

MODEL MT-3000

(TW-3)

S/N # 108

TORQUE WRENCH

THE STATE OF

NEW YORK

IN SENATE

JANUARY

1900

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REPORT

OF THE

COMMISSIONERS

OF THE

LAND OFFICE

FOR THE

YEAR

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****WARNING****

FOR THE PROTECTION OF THE OPERATOR AND YOUR SERVICE EQUIPMENT,
WE RECOMMEND THAT ALL ELECTRICAL SERVICING BE COMPLETED BY A
QUALIFIED ELECTRICIAN.

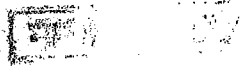
WE STRONGLY SUGGEST THAT AN ELECTRICIAN BE USED WHEN REPLACING
ANY ELECTRICAL COMPONENT. DESIGN CHANGES OR MODIFICATIONS IN
REPLACEMENT PARTS (SUPPLIED THROUGH EITHER WOLFF MANUFACTURING
COMPANY AND/OR AN INDEPENDENT SUPPLY HOUSE) CAN CAUSE SERIOUS
PROBLEMS WITH THE EQUIPMENT AND ITS PROPER OPERATION.

AVOID THE THREAT OF EXTENDED "DOWN TIME" BY HAVING A GOOD SUPPLY
OF THE PROPER REPLACEMENT PARTS ON HAND. THE PART YOU NEED
MAY NOT ALWAYS BE A "KEPT ON SHELF ITEM" FROM OUR PARTS STOCK
INVENTORY.

IF EVER A PROBLEM DEVELOPS WITH A WOLFF PRODUCT THAT REQUIRES
ASSISTENCE, PLEASE CONTACT OUR FACTORY SERVICE DEPARTMENT FOR
HELP IN RESOLVING THIS DIFFICULTY.

THANK YOU,

PARTS ORDER DESK
SERVICE DEPARTMENT
WOLFF MANUFACTURING COMPANY



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WOLFF HYDRAULIC TORQUE WRENCH

THE WOLFF TORQUE WRENCH INCORPORATES MANY NEW FEATURES THAT PROVIDE VARIABLE CONTROLS FOR THE REMOVAL AND RETIGHTENING OF TRACK PADS (SHOES) TO THE TRACK CHAIN. THESE INCLUDE:

1. A PRECISE PRESSURE OR TENSION CAN BE ESTABLISHED WHEN TIGHTENING THE TRACK BOLT. THIS CAN BE ACCOMPLISHED BY USING EITHER A TOTAL TORQUE CAPABILITY OR THE PRE-SET TORQUE PLUS A THIRD OF A TURN CAPABILITY; DEPENDING UPON A USER'S REQUIREMENTS.
2. THE ELIMINATION OF IMPACTING PROVIDED THROUGH THE STEADY AND CONSISTENT HYDRAULIC PRESSURE WILL SAVE ON SOCKETS. NO LONGER WILL YOUR OPERATOR ROUND OUT ONE OR MORE SOCKETS WITH EACH TRACK CHAIN.
3. A LEVER ACTIVATED HYDRAULIC CYLINDER WILL LOCK THE SOCKET TO THE BOLT HEAD. THE VERTICAL TRAVEL RANGE OF THE CYLINDER PERMITS WORKING ALL TRACKS CURRENTLY ON THE MARKET.
4. ELECTRICAL CONTROLS SIMPLIFIED FOR EASE OF OPERATION. THESE INCLUDE:
 - a) A SINGLE ADJUSTABLE INDICATOR SWITCH LETS THE OPERATOR TURN TO A PRESET PRESSURE SETTING AS INDICATED FOR A SPECIFIC BOLT SIZE AND TYPE.
 - b) A BI-DIRECTIONAL JOY STICK IS USED TO LOOSEN OR TIGHTEN THE BOLTS.
 - c) A BI-DIRECTIONAL JOY STICK RAISES AND LOWERS THE WRENCH WHEN LOCKING TO THE BOLT HEAD.
 - d) LARGE, EASY TO REACH START AND STOP POWER SWITCHES.
 - e) TWO POSITION SWITCH FOR EITHER TOTAL TORQUE OR THIRD OF A TURN OPERATIONAL CAPABILITY.
5. TORQUE WRENCH CARRIER FRAME IS LARGER AND STRONGER TO ACCOMMODATE THE TORQUE PRESSURES IN THE WRENCH PLUS THE NEWER AND WIDER PADS BEING USED TODAY.

THE
MUSEUM



INTRODUCTION	i
CONTENTS	iii
LUBRICATION REQUIREMENTS	v
EQUIPMENT SPECIFICATIONS	vi
<u>INSTALLATION</u>	Chapter 1.0
<u>EQUIPMENT IDENTIFICATION</u>	Chapter 2.0
<u>OPERATION</u> (including Torque charts)	Chapter 3.0
<u>MAINTENANCE</u>	Chapter 4.0
<u>TROUBLE SHOOTING</u>	Chapter 5.0
Lifting Mechanism - Main Frame	5.1
Trackbolt Operation - Loosening	5.2
Trackbolt Operation - Tightening	5.3
Component Analysis	5.4
<u>REPLACEMENT PARTS</u>	Chapter 6.0
How to order parts	6.1
Recommended spare parts list	6.2
Main assembly illustration	
(Sheet 1 of 3) P.N. 530-532 Rev. C	6.3
(Sheet 2 of 3) P.N. 530-532 No Rev.	6.5
(Sheet 3 of 3) P.N. 530-532 Rev. B	6.7
TORQUE WRENCH RAIL ASSEMBLY P.N. 530-555 No Revision	6.9
ELECTRICAL SCHEMATIC P.N. 109-252 Revision A	6.11
BOX #1 POWER BOX WIRING/COMPONENT LIST P.N. 109-257 Revision B	6.13
BOX #2 WIRING & COMPONENT ASSEMBLY P.N. 109-258 Revision A	6.15
PUSHBUTTON CONTROL STATION ASSEMBLY P.N. 109-243 Revision B	6.17

TORQUE METER WIRING P.N. 106-048 No Revision	6.18
HYDRAULIC SCHEMATIC P.N. 533-102	6.19
GRAVITY CONVEYOR ASSEMBLY P.N. 530-531 No Revision	6.21
CARRIAGE ASSEMBLY P.N. 530-533 Revision D	6.22-6.23
COLUMN ASSEMBLY P.N. 530-534 Revision A	6.24-6.25
CYLINDER LIMIT SWITCH ASSEMBLY P.N. 530-535 Revision E	6.26-6.27
CLUTCH JAW & SHIFTING CYLINDER P.N. 532-182 Revision D	6.28-6.29
<u>ASSORTED VENDOR'S CATALOGUES</u>	Chapter 7.0
<u>EQUIPMENT WARRANTY</u>	Chapter 8.0

For the proper set-up and operation of the Wolff Torque Wrench, the following guidelines must be followed:

1. CONVEYOR SYSTEM
2. WRENCH RAILS
3. EQUIPMENT LEVELING
4. MATING THE WRENCH ON CONVEYOR SYSTEM
5. HYDRAULIC RESERVOIR TO PRIMING THE PUMP
6. ELECTRICAL HOOKUP.

1. CONVEYOR SYSTEM

For the Torque Wrench to operate correctly and safely, the conveyor system must be structurally capable of reacting to the torque pressures produced by the unit. Please note the following:

- a. Two conveyor stands are recommended to every eight (8) foot section of conveyor.
- b. The wrench rails and gravity conveyor sections must be permanently attached to each conveyor stand.
- c. The entire conveyor assembly must be level in order to permit free travel of the Torque Wrench.
- d. Each conveyor stand is to be bolted to the floor.
- e. REFERENCE THE ILLUSTRATION AND ASSEMBLY INSTRUCTIONS ON PAGES _____ TO COMPLETE THE ACTUAL INSTALLATION OF YOUR CONVEYOR SYSTEM.

2. WRENCH RAILS

A heavier and more durable wrench rail assembly is supplied with the Torque Wrench to help handle the torquing effect of the wrench.

3. LEVELING:

For the Torque Wrench to travel easily along the conveyor system, that entire system must be properly level to prevent beads or kinks in the system. Although the Torque Wrench is heavier than the impact style wrench, the larger travel bearings will permit easy movement along the conveyor once the conveyor is leveled.

4. MOUNTING THE TORQUE WRENCH

Two methods are acceptable for locating the Torque Wrench to the conveyor system.

- a. With the side roller bearings (Item _____ Page _____) on the wrench carrier frame still in place, the unit can be mounted over the conveyor ramp end of the conveyor assembly if the wrench is properly suspended by slings from an overhead hoist.
 1. Once the wrench is resting on the rails, check the adjustment of the wheel guide bearings. Note that these bearings are guides only and should not be overly tightened.
 2. Some conveyor ramps may be located in such a position that the steel guide roller may have to be removed to provide clearance for mounting the wrench.
- b. With the wrench frame balanced on the forks of a lift truck and the side rail guide bearings temporarily removed, simply lower the unit until the travel wheels center to the wrench rails. Reattach the guide bearings and adjust them for safe travel along the rail system. Note that these bearings are guides only and should not be overly tightened.
- c. A bolt or welded tab should now be located at the end of the conveyor assembly to prevent the wrench from running off the rail.

5. FILLING THE RESERVOIR/PRIMING THE PUMP

C A U T I O N !

NEW OIL IS NOT ALWAYS CLEAN OIL! WHENEVER THE OIL IS CHANGED, USE A 10 MICRON PRE-FILTERING SYSTEM AND PUMP FROM THE TOP OF THE BARREL TO MINIMIZE THE CHANCE OF CONTAMINATION.

- a. Add 20 gallons (75.70 liters) into the reservoir through the screened breather cap port. Use a premium quality hydraulic oil with a viscosity range between 150-250 ssg (30-50 CST.) at 100°F. (38°C.). Normal operating viscosity range between 80-1000 SSU (17-180 CST.) Maximum start-up viscosity is 4000 SSS (1000 CST).
- b. Priming the pump - since the unit is a self primer, run the motor for several minutes after rotation has been established and the reservoir fluid level has been checked to purge air from the casing and lines.

NOTE: FOR PROPER MOTOR ROTATION - REFERENCE "ELECTRICAL HOOKUP"

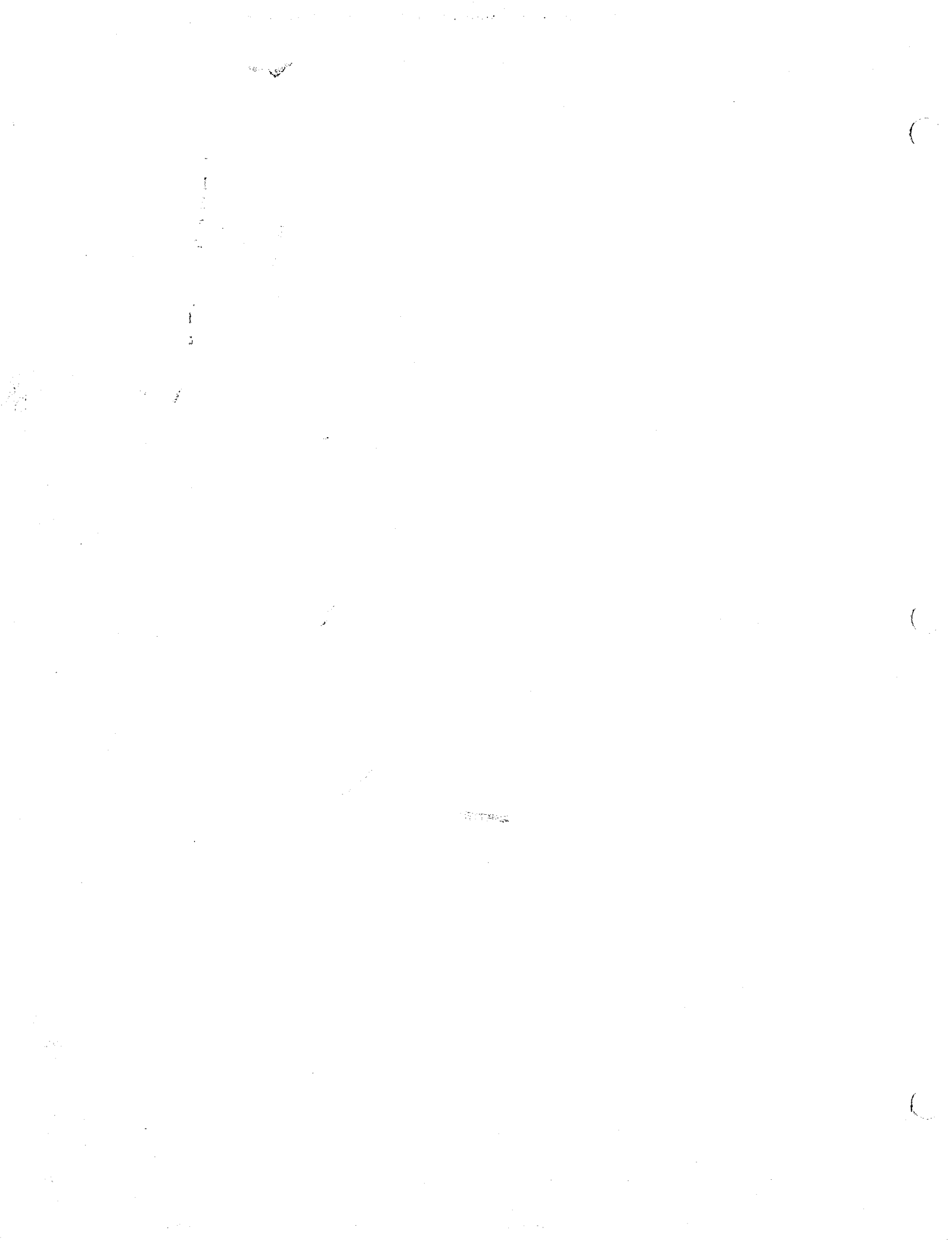
6. ELECTRICAL HOOKUP

- a. Input power to the wrench must be run through a wall disconnect switch..

C A U T I O N !

THE MAIN POWER CABLE MUST BE RUN THROUGH A WALL BREAKER BOX. WHENEVER THE WRENCH IS LEFT UNATTENDED OR WHENEVER THE UNIT IS TO BE SERVICED, THE BREAKER BOX MUST BE IN THE OFF POSITION.

- b. The electrical cable should be suspended along a guide wire to keep it off the floor in order to avoid possible interference during track handling.
- c. Jog the motor to check rotation. There is an indicator arrow on the motor which shows a clockwise rotation when viewed from the fan end.
- d. The Programmable Controller has a key lock. For the unit to function, the key must be turned to the "Run" position. Remove the key and store in safe and secure location.



This chapter is offered to permit the machine operator and maintenance personnel a ready reference guide to the controls and control functions of the wrench.

In order to simplify our explanation, we will break this chapter down to three basic sections. These include:

- a. MECHANICAL
- b. ELECTRICAL
- c. HYDRAULIC

The components that will be discussed are all shown in one or more of the assembly illustrations in the replacement parts section of this manual. Please reference them as needed.

CAUTION!

BEFORE ACTIVATING THE WRENCH COMPONENTS, DOUBLECHECK THE SETUP INSTRUCTIONS DETAILED IN THE INSTALLATION CHAPTER.

WARNING!

THE ALTERATION OF ANY PART OF THE WRENCH'S COMPONENTS OR THE USE OF ANY PART OF THE MACHINE IN A MANNER OTHER THAN THAT FOR WHICH IT WAS DESIGNED WILL BE AT THE OPERATOR'S OWN RISK. SUCH ACTIONS RESULTING IN THE MISUSE OF ANY PART OF THE EQUIPMENT MUST NECESSARILY VOID THE EQUIPMENT'S WARRANTY.

A. MECHANICAL COMPONENTS

1. For the wrench carrier frame to travel smoothly along the length of the conveyor assembly, that assembly must be level, free of twists and properly spaced. The side guide bearings on the wrench carrier must be tightened just enough to let the carrier frame travel freely while holding the larger travel bearings on the top side of wrench rail channel.
2. Make at least a weekly check of all hoses, tubes, cables and assorted fasteners to be certain that they are in an operable state.
3. The following locations should be checked and greased every two to three months or as needed.
 - a. Pivot bearing on stroking cylinder.
 - b. Coupling between hydraulic motor and main drive shaft; remove large plug in motor mount casing and rotate shaft until zerker fitting is exposed.
 - c. All four carrier wheel bearings.
 - d. Three fittings on main frame lifting cylinder assembly.
4. There is a red pop-up indicator on the system's main filter. If this should ever rise above the lip of the metal casing,

- it will be indicating blockage in the filter creating a back pressure on the return line. Replace and clean filter element and replace the system's oil if necessary.
5. The main intake suction screen should be checked and cleaned or replaced as needed whenever the oil is changed.
 6. The filler/breather cap screen is used to screen out bulky contaminant when filling the main reservoir. It should be checked and cleaned as necessary.
 7. The clutch jaw teeth are secured to the upper and lower clutches with fasteners held with a locktite compound. At least once a month these fasteners should be checked to be certain that they have not loosened. Always retighten with a locktite type sealant.
 8. The clutch jaw mechanisms are spaced on the main drive shaft with snap rings. If the clutch jaws fail to engage, check the snap rings both top and bottom of each clutch.
 9. The clutch jaw is raised and lowered by a lifting yoke locked to the clutch jaw lifting cylinder. Set screws are recessed into dimpled shaft.

B. ELECTRICAL

1. Front Panel - System's operational controls:
 - a. Start button - P/N 117-081. Used to start the electric motor to develop system pressure.

NOTE: WHEN THE GREEN POWER-ON LIGHT IS ILLUMINATED, THERE IS CURRENT TO THE FRONT PANEL WHETHER THE ELECTRIC MOTOR IS OPERATING OR NOT. NO ENTRY TO PANEL BOX FOR SERVICING UNLESS CURRENT WALL DISCONNECT SWITCH IS OFF AND GREEN LIGHT IS EXTINGUISHED.

- b. Power on light - P/N 105-008. When illuminated, this light signals that there is control power to the front panel. It does not indicate if the electrical drive motor is operating.
- c. Torque Light - P/N 105-007. When full torque is achieved in either the Total Torque or Torque turn modes, this light will illuminate indicating that all control functions have now ceased.
- d. Stop pushbutton - P/N 117-080. In order to disengage the electric motor, the Stop button must be depressed.
- e. A or B bolt style designation switch - P/N 117-079. Positional settings for this switch to be determined by the track guide chart. Its function is either to permit or prohibit the stroking cylinder from aiding in the initial torque development prior to the engagement of the third of a turn (torque turn) sequence.
- f. Loosen/Tighten joystick - P/N 117-082. Three position heavy duty control switch.
 - 1) Center position is neutral.
 - 2) Handle raised turns drive shaft counter-clockwise.
 - 3) Handle lowered turns drive shaft clockwise.
- g. Raise/Lower joystick - P/N 117-082. Three position heavy

duty control switch.

- 1) Center position is neutral.
 - 2) Handle raised will cause the entire wrench frame to rise on the center column.
 - 3) Handle lowered will cause the entire wrench frame to lower on the center column.
- h. Machine Mode switch - P/N 117-079.
- 1) In Total Torque, the wrench will develop whatever pressure is dialed into the meter relay controller and then pressure will drop back to the at-rest position.
 - 2) In Torque Turn, the wrench will develop whatever pressure is dialed into the meter relay controller and then the programmable controller will initiate the stroking cylinder to turn the drive shaft an additional 1/3 of a turn before resetting to the at-rest position.
- i. Torque controlling meter - P/N 106-048. Whenever a specific torque rating is desired, set the meter control dial to the PSI setting designated by the bolt tightening chart for a particularly sized bolt. When the system senses that the correct pressure has been achieved, the meter relay will trip and send the machine back into an at-rest position.
2. Power Box No. 1 for main control power input.
- a. Main transformer - P/N 123-079. Provides control voltage to the wrench.
 - b. Starter - P/N 123-078. Built in reset control to protect against power overload.
 - c. Control voltage fuse - P/N 103-019. Control power is protected by a 5 amp, slo-blow fuse.
- Note* → 3. Power Box No. 2 for operational control of wrench components.
- a. 10 VOLT power supply - P/N 113-008. Provides control power for pressure transducer and meter relay controller.
 - b. Programmable controller with memory - P/N 107-028. Provides operational signals to specific wrench control systems.
4. Miscellaneous electrical components:
- a. 5 H.P. electric motor - P/N 108-028. Prime mover for wrench hydraulic system.
 - b. Pressure Transducer - P/N 525-272. This component is used to register system pressure within the unit for the purpose of regulating specific control functions.
 - c. Limit switches on stroking cylinders - P/N 117-073. Used to limit the stroke on the "Stroking Cylinder" during the torque turn sequence. Note: When the wrench is in the "At Rest" position, the stroking cylinder rod should be extended and indicator light 1.04 should be illuminated.
 - d. Control valve solenoids:
 - 1) Hydraulic motor and lifting yoke solenoid valve - P/N 531-210. Located on the large manifold block closest to the hydraulic motor.
 - 2) Stroking cylinder solenoid valve - P/N 531-223. Only single solenoid valve in the system. It is the middle of three valves on the manifold block.

WOLFF

- 3) Main frame lifting cylinder control solenoid valve - P/N 531-226. Used to raise and lower wrench for positioning of socket to track bolt.
- 4) Main system pressure control solenoid - P/N 531-209.

C. HYDRAULIC COMPONENTS

1. Hydraulic motor - P/N 531-206. Drive component that rotates tightening/loosening shaft either clockwise or counter-clockwise.
2. Hydraulic pump - P/N 531-208. Provides system pressure from 0-3000 PSI as required.
3. Lifting cylinder - P/N 531-207. Raises or lowers the entire wrench frame for proper positioning of socket to bolt head.
4. Stroking cylinder - P/N 531-194. Used to help achieve total torque level upon certain circumstances or to turn the tightening shaft the 1/3 of a turn required for total torque operations.
5. Clutch cylinder - P/N 531-205. Used when changing directions on the drive shaft. Under pressure, the cylinder retracts the center clutch jaw into the UP position when loosening; conversely, it extends the rod to the down position for tightening.
6. Solenoid valves: Please refer to the Electrical section for a brief description of these valves.
7. Dual cross-over check valve for lifting cylinder - P/N 531-211. Prevents the cylinder from drifting.
8. Pressure relief valve for lifting cylinder - P/N 531-213. Pre-set at _____ PSI on the retract side of the cylinder to provide protection for the cylinder.
9. Dual cross-over valve for the hydraulic motor and clutch lifting cylinder - P/N 531-216. Pre-set at 3000 PSI to provide protection against system pressure overload.
10. Flow control valves - P/N 531-215. Used to cushion cylinder action by restricting flow to a safe but operable level.
11. Relief valve - P/N 531-212. Pre-set at 3200 PSI to provide protection against system pressure overload.
12. Pop-up filter element system - P/N 527-834. When red pop-up button raises above the housing it indicates excessive system back pressure. A replaceable filter element (P/N 527-870) can either be cleaned or replaced.

