DT MARINE
TOW WINCH
MODEL 210EHLWR

S/N 1095

WARNING

PROTECT YOURSELF AND OTHERS
READ AND UNDERSTAND THESE INSTRUCTIONS
BE SURE THESE INSTRUCTIONS REACH THE OPERATOR

WARNING

DUE TO VIBRATION DURING SHIPMENT, MOUNTING SCREWS ANDELECTRICAL TERMINAL SCREWS MAY HAVE LOOSENED. ALL MOUNTING AND TERMINAL SCREWS MUST BE THROUGHLY CHECKED AND RE-TIGHTENED IF NECESSARY BEFORE POWER IS APPLIED TO THIS UNIT.

WARNING

THIS WINCH IS NOT FOR MAN RATED USE

WARNING

GOODS ARE NOT DESIGNED FOR USE IN THE LIFTING OR MOVING OF PERSONS

The system described herein are neither designed nor intended for use or applications to equipment used in the lifting or moving of persons.

WARNING

THE CABLE ANCHORS ALONE ON WINCHES ARE NOT DESIGNED TO HOLD RATED LOADS

Therefor a minimum of 12 wraps of cable must be left on drum to achieve rated load.

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1.0 GENERAL INFORMATION

1.1 User Responsibility and Safety Precautions.

This equipment will perform in conformity with the description thereof contained in this manual, its accompanying labels and/or inserts when it is installed, operated, maintained and repaired checked periodically. Deficient equipment should not be used. Parts that are broken, missing, plainly worn, distorted or contaminated should be replaced immediately. Should such repair or replacement become necessary, we recommend that a telephone or written request for service be made to the DT Marine agent from which the unit was purchased or directly to DT Marine Products, Inc.

This equipment or any of its part should not be altered without the prior written approval of DT Marine. The user of this equipment should have the sole responsibility for any malfunction that results from improper use, faulty maintenance, improper repairs of damage or alterations made by anyone other than DT Marine Products, Inc. or a service facility designated by DT Marine.

1.2 Introduction.

1.2.1 Purpose.

The purpose of this manual is to provide operating instructions and maintenance procedure for your DT Marine Products, Inc. unit.

1.2.2 Model Number, Serial Number and Options.

This manual covers the Standard 200 series and its options. Your particular unit model number and serial number are listed on the enclosed warranty certificate.

1.2.3 Warranty.

The warranty is included as Section 1.2.3 and its terms are stated on the following Quality Assurance Certificate.

DT MARINE PRODUCTS, INC.

9901 TANNER ROAD * HOUSTON, TEXAS 77041
(713) 460-1400 * FAX (713) 460-3585

QUALITY ASSURANCE CERTIFICATE

Product: DT Model : 210EHLWR
Serial Number : 1095
Bare drum rating 2,000 lbs. line pull @ 0-100 fpm.

DT MARINE PRODUCTS, INC. certifies herewith that this products was manufactured with the utmost care in respect to workmanship, performance and material used, the contents of warranty are as follows:

WARRANTY

The manufacturer warrants that this DT product has been tested for quality control to insure optimum performance and repeatability of results. It further warrants that this instrument is free from defects in materials and workmanship. Should defects in materials or workmanship develop within a six(6) months period from delivery of the product, the manufacturer will service or repair the equipment without charge, except for rotating machinery which is subject to the warranty offered by the original manufacturer.

If the manufacturer determines that a fault has been caused by the misuse, abnormal operating conditions or repairs by unauthorized personnel during the warranty period, repairs by the manufacturer will be billed at a nominal charge.

The manufacturer reserves the right to perform warranty service either in his own factory or at an authorized repair station. All repairs and replacements of parts under the above warranties are F.O.B. factory or service branch.

QUALITY CONTROL CHECKOUT

Measured speed: 0-100 fpm.
Static dynamometer capacity @ bare drum 2,000 lbs.

This certifies the checkout of all components, mechanically and electrically, to insure conformity with the performance listed above.

Signature:_____ Date: _____ 20_____

1.3. Equipment Description

1.3.1 Capabilities and limitations.

The DT Marine model 210EHLWR is a self-contained, electro-hydraulic, variable speed, cable-handling system specially designed for the marine environment.

1.3.2 Specifications and descriptive data.

Overall dimensions	Width	- 42 inches
	Depth	- 46 inches (Includes level wind)
	Height	- 46 inches (Includes level wind)
Drum dimensions	Flange diameter	- 36 inches
	Drum diameter	- 20 inches
	Drum width	- 12 inches
Cable capacity	1000 meters of .322" diameter cable(leaves 2″ clear flange).	
Construction	All welded steel with stainless steel hardware	
Finish	Sandblasted to near white metal and coated with three-coat epoxy system consisting of Zinc primer, one tiecoat and topped with Polyurethane paint.	
Bearings	Sealed, self-aligning ball bearing type.	
Drive system	10 HP, 230/460VAC, 3 phase, 50/60HZ, totally enclosed, fan cooled electric motor driving a hydraulic pump that in turn drives a hydraulic motor connected in open loop configuration. The hydraulic motor is coupled to the drum through a planetary gear reducer that is attached directly to the winch drum. A multiple disc, fail-safe brake is incorporated into the final drive and is located between the hydraulic motor and the gear reducer. The hydraulic reservoir which is supplied with sight level gauge and drain plug contained in the base of the winch so except for having to be supplied with outside electric power the unit is self-contained.	
Controls	A self-centering, single lever, 4-way control valve, with metering spool, which affords variable speed in both directions, is located on a sloping panel on the drive component housing. A system pressure gauge for monitoring performance is also mounted on this	

	panel. A power control switch is located directly below the sloping panel and provides control for a full voltage across the line motor starter housed in a NEMA 4X enclosure and is located inside the drive system housing.
Braking system	A Fail-safe multiple disc brake is incorporated into the final drive and is actuated at the center position of the control handle or in the event of hydraulic pressure 2 inch stainless steel band brake is also located on the winch drum for an added measure of safety.
Performance	Bare drum rating of 2,000 lbs line pull at a line speed of 0-100 fpm.
Handling	Lifting eyes provided at four points.
Options	See Section 2.3

DRUM OR REEL CAPACITY

The length of wire rope, in feet, that can be spooled onto a drum or reel can be computed by the following formula:

$$L = (A+D) \times A \times B \times K:$$

In this formula

A= Depth of rope in inches on drum in inches: A=(H-D-2Y).
B= Width between the drum flanges in inches.
D= Diameter of the drum in inches.
H= diameter of the drum flanges in inches.
K= constant factor from table below.
Y= depth not filled on drum or reel when winding is to be less then the fill capacity of the drum.
L= Length on wire rope on drum or reel.

EXAMPLE: Find the length in feet of 9/16" diameter rope required to fill a drum having these dimensions:

B=24", D=18", H=30"

$$A = \frac{(30-18-0)}{2} = 6 \text{ inches}$$

$$L=(6+18) \times 6 \times 24 \times 0.828 = 2861.5 \text{ feet}$$

NOTE: The above formula and factors "K" allow for normal oversize of ropes but will not give correct figures if rope is not wound uniformly on the reel.

ROPE DIA.	FACTOR K	ROPE DIA.	FACTOR K	ROPE DIA.	FACTOR K
3/32	29.8	5/8	.671	1 3/4	.086
1/8	16.8	11/16	.554	1 7/8	.075
5/32	10.7	3/4	.446	2	.066
3/16	7.44	13/16	.397	2 1/8	.058
7/32	5.48	7/8	.342	2 1/4	.052
1/4	4.19	1	.262	2 3/8	.046
5/16	2.68	1 1/8	.207	2 1/2	.042
3/8	1.86	1 1/4	.168		
7/16	1.37	1 3/8	.139		
1/2	1.05	1 1/2	.116		
9/16	.828	1 5/8	.099		

NOTE: The values of "K" allow for nominal oversize of ropes, and because it is physically impossible to "thread-wind" ropes of small diameter. However the formula is based on uniform rope winding and will not give correct figures if rope is wound non-uniformly on the reel. The amount of tension applied when spooling the rope will also affect the length. The formula is based on the same number of wraps in each layer, which is not strictly correct, but does not result in appreciable error unless the width (B) of the reel is quite small compared with the flange diameter.

2.0 FUNCTIONAL DESCRIPTION

2.1 Major Assemblies.

2.1.1 Drive Assemblies.

The model 210EHLWR consists of the following major drive assemblies:

a. Electrical assembly.
b. Hydraulic assembly.
c. Optional assemblies

2.2 Interaction of the Major Assemblies.

2.2.1 Introduction.

The model 210EHLWR winch is a rugged, general purpose oceanographic winch. Except for having to supply "outside power" to the electric motor, the unit is self-contained.

2.2.2 General theory of the electrical system.

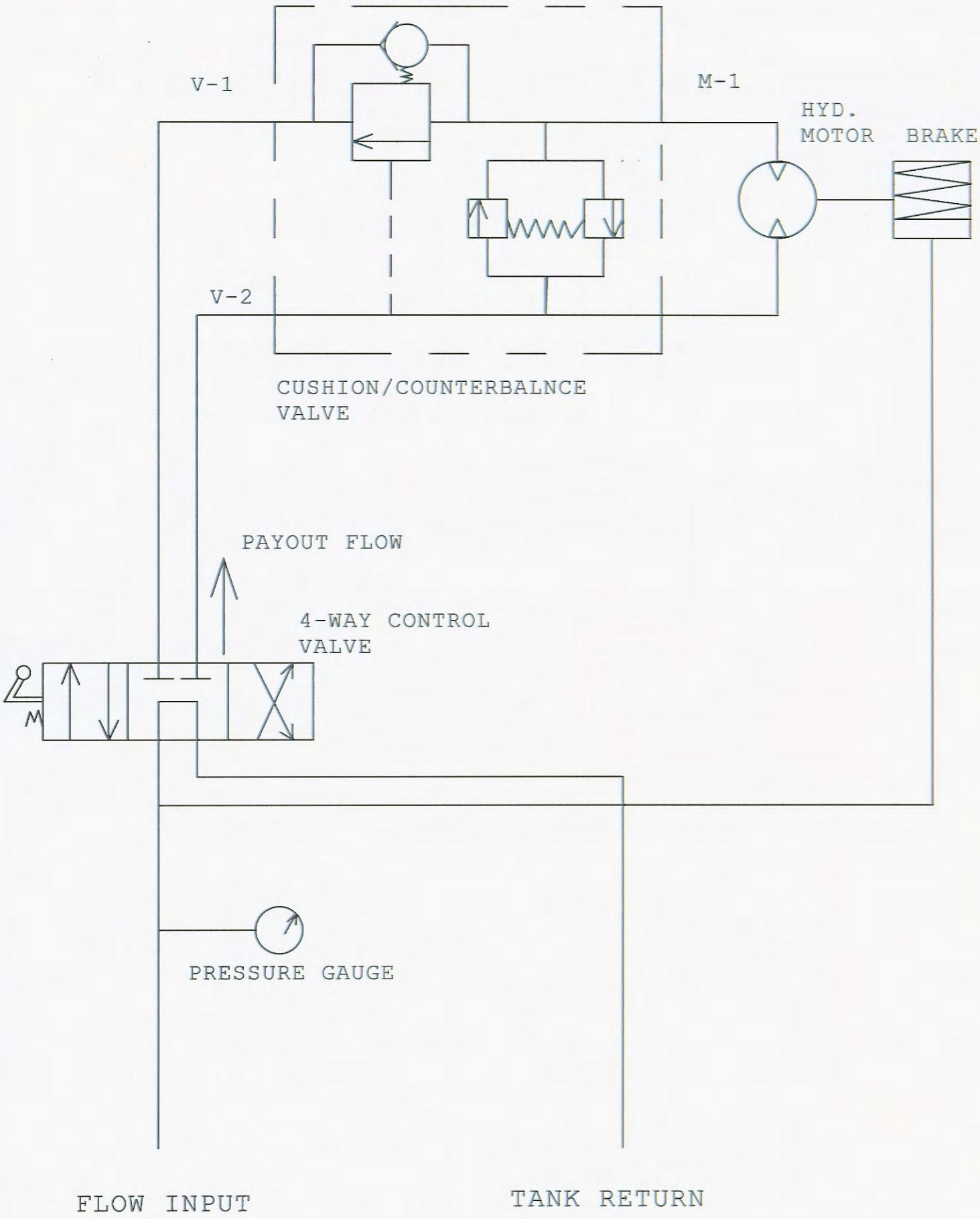
The model 210EHLWR is equipped with a self-contained electrical starter system consisting of a water tight selector ON/OFF switch and a magnetic starter. Shipboard 3 phase power at the required voltage is routed to the starter box and the start is actuated by the rotary switch on the control console. Phase rotation must be correct to insure proper rotation of the 3 phase totally enclosed, a cooled electric motor driving the hydraulic pump. Thermal overload protection is provided by the starter and is adjusted by a rotary adjustment screw inside the starter enclosure.

2.2.3 General Theory of the Hydraulic System.

In the open loop circuit the hydraulic flow is filtered from the tank through a 25 micron filter in a positive displacement gear pump. This flow is circulated at low pressure through the main control valve and back to the tank when the system is in neutral. During winching operations, the main control valve(a 4-way spool valve that incorporates the main system valve),is shifted and the required flow is

diverted to the winch motor. Pressure is generated in proportion to the loads requirements, and the fail-safe brake is released to allow rotation of the drum. During pay-out operations, the counterbalance valve maintains sufficient back pressure to prevent the drum from overrunning. A cushion valve is also connected to the hydraulic motor ports to relieve pressure "spikes" that could occur due to the shock loads imposed on the winch drum. This valve is a crossover relief type that will allow the flow to cross over to the other side of the hydraulic motor at the required PSI.

SEE HYDRAULIC SCHEMATIC IN SECTION 2.2.4.


V-1
M-1
HYD.
MOTOR
BRAKE
V-2
CUSHION/COUNTERBALNCE
VALVE
PAYOUT FLOW
4-WAY CONTROL
VALVE
PRESSURE GAUGE
FLOW INPUT
TANK RETURN

2.3 Options.

2.3.1 Level wind.

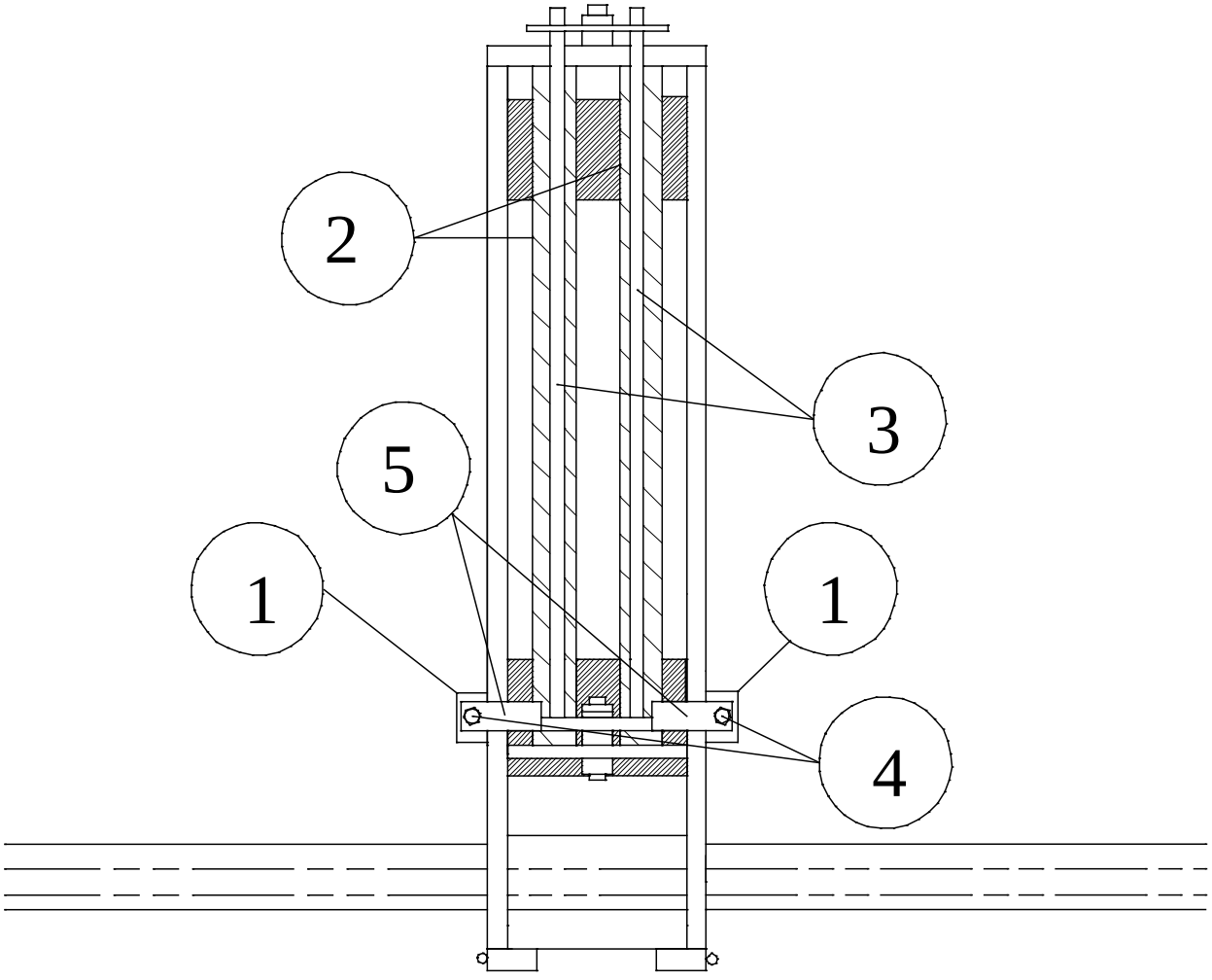
Your DT model 210EHLWR is equipped with a hydroactive type level wind system. This system is an automatic hydraulically operated device that is guided by the cable angle of incidence on the drum, and is independent of the cable diameter or side loads. Position is determined by a sensing mechanism on the cable guide assembly that causes movement of a ball screw by actuating a solenoid operated 4-way control valve. The system utilizes a roller thread ball screw and a ball nut with circulating ball screws. Due to the use of high strength screw and of a hydraulic motor driving the screw, it is possible to achieve high side loads without wear on the essential parts of the system. This ability to tolerate heavy side loads allows the winch to be positioned in a convenient location on the deck without affecting proper operations.

B. Positioning and adjustments.

To be able to initially position the level wind when first spooling the cable on the drum, two push-button controls allow the system to be overridden. These two controls are located on the control console and are identified by "LEFT" and "RIGHT" stickers.

Adjustment of the level wind system is accomplished by setting the sensitivity of the limit switches (1) on either side of the level wind carriage assembly. The separation of the vertical guide rollers' bars (2) in the guide assembly is set at the specified cable diameter when the units leave the factory. The spacing of the sensing bars (3) is normally set in the field. After the cable is fed through the guide rollers and sensing bars, the sensing bars should be set so that they are barely touching the cable being used. After the adjustment of the sensing bar is made, it is time to adjust the sensitivity of the limit switches. Initially, the actuating screws (4) on the sensing bar assembly(5) are positioned so that they are extended equally and touching the limit switches. With the cable passing through the guide rollers and the sensing bars, tension should be applied to the cable(system will not operate properly without cable tension). The actuating screws should then be adjusted so

that the limit switches are actuated when the sensing bars move toward the center of the cable a distance equal to 1/2 the cable diameter. Start the winch with tension applied to the cable being spooled and make final adjustments to the actuating screws so the cable winds properly.



2.3.2 **Remote Control.**

This unit is also equipped with a remote control option that allows the winch to be operated remotely at a distance of up to 150’(length of cable supplied). The remote control is of the proportional type and allows variable speed operation operations similar to that of the local control handle.
The remote control unit is a single lever, “JOY-STICK” type electrical controller that works in the same manner as the main control handle.

Operation of the remote control.

- Return the main control handle to the center position.
- Operate the activated controller by pushing the handle in either the "IN" or "OUT" direction as indicated by the labels on the controller.

To return control to the main control handle, return the remote control handle to the center position. The remote and the local handle work at the same time.

3.0 INSTALLATION INSTRUCTION

3.1 Site Selection.

The winch should be installed in a location that meets the following requirements:

- Firm foundation that allows the unit to be welded to the deck.
- Accessibility by the operator.
- Protection from heavy falling objects.
- Out of the way of other operations.

3.2 Handling.

Lifting holes are located on the top of each A-frame structure and will accommodate standard shackle and pins for a sling if crane hoisting is used.

CAUTION
DO NOT LIFT WINCH BY CABLE DRUM - DAMAGE TO CABLE AND/OR BRAKE ASSEMBLY MAY RESULT

3.3 Installation Procedures.

3.3.1 Welding/Bolt Down.

When the winch is at or near the desired location, remove the shipping protection and position it exactly. If the winch is to be welded to the deck, (welded clips provided) all exposed metal surfaces should be painted immediately to inhibit rusting.

CAUTION
EXTREME CARE SHOULD BE TAKEN TO ORIENT THE CENTER OF THE WINCH DRUM EXACTLY PERPENDICULAR TO THE CABLE RUNNING TO THE SHEAVE. THIS CAN BE DONE BY AVERAGE SIGHTINGS ALONG THE FLAT SURFACES OF THE WINCH (SIDEWALL, DRUM FLANGES OR WITH THE HELP OF A SQUARE TO find THE TRUE PERPENDICULAR CENTER LINE, IF IT IS NOT PROPERLY ALIGNED, CABLE LAYING PROBLEMS WILL CREATE DIFFICULTIES AND POSSIBLY DAMAGE THE CABLE, THE WINCH AND/OR PERSONNEL. BE SURE THE FRONT SIDE (LOWER END WHERE THE HOSES ARE) IS FACING THE SHEAVE SO THAT THE CABLE DIRECTION WILL BE CORRECT.

3.3.2 Hydraulic Requirements Prior to Start-Up.

Open oil filler cap located at the front of the winch underneath the level wind assembly . Fill with recommended hydraulic oil to the red line on the sight level guage.(See section 5.5.1}

3.3.3 Electrical Connection Requirements.

When installing the system aboard ship, it is wise to keep input power leads as short as possible and use # 10/3 wire or larger. It is also advised that all exposed moving parts be coated with an anti-seize compound to inhibit rust and prevent "freezing" of the parts.

CAUTION
THIS UNIT IS WIRED FOR 230/460 VAC 3 PHASE 50/60HZ OPERATION
SEE WIRING DIAGRAM IN APPENDICES SECTION

3.4 Installation Checkout.

3.4.1. Installation inspection.

- Do not locate winch backward (with cable paid out on operator side of the winch. Erratic control with possible loss of control will occur.
- Ensure that control handle is in "mid" position.
- Check that proper power is supplied to the winch.

3.4.2 Turn-On and preliminary test.

1. Rotation check.

Before the winch is placed into service, it is imperative that the electric motor/pump direction of rotation is correct. To determine rotation, switch the main power ON momentarily and check to see if the shaft is rotating in the direction showed by the label located on the pump. This can be observed through the fan housing at the rear of the motor. If it is not rotating in the proper direction; reverse any two (2) input power leads.

2. Leaks.

All fittings and hoses are inspected for leaks at the factory prior to shipment. If leakage is noticed; tighten or replace as required to correct.

3.4.3 Installation Verification Test Check List.

- Check the following conditions:
- Location and position of the unit.
- Controls position on control console.
- Power supply to unit
- Leaks.

3.5 Cable Installation.

3.5.1 Cable termination on drum.

A cable lead-in slot is cut into the core to allow termination inside the drum. A cable clamp is placed inside the drum to constrain the cable and prevent wear at the slip ring termination. A customer supplied junction box is also mounted inside of the drum. An access hole with removable cover plate is cut out on the side of the drum.

CAUTION *
THE CABLE CLAMP IS NOT INTENDED TO TAKE FULL LOAD OF THE CABLE

3.5.2 Spooling.

Whenever cable is coming up and wrapping onto the winch drum, the winch and cable must not stack up above the drum flanges or it will fall off the side of the drum and possibly damage the cable. Whenever the equipment is being raised, the winch operator must watch for the end of the cable markings or the equipment itself. Before the equipment gets near the sheave, the operator should stop the winch and start handling the equipment
(See information on cable handling in the following pages)

3.6 Slip Ring Installation.

A slip ring adaptor with a pattern matching that of the customer slip ring is provided and is mounted to the external end of the shaft on the bearing side of the drum.

4.0 OPERATING INSTRUCTIONS

4.1 Control Console.

The winch controls are located at the rear of the winch at a convenient height for the operator. A 45 degree sloped panel contains the main control lever, a pressure gauge and any other optional function controls. The ON/OFF switch is located directly below the sloping panel on the vertical face of the cabinet.

4.2 Operating Procedures.

4.2.1 Operator Turn-on

- Ensure that control handle is in mid position.
- Check that proper power is supplied to the winch and electric motor.
- Turn on main power to winch and electric motor.

NOTE: ELECTRIC MOTOR/PUMP NOISE WILL BE HEARD AFTER THIS STEP. IF ANY LOUD NOISE IS PRESENT, SEE SECTION 6.0 OF MANUAL

4.2.2 Cold Start Operation.

After starting the system, allow unit to run for approximately 30 minutes to warm the oil with control handle in central or neutral position. After start up, Cable In or Cable Out is controlled by the control handle located on the sloping panel of the control console.

4.2.3 Shut Down/Turn Off.

- Release winch control handle, (valve will return handle to central or neutral position)
- Turn ON/OFF switch to OFF position.
- Turn off main power to winch

5.0 MAINTENANCE PROCEDURE

5.1 Introduction.

This section gives necessary information for regular, periodic and preventive maintenance, and for some repairs or replacements. For further information, service assistance or problems; refer to DT Marine Products, Inc. factory.

5.2 Maintenance Plan.

5.2.1 Lubrication Schedule.

Under normal operating conditions on a permanent deck installation the following lubrication schedule is recommended:

1. The motor is equipped ball bearings pre-lubricated with special grease by the bearing manufacturer. This lubrication will last for the life of the bearings.
2. The gear head reducer is filled with oil at the factory. After 1,000 hours of operation, drain and refill with EP-90 weight lubricant.
3. Lubricate control handle valve with 30 weight oil at 50 hours intervals.
4. Lubricate the pillow block bearing with Lubriplate 130AA or equivalent at 50 hours intervals.
5. Lubricate manual brake lever grease fitting and hardware regularly to insure reliability.
6. Lubricate level wind screw as required per manufacturer's instruction. Coat exterior of ball nut with grease.
7. Lubricate level wind flange bearing with Lubriplate 130AA or equivalent at 50 hours intervals.
8. Check oil level of unit weekly; level should be at 1/2 inch below tank top.
9. Replace filter every 90 days or when erratic condition exists (See Section 6.0 CORRECTIVE MAINTENANCE).

NOTE: THE OIL LEVEL IN THE WINCH SHOULD BE MAINTAINED AT FULL CONDITION OR PUMP CAVITATION WILL RESULT AND THE WINCH WILL NOT OPERATE PROPERLY.

Recommended oil is as follows:

Shell Tellus 32, Exxon Nuto 32, Texaco Rando 32 or equivalent	
Emergency	Any 10 weight hydraulic oil

CAUTION
DO NOT LUBRICATE WHILE UNIT IS OPERATING

5.2.2 Cleaning.

The winches will last longer and be easier to maintain if it is kept relatively free of oil, dirt and rust. Rinsing as often as possible with fresh water will help minimize corrosion.

5.2.3 Brake.

Check brake adjustment weekly and adjust (tighten or loosen nuts located on A-frame structure) as required to allow handle to lock with sufficient force to stop the drum under maximum load.

NOTE: WHEN HAND BRAKE IS WORN DOWN TO THE RIVET HEADS OR BEYOND ADJUSTMENTS, THE BRAKE LINING SHOULD BE REPLACED.

5.2.3 Cables and hoses.

All electrical cables should be checked periodically for wear, chaffing, cutting, decaying or other imperfections. All hoses assemblies in service should be checked periodically for leaks, abrasions, kinks, cover blisters or other such damages. Assemblies showing signs of wear or damage must be replaced before they cause a failure or create a hazard.

5.2.4 Fasteners.

Periodically check for loose or missing screws, bolts, nuts and parts and tighten or replaced them as needed.

6.0 CORRECTIVE MAINTENANCE

6.1 Troubleshooting

Symptom/Signal	Cause/Remedy
Loud noise when unit is started	Check for interference of fan/shroud on electric motor and pump coupler
Erratic or low speed condition intermittent fluid borne noise	Pump cavitation: Check fluid with level, check suction filter; replace if necessary.
Motor runs but winch inoperative	Motor direction is reverse. Check phase rotation of input leads. (See Section 3.4.2)
Erratic or intermittent operation of drum in one direction or complete lack of movement.	Main control valve malfunction. Disassemble and clean or replace. (See Section 6.2.3)

6.2 Component Removal/Replacement.

6.2.1 Introduction.

Maintenance of the winch consists of determining the defective part and removing or replacing that component. all work should be done after the electrical supply is shut down at the main breaker. If needed, consult with DT Marine Products, Inc. factory or its nearest trained representative for 24-hour world wide service.

6.2.2 Cable Drum.

Cable drum is easier to remove/replace if cable is removed.

The drum can be removed as follow:

1. Open cabinet
2. Remove the two bolts holding the hydraulic motor and move clear.
3. Slide the brake out and move clear.
4. Remove all the bolts on the A-frame gear reducer mount.
5. Remove Pillow Block bearings bolts.
6. Support drum with slings and move sideways to clear gear reducer mount from frame and lift drum clear.
7. Unbolt gear reducer from drum.

7.0 LIST OF REPLACEMENT PARTS
MODEL: 210EHLWR S/N: 1095

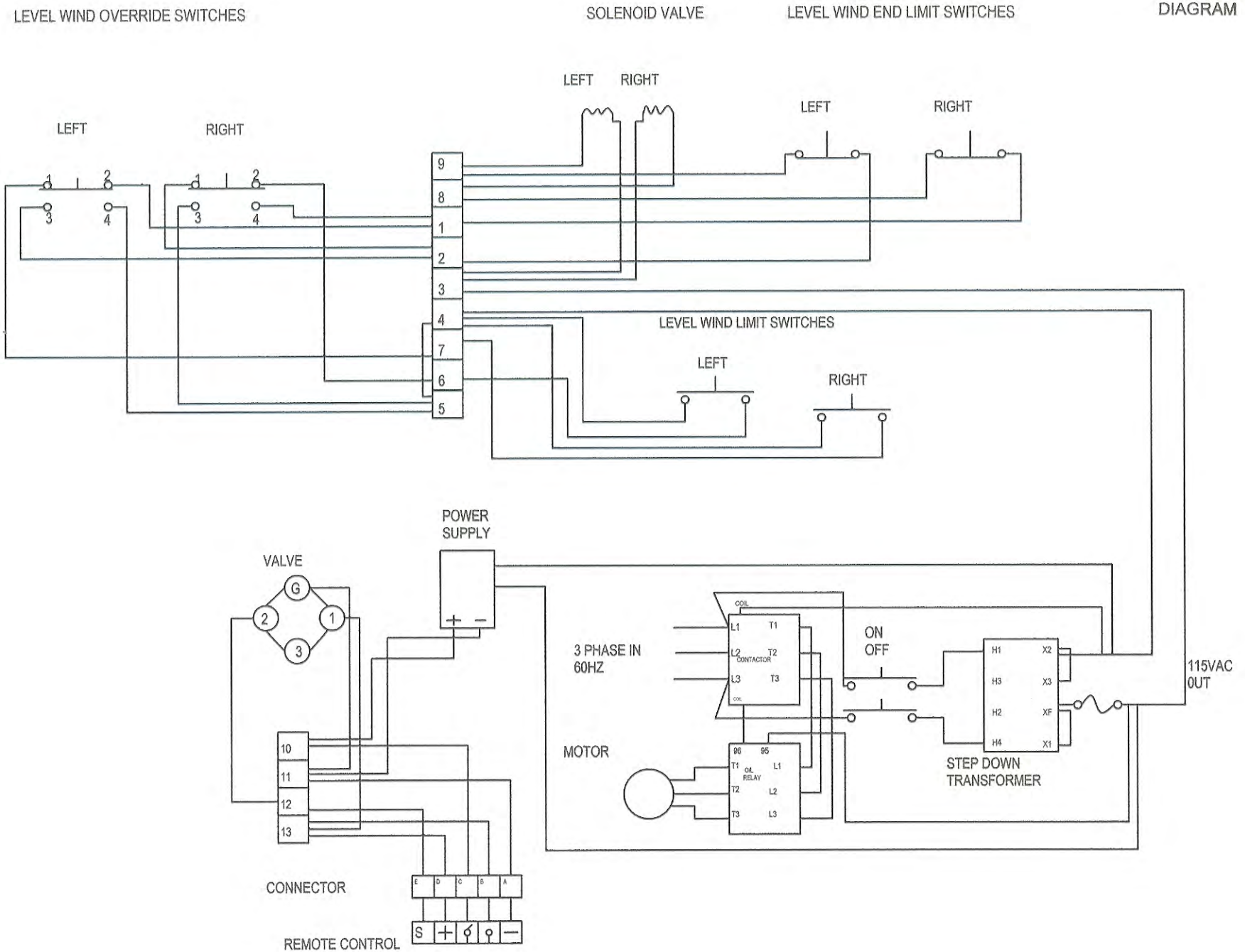
QTY	PART DESCRIPTION	MANUFACTURER	PART NO.
1	ELECTRIC MOTOR	BROOK CROMPTON	10WD256T
1	PLANETARY GEAR REDUCER	OMNI	WD0330B113H1NS
1	HYDRAULIC PUMP	PARKER	PGP511AO14OCK1H2ND6D5B1B1
1	HYDRAULIC MOTOR	PARKER	TBOO36B5280AAAB
1	FILTER ELEMENT	ZINGA	SE-25
1	PRESSURE GAUGE	PRECISION	2.5X0-4000
1	MAIN CONTROLLER	DANFOSS	PVG32 - 157F0328
1	REMOTE OPERATOR	DANFOSS	PVREL-155U2605
1	CUSHION/C-B VALVE	DT MARINE	CBC-150
1	PRIORITY VALVE	BRAND HYDRAULICS	BG5-1
1	POWER OPERATOR SWITCH	SQUARE D	SKS11B-9001
1	POWER CONTACTOR	SPRECHER & SCHUN	CA7-30
1	OVERLOAD RELAY	SPRECHER & SCHUN	CEP7-EEFD
1	COIL	SPRECHER & SCHUN	CA7-30-110V
1	STEP-DOWN TRANSFORMER	ACME	AE06-0100
1	POWER SUPPLY	SOLA	SLS-122-017T
1	FAILSAFE BRAKE	MICO	02-556-324
1	PILLOW BLOCK BEARING	BROWNING	VF4S-240
1	L/W SCREW	NOOK INDUSTRIES	SRT8746/SBN1566/FLG8283
1	BRAKE VALVE	MARCO	H1071
1	L/W HYDRAULIC MOTOR	DANFOSS	151G0036
1	L/W SOLENOID VALVE	COMPACT CONTROLS	CP530-3P-8S-120AC
2	L/W SUPPORT BEARING	CONSOLIDATED	7205-BG
2	L/W OVERRIDE SWITCH	SQUARE D	KR1U-9001
2	L/W POSITIONING SWITCH	OMRON	D4C1632
2	L/W END LIMIT SWITCH	OMRON	D4C1632

8.0 APPENDIXES

APPENDIX "A" : WIRING DIAGRAMS
APPENDIX "B" : CABLE HANDLING INFORMATION
APPENDIX "C" : HYDRAULIC SYSTEMS TROUBLESHOOTING

Manufacturer's data sheets follow.

APPENDIX "A" WIRING DIAGRAM



Receiving and Handling

Here are some tips to help you avoid cable damage during initial handling of your cable.

UNLOADING AND HANDLING

When unloading reels of electromechanical cable, do not drop the reels to the ground or floor from the freight car or truck. Reels are not designed to withstand this abuse. The weight of the cable could collapse the reel. Removing cable from a collapsed reel is very difficult, and very likely to damage the cable permanently.

When using a bar to roll a reel of cable, pry against the reel head, not against the cable itself. When moving the reel in any way, avoid contact with the cable.

Unload the reel directly from the truck or freight car onto the loading dock when possible.

UNREELING

During the unreeling process, it is imperative that the reel rotates as the cable is unwound.

SPOOLING FROM REEL TO DRUM

To reel a cable onto the spooling drum, the cable should travel from the top of the reel to the top of the drum. This will prevent a reverse bend in the cable. A reverse bend may make the cable livelier and harder to handle. (Fig. 3 Preferred Way.)

THE CORRECT WAY TO UNREEL ELECTRO-MECHANICAL CABLE

1. The reel may be mounted on a shaft supported by two jacks. (See Fig. 1.) By holding the end of the cable and walking away from the reel, the workman pulls the cable from the reel and the reel rotates properly.

2. The reel may also be mounted on a unreeling stand. (See Fig. 2.) It can then be unwound as above. However, extra care must be exercised to keep the cable under sufficient back-tension. If slack accumulates and the cable drops below the lower reel-head, kinks will form. Solid back tension will also assure tight spooling onto the winding drum for initial service.

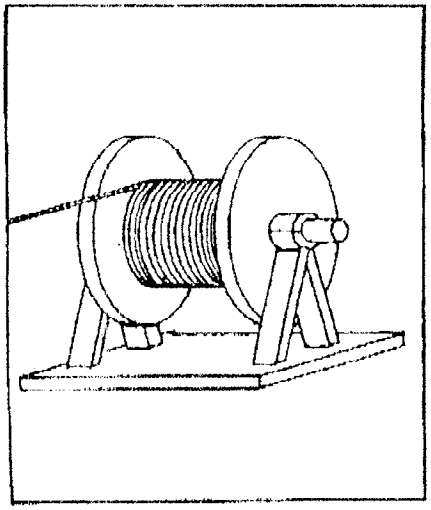


FIGURE 1

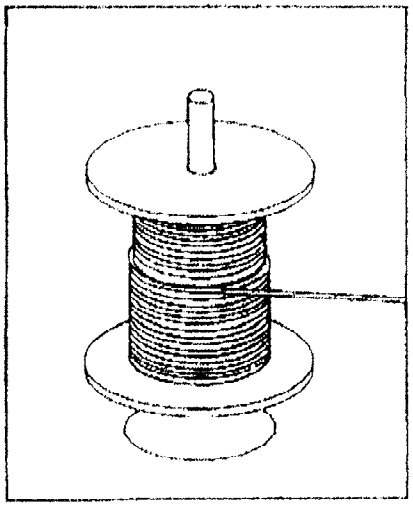


FIGURE 2

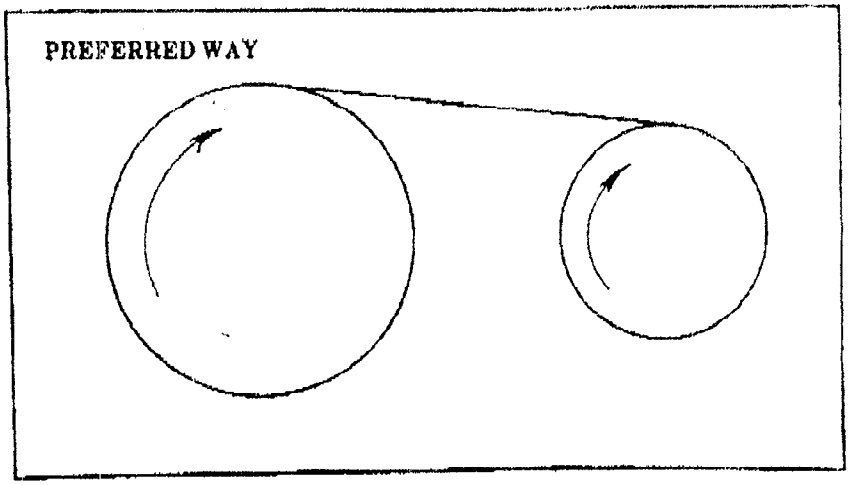


FIGURE 3

Installation and Spooling

GAUGING

To gauge electromechanical cables, measure the diameter twice, with the second measurement at a right angle to the first. By averaging the two figures, you will arrive at an accurate estimate of the cable's diameter. (See Fig. 4.) This method assures you an accurate gauging, since it compensates for any flattening of the cable that may have occurred during winding.

GROOVES

Grooves in running sheaves should be checked to fit the particular cable being used. (See Fig. 5.)

It is important that the cable fit properly in the sheave groove. (See Fig. 6.) If the groove is too tight, the armor wires of the cable will wear quickly and soon break. (See Fig. 7.) If the groove is too wide, the tension on the cable will flatten it, which will also result in uneven wear and premature failure. (See Fig. 8.)

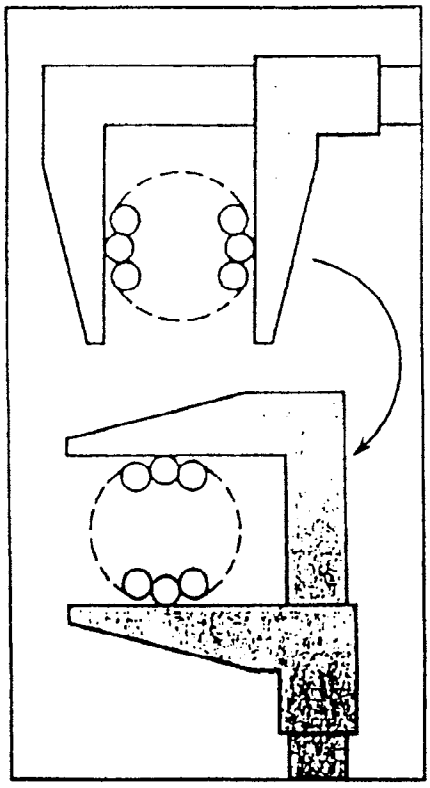


FIGURE 4

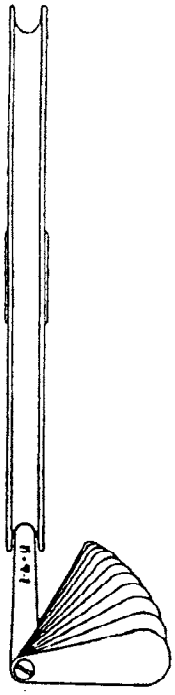


FIGURE 5

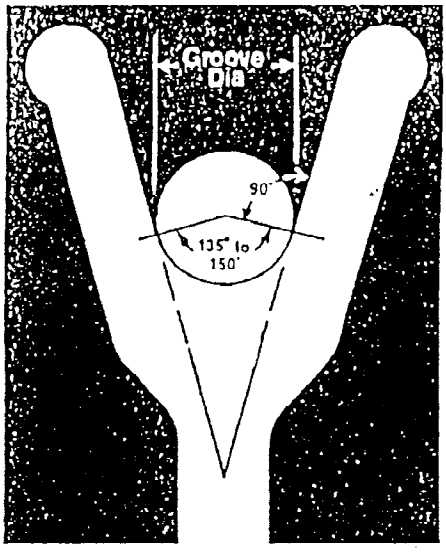


FIGURE 6

FIGURE 7

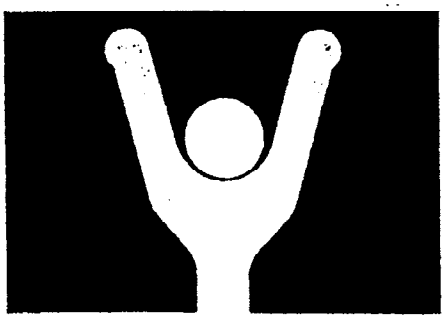


FIGURE 8

Installation and Spooling (CONTINUED)

SHEAVES

Sheaves should be aligned so that the axis of the cable is parallel to a line drawn from the center of the groove of one sheave to the center of the groove of the next sheave. This alignment prevents excessive wear caused by the cable bearing against flanges or dragging across shoulders. This wear will destroy the outer armor wire long before the cable has given even nominal service. Using sheaves with broken flanges has the same undesirable results.

FLEET ANGLES

On installations where the cable passes over a lead sheave, then onto a dru, it is important that the lead sheave be located at a sufficient distance from the drum to maintain a small fleet angle at all times. The fleet angle is the side angle at which the cable approaches the sheave from the drum. (See Fig. 9.)

The best electromechanical cable service is obtained when the maximum fleet angle is not more than 1¼ degrees. The maximum fleet angle is the angle between the centerline of the sheave and the cable, when the cable is at the end of its traverse travel on the drum. A lead of twenty-five times the drum width (measured between flanges) will normally establish a suitable fleet angle. Thus a drum three feet wide should be located approximately 75 feet from the lead sheave.

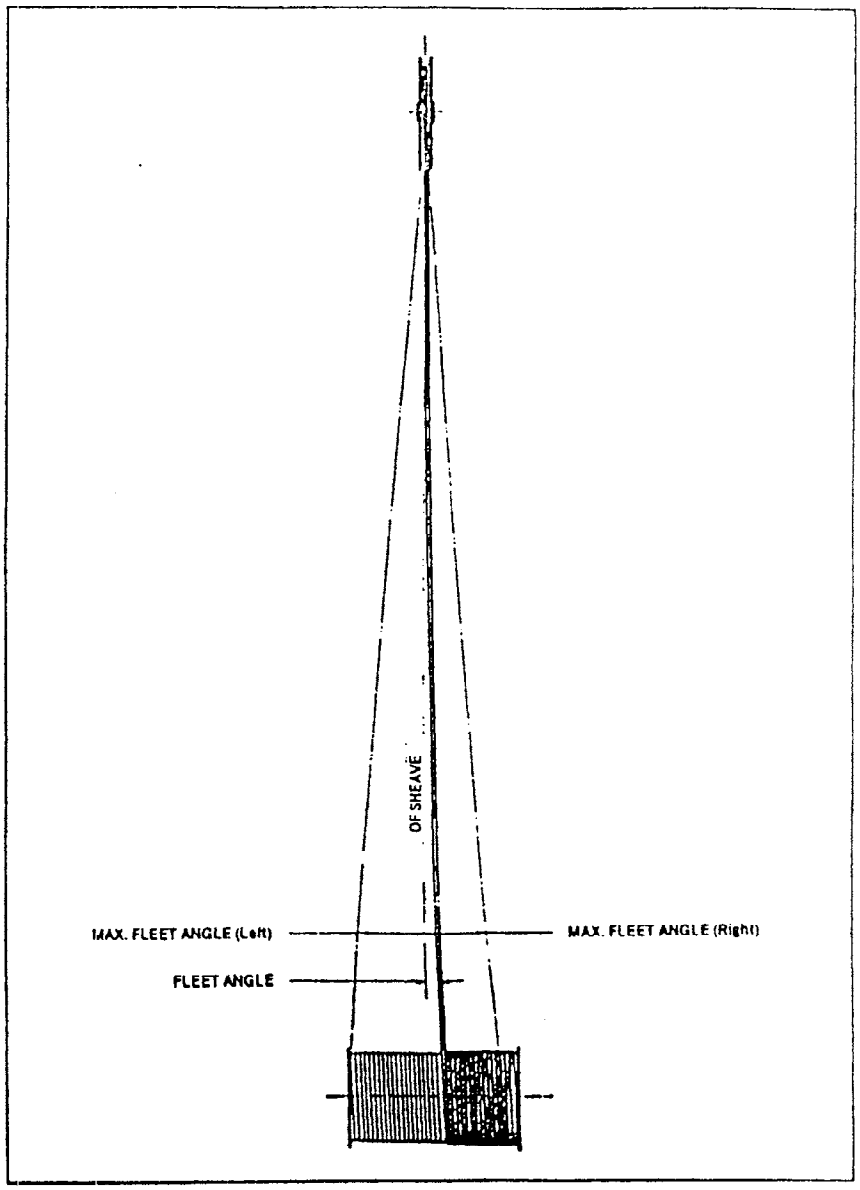


FIGURE 9

TIPS ON SPOOLING

- Make certain the winch drum is in good mechanical condition: the flanges must be perpendicular to the drum core; and the core surface should be smooth and straight with no dishing. If using a grooved drum, be sure the grooves are the correct size for the cable being spooled and in good condition.
- Apply the first layer in a predetermined pattern that can be easily reproduced on all subsequent layers.
- Watch crossover points carefully, so that proper position is maintained
- Recheck the fleet angle after the second and third layers have been applied to make sure equipment is still in alignment
- Maintain proper back tension for each layer

BREAKING IN ELECTRO-MECHANICAL CABLE

After a new cable has been installed, it is advisable to run it in a test well for a short period. This gives the component parts a chance to adjust themselves to the operating conditions. Time spent in breaking in the cable will pay off in extended cable life.

Installation and Spooling (CONTINUED)

The Spooling of Armored Wireline cable on a smooth surface winch drum requires proper handling equipment, plus proven installation techniques. After the cable is installed, the winch operator must also use correct operating methods or the best spooling effort can be lost.

Condition of drum

The winch drum should be in good mechanical condition; the core surface should be smooth and straight with no dishing; and the flanges must be perpendicular to the drum core.

Removing cable from shipping reel

Normal installation requires spooling from the top of the shipping reel to the top of the winch drum. The cable bed layer can travel from left to right or right to left, but a back tension of some form should be held, as the cable is spooled on the winch drum. Proper back tension allows removal of the cable from the shipping reel without cutting into the lower layers and can best be accomplished by using a tension capstan between the shipping reel and the winch. This arrangement not only prevents cable damage on the shipping reel, but allows for the use of pre-calculated tension under controlled conditions.

Proper alignment

For a cable to be spooled properly, the angle from the winch drum to the first fixed point should be correctly established. This is known as the fleet angle and should be no greater than 1¼° at the flange. The approximate distance required to develop this angle is found by multiplying the drum width by 25; thus, for every foot between flanges of the drum, a distance of 25 feet is needed to the fixed point.

Basic spooling concept

The main concept of controlled cable spooling is to apply the first layer in a predetermined pattern that can be readily reproduced on the second and all subsequent layers.

During spooling, the cable should lie parallel to the flanges except for the two cross-over sections where the cable moves across the drum one-half pitch (½ cable diameter) to give a full pitch movement per drum revolution.

The area of the cross-over or "break" points covers about 10% of the circumference of the drum. This area is divided between the two cross-over sections spaced 180° apart, thus creating a counter-balanced effect on the drum.

Establishing cross-over points

The winch drum should have a entry hole on the side of one flange where it joins with the core. This hole should be drilled just slightly larger than the cable and at an angle to allow movement of the cable along the face of the flange without a sharp bend. A clamp or other means should be used to keep the cable from pulling back through the entry hole.

The first cross-over point is developed at the entry hole. Using a carpenter's square (held at right angle with core and flange) and a chalk stick, draw a line from the center point of the entry hole across the drum core to opposite flange. This line should be carried up on both of the flanges.

The second cross-over point is located 180° from the first and marked in the same manner. This point can be quickly located by wrapping a length of the unarmored conductor core around the full circumference of the drum barrel. Dividing this into two equal lengths, take one length (holding one end at the first chalk mark) and wrap it around the drum core. Then place a mark at the opposite end; it should be 180° from the first cross-over point.

Sometimes it is found helpful to add an additional chalk line parallel to each of the two cross-over lines. This line is positioned to show where "break" should finish. This line should be about 3" from the main cross-over line when spooling a 15/32" diameter cable and proportionately less for smaller cables.

Calculating first layer on drum

The next step is to determine how many turns of cable will be needed for the first or bed layer to wrap around the core and fill the area between flanges. It is suggested that the cable diameter be divided into the measurement between flanges; thus, if using a .200" O.D. cable with 20" between flanges, 100 turns would be required to fill the drum.

This method should work well within a half turn. If slightly more or less is required, add or remove a half turn. Judgment must be used in an effort not to disturb the bed layer any more than needed. Generally, cables will spool, or thread lay, easier if a half turn is removed than when an extra half turn is added.

After the required number of turns is determined, the cable end is inserted through the entry hole near the side of the flange where it is properly tied down and prepared for connection to the collector ring. The drum is then rotated to add three or four turns. Just enough back tension is used to hold cable in place.

Beginning installation

Using a hammer (Blacksmith) and dull nosed (3") chisel, work the cable away from the flange (starting at the break point 180° from the entry hole, continuing around to the entry hole) and insert the first length of packing material between the flange and the cable. The packing material (approximately ½ diameter of cable) is fitted into place with the hammer and chisel as the drum rotates slowly with all turns being moved into proper position. (Generally, the unarmored conductor core can be used as packing material.)

After the first length of packing has been inserted, continue to rotate the drum, adding the balance of cable required for the bed layer. (see fig. 11)

Installation and Spooling (continued)

Table of Suggested Tensions				
Cable Size	1st Layer	2nd Layer	3rd Layer	Balance
3/16	300 lbs.	450 lbs.	650 lbs.	Tension held for ½ of the cable length, then reduced by the weight (lbs. per M') of cable as each 1,000' is installed. This is done until a minimum of 200-300 lbs. is reached on 7/32" and smaller cable and 1,000 lbs. on larger cable. This minimum is then held until the entire cable is installed.
7/32	400 lbs.	600 lbs.	850 lbs.	
5/16	1,500 lbs.	2,000 lbs.	2,800 lbs.	
7/16	2,500 lbs.	3,500 lbs.	4,500 lbs.	
15/32	2,500 lbs.	3,500 lbs.	4,500 lbs.	

