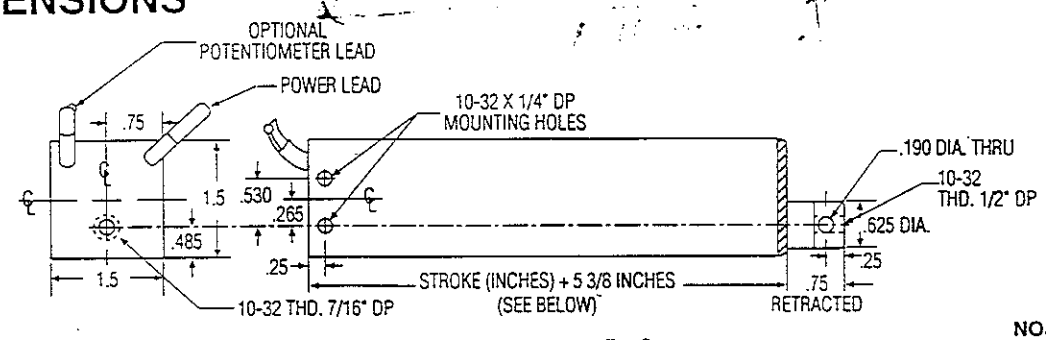
Duty Cycle: Duty cycle varies with load, load screw type and ambient temperature. Consult the factory for your specific application. Motor temperature is a function of current ambient temperature. As a general rule, the motor case operation temperature should not exceed 165 degrees F. for longest life.

Torque and Side Load: Side loads should not exceed 3 lbs. especially in the extended position. Torque should never be applied directly to the polished stainless steel shaft. The end plug is designed to rotate at several in.-lbs. of torque to protect the internal parts. When tightening a nut or fixture to the end plug, the end plug should be held from rotating as the nut or fixture is tightened against it.

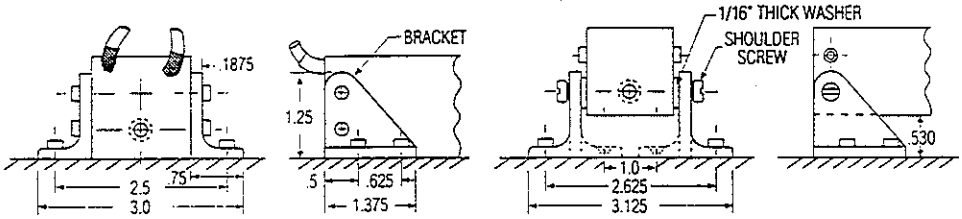
CUTAWAY OF ACTUATOR



DIMENSIONS



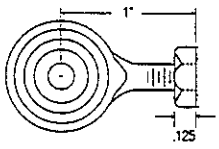
MOUNTS



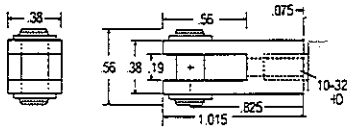
HARD MOUNT

SWIVEL MOUNT

AVAILABLE AT NOSE OR BASE ENDS

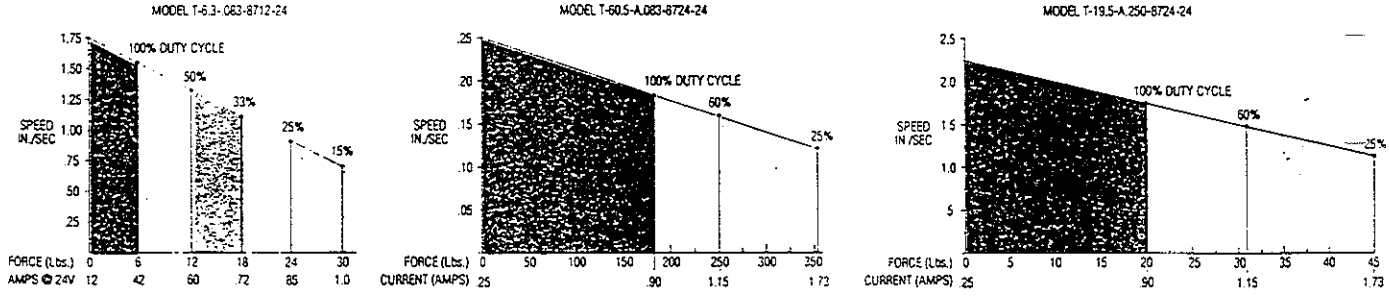


ROD BEARING CLEVIS



EYE CLEVIS

REPRESENTATIVE SPEED/FORCE CURVES*



* Many others available (call factor

ORDERING INFORMATION

Example (T—19.5—A.083—8724—24—1—P—SS/P)

T (Tower)	Gear Ratio	Lead Screw Pitch (in.)	Anti Backlash Nut	Motor Type	Motor Voltage	Stroke (inches)	Linear Pot.	Environmentally Sealed	Mountings Base / Nose End / End
T	6.3	B .125	AB	8712	12	1	P	ES	SS ..... Shoulder Screw
	19.5	A .083	—	8724	24	2		—	RBC ... Rod Bearing Clevis
	60.5	A .250				4			EC ..... Eye Clevis
	187.7	A .400							B ..... Brackets

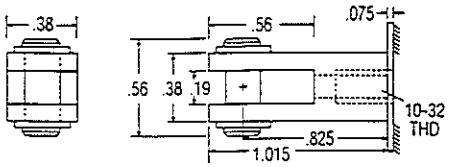
ULTRA MOTION

225 East Side Ave., Mattituck, N.Y. 11952

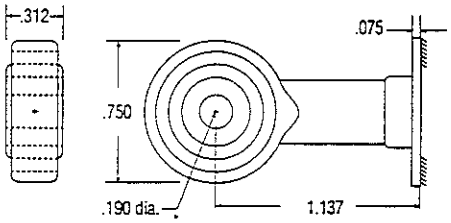
Phone/Fax 516-298-9179

MOUNTINGS

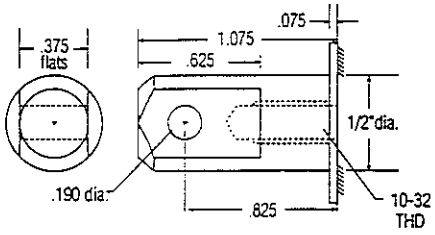
BASE



EYE CLEVIS

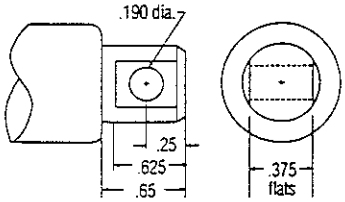


ROD BEARING CLEVIS

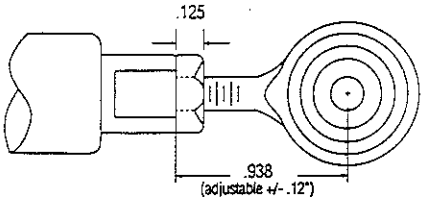


ROD CLEVIS

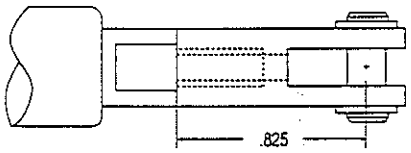
NOSE



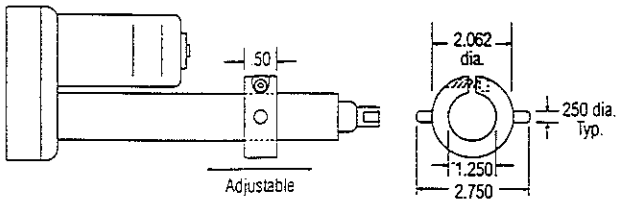
NOSE ROD CLEVIS



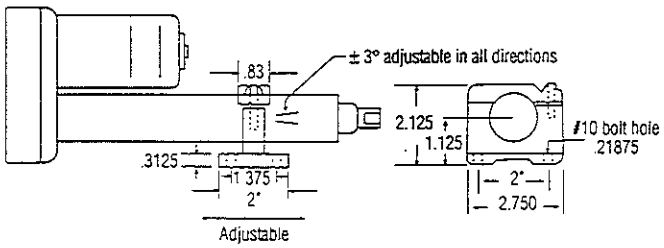
ROD BEARING CLEVIS



EYE CLEVIS



TRUNION MOUNT



BLOCK MOUNT

ORDERING INFORMATION

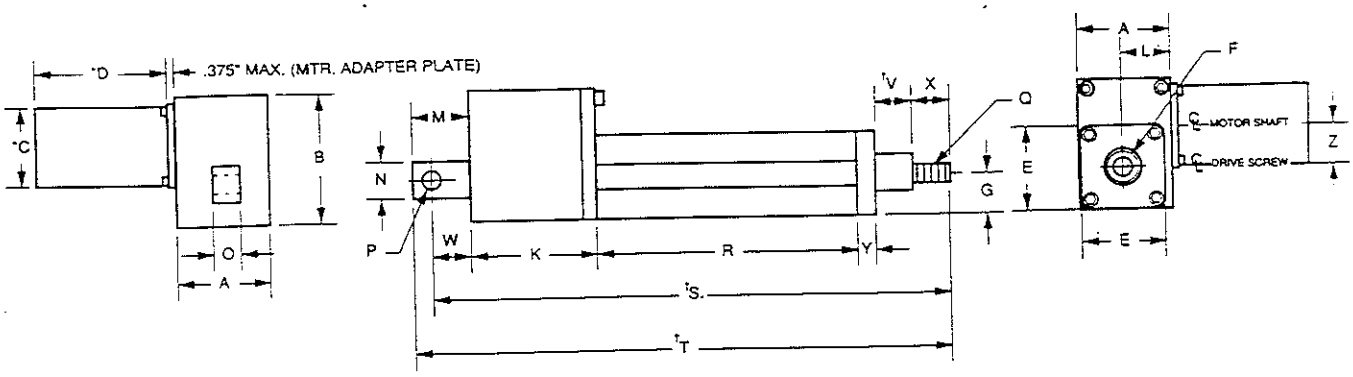
Example (5—B.125—DCG 5.9—24—4—E 256—RC/RBC)

Belt Drive Ratio	Screw Ball, Acme/ Lead (in.)	Anti Backlash Nut	Motor Type	Motor Voltage	Stroke (inches)	Linear Pot.	Keyed Shaft	Environ-mentally Sealed	Encoder	Brake	Mtn'g Base/ Nose
2:1	B .125	AB	DC	6	2	P	K	ES	E(LC)**	BR	EC..... Eye Clevis
3:1	A .083	–	DC143	12	4	–	–	–	–	–	RBC ... Rod Bearing Clevis
4:1	A .250		DC146	24	8						RC..... Rod Clevis
5:1	A .400		DCG(R)* ST								NRC ... Nose Rod Clevis
											T..... Trunion
											B ..... Block

* Standard Gear Ratios: 5.9, 19.7, 65.5, 218 **Standard Line Counts: 256, 360, 500, 512

ULTRA MOTION

225 East Side Ave., Mattituck, N.Y. 11952
Phone/Fax 516-298-9179

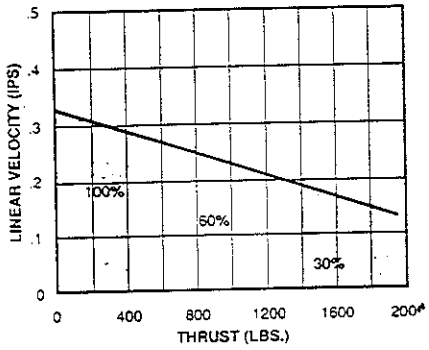


*For motor dimensions, refer to page 14 § = Stroke † = Retracted length

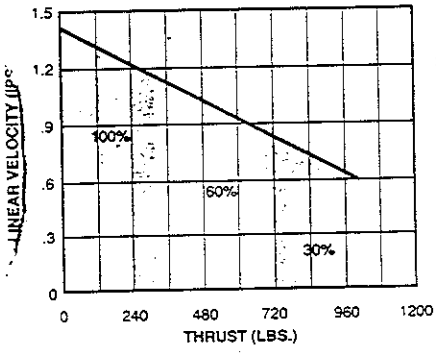
A	B	C	D	E	F	G	K	L	M	N
2.5"	3.5"	-	-	2.25"	Ø1.0"	1.13"	3.38"	1.35"	1.5"	1.0"
O	P	Q	R	S	T	V	W	X	Y	Z
.75"	Ø.50" THRU	1/2-20 UNF	3.9" + §	10.8" + §	11.3" + §	1.0"	1.0"	1.0"	.50"	1.08"

Thrust vs. Velocity Curves

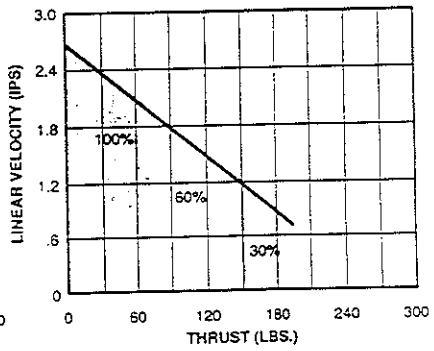
JJ-B5-W40-24D3



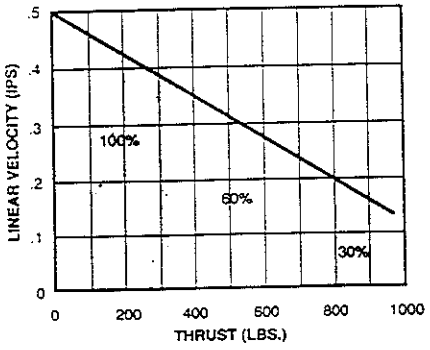
JJ-B2-W20-24D4



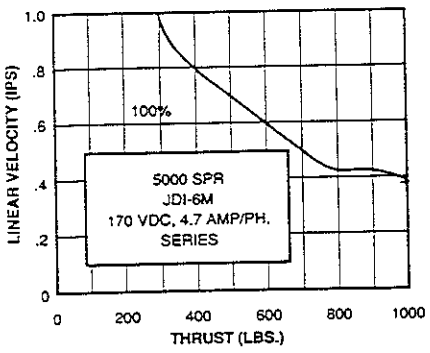
JJ-B2-W10-90D1



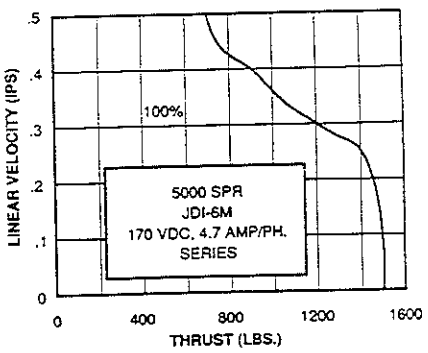
JJ-B5-W20-90D1



JJ-B5-W10-23S3/06



JJ-B2-W40-23S3/06

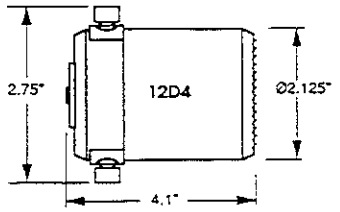


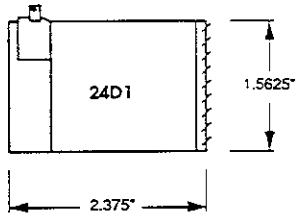
Note: Percentages under curve represent actuator duty cycle.

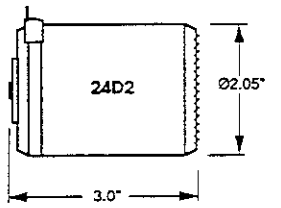
Linear industries 800 821-2875

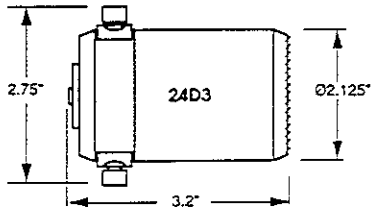
Motor Dimensions

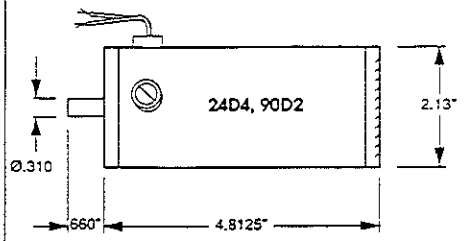
DC Brush Motors

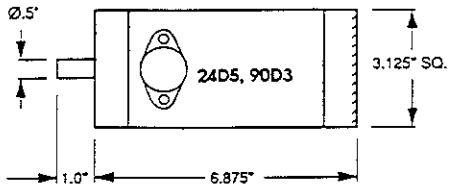












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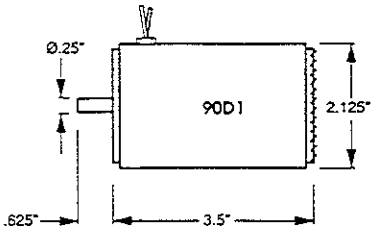

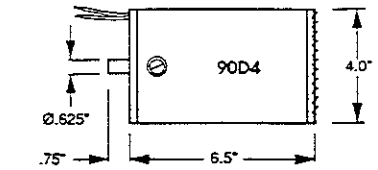

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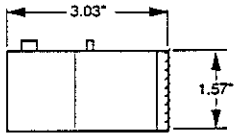

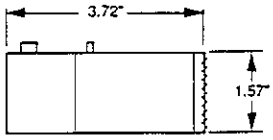

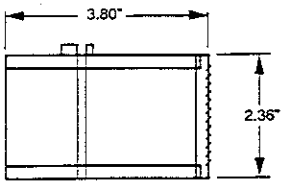

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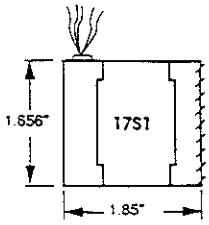
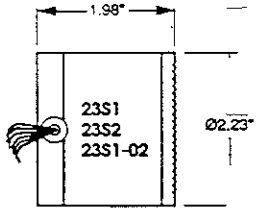
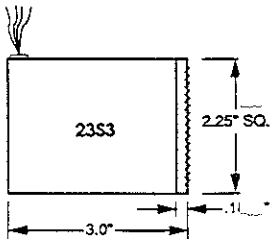
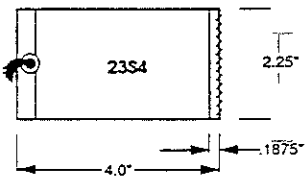
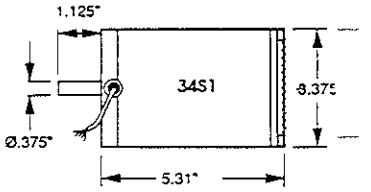
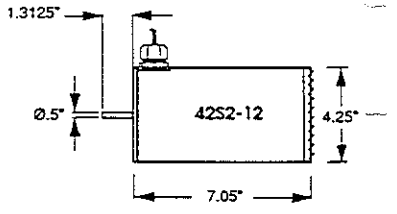












Note: ⫽ represents the side of motor mounted to actuator.

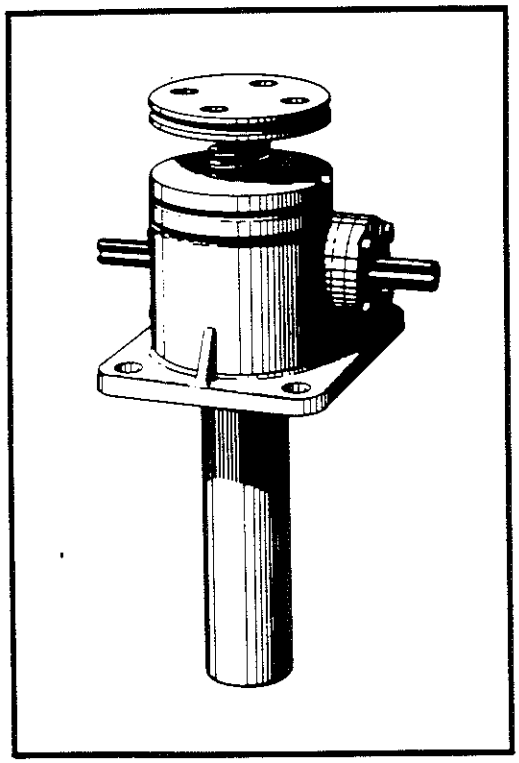
D330095-6
D330095-7

Duff-Norton®

MAINTENANCE INSTRUCTIONS WITH PARTS LIST

PUBLICATION PART NO. SK-2389

MACHINE SCREW ACTUATORS



SERIES
1800
9000
4800
9400

IMPORTANT — CAUTION

This manual contains important information for the correct installation, operation and maintenance of the equipment described herein. All persons involved in such installation, operation, and maintenance should be thoroughly familar with the contents. To safeguard against the possibility of personal injury or property damage, follow the recommendations and instructions of this manual and keep it for further reference.

⚠WARNING

The equipment shown in this manual is intended for industrial use only and should not be used to lift, support, or otherwise transport people.

Duff-Norton

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SECTION I

GENERAL INFORMATION

1-1. General

This manual contains maintenance instructions for Duff-Norton® 1800, 9000, 4800 and 9400 machine screw actuators. It describes and details procedures for disassembly, cleaning, inspection, rebuilding and assembly of these actuators.

1-2. Industrial Use Only

The machine screw actuators described and illustrated in this manual are intended for industrial use only and should not be used to lift, support or otherwise transport people unless you have a written statement from Duff-Norton Company which authorizes the specific actuator unit, as used in your application, as suitable for moving people.

1-3. Specifications

TABLE 1. 1800 AND 9000 SERIES

Actuator Number											
Actuator Number	Upright	**1802 & 9002**	**9005**	**9010**	**9015**	**9020**	**9025**	**9035**	**1850**	**1899**	**18150**
	Inverted	**1801 & 9001**	**9004**	**9009**	**9014**	**9019**	**9024**	**9034**	**1849**	**1898**	**18149**
Rated Load (tons)		2	5	10	15	20	25	35	50	100	150
Diameter of Lifting Screw (inches)		1 .250 Pitch Acme	1½ .375 Pitch Acme	2 .500 Pitch Acme	2¼ .500 Pitch Acme	2½ .500 Pitch Acme	3⅜ .666 Pitch Acme	3¾ .666 Pitch Acme	4½ .666 Pitch Square	6 .750 Pitch Square	7 1.000 Pitch Square
Closed Height ** (in)		5¼	7	7¼	8	9¼	11	12	13	24	24
Base Size (in)		3½ × 7 4⅛ × 6¼	6 × 8	7½ × 8¾	7¾ × 9¼	8¼ × 11	10¼ × 13¾	10¼ × 15½	9¾ × 19¾	20¾ × 24½	20¾ × 24½
Worm Gear Ratios	Std. Ratio	6:1	6:1	8:1	8:1	8:1	10⅔:1	10⅔:1	10⅔:1	12:1	12:1
	Optional	24:1	24:1	24:1	24:1	24:1	32:1	32:1	32:1	36:1	36:1
Turns of Worm For 1" Raise	Std. Ratio	24	16	16	16	16	16	16	16	16	12
	Optional	96	64	48	48	48	48	48	48	48	36
Maximum H.P. Per Actuator	Std. Ratio	2	4	5	5	5	8	8	15	25	25
	Optional	½	½	1½	1½	1½	2½	2½	6	11	11
Torque at Full Load* (in-lbs)	Std. Ratio	120	450	950	1,430	2,050	3,360	4,600	7,500	16,000	28,100
	Optional	50	185	490	820	1,170	1,900	2,750	4,200	8,600	15,500
Actuator Efficiency Rating (%)	Std. Ratio	23.2	22.1	22.0	20.2	18.8	16.4	15.2	13.8	13.0	14.1
	Optional	13.3	12.1	14.0	12.9	20.2	9.2	8.5	8.3	8.0	8.6
Weight with Base Raise of 6" (lb)		17	35	52	66	93	181	240	410	1,200	1,350
Weight For Each Additional 1" Raise (lb)		.33	.85	1.4	1.5	2.6	3.5	4.1	5.5	9.0	12.6

* For loads of from 25% to 100% of Actuator load rating. Torque requirements are approximately proportional to the load.

** Closed heights are for standard upright models and may vary with different screw ends, inverted models, or when bellows boot is used.

TABLE 2. 4800 AND 9400 SERIES

Actuator No.		4802 & 9402	9405	9410	9415	9420	9425	9435	4850	4899	48150
Rated Load (tons)		2	5	10	15	20	25	35	50	100	150
Torque at Full Load (in-lbs)	Std. Ratio	135	500	1045	1573	2255	3700	5060	8250	17600	30900
	Optional	55	205	540	905	1290	2090	3025	4620	9460	17050
Actuator Efficiency Rating %		20.9 11.9	19.9 10.9	19.8 12.6	18.0 11.7	16.9 10.8	14.8 8.3	13.7 7.7	12.4 7.3	11.7 7.2	12.7 7.7
Closed Height (in)		5¼	7	7¼	8	9¼	12	13	14	26½	26¼
Weight with Base Raise of 6 " (lb)		18	37	55	70	101	197	250	440	1325	1475

NOTE: Additional specifications are same as for Series 1800 and 9000. See Table 1.

TABLE 3. DECIMAL RATIOS

Actuator No.	Upright	1802 & 9002	9005	9010	9015	9020	9025
	Inverted	1801 & 9001	9004	9009	9014	9019	9024
Rated Load (tons)		2	5	10	15	20	25
Lifting Screw		1 " Dia. .250 Pitch Acme	1½ " Dia. .250 Pitch Acme	2 " Dia. .250 Pitch Acme	2¼ " Dia. .250 Pitch Acme	2½ " Dia. .250 Pitch Acme	3⅜ " Dia. .320 Pitch Square
Worm Gear Ratio		25:1	25:1	25:1	25:1	25:1	32:1
Turns of Worm for 1 " Raise		100	100	100	100	100	100
Torque at Full Load (in-lbs)		48	175	270	640	925	1500
Actuator Efficiency Rating %		13.2	9.1	8.6	7.5	6.9	5.3
Maximum H.P per Actuator		½	¾	1½	1½	1½	2½

NOTE: All other data for these models same as shown in Table 1.

1-4. Important Precautions

In order to ensure that Duff-Norton® machine screw actuators provide good service over a period of years the following precautions should be taken:

1. Select an actuator that has a load rating greater than the maximum load that may be imposed on it.
2. The structure on which the actuators are mounted should have ample strength to carry the maximum load, and should be rigid enough to prevent undue deflection or distortion of the actuator supporting members.
3. It is essential that the actuators be carefully aligned during installation so that the lifting screws are perfectly plumb and the connecting shafts are exactly in line with the worm shafts. After the actuators, shafting, gear boxes, etc., are coupled together, it should be possible to turn the main drive shaft by hand. If there are no signs of binding or misalignment, the actuator system is then ready for normal operation.
4. Machine screw actuators should have a greater raise than is needed in the actual installation. Should it be necessary to operate these actuators at the extreme limits of travel, it should be done cautiously.

CAUTION

Do not allow actuator travel to go beyond specified (catalog) closed height, or serious damage to internal mechanism may result. Refer to table of specifications (par. 1-3) for closed heights of respective units.

5. The worm shaft speed for these actuators should not exceed 500 RPM for heavy loads, 1200 RPM for light loads of one-fourth (or less) of the actuator load rating.
6. The lifting screw should not be permitted to accumulate dust and grit on the threads. If possible, lifting screws should be returned to closed position when not in use.

CAUTION

Where lifting screws are not protected from airborne dirt, dust, etc., bellows boots should be used. Inspect frequently at regular intervals to be certain that a lubricating film is present. Lifting screws should never be run dry.

7. When using an 1800 or 9000 Series Actuator, a periodic check of backlash of the lifting screw thread is recommended to check wear of the worm gear internal threads. The normal backlash on a new unit of this type is approximately .010 inch. **Backlash of 50% or more of the thread thickness indicates the need to replace the worm gear.**

   The 4800 and 9400 Series Anti-backlash Actuators are designed to be adjusted for minimum backlash, approximately .002 inch. The worm gear and anti-backlash nut are manufactured to have a clearance between their surfaces of ½ the thread thickness. **When adjustments have been made to the point where all this clearance is gone, 50% of the thread thickness is gone and replacement is necessary.** (See page 5, paragraph 2-8 for a detailed explanation of how the anti-backlash nut functions.)

NOTE

For loads of from 25% to 100% of actuator capacity, torque requirements are approximately proportioned to the load, except for very light loads.

8. The lubrication procedures for normal and severe service conditions, as described in Section II, paragraph 2-1, should be closely followed.

1-5. Warranty and Warranty Repair

Subject to the conditions stated herein, Duff-Norton will repair or replace, without charge, any parts proven to Duff-Norton's satisfaction to have been defective in material or workmanship. Claims must be made within one year after date of shipment. Duff-Norton will not repair or replace any parts that become inoperative because of improper maintenance, eccentric loading, overloading, chemical or abrasive action, excessive heat, or other abuse.

Equipment and accessories not of Duff-Norton's manufacture are warranted only to the extent that they are warranted

by the manufacturer, and only if the claimed defect arose during normal use, applications and service. Equipment which has been altered or modified by anyone without Duff-Norton's authorization is not warranted by Duff-Norton. EXCEPT AS STATED HEREIN, DUFF-NORTON MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

If you have any questions concerning warranty repair, please contact a convenient Duff-Norton Warehouse and Customer Service Center.

Authorization for return must be received from the Duff-Norton Company before returning any equipment for inspection or warranty repair.

SECTION II

MAINTENANCE

2-1. Lubrication

Unless otherwise specified, actuators and gear boxes are shipped packed with grease which should be sufficient for one month of normal operation. For normal operation, the actuator and gear boxes should be lubricated once a month using one of the following Extreme Pressure greases or their equivalent:

Socony Mobile Oil Co. . . . . Mobilplex E.P. #1
Texaco . . . . . Texaco E.P. #1
Gulf Oil Corp. . . . . Gulf Crown E.P. #1
Shell Oil Co. . . . . Shell Alvania E.P. #1

For severe service conditions, the actuators should be lubricated more frequently using one of the above greases (daily to weekly depending on conditions). If duty is heavy, an automatic lubrication system is strongly recommended. If ambient temperatures exceed 200 °F, consult lubricant manufacturers.

CAUTION

Where lifting screws are not protected from airborne dirt, dust, etc., bellows boots should be used. Inspect frequently at regular intervals to be certain that a lubricating film is present. Lifting screws should never be run dry.

2-2. Rebuild Procedure

Duff-Norton recommends the following procedures for assembly and disassembly of machine screw actuators.

1. Tag critical parts to facilitate reassembly.
2. Mark mating surfaces to ensure proper meshing.
3. Clean and lubricate all parts as required.
4. All seals must be replaced when rebuilding.
5. All screws, washers and other small common parts must be replaced if damaged in any way.
6. Replace damaged or frozen lubrication fittings with new ones.

2-3. Required Tools

A bearing puller or press and common hand tools are necessary for proper assembly and disassembly.

2-4. Disassembly (Refer to Figure 3-1)

1. Remove lifting screw (5) from actuator.
2. Remove bottom pipe (4) from shell (3) (upright models) or shell cap (2) (inverted models) or base plate as applicable.
3. **FOR ALL MODELS EXCEPT 100 AND 150-TON—** Loosen and remove set screws (1) in cap (2) and remove cap from shell (3).

   FOR 100 AND 150-TON MODELS— Loosen the lock screw in the shell and unscrew (counterclockwise) the base plate from the shell.

   NOTE

   It may be necessary to break shell cap or base plate loose with a hammer.

4. Remove gear (6A) or worm gear and nut assembly (6B) from shell (3).

   NOTE

   To facilitate removal of the gear from the shell on models with 50-ton or higher load ratings, partially reassemble the lifting screw into the worm gear (or worm gear and nut assembly) and use a hoist or pulley block to lift on the screw.

5. Remove top load bearing (7) which may be attached to either shell cap (2) or worm gear (6A) or anti-backlash nut.

   CAUTION

   Use only a wooden mallet to tap bearings loose.

6. Remove bottom load bearing (8) which may be attached to either the shell (3) (base plate for 100 and 150-ton models) or worm gear (6A).
7. Remove four cap screws (9) from each of the two worm flanges (11) and remove flanges.

   NOTE

   Take care not to lose the flange shims (12).

8. Press oil seal (13) out of flange (11).
9. Remove worm (14) and worm bearings (15) from shell (3) by striking one end of worm with a wooden or lead mallet.
10. Remove worm bearings (15) from worm (14) with bearing puller or press. (**NOTE**: This step will not be necessary if worm and worm bearings are not damaged.)
11. If actuator is keyed, remove screw in shell cap (shell on 100 and 150-ton models) and tap key out of keyway.

2-5. Cleaning

1. Use degreasing solvent to remove grease or oil from all parts.

CAUTION

Remove grease from unit and do not reuse old grease.

WARNING

Provide adequate ventilation during the use of cleaning agents; avoid prolonged breathing of fumes and contact with skin.

2. Use clean hot water or a soap solution for general cleaning of painted surfaces.
3. Dry parts thoroughly after cleaning.

NOTE

Before installing new parts, remove any rust preventive, protection grease, etc.

2-6. Inspection (Refer to Figure 3-1)

1. Make a visual inspection of shell (3) for broken, cracked or distorted areas. Check threads of all bores for burrs or broken threads.
2. Check shell cap (2), base plate, bottom pipe (4), lifting screw (5), worm gear (6A) or worm gear and nut assembly (6B) for burrs or scratches on their working or mating surfaces.
3. Check fit between lifting screw thread and internal thread in worm gear. If fit is excessively loose, replace worm gear or lifting screw as required. Replace worm gear and nut assembly as a set (4800 and 9400 Series).
4. Check small common components (screws, etc.) and replace as required.
5. Check bearings (7), (8) and (15) for seizure, galling or play and replace as required.

2-7. Assembly (Refer to Figure 3-1)

1. Press worm bearings (15) onto worm shaft (14) making sure that bearings are seated properly against shoulder.

NOTE

When tapered roller bearings are used, the small end of the cone should point to the worm end.

2. Position worm shaft end (14) in shell (3).

NOTE

If tapered roller bearings are used, tap worm bearing cups into place in the shell.

3. Press oil seals (13) into worm flange (11).

NOTE

The sealing element should point inward.

4. Position worm flanges (11) with shims (12) and bolt in place.
5. Position bottom load bearing (8) (bearing cup on 5-ton and 35-ton models, top load bearing on 100 and 150-ton models) in shell (3).

5a. **On 5-ton and 35-ton models**, press load bearing cones onto worm gear (6A) or worm gear nut assembly (6B). Small end of bearing cone should face away from gear teeth.

6. Install worm gear (6A) or worm gear and nut assembly (6B) in shell (3).

CAUTION

Strike each end of worm shaft sharply with a wooden mallet to seat bearing properly. Recheck flange bolts for tightness. Worm should turn freely with minimum drag and end play. If too much end play is present, remove shims as required. If worm does not turn freely, add shims as required.

7. Install top load bearing (7) (bottom load bearing (8) for 100 and 150-ton models) on worm gear (6A) or worm gear and nut assembly (6B).
8. Fill housing fully with grease.
9. **FOR ALL MODELS EXCEPT 100 AND 150-TON—** Install shell cap (2) and screw down until tight.

NOTE

Shell cap flange does not necessarily have to bear against top of shell, there will usually be a gap. This will put a slight drag on worm. If worm is hard to turn, back off slightly on shell cap.

FOR ALL 100 AND 150-TON MODELS— Install base plate and screw down base plate until tight.

NOTE

This should put a slight drag on the worm. If the worm is hard to turn, back off slightly on the base plate. Be sure base plate does not project past base surface of housing.

10. Lock shell cap in place with set screws (lock screw on 100 and 150-ton models).

NOTE

If new parts have been installed, it may be necessary to respot holes for these screws.

11. **FOR ALL MODELS EXCEPT 100 AND 150-TON—** Screw bottom pipe (4) into shell (3) (upright models) or into shell cap (2) (inverted models).

FOR 100 AND 150-TON MODELS— Screw bottom pipe into base plate (upright models) or into shell (inverted models).

12. Brush lifting screw (5) with a light film of grease and install in actuator. On inverted models, install guide bushing (16) and then install lifting screw (5).
13. If actuator is keyed, install key in shell cap (2) (shell for 100 and 150-ton models) and bolt in place.
14. Operate unit to ensure proper functioning of all components prior to reinstallation.

2-8. Anti-Backlash Nut Function

As shown in Figure 2-1, the worm gear (2) and anti-backlash nut (3) are pinned together with guide pins. The threads in the anti-backlash nut work in opposition to the threads in the worm gear as they engage the threads of the lifting screw (1). Adjustment of backlash is made by running down

on the shell cap of the actuator. This forces the anti-backlash nut threads into closer contact, reducing clearance and thus reducing backlash.

2-9. Anti-Backlash Nut Adjustment

1. To minimize backlash remove the two set screws (4) and tighten down on shell cap until the desired backlash is obtained. Spot drill top of shell through set screw holes, then replace set screws and tighten to prevent shell cap backing off.
2. To avoid binding and excessive wear, do not adjust lifting screw backlash to less than 0.002 inch.
3. The clearance (A) designed into the worm gear and anti-backlash nut set is one-half the thread thickness. When adjustments have been made to use all this clearance replace the worm gear and anti-backlash nut as a set.