W A R N I N G !

1. THIS HYDRAULIC UNIT OPERATES UNDER PRESSURE. THE OPERATOR MUST WEAR SAFETY GLASSES AND FOLLOW ANY OTHER SPECIFIC REGIONAL SAFETY CODES.
2. WHEN TRACK BOLT NUTS ARE HELD WITH ANY TYPE OF TOOL, THE TOOL MUST BE LONG ENOUGH TO EXTEND BEYOND THE WRENCH CARRIER FRAME. THIS WILL KEEP HANDS AND FINGERS CLEAR OF ANY CONTACT SURFACES.
3. THE WRENCH RAISES AND LOWERS THROUGH CYLINDRICAL ACTION. THEREFORE, THE OPERATOR MUST KEEP HIMSELF AND ALL WORK ITEMS CLEAR OF THE TRAVEL AREA. THE TOP PLATE OF THE CARRIAGE FRAME IS NOT A STORAGE SHELF AND MUST NOT BE USED AS SUCH.

1. The Magnetic Starter is mounted in Box #2 and must be energized through a wall disconnect switch before using the wrench.
2. An illuminated PUSH TO START switch will open control power to the wrench operational controls.
3. A large red safety PUSH TO STOP button switch will immediately kill power to the wrench proper but there will still be power to the transformer. The wall disconnect switch must be turned off before servicing.
4. An Equipment "In Operation Light" (RUN LIGHT) will indicate when power is established to the wrench.
5. A Torque Achieved (TORQUE LIGHT) indicates when a pre-established torque rating has been achieved. The torque adjustment range is a variable for working different bolt sizes.
6. The wrench is set to work two different operational modes.
 - a) TOTAL TORQUE -- In this position, the wrench will develop a torquing pressure equal to a preset mark indicated on the torque/PSI meter. This setting is variable for the different bolt sizes.

- b) TORQUE TURN - In this position, the wrench will also develop a torquing pressure equal to a pre-set mark indicated on the torque/P.S.I. meter. Once this setting has been achieved, the unit will automatically storke the bolt to achieve an additional 1/3 of a turn. Again, the bese setting through the meter is adjustable for any given bolt size.
7. A variable torque/P.S.I. control meter is used to control the working limits of the torque wrench. By adjusting the range of the meter/scale, the sensors permit more or less torquing pressure to be developed to meet the requirements of a particular bolt size.
8. A two position "Bolt Type" switch is used when establishing the correct torque rating for a particular bolt type. Reference the Operational Chart to determine if Position "A" or "B" is to be used.
9. A three position joystick determines the height of the wrench to the track by controlling the lifting cylinder built into the column's center base. Extenting the ram by raising the joystick will raise the wrench. Lowering the handle will bring the wrench down to the work surface.
10. A second three position joystick is used to either loosen or tighten the track bolts.
- a) LOOSEN -- when breaking a bolt loose, the wrench operates at a non-adjustable pre-set high torque setting. As soon as the bolt begins to spin fairly free with only limited resistance, an electrical sensing unit puts the wrench into a lower torque higher speed mode.
- b) TIGHTEN -- With the joystick in the lower (TIGHTEN) position, the wrench will spin the bolt at a higher speed and lower torque until a certain level of resistance is effected through the bolt. At this point the electrical sensing system will switch the unit into a slower speed high torque mode until the range set on the adjustable torque/PSI meter has been achieved.

OPERATIONAL INSTRUCTIONSDISASSEMBLY

1. Turn on the wall disconnect switch to the wrench assembly.
2. Push the START switch to put control power to the wrench proper
3. Pick the appropriate MACHINE MODE to operate either the Total Torque or the Torque Turn Mode.

NOTE: WHEN DISASSEMBLING TACK BOLTS, MAXIMUM TORQUING PRESSURE MAY BE DEVELOPED IN EITHER OPERATIONAL MODE POSITION.

4. The wrench carriage rolls along the rail system and is to be located over the track bolt. When the head position joystick is used to lower the wrench to bolt, the socket can be quickly aligned to the bolt head. Even if the socket does not set to the head of the bolt, it will normally drop into position as soon as the shaft is turned.
5. With the wrench locked down to the bolt, use the OPERATION JOYSTICK in the UP (LOOSEN) position to break the bolt loose and then speed spin and nut clear.
6. Raise the wrench and locate it to the next bolt.
7. Repeat Steps 4 through 6 until all bolts have been loosened.

ASSEMBLY

1. Turn on the wall disconnect switch to the wrench assembly.
2. Push the START switch to put control power to the wrench proper.
3. Pick the appropriate MACHINE MODE to operate either the Total Torque or the Torque Turn Mode.
4. Check the BOLT TORQUING REFERENCE CHART to set the torquing limits on the torque/P.S.I. meter on the front panel. The left hand adjustment knob is used to make the proper scale setting.
5. Again, according to the reference chart, pick position "A" or "B."
6. The wrench carriage rolls along the rail system and is to be located over the track bolt. Use the HEAD POSITION JOYSTICK to lock the socket to the bolt.
7. By putting the OPERATION JOYSTICK into the TIGHTEN mode, the wrench will speed spin the bolt until a certain amount of resistance is effected. At this point, the electrical sensing system engages which switches the tightening operation into the slower, high torque capability until the desired torquing pressure is achieved.
8. Raise the wrench and locate it to the next bolt.
9. Repeat Steps 5 through 7 until all bolts have been properly tightened.

TRACTOR MODEL (CATERPILLAR)	BOLT SIZE	TORQUE - TURN
	7/16 - 20	—
	1/2 - 20	—
D3 - 931	9/16 - 18	65 ± 15 lb-FT PLUS 120 ± 5
D5-D4-953 951-943-941	5/8 - 18	120 ± 30 lb-FT PLUS 120 ± 5
D7-D6-977 973-955	3/4 - 16	220 ± 40 lb-FT PLUS 120 ± 5
D8-983	7/8 - 14	250 ± 50 lb-FT PLUS 120 ± 5
D8L	7/8 - 14	480 ± 50 lb-FT PLUS 120 ± 5
D9nc	1 - 14	400 ± 50 lb-FT PLUS 120 ± 5
D9L	1 - 14	650 ± 50 lb-FT PLUS 120 ± 5
D10	1 1/8 - 12	650 ± 50 lb-FT PLUS 120 ± 5

TOTAL - TORQUE	MACHINE MODE SELECTOR SWITCH	A - B SELECTOR SWITCH	PRESSURE SETTING P.S.I.
80 ± 15 lb-FT	TOTAL TORQUE	B	747
130 ± 20 lb-FT	TOTAL TORQUE	B	1214
—	TORQUE TURN	B	607
—	TORQUE TURN	B	1121
—	TORQUE TURN	B	2054
—	TORQUE TURN	B	2334
—	TORQUE TURN	A	480
—	TORQUE TURN	A	400
—	TORQUE TURN	A	650
—	TORQUE TURN	A	650

DESTROY ALL

DEC - 6 1984

PREVIOUS DRAWINGS

PROPRIETARY INFORMATION
NOT TO BE USED WITHOUT
WRITTEN PERMISSION FROM
WOLFF MANUFACTURING CO.

MT3000(TW-3)

C.B. GILL	11/9/83	WOLFF MFG CO.	B 101-533-104
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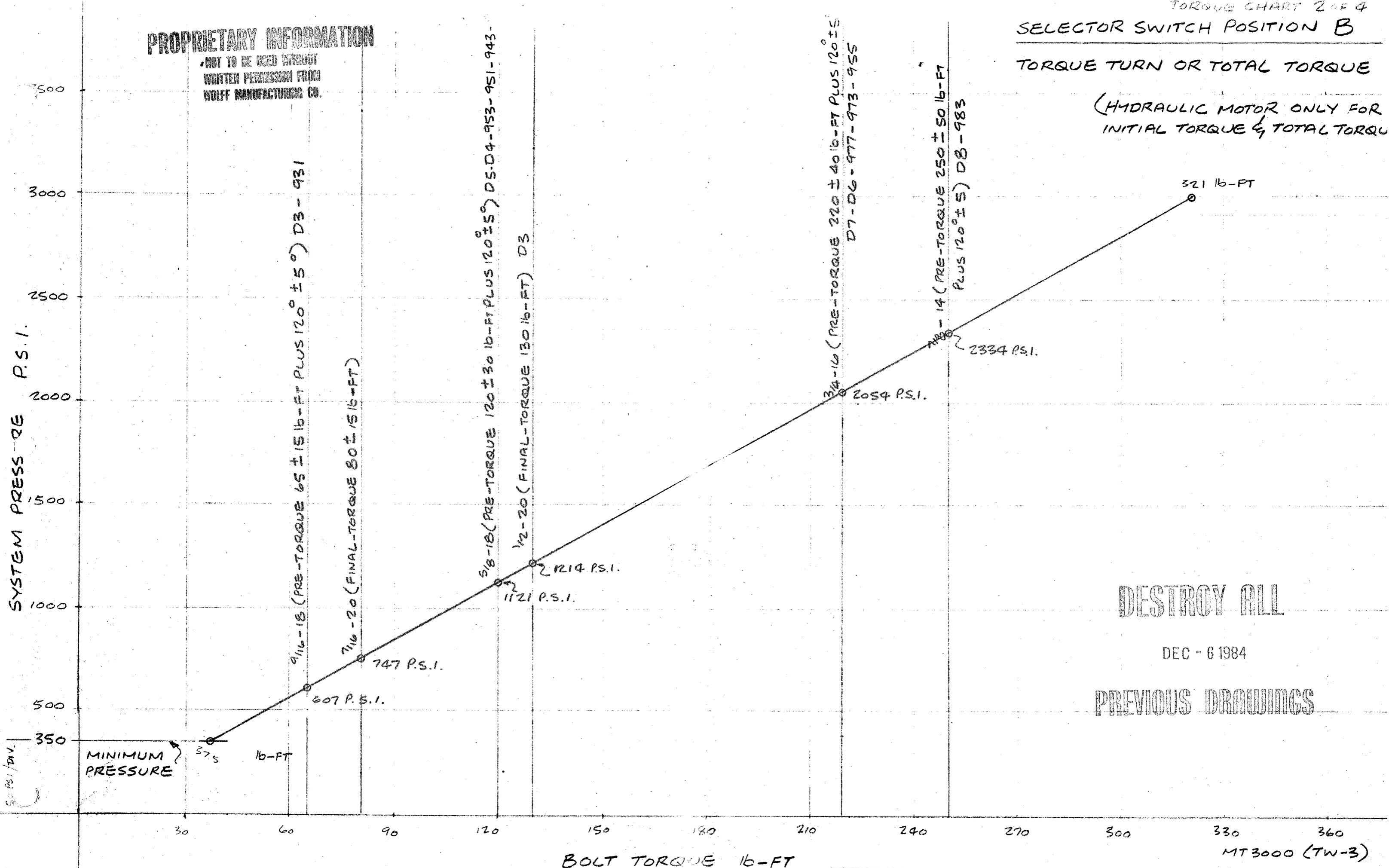
PROPRIETARY INFORMATION

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SELECTOR SWITCH POSITION B

TORQUE TURN OR TOTAL TORQUE

(HYDRAULIC MOTOR ONLY FOR INITIAL TORQUE & TOTAL TORQUE)



DESTROY ALL

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PREVIOUS DRAWINGS

PROPRIETARY INFORMATION

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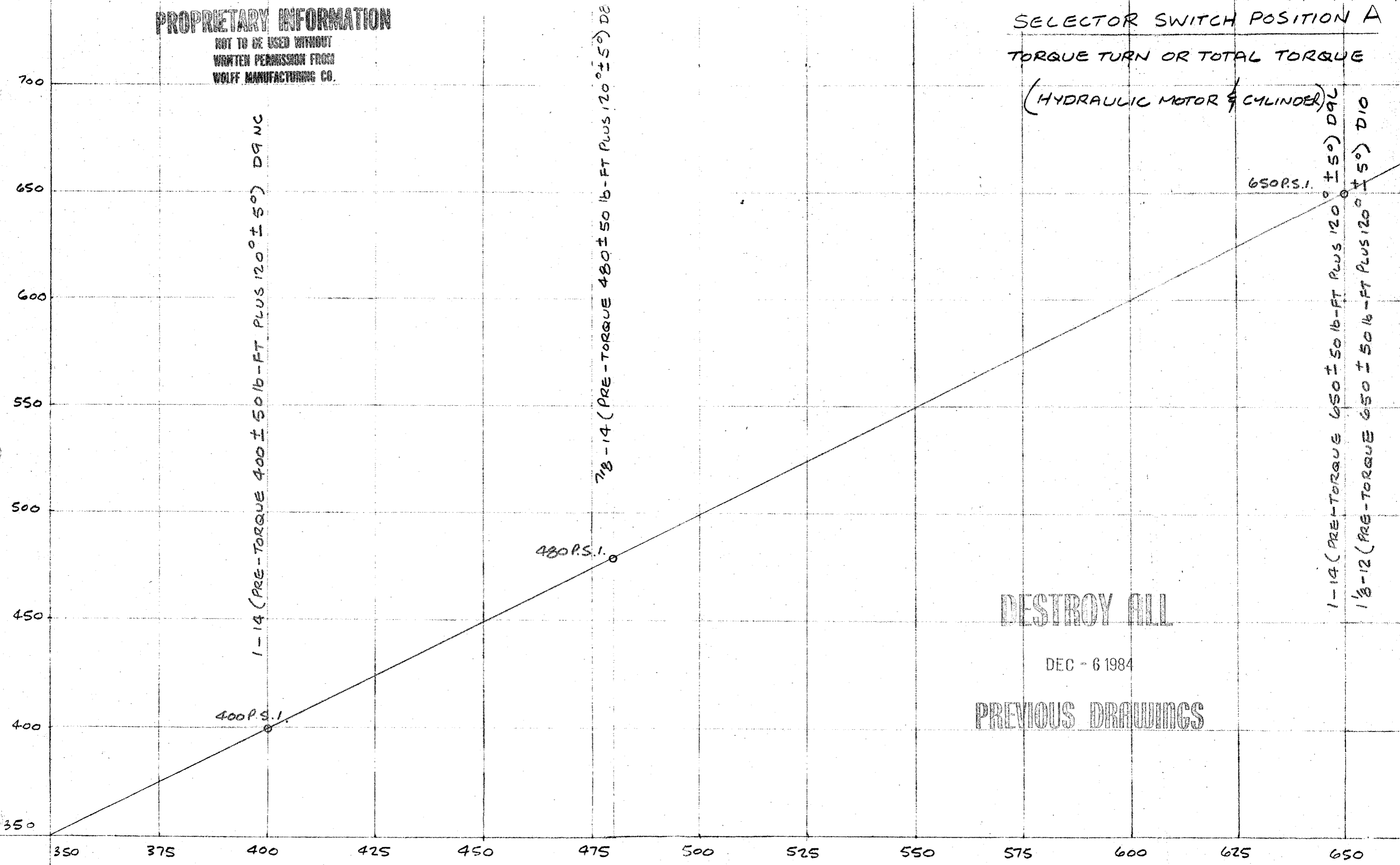
SELECTOR SWITCH POSITION A

TORQUE TURN OR TOTAL TORQUE

(HYDRAULIC MOTOR & CYLINDER)

SYSTEM PRESSURE P.S.I.

5 PSI/DIV.



DESTROY ALL

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PREVIOUS DRAWINGS

25 lb-FT/DIV

BOLT TORQUE lb-FT

MT 3000 (TW-3)

PROPRIETARY INFORMATION
NOT TO BE USED WITHOUT
WRITTEN PERMISSION FROM
WOLFF MANUFACTURING CO.

SYSTEM PRESSURE P.S.I.

500
3000
2500
2000
1500
1000
500
350
0

TIGHTENING TORQUE WITH S.S. IN POSITION 'A'
PRE-TORQUE AND TOTAL TORQUE
LOOSENING TORQUE

NOMINAL
MAX PRESSURE 2850 PSI

2850 lb-FT
MAX INTERMITTENT
TORQUE

3062 lb-FT
MAX
INTERMITTENT
TORQUE

MAX CONTINUOUS TORQUE 2600 lb-FT

DESTROY ALL

DEC - 6 1984

PREVIOUS DRAWINGS

250 500 750 1000 1250 1500 1750 2000 2250 2500 2750 3000 3250

BOLT TORQUE lb-FT

MT3000 (TW-3)

C. B. GILL	11/9/83	WOLFF MFG. CO.	B-101-533-107
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PSI/DIV.

1000 2000

W A R N I N G !

TO KEEP YOUR WRENCH OPERATING SAFELY - PROPERLY - EFFICIENTLY - IT IS IMPORTANT TO SET UP AND CONTINUE A REGULARLY SCHEDULED MAINTENANCE PROGRAM.

Wrench cleanliness, periodic inspections and minor servicing will prevent major repairs and AVOID COSTLY "DOWN TIME."

MOST IMPORTANT!

This system must use a premium quality hydraulic oil with a viscosity range between 150-250 SSU (30-50 CST.) at 100°F. (38°C.). Normal operating viscosity range between 80-1000 SSU (17-180 CST.). Maximum start-up viscosity is 4000 SSU (1000 CST.). Oil should have anti-wear properties, rust and oxidation treatment.

NOTE: HOW OFTEN THE HYDRAULIC FLUID IS CHANGED DEPENDS ENTIRELY UPON THE USE AND ENVIRONMENT OF THE WRENCH AND THE MAINTENANCE CHECKS YOU SET UP.

MAINTENANCE CHECKLIST

Replace oil as needed.
Clean oil filter if "Restricted Oil Flow Button" is extended.
Check fittings for loose or frayed parts.
Replace worn or leaky hoses.
Remove and wash breather cap in a solvent on a 30-day basis.
Oil filter should be removed and cleaned whenever hydraulic oil is changed. Check the filter for tears or holes.
Be certain that the power cable is kept clear of the floor and the conveyor system. Inspect for split or cracked insulation.
Inspect and tighten the carrier bearings as needed to keep the wrench riding smoothly and easily.

BEWARE OF DIRT!

MOST HYDRAULIC SERVICE PROBLEMS ARE CAUSED BY DIRT AND/OR METAL IN THE HYDRAULIC SYSTEM.

This section of the service manual will be broken into the following areas in order to simplify the isolation of a problem component.

1. Lifting mechanism for raising and lowering the wrench body.
2. Track bolt operation - Loosening the bolt.
3. Track bolt operation - Tightening the bolt.
4. Individual component analysis:

a) Mechanical

1. Torquing assembly.
2. Cylinder stop guides.

b) Hydraulic

1. Hydraulic Motor.
2. Hydraulic Pump.
3. Lifting Cylinder.
4. Stroking Cylinder.
5. Filter.
6. Directional Control Valve.
7. Relief Valve.
8. Pilot-operated Check Valve.
9. Flow Control Valve.
10. Check Valve.
11. Needle Valve.

c) Electrical

1. Electrical Motor.
2. Solenoid.
3. Limit Switch.
4. Voltage Control Motor.
5. Programmer.

1. The lifting mechanism for raising and lowering the wrench main frame is a hydraulic cylinder built into the center column.
 - a. If the lifting cylinder will not move at all:
 - 1) There must be power to the hydraulic system.
 - 2) The raising/lower directional joystick is defective.
 - a) Check cable leads for continuity in all three operational mode positions.
 - b) Check cable leads to lifting cylinder activator solenoid.
 - 3) Check the system's hydraulic pressure setting in the at-rest position. Low oil pressure will cause the cylinder to work sluggishly or not at all.
 - a) Check the pop-up indicator on the system's filter. Clean and replace if necessary.
 - b) Possible pump malfunction. Have pump evaluated and repaired if necessary.
 - b. If the lifting cylinder moves in one direction only:
 - 1) The hydraulic pressure is too low.
 - a) The cylinder will not raise the frame.
 - b) The combined weight of the frame plus the low oil flow may permit the cylinder to lower the frame.
 - 2) The solenoid valve that regulates oil flow to one or the other side of the cylinder is stuck.
 - a) Physically check to see if either piston on either solenoid is stuck in the depressed position. Push to see if it can be manually freed. Disassemble, inspect, and clean the valve.
 - b) By physically depressing the piston on each solenoid, the control system can be bypassed and the cylinder raised and lowered depending upon the side of the valve that is depressed. Be careful whenever overriding the electrical controls.
2. When working the track to dis-assemble track shoes (pads) from links, if the system does not function properly, check the following:
 - a. With the joystick controller in the LOOSEN position, neither the hydraulic torquing motor nor the stroking system will work.
 - 1) The electrical drive motor is not activating the system's hydraulic pump.
 - 2) The programmable controller is not in the RUN position.
 - 3) The stroking cylinder inside the main frame is either not extended or it has not tripped the limit switch on the guide arm.
 - a) Both limit switches that limit the travel distance on the stroking cylinder are pinned. Check to see if the pins have sheared or if the trip arms have worked loose.

- b) The stroking cylinder should always be fully extended when in the at-rest position. Limit switch no. 1 should be tripped at this point and indicator light no. 1.04 should be lit on the programmable controller display board.
- c) With the motor running, depress the piston in the solenoid on the stroking cylinder valve assembly and the cylinder should retract until limit switch no. 2 is tripped and indicator light no. 1.03 comes on. As soon as the piston is released, the cylinder should again extend and indicator light 1.04 will again come on.
- 4) The pressure setting meter relay is not initiating the loosening sequence.
 - a) The pressure setting indicator is set too low. The torque turn sequence would immediately come into play.
 - b) Check for loose or broken wires.
 - c) There is no signal from the programmable controller (indicator light no. 2.03) to the motor loosen solenoid control valve which means that no pressure will build and register on the meter relay.
- 5) With the joystick still in the loosen position and the selector switches set for Torque turn and "B" bolt type, the following indicator lights should be lit.
 - a) Input light 1.01 indicates power to the meter relay from the pressure transducer.
 - b) Input light 1.04 indicates that the stroking cylinder is still fully extended and that the torque turn has not yet begun.
 - c) Input light 1.06 indicates that the joystick is in the Loosen mode.
 - d) Input light 1.07 indicates that there is current to line 1 of the control circuitry.
 - e) Input light 1.08 indicates that the signal line which initiates the use of the stroking cylinder to aid in developing an initial torque range which is beyond the capability of the hydraulic motor alone, is now in the control system.
 - f) Output light 2.02 will come on if the pressure necessary to loosen a bolt is greater than the output capability of the hydraulic motor by itself. At this point the stroking cylinder should come into play to break the bolt free.
 - g) Output light 2.03 indicates a signal to the hydraulic motor solenoid valve to turn the motor in the loosen mode.
 - h) Output light 2,04 will indicate that the pump sensing line solenoid is activated to permit full system pressure to be developed. If this line is not lit, only the at-rest line pressure will be available to the working controls.