FIGURE 11

Correct back tension

Back tension is very important from this point on. Generally, just enough tension is used on the bed layer to obtain the required number of turns. Using too much tension will cause the cable to oval and not allow the required number of turns to fit between the flanges. Normal tension on the first layer would be approximately 10-15% of the breaking strength of the cable. On a 7/32" cable, we suggest using 400 lbs. and 1,500 lbs. on a 5/16" cable. (see table for suggested tensions and fig. 3.)

Installing second and third layers

Before adding the last turn to fill the drum on the first layer, the decision must be made as where the second length of packing material should be placed. If no additional turns appear to be needed, the second packing should be inserted in the 0° to 180° position or on the opposit (bottom side from the first packing. If an additional half wrap is required, it should be inserted (using hammer and chisel to evenly move cable turns closer together) in the 180°-360° position or directly across (top) from the first packing.

With the drum again rotating slowly, the tension should be increased to approximately 15 to 20% of the cable's rated breaking strength to add the second layer.

After the second layer has been added, again check for proper fleet angle. This may require movement of equipment to obtain correct position. Slight adjustments, using hammer and chisel, may also be required to help develop proper cross-over points.

During application of the third layer, the tension should be increased to approximately 20-25% of breaking strength. At the end of the third layer, fleet angle and break points should again be checked and any slight adjustments made.

Completion of spooling/points to watch

From this point on, as each layer is added, the "break" points should move back slightly. This can be checked with the chalk marks located on the side of the flanges. If the "break" line moves back too quickly, it means there are too many turns in bed layer.

Should the "break" line move forward very quickly, it means there are not enough turns in bed layer. This also causes large spaces between cable turns, which allows the cable to "crack out" or develop "low spots."

Should the outside diameter of the cable vary, it should be compensated for by adding or removing turns in the bed layer. Slight adjustments in the back tension may also be needed to adjust for minor O.D. changes and overall cable condition.

Good spooling can be obtained if the equipment is in good condition and properly handled. Working with the known O.D. of the cable plus proper handling of back tension and fleet angle, will generally insure good thread lay spooling with a minimum of effort.

The foregoing information is intended only as a "standard guide" for normal hoisting conditions. It is not intended to cover every detail nor satisfy every operating condition. Many special services, such as deviated and extremely deep hole work, may require some modification of these procedures to suit the special conditions.

Operating and Maintenance

RUNNING CONDITIONS

Many operating conditions vary from job to job. Rate of running speed, either paying out of returning cable to the winch drum, depends upon a particular condition of each operation. Constant tension, however, must be maintained at all times. Damage from overruning or sudden release of tension may cause:

- Bird caging
- General loosening of armor wire
- Kinking
- Conductor fatigue
- Possible insulation failure

Proper judgment must also be exercised in selecting correct running gear or equipment. Improper operating angles or excessive friction holding devices could cause permanent cable damage.

STORING ELECTRO-MECHANICAL CABLE

When not in use, electromechanical cable should be stored in a dry place free from corrosive fumes, and protected from the weather. The outer layer of cable on the reel should be protected by a coating of lubricant.

CARE OF IDLE CABLE

If possible, cable on idle equipment should be cleaned, lubricated, wound on a reel, and stored in a dry place where it is protected from the weather. If it is not possible to remove the cable from the equipment, the entire cable should be cleaned and lubricated. This lubrication should be heavy enough to protect the cable against corrosion.

CORROSION PROTECTION

Electomechanical cables are normally coated with a rust inhibitor during the process of manufacture. If this initial rust inhibitor is not sufficient to last the life of the cable, periodic applications of a lubricant or rust inhibitor are advisable. Lubricants should:

- Be free from acids and alkalies
- Have sufficient adhesive strength
- Be nonsoluable under prevailing conditions
- Have a high film strength
- Resist oxidation
- Should not be damaging to insulation
- Preferably contain water displacement additives.

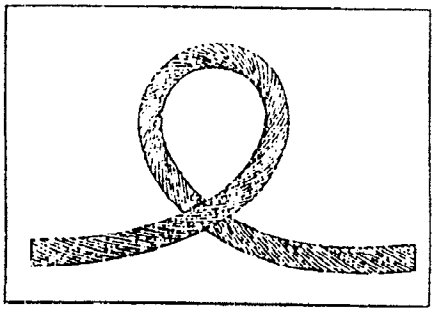
Cables should be cleaned before being lubricated. Cleaning may be done with wire brushes or other suitable devices. The entire length of the cable should be pressure lubricated uniformly.

Common Cable Abuses

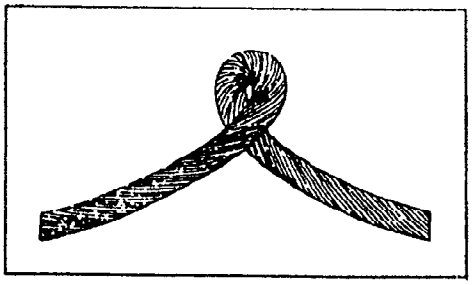
- Use of incorrect size or construction
- Inadequate or improper corrosion protection
- Sheaves and drums of inadequate size
- Crosswinding or piling up on sides of drums
- Sheaves and drums out of alignment
- Sheaves and drums with worn grooves or worn flanges
- Permitting lines to jump sheaves
- Improperly attached fittings
- Permitting lines to untwist
- Kinked lines
- Severe overloads
- Hammering and peening wear resulting from cables being improperly installed or handled.
- Excessive running speeds
- Overrunning or sudden release of tension
- Improperly adjusted packing glands

KINKS

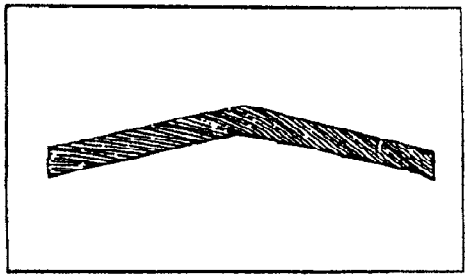
Any kink in electromechanical cable will damage the armor wire and insulation, greatly reducing the life of the life of the cable. Careful handling will keep the cable free of kinks.



The Starting Loop
Do not allow the cable to form a loop. If a loop should form, removing it at this stage will prevent kinking.

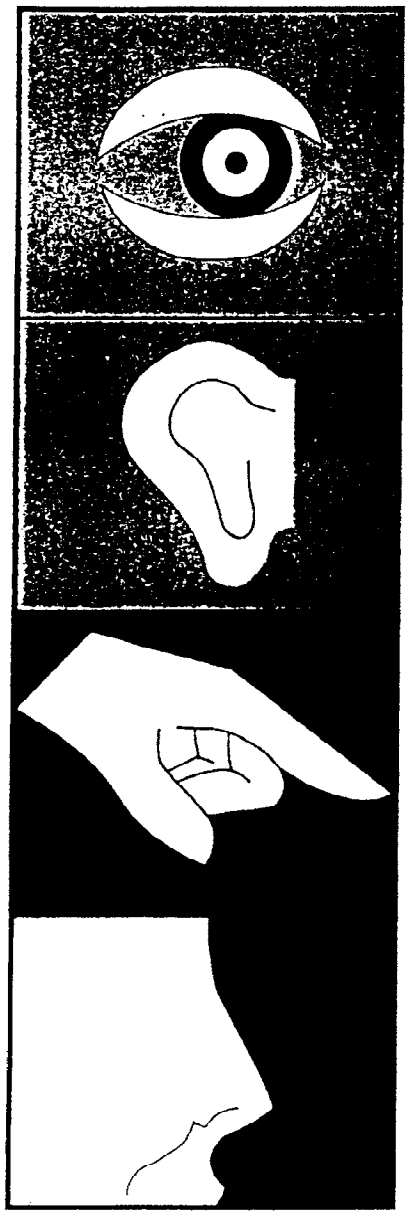


The Kink
Here the looped cable has been put under tension and the kink has formed. The cable is permanently damaged.



The Result
The damaged armor wires will wear very quickly at the kink and cause premature failure of the insulated conductor.

HOW TO
troubleshoot hydraulic systems by using your senses



Sight

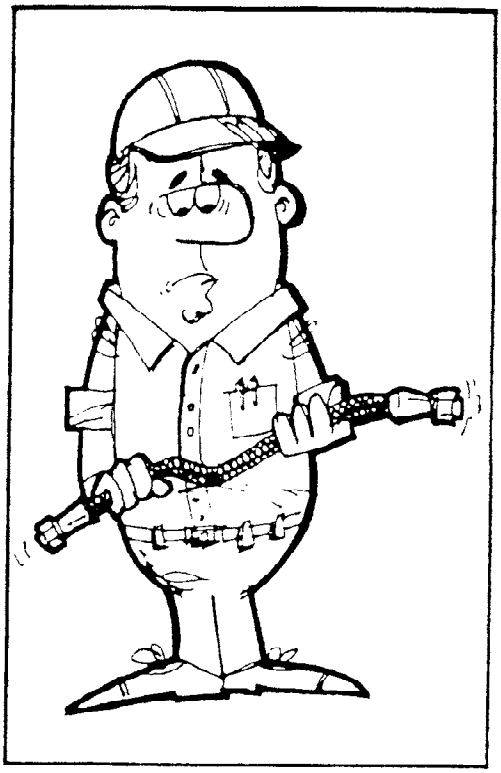
Hearing

Touch

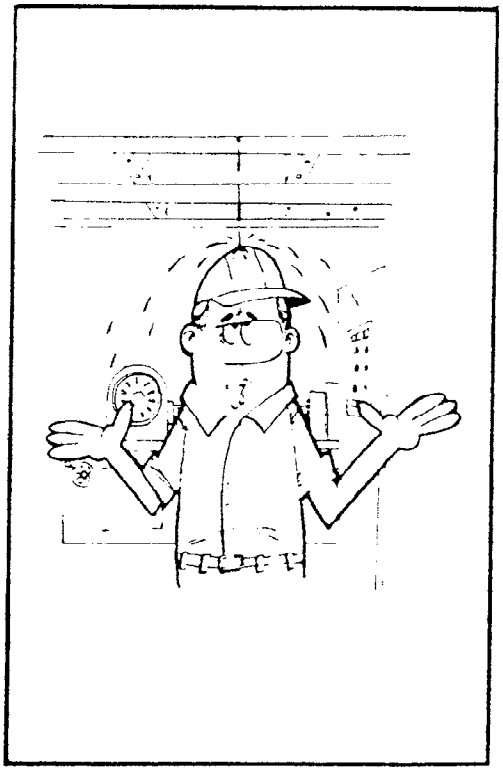
Smell

SIGHT

One good way to forestall problems with a hydraulic system is to periodically look over your equipment. Watch for any signs of leakage—a wet machine or hose, oil stains, low levels in the reservoir. It's a good idea to look at the reservoir regularly, not just to check the fluid level but to actually examine the fluid. If the oil in the reservoir has a milky appearance it is probably saturated with air or water. In either case, your hydraulic system is in for trouble.



To continue your visual tour take a look at the fluid conductors in the system. Watch for hose lines that are abrading or for lines that are too short when pressurized. These are conditions that can lead to a premature failure of the hose. You should also watch for kinked or flattened lines because a kink will restrict flow and in the case of a pump supply line could ruin a pump. Naturally you should check the hydraulic gauges to make sure the system pressures are within the designed limits.



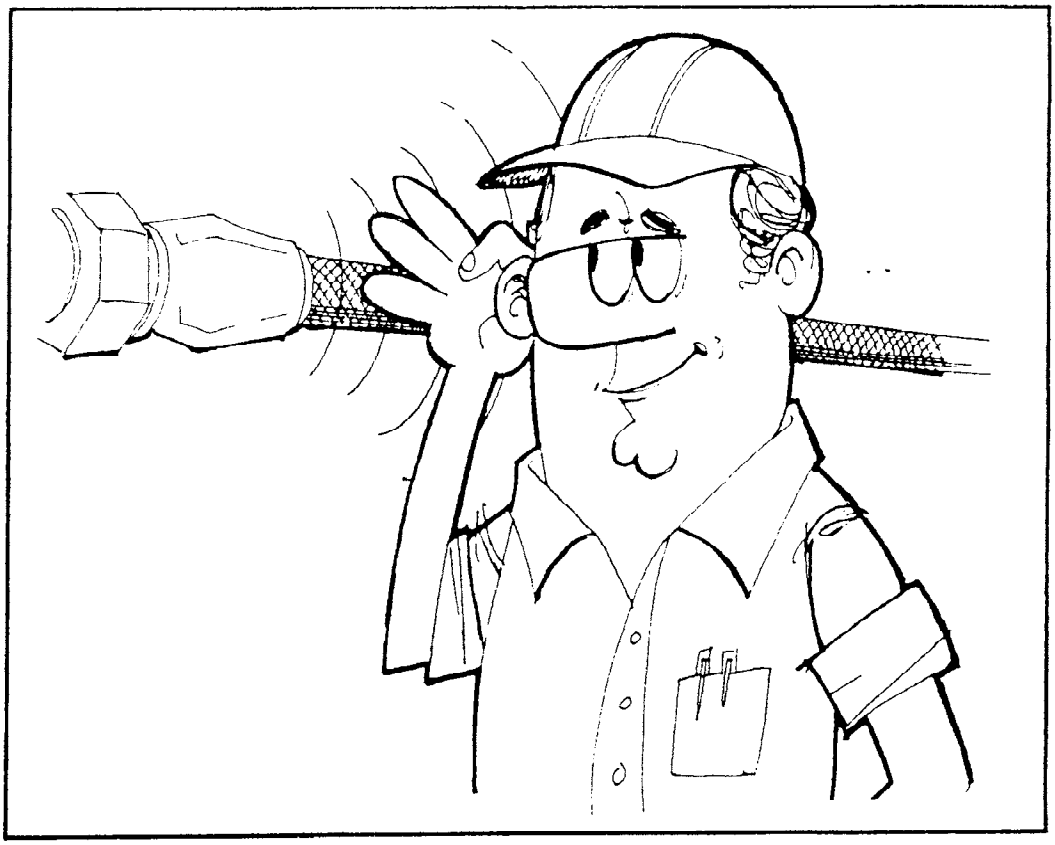
Observe the action of the hydraulic cylinders. If the movement is jerky or erratic something is wrong. It may be air in the system or a bent cylinder rod.

Most important of all, make sure there is sufficient oil in the hydraulic reservoir after the complete system is charged and the cylinders are extended. Follow the manufacturer's recommendations on the fluid level as well as on the type of fluid to use.

HEARING

A good troubleshooter will listen for unusual sounds coming from a hydraulic system. The loud, shot-like, sound that you hear when a tap is closed quickly is called "water hammer." This is caused by the sudden stoppage of moving liquid. The hydraulic surge created by this condition increases with the speed at which the liquid is moving. A pressure surge may go as high as four times the normal working pressure. This can cause great physical damage to fluid conductors and other components in a system. A shock-wave travels at the speed of sound in hydraulic fluid, and normal hydraulic gauges will not record these fast transient pressure surges.

The main function of a hydraulic pump is to move liquids against comparatively high resistance. When the supply of fluid is insufficient to meet the demands of a pump, the pump goes into a state of hydraulic shock described as cavitation. When this occurs the injured pump emits a most unusual sound. If there is no back pressure it sounds as if you were pumping marbles, and you can hear them rattling. When back pressure is present the pump emits a shrill whine that will have you holding your ears. Unusual sound anywhere in a hydraulic system bears investigation by a fluid power mechanic.



TOUCH

When you put your hand on a hydraulic pump and wish you hadn't because it's hot, the pump is trying to tell you something. When the maximum temperature of a hydraulic system exceeds 150°F. several malfunctions occur. Oxidation is accelerated. Tests have shown that, below 135°F., oil oxidizes very slowly. The rate of oxidation approximately doubles for every 18°F. increase in temperature. It is estimated that the working life of most oil is decreased by 50% for every 15°F. rise in temperature above 140°F. Oxidation causes sludge to form, reduces clearances, causes corrosion and creates more heat, thus establishing a vicious cycle.

Just because the hydraulic reservoir is not hot does not mean there is no heat problem. A good troubleshooter will feel the fluid conductors in various parts of the system to make sure there are no "hot spots." If any part of a hydraulic system is unusually hot you can be sure there is a problem developing.

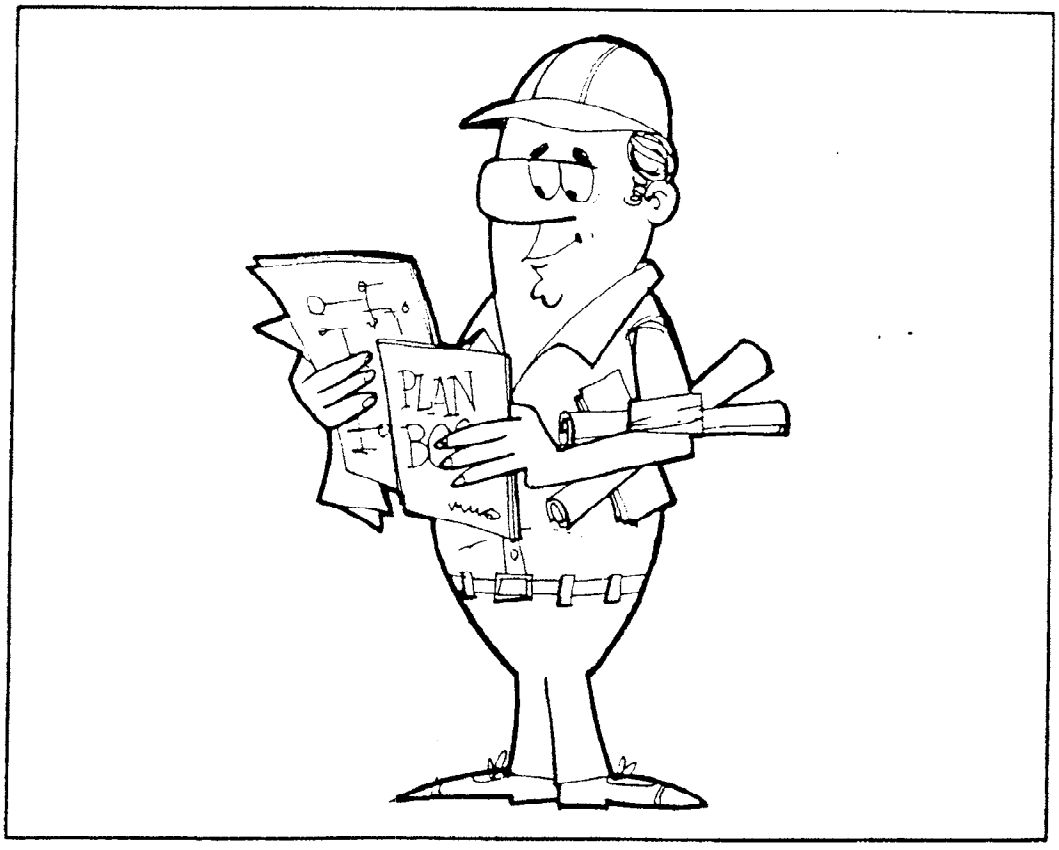
Remember, high heat can be very damaging to a fluid power system and should not be tolerated.

Another extremely damaging condition encountered in a hydraulic system is high frequency vibration. You can feel these vibrations with your hand by touching steel fluid conductors. This condition has been known to break weldments and other components and should be corrected. You can also "see" this condition by placing an ordinary tumbler of water on a steel tube and watching the surface conditions. When the water pops off the surface the condition is serious enough to warrant further investigation and correction.

SMELL

When hydraulic oil is saturated with air, or when a hydraulic pump is cavitating, the air bubbles in the system go from a subpressure condition (vacuum) to a high pressure condition in a fraction of a second which generates a great deal of heat. In fact, it has been estimated that a pocket of air in a hydraulic system may reach temperatures in excess of 2000°F. This is hot enough to scorch surrounding oil and a good troubleshooter can smell this "burned" oil in the reservoir.

When any of these abnormal conditions are present, a good troubleshooter will follow-up. Any factor known to him that could cause the irregularity must be checked out. Nothing should be overlooked. He should obtain a drawing of the system and a specification sheet from the manufacturer so that he knows the system. Although he may have to use pressure gauges, surface pyrometers, flow gauges, vacuum gauges, and oscilloscopes in order to ferret out the problem, the most important tools that he has are his God-given senses, and the finest computer ever made—his brain.



BROOK CROMPTON

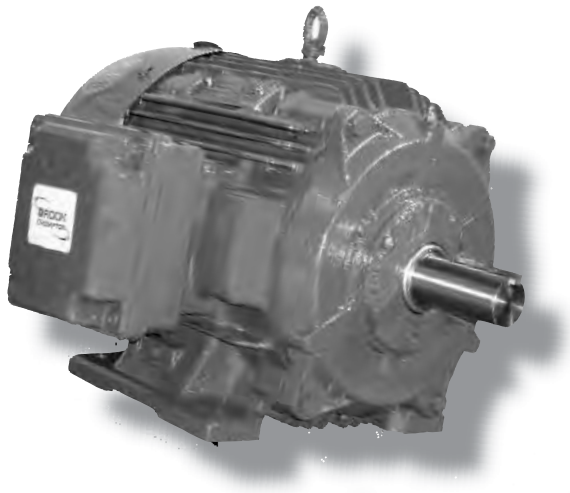
DATA SHEET

CAST IRON

NEMA MOTORS

Heavy Duty Cast Iron construction for use on severe duty applications Frames143-447T

Brook Crompton has manufactured these motors with North American industry in mind and the low maintainence cost make them the obvious choice.



Features:

- Enclosure IP Code: Totally Enclosed IP55
- Warranty 24 months
- Nameplate Certifications: CSA ~ C/US, CE, Class 1 Div 2, Groups A,B,C&D Temperature Class T3

Electrical Characteristics:

- Phase 3
- Frequency 60hz
- F1 Conduit box location
- Ambient 40 degrees C
- Class F Insulation
- Service Factor 1.15
- Class B Temperature Rise
- Inverter Duty suitable for MG1 Part 31 rating for use with VFD - 5:1 constant torque and 10:1 variable torque speed range

Application Information:

- The Brook Crompton Cast Iron design motor is supplied painted in a Synthetic Enamel on an Alkyd High build primer suitable for 200 hours salt spray life tested in accordance with ASTM B117
- Motors can be supplied as 50 hz with voltages and approvals to suit export

Construction features:

- By changing the position of the rotor F2 mounting arrangements can be attained
- Materials: Cast Iron frame, endshields and oversize conduit box,Sheet Metal Fan Cover
- NEMA C face available
- Gasketed conduit box for hose proof protection
- V Ring slinger on shaft
- Double sealed bearings up to 215T frame, regreasable bearings for 254T and larger
- Altitude 3300ft (1000m)
- Shaft Material: 1045 carbon steel
- Stainless Steel Nameplate
- NPT threaded Terminal Box
- Grounding Terminal on frames and inside conduit box

DOE No. **CC047A**

OUTPUT		RPM	FRAME	FL AMPS			EFFICIENCY % Nominal			POWER FACTOR			TORQUE			LOCKED ROTOR AMPS			NEMA CODE	INERTIA WK^2	EST WT (lbs)
kW	HP	FL		230V	460V	575V	FL	3/4 FL	1/2 FL	FL	3/4 FL	1/2 FL	lb-ft	LR %	BD %	230V	460V	575V		$lb\text{-}ft^2$	
0.55	0.75	1140	143T	3.4	1.7	1.4	72.0	69.0	64.0	0.57	0.50	0.40	3.50	240	280	15	7.5	6	J	0.13	54
		3400	143T	3.1	1.6	1.3	75.5	73.0	71.0	0.80	0.75	0.70	1.50	300	350	24	12	10	L	0.03	54
0.75	1	1710	143T	3.3	1.7	1.4	82.5	81.0	77.0	0.71	0.60	0.40	3.10	275	300	24	12	10	L	0.13	54
		1150	145T	4.0	2.0	1.6	80.0	79.0	76.0	0.60	0.50	0.40	4.60	250	270	24	12	10	L	0.16	60
		3400	143T	4.1	2.1	1.7	82.5	82.5	82.0	0.82	0.80	0.70	2.30	275	300	36	18	14.5	L	0.05	54
1.1	1.5	1710	145T	4.6	2.3	1.9	84.0	84.0	83.0	0.72	0.65	0.60	4.60	230	280	36	18	16	L	0.13	60
		1145	182T	5.0	2.5	2.0	85.5	85.5	85.0	0.65	0.60	0.50	6.90	220	250	36	18	16	L	0.27	88
		3400	145T	5.4	2.7	2.2	84.0	84.0	84.0	0.84	0.80	0.70	3.10	275	300	50	25	20	L	0.06	60
1.5	2	1710	145T	5.8	2.9	2.3	84.0	84.0	83.0	0.77	0.70	0.60	6.10	240	280	50	25	20	L	0.16	60
		1145	184T	6.0	3.0	2.4	86.5	86.5	86.0	0.72	0.65	0.60	9.20	220	250	50	25	20	L	0.34	88
		3480	182T	7.2	3.6	2.9	85.5	85.5	85.0	0.89	0.87	0.85	4.50	275	300	64	32	25	K	0.14	88
2.2	3	1740	182T	7.6	3.8	3.0	87.5	87.5	87.0	0.83	0.76	0.64	9.10	230	280	64	32	25	K	0.27	88
		1150	213T	8.4	4.2	3.4	87.5	87.5	87.0	0.75	0.67	0.60	13.70	220	250	64	32	25	K	0.88	172
		3480	184T	12.0	6.0	4.8	87.5	87.5	87.0	0.89	0.87	0.85	7.50	275	300	92	46	37	J	0.18	88
3.7	5	1740	184T	12.8	6.4	5.1	87.5	87.5	87.0	0.83	0.78	0.67	15.10	230	280	92	46	37	J	0.34	88
		1160	215T	14.2	7.1	5.7	87.5	87.5	87.0	0.75	0.67	0.60	22.60	210	240	92	46	37	J	0.97	196
		3480	213T	17.2	8.6	6.9	88.5	88.5	88.0	0.90	0.88	0.86	11.30	210	240	126	63	50	H	0.39	172
5.5	7.5	1740	213T	18.4	9.2	7.4	89.5	89.5	89.0	0.84	0.81	0.74	22.60	210	240	126	63	50	H	0.88	172
		1164	254T	20.0	10.0	8.0	89.5	86.5	83.5	0.80	0.76	0.68	33.27	200	250	126	63	50	H	1.27	405
		3480	215T	23.4	11.7	9.4	89.5	89.5	89.0	0.90	0.88	0.86	15.10	210	240	162	81	65	H	0.43	196
7.5	10	1750	215T	25.0	12.5	10.0	89.5	89.5	89.0	0.84	0.81	0.74	30.00	210	240	162	81	65	H	0.97	196
		1170	256T	27.5	13.8	11.0	89.5	90.2	89.0	0.80	0.76	0.68	45.14	200	250	162	81	65	H	2.73	453
		3504	254T	35.0	17.5	14.0	90.2	89.5	88.0	0.88	0.86	0.78	22.10	250	300	232	116	92.8	G	0.77	405
11	15	1752	254T	35.0	17.5	14.0	91.0	91.0	89.5	0.84	0.82	0.74	44.21	200	250	232	116	92.8	G	2.14	405
		1170	284T	37.5	18.8	15.0	90.2	90.2	89.0	0.80	0.76	0.68	66.21	200	250	232	116	92.8	G	3.80	563
		3504	256T	47.5	23.8	19.0	90.2	90.2	89.0	0.88	0.86	0.79	30.50	250	300	290	145	116	G	1.01	453
15	20	1752	256T	50.0	25.0	20.0	91.0	91.0	89.5	0.84	0.83	0.75	60.29	200	250	290	145	116	G	2.79	453
		1170	286T	52.5	26.3	21.0	90.2	91.0	89.5	0.80	0.73	0.68	90.28	225	275	290	145	116	G	6.88	607
		3504	284TS	57.5	28.8	23.0	91.0	91.0	89.5	0.88	0.86	0.79	37.18	275	325	365	182.5	146	G	1.25	563
18.5	25	1770	284T	60.0	30.0	24.0	92.4	91.7	90.0	0.84	0.80	0.72	73.60	200	250	365	182.5	146	G	4.81	563
		1170	324T	60.0	30.0	24.0	91.7	91.7	90.0	0.84	0.82	0.73	111.35	200	250	365	182.5	146	G	10.03	810
		3504	286TS	65.0	32.5	26.0	91.0	91.0	89.5	0.92	0.90	0.84	44.21	275	325	435	217.5	174	G	2.61	607
22	30	1770	286T	70.0	35.0	28.0	92.4	92.4	91.0	0.86	0.84	0.77	87.53	200	250	435	217.5	174	G	5.64	607
		1170	326T	72.5	36.3	29.0	91.7	92.4	91.0	0.84	0.82	0.78	132.40	200	250	435	217.5	174	G	12.10	843
		3528	324TS	92.5	46.3	37.0	91.7	91.7	90.0	0.90	0.89	0.87	59.88	200	250	580	290	232	G	4.75	810
30	40	1770	324T	90.0	45.0	36.0	93.0	93.0	91.0	0.89	0.86	0.78	119.36	250	300	580	290	232	G	9.61	810
		1176	364T	95.0	47.5	38.0	93.0	93.0	91.0	0.85	0.82	0.73	179.64	200	250	580	290	232	G	21.25	990
		3540	326TS	112.5	56.3	45.0	92.4	92.4	91.0	0.90	0.89	0.87	73.60	200	250	725	362.5	290	G	5.28	843
37	50	1776	326T	112.5	56.3	45.0	93.0	93.0	91.0	0.89	0.86	0.78	146.70	250	300	725	362.5	290	G	15.66	843
		1176	365T	120.0	60.0	48.0	93.0	93.0	92.0	0.84	0.81	0.72	221.56	250	300	725	362.5	290	G	25.75	1087
		3546	364TS	130.0	65.0	52.0	93.0	93.0	91.0	0.94	0.92	0.88	89.37	225	275	870	435	348	G	11.09	990
45	60	1776	364T	135.0	67.5	54.0	93.6	93.6	92.0	0.89	0.86	0.78	178.43	250	300	870	435	348	G	18.56	990
		1164	405T	142.5	71.3	57.0	93.6	93.0	91.0	0.85	0.81	0.73	272.24	200	250	870	435	348	G	28.5	1410
		3546	365TS	157.5	78.8	63.0	93.0	93.0	91.0	0.94	0.92	0.88	109.22	175	225	1085	542.5	434	G	16.55	1087
55	75	1770	365T	165.0	82.5	66.0	94.1	94.1	92.0	0.89	0.86	0.82	218.82	200	250	1085	542.5	434	G	20.46	1087
		1164	405T	175.0	87.5	70.0	93.6	93.0	91.0	0.84	0.80	0.72	332.74	200	250	1085	542.5	434	G	34.25	1410
		3546	405TS	215.0	107.5	86.0	93.6	93.0	91.0	0.94	0.92	0.88	148.94	150	200	1450	725	580	G	20	1410
75	100	1770	405T	232.5	116.3	93.0	94.5	94.1	92.0	0.86	0.82	0.74	298.39	200	250	1450	725	580	G	24.5	1410
		1170	444T	238	119	95	94.1	93.6	93	0.79	0.75	0.67	451.35	200	250	1450	725	580	G	14.12	2873
		3550	444T	266	133	106	94.5	94.1	93.5	0.88	0.84	0.76	184.46	150	200	1815	907.5	726	G	5.82	2873
93	125	1775	444T	266	133	106	94.5	94.1	93.5	0.88	0.84	0.76	368.91	175	225	1815	907.5	726	G	11.62	2873
		1170	447T	280	140	112	94.1	93.6	93	0.83	0.79	0.71	559.67	200	250	1815	907.5	726	G	17	3036
		3550	445T	312	156	125	94.5	94.1	93.5	0.89	0.85	0.77	218.17	150	200	2170	1085	868	G	5.82	3036
110	150	1775	445T	318	159	127	95	94.5	94	0.87	0.83	0.75	436.35	175	225	2170	1085	868	G	11.62	3036
		1170	447T	340	170	136	95	94.5	94	0.81	0.77	0.69	661.98	200	250	2170	1085	868	G	18.98	3036
		3550	447T	424	212	170	95	94.5	94	0.89	0.85	0.77	297.51	150	200	2900	1450	1160	G	6.98	3036
150	200	1775	447T	432	216	173	95	94.5	94	0.87	0.83	0.75	595.02	175	225	2900	1450	1160	G	13.98	3036

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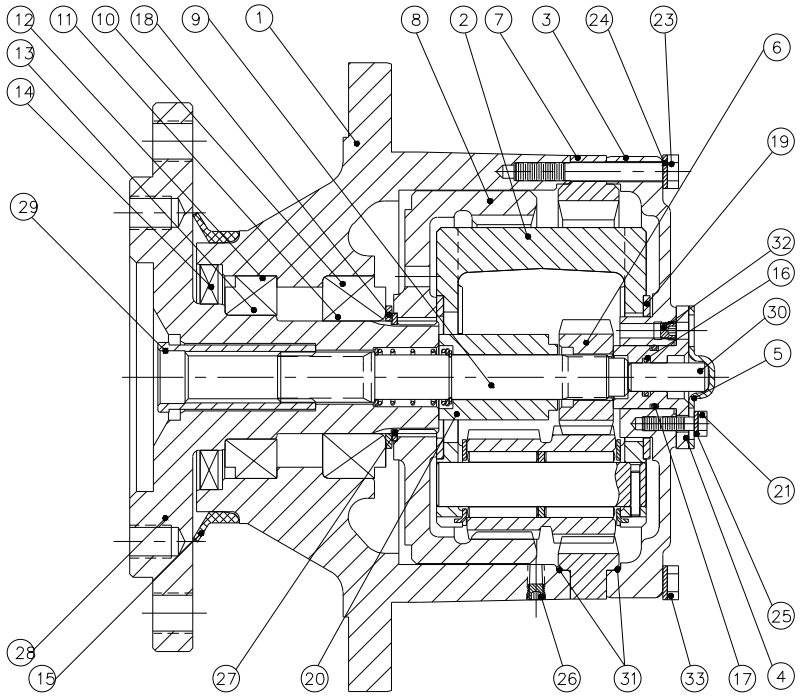
REVISIONS		
SYMBOL	DESCRIPTION	DATE & APPROVAL



NOTES:
1) SEE OMNI DWG. 710212 FOR EXTERNAL DIMENSIONS

PARTS LIST FOR W0330B113H1NS			
33	110195	4	BODY FIT CAPSCREW-M8
32	140001	1	PIPE PLUG SOC. HEAD-1/8-27NPT
31	060116	2	O-RING, RING GEAR
30	240083	1	PLUNGER
29	240278	1	INPUT COUPLER
28	040170	1	MOUNTING FLANGE SHAFT
27	200034	1	RETAINING RING (REF#-1065R)
26	140002	2	PIPE PLUG SOC. HEAD-1/4-18NPT
25	130101	4	WASHER-M6
24	130058	16	WASHER-M8
23	110194	12	CAP SCREW-M8
21	110104	4	CAP SCREW-M6
20	090054	1	SPACER
19	090053	2	SPACER
18	090052	1	SPACER
17	060217	1	O-RING, CAP
16	060047	1	O-RING, PLUNGER
15	060048	1	PROTECTOR RING
14	060113	1	SEAL (REF#-CR25440)
13	050097	1	BEARING CONE (REF#-JLM506849)
12	050096	1	BEARING CUP (REF#-JLM506810)
11	050095	1	BEARING CONE (REF#-JM205149)
10	050094	1	BEARING CUP (REF#-JM205110)
9	180168	1	DRIVE SHAFT SUB ASSY
8	030451	1	RING GEAR 66T
7	030379	1	RING GEAR 73T
6	030383	1	SUN GEAR 17T
5	020218	1	LOCKOUT CAP
4	020217	1	PLUNGER CAP
3	020101	1	CAP
2	180153	1	CARRIER SUB ASSY
1	010159	1	HOUSING
DET	PART NUMBER	QTY	DESCRIPTION

REFERENCE DRAWINGS

OMNI GEAR

MACHINE TOLERANCES (EXCEPT AS NOTED)
DIMENSIONS
X=±0.6
X.X=±0.4
X.XX=±0.2
ANGLES=±.5°
CHAMFERS=+1.0 -0.0
RADII=±0.3
UNSPECIFIED DIMENSIONS
EDGE CHAMFER BROKEN
SURFACE FINISH 3.2µM
CORNER RADII .5R 6.3µM
DRILLED HOLE √ AS DRILLED
EXCLUDING GEAR/SPLINE TEETH
ALL DIMENSIONS IN MM (EXCEPT AS NOTED)

TITLE ASSEMBLY
W0330B113H1NS

DRAWN BY ZHX
APPROVED BY
DATE 27 APR 04

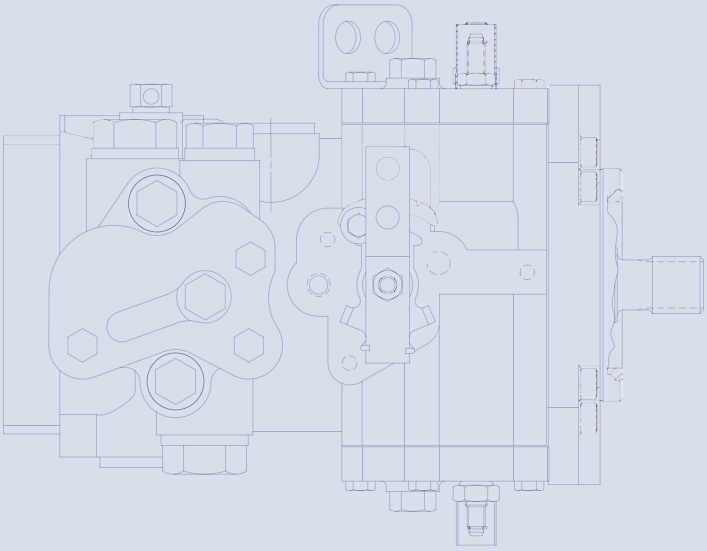
FINISH WT KG
SCALE NTS
ACAD REF. NUMBER 70-\700409
OMNI DWG. NUMBER 700409
REV -

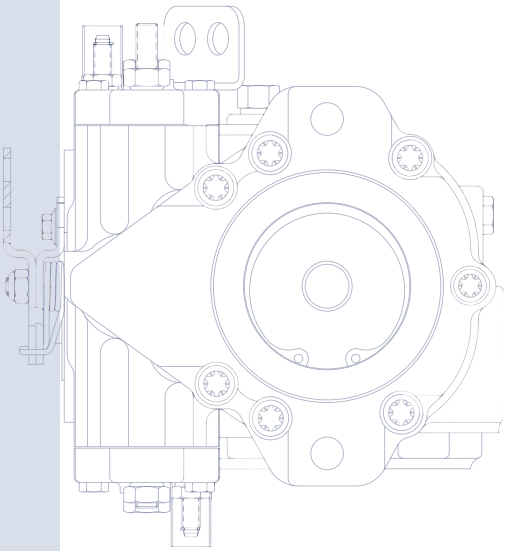
SAUER DANFOSS

Genuine Parts

Series 40 - M46 Variable Pumps

Service Manual





OVERVIEW

This manual includes information for the installation, maintenance, and minor repair of the Series 40 M46 pump. It includes a description of the unit and its individual components, troubleshooting information, and minor repair procedures.

Performing minor repairs requires the unit to be removed from the vehicle/machine. Thoroughly clean the unit before beginning maintenance, or repair activities. Since dirt and contamination are the greatest enemies of any type of hydraulic equipment, follow cleanliness requirements strictly. This is especially important when changing the system filter and when removing hoses or plumbing.

A worldwide network of Sauer-Danfoss Global Service Partners is available for major repairs. Sauer-Danfoss trains Global Service Partners and certifies their facilities on a regular basis. You can locate your nearest Global Service Partner using the distributor locator at www.sauer-danfoss.com.

WARRANTY

Performing installation, maintenance, and minor repairs according to the procedures in this manual will not affect your warranty. Major repairs requiring the removal of a unit's front flange voids the warranty unless done by a Sauer-Danfoss Global Service Partner.

GENERAL INSTRUCTIONS

Follow these general procedures when repairing Series 40 M46 variable displacement closed circuit pumps.

Remove the unit

Prior to performing repairs, remove the unit from the vehicle/machine. Chock the wheels on the vehicle or lock the mechanism to inhibit movement. Be aware that hydraulic fluid may be under high pressure and/or hot. Inspect the outside of the pump and fittings for damage. Cap hoses and plug ports after removal to prevent contamination.

Keep it clean

Cleanliness is a primary means of assuring satisfactory pump life, on either new or repaired units. Clean the outside of the pump thoroughly before disassembly. Take care to avoid contamination of the system ports. Cleaning parts using a clean solvent wash and air drying is usually adequate.

As with any precision equipment, keep all parts free of foreign materials and chemicals. Protect all exposed sealing surfaces and open cavities from damage and foreign material. If left unattended, cover the pump with a protective layer of plastic.

Replace all O-rings and gaskets

Sauer-Danfoss reccommends you replace all O-rings, seals, and gaskets during repair. Lightly lubricate all O-rings with clean petroleum jelly prior to assembly.

SAFETY PRECAUTIONS

Always consider safety precautions before beginning a service procedure. Protect yourself and others from injury. Take the following general precautions whenever servicing a hydraulic system.

Unintended machine movement

⚠ Warning

Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. To protect against unintended movement, secure the machine or disable/disconnect the mechanism while servicing.

Flammable cleaning solvents

⚠ Warning

Some cleaning solvents are flammable. To avoid possible fire, do not use cleaning solvents in an area where a source of ignition may be present.

Fluid under pressure

⚠ Warning

Escaping hydraulic fluid under pressure can have sufficient force to penetrate your skin causing serious injury and/or infection. This fluid may also be hot enough to cause burns. Use caution when dealing with hydraulic fluid under pressure. Relieve pressure in the system before removing hoses, fittings, gauges, or components. Never use your hand or any other body part to check for leaks in a pressurized line. Seek medical attention immediately if you are cut by hydraulic fluid.

Personal safety

⚠ Warning

Protect yourself from injury. Use proper safety equipment, including safety glasses, at all times.

Hazardous material

⚠ Warning

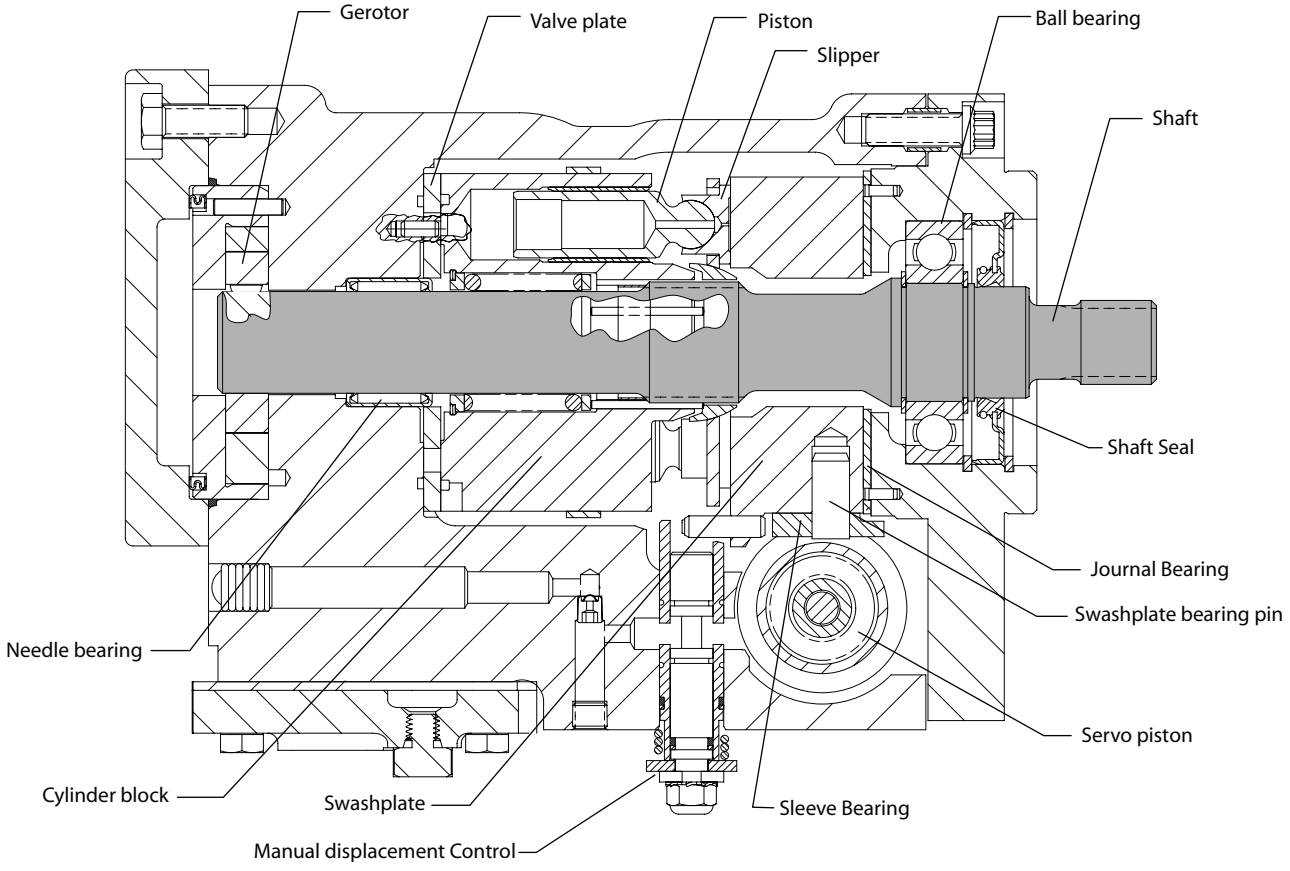
Hydraulic fluid contains hazardous material. Avoid prolonged contact with hydraulic fluid. Always dispose of used hydraulic fluid according to state, and federal environmental regulations.

DESIGN

Sauer-Danfoss Series 40 M46 closed-circuit axial-piston pumps convert input torque into hydraulic power. The input shaft transmits rotational force to the cylinder block. Bearings at the front and rear of the pump support the input shaft. Splines connect the cylinder block to the input shaft. A lip-seal at the front end of the pump prevents leakage where the shaft exits the pump housing. The spinning cylinder block contains seven reciprocating pistons. A ball joint connects a brass slipper to each piston. A spring washer and the force of charge pressure holds the slippers to the swashplate. The reciprocating movement of the pistons occurs as the slippers slide against the inclined swashplate during rotation. Via the valve plate, one half of the cylinder block connects to low pressure and the other half to high pressure. As each piston cycles in and out of its bore, fluid displaces from inlet to outlet imparting hydraulic power into the system. A small amount of fluid flows from the cylinder block/valve plate and slipper/swashplate interfaces for lubrication and cooling. The pump also uses excess flow from the charge pressure relief valve for cooling. Case drain ports return this fluid to the reservoir. A gerotor-style charge pump provides this flow and maintains a minimum pressure in the system loop.

The angle of the swashplate controls the volume of fluid displaced into the system. The servo piston sets swashplate angle. The pump control modulates servo piston position by varying differential pressure across the piston.

Cross section view



THE SYSTEM CIRCUIT

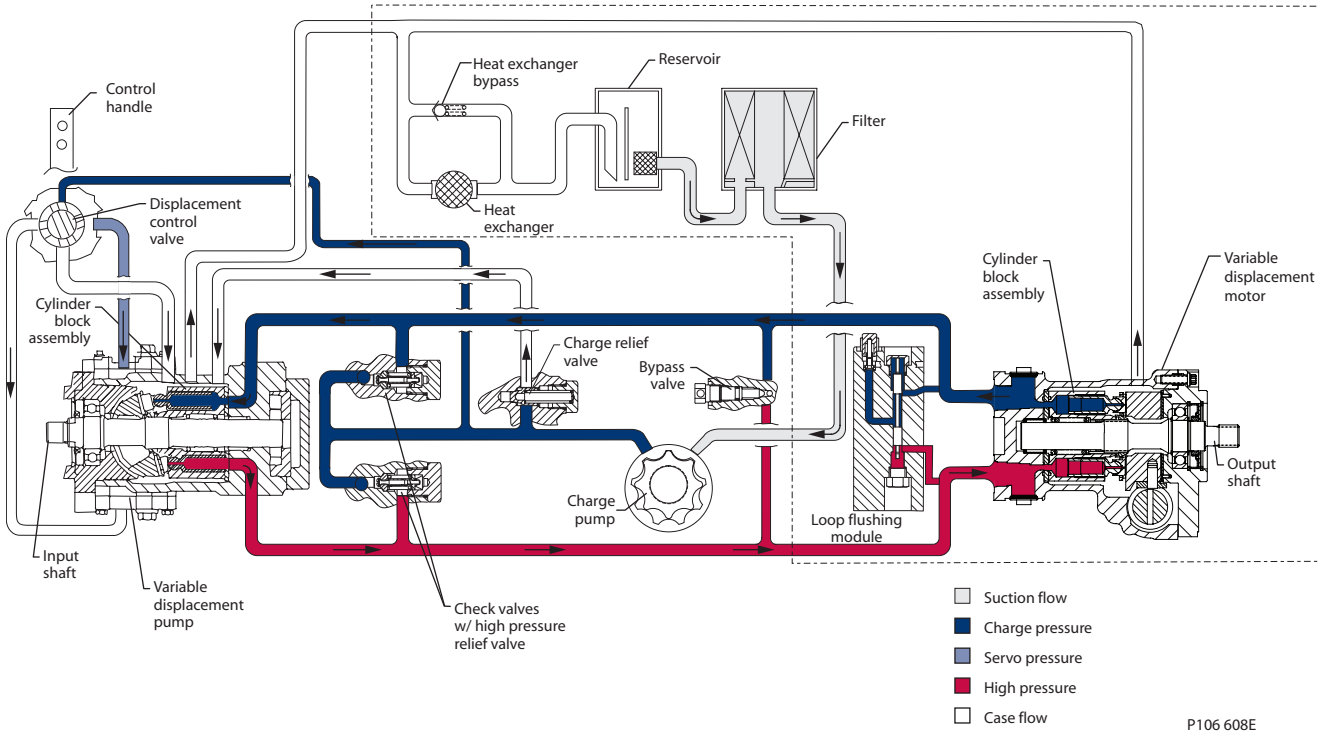
The basic closed circuit

Hydraulic lines connect the main ports of the pump to the main ports of the motor. Fluid flows in either direction from the pump to the motor and back in this closed circuit. Either of the hydraulic lines can be under high pressure. In pumping mode the angle of the pump swashplate determines which line is high pressure as well as the direction of fluid flow.

Case drain and heat exchanger

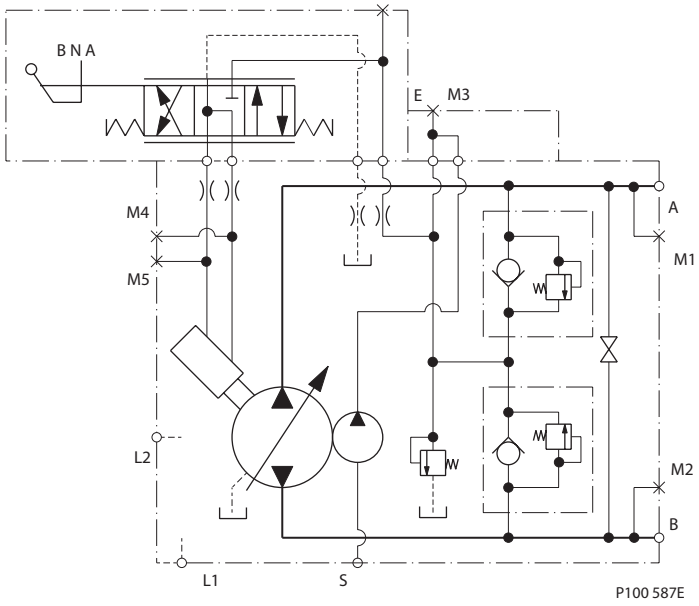
The pump and motor require case drain lines to remove hot fluid from the system. The pump and motor should be drained from their top most drain port to ensure the case remains full of fluid. Flow from the motor case drain may route to the lower drain port on the pump housing and out the top most port, or feed directly to the heat exchanger. The system requires a heat exchanger with a bypass valve to cool the case drain fluid before it returns to the reservoir.

System circuit diagram



PUMP SCHEMATIC

Pump schematic



Above schematic shows the function of a Series 40 M46 axial piston variable displacement pump.

FLUID AND FILTER RECOMMENDATIONS

To ensure optimum life, perform regular maintenance of the fluid and filter. Contaminated fluid is the main cause of unit failure. Take care to maintain fluid cleanliness when servicing.