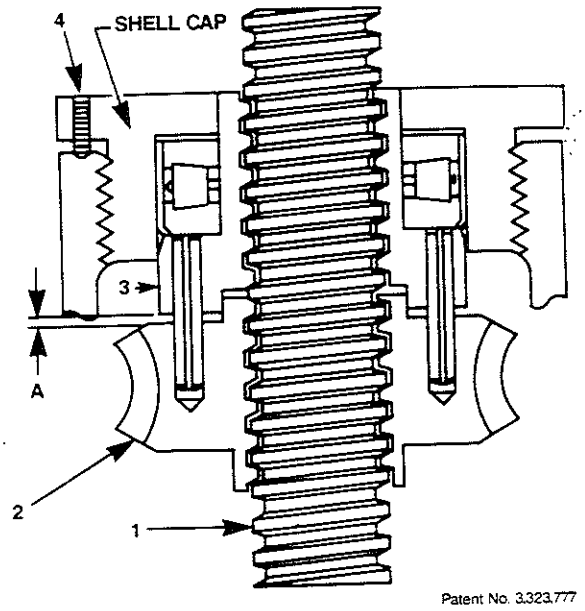


FIGURE 2-1. ANTI-BACKLASH NUT ADJUSTMENT

SECTION III

ILLUSTRATED PARTS LIST

3-1. General

This section contains an exploded illustration of the 1800, 9000, 4800 and 9400 Series machine screw actuator. The number adjacent to each part on the illustration is the index number. Keyed to this index number on the parts list is the part name.

When ordering parts be sure to include:

1. The nameplate model of your unit.
2. Index number and name of part.

3-2. PARTS LIST FOR 1800, 9000, 4800 and 9400 SERIES MACHINE SCREW ACTUATORS

INDEX NO.	PART NAME	QTY. REQ.
1	Screw, Set (All models except 100 and 150-ton)	2
2	Cap, Shell (All models except 100 and 150-ton)	1
3	Shell, Actuator	1
4	Pipe, Bottom	1
5	Screw Assembly, Lifting	1
6A	Worm Gear	1
6B	Worm Gear and Anti-backlash Nut Assembly (Mfg'd and sold in sets only)	1
7	Bearing, Top Load	1
8	Bearing, Bottom Load	1
9	Screw, Cap	8
10	Washer, Lock	8
11	Flange, Worm	2
12	Shim, Flange	2
13	Seal, Oil	2
14	Worm	1
15	Bearing, Worm	2
16	Bushing, Guide (inverted model only)	1
18	Nameplate	1
19	Screw, Lock (100 and 150-ton only)	1*
20	Plate, Base (100 and 150-ton only)	1*

*Not shown

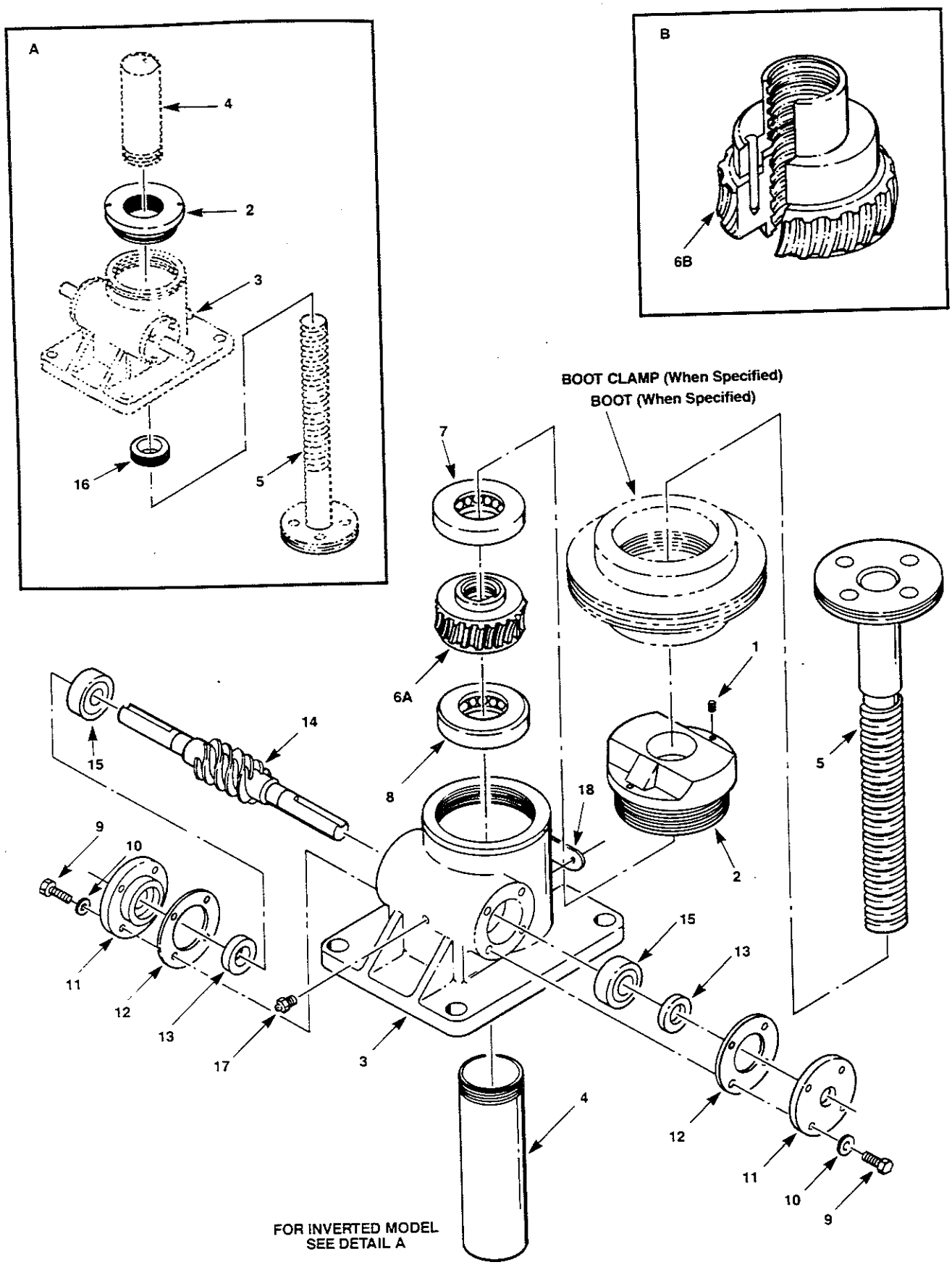
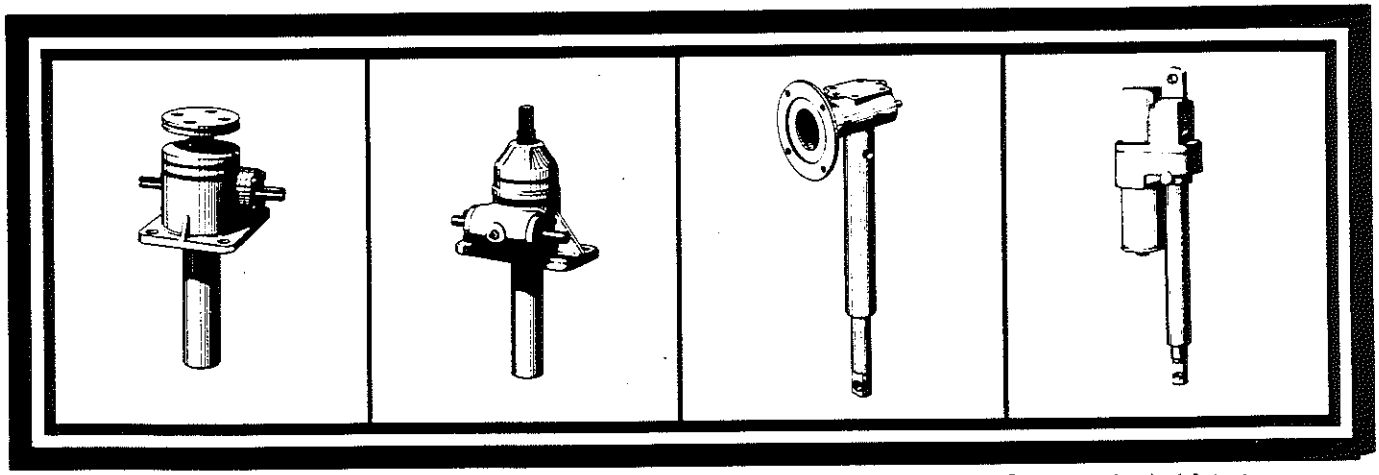


FIGURE 3-1. EXPLODED ILLUSTRATION 1800, 9000, 4800 and 9400 SERIES MACHINE SCREW ACTUATORS.

DUFF-NORTON OFFERS A COMPLETE LINE OF MECHANICAL AND ELECTROMECHANICAL ACTUATORS FOR PRECISE POSITIONING OF LOADS UP TO 250 TONS.

For reliable motion — in-line or through an arc — Duff-Norton has the right actuator to put your designs in motion. You can select from a comprehensive line of machine screw, ball screw, high-duty cycle, electromechanical and modular models to solve your design and production problems.

Duff-Norton® actuators are easy to specify, install and operate. Compact and self-contained, they do not require bothersome selection of individual components nor the attendant maintenance of leaky hydraulic hoses, valves or couplings. They provide many options in meeting a wide range of lifting, pushing, pulling and tensioning requirements.



Machine Screw Actuators. Capacities from 1/4 to 250 tons. Worm gear ratios from 5:1 to 50:1. More than 200 standard combinations to choose. Can be operated manually or by gear motor. Used to push, pull, apply pressure, or as linear actuators. Hold loads indefinitely without creep, when not subject to vibration.

Ball Screw Actuators. Capacities from 1/2 to 50 tons. Ball bearing screw and nut design reduces friction, increases efficiency as much as 70%. Permits linear motion up to 300 in/min @ 1800 rpm worm shaft speed. Available in 40 standard models. Multiple units may be synchronized for uniform raises to 10 feet.

Modular Actuators. Capacities to 2,000 pounds depending on actuator gear ratio and motor horsepower. Engineered for 56 frame motor, C face mounting. Choice of 5:1 or 20:1 gear ratios in rotating screw or translating tube models. Travel lengths to 24 inches. Lift speeds to 170 inches per minute.

Electromechanical Actuators. Capacities to 3/4 ton. Choice of 115 VAC or 12 VDC motors for indoor or outdoor applications. Standard raises from 3" to 24". Speeds to 145 in/min. All components sealed in a corrosion-resistant, aluminum alloy die-cast housing. Fully-adjustable limit switches available on some models.

For more information on these or other Duff-Norton® actuators, ask your local distributor or Duff-Norton District Sales Manager for Catalog 172. Or write factory.

WARNING: The equipment shown in this manual is intended for industrial use only and should not be used to lift, support, or otherwise transport people unless you have a written statement from Duff-Norton Company which authorizes the specific actuator unit, as used in your application, as suitable for moving people.

AVAILABLE FROM YOUR LOCAL ACTUATOR DISTRIBUTOR:

Duff-Norton

P.O. Box 7010
Charlotte, NC 28241-7010

Customer Service (800) 477-5002
FAX (704) 588-1994

Duff-Norton Manufactures:
Duff-Norton® Actuators • Mechanical Jacks • Rotary Unions® • Coffing® Hoists
Duff Lynx® Hoists and Pullers

Printed in USA

4M\SK2389\12-96

INDUSTRIAL DRIVES

WORM GEAR REDUCER

INSTALLATION and MAINTENANCE MANUAL

STERLING
ELECTRIC, INC.

HEADQUARTERS
16752 Armstrong Avenue, Irvine, CA 92714
(800) 654-6220 FAX (714) 474-0543

BRANCH
7973 Allison Avenue, Indianapolis, IN 46268
(800) 866-7973 FAX (317) 872-0907

STERLING ELECTRIC MOTORS
799 Rennie Street, Hamilton, Ontario, Canada L8H 7L4
(416) 547-2345 FAX (416) 547-2381

LUBRICATION and MAINTENANCE
Worm Gearmotor or Gear Reducer.

WARNING

Improper installation or operation of the gearmotor may cause injury to personnel or gearmotor failure. Read all of the operating instructions. Motor must be installed and grounded per local and national electrical codes.

To reduce potential of electrical shock, disconnect all power sources before initiating any maintenance or repairs. Keep fingers and foreign objects away from ventilation and other openings. Keep air passages clear.

A. Installation

1. General

The Reducer or Gearmotor should be mounted on a flat surface on the machine or foundation, securely bolted down and accurately aligned. Shims under the mounting base should be used when required to provide a level mounting surface.

2. Solid Shaft Mounting

The output shaft should be connected to the load by flexible coupling, sprocket and chain, sheave and V-Belt or pinion. Check to insure proper alignment and tension of all loads. If sprocket, sheave or pinion is used, mount as close to gear housing as possible to minimize bearing load and shaft deflection. Overhung load must be checked to make certain it does not exceed published capacity.

3. Hollow Shaft Mounting

The torque arm of the shaft-mounted worm reducer must not be mounted too rigidly. If the torque arm is held down without any flexibility, shaft eccentricity, which is usually present, can seriously overload the bearings of the gearmotor. The flexible grommet provided with all torque arms must be retained, or some other suitable means provided to allow the torque arm to be mounted with some flexibility. The torque arm should be in tension (based on direction of rotation).

B. Run-In Period

1. The maximum efficiency of worm reducers is obtained after a "Run-In" period. The length of time required will depend on the load applied and will be two to four hours at rated load and considerably longer at light loads. Overloading will not decrease the "Run-In" time but may cause severe wear. During "Run-In" higher than normal motor currents, higher than normal temperature and lower efficiency and output torque can be expected.

C. Lubrication

CAUTION:

All WORM REDUCERS are shipped without oil — **FILL BEFORE OPERATING** or if storing for more than 6 months.

1. Worm Gear Reducer oil must be used to obtain satisfactory gear and worm operating life. Select the proper type of oil from the recommended lubricant chart depending on expected ambient temperature.

a. For Ambient temperatures below 15°F or above 100°F, refer to Factory for recommendations.

b. Worm Gear Reducer oils and compounds in accordance with AGMA specifications are commercially available from all major oil companies.

2. Before placing in operation, make certain that the solid plugs located in the highest position on the gear housing are replaced with the vented breather plug supplied with the unit. If the mounting position is changed from the position ordered, consult the oil level and mounting positions chart to obtain proper oil level.

3. Drain and refill oil after first 100 hours of operation. Unc normal operating conditions change oil every 2,000 hours o operation or every 6 months thereafter, whichever occurs first.

4. The maximum input HP rating as shown in the published Rating Tables is based on a stabilized oil bath temperature not exceeding 200°F for normal ambients. Higher oil bath temperatures or continued operation in excess of rated input HP will tend to shorten the useful life of a lubricant. For high ambient temperatures in excess of 100°F, special lubricants or derating of the Gearmotor may be required. Consult the Factory or Local Office with complete application engineering data if this occurs.

D. Maintenance

1. This gear reducer was accurately adjusted and tested at the factory. Care must be taken when the gearcase is disassembled and reassembled. This should be done by an authorized service station as damage to internal parts may result if adjusted improperly. Frequent oil level inspection with the unit not running, (preferably when warm) should be made by removing the proper oil level plug to see that the oil level is being maintained. If low (without replacing oil level plug) add lubricant through one of the upper openings until it comes out of the oil level hole.

E. Service Factor

CAUTION

1. Load conditions must be in accordance with accepted NEMA and AGMA standards.

F. Long-Term Storage (6 Months Up)

1. Units must be stored indoors, in a dry, warm temperature.

2. Completely fill the unit with oil.

3. Rotate the input shaft so that the output shaft rotates at least one revolution per month.

4. Completely cover the input and output shaft with grease.

5. At the time of start up, drain the storage oil, install the breather, and fill to the proper oil level with the correct lubricant for the operating condition.

G. Warranty (Limited)

1. The warranty will cover all of the parts in the gearmotor or reducer unit for 12 months from the date of shipment.

2. The warranty is only for parts and labor. In no event shall our liability exceed the original price of the unit, nor does it cover cost of on site repair, installation, or freight.

3. Contact the service department for a complete explanation as to the full warranty policies and conditions of sale.

All dimensions, designs and specifications are subject to change without notice.

Notes:

1. The above lubricants are specially compounded for use in worm gear units; some contain non-corrosive, extreme pressure additives. DO NOT USE lubricants that are compounded with sulphur and/or chlorine which are corrosive to bronze worm gears.

2. The lubricant used should have a pour point of at least 10°F lower than the lowest ambient temperature in wh the unit will operate.

3. Extreme pressure (EP) Worm Gear Lubricants, in some cases contain materials that are considered toxic. Care should be taken to avoid the use of these lubricants where they can result in harmful effects. If in doubt, consult your local Lubricant Supplier.

WORM GEAR REDUCERS

LUBRICATION INSTRUCTIONS

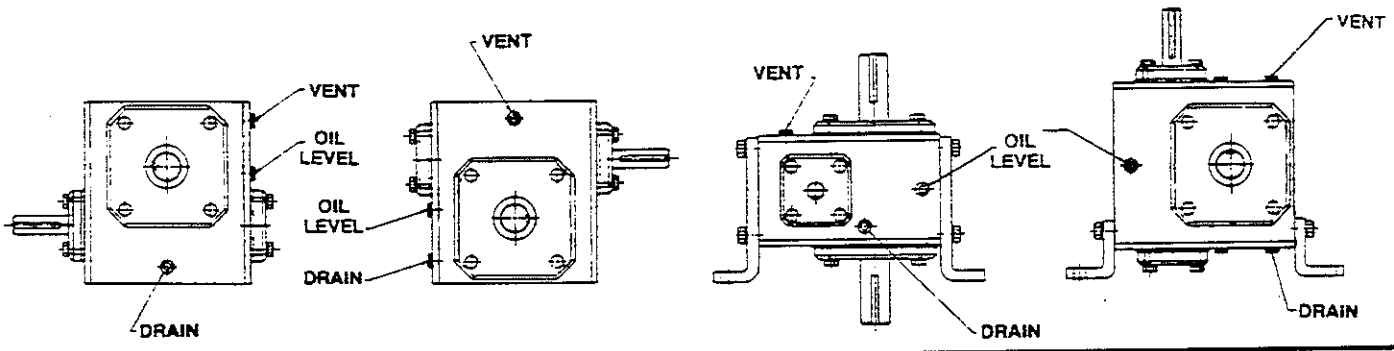
LUBRICATION

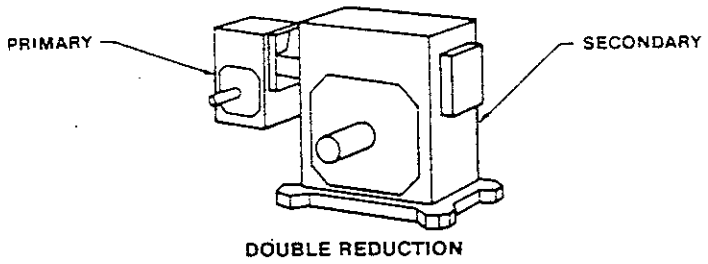
Manufacturer	15° to 60°F Ambient Temperature AGMA Compounded No. 7	50° to 125°F Ambient Temperature AGMA Compounded No. 8
Amoco Oil Co.	Worm Gear Oil	Cylinder Oil #680
Chevron USA, Inc.	Cylinder Oil #460X	Cylinder Oil #680X
Exxon Co. USA	Cylesstic TK-460	Cylesstic TK-680
Gulf Oil Co.	Senate 460	Senate 680D
Mobil Oil Corp.	600W Super	Extra Hecla Super
Shell Oil Co.	Valvata Oil J460	Valvata Oil J680
Sun Oil Co.	Gear Oil 7C	Gear Oil 8C
Texaco	Honor Cylinder Oil	650T Cylinder Oil
Union Oil Co. of California	Steaval A	Worm Gear Lube 140

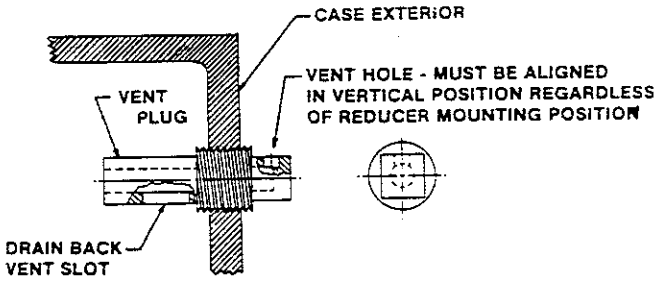
NOTE: For temperature ranges not shown and synthetic lubrication, contact factory.

VENT PLUG LOCATION

WARNING: THIS REDUCER WAS SHIPPED FROM FACTORY WITHOUT OIL. BEFORE RUNNING OR FILLING WITH OIL, REPLACE SOLID PIPE PLUG WITH VENT PLUG. FOR DOUBLE WORM REDUCERS, BOTH PRIMARY AND SECONDARY UNITS MUST BE VENTED. SEE BELOW FOR VENT LOCATIONS.







OIL CAPACITIES (oz.)

MOUNTING POSITION	UNIT SIZE														
	100	133	154	175	206	238	262	300	325	425	525	600	700	800	1000
WORM OVER	3	5	10	15	21	25	45	55	73	135	200	310	563	768	1152
WORM UNDER	4	7	14	18	25	30	49	61	89	127	216	330	525	822	1280
VERTICAL OUTPUT	4	6	13	16	23	26	46	58	74	120	216	320	332	460	640
"J" MOUNT	3	7	12	16	24	25	47	60	75	126	216	325	585	800	1200

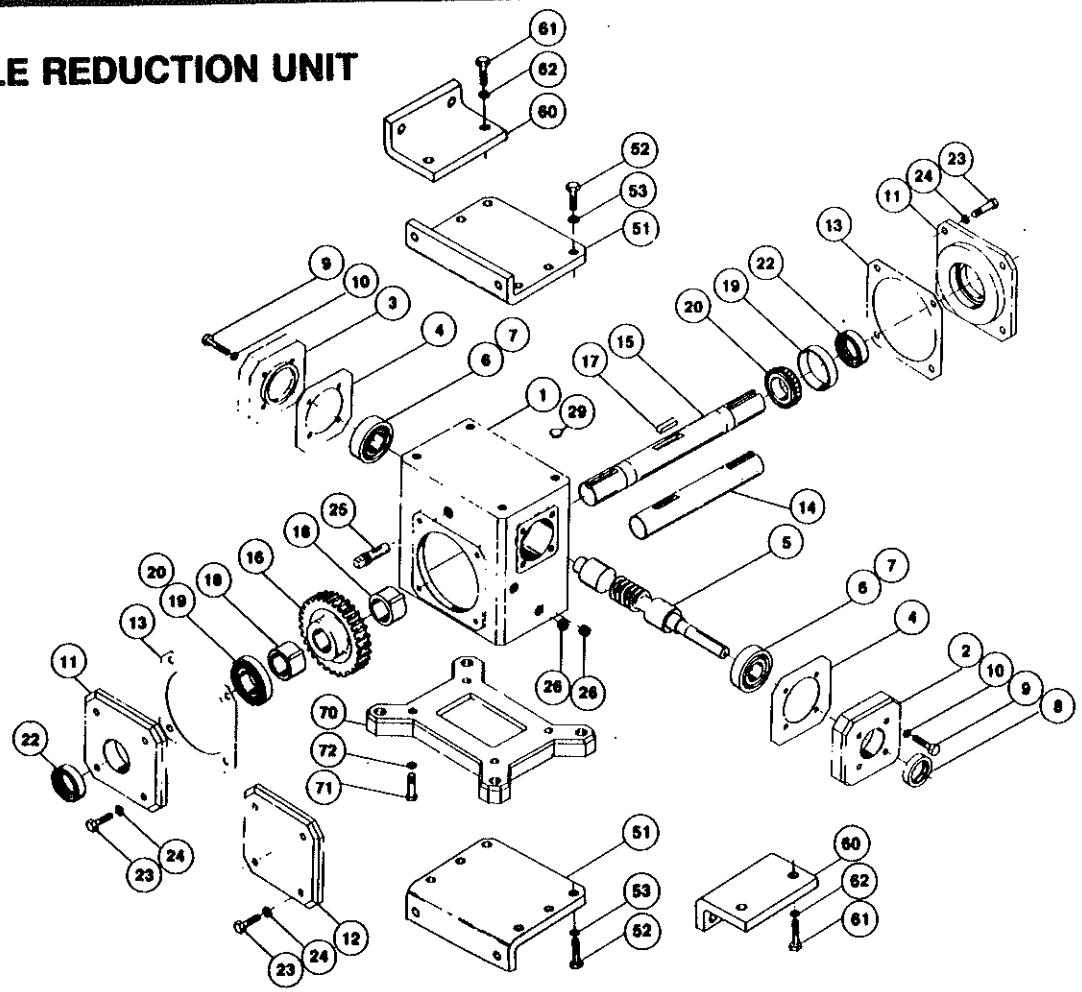
PARTS LIST—SINGLE REDUCTION

Item No.	Description	Qty.
1	Gear Housing	(1)
2	Input Cover (Seal)	(1)
3	Input Cover (Bearing)	(1)
4	Input Cover Gaskets	(as req'd)
5	Input Shaft	(1)
6	Input Bearing (Cup)	(2)
7	Input Bearing (Cone)	(2)
8	Input Oil Seal	(1)
9	Hex Head Capscrew	(8)
10	Lock Washer	(8)
11	Output Cover (Seal)	(1)
12	Output Cover (Bearing)	(1)
13	Output Cover Gaskets	(as req'd)
14	Single Output Shaft	(1)
15	Double Output Shaft	(1)
16	Worm Gear	(1)
17	Gear Key	(1)
18	Gear Spacer	(2)
19	Output Bearing (Cup)	(2)
20	Output Bearing (Cone)	(2)
22	Output Oil Seal	(1)
23	Hex Head Capscrew	(8)*
24	Lock Washer	(8)*
25	Vent Plug	(1)
26	Pipe Plug	(2)
29	Protective Plug	(4)
	Fan Unit	
40	Slotted Hex Head Capscrew	(4)
41	Plain Flat Washer	(4)
42	Fan Bracket	(4)
43	Oil Seal	(1)
44	Hex Head Capscrew	(1)
45	Lock Washer	(1)
46	Fan	(1)
47	Fan Cover	(1)
	Vertical Risers Unit	
51	High and Low Riser Bracket	(2)
52	Hex Head Capscrew	(8)
53	Lock Washer	(8)
	"J" Mount Unit	
60	"J" Mount Bracket	(2)
61	Hex Head Capscrew	(4)
62	Lock Washer	(4)
	Horizontal Base Unit	
70	Horizontal Base	(1)
71	Hex Head Capscrew	(4)
72	Lock Washer	(4)

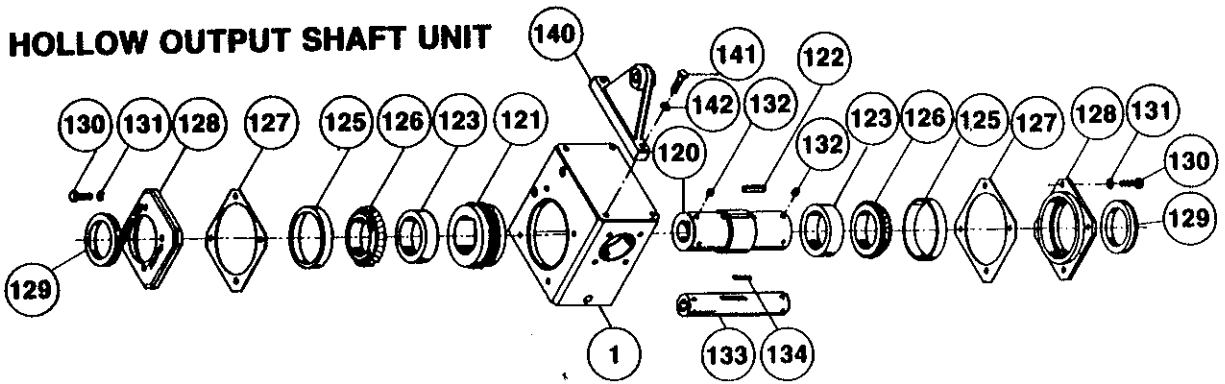
* 425 Unit has (10) and 525 Unit has (16)

Item No.	Description	Qty.
	Long Motor Flange Unit	
80	'C' Face Motor Flange	(1)
81	Hex Head Capscrew	(4)
82	Lock Washer	(4)
	Quill Motor Flange Unit	
90	Quill Input Shaft	(1)
91	Retaining Ring (Shaft)	(1)
92	Input Bearing (Cup)	(2)
93	Input Bearing (Cone)	(2)
94	Retaining Ring (Housing)	(1)
95	Quill Motor Flange	(1)
96	Oil Seal	(1)
97	Hex Head Capscrew	(4)
98	Lock Washer	(4)
	Output Flange Unit	
110	Output Flange (Hollow)	(1)
111	Output Flange (Solid)	(1)
112	Output Cover (Ground Face)	(1)
113	Hex Head Capscrew	(4)
114	Lock Washer	(4)
	Hollow Output Shaft Unit	
120	Hollow Output Shaft	(1)
121	Worm Gear (Hollow)	(1)
122	Worm Gear Key	(1)
123	Worm Gear Spacer	(2)
125	Output Shaft Bearing (Cup)	(2)
126	Output Shaft Bearing (Cone)	(2)
127	Output Gaskets	(as req'd)
128	Output Cover	(2)
129	Output Oil Seal	(2)
130	Hex Head Capscrew	(8)
131	Lock Washer	(8)
132	Set Screw	(6)
133	Shaft Bushing	(1)
134	Bushing Kit	(1)
140	Torque Bracket	(1)
141	Hex Head Capscrew	(8)
142	Lock Washer	(8)
	Coupling Kits	
190	Coupling Sleeve	(1)
191	Coupling Gear	(1)
192	Coupling Gear	(1)
193	Setscrew	(1)
194	Setscrew	(1)
195	Key	(1)
196	Key	(1)

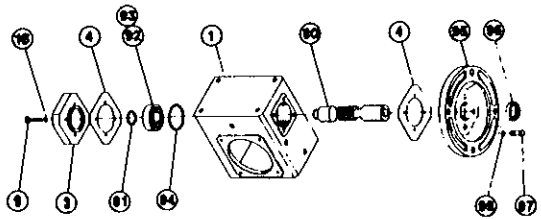
SINGLE REDUCTION UNIT



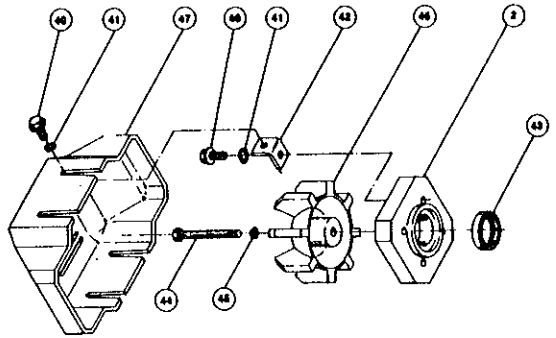
HOLLOW OUTPUT SHAFT UNIT



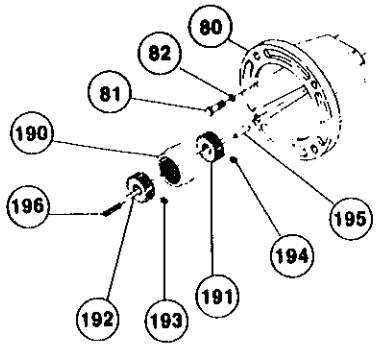
QUILL MOTOR FLANGE UNIT



FAN UNIT
For Models 325, 425 and 525 Only.



LONG MOTOR FLANGE AND COUPLING KIT



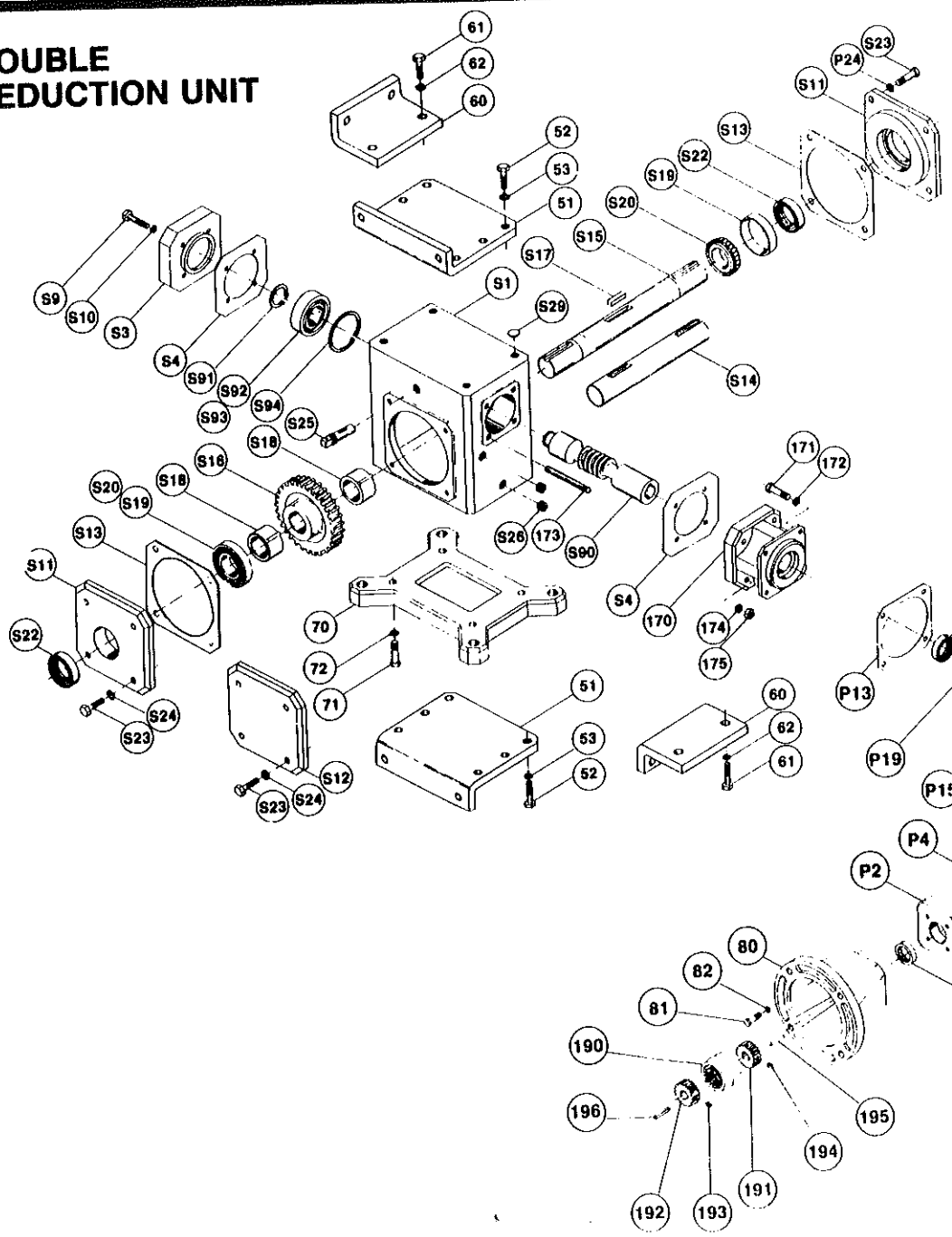
PARTS LIST—DOUBLE REDUCTION

Item No.	Description	Qty.
P1/S1	Gear Housing	(1)
P2/S2	Input Cover (Seal)	(1)
P3/S3	Input Cover (Bearing)	(1)
P4/S4	Input Cover Gaskets	(as req'd)
P5/S5	Input Shaft	(1)
P6/S6	Input Bearing (Cup)	(2)
P7/S7	Input Bearing (Cone)	(2)
P8/S8	Input Oil Seal	(1)
P9/S9	Hex Head Capscrew	(8)
P10/S10	Lock Washer	(8)
P11/S11	Output Cover (Seal)	(1)
P12/S12	Output Cover (Bearing)	(1)
P13/S13	Output Cover Gaskets	(as req'd)
P14/S14	Single Output Shaft	(1)
P15/S15	Double Output Shaft	(1)
P16/S16	Worm Gear	(1)
P17/S17	Gear Key	(1)
P18/S18	Gear Spacer	(2)
P19/S19	Output Bearing (Cup)	(2)
P20/S20	Output Bearing (Cone)	(2)
P22/S22	Output Oil Seal	(1)
P23/S23	Hex Head Capscrew	(8)*
P24/S24	Lock Washer	(8)*
P25/S25	Vent Plug	(1)
P26/S26	Pipe Plug	(2)
P29/S29	Protective Plug	(4)
	Vertical Risers Unit	
51	High and Low Riser Bracket	(2)
52	Hex Head Capscrew	(8)
53	Lock Washer	(8)
	"J" Mount Unit	
60	"J" Mount Bracket	(2)
61	Hex Head Capscrew	(4)
62	Lock Washer	(4)
	Horizontal Base Unit	
70	Horizontal Base	(1)
71	Hex Head Capscrew	(4)
72	Lock Washer	(4)
	Long Motor Flange Unit	
80	'C' Face Motor Flange	(1)
81	Hex Head Capscrew	(4)
82	Lock Washer	(4)

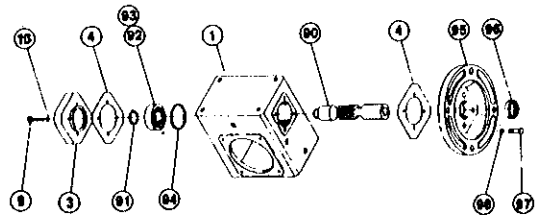
* 425 Unit has (10) and 525 Unit has (16).