NOTE: THE FAILURE OF ANY OF THE EIGHT INDICATED LIGHTS TO GLOW WILL PROVIDE THE GUIDE TO CHECKING FOR A NON-FUNCTIONING COMPONENT.

- b. With the joystick controller in the LOOSEN position, the hydraulic motor works but the stroking cylinder does not activate to provide additional torque for bolts tightened beyond the motors capability.
 - 1) Check output light 2.02 to see that it is lit.
 - 2) Input lights 1.01, 1.04, 1.06, 1.07, and 1.08 should also be lit.
 - 3) If all indicator lights are properly lit, check the pressure indicator dial on the meter relay to see if pressure is building.
 - a) If pressure is not building, check the pump sensing line solenoid.
 - b) If pressure builds but the stroking cylinder does not activate, check the stroking cylinder solenoid.
- c. With the joystick controller in the LOOSEN position, both the hydraulic motor and the stroking cylinder go through the proper sequence for loosening the bolts but the bolt does not come free:
 - 1) The thread on the nut and bolt on the track shoe is stripped and therefore the bolt head is free spinning.
 - 2) There is a clutch engagement problem within the torque wrench frame.
 - a) Remove the side panel and check for obvious damage or misalignment.
 - b) All fasteners have been installed with a locktite compound. Always clean and replace with a similar component if a unit must be disassembled.
 - c) The clutch jaws should be fully engaged when the LOOSEN mode is activated and there is pressure on the shaft. Without pressure, the jaw teeth may not close completely.
3. When working the track to assemble track shoes (pads) to the links, if the system does not function properly, check the following:
 - a. With the joystick controller in the TIGHTEN position, neither the hydraulic torquing motor nor the stroking system will work.
 - 1) The electrical drive motor is not activating the system's hydraulic pump.
 - 2) The programmable controller is not in the RUN position.
 - 3) The stroking cylinder inside the main frame is either not extended or it has not tripped the limit switch on the guide arm.
 - a) Both limit switches that determine the travel distance on the stroking cylinder are pinned. Check to see if the pins have sheared or if the trip arms have worked loose.
 - b) The stroking cylinder should always be fully extended when in the at-rest position. Limit switch no. 1 should be tripped at this point and indicator light no. 1.04 should be lit on the programmable controller display board.

- c) With the motor running, depress the piston in the solenoid on the stroking cylinder valve assembly and the cylinder should retract until limit switch no. 2 is tripped and indicator light no. ~~1.03~~ comes on. As soon as the piston is released, the cylinder should again extend and indicator light ~~1.04~~ will again come on.
- 4) With the joystick still in the TIGHTEN position and the selector switches set for torque turn and "B" bolt type, the following indicator lights should be lit.
 - a) Input light 1.01 indicates power to the meter relay from the pressure transducer.
 - b) Input light 1.04 indicates that the stroking cylinder is still fully extended and that the torque turn sequence has not yet begun.
 - c) Input light ~~1.05~~³ indicates that the joystick is in the TIGHTEN mode.
 - d) Input light 1.07 indicates that there is current to line 1 of the control circuitry.
 - e) Input light 1.08 indicates that the signal line which initiates the use of the stroking cylinder to aid in developing an initial torque range which is beyond the capability of the hydraulic motor alone, is now in the control system.
 - f) Output light ~~2.01~~ indicates that the control signal is being sent to the Motor Tighten Solenoid to turn the drive shaft clockwise.
 - g) Output light ~~2.02~~ will come on if the pressure necessary to TIGHTEN a bolt is greater than the output capability of the hydraulic motor alone. At this point the stroking cylinder should come into play to help achieve the initial torque set. Then, the stroking cylinder will re-set itself prior to the start of the third of a turn sequence.
 - h) Output light 2.04 will indicate that the pump sensing line is activated to permit full system pressure to be developed unless limited by the setting on the front panel meter relay. If this line is not lit, only the at-rest line pressure will be available to the working controls.

4. Individual component analysis:

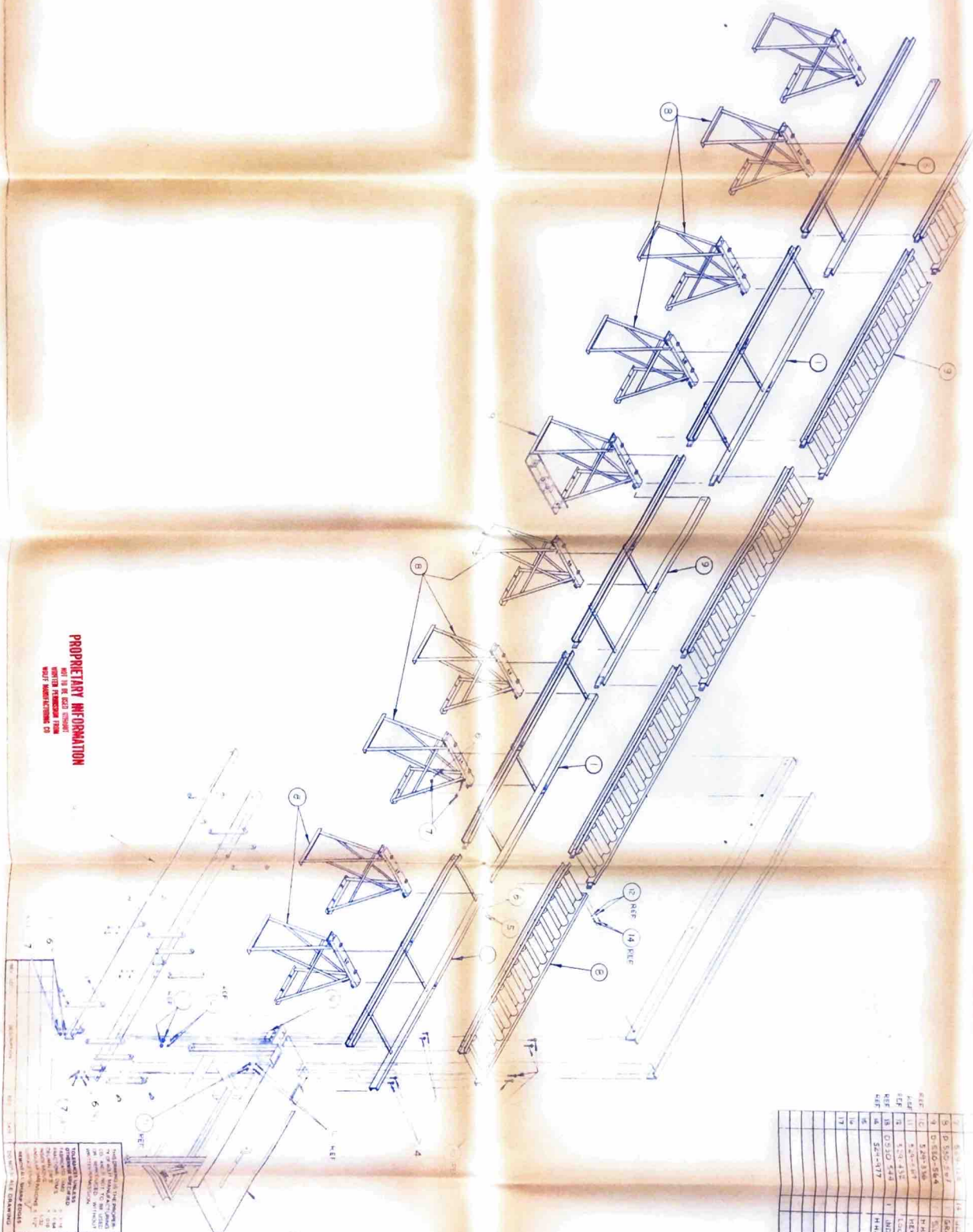
a. Mechanical

- 1) Torquing assembly: Reference drawing 532-182.
 - a) Snap rings locate the clutch pieces to the drive shaft. If the drive shaft turns and the stroking cylinder activates but fails to make an additional 1/3 of a turn, check to be certain that the snap ring is still in place.
 - b) Bolt heads sit flush with the counter-sunk mounting holes. If any work loose, clean and retighten using a locktite thread sealant.
- 2) Cylinder Limit Switch Assembly: Reference drawing 530-535.
 - a) Limit switch set collars are pinned for proper positioning.

If pin should shear, it must be re-pinned to the same location.

- b) Limit switch trip arms are bolted to set collars and secured with locktite. If they should work free, a similar thread sealant must be used to hold them in place.
- 3) Carriage Assembly: Reference drawing 530-533.
 - a) Every three months, grease the main travel bearings through the zerk fittings.
 - b) The inner rail guide bearings should be tightened just to the point that they permit the main travel bearings to contact fully on the top wrench rail channel.
 - 1) Avoid overtightening as this will make it difficult to run the wrench back and forth on the rail assembly.
 - 2) Under-tightening the bearing will cause excessive side-slippage on the rail as track is being worked.
- b. Hydraulic
 - 1) Cylinders - leaking seals will be the most common problem with the cylinders.
 - a) Main frame lifting cylinder seal kit - P/N _____
 - b) Stroking cylinder seal kit - P/N _____
 - c) Clutch jaw cylinder seal kit - P/N _____
 - 2) Motor - leaking seals will be the most common problem with the hydraulic motor.
 - 3) Valves will stick because of contaminated oil. Disassemble and clean valve. Flush and re-fill reservoir with clean oil.
 - 4) Filter - When the system's back pressure builds, the poppet button on the filter will extend indicating a contaminated filter and reservoir. Flush and replace.
- c. Electrical
 - 1) If electrical motor fails to run, check feed lines to motor.
 - a) If proper electrical to motor, check internal wiring connections.
 - b) If no electrical to the motor, check the supply side to the motor.
 - 2) Control valve solenoids - Check the feed lines to the affected solenoid when the proper sequence is engaged. If feed power is available, solenoid must be checked or replaced.
 - 3) Limit switches
 - a) Manually depressing L.S. 1 will light indicator light 1.04.
 - b) Manually depressing L.S. 2 will light indicator light 1.03.
 - 4) 10 V. power supply
 - a) 115 VAC into power supply.
 - b) 10 VDC output from power supply.
 - 5) Programmable controller - Reference the catalog in the vendor's catalog section of this manual for a detailed explanation of the controller unit. If a problem develops with this system, please contact the Service Department at Wolff Manufacturing Company immediately for assistance in troubleshooting.
 - 6) If you have incoming power to the wrench but no line voltage to the motor or control voltage to the rest of the wrench, reset the coils on the motor starter by hitting the reset button.

QTY	PART NO.	DESCRIPTION	MATERIAL
1	10-517-001	1. UPRIGHT RAIL (REF 1)	
2	10-517-002	2. UPRIGHT RAIL (REF 2)	
3	10-517-003	3. UPRIGHT RAIL (REF 3)	
4	524-941	4. HINGE PLATE (REF 4)	
5	524-942	5. HINGE PLATE (REF 5)	
6	524-943	6. HINGE PLATE (REF 6)	
7	524-944	7. HINGE PLATE (REF 7)	
8	524-945	8. HINGE PLATE (REF 8)	
9	524-946	9. HINGE PLATE (REF 9)	
10	524-947	10. HINGE PLATE (REF 10)	
11	524-948	11. HINGE PLATE (REF 11)	
12	524-949	12. HINGE PLATE (REF 12)	
13	524-950	13. HINGE PLATE (REF 13)	
14	524-951	14. HINGE PLATE (REF 14)	
15	524-952	15. HINGE PLATE (REF 15)	
16	524-953	16. HINGE PLATE (REF 16)	
17	524-954	17. HINGE PLATE (REF 17)	
18	524-955	18. HINGE PLATE (REF 18)	
19	524-956	19. HINGE PLATE (REF 19)	
20	524-957	20. HINGE PLATE (REF 20)	
21	524-958	21. HINGE PLATE (REF 21)	
22	524-959	22. HINGE PLATE (REF 22)	
23	524-960	23. HINGE PLATE (REF 23)	
24	524-961	24. HINGE PLATE (REF 24)	
25	524-962	25. HINGE PLATE (REF 25)	
26	524-963	26. HINGE PLATE (REF 26)	
27	524-964	27. HINGE PLATE (REF 27)	
28	524-965	28. HINGE PLATE (REF 28)	
29	524-966	29. HINGE PLATE (REF 29)	
30	524-967	30. HINGE PLATE (REF 30)	
31	524-968	31. HINGE PLATE (REF 31)	
32	524-969	32. HINGE PLATE (REF 32)	
33	524-970	33. HINGE PLATE (REF 33)	
34	524-971	34. HINGE PLATE (REF 34)	
35	524-972	35. HINGE PLATE (REF 35)	
36	524-973	36. HINGE PLATE (REF 36)	
37	524-974	37. HINGE PLATE (REF 37)	
38	524-975	38. HINGE PLATE (REF 38)	
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41	524-978	41. HINGE PLATE (REF 41)	
42	524-979	42. HINGE PLATE (REF 42)	
43	524-980	43. HINGE PLATE (REF 43)	
44	524-981	44. HINGE PLATE (REF 44)	
45	524-982	45. HINGE PLATE (REF 45)	
46	524-983	46. HINGE PLATE (REF 46)	
47	524-984	47. HINGE PLATE (REF 47)	
48	524-985	48. HINGE PLATE (REF 48)	
49	524-986	49. HINGE PLATE (REF 49)	
50	524-987	50. HINGE PLATE (REF 50)	
51	524-988	51. HINGE PLATE (REF 51)	
52	524-989	52. HINGE PLATE (REF 52)	
53	524-990	53. HINGE PLATE (REF 53)	
54	524-991	54. HINGE PLATE (REF 54)	
55	524-992	55. HINGE PLATE (REF 55)	
56	524-993	56. HINGE PLATE (REF 56)	
57	524-994	57. HINGE PLATE (REF 57)	
58	524-995	58. HINGE PLATE (REF 58)	
59	524-996	59. HINGE PLATE (REF 59)	
60	524-997	60. HINGE PLATE (REF 60)	
61	524-998	61. HINGE PLATE (REF 61)	
62	524-999	62. HINGE PLATE (REF 62)	
63	524-1000	63. HINGE PLATE (REF 63)	



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WOLFF MANUFACTURING COMPANY

101 S. 5th St. St. Paul, MN 55102

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DWG NO: 101 S. 5th St. St. Paul, MN 55102

REV: 0

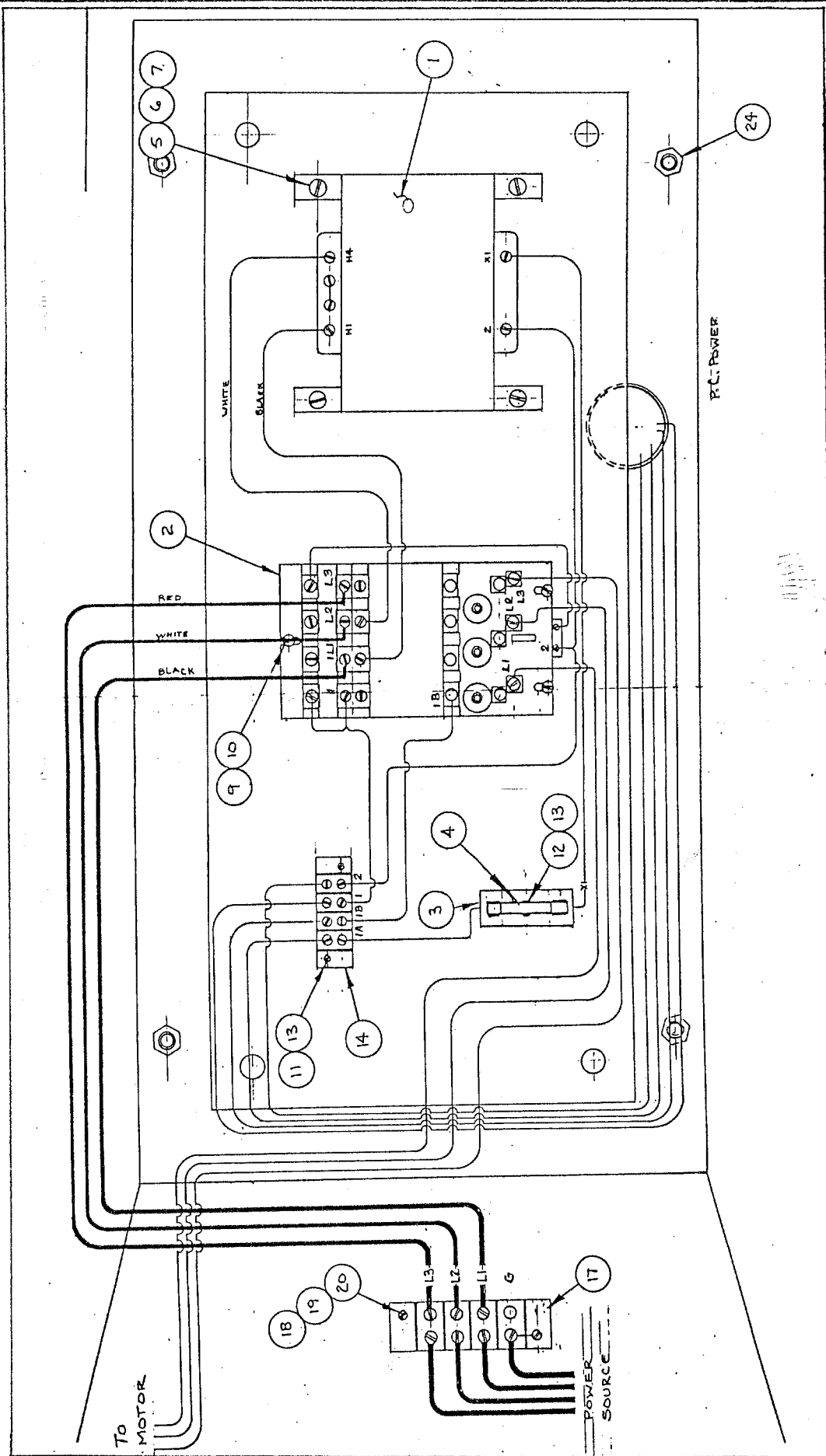
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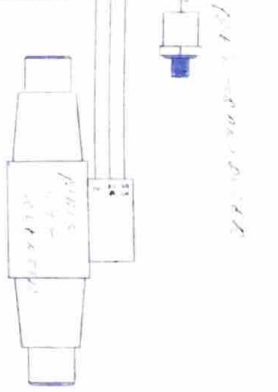
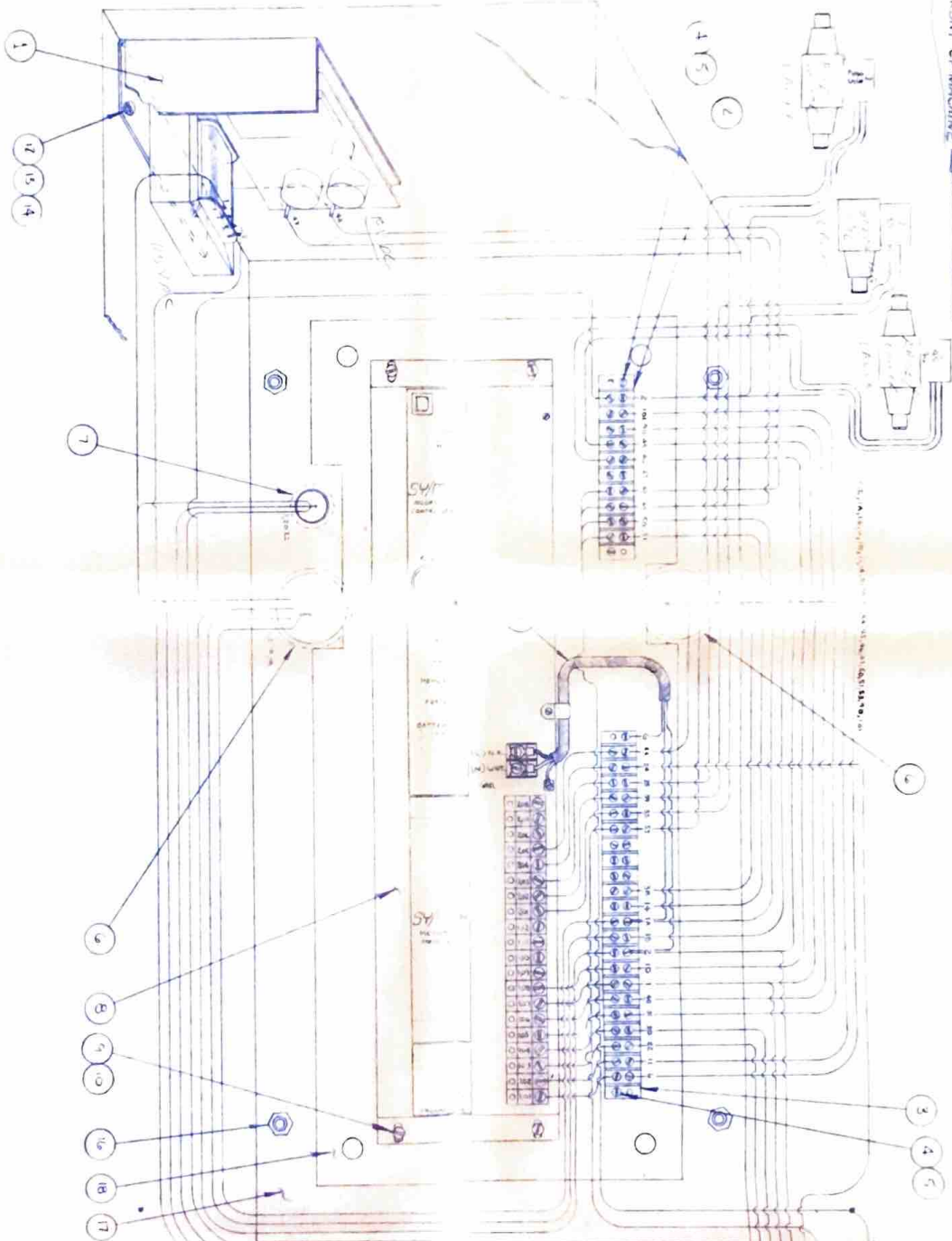
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WOLFF