Check the reservoir daily for proper fluid level, the presence of water, and rancid fluid odor. Fluid contaminated by water may appear cloudy or milky, or free water may settle in the bottom of the reservoir. Rancid odor indicates the fluid was exposed to excessive heat. Change the fluid immediately if these conditions occur. Correct the problem immediately. Inspect vehicle for leaks daily.

Change the fluid and filter per the vehicle/machine manufacturer's recommendations or at these intervals: We recommend first fluid change at 500 hours.

Fluid and filter change interval

Reservoir type	Max oil change interval
Sealed	2000 hours
Breather	500 hours

Caution

High temperatures and pressures accelerate fluid aging. More frequent fluid changes may be required.

Change the fluid more frequently if it becomes contaminated with foreign matter (dirt, water, grease, etc.) or if the fluid is subjected to temperature levels greater than the recommended maximum.

Dispose of used hydraulic fluid properly. Never reuse hydraulic fluid.

Change filters whenever you change the fluid or when the filter indicator shows that it is necessary to change the filter. Replace all fluid lost during filter change.

Hazardous material

Warning

Hydraulic fluid contains hazardous material. Avoid contact with hydraulic fluid. Always dispose of used hydraulic fluid according to state, and federal environmental regulations.

GENERAL

Follow this procedure when starting-up a new pump installation or when restarting an installation in which the pump was removed. Ensure pump is thoroughly tested on a test stand before installing.

⚠ Warning

Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. To protect against unintended movement, secure the machine or disable/disconnect the mechanism while servicing.

Prior to installing the pump, inspect for shipping damage.

START-UP PROCEDURE

1. Ensure the machine hydraulic oil and system components (reservoir, hoses, valves, fittings, and heat exchanger) are clean and free of any foreign material.

2. Install new system filter element(s) if necessary. Check that inlet line fittings are properly tightened and there are no air leaks.

3. Install the pump. Install a 50 bar [1000 psi] gauge in the charge pressure gauge port M3.

4. Fill the housing by adding filtered oil in the upper case drain port. Replace plug.

5. Fill the reservoir with hydraulic fluid of the recommended type and viscosity. Use a 10-micron reservoir filler filter. Ensure inlet line from reservoir to pump is filled.

6. Disconnect the pump from all control input signals.

After start-up the oil level in the reservoir may drop due to filling of the system components. Check the level in the reservoir to maintain a full oil level throughout start-up.

⚠ Warning

Damage to hydraulic components may occur if you fail to maintain the oil supply.

7. Use a common method to disable the engine to prevent it from starting. Crank the starter for several seconds. Do not to exceed the engine manufacturer's recommendation. Wait 30 seconds and then crank the engine a second time as stated above. This operation helps remove air from the system lines. Refill the reservoir to recommended full oil level.

STARTUP PROCEDURE (continued)

8. Check the pressure gauge at M3. When charge pressure begins to build, enable and start engine. Let the engine run for a minimum of 30 seconds at low idle to allow the air to work itself out of the system. Check for leaks at all line connections and listen for cavitation. Check for proper fluid level in reservoir.

Caution

Air entrapment in oil under high pressure may damage hydraulic components. Do not run at maximum pressure until system is free of air and fluid has been thoroughly filtered.

9. When the pump estabishes adequate charge pressure (as shown in model code), increase engine speed to normal operating rpm to further purge residual air from the system.

10. Shut off engine. Connect pump control signal. Start engine, checking to be certain pump remains in neutral. Run engine at normal operating speed and carefully check for forward and reverse control operation.

11. Continue to cycle between forward and reverse for at least five minutes to bleed all air and flush system contaminants out of loop.

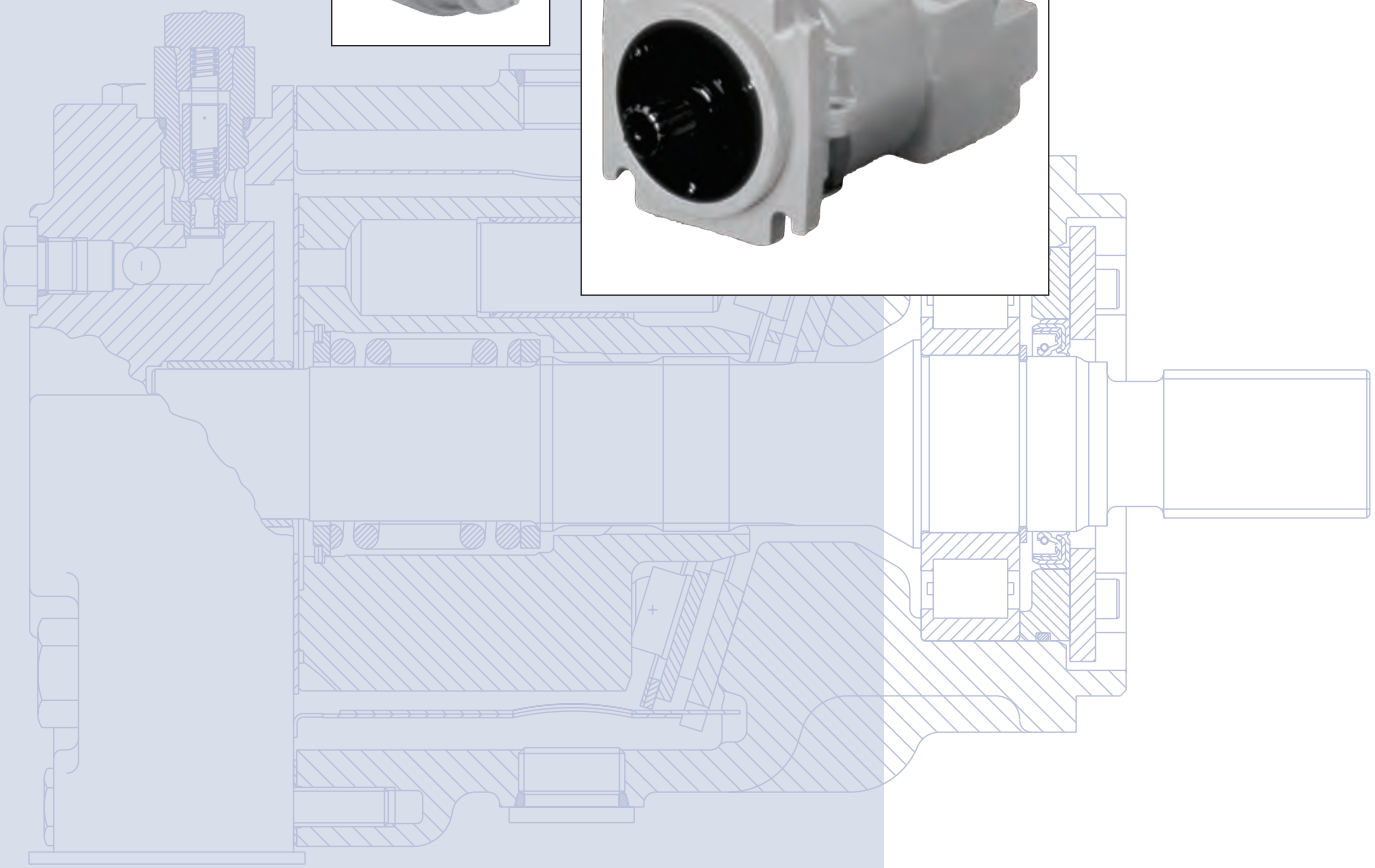
Normal charge pressure fluctuation may occur during forward and reverse operation.

12. Check that the reservoir is full. Remove charge pressure gauge. Re-intall charge pressure plug. The pump is now ready for operation.

SAUER DANFOSS

Series 90 Axial Piston Motors

Technical Information



SERIES 90 FAMILY OF PUMPS AND MOTORS

Series 90 hydrostatic pumps and motors can be applied together or combined with other products in a system to transfer and control hydraulic power. They are intended for closed circuit applications.

Series 90 variable displacement pumps are compact, high power density units. All models utilize the parallel axial piston/slipper concept in conjunction with a tiltable swashplate to vary the pump's displacement. Reversing the angle of the swashplate reverses the flow of oil from the pump and thus reverses the direction of rotation of the motor output.

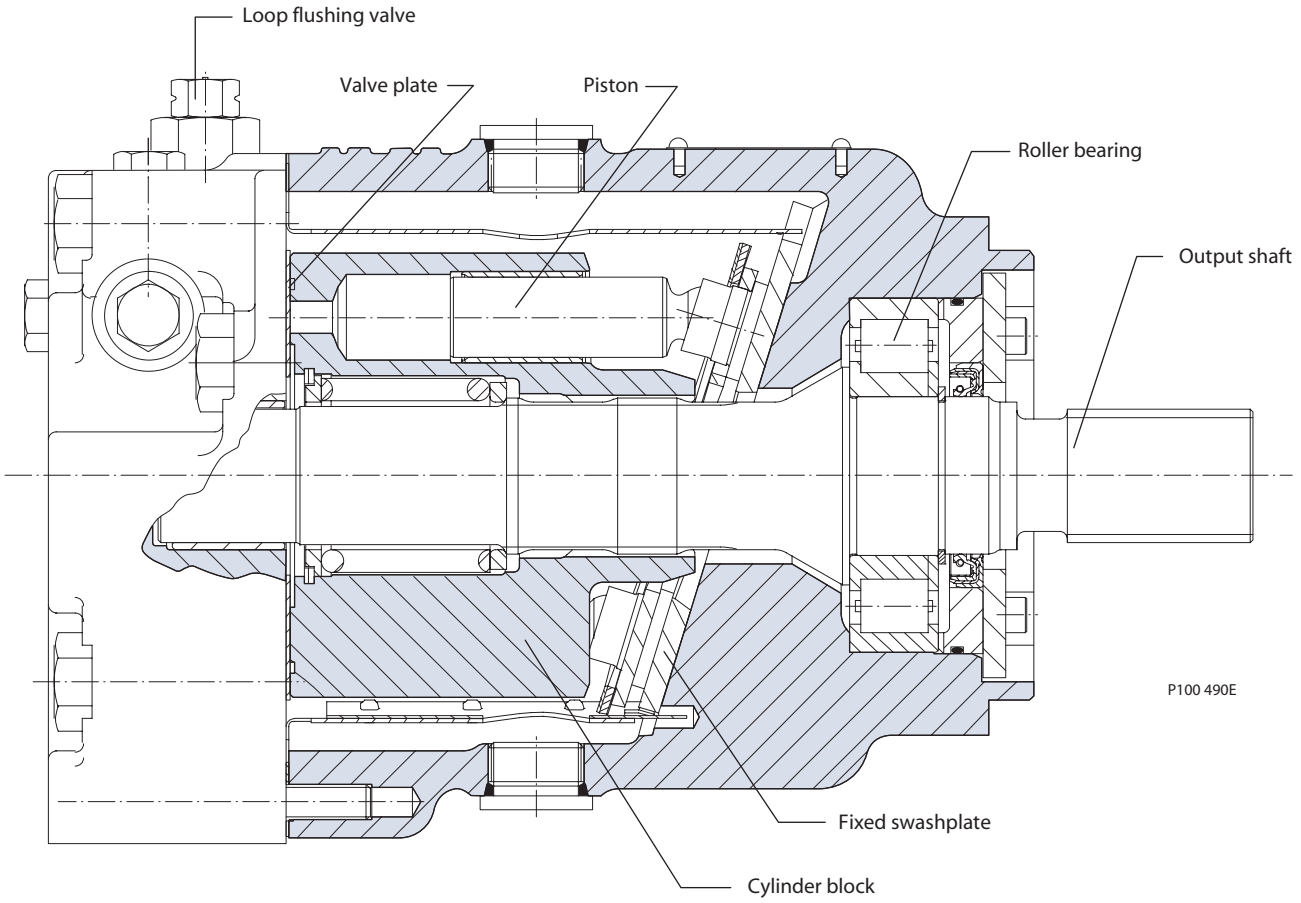
Series 90 pumps include an integral charge pump to provide system replenishing and cooling oil flow, as well as control fluid flow. They also feature a range of auxiliary mounting pads to accept auxiliary hydraulic pumps for use in complementary hydraulic systems. A complete family of control options is available to suit a variety of control systems (mechanical, hydraulic, electric).

Series 90 motors also use the parallel axial piston/slipper design in conjunction with a fixed or tiltable swashplate. They can intake/discharge fluid through either port; they are bidirectional. They also include an optional loop flushing feature that provides additional cooling and cleaning of fluid in the working loop.

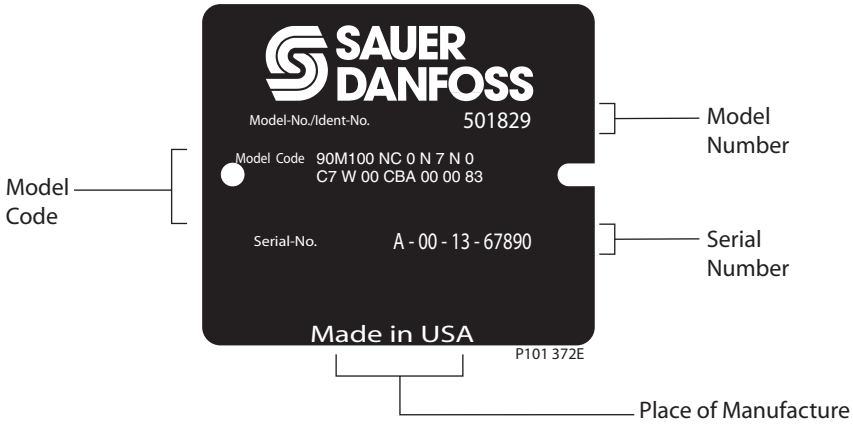
- Series 90 – advanced technology today
- Seven sizes of variable displacement pumps
- Five sizes of fixed displacement motors
- One variable displacement motor
- SAE and cartridge mount configurations
- Efficient axial piston design
- Proven reliability and performance
- Compact, lightweight
- Worldwide sales and service

FIXED DISPLACEMENT MOTOR

Cross section

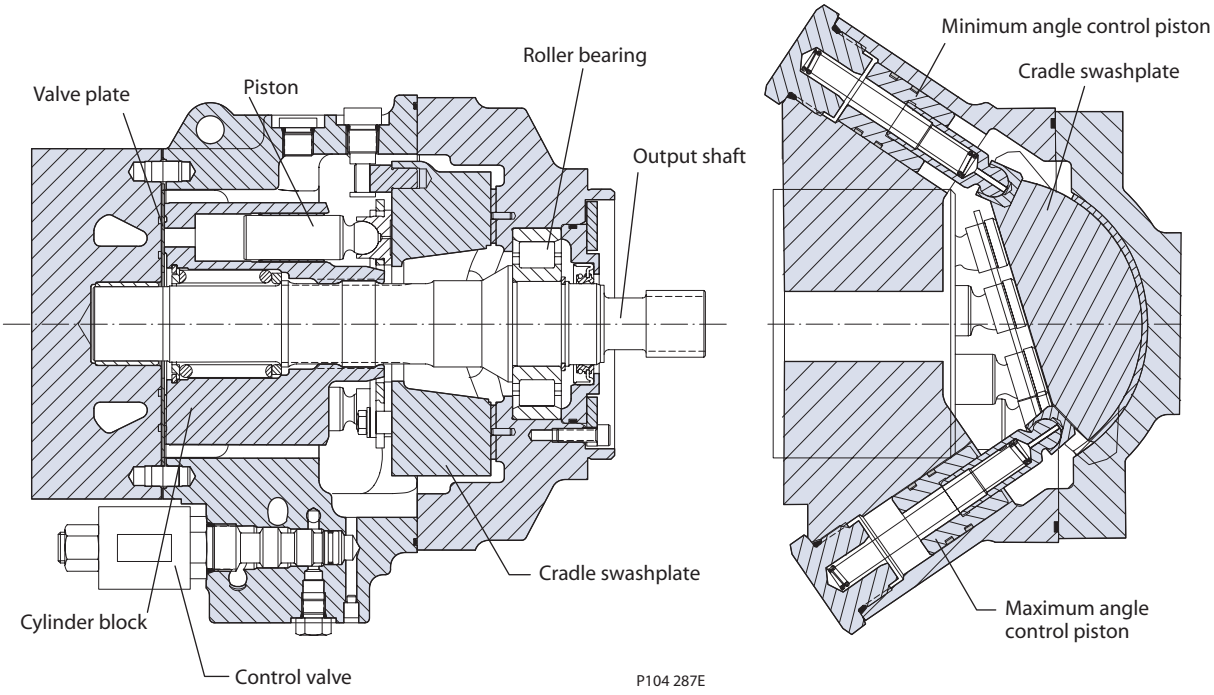


Name plate

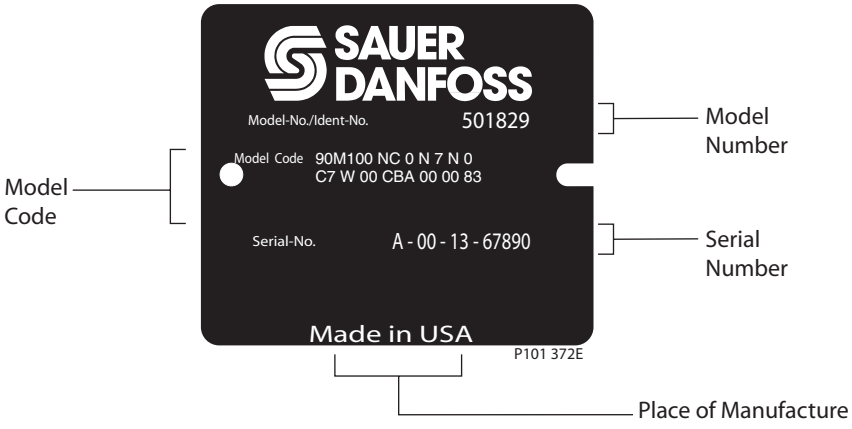


VARIABLE DISPLACEMENT MOTOR

Cross section

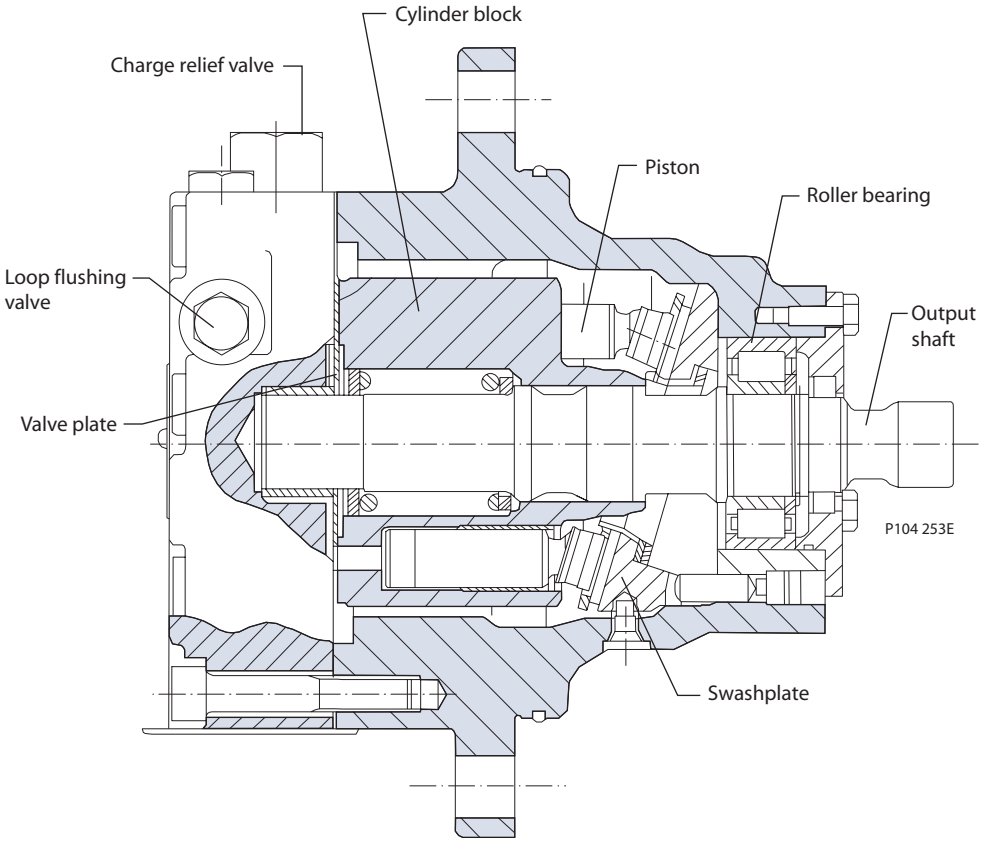


Name plate



FIXED DISPLACEMENT MOTOR, CARTRIDGE MOUNT

Cross section



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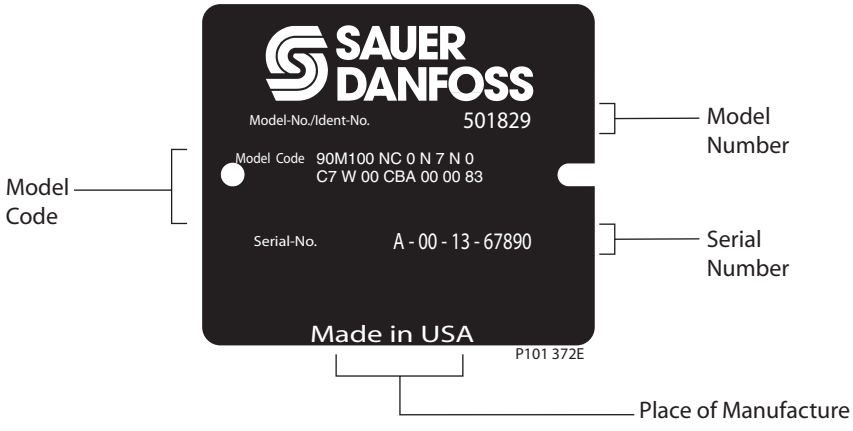
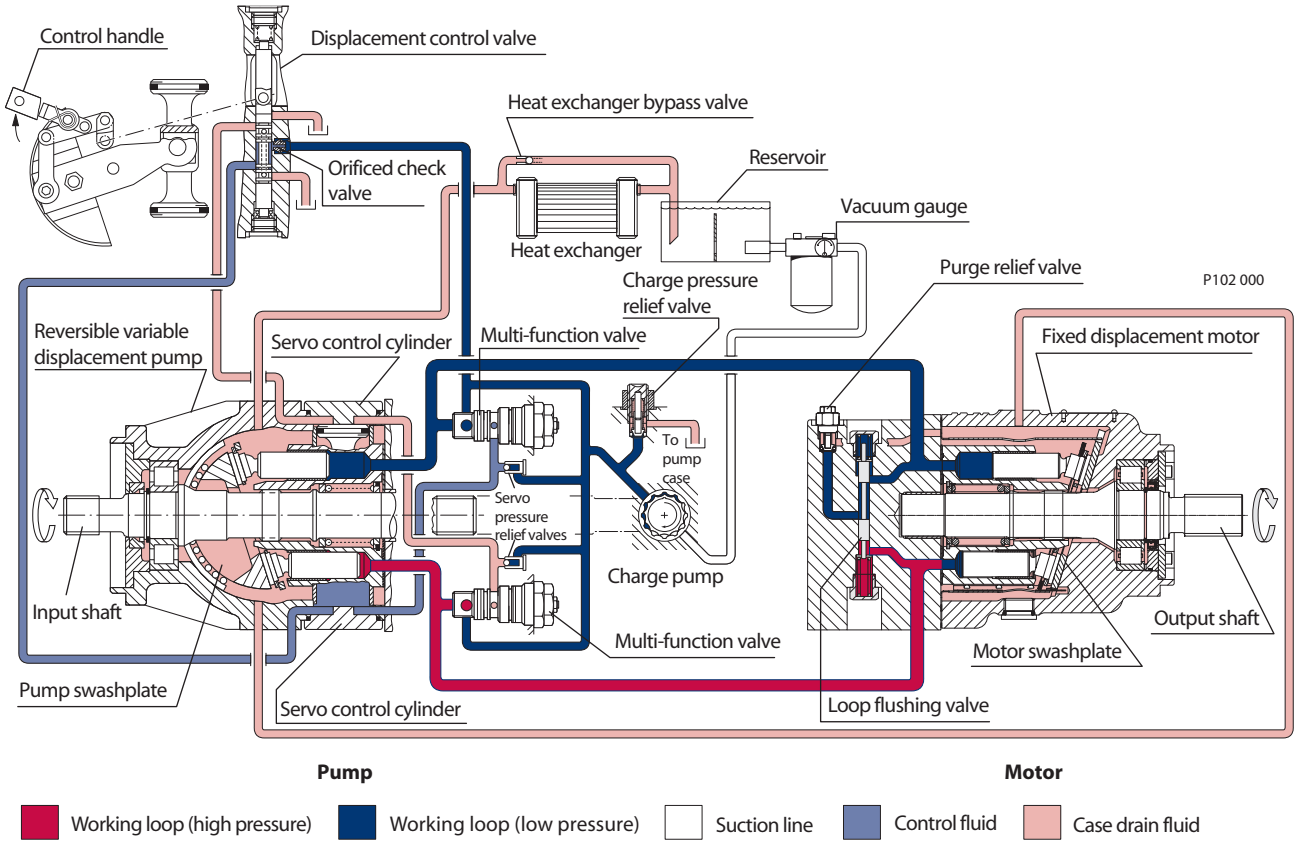
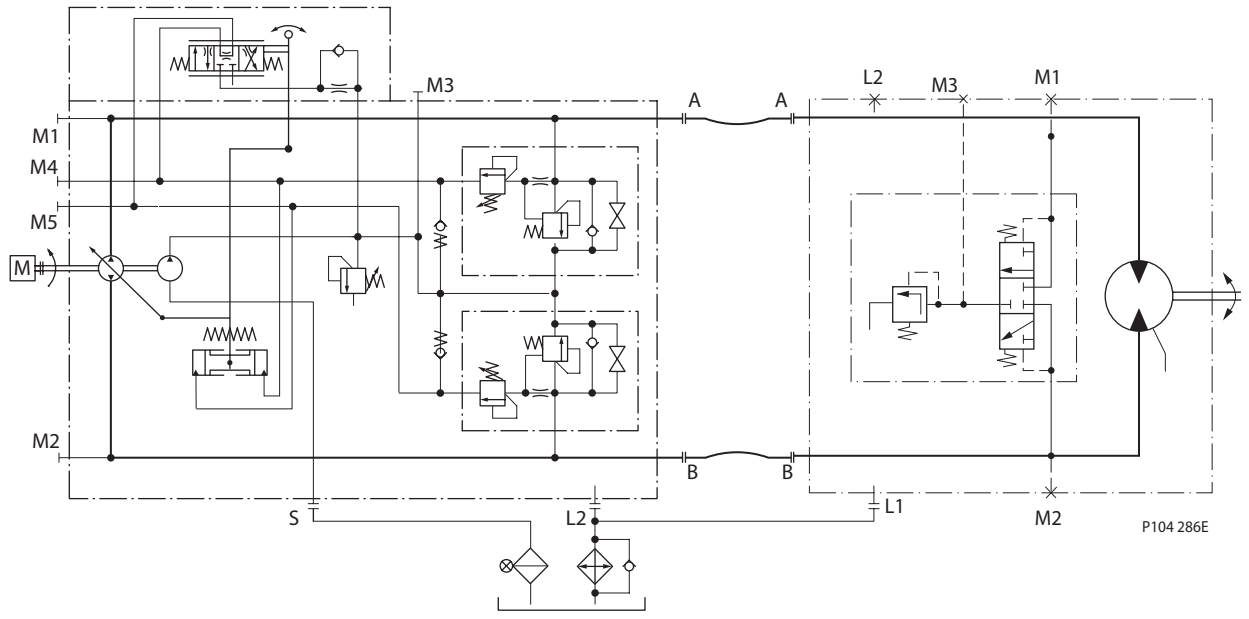


PICTORIAL CIRCUIT DIAGRAM

This configuration shows a hydrostatic transmission using a Series 90 axial piston variable displacement pump and a Series 90 fixed displacement motor.



SYSTEM SCHEMATIC



OVERVIEW

Specifications for the Series 90 motors are listed here for quick reference. For definitions and additional information, see *Operating Parameters*, page 13, *Features and Options*, page 19, and the *Series 90 Model Code Supplement*.

FEATURES AND OPTIONS

Motor type	In-line, axial piston, closed loop, positive displacement motors
Direction of rotation	Bi-directional, see outline drawings for rotation vs. flow direction information
Installation position	Discretionary: Housing must be filled with hydraulic fluid
Other system requirements	Independent braking system, overpressure protection, suitable reservoir, proper filtration

Parameter	042 MF	055 MF	055 MV	075 MF	100 MF	130 MF
Types of mounting (SAE flange size per SAE J744)	SAE B	SAE C, cartridge	SAE C, cartridge	SAE C, cartridge	SAE C	SAE D
Port connections	Twin	Twin, axial	Twin	Twin, axial	Twin	Twin
Output shaft options	Spline	Spline, tapered, straight	Spline	Spline, tapered, straight	Spline, tapered, straight	Spline
Control options	—	—	Two-position electro-hydraulic, hydraulic	—	—	—
Loop flushing						
Speed sensor						
Displacement limiters	—	—		—	—	—

Standard Optional — Not available / not applicable

SPECIFICATIONS

Parameter		042 MF	055 MF	055 MV	075 MF	100 MF	130 MF
Swashplate		Fixed	Fixed	Variable	Fixed	Fixed	Fixed
Max. displacement cm³/rev [in³/rev]		42 [2.56]	55 [3.35]	55 [3.35]	75 [4.57]	100 [6.10]	130 [7.90]
Maximum corner power kW [hp]		155 [208]	187 [251]	187 [251]	237 [318]	292 [392]	354 [475]
Theoretical torque N•m/bar [lbf•in/1000 psi]		0.67 [410]	0.88 [530]	0.88 [530]	1.19 [730]	1.59 [970]	2.07 [1260]
Weight kg [lb]	SAE	15 [34]	22 [49]	39 [86]	26 [57]	34 [74]	45 [99]
	Cartridge	21 [46]	26 [57]	40 [88]	33 [72]	—	—
Mass moment of inertia kg•m² [slug•ft²]		0.0023 [0.0017]	0.0060 [0.0044]	0.0060 [0.0044]	0.0096 [0.0071]	0.0150 [0.0111]	0.0230 [0.0170]

OPERATING PARAMETERS

Parameter	Unit	042 MF	055 MF	055 MV	075 MF	100 MF	130 MF
Speed limits							
Continuous (max. disp.)	min^{-1}(rpm)	4200	3900	3900	3600	3300	3100
Maximum (max. disp.)		4600	4250	4250	3950	3650	3400
Continuous (min. disp.)		—	—	4600	—	—	—
Maximum (min. disp.)		—	—	5100	—	—	—
System pressure							
Continuous	bar [psi]	420 [6000]					
Maximum		480 [7000]					
Flow ratings							
Rated (max. disp., rated speed)	l/min [US gal/min]	176 [46]	215 [57]	215 [57]	270 [71]	330 [87]	403 [106]
Maximum (max. disp., max. speed)		193 [51]	234 [62]	234 [62]	296 [78]	365 [96]	442 [117]
Case pressure							
Continuous	bar [psi]	3 [44]					
Maximum (cold start)		5 [73]					

FLUID SPECIFICATIONS

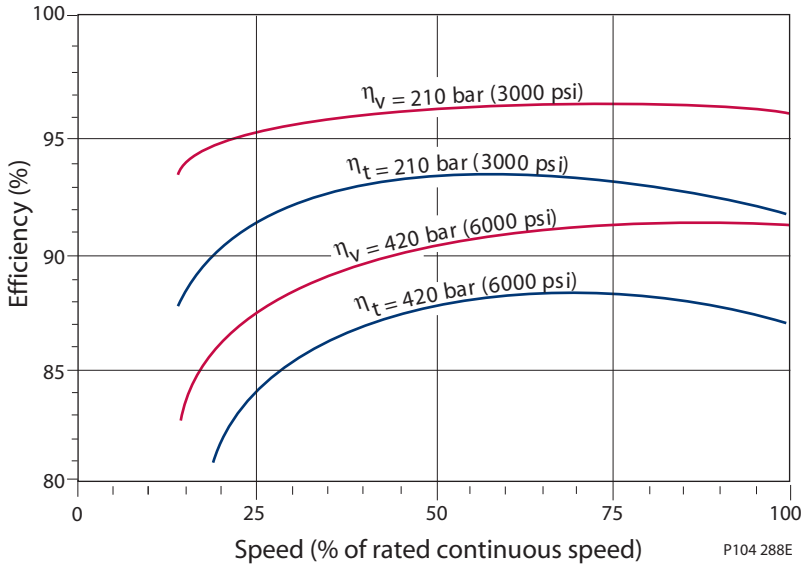
Viscosity mm²/sec (cSt) [SUS]	
Minimum	7 [49]
Continuous	12-80 [70-370]
Maximum	1600 [7500]
Temperature °C [°F]	(measured at the hottest point in the system, usually the case drain)
Minimum	-40 [-40]
Continuous	104 [220]
Maximum	115 [240]
Filtration	
Cleanliness	22/18/13 or better per ISO 4406
Efficiency (suction filtration)	$\beta_{35\text{-}45}$=75 ($\beta_{10}\geq 2$)
Efficiency (charge filtration)	$\beta_{15\text{-}20}$=75 ($\beta_{10}\geq 10$)
Recommended inlet screen size	100-125 µm [0.0039-0.0049 in]

EFFICIENCY GRAPHS

Motor performance as a function of operating speed

The following performance graph provides typical volumetric and overall efficiencies for Series 90 motors. These efficiencies apply for all frame sizes.

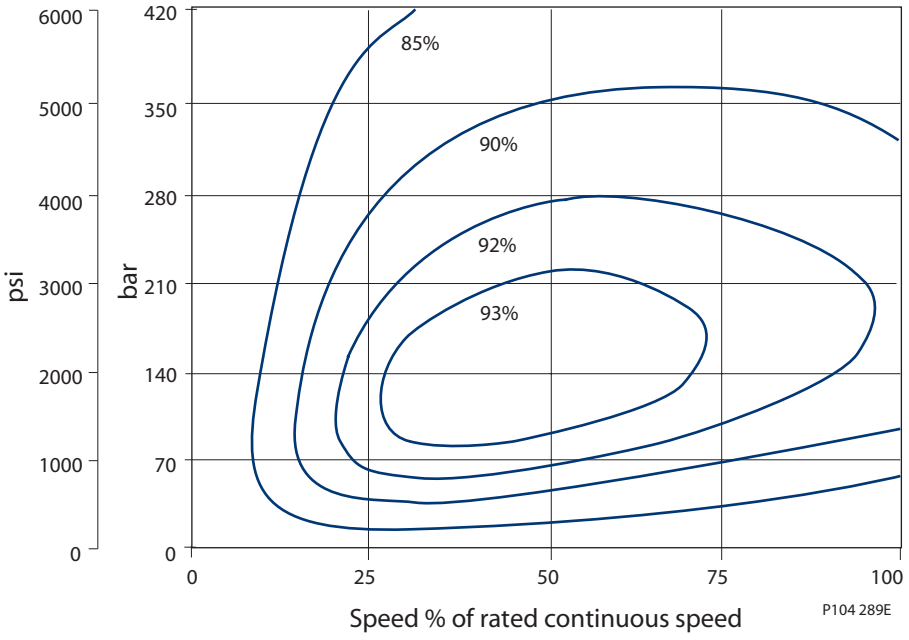
Efficiency vs. speed



Motor performance as a function of pressure and speed

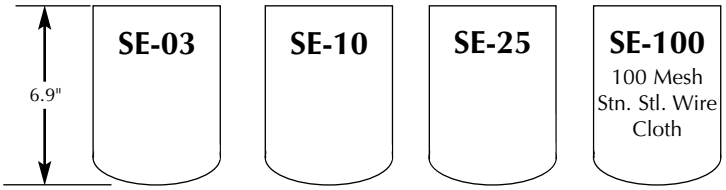
The performance map provides typical motor overall efficiencies at various pressures and speeds. These efficiencies also apply for all frame sizes.

Efficiency plotted at various pressures and speeds

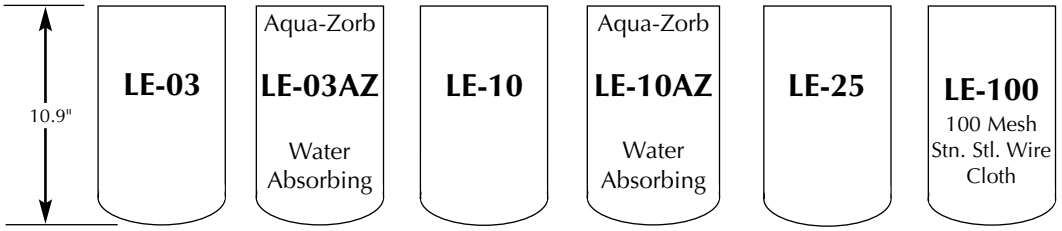


SE & LE SERIES
SPIN-ON FILTER ELEMENTS

For Use With SF, DF, MF, MFT & ZDF Series Filter Heads



	SE-03	SE-10	SE-25	SE-100
Part Number	SE-03	SE-10	SE-25	SE-100
Diameter	5.1"	5.1"	5.1"	5.1"
Mounting Thread	1 1/2" - 16	1 1/2" - 16	1 1/2" - 16	1 1/2" - 16
Micron Rating	3 Micron	10 Micron	25 Micron	141 Micron
Beta 2/20/75 (See Below)	3/10/22	9/22/24	29/46/54	----------
Filter Media Area	850 Sq. In.	950 Sq. In.	950 Sq. In.	200 Sq. In.
Can Color / Imprint	White/Green	White/Red	White/Black	White/Blue



	LE-03	LE-03AZ	LE-10	LE-10AZ	LE-25	LE-100
Part Number	LE-03	LE-03AZ	LE-10	LE-10AZ	LE-25	LE-100
Diameter	5.1"	5.1"	5.1"	5.1"	5.1"	5.1"
Mounting Thread	1 1/2" - 16	1 1/2" - 16	1 1/2" - 16	1 1/2" - 16	1 1/2" - 16	1 1/2" - 16
Micron Rating (Nominal)	3 Micron	3 Micron	10 Micron	10 Micron	25 Micron	141 Micron
Beta 2/20/75 (See Below)	3/10/22	5/21/23	10/22/33	8/25/30	29/46/54	----------
Filter Media Area	1170 Sq. In.	648 Sq. In.	1710 Sq. In.	648 Sq. In.	1710 Sq. In.	380 Sq. In.
Water Holding Capacity	----------	15 oz.	----------	15 oz.	----------	----------
Can Color / Imprint	White/Green	White/Orange	White/Red	White/Orange	White/Black	White/Blue

Application Data:

- Reference:
  $Beta_x$ Rating of 2 = 50% Efficiency (Nominal Rating)
  $Beta_x$ Rating of 20 = 95% Efficiency
  $Beta_x$ Rating of 75 = 98.7% Efficiency (Absolute Rating)
- Maximum Operating Pressure: 200 PSI All Models.
  Warning: 80 PSI ΔP max. without by-pass valve in filter head.
- Operating Temperature: -65 to +250° F.
- Application: Suitable for petroleum based fluids only. Consult factory for synthetic fluids.
- Buna "N" Gasket standard. Fluorocarbon Gasket optional, consult factory.
- Consult local distributor or factory for SE & LE Element interchange with those of other manufacturers.
- **Caution:** *Do not* use SE & LE Series filter elements on internal combustion engines.

PRECISION INSTRUMENT COMPANY

MODEL '203L', LIQUID FILLED GAUGES

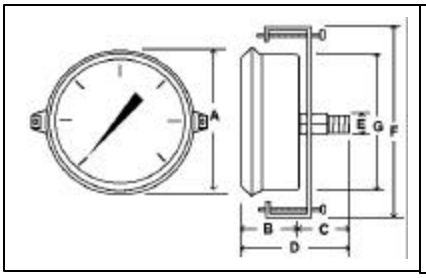
Our '200' Series Gauge Line Is A High Quality Line Of Liquid Filled Gauges. The Glycerine Filling Helps Dampen The Effects Of Pulsation And Vibration, While Also Perpetually Lubricating The Movement (And Keeping Contaminates Such As Dirt Away From All Moving Parts) Which Will Extend The Life Of The Gauge.

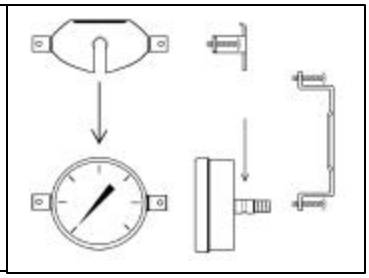
This Gauge Has Been Specifically Designed With The Original Equipment Manufacturers In Mind And Are Typically Used On Hydraulic & Pneumatic Systems As Well As Any Commercial Or Industrial Application Not Corrosive To Brass And Bronze Wetted Parts Where Glycerine Filling Is Suitable For Use.

SPECIFICATIONS:

- **U-Clamp Panel Mount Design**
- **Available Dial Sizes:** 1 ½, 2", 2 ½, 3 ½, 4"
- **Available Connection Sizes:**
  1/8"MNPT on 1 ½and 2"
  1/4"MNPT on 2", 2 ½, 3 ½and 4"
- **Stainless Steel Case And Bezel**
- **Brass Internals & Connection**
- **Phosphour Bronze Bourdon Tube**
- **Liquid Filled (Dry Available)**
- **Accuracy :** Standard = 3-2-3 % Per ANSI grade B
  (Special Accuracy Available Upon Request)
- **Dual Scale: PSI & Bar (x100=kPa)**
  Single Scale available from stock
- **Ambient temperature:** FILLED: 30'F to 160'F
  DRY: -30'F to 180'F

RANGE	CODE	Major In	Minor In
30/0"VAC	A	5	0.5
30/0/15	CB	5	0.5
30/0/30	CC	10	1
30/0/60	CD	10	1
30/0/100	CE	20	2
30/0/150	CF	20	2
30/0/300	CH	50	10
0/15	B	2	0.2
0/30	C	5	0.5
0/60	D	10	1
0/100	E	20	2
0/160	F	20	2
0/200	G	40	5
0/300	H	50	5
0/400	I	50	5
0/600	K	100	10
0/1000	M	200	20
0/1500	N	200	20
0/2000	O	400	50
0/3000	P	500	50
0/5000	R	1000	100
0/10,000	U	1000	100
0/15,000	V	2000	200





		A	B	C	D	E	F	G
1 ½ Dial	In	1.88	1.06	.89	1.95	1/8"	2.63	1.63
	MM	48	27	23	50	Npt	67	42
2" Dial	In	2.23	1.09	.71	1.99	1/8" or	2.81	2.00
	MM	57	28	23	51	¼"npt	72	51
2 ½ Dial	In	2.80	1.28	1.19	2.46	1/4"	3.48	2.50
	MM	71	33	30	63	Npt	88	64
3 ½ Dial	In	3.83	1.14	1.08	2.20	1/4"	3.70	3.5
	MM	97	29	27	56	Npt	94	89
4" Dial	In	4.32	1.63	1.14	2.77	1/4"	5.20	3.87
	MM	110	42	29	71	Npt	132	98

Note: All Dial Size Gauges are Center Back Connection Except 3 ½ Dial Size which are Lower Back Connection

MCHXXX

Control Handle

BLN-95-8956-11 **Issued**: June 1995

DESCRIPTION

The MCHXXX Control Handle is intended for use in open loop systems or as a setpoint for analog or microprocessor closed loop systems for controlling position, speed, pressure, horsepower or other dynamic parameters.

The Control Handle is designed to provide remote electrical actuation of the MCV101 Pressure Control Pilot Valve or other pilots for pressure and flow control servovalves as well as directly controlling main spool valves. It may also be used to power the V7058 Hydrotransmission Valve for Sauer-Danfoss pumps/motors, or other electrically-actuated pump strokers such as the MCV104 Electrical Displacement Control.

FEATURES

- Shock and vibration resistant
- Choice of three mounting styles, with or without watertight case
- Rugged components designed for the construction environment
- High-torque handle actuation gives sure feel
- Simple to install
- Mechanical options include center-lock, spring-return, friction drag, uni/bi-directionality and Packard connector
- Electrical characteristics customized to the application

TECHNICAL DATA

ELECTRICAL

OPERATING VOLTAGE
11 - 15 Vdc (12 Volt models)
22 - 30 Vdc (24 Volt models)

POWER
See Ordering Information

LOAD RESISTANCE
Customer specified. See Ordering Information.

SWITCH CURRENT CAPABILITY
3 amps inductive at 28 Vdc.

MECHANICAL

HANDLE STROKE
± 30° (± .52 radians)

SPRING TORQUE
11 ± 4 in-lbs. (1.2 ± .4 N-m) at center breakaway
18 ± 6 in-lbs. (2.0 ± .7 N-m) at full stroke

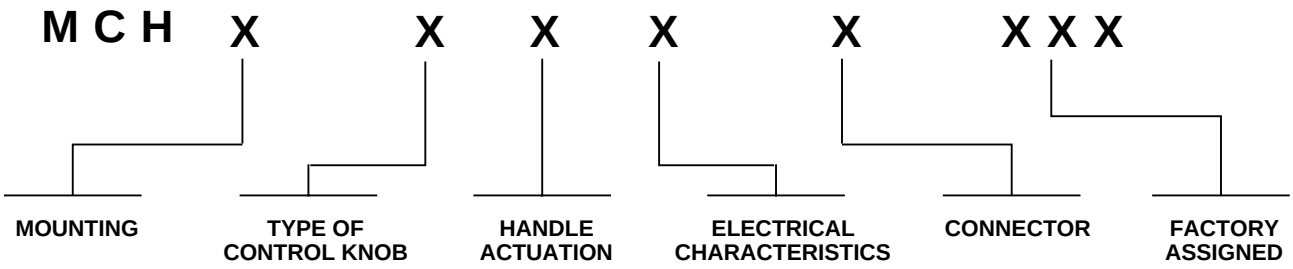
DETENT TORQUE (OVER AND ABOVE FRICTION DRAG)
10 in - lbs. (1.1 N-m)

FRICTION DRAG
13.5 ± 3 in-lbs. (1.5 ± .3 N-m). Friction is adjusted at the brake with a 5/32 English Allen wrench and 3/8 open end wrench.

ORDERING INFORMATION

A wide range of options to the basic Control Handle allows it to be custom-tailored to each application. See the Ordering Specification Chart for assistance in determining Model Number. Other options are possible; consult Sauer-Danfoss with further questions.

ORDERING SPECIFICATION CHART



MOUNTING

1 BASE (SURFACE) MOUNT ALUMINUM CASE
2 TOP MOUNT (DROP IN) WITH PLASTIC CASE
3 TOP MOUNT (DROP IN) WITHOUT CASE
4 PANEL MOUNT WITH PLASTIC CASE
5 PANEL MOUNT WITHOUT CASE

TYPE OF CONTROL KNOB

1 NON LOCKING
2 CENTER LOCK
3 PUSH BUTTON IN KNOB
4 TRON MAINTAINED ROCKER SWITCH
5 NON-LOCKING NO KNOB
6 3 POSITION MAINTAINED ROCKER SWITCH IN KNOB
7 TRON MOMENTARY ROCKER SWITCH
8 SPECIAL (NO HANDLE OR KNOB)
9 3 POSITION MOMENTARY ROCKER SWITCH IN KNOB

HANDLE ACTUATION

A SPRING RETURN, BI-DIRECTIONAL
B FRICTION HELD, BI-DIRECTIONAL
C FRICTION HELD, UNI-DIRECTIONAL
D SPECIAL (FRICTION HELD, CENTER DETENT ONLY, NO BRAKE)

ELECTRICAL CHARACTERISTICS

A PROPORTIONAL, NO SWITCHES
B PROPORTIONAL, 12 VDC CENTER OFF SWITCH
C PROPORTIONAL, 24 VDC CENTER OFF SWITCH
D PROPORTIONAL, CENTER OFF AND AUX SWITCH
E PROPORTIONAL, SET-POINT POTENTIOMETER
F STEP PLUS PROPORTIONAL, 12 VDC
G STEP PLUS PROPORTIONAL, 24 VDC
H SWITCHING
J STEP PLUS PROPORTIONAL, AUX SWITCHING
K PROPORTIONAL, UNWIRED SWITCH
L ELECTRONIC PWM AUX SWITCHING
M 3 SWITCHES
X SPECIAL
Y SPECIAL
Z SPECIAL

CONNECTOR

1 TERMINAL STRIP INTERNAL
2 PIGTAIL 60 INCH WITH NO CONNECTOR
3 PIGTAIL WITH UNSEALED PACKARD CONNECTOR
6 SEALED PACKARD CONNECTOR 4 PIN MALE AND FEMALE
7 PIGTAIL SEALED PACKARD CONNECTOR
8 PIGTAIL SEALED DEUTSCH CONNECTOR

ORDERING INFORMATION *(continued)*

I. MOUNTING

See the Dimensions diagram.

1. BASE OR SURFACE MOUNT
   Connection is via four screws to the flanges on the bottom of the metal case.

2. TOP MOUNT WITH CASE
   Connection is via two screws to an enlarged mounting plate. Top mounting allows the entire handle to be removed from above the panel. The case is made of black nylon plastic.

3. TOP MOUNT WITHOUT CASE
   Same as 2, but without case.

4. PANEL MOUNT WITH CASE
   Connection is via four screws to the top plate that holds the boot in place. The case is made of black nylon plastic.

5. PANEL MOUNT WITHOUT CASE
   Same as 4, but without case.

II. TYPE OF CONTROL KNOB

See the Dimensions diagram.

1. NON-LOCKING
   The non-locking handle has a standard ball knob. The friction-held handle detents with a spring-loaded ball to indicate null, while the spring-return handle has a spring-preload indicating null.

ORDERING INFORMATION *(continued)*

II. TYPE OF CONTROL KNOB *(continued)*

2. CENTER-LOCK
The center-lock handle has a cylindrical knob and provides a positive center-lock that unlatches when the operator pulls up on the knob.

3. NON-LOCKING, AUXILIARY SWITCH
This knob is teardrop shaped, with an auxiliary momentary push-button switch on top. The switch is wired through the handle shaft to the body with three wires (common, normally open and normally closed).

5. NON-LOCKING, NO KNOB
The customer provides his own customized knob.

6. THREE POSITION MAINTAINED ROCKER SWITCH IN KNOB
The cylindrical knob has a boot covering the three position switch in the knob. The switch, wired through the handle, is used for auxiliary functions.

9. THREE POSITION MOMENTARY ROCKER SWITCH IN KNOB
This is the same as II.6, but the switch returns to the center position when released.

III. HANDLE ACTUATION

A. SPRING-RETURN, BI-DIRECTIONAL
This handle uses a torsion spring to return to the mechanical center position and has 30 degrees of handle throw on either side of center.

B. FRICTION-HELD, BI-DIRECTIONAL
This handle has an adjustable drag, set with a clamp-type brake, that holds the handle at the set position and has 30 degrees of handle throw on either side of the center detent.

C. FRICTION-HELD, UNI-DIRECTIONAL
This handle has a high-resolution 60 degrees of handle throw, rotating on only one side of mechanical null, which is at full stroke. It has no detent mechanism.

IV. ELECTRICAL CHARACTERISTICS

A. PROPORTIONAL, NO SWITCHES, 12 VOLT BI-POLAR
This handle's output curve is fairly linear (see the Proportional Control Handle diagram), with output voltages a function of handle stroke. The supply voltage is 12 volts, and there are no auxiliary function switches.

B. PROPORTIONAL, CENTER-OFF SWITCH, 12 VOLT, BI-POLAR
This handle has a center-off switch that ensures zero output voltage over ± 3 degrees handle throw.

C. PROPORTIONAL, CENTER-OFF SWITCH, 24 VOLT, BI-POLAR
This handle runs on a supply voltage of 24 Volts.

D. PROPORTIONAL, CENTER-OFF SWITCH, AUXILIARY SWITCH, 12 VOLT, BI-POLAR
This handle has a second switch that actuates at + 2 or - 2 degrees.

E. PROPORTIONAL, CENTER-OFF SWITCH, 12 VOLT, UNI-POLAR
This handle maintains a single direction of current or voltage flow at all handle angles.

F. STEP-PLUS-PROPORTIONAL, 12 VOLT, BI-POLAR
This handle uses two switches to give the step-plus-proportional output current on either side of null. This is used to overcome deadbands in spool valves. (See the Step Plus Proportional Control Handle diagram.) Current beyond this step output is proportional through the rest of the handle throw. Full current output at 30 degrees handle stroke is maximum of 250 ma. Step current is a maximum of 50% of full current output.

G. STEP-PLUS-PROPORTIONAL, 24 VOLT, BI-POLAR
Same as F, but 24 Volt.

H. SWITCHING
This handle is non-proportional. Moving the handle off null activates switches that power ON/OFF devices (e.g., solenoid valves).