Item No.	Description	Qty.
	Quill Motor Flange Unit	
P90/S90	Quill Input Shaft	(1)
P91/S91	Retaining Ring (Shaft)	(1)
P92/S92	Input Bearing (Cup)	(2)
P93/S93	Input Bearing (Cone)	(2)
P94/S94	Retaining Ring (Housing)	(1)
P95/S95	Quill Motor Flange	(1)
P96/S96	Oil Seal	(1)
P97/S97	Hex Head Capscrew	(4)
P98/S98	Lock Washer	(4)
	Hollow Output Shaft Unit	
120	Hollow Output Shaft	(1)
121	Worm Gear (Hollow)	(1)
122	Worm Gear Key	(1)
123	Worm Gear Spacer	(2)
125	Output Shaft Bearing (Cup)	(2)
126	Output Shaft Bearing (Cone)	(2)
127	Output Gaskets	(as req'd)
128	Output Cover	(2)
129	Output Oil Seal	(2)
130	Hex Head Capscrew	(8)
131	Lock Washer	(8)
132	Set Screw	(6)
140	Torque Bracket	(1)
141	Hex Head Capscrew	(8)
142	Lock Washer	(8)
	Double Reduction Unit	
170	Double Reduction Adaptor	(1)
171	Hex Head Capscrew	(4)
172	Lock Washer	(4)
173	Stud Bolt	(4)
174	Lock Washer	(4)
175	Hex Head Washer	(4)
176	Oil Seal	(1)
177	Shaft Bushing	(1)
178	Shaft Key	(1)
	Coupling Kits	
190	Coupling Sleeve	(1)
191	Coupling Gear	(1)
192	Coupling Gear	(1)
193	Setscrew	(1)
194	Setscrew	(1)
195	Key	(1)
196	Key	(1)

DOUBLE REDUCTION UNIT



QUILL MOTOR FLANGE UNIT



GNB Corporation

E330096-1

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vard, CA 94544

(510) 441-1900
FAX (510) 441-0939

JANUARY 23, 1996

MAINTENANCE MANUAL

GATE VALVE G48PSOP-X

Table of Contents:

1. Installation, Operation and Maintenance
2. Gate Adjustment Drawing No. 34264
3. Instructional Drawing No. 102202
4. Outline Drawing No. 101114-12
5. Spare Parts List Drawing No. 101128-02
6. Speed Control Instructions
7. Reed Switch Catalog Cut Sheet
8. Solenoid Valve Catalog Cut Sheet

GNB Corporation

INSTALLATION, OPERATION AND MAINTENANCE GUIDE

1.0 The purpose of this document is to assist the installer/user of the GNB valve with the correct installation, operation and maintenance procedures required for meeting all warranty conditions expressed or implied in the Terms and Conditions of Sale.

1.1 It is understood that installation of the product implies acceptance of the product with the exception of leakage experienced across a gate seal (see storage recommendations), weld or other non-compliance with order specifications.

1.1.0 Unacceptable leakage is defined as weld leaks larger than $1x10^{-9}$ std cc sec helium or static seal leaks larger than $7x10^{-9}$ std cc sec^{-1} helium.

2.0 INSTALLATION

2.1 Locate the appropriate seal interface medium (o-ring, copper seal or specially designed seal) between the valve flange and the mating flange, if required. In the case of an o-ring seal the o-ring should be located in the o-ring groove on the valve flange face or the mating flange face. The o-ring may be lightly coated with an acceptable vacuum compatible grease or oil to facilitate movement of the ring during the joining process and to aid in filling extremely small surface irregularities. Copper or wire seals demand extreme cleanliness and should be handled with gloved hands and good UHV technique.

2.2 Orient the valve appropriately to the installation requirements. Be sure that bolt holes if present, are in alignment between the two flanges.

NOTE:
GNB gate valves with port diameters ≤20 inches will seal vacuum against atmosphere in either direction as a standard design feature. Therefore, gate valves in this size range can be mounted on a system or manifold in either direction and they will function normally. Gate valves with port sizes larger than 20 inches should be installed so that a release to atmospheric pressure against vacuum will force the gate against the valve seat (the easy way) unless initial ordering specifications included sealing pressure differentials. Small Angle (SA) valves will also seal in both directions (vacuum:atm) as will the custom "RA" type angle valves. Typically, angle valves seal vacuum against atmosphere only the "easy" way, i.e. with atmosphere on the branch tube (actuator shaft or bellows shaft) side of the valve working in favor of the normal sealing design of the valve.

2.3 Secure the mating flanges with the appropriate media (bolts, claw clamps, quick clamps or weld) to the appropriate torque or until the flanges are "face to face".

2.4 UTILITY CONNECTION (All valves except manual actuation)

2.4.0 Connect the appropriate utilities to the valve for actuation. Typical utilities will be electrical (for electric motor, solenoid or hydraulic pump actuation) and, if required, shop air or other gas source with nominal operating supply pressure of 80-100 psig.

WARNING

THE VALVE SHOULD BE IN THE CLOSED POSITION DURING INSTALLATION. KEEP BODY PARTS AWAY FROM THE EXPOSED GATE OR POPPET ACTUATOR/MECHANISM WHILE CONNECTING THE UTILITIES.

2.5 ACTUATION TEST

2.5.0 Cycle the valve several times checking for smooth actuation during both the opening and closing.

2.5.1 Close the valve.

2.6 LEAK TEST

2.6.0 Pump down the chamber or component to which the valve is attached and leak check the gate or poppet seal. Also check the flange seal for integrity.

NOTE:
Leak checking can be done by employing a helium mass spectrometer leak detector, RGA or other acceptable device. Though GNB valves are rigorously tested at the factory, torquing the valve flanges onto uneven mating surfaces may distort the valve body enough to affect the seal integrity of the gate or poppet seal. Therefore, it is prudent to leak check the gate after installation to reduce potential system dismantling time required to fix the problem later.

2.6.1 Note any leaks found.

2.6.2 Vent the chamber or component.

2.6.3 Repair any leaks found.

NOTE:
Flange o-ring seal leaks may be due to uneven or excessive torque, small pieces of debris across the sealing surface, a twisted o-ring (where the flash line on the ring crosses the sealing surface) or a damaged o-ring. See the section on gate adjustment if a leak is found across the gate seal. Leakage across a poppet seal may be due to mating the valve to an extremely uneven surface. This can be corrected by resurfacing or replacing the uneven flange.

2.6.4 Repeat Section 2.6 until leak integrity is achieved.

2.7 MATE NEXT COMPONENT TO VALVE

2.7.1 Repeat the process noted in Sections 2.1, 2.2, and 2.3 for the mating component. Leak check the flange seal as soon as it is convenient.

3.0 OPERATION

3.1 Manual Valves

3.1.0 The valve will be opened or closed by turning the handwheel in either clockwise or counter-clockwise direction. Unless otherwise noted, turning the handwheel clockwise will close the valve, counter-clockwise will open the valve. The handwheel should be turned to the end of travel and then backed off 1/8 to 1/4 turn to take the mechanical stress off of the actuator seals.

3.1.1 Lever or Toggle actuated valves are opened or closed by moving the operating handle from one end of its travel to the other.

3.2 ELECTROPNEUMATIC, ELECTRIC MOTOR AND HYDRAULIC VALVES

3.2.0 Make sure that the valve utilities have been properly installed (see Section 2.4).

3.2.1 The valve will be actuated by sending or removing the required electrical signal to the valve operator (solenoid switch or motor/pump). If the valve is equipped with position indicators an electrical signal from one of the switches will indicate whether the gate or poppet is in the open or closed position.

4.0 MAINTENANCE

4.1 Seal replacement - gate/poppet/bonnet

NOTE:
GNB valves do not have to be removed from the vacuum system manifold in order to preform this operation. However, sufficient space must be available around the valve to allow for the removal of the bonnet flange and bonnet/actuator assembly from the valve body. If space is not available to perform this task in place, the valve must be removed from the system.

4.1.0 Vent the system to atmospheric pressure on both sides of the valve.

WARNING

IF TOXIC, COMBUSTIBLE OR REACTIVE GASES HAVE BEEN USED IN THE SYSTEM DURING NORMAL PROCESS OPERATION, ALL NECESSARY PRECAUTIONS MUST BE TAKEN TO PROTECT THE MAINTENANCE PERSONNEL FROM POSSIBLE INJURY. REQUIRED STEPS MAY CONSIST OF SYSTEM GAS PURGING, WEARING OF PROTECTIVE CLOTHING AND BREATHING APPARATUS AS WELL AS DECONTAMINATION OF THE COMPONENTS REMOVED FROM THE SYSTEM. DISPOSE OF ALL USED/CONTAMINATED MATERIALS IN ACCORDANCE WITH LOCAL, STATE AND FEDERAL ORDINANCES.

4.1.1 Remove all utilities from the valve.

4.1.2 Remove the bonnet and actuator assembly from the valve body.

4.1.3 Remove the suspect o-ring from the o-ring groove.

NOTE:
Take extreme care to not scratch the sealing surfaces of the o-ring groove or mating surface during the removal/installation procedures.

4.1.4 Clean the o-ring groove and mating surface with an acceptable, vacuum compatible solvent and lint-free towel.

4.1.5 Rinse the cleaned surfaces with 2 propanol or other vacuum compatible alcohol.

4.1.6 Inspect the sealing surfaces for any scratches or debris that may be present.

NOTE:
Remove debris or scratches from the sealing surfaces, if present. Remember, never polish or abrade across the sealing surface. Always polish in a direction parallel with the sealing surface of the o-ring. Repeat steps 4.1.4 through 4.1.6 until the surfaces are clean and free from scratches across the sealing surfaces.

4.1.7 Verify that the replacement o-ring is clean, free from cracks, gouges, dings, manufacturing anomalies, of the correct material and the correct size for the o-ring groove.

4.1.8 Apply a thin film of vacuum grease to the o-ring surface.

NOTE:
Only a microfilm of grease is required. General vacuum practice usually specifies that the excess grease be wiped from the o-ring with a lint-free towel. The grease remaining on the o-ring should be sufficient for good sealing.

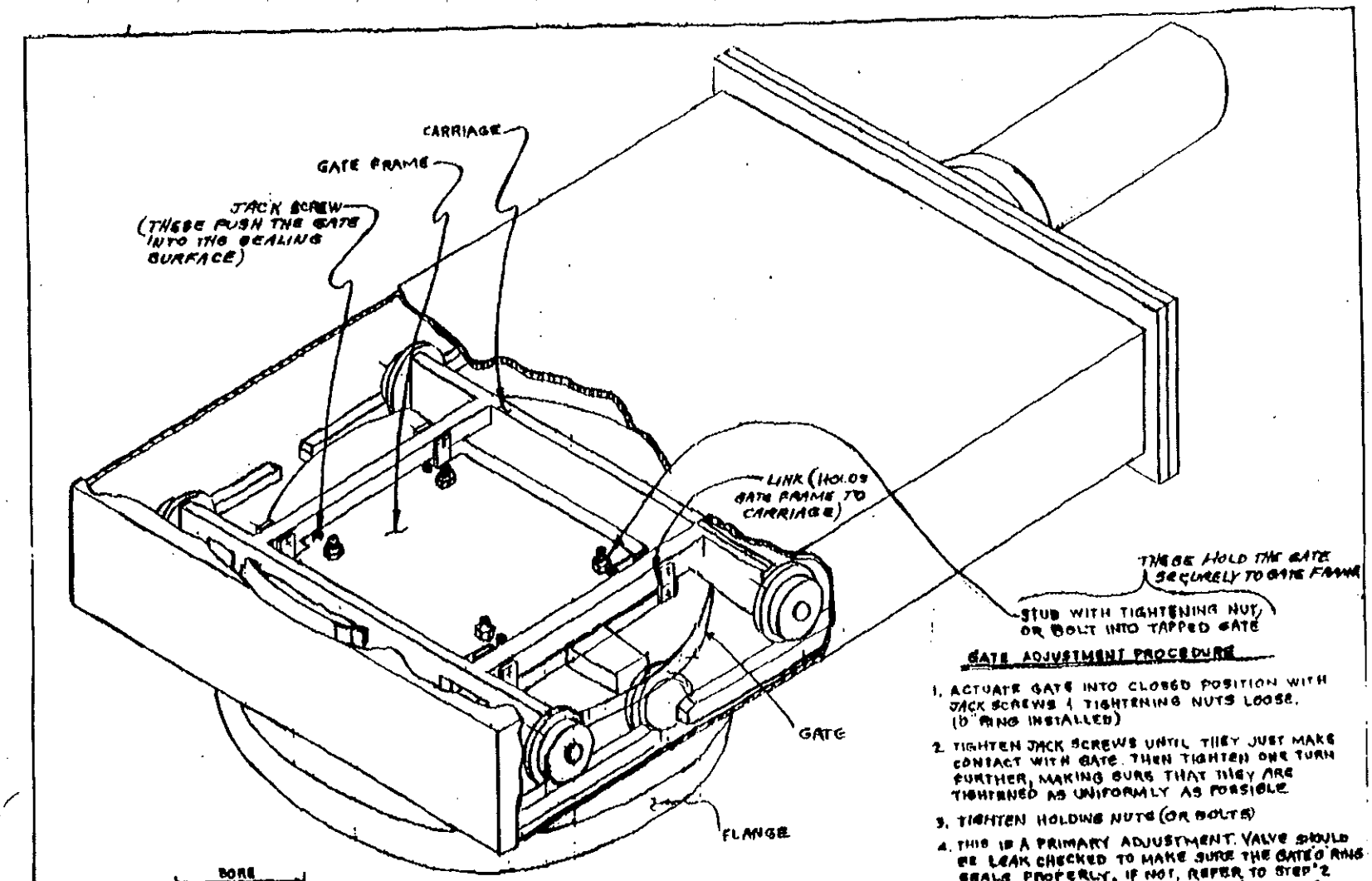
4.1.9 Install the o-ring into the groove. Take care not to twist, stretch or damage the o-ring during installation.

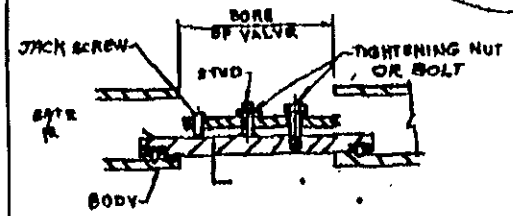
4.1.10 Repeat steps 4.1.3 through 4.1.9 for each o-ring to be replaced.

4.1.11 Locate the valve bonnet/actuator in the valve body.

4.1.12 Install the bonnet retention bolts or clip as required.

4.1.13 Leak check the valve seals prior to resuming system operation.

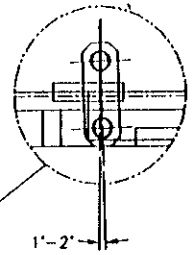




GATE ADJUSTMENT PROCEDURE

1. ACTUATE GATE INTO CLOSED POSITION WITH JACK SCREWS & TIGHTENING NUTS LOOSE. (O RING INSTALLED)
2. TIGHTEN JACK SCREWS UNTIL THEY JUST MAKE CONTACT WITH GATE. THEN TIGHTEN ONE TURN FURTHER, MAKING SURE THAT THEY ARE TIGHTENED AS UNIFORMLY AS POSSIBLE.
3. TIGHTEN HOLDING NUTS (OR BOLTS)
4. THIS IS A PRIMARY ADJUSTMENT. VALVE SHOULD BE LEAK CHECKED TO MAKE SURE THE GATE'S RING SEALS PROPERLY, IF NOT, REFER TO STEP 2. TIGHTEN JACK SCREWS ONLY ABOUT ¼ OF A TURN UNIFORMLY UNTIL LEAK TIGHT SEAL IS ATTAINED.

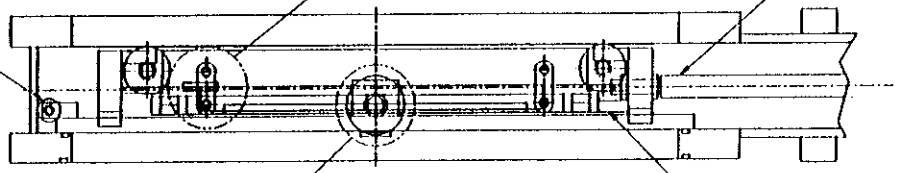
ONB Corporation		
HAYWARD		CALIFORNIA
N/A		
GATE ADJUSTMENT		ALL
		34261



(5) FRONT STOP WHEEL: A RELATIONSHIP EXISTS BETWEEN THE CENTER WHEEL AND THE FRONT STOP WHEEL. THE FRONT STOP WHEEL SHOULD CONTACT THE FRONT END PLATE AT THE SAME TIME THAT THE CENTER WHEEL DROPS INTO IT'S RESPECTIVE SLOT, PREVIOUSLY MENTIONED. IF BOTH STOP AND CENTER WHEEL ARE NOT IN UNISON THE GATE WILL EITHER SLIDE FORWARD OR CENTER WHEEL WILL BIND ON THE EDGE OF THE POCKET.

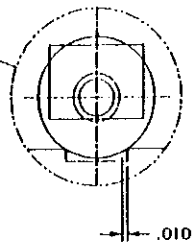
(1) LINKS: TRANSMIT FORCE TO THE GATE IN ORDER TO SEAL THE "O" RING AGAINST THE GATE AND THE FLANGE. LINK SHOULD BE INCLINED AT 1-2' BEYOND CENTER. (SEE DIAGRAM)

(3) AIR CYLINDER STROKE: STROKE SHOULD BE LONG ENOUGH TO PUSH THE CARRIAGE AGAINST THE STOP BLOCKS.



(4) CENTER WHEEL: ATTACHED TO THE GATE OR GATE FRAME, AND ALLOWS THE GATE TO DROP INTO POSITION TO SEAT THE "O" RING. WHEEL SHOULD BE FREE AND ROTATABLE WHEN IN THE WHEEL POCKET. THE GAP BETWEEN THE WHEEL AND THE REAR OF THE POCKET SHOULD BE NO GREATER THAN .010. (SEE DIAGRAM)

(2) STOP BLOCK: STOPS THE FORWARD MOTION OF THE CARRIAGE. IF STOP BLOCK IS TO LONG THE LINKS WILL BE BEHIND CENTER, IF TO SHORT THEY WILL BE BEYOND CENTER. THAT IS THE LINKS WILL BE SET AT AN ANGLE GREATER THAN THE 1-2' SPECIFIED ABOVE.



NOTES:

1. VACUUM SEALING SURFACE
2. PROTECT ALL SURFACES FROM SCRATCHES, GOUGES AND TOOLING MARKS DURING HANDLING

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: DECIMALS XX ± .03 ± 10' FINISH 125 .XXX ± .010 // □ .1 WITHIN .05 UNSPECIFIED FILLETS R.010 BREAK EDGES .010 x 45° REMOVE ALL BURRS	CONTRACT OR SALES ORDER NO.	GNB Corporation SCIENTIFIC AND INDUSTRIAL EQUIPMENT 29393 PACIFIC STREET HAYWARD, CALIFORNIA 94544 (510) 537-4722 FAX: (510) 537-4729
	APPR. BY / APPROVALS / DATE	
THIRD ANGLE PROJECTION	DRAFTER	TITLE: INSTRUCTIONAL DWG. GENERAL GATE VALVE
DO NOT SCALE DRAWING	CHECKER	
CADD FILE NAME C:\STD\G52\3102202.DWG	ENGINEER MJK 9/12/94	C / DWG. NO. 102202 / REV.
		SCALE: 1:8 / SHEET 1 / OF 1

6010/01

6010/02

JOB _____ REL. DATE NOV 2 1 1995

QTY. _____ DUE _____

SAW/BURN _____ DUE _____

MACH _____ DUE _____

WELD _____ DUE _____

ASSY _____ DUE _____

ITEM	QTY.	PART NO.	DESCRIPTION	PRICE (LOT)
22	1		GATE SEAL	
			O-RING, ø49.00 ID, 1/2 C/S, VITON	
			O-RING, ø49.00 ID, 1/2 C/S, BUNA	
21	REF		FLANGE SEAL	
			ø54.00 ID, 3/8 C/S, VITON	
			ø54.00 ID, 3/8 C/S, BUNA	
20	1		BONNET SEAL	
			O-RING, ø39.75 ID, 1/2 C/S, VITON	
			O-RING, ø39.75 ID, 1/2 C/S, BUNA	
19	1		HOUSING / SHAFT SEAL	
	1	#329	O-RING, ø2.00 ID, 3/16 C/S VITON/BUNA	
	2	#220	O-RING, ø1.38 ID, 1/8 C/S VITON/BUNA	
18	16	5100-75	R-RING	
17	2		THREAD COLLAR	
		TCL16-14-SS	SST COLLAR	
		TCL16-14-F	STEEL COLLAR	
16	2	92390A389	CLEVIS PIN	
15	2	98338A488	COTTER PIN	
14	4	90298A836	SHOULDER SCREW	
13	6	G14DU	DUWASHER	
12	20	G10DU	DUWASHER	
11	4	G06DU	DUWASHER	
10	8	3101125	LINK	
9	8	2100650-03	LINK PIN	
8	2	1100340-03	STOP WHEEL	
7	6	2101130-01	CARRIAGE WHEEL	
6	6	2101129-00	WHEEL AXLE	
5	1	21292-04	CENTERING RING	
4	1	2101742-91	LANTERN RING	
3	1	1101124	AIR CYLINDER	
2	4	1100259-04	GUIDE WHEEL	
1	1	L23BA4520-	SOLENOID	

PART LIST

MATERIAL SPECIFICATION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
DECIMALS ANGLES FINISH
.XX ± ±
.XXX ±
UNSPECIFIED FILLETS: R.015
BREAK EDGES .010 x 45°
REMOVE ALL BURRS

THIRD ANGLE PROJECTION

DO NOT SCALE DRAWING

CONTRACT OR SALES ORDER NO.

APPROVALS DATE

DRAFTER

CHECKER

ENGINEER ZII 3-1-95

CAD FILE NAME
C:\SID\G48\1101282.DWG

GNB Corporation
SCIENTIFIC AND INDUSTRIAL EQUIPMENT

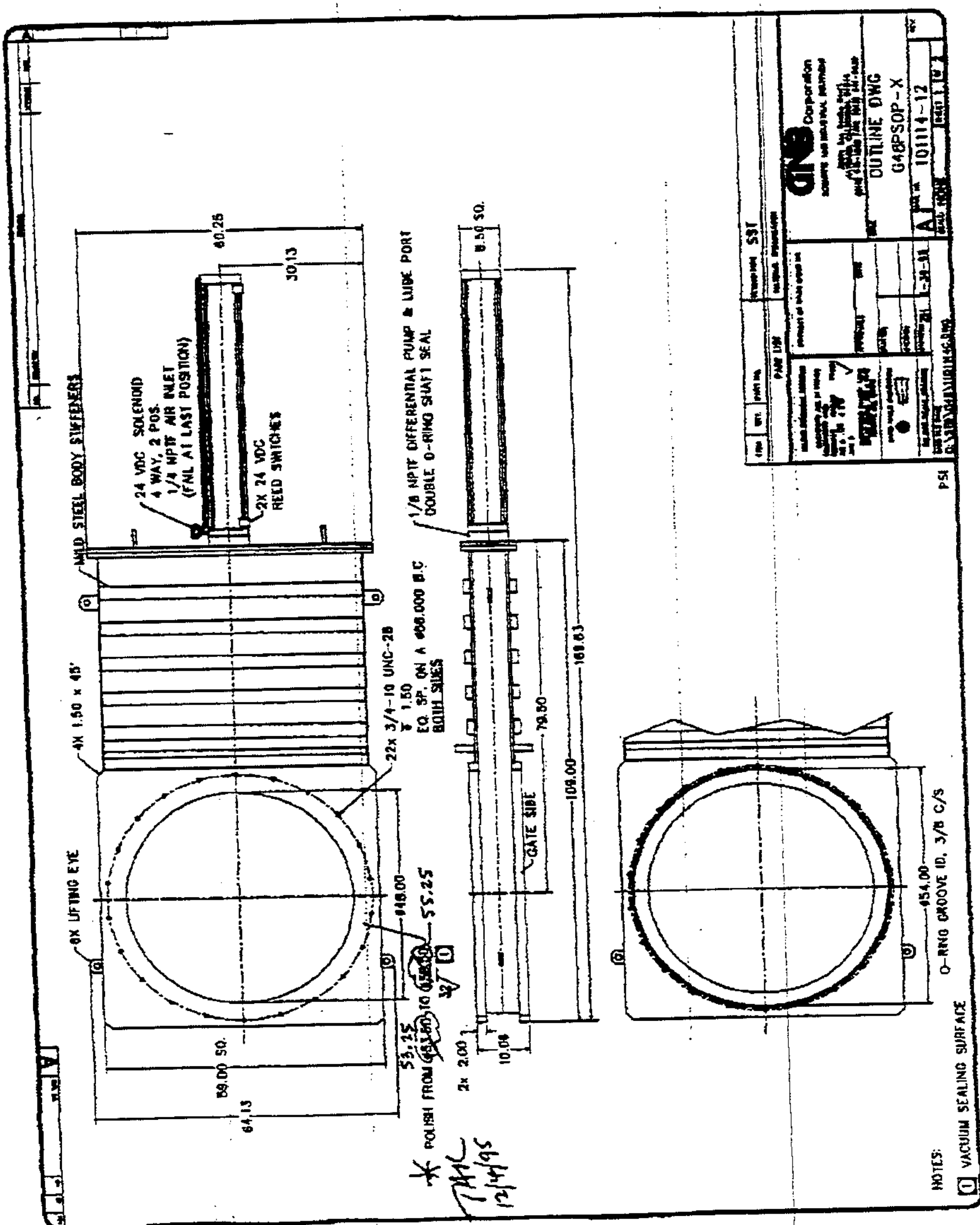
30971 San Benito Court
HAYWARD, CALIFORNIA 94544
(510) 441-1900 FAX: (510) 441-0939

TITLE
SPARE PARTS LIST
G48PMOP-X

A DWG NO. 101128-02 REV

SCALE: NONE SHEET 1 OF 1

REF:
ASSEMBLY DWG
4101115.DWG
(PSI)


MILD STEEL BODY STIFFENERS
24 VDC SOLENOID
4 WAY, 2 POS.
1/4 NPTF AIR INLET
(FAIL AT LAST POSITION)
2X 24 VDC
REED SWITCHES
1/8 NPTF DIFFERENTIAL PUMP & LUBE PORT
DOUBLE O-RING SHAFT SEAL
4X 1.50 x 45°
22x 3/4-10 UNC-2B
▽ 1.50
EQ. SP. ON A Ø58.000 B.C.
BOTH SIDES
8X LIFTING EYE
GATE SIDE
O-RING GROOVE ID, 3/8 C/S
Ø54.00
Ø48.00
60.25
30.13
8.50 SQ.
169.63
109.00
79.50
59.00 SQ.
64.13
2x 2.00
10.06
55.25
53.25
POLISH FROM
NOTES:
1 VACUUM SEALING SURFACE
Corporation
OUTLINE DWG
G48PSOP-X
101114-12
A

PC TYPE - MODEL C
½" TO 1" MNPT

POROUS METAL

Adjustable Flow Filter & Muffler

MALE PIPE THREAD CONNECTIONS

Controls Air Cylinder Speeds on Welders, Presses, Assembly Equipment etc...

Regulates Air Flow to Vacuum Breakers.

Tough, cellular sintered bronze structure, securely brazed to metal ferrule, insures desired combination of filtering and mufflering plus adjustable flow.

The adjustable tapered metering valve provides needle point control of air flow... on pressure applications... and for vacuum relief on vacuum systems.

External adjustment screw accurately varies orifice opening from closed to full flow as required. Securely locked at the desired setting with a locknut, it cannot be accidently tampered with, removed, or blown out.

Ample latitude provided by adjustment screw insures smooth even adjustment of air flow - makes it easy for operator to "zero in" to exact setting required.

Standard pipe thread connections provide easy attachment to equipment.

Custom-made Units for Special Applications

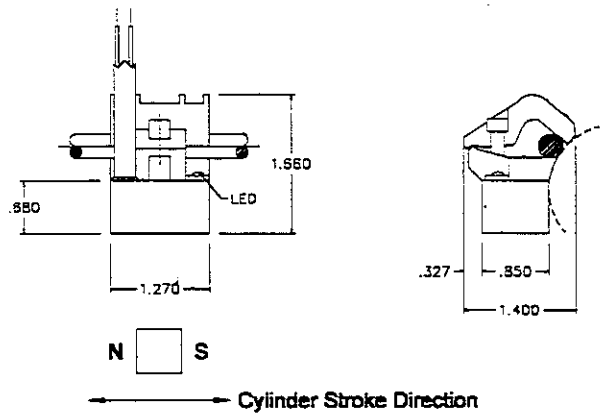
Units can be made in a wide range of pore sizes, connections and dimensions.

They can also be supplied with various types of orifice valve actuators other than the standard threaded adjustment screw.

MODEL NO.	PORT SIZE	OVERALL LENGTH (CLOSED) IN. (mm)	OVERALL LENGTH (OPEN) IN. (mm)
20313-1	1/8"	1 3/8 (34.9)	2 (50.8)
20313-2	1/4"	1 9/16 (39.7)	2 3/16 (55.6)
20313-3	3/8"	1 7/8 (47.6)	2 13/16 (71.4)
20313-4	1/2"	2 1/4 (57.2)	3 5/16 (84.1)
20313-6	3/4"	2 3/4 (69.9)	3 13/16 (96.8)
20313-8	1"	3 1/4 (82.6)	4 5/8 (117.5)

STANDARD REED SWITCH - *Tie rod mount only*

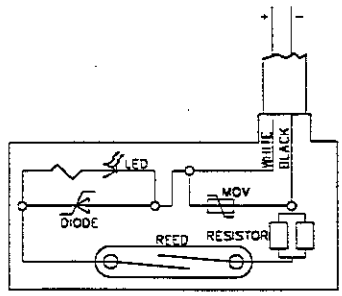
MOUNTING DIMENSIONS



TIE ROD MOUNT

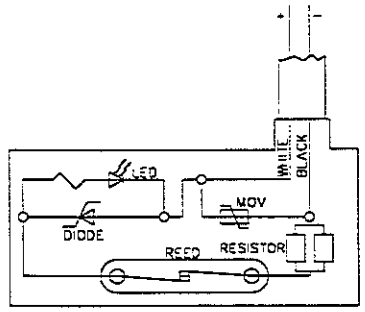
Reed Magnet Orientation: Poles parallel to direction of piston rod motion.

WIRING DIAGRAM



AR6-001

NORMALLY OPEN



AR6-002

NORMALLY CLOSED

Numatics Actuator Reed Switch Features:

-Simple operation. Switch is tripped by a magnet installed on piston.
-Easy to adjust tie rod clamp can signal any point along cylinder stroke.
Multiple switches may be used on any cylinder depending on stroke.
-Multipurpose switch function 5-240 volts AC or DC. 1 Amp maximum current.
-LED helps minimize set-up and trouble-shooting time.
-Internal surge suppression for spike and noise reduction.
-Nema 4 enclosure
-Suitable for outdoor and wash down environment
-Dust proof
-Water tight

Technical Information

Working Temperature	Min. -30° C Max. 80° C
Operating Time	On 2 ms. Off .1 ms
Repeatability	.001 inch
Vibration Resistance	5 to 1000 HZ
Shock Resistance	30g @ 11 ms.
Maximum Switch Current	1 Amp
Lead Length	6 ft.

numatics® "L2" SERIES

"L2" SERIES VALVES–SOLENOID PILOT OR AIR PILOT MULTIPURPOSE, 5–PORTED, 4–WAY, INLINE OR MANIFOLD MOUNTED, 2–POSITION OR 3–POSITION 1/4 NPTF (G1/4) OR 3/8 NPTF (G 3/8)

umatics "L2" Series line valves are high speed, heavy uty, multipurpose, inline mounted, 4–way valves de-igned for general service on all types of automation for wide range of air cylinders. They offer all the advanced esign features of other Numatics valves, including the amous, patented, lapped spool and sleeve.

ll "L2" valves are multipurpose construction and may e used as normally open or closed 2– or 3–way valves, ingle or dual pressure 4–ways or as selector or diverter alves, dependent only on how they are piped or lugged.

IOUNTING: Valves are inline mounted and may be nounted in any position. "L2" valves will also mount on nanifolds with common supply and exhaust galleries or ith a common supply gallery only and individual ex-aust.

OPERATING DATA

RESSURE RANGE:
- Internal Pilot Supply:
  - All A.C. and
  - 3.5 Watt D.C. Sol., 14.5–145 PSIG (1–10 Bar)
  - 1.4 Watt D.C. Sol., 14.5–116 PSIG (1–8 Bar)*
- External Pilot Supply:
  - Main Valve: 28" Hg. vacuum to 145 PSIG
  - Pilot Supply: Same as internal pilot supply.

EMPERATURE RANGE: –10° F to +115° F ambient.

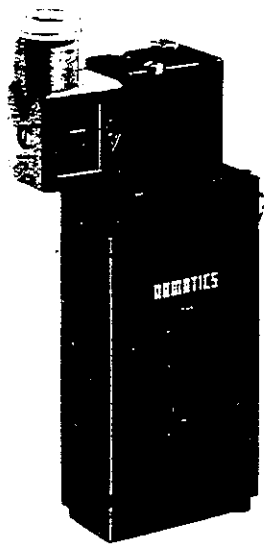
ERVICE: Valves can be used on the following properly ltered media:
ubricated air, dry (oil free) air, vacuum, and non–corro-ive, non–toxic , non–flammable dry gases. See lumatics' Engineering and Technical Data for a list of ecommended lubricants and filtration requirements for nlubricated service.

LOW CAPACITY: "L2" valves have Cv of 1.7. See lumatics' Engineering and Technical Data for complete ow chart.

LECTRICAL: Solenoids are continuous duty rated. Stan-ard A.C. voltages are 24/50–60; 115–120/60; 00–115/50 and 220–240/60; 200–240/50. 24 VDC is tandard.

		A.C.	D.C.
rush current (amps.) @:	120/60	.085	—
lolding current (amps.) @:	120/60	.050	—
Vattage – 24 VDC		—	3.5*
ime to Energize (secs.)			
Single Solenoid		.010	.010
Double Solenoid, 2–Position		.010	.010
Double Solenoid, 3–Position		.012	.012
ime to de–energize, Single Solenoid		.035	.035
ime to de–energize, 3–Position		.040	.040
laximum cycle rate (continuous)		500 CPM	

A 1.4 Watt D.C. solenoid is available on special order. dd "017G" to the model number.