<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QTY.</u>
1	123-079	Transformer	1
2	123-078	Starter	1
3	111-019	Fuse Block	1
4	103-019	Fuse	1
5	529-387	Flatwasher, 1/4"	4
6	529-1004	R.H.M.S., 1/4"-20NC x 3/8" Lg.	4
7	529-454	Lockwasher, 1/4"	4
8	524-217	O-Ring, 1.725 I.D. x .210 Thk.	1
9	529-775	R.H.M.S., #10-32NF x 1/2" Lg.	3
10	529-776	Lockwasher, #10	3
11	529-1001	R.H.M.S., #6-32NC x 5/8" Lg.	2
12	529-1002	R.H.M.S., #6-32NC x 3/8" Lg.	1
13	529-401	External Starwasher, #6	3
14	118-060	Terminal Block, 4-Tie	1
15		(No longer used)	
16		(No longer used)	
17	118-079	Terminal Block, 4-Tie	1
18	529-411	Hex Nut, #8-32NC	2
19	529-939	Lockwasher, #8	2
20	529-1003	R.H.M.S., #8-32NC x 3/4" Lg.	2
21	117-087	Reset Button Kit	1
22	109-255	Power Box #1 Enclosure Modification	1
23	109-256	Enclosure Box #1 Panel Modification	1
24	529-155	Esna (Nyloc) Nut, 1/4"-20NC	4

FRONT OF MACHINE



QTY	SKETCH	DESCRIPTION
1	1.008	1.008 POWER SUPPLY (REF 550445)
2	1.014	2.014 TERMINAL BLOCK (10 PR)
4	5.24.401	4.014 TERMINAL BLOCK (27 PR & 10 WORN)
4	5.24.401	4.014 L.A.M.S. 1/2" 32 NC X 5/8" L
4	5.24.401	4.014 EXTERNAL SPACER/SHEER * 1/2"
4	5.24.401	4.014 EXTERNAL SPACER/SHEER * 1/2"

QTY	SKETCH	DESCRIPTION
4	5.24.419	4.019 2" L.A.M.S. 1/2" 32 NC X 5/8" L
1	1.02.014	1.014 INTERNAL STRAP/WASHER * 1/2"
2	5.24.402	2.014 PLASTIC CLAMP 3/8" (EG. U)
2	5.24.445	2.014 R.H.M.S. 9/16" 32 NC X 5/8" L
2	5.24.412	2.012 INTERNAL SPACER/SHEER * 1/2"
2	5.24.412	2.012 HE X NUT 8-32 NC
146	1.02.151	146 CABLE TIES (NOT SHOWN)
4	5.24.155	4.015 ES/AL/INCO (NUT) 1/2" 20 NC
1	1.04.259	1.015 CONTROLLER BOX #2 (MODIFICATION 104.259)
1	1.04.259	1.015 CONTROLLER BOX #2 (MODIFICATION 104.259)
1	1.04.259	1.015 PANEL MODIFICATION BOX #2 (MODIFICATION 104.259)

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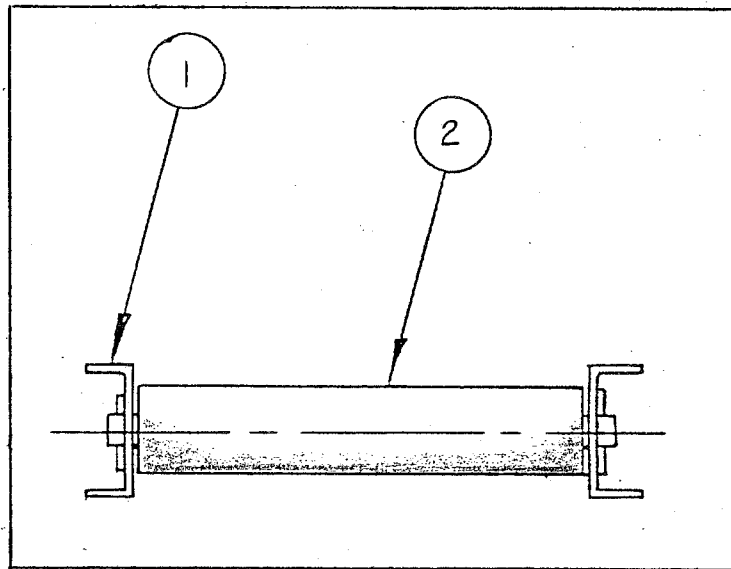
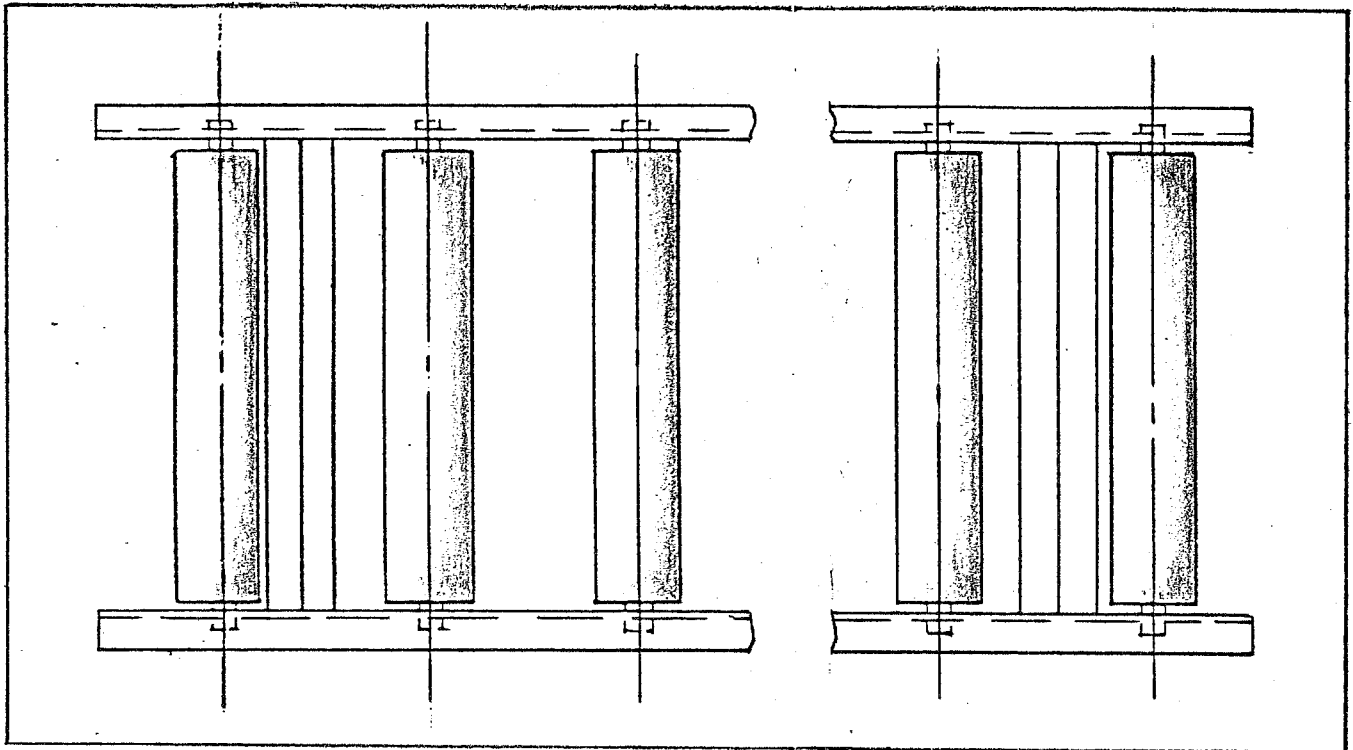
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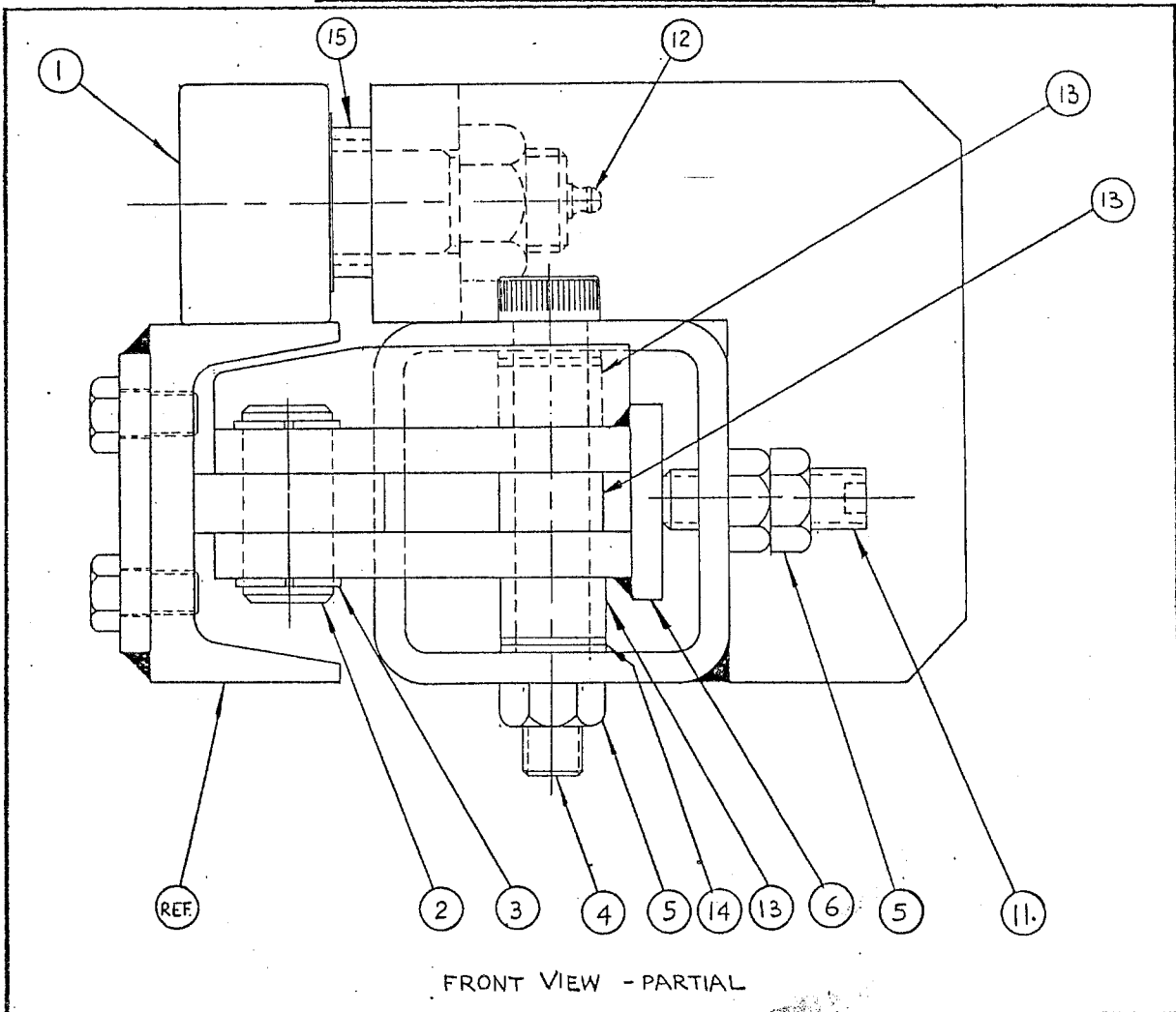
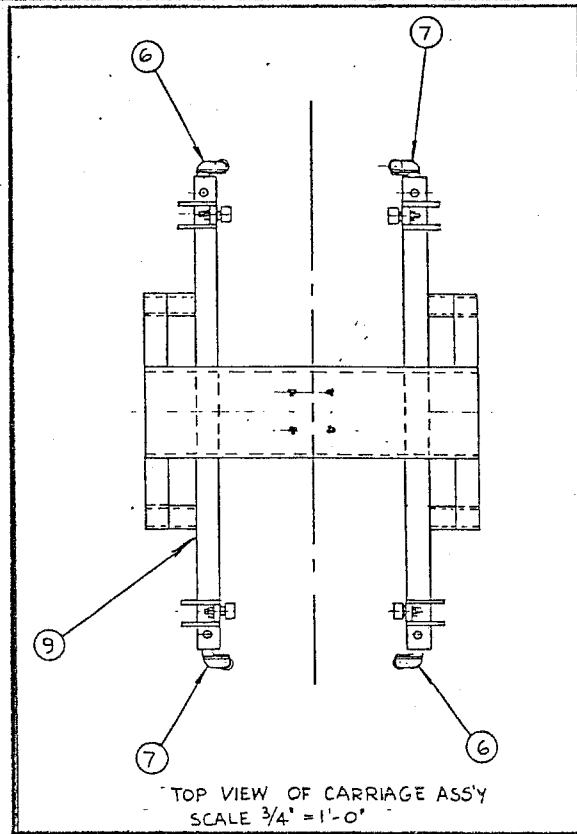
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1		FOR REVISIONS ONLY (NOT TO BE USED FOR PRODUCTION)	4574	7-24-54

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<p>MATERIALS:</p> <p>See PARTS LIST</p> <p>SCALE: 1/2" = 1"</p> <p>DATE: 2-4-83</p> <p>DESIGN: (H) TROTT</p> <p>DRAWN: (H) TROTT</p> <p>PART NUMBER:</p>	<p>PART DESCRIPTION:</p> <p>1.015 Controller Box #2 Assembly</p> <p>REF ASSEMBLY: D-530-532</p> <p>DATE: 2-4-83</p> <p>DESIGN: (H) TROTT</p> <p>DRAWN: (H) TROTT</p> <p>DATE: 2-4-83</p> <p>SCALE: 1/2" = 1"</p> <p>DO NOT SCALE DRAWING</p>
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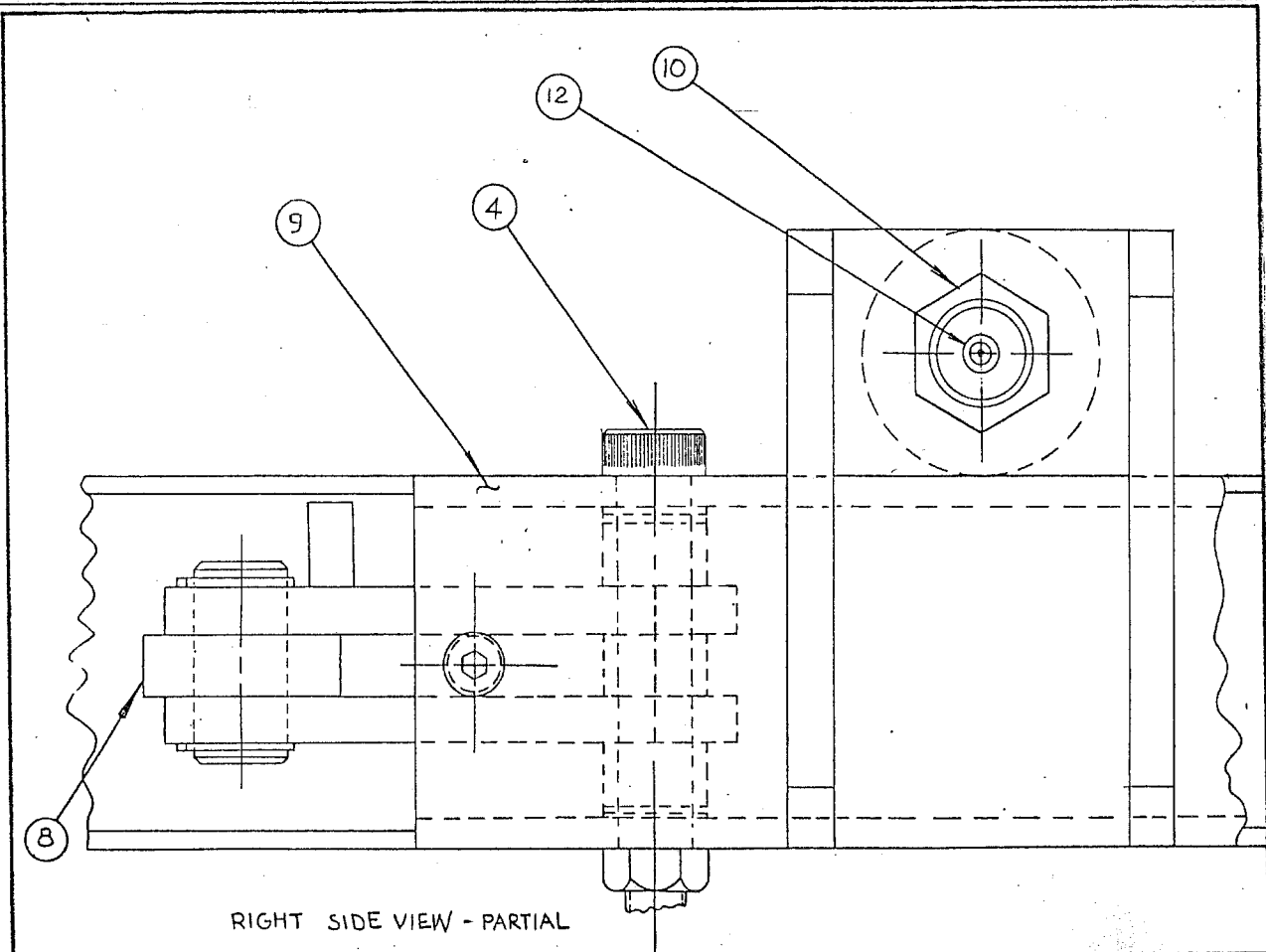


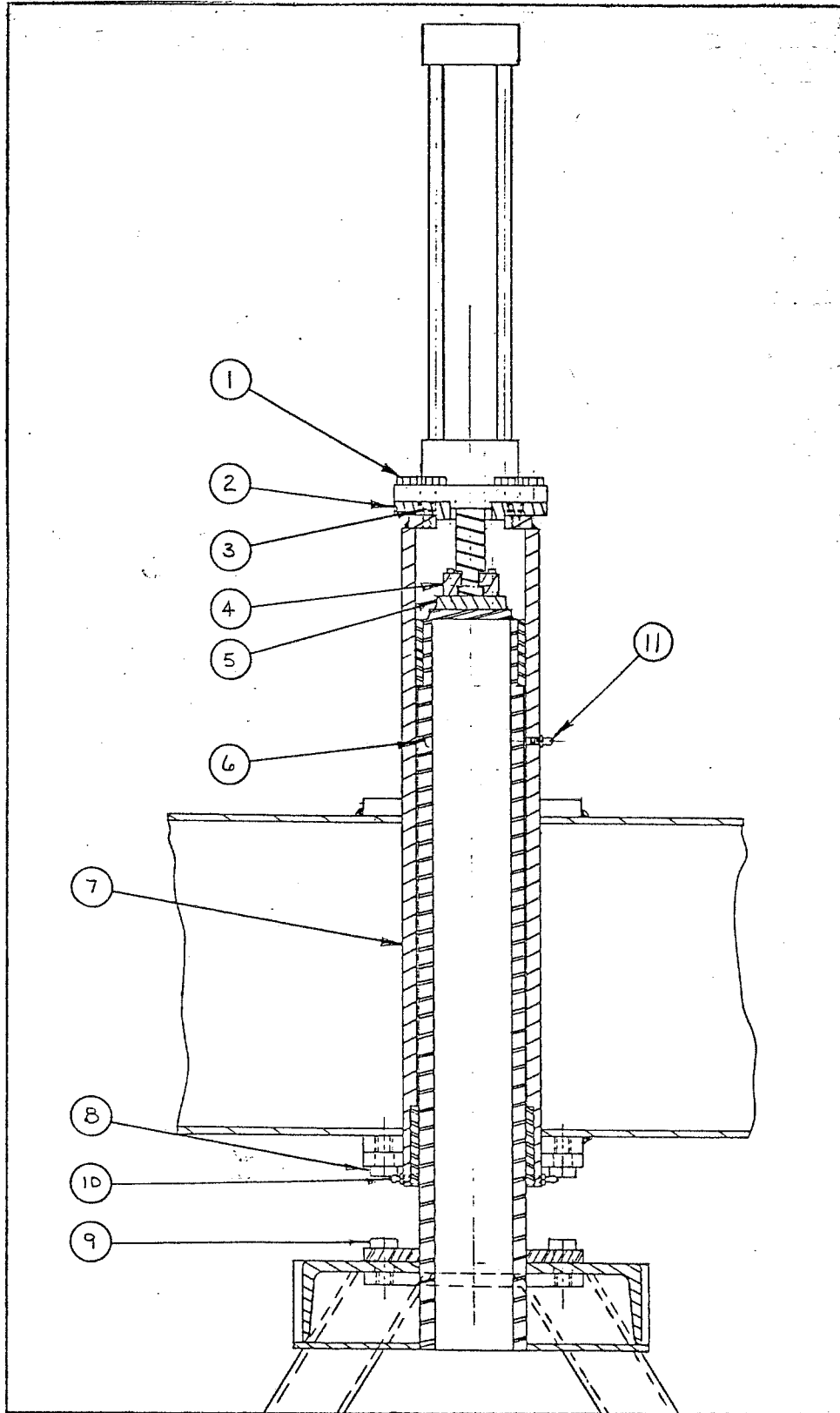
<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QTY.</u>
1	517-598	Gravity Conveyor Frame	1
2	177001	Roller (Complete)	15



7/84

<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QTY.</u>
1	508-146	Cam Follower Bearing, 2-3/4" Roller Dia.	4
2	525-282	Bearing Mounting Pin	4
3	529-191	Retaining Ring	8
4	529-970	S. H. S. B., 5/8" Dia. x 3" Lg.	4
5	529-587	Hex Nut, 1/2" - 13NC	8
6	517-608	Bracket Weldment L. H.	2
7	517-609	Bracket Weldment R. H.	2
8	508-068	Ball Bearings, 1-5/8" O.D., 3/4" I.D.	4
9	517-605	Carriage Weldment	1
10	529-682	Hex Nut, 1" - 14NC	4
11	529-197	S. H. S. S., 1/2" - 13NC x 1-3/4" Lg.	4
12	527-182	Grease Fitting - Drive Type, 3/16" Dia.	4
13	528-129	Spacer, 7/8" O.D. x .083 Wall x 1/2" Lg.	12
14	529-971	Washer, 18GA x 1" O.D. x 5/8" I.D.	As req.
15	528-151	Spacer, 1-1/2" O.D. x 1-1/64" I.D. x 1/4" Lg.	4