J. STEP-PLUS-PROPORTIONAL, FULL AUXILIARY SWITCHING, 12 VOLT, BI-POLAR
This handle uses the step switches for additional secondary functions. Full current output at 30 degrees handle stroke is a maximum of 250 ma. Step current is a maximum of 50% of full current output.

K. PROPORTIONAL, UNWIRED SWITCH
The customer provides an auxiliary function, such as a neutral start interlock, with the unwired center switch.

L. STEP-PLUS-PROPORTIONAL, FULL AUXILIARY SWITCHING, 12 VOLT, BI-POLAR ELECTRONIC, PULSE WIDTH MODULATED
This handle uses a printed circuit board that makes the step height and output current fully adjustable, accomodating high current applications. It also has pulse width modulation, which "dithers" the load to avoid stiction. Full current output at 30 degrees handle stroke is a maximum of 2 amps into a 5 ohm load. Step current is a maximum 50% of full current output. Typical dither frequencies (dependent on resistance of the load, specified in the suffix number) are: 60 Hz for the HPI solenoid actuator, approximately 400 Hz for the V7058 Hydrotransmission Valve and approximately 1000 Hz for the MCV101A Pressure Control Pilot Valve.

M. PROPORTIONAL, THREE SWITCHES
The three switches are: a wired center switch, one unwired switch in forward and one unwired switch in reverse.

ORDERING INFORMATION *(continued)*

V. CONNECTOR

1. TERMINAL STRIP
   Electrical connections are made to a set of four internal screw terminals.

2. PIGTAIL WITHOUT CONNECTOR
   Four wires extend from the handle case. See Connection Diagram 2 for lengths.

3. PIGTAIL WITH CONNECTOR
   The wires from the case terminate in a Packard environmental connector. See Connection Diagram 2.

6. PIGTAIL WITH SEALED PACKARD CONNECTOR
   These are two separate connectors, each connected to a separate potentiometer.

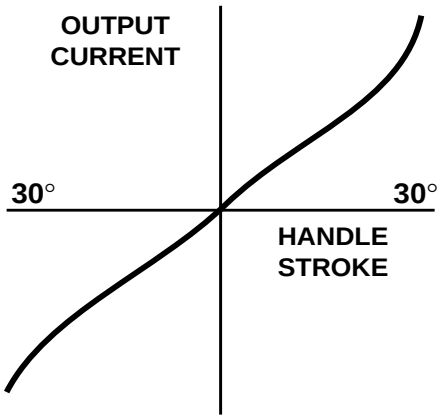
7. PIGTAIL SEALED PACKARD CONNECTOR

8. PIGTAIL SEALED DEUTSCH CONNECTOR

VI. SUFFIX NUMBER

These final three numbers are factory-generated. To create the suffix number, the following information must be supplied: number of additional switches needed and actuation angle of each with respect to null, full current output, resistance of the driven load and step current needed (if necessary).

PROPORTIONAL CONTROL HANDLE



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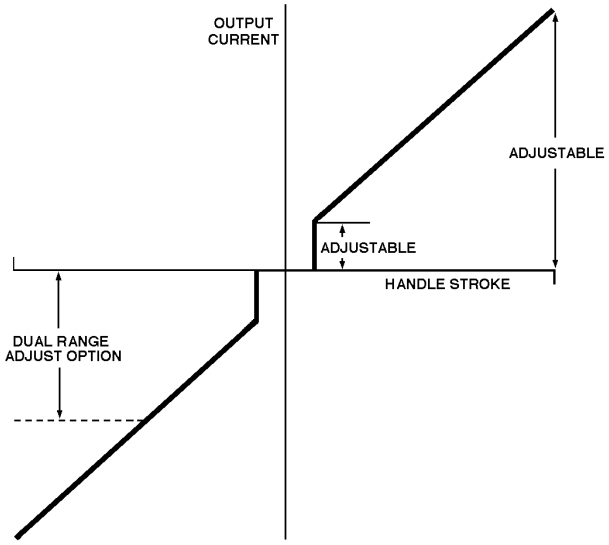
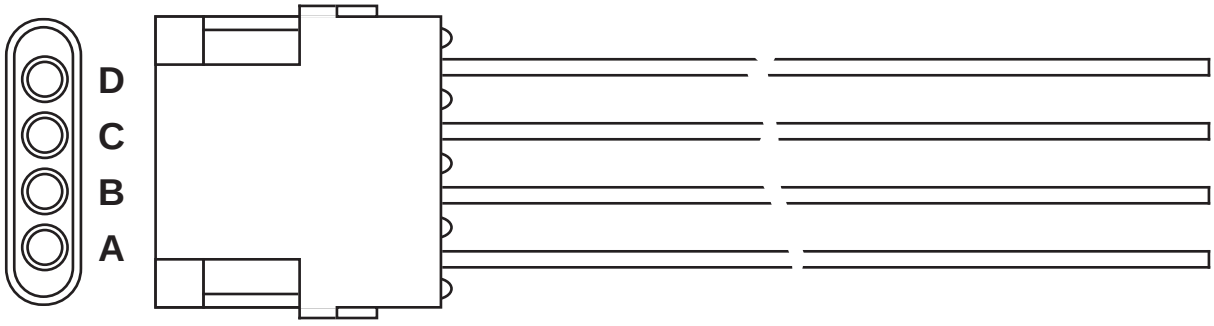
STEP-PLUS-PROPORTIONAL CONTROL HANDLE



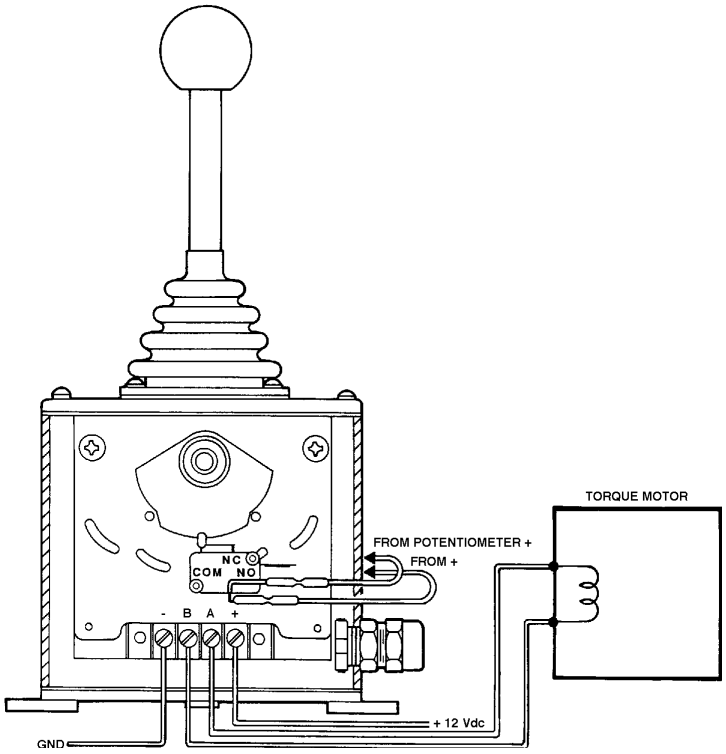
1140A

SEALED PACKARD CONNECTOR



1376

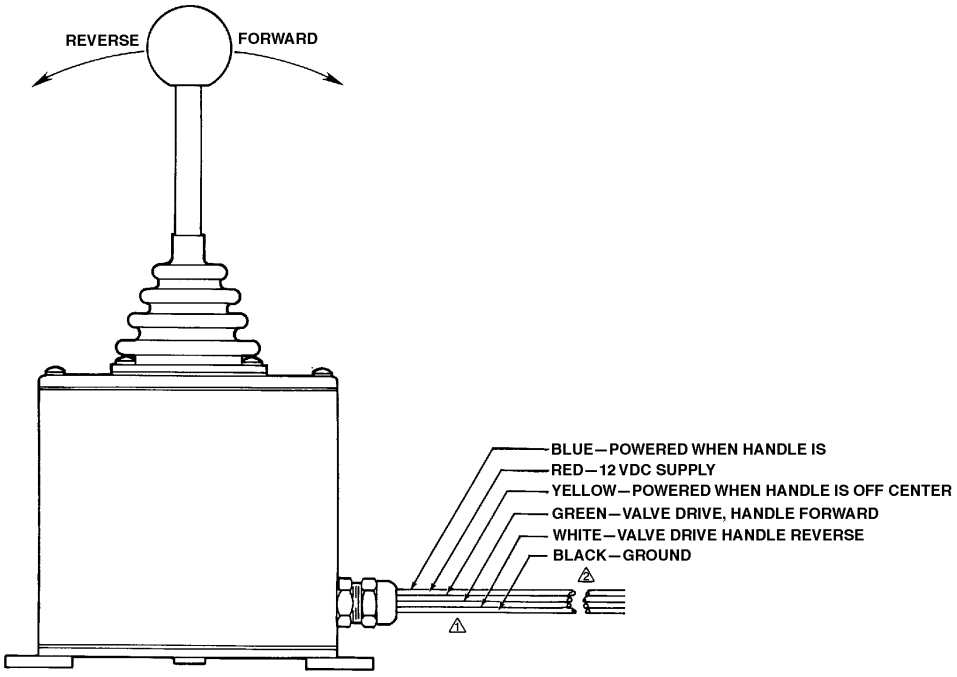
CONNECTION DIAGRAM 1



1223A

Center-Off Switch Assembly and Wiring Connections For the Control Handle. If No Center-Off Switch is Used the Power Lead Should be Wired to the "+" Terminal on the Terminal Strip. Ground and A, B Wires Are Attached Through the Connector, at Right. The Terminal Strip Can Also be Accessed From the Other (Potentiometer) Side of the Handle. Connecting the Center-Off Switch Necessitates Wrapping Wires From One Side to the Other.

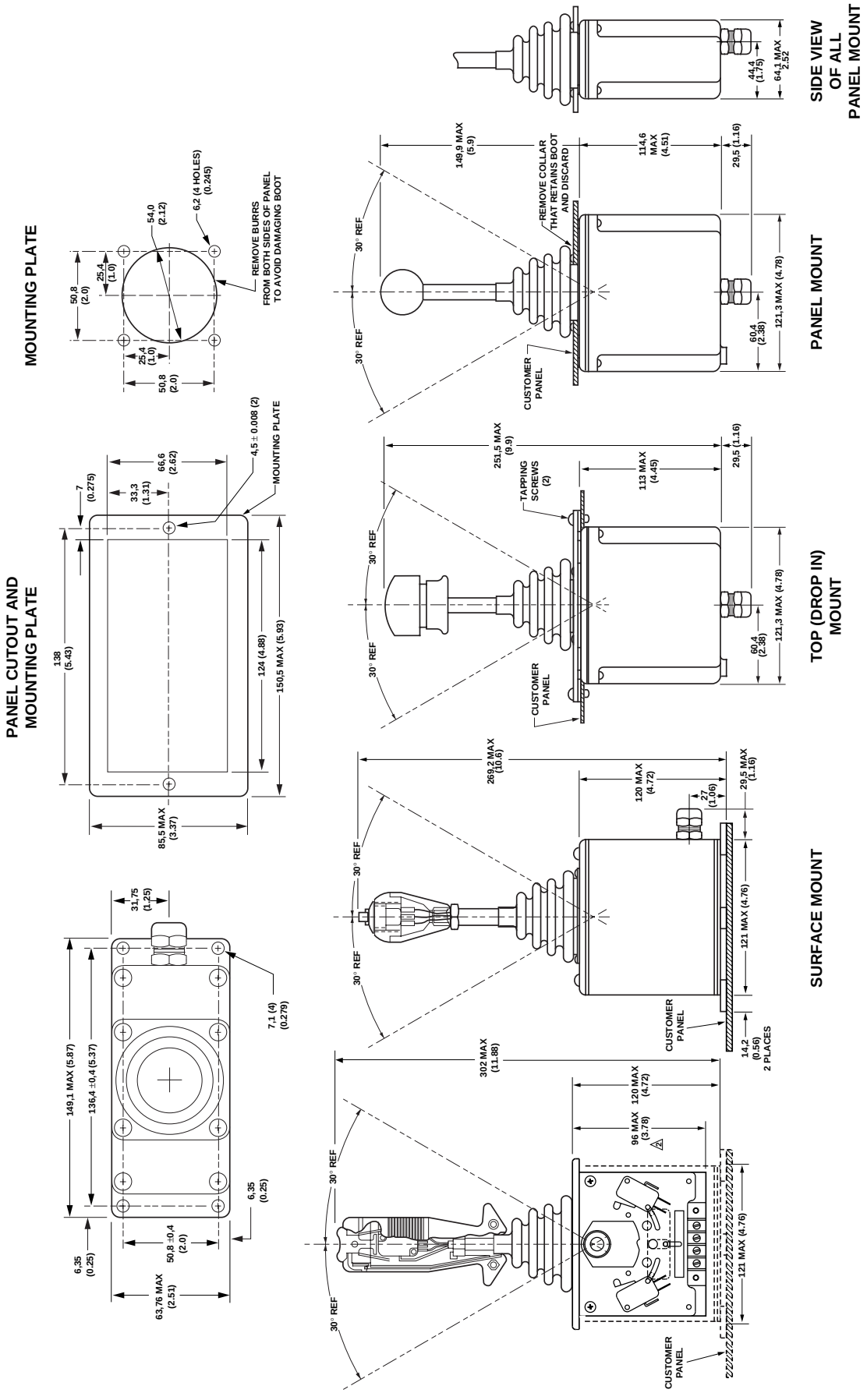
CONNECTION DIAGRAM 2



1136A

Phasing and Color Scheme For Handle With Cable and Connector.

DIMENSIONS



1135C

Dimensions of the MCHXXX Control Handle in Millimeters (Inches).

PERFORMANCE

NULL CURRENT
± 5 ma maximum if not switched (12 Vdc models)
± 8 ma maximum if not switched (24 Vdc models)

CENTER DEADZONE (OPTIONAL)
± 3° nominal

FULL STROKE CURRENT CAPABILITY
Customer specified. See Ordering Information.

STEP CURRENT
Customer specified. See Ordering Information. Step current occurs at end of deadzone.

ENVIRONMENTAL

TEMPERATURE
- 40° to 170° F (- 40° to 77° C) operating
- 30° to 150° F (- 34° to 66° C) storage

HUMIDITY
After being placed in a controlled atmosphere of 95% humidity at 38° C (100° F) for 10 days, the Control Handle will perform within specification limits.

RAIN
After being showered from all directions by a high pressure hose down, the Control Handle will perform within specification limits (applied to cased models only). This test fulfills NEMA 4 specifications.

VIBRATION
Withstands a vibration test designed for mobile equipment controls consisting of two parts:
1. Cycling from 5 to 2000 Hz in each of the 3 axes.
2. Resonance dwell for one million cycles for each resonance point in each of the 3 axes.

SHOCK
50 g for 11 milliseconds. Three shocks in both directions of the 3 mutually perpendicular axes for a total of 18 shocks.

LIFE
Greater than 1,000,000 cycles excluding potentiometers. Potentiometers with greater than 1,000,000 cycles available for most applications.

DIMENSIONS
See the Dimensions diagram.

WIRING

If no external cabling is ordered, access to power, ground and the potentiometer(s) is gained through a barrier terminal strip inside the handle's case. The customer should run a cable from the strip through the connector on the side or bottom of the case. See Connection Diagram 1. A clockwise handle movement causes a current flow from terminal B to A when the terminal strip is facing you.

WARNING

A failure may cause an output which could activate the valve or pump. If this occurs, the apparatus may move, possibly endangering people or equipment. It is strongly recommended that handles be equipped with a neutral off switch to prevent this eventuality. For cases in which an active neutral is necessary, an emergency shut down and/or braking system sufficient to stop the system or vehicle immediately should be provided.

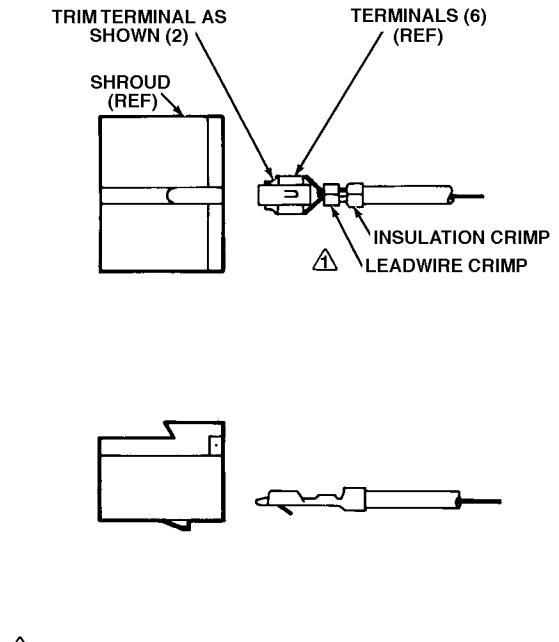
In most applications, auxiliary switches must be customer-wired, as shown in Connection Diagram 1. When the switch is used as a center-off, power is connected from the external 12 Volt supply to the terminal labeled "common". The switch terminals are 3/16" quick-connect. Connection Diagram 2 shows a pre-wired Control Handle with center-off switch and Packard connector, exhibiting the handle phasing and color coding of the wires.

The Packard Connector Assembly diagram demonstrates how to assemble the mating Packard connector (male shell, female sockets) used in Connection Diagram 2. The necessary parts are shipped in a bag assembly (Part Number K03370) composed of six sockets and one plastic connector body.

The Potentiometer Locations diagram shows the location of the three trim potentiometers on the "L" handle. See the "Electrical Characteristics" section of the Ordering Information.

In order to avoid damaging the Control Handle, a 1 amp fuse wired in series is recommended for applications with low current-drawing requirements.

PACKARD CONNECTOR ASSEMBLY

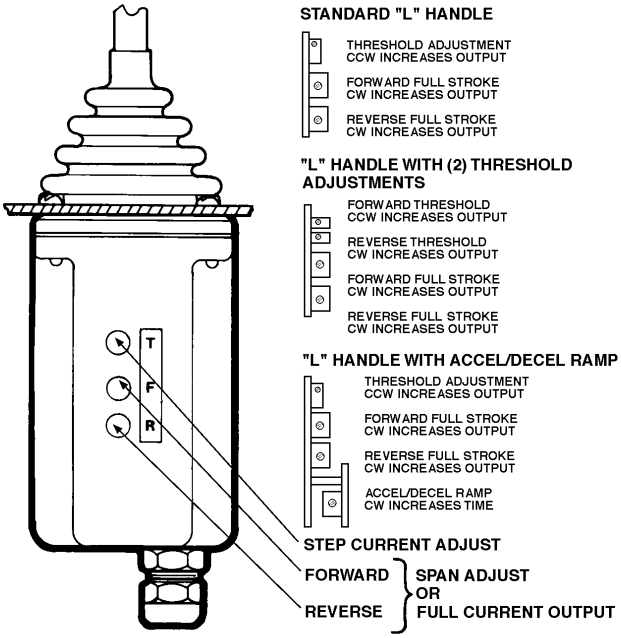


1 CRIMP BEFORE INSERTING TERMINAL INTO BODY

1137B

Unsealed Packard Mating Connector Assembly.

POTENTIOMETER LOCATIONS



1138B

Location of Trim Potentiometers on "L" Control Handles.

CUSTOMER SERVICE

NORTH AMERICA

ORDER FROM

Sauer-Danfoss (US) Company
Customer Service Department
3500 Annapolis Lane North
Minneapolis, Minnesota 55447
Phone: (763) 509-2084
Fax: (763) 559-0108

DEVICE REPAIR

For devices in need of repair, include a description of the problem, a copy of the purchase order and your name, address and telephone number.

RETURN TO

Sauer-Danfoss (US) Company
Return Goods Department
3500 Annapolis Lane North
Minneapolis, Minnesota 55447

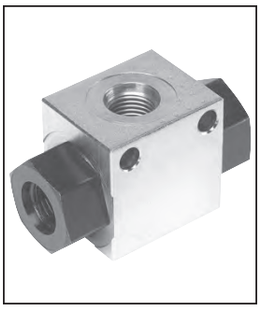
EUROPE

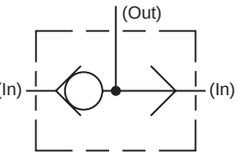
ORDER FROM

Sauer-Danfoss (Neumünster) GmbH & Co.
Order Entry Department
Krokamp 35
Postfach 2460
D-24531 Neumünster
Germany
Phone: 49-4321-8710
Fax: 49-4321-871355

General Description

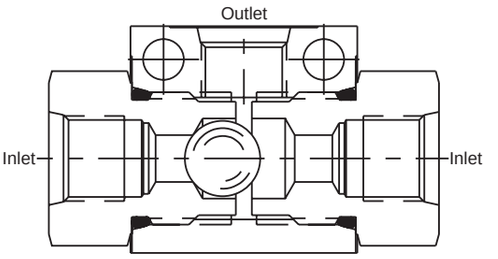
In-Line Style Shuttle Valve. For additional information see Technical Tips on pages SH1-SH2.





Features

- Compact in size
- In-line mounting
- Easily adaptable to various applications
- All external parts zinc plated

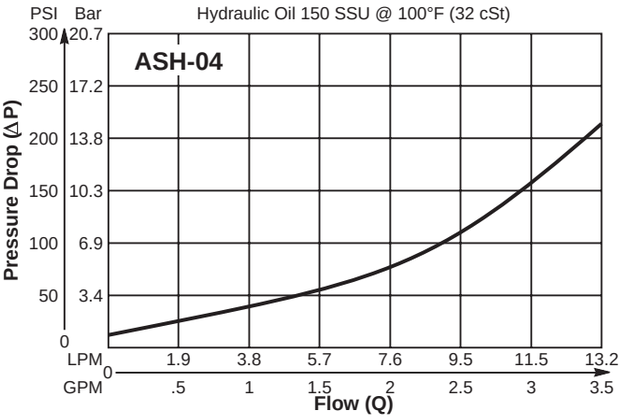


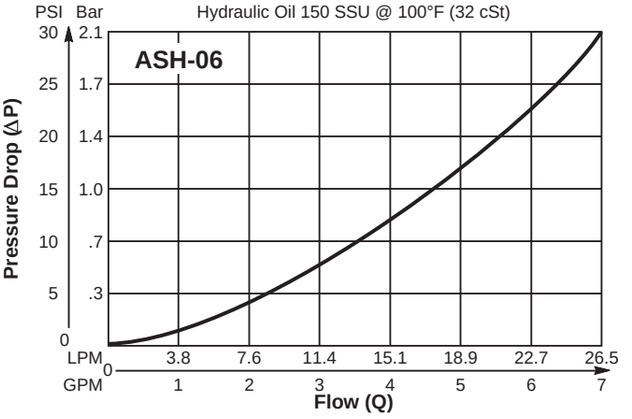
Specifications

Rated Flow	**ASH-04-3** 11 LPM (3 GPM) **ASH-06-2** 22 LPM (6 GPM)
Nominal Flow @ 7 Bar (100 PSI)	**ASH-04-3** ?? LPM (?? GPM) **ASH-06-2** ?? LPM (?? GPM)
Maximum Inlet Pressure	207 Bar (3000 PSI)
Leakage at 150 SSU (32 cSt)	5 drops/min. (.33 cc/min.) at 172 Bar (2500 PSI)
Body Material	Steel (Chromate Plated)
Operating Temp. Range/Seals	-40°C to +93.3°C (-40°F to +200°F) (Nitrile Seals Only)
Fluid Compatibility/ Viscosity	Mineral-based or synthetic with lubricating properties at viscosities of 45 to 2000 SSU (6 to 420 cSt)
Filtration	ISO code 16/13, SAE Class 4 or better
Approx. Weight	**ASH-04-3** .36 kg (0.8 lbs.) **ASH-06-2** .45 kg (1.0 lbs.)

Performance Curves

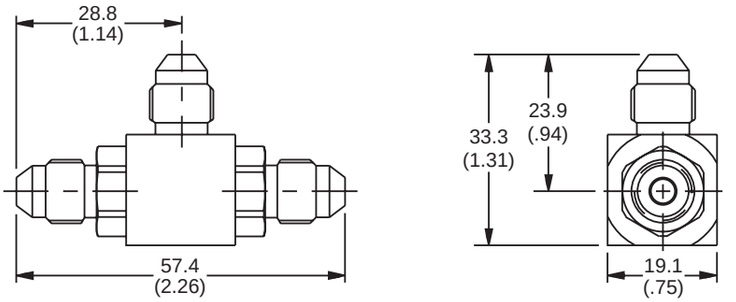
Flow vs. Pressure Drop (Through cartridge only)



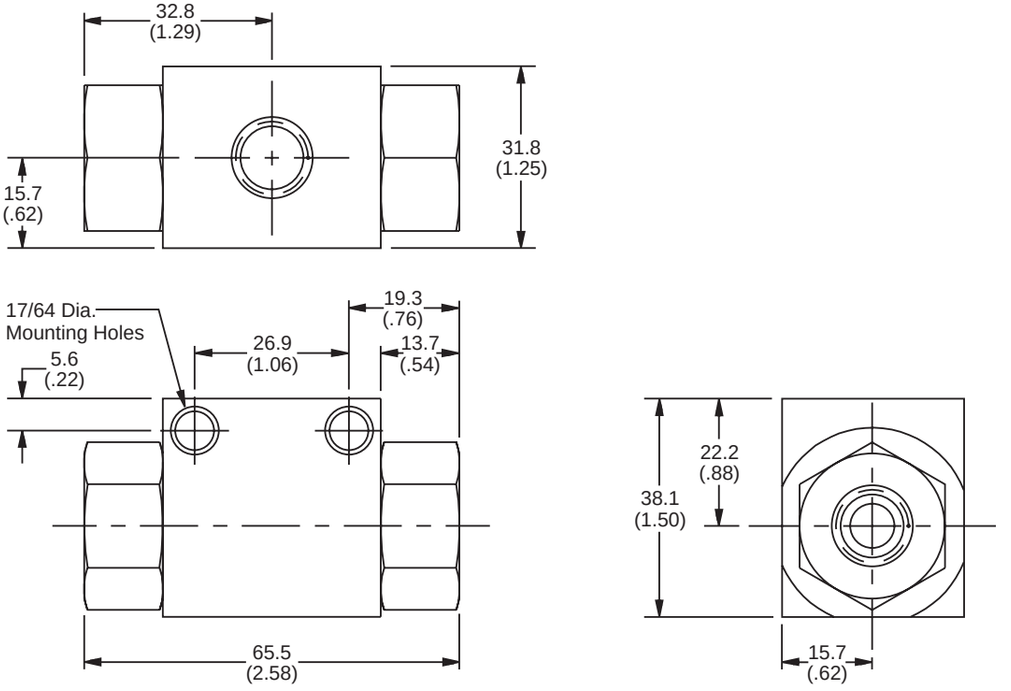


Dimensions Millimeters (Inches)

ASH-04-3



ASH-06-2



Ordering Information

ASH — ☐ — ☐

In-Line Shuttle Valve | **Port Size** | **Port Type**

Code	Port Size
04	1/4″ JIC
06	SAE-6

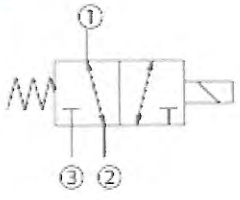
Code	Port Type
2	SAE (#6)
3	Male JIC (1/4″ only)

CP520-1

OPERATION

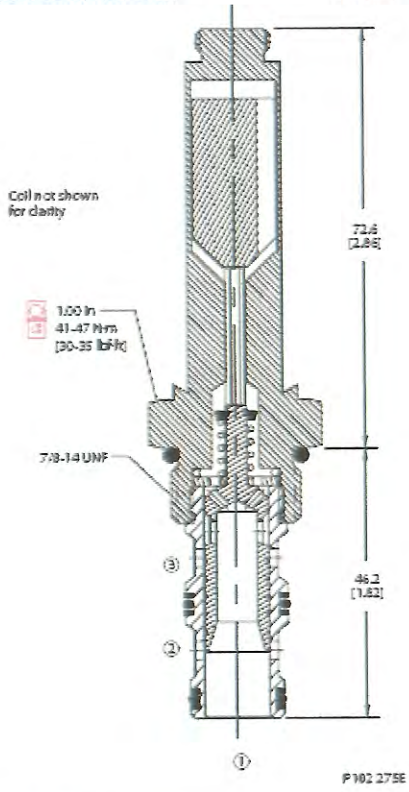
This valve is a direct acting, 2 position, 3 way spool type solenoid.

Schematic



P102 720

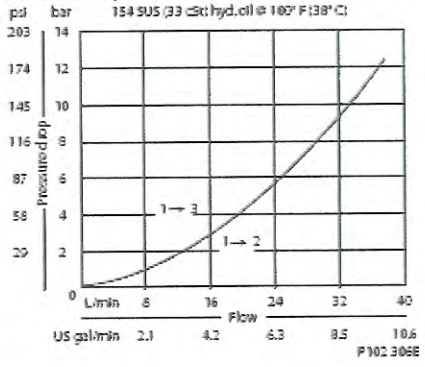
Cross-sectional view mm [in]



P102 275E

SPECIFICATIONS

Theoretical performance



P102 306E

Specifications

Rated pressure	207 bar [3000 psi]
Rated flow at 7 bar [100 psi]	27 l/min [7 US gal/min]
Leakage	82 cm³/min [5 in³/min] @ Rated pressure
Weight	0.49 kg [1.08 lb]
Cavity	CP10-3
Coil	D10 16 watt

ORDERING INFORMATION

CP520 - 1 - B - 6S - 24D - S - M

Seals

	Seal kit
B = Buna-N	120009
V = Viton	120010

Body and ports

	Body P/N
0 = Cartridge	No body
6S = Aluminum #6 SAE	CP10-3-6S
8S = Aluminum #8 SAE	CP10-3-8S

Voltage

10D = 10 VDC
12D = 12 VDC
20D = 20 VDC
24D = 24 VDC
120A = 120 VAC
240A = 240 VAC

Manual override

Omit = No override
M = Manual override

Replaces / Reemplaza / Remplace 65013-002-18M (10/97)

Illuminated and Non-Illuminated, Maintained and Spring-Return Selector Switches
Interruptores selectores de contacto sostenido o de retorno por resorte iluminados o no iluminados
Sélecteurs maintenus ou à rappel par ressort lumineux ou non lumineux

CE

Class Clase Classe	Type Tipo Type	Application Aplicación Application	Operators / Operadores / Opérateurs Non-Illuminated No iluminados Non lumineux	Illuminated Iluminados Lumineux	Keyed Con llave À clé	UL Listed for use on a flat surface of enclosure types: Registrado por UL para utilizar sobre una superficie plana de gabinetes tipo: Homologué par UL pour utilisatlon sur une surface plate des armoires de type :	
9001	KS	Heavy Duty Uso pesado Fort calibre	X		X	1, 2, 3, 3R, 4, 6, 12 & 13	The lens gasket (P) must be installed to retain enclosure Type 4 and 6 ratings. El empaque del lente (P) deberá ser instalado para conservar los valores nominales del gabinete tipo 4 y 6. Le joint de la lentille (P) doit être installé pour préserver les valeurs nominales de l'armoire type 4 et 6.
	K••J			X			
	SKS	Corrosion Resistant Resistente a la corrosión Résistant à la corrosion	X			1, 2, 3, 3R, 4, 4X, 6, 12 & 13	
	SK••J			X			

⚠ DANGER / PELIGRO / DANGER

HAZARDOUS VOLTAGE

Disconnect all power before servicing.

Electric shock will result in death or serious injury.

TENSION PELIGROSA

Desconecte todas las alimentaciones antes de efectuar el servicio.

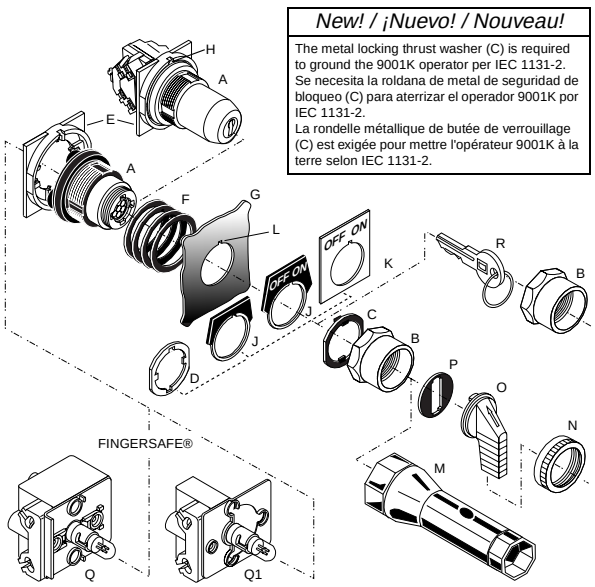
Una descarga eléctrica podrá causar la muerte o lesiones serias.

TENSION DANGEREUSE

Coupez toutes les alimentations avant l'entretien.

L'électrocution entraînera la mort ou des blessures graves.

Full View / Vista completa / Vue complète



New! / ¡Nuevo! / Nouveau!

The metal locking thrust washer (C) is required to ground the 9001K operator per IEC 1131-2.
Se necesita la roldana de metal de seguridad de bloqueo (C) para aterrizar el operador 9001K por IEC 1131-2.
La rondelle métallique de butée de verrouillage (C) est exigée pour mettre l'opérateur 9001K à la terre selon IEC 1131-2.

Mounting / Montaje / Montage

Dim.:
in. / pulg / po (mm)

Hole & Notch Punch

Ø 31 mm: Greenlee knockout punch 60242
Push buttons also mount in 1.20 (30.5) hole.

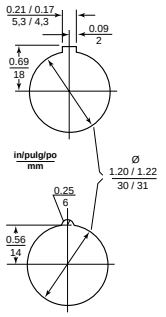
Punzonado y Muesca

Ø 31 mm: Punzonado de discos removibles 60242
Estos operadores también se pueden montar en un agujero de 1,20 (30,25).

Poinçon et Encoche

Ø 31 mm : Emporte-pièce Greenlee 60242
Ces opérateurs se montent aussi dans un trou de 1,20 (30,5).

Preferred Cover Drilling
Perforación sugerida de la cubierta
Perçage préféré du couvercle



Alternate Cover Drilling
Perforación alterna de la cubierta
Perçage alternatif du couvercle

Min. Centerline Spacing / Espacio min. al eje Espacement min. à l'axe

	Vertical	Horizontal
Without legend plate	1.56 (40)	2.25 (57)
Sin placa leyenda	1,56 (40)	2,25 (57)
Sans plaque à légende	1,56 (40)	2,25 (57)
With legend plate	*Consult the Square D Digest*	
Con placa leyenda	*Consultar el Compendiado Square D*	
Avec plaque à légende	*Consulter le Digest Square D*	

Legend

A. operator
B. ring nut
C. locking thrust washer
D. trim washer
E. liner (KS & SKS)
F. compensating gaskets
G. panel
H. locating mark
J. metal legend plate
K. plastic legend plate
L. alignment tab
M. ring nut wrench (K95)
N. secondary (knob) ring nut
O. knob
P. lens gasket
Q. standard light module (K••J, SK••J)
Q1. shallow depth light module (K••J, SK••J)
R. key

Leyenda

A. operador
B. tuerca arillo
C. roldana de seguridad de bloqueo
D. roldana del marco
E. revestimiento protector (KS & SKS)
F. empaques de compensación
G. panel
H. indicador
J. placa leyenda metálica
K. placa leyenda de plástico
L. muesca de alineamiento
M. llave para tuercas (K95)
N. tuerca arillo secundaria (perilla)
O. perilla
P. empaque del lente
Q. módulo de luz estándar (K••J, SK••J)
Q1. módulo de luz de poca profundidad (K••J, SK••J)
R. llave

Légende

A. opérateur
B. écrou de blocage
C. rondelle de butée de verrouillage
D. rondelle de garniture
E. revêtement (KS & SKS)
F. joints de compensation
G. panneau
H. repère
J. plaque à légende en métal
K. plaque à légende en plastique
L. languette d'alignement
M. clé pour écrou de blocage (K95)
N. écrou de blocage (de bouton) secondaire
O. bouton
P. joint de la lentille
Q. module lumineux standard (K••J, SK••J)
Q1. module lumineux de faible profondeur (K••J, SK••J)
R. clé

SQUARE D

Telemecanique

Installation / Instalación / Installation

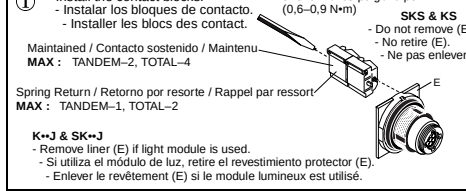
① - Install the contact blocks.
- Instalar los bloques de contacto.
- Installer les blocs des contact.

5–8 lb-in / lbs-pulg / lb-po (0,6–0,9 N•m)

SKS & KS
- Do not remove (E).
- No retire (E).
- Ne pas enlever (E).

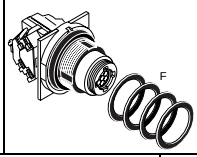
Maintained / Contacto sostenido / Maintenu
MAX : TANDEM–2, TOTAL–4

Spring Return / Retorno por resorte / Rappel par ressort
MAX : TANDEM–1, TOTAL–2



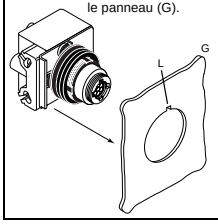
K••J & SK••J
- Remove liner (E) if light module is used.
- Si utiliza el módulo de luz, retire el revestimiento protector (E).
- Enlever le revêtement (E) si le module lumineux est utilisé.

② - Select the number of gaskets (F).
- Seleccionar el número de empaques (F).
- Choisir le nombre de joints (F).

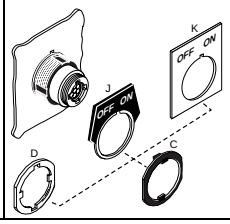


Panel thickness Espesor del panel Épaisseur du panneau in. / pulg / po (mm)	No. gaskets No. de empaques Nombre de joints
1/16 (1,6)	4
1/8 (3,2)	3
3/16 (4,8)	2
1/4 (6,4)	1

③ - Mount onto the panel (G).
- Montar sobre el panel (G).
- Monter sur le panneau (G).

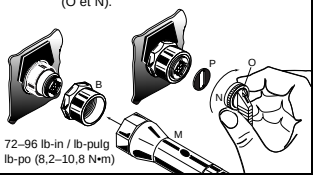


④ - Install the legend plate and washer (see table).
- Instalar la placa y roldana (vea la tabla).
- Installer la plaque de légende et rondelle (voir le tableau).



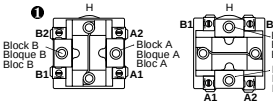
Legend Plate	Washer
Metal (J) Plastic (K) None	C only C only D and C
Placa leyenda	**Roldana**
De metal (J) De plástico (K) Ninguna	C solamente C solamente D y C
Plaque à légende	**Rondelle**
En métal (J) En plastique (K) Aucune	C seulement C seulement D et C

⑤ - Install the ring nut (B), lens gasket (P), and knob assembly (O & N).
- Instalar la tuerca arillo (B), el empaque del lente (P) y el ensamble de la perilla (O y N).
- Installer l'écrou de blocage (B), le joint de la lentille (P) et l'assemblage du bouton (O et N).



Contact Sequence Selection Table / Tabla de selección de las secuencias de contactos / Tableau de séquence de contact

Contact Block Location / Ubicación de los bloques de contactos / Emplacement des blocs à contacts



CONTACT(O)S	Non-Illuminated Operator, Type: / Operador no luminoso, tipo: / Operateurs non lumineux, type :													
	KS11	KS12	KS25	KS34	KS42	KS43	KS44	KS45	KS46	KS47	KS49	KS401	KS402	KS88
	Cam / Leva / Came													
	E	D	E	D	B	C	D	E	F	G★	J	L★	M	H★
	Knob Position / Posición de la perilla / Position du bouton													
	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗
A1 A2	X O O X	O X X O	X O O X	O X X O	X O O O X X	X O O O O X	O O X O X O	X O O O X O	X O O O O X	X O O O X X	X O O O X X	O X O X O O	X X O O O X	X O O O O O X O
B1 B2	X O O X	O X X O	X O O X	O X X O	O O X X X O	X O O O O X	O O X O X O	X O O O X O	X O O O O X	O X O O O X	O O X X O O	X O X X O O	O O X O X O	O O O X O X O O
A1 A2 B1 B2	X O O X X O O X	O X X O O X X O	X O O X X O O X	O X X O O X X O	X O O O X X O O X X X O	X O O O O X X O O O O X	O O X O X O O O X O X O	X O O O X O X O O O X O	X O O O O X O X O O O X	X O O O X X O O X X O O	X O O O X X X O X O X O	O X O X O O O O X O X O	X X O O O X O X X X O O	X O O O O O X O O O O X O X O O

Block A Only Bloque A solamente Bloc A seulement		A1 A2 ○○
Block B Only Bloque B solamente Bloc B seulement	B1 B2 ○○	
Block A and B Bloques A y B Blocs A et B	B1 B2 ○○	A1 A2 ○○

Note: Contacts Closed = X; Open = O

* *An intermediate contact state can exist while changing the switch position.*

Nota: Contactos Cerrados = X; Abiertos = O

* *Es posible que el contacto se encuentre en un estado intermedio al cambiar la posición del interruptor.*

Remarque : Contacts Fermés = X; Ouverts = O

* *C'est possible que un état de contact intermédiaire peut exister en changeant la position de l'interrupteur.*

CAM REPLACEMENT ❶ (wire channels on side) 1. Rotate the knob to the switch position shown in **X**, **Y**, and **Z** as required. 2. Snap the cam into position with the cam key inserted into keyway A1.

CAM REPLACEMENT ❷ (wire channels on top & bottom) Follow steps 1 & 2 above and snap the cam into keyway A2.

Note: The left-most knob position is position #1 for Type KS25.

REEMPLAZO DE LA LEVA ❶ (canales para conductores laterales) 1. Haga girar la perilla a la posición del interruptor mostrada en **X**, **Y** y **Z** según sea necesario. 2. Fije la leva en su posición con la llave insertada en la muesca posicionadora no. A1.

REEMPLAZO DE LA LEVA ❷ (canales para conductores en las partes superior e inferior) Siga los pasos descritos en 1 y 2, y fije la leva en la muesca posicionadora no. A2.

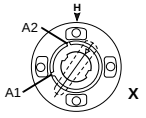
Nota: La posición de la perilla de la extrema izquierda es la posición no. 1 para el tipo KS25.

REMPLACEMENT DE LA CAME ❶ (caniveaux de fil sur le côté) 1. Tourner le bouton sur la position d'interrupteur indiquée sur **X**, **Y**, et **Z** selon les besoins. 2. Encliqueter la came en position, avec la clé de came insérée dans la cannelure n° A1.

REMPLACEMENT DE LA CAME ❷ (caniveaux de fil en haut et en bas) Suivre les étapes 1 et 2 ci-dessus et mettre en place la came avec un déclic dans la cannelure n° A2.

Remarque : La position du bouton qui est le plus à gauche est le n° 1 pour le type KS25.

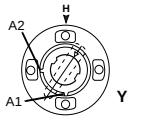
Cam Key
Llave de la leva
Clé de came



2 Position, spring return to right
2 or 4 Position, maintained

Retorno por resorte hacia la derecha, 2 posiciones
Sostenido, 2 o 4 posiciones

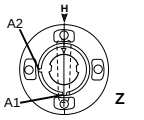
Rappel par ressort vers la droite, 2 positions
Maintenu, 2 ou 4 positions



2 Position, spring return to left

Retorno por resorte hacia la izquierda, 2 posiciones

Rappel par ressort vers la gauche, 2 positions



3 Position, maintained or spring return

Sostenido o retorno por resorte, 3 posiciones

Maintenu ou rappel par ressort, 3 positions

Electrical equipment should be serviced only by qualified electrical maintenance personnel. No responsibility is assumed by Square D for any consequences arising out of the use of this material.

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SQUARE D Telemecanique

Series CA7 Contactors

Rugged, space saving and modular… Sprecher + Schuh's newest contactor for applications up to 60HP

Over 95 years of design experience has produced Sprecher + Schuh's seventh generation contactor line. The CA7 represents the most modern and flexible IEC power contactor available today, meeting the highest industrial application requirements.

Big performance in a small package

A wide selection of ten contactors in four frame sizes covers the entire CA7 horsepower range (up to 60HP @ 460/575V). Six of the contactors are only 45mm wide, an extremely small footprint for such rugged performance. A number of design features account for this efficiency, including high contact pressure and "bounce-free" contacts, allowing the devices to handle the high starting currents typical of modern motors.

Type 1 and Type 2 Coordination

Whether you're designing motor circuits for use in North America, Europe or any other part of the world, all CA7 contactors have been designed and tested with respect to Type 1 and Type 2 short circuit coordination. Find out more in the CA7 Technical Information section in this chapter.

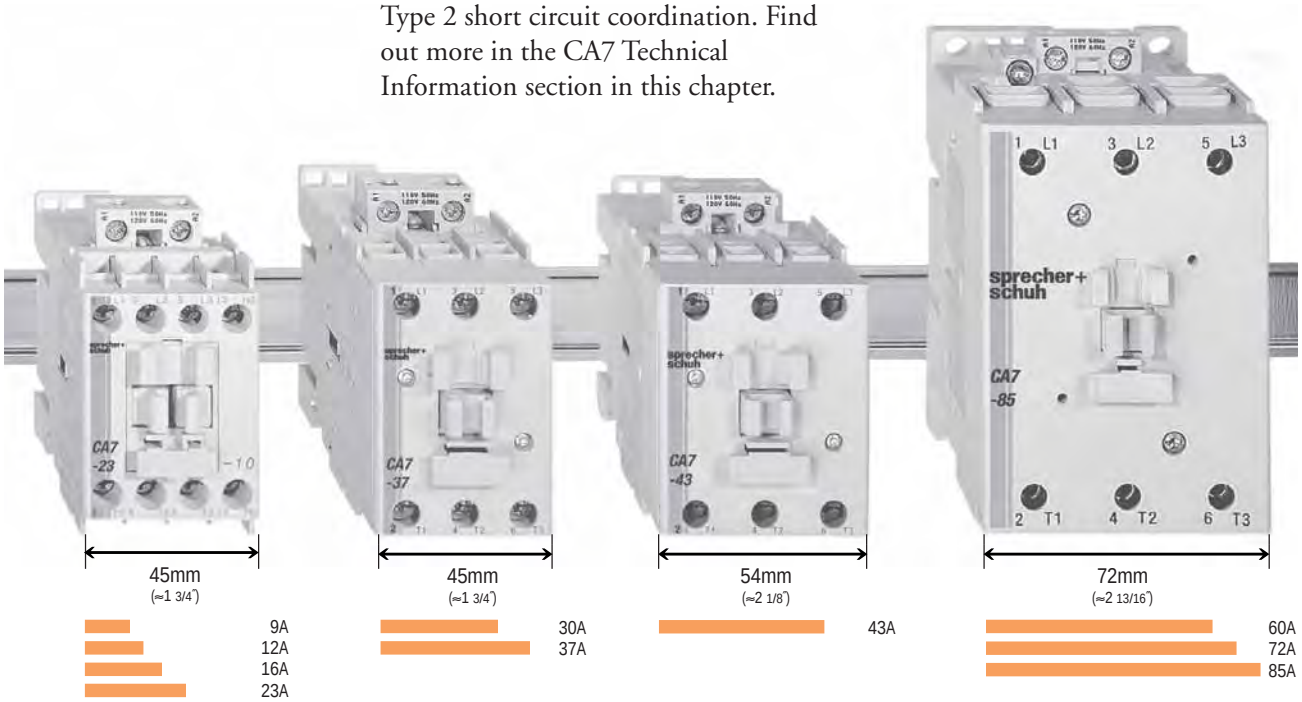
Advanced safety and reliability features

The entire CA7 line features mechanically linked contacts, such that if a main power pole welds, adequate clearances exist (≥0.3mm) to ensure that the auxiliary contacts do not change state when coil power is removed and the device tries to open. This is a requirement in safety circuits.

Reliability is further assured by "cross-stamped" auxiliary contacts, which provide multi-point reliability in low current, low voltage applications.

Two types of DC coils available

CA7-9C through 43C contactors are available with true DC coils that dramatically decrease wattage consumption during pull-in. This allows the use of smaller power supplies. The entire CA7 line is also available with a two winding DC coil that reduces the size of the contactor, as well as the hold-in values. Two winding coils include built-in coil suppression and an internal contact that bypasses the pull-in coil to the hold-in coil.



Modular accessories are common to all devices

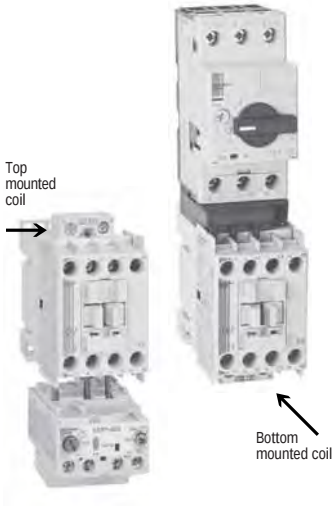
All accessories are interchangeable among all CA7 contactors and CS7 control relays. This minimizes inventory requirements and maximizes flexibility. Top and side mount auxiliary contacts are available depending on your application. A mechanical interlock with two built-in NC auxiliaries also provides electrical interlocking if desired. Pneumatic and electronic timers, surge suppressors and electronic interface modules provide solutions for even the most complex applications.

Reversible coil provides total flexibility

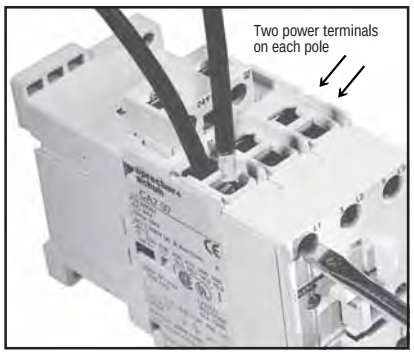
When shipped, both coil connections are normally located at the top of the contactor in preparation for mounting an overload relay at the bottom. For multi-starter panels, however, the coil can be reversed, which provides space to close-couple a KT7 Motor Circuit Controller on the top of the contactor. CA7 contactors can either be ordered with the coil reversed or may be easily reversed in the field.

Dual power terminals speed wiring

CA7-30 through 85 contactors are designed with two power terminals for all three poles. This simplifies power wiring of interconnected contactors in reversing, reduced voltage and two-speed applications. Preformed power wiring connectors are also available for virtually instantaneous wiring in these labor intensive applications. Simplified wiring means less labor and less cost.



Reversible coils are standard on all CA7 contactors



Dual power terminals assure hassle-free wiring in complex control schemes

Special use contactors for specialized applications

The CA7 line has been expanded to include a number of contactors designed and labeled for specific industrial applications. In all cases, these devices are UL and CSA approved for these specialized uses.

Lighting contactors

The CAL7 contactor can be used to control a wide variety of lighting loads. These contactors are well suited to handle the high inrush currents typical of this application as well as other non-motor (resistive) loads. Both mechanically held and electrically held models are available for applications up to 20A for lighting and 30A for resistive loads.

Sprecher + Schuh's expanded CA7 line includes contactors designed and labeled for specific industrial applications

Capacitor contactors

CAQ7 contactors overcome the complicated design issues inherant with capacitor switching by incorporating a built-in set of resistors and early-make contacts, wired in parallel with the power contacts, to pre-charge the capacitors. This manages the peak inrush common with capacitor switching. This circuitry is housed in a front mounted add-on deck that results in a compact design and ease of selection based on applied KVAR.

Special purpose contactors

CNX contactors are standard CA7 contactors that have been tested, approved and labeled by UL for heating ventilation and air conditioning (HVAC) applications.