L22BA4520

L22JJ4520

A.N.S.I. SYMBOLS

SOLENOID PILOT	AIR PILOT
L22BA4	L22PA4
L22BB4	L22PP4
L22BB5	L22PP5
L22BB6	L22PP6
L22BB7	L22PP7

MODEL SELECTION CHART

SERIES IDENTIFIER & TAP SIZE	"14" ACTUATOR	"12" ACTUATOR	FUNCTION	MOUNTING MEANS	WIRING OPTIONS
22 1/4 NPTF 23 3/8 NPTF	B = Solenoid–Pilot P = Air Pilot Cap J Air pilot Cap with Flush Non–locking Override	B = Solenoid–Pilot A = Spring Return P = Air Pilot Cap J = Air Pilot Cap with Flush Non–locking Override	4 = 2–Position 4–way 5 = 3–Position Dual Pressure In Neutral 6 = 3–Position All Ports Blocked In Neutral 7 = 3–Position Supply Open to A & B In Neutral	52 = Line Mounted	O = Std. A.C., No Plug** A = Special A.C., No Plug** B = Std. D.C., No Plug**

NOTE: Ports are available tapped G1/4 or G3/8

** NOTE:
Order Plug–In Socket Ass'y. Separately

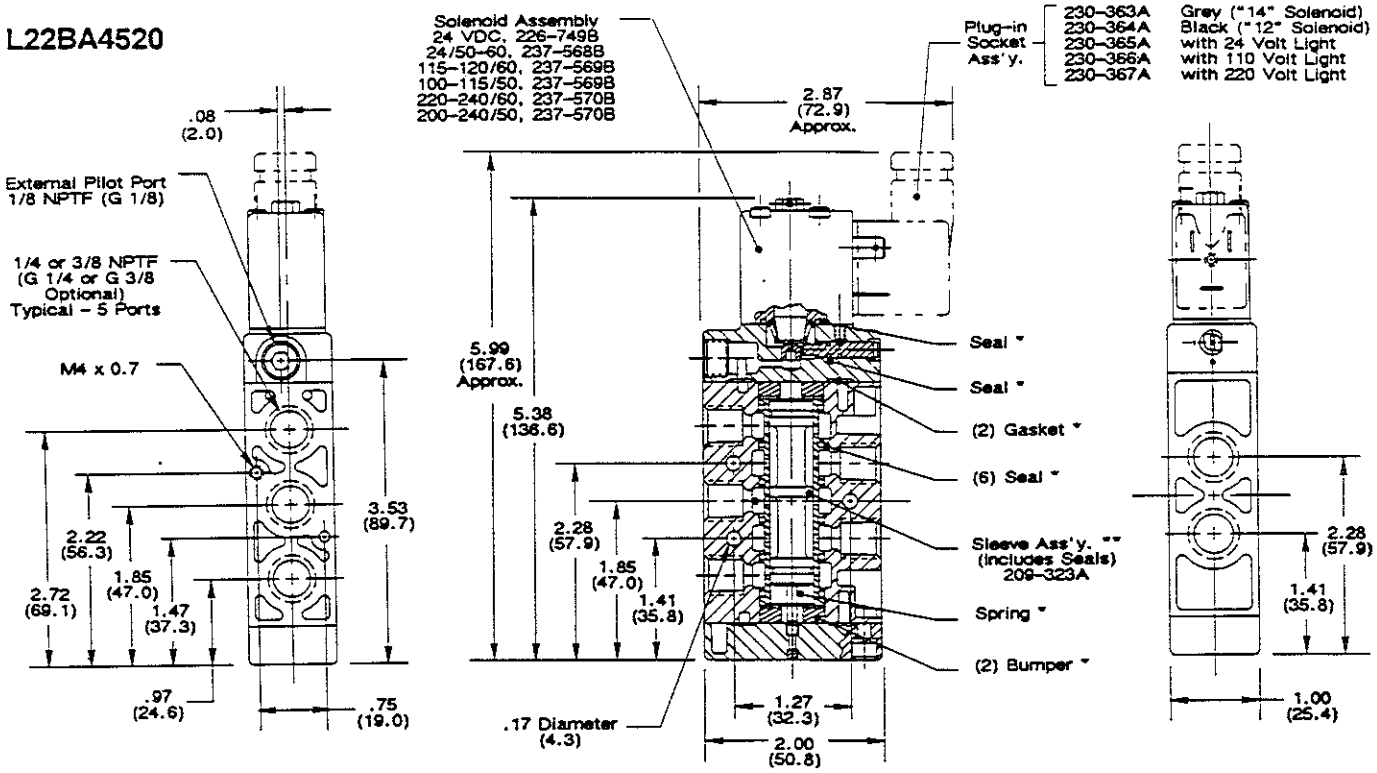
230–363A	Grey ("14" Solenoid)
230–364A	Black ("12" Solenoid)
230–365A	with 24 Volt Light
230–366A	with 110 Volt Light
230–367A	with 220 Volt Light

Top Dimensions = Inches
Bottom Dimensions
(In Parentheses) = Millimeters

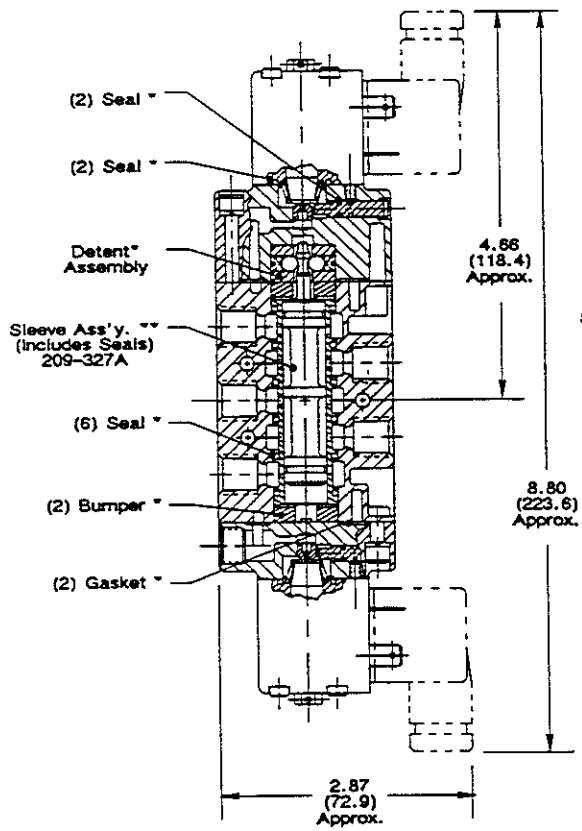
SOLENOID PILOT ACTUATED DIMENSIONS AND PARTS

numatics®
"L2" SERIES

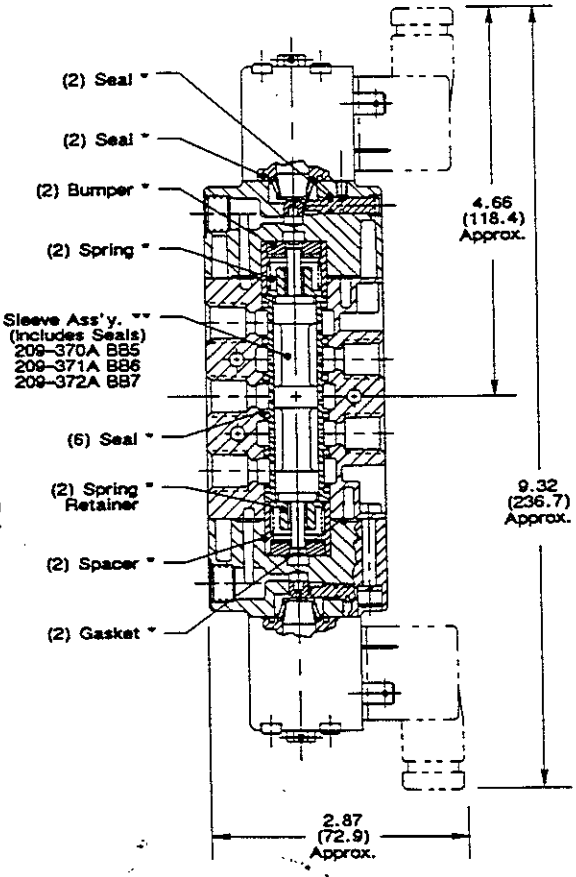
L22BA4520



L22BB4520



L22BB5520, L22BB6520, L22BB7520



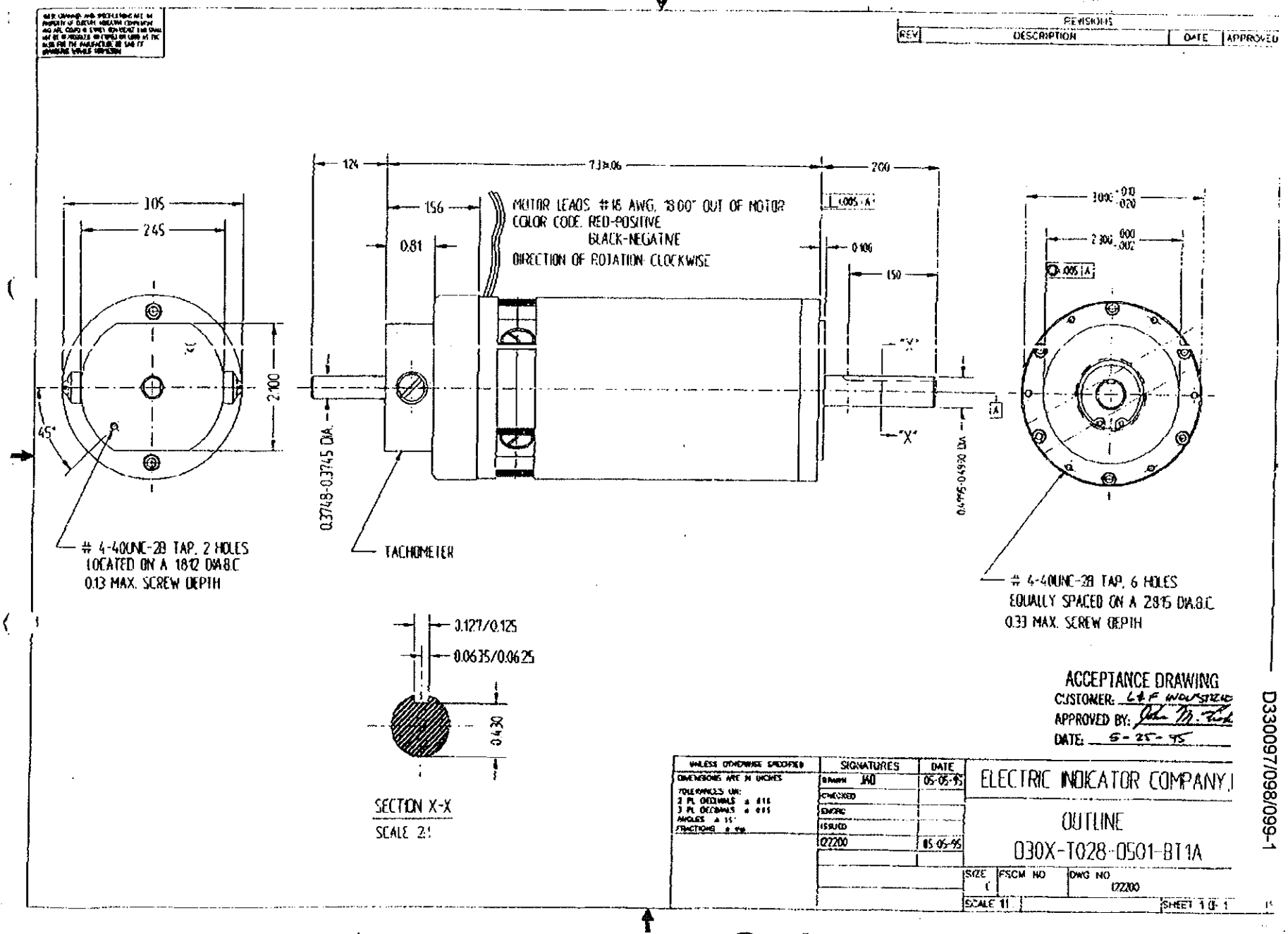
EXTERNAL PILOT SUPPLY

To convert any valve to external pilot supply, remove the adapter from the valve body, rotate the gasket to block the internal supply, and replace the adapter in the same position. Remove the 1/8" pipe plug from the adapter, and supply external pilot pressure to this port.

On double solenoid-pilot valves, both ends must be converted.

External pilot supply must be used if pressure is supplied to any port except No. 1

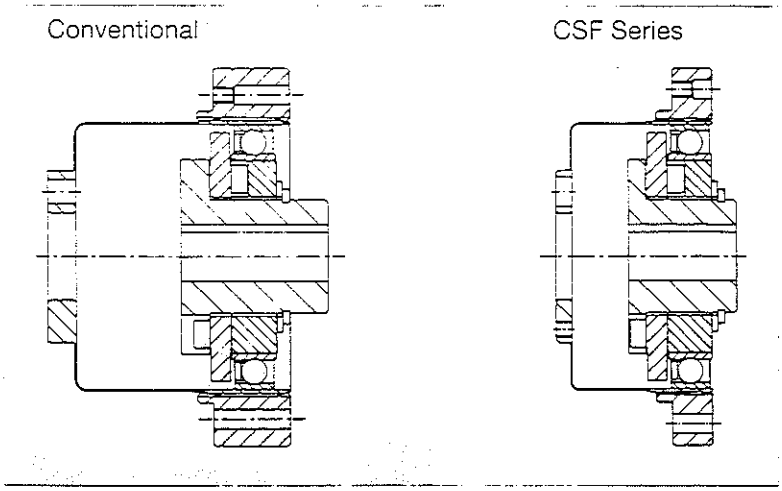
** This spool and Sleeve assembly is sold as a precision matched set only. Spools are not interchangeable.



IR DRIVE MOTOR
RECEIVED FROM JOE OLIWA 6/16/98

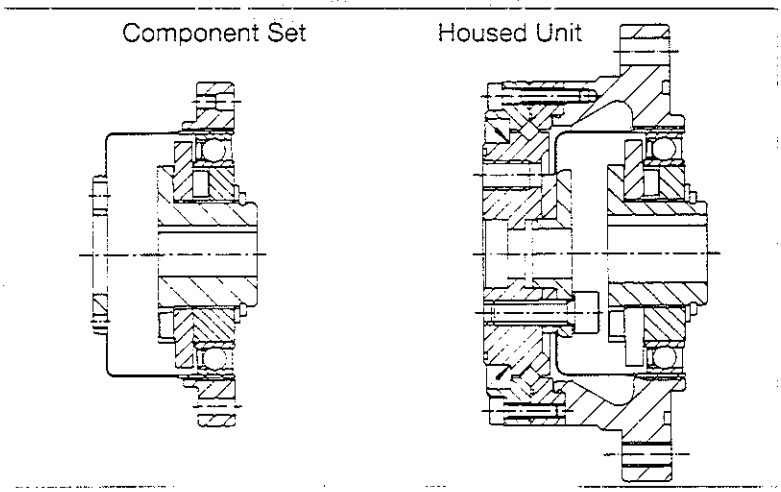
Harmonic Drive Short Flexspline Component Sets and Housed Units

The CSF Series of Component Sets and Housed Units . . .



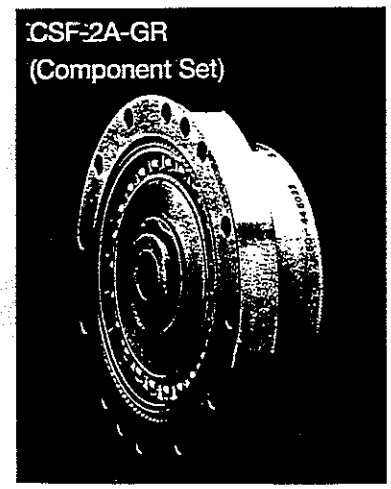
The new CSF component sets and housed units are the result of our continuous development of harmonic drive precision reduction gearing. In comparison with traditional harmonic drive gears. the new CSF series features a shortened Flexspline, which results in an important reduction of the axial length. The CSF uses the high performance "S" tooth profile which provides significantly increased torque capacity compared to harmonic drive gears incorporating the traditional involute gear tooth profile.

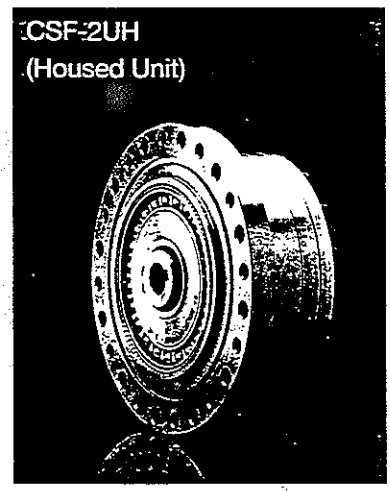
. . . with a shortened Flexspline . . .



The CSF-2UH series of housed units, combines a short Flexspline component set with a high stiffness, cross roller bearing. The integration of this high capacity bearing to support output loads eliminates the need for the user to design an output bearing assembly, thus reducing design and production costs. This efficient design minimizes the unit size.

. . . offer many important advantages

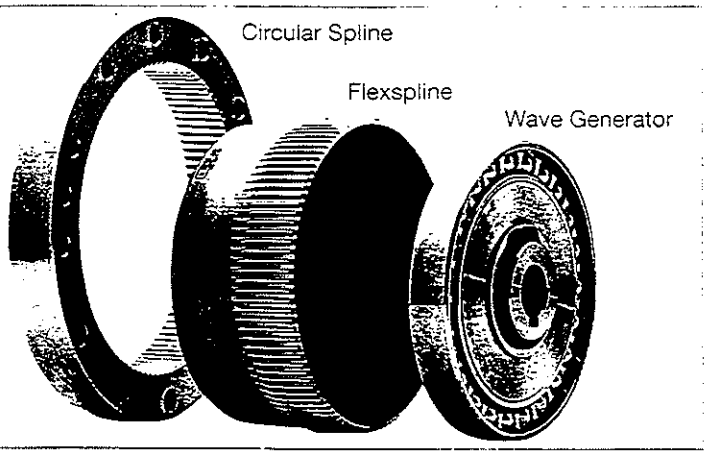




- High Torque Capacity
- Excellent Positioning Accuracy and Repeatability
- Compact Design/Reduced Weight
- High Single Stage Ratios
- High Capacity Output Bearing
- High Torsional Stiffness
- Zero Backlash
- Long Life
- High Efficiency
- Simple Installation and Assembly

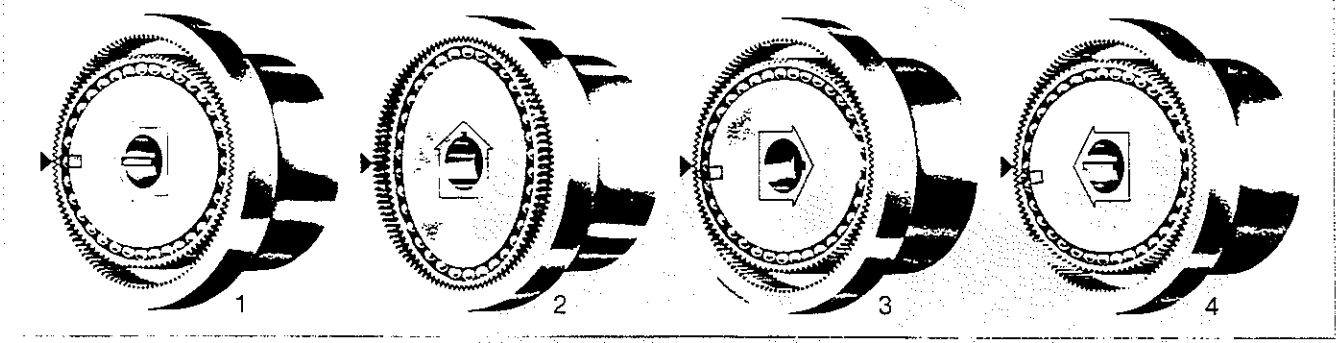
Harmonic drive gears are made up of three basic parts:

1. The Circular Spline is a rigid ring with internal teeth, engaging the teeth of the Flexspline across the major axis of the Wave Generator.
2. The Flexspline is a non-rigid, thin cylindrical cup with external teeth on a slightly smaller pitch diameter than the Circular Spline. It fits over and is held in an elliptical shape by the Wave Generator.
3. The Wave Generator is a thin raced ball bearing fitted onto an elliptical plug serving as a high efficiency torque converter.



These three basic parts of the CSF Series gears function in the following way:

1. The Flexspline (FS) is slightly smaller in diameter than the Circular Spline (CS) and usually has two fewer teeth than the CS. The elliptical shape of the Wave Generator (WG) causes the teeth of the FS to engage the CS at two opposite regions across the major axis of the ellipse.
2. As the WG rotates, the zone where the teeth of the FS engage those of the CS travels with the major elliptical axis.
3. For each 180° clockwise movement of the WG, the FS moves counterclockwise by one tooth relative to the CS.
4. Each complete clockwise rotation of the WG results in the FS moving counterclockwise by two teeth from its original position relative to the CS.

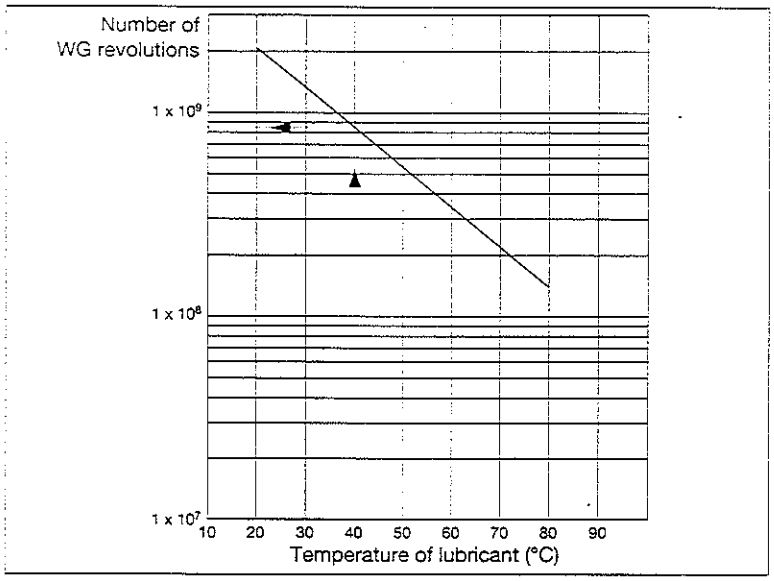


Note: The amount of Flexspline deflection is greatly exaggerated in the diagrams in order to demonstrate the principle of operation. Actual deflection is much smaller than shown and the incurred stress is well within the material's fatigue limit.

Grease change

The interval for a grease change is affected by the load pattern. SK-1A and SK-2 grease has been developed so that a grease change will first become necessary after:

- 3 x 10^8 Wave Generator revolutions for a constant load
- 1 x 10^9 Wave Generator revolutions for a sinusoidal load.



To change the grease, the component set should be completely disassembled and cleaned before regreasing. Fresh grease should be applied generously to the inside of the Flexspline, the Wave Generator bearing, the input coupling and the teeth of the Circular Spline and Flexspline.

In the diagram on the left, the grease change interval is given as a function of grease temperature. The number of allowable revolutions of the input shaft which represents the grease change interval can be estimated as shown in the example. This means, that SK-1A or SK-2 grease operating at a temperature of 40°C, should be changed after approximately 8.5 · 10^8 revolutions of the input shaft.

All grease change data refers to operation at Rated speed and Rated torque.

Grease Quantity for component set (g)

Table 6

Size	14	17	20	25	32	40	45	50	58	65	80	90	100
Total	5.5	10	16	40	60	130	180	260	360	440	850	990	1200

The output bearing of the CSF-2UH type is delivered with a lifetime lubricant. A grease change is not necessary for this bearing.

Efficiency

Efficiency for Oil Lubrication (Sizes 14–100) at Rated Torque

Oil: Mineral Oil CLP 68

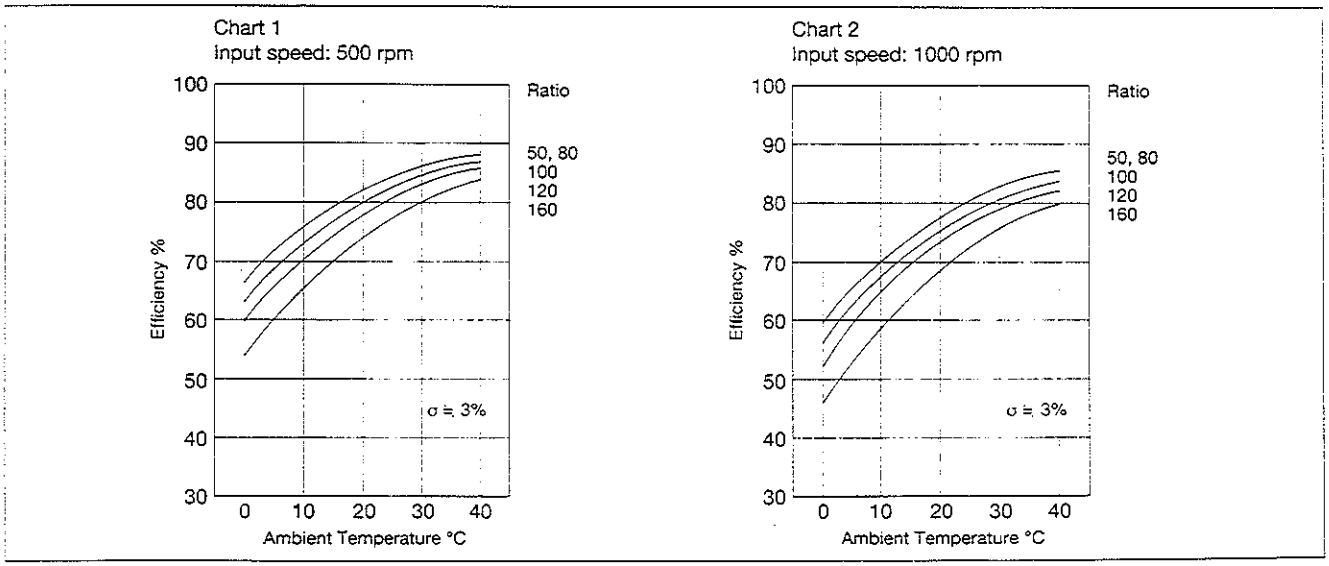


Chart 3
Input speed: 2000 rpm

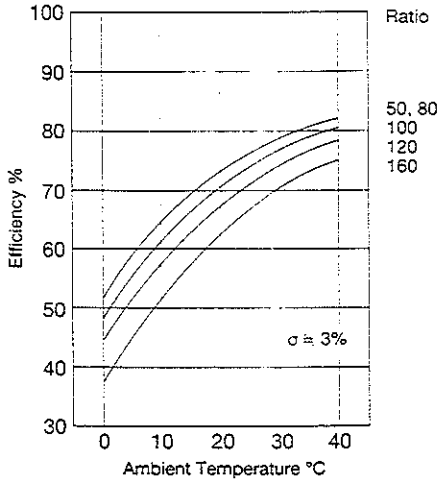
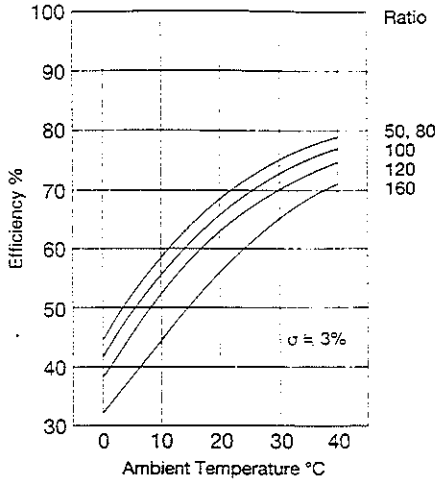


Chart 4
Input speed: 3500 rpm



Efficiency for Grease Lubrication (Sizes 14–100) at Rated Torque

Grease: Harmonic Drive Grease

Chart 5
Input speed: 500 rpm

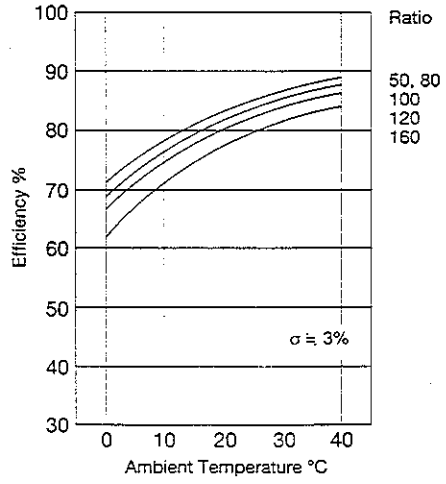


Chart 6
Input speed: 1000 rpm

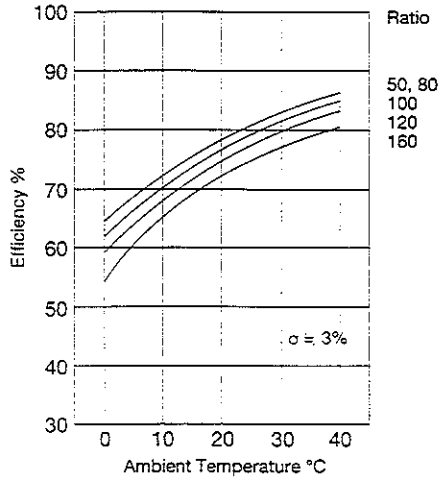


Chart 7
Input speed: 2000 rpm

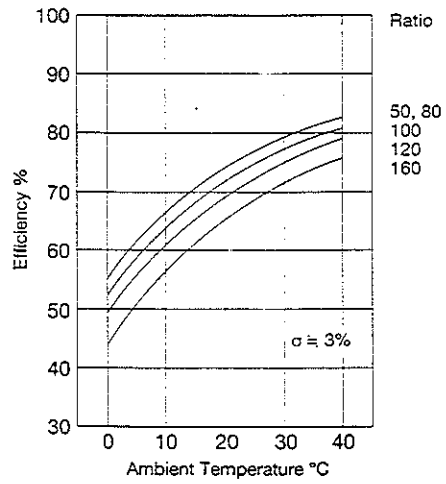
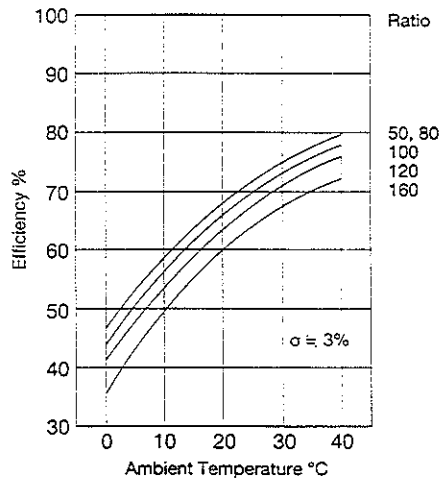
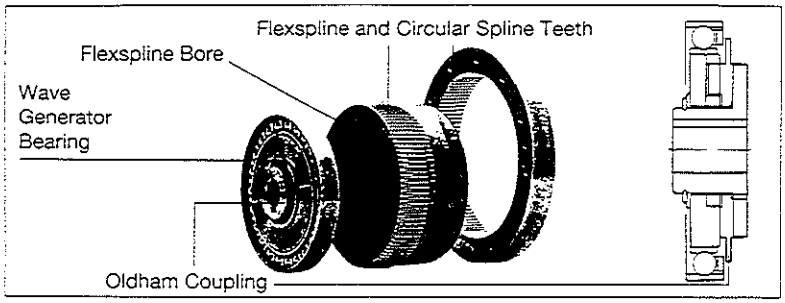


Chart 8
Input speed: 3500 rpm



Lubrication



Harmonic drive CSF component sets and housed units require lubrication in four major regions as indicated by the arrows.

Oil Lubrication

Commonly Available Oil Lubricants

Table 1

Type	Aral	BP	DEA	Esso (Exxon)	Klüber	Mobil	Optimol	Shell	Texaco
Compound Gear oil	Degol BG 68	Energol GR-XP68	Falcon CLP 68	Spartan EP 68	Lamora 68	Mobil Gear 626	Optigear BM 68	Omala Oil 68	Meropa 68

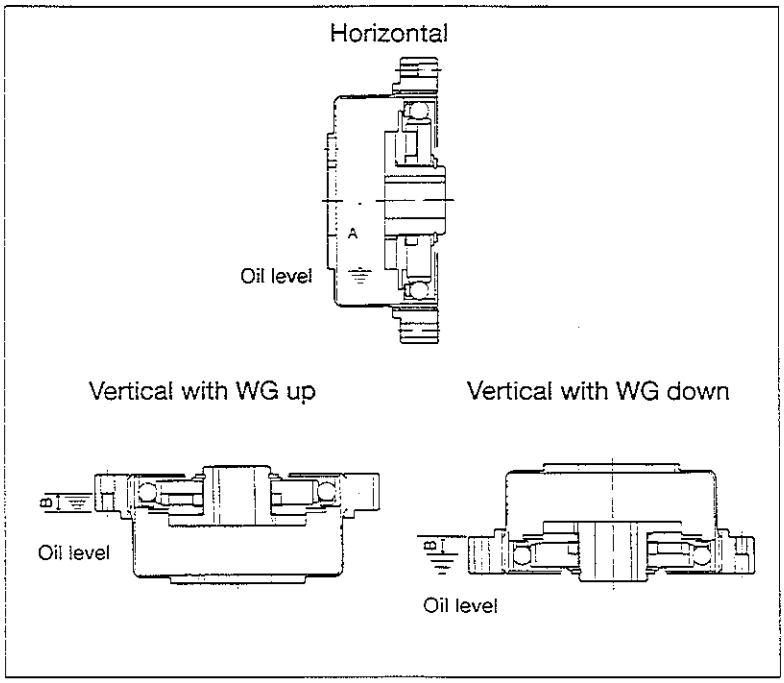
Minimum Oil Volume

Size	14	17	20	25	32	40	45	50	58	65	80	90	100
Liters	0.01	0.02	0.03	0.07	0.13	0.25	0.32	0.4	0.7	1.0	2.0	2.8	3.8

Table 2

Mounting Position and Lubrication

The oil levels recommended for horizontal and vertical installations are shown. Total quantity is determined by casing size. The minimum quantity required for each size is listed in the table 2.



Vertical Installations

If the input shaft is on top, lube holes are provided on the boss of the Flexspline to facilitate the flow of oil inside the Flexspline cup. The lube holes serve as breathers if the component set is used with input down.

When the harmonic drive unit is to be used vertically with the Wave Generator placed at the bottom, special consideration must be given. If the Wave Generator assembly is completely submerged in oil, the heat generation caused by churning would be substantial and a loss of efficiency would result. It is recommended that the oil level be maintained in such a way that approximately one half of the Wave Generator bearing is submerged.

To ensure a sufficient amount of lubricant it may be necessary to extend the bottom area of the housing or to provide an external oil reservoir. A forced lubrication system may also be considered.

Oil Level

mm

Size	14	17	20	25	32	40	45	50	58	65	80	90	100
A	10	12	14	17	24	31	35	38	44	50	59	66	74
B	2.5	3	3	5	7	9	10	12	13	15	19	22	25

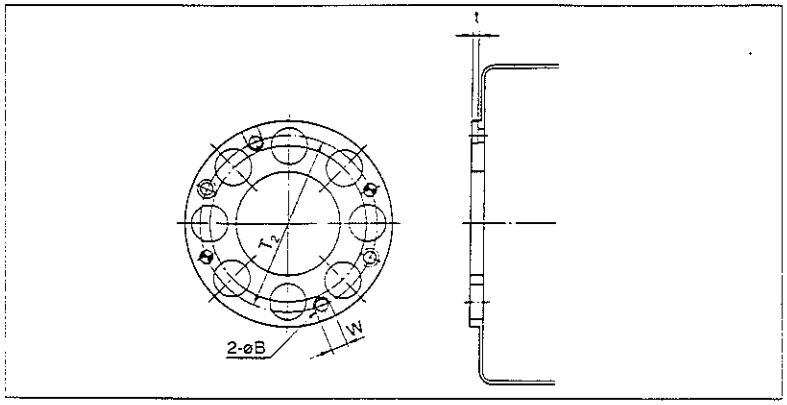
Table 3

Lube Holes

Dimensions of Lube Holes (mm) Table 4

Size	14[1]	17[1]	20	25	32	40	45	50	58	65	80	90	100
T_2	–	–	27	34	45	56	61	68	79	90	114	120	142
B	–	–	2.5	2.5	3.5	3.5	3.5	5.5	5.5	5.5	6.5	6.5	6.5
W	–	–	2.8	3.5	4.0	4.0	4.0	6.0	6.0	6.0	7.0	7.0	7.0
t	–	–	1.2	1.2	1.4	1.4	1.4	2	2	2	3	3	3

[1] No Lube Hole available.



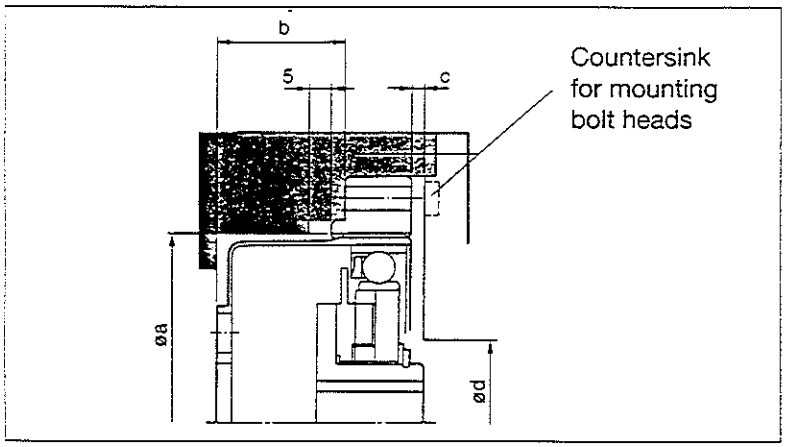
Oil Temperature

In normal use, the oil temperature must not exceed 90°C, as oil loses its lubricating capability quickly above this limit.

Oil Change

The first oil change should be performed after 100 hours of operation. The need to perform subsequent oil changes will depend on operating conditions, but should take place at intervals of approximately 1000 running hours.

Grease Lubrication



We recommend the use of harmonic drive grease SK-1A which has been specially developed for use with sizes 20 to 100. For sizes 14 and 17 we recommend the use of harmonic drive micro-particle grease SK-2. When using these special greases continuous operation is permissible.