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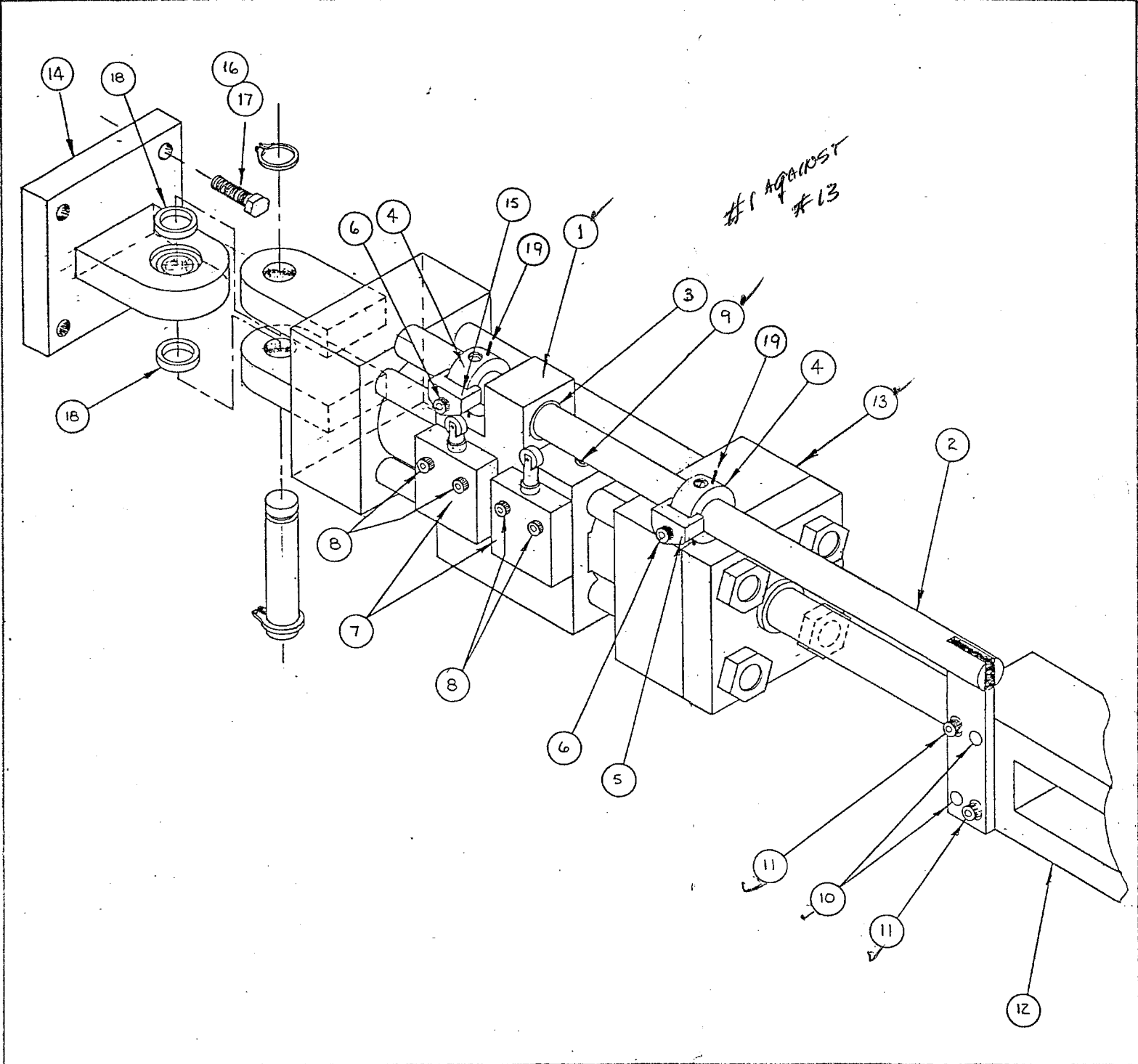
<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QTY.</u>
1	529-112	H.H.C.S., 1/2"-13NC. x 1-1/4" Lg.	8
2	515-044	Cylinder Mounting Plate	1
3	529-832	S.H.C.S., 3/8"-16NC. x 5/8" Lg.	4
4	503-315	Self Aligning Flange End Coupling	1
5	503-316	Self Aligning Flange End Coupling Weld Plate	1
6	532-181	Inside Column W/Bearing Sub-Assembly	1
7	512-1023	Outside Column Weldment & Machining	1
8	529-972	H.H.C.S., 5/8"-11NC. x 1-1/4" Lg.	4
9	529-111	H.H.C.S., 5/8"-11NC. x 1-1/2" Lg.	4
10	527-826	Grease Fitting (1/4"-28NF. Thread)	2
11	527-011	Grease Fitting (1/4"-28NF. Thread)	1

CYLINDER LIMIT SWITCH ASSEMBLY

P/N 530-535 Revision E

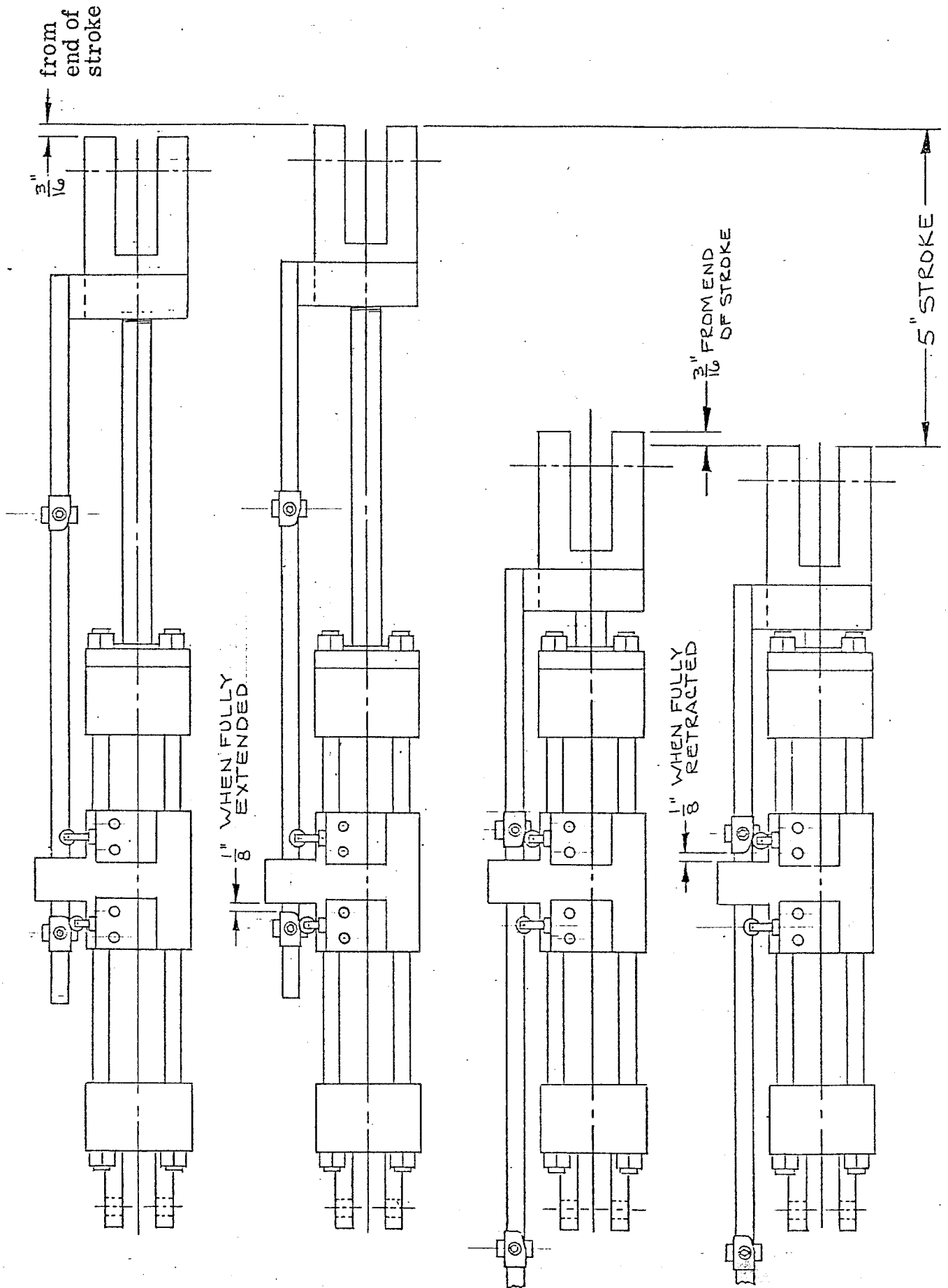
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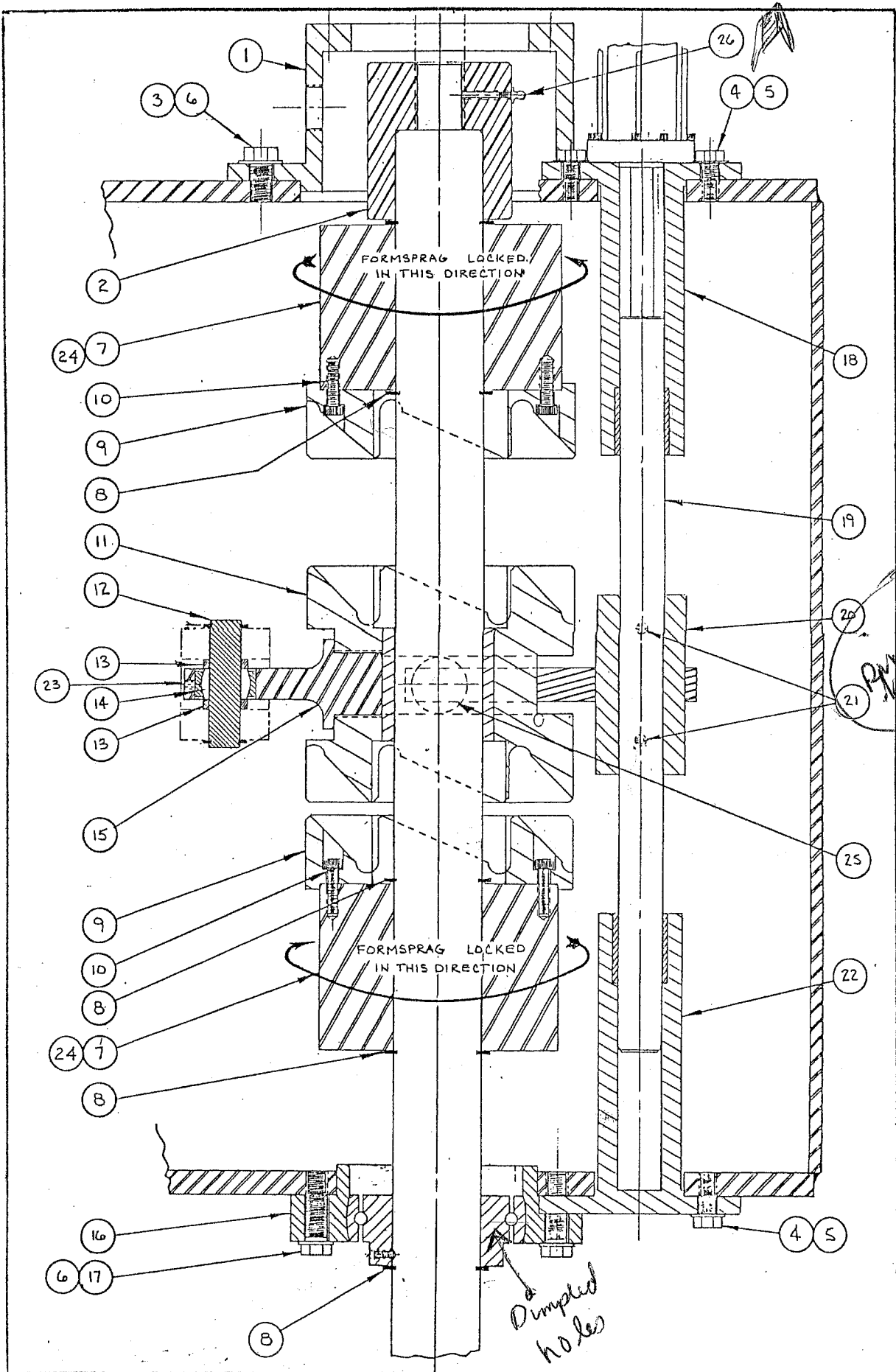


<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QTY.</u>
1	512-1027	Limit Switch Mounting Bracket	1
2	517-610	Guide Rod & Mounting Bracket Weldment	1
3	509-181	Bearing, Oil-Impregnated	1
4	512-1031	Set Collar	2
5	512-1030	Switch Trip R.H.	1
6	529-007	S.H.C.S., 1/4"-20NC x 1/2" Lg.	2
7	117-073	Switch, Micro Switch	2
8	529-973	S.H.C.S., #10-32NF x 3/4" Lg.	4
9	529-125	S.H.S.S., 3/8"-16NC x 1/2" Lg.	4
10	529-041	Roll Pin, 3/16" Dia. x 1" Lg.	2
11	529-046	S.H.C.S., 1/4"-20NC x 3/4" Lg.	2
12	512-1032	Clevis	1
13	531-227	Hydraulic Cylinder	1
14	525-393	Swivel Pivot Mounting Bracket	1
15	512-1182	Switch Trip L.H.	1
16	529-112	H.H.C.S., 1/2"-13NC x 1-1/4" Lg.	4
17	529-432	Lockwasher, 1/2"	4
18	528-152	Spacer	2
19	529-341	Roll Pin, 1/8" x 1" Lg.	2

NOTE: To reset rod travel distance when components replaced, reference travel stop setting illustrations on page 6.27a



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CLUTCH JAW & SHIFTING CYLINDER ASSEMBLY

P/N 532-182 Revision D

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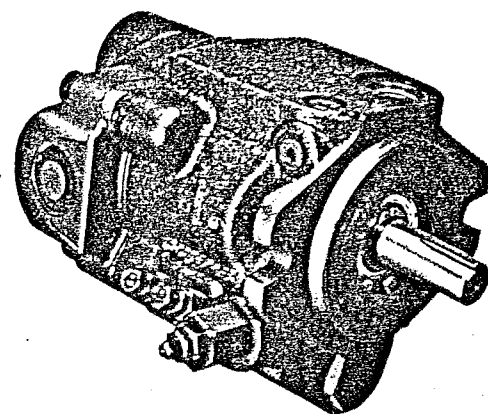
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<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QTY.</u>
1	512-1040	Hydraulic Motor Mounting Bracket	1
2	531-201	Splined Coupling & Shaft Assembly	1
3	529-336	H. H. C. S., 1/2"-13NC x 1" Lg.	4
4	529-003	H. H. C. S., 3/8"-16NC x 1" Lg.	6
5	529-004	Lockwasher, 3/8"	6
6	529-432	Lockwasher, 1/2"	8
7	525-287	Clutch	2
8	529-981	Snap Ring	4
9	503-317	Clutch Jaw Coupling	2
10	529-556	S. H. C. S., 5/16"-24NF x 1-1/4" Lg.	12
11	531-202	Clutch Jaw Coupling (Center) & Bushing Ass'y	1
12	529-984	Spherical Bearing Mtg. Pin W/Snap Rings	1
13	528-131	Spacer	2
14	508-143	Spherical Bearing	1
15	503-321	Coupling Yoke	1
16	508-144	Self Aligning Flange Bearing	1
17	529-285	H. H. C. S., 1/2"-13NC x 1-1/2" Lg.	4
18	531-203	Upper Shifting Cyl. Bearing Guide & Bushing Ass'y	1
19	503-322	Shifting Shaft	1
20	525-288	Shifting Yoke	1
21	529-125	S. H. S. S., 3/8"-16NC x 1/2" Lg.	2
22	531-204	Lower Shifting Cyl. Bearing Guide & Bushing Ass'y	1
23	529-460	S. H. S. S., 1/4"-20NC x 3/8" Lg.	3
24	529-983	Key, 3/8" x .296" x 3-3/8" Lg.	2
25	508-147	Cam Follower Bearing	2
26	527-011	Zerk Fitting	1

Installation Information

Pumps, Variable Piston

10 MICRON



USE OF A RELIEF VALVE

The use of a relief valve, while not mandatory is recommended in the main circuit to suppress hydraulic shock loads and as additional system protection.

FLUID RECOMMENDATIONS

Premium quality hydraulic oil with a viscosity range between 150-250 SSU (30-50 cst.) at 100°F. (38°C.). Normal operating viscosity range between 80-1000 SSU (17-180 cst.). Maximum start-up viscosity is 4000 SSU (1000 cst.).

NOTE: Consult Parker when exceeding 160°F. operation. Oil should have maximum anti-wear properties, rust and oxidation treatment.

FILTRATION

For maximum pump and system component life, the system should be protected from contamination at a level not to exceed 125 particles greater than 10 microns per milliliter of fluid. (SAE Class 4/ISO 16/13.)

START-UP

On initial start-up, the case should be filled with oil, pressure should be reduced and the circuit should be open or the air bled from the pump outlet to permit priming.

INLET CONDITIONS

Not to exceed 6 inches. Hg. Vacuum at 1800 RPM on petroleum base fluids. See recommended speed spectrum for specific inlet conditions.

SHAFT ROTATION AND LINE UP

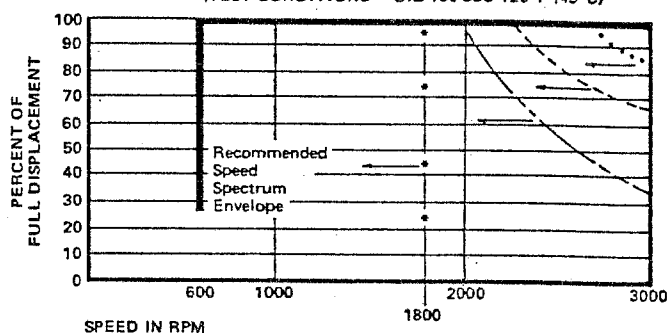
Pump and motor shaft alignment must be within .010 TIR maximum, using a standard floating coupling. Please follow coupling manufacturer's recommended installation instructions to prevent end thrust on pump shaft. Turn pump to assure freedom of rotation. Pump and motor must be on a rigid base.

The coupling should be sized to absorb the peak horsepower developed.

INSTALLATION AND MOUNTING

When pump is mounted above fluid level, the INLET PRESSURE and CASE FILL PORTS, must be on top.

RECOMMENDED SPEED SPECTRUM FOR SPECIFIC INLET CONDITIONS
(TEST CONDITIONS - OIL 100 SSU 120°F (49°C))



NOTE: This chart shows the effects of pump displacement and inlet conditions on recommended speed limits.

INLET CONDITION

- 0 in. Hg
- 2 in. Hg - 51 torrs
- 4 in. Hg - 102 torrs
- · - · - 5 in. Hg - 127 torrs
- · — · — 6 in. Hg - 152 torrs

DRAIN PORT should be a separate line unrestricted to reservoir. This drain line should extend below reservoir oil level as far from the intake line as possible. Drain line should be at a level exceeding the case height of pump. The drain line must not exceed 10 PSI (.5 Bar) back pressure. Suggested maximum line length is 10 feet. **AIRBLEED** is standard on all PAVC Pumps. When required, remove airbleed drain plug and connect unrestricted to tank below minimum oil level. Back pressure in this line not to exceed 4 PSI (.20 Bar).

SPECIAL INSTALLATIONS

Consult your Parker representative for any application requiring the following:

Pressure above rated, drive speed above maximum, indirect drive, fluid other than petroleum oil, oil temperature above 160°F.

INLET PRESSURE

Not to exceed 25 PSI (1.75 Bar).



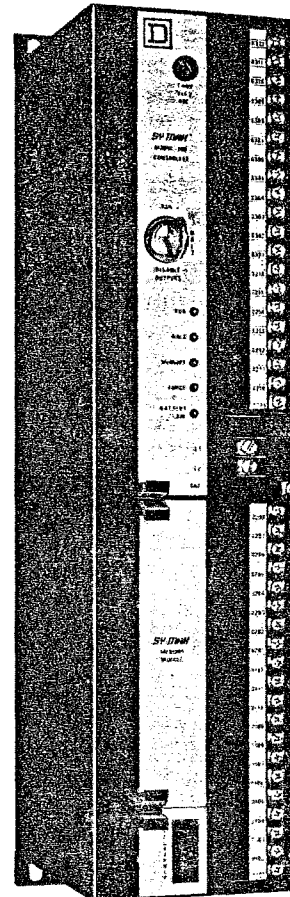


Instruction Bulletin

Subject: **SY/MAX[®]**
SY/MAX MODEL 100
PROGRAMMABLE CONTROLLER
HARDWARE, INSTALLATION,
CONNECTION, AND START-UP

DESCRIPTION:

This Instruction Bulletin describes the hardware features and contains directions for mounting and connecting the SY/MAX Model 100 Programmable Controller. The SY/MAX Model 100 Programmable Controller is a small yet powerful complete programmable controller system contained in a single package. A checklist for a successful system start-up is also provided.



WARNING:

The installation procedures described in this bulletin require the handling of devices which can produce electric shock. Only trained, qualified personnel should perform installation and servicing operations on this equipment.

NOTE:

READ and SAVE this Instruction Bulletin. It explains the correct and safe installation and use of the SY/MAX Model 100 Programmable Controller.

The installation of the SY/MAX Model 100 Programmable Controller should be made in accordance with the current edition of the National Electric Code and any other applicable codes.

For programming information, see any applicable Programmer Instruction Bulletin.

READ and SAVE other product Instruction Bulletins for complete operational information.