Non-Reversing, Three Pole Contactors With AC Coil, Series CA7 (Open type only) ❶

I_e [A] ❶		Ratings for Switching AC Motors (AC2 / AC3 / AC4) kW (50 Hz)				UL/CSA HP (60 Hz) 1 Ø		3 Ø				Auxiliary Contacts per Contactor		Open Type Catalog Number	Price
AC-3	AC-1	230V	415V / 400V	500V	690V	115V	230V	200V	230V	460V	575V	NO	NC		
9	32	3	4	4	4	1/3	1	2	2	5	7-1/2	1	0	CA7-9-10-✱	72
												0	1	CA7-9-01-✱	
12	32	4	5.5	5.5	5.5	1/2	2	3	3	7-1/2	10	1	0	CA7-12-10-✱	94
												0	1	CA7-12-01-✱	
16	32	5.5	7.5	7.5	7.5	1	3	5	5	10	15	1	0	CA7-16-10-✱	105
												0	1	CA7-16-01-✱	
23	32	7.5	11	11	10	2	3	5	7-1/2	15	15	1	0	CA7-23-10-✱	116
												0	1	CA7-23-01-✱	
30	65	10	15	15	15	2	5	7-1/2	10	20	25	0	0	CA7-30-00-✱	133
												1	0	CA7-30-10-✱	145
												0	1	CA7-30-01-✱	145
37	65	11	18.5 / 20	20	18.5	3	5	10	10	25	30	0	0	CA7-37-00-✱	158
												1	0	CA7-37-10-✱	170
												0	1	CA7-37-01-✱	170
43	85	13	22	22	22	3	7-1/2	10	15	30	30	0	0	CA7-43-00-✱	170
												1	0	CA7-43-10-✱	182
												0	1	CA7-43-01-✱	182
60	100	18.5	30	30	30	5	10	15	20	40	50	0	0	CA7-60-00-✱	204
												1	0	CA7-60-10-✱	216
												0	1	CA7-60-01-✱	216
72	100	22	37	37	37	5	15	20	25	50	60	0	0	CA7-72-00-✱	238
												1	0	CA7-72-10-✱	249
												0	1	CA7-72-01-✱	249
85	100	25	45	45	45	7-1/2	15	25	30	60	60	0	0	CA7-85-00-✱	273
												1	0	CA7-85-10-✱	284
												0	1	CA7-85-01-✱	284

CA7-9-10-120 contactor

CA7-43-00-120 contactor

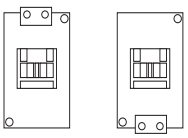
CA7-85-00-120 contactor

Coil Codes ❷

A.C. Coil Code	Voltage Range 50 Hz	60 Hz
24Z	24V	24V
120	110V	120V
208	~	208V
220W	~	208V-240V
240	220V	240V
277	240V	277V
380	380V-400V	440V
480	440V	480V
600	550V	600V

Coil Terminal Position

All CA7 contactors are stocked and delivered with the coil terminals located on the line side (top) of the contactor. This is the typical configuration when using the contactor with an overload relay. When the contactor is used with the KT7 Motor Circuit Controller, the coil must be reversed, so that the coil terminals are located at the load side (bottom) of the contactor. CA7 coils can easily be reversed in the field, however, they are also available for order with the coils reversed from the factory. Contact your Sprecher+Schuh representative for more information about ordering CA7 contactors with reversed coils.



All CA7 contactors come with reversible coils.

Ordering Instructions

- Specify Catalog Number
- Replace (✱) With Coil Code

See Coil Code table on this page for codes

❶ AC1 Resistive Ratings and UL/CSA Continuous Current Ratings may be increased by the use of Lug Kits or Paralleling Links. See CA7 Accessories section for applicable information.

❷ Other voltages available, see page A37. *Non-standard coil voltages not listed here must be ordered and installed separately as renewal parts.*

Non-Reversing, Four Pole Contactors With AC Coil, Series CA7 (Open type only)

I_e [A]		Ratings for Switching AC Motors (AC2 / AC3 / AC4)										Contact Configuration, Main Pole		Open Type	
		kW (50 Hz)				UL/CSA HP (60 Hz)									
						1 Ø		3 Ø							
AC-3	AC-1	230V	415V 400V	500V	690V	115V	230V	200V	230V	460V	575V	NO	NC	Catalog Number	Price
9	32	3	4	4	4	**1/3**	**1**	**2**	**2**	**5**	**7-1/2**	4	0	**CA7-9-M40-✱**	**72**
												3	1	**CA7-9-M31-✱**	**80**
												2	2	**CA7-9-M22-✱**	**80**
12	32	4	5.5	5.5	5.5	**1/2**	**2**	**3**	**3**	**7-1/2**	**10**	4	0	**CA7-12-M40-✱**	**94**
												3	1	**CA7-12-M31-✱**	**100**
												2	2	**CA7-12-M22-✱**	**100**
16	32	5.5	7.5	7.5	7.5	**1**	**3**	**5**	**5**	**10**	**15**	4	0	**CA7-16-M40-✱**	**105**
												3	1	**CA7-16-M31-✱**	**111**
												2	2	**CA7-16-M22-✱**	**111**
23	32	7.5	11	11	11	**2**	**3**	**5**	**7-1/2**	**15**	**15**	4	0	**CA7-23-M40-✱**	**116**
												3	1	**CA7-23-M31-✱**	**124**
												2	2	**CA7-23-M22-✱**	**124**

CA7-23-M22-120 contactor

Coil Codes ❶

A.C. Coil Code	Voltage Range	
	50 Hz	60 Hz
24Z	24V	24V
120	110V	120V
208	~	208V
220W	~	208V-240V
240	220V	240V
277	240V	277V
380	380V-400V	440V
480	440V	480V
600	550V	600V

Ordering Instructions

- Specify Catalog Number
- Replace (✱) With Coil Code

See Coil Code table on this page for codes

❶ Other voltages available, see page A37. *Non-standard coil voltages not listed here must be ordered and installed separately as renewal parts.*

Series CEP7 Solid State Overload Relays

Advanced solid state motor protection at electromechanical prices

For Contactor…	Use Overload Relay Family…					
	CEP7	*CT7*	*CT7K*	*CT4*	*CEF1*	*CET4*
CA7	✔	✔	✔			
CA6	✔				✔	✔
CA5						✔
CA4	✔			✔		

Described in this section

Sprecher + Schuh is at the leading edge of technology developing affordable solid state overload relays that utilize the latest Application Specific Integrated Circuits (ASICs) in their construction. This gives our new CEP7 overload relay many features that are simply not possible with traditional bimetallic or eutectic alloy electromechanical overload relays.

Increased accuracy and improved motor protection

Unlike traditional overload relays that simulate heat build-up in the motor by passing current through a heater element, CEP7 solid state overload relays measure motor current *directly* through integrated current transformers. The transformers, in turn, create a magnetic field that induces DC voltage onto the ASIC board. The electronics identify excessive current or

Microelectronics provide flexible and accurate motor overload protection

loss of phase more accurately, and react to the condition with greater speed and reliability, than traditional overload relays. In addition, CEP7 solid state relays offer setting accuracies from 2.5 – 5% and repeat accuracy of 1%.

Self-powered design means convenience

By developing the power it requires from the applied voltage, the CEP7 is "self-powered," eliminating the need for a separate control power source. This is not the case with traditional overloads and some other competitive electronic overload relays. Since the CEP7 is self-powered and a typical auxiliary contact is used to interface with the contactor, the user can apply the CEP7 the same way as an electromechanical overload. No special connections or control schematic diagram provisions are required in 3-phase applications.

Superior phase failure protection

The CEP7's on-board electronics are constantly monitoring all three phases. If the ASIC board senses that one phase is missing during a steady state running condition on a 100% loaded motor, it will trigger in 2 seconds; and from 2 – 3 seconds on a lightly loaded motor. If the single phase condition is present during starting, the CEP7 will trip within 8 seconds (for a motor >80% loaded). These times are much faster than any electromechanical overload relay. In addition, CEP7 overload relays detect a 50% phase imbalance in the same way as a phase loss.

32A

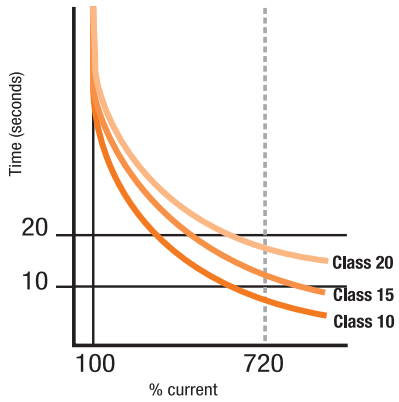
45A

85A

110A
180A

Choice of tripping classes…

Because of today's lighter T-frame motors, Class 10 overload relays (relays that trip within 10 seconds of a locked rotor condition) have become the industry standard. If your application requires a longer motor run-up time, Class 15 and 20 versions of the CEP7 are also available in all amp ranges.



CEP7 overload relays are available with Class 10, 15 or 20 tripping characteristics

Choice of reset options

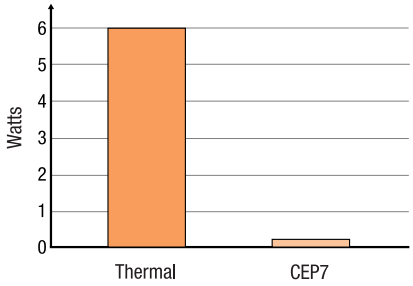
Most industrial applications usually call for an overload relay that must be manually reset in the event of a trip. This allows the cause of the overload to be identified before the motor is restarted. In specialized cases,

however, such as rooftop AC units or where restarting the motor will not harm people or equipment, automatic reset may be desired. CEP7 overload relays are available with either Manual Reset exclusively, or Manual and Automatic Reset models which can be toggled to the desired mode.

Dramatically reduced energy requirement saves money and reduces panel space

Because traditional overload relays work on the principle of "modeling" the heat generated in the motor (recreating the heat in the bimetal elements or heaters), a significant amount of energy is wasted. In traditional overload relays, as many as six watts of heat are dissipated to perform the protective function.

Because the CEP7 uses sampling techniques to actually measure the current flowing in the circuit, very little heat is dissipated in the device…as little as 150 milliwatts. This not only reduces the total amount of electrical energy consumed in an application, but it can also have a dramatic impact on the design and layout of control panels. The density of motor starters can be much greater because less heat is generated by each of the individual components. Higher density results in smaller control panels. In addition, special ventilation or air conditioning that might have been required to protect sensitive electronic equipment such as PLC's can now be reduced or eliminated.



Conventional overload relays dissipate as much as six watts of energy compared with as little as 150 milliwatts for the CEP7

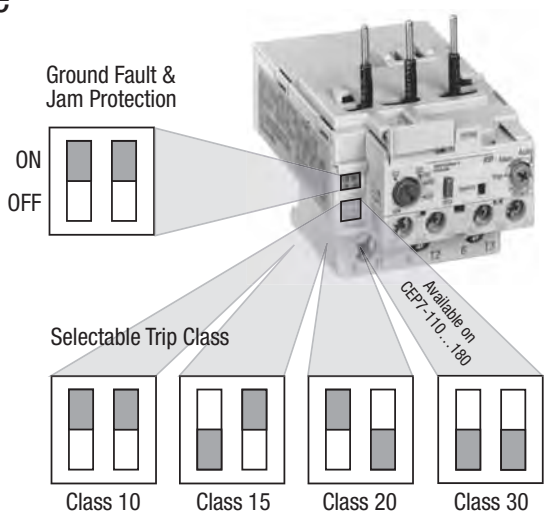
Wide current adjustment range

Bi-metallic overload relays typically have a small curent adjustment range of 1.5 to 1, meaning that the maximum setting is generally 1.5 times the lower setting. CEP7 relays, on the other hand, have an adjustment setting of 3.2 to 1. This reduces relay stocks over 50% and helps assure the correct relay is always on hand.

Ground fault and jam protection also available

NEW

Our new CEP7-B solid state overload relay is the ultimate motor protection relay in this price class. DIP-switches provide Trip Class selection of 10, 15, 20 or 30 seconds. This ability allows you to closely match the Trip Class with the run-up time of the motor. Ground Fault and Jam Protection are also included. Ground Fault protection trips at 50% of FLA setting, while Jam / Stall Protection trips at 400% of FLA (after inrush).



Directly Mounted CEP7 Solid State Overload Relays, Manual Reset ❶❷❺

Overload Relay	Directly Mounts to Contactor… ❷	Adustment Range (A)	Trip Class 10		Trip Class 20	
			Catalog Number	Price	Catalog Number	Price
Manual Reset for 3∅ Applications ❶						
 *CEP7-M32*	CA4-9…CA7-23 ❸	0.1…0.32	**CEP7-M32-0.32-10**	**51**	**CEP7-M32-0.32-20**	**51**
		0.32…1.0	**CEP7-M32-1.0-10**	**51**	**CEP7-M32-1.0-20**	**51**
		1.0…2.9	**CEP7-M32-2.9-10**	**51**	**CEP7-M32-2.9-20**	**51**
		1.6… 5.0	**CEP7-M32-5-10**	**51**	**CEP7-M32-5-20**	**51**
		3.7…12	**CEP7-M32-12-10**	**51**	**CEP7-M32-12-20**	**51**
		12…32	**CEP7-M32-32-10**	**55**	**CEP7-M32-32-20**	**55**
	CA7-30…37	3.7…12	**CEP7-M37-12-10**	**51**	**CEP7-M37-12-20**	**51**
		12…37	**CEP7-M37-37-10**	**76**	**CEP7-M37-37-20**	**76**
	CA7-43	14…45	**CEP7-M45-45-10**	**110**	**CEP7-M45-45-20**	**110**
	CA7-60...85	26…85	**CEP7-M85-85-10**	**125**	**CEP7-M85-85-20**	**125**
Manual Reset for 1∅ Applications ❶						
 *CEP7S-M32*	CA4-9…CA7-23 ❸	2.0…7.0	**CEP7S-M32-7-10**	**51**	**CEP7S-M32-7-20**	**51**
		5.0…15	**CEP7S-M32-15-10**	**51**	**CEP7S-M32-15-20**	**51**
		12…32	**CEP7S-M32-32-10**	**55**	**CEP7S-M32-32-20**	**55**
	CA7-30…37	5…15	**CEP7S-M37-15-10**	**51**	**CEP7S-M37-15-20**	**51**
		12…37	**CEP7S-M37-37-10**	**76**	**CEP7S-M37-37-20**	**76**
	CA7-43	14…45	**CEP7S-M45-45-10**	**110**	**CEP7S-M45-45-20**	**110**
	CA7-60...85	26…85	**CEP7S-M85-85-10**	**125**	**CEP7S-M85-85-20**	**125**

Directly Mounted CEP7 Solid State Overload Relays, Automatic/Manual Reset ❶❷❹❺

Overload Relay	Directly Mounts to Contactor… ❷	Adustment Range (A)	Trip Class 10		Trip Class 20	
			Catalog Number	Price	Catalog Number	Price
Automatic or Manual Reset for 3∅ Applications ❶❹						
 *CEP7-A45*	CA4-9…CA7-23 ❸	0.1…0.32	**CEP7-A32-0.32-10**	**54**	**CEP7-A32-0.32-20**	**54**
		0.32…1.0	**CEP7-A32-1.0-10**	**54**	**CEP7-A32-1.0-20**	**54**
		1.0…2.9	**CEP7-A32-2.9-10**	**54**	**CEP7-A32-2.9-20**	**54**
		1.6…5.0	**CEP7-A32-5-10**	**54**	**CEP7-A32-5-20**	**54**
		3.7…12	**CEP7-A32-12-10**	**54**	**CEP7-A32-12-20**	**54**
		12…32	**CEP7-A32-32-10**	**58**	**CEP7-A32-32-20**	**58**
	CA7-30…37	3.7…12	**CEP7-A37-12-10**	**54**	**CEP7-A37-12-20**	**54**
		12…37	**CEP7-A37-37-10**	**81**	**CEP7-A37-37-20**	**81**
	CA7-43	14…45	**CEP7-A45-45-10**	**115**	**CEP7-A45-45-20**	**115**
	CA7-60…85	14…45	**CEP7-A85-45-10**	**125**	**CEP7-A85-45-20**	**125**
		26…85	**CEP7-A85-85-10**	**130**	**CEP7-A85-85-20**	**130**
Automatic or Manual Reset for 1∅ Applications ❶❹						
 *CEP7S-A45*	CA4-9…CA7-23 ❸	2.0…7.0	**CEP7S-A32-7-10**	**54**	**CEP7S-A32-7-20**	**54**
		5.0…15	**CEP7S-A32-15-10**	**54**	**CEP7S-A32-15-20**	**54**
		12…32	**CEP7S-A32-32-10**	**54**	**CEP7S-A32-32-20**	**54**
	CA7-30…37	5…15	**CEP7S-A37-15-10**	**54**	**CEP7S-A37-15-20**	**54**
		12…37	**CEP7S-A37-37-10**	**81**	**CEP7S-A37-37-20**	**81**
	CA7-43	14…45	**CEP7S-A45-45-10**	**115**	**CEP7S-A45-45-20**	**115**
	CA7-60...85	26…85	**CEP7S-A85-85-10**	**130**	**CEP7S-A85-85-20**	**130**

TIP!

Most industrial applications usually call for an overload relay that must be manually reset in the event of a trip. This allows the cause of the overload to be identified before the motor is restarted. An overload relay that resets automatically is generally for specialized, or remote applications, such as rooftop AC units where restarting the motor will not harm people or equipment.

❶ 3-phase CEP7 units are only designed for 3∅ applications. Single phase CEP7S units are only designed for 1∅ applications.

❷ Contactors noted will physically attach to the overload relays listed. This reference is not intended to be a guide for selecting contactors. Size overload relays using the full load current of the motor.

❸ CEP7 overload relays are shipped with a CA4 wiring adaptor (labeled “A”) in the box which replaces the CA7 wiring adaptor (labeled “B”) that is installed on the overload as standard.

❹ The reset time of a CEP7 set in the automatic mode is approximately 180 seconds.

❺ CEP7 Overload relays do not work with Variable Frequency Drives or any PN Softstarter with braking options.

Separate Mount CEP7 Solid State Overload Relays, Manual Reset ❶❷❹

Overload Relay	Adustment Range (A)	Trip Class 10		Trip Class 20	
		Catalog Number	Price	Catalog Number	Price
Manual Reset for 3∅ Applications ❶					
 *CEP7-M37*	0.1…0.32	CEP7-M32-0.32-10-P-A	61	CEP7-M32-0.32-20-P-A	61
	0.32…1.0	CEP7-M32-1.0-10-P-A	61	CEP7-M32-1.0-20-P-A	61
	1.0…2.9	CEP7-M32-2.9-10-P-A	61	CEP7-M32-2.9-20-P-A	61
	1.6… 5.0	CEP7-M32-5-10-P-A	61	CEP7-M32-5-20-P-A	61
	3.7…12	CEP7-M32-12-10-P-A	61	CEP7-M32-12-20-P-A	61
	12…32	CEP7-M32-32-10-P-A	65	CEP7-M32-32-20-P-A	65
	3.7…12	CEP7-M37-12-10-P-A	61	CEP7-M37-12-20-P-A	61
	12…37	CEP7-M37-37-10-P-A	86	CEP7-M37-37-20-P-A	86
	14…45	CEP7-M45-45-10-P-A	126	CEP7-M45-45-20-P-A	126
	26…85	CEP7-M85-85-10-P-A	147	CEP7-M85-85-20-P-A	147
Manual Reset for 1∅ Applications ❶					
 *CEP7S-M85*	2.0…7.0	CEP7S-M32-7-10-P-A	61	CEP7S-M32-7-20-P-A	61
	5.0…15	CEP7S-M32-15-10-P-A	61	CEP7S-M32-15-20-P-A	61
	12…32	CEP7S-M32-32-10-P-A	65	CEP7S-M32-32-20-P-A	65
	12…37	CEP7S-M37-37-10-P-A	85	CEP7S-M37-37-20-P-A	85
	14…45	CEP7S-M45-45-10-P-A	126	CEP7S-M45-45-20-P-A	126
	26…85	CEP7S-M85-85-10-P-A	147	CEP7S-M85-85-20-P-A	147

Separate Mount CEP7 Solid State Overload Relays, Automatic/Manual Reset ❶❷❸❹

Overload Relay	Adustment Range (A)	Trip Class 10		Trip Class 20	
		Catalog Number	Price	Catalog Number	Price
Automatic or Manual Reset for 3∅ Applications ❶❸					
 *CEP7-A45*	0.1…0.32	CEP7-A32-0.32-10-P-A	64	CEP7-A32-0.32-20-P-A	64
	0.32…1.0	CEP7-A32-1.0-10-P-A	64	CEP7-A32-1.0-20-P-A	64
	1.0…2.9	CEP7-A32-2.9-10-P-A	64	CEP7-A32-2.9-20-P-A	64
	1.6…5.0	CEP7-A32-5-10-P-A	64	CEP7-A32-5-20-P-A	64
	3.7…12	CEP7-A32-12-10-P-A	64	CEP7-A32-12-20-P-A	64
	12…32	CEP7-A32-32-10-P-A	68	CEP7-A32-32-20-P-A	68
	3.7…12	CEP7-A37-12-10-P-A	64	CEP7-A37-12-20-P-A	64
	12…37	CEP7-A37-37-10-P-A	91	CEP7-A37-37-20-P-A	91
	14…45	CEP7-A45-45-10-P-A	105	CEP7-A45-45-20-P-A	105
	26…85	CEP7-A85-85-10-P-A	116	CEP7-A85-85-20-P-A	116
Automatic or Manual Reset for 1∅ Applications ❶❸					
 *CEP7S-A32*	2.0…7.0	CEP7S-A32-7-10-P-A	64	CEP7S-A32-7-20-P-A	64
	5.0…15	CEP7S-A32-15-10-P-A	64	CEP7S-A32-15-20-P-A	64
	12…32	CEP7S-A32-32-10-P-A	64	CEP7S-A32-32-20-P-A	64
	12…37	CEP7S-A37-37-10-P-A	91	CEP7S-A37-37-20-P-A	91
	14…45	CEP7S-A45-45-10-P-A	135	CEP7S-A45-45-20-P-A	135
	26…85	CEP7S-A85-85-10-P-A	152	CEP7S-A85-85-20-P-A	152

TIP!

Most industrial applications usually call for an overload relay that must be manually reset in the event of a trip. This allows the cause of the overload to be identified before the motor is restarted. An overload relay that resets automatically is generally for specialized, or remote applications, such as rooftop AC units where restarting the motor will not harm people or equipment.

❶ 3-phase CEP7 units are only designed for 3∅ applications. Single phase CEP7S units are only designed for 1∅ applications.

❷ This reference is not intended to be a guide for selecting contactors. Size overload relays using the full load current of the motor.

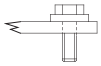
❸ The reset time of a CEP7 set in the automatic mode is approximately 180 seconds.

❹ CEP7 Overload relays do not work with Variable Frequency Drives or any PN Softstarter with braking options.

Large Amp CEP7 Solid State Overload Relays, Automatic and Manual Reset ❶❷❸❹

Overload Relay	Used with Contactor…	Adustment Range (A)	Trip Class 10		Trip Class 20	
			Catalog Number	Price	Catalog Number	Price
Manual Reset for 3∅ Applications ❶						
 *CEP7-M110*	CA6-95(-EI)…CA6-115(-EI)	66…110	**CEP7-M110-10**	**200**	**CEP7-M110-20**	**200**
	CA6-140(-EI)…CA6-180(-EI)	57…180	**CEP7-M180-10**	**260**	**CEP7-M180-20**	**260**
Automatic or Manual Reset for 3∅ Applications ❶❸						
 *CEP7-A110*	CA6-95(-EI)…CA6-110(-EI)	66…110	**CEP7-A110-10**	**207**	**CEP7-A110-20**	**207**
	CA6-140(-EI)…CA6-180(-EI)	57…180	**CEP7-A180-10**	**277**	**CEP7-A180-20**	**277**

Connection Hardware for Large Amp CEP7 Overload Relays

Lug or Accessory	Connection	Description	Catalog Number	Price
	• Hex head bolts 	**Flexible Conductors** (priced as complete set, containing 3 conductors and 6 washers)		
		For CEP7-M(A)110…	**CEP7-110-PCE1**	**45**
		For CEP7-M(A)180…	**CEP7-180-PCF1**	**63**
	• Single connections to each pole • Accepts round conductors only • #8…#1/0 AWG (for CEP7-110) • #6…250 MCM (for CEP7-180) 	**Screw Type Lugs ❺ -** (set of 3 - two sets required to wire line and load sides)		
		For CEP7-M(A/B)110…	**CEP7-110-LE1**	**25**
		For CEP7-M(A/B)180…	**CEP7-180-LF1**	**55**
		**Terminal Covers -** Provides touch protection to IP20. Includes both line and load side.		
		For CEP7-M(A, B)110…	**CEP7-110-HA**	**19**
		For CEP7-M(A, B)180…	**CEP7-180-HA**	**24**

❶ 3-phase CEP7 units are only designed for 3∅ applications.
❷ This reference is not intended to be a guide for selecting contactors. Size overload relays using the full load current of the motor.
❸ The reset time of a CEP7 set in the automatic mode is approximately 180 seconds.
❹ CEP7 Overload relays do not work with Variable Frequency Drives or any Sprecher + Schuh PN Softstarter with braking options.
❺ If connecting the CEP7 directly to a CA6 contactor with flexible conductors, order one set of lugs from this page for the CEP7 (load side) and one set of lugs from the CA6 section for the CA6 (line side). CA6-HB and HU lugs will not work with the CEP7.

Note on Coil Codes: All catalog numbers, list prices and enclosure dimensions in this section reflect contactors with AC coils. If necessary, add the appropriate price adder to the list price for each coil required. Remember that reversing applications require two coils (Price Adder x 2). For DC coils, select Coil Code from the second table. – CA7 contactor catalog numbers must be modified when using DC coils. Example: For CA7-9…CA7-43 contactors, add a "C" to catalog number. Ex: CA7-9… becomes CA7-9**C**… For CA7-60…85 contactors, add a "D" to catalog number. Ex: CA7-60… becomes CA7-60**D**…

A.C. Coil Codes & Voltage Ranges ❶❺

A.C. Coil ⇓ Codes ⇓ (Replace "✱" in cat.# with coil code)	CA7-9 thru CA7-85		CA6-95 CA6-110 CA6-140 CA6-180		CA6-95-EI ❸ CA6-110-EI ❸	CA6-140-EI ❸ CA6-180-EI ❸	CA6-210-EI ❸ CA6-250-EI ❸ CA6-300-EI ❸ CA6-420-EI ❸	❻ CA5-700 CA5-860	❻ CA5-1000 CA5-1200
	50 Hz	60 Hz	50 Hz	60 Hz	50 / 60 Hz	50 / 60 Hz	50 / 60 Hz	50 / 60 Hz	50 / 60 Hz
24			21V	24V	24-28V	24-28V	~	~	~
24Z	24V	24V	~	~	~	~	~	~	~
110	100V	100-110V	95V	110V	~	~	~		110V
120	110V	120V	105V	120V	110-130V	110-130V	110-130V	110-120V	~
208	~	208V	180V	208V	~	~	~	~	~
220	~	~	190V	220V	~	~	~	~	220V
220W ❷	~	208-240V	~	~	208-277V	208-277V	~	~	
240	220V	240V	210V	240V	~	~	~	220-240V	~
277	240V	277V	240V	277V	~	~	~	~	~
380	380-400V	440V	380-400V	440-460V	380-400V	380-400V	380-400V	380-415V	380V
440	~	~	~	~	~	~	~	~	440V
480	440V	480V	415V	480V	~	~	~	440-480V	~
575	~	~	500V	575V	~	~	~	~	~
600	550V	600V	~	~	~	~	~	~	~
XXX	~	~	~	~	~	~	~	Without coil	Without coil
Price Adder ❺	~		~		75	150	~	~	~

D.C. Coil Codes & Voltage Ranges ❶❺

D.C. Coil ⇓ Codes ⇓ (Replace "✱" in cat.# with coil code)	CA7-9C ❼ thru CA7-30C ❼	CA7-37C ❼ CA7-43C ❼	CA7-60D ❼ CA7-72D ❼ CA7-85D ❼	CA6-95 CA6-110	CA6-140	CA6-95-EI ❸ CA6-110-EI ❸	CA6-140-EI thru CA6-300-EI ❸	CA6-420-EI ❸	CA5-700 thru CA5-1200 ❻
	Voltage	Voltage	Voltage	Voltage	Voltage	Voltage	Voltage	Voltage	
12D	12VDC	12VDC	~	~	~	~	~	~	CA5-700 and 860 contactors are equipped with coils that operate with both AC and DC control voltages. For DC coil operation, select A.C. Coil Code from table above: **AC Coil Code 120** 100-110VDC **AC Coil Code 240** 200-220VDC **AC Coil Code 380** 345-380VDC **AC Coil Code 480** 400-440VDC Contact factory for information on DC coils for CA5-1000 and CA5-1200 contactors.
12DD ❹	~	~	12VDC	~	~	~	~	~	
24D	24VDC	24VDC	~	24VDC	24VDC	24-28VDC	24-28VDC	~	
24DD ❹	24VDC	24VDC	24VDC	~	~	~	~		
48D	48VDC	48VDC	~	48VDC	48VDC	48-72VDC	48-72VDC	48-72VDC	
48DD ❹	~	~	48VDC	~	~	~	~	~	
110D	110VDC	110VDC	~	110VDC	90-135VDC	90-135VDC	90-135VDC	110-135VDC	
110DD ❹	~	~	110VDC	~	~	~	~	~	
220D	220VDC	220VDC	~	220VDC	170-255VDC	170-255VDC	170-255VDC	190-255VDC	
220DD ❹	~	~	220VDC	~	~	~	~	~	
Price Adder ❺	35	60	75	100	200	175	350	775	~

❶ Other coil voltages available. Refer to Contactor Renewal Parts in Section A of this catalog, or contact nearest Sprecher+Schuh sales office.
❷ Wide range coil.
❸ Coils are field convertable to operate with PLC interface.
❹ "DD" coils include built-in diode surge suppressor.
❺ Add appropriate price adder(s) to list price of enclosed contactors and starters. Remember to add price for each coil required. Reversing applications require two coils (Price Adder x 2).
❻ CA5 coils utilize a special coil pair arrangement with a feeder group. For detailed coil information, please refer to CA5 contactors in Section A.
❼ Modify CA7 catalog numbers to include either a "C" or a "D" as shown at top of page.

Renewal Coils - D.C. ❶❷❼

DC Control Voltages	DC Coil ⇓ Codes ⇓ ❷	True DC Replacement Coils ❼ For use with contactor…			Two Winding DC Replacement Coils ❻ For use with contactor…			
		CA7-9C…16C	CA7-23C…37C	CA7-43C	CA7-9Y…16Y	CA7-23Y…37Y	CA7-43Y	CA7-60D…85D
		CA7-9D…16D	CA7-23D…37D	CA7-43D	~	~	~	❺
		CAQ7-16C	CAQ7-37C	~	~	~	~	~
		CAN7-12C	CAN7-30C…37C	~	~	~	~	CAN7-72D
		CNX-205…206	CNX-207…209	CNX-212	~	~	~	CNX-218
		Cat. No.	Cat. No.	Cat. No.	Cat. No.	Cat. No.	Cat. No.	Cat. No.
9V ❸	9D	**TA766**	**TC766**	**TD766**	~	~	~	~
9V Diode ❸	9DD	~	~	~	**TA766Y**	**TC766Y**	**TD766Y**	**TE766M**
12V	**12D**	**TA708**	**TC708**	**TD708**	~	~	~	~
12V Diode ❽	**12DD**	~	~	~	**TA708Y**	**TC708Y**	**TD708Y**	**TE708M**
24V ❹	**24D**	**TA714**	**TC714**	**TD714**	~	~	~	~
24V Diode ❹❽	**24DD**	**TA714M**	**TC714M**	**TD714M**	**TA714Y**	**TC714Y**	**TD714Y**	**TE714M**
36V	36D	**TA719**	**TC719**	**TD719**	~	~	~	~
36V Diode	36DD	~	~	~	**TA719Y**	**TC719Y**	**TD719Y**	**TE719M**
48V	**48D**	**TA724**	**TC724**	**TD724**	~	~	~	~
48V Diode	**48DD**	~	~	~	**TA724Y**	**TC724Y**	**TD724Y**	**TE724M**
60V	60D	**TA774**	**TC774**	**TD774**	~	~	~	~
60V Diode	60DD	~	~	~	**TA774Y**	**TC774Y**	**TD774Y**	**TE774M**
64V	64D	**TA727**	**TC727**	**TD727**	~	~	~	~
64V Diode	64DD	~	~	~	**TA727Y**	**TC727Y**	**TD727Y**	**TE727**
72V	72D	**TA728**	**TC728**	**TD728**	~	~	~	~
72V Diode	72DD	~	~	~	**TA728Y**	**TC728Y**	**TD728Y**	**TE728M**
80V	80D	**TA729**	**TC729**	**TD729**	~	~	~	~
80V Diode	80DD	~	~	~	**TA729Y**	**TC729Y**	**TD729Y**	**TE729M**
110V	**110D**	**TA733**	**TC733**	**TD733**	~	~	~	~
110V Diode	**110DD**	~	~	~	**TA733Y**	**TC733Y**	**TD733Y**	**TE733M**
115V	115D	**TA734**	**TC734**	**TD734**	~	~	~	~
115V Diode	115DD	~	~	~	**TA734Y**	**TC734Y**	**TD734Y**	**TE734M**
125V	125D	**TA737**	**TC737**	**TD737**	~	~	~	~
125V Diode	125DD	~	~	~	**TA737Y**	**TC737Y**	**TD737Y**	**TE737M**
220V	**220D**	**TA747**	**TC747**	**TD747**	~	~	~	~
220V Diode	**220DD**	~	~	~	**TA747Y**	**TC747Y**	**TD747Y**	**TE747M**
230V	230D	**TA749**	**TC749**	**TD749**	~	~	~	~
230V Suppres.	230DS	~	~	~	**TA749Y**	**TC749Y**	**TD749Y**	**TE749F**
250V	250D	**TA751**	**TC751**	**TD751**	~	~	~	~
250V Suppres.	250DS	~	~	~	**TA751Y**	**TC751Y**	**TD751Y**	**TE751F**
Price (coil without diode)		**55**	**75**	**95**	~	~	~	~
Price (coil with diode)		**80**	**100**	**120**	**80**	**100**	**120**	**140**

True DC coil (typical)

Two Winding DC coil (typical) ❺

Note: The "DD" coils listed above include an integrated bi-directional diode. Drop out time of this design is significantly improved when compared to an external diode. See ratings on page A47.

❶ Other coil voltages available. Contact your Sprecher + Schuh representative for information.
❷ DC Codes in large, bold letters indicate coils that are standard stocked items.
❸ Voltage operating range: 0.65…1.3 x U_s.
❹ Voltage operating range: 0.7…1.25 x U_s.
❺ CA7-60D…85D contactors have a two winding coil with built-in late break auxiliary contact and coil suppression.
❻ CA7-9Y…43Y two winding coils are sold for renewal parts only and are not interchangeable with standard CA7-9…43 AC coil contactors or CA7-9C…43C true DC coil contactors. CA7-9Y…43Y contactors should be tested following a coil swap to insure functionality of the timed auxiliary.
❼ AC and DC coils on CNX-xxx contactors are not interchangeable.
❽ "DD" coils with integrated surge suppression diode fit CA7-xxD contactors.

NEW

GROUP VI

240 x 480, 230 x 460, 220 x 440 PRIMARY VOLTS —120/115/110 SECONDARY VOLTS — 1Ø, 50/60 Hz

VA RATING	CATALOG NUMBER	APPROX. DIMENSIONS INCHES (CM.)					MOUNTING SLOT	APPROX. SHIPPING WT
		A	B	C	D	E	F	
50	AE06-0050	2.69 (6.8)	3.00 (7.6)	2.81 (7.1)	2.03 (5.1)	2.53 (6.4)	.20 x .40 (0.5 x 1.0)	2.5 (1.1)
75	AE06-0075	3.22 (8.1)	3.00 (7.6)	2.81 (7.1)	2.53 (6.4)	2.53 (6.4)	.20 x .40 (0.5 x 1.0)	3.5 (1.6)
100	AE06-0100	3.28 (8.3)	3.41 (8.6)	3.09 (7.8)	2.41 (6.1)	2.81 (7.1)	.20 x .40 (0.5 x 1.0)	4.0 (1.8)
150	AE06-0150	3.88 (9.8)	3.84 (9.7)	3.41 (8.6)	2.97 (7.5)	3.13 (7.5)	.20 x .40 (0.5 x 1.0)	6.5 (2.9)
250	AE06-0250	4.13 (10.4)	4.50 (11.4)	3.84 (9.7)	2.94 (7.4)	3.75 (9.5)	.20 x .40 (0.5 x 1.0)	9.2 (4.2)
350	AE06-0350	5.00 (12.7)	4.50 (11.4)	3.84 (9.7)	3.78 (9.6)	3.75 (9.5)	.20 x .40 (0.5 x 1.0)	12.7 (5.8)
500	AE06-0500	5.53 (14.0)	5.25 (13.3)	4.66 (11.8)	4.16 (10.5)	4.34 (11.0)	.31 x .69 (0.8 X 1.7)	19.0 (8.6)
750	AE06-0750	6.81 (17.3)	5.25 (13.3)	4.66 (11.8)	5.75 (14.6)	4.31 (10.9)	.31 x .69 (0.8 X 1.7)	26.0 (11.8)

NEW

GROUP VII

208/230/460 PRIMARY VOLTS — 115 SECONDARY VOLTS — 1Ø, 50/60 Hz

VA RATING	CATALOG NUMBER	APPROX. DIMENSIONS INCHES (CM.)					MOUNTING SLOT	APPROX. SHIPPING WT
		A	B	C	D	E	F	
50	AE07-0050	2.84 (7.2)	3.00 (7.6)	2.81 (7.1)	2.16 (5.4)	2.53 (6.4)	.20 x .40 (0.5 x 1.0)	2.6 (1.2)
100	AE07-0100	3.41 (6.6)	3.41 (8.6)	3.09 (7.8)	2.69 (6.8)	2.81 (7.1)	.20 x .40 (0.5 x 1.0)	4.2 (1.9)
150	AE07-0150	3.88 (9.8)	3.75 (9.5)	3.41 (8.6)	3.09 (7.8)	3.09 (7.8)	.20 x .40 (0.5 x 1.0)	6.7 (3.1)
250	AE07-0250	4.16 (10.5)	4.50 (11.4)	4.03 (10.2)	3.28 (8.3)	3.75 (9.5)	.20 x .40 (0.5 x 1.0)	9.5 (4.3)
350	AE07-0350	5.19 (13.1)	4.50 (11.4)	4.03 (10.2)	4.38 (11.1)	3.75 (9.5)	.20 x .40 (0.5 x 1.0)	13.4 (6.1)
500	AE07-0500	5.88 (14.9)	5.25 (13.3)	4.66 (11.8)	4.78 (12.1)	4.38 (11.1)	.31 x .69 (0.8 X 1.7)	19.0 (8.6)
750	AE07-0750	6.81 (17.3)	5.25 (13.3)	4.66 (11.8)	5.75 (14.6)	4.38 (11.1)	.31 x .69 (0.8 X 1.7)	27.0 (12.2)

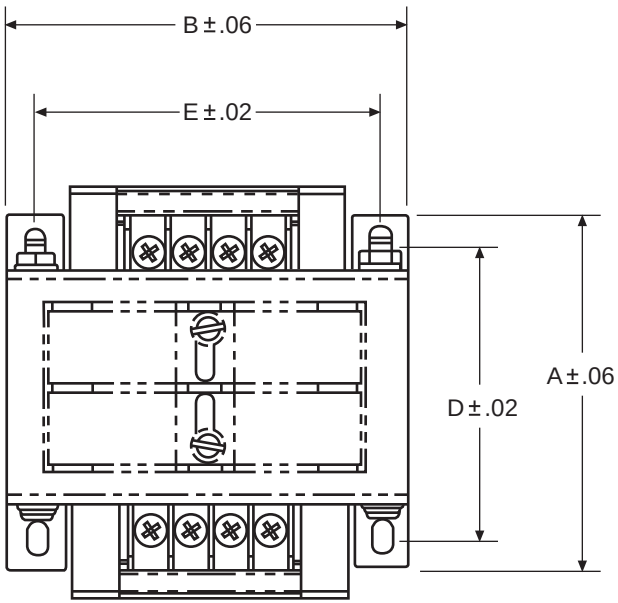
NEW

GROUP XII

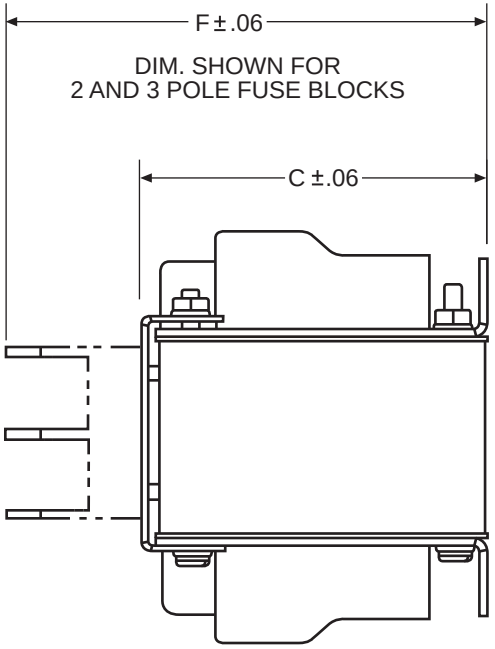
230/460/575 PRIMARY VOLTS — 95/115 SECONDARY VOLTS — 1Ø, 50/60 Hz

VA RATING	CATALOG NUMBER	APPROX. DIMENSIONS INCHES (CM.)					MOUNTING SLOT	APPROX. SHIPPING WT
		A	B	C	D	E	F	
50	AE12-0050	2.88 (7.3)	3.00 (7.6)	2.81 (7.1)	2.19 (5.5)	2.53 (6.4)	.20 x .40 (0.5 x 1.0)	2.6 (1.2)
100	AE12-0100	3.59 (9.1)	3.41 (8.6)	3.09 (7.8)	2.88 (7.3)	2.81 (7.1)	.20 x .40 (0.5 x 1.0)	4.2 (1.9)
150	AE12-0150	3.94 (10.0)	3.78 (9.6)	3.41 (8.6)	3.28 (8.3)	3.09 (7.8)	.20 x .40 (0.5 x 1.0)	6.8 (3.1)
250	AE12-0250	4.16 (10.5)	4.50 (11.4)	4.03 (10.2)	3.22 (8.1)	3.75 (9.5)	.20 x .40 (0.5 x 1.0)	9.5 (4.3)
350	AE12-0350	5.00 (12.7)	4.50 (11.4)	4.03 (10.2)	3.69 (9.3)	4.31 (10.9)	.20 x .40 (0.5 x 1.0)	13.2 (6.0)
500	AE12-0500	5.84 (14.8)	5.25 (13.3)	4.66 (11.8)	4.66 (11.8)	4.38 (11.1)	.31 x .69 (0.8 X 1.7)	19.2 (8.7)
750	AE12-0750	6.81 (17.3)	5.25 (13.3)	4.66 (11.8)	5.81 (14.7)	4.38 (11.1)	.31 x .69 (0.8 X 1.7)	27.0 (12.2)

TOP VIEW



SIDE VIEW



Acme Electric Corporation
Power Distribution Products Division

4815 West Fifth Street
Lumberton, NC 28358
910-738-1121 Inside NC
800-334-5214 Outside NC
910-739-0024 Fax
www.acmepowerdist.com

A-702463

Linear Open Frame DC Power Supplies
Silver Line Instruction Manual
Models: SLS-05-030-1T, SLS-12-017T, SLS-15-015T, SLS-24-012T

Features

- Easy installation with strip terminal
- Output adjustable from 12V to 15V
- Tight regulation: 0.05% Line; 0.05% Load
- Full Output Ratings to +50^{O}C
- Built in OVP on 5 Volt Outputs
- OVP Option for 12V, 15V and 24V
- Foldback Current Limiting Overload Protection with Automatic Recovery
- Multi-Tap AC Inputs
- 100% Four-Hour Burn-in
- Limited Warranty for one year
- UL Recognized
- cUL, UL Recognized for Canada
- TUV Certified

General Specifications

Voltage/Current Ratings	
Model Number	Output 1 (*Refer to Adjustment section)*
SLS-05-030-1T	5V/3.0A
SLS-12-017T	+12V/1.7A or +15V/1.5A
SLS-15-015T	+15V/1.5A or +12V/1.7A
SLS-24-012T	+24V/1.2A
Operating Temperature Range	0 to +50^{O}C (Derate to 40% at +70^{O}C)
Temperature Coefficient (Typical)	+/- 0.01% / ^{O}C
Stability	Within +/- 0.05% (For 24 hours after warm-up)
Vibration	Per MIL-STD-810C, Method 514
Shock	Per MIL-STD-810C, Method 516
EMI/RFI	Linear power supplies have inherently low conducted and radiated noise levels. For most system applications, these power supplies will meet the requirements of FCC Class “B” and VDE 0871 for Class “B” equipment without additional noise filtering.
Cooling	Convection
Input Specifications	
Multi Input (all units)	100/120/220/230/240 VAC selectable +/- 10% except 230 VAC is +15%, -6%
Frequency Range	47-63 Hz (Typical is 60 Hz. Derate output 10% at 50 Hz)
Transient Response Time	50 usec at 50% load changes for outputs rated up to 6A 100 usec at 50% load changes for outputs rated 6A and over.
Fuse Requirements	Units are *not* fused internally. For safe operation, user must provide input line fuse as per values given in table.
Output Specifications	
Line Regulation	0.05% for +/- 10% change
Load Regulation	0.05% for 50% change
Ripple	3.0 mV maximum peak-to-peak
DC Output Adjustment Range	+/- 5% minimum
Overvoltage Protection	All 5 volt outputs include built-in OVP as standard (setting is 6.2V +/- 0.4V). OVP is optionally available on outputs
Remote Sensing	All units listed have remote sensing capability.
Overload Protection	125 to 150% foldback current limit

Connection Chart

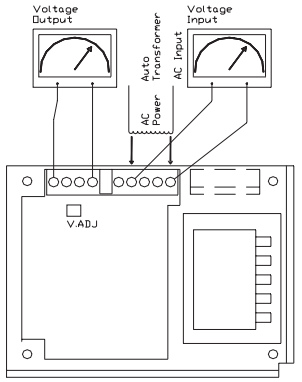


Figure 1

Output Adjustment

Step 1: Check the input AC connections

Step 2: AC Adjust the AC input according to the connections.

Step 3: Adjust +V. Adj. to +15V or +12V

Step 4: Adjust -V. Adj. to -15V or -12V

Input AC Connections (See Figure 2)

For use at	Connect	Apply AC to:	Primary Fuse	Primary Fuse
			SLS-05-030-1T	SLS-12-017T SLS-15-015T SLS-24-012T
100 VAC	1-3, 2-4	1 & 5	0.5A / 125V	1.0A / 125V
120 VAC	1-3, 2-4	1 & 4	0.5A / 125V	1.0A / 125V
220 VAC	2-3	1 & 5	0.25A / 250V	0.5A / 250V
230 VAC	2-3	1 & 4	0.25A / 250V	0.5A / 250V
240 VAC	2-3	1 & 4	0.25A / 250V	0.5A / 250V

Mechanical Dimensions: mm (inches)

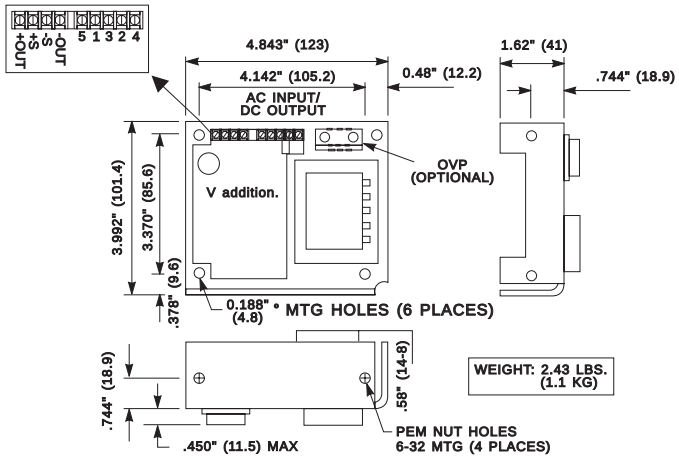


Figure 2: Case A

Contact Technical Services at tech@sola-hevi-duty.com with any questions.
Visit our website at www.solaheviduty.com

B-Mount "Narrow" Brakes

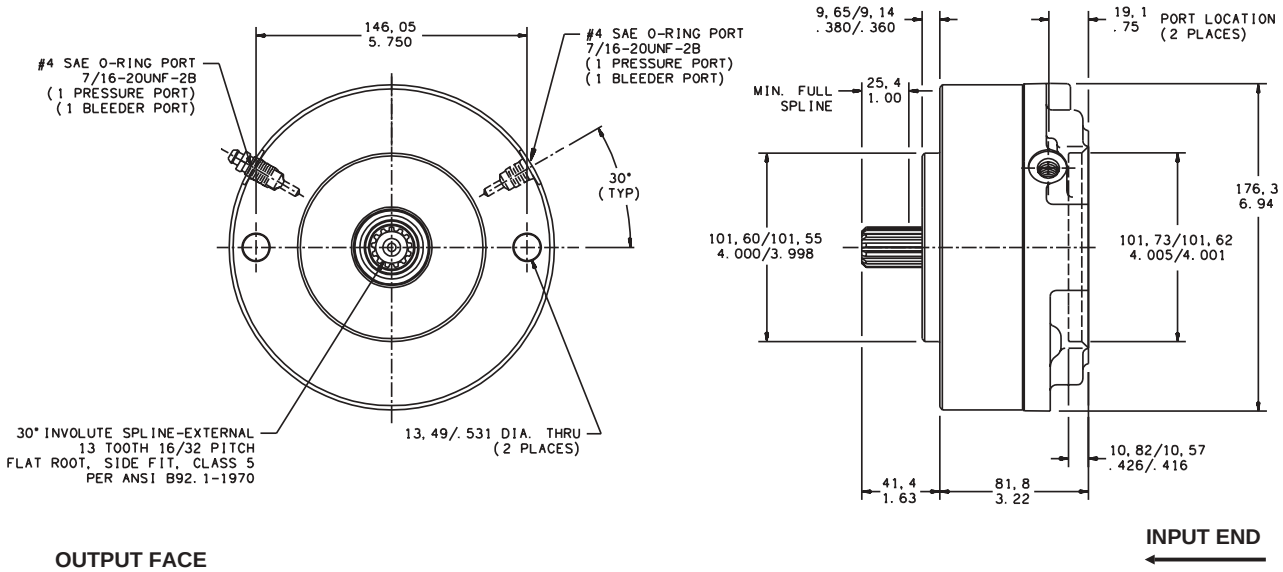
FEATURES

- Complete self-contained dry design package
- Standard SAE mounting flanges
- High strength ductile iron castings for strength and durability
- Sintered bronze friction plates for high strength and long lining life
- Sealed environment - isolation from contaminants
- Optional pressure override models available for limited service braking

TYPICAL MODEL SHOWN For detailed information on other models, contact MICO West

02-556-326
(LMB-131321-B)

millimeters
inches



SPECIFICATIONS

Torque range at 0 bar (0 psi)
back pressure . . . . . 113 - 542 N-m (1000 - 4800 lb-in)
Release pressure range . . . . . 8.3 - 23.8 bar (120 - 345 psi)
Maximum operating pressure . . . . . 207 bar (3000 psi)
Maximum speed . . . . . 4000 rpm
Volume of oil
to release brake . . . . . 8.2 cm³ (0.5 in³) (new linings)
14.8 cm³ (0.9 in³) (maximum)

Maximum energy input . . . . . 339,000 joule (250,000 ft-lb)
(one stop, no damage)
Fluid type . . . . . Mineral base hydraulic oil
Maximum operating temperature . . . . . 132 °C (270 °F)
Approximate weight . . . . . 10.9 kg (24 lb)

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ORDER INFORMATION (See NOTE on the top of page 5)

NOTE: On oil cooled models (Z option) actual torque is 67% of value shown on torque code chart. Recommended sump oil fluid volume when mounted: Horizontal - 88.7 mL (3 oz), Vertical - Contact MICO West

L M B - [ ][ ][ ][ ] [ ][ ] - [ ][ ] [ ]

SERIES
LM - MICO

OUTPUT FACE
B - SAE B-Mount 2-Bolt

OUTPUT SPLINE / INPUT SPLINE

	SAE Designation
06/06	06 = 25.4 mm (1.00") Dia. 6B
13/06	12 = 12T 12/24 used with L2 input face only
13/12	13 = 13T 16/32
13/13	15 = 15T 16/32
15/12	
15/15	

Other configurations consult MICO West.