An important consideration in grease lubrication is ensuring maximum grease retention at points where lubrication is required. This can be achieved by keeping the clearance between the unit and housing as small as possible. Recommended clearances are shown below.

mm Table 5

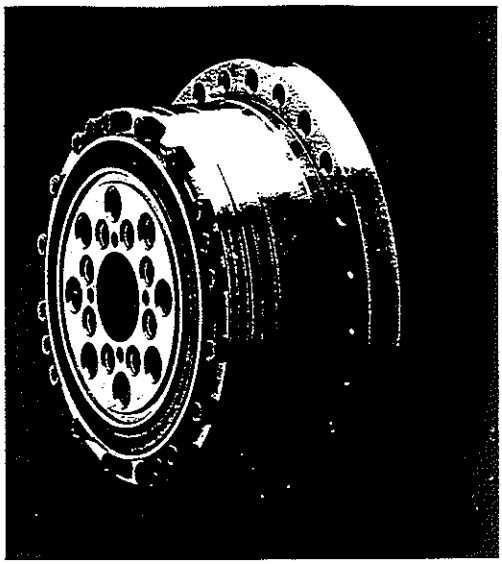
Size	14	17	20	25	32	40	45	50	58	65	80	90	100
Ø a	38	45	53	66	86	106	119	133	154	172	212	239	265
b	17.1	19	20.5	23	26.8	33	36.5	39	46.2	50	61	68.5	76
c	1	1	1.5	1.5	1.5	2	2	2	2.5	2.5	3	3	3
Ø d	16	26	30	37	37	45	45	45	56	62	67	73	79

Grease re-lubrication

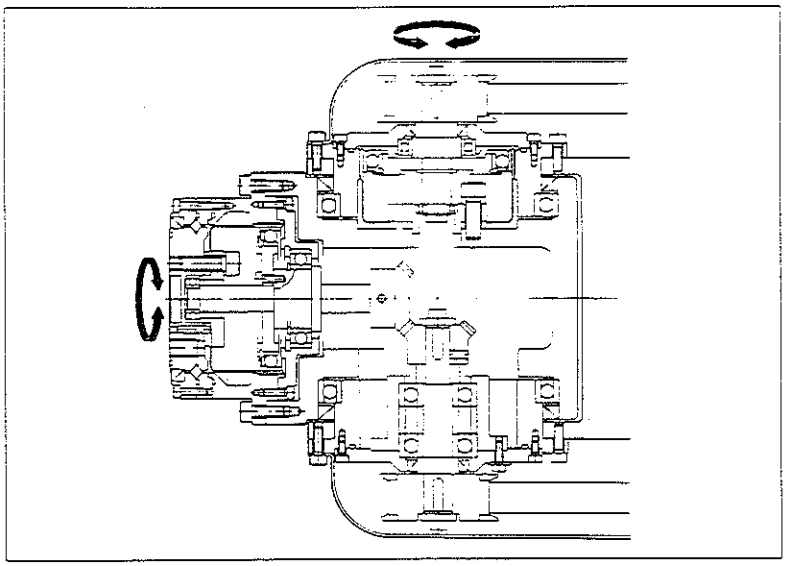
When using SK-1A or SK-2 grease, additional grease needs to be provided after approximately 1.5×10^8 revolutions of the Wave Generator. Light duty operation may permit a longer service interval. For high duty applications, where it is anticipated that high temperatures will occur, it is recommended that a grease nipple be provided to allow the addition of fresh grease.

CSF-2UH Short Flexspline Housed Unit with Integral Output Bearing

In the CSF-2UH series, a short Flexspline component set is combined with a high stiffness cross roller bearing. The integration of this high capacity bearing to support output loads will eliminate the need for the user to design an output bearing assembly, thus reducing design and production costs. This efficient design minimizes the unit size.

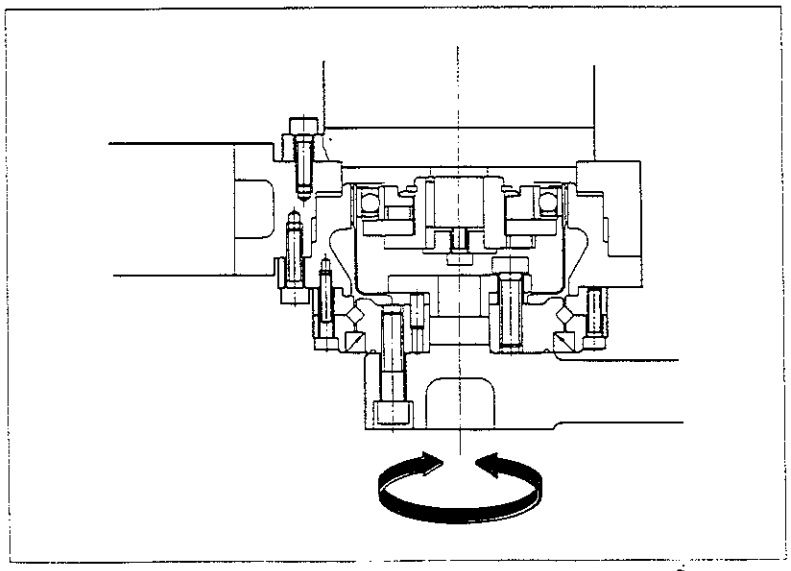


Application Examples



1. Hand axis of an industrial robot

Simple integration and high torque capacity were the determining factors leading to the use of a CSF Unit in this application. For this special version the output flange has been machined to suit the ISO standard for mechanical interfaces for industrial robots, enabling the direct attachment of a wide range of standard robot grippers and tools.



2. Elbow axis of SCARA robot

In this application the low weight and high positional accuracy of the CSF Unit enabled the desired combination of high precision and high dynamic performance to be achieved. The Wave Generator is provided with an Oldham Coupling to counteract possible run-out errors from the motor shaft.

Rating Table

Table 18

CSF-2UH Size[1]	Ratio	Rated Torque at 2000 rpm T_N Nm	lb-in	Limit for Average Torque T_A Nm	lb-in	Limit for Repeated Peak Torque T_R Nm	lb-in	Limit for Momentary Peak Torque T_M Nm	lb-in	Max. Input Speed rpm Oil Lub.[2]	Grease Lub.[3]	Limit for Average Input Speed rpm Oil Lub.[2]	Grease Lub.[3]	Moment of Inertia[4] kgcm²	lb-in²	Weight kg	lb
14	50	5.4	47.8	6.9	61.1	18	159	35	310	14000	5000	6500	3500	0.033	0.011	0.52	1.14
	80	7.8	69.0	11	97.4	23	204	47	416								
	100	7.8	69.0	11	97.4	28	248	54	478								
17	50	16	142	26	230	34	301	70	620	10000	4000	6500	3500	0.079	0.027	0.68	1.50
	80	22	195	27	239	43	381	87	770								
	100	24	212	39	345	54	478	86	761								
	120	24	212	39	345	54	478	78	690								
20	50	25	221	34	301	56	496	98	867	10000	4000	6500	3500	0.193	0.066	0.98	2.16
	80	34	301	47	416	74	655	127	1124								
	100	40	354	49	434	82	726	147	1301								
	120	40	354	49	434	87	770	147	1301								
	160	40	354	49	434	92	814	147	1301								
25	50	39	345	55	487	98	867	186	1646	7500	4000	5600	3500	0.413	0.141	1.5	3.30
	80	63	558	87	770	137	1213	255	2257								
	100	67	593	108	956	157	1390	284	2514								
	120	67	593	108	956	167	1478	304	2691								
	160	67	593	108	956	176	1558	314	2779								
32	50	76	673	108	956	216	1912	382	3381	7000	4000	4600	3500	1.69	0.578	3.2	7.04
	80	118	1044	167	1478	304	2691	568	5027								
	100	137	1213	216	1912	333	2947	647	5726								
	120	137	1213	216	1912	353	3124	686	6072								
	160	137	1213	216	1912	372	3292	686	6072								
40	50	137	1213	196	1735	402	3558	686	6072	5600	3500	3600	3000	4.50	1.54	5.0	11.0
	80	206	1823	284	2514	519	4594	980	8674								
	100	265	2345	372	3292	568	5027	1080	9559								
	120	294	2602	451	3992	617	5461	1180	10444								
	160	294	2602	451	3992	647	5726	1180	10444								
45	50	176	1558	265	2345	500	4425	950	8408	5000	3500	3300	3000	8.68	2.97	7.0	15.4
	80	313	2770	390	3452	706	6249	1270	11240								
	100	353	3124	500	4425	755	6682	1570	13896								
	120	402	3558	620	5487	823	7284	1760	15577								
	160	402	3558	630	5576	882	7806	1910	16905								
50	50 [5]	245	2168	350	3098	715	6328	1430	12657	4500	3500	3000	2500	12.5	4.27	8.9	19.6
	80	372	3292	519	4594	941	8329	1860	16462								
	100	470	4160	666	5895	980	8674	2060	18233								
	120	529	4682	813	7196	1080	9559	2060	18233								
	160	529	4682	843	7461	1180	10444	2450	21684								
58	50 [5]	353	3124	520	4602	1020	9028	1960	17347	4000	3000	2700	2200	27.3	9.33	14.6	32.1
	80	549	4859	770	6815	1480	13099	2450	21684								
	100	696	6160	1060	9382	1590	14073	3180	28145								
	120	745	6594	1190	10532	1720	15223	3330	29473								
	160	745	6594	1210	10709	1840	16285	3430	30358								
65	50 [5]	490	4337	720	6373	1420	12568	2830	25048	3500	2800	2400	1900	46.8	16.0	20.9	46.0
	80	745	6594	1040	9205	2110	18675	3720	32925								
	100	951	8417	1520	13453	2300	20357	4750	42041								
	120	951	8417	1570	13896	2510	22215	4750	42041								
	160	951	8417	1570	13896	2630	23277	4750	42041								

Please Note:

[1] Component sets CSF-2UH sizes 80 and 90 only on request.

[2] Oil lubrication available as an option.

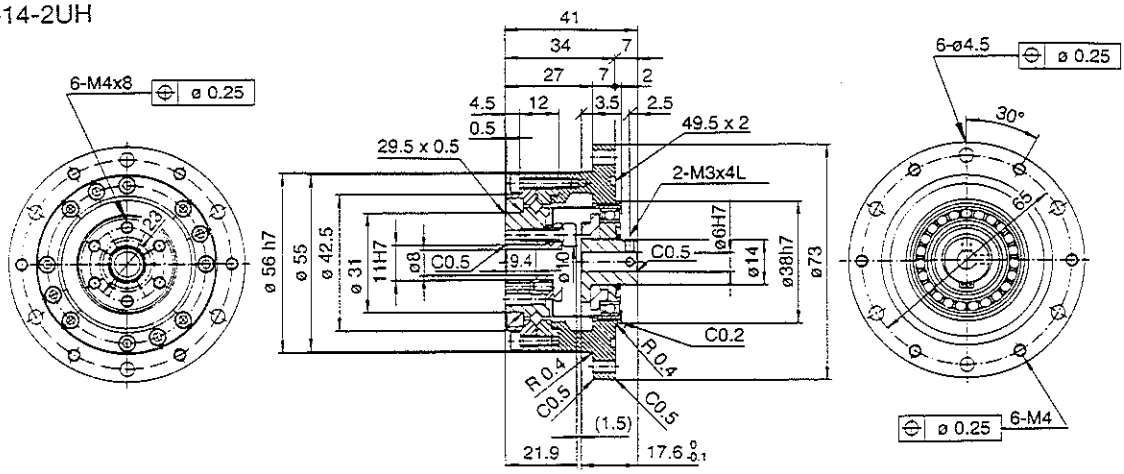
[3] Applicable for harmonic drive grease SK-1A for size 20 to 65 or SK-2 for size 14 to 17.

[4] The moment of inertia refers to the input side and is valid for a standard Wave Generator.

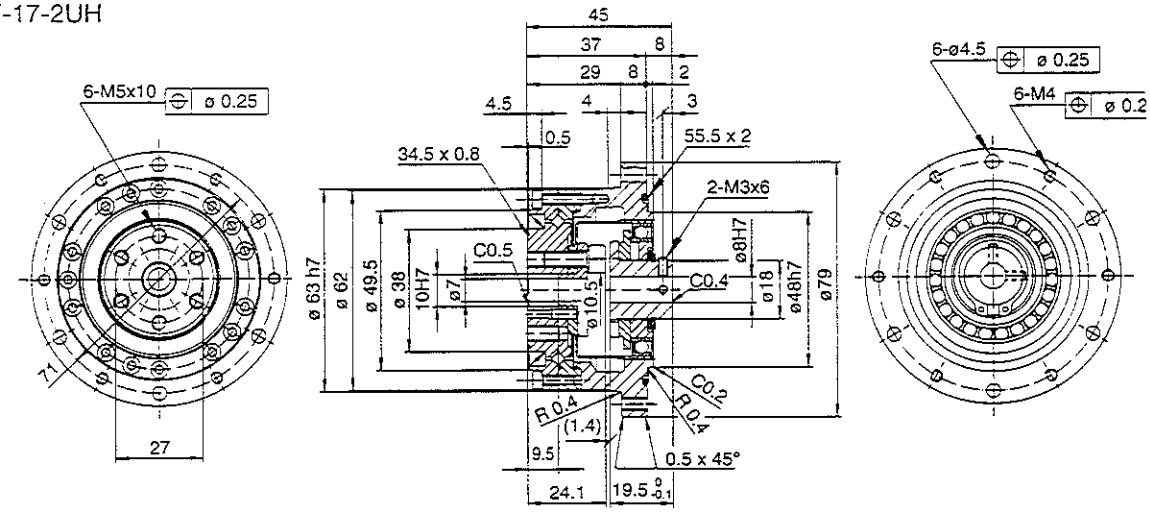
[5] Use only with oil lubrication.

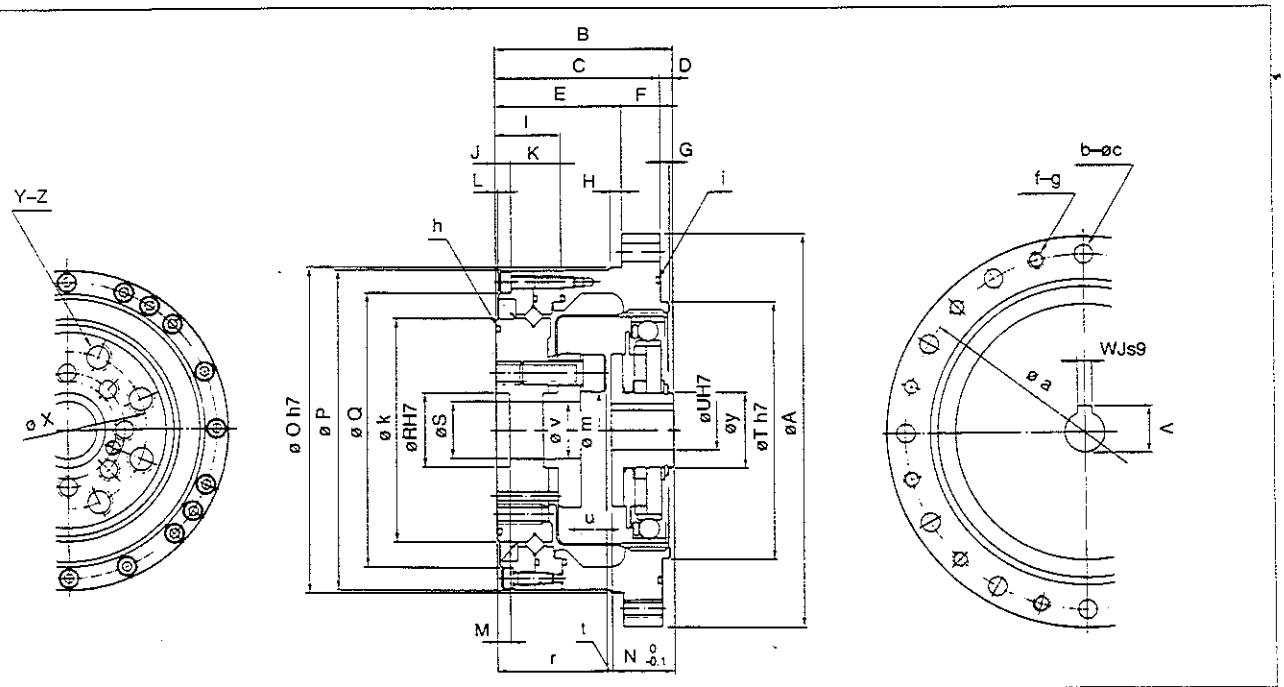
Dimensions (mm)

CSF-14-2UH



CSF-17-2UH





mm

Table 19

CSF-2UH Size	20	25	32	40	45	50	58	65
Ø A	93	107	138	160	180	190	226	260
B	45.5	52	62	72.5	79.5	90	104.5	115
C	38	46	57	66.5	74	85	97	108.5
D	7.5	6	5	6	5.5	5	7.5	6.5
E	28	36	45	50.5	58	69	77	84.5
F	10	10	12	16	16	16	20	24
G	3	3	3	4	4	4	5	5
H	5	5	5	5	6	6	6	6
I	16.5	18.5	22.5	24	27	31	35	39
J	4	4.5	5.5	7.5	7	8	8.5	8.5
K	12.5	14	17	16.5	20	23	26.5	30.5
L	0.5	0.5	1	1.5	1	1	1.5	2
M	5	5	5	5	6	8	10	4
N $^{0}_{-0.1}$	20.1	20.2	22	27.5	27.9	32	34.9	40.9
Ø O h7	72	86	113	127	148	158	186	212
Ø P	70	85	112	126	147	157	185	210
Ø Q	58	73	96	109	127	137	161	186
Ø R H7	14	20	26	32	32	40	46	142
Ø S	10	15	20	24	25	32	38	44
Ø T h7	56	67	90	110	124	135	156	177
Ø U H7	12	14	14	14	19	19	22	24
V	13.8 $^{-0.1}_{0}$	16.3 $^{-0.1}_{0}$	16.3 $^{-0.1}_{0}$	16.3 $^{-0.1}_{0}$	21.8 $^{-0.1}_{0}$	21.8 $^{-0.1}_{0}$	24.8 $^{-0.1}_{0}$	27.3 $^{-0.2}_{0}$
W Js9	4	5	5	5	6	6	6	8
Ø X	32	42	55	68	82	84	100	110
Y	8	8	8	8	8	8	8	8
Z	M6 x 9	M8 x 12	M10 x 15	M10 x 15	M12 x 18	M14 x 21	M16 x 24	M16 x 24
Ø a	82	96	125	144	164	174	206	236
b	6	8	12	8	12	12	12	8
Ø c	5.5	5.5	6.6	9	9	9	11	14
f	6	8	12	8	12	12	12	8
g	M5	M5	M6	M8	M8	M8	M10	M12
h (O-Ring)	40.64 x 1.14	53.82 x 0.99	70.5 x 2	82.27 x 1.78	99.5 x 2	104.5 x 2	124.5 x 2	134.5 x 2
i (O-Ring)	66.5 x 2	79.5 x 2	104.5 x 2	124.5 x 2	144.5 x 2	154.5 x 2	179.5 x 2	204.5 x 2
Ø k	45	58	78	90	107	112	135	155
Ø m	15.5	20	27	34	36	39	46	56
r	23.6	30	38.2	41	47.3	55	65.1	68.8
t	1.8	1.8	1.8	4	4.3	3	4.5	5.3
u	5.6	7	9.2	11.5	13.8	16	18.3	18.3
Ø v	10	15	20	24	25	32	38	44
Ø y	21	26	26	32	32	32	40	48

Torsional Stiffness

Table 20

CSF-2UH Size		14	17	20	25	32	40	45	50	58	65
T_1 in Nm		1.96	3.9	7	14	29	54	76	108	168	235
T_2 in Nm		6.9	11.8	25	48	108	196	275	382	598	843
i=50	K_1 in Nm/rad	$0.337x10^4$	$0.81x10^4$	$1.3x10^4$	$2.5x10^4$	$5.4x10^4$	$1.0x10^5$	$1.5x10^5$	$2.0x10^5$	$3.1x10^5$	$4.4x10^5$
	K_2 in Nm/rad	$0.472x10^4$	$1.08x10^4$	$1.8x10^4$	$3.4x10^4$	$7.8x10^4$	$1.4x10^5$	$2.0x10^5$	$2.7x10^5$	$4.4x10^5$	$6.1x10^5$
	K_3 in Nm/rad	-	-	$2.3x10^4$	$4.4x10^4$	$9.8x10^4$	$1.8x10^5$	$2.6x10^5$	$3.4x10^5$	$5.4x10^5$	$7.8x10^5$
i>50	K_1 in Nm/rad	$0.472x10^4$	$1.01x10^4$	$1.6x10^4$	$3.1x10^4$	$6.7x10^4$	$1.3x10^5$	$1.8x10^5$	$2.5x10^5$	$4.0x10^5$	$5.4x10^5$
	K_2 in Nm/rad	$0.610x10^4$	$1.35x10^4$	$2.5x10^4$	$5.0x10^4$	$1.1x10^5$	$2.0x10^5$	$2.9x10^5$	$4.0x10^5$	$6.1x10^5$	$8.8x10^5$
	K_3 in Nm/rad	$0.710x10^4$	$1.55x10^4$	$2.9x10^4$	$5.7x10^4$	$1.2x10^5$	$2.3x10^5$	$3.3x10^5$	$4.4x10^5$	$7.1x10^5$	$9.8x10^5$

Definition of T_1, T_2, K_1, K_2, and K_3 see page 8.

To convert from Nm to lb-in or from Nm/rad to lb-in/rad, multiply the value in the table by 8.85

Accuracy

Table 21

Accuracy of CSF-2UH Units in [arc min]				
CSF-2UH Size	Lost Motion	Repeatability (arc sec)*	Positioning Accuracy	Hysteresis
14,17	0.7	±0.7	<1.5	<1
20–65	0.7	±0.5	<1 (0.5)**	<1

Definitions see pages 7 and 8. *typical value ** on request

Accuracy of the Oldham coupling

In the region of tooth engagement harmonic drive component sets have no backlash. If an Oldham coupling is used for the compensation of eccentric errors of motor shafts, a small backlash in the range of a few seconds of arc can occur at the output shaft, as listed in table 22.

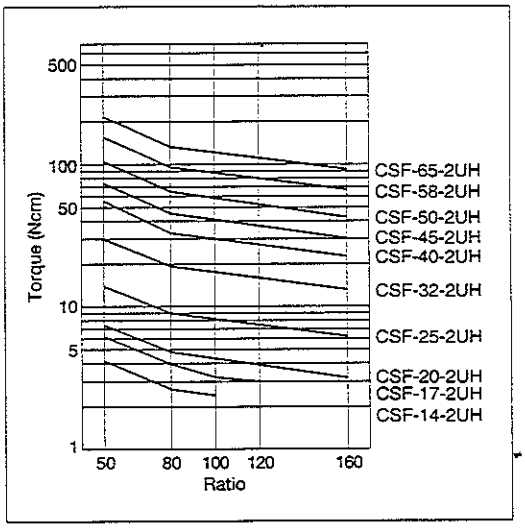
arc sec

Table 22

CSF-2UH Size	14	17	20	25	32	40	45	50	58	65
Ratio 50	36	20	17	17	14	14	12	12	10	10
Ratio 80	23	13	11	11	9	9	8	8	6	6
Ratio 100	18	10	9	9	7	7	6	6	5	5
Ratio 120	–	8	8	8	6	6	5	5	4	4
Ratio 160	–	–	6	6	5	5	4	4	3	3

No-load Starting Torque

The no-load starting torque is the torque required to commence rotation of the Wave Generator (high speed side) with no load applied to the output element (low speed side). The approximate range for no-load starting torque, based on tests of actual production units, is shown on the right.

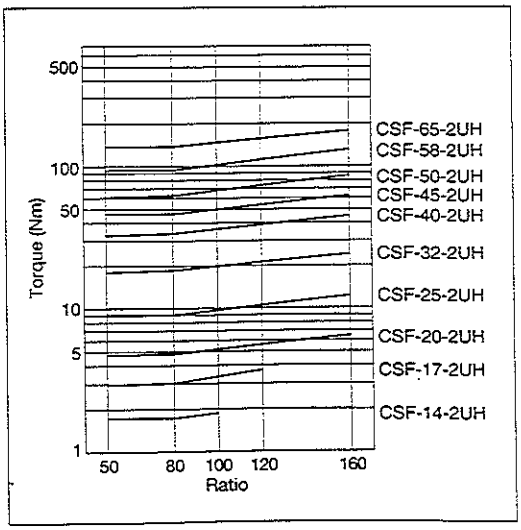


No-load Back Driving Torque

The no-load back driving torque is the torque required to commence rotation of the Flexspline (low speed side) with no load applied to the Wave Generator (high speed side).

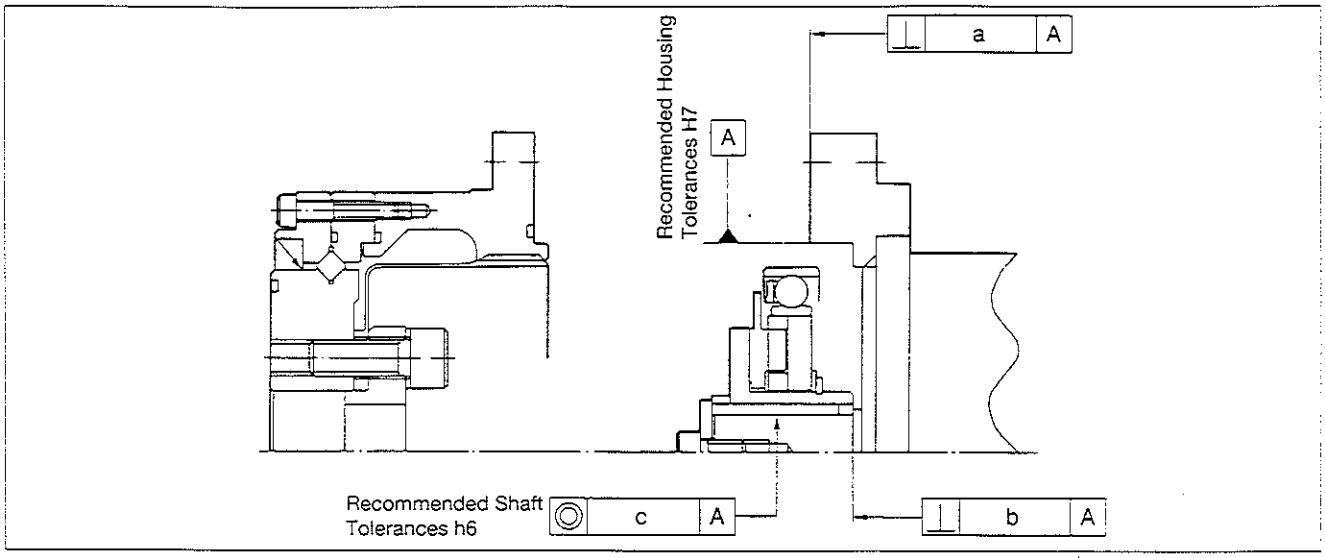
The approximate range for no-load back driving torque, based on tests of actual production units, is shown on the right.

In no case should the values given be regarded as a margin in a system that must hold an external load. Where back driving is not permissible, a brake must be used.



Recommended Tolerances for Assembly

In order for the performance of the CSF-2UH units to be fully realized, it is essential that the following tolerances be observed for the input assembly.



mm

Table 23

CSF-2UH Size	14	17	20	25	32	40	45	50	58	65
a	0.011	0.015	0.017	0.024	0.026	0.026	0.027	0.028	0.031	0.034
b	0.017 (0.008)	0.020 (0.010)	0.020 (0.010)	0.024 (0.012)	0.024 (0.012)	0.032 (0.012)	0.032 (0.013)	0.032 (0.015)	0.032 (0.015)	0.032 (0.015)
c	0.030 (0.016)	0.034 (0.018)	0.044 (0.019)	0.047 (0.022)	0.050 (0.022)	0.063 (0.024)	0.065 (0.027)	0.066 (0.030)	0.068 (0.033)	0.070 (0.035)

( ) The values in brackets are the recommended tolerances for CSF-2UH Units featuring a Wave Generator without Oldham coupling. This coupling serves to compensate for eccentricity of the input shaft and is available in the standard version. For the direct mounting of a Wave Generator without oldham coupling (optional) on a motor shaft, the shaft tolerances must fulfill the DIN 42955 R standard.

Housing and Output Flange Assembly

Output Flange

Table 24

CSF-2UH Size		14	17	20	25	32	40	45	50	58	65
Number of screws		6	6	8	8	8	8	8	8	8	8
Size of screws		M4	M5	M6	M8	M10	M10	M12	M14	M16	M16
Pitch circle diameter	[mm]	23	27	32	42	55	68	82	84	100	110
Clamp torque/screw	[Nm]	4.5	9	15.3	37	74	74	128	205	319	319
Torque transmitting capacity*	[Nm]	48	91	206	490	1010	1240	2200	3070	4980	5480

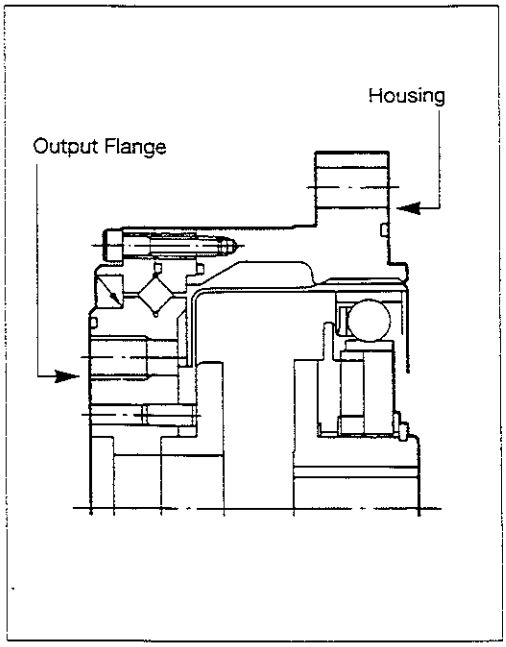
* Friction coefficient μ= 0.15

Housing

Table 25

CSF-2UH Size		14	17	20	25	32	40	45	50	58	65
Number of screws		6	6	6	8	12	8	12	12	12	8
Size of screws		M4	M4	M5	M5	M6	M8	M8	M8	M10	M12
Pitch circle diameter	[mm]	65	71	82	96	125	144	164	174	206	236
Clamp torque/screw	[Nm]	4.5	4.5	9	9	15.3	37	37	37	74	128
Torque transmitting capacity*	[Nm]	137	147	274	431	1200	1680	2860	3040	5670	6310

* Friction coefficient μ= 0.15



Output Bearing Ratings

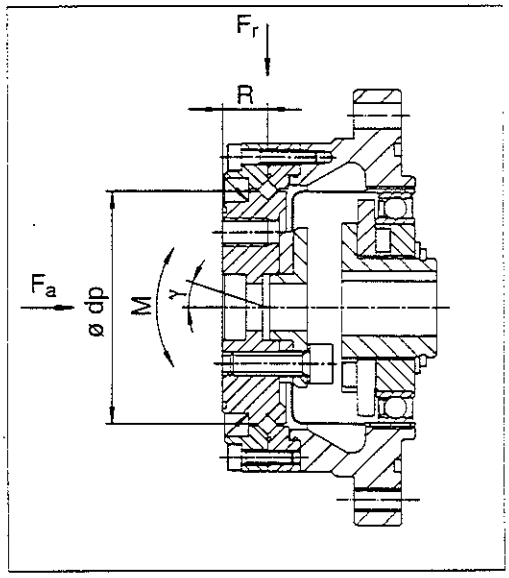
CSF-2UH housed units incorporate a high stiffness cross roller bearing to support output loads. This specially developed bearing can withstand high axial and radial forces as well as high tilting moments. The reduction gear is thus protected from external loads, guaranteeing a long life and consistent performance. The integration of an output bearing also serves to reduce subsequent design and production costs, by removing the need for additional output bearings in many applications. Furthermore, installation and assembly of the reduction gear is greatly simplified. The following table lists ratings and important dimensions for the output bearings.

Table 26

CSF-2UH Size	Pitch Circle Ø d_p [m]	Offset R [mm]	Dynamic load ratings C [N]	Static load rating C_O [N]	Permissible[1] dynamic Tilting Moment M [Nm]	Permissible[2] static Tilting Moment M_0 [Nm]	Moment Stiffness K_B [Nm/arcmin]	Permissible[1] Axial Load F_a [N]	Permissible[1] Radial Load F_r [N]
14	0.035	9.5	4740	6070	41	53	13	3374	2256
17	0.0425	9.5	5290	7550	64	80	22.5	3207	2148
20	0.050	9.5	5780	9000	91	113	37	3511	2354
25	0.062	11.5	9600	15100	156	234	70	5827	3904
32	0.080	13.0	15000	25000	313	500	157	7926	6101
40	0.096	14.5	21300	36500	450	876	265	11242	8652
45	0.111	15.5	23000	42600	686	1182	410	12174	9368
50	0.119	18.0	34800	60200	759	1791	497	18393	14155
58	0.141	20.5	51800	90400	1180	3187	823	27409	21091
65	0.160	22.5	55600	103000	1860	4120	1175	29371	22602

1) These values are valid for dynamic load.
For M : F_a = 0; F_r = 0
F_a : M = 0; F_r = 0
F_r : M = 0; F_a = 0

2) These values are valid for f_s = 2
for other f_s see equation 28 and 29



The angle of inclination of the output flange as a function of the tilting moment acting on the output bearing, can be calculated by means of the equation below:

$$\gamma = \frac{M}{K_B} \qquad \text{[Equation 27]}$$

Where:
- γ (arc min) = Angle of inclination deviation of the output flange
- M (Nm) = Tilting moment acting on the output bearing
- K_B (Nm/arc min) = Moment stiffness of the output bearing

Calculation of the static tilting moment

$$f_s = \frac{C_0}{P_0} \quad \text{with} \quad P_0 = x_0 \left(F_r + \frac{2M}{d_p}\right) + y_0 \cdot F_a \qquad \text{[Equation 28]}$$

and so

$$M = \frac{d_p \cdot C_0}{2 \cdot f_s} \qquad \text{[Equation 29]}$$

Table 27

Rotation Conditions	Load Conditions	Lower limit value for f_s
Normally not rotating	Slight oscillations	0.5
	Impact loads	1 – 1.5
Normally rotating	Normal loads	1 – 2
	Impact loads	2 – 3

In case of static overload, the bearings load capacity can be determined as follows:

- f_s = static load safety factor (f_s = 0.5 ... 3)
- C_0 = static load rating (see table 26)
- F_r = F_a = 0
- x_0 = 1
- y_0 = 0.44
- P_0 = static equivalent load
- d_p = pitch circle diameter of the output bearing

Output Bearing Life

Because the cross roller bearing used for the output flange is very robust, it may handle very high loads yet provide a long service life. The life of the output bearing may be calculated for specific operating conditions by using equation 30.

$$L_{10} = \frac{10^6}{60 \cdot n} \cdot \left(\frac{C}{f_w \cdot P_c}\right)^{10/3} \quad \text{[Equation 30]}$$

where: L_{10} [h] = Operating life
n [rpm] = Actual output speed
C [N] = Dynamic load rating
P_c [N] = Dynamic equivalent load
f_w = Dynamic load safety factor

Values for fw: Slight oscillations: $f_w = 1.3$
Impact loads: $f_w = 2.3$

Calculation of the dynamic equivalent load

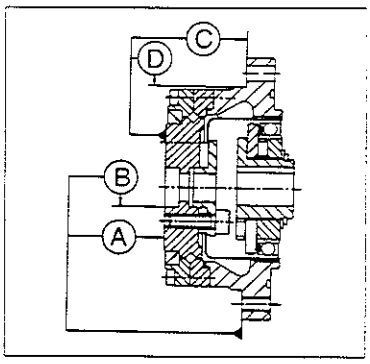
$$P_c = x \cdot \left(F_r + \frac{2M}{d_p}\right) + y \cdot F_a \quad \text{[Equation 31]}$$

where: F_r [N] = Radial force
F_a [N] = Axial force
M [Nm] = Tilting moment
d_p [m] = Pitch circle (see table 26)
x = Radial load factor (see table 28)
y = Axial load factor (see table 28)

Table 28

Load Factors	x	y
$\frac{F_a}{F_r + 2M/d_p} \leq 1.5$	1	0.45
$\frac{F_a}{F_r + 2M/d_p} > 1.5$	0.67	0.67

Output Bearing Tolerances



mm Table 29

CSF Size	A	B	C	D
14	0.010	0.010	0.024	0.015
17	0.010	0.012	0.026	0.018
20	0.010	0.012	0.038	0.019
25	0.015	0.013	0.045	0.022
32	0.015	0.013	0.056	0.022
40	0.015	0.015	0.060	0.024
45	0.018	0.015	0.068	0.027
50	0.018	0.015	0.069	0.030
58	0.018	0.017	0.076	0.032
65	0.018	0.017	0.085	0.035

Ordering Information

Model	Size	Ratio	Output assembly	Options
CSF Harmonic drive gearing with shortened Flexspline and "S" tooth profile	14 17 20 25 32 40 45 50 58 65 80 90 100	50 80 100 50 80 100 120 50 80 100 120 160 50 80 100 120 160 50 80 100 120 160 50 80 100 120 160 50 80 100 120 160 50 80 100 120 160 50 80 100 120 160 50 80 100 120 160 50 80 100 120 160 50 80 100 120 160 50 80 100 120 160	2A-R Component Set (size 14, 17) 2A-GR Component Set (size 20 to 100) 2UH Housed Unit with integral output bearing (size 14 to 65)	Our technical team will be pleased to assist you with special options and their ordering code