TABLE OF CONTENTS

Section	Title	Page No.
1.0	INTRODUCTION	5
2.0	SPECIFICATIONS.....	6
2.1	General.....	6
2.2	Processor Section.....	6
2.3	I/O Section.....	6
2.3.1	INPUTS	6
2.3.2	OUTPUTS	7
2.4	Programmer Port.....	7
2.5	Power Supply Section	7
3.0	MODEL 100 PROGRAMMABLE CONTROLLER HARDWARE	8
3.1	Products Available.....	8
3.1.1	SY/MAX MODEL 100 PROGRAMMABLE CONTROLLERS AVAILABLE.....	8
3.1.2	SY/MAX MODEL 100 ACCESSORIES	8
3.2	Processor Section.....	9
3.2.1	MEMORY.....	9
	RAM	9
	UV PROM	9
3.2.2	KEYSWITCH.....	9
	Run.....	9
	Halt.....	9
	Disable Outputs	9
3.2.3	INDICATING LIGHTS.....	10
	Run.....	10
	Halt.....	10
	Memory.....	10
	Force.....	10
	Battery Low.....	10
	All Lights Off	10
	All Lights On Except Run.....	10
3.2.4	PROGRAMMER PORT	10
	Programmings.....	11
	Loader/Monitor.....	11
	Cartridge Tape Loader/Recorder	11
	Distributed Control	11
	Communication Module	12
3.2.5	PROGRAMMER PORT RESTRICTED ACCESS	12
	Register Protect.....	12
	Storage Register Fencing	12
	I/O Forcing.....	13
3.2.6	PROCESSOR TECHNICAL DATA	13
	Memory Utilization.....	13
	Scanning Technique	13
	Processor Start-up Sequence.....	14
	Processor Power-Down Sequence	14
	Output Reset Operation	14
	Internal Circuit and Operational Checks	14
3.3	I/O Section.....	14
3.3.1	GENERAL	14
3.3.2	SIMPLIFIED I/O SCHEMATIC	14
3.4	Power Supply Section	14

TABLE OF CONTENTS

Section	Title	Page No.
4.0	INSTALLATION	15
4.1	Environment	15
4.1.1	INTRODUCTION	15
4.1.2	ELECTRICAL NOISE IMMUNITY.....	15
4.1.3	TEMPERATURE.....	15
4.1.4	HUMIDITY.....	15
4.2	Layout	15
4.2.1	MODEL 100 PROGRAMMABLE CONTROLLER	15
4.2.2	AC INCOMING LINE EQUIPMENT	15
4.2.3	ELECTRO-MECHANICAL OUTPUT DEVICES	16
4.2.4	COMPONENT SPACING	16
4.3	Mounting	16
4.3.1	MODEL 100 PROGRAMMABLE CONTROLLER	16
4.3.2	LOADER/MONITOR MOUNTING	16
4.3.3	ENCLOSURE CONSIDERATIONS	16
	Enclosure Type and Access	16
	Incoming Conduit.....	17
	Redundant I/O Terminals.....	17
	Windows.....	17
	Accessories For Enclosures	17
4.3.4	WIRE ROUTING.....	17
	Power Wire Isolation.....	17
4.4	Connections	17
4.4.1	I/O TERMINAL WIRING.....	17
4.4.2	I/O TERMINAL IDENTIFICATION.....	17
4.4.3	POWER CONNECTIONS	17
	Incoming Line	17
	Constant Voltage Transformer.....	19
	Surge Suppression-Incoming Power	19
	Surge Suppression-I/O.....	19
4.4.4	PERIPHERAL DEVICE CONNECTION	20
	CRT Programmer.....	20
	Hand-Held Programmer	21
	Loader/Monitor.....	21
	Cartridge Tape Loader/Recorder	21
4.4.5	CABLES.....	21
5.0	OTHER SY/MAX PRODUCT DIMENSIONS	22
6.0	START-UP CHECKLIST	24
6.1	Preliminary Checks	24
6.1.1	MACHINE AND ENVIRONMENT	24
6.1.2	PROGRAMMABLE CONTROLLER	24
6.2	Power-Up	24
6.3	Initially Programming RAM Memory	24
6.4	Programming UV PROM Memory	24
6.5	General Start-Up Sequence	24
6.6	Troubleshooting	24
7.0	BATTERY MAINTENANCE	25
APPENDIX A	ADDRESSING FORMAT	25
APPENDIX B	UV PROM VERSION PROGRAMMABLE CONTROLLER	26
APPENDIX C	PROCESSOR TO PROCESSOR COMMUNICATION	28
APPENDIX D	OTHER SY/MAX COMPONENT WEIGHTS	29
APPENDIX E	MODEL 100 PC IN MOTOR CONTROL CENTERS	29
APPENDIX F	CONTROL REGISTERS	31

LISTING OF FIGURES

Figure	Description	Page No.
1.1	SY/MAX Model 100 Programmable Controller.....	5
1.2	Model 100 Block Diagram	5
2.1	Model 100 Approximate Weights (unpackaged)	6
2.2	Model 100 Dimensions	6
2.3	Model 100 Programmer Port Pin-Out.....	7
3.1	Model 100 PC Types Available.....	8
3.2	Model 100 Memory Module	8
3.3	Model 100 Low Profile Mounting Brackets.....	9
3.4	Model 100 Accessories Listing	9
3.5	Model 100 Keypad.....	9
3.6	Model 100 Indicating Lights	10
3.7	Model 100 Programmer Port	11
3.8	Multiple Processor Communication	11
3.9	Storage Register Fencing Example.....	12
3.10	Rungs Used To Preset Start And End Fence Registers.....	12
3.11	Storage Register Fencing Table.....	12
3.12	Ladder Diagram Rung with 11 Words.....	13
3.13	Ladder Diagram Rung with 14 Words.....	13
3.14	Ladder Diagram Rung with 11 Words.....	13
3.15	Ladder Diagram Rung with 12 Words.....	13
3.16	Ladder Diagram Rung with 14 Words.....	13
3.17	Ladder Diagram Rung with 10 Words.....	13
3.18	Ladder Diagram Rung with 10 Words.....	13
3.19	Memory Utilization Chart.....	13
3.20	Scan Rate of Instructions	14
3.21	Simplified I/O Schematic	14
4.1	Temperature and Humidity Rating Exceptions	15
4.2	Model 100 Mounting Clearance	16
4.3	Model 100 Mounted Vertically	16
4.4	Model 100 I/O Addressing Configuration	17
4.5	Typical Wiring	18
4.6	Typical Wiring With MCR	18
4.7	Typical Wiring With Expanded MCR	19
4.8	Surge Suppression For Input	19
4.9	Surge Suppression For Output-Switch in Series with Output (After Output)	20
4.10	Surge Suppression For Output-Switch in Parallel with Output.....	20
4.11	Recommended Surge Suppressors.....	20
4.12	Cable Listing	21
5.1	Type SPR-200/210 CRT Programmer	22
5.2	Type SPR-100 Hand-Held Programmings.....	22
5.3	Type SLM-100 Loader/Monitor.....	23
5.4	Type SLR-100/110 Cartridge Tape Loader/Recorder	23
A.1	Model 100 Register Assignments	25
A.2	Model 100 Addressing Configuration.....	26
B.1	UV PROM Memory Module.....	26
B.2	UV PROM Security Jumper	27
B.3	UV PROM Inhibit Rung	27
B.4	UV PROM Chip Installation/Removal Diagram	27
B.5	UV PROM Specifications	28
C.1	Processor to Processor Communication.....	28
D.1	Other SY/MAX Component Weights	29
E.1	Model 100 PC in Motor Control Centers	29
E.2	Model 100 System Drilling Dimensions	30
E.3	Model 100 System Layout.....	30
F.1	Control Register-Data Field vs Status Field.....	31
F.2	Control Register Usage	31

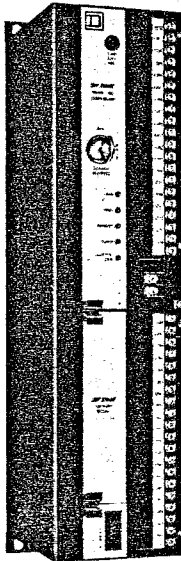
CAUTION

The possibility of electrical shock exists if the Input or the Output terminals of the Model 100 PC are touched while power is applied to the L-N terminals. Since the I/O circuits share the L-N terminals as commons, leakage current may be available at the I/O terminals irrespective of connections to the terminals or whether the PC outputs are on or off.

TO REMOVE POWER FROM THE INPUT AND OUTPUT CIRCUITS OF THE PC, INCOMING POWER MUST BE REMOVED FROM THE L-N TERMINALS OF THE PC BY OPENING THE MAIN DISCONNECT SWITCH SUPPLYING THE PC. NOTE: Removal of the Model 100 fuse does not interrupt power to the input and output circuits because the fuse is used only in the incoming line circuit to the internal power supply. See Figure 1.2.

1.0 INTRODUCTION

The SY/MAX Model 100 Programmable Controller is a self-contained unit which includes the processor, Input/Output circuits, programmer interface, and power supply in a single compact package. No additional hardware is required with the exception of programming equipment.



The SY/MAX Model 100 Programmable Controller is housed in a rugged extruded aluminum case. Located on the front of the controller is a keyswitch used to select one of the three possible operating modes. Also included are five diagnostic LED (Light Emitting Diode) indicators used to indicate complete operational status of the controller as well as a communication port for connection to programming equipment and other devices.

The SY/MAX Model 100 Programmable Controller is available in two memory versions: RAM or UV PROM, and two I/O versions: 20 or 40 I/O. Terminal blocks on the front of the unit are the wiring points for I/O field devices such as pushbuttons, limit switches, motor starters and solenoids. The I/O section is used to convert high level signals (120 VAC 50/60 Hz) from the I/O field devices to the logic voltage level used by the processor section.

Power used to drive the processor logic, I/O circuitry, and programmer interface circuitry is obtained from an internal power supply. This supply converts the incoming voltage to the logic level used internally. Battery back-up is provided to retain program information stored in RAM memory, storage register data and latch relay status during power-out conditions. The battery is located on the memory module.

Figure 1.1 - SY/MAX Model 100 Programmable Controller

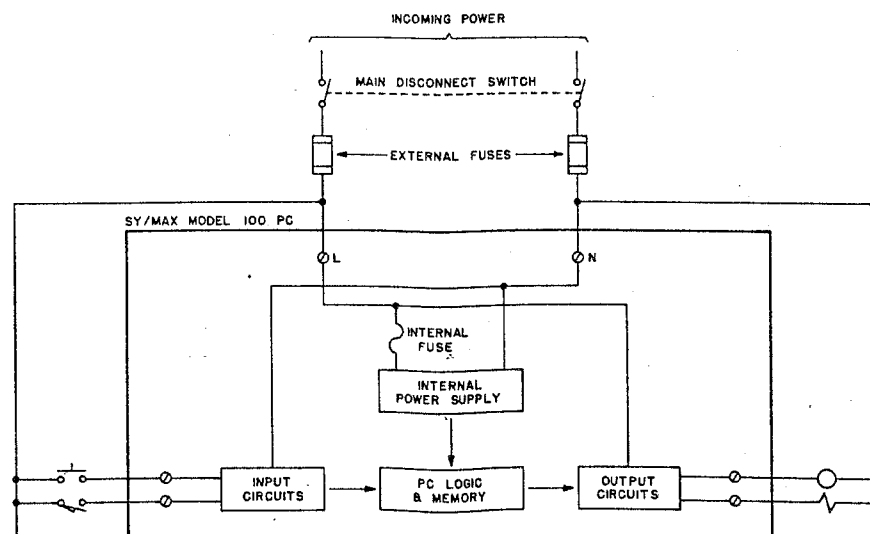


Figure 1.2 - Model 100 Block Diagram

2.0 SPECIFICATIONS

2.1 General

Ambient Temperature Rating .. 0 to 60°C (32 to 140°F)
 Operational
 -40 to 80°C (-40 to 176°F) Storage
 Humidity Rating 0-95% non-condensing

TYPE	DESCRIPTION	APPROXIMATE WEIGHT (lb/kg)
MODEL 100 PC		
SCP-111,112	20 I/O PC	10.7/4.85
SCP-121,122	40 I/O PC	11.0/4.99

Figure 2.1 - Model 100 Approximate Weights (unpackaged)

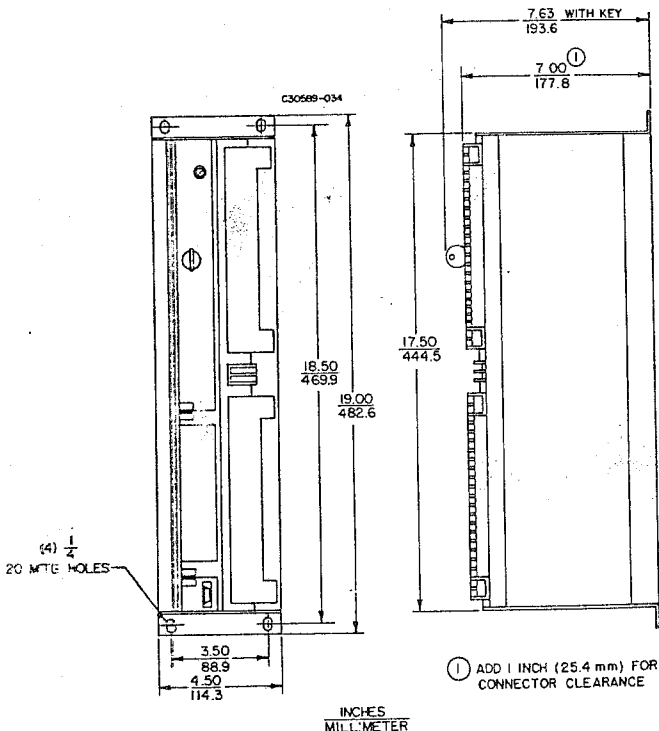


Figure 2.2 - Model 100 Dimensions

2.2 Processor Section

Logic:..... Microprocessor based
 Memory Size..... 420 Words (16 bit)
 Memory Type..... RAM or UV PROM
 Memory Utilization 1 word per contact, coil, branch
 Memory Overhead None
 Diagnostic Lights RUN, HALT, MEMORY, FORCE, BATTERY LOW
 Scan Speed..... 40ms typical for a fully programmed memory
 Instruction Set..... Relay Logic (Contacts, Coils) Data Transfer Latch/Unlatch Relays Data Comparisons (=, ≠, ≥, <) Timers (0.1 sec time base) Counters (up and down) Master Control Relay Synchronous Shift Register (Forward and reverse, 1, 8, or 16 channel) Bit Read and Control Transitional Output I/O Forcing
 Storage Registers 38 (4 digit)

2.3 I/O Section

External I/O 20 I/O - 12 Inputs/8 Outputs or 40 I/O - 24 Inputs/16 Outputs
 Internal Relay Equivalents (Regular or Latching) up to 64

2.3.1 INPUTS

Voltage Operation Range.... 94-132 VAC (47-63 Hz)
 Input Current Draw 11-16mA (60 Hz), 9-13mA (50 Hz)
 Must Turn On Voltage..... 94V
 Must Turn On Current 11.1mA (at 94V 60 Hz) 9.4mA (at 94V 50 Hz)
 Must Turn Off Voltage 40V
 Must Turn OFF Current 4.7mA (at 40V 60 Hz) 4.0mA (at 40V 50 Hz)
 Input Impedance..... 8.5K ohms (at 60 Hz) 10.0K ohms (at 50Hz)
 Turn On/Off Time 8 ms (60 Hz), 10ms (50 Hz) nominal plus scan time. 16.6 (60 Hz), 20ms (50 Hz) worst case plus scan time
 LED Operation Indication... Red LED illuminates when the input receives an "ON" signal from the field input device.

Compatibility with SY/MAX
 Class 8030 Ouput Modules.. COM-221, DOM-221, GOM-221, DOM-225

2.3.2 OUTPUTS

Voltage and Current Characteristics:

	VOLTAGE	CURRENT
Voltage Range	94-132 V 47-63 Hz	—
Maximum Current	—	2 Amp/Output at 35°C (20 Amps total)*
Minimum Load	—	NONE
Maximum On State Voltage Drop Across Output	2.0 V at 2 Amp Load	—
Maximum Off State Leakage Current	—	2 mA at 132 V 50/60 Hz
Maximum Surge Current	—	25 Amp for 1 cycle (60 Hz) (Non-repetitive)

*1 Amp/Output at 60° C.

Turn On/Off Time 4.2ms (60 Hz), 5ms (50 Hz) nominal*
8.3 ms (60 Hz), 10 ms (50 Hz) worst case*

LED Operation Indication... Red LED illuminated when receiving "ON" signal from processor logic.

Compatibility with SY/MAX Class 8030 Input Modules ... CIM-101, DIM-101

*Plus scan time (Note: Outputs turn on/off at AC sine wave zero crossing point).

2.4 Programmer Port

Connector D-Type 9 Pin Female Slide-Lock
Communication Method RS-422 (Differential)
Communications Rate 9600 baud (bits per second)
Maximum Cable Length 10,000 Feet (3,048m)
Cable Type..... Beldon 8723 or equivalent

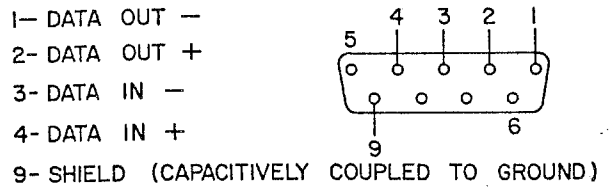


Figure 2.3 - Model 100 Programmer Port Pin-Out

2.5 Power Supply Section

Incoming Voltage Range...	94-132 VAC (47-63 Hz)
Input Power Consumption ..	25 VA*
Power Loss Ride Through (at full rated load)	16ms (at 94 V)
Input Fuse Rating	3A 250 V
Input Fuse Type or Equivalent.....	BUSS ABC-3

*With either the Hand-Held Programmer or Loader/Monitor attached. Does not include output loading.

Battery Type	One Class 8020 Type SMM-115 Battery (TADIRAN #TL-2150 3.4V Lithium Battery Size ½ AA or equivalent)
Battery Life - no load (installed in PC with PC power on)	3 years minimum at 60°C
Battery Life after "BATTERY LOW" LED Indicator Illuminates	2 weeks minimum
Battery Life - with load (processor RAM Memory Support Time)	1 year

3.0 MODEL 100 PROGRAMMABLE CONTROLLER HARDWARE

3.1 Products Available

3.1.1 SY/MAX MODEL 100 PROGRAMMABLE CONTROLLERS AVAILABLE

Four versions of the Model 100 PC are offered to fit the needs of a particular application. The I/O are a permanent part of the controller. The I/O mix (12 Inputs/8 Outputs, 24 Inputs/16 Outputs) is fixed. All I/O operate at 120 VAC (See Sections 2.3.1 and 2.3.2).

	DESCRIPTION		CLASS	TYPE
	Memory	I/O		
MODEL 100 PC	420 Words RAM.....	20 (12 Inputs, 8 Outputs)	8020	SCP-111
	420 Words RAM.....	40 (24 Inputs, 16 Outputs)	8020	SCP-121
	420 Words UV PROM.....	20 (12 Inputs, 8 Outputs)	8020	SCP-112
	420 Words UV PROM.....	40 (24 Inputs, 16 Outputs)	8020	SCP-122

Figure 3.1 - Model 100 PC Types Available

3.1.2 SY/MAX MODEL 100 ACCESSORIES

Spare Model 100 Memory Modules are available to hold spare programs. This allows easy program change when different operating sequences are required. The memory modules include a battery so that the RAM Memory remains powered even when the module is removed from the PC. NOTE: The battery is also used to retain storage register data and latch relay status and is therefore also included in the UV PROM Memory Module.

Remove incoming AC power from the Model 100 PC before removing or inserting either memory module.

The Model 100 PC is provided with labeling for vertical mounting. When mounted horizontally, a Horizontal Label Set is required. The Model 100 PC can be mounted vertically or horizontally using the mounting plates included with the controller. In applications requiring minimum mounting depth, the Model 100 PC can be mounted on its side. Order the Low Profile Mounting Brackets.

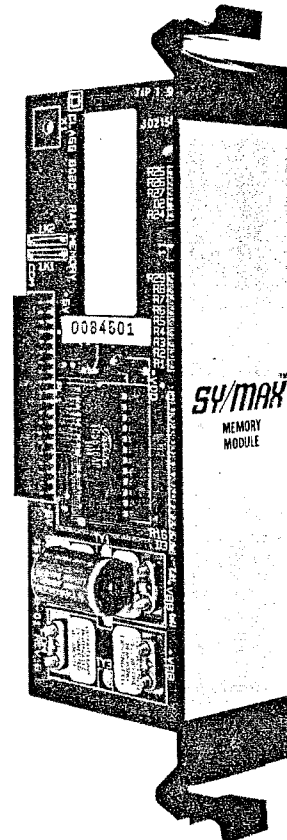


Figure 3.2 - Model 100 Memory Module

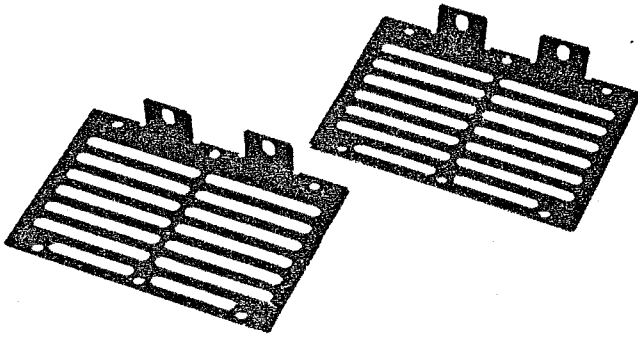


Figure 3.3 - Model 100 Low Profile Mounting Brackets

DESCRIPTION		CLASS	TYPE
Spare Memory Module	RAM	8020	SMM-100
	UV PROM	8020	SMM-110
Replacement Battery		8020	SMM-115
Low Profile Mounting Bracket Set		8020	SMB-120
Horizontal Label Set		8020	SMB-130

Figure 3.4 - Model 100 Accessories Listing

3.2 Processor Section

3.2.1 MEMORY

The memory for storing the ladder diagram control program is contained in the removable memory module. It has a capacity of 420 twenty-four bit words. There are two types of memory available based on the user's needs.

RAM (Random Access Memory)

This memory is widely used for programmable controllers. Volatile memories, such as RAM, utilize a battery to maintain the ladder diagram program upon power loss. The battery is contained in the memory module. For information on battery replacement see Section 7.0.

UV PROM (Ultraviolet Erasable Programmable Read Only Memory)

This memory is non-volatile (does not require power to maintain program information). It is programmed by the same programming equipment used for RAM memory, but requires an ultraviolet light source to erase the program. NOTE: The battery included in the UV PROM memory module is required to retain storage register data and latch relay status (both stored on a RAM memory also located on this module) during power loss situations.

3.2.2 KEYSWITCH

The key-operated selector switch allows the processor to be locked into any one of three operating modes for security purposes. The key may be removed in any position.



Figure 3.5 - Model 100 Keyswitch

Run

In this mode the processor operates and all external outputs are under control of the ladder diagram program.

Halt

In this mode the processor is not operating on the stored program. All external outputs are turned off.

Disable Outputs

In this mode the processor operates on the ladder diagram program, but all external outputs are held off. Internal outputs and storage registers (counters, timers, etc.) are updated according to the program. Output LED indicators operate per the control program. This mode allows the control program to be tested without energizing any external outputs, thus minimizing the possibility of machine or process damage should the program be incorrect.

3.2.3 INDICATING LIGHTS

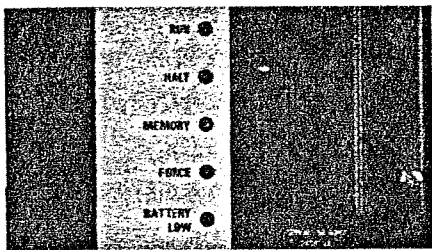


Figure 3.6 - Model 100 Indicating Lights

Run (Green)

ON—A green LED illuminates when the PC is scanning memory and the system is operating correctly (PC key-switch in the RUN position).