OPTIONS
(Available separately or in combination)

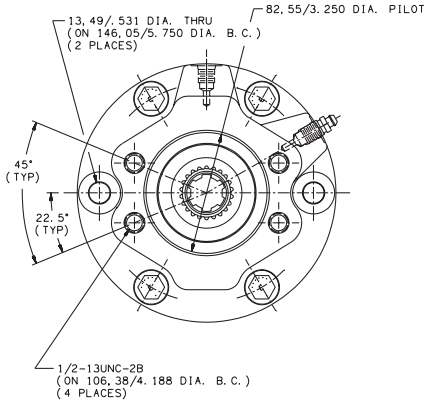
S - Speed Sensor
Z - Oil Cooled - see note above

INPUT FACE
M - Modified SAE A-Mount 2 or 4-Bolt
B - SAE B-Mount 2-Bolt
L2 - Eaton Bearingless 2000
N - NEMA

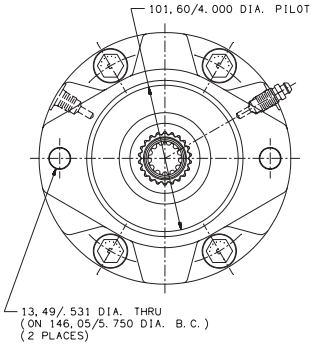
TORQUE

Code	Torque Rating		Initial Release Pressure		Full Release Pressure	
	N-m	(lb-in)	bar	(psi)	bar	(psi)
48	542	(4800)	17.9	(260)	21.4	(310)
40	452	(4000)	15.2	(220)	17.9	(260)
35	396	(3500)	20.0	(290)	23.8	(345)
30	339	(3000)	16.5	(240)	20.0	(290)
28	316	(2800)	15.9	(230)	19.3	(280)
24	271	(2400)	12.4	(180)	15.2	(220)
21	237	(2100)	12.4	(180)	14.5	(210)
19	215	(19000	11.7	(170)	13.8	(200)
17	192	(1700)	9.7	(140)	11.7	(170)
14	158	(1400)	8.3	(120)	10.0	(145)
12	136	(1200)	13.8	(200)	16.2	(235)
10	113	(1000)	11.7	(170)	13.8	(200)

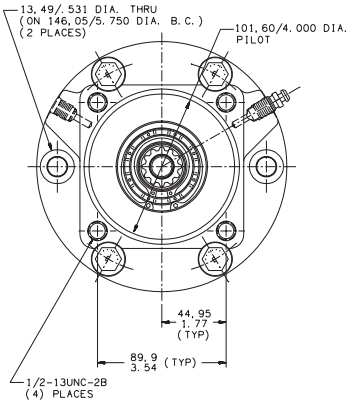
INPUT FACES



M - Modified SAE A-Mount 2 or 4-Bolt



B - SAE B-Mount 2-Bolt

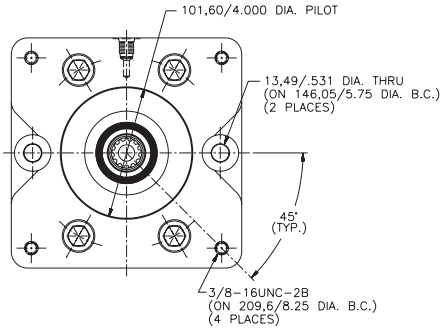


L2 - Eaton Bearingless 2000

ASSIGNED NUMBERS

CATALOG CODE NUMBER	PRODUCTION ORDER NUMBER
LMB-130621-M	02-556-328
LMB-130628-M	02-556-378
LMB-130635-M	02-556-336
LMB-130640-M	02-556-358
LMB-131219-L2	02-556-348
LMB-131228-L2	02-556-350
LMB-131240-L2	02-556-352
LMB-131310-B	02-556-322
LMB-131312-B	02-556-330
LMB-131314-B	02-556-318
LMB-131317-B	02-556-332
LMB-131321-B	02-556-326

CATALOG CODE NUMBER	PRODUCTION ORDER NUMBER
LMB-131324-B	02-556-360
LMB-131328-B	02-556-324
LMB-131330-B	02-556-320
LMB-131335-B	02-556-334
LMB-131340-B	02-556-376
LMB-151240-L2	02-556-428
LMB-151528-B	02-556-404
LMB-151535-B	02-556-340
LMB-151540-B	02-556-392



NEMA Mount

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Multiple Disc Brakes (gold series)

Features

- Non-metallic lining material
- Extremely compact design
- Low release pressures
- Full system pressure capacity
- Low actuation volume

Integrated return plate/separators help prevent piston cocking.

Benefits

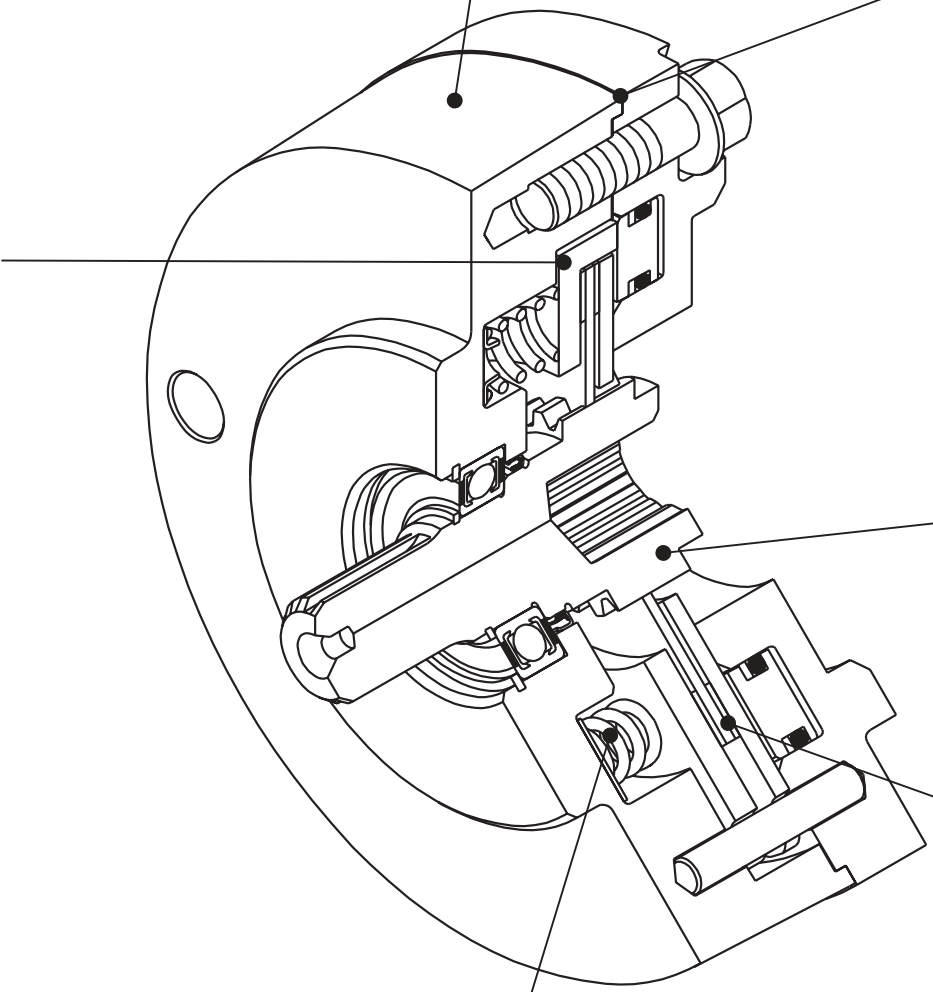
- Design allows for pressure spikes of up to 4000 psi without affecting cycle life
- One repair kit for all serviceable parts
- Non-metallic lining material contributes

Operation

Braking is provided by stationary friction plates and a rotating disc splined to the shaft. Force is transmitted to the disc pack through the return plate by a series of preloaded springs. The brake is released by hydraulic pressure applied to the piston to compress the springs. The brake is self-applying since any function which reduces the hydraulic system pressure of the brake will start to initiate a brake application. Zero pressure produces maximum brake torque.

High quality ductile iron casting material for strength and durability.

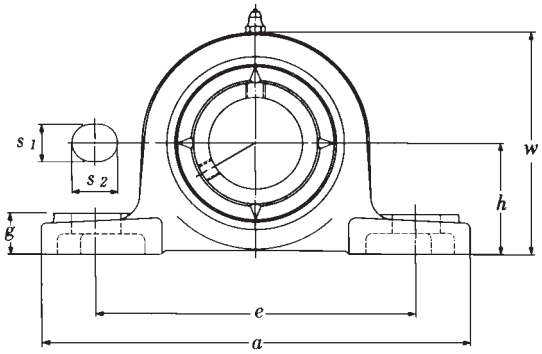
Gasket design and high strength bolts provide high pressure capability and long life.

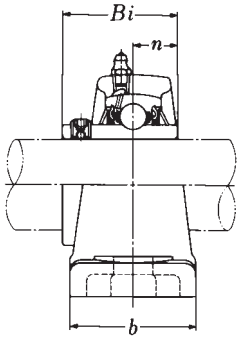


8620 alloy steel shafts are heat treated for strength and shock resistance.

High performance non-metallic lining materials contribute to high torque, low release pressure.

Chrome silicon die springs for long life and higher torque.





Units: Millimeters
INCHES

NTN
SERIES UCP2 SET SCREW TYPE

PILLOW BLOCKS - CAST HOUSING

Shaft Dia.	Complete Pillow Block Number	Nominal Dimensions										Bolt Size	Housing Number	Bearing Number	Basic Load Ratings (lbs)	
		h	*a*	*e*	*b*	s_1	s_2	*g*	*w*	*Bi*	*n*				*Dynamic C*	*Static* C_o
65 **2 ½**	UCP213D1 **UCP213-208T**	76.2 **3**	265 **10 7/16**	203 **8**	70 **2 ¾**	25 **31/32**	28 **1 3/32**	27 **1 1/16**	151 **5 15/16**	65.1 **2.563**	25.4 **1.000**	M20 **¾**	P213D1 **P213T**	UC213D1 **UC213-208D1**	**12,900**	**9,000**
70 **2 11/16** **2 ¾**	UCP214D1 **UCP214-211T** **UCP214-212T**	79.4 **3 1/8**	266 **10 15/32**	210 **8 9/32**	72 **2 27/32**	25 **31/32**	28 **1 3/32**	27 **1 1/16**	157 **6 3/16**	74.6 **2.937**	30.2 **1.189**	M20 **¾**	P214D1 **P214T** **P214T**	UC214D1 **UC214-211D1** **UC214-211D1**	**14,000**	**9,900**
75 **2 15/16** **3**	UCP215D1 **UCP215-215T** **UCP215-300T**	82.6 **3 ¼**	275 **10 13/16**	217 **8 17/32**	74 **2 29/32**	25 **31/32**	28 **1 3/32**	28 **1 3/32**	163 **6 13/32**	77.8 **3.063**	33.3 **1.311**	M20 **¾**	P215D1 **P215T** **P215T**	UC215D1 **UC215-215D1** **UC215-300D1**	**14,900**	**11,100**
80 **3 1/8**	UCP216D1 **UCP216-302T**	88.9 **3 ½**	292 **11 ½**	232 **9 1/8**	78 **3 1/16**	25 **31/32**	28 **1 3/32**	30 **1 3/16**	175 **6 7/8**	82.6 **3.252**	33.3 **1.311**	M20 **¾**	P216D1 **P216T**	UC216D1 **UC216-302D1**	**16,300**	**11,900**
85 **3 ¼**	UCP217D1 **UCP217-304T**	95.2 **3 ¾**	310 **12 7/32**	247 **9 23/32**	83 **3 9/32**	25 **31/32**	28 **1 3/32**	32 **1 ¼**	187 **7 3/8**	85.7 **3.374**	34.1 **1.343**	M20 **¾**	P217D1 **P217T**	UC217D1 **UC217-304D1**	**18,700**	**14,400**
90 **3 ½**	UCP218D1 **UCP218-308T**	101.6 **4**	327 **12 7/8**	262 **10 5/16**	88 **3 15/32**	27 **1 1/16**	30 **1 3/16**	33 **1 5/16**	200 **7 7/8**	96 **3.780**	39.7 **1.563**	M22 **7/8**	P218D1 **P218T**	UC218D1 **UC218-308D1**	**21,600**	**16,100**

***** Unit with notched set screw as standard.

STANDARD MOTORS

When the Ultimate in Efficiency and Reliability is a Must

This high performance motor contains a power element that is pressure loaded against internal leakage for high volumetric efficiency. It is wear compensated, so that its volumetric efficiency will not degrade with use. It can provide up to 7247 lb in of torque through a one-piece solid fixed axis shaft. This shaft design allows for full stationary spline contact between shaft and rotor, minimizing spline contact stresses. It also allows the shaft to be extended through the rear cover for mounting parking brakes, auxiliary drive functions or encoders for speed readout or closed loop control. Low internal pressure drop means high mechanical efficiency and higher flow capability. This rugged motor is the most compact on the market.

Options

- All Common 7/8 inch, 1 inch, 1 1/4 inch, 25 mm and 32 mm Shafts
- SAE O-Ring, NPTF, Manifold, BSPP and ISO6149-1 m22 x 1.5 Porting
- SAE A and SAE B Mounting
- 4 Bolt Mounting
- Cross-Over Relief Valve Package

- Low Speed Valve***
- Thru-Shaft*** for Parking Brake, Encoder Mount, Auxiliary Drive
- Stainless Steel Shaft ***

*** See Installation / Operation Information Section for Rating Limitations

Features

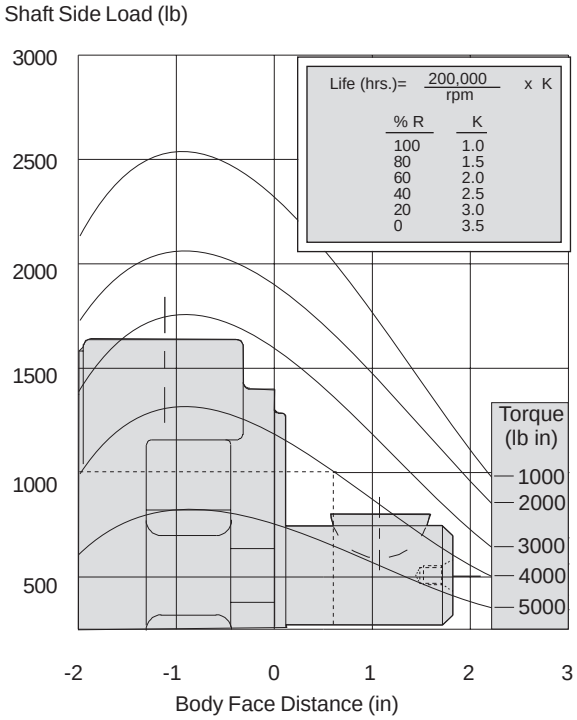
- **Self Sealing Power Element** — For High Volumetric Efficiency
- **Wear Compensated Power Element** — Means Performance Will Not Degrade With Use
- **One-Piece, Fixed Axis Shaft** — For Severe Applications
- **Most Compact Motor on the Market**
- **Long Life**
- **Shaft Speed Disc Valve** — For High Overall Efficiency
- **Low Internal Pressure Drop**
- **External Case Drain Possible**
- **High Starting Torque**

Specifications

Code		036	054	071	088	106	129	164	189	241
Displacement	cc/rev	59	89	116	144	174	211	269	310	395
	(cu in/rev)	(3.6)	(5.4)	(7.1)	(8.8)	(10.6)	(12.9)	(16.4)	(18.9)	(24.1)
Max Speed (rpm) @ Max Continuous Flow		770	684	651	525	436	358	282	263	184
Pressure Differential (psi) Max Continuous		3000	3000	3000	3000	2750	2750	2500	2250	2250
Pressure Differential (psi) Max Intermittent		3500	3500	3500	3500	3500	3500	3250	2500	2250
MaxTorque (lb in) @ Max Continuous Pressure		1375	2129	2915	3593	4251	4729	5462	6131	7077
MaxTorque (lb in) @ Max Intermittent Pressure		1664	2543	3401	4192	5019	6108	7247	6468	7163
Maximum transient (less than 1% per minute) pressure is not to exceed 4000 psi.										

STANDARD MOTORS

Maximum Side Load Capacity



Example:
Distance = .5 inches
Torque = 4000 lb. in.
Actual Side Load = 600 lbs @ 100 RPM
From the chart above: Max. Side Load = 1000 lb
Therefore, % S = $\frac{600}{1000}$ = 60%
From the table: K=2.0
Calculation:
Life = $\frac{200{,}000 \times 2.0}{100}$ = 4000 hours

Performance Data

Continuous / Intermittent* Operation

	With No Side Load	With Rated Side Load
▭	Continuous	Continuous
▭	Continuous	Intermittent*
▭	Intermittent*	

**Intermittent operation is defined as less than 10% each minute.*

Performance data based on testing using hydraulic fluid with a viscosity of 180 SUS at 120° F.

Performance data is typical. Actual data may vary slightly from one production motor to another.

3.6 cu in / rev

PRESSURE (PSI)

	500	1000	1500	2000	2500	3000	3500
2	244 **128**	473 **124**	688 **119**	882 **105**	1031 **82**		
4	238 **257**	471 **251**	700 **245**	905 **226**	1067 **193**	1203 **139**	1293 **87**
6	232 **385**	470 **381**	713 **377**	928 **362**	1103 **331**	1255 **289**	1344 **250**
8	226 **513**	461 **508**	700 **503**	922 **490**	1117 **454**	1289 **403**	1404 **359**
10	221 **642**	453 **635**	688 **629**	917 **622**	1132 **584**	1324 **526**	1464 **481**
12	216 **770**	443 **762**	675 **755**	897 **747**	1117 **708**	1349 **651**	1564 **601**
14	212 **898**	433 **889**	662 **880**	877 **871**	1103 **835**	1375 **782**	1664 **728**

FLOW (GPM)

TORQUE (LB IN) 1664
SPEED (RPM) **728**

5.4 cu in / rev

PRESSURE (PSI)

	500	1000	1500	2000	2500	3000	3500
2	365 **86**	716 **83**	1051 **80**	1368 **72**	1635 **58**		
4	365 **171**	713 **167**	1076 **164**	1407 **153**	1700 **134**	1957 **101**	2134 **60**
6	361 **257**	722 **253**	1100 **250**	1445 **244**	1765 **226**	2055 **198**	2278 **171**
8	352 **342**	713 **338**	1057 **334**	1419 **329**	1731 **309**	2020 **278**	2237 **247**
10	340 **428**	713 **424**	1057 **419**	1392 **415**	1697 **396**	1985 **366**	2196 **332**
12	331 **513**	679 **508**	1038 **503**	1382 **498**	1697 **480**	2011 **450**	2316 **408**
14	318 **599**	653 **593**	1019 **587**	1372 **581**	1732 **566**	2129 **536**	2543 **488**
16	309 **684**	636 **678**	987 **671**	1335 **664**	1700 **645**	2091 **618**	2491 **566**
18	281 **770**	600 **762**	955 **755**	1298 **747**	1668 **724**	2052 **701**	2438 **647**
20	264 **856**	567 **849**	880 **843**	1220 **830**	1581 **804**	1947 **785**	2235 **729**
22	247 **942**	541 **936**	824 **931**	1390 **913**	1593 **885**	2026 **871**	2423 **813**

FLOW (GPM)

7.1 cu in / rev

PRESSURE (PSI)

FLOW (GPM)	500	1000	1500	2000	2500	3000	3500
2	480 **65**	949 **63**	1407 **62**	1853 **56**	2260 **47**		
4	480 **130**	994 **128**	1492 **125**	1989 **118**	2430 **105**	2848 **83**	3243 **47**
6	458 **195**	972 **192**	1483 **189**	1966 **187**	2458 **176**	2915 **154**	3322 **133**
8	446 **260**	961 **258**	1475 **255**	1966 **251**	2458 **239**	2915 **219**	3362 **193**
10	424 **325**	927 **322**	1449 **319**	1944 **316**	2444 **306**	2915 **290**	3382 **260**
12	412 **390**	904 **387**	1407 **383**	1921 **379**	2444 **371**	2898 **353**	3391 **316**
14	396 **455**	859 **451**	1373 **447**	1876 **442**	2373 **437**	2882 **419**	3401 **374**
16	379 **521**	825 **515**	1339 **510**	1853 **505**	2345 **497**	2848 **482**	3342 **429**
18	362 **586**	791 **580**	1288 **574**	1785 **568**	2317 **556**	2814 **545**	3283 **486**
20	339 **651**	757 **644**	1237 **638**	1763 **631**	2288 **618**	2780 **608**	3243 **543**
22	305 **716**	701 **709**	1187 **701**	1740 **694**	2232 **680**	2746 **673**	3243 **601**

TORQUE (LB IN) 701
SPEED (RPM) 709

8.8 cu in / rev

PRESSURE (PSI)

FLOW (GPM)	500	1000	1500	2000	2500	3000	3500
2	605 **52**	1210 **51**	1774 **50**	2324 **48**	2869 **41**		
4	590 **105**	1207 **103**	1804 **102**	2387 **99**	2975 **88**	3475 **73**	3929 **63**
6	574 **158**	1204 **156**	1833 **154**	2451 **152**	3080 **142**	3593 **126**	4141 **107**
8	553 **210**	1183 **208**	1817 **206**	2437 **203**	3067 **192**	3634 **178**	4154 **159**
10	532 **263**	1162 **261**	1801 **259**	2423 **253**	3054 **243**	3675 **235**	4167 **219**
12	509 **315**	1127 **312**	1762 **309**	2381 **303**	3006 **295**	3623 **284**	4179 **264**
14	487 **367**	1092 **363**	1722 **358**	2339 **353**	2958 **347**	3571 **335**	4192 **310**
16	468 **420**	1044 **415**	1659 **411**	2269 **403**	2914 **396**	3529 **384**	4143 **362**
18	448 **472**	997 **468**	1595 **463**	2199 **454**	2870 **444**	3487 **435**	4094 **416**
20	428 **525**	973 **520**	1551 **516**	2178 **507**	2832 **499**	3446 **486**	4051 **458**
22	408 **578**	949 **573**	1506 **569**	2158 **562**	2794 **555**	3405 **537**	4008 **499**
25	348 **656**	846 **651**	1423 **647**	2008 **636**	2610 **625**	3191 **608**	3809 **575**
30	279 **787**	740 **782**	1313 **776**	1821 **760**	2381 **744**	2921 **725**	3555 **697**

10.6 cu in / rev

PRESSURE (PSI)

FLOW (GPM)	500	1000	1500	1750	2000	2250	2500	2750	3000	3250	3500
2	742 **44**	1501 **43**	2227 **42**	2569 **41**	2919 **40**	3264 **39**	3585 **37**	3897 **34**	4201 **31**	4537 **27**	4871 **23**
4	721 **87**	1485 **86**	2214 **85**	2576 **83**	2935 **82**	3302 **79**	3669 **76**	3990 **71**	4251 **66**	4599 **61**	4945 **57**
6	700 **131**	1468 **129**	2202 **128**	2583 **127**	2969 **126**	3359 **122**	3754 **118**	4036 **112**	4302 **106**	4660 **104**	5019 **102**
8	675 **174**	1442 **173**	2189 **171**	2569 **169**	2952 **166**	3340 **162**	3733 **158**	4071 **153**	4403 **149**	4715 **146**	5019 **144**
10	650 **218**	1417 **216**	2176 **214**	2554 **210**	2935 **207**	3321 **203**	3711 **198**	4106 **197**	4504 **196**	4770 **193**	5019 **190**
12	616 **262**	1383 **258**	2138 **255**	2509 **252**	2885 **248**	3264 **245**	3648 **241**	4025 **238**	4403 **235**	4715 **232**	5019 **229**
14	582 **305**	1350 **301**	2100 **296**	2465 **293**	2834 **290**	3207 **287**	3585 **284**	3943 **279**	4302 **275**	4660 **272**	5019 **268**
16	567 **349**	1278 **344**	2050 **340**	2410 **336**	2775 **331**	3155 **328**	3543 **324**	3903 **320**	4264 **316**	4626 **311**	4989 **307**
18	553 **392**	1206 **388**	1999 **384**	2354 **379**	2716 **373**	3103 **369**	3501 **365**	3862 **361**	4226 **357**	4592 **351**	4960 **345**
20	529 **436**	1168 **431**	1885 **427**	2270 **422**	2674 **416**	3060 **412**	3458 **408**	3822 **403**	4188 **399**		
22	506 **479**	1130 **475**	1771 **470**	2185 **465**	2632 **460**	3018 **455**	3416 **451**	3781 **446**	4150 **441**		
25	492 **545**	1110 **541**	1747 **537**	2145 **531**	2573 **526**	2951 **520**	3342 **515**	3700 **511**	4061 **507**		
30	470 **654**	1076 **651**	1708 **647**	2078 **641**	2474 **634**	2840 **628**	3219 **621**	3564 **615**	3913 **608**		

12.9 cu in / rev

PRESSURE (PSI)

FLOW (GPM)	500	1000	1500	1750	2000	2250	2500	2750	3000	3250	3500
2	905 **36**	1827 **35**	2698 **34**	3112 **33**	3527 **32**	3943 **31**	4336 **29**	4729 **27**	5115 **25**	5522 **23**	5925 **20**
4	880 **72**	1807 **70**	2691 **69**	3128 **68**	3567 **66**	3999 **64**	4420 **62**	4805 **58**	5180 **55**	5599 **51**	6017 **48**
6	854 **107**	1786 **106**	2684 **105**	3144 **104**	3607 **103**	4055 **100**	4503 **97**	4881 **93**	5245 **89**	5677 **87**	6108 **85**
8	822 **143**	1755 **142**	2666 **140**	3122 **139**	3582 **137**	4035 **134**	4490 **130**	4912 **127**	5330 **123**	5723 **121**	6108 **118**
10	790 **179**	1725 **177**	2648 **175**	3101 **173**	3556 **171**	4015 **168**	4476 **164**	4944 **162**	5416 **160**	5769 **157**	6108 **154**
12	750 **215**	1683 **212**	2605 **210**	3060 **208**	3511 **205**	3965 **202**	4419 **199**	4867 **196**	5324 **193**	5718 **189**	6104 **186**
14	710 **251**	1642 **247**	2562 **244**	3020 **242**	3465 **240**	3914 **237**	4363 **234**	4790 **230**	5233 **226**		
16	685 **287**	1557 **283**	2501 **280**	2948 **277**	3394 **274**	3850 **271**	4309 **268**	4742 **263**	5183 **259**		
18	661 **322**	1472 **319**	2439 **316**	2876 **312**	3322 **307**	3785 **304**	4256 **301**	4695 **297**	5133 **293**		
20	628 **358**	1418 **355**	2294 **351**	2741 **347**	3205 **343**	3651 **339**	4105 **336**	4522 **331**			
22	596 **394**	1363 **390**	2150 **386**	2605 **382**	3089 **378**	3517 **374**	3954 **370**				
25	571 **448**	1322 **444**	2093 **440**	2532 **436**	2997 **431**	3427 **427**	3869 **422**				
30	531 **537**	1254 **533**	1999 **530**	2410 **524**	2843 **519**	3276 **514**					

Performance data is typical. Actual data may vary slightly from one production motor to another.

PSSGC.PM6, dg, ki

Parker Hydraulics
Parker Hannifin Corporation
Hydraulic Pump/Motor Division
Greeneville, TN 37744 USA

16.4 cu in / rev

PRESSURE (PSI)

	500	1000	1500	1750	2000	2250	2500	2750	3000	3250
2	1155 **28**	2323 **27**	3406 **26**	3928 **25**	4437 **24**	4954 **23**	5462 **22**	5986 **21**	6507 **20**	7020 **19**
4	1122 **56**	2297 **55**	3414 **54**	3963 **53**	4505 **51**	5023 **49**	5530 **48**	6065 **46**	6597 **44**	7124 **43**
6	1088 **85**	2271 **84**	3422 **83**	3997 **82**	4573 **80**	5092 **79**	5599 **77**	6144 **74**	6687 **72**	7227 **70**
8	1047 **113**	2232 **112**	3394 **110**	3963 **109**	4531 **108**	5071 **106**	5605 **104**	6164 **101**	6722 **98**	7247 **95**
10	1005 **141**	2193 **139**	3367 **138**	3928 **137**	4489 **135**	5051 **133**	5612 **131**	6184 **128**	6758 **125**	
12	955 **169**	2061 **167**	3318 **166**	3888 **164**	4463 **163**	5021 **161**	5579 **158**	6141 **155**		
14	904 **197**	2086 **195**	3269 **193**	3878 **192**	4437 **191**	4998 **188**	5547 **185**	6072 **181**		
16	861 **225**	1925 **223**	3191 **221**	3763 **219**	4346 **217**	4908 **215**	5475 **212**			
18	818 **254**	1879 **251**	3113 **248**	3677 **246**	4255 **243**	4827 **241**				
20	783 **282**	1853 **279**	3015 **276**	3577 **273**	4155 **270**	4733 **268**				
22	718 **310**	1710 **307**	2721 **304**	3209 **301**	3706 **297**	4170 **294**				
25	672 **352**	1626 **349**	2596 **345**	3068 **342**	3550 **338**	4038 **335**				
30	596 **423**	1488 **418**	2388 **414**	2832 **410**	3289 **406**	3817 **401**				

FLOW (GPM)

18.9 cu in / rev

PRESSURE (PSI)

	500	1000	1250	1500	1750	2250	2500
2	1285 **23**	2619 **22**	3224 **21**	3838 **20**	4442 **18**	5548 **16**	6131 **13**
4	1264 **47**	2589 **46**	3250 **45**	3859 **44**	4486 **42**	5668 **40**	6282 **38**
6	1228 **73**	2559 **72**	3240 **71**	3865 **70**	4513 **69**	5765 **67**	6409 **66**
8	1171 **97**	2509 **96**	3176 **95**	3829 **94**	4503 **93**	5771 **90**	6439 **89**
10	1114 **121**	2449 **120**	3111 **119**	3793 **118**	4476 **117**	5777 **114**	6468 **112**
12	1065 **145**	2391 **144**	3061 **143**	3750 **142**	4439 **141**	5747 **137**	
14	1016 **169**	2333 **168**	3011 **167**	3707 **166**	4402 **165**	5717 **161**	
16	975 **200**	2257 **199**	2938 **198**	3636 **197**	4326 **195**	5645 **185**	
18	966 **232**	1988 **230**	2506 **228**	3037 **227**	3563 **226**		
20	941 **263**	1815 **261**	2253 **259**	2702 **258**	3143 **256**		
22	916 **295**	1643 **293**	2001 **290**	2367 **288**	2724 **286**		
25	879 **342**	1384 **339**	1622 **335**	1865 **334**	2094 **331**		
30	816 **420**	952 **417**	990 **412**	1027 **410**	1045 **407**		

FLOW (GPM)

TORQUE (LB IN) 5717
SPEED (RPM) 161

24.1 cu in / rev

PRESSURE (PSI)

	500	1000	1250	1500	1750	2250
2	1515 **15**	3184 **14**	3884 **12**	4660 **11**	5427 **10**	6645 **9**
4	1534 **35**	3145 **34**	4027 **32**	4718 **30**	5504 **29**	6904 **28**
6	1496 **56**	3107 **55**	4027 **54**	4718 **53**	5504 **52**	7077 **51**
8	1400 **74**	3030 **73**	3884 **72**	4660 **70**	5571 **68**	7163 **66**
10	1304 **93**	2915 **92**	3740 **91**	4603 **90**	5571 **89**	
12	1266 **112**	2851 **112**	3708 **110**	4584 **109**	5549 **107**	
14	1227 **130**	2787 **129**	3676 **128**	4564 **127**	5527 **126**	
16	1189 **149**	2723 **148**	3644 **147**	4545 **146**	5504 **144**	
18	1170 **167**	2685 **166**	3596 **165**	4488 **164**	5437 **162**	
20	1151 **184**	2685 **183**	3596 **182**	4430 **180**	5370 **178**	
22	1112 **205**	2608 **204**	3452 **203**	4258 **202**	5169 **200**	
25	1055 **235**	2455 **232**	3260 **231**	4085 **230**	4900 **228**	
30	959 **288**	2225 **285**	2925 **282**	3682 **279**	4363 **273**	

FLOW (GPM)

Performance data is typical. Actual data may vary slightly from one production motor to another.

PSSGC.PM6, dg, ki

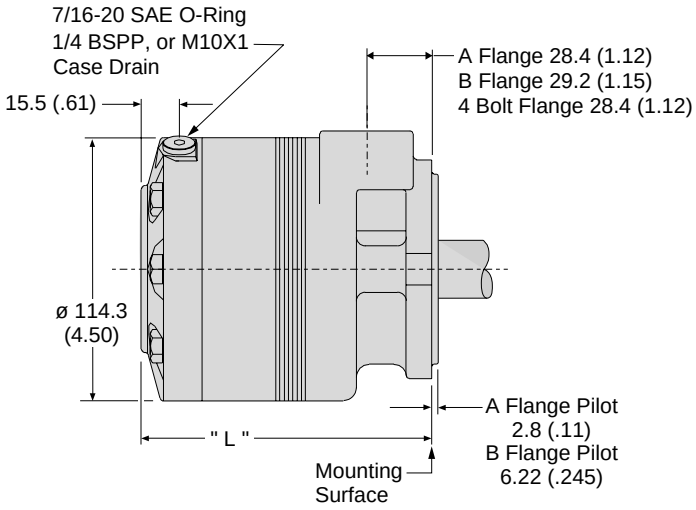
Parker Hydraulics

Parker Hannifin Corporation
Hydraulic Pump/Motor Division
Greeneville, TN 37744 USA

Inch equivalents for metric dimensions are shown in (**)

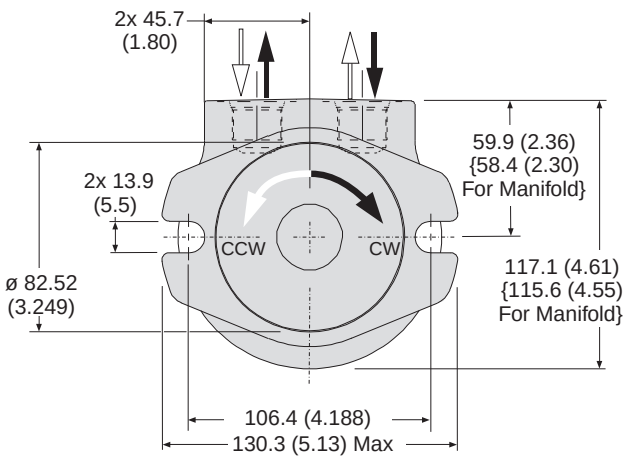
Length "L" and Weight

Displacement, Code		036	054	071	088	106
Length "L"	mm	112	117	121	127	131
	(inches)	(4.41)	(4.60)	(4.78)	(4.98)	(5.17)
Weight	kg	(7.0)	(7.4)	(7.7)	(8.0)	(8.4)
	(lb)	15.4	16.2	16.9	17.5	18.4
Displacement, Code		**129**	**164**	**189**	**241**	
Length "L"	mm	138	147	154	169	
	(inches)	(5.42)	(5.80)	(6.07)	(6.64)	
Weight	kg	8.7	9.4	9.8	10.8	
	(lb)	(19.1)	(20.6)	(21.6)	(23.7)	
Add 2.54 (.10) to "L" and .8 kg (1.7 lb) to Weight for Thru-Shaft						

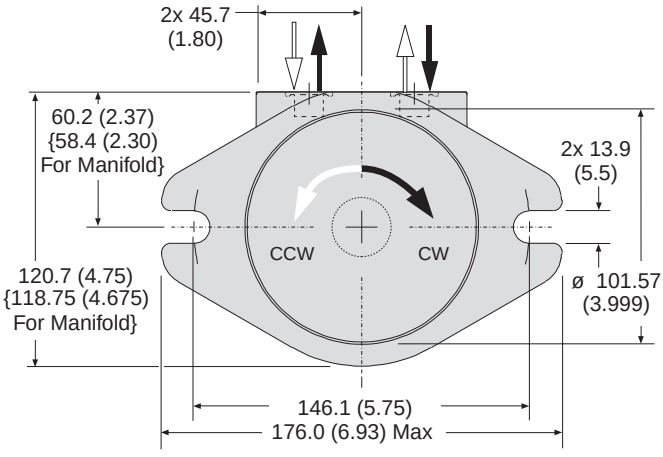


Mounting

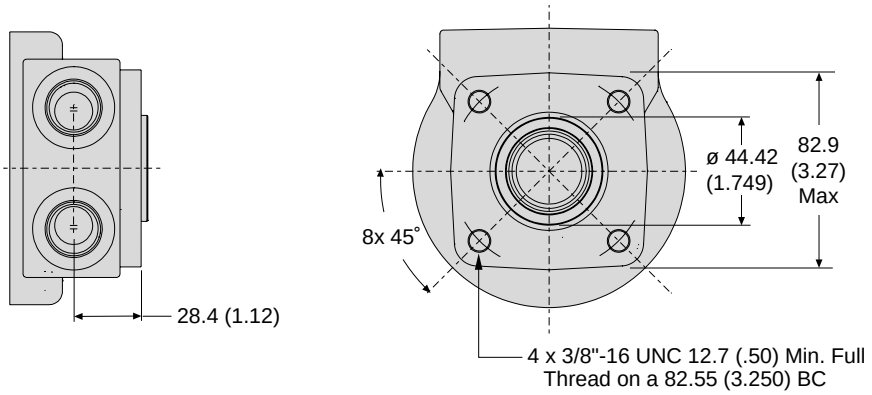
SAE A Flange



SAE B Flange



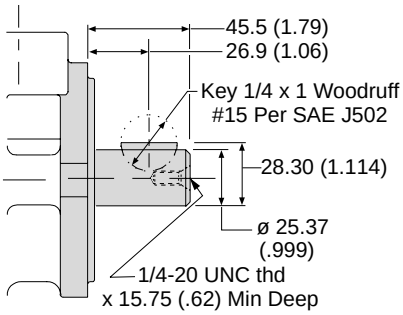
4 Bolt Flange



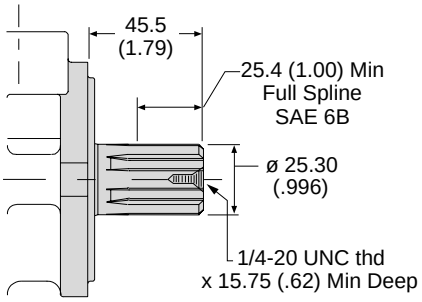
Shafts

Inch equivalents for metric dimensions are shown in (**)

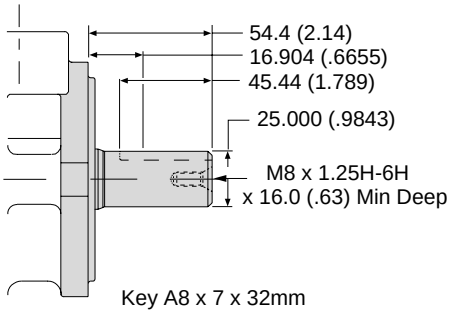
1" Keyed



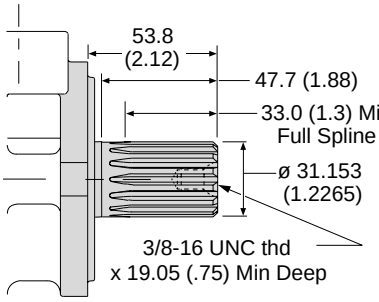
1" 6B Spline



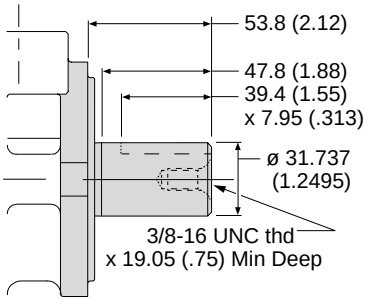
25 mm Keyed



1 1/4" 14 Tooth Spline

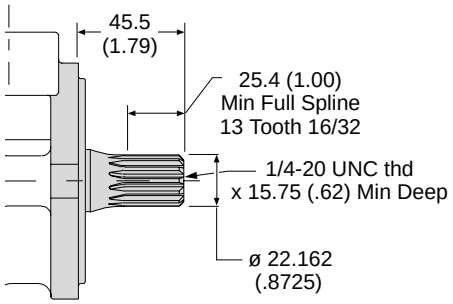


1 1/4" Keyed

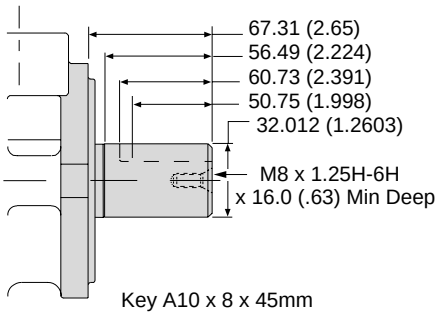


Key 7.950 x 31.5 (.3130 x 1.24) Square

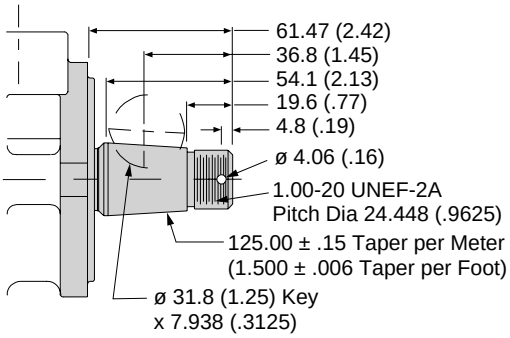
7/8" 13 Tooth Spline



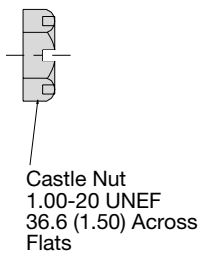
32mm Keyed



1 1/4" Taper

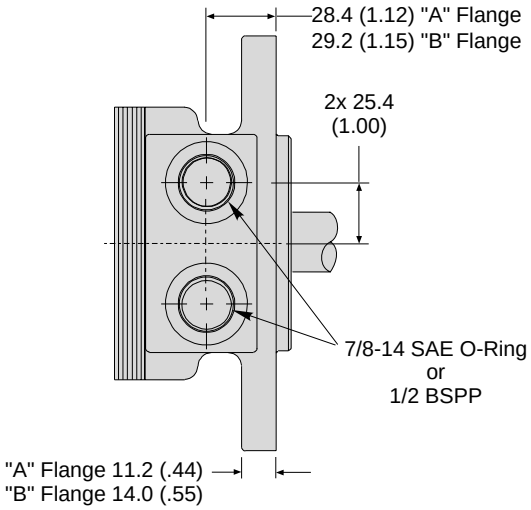


1"-20 Hex Nut

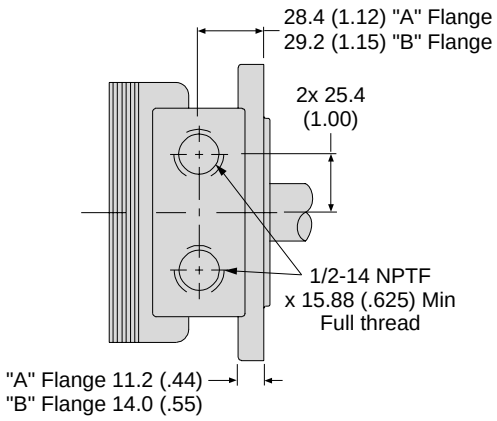


Porting

SAE O-Ring & BSPP

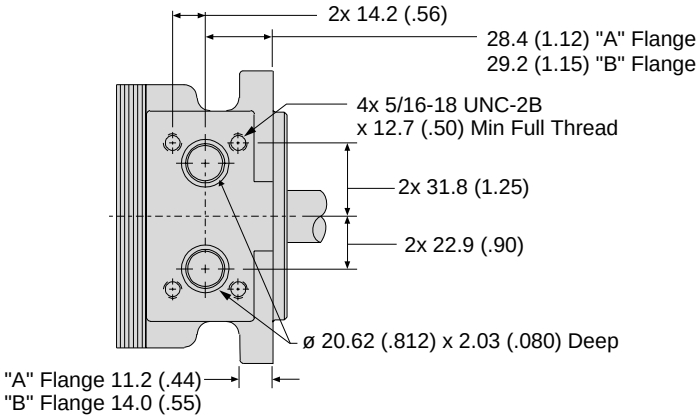


NPTF

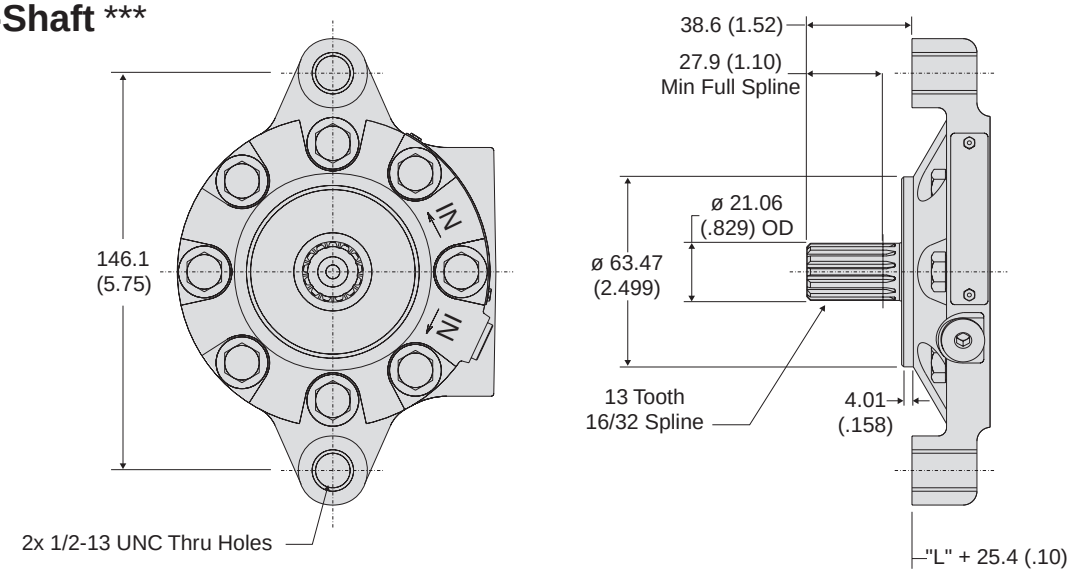


Manifold

Consult Factory for
ISO 6149 Porting



Thru-Shaft ***



*** See Installation/Operating Information Sections For Rating Limitations

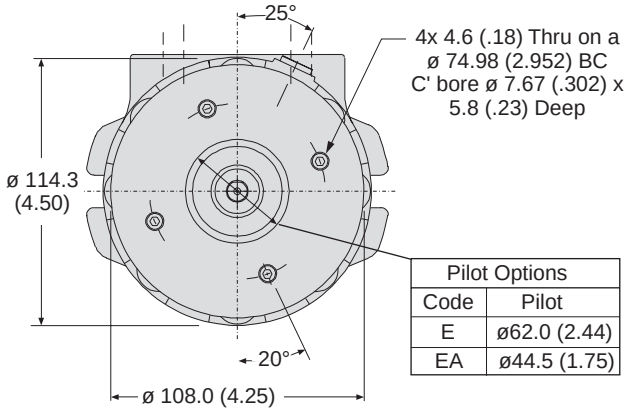
Parker Hydraulics

Parker Hannifin Corporation
Hydraulic Pump/Motor Division
Greeneville, TN 37744 USA

Dimensions

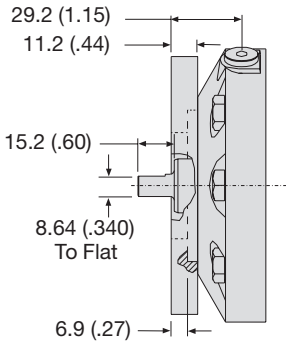
Inch equivalents for metric dimensions are shown in (**)

Encoder Mount

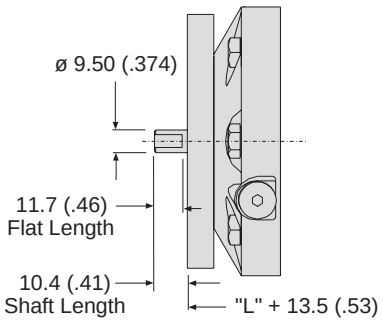


Pilot Options	
Code	Pilot
E	ø62.0 (2.44)
EA	ø44.5 (1.75)

Rear View



Side View



Top View

Ordering Information

11		A	—		—			—		—		—		
Series	Shaft	Engineering Design		Displacement		Mounting	Porting		Thru-Shaft		Shaft Material		Cross-Over Relief Valve	Paint

Code	Shaft
0	1" Keyed
1	1" 6B Spline
2	25 mm Keyed
3	1 1/4" Keyed
4	1 1/4" Taper
5	1 1/4" 14-T Spline
6	7/8" 13-T Spline
8	32 mm Keyed

Code	Displacement
036	3.6 cu in/rev
054	5.4 cu in/rev
071	7.1 cu in/rev
088	8.8 cu in/rev
106	10.6 cu in/rev
129	12.9 cu in/rev
164	16.4 cu in/rev
189	18.9 cu in/rev
241	24.1 cu in/rev

Code	Mounting
A	SAE A 2 Bolt
B	SAE B 2 Bolt
F	4 Bolt (3.25" BC)

Code	Porting
S	7/8"-14 SAE O-Ring
P	1/2"-14 NPTF Pipe
T	1/2" BSPP
M	Manifold
H	ISO 6149-1 M22 x 1.5

Code	Thru-Shaft***
0	No Thru-Shaft
1	7/8" 13-T Spline w/Brake Mount
E	Encoder Mount Std. 2.44 Pilot
EA	Encoder Mount Optional 1.75 Pilot

Code	Shaft Material
Omit	For Alloy Steel
S	Stainless Steel ***

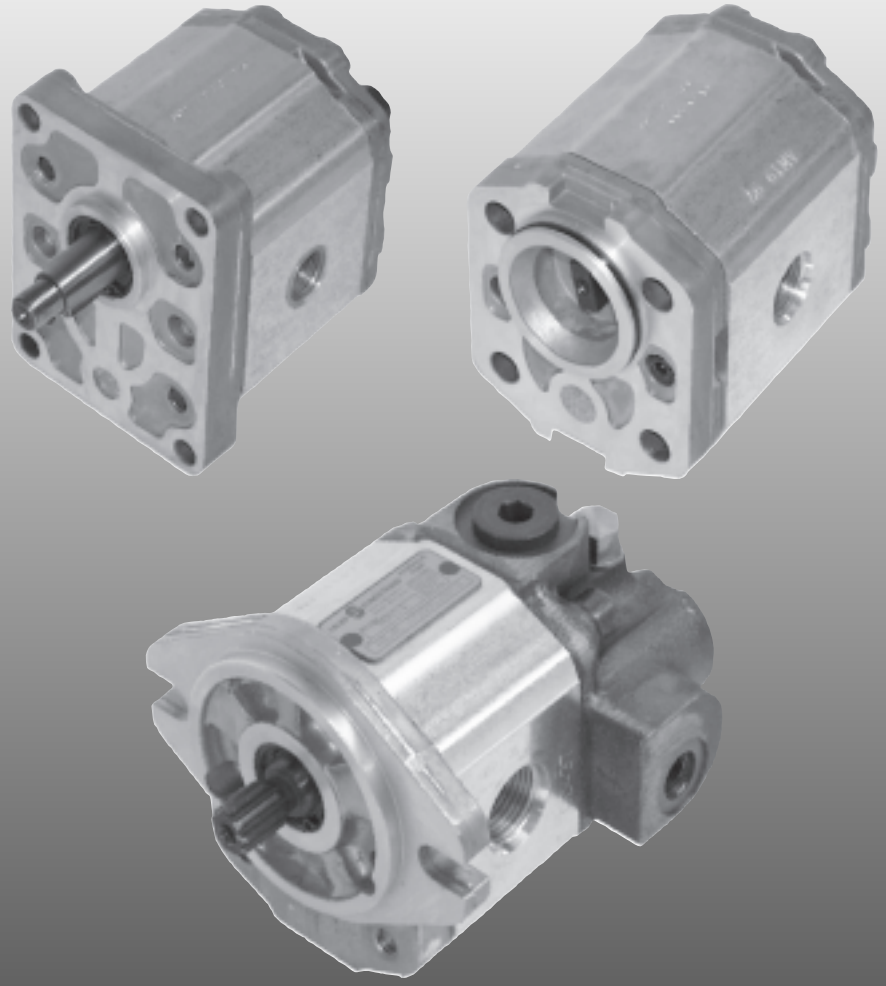
Code	Cross-Over Relief Valve
R1	Adjustable to 3500 psi (Factory Set at 1750 psi) (Manifold Mount Required)
Omit	If Not Required

Code	Paint
F	Black
W	White Epoxy
Omit	For No Paint

*** See Installation / Operation Information Section for Rating Limitations

SAUER DANFOSS

Group 2



Gear Pumps and Motors

Service Manual

2. General Information

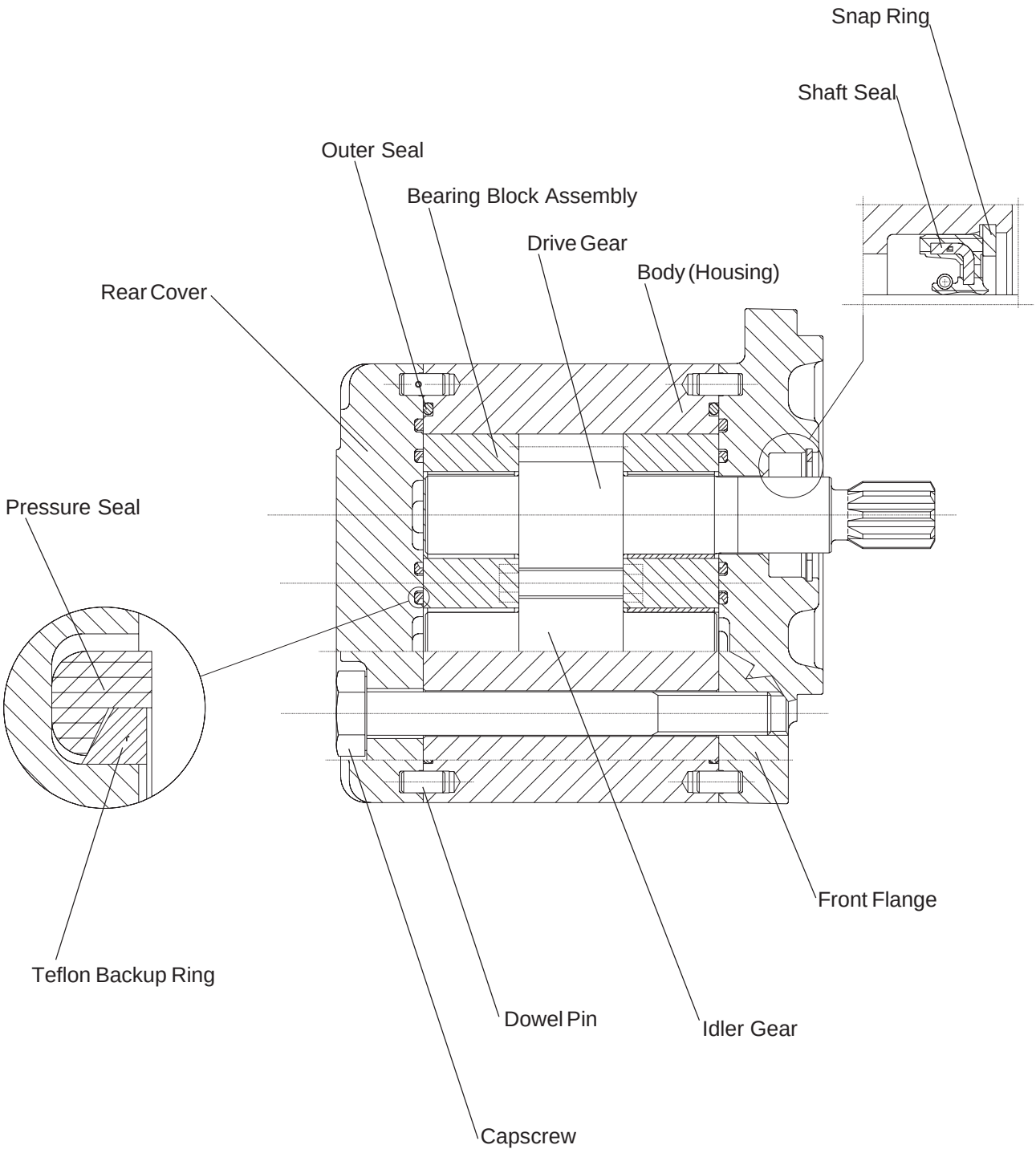
2.1 General Description

Group 2 gear products consist of pumps, reversible pumps, uni- and bidirectional motors. This group of gear pumps and motors is characterized by a wide selection of components. It is possible to have a wide range of units resulting from a common base of components or processes. This manual describes the service procedures that can be applied to all the products of this range. The complete range of products detailed in this manual are:

- **SNP 2** Standard gear pump
- **SEP 2** Gear pump, similar to SNP2, without DU-Bushings (Cost Effective Model)
- **SHP 2** Gear pump, similar to SNP2, with longer shaft journal bearings (high performance model)
- **SKP 2** Gear pump, similar to SNP2, with larger shaft specially designed to accommodate SAE 11 tooth spline
- **SNU 2** Unidirectional gear motor, similar to SNP2 pump
- **SNM 2** Standard bidirectional gear motor
- **SEM 2** Bidirectional gear motor, similar to SNM2, with lower pressure limits (Cost effective model)
- **SNR 2** Bidirectional gear pump.
- **SHM 2** Bidirectional gear motor, similar to SHP2 pumps, with longer shaft journal bearings, and higher pressure rating than SNM2

Generally, all these products follow the same procedures for assembling, disassembling, and servicing. In this manual, the SNP2 will be used as an example for all unidirectional pumps and motors (SNP/SEP/SHP/SNU 2), and the SNM2 for all the bi-direction pumps and motors (SNM/SEM/SNR/SHM 2). SKP assembly and disassembly information will be handled in a separate section of this manual.