CSF - 25 - 100 - 2UH - SP

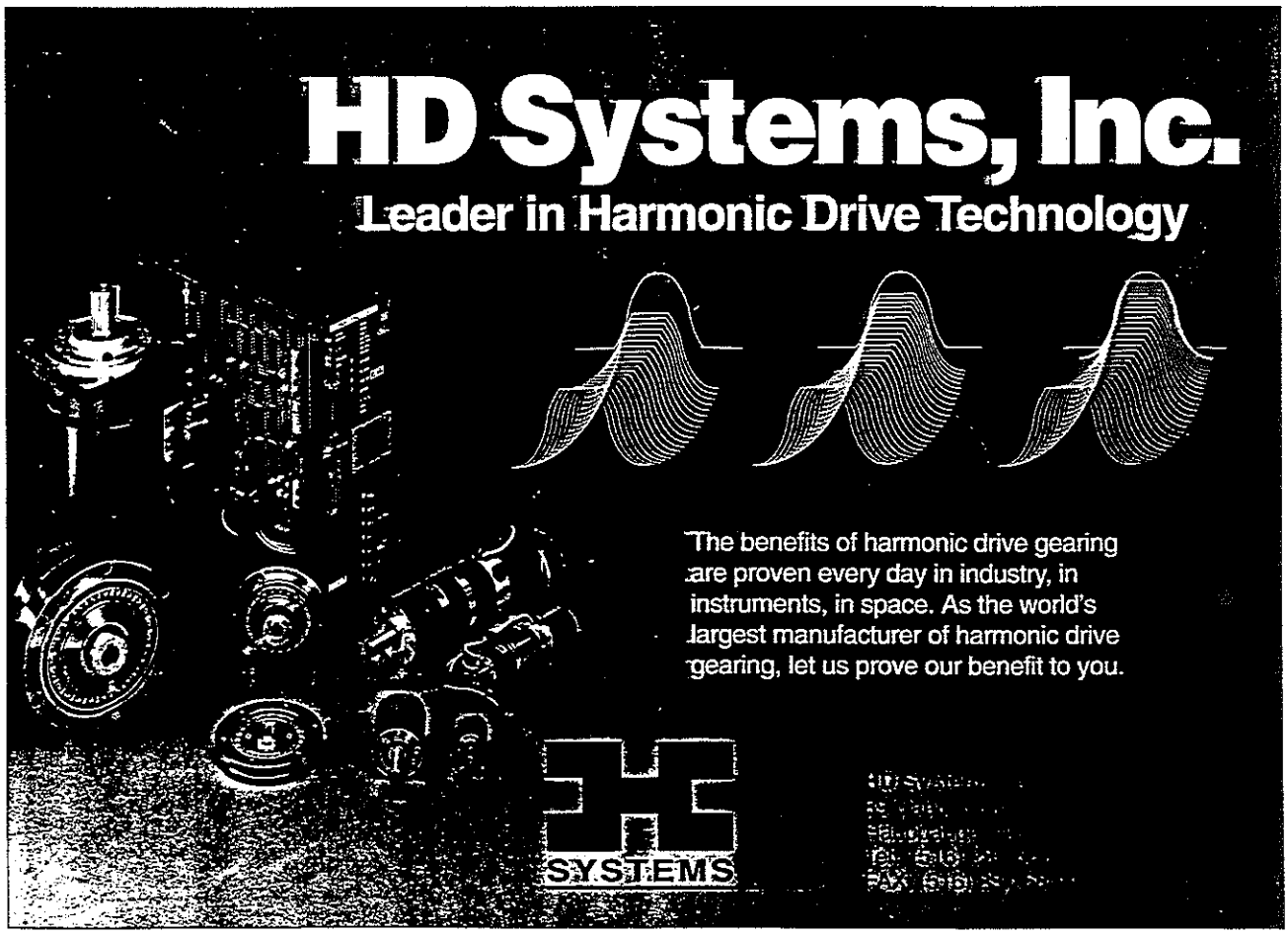
Other Products From HD Systems

Gearing

HDUC	Cup Type Component Sets
SHF	Hollow Shaft Gearheads and Components
HDUF	Pancake Type Component Sets
HDUR/HIUR	Heavy Duty Pancake Components
HDUA	Harmonic Drive Differential Gearing
RHS/RFS-CC	Precision Close Couple Gearheads
CP/HP	Precision Planetary Gearheads

Motion Control

RH Mini series	Miniature DC Servo Actuators
RHS/RFS	High Torque DC Servo Actuators
RS Mini series	Miniature Brushless Servo Actuators
RSS/RKS	High Torque Brushless Servo Actuators
FHA	Hollow Shaft Brushless Servo Actuators
LA	High Precision Linear Servo Actuators
HS	DC Servo Controller
HA	Brushless DC Servo Controller



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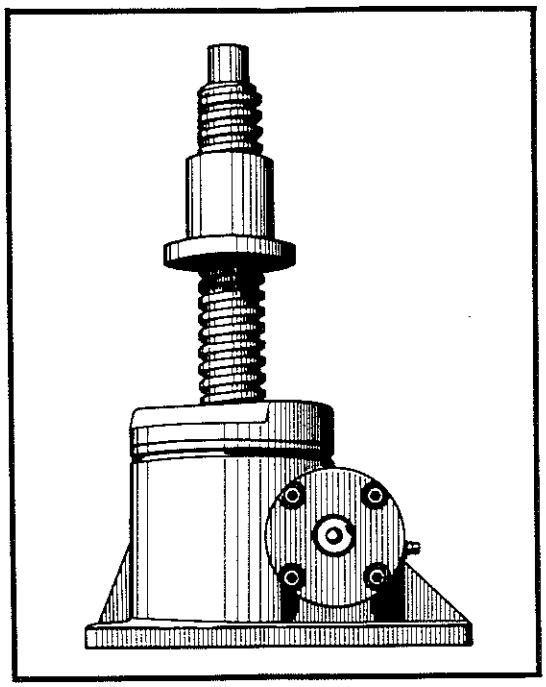
Duff-Norton®

MAINTENANCE INSTRUCTIONS
WITH PARTS LIST
PUBLICATION PART NO. SK-2389-R

ROTATING MACHINE SCREW ACTUATORS



SERIES
1800
9000

IMPORTANT — CAUTION

This manual contains important information for the correct installation, operation and maintenance of the equipment described herein. All persons involved in such installation, operation, and maintenance should be thoroughly familar with the contents. To safeguard against the possibility of personal injury or property damage, follow the recommendations and instructions of this manual and keep it for further reference.

WARNING

The equipment shown in this manual is intended for industrial use only and should not be used to lift, support, or otherwise transport people.

Duff-Norton

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SECTION I

GENERAL INFORMATION

1-1. General

This manual contains maintenance instructions for Duff-Norton® 1800 and 9000 Series rotating machine screw actuators. It describes and details procedures for disassembly, cleaning, inspection, rebuilding and assembly of these actuators.

1-2. Industrial Use Only

The rotating machine screw actuators described and illustrated in this manual are intended for industrial use only and should not be used to lift, support or otherwise transport people unless you have a written statement from Duff-Norton Company which authorizes the specific actuator unit, as used in your application, as suitable for moving people.

1-3. Specifications

TABLE 1. 1800 AND 9000 SERIES ROTATING MACHINE SCREW ACTUATORS

Actuator Number	Upright (UM)	1803 & 9003	9006	9011	9016	9021	9026	9036	1851	1897	18151
	Inverted (DM)	1803 & 9003	9006	9011	9016	9021	9026	9036	1851	1897	18151
Rated Load (tons)		2	5	10	15	20	25	35	50	100	150
Diameter of Lifting Screw (inches)		1 .250 Pitch Acme	1½ .375 Pitch Square	2 .500 Pitch Square	2¼ .500 Pitch Square	2½ .500 Pitch Square	3⅜ .666 Pitch Square	3¾ .666 Pitch Square	4½ .666 Pitch Square	6 .750 Pitch Square	7 1.000 Pitch Square
Base Size (in)		3½×7**	6×8	7½×8¾	7¾×9¼	8¾×11	10¼×13¾	10¼×15½	9¾×19¾	20¾×24½	20¾×24½
Worm Gear Ratios	Std. Ratio	6:1	6:1	8:1	8:1	8:1	10⅔:1	10⅔:1	10⅔:1	12:1	12:1
	Optional	24:1	24:1	24:1	24:1	24:1	32:1	32:1	32:1	36:1	36:1
Turns of Worm for 1" Raise	Std. Ratio	24	16	16	16	16	16	16	16	16	12
	Optional	96	64	48	48	48	48	48	48	48	36
Maximum H.P. Per Actuator	Std. Ratio	¼	¾	1½	1½	1½	2½	2½	6	11	11
	Optional	½	¾	1½	1½	1½	2½	2½	6	11	11
Torque at Full Load* (in-lbs)	Std. Ratio	120	450	950	1,430	2,050	3,360	4,600	7,500	16,000	28,100
	Optional	50	185	490	820	1,170	1,900	2,750	4,200	8,600	15,500
Jack Efficiency Rating (%)	Std. Ratio	23.2	22.1	22.0	20.2	18.8	16.4	15.2	13.8	13.0	14.1
	Optional	13.3	12.1	14.0	12.9	20.2	9.2	8.5	8.3	8.0	8.6
Weight with Base Raise of 6" (lb)		17	35	52	66	93	181	240	410	1,200	1,350
Weight for Each Additional 1" Raise (lb)		.33	.85	1.4	1.5	2.6	3.5	4.1	5.5	9.0	12.6

* For loads of from 25% to 100% of Actuator load rating. Torque requirements are approximately proportional to the load.

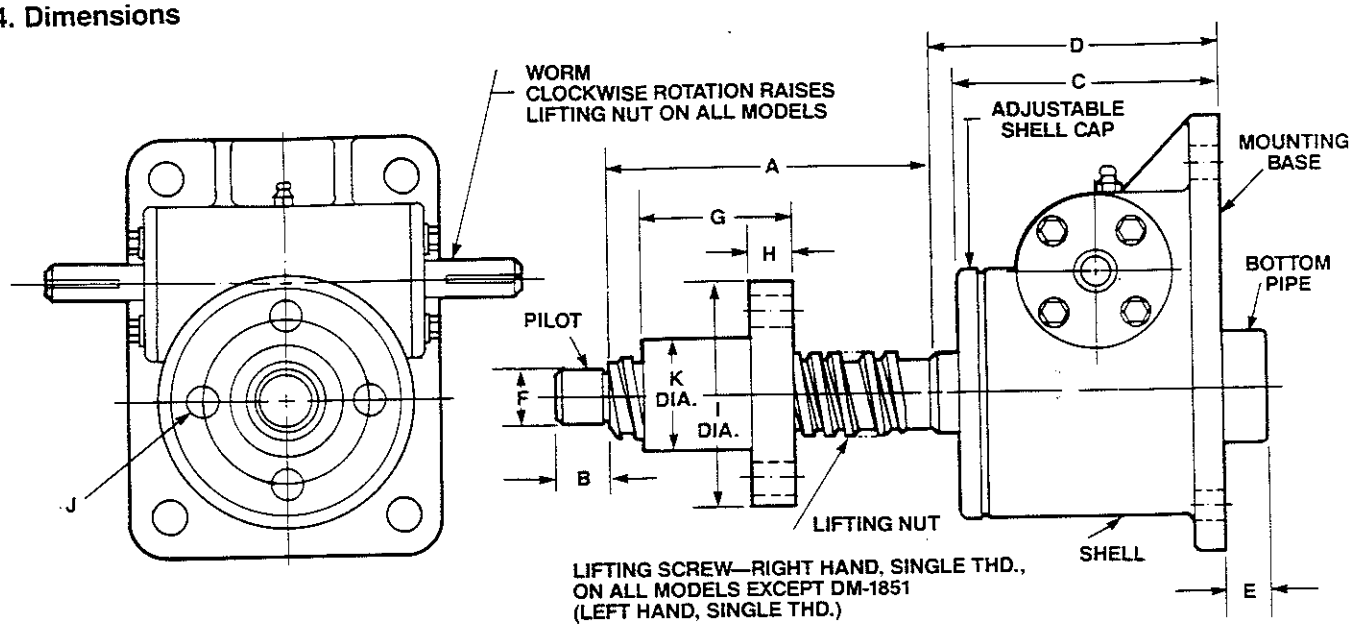
** 9003 base is 4¼ × 6¼.

TABLE 2. DECIMAL RATIOS

Actuator No.	Upright (UM)	1802 & 9002	9005	9010	9015	9020	9025
	Inverted (DM)	1801 & 9001	9004	9009	9014	9019	9024
Rated Load (tons)		2	5	10	15	20	25
Lifting Screw		1" Dia. .250 Pitch Acme	1½" Dia. .250 Pitch Acme	2" Dia. .250 Pitch Acme	2¼" Dia. .250 Pitch Acme	2½" Dia. .250 Pitch Acme	3⅜" Dia. .320 Pitch Square
Worm Gear Ratio		25:1	25:1	25:1	25:1	25:1	32:1
Turns of Worm for 1" Raise		100	100	100	100	100	100
Torque at Full Load (in-lbs)		48	175	370	640	925	1500
Actuator Efficiency Rating %		13.2	9.1	8.6	7.5	6.9	5.3
Maximum H.P. per Actuator		½	¾	1½	1½	1½	2½

NOTE: All other data for these models same as shown in Table 1.

1-4. Dimensions



NOTE: HOUSING DIMENSIONS AND BASE CONFIGURATIONS VARY. DIMENSIONS NOT SHOWN ARE SAME AS TRANSLATING SCREW UNITS.

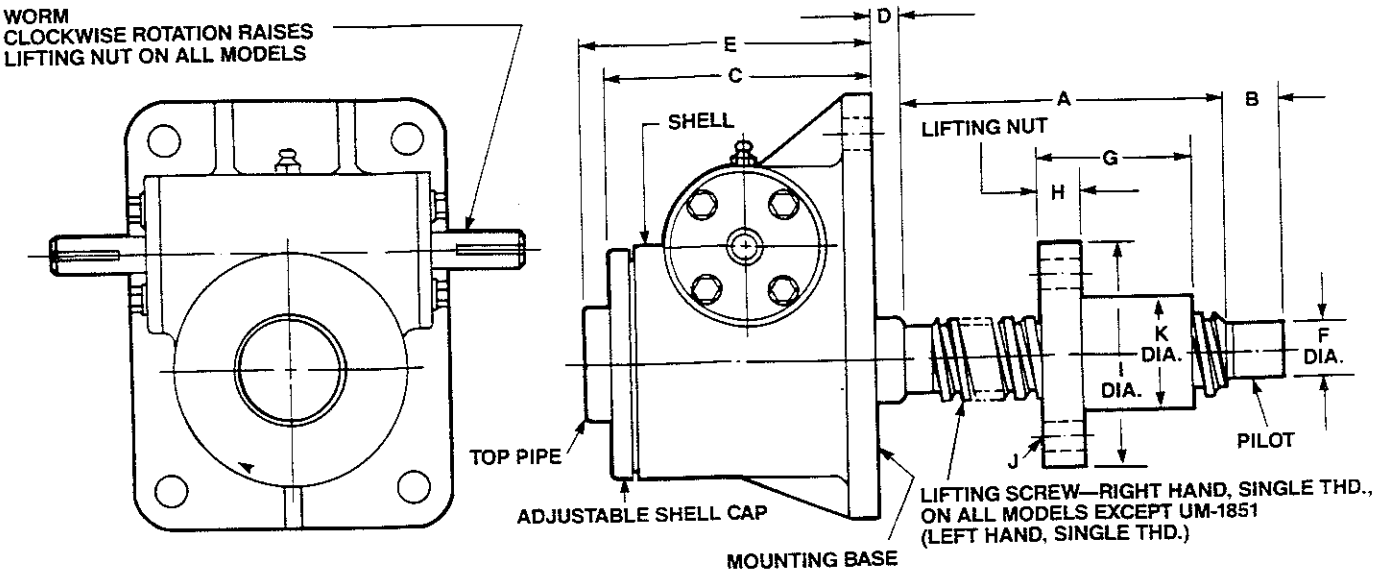
WORM GEAR RATIOS AND NO. OF TURNS FOR 1" RAISE SAME AS 1800 AND 9000 SERIES.

TABLE 3. UPRIGHT MODELS

Model Number	Rating	Drawing Ref.	A	B	C	D	E	F	G	H	I	J	K
UM-1803	2 TON	1802	RAISE + 2⅜	¾	4 1/16	C	0	.625	1½	½	3¼	4 Holes - 13/32 Dia. on 2⅜ Dia. B.C.	1½
UM-9003	2 TON	9002	RAISE + 2⅜	¾	4 1/16	C	0	.625	1½	½	3¼	4 Holes - 13/32 Dia. on 2⅜ Dia. B.C.	1½
UM-9006	5 TON	9005	RAISE + 3	1	5¼	C	0	1.000	2½	¾	4	4 Holes - 9/16 Dia. on 3 Dia. B.C.	2
UM-9011	10 TON	9010	RAISE + 4	2	5⅝	C	¾	1.249	3	1	6	4 Holes - 13/16 Dia. on 4½ Dia. B.C.	3
UM-9016	15 TON	9015	RAISE + 4	2	6 5/16	C	1	1.500	3	1	6½	4 Holes - 13/16 Dia. on 5 Dia. B.C.	3½
UM-9021	20 TON	9020	RAISE + 5	2½	7⅛	C	1½	1.750	3	1	7½	4 Holes - 15/16 Dia. on 5½ Dia. B.C.	3¾
UM-9026	25 TON	9025	RAISE + 7	3	8⅞	12	2	2.500	5½	1¼	8½	4 Holes - 1 1/16 Dia. on 6½ Dia. B.C.	4½
UM-9036	35 TON	9035	RAISE + 6	3½	8⅞	C	2	3.000	5½	1½	9	4 Holes - 1 1/16 Dia. on 7 Dia. B.C.	5
UM-1851	50 TON	1850	RAISE + 7	4	10⅞	12	2½	3.500	6	2	10	6 Holes - 1 1/16 Dia. on 8 Dia. B.C.	6
UM-1897	100 TON	1899	RAISE + 8	5	17	19	5	5.000	7	2	14	6 Holes - 1⅛ Dia. on 11 Dia. B.C.	8
UM-18151	150 TON	18150	RAISE + 9¾	5½	17	19	3½	5.500	8¾	2½	15½	6 Holes - 1½ Dia. on 12 1/2 Dia. B.C.	9

Note: Dimensions are subject to change without notice.

1-4 Dimensions (Cont.)



NOTE: HOUSING DIMENSIONS AND BASE CONFIGURATIONS VARY. DIMENSIONS NOT SHOWN ARE SAME AS TRANSLATING SCREW UNITS.

WORM GEAR RATIOS AND NO. OF TURNS FOR 1" RAISE SAME AS 1800 AND 9000 SERIES.

TABLE 4. INVERTED MODELS

Model Number	Rating	Drawing Ref.	A	B	C	D	E	F	G	H	I	J	K
DM-1803	2 TON	1802	RAISE + 2⅜	¾	3¾	⅝	C	.625	1½	½	3¼	4 Holes - 13/32 Dia. on 2⅜ Dia. B.C.	1½
DM-9003	2 TON	9002	RAISE + 2⅜	¾	3¾	⅝	C	.625	1½	½	3¼	4 Holes - 13/32 Dia. on 2⅜ Dia. B.C.	1½
DM-9006	5 TON	9005	RAISE + 3	1	4¾	2	C	1.000	2½	¾	4	4 Holes - 9/16 Dia. on 3 Dia. B.C.	2
DM-9011	10 TON	9010	RAISE + 4	2	5⅝	1⅛	C	1.249	3	1	6	4 Holes - 13/16 Dia. on 4½ Dia. B.C.	3
DM-9016	15 TON	9015	RAISE + 4	2	5½	13/16	6½	1.500	3	1	6½	4 Holes - 13/16 Dia. on 5 Dia. B.C.	3½
DM-9021	20 TON	9020	RAISE + 5	2½	7⅛	⅝	7⅝	1.750	3	1	7½	4 Holes - 15/16 Dia. on 5½ Dia. B.C.	3¾
DM-9026	25 TON	9025	RAISE + 7	3	8⅞	1½	9⅞	2.500	5½	1¼	8½	4 Holes - 1 1/16 Dia. on 6½ Dia. B.C.	4½
DM-9036	35 TON	9035	RAISE + 6	3½	8⅞	⅞	9⅞	3.000	5½	1½	9	4 Holes - 1 1/16 Dia. on 7 Dia. B.C.	5
DM-1851	50 TON	1850	RAISE + 7	4	10⅞	2⅝	11½	3.500	6	2	10	6 Holes - 1 1/16 Dia. on 8 Dia. B.C.	6
DM-1897	100 TON	1899	RAISE + 8	5	17	2	18	5.000	7	2	14	6 Holes - 1⅛ Dia. on 11 Dia. B.C.	8
DM-18151	150 TON	18150	RAISE + 9¾	5½	17	2	17	5.500	8¾	2½	15½	6 Holes - 1½ Dia. on 12½ Dia. B.C.	9

Note: Dimensions are subject to change without notice.

1-5. Important Precautions

In order to ensure that Duff-Norton® rotating machine screw actuators provide good service over a period of years the following precautions should be taken:

1. Select an actuator that has a load rating greater than the maximum load that may be imposed on it.
2. The structure on which the actuators are mounted should have ample strength to carry the maximum load, and should be rigid enough to prevent undue deflection or distortion of the actuator supporting members.
3. It is essential that the actuators be carefully aligned during installation so that the lifting screws are perfectly plumb and the connecting shafts are exactly in line with the worm shafts. After the actuators, shafting, gear boxes, etc., are coupled together, it should be possible to turn the main drive shaft by hand. If there are no signs of binding or misalignment, the actuator system is then ready for normal operation.
4. Rotating screw actuators should have a greater raise than is needed in the actual installation. Should it be necessary to operate these actuators at the extreme limits of travel, it should be done cautiously.

CAUTION

Do not allow actuator travel to go beyond catalog closed height (A), or serious damage to lifting nut or the internal actuator mechanism may result. Refer to tables of specifications (par. 1-4) for closed height (A) of respective units.

5. The worm shaft speed for these actuators should not exceed 500 RPM for heavy loads, 1200 RPM for light loads of one-fourth (or less) of the actuator load rating.
6. The rotating screw should not be permitted to accumulate dust and grit on the threads. If possible, screws should be protected by some means such as a boot.

CAUTION

Rotating screws should never be run dry. Inspect frequently at regular intervals to be certain that a lubricating film is present.

NOTE

For loads of from 25% to 100% of actuator capacity, torque requirements are approximately proportioned to the load, except for very light loads.

7. **Models 1803 & 9003 - 2 Ton, 9006 - 5 Ton, 9011 - 10 Ton and 9015 - 15 Ton are self-lowering and these units require a brake or other hold back device.**

   Other capacities are self-locking in most cases. If vibration is present a brake or other hold back device should be used. When in doubt, Duff-Norton Co. should be consulted.

8. The lubrication procedures for normal and severe service conditions, as described in Section II, paragraph 2-1, should be closely followed.

1-6. Warranty and Warranty Repair

Subject to the conditions stated herein, Duff-Norton will repair or replace, without charge, any parts proven to Duff-Norton's satisfaction to have been defective in material or workmanship. Claims must be made within one year after date of shipment. Duff-Norton will not repair or replace any parts that become inoperative because of improper maintenance, eccentric loading, overloading, chemical or abrasive action, excessive heat, or other abuse.

Equipment and accessories not of Duff-Norton's manufacture are warranted only to the extent that they are warranted by the manufacturer, and only if the claimed defect arose during normal use, applications and service. Equipment which has been altered or modified by anyone without Duff-Norton's authorization is not warranted by Duff-Norton. EXCEPT AS STATED HEREIN, DUFF-NORTON MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

If you have any questions concerning warranty repair, please contact the Duff-Norton Company.

Authorization for return must be received from the Duff-Norton Company before returning any equipment for inspection or warranty repair.

SECTION II

MAINTENANCE

2-1. Lubrication

Unless otherwise specified, actuators and gear boxes are shipped packed with grease which should be sufficient for one month of normal operation. For normal operation, the actuator and gear boxes should be lubricated once a month using one of the following Extreme Pressure greases or their equivalent:

Socony Mobile Oil Co.	Mobilplex E.P.#1
Texaco	Texaco E.P. #1
Gulf Oil Corp.	Gulf Crown E.P.#1
Shell Oil Co.	Shell Alvania E.P. #1

For severe service conditions, the actuators should be lubricated more frequently using one of the above greases (daily to weekly depending on conditions). If duty is heavy, an automatic lubrication system is strongly recommended. If ambient temperatures exceed 200° F, consult lubricant manufacturers.

CAUTION

Rotating screws should never be run dry. Inspect frequently at regular intervals to be certain that a lubricating film is present.

2-2. Rebuild Procedure

Duff-Norton recommends the following procedures for assembly and disassembly of machine screw actuators.

1. Tag critical parts to facilitate reassembly.
2. Mark mating surfaces to ensure proper meshing.
3. Clean and lubricate all parts as required.
4. All seals must be replaced when rebuilding.
5. All screws, washers and other small common parts must be replaced if damaged in any way.
6. Replace damaged or frozen lubrication fittings with new ones.

2-3. Required Tools

A bearing puller and press, soft jaw table clamp and common hand tools are necessary for proper assembly and disassembly.

2-4. Disassembly (Refer to Figure 3-1)

1. Remove lifting nut (23) from screw (5).
2. Remove pipe (4) from shell (3) for upright units or shell cap (2) for inverted units.

   NOTE

   Upright and inverted 2-ton and 5-ton units and 10-ton inverted units are sealed with an expansion plug (4a) instead of a pipe (4). If necessary, these can be removed later.

3. **FOR ALL MODELS EXCEPT 100 and 150-TON**—Remove set screw (1) from shell cap (2) and remove shell cap from shell (3).

   FOR 100 AND 150-TON MODELS—Remove lock screw from shell (3) and remove base plate from shell (3).

   NOTE

   It may be necessary to tap on shell cap (2) or shell (3) with a hammer to loosen shell cap or base plate for removal.

4. Remove lifting screw (5) and gear (6) from shell (3). To allow gear and screw assembly to be removed more easily

loosen cap screws (9) holding flanges (11) and shift worm (14) slightly.

NOTE

On some units it may be necessary to remove worm (14) before removing screw and gear assembly. See steps 6 and 7.

. Remove top bearing (7) which may be attached to either shell cap (2) or worm gear (6).

FOR 100 AND 150-TON MODELS - this will be the bottom load bearing (8) in base plate.

CAUTION

If necessary, tap bearing loose with only a soft plastic or wooden mallet.

6. Remove cap screws (9), lockwashers (10) and remove flanges (11).

NOTE

Be careful not to lose flange shims (12).

7. Remove worm (14) and worm bearings (15) from shell (3) by striking end of worm shaft (14) with a soft-head hammer or mallet.

3. Remove bottom load bearing (8), which may be attached to either shell (3) or gear (6).

FOR 100 AND 150-TON MODELS - this will be top load bearing (7).

9. Press oil seals (13) out of flanges (11).

10. Remove worm bearings (15) from worm (14) with puller or press.

NOTE

This step is not necessary if worm or worm bearings are not damaged.

.1. Remove set screw (21) from locknut (20).

NOTE

Some models may not utilize set screw.

12. Restraining screw (5) from turning (use soft jaws), remove locknut (20) from screw (5).

NOTE

If all parts are to be reused, match-mark end of screw and locknut so that they can be reassembled in the same order.

3. Remove worm gear (6) from screw (5).

NOTE

It may be necessary to tap on worm gear. Use only a soft-head mallet. **Do not tap on gear teeth.**

14. Remove key (22) from screw (5).

5. **Inverted models** - remove guide bushing (16) from shell (3).

100 AND 150-TON MODELS - remove guide bushing (16) from base plate.

.6. For units with expansion plug (4a) in shell (3) or shell cap (2): if expansion plug is damaged and must be removed, drive or press plug out of shell (3) or shell cap (2) with a large die punch (1 " diameter).

Disassembly is now complete.

2-5. Cleaning

1. Use degreasing solvent to remove grease or oil from all parts.

CAUTION

Remove grease from unit and do not reuse old grease.

WARNING

Provide adequate ventilation during the use of cleaning agents; avoid prolonged breathing of fumes and contact with skin.

2. Use clean hot water or a soap solution for general cleaning of painted surfaces.
3. Dry parts thoroughly after cleaning.

NOTE

Before installing new parts, remove any rust preventive, protection grease, etc.

2-6. Inspection (Refer to Figure 3-1)

1. Make a visual inspection of shell (3) for broken, cracked or distorted areas. Check threads of all bores for burrs or broken threads.
2. Check shell cap (2), base plate, bottom pipe (4), lifting screw (5), lifting nut (23) and worm gear (6) for burrs or scratches on their working or mating surfaces.
3. Check fit between rotating screw thread and internal thread of lifting nut. If fit is excessively loose, replace lifting nut or rotating screw as required.
4. Check small common components (screws, etc.) and replace as required.
5. Check bearings (7 and 15) for seizure, galling or play and replace as required.

2-7. Assembly (Refer to Figure 3-1)

1. To replace expansion plug (4a) in 2 and 5-ton upright and inverted units and in 10-ton inverted models; refer to Figure 2-1. For upright models plug is installed in shell (3) (see Figure 3-1) and in shell cap (2) for inverted units (see Figure 3-1, Detail A).

   a. As is appropriate, set shell cap (2) or shell (3) over a steel bar which is approximately $\frac{1}{8}$" or $\frac{3}{16}$" shorter in height than the shell or shell cap. The diameter of the bar should be close to the I.D. of the shell or shell cap.

   b. Place expansion plug (4a) on the bar (concave surface down) and flatten the plug against the bar. Use a large diameter punch or press making sure that the plug is flattened throughout its entire diameter.

2. For models with tapered load bearings, press bearing cones on worm gear (6) with small end of cone facing away from gear surface. Be sure that cone is seated properly against shoulder.
3. Insert key (22) in screw (5).
4. Assemble worm gear (6) on screw (5). For counter-bored worm gears, counter-bore must face away from screw threads.

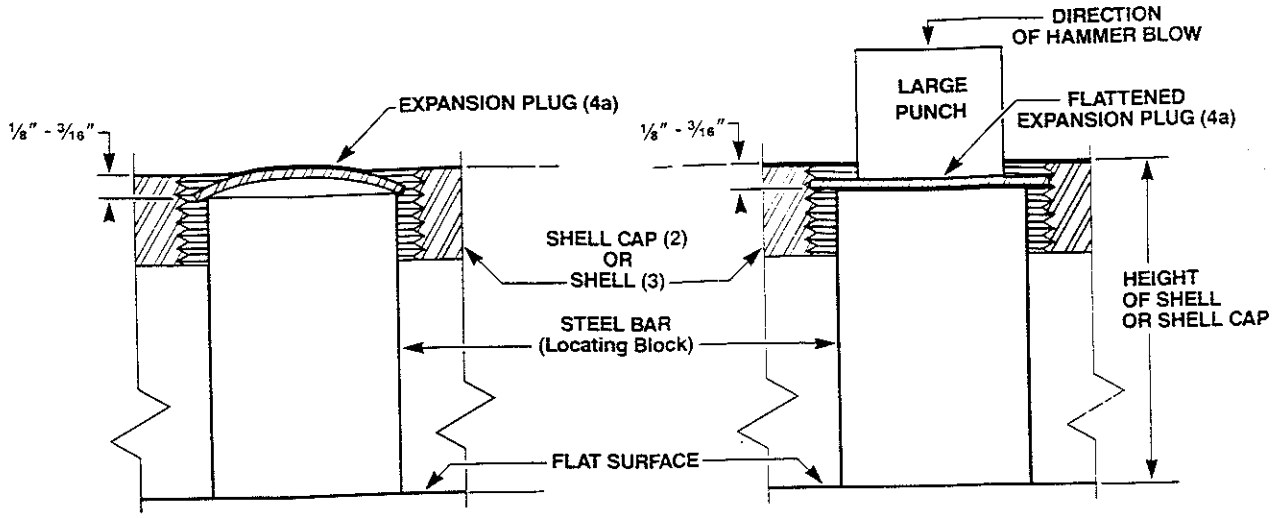


FIGURE 2-1. EXPANSION PLUG REPLACEMENT.

5. Thread locknut (20) onto screw (5) and turn tightly against gear (6). Be sure assembly is tightly drawn together. Install set screw (21) in locknut (20) and lock in place (if rotating screw or locknut are new, respot screw for set screw).

CAUTION

On some locknuts, the tapped set screw hole is not centered, and the locknut should be assembled with the tapped hole located as far as possible from the gear face.

6. Press worm bearings (15) onto worm (14), making certain that they are seated properly against the worm shoulder.

NOTE

When tapered roller bearings are used, the small end of the cone should point towards the end of the worm shaft.

7. **Inverted units only.** Install guide bushing (16) in shell (3). Guide bushing must be flush with base. Lock guide bushing in place by peening on the thread O.D. of the bushing and shell with a center punch.
8. Install bottom load bearing (8) [top load bearing (7) for 100 and 150-ton models] in shell (3).
9. Install worm (14) and bearing (or bearing cone) assembly (15) in shell. On units with tapered roller worm bearings, install bearing cups in shell.

NOTE

For some units, it is easier to assemble worm and bearing assembly after the worm gear is in place. (See Step 12.)

10. Press oil seal (13) into flanges (11).

NOTE

The sealing element of the seal should face inward.

11. Assemble worm flanges (11) with shims (12) and bolt in place with cap screws (9) and lock-washers (10). This should be accomplished carefully to prevent cutting of seal on worm keyway.
12. Install screw (5) and worm gear (6).

NOTE

For some units it is easier to install worm and bearing assembly after gear and screw assembly are in place (see Step 9).

NOTE

After worm, worm gear and screw assembly are in place with flanges assembled, strike each end of worm shaft sharply with a wooden mallet to set bearing properly. Recheck flange bolts for tightness. Worm should turn freely with minimum drag and end play. If too much end play is present, remove shims as required. If worm does not turn freely, add shims as required.

13. Assemble top load bearing (7) [bottom load bearing (8) for 100 and 150-ton models] onto worm gear (6).

NOTE

For units with tapered load bearings, assemble bearing cup in shell cap (2) [base plate for 100 and 150-ton models].

14. Fill shell (3) approximately one half full of grease and install grease fitting (17).
15. **FOR ALL MODELS EXCEPT 100 AND 150-TON** - Install shell cap (2) and screw down until tight.

NOTE

Shell cap flange does not necessarily have to bear against top of shell. There will usually be a gap. This will put a slight drag on worm. If worm is hard to turn, back off slightly on shell cap.

FOR ALL 100 AND 150-TON MODELS - Install base plate and screw down base plate until tight.

NOTE

This should put a slight drag on the worm. If the worm is hard to turn, back off slightly on the base plate. Be sure base plate does not project past base surface of housing.

16. Install set screws (1) in shell cap (2) [100 and 150-ton models install lock screw], locking shell cap (base plate) in place. Tap shell cap or base plate sharply with hammer and re-tighten set screw.

NOTE

If new parts have been installed, it may be necessary to re-spot holes for these screws.

17. For all units *except* those with expansion plugs, install pipe (4) in shell (3) for upright models (base plate for 100 and 150-ton units) or in shell cap (2) for inverte models (shell for 100 and 150-ton units).
18. Brush screw (5) with a light film of grease and threa lifting nut (23) on screw (5). The face of lifting nut flang should be nearest to the shell.
19. Operate unit to insure proper functioning of all con ponents prior to installation and use.

Assembly is now complete.

SECTION III

ILLUSTRATED PARTS LIST

3-1. General

This section contains an exploded illustration of the 1800 and 9000 Series rotating machine screw actuators. The number adjacent to each part on the illustration is the index number. Keyed to this index number on the parts list is the part name.

3-2. PARTS LIST FOR 1800 AND 9000 SERIES ROTATING MACHINE SCREW ACTUATORS.