OFF—The LED is off if the PC halts due to the key selector switch being placed in the HALT position, or if the PC is instructed to halt via the programming equipment or program operation - See Appendix F - Control Registers. The LED will also be off if the PC halts due to system malfunction.

FLASHING—The RUN LED flashes if the PC is in the DISABLE OUTPUTS mode due to:

1. The key selector switch being placed in the DISABLE OUTPUTS position.
2. The user program or programming equipment has instructed the PC to run in the DISABLE OUTPUTS mode (key selector switch must be in RUN - See Appendix F - Control Registers).

HALT (Red)

ON—If the HALT LED is on, one of the following conditions has occurred:

1. The key selector switch has been placed in the HALT position.
2. User program or programming device has instructed the PC to halt (See Appendix F - Control Registers). In this case, PC will remain halted until the HALT BIT is cleared.
3. A memory error has occurred in which case the MEMORY light will be on.
4. An I/O error has occurred.
5. Additionally, several diagnostic checks are made continuously within the PC to insure its proper operation. Should a malfunction be detected within the PC, the PC halts, all external outputs are turned off, and the red HALT LED is illuminated. The diagnostic lights and the PC keyswitch position can be interpreted to indicate the cause of the HALT light to illuminate.

In the event of a PC error indication (PC keyswitch in RUN or DISABLE OUTPUTS position *and* HALT light on) the following steps should be taken:

1. Remove line power from the output devices by opening the on/off switch to the output devices (See Figure 4.5) or by de-energizing the external MCR circuit (See Figures 4.6 or 4.7). *No other action should be taken before this step is completed.*

2. Turn the processor keyswitch to the HALT position.
3. Diagnose and correct the fault.
4. Verify correct operation of the system with the key-switch in the DISABLE OUTPUTS position.
5. Restore power to the outputs and turn the keyswitch to RUN.

OFF—If the LED is off, the PC is either operating in the RUN mode or the DISABLE OUTPUTS mode (the RUN LED is on).

MEMORY (Red)

ON—A red LED illuminates when the processor has detected a parity error in the user memory. This condition can also be caused by trying to run the processor (key-switch in RUN or DISABLE OUTPUTS) when no ladder diagram program exists in memory. When the memory LED is on, the HALT LED will also be on, indicating the processor has halted due to this error condition.

OFF—User memory is operational.

FORCE (Red)

ON—The forcing LED indicates that one or more inputs or outputs have been forced to the ON or OFF state. Forcing overrides the actual input status or output commands per the ladder diagram program.

OFF—When the LED is off, this indicates no I/O's are being forced.

BATTERY LOW (Red)

ON—Indicates a low battery condition has been detected by the Model 100 programmable controller. Battery performance characteristics are indicated in Section 2.0—Specifications. Battery replacement directions are listed in Section 7.0.

OFF—Indicates normal battery condition.

All Lights Off

If all indicating lights are off, this indicates loss of AC power to the PC or loss of 5 VDC power in the PC.

All Lights On Except RUN

If all indicating lights except RUN are on, this indicates that the microprocessor within the Model 100 PC is not operating.

3.2.4 PROGRAMMER PORT

There is one 9-pin RS-422 differential communication port located on the front of the Model 100 programmable controller labeled PROGRAMMER. This port is used for connection to programming equipment or other peripheral equipment.

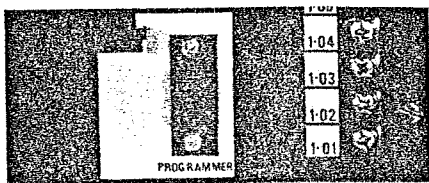


Figure 3.7 - Model 100 Programmer Port

Programmers

Either the Class 8010 Hand-Held Programmer or the CRT Programmer can be connected to the processor via the programmer port. Both devices provide complete monitoring, programming and diagnostic capabilities. The Hand-Held programmer derives its power directly from the Model 100 PC and must be within a maximum distance of six cable feet (1.8m). The CRT programmer has its own power supply and can be placed up to 10,000 feet (3,048m) from the PC.

Loader/Monitor

The Class 8010 Loader/Monitor provides a simple and inexpensive means for an operator to monitor I/O status and storage register (counter, timer) values. It also allows the operator to change storage register values without providing access to the control (ladder diagram) program.

Cartridge Tape Loader/Recorder

By attaching the Class 8010 Cartridge Tape Loader/Recorder, it is possible to record the ladder diagram program onto tape for developing a spare program source. If the program were somehow altered or lost, it could then be quickly reloaded without the need for manually reprogramming with a CRT or Hand-Held Programmer.

Distributed Control

For small distributed control networks, a SY/MAX Deluxe Model 300 processor can be connected to a Model 100 PC for the exchange of I/O status and register data. In this configuration, the Deluxe Model 300 processor initiates the communication. See Figure 3.8. NOTE: The Model 100 PC can only respond to communications—it cannot initiate communications.

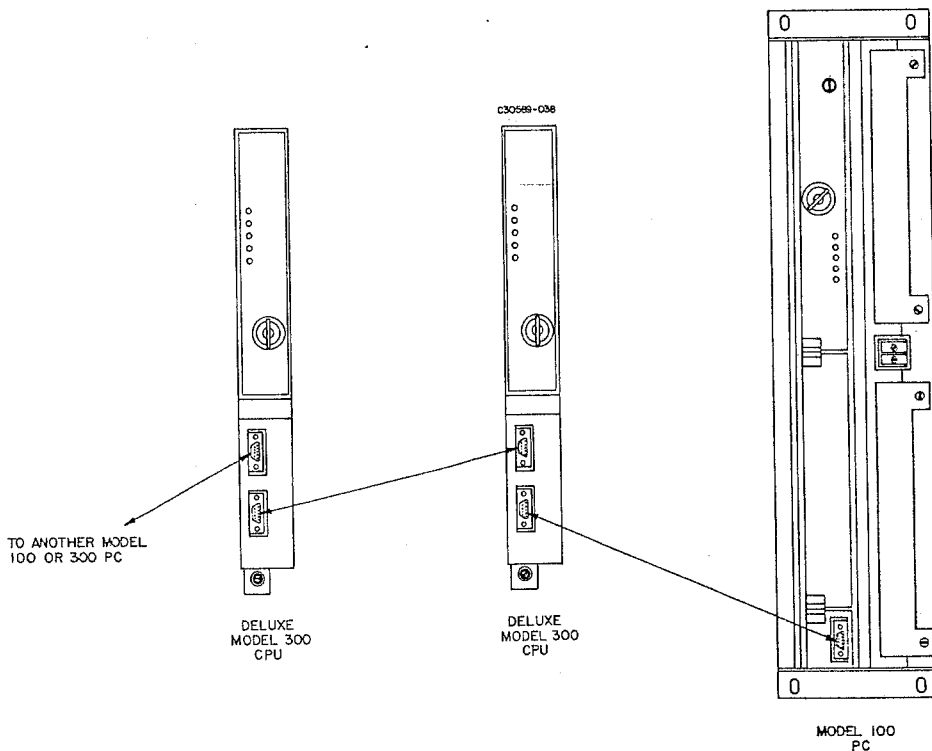


Figure 3.8 - Multiple Processor Communication

Communication Module

For larger distributed control networks, the Model 100 PC can be connected to a communication module allowing interfacing to other PC's, computers, programmers, etc.

3.2.5 PROGRAMMER PORT RESTRICTED ACCESS

In certain applications the user may wish to restrict access to the Model 100 PC by devices connected to the PROGRAMMER Port. Refer to Appendix F - Control Registers for additional information.

Register Protect

Setting the Register Protect Bit (8176-06) protects the registers from changes by the CRT or Hand-Held Programmers or by the Loader/Monitor (with the following exceptions: 1) CRT Programmer—when the CRT Programmer keyswitch is in OVERRIDE; 2) Hand-Held Programmer—when the Model 100 PC keyswitch is in HALT).

Storage Register Fencing

It is possible to protect certain blocks of storage registers from alteration by using the fencing feature.

Registers 8173 and 8174 are used to define the block of registers which will remain accessible. Register 8174 contains the starting address while 8173 contains the ending address. All registers between and including the starting and ending addresses remain accessible or unprotected. All other registers will be fenced (protected from alteration).

Example:

Assume the value 20 is entered into the register 8174 (start fence) and the value 30 is entered into register 8173 (End Fence). This determines the block of registers from addresses 20 through 30 to be accessible (not fenced). In other words, registers 1 through 19 and registers 31 through 8192 will be non-accessible (fenced). Figure 3.9 illustrates this:

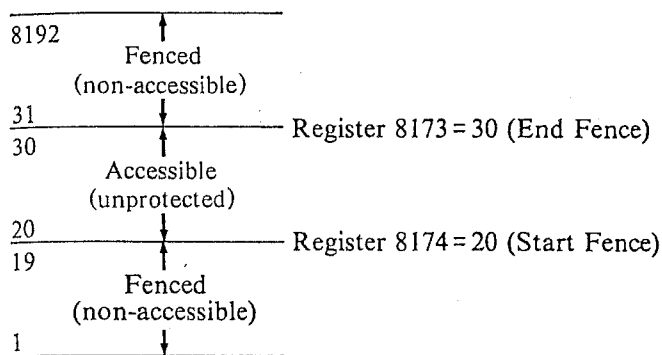


Figure 3.9 - Storage Register Fencing Example

It should be noted that when the processor memory is cleared, register 8173 is set to 8176 and register 8174 is set to 1 automatically (this allows registers 1 through 8176 to be accessible). Fencing can be set by programming rungs into memory to preset registers 8173 and 8174. In the above example, if it is desired to fence registers 1-19 and 31-8192 upon power up of the processor, the rungs in Figure 3.10 should be programmed.

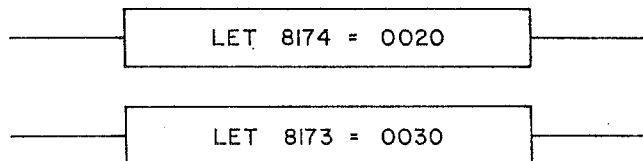


Figure 3.10 - Rungs Used to Preset Start and End Fence Registers

The effect of fencing on the storage registers depends upon which device is connected to the PROGRAMMER port and the position of the processor key switch. See Figure 3.11.

DEVICE CONNECTED TO PROGRAMMER PORT		PROCESSOR KEYSWITCH POSITION	FENCED REGISTERS	
			ALTERABLE	NON-ALTERABLE
Class 8010 Type SPR-200 201,210,211 CRT PROGRAMMER	CRT Keyswitch in OVERRIDE	HALT, RUN or DISABLE OUTPUT	X	
	CRT Keyswitch in MONITOR, DATA ENTER or PROGRAM	HALT, RUN or DISABLE OUTPUT		X
Class 8010 Type SPR-100 Hand-Held Programmer or Type SLR-100, 110 Cartridge Tape Loader/Recorder	HALT		X	
	RUN or DISABLE OUTPUT			X
Class 8010 Type SLM-100 Loader/Monitor	HALT, RUN or DISABLE OUTPUT			X
Class 8020 Deluxe Model 300 Processor	HALT, RUN or DISABLE OUTPUT		X	
Communications Module	*		*	*

*Access to fenced registers is determined by the device attached to the other end of the communications module and by the PC keyswitch position.

Figure 3.11 - Storage Register Fencing Table

I/O Forcing

The FORCING capability allows the user to turn an input or output or the bit of a register ON or OFF from the Hand-Held or the CRT Programmer. This is accomplished regardless of the actual state of the field device (limit switch, etc.) or the logic rung for an output or storage register. This capability allows a machine or process having a faulty input to continue operation until the field device can be repaired. It is also valuable during start-up of a machine or process to simulate the action of portions of the program which have not been implemented yet.

The PROGRAMMER port provides access to the I/O data table. Thus, the status of any I/O can be obtained or the state of any given I/O can be FORCED. Only registers 1 through 16 can be forced.

Setting the Force Inhibit Bit (8176-05) prevents the Hand-Held and the CRT programmer (except when the CRT programmer keyswitch is in the OVERRIDE position) from forcing I/O. Monitoring I/O status is still possible.

3.2.6 PROCESSOR TECHNICAL DATA

The following provides technical detail which is not required for the typical application of a Model 100 Processor section. This information is provided for those readers who desire greater knowledge of the internal operation of the system.

Memory Utilization

In general, the amount of memory required for relay circuits can be determined by simply counting the number of contacts, coils and branches in each rung. A contact or coil (including latches) and its address number requires one word of memory. Spaces and connects do not require any words. Branches require one word for each opening branch and one word for each closing branch. Several sample circuits are shown in the following figures along with amount of memory required.

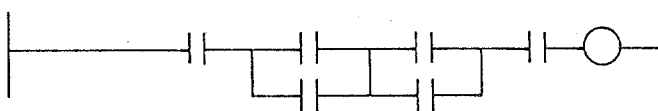


Figure 3.12 - Ladder Diagram Rung with 11 Words

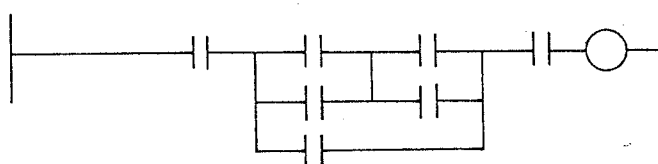


Figure 3.13 - Ladder Diagram Rung with 14 Words

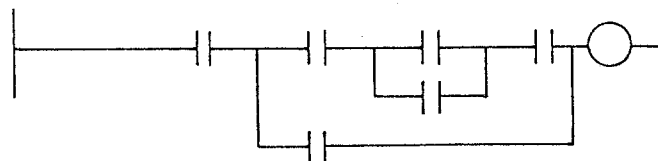


Figure 3.14 - Ladder Diagram Rung with 11 Words

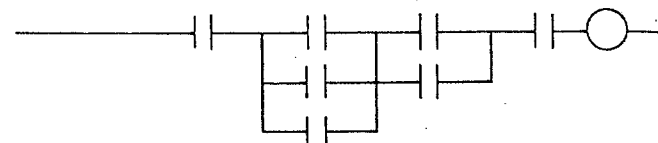


Figure 3.15 - Ladder Diagram Rung with 12 Words

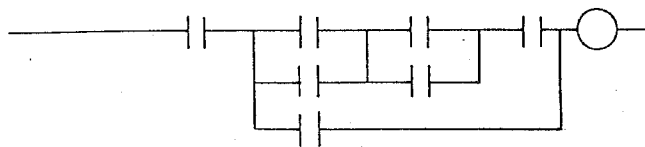


Figure 3.16 - Ladder Diagram Rung with 14 Words

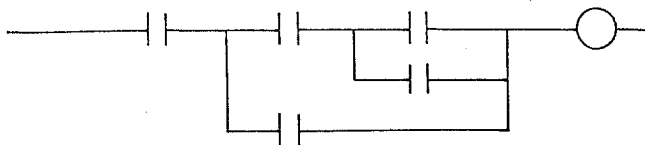


Figure 3.17 - Ladder Diagram Rung with 10 Words

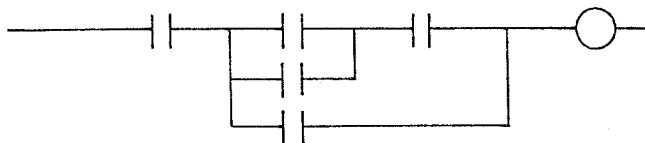


Figure 3.18 - Ladder Diagram Rung with 10 Words

Figure 3.19 lists the amount of memory required for each instruction.

INSTRUCTION	NUMBER OF WORDS
Contact	One
Coil	One
Branch	One
Latch or Unlatch Coil	One
Transition Coil	One
Master Control Relay	One
Timer	Six*
Counter	Six*
Shift Register	Six*
If	Three*
Let	Three*

* Does not include contacts and/or coils used outside of the function box.

Figure 3.19 - Memory Utilization Chart

Scanning Technique

The Model 100 Programmable Controller scans only the portion of user memory which is utilized by the ladder diagram program. Unprogrammed memory is not scanned. After the PC completes one memory scan, it begins another scan (with a maximum worst case delay of up to 12.5ms - 60 Hz applications or 15ms - 50 Hz application). The ladder diagram program is stored in memory beginning at the first word and extending for as many words as required. No gaps exist in this program. (The programming equipment is capable of editing the program in any manner, including the insertion and removal of contacts in existing rungs, inserting a new rung between existing rungs, and deleting any rungs.)

I/O status is updated based on the AC sine wave from the incoming power (50 or 60 HZ). Inputs are interrogated at each positive peak (N positive with respect to L) of the AC sine wave. Outputs are updated at every zero crossing of the AC sine wave. Actual I/O information is transmitted between the external I/O and an image table. Programmed control action is based on I/O information in the image table.

INSTRUCTION	APPROX. EXECUTION TIME
Contact	56 μ sec
Coil	90 μ sec
Latch or Unlatch Coil	90 μ sec
Data Transfer	155 μ sec
Compare	135 μ sec
Counter	395 μ sec
Timer	320 μ sec
Master Control relay	55 μ sec
Synchronous shift register	260 μ sec + 65 μ sec per register

Figure 3.20 - Scan Rate of Instructions

NOTE: Typical scan time for 420 words of relay logic is approximately 40ms (including the delay between scan cycle and the time to service the programmer).

Processor Start-Up Sequence

Upon application of AC power to the processor, the following start-up sequence occurs:

1. A signal pulse to turn off external outputs is generated.
2. A self test is performed on the microprocessor to determine proper operation.
3. The I/O forcing memory is reset, therefore releasing all forced I/O.
4. Input status is updated.
5. The processor then scans the user memory if the key-switch is in the DISABLE OUTPUTS or RUN position. During the first memory scan, all outputs which have been programmed are automatically turned off except those internal outputs which have been programmed as latches. (All storage register data is maintained at previous states.)
6. The processor then begins another memory scan setting outputs on or off according to the ladder program in memory.

Processor Power-down Sequence

When AC power is removed from the system, the processor shuts down resetting all external outputs to their off state and halting the memory scan.

The PC will ride through any power loss or "brown-out" situation of up to approximately 16 milliseconds, with no interruptions in operation. Beyond this length of time, it shuts down and then restarts upon resumption of power.

Output Reset Operation

Upon changing the PC keyswitch from any position to either the DISABLE OUTPUTS or RUN position, the PC follows the start-up sequence described above.

Internal Circuit and Operational Checks

The processor performs a number of internal diagnostic checks. Among these are:

1. A continuous check made to insure that the internal clock driving the processor logic is fully operational.

2. Each word of memory incorporates a parity bit. The processor checks each word for proper parity. If an error is detected, the processor halts operation and turns external outputs off. (In this case, the HALT light and the MEMORY light will illuminate.) This check prevents the processor from operating on an erroneously altered program. The processor will also halt and illuminate the HALT and MEMORY LED's if it scans a memory which is unprogrammed.
3. At each zero crossing of the AC sine wave, the processor sets each output on or off according to the status of the image table. It then compares the status of the output image table with the actual status of each output within the system. If the image table does not match the actual output status, the processor halts operation and turns external outputs off. The HALT light will illuminate.

3.3 I/O Section

3.3.1 GENERAL

The Model 100 is supplied with either 20 or 40 I/O (12 inputs/8 outputs or 24 inputs/16 outputs respectively). All I/O are 120 VAC 50/60 Hz. For detailed I/O information, see Section 2.0—Specifications. Outputs are not fused. Output triacs are replaceable by removing the I/O card from the Model 100 housing and removing individual triacs from the card by removing their heat sink screws.

All inputs share the N (Neutral) terminal and all outputs share the L (Line) terminal both of which are used for the incoming power to the Model 100 PC. See Figures 4.5, 4.6 and 4.7 for typical wiring information.

3.3.2 SIMPLIFIED I/O SCHEMATIC

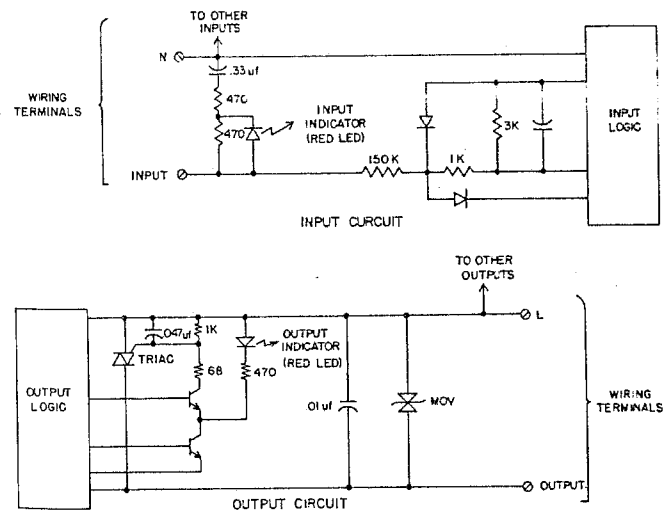


Figure 3.21 - Simplified I/O Schematic

3.4 Power Supply Section

The power supply section of the Model 100 PC is a linear supply with 5 VDC output. See Section 2.0—Specifications for incoming power requirements. The power supply is undervoltage and overcurrent protected.

4.0 INSTALLATION

4.1 Environment

4.1.1 INTRODUCTION

The SY/MAX Model 100 Programmable Controller is designed to operate in an industrial environment. System components can withstand variations in temperature, humidity and electrical noise. Consult the factory for additional application information when using the Model 100 PC in severe environments.

4.1.2 ELECTRICAL NOISE IMMUNITY

Resistance to electrical noise is built into all Square D programmable controllers. The power supply section is protected against overcurrent conditions. The I/O section includes transient noise suppression to reject voltage and current spikes. The Model 100 PC has shielding to protect the logic circuitry from noise. All components are designed for resistance to radio frequency interference (RFI).

To enhance system noise immunity, care should be taken in the routing of power wires (see Section 4.3.4) and in connecting the incoming service (see Section 4.4.3). In applications where inductive loads are wired in parallel with inputs or when outputs are wired in series or parallel with hard contact switches used to control inductive loads, additional transient noise suppression should be provided. See Section 4.4.3 for proper suppressor selection and wiring.

4.1.3 TEMPERATURE

SY/MAX Programmable Controller components are rated for an operating temperature range of 0 to 60°C (32 to 140°F). Storage temperature rating is -40 to 80°C (-40 to 176°F). The operating range applies to ambient temperatures around the PC devices (inside the enclosure). If conditions produce temperature "hot spots" inside the enclosure that are higher than the stated range, a fan or other means should be installed to circulate the air and equalize the temperature. See Figure 4.1 for temperature rating exceptions.

4.1.4 HUMIDITY

A humidity range of 0 to 95% non-condensing is allowed for SY/MAX PC devices (see Figure 4.1 for humidity rating exceptions). Should condensation be a possibility, a thermostatically controlled heater may be installed in the enclosure.