2.2 Design



P101 130

3. Technical Specifications

3.1 Hardware Specifications

Pump Model		4	6	8	11	14	17	19	22	25
Displacement	cm^3/rev [in^3/rev]	3.9 [0.24]	6.0 [0.37]	8.4 [0.51]	10.8 [0.66]	14.4 [0.88]	16.8 [1.02]	19.2 [1.17]	22.8 [1.39]	25.2 [1.54]
SNP										
Peak Pressure	bar [psi]	280 [4060]	280 [4060]	280 [4060]	280 [4060]	280 [4060]	280 [4060]	230 [3335]	200 [2900]	175 [2538]
Rated Pressure	bar [psi]	250 [3625]	250 [3625]	250 [3625]	250 [3625]	250 [3625]	250 [3625]	210 [3045]	180 [2610]	160 [2320]
Minimum Speed at 0-100 bar	min^{-1} (rpm)	600	600	600	500	500	500	500	500	500
Minimum Speed at 100-180 bar	min^{-1} (rpm)	1200	1200	1000	800	750	750	700	700	700
Minimum Speed at 180 bar to rated pressure	min^{-1} (rpm)	1400	1400	1400	1200	1000	1000	1000	-	-
Maximum Speed	min^{-1} (rpm)	4000	4000	4000	4000	3500	3000	3000	3000	3000
SKP										
Peak Pressure	bar [psi]	280 [4060]	280 [4060]	280 [4060]	280 [4060]	280 [4060]	280 [4060]	260 [3770]	230 [3335]	200 [2900]
Rated Pressure	bar [psi]	250 [3625]	250 [3625]	250 [3625]	250 [3625]	250 [3625]	250 [3625]	240 [3480]	210 [3045]	190 [2755]
Minimum Speed at 0-100 bar	min^{-1} (rpm)	600	600	600	500	500	500	500	500	500
Minimum Speed at 100-180 bar	min^{-1} (rpm)	1200	1200	1000	800	750	750	700	700	700
Minimum Speed at 180 bar to rated pressure	min^{-1} (rpm)	1400	1400	1400	1200	1000	1000	1000	800	800
Maximum Speed	min^{-1} (rpm)	4000	4000	4000	4000	3500	3000	3000	3000	3000
SHP										
Peak Pressure	bar [psi]							260 [3770]	230 [3335]	200 [2900]
Rated Pressure	bar [psi]							240 [3480]	210 [3045]	190 [2755]
Minimum Speed at 0-100 bar	min^{-1} (rpm)							600	600	600
Minimum Speed at 100-180 bar	min^{-1} (rpm)							800	800	800
Minimum Speed at 180 bar to rated pressure	min^{-1} (rpm)							1000	1000	1000
Maximum Speed	min^{-1} (rpm)							3000	3000	3000
ALL		The data below represent mean values for standard configured pumps.								
Weight	kg [lb]	2.3 [5.1]	2.4 [5.3]	2.5 [5.5]	2.7 [5.8]	2.9 [6.3]	3.0 [6.5]	3.1 [6.7]	3.2 [7.0]	3.3 [7.3]
Moment of Inertia of rotating components	$x10^{-6}$ kg m^2 [$x10^{-6}$ lbf ft^2]	20.6 [489]	25.7 [610]	31.5 [747]	37.3 [885]	45.9 [1089]	51.7 [1227]	57.5 [1364]	66.2 [1571]	72.0 [1709]
Theoretical Flow at Maximum Speed	l / min [US gal / min]	15.6 [4.12]	24.0 [6.34]	33.6 [8.87]	43.2 [11.4]	50.4 [13.3]	50.4 [13.3]	57.6 [15.2]	68.4 [18.0]	75.6 [20.0]

T101 000E

3.2 System Specifications

Inlet Pressure	
	bar absolute
Recommended Range	**0.8 to 3.0**
Minimum (cold start)	**0.6**
	T101 001E

T101 001E

Temperature		
	°C	°F
Minimum (cold start)	**-20**	-4
Maximum Continuous	**80**	176
Peak (Intermittent)	**90**	194
		T101 003E

T101 003E

Fluid Viscosity -mm²/s (cSt) [SUS]	
Minimum	10 [60]
Recommended Range	12 to 60 [66 to 290]
Maximum (cold start)	1600 [7500]

T101 002E

Fluid Cleanliness Level and β_x-Ratio	
Required Fluid Cleanliness Level (per ISO 4406)	Class 18/13 or better
Recommended β_x-Ratio (Suction Filtration)	$\beta_{35-45} = 75$ $\beta_{10} \geq 2$
Recommended β_x-Ratio (Pressure or Return Filtration)	$\beta_{15-20} = 75$ $\beta_{10} \geq 10$
Recommended Inlet Screen Size (for Pressure or Return Filtration)	100 µm-125 µm
	T101 004E

T101 004E

3.3 Fluids and Filtration

To prevent premature wear, it is imperative that only clean fluid enter the pump and hydraulic circuit. A filter capable of controlling the fluid cleanliness to Class 18/13 per ISO 4406 or better under normal operating conditions is recommended.

The filter may be located on the pump outlet (pressure filtration), inlet (suction filtration), or the reservoir return (return line filtration).

The selection of a filter depends on a number of factors including the contaminant ingression rate, the generation of contaminants in the system, the required fluid cleanliness, and the desired maintenance interval. Contaminant ingression rate is determined (among other things) by the type of actuators used in the system. Hydraulic cylinders normally cause higher levels of contamination to enter the system.

Filters are selected to meet these requirements using rating parameters of efficiency and capacity. Filter efficiency may be measured with a Beta ratio[1] (β_x). For suction filtration, with controlled reservoir ingression, a filter with β_{35-45} >= 75 (and β_{10} >= 2) or better has been found to be satisfactory. For return or pressure filtration, filters with an efficiency of β_{15-20} >= 75 (and β_{10} >= 10) are typically required.

Since each system is unique, the filtration requirements for that system will be unique and must be determined by test in each case. Filtration system acceptability should be judged by monitoring of prototypes, evaluation of components, and performance throughout the test program.

See Sauer-Danfoss publications BLN-9887 [697581] and ATI-E 9201 for more information.

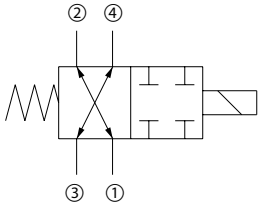
(1) Filter β_x ratio is a measure of filter efficiency defined by ISO 4572. It is defined as the ratio of the number of particles greater than a given diameter (“x” in microns) upstream of the filter to the number of these particles downstream of the filter.

Cartridge Valves Technical Information
Solenoid valves
CP530-3

OPERATION

This valve is a direct acting, 2 position, 4 way spool type solenoid.

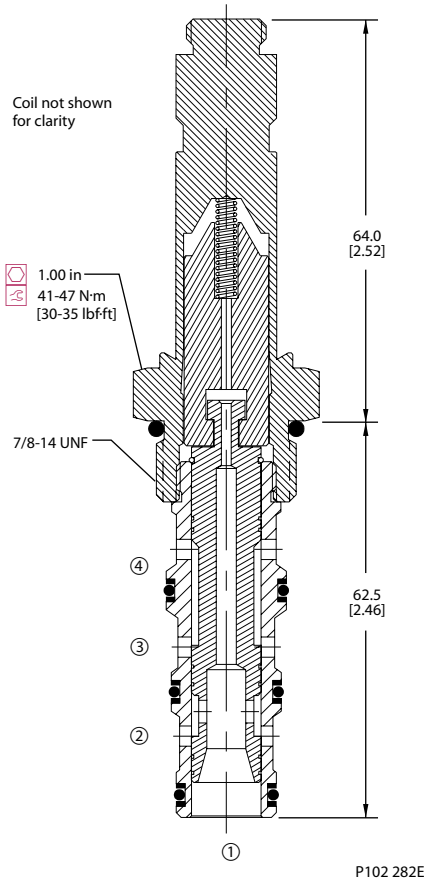
Schematic



P102 396

Cross-sectional view

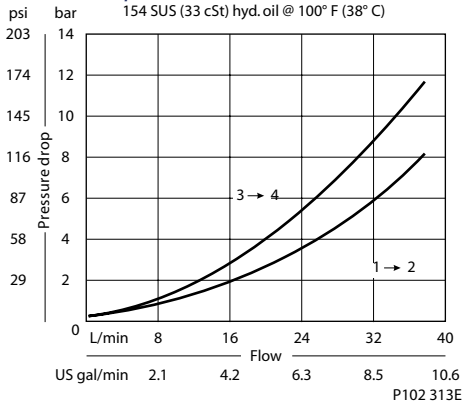
mm [in]



P102 282E

SPECIFICATIONS

Theoretical performance



P102 313E

Specifications

Rated pressure	207 bar [3000 psi]
Rated flow at 7 bar [100 psi]	28 l/min [7 US gal/min]
Leakage	82 cm³/min [5 in³/min] @ Rated pressure
Weight	0.49 kg [1.08 lb]
Cavity	CP10-4
Coil	D10 16 watt

ORDERING INFORMATION

CP530 - 3 - B - 6S - 24D - S

Seals

	Seal kit
B = Buna-N	120023
V = Viton	120024

Body and ports

	Body P/N
0 = Cartridge	No body
6S = Aluminum, #6 SAE	CP10-4-6S
8S = Aluminum, #8 SAE	CP10-4-8S

Voltage

10D = 10 VDC
12D = 12 VDC
20D = 20 VDC
24D = 24 VDC
120A = 120 VAC
240A = 240 VAC

Termination

S = Spade
L = Lead
C = Conduit
H = DIN 43650
DE = Deutsch
M2 = Metri-Pak 150

P102 325E

1150-0200 SRT

LEAD ACCURACY: ±0.004 in./ft.

Single Start

1.150 Ball Circle Diameter
0.200 Lead
1.015 Root Diameter
0.125 Nominal Ball Diameter
3.18 Screw Weight (lbs./ft.)

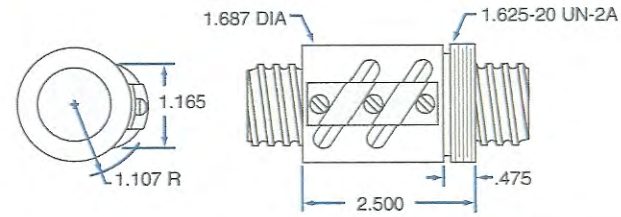
Standard Screw Lengths	PART NUMBERS	
	RH	LH
4 FT.	SRT8738	SRT0285
8 FT.	SRT8746	SRT0286
12 FT.	SRT8753	SRT0287
16 FT.	SRT0430	SRT0431

Custom cut lengths available up to 24'. For longer lengths contact Customer Service.

SBN Double Circuit Ball Nut

121 bearing balls per circuit - 242 total per nut

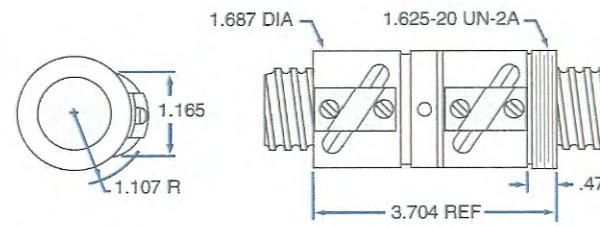
PRODUCT SPECIFICATIONS	RH	LH
Dynamic Load (lbs.)	2,370	2,370
Static Load (lbs.)	26,180	26,180
Torque to Raise 1 lb. (in.-lb.)	.035	.035
Nut Weight (lbs.)	.9	.9
Ball Nut Number	SBN1566	SBN0207
Flange Part Number	FLG8283	FLG8283
Wiper Kit Part Number	WKB2652	WKB2652



SEL Adjustable Preload Ball Nut

121 bearing balls per circuit - 242 total per nut

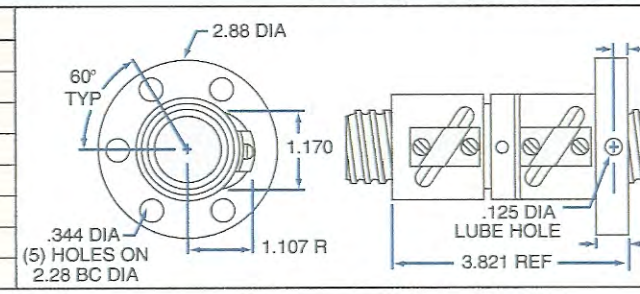
PRODUCT SPECIFICATIONS	RH	LH
Dynamic Load (lbs.)	1,185	1,185
Static Load (lbs.)	13,090	13,090
Torque to Raise 1 lb. (in.-lb.)	.035	.035
Preload (lbs.)	240	240
Nut Weight (lbs.)	1.34	1.34
Ball Nut Number	SEL4270	SEL0206
Flange Part Number	FLG8283	FLG8283
Wiper Kit Part Number	WKB2652	WKB2652



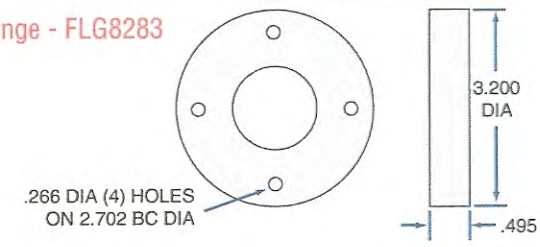
SAR Adjustable Preload Flanged Ball Nut

121 bearing balls per circuit - 242 total per nut

PRODUCT SPECIFICATIONS	RH	LH
Dynamic Load (lbs.)	1,185	—
Static Load (lbs.)	13,090	—
Torque to Raise 1 lb. (in.-lb.)	.035	—
Preload (lbs.)	240	—
Nut Weight (lbs.)	1.8	—
Ball Nut Number	SAR3042	—
Flange	INTEGRAL	—
Wiper Type	BRUSH	—

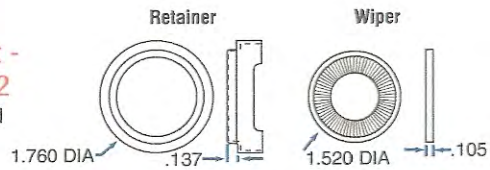


Flange - FLG8283



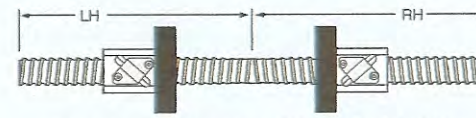
Brush Wiper Kit - WKB2652

2 wipers and 1 retainer



TWIN-LEAD SCREW

Single piece twin-lead screws offer opposing motion through a single drive system.



See page 148 for complete product details.

LUBRICANT

Prolong ball screw and nut performance with this special lubricant.

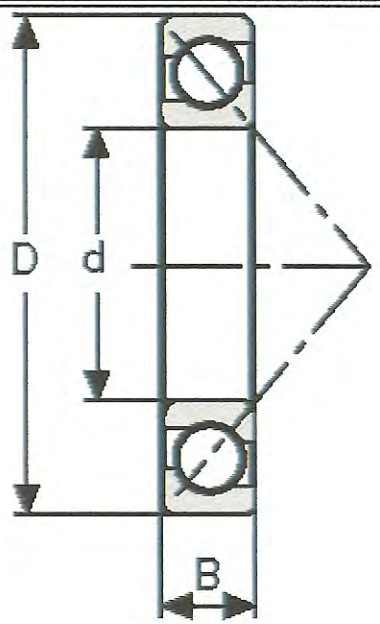
See page 95 for complete product details.

Go Back to Previous Screen

CONSOLIDATED NO. 7205 BG

ANGULAR CONTACT BALL BEARINGS - FLUSH GROUND 40° CONTACT ANGLE

Dimensions (metric)	d	25
	D	52
	B	15
Approx. Wgt. lbs		.300
Interchange	FAF	7205W SU
	FAG	7205 B.U (A/O)
	MRC	7205 DU
	ND	U-30205
	R&M	LJT 25
	SKF	7205 BEAG (Y/P)
	SKF (Eur.)	7205 BEAG (Y/P)
	STEYR	7205 BEAG (Y/P)
	Torrington	-



* These sizes are also available in suffix "B" - not flush ground.

1) The degree of contact angle varies between domestic manufacturers within a manufacturer's range; such as Fafnir - 20° up to and including 30 mm. bore, MRC-30°, New Departure - 35° for the entire range.

2) Suffix "M" indicates machined bronze cage.

3) Suffix "G" indicates that the bearings are universally flush ground suitable for Back-to-Back, Face-to-Face, or Tandem mounting.

4) Sizes 7200 BG thru 7218 BG may be equipped with steel retainers or with cages made from glass fiber reinforced polyamide 66 material.

Consolidated Bearings Company
10 Wing Drive, Cedar Knolls, NJ 07927
Phone: 973-539-8300 • Fax: 973-539-5902
Toll Free: 877-266-2744

Warehouses in:
Atlanta • Chicago • Cedar Knolls • Columbus • Dallas • Houston
Kansas City • Los Angeles • San Francisco

Non-Illuminated Momentary Push Button Operators—UL Types 4, 13/NEMA 4, 13

For use in hazardous locations—See page 17-79.
Contact blocks and legend plate not included unless otherwise noted.

Description		Color	Operator with 1 N.O. and 1 N.C. Contact (KA1)	Price	Operator with 1 N.O. Contact (KA2)	Operator with 1 N.C. Contact (KA3)	Price	Operator Only with No Contacts	Price
 9001KR1B	Full Guard	Black	KR1BH13	**$54.00**	KR1BH5	KR1BH6	**$39.90**	KR1B	**$25.70**
		Red	KR1RH13	**54.00**	KR1RH5	KR1RH6	**39.90**	KR1R	**25.70**
		Green	KR1GH13	**54.00**	KR1GH5	KR1GH6	**39.90**	KR1G	**25.70**
		Universal ▲	KR1UH13	**54.00**	KR1UH5	KR1UH6	**39.90**	KR1U	**25.70**
		Other ■	KR1■H13	**54.00**	KR1■H5	KR1■H6	**39.90**	KR1■	**25.70**
 9001KR3B	No Guard	Black	KR3BH13	**54.00**	KR3BH5	KR3BH6	**39.90**	KR3B	**25.70**
		Red	KR3RH13	**54.00**	KR3RH5	KR3RH6	**39.90**	KR3R	**25.70**
		Green	KR3GH13	**54.00**	KR3GH5	KR3GH6	**39.90**	KR3G	**25.70**
		Universal ▲	KR3UH13	**54.00**	KR3UH5	KR3UH6	**39.90**	KR3U	**25.70**
		Other ■	KR3■H13	**54.00**	KR3■H5	KR3■H6	**39.90**	KR3■	**25.70**
 9001KR2B	Extended Guard	Black	KR2BH13	**54.00**	KR2BH5	KR2BH6	**39.90**	KR2B	**25.70**
		Red	KR2RH13	**54.00**	KR2RH5	KR2RH6	**39.90**	KR2R	**25.70**
		Green	KR2GH13	**54.00**	KR2GH5	KR2GH6	**39.90**	KR2G	**25.70**
		Universal ▲	KR2UH13	**54.00**	KR2UH5	KR2UH6	**39.90**	KR2U	**25.70**
		Other■	KR2■H13	**54.00**	KR2■H5	KR2■H6	**39.90**	KR2■	**25.70**

▲ The universal push button operators contain one each of the following color inserts: black, red, green, yellow, orange, blue and white.
■ See table below for color code.

Description		Color	Operator with 1 N.O. and 1 N.C. Contact (KA1)	Price	Operator with 1 N.O. Contact (KA2)	Operator with 1 N.C. Contact (KA3)	Price	Operator Only with No Contacts	Price
 9001KR4B	$1\frac{3}{8}$" Diameter Mushroom Button	**Snap-In Mushroom Button**							
		Black	KR4BH13	**$83.00**	KR4BH5	KR4BH6	**$68.00**	KR4B	**$54.00**
		Red	KR4RH13	**83.00**	KR4RH5	KR4RH6	**68.00**	KR4R	**54.00**
		Red♦	KR4R05H13	**86.00**	KR4R05H5	KR4R05H6	**72.00**	KR4R05	**57.00**
		Green	KR4GH13	**83.00**	KR4GH5	KR4GH6	**68.00**	KR4G	**54.00**
		Other★	KR4★H13	**83.00**	KR4★H5	KR4★H6	**68.00**	KR4★	**54.00**
		Screw-On Mushroom Button With Set Screw Security							
		Black	KR24BH13	**83.00**	KR24BH5	KR24BH6	**68.00**	KR24B	**54.00**
		Red	KR24RH13	**83.00**	KR24RH5	KR24RH6	**68.00**	KR24R	**54.00**
		Green	KR24GH13	**83.00**	KR24GH5	KR24GH6	**68.00**	KR24G	**54.00**
		Other★	KR24★H13	**83.00**	KR24★H5	KR24★H6	**68.00**	KR24★	**54.00**
 9001KR5B	$2\frac{1}{4}$" Diameter Mushroom Button	**Snap-In Mushroom Button**							
		Black	KR5BH13	**83.00**	KR5BH5	KR5BH6	**68.00**	KR5B	**54.00**
		Red	KR5RH13	**83.00**	KR5RH5	KR5RH6	**68.00**	KR5R	**54.00**
		Red ♦	KR5R05H13	**86.00**	KR5R05H5	KR5R05H6	**72.00**	KR5R05	**57.00**
		Green	KR5GH13	**83.00**	KR5GH5	KR5GH6	**68.00**	KR5G	**54.00**
		Other★	KR5★H13	**83.00**	KR5★H5	KR5★H6	**68.00**	KR5★	**54.00**
		Screw-On Mushroom Button With Set Screw Security							
		Black	KR25BH13	**83.00**	KR25BH5	KR25BH6	**68.00**	KR25B	**54.00**
		Red	KR25RH13	**83.00**	KR25RH5	KR25RH6	**68.00**	KR25R	**54.00**
		Green	KR25GH13	**83.00**	KR25GH5	KR25GH6	**68.00**	KR25G	**54.00**
		Other★	KR25★H13	**83.00**	KR25★H5	KR25★H6	**68.00**	KR25★	**54.00**

♦ Knob has the words "Emergency Stop" in raised letters highlighted in white for readability.
★ See table below for color code.

Color	■ KR1, 2, 3 Place Color Code in Type Number	★ KR4, 5, 24, 25 Place Color Code in Type Number
Blue	L	L
Yellow	Y	Y
White	W	. . .
Orange	S	S
Gray	E	. . .

Light Modules . . . . . page 17-77
Contact Blocks . . . . . page 17-78
H Contact Block Assembly Codes . . . . . page 17-80
Legend Plates . . . . . page 17-81
Accessories . . . . . page 17-83
Replacement Parts . . . . . page 17-86

For additional information, reference Catalog #9001CT0001.

D4B-N

OMRON

Safety Limit Switch

Positive Action Limit Switches with Direct Drive Contacts for Critical Switching Applications

- Snap-action contact for accurate switching with safe operation via direct drive positive opening mechanism
- Two sets of contacts: one (NC) for safety circuit and the other (NO) for control circuit
- Safety of lever settings ensured as a mechanism engages a gear between the operating position indicator plate and the lever
- Conforms to EN (TÜV) standards corresponding to the CE marking
- 3-conduit switches are available for easy wiring
- Conforms to these standards and EC Directives:

  Machinery Directive

  Low Voltage Directive

  EN1088

  EN50041
- Approved Standards

Snap-Action Models

Agency	Standard	File No.
TÜV Rheinland	EN60947-5-1	R9851083 (Positive opening: approved) R9151372 (Positive opening: approval pending) (See note 1.)
UL	UL508	E76675
CSA	C22.2 No. 14	LR45746
BIA (See note 2.)	GS-ET-15	1-conduit: 9202158 3-conduit: 9309655

Note: 1. Adjustable roller lever, adjustable rod lever, coil spring, and plastic rod models only.

2. Not including adjustable roller lever, adjustable rod lever, coil spring, and plastic rod models.

Slow-Action Models

Agency	Standard	File No.
TÜV Rheinland	EN60947-5-1	R9151643 (Positive opening: approved) (See note)
UL	UL508	E76675
CSA	C22.2 No. 14	LR45746
BIA (See note.)	GS-ET-15	1-conduit: 9202158 3-conduit: 9309655
SUVA (See note.)	SUVA	1-conduit: E6188.d 3-conduit: E6189.d

Note: Not including adjustable roller lever, adjustable rod lever, coil spring, and plastic rod models.

Ordering Information

■ MODEL NUMBER LEGEND

D4B-□□□□N
1 2 3

1. Conduit
- 1: PG13.5 (1-conduit) European type
- 2: G1/2 (PF1/2) (1-conduit) Japanese type
- 3: 1/2-14NPT (1-conduit) North American type
- 5: PG13.5 (3-conduit) European type
- 6: G1/2 (PF1/2) (3-conduit) Japanese type
- 7: 1/2-14NPT (3-conduit) North American type

2. Built-in Switch
- 1: 1NC/1NO (Snap-action)
- A: 2NC (Slow-action)
- 5: 1NC/1NO (Slow-action) (See Note)

Note: Excluding D4B-□□81N and D4B-□□87N models.

3. Actuator
- 00: Switch box (without head)
- 11: Roller lever (standard)
- 13: Adjustable rubber roller lever
- 16: Adjustable roller lever
- 17: Adjustable rod lever
- 1R: Roller lever (conventional D4B-compatible)
- 70: Top plunger
- 71: Top roller plunger
- 81: Coil spring
- 87: Plastic rod

■ SWITCHES (EN50041)

Description		**Part number**								
Actuator		Conduit size/type								
		PG13.5 (European)			G1/2 (Japanese)			1/2-14NPT (North American)		
		1NC/1NO (Snap-action)	1NC/1NO (Slow-action)	2NC (Slow-action)	1NC/1NO (Snap-action)	1NC/1NO (Slow-action)	2NC (Slow-action)	1NC/1NO (Snap-action)	1NC/1NO (Slow-action)	2NC (Slow-action)
Side rotary	Roller lever (form A)	**D4B-1111N**	**D4B-1511N**	**D4B-1A11N**	**D4B-2111N**	**D4B-2511N**	**D4B-2A11N**	**D4B-3111N**	**D4B-3511N**	**D4B-3A11N**
	Adjustable roller lever, rubber, 50.0 mm (1.97 in) dia.1/2-14NPT	**D4B-3113N**	**D4B-3513N**	**D4B-3A13N**	———			———		
	Adjustable roller lever (See Note 1)	**D4B-1116N**	**D4B-1516N**	**D4B-1A16N**	**D4B-2116N**	**D4B-2516N**	**D4B-2A16N**	**D4B-3116N**	**D4B-3516N**	**D4B-3A16N**
	Adjustable rod lever (form D) (See Note 1)	**D4B-1117N**	**D4B-1517N**	**D4B-1A17N**	**D4B-2117N**	**D4B-2517N**	**D4B-2A17N**	**D4B-3117N**	**D4B-3517N**	**D4B-3A17N**
Top plunger	Plain (form B)	**D4B-1170N**	**D4B-1570N**	**D4B-1A70N**	**D4B-2170N**	**D4B-2570N**	**D4B-2A70N**	**D4B-3170N**	**D4B-3570N**	**D4B-3A70N**
	Roller (form C)	**D4B-1171N**	**D4B-1571N**	**D4B-1A71N**	**D4B-2171N**	**D4B-2571N**	**D4B-2A71N**	**D4B-3171N**	**D4B-3571N**	**D4B-3A71N**
Wobble lever (See Note 2)	Coil spring	**D4B-1181N**	**---**	**D4B-1A81N**	**D4B-2181N**	**---**	**D4B-2A81N**	**D4B-3181N**	**---**	**D4B-3A81N**
	Plastic rod	**D4B-1187N**	**---**	**D4B-1A87N**	**D4B-2187N**	**---**	**D4B-2A87N**	**D4B-3187N**	**---**	**D4B-3A87N**
Standards		EN60947-5-1			EN60947-5-1			EN60947-5-1		

Note: 1. The slow-action models with adjustable roller levers or adjustable rod levers are approved under the Forced Opening Certificate (TÜV) of the EN standard, but they do not conform to the GS-ET-15 Standard (BIA) and SUVA.
The snap-action models with adjustable roller levers or adjustable rod levers are not approved under the Forced Opening Certificate (TÜV) of the EN standard.

2. The wobble lever models are ordinary limit switches and are not approved under EN, GS, and SUVA's Forced Opening Certificate.

3-Conduit Switch

Description		Part number								
Actuator		Conduit size								
		PG13.5 (European) See Note 2			G1/2 (Japanese)			1/2-14NPT North American		
		1NC/1NO (Snap-action)	1NC/1NO (Slow-action)	2NC (Slow-action)	1NC/1NO (Snap-action)	1NC/1NO (Slow-action)	2NC (Slow-action)	1NC/1NO (Snap-action)	1NC/1NO (Slow-action)	2NC (Slow-action)
Side rotary	Roller lever (form A)	**D4B-5111N**	**D4B-5511N**	**D4B-5A11N**	**D4B-6111N**	**D4B-6511N**	**D4B-6A11N**	**D4B-7111N**	**D4B-7511N**	**D4B-7A11N**
	Adjustable roller lever, rubber, 50.0 mm (1.97 in) dia.	**D4B-7113N**	**D4B-7513N**	**D4B-7A13N**	———					
	Adjustable roller lever (See Note 1)	**D4B-5116N**	**D4B-5516N**	**D4B-5A16N**	**D4B-6116N**	**D4B-6516N**	**D4B-6A16N**	**D4B-7116N**	**D4B-7516N**	**D4B-7A16N**
	Adjustable rod lever (form D) (See Note 1)	**D4B-5117N**	**D4B-5517N**	**D4B-5A17N**	**D4B-6117N**	**D4B-6517N**	**D4B-6A17N**	**D4B-7117N**	**D4B-7517N**	**D4B-7A17N**
Top plunger	Plain (form B)	**D4B-5170N**	**D4B-5570N**	**D4B-5A70N**	**D4B-6170N**	**D4B-6570N**	**D4B-6A70N**	**D4B-7170N**	**D4B-7570N**	**D4B-7A70N**
	Roller (form C)	**D4B-5171N**	**D4B-5571N**	**D4B-5A71N**	**D4B-6171N**	**D4B-6571N**	**D4B-6A71N**	**D4B-7171N**	**D4B-7571N**	**D4B-7A71N**
Wobble lever (See Note 2)	Coil spring	**D4B-5181N**	**---**	**D4B-5A81N**	**D4B-6181N**	**---**	**D4B-6A81N**	**D4B-7181N**	**---**	**D4B-7A81N**
	Plastic rod	**D4B-5187N**	**---**	**D4B-5A87N**	**D4B-6187N**	**---**	**D4B-6A87N**	**D4B-7187N**	**---**	**D4B-7A87N**
Standards		**EN60947-5-1**			**EN60947-5-1**			**EN60947-5-1**		

Note: 1. The slow-action models with adjustable roller levers or adjustable rod levers are approved under the Forced Opening Certificate (TÜV) of the EN standard, but they do not conform to the GS-ET-15 Standard (BIA) and SUVA.
The snap-action models with adjustable roller levers or adjustable rod levers are not approved under the Forced Opening Certificate (TÜV) of the EN standard.

2. The D4B-□N is a Limit Switch conforming to European standards, and PG13.5 is commonly used in Europe.
3. The wobble lever models are ordinary limit switches and are not approved under EN, GS, and SUVA's Forced Opening Certificate.

■ LEVERS (FOR SIDE ROTARY SWITCHES)

Description			Part number
Actuator	Length	Diameter of roller	
Standard	31.5	17.5 dia.	**D4B-0001N**
Adjustable roller lever	25 to 89	19 dia.	**D4B-0006N**
Adjustable rod lever	145 max.	---	**D4B-0007N**
Interchangeable with D4B-0001	33.7	19 dia.	**D4B-000RN**

Note: Other lever types are also available.

Specifications

■ APPROVED STANDARD RATINGS

TÜV Rheinland: EN60947-5-1

Utilization category	AC-15
Rated operating current (I_e)	2 A
Rated operating voltage (U_e)	400 V

Note: As protection against short-circuiting, use either a gI-type or gG-type 10-A fuse that conforms to IEC269.

■ UL/CSA: (UL508, CSA C22.2 NO. 14)

A600

Rated voltage	Carry current	Current		Volt-amperes	
		Make	Break	Make	Break
120 VAC 240 VAC 480 VAC 600 VAC	10 A	60 A 30 A 15 A 12 A	6 A 3 A 1.5 A 1.2 A	7,200 VA	720 VA

Q150

Rating Codes for DC Control-Circuit Contacts

Thermal continuous test current, amperes	Maximum make or break current, amperes			Maximum make or break volt-amperes at 300 volts or less
	125 Volt	250 Volt	301 to 600 Volt	
2.5	0.55	—	—	69

■ CHARACTERISTICS

Item		Snap-action	Slow-action
Life expectancy (see note 2)	Mechanical	30,000,000 operations min.	10,000,000 operations min.
	Electrical	500,000 operations min. (at a 250 VAC, 10-A resistive load)	
Operating speed		1 mm/s to 0.5 m/s	
Operating frequency		Mechanical: 120 operations/min Electrical: 30 operations/min	
Rated frequency		50/60 Hz	
Insulation resistance		100 MΩ min. (at 500 VDC) between terminals of the same polarity and between each terminal and non-current-carrying part	
Contact resistance		25 mΩ max. (initial value)	
Dielectric strength			
	Between terminals of same polarity	U_{imp} 2.5 kV	U_{imp} 4 kV
	Between terminals of different polarity	---	U_{imp} 4 kV
	Between current-carrying metal parts and ground	U_{imp} 4 kV	U_{imp} 4 kV
	Between each terminal and non-current-carrying parts	U_{imp} 4 kV	U_{imp} 4 kV
Rated insulation voltage (U_i)		600 VAC (EN60947-5-1)	
Counter electromotive voltage at switching		1,500 VAC max. (EN60947-5-1)	
Operating environmental pollution level		3 (EN60947-5-1)	
Conditional short-circuit current		100 A (EN60947-5-1)	
Conventional enclosed thermal current (I_{the})		20 A (EN60947-5-1)	
Electric shock protection class		Class I (with grounding terminal)	
Vibration resistance		Malfunction: 10 to 55 Hz, 0.75 mm single amplitude	
Shock resistance		Destruction: 1,000 m/s^2 min. Malfunction: 300 m/s^2 min.	
Ambient temperature		Operating: -40°C to 80°C, with no icing (-25°C to 80°C for the flexible-rod type)	
Ambient humidity		Operating: 95% max.	
Degree of protection		IP67 (EN60947-5-1)	
Weight		Approx. 250 g	

Note: 1. The above values are for initial operation.
2. The life expectancy is for an ambient temperature of 5°C to 35°C and ambient humidity of 40% to 70%. For further conditions, consult your OMRON sales representative.
3. The values in this table are for an ambient temperature of 5°C to 35°C and ambient humidity of 40% to 70%. For further conditions, consult your OMRON sales representative.

■ OPERATING CHARACTERISTICS

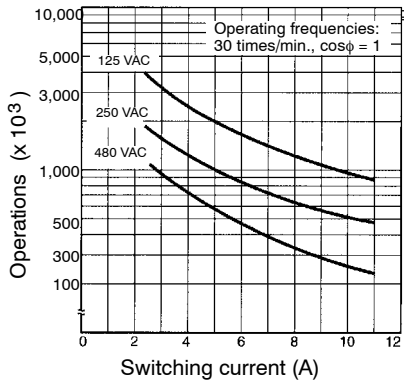
Model	D4B-□□11N	D4B-□□16N (see note 1)	D4B-□□17N (see note 2)	D4B-□□70N	D4B-□□71N	D4B-□□81N	D4B-□□87N
OF max.	9.41 N		2.12 N	18.63 N		1.47 N	
RF min.	1.47 N		0.29 N	1.96 N		---	
PT	21±3°			2.0 mm max.		15° max.	
PT (2nd) (see note 3)	45°			3.0 mm		---	
OT min.	50°			5.0 mm		---	
MD max. (see note 4)	12°			1.0 mm		---	
POT min.	35° (Slow-action models)			3.2 mm		---	
	55° (Snap-action models)						
POF min.	19.61 N			49.03 N		---	
TT	75°			7.0 mm		---	
FP max.	---			38 mm	51 mm	---	
OP	---			35±1 mm	48±1 mm	---	

Note: 1. The operating characteristics of these Switches were measured with the roller lever set at 31.5 mm.
2. The operating characteristics of these Switches were measured with the rod lever set at 140 mm.
3. Only for slow-action models.
4. Only for snap-action models.

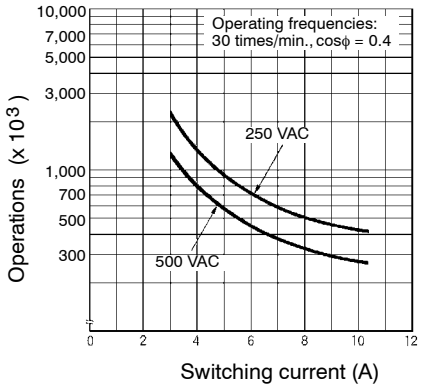
Engineering Data

■ ELECTRICAL LIFE EXPECTANCY SNAP-ACTION MODELS

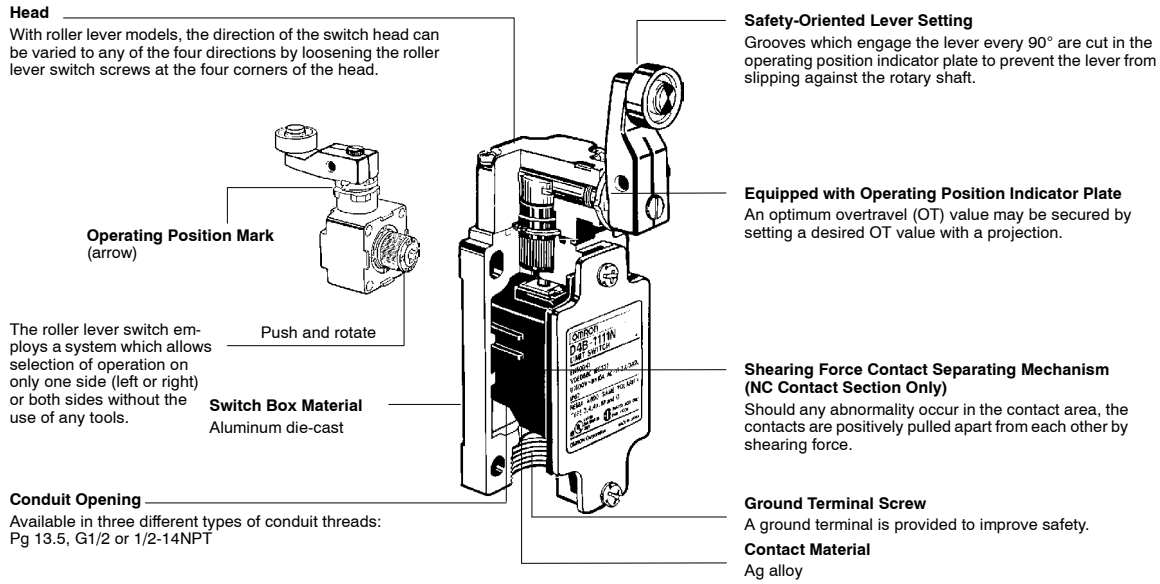
(cosϕ = 1)



(cosϕ = 0.4)

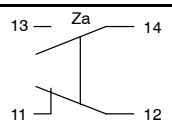
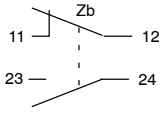
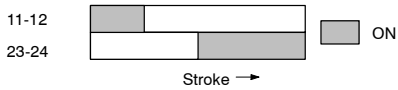
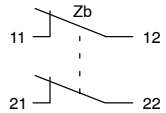
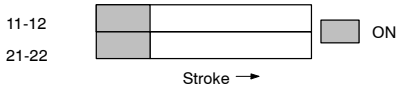


Nomenclature



Operation

■ CONTACT FORM (EN50013)

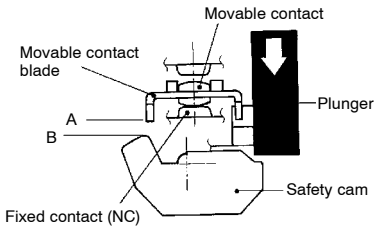
Model	Contact		Diagrams	Explanation
D4B-□1□N	1NC/1NO (Snap-action)			Only NC contact 11-12 has an approved positive opening mechanism. ⊖ Terminal numbers 11-12 and 13-14 cannot be used as unlike poles.
D4B-□5□N	1NC/1NO (Slow-action)			Only NC contact 11-12 has an approved positive opening mechanism. ⊖ Terminal numbers 11-12 or 23-24 can be used as unlike poles.
D4B-□A□N	2NC (Slow-action)			Both NC contacts 11-12 and 21-22 have an approved positive opening mechanism. ⊖ Terminal numbers 11-12 and 21-22 can be used as unlike poles.

■ POSITIVE CONTACT OPENING MECHANISM

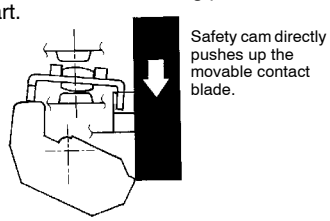
1NO/1NC Contact (Snap-action)

If metal deposition between mating contacts occurs on the NC contact side, they can be pulled apart by the shearing force and tensile force generated when part B of the safety cam or plunger engages part A of the movable contact blade. When the safety cam or plunger is moved in the direction of the arrow, the Limit Switch releases.

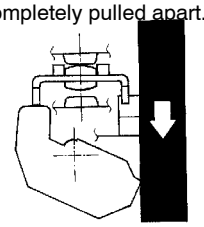
1. When metal deposition occurs.



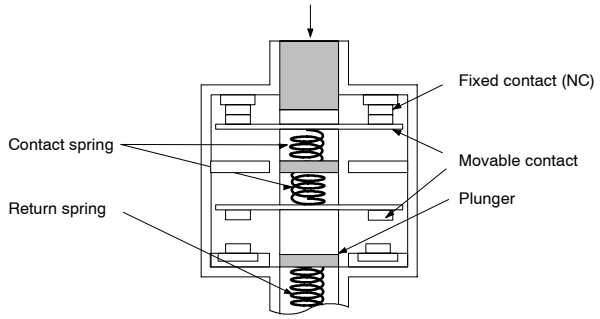
2. When contacts are being pulled apart.



3. When contacts are completely pulled apart.



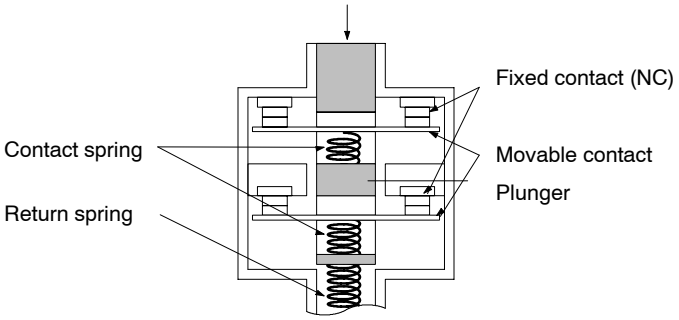
1NC/1NO Contact (Slow-Action)



Conforms to IEC 947-5-1 Positive Opening

When metal deposition occurs, the contacts are separated from each other by the plunger being pushed in.

2NC Contact (Slow-Action)



Conforms to EN60947-5-1

When metal deposition occurs, the contacts are separated from each other by the plunger being pushed in.

is marked on the product to indicate approval of positive opening.

Dimensions

Unit: mm (inch)

Note: 1. Unless otherwise specified, a tolerance of ±0.4 mm applies to all dimensions shown in this section.

2. When placing your order, specify the conduit type by adding a code (see below) to the first blank box in the model number of the selected switch. (For more ordering information, refer to the Model Number Legend, found in the *Ordering Information* of this data sheet.)

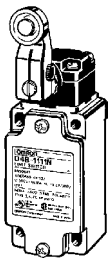
Key for Part No. Code:

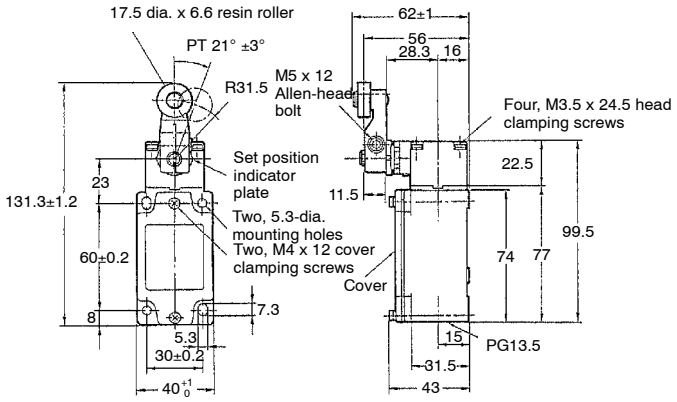
Conduit type for standard switches
1: PG 13.5 (European)
2: G 1/2 (Japanese)
3: 1/2-14NPT (North American)

Conduit type for 3-conduit switches
5: PG 13.5 (European)
6: G 1/2 (Japanese)
7: 1/2-14NPT (North American)

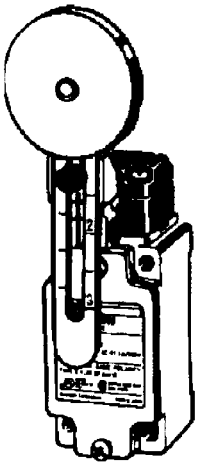
■ SWITCHES

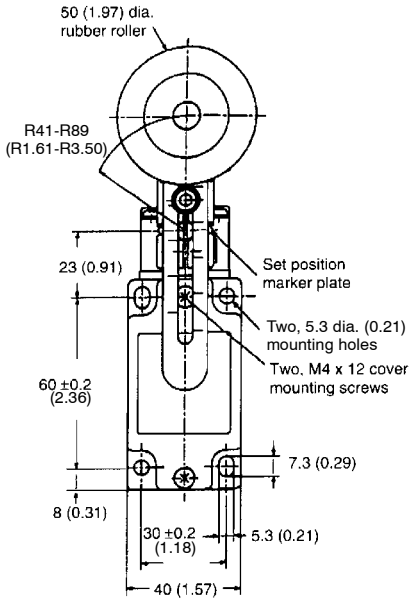
Roller Lever
D4B-□□11N

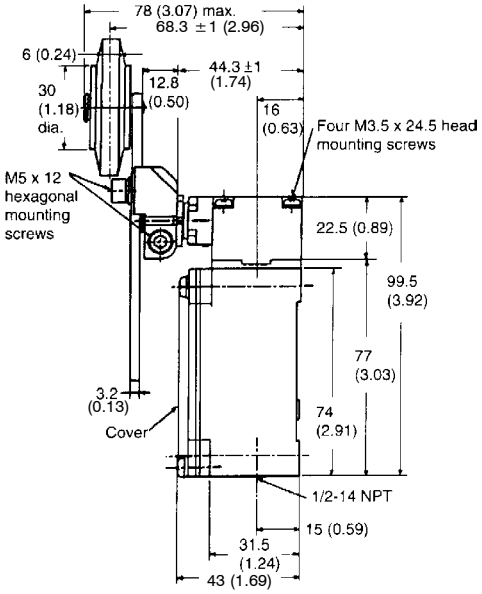




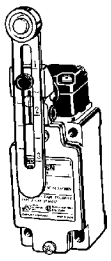
Adjustable Roller Lever Switch, Rubber Roller
D4B-3113N, D4B-3513N, D4B-3A13N

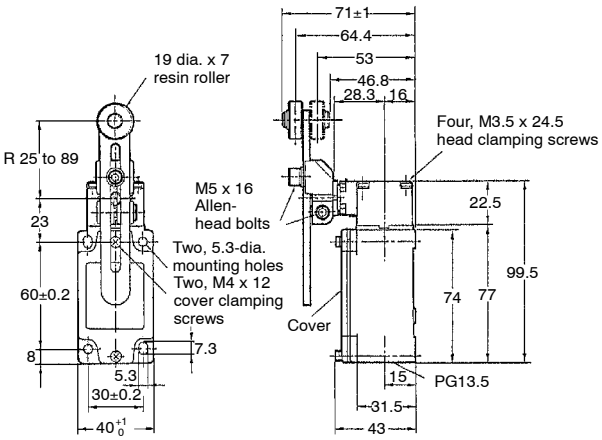




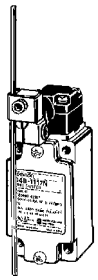


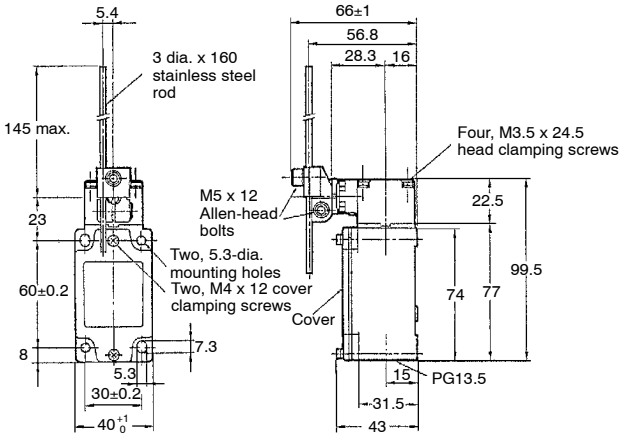
Adjustable Roller Lever
D4B-□□16N



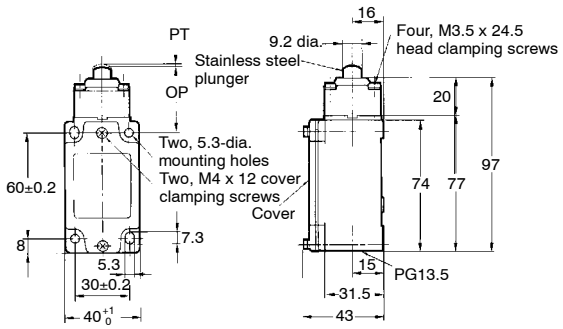


Adjustable Rod Lever
D4B-□□17N

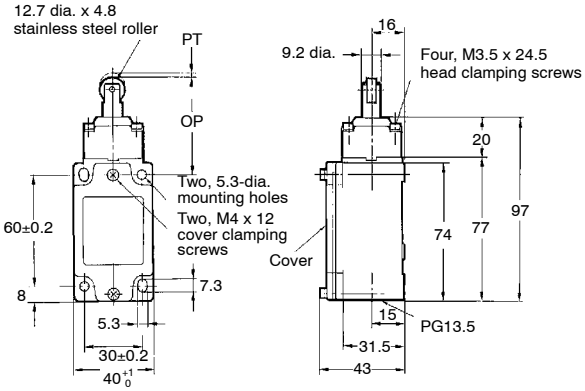




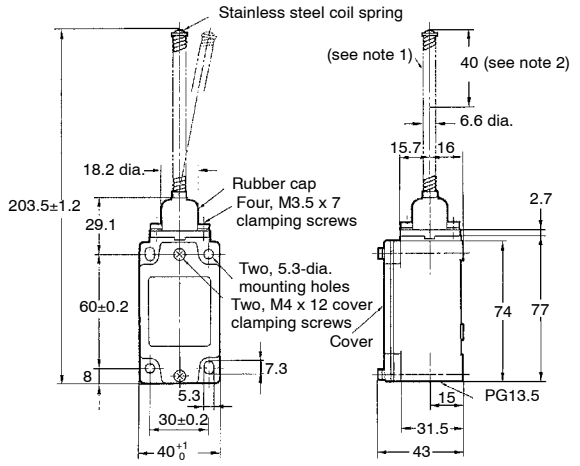
Top Plunger
D4B-□□70N



Top Roller Plunger
D4B-□□71N



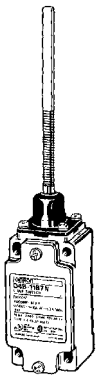
Coil Spring
D4B-□□81N

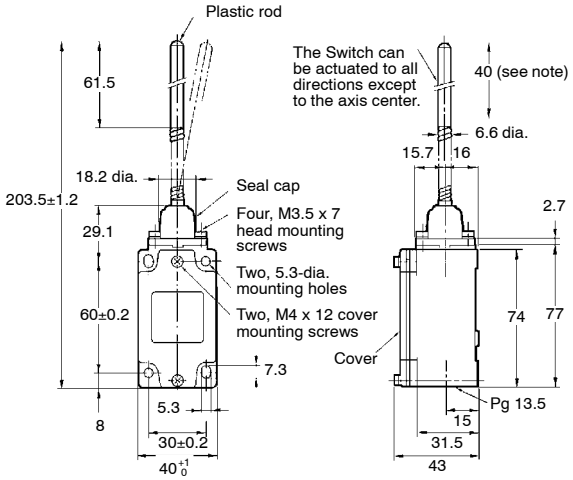


Note: 1. The coil spring may be operated from any directions except axial directions (↓).