INDEX NO.	PART NAME	QTY. REQ.
1	Screw, Set (All models except 100 and 150-ton)	2
2	Cap, Shell (All models except 100 and 150-ton)	1
3	Shell, Actuator	1
4	Pipe, Bottom	1
4a	Expansion Plug	1
5	Screw Assembly, Lifting	1
6	Worm Gear	1
7	Bearing, Top Load	1
8	Bearing, Bottom Load	1
9	Screw, Cap	8
10	Washer, Lock	8
11	Flange, Worm	2
12	Shim, Flange (.003 and .010)	2 Each
13	Seal, Oil	2
14	Worm	1
15	Bearing, Worm	2
16	Bushing, Guide (inverted model only)	1
17	Fitting, Grease	2
18	Nameplate	1
19	Screws, Drive	2
20	Nut, Lock	1
21	Screw, Set	1
22	Key	1
23	Lifting Nut	1

When ordering spare parts be sure to include:

1. The nameplate model number of your actuator.
2. Index number and name of part.

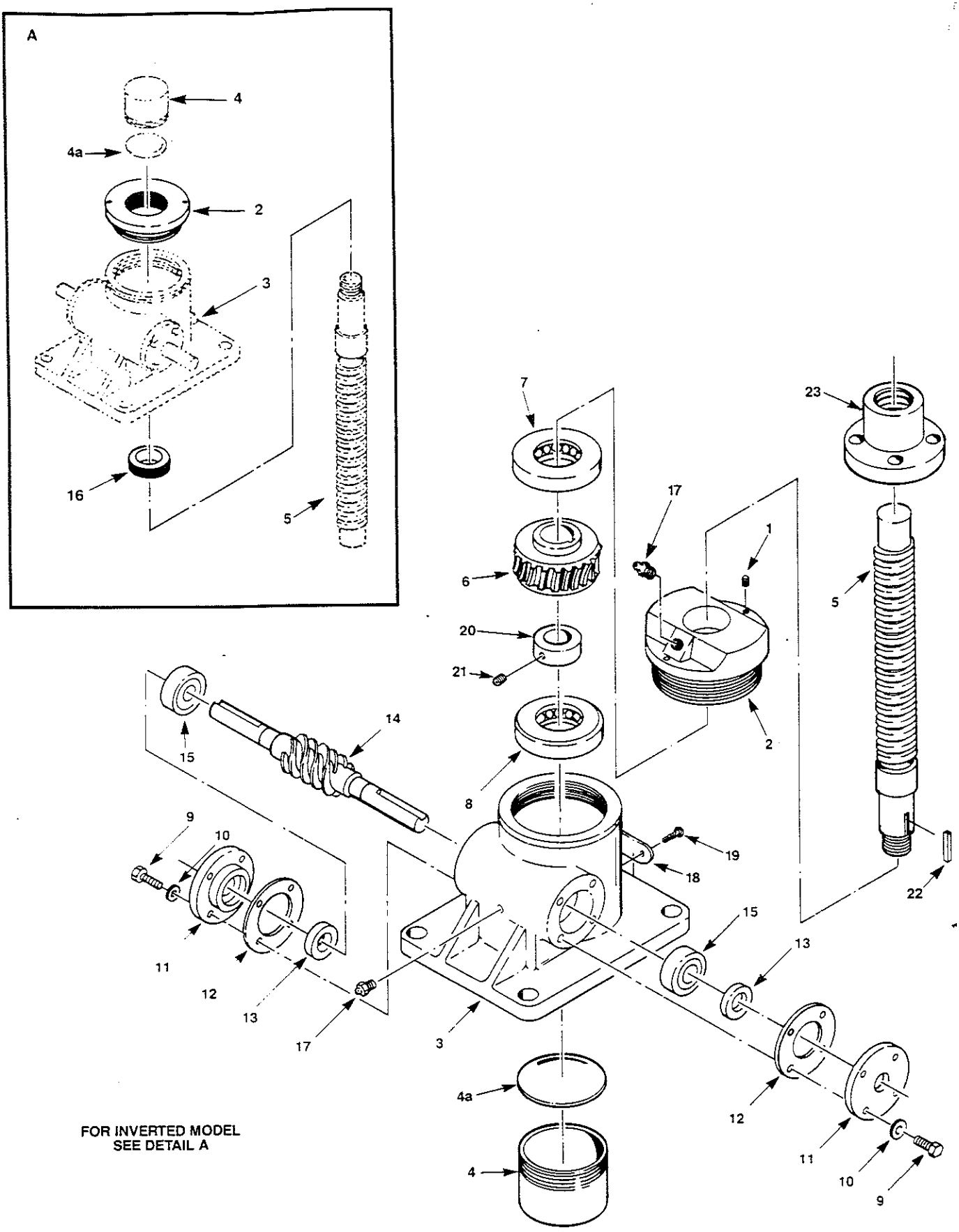
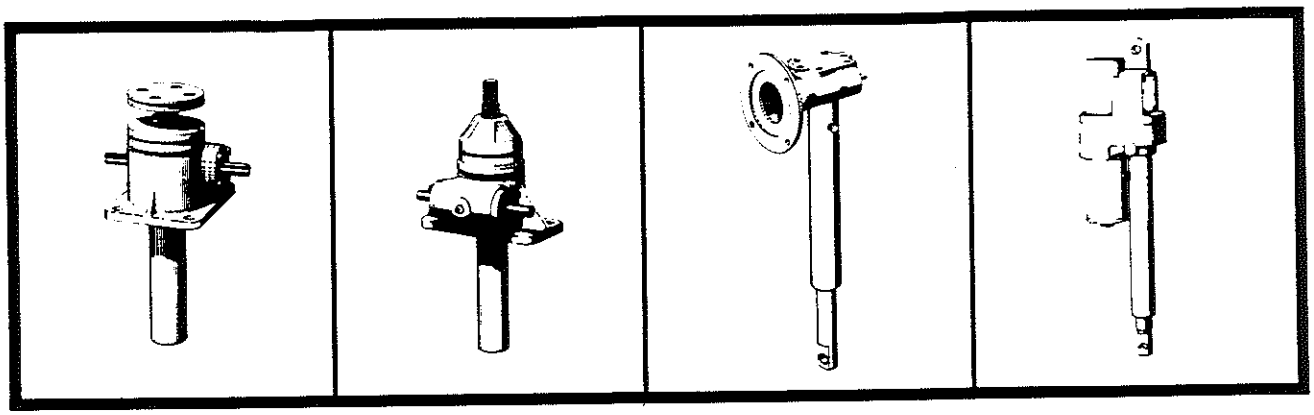


FIGURE 3-1. EXPLODED ILLUSTRATION 1800 AND 9000 SERIES ROTATING MACHINE SCREW ACTUATORS.

DUFF-NORTON OFFERS A COMPLETE LINE OF MECHANICAL AND ELECTROMECHANICAL ACTUATORS FOR PRECISE POSITIONING OF LOADS UP TO 250 TONS.

For reliable motion — in-line or through an arc — Duff-Norton has the right actuator to put your designs in motion. You can select from a comprehensive line of machine screw, ball screw, high-duty cycle, electro-mechanical and modular models to solve your design and production problems.

Duff-Norton® actuators are easy to specify, install and operate. Compact and self-contained, they do not require bothersome selection of individual components nor the attendant maintenance of leaky hydraulic hoses, valves or couplings. They provide many options in meeting a wide range of lifting, pushing, pulling and tensioning requirements.



Machine Screw Actuators. Capacities from ¼ to 250 tons. Worm gear ratios from 5:1 to 50:1. More than 200 standard combinations to choose. Can be operated manually or by gear motor. Used to push, pull, apply pressure, or as linear actuators. Hold loads indefinitely without creep, when not subject to vibration.

Ball Screw Actuators. Capacities from ½ to 50 tons. Ball bearing screw and nut design reduces friction, increases efficiency as much as 70%. Permits linear motion up to 300 in/min @ 1800 rpm worm shaft speed. Available in 40 standard models. Multiple units may be synchronized for uniform raises to 10 feet.

Modular Actuators. Capacities to 2,000 pounds depending on actuator gear ratio and motor horsepower. Engineered for 56 frame motor, C face mounting. Choice of 5:1 or 20:1 gear ratios in rotating screw or translating tube models. Travel lengths to 24 inches. Lift speeds to 170 inches per minute.

Electromechanical Actuators. Capacities to ¾ ton. Choice of 115 VAC or 12 VDC motors for indoor or outdoor applications. Standard raises from 3" to 24". Speeds to 145 in/min. All components sealed in a corrosion-resistant, aluminum alloy die-cast housing. Fully-adjustable limit switches available on some models.

For more information on these or other Duff-Norton® actuators, ask your local distributor or Duff-Norton District Sales Manager for Catalog 172. Or write factory.

WARNING: The equipment shown in this manual is intended for industrial use only and should not be used to lift, support, or otherwise transport people unless you have a written statement from Duff-Norton Company which authorizes the specific actuator unit, as used in your application, as suitable for moving people.

AVAILABLE FROM YOUR LOCAL ACTUATOR DISTRIBUTOR:

Duff-Norton
P.O. Box 7010
Charlotte, NC 28241-7010

Phone (800) 477-5002
FAX (704) 588-1994

Duff-Norton Manufactures:
Duff-Norton® Actuators • Mechanical Jacks • Rotary Unions® • Coffing® Hoists
Duff Lynx® Hoists • Yale® Hoists • Shop King Hoists • Little Mule® Products • American Lifts

Printed in USA

1M\SK2389-R\12-95

D330634-1
D330635-1

INSTRUCTION FOR SELECTING, INSTALLING AND ADJUSTING THE OVERLOAD RELAY

WARNING: To avoid risk of electrical shock and fire, disconnect power before servicing.

IMPORTANT: The overload relay selection is based upon the full load value shown on the motor nameplate.

WARNING: To maintain overcurrent, short circuit and ground fault protection, the manufacturer's instructions for setting the overload relay must be followed.
AVERTISSEMENT: Toujours suivre les instructions du manufacturier pour le réglage du relais de surcharge afin de maintenir une protection contre les surintensités de courant, les courts-circuits et les courants de fuite à la terre.

WARNING: The opening of the branch-circuit protective device may be an indication than a fault current has been interrupted. To reduce the risk of fire or electrical shock, current-carrying parts and other components of the controller should be examined and replaced if damaged. If burnout of the current element of an overload relay occurs, the complete overload relay must be replaced.
ADVERTISSEMENNT: L'ouverture d'un appareil de protection du circuit de dérivatiojun peut indiquer qu'une surintensité de courant fût interrompue. Afin de réduire le risque d'incendie ou de chocs électriques, les pièces sous tension et autres composants du contrôleur deivent être examinés et remplacés s'ils sont endonmagés. Si l'élément de courant de relais de surcharge est brûlé, on doit remlacer le relais de surcharge en son entier.

Prior to assembly of the overload relay to the contactor, it may be desirable to make the connection from the tie point terminal of the overload relay to the contactor coil terminal A2 to facilitate any future connections that may be required to be made at A2.

Align the stabs of the Bulletin 193 overload relay with the T1, T2 and T3 load terminals of the contactor. Devices having 9A and 12A contactors will require the user to position the left stab to the left-hand side of the T1 load terminal screw, and the center and right stabs to the right-hand sides of the T2 and T3 load terminal screws. Devices using 18A and 24A contactors will require all three overload relay stabs to be positioned to the left-hand side of the load terminal screws. Align one of the supports projecting from the overload relay into the support opening on the contactor base. Slide the overload relay toward the contactor, ensuring that the relay support has entered the contactor base and that the overload stabs are positioned between the wire clamps and the contactor terminal. Tighten the terminal screws to the torque specified on the contactor (12 lb-in). NOTE: alignment is important for a good electrical connection, to minimize the stress on the overload stabs and molded supports, and also to ensure alignment if an external rest button,Cat. 198-MR3 is to be used.

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Printed in U.S.A.

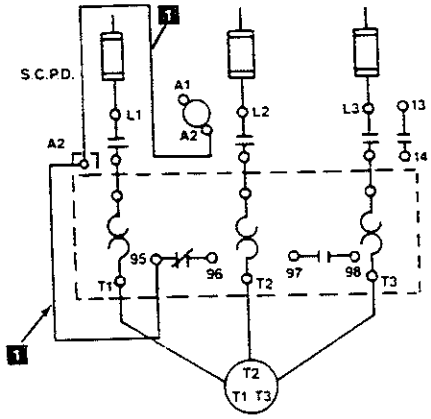
ALLEN-BRADLEY
A ROCKWELL INTERNATIONAL COMPANY

BULLETIN 193
APPLICATION AND INSTALLATION INSTRUCTIONS
U.S.A. & CANADA

WARNING: To avoid risk of electrical shock, disconnect power before installing or adjusting.

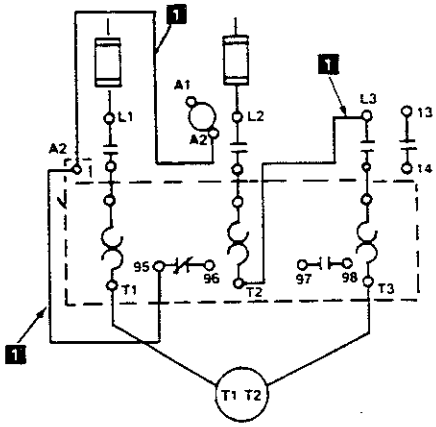
TYPICAL APPLICATIONS

3 PHASE FULL VOLTAGE

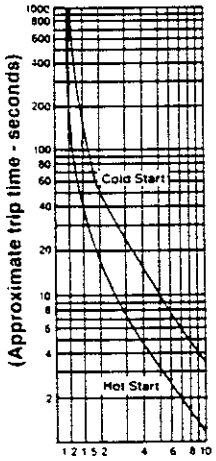


1 CONNECTION MUST BE FITTED BY USER

SINGLE PHASE FULL VOLTAGE



TRIP CURVE



TRIP CURRENT SETTING

Relay is Class 10 (NEMA ICS 2-222.06).
To adjust trip current, turn dial until the desired current is aligned with the △ pointe

MOTORS WITH A SERVICE FACTOR OF 1.15 OR GREATER

Set dial to motor full load current taken from motor nameplate.

MOTORS WITH SERVICE FACTOR OF LESS THAN 1.15

Set at 90% of motor full load current.

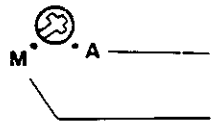
WYE-DELTA (Y△) APPLICATIONS. (Relay elements carrying motor phase curre
Follow instructions above except divide the motor nameplate full load current amp
by 1.73.

TRIP INDICATION

WARNING: Do not use automatic reset mode in applications where unexpected automatic restart of t
motor can cause injury to persons or damage to equipment.

OPERATING MODES

An anti-tamper shield – Bulletin Number 193-BC 1 Series B is available to inhibit unauthorized or accidental changes of mode or current setting.



AUTO
The relay resets automatically after cooling (about 1 minute after tripping.)

MANUAL
Reset by pushing button in. (Allow about 1 minute for relay to cool down after tripp

TEST BUTTON

CONTACT STATUS			
Normal		Push (Momentary)	Pull
95—||—96	Closed	Open	Open
97—||—98	Open	Open	Closed

40053-144-01 (C)

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(2/89 AWA 23-889)

ALLEN-BRADLEY
A ROCKWELL INTERNATIONAL CO.

BULLETIN
104

REVERSING CONTACTOR
CONTACTEUR INVERSEUR
WENDESCHÜTZ-KOMBINATION
ARRANCADOR INVERSOR
CONTATOR DE REVERSÃO

–A09
–A12

WARNING: Isolate before servicing. Install in suitable enclosure. Keep free from contaminants. Do not lubricate or degrease magnet assemblies.

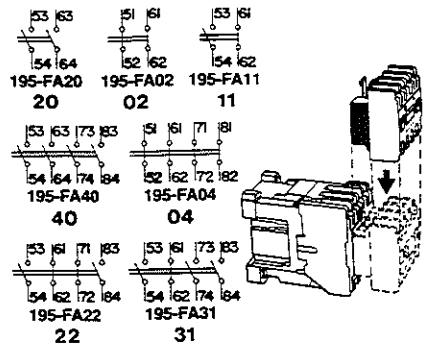
ATTENTION: Toujours couper toutes sources d'alimentation avant de commencer l'entretien. Installer dans une boite appropriée. Protéger le relais contre les contaminants. Ne jamais lubrifier ou dégraisser l'assemblage de l'aimant.

WARNUNG: Vor Wartungsarbeiten Anlage abschalten. Die Gerate müssen in einem passenden Gehäuse eingebaut und gegen Verschmutzung geschützt werden. Der Magnetkern darf nicht geölt oder gefettet werden.

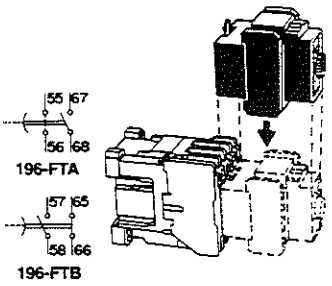
PRECAUCION: Desconéctelo antes de servirlo. Instálelo en una caja apropiada. Manténgalo libre de contaminantes. No lubrique o desengrase los conjuntos magnéticos.

CUIDADO: Desconectar antes de usar. Instalar em caixa apropriada. Manter livre de contaminantes. Náo lubrificar nem desengraxar os conjuntos magneticos.

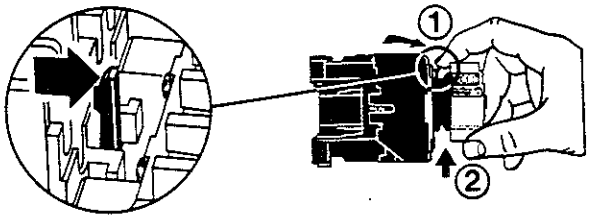
ADD-ON CONTACT BLOCK
BLOC DE CONTACTS
KONTAKTBLOCK–AUFSATZ
BLOQUE DE CONTACTOS SUPLEMENTARIO
BLOCO DE CONTATOS AUXILIARES



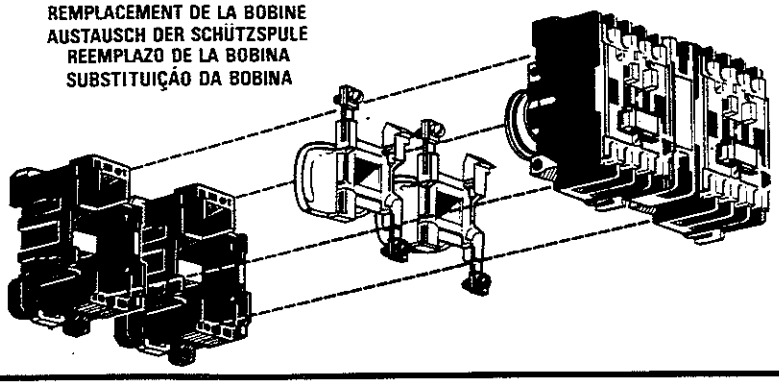
PNEUMATIC TIMING UNIT
TEMPORISATEUR PNEUMATIQUE
PNEUMATISCHER ZEITRELAIS–AUFSATZ
UNIDAD TEMPORIZADORA NEUMATICA
UNIDADE DE TEMPO PNEUMÁTICA



REMOVAL DEMONTAGE REMOVIBLE REMOVÍVEL



COIL REPLACEMENT
REMPLACEMENT DE LA BOBINE
AUSTAUSCH DER SCHÜTZSPULE
REEMPLAZO DE LA BOBINA
SUBSTITUIÇÃO DA BOBINA



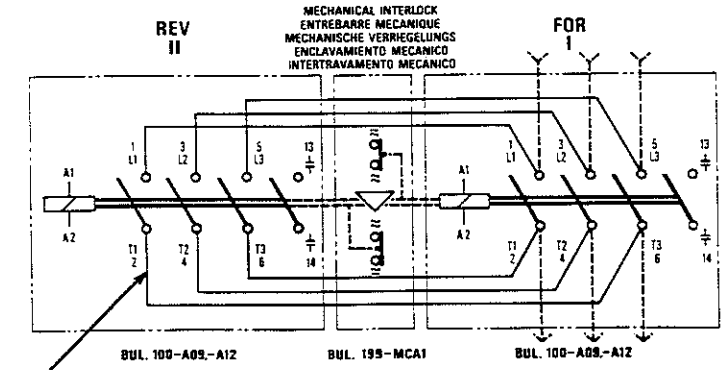
ATTENTION: Coil replacement requires the removal of both contactor housings and interlock as a unit to ensure jam-free operation. If either contactor housing becomes disengaged from the interlock, follow the recommended re-assembly on the reverse side.

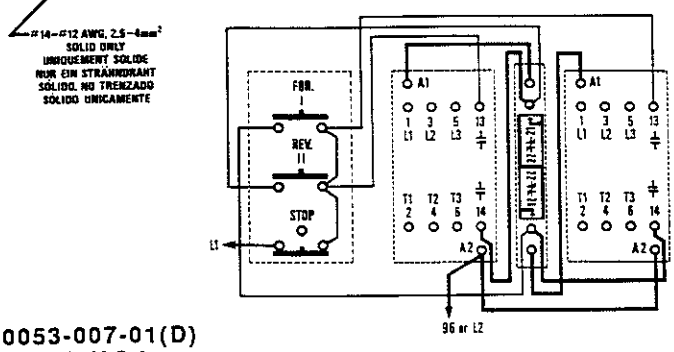
ATTENTION: Pour remplacer une bobine, toujours enlever les deux blocs de contacts et l'entrebarre comme un assemblage pour éviter des coincements. Si l'un ou l'autre des blocs de contacts sont dégagés de l'entrebarre se référer à l'autre côté pour les renseignements sur le re-assemblage.

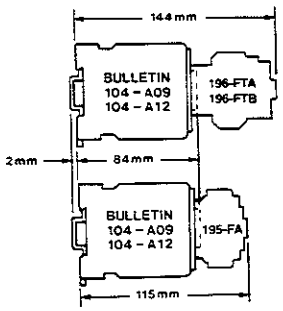
ACHTUNG: Zum Spulenaustausch ist es notwendig, sowohl das Schützgehäuse als auch das Verriegelungselement als eine Einheit abzunehmen, um einen störungsfreien Betrieb sicherzustellen. Falls sich das Schützgehäuse doch vom Verriegelungselement mechanisch löst, dann befolgen Sie bitte die Instruktionen zum Zusammenbau auf der Rückseite des Kartons.

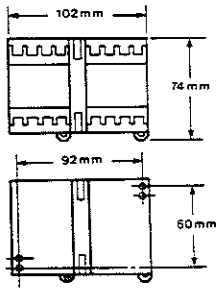
ATENCION: Para cambiar la bobina es necesario desmontar el asemblaje de contactor y el enclavamiento en una unidad completa. En caso de separacion del asemblaje de contactor y el enclavamiento deben seguirse las instrucciones del reverso, para volver a montar.

ATENÇÃO: Para substituição da bobina é necessário remover-se os blocos dos contatores e o intertravamento simultaneamente, como um todo, para que não haja emperramento durante a operação. Se os blocos se separarem do intertravamento, siga as recomendações de montagem no verso.









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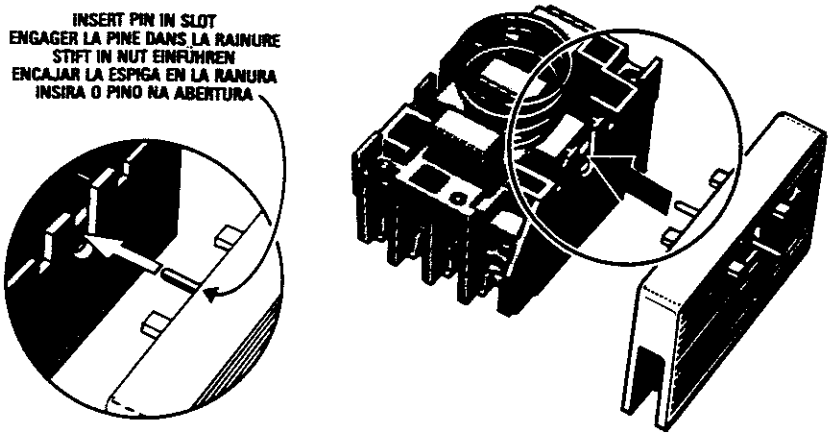
ALLEN-BRADLEY
A ROCKWELL INTERNATIONAL COMPANY

MECHANICAL INTERLOCK INSTALLATION
INSTALLATION D ENTREBARRE MÉCANIQUE
MECHANISCHE VERRIEGELUNGS INSTALLATION
INSTALACIÓN DE ENCLAVAMIENTO MECÁNICO
INSTALAÇÃO DO INTERTRAVAMENTO MECÂNICO

1



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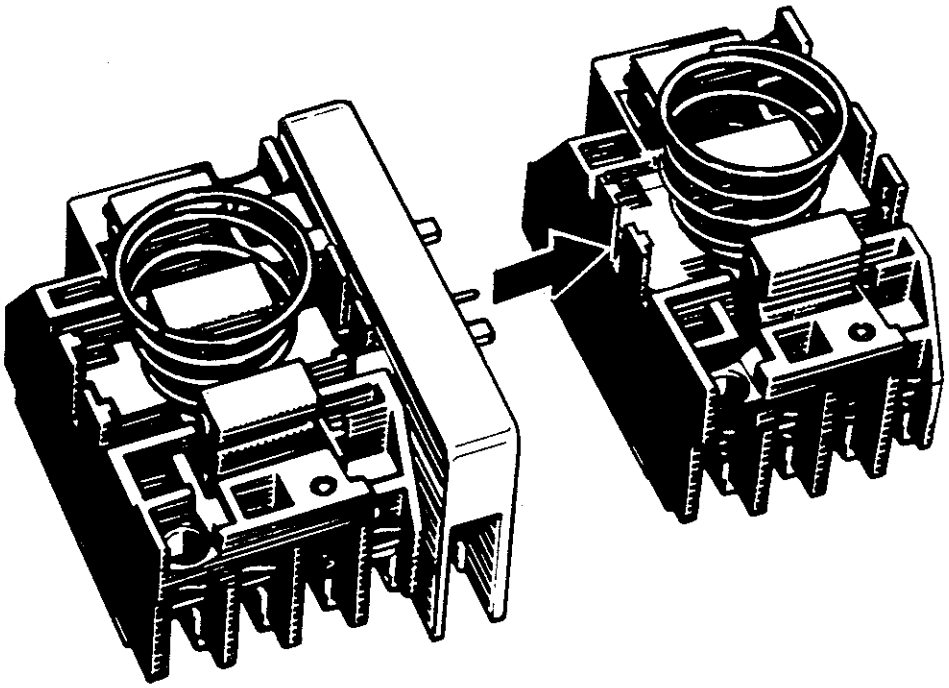

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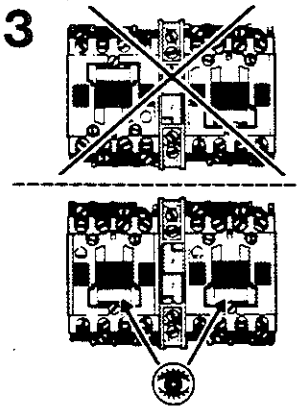

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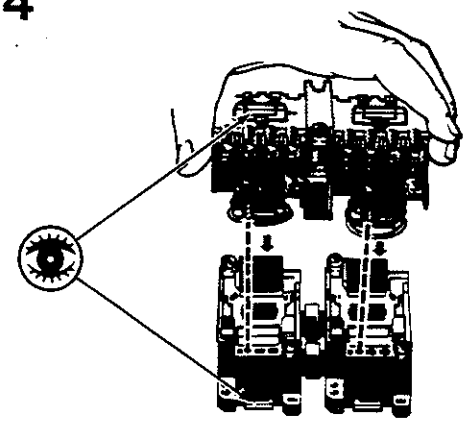

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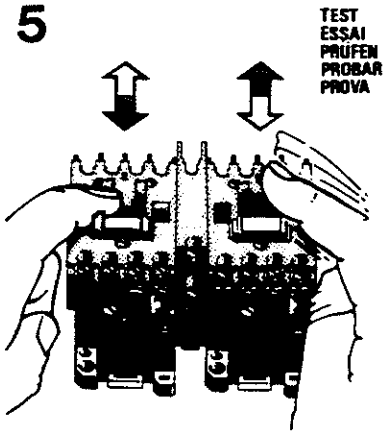
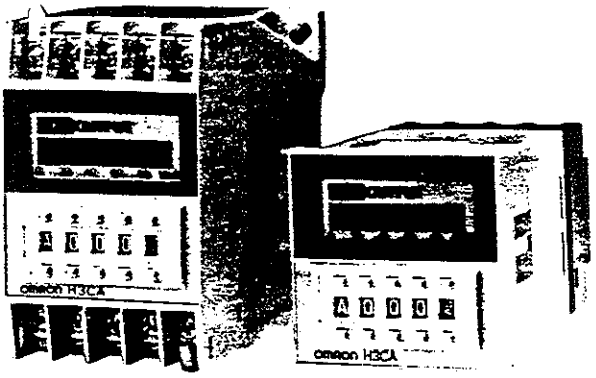


Solid-State Timer — H3CA

1/16 DIN, Digital-Set Timer with 0.1 Second to 9,990 Hours Range

- 8 field-selectable operation modes
- Universal AC/DC supply voltage timers available
- Operations include ON-delay, Repeat cycle, Signal Interval/OFF-delay, Signal-OFF delay (I and II), Interval, Cycle and Signal ON-delay/OFF-delay
- Selectable no-voltage start, reset, gate and check inputs expand capabilities
- Time remaining LCD bar graph and LCD output status indicator
- Panel mounting adapters, sockets, and accessories may be ordered separately



Ordering Information

■ TIMERS

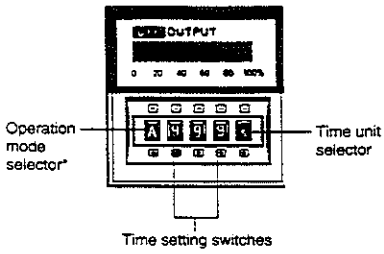
Add the supply voltage to the part number when you order ON-delay only timers H3CA-8 and H3CA-8H. For example, **H3CA-8H-AC/100/110/120**.

Timing function		8 field-selectable functions		ON-delay only	
Contact type	Time limit	SPDT	SPDT	SPDT	DPDT
	Instantaneous	–	–	SPDT	–
Terminal form		11-pin round socket	Front mounted screw terminals	8-pin round socket	
Part number		**H3CA-A**	**H3CA-FA**	**H3CA-8H**	**H3CA-8**
Supply voltages	AC	24 to 240 V, 50/60 Hz or		Specify 24 V, 100/110/120 V, or 200/220/240 V; 50/60 Hz	
	DC	12 to 240 V		Specify 12 V, 24 V, 48 V or 110 V	

■ ACCESSORIES

Description			Part number
Sockets	H3CA-A timer	Bottom surface or track mounting, top screw terminals	**P2CF-11**
		Back mounting, for use with Y92F-30 mounting adapter, bottom screw terminals	**P3GA-11**
	H3CA-8, H3CA-8H timers	Bottom surface or track mounting, top screw terminals	**P2CF-08**
		Back mounting, for use with Y92F-30 mounting adapter, bottom screw terminals	**P3G-08**
Panel mounting adapters		Fits behind panel, ideal for side by side installation. Use P3G-□□ sockets.	**Y92F-30**
		Installs through panel front; timer face fits bezel, rear of timer clips to adapter. Use P3G-□□ sockets. Fits 65-66 mm (2.56 - 2.59 in) x 52-53 (2.04 x 2.09 in) panel cutout. Charcoal gray face plate measures 88 H x 58 W mm (3.46 x 2.28 in).	**Y92F-70**
		Installs through panel front; timer face fits bezel, rear of timer clips to adapter. Use P3G-□□ sockets. Fits 55 x 45 mm (2.17 x 1.77 in) panel cutout. Charcoal gray face plate measures 58 H x 50 W mm (2.28 x 1.97 in).	**Y92F-71**
Protective cover		Hard plastic cover; not for use with Y92F-70 or Y92F-71 panel adapters.	**Y92A-48B**
		Soft plastic cover; not for use with Y92F-70 or Y92F-71 panel adapters.	**Y92A-48D**
Mounting track		DIN rail, 50 cm (1.64 ft) length	**PFP-50N**
		DIN rail, 1 m (3.28 ft) length	**PFP-100N**
		End plate	**PFP-M**
		Spacer	**PFP-S**

■ RANGE AND OPERATION MODE SELECTION



Time unit	Timing range
0.1 s	0.1 to 99.9 seconds
s	1 to 999 seconds
0.1 m	0.1 to 99.9 minutes
m	1 to 999 minutes
0.1 h	0.1 to 99.9 hours
h	1 to 999 hours
10 h	10 to 9990 hours

Mode	Operation
A	ON-delay
B	Repeat cycle
C	Signal Interval/OFF-delay
D	Signal OFF-delay I
E	Interval
F	Cycle
G	Signal ON-delay/OFF-delay
H	Signal OFF-delay II

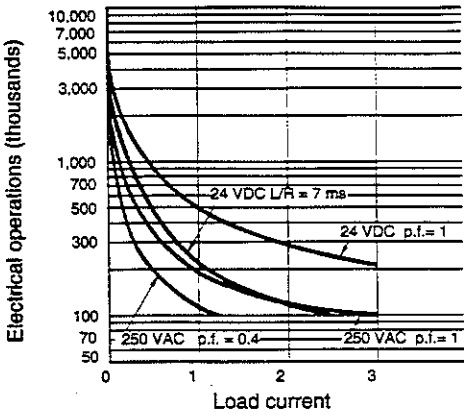
Note: *Operation mode selector not included with ON-delay only models.

Specifications

Part number			H3CA-A	H3CA-FA	H3CA-8H	H3CA-8
Supply voltage	AC		24 to 240 V, 50/60 Hz		24 V, 100/110/120 V, 200/220/240 V; 50/60 Hz	
	DC		12 to 240 V		12 V, 24 V, 48 V, 110 V, (permissible ripple factor: 20% max. using single-phase, full-wave rectified power sources)	
Operating voltage			90 to 110% of rated voltage			
Power consumption	AC		3 VA		10 VA	
	DC		3 W		2W	
Timing functions			8 field-selectable modes: ON-delay, Repeat cycle, Signal Interval/OFF-delay, Signal ON-/OFF-delay, Signal OFF-delay (I and II), Interval and Cycle		ON-delay only	
Start, reset, gate inputs			No voltage	No voltage	–	–
Control output	Type	Time limit	SPDT		SPDT	DPDT
		Instantaneous	–		SPDT	–
	Max. load		3 A, 250 VAC (p.f. = 1)			
	Min. load		10 mA, 5 VDC			
Repeat accuracy			±0.3%, ±0.05 sec (includes variation due to voltage and temperature changes)			
Setting error			±0.5%, ±0.05 sec			
Resetting system			Power-OFF, external and self-reset		Power-OFF	
Resetting time			0.5 sec max.		0.1 sec max.	
Indicators			Time Remaining (LCD bar graph), Output Status (LCD message)			
Materials			Plastic case			
Mounting			Panel, track, surface			
Connections			11-pin round socket	Terminal screws	8-pin round socket	
Weight			110 g (3.9 oz)	190 g (6.7 oz)	110 g (3.9 oz)	
Approvals		UL	Recognized, File No. E41515			
		CSA	Certified, File No. LR22310			
		Others	SEV, File No. 1021			
Operating ambient temperature			-10° to 55°C (14° to 131°F)			
Humidity			35 to 85% RH			
Vibration	Mechanical durability		10 to 55 Hz; 0.75 mm (0.03 in) double amplitude			
	Malfunction durability		10 to 55 Hz; 0.5 mm (0.02 in) double amplitude			
Shock	Mechanical durability		100 G			
	Malfunction durability		10 G			
Variation due to voltage change			See "Repeat Accuracy"			
Variation due to temperature change			See "Repeat Accuracy"			
Insulation resistance			100 MΩ min. at 500 VDC			
Dielectric strength			2,000 VAC, 50/60 Hz for 1 minute between current-carrying and non-current-carrying parts and between contact and control circuit 1,000 VAC, 50/60 Hz for 1 minute between non-continuous contacts			
Service life	Mechanical		10 million operations minimum (under no load, at 1,800 operations/hour)			
	Electrical		100,000 operations minimum at maximum ratings			

Engineering Data

■ ELECTRICAL SERVICE LIFE



Timing Charts

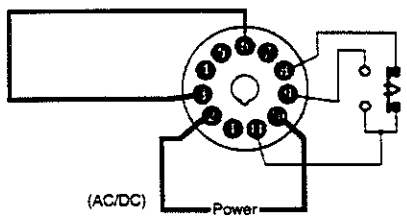
In the schematic diagrams, each **thick line** indicates the external wiring necessary for the selected operation.

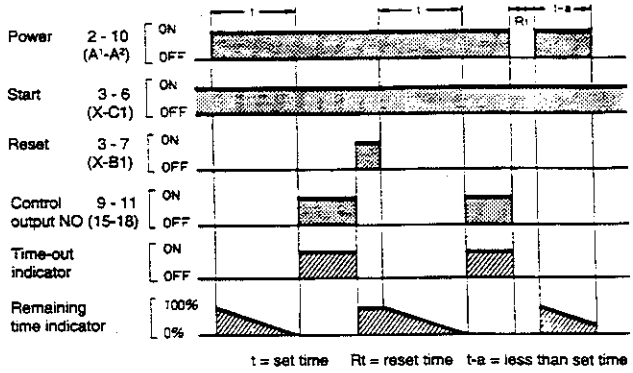
■ H3CA-A, H3CA-FA

Mode A ON-Delay

Power-ON Start/Power-OFF Reset

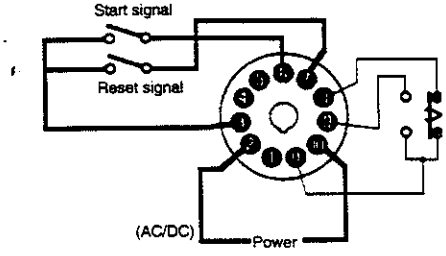
The start terminals are connected. Timing starts when power is applied. The output is energized when the accumulated time equals the set time. The output remains energized until power is disconnected or a reset input is applied.

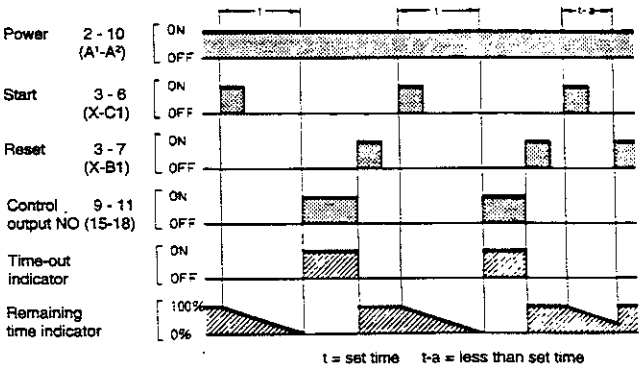




Signal Start

Power is applied continuously. Timing starts at the leading edge of the start input. The output is energized when the accumulated time equals the set time. Subsequent start signals during or after timing will not be accepted. The output relay will remain energized until a reset input is applied or power is interrupted.