4.2 Layout

4.2.1 MODEL 100 PROGRAMMABLE CONTROLLER

The Model 100 PC can be mounted vertically, horizontally, or on its side. Situate the PC so that a minimum of four inch (10 cm) clearance is maintained on all sides. Appropriate spacing should be provided for a wiring duct for power and I/O wiring.

A medium height location in the PC enclosure is preferable for the Model 100 PC. This permits easy wiring of terminals and better viewing of indicator lights. However, if temperatures in the enclosure are expected to approach the operating limit of 60°C (140°F), the Model 100 PC should occupy a lower and therefore cooler position. The PC must be located at a position in the enclosure that allows unobstructed insertion and removal of the memory module. See Section 4.3 for mounting information.

4.2.2 AC INCOMING LINE EQUIPMENT

The preferred location for incoming line devices such as constant voltage transformers and surge suppressors (see Section 4.4.3) is above the PC or near the top of the enclosure. This assumes that the incoming power enters at the top of the cabinet. The object is to keep incoming power wire runs as short as possible to minimize the chance of transmitting electrical noise from incoming line devices to the programmable controller components.

CLASS	TYPE	DESCRIPTION	OPERATING TEMPERATURE	STORAGE TEMPERATURE	HUMIDITY NON-CONDENSING
8010	SPR-200, 201, 210, 211	CRT Programmer	0 to 50°C (32 to 122°F)	-20 to 65°C (-4 to 150°F)	10 to 80%
8010	SPR-100	Hand-Held Programmer	0 to 50°C (32 to 122°F)	-40 to 80°C (-40 to 176°F)	0 to 95%
8010	SLM-100	Loader/Monitor	0 to 60°C (32 to 140°F)	-40 to 80°C (-40 to 176°F)	0 to 95%
8010	SLR-100, 110	Cartridge Tape Loader/Recorder	0 to 40°C (32 to 104°F)	-20 to 80°C (-4 to 176°F) w/o tape*	20 to 80%

*with tape, storage temperature is 0 to 50°C (32 to 122°F).

Figure 4.1 - Temperature And Humidity Rating Exceptions

4.2.3 ELECTRO-MECHANICAL OUTPUT DEVICES

Magnetic starters, contactors, relays, etc., should be located above or to either side of the PC and have a six inch (15 cm) minimum separation from the PC. When any of these devices are mounted above the PC, barriers should be installed to catch falling debris.

4.2.4 COMPONENT SPACING

Recommended spacings between the PC and between components and the sides of the enclosure are indicated in Figure 4.2. Remember that a six inch (15 cm) clearance is required between PC components and any electro-mechanical or incoming line device. Clearances are determined by the space necessary to attach electrical plugs, route cables and wires, meet ventilation requirements for heat dissipation, prevent electrical noise transmission, and provide hand and tool access for maintenance. Allow appropriate space along side the PC for the installation of a wire duct.

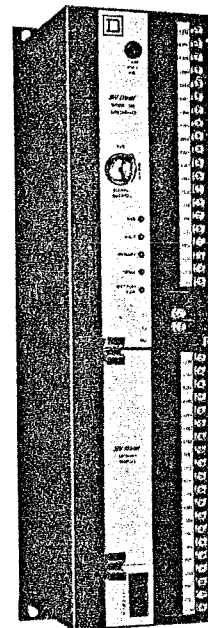


Figure 4.3 - Model 100 Mounted Vertically

The PC should be mounted using four 10-24 UNC screws. The PC mounting plate must be tied to a "true-earth" ground either by directly mounting the PC to a grounded back panel using "star" washers to insure a good electrical connection, or by running a braided grounding strap from the PC mounting plate to the earth ground.

If it is necessary to mount electro-mechanical devices above the PC, a barrier between these devices and the PC must be incorporated to prevent debris from falling onto the PC.

4.3.2 LOADER/MONITOR MOUNTING

A Type SLM-100 Loader/Monitor may be used with the Model 100 PC. It can be either hand-held or cabinet mounted. For mounting, the Loader/Monitor is designed to fit flush in a cabinet door with two #8-32 mounting screws pretapped. The 10 ft. (3m) length of the Loader/Monitor cable must be considered when positioning the Loader/Monitor to ensure that it can be plugged into the processor. Loader/Monitor dimensions and panel cut-out dimensions are given in Section 5.0.

4.3.3 ENCLOSURE CONSIDERATIONS

Enclosure Type and Access

The typical PC cabinet is a NEMA Type 12 enclosure. Enclosure size depends on user requirements.

Two access arrangements are possible: front-of-board and back-to-back. Front-of-board is frequently used where the enclosure will be positioned against a wall or other obstruction. It allows the shallowest possible enclosure to be used. Most controllers are laid out with front-of-board access.

Back-to-back arrangement allows access from both the front and the rear. It requires a deeper enclosure. Usually, the PC is mounted on one side of the mounting panel while the opposite side accommodates items such as relays, starters, power supplies, incoming line devices, and redundant I/O terminals.

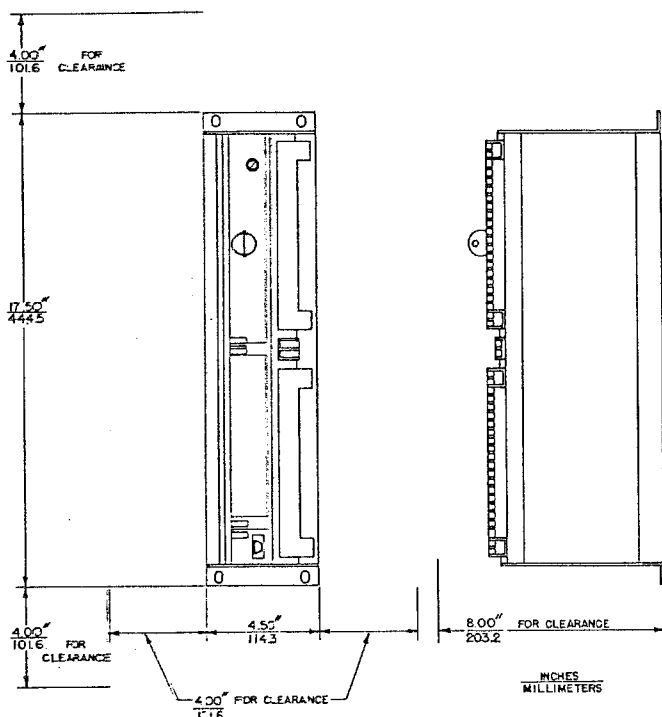


Figure 4.2 - Model 100 Mounting Clearance.

4.3 Mounting

4.3.1 MODEL 100 PROGRAMMABLE CONTROLLER

The Model 100 PC may be either rack, panel, or flush mounted. It can be mounted vertically, horizontally, or on its side. When mounting the PC horizontally, a Class 8020 Type SMB-130 Horizontal Label Set is required. When mounting the PC on its side, the end plate used for vertical or horizontal mounting must be replaced with Class 8020 Type SMB-120 Low Profile Mounting Brackets. When flush mounting the PC, the end plate used for vertical or horizontal mounting can be reversed so the mounting holes are flush with the front of the PC.

Incoming Conduit

Conduits generally enter the enclosure from above or below. Wires from the conduit are then routed either to redundant I/O terminals (see below) or directly to the I/O terminals. For information on wire routing, see Section 4.3.4.

Redundant I/O Terminals

Although not necessary, additional or redundant I/O terminals may be desired in the enclosure. These are mounted directly adjacent to conduit entry areas and receive the wires from the conduit. Wires from the redundant terminals to the I/O terminals on the PC are installed to complete the run from conduit to the PC.

Windows

Some applications require the viewing of PC and I/O indicating lights through windows in the enclosure doors. A NEMA 12 gasketed plexiglass window may be used.

Accessories for Enclosure

The accessories most frequently found in PC enclosures are interior lighting (either incandescent or fluorescent) with suitable light switches, and a network of convenience AC power outlets for peripheral devices. Spare convenience outlets are also useful for electric tools (drill, soldering iron, etc.).

4.3.4 WIRE ROUTING

Provisions must be made for wire routing inside the enclosure. Wires should be run in wire duct or should be bundled and tied.

Power Wire Isolation

All AC and DC power wires for incoming line equipment, power supplies, and electromechanical output devices should be kept isolated from: 1) SY/MAX power cables, 2) DC signal wiring, and 3) programmer or peripheral communication cable. Power wires should not be run in the same wire duct nor be bundled together for parallel runs with these other wires. Right angle cross-overs can be used. Segregation of power wires minimizes the chance of electrical noise pick-up.

4.4 Connections

4.4.1 I/O TERMINAL WIRING

Input and output field devices are wired to the terminal blocks located on the front of the Model 100 PC. Typical wiring diagrams are shown in Figures 4.5, 4.6, and 4.7. Note that all I/O share the incoming power terminals as commons.

4.4.2 I/O TERMINAL IDENTIFICATION

Model 100 I/O addressing and terminal identification is shown in Figure 4.4. A user marking area is supplied directly above each address indication. See Appendix A for additional addressing information.

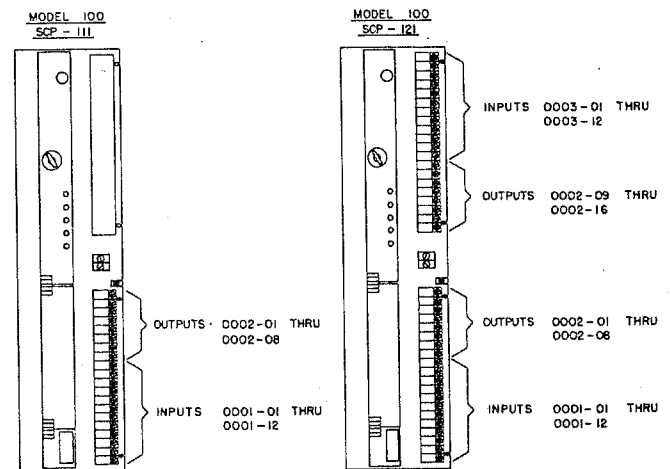


Figure 4.4 - Model 100 I/O Addressing Configuration

4.4.3 POWER CONNECTIONS

Incoming Line

Incoming power is wired directly to the L, N, GND terminals on the front of the Model 100 PC. The terminals will accept one #12 or two #14 stranded or solid wires. Ring lugged wires may be used. A properly sized main disconnect switch should be used in the power circuit feeding the PC as a means to remove power. An on/off switch should be wired in the circuit feeding power to the field output devices. This will enable the removal of output power while leaving the PC and input devices operational for troubleshooting purposes. See Figure 4.5. Wire the power supply according to applicable electrical codes.

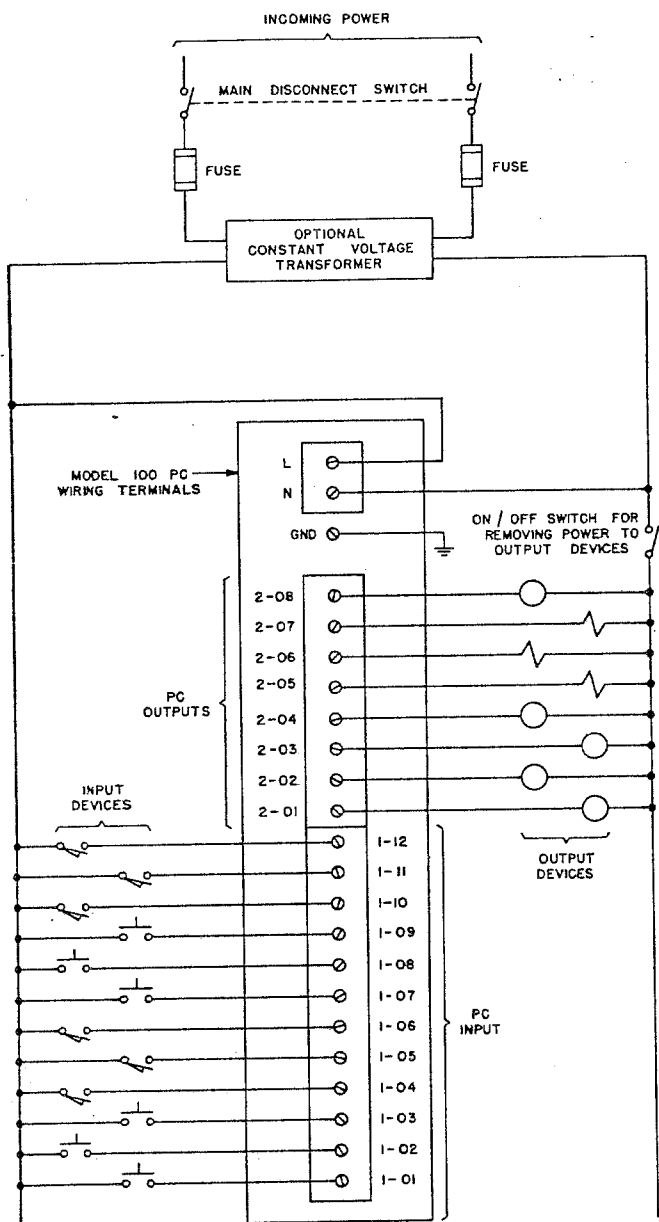


Figure 4.5 - Typical Wiring

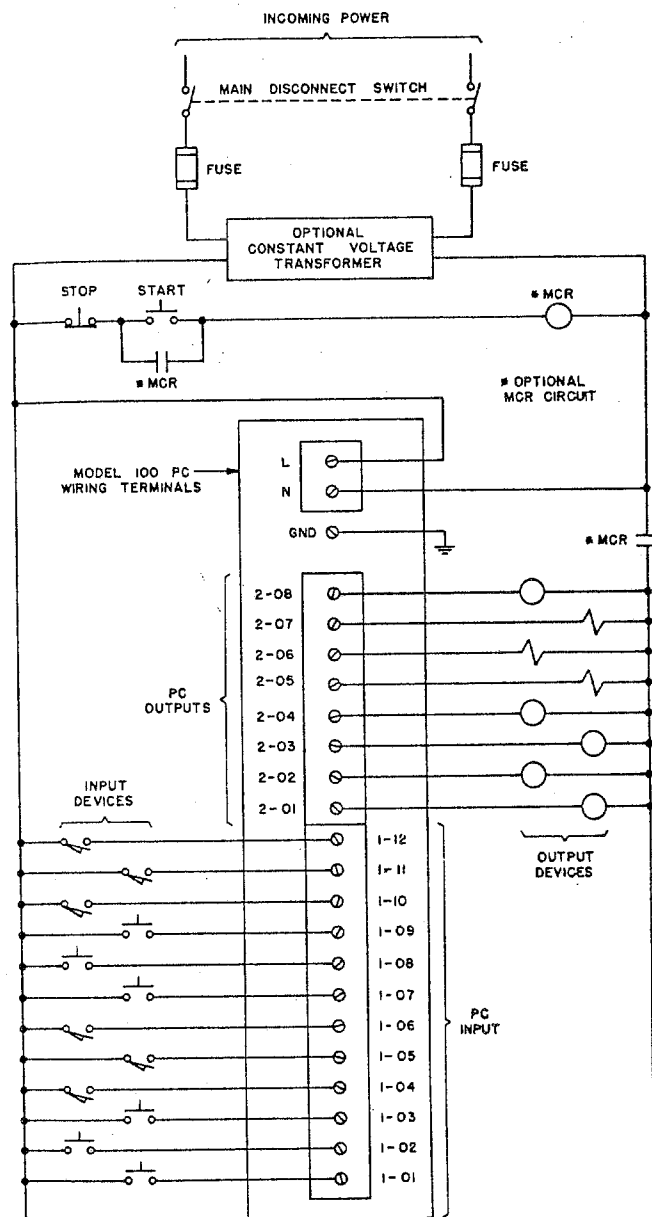


Figure 4.6 - Typical Wiring - With MCR

An optional Master Control Relay circuit may be added to the incoming power circuit in lieu of the output on/off switch. The MCR circuit provides protection by removing power to the outputs whenever a system power loss occurs. To supply power to the outputs after system power is regained, the start button must be depressed manually. Note: The processor would come back on-line automatically after resumption of power. See Figure 4.6.

The Master Control Relay circuit may be expanded by placing a programmable controller output (which is programmed to always be closed whenever the processor is running) in series with the MCR holding circuit interlock. This version of the MCR circuit provides additional protection in that whenever the processor is halted (for whatever reason: i.e., intentionally halting the processor, the system power loss, device failure, etc.), the MCR coil is dropped out causing power to be removed from the output devices. When the processor is restarted, the start button must be manually depressed to reapply power to the output devices. See Figure 4.7.

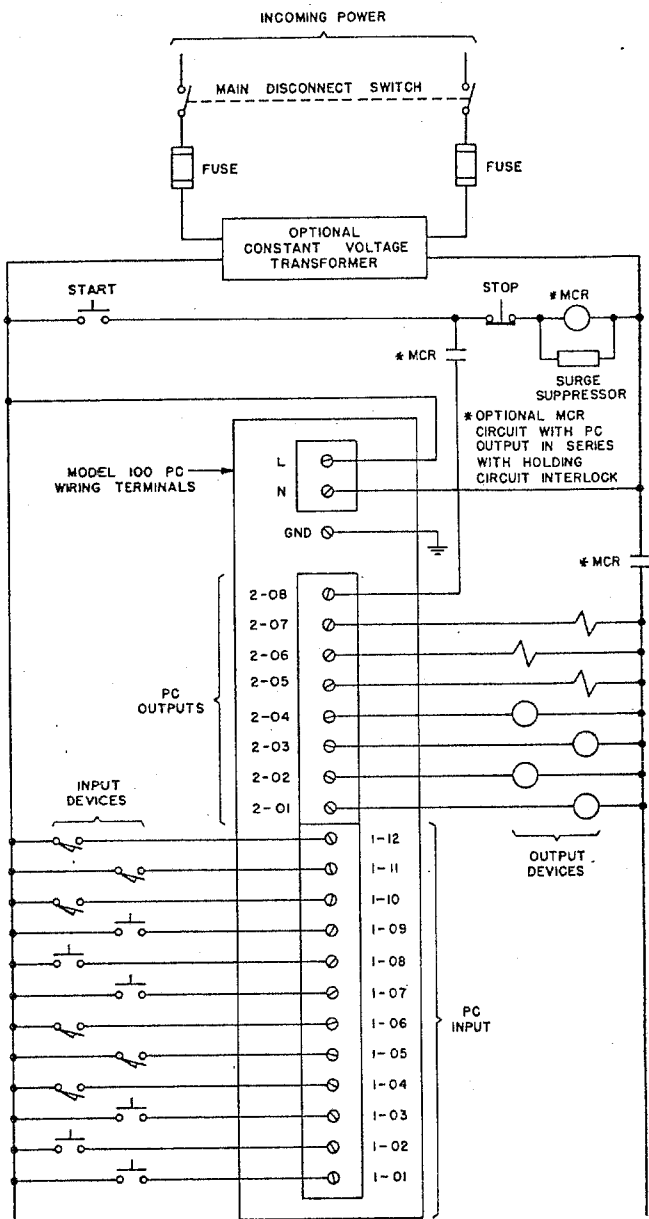


Figure 4.7 - Typical Wiring - With Expanded MCR

Constant Voltage Transformer

If line voltage fluctuations occur that are greater than the power supply's input voltage range (see Section 2.0 - Specification) with a duration greater than the given power loss ride-through time, then a properly sized SOLA* Type CVS (Constant Voltage Transformer) or equivalent is recommended. When connected to the incoming service, the constant voltage transformer (CVT) will stabilize the voltage to the PC. See Figures 4.5, 4.6, and 4.7.

*SOLA is a registered trademark of SOLA BASIC INDUSTRIES; Elk Grove Village, IL (USA).

Surge Suppression - Incoming Power

In addition to the voltage variations mentioned above, high frequency power line transients may be caused by lightning strikes or switching large loads. Because of the high frequency, constant voltage transformers may not be adequate to protect electronic equipment such as programmable controllers from these transients. Therefore, it is desirable to also protect the equipment from shutdown and possible permanent damage by adding transient suppressors to the lines supplying the electronic equipment.

Surge Suppression - I/O

In those applications in which an inductive load such as a motor starter or solenoid is wired in parallel with a Model 100 input or when the Model 100 output is wired in series or in parallel with hard contact switches to control an inductive load, additional transient noise suppression should be provided. Figures 4.8, 4.9, and 4.10 show different wiring configurations. In each case, the suppressor should be installed close to the inductive load.

A typical suppressor for 120 VAC operation consists of 0.5 mfd, 400 volt capacitor and a 220 ohm, 1/2 watt resistor in series. Recommended Square D suppressors for different 120 VAC applications are listed in Figure 4.11.

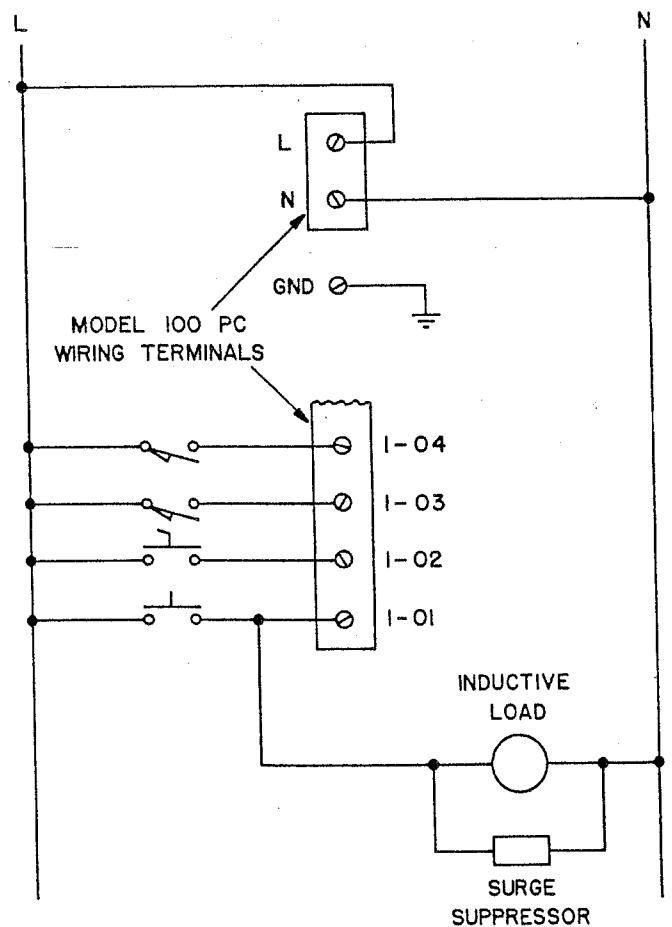


Figure 4.8 - Surge Suppression for Input