2. Be sure to adjust the dog to within 40 mm from the top end of the coil spring.

Plastic Rod
D4B-□□87N

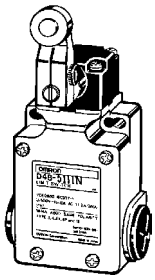


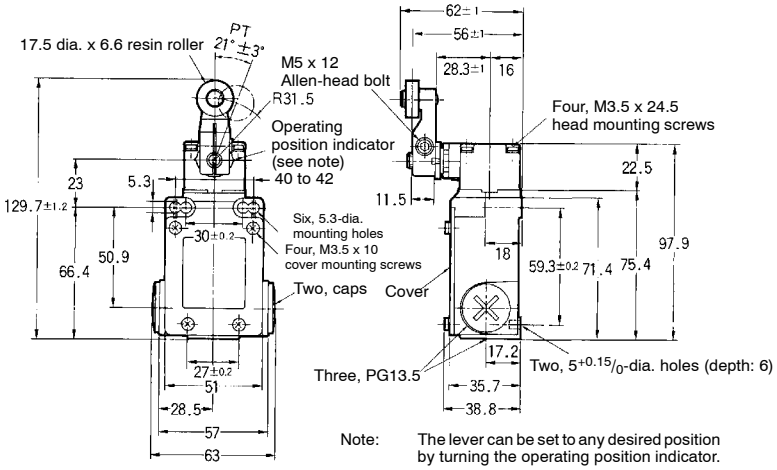


Note: Be sure to adjust the dog to within 40 mm from the top end of the plastic rod.

3-Conduit Switches

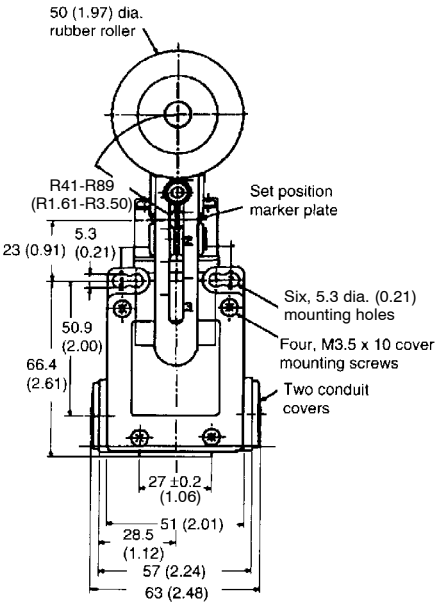
Roller Lever
D4B-□□11N

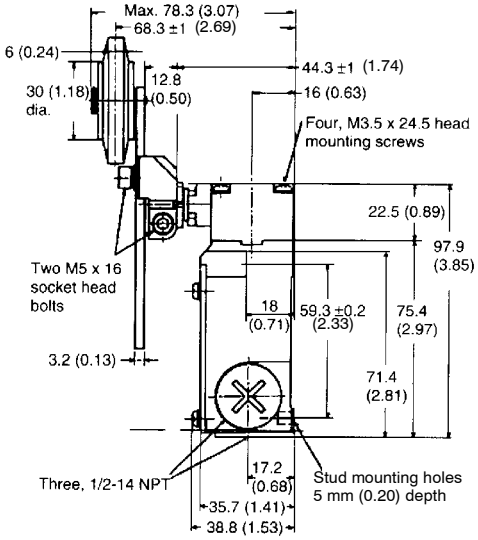




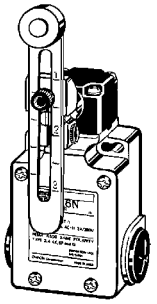
Note: The lever can be set to any desired position by turning the operating position indicator.

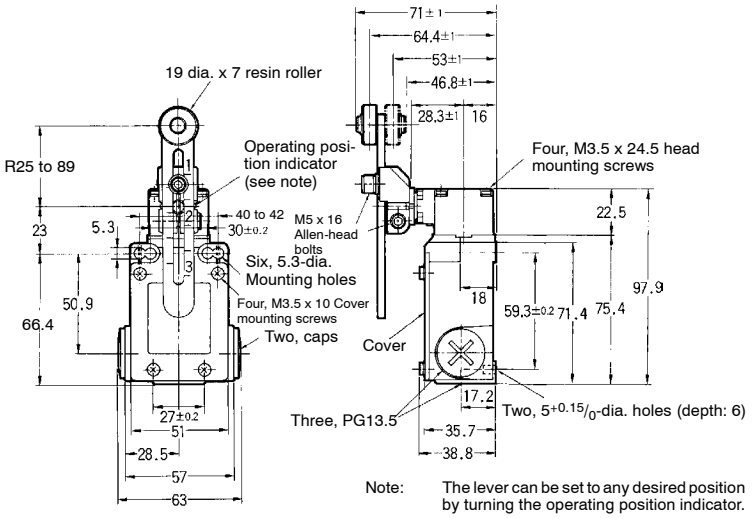
Adjustable Roller Lever Switch, Rubber Roller
D4B-7113N, D4B-7513N, D4B-7A13N





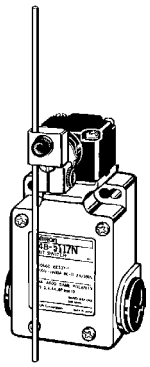
Adjustable Roller Lever
D4B-□□16N

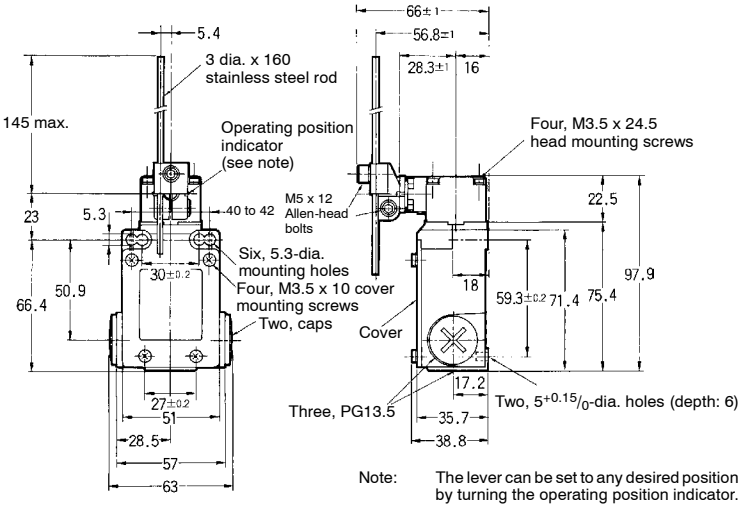




Note: The lever can be set to any desired position by turning the operating position indicator.

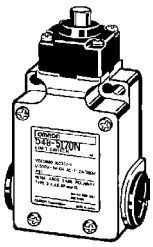
Adjustable Rod Lever
D4B-□□17N

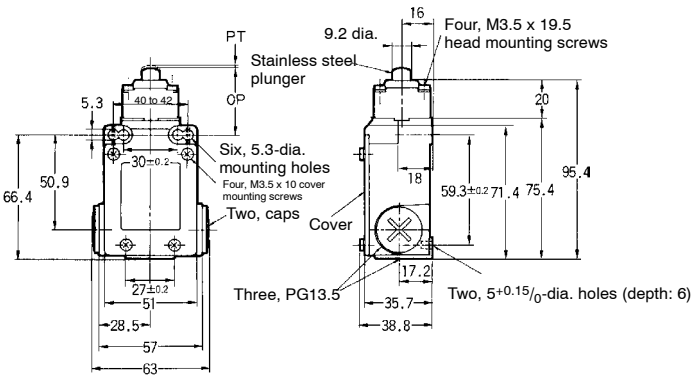




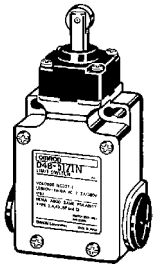
Note: The lever can be set to any desired position by turning the operating position indicator.

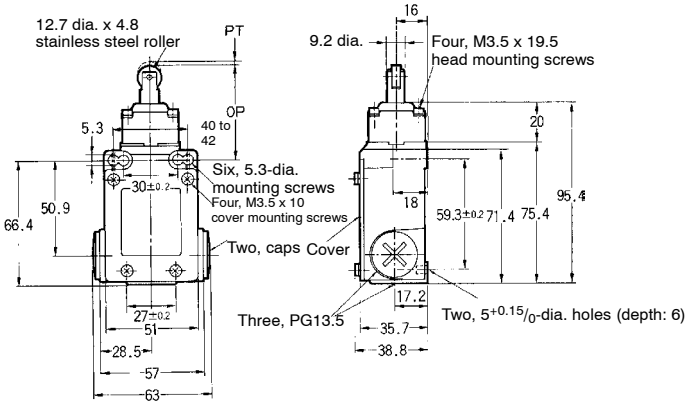
Top Plunger
D4B-□□70N



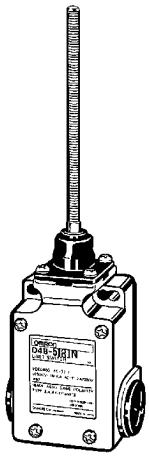


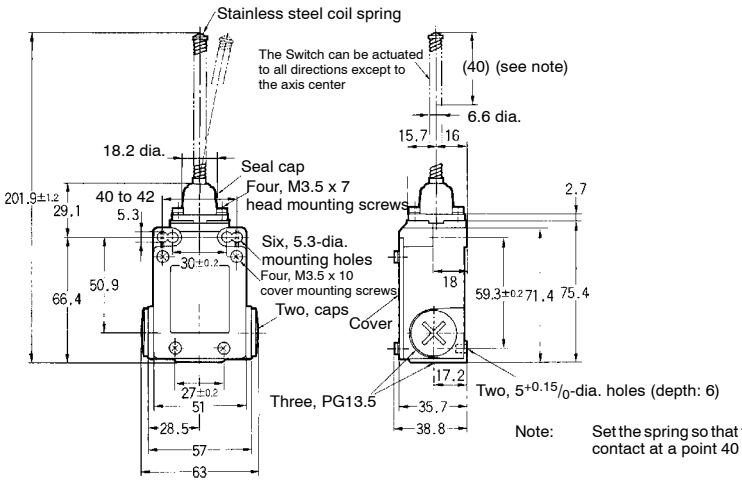
Top Roller Plunger
D4B-□□71N





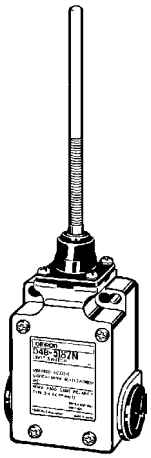
Coil Spring
D4B-□□81N

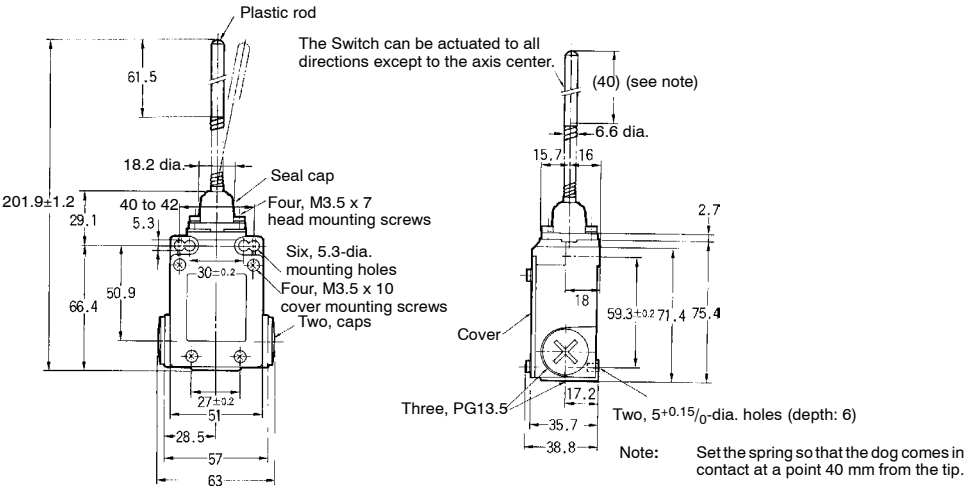




Note: Set the spring so that the dog comes in contact at a point 40 mm from the tip.

Plastic Rod
D4B-□□87N

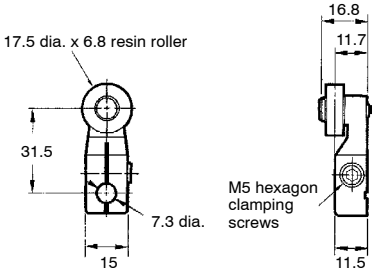




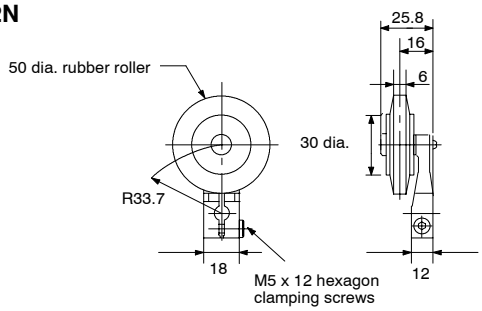
Note: Set the spring so that the dog comes in contact at a point 40 mm from the tip.

■ ROLLER LEVERS

D4B-0001N



D4B-0002N



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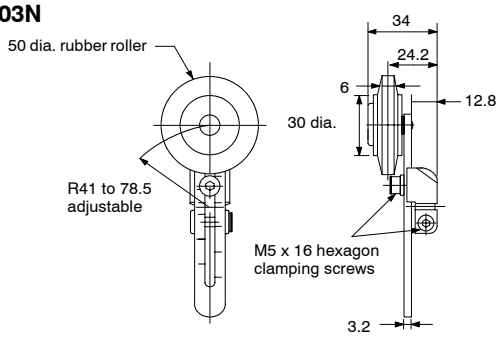

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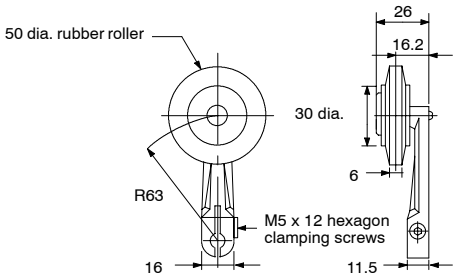

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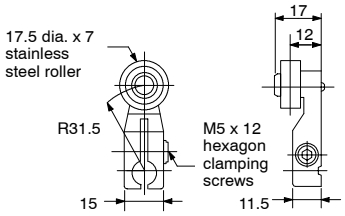

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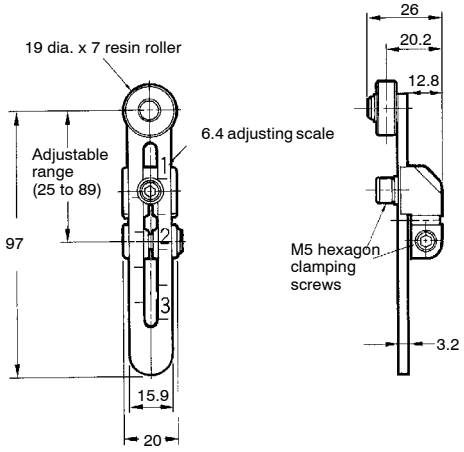

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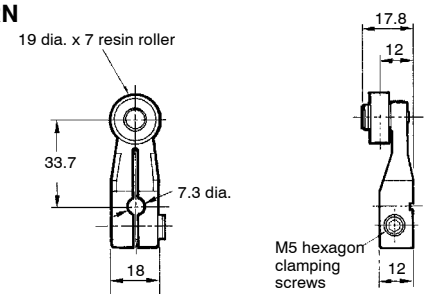

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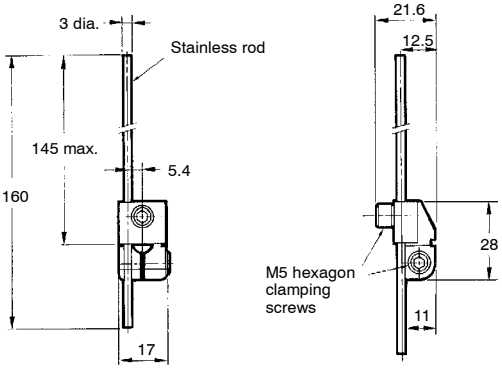
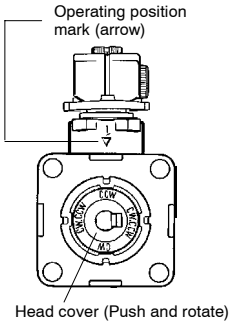


CW, CCW or Two-way Operation

The head of Side Rotary Switches can be converted in seconds to CW, CCW, or two-way operation. The conversion procedure follows.



Procedure

1. Remove the head by loosening the four screws that secure it.
2. Turn over the head to set the desired operation (CW, CCW, or both). The desired operation can be selected by setting the mode selector knob shown in the figure. This knob is factory set to the "CW + CCW" (two-way operation) position.
3. Set the CW hole on the head at the operation position mark (arrow) for clockwise operation or set the CCW hole right at the arrow for counterclockwise operation. In either case, be sure to set the hole position exactly at the arrow point.

Precautions

If the D4B-□N is applied to an emergency stop circuit or safety circuit for prevention of injury, use the D4B-□N model that has an NC contact equipped with a force-separation mechanism, and make sure that the D4B-□N operates in the positive mode. In addition, secure the D4B-□N with screws that are tightened in a single direction so that the D4B-□N cannot be easily removed. Then provide a protection cover for the D4B-□N and post a warning label near the D4B-□N.

In order to protect the D4B-□N from damage due to short-circuiting, connect a fuse breaking a current 1.5 to 2 times higher than the rated current in parallel with the D4B-□N.

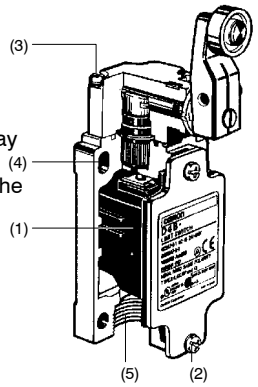
If an application satisfying EN standards is to employ the D4BL, apply the 10-A gI or gG fuse approved by IEC269.

Do not apply the D4B-□N to the door without applying a stopper to the door.

If the D4B-□N is used with the actuator normally pressed, the D4B-□N may malfunction or may soon have reset failures. Be sure to check and replace the D4B-□N regularly.

Tightening Torque

Since loose screws may cause a malfunction, tighten each screw to the appropriate torque.



	Type	Proper tightening torque
1	Terminal screw (M3.5)	0.59 to 0.78 N • m
2	Cover-mounting screw (see note)	1.18 to 1.37 N • m
3	Head-mounting screw	0.78 to 0.98 N • m
4	Switch-mounting screw (M5)	4.90 to 5.88 N • m
5	Connector	1.77 to 2.16 N • m
6	Cap screw (for three-conduit models)	1.27 to 1.67 N • m

Note: Apply a tightening torque of 0.78 to 0.88 N • m to conduit models.

■ CORRECT USE

Operating Environment

The D4B-□N is for indoor use. The D4B-□N may malfunction if the D4B-□N is used outdoors. Be sure to use a model with a lever-type actuator for outdoor use instead.

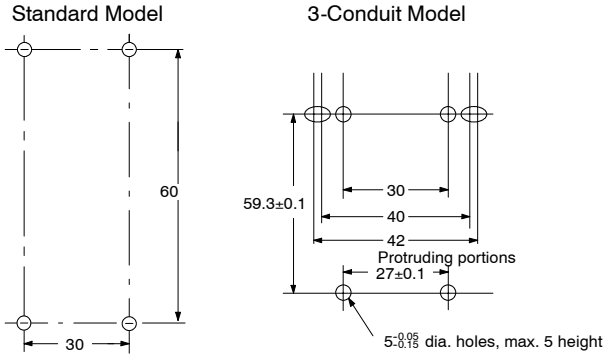
Do not use the D4B-□N in the following places:

- Places with radical temperature changes.
- Places with excessive humidity that may cause condensation.
- Places with excessive vibration.
- Places where metal dust, oil, or chemical may be sprayed to the D4B-□N.

Mounting

Use four M5 screws with washers to mount the standard model. Be sure to apply the proper torque to tighten each screw. The D4B-□N can be mounted more securely by using the four screws plus two 5 $^{-0.05}/_{-0.15}$-mm protruding parts, each of which has a maximum height of 4.8 mm as shown below.

Mounting Dimensions (M5)



Changes in Actuator Mounting Position

To change the angle of the lever, loosen the Allen-head bolts on the side of the lever.

The operating position indicator plate has protruding parts which engage with the lever, thus allowing changes to the lever position by 90°.

The back of the operating position indicator plate has no protruding parts. The lever can be set at any angle by attaching the operating position indicator plate to the Switch so that this side will face the lever. In this case, however, the D4B-□N will not be approved by SUVA or BIA. Make sure that the lever engages with the operating position indicator plate securely so that the lever will not slip.

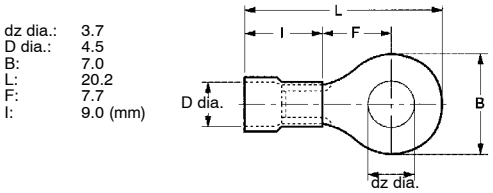
Changes in Head Mounting Position

By removing the screws on the four corners of the head, the head can be reset in any of four directions. Make sure that no foreign materials will penetrate through the head.

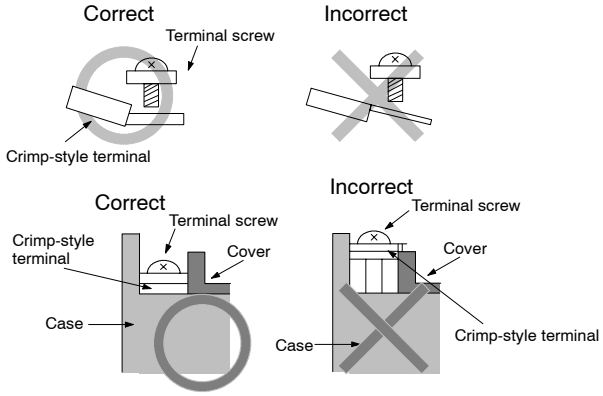
Wiring

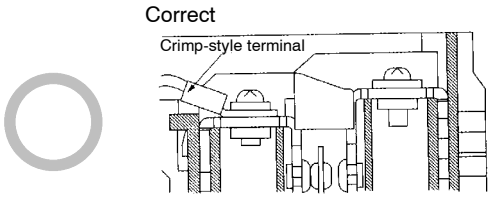
Do not connect the bare lead wires directly to the terminals but be sure to connect each of them by using an insulation tube and M3.5 round solderless terminals and tighten each terminal screw within the specified torque range.

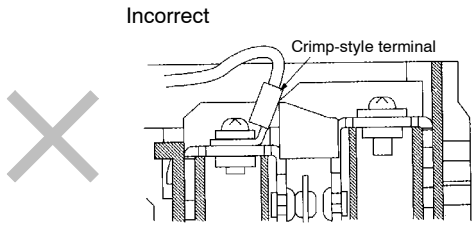
The proper lead wire is 20 to 14 AWG (0.5 to 2.5 mm^2) in size.



Make sure that all solderless terminals come into contact with the casing or cover as shown below, or the cover may not be mounted properly or the D4B-□N may malfunction.







Connector

Make sure that each connector is tightened within the specified torque range. The casing may be damaged if the connector is tightened excessively.

If the 1/2-14NPT is used, cover the cable and conduit end with sealing tape in order to ensure IP67.

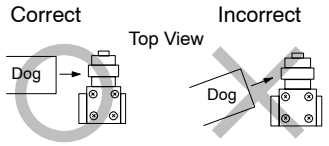
The Pg13.5 connector must be Nippon Flex's ABS-08Pg13.5 or ABS-12 Pg13.5.

Use OMRON's SC-series connector which is suited to the cable in diameter.

Properly attach the provided conduit cap to the unused conduit opening and securely tighten the cap screw within the specified torque when wiring the D4B-□N.

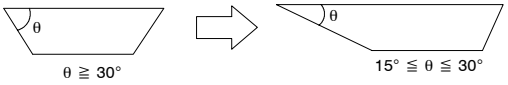
Actuator Load

The load for the actuator (roller) of the Switch must be imposed on the actuator in the horizontal direction, or the actuator or the rotating axis may be deformed or damaged.



When using a long lever model like the D4B-□□16N or D4B-□□17N, the Switch may telegraph. To avoid telegraphing, take the following precautions.

1. Set the lever to operate in one direction. (For details, see the data sheet section: *CW, CCW or Two-way Operation*.)
2. Modify the rear end of the dog to an angle of 15° to 30° as shown below or to a secondary-degree curve.



3. Modify the circuit so as not to detect the wrong operating signals.

ALL DIMENSIONS SHOWN ARE IN MILLIMETERS. To convert millimeters into inches, divide by 25.4

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Cat. No. GC SAFETY-2 2/03 Specifications subject to change without notice Printed in USA

OMRON

Slim Enclosed Limit Switches

D4C

Sealed, Compact, Slim Prewired Limit Switch

- Rugged diecast housing
- Meets UL types 3, 4 and 13
- Triple-sealed construction
- Designed for easy gang mounting
- Rated load of 5 amps, 250 VAC
- Prewired with 3 m (9.8 ft) or 5 m (16.4 ft) of cable

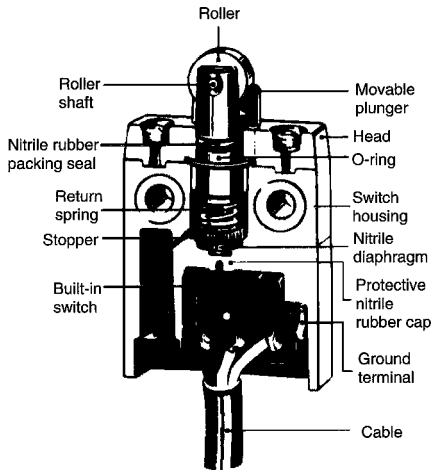
Ordering Information

■ LIMIT SWITCHES

Actuator	3 m (9.8 ft) cable	5 m (16.4 ft) cable (See Note.)
Pin plunger	**D4C-1601**	**D4C-1701**
Sealed plunger	**D4C-1631**	**D4C-1731**
Roller plunger	**D4C-1602**	**D4C-1702**
Sealed roller plunger	**D4C-1632**	**D4C-1732**
Cross roller plunger	**D4C-1603**	**D4C-1703**
Sealed cross roller plunger	**D4C-1633**	**D4C-1733**
Bevel plunger	**D4C-1610**	**D4C-1710**
Coil spring	**D4C-1650**	**D4C-1750**
Roller lever	**D4C-1620**	**D4C-1720**

Note: 5 m cable types are available on special order only.

Construction



Specifications

■ RATINGS

Model	Rated voltage	Non-inductive load				Inductive load				Inrush current	
		Resistive load		Lamp load		Inductive load		Motor load			
		NC	NO	NC	NO	NC	NO	NC	NO	NC	NO
D4C-1□□□	125 VAC	5 A	5 A	1.5 A	0.7 A	3 A	3 A	2.5 A	1.3 A	20 A max	10 A max
	250 VAC	5 A	5 A	1 A	0.5 A	2 A	2 A	1.5 A	0.8 A		
	8 VDC	5 A	5 A	2 A	2 A	5 A	4 A	3 A	3 A		
	14 VDC	5 A	5 A	2 A	2 A	4 A	4 A	3 A	3 A		
	30 VDC	4 A	4 A	2 A	2 A	3 A	3 A	3 A	3 A		
	125 VDC	0.4 A	0.4 A	0.05 A	0.05 A	0.4 A	0.4 A	0.05 A	0.05 A		
	250 VDC	0.2 A	0.2 A	0.03 A	0.03 A	0.2 A	0.2 A	0.03 A	0.03 A		

Note: 1. Inductive loads have a power factor of 0.4 min. (AC) and a time constant of 7 ms max. (DC).
2. Lamp loads have an inrush current of 10 times the steady-state current.
3. Motor loads have an inrush current of 6 times the steady-state current.

■ APPROVED RATINGS

Approval	Standard	File no.
UL	UL508	E76675
CSA	CSA C22.2 No. 14	LR45746

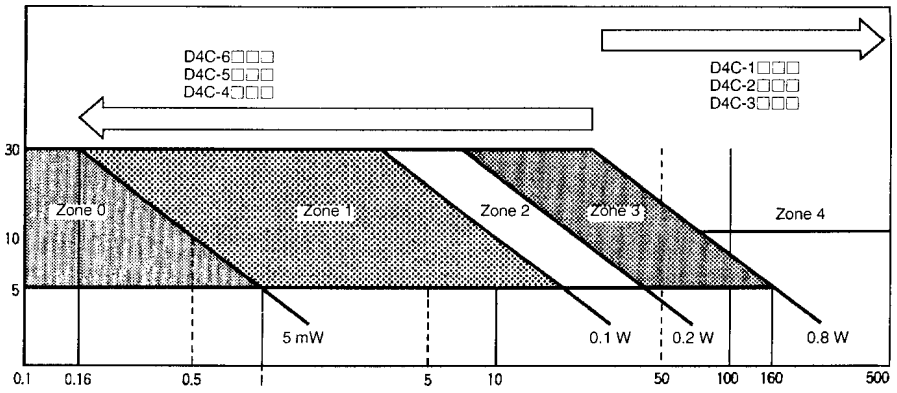
UL/CSA Approved Ratings

B300 (D4C-16□□, -17□□)

NEMA B300 (D4C-16□□, -17□□)

Rated voltage	Current		Voltamperes	
	Make	Break	Make	Break
120 VAC	30 A	3 A	3,600 VA	360 VA
250 VAC	15 A	1.5 A		

Applicable Load Range



■ CHARACTERISTICS

Operating speed		0.1 mm to 0.5 m/s (D4C-oo20:1 mm to 1 m/s)
Operating frequency	Mechanical	120 operations/min
	Electrical	30 operations/min
Insulation resistance		100 MΩ min. (at 500 VDC)
Rated insulation voltage (U_i)		300 V (IEC947-5-1)
Rated impulse withstand voltage (U_{imp})		2.5 kV (IEC947-5-1)
Switching overvoltage		1,000 VAC, 300 VDC max. (IEC947-5-1)
Short-circuit protective device		10 A fuse (type gG) (IEC269)
Conditional short-circuit current		100 A (IEC947-5-1)
Contact resistance		300 mΩ (initial value with 3 m VCTF cable) 400 mΩ (initial value with 5 m VCTF cable)
Dielectic strength		1,000 VAC, 50/60 Hz for 1 min between non-continuous terminals 1,500 VAC, 50/60 Hz for 1 min between current-carrying metal part and ground, and between each terminal and non-current-carrying metal part
Vibration resistance	Malfunction	10 to 55 Hz, 1.5 mm double amplitude
Shock resistance	Destruction	Approx. 1,000 m/s^2 (approx. 100 G)
	Malfunction	Approx. 500 m/s^2 (approx. 50 G)
Ambient temperature	Operating	-10°C to 70°C (14°F to 158°F)
Ambient humidity	Operating	95% max
Operating environmental pollution level		Pollution degree 3 (IEC947-5-1)
Life expectancy	Mechanical	10,000,000 operations min. (at 1.5 to 2 mm OT)
	Electrical	See: *Engineering Data*
Enclosure ratings	UL	Types 3, 4 and 13
	NEMA	Types 1, 3, 3R, 4, 5, 6, 12 and 13
	IEC	IP67
Weight		With 3 m VCTF cable: 360 g With 5 m VCTF cable: 540 g

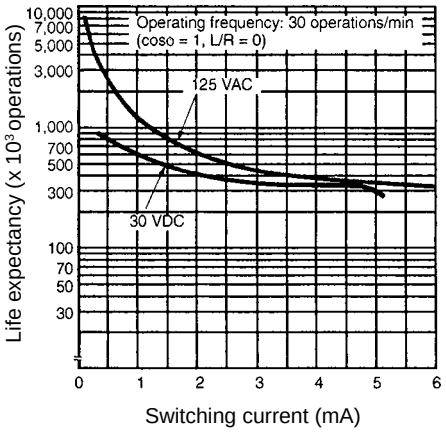
■ OPERATING CHARACTERISTICS

Legend: OF = Operating Force (max.); RF = Reset Force (min.); OT = Overtravel (min.); PT = Pretravel
MD = Movement Differential (max.); OP = Operating Position

Part number	Description	OF	RF	OT	PT	MD	OP
D4C-□□01	Pin plunger	1.2 kg (42.32 oz)	450 g (15.87 oz)	3 mm (0.118 in)	1.8 mm (0.07 in)	0.2 mm (0.008 in)	15.7 ±1 mm (0.62 ±0.04 in)
D4C-□□31	Sealed plunger	1.8 kg (63.49 oz)	450 g (15.87 oz)	3 mm (0.118 in)	1.8 mm (0.07 in)	0.2 mm (0.008 in)	24.9 ±1 mm (0.99 ±0.04 in)
D4C-□□02	Roller plunger	1.2 kg (42.32 oz)	450 g (15.87 oz)	3 mm (0.118 in)	1.8 mm (0.07 in)	0.2 mm (0.008 in)	28.5 ±1 mm (1.12 ±0.04 in)
D4C-□□32	Sealed roller plunger	1.8 kg (63.49 oz)	450 g (15.87 oz)	3 mm (0.118 in)	1.8 mm (0.07 in)	0.2 mm (0.008 in)	34.3 ±1 mm (1.35 ±0.04 in)
D4C-□□03	Cross roller plunger	1.2 kg (42.32 oz)	450 g (15.87 oz)	3 mm (0.118 in)	1.8 mm (0.07 in)	0.2 mm (0.008 in)	28.5 ±1 mm (1.12 ±0.04 in)
D4C-□□33	Sealed cross roller plunger	1.8 kg (63.49 oz)	450 g (15.87 oz)	3 mm (0.118 in)	1.8 mm (0.07 in)	0.2 mm (0.008 in)	34.3 ±1 mm (1.35 ±0.04 in)
D4C-□□10	Bevel plunger	1.2 kg (42.32 oz)	450 g (15.87 oz)	3 mm (0.118 in)	1.8 mm (0.07 in)	0.2 mm (0.008 in)	28.5 ±1 mm (1.12 ±0.04 in)
D4C-□□50	Coil spring	150 g (5.29 oz)	—	—	15°	—	—
D4C-□□20	Roller lever	580 g (20.46 oz)	150 g (5.29 oz)	40°	25°	3°	—

Engineering Data

■ ELECTRICAL LIFE EXPECTANCY



■ CONTACT RATINGS

NEMA B300

■ CONTACT RESISTANCE

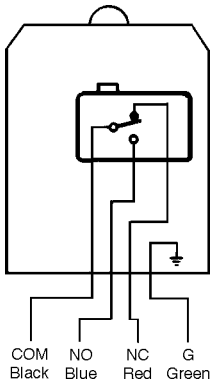
30 mΩ max, initial value with 3 m (9.84 ft) cable

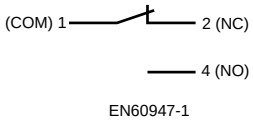
■ ELECTRICAL APPROVALS

UL Recognized, File No. E76675
CSA Certified, File No. LR45746

Operation

■ CONTACT FORM





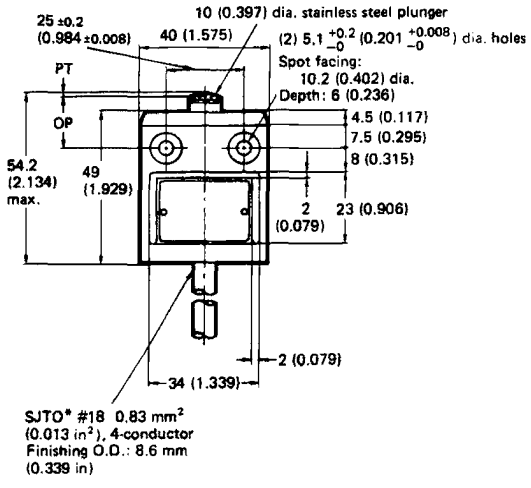
EN60947-1

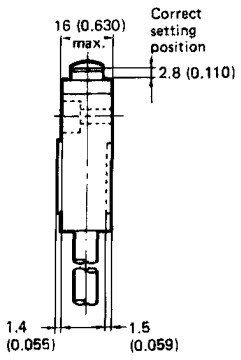
Dimensions

Unit: mm (inch)

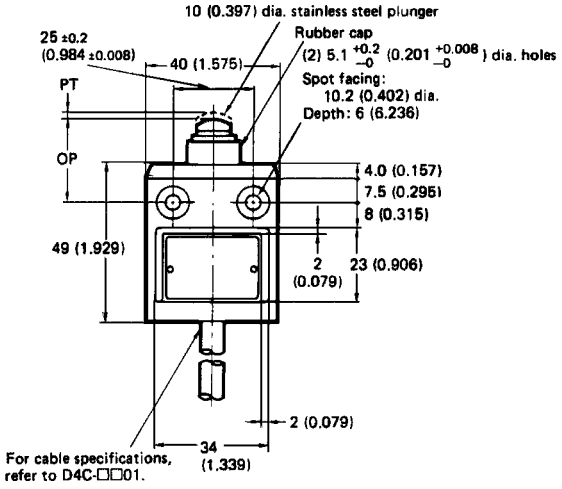
■ LIMIT SWITCHES

D4C-□□01 Pin Plunger Switch

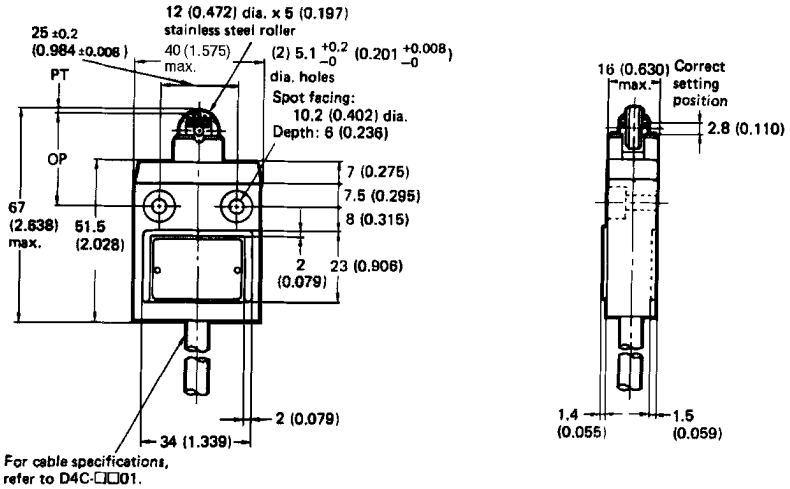




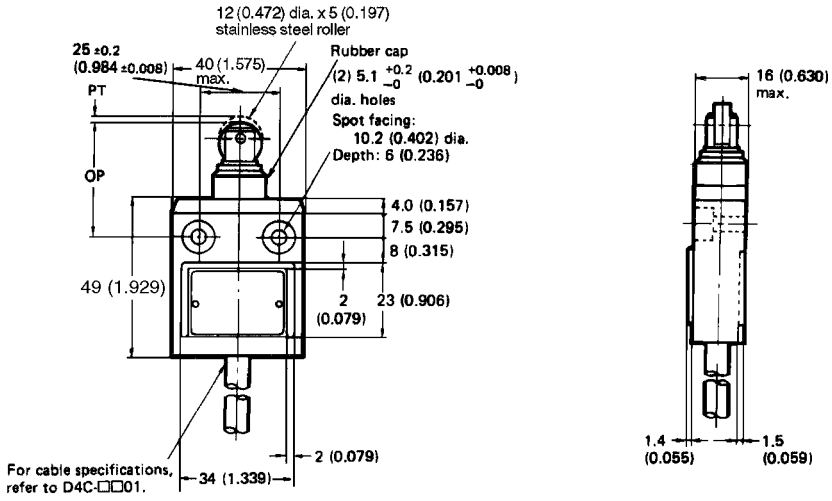
D4C-□□31 Sealed Plunger Switch



D4C-□□02 Roller Plunger Switch

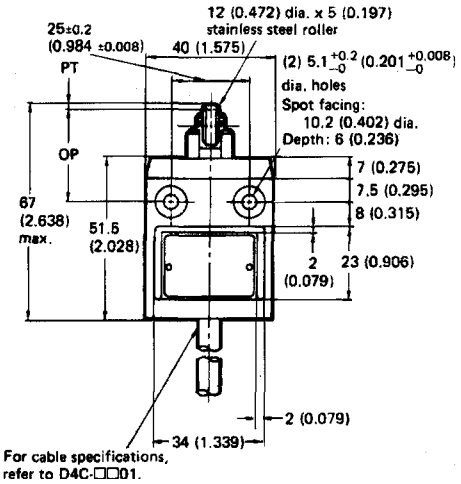


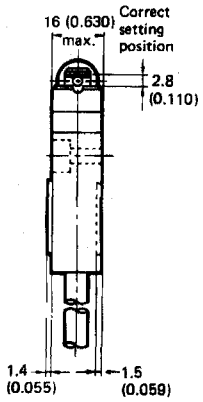
D4C-□□32 Sealed Roller Plunger Switch



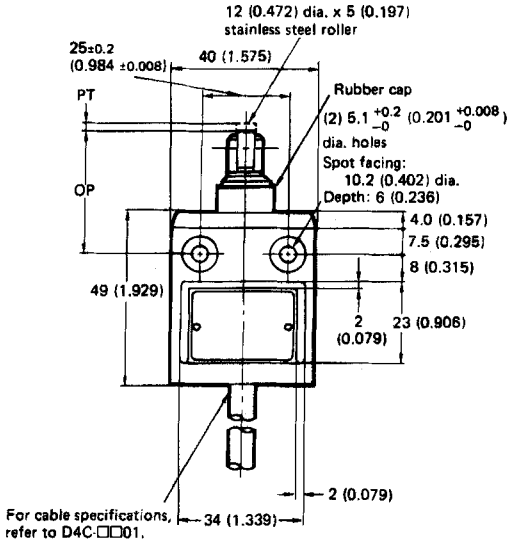
Unit: mm (inch)

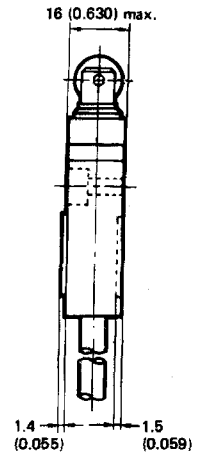
D4C-□□03 Cross Roller Plunger Switch



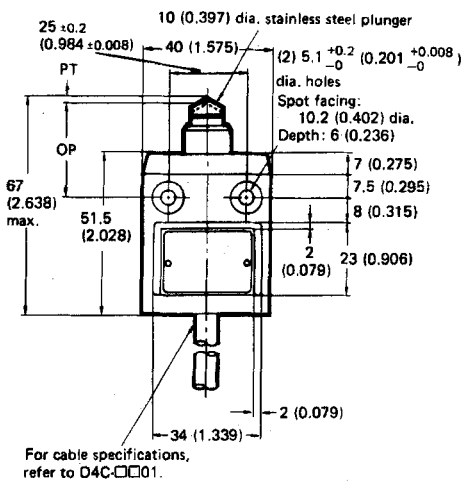


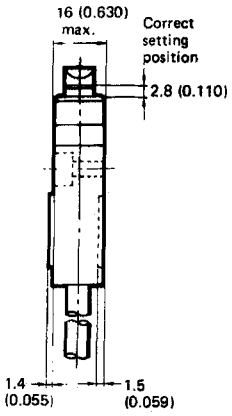
D4C-□□33 Sealed Cross Roller Plunger Switch



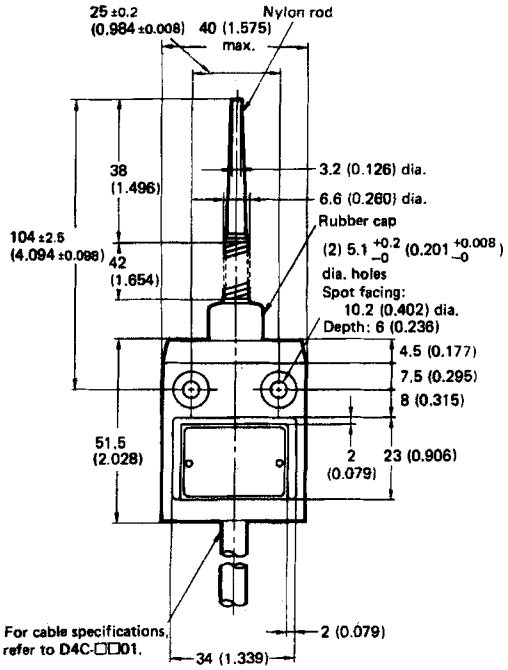


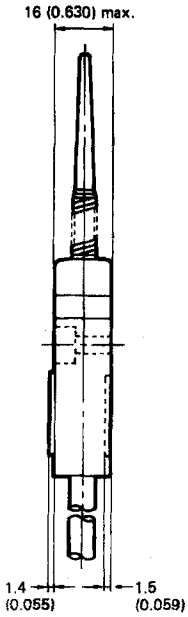
D4C-□□10 Bevel Plunger Switch



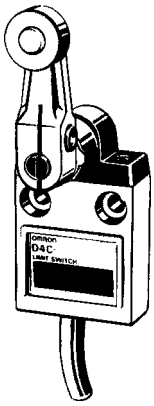


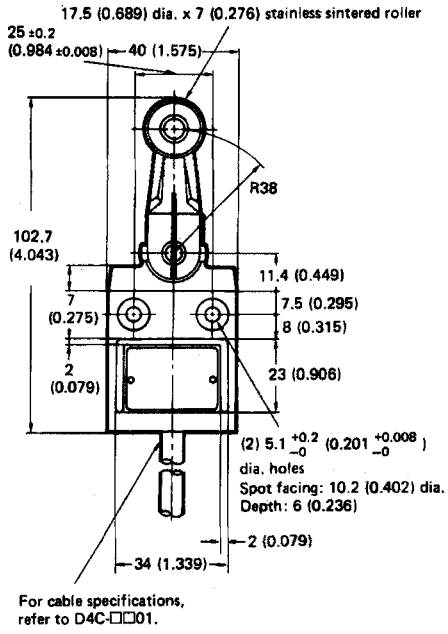
D4C-□□50 Coil Spring Switch

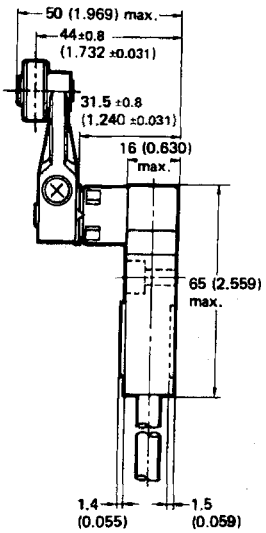




D4C-□□20 Roller Lever Switch

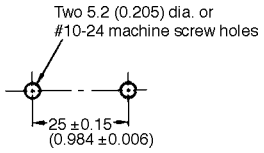






Installation

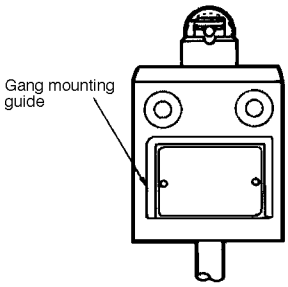
■ MOUNTING HOLES

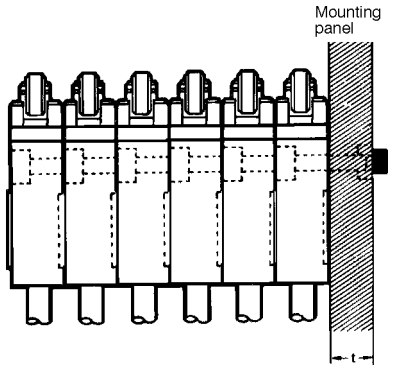


Secure the switch to the mounting panel with two #10-24 machine screws and washers and tighten them from 3.6 ft•lb to 4.3 ft•lb torque.

■ GANG MOUNTING SWITCHES

A maximum of 6 switch units may be gang mounted. See the figures for proper orientation of switches.



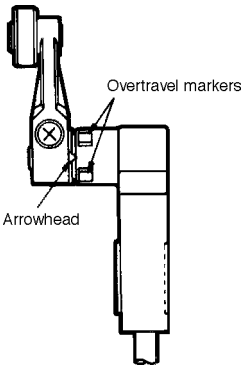


■ PROPER CAM SHAPE

Operation method, shapes of cam and dog, operating frequency, and overtravel have a significant effect on the service life and precision of a limit switch. For this reason, the cam angle should be 30° max. The surface roughness of the cam should be 6.3 microns min., and the hardness of the cam must be about Hv450 (Brinell #425).

■ OVERTRAVEL MARKERS

To allow the roller lever type actuator to travel properly, set the roller lever according to the dog or cam stroke so that the arrowhead of the lever is positioned between the two overtravel markers as shown.



■ CABLE TIE POSITIONING

The bottom of the enclosed switch at the cable outlet is resin-molded. Secure the cable at a point 5 cm (1.97 in) from the switch bottom to prevent exertion of undue force on the cable.

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