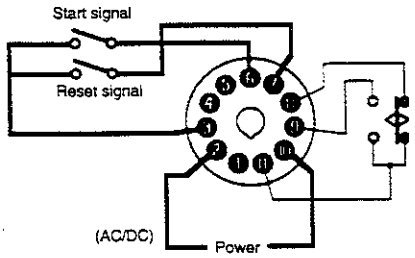


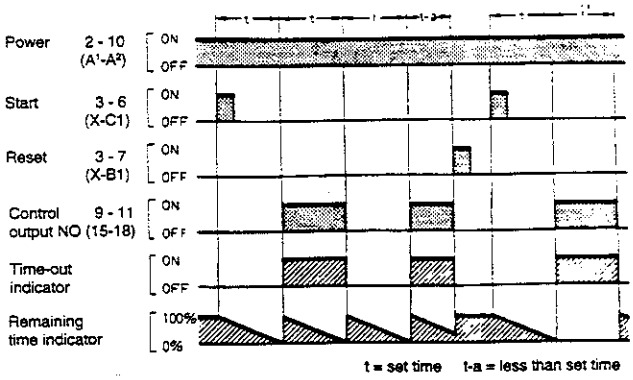
In the schematic diagrams, each **thick line** indicates the external wiring necessary for the selected operation.

Mode B Repeat Cycle

Signal Start

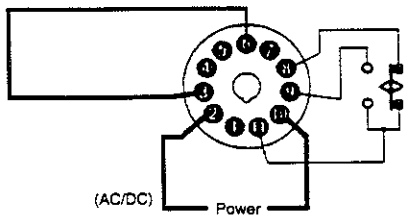
Power is continuously applied. The OFF/ON cycle is initiated at the leading edge of the start input. The output relay will be OFF for the set time and then ON for the set time. This cycle will be repeated until a reset input is applied or power is disconnected.

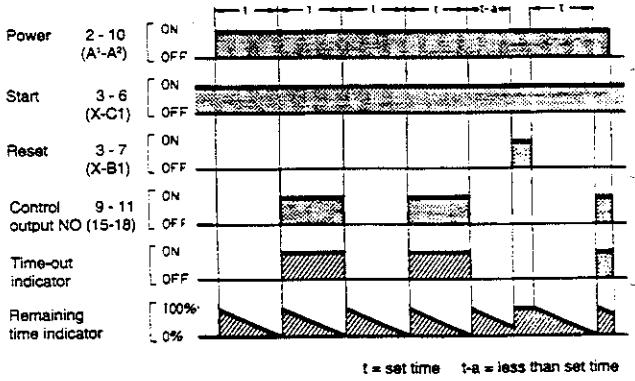




Power-ON Start/Power-OFF Reset

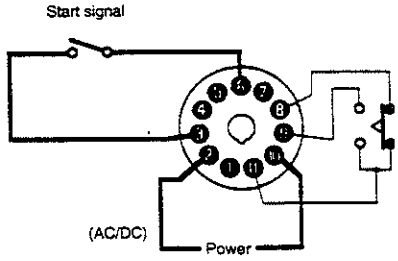
The start terminals are connected. Timing starts when power is applied. The output relay will be OFF for the set time and then ON for the set time. This cycle will be repeated until a reset input is applied or power is disconnected.

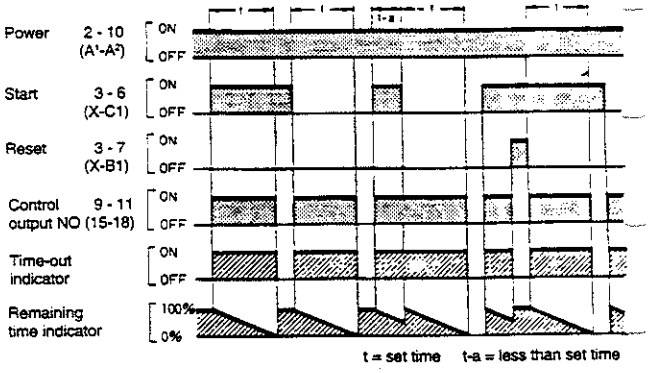




Mode C Signal Interval/OFF-Delay

Power is continuously applied. Timing begins on both the leading and trailing edges of the start input. The output relay is energized during timing. Once the timer has timed out from the trailing edge, it resets and is ready for subsequent start inputs.

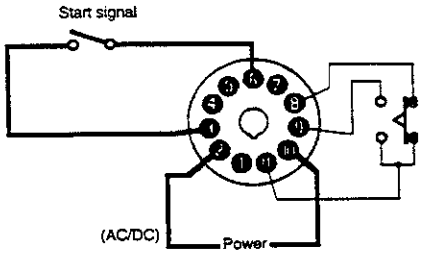


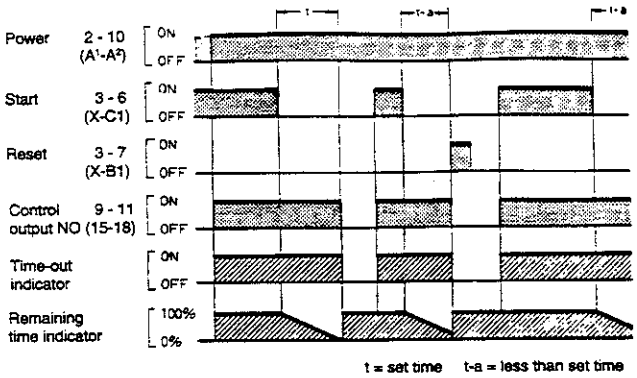


In the schematic diagrams, each **thick line** indicates the external wiring necessary for the selected operation.

Mode D Signal OFF-Delay (I)

Power is continuously applied. The output relay is energized at the leading edge of the start input. Timing starts at the trailing edge of the start input. The output relay is de-energized when the accumulated time equals the set time.

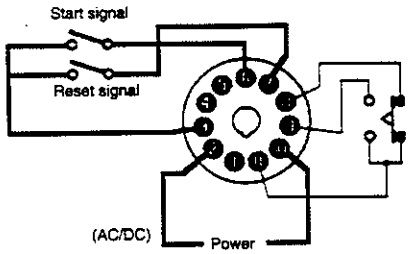


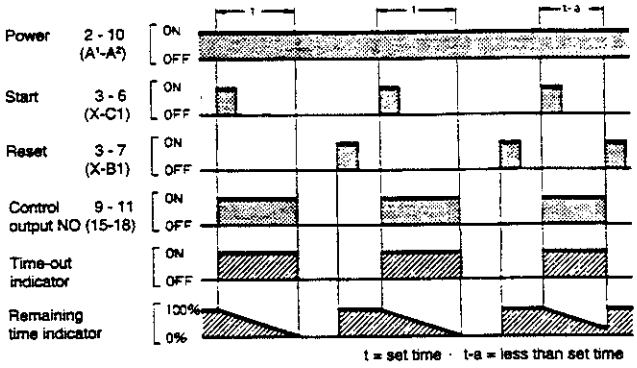


Mode E Interval

Signal Start

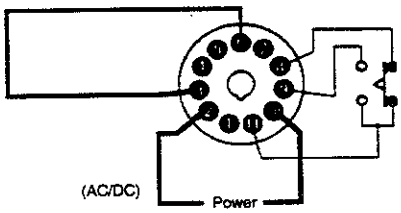
Power is applied continuously. Timing starts at the leading edge of the start input. The output relay is only energized during timing. The timer is reset when power is disconnected or a reset input is applied.

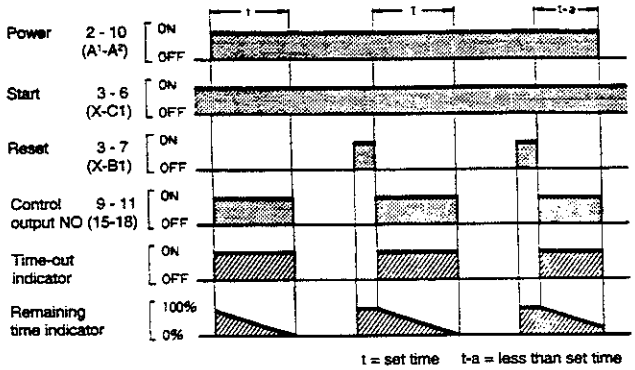




Power-ON Start/Power-OFF reset

The start terminals are connected. Timing starts when power is applied. The output relay is only energized during timing. The timer is reset when power is disconnected or a reset input is applied.



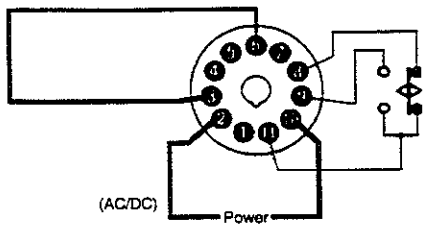


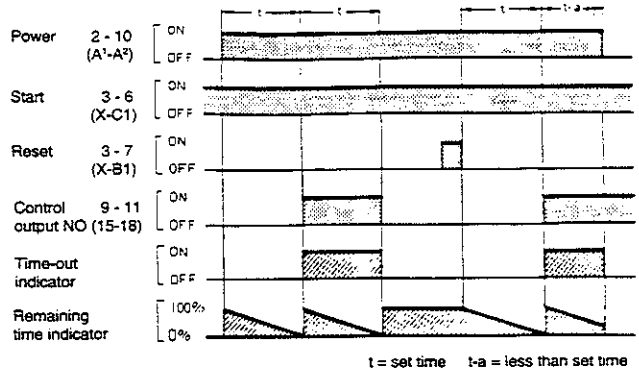
In the schematic diagrams, each **thick line** indicates the external wiring necessary for the selected operation.

Mode F Cycle One-Shot

Power-ON Short/Power-OFF Reset

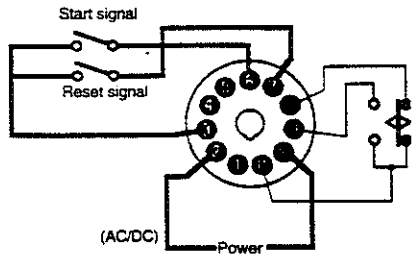
The start terminals are connected. Timing starts when power is applied. The output relay will be OFF for the set time and then ON for the set time. The timer is reset when power is disconnected or a reset input is applied.

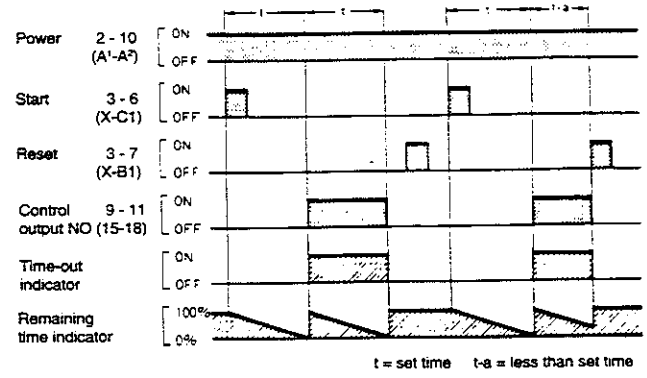




Signal Start

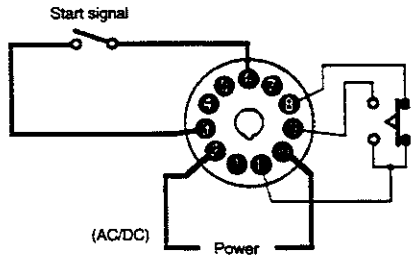
Power is applied continuously. The OFF/ON cycle is initiated at the leading edge of the start input. The output relay will be OFF for the set time and then ON for the set time. The timer is reset when power is disconnected or a reset input is applied.

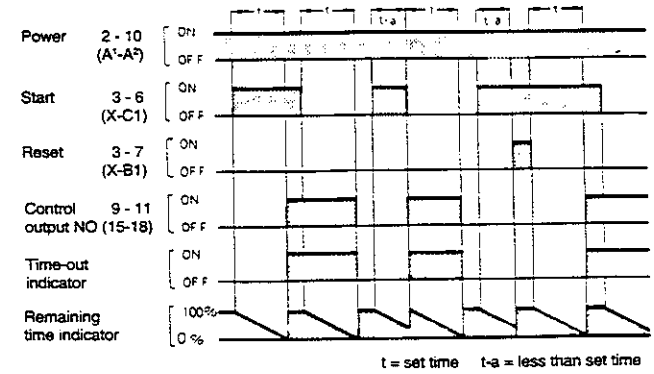




Mode G Signal ON-delay/OFF-delay

Power is continuously applied. Timing begins on both the leading and trailing edges of the start input. The output relay is energized when the accumulated time from the leading edge equals the set time. It is also energized for the set amount of time from the trailing edge of the start input.

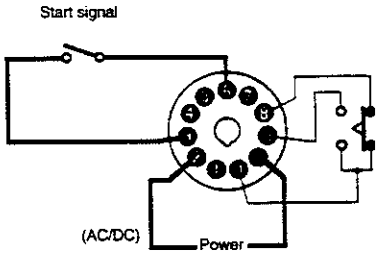


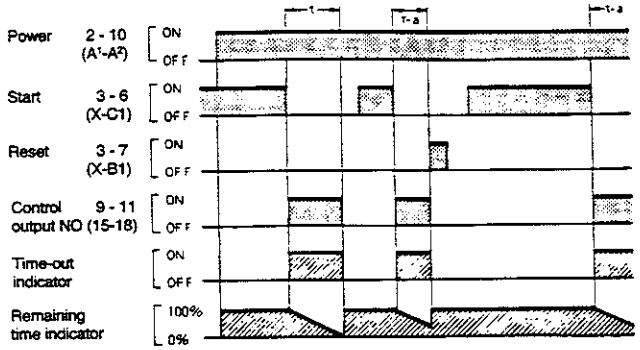


In the schematic diagrams, each **thick line** indicates the external wiring necessary for the selected operation.

Mode H Signal OFF-Delay (II)

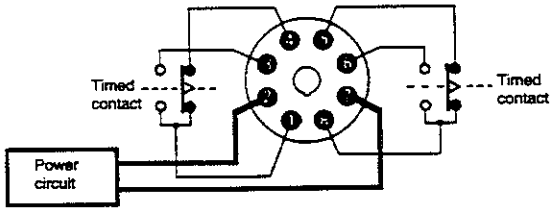
Power is continuously applied. Timing starts at the trailing edge of the start input. The output relay is energized during timing.

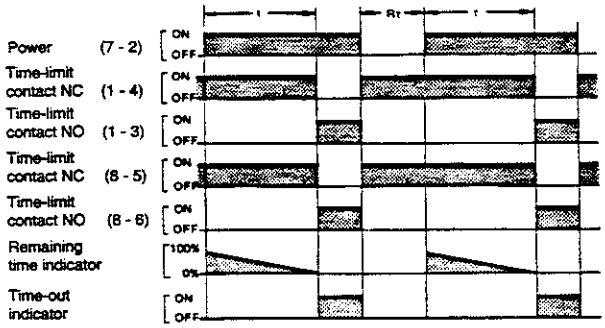




t = set time t-a = less than set time

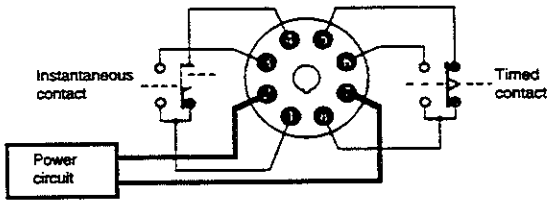
■ H3CA-8

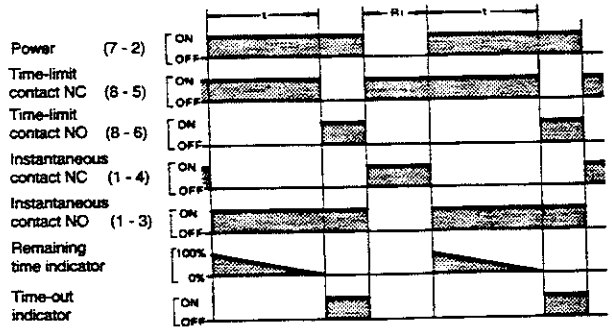




t = set time Rt = reset time

■ H3CA-8H





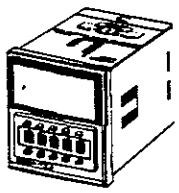
t = set time Rt = reset time

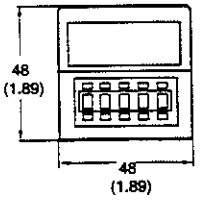
Dimensions

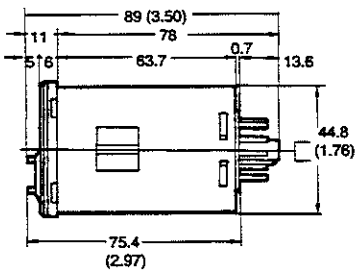
Unit: mm (inch)

■ TIMERS

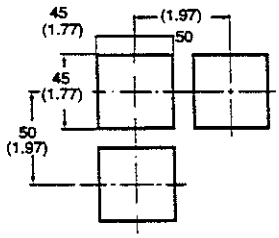
H3CA-A







Panel cutout

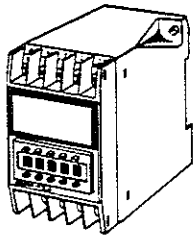


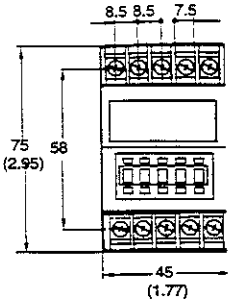
Note: Recommended panel thickness is 1 to 3.2 mm.

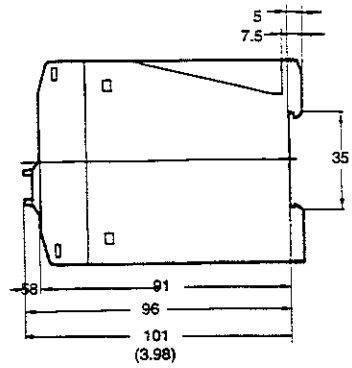
Panel cutout conforms to DIN 43700.

In the schematic diagrams, each **thick line** indicates the external wiring necessary for the selected operation.

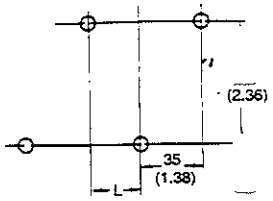
■ H3CA-FA





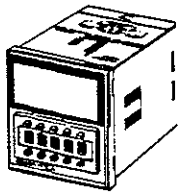


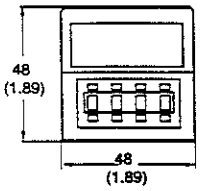
Mounting holes

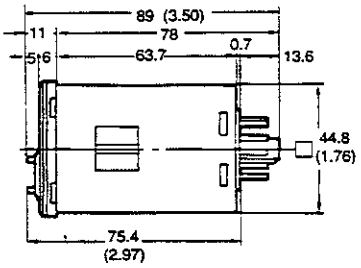


Note: When mounting two or more timers next to one another, allow 10 mm (0.39 in) between timers (dimension L).

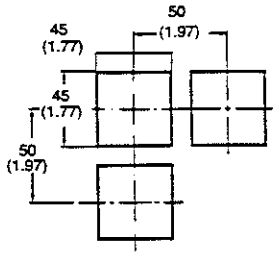
■ H3CA-8, H3CA-8H







Panel cutout



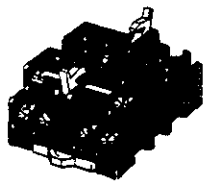
Note: Recommended panel thickness is 1 to 3.2 mm.

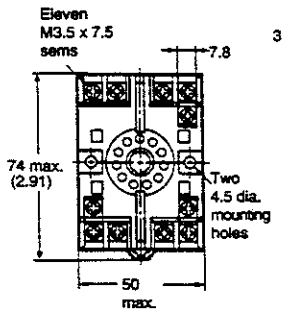
Panel cutout conforms to DIN 43700.

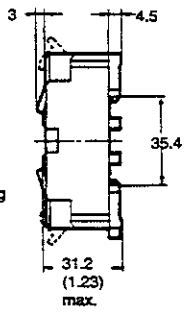
■ SOCKETS

11-Pin Sockets for H3CA-A

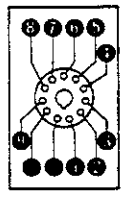
P2CF-11 Bottom surface or track mounting socket



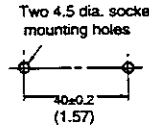




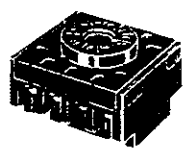
Terminal arrangement

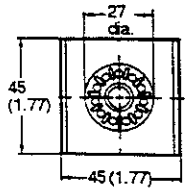


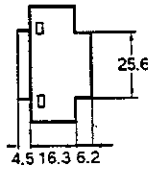
Mounting holes



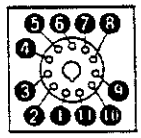
P3GA-11 Back Mounting Socket





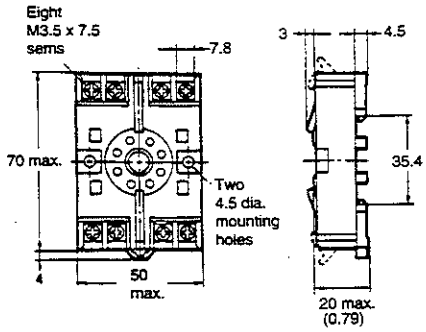


Terminal arrangement

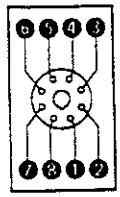


8-Pin Sockets for H3CA-8, H3CA-8H

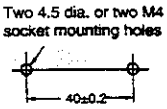
P2CF-08 Bottom surface or track mounting



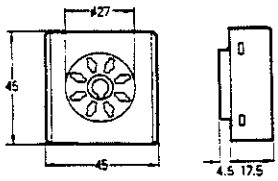
Terminal arrangement

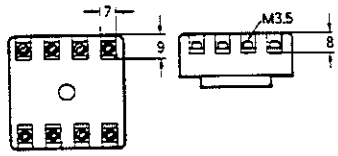


Mounting holes

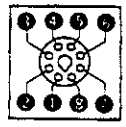


P3G-08 Back mounting socket





Terminal arrangement

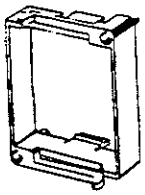


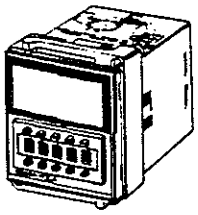
■ PANEL MOUNTING ADAPTERS

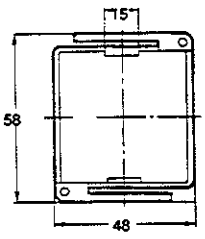
For H3CA, H3CA-8, H3CA-8H

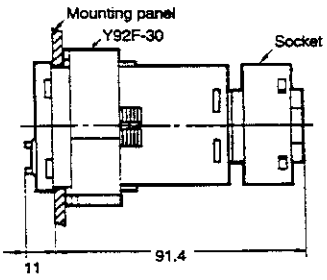
Y92F-30 Mounting Adapter

Adapter installs behind the panel. It is ideal for side by side installation. Use P3GA-11 or P3G-08 sockets.

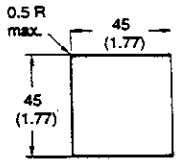








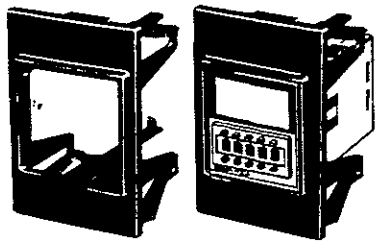
Panel cutout

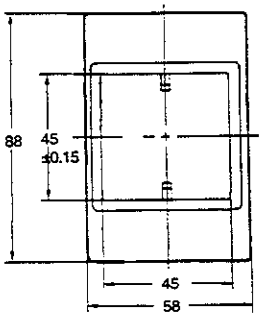


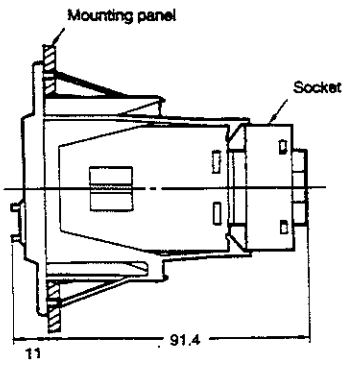
Note: Recommended panel thickness is 1 to 3.2 mm.

Y92F-70 Mounting Adapter

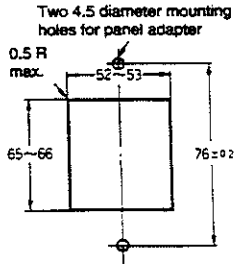
Charcoal gray panel adapter installs through panel front. Timer fits bezel, rear of timer clips to adapter. Use P3GA-11 or P3G-08 sockets.







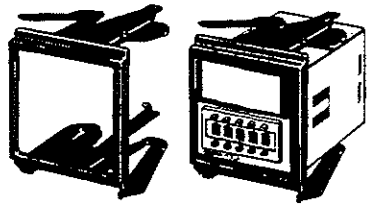
Panel cutout

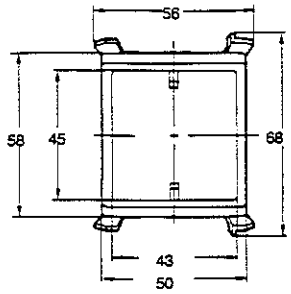


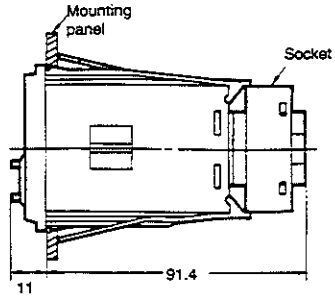
Note: recommended panel thickness is 1 to 3.2 mm..

Y92F-71 Mounting Adapter

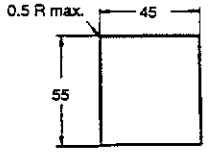
Charcoal gray panel adapter installs through panel front. Timer face fits bezel, rear of timer clips to adapter. Use P3GA-11 or P3G-08.







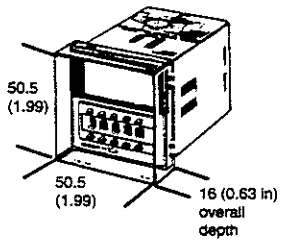
Panel cutout



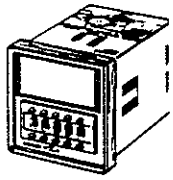
Note: Recommended panel thickness is 1 to 3.2 mm.

■ PROTECTIVE COVERS

Y92A-48B Hard Plastic Cover



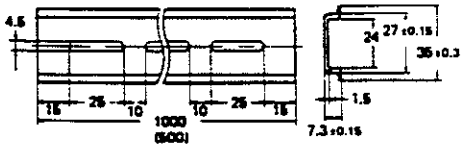
Y92A-48D Soft Plastic Cover



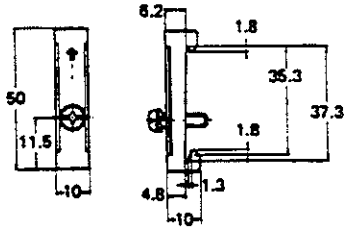
Hard plastic cover Y92A-48B and soft plastic cover Y92A-48D snap onto the front of the timer to protect against dust and water. The Y92A-48B hard plastic cover prevents accidental resetting. Y92A-48D soft plastic cover fits snugly over the front and allows settings to be changed. These covers are intended for use in areas where unusual service conditions do not exist.

■ MOUNTING TRACK AND ACCESSORIES

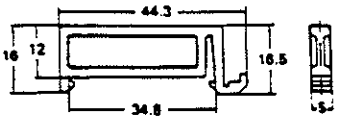
PFP-100N/PFP-50N DIN Rail



PFP-M End Plate



PFP-S Spacer



Connections

Part number	Input terminal numbers (no-voltage only)					Power supply terminal numbers		Output terminal numbers			
	Gate	Start	Reset	Check	COM	AC (common), DC-	AC (hot), DC+	Type	COM	NC	NO
H3CA-A	5	6	7	4	3	2	10	Timed contact	11	8	9
H3CA-FA	D1	C1	B1	E1	X	A2	A1	Timed contact	15	16	18
H3CA-8H	–	–	–	–	–	2	7	Instantaneous	1	4	3
								Timed contact	8	5	6
H3CA-8	–	–	–	–	–	2	7	Timed contact	1	4	3
								Timed contact	8	5	6

■ CONTACT SIGNAL INPUTS

Input Signal Requirements

Resistance	1 K max.
Residual voltage	1 V max. when the contact makes
Contact material	Gold-plated contacts recommended

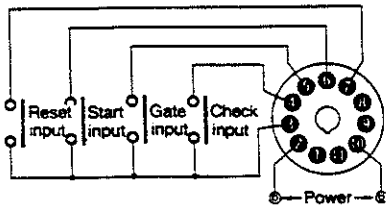
H3CA-A

- Start input contact between terminals 3 and 6.
- Reset input contact between terminals 3 and 7.
- Gate input contact between terminals 3 and 5.
- Check input contact between terminals 3 and 4.

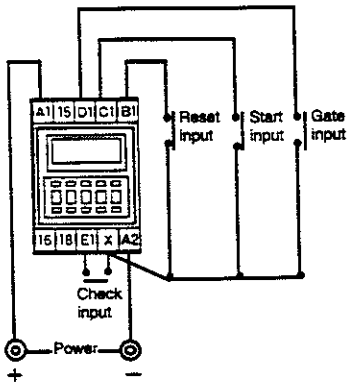
H3CA-FA

- Start input contact between terminals X and C1.
- Reset input contact between terminals X and B1.
- Gate input contact between terminals X and D1.
- Check input contact between terminals X and E1.

H3CA-A



H3CA-FA



■ SOLID-STATE SIGNAL INPUTS

Input Signal Requirements

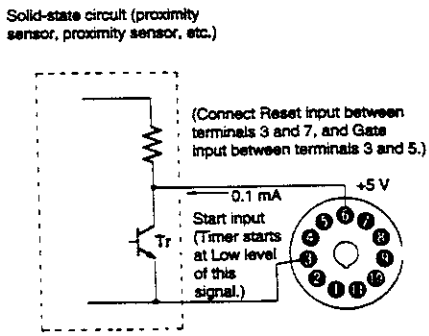
Input type	Open collector transistor
Voltage when collector is OFF	20 V min.
Saturated voltage when transistor is ON	1 V max.
Collector current	50 mA max.
Input current between collector and base	0.5 μA max.
Resistance when transistor is ON	1 KΩ max.
Residual voltage when transistor is ON	1 V max.
Resistance when transistor is OFF	200 KΩ min.

H3CA-A and H3CA-FA

Solid-state input terminal connections are the same as those for contact signal inputs.

Solid-State Inputs (Not Open Collector Type)

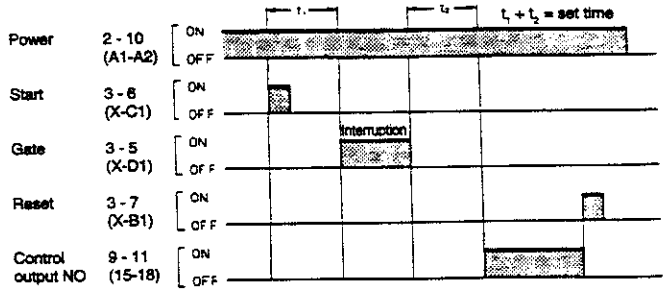
Proximity and photoelectric sensors often have NPN or PNP type solid-state output circuits and rated supply voltages ranging from 6 to 30 VDC. These signals are applied to the timer according to the diagram below.



■ CUMULATIVE TIMING

Using the Gate Input with ON-Delay

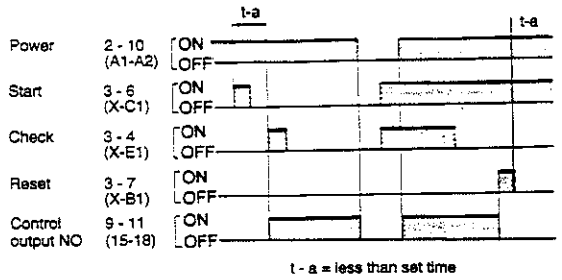
When the gate signal is closed, timing is temporarily stopped. When the gate signal opens, timing resumes at the point of interruption. The gate input terminal permits the timer to sum up times t_1 and t_2 as shown in the timing chart.



■ CHECK INPUT

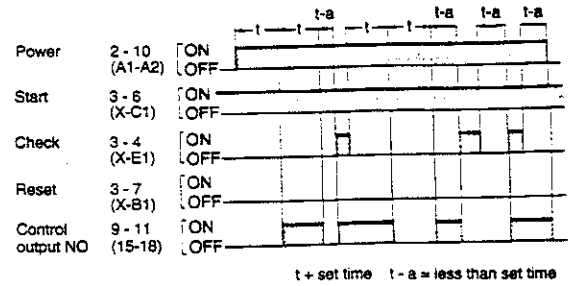
ON-Delay Operation

When a no-voltage input signal is applied to the timer during the lapse of a set time, the remaining set time will become 0 and the timer will enter the next control state. Also, while the Check Signal is applied, the elapsed time measurement of the set time is not performed. The Check input is especially useful where ON-delay override may be desirable.



Repeat Cycle Operation

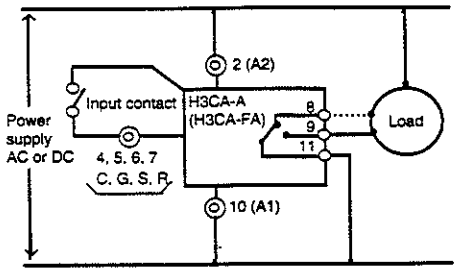
The Check input signal in Repeat cycle mode allows the timer to be used like a binary flip-flop or alternating relay. Set an unattainable time, such as 999 hours. Apply the no-voltage Check input to shift output status from ON to OFF, or vice-versa. Jumper terminals 3 and 6 (X and C1) to short the start function. The Check input then controls the output relay like a flip-flop or alternating relay. This may be used to alternate wear on main and secondary equipment such as pumps.



Installation

■ PROPER INPUT CONNECTIONS (H3CA-A, H3CA-FA)

The neutral or common of the power supply is connected to terminal 2 (A2) of the timer. Terminal 10 (A1) should be connected to the "hot" or positive of the power supply. Do not apply voltage to Check, Gate, Start and Reset inputs. These are no-voltage type inputs.



■ PROPER OUTPUT CONNECTIONS

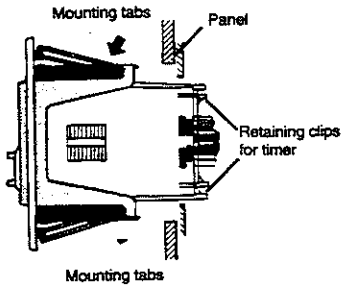
Design your control circuit using the output relay contacts to switch the load. **Never switch a load with the contact that is being used as an input signal.** The timer's circuitry may be damaged.

Using Y92F-70 and Y92F-71 Adapters

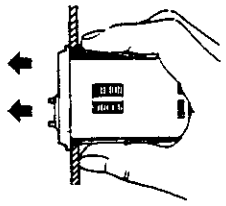
Install the H3CA timer, face first, into the back side of the Y92F-70 or Y92F-71 adapter so the bezel fits snugly. Be sure the retaining clips at the back of the adapter fit into the slots on either side of the timer. Compress the top and bottom tabs of the adapter then push the adapter through the front side of the panel cutout. Be sure the tabs extend after installation for a secure fit.

To remove the timer from the adapter, unclip the two retaining clips at the back of the adapter. To remove the adapter and timer from the panel as a unit, compress the tabs behind the panel and push the unit out the front of the panel.

Installation



Removal

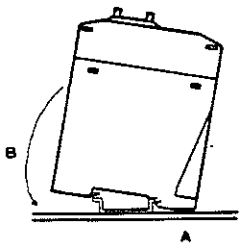


■ TRACK MOUNTING

H3CA-FA with Built-In Track Adapter

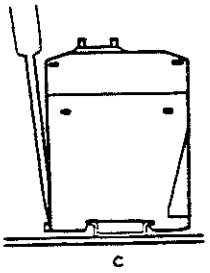
Mounting

First hook part "A" on the rear of the timer onto an edge of the track. Then, press the timer in direction "B" until the latch on the bottom rear of the timer locks securely.



Removal

Pull the latch "C" with a flat-blade screwdriver and remove the timer from the mounting track.

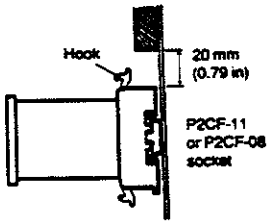


P2CF-□□ Socket

For H3CA-A, H3CA-8 and H3CA-8H

Mounting

The P2CF-□□ socket has two hooks that secure the timer to the socket. Be sure to allow at least 20 mm (0.79 in) clearance above and below the socket to gain access and to release the hooks for servicing and maintenance. Insert timer into the socket. Latch hooks. Then clip rear of the socket to the track. Push the bottom onto the track until the latch hooks securely.



Removal

Pull the latch on the socket with a flat-blade screwdriver and remove the timer and socket as one unit.

NOTE: ALL DIMENSIONS ARE IN MILLIMETERS. To convert millimeters into inches divide by 25.4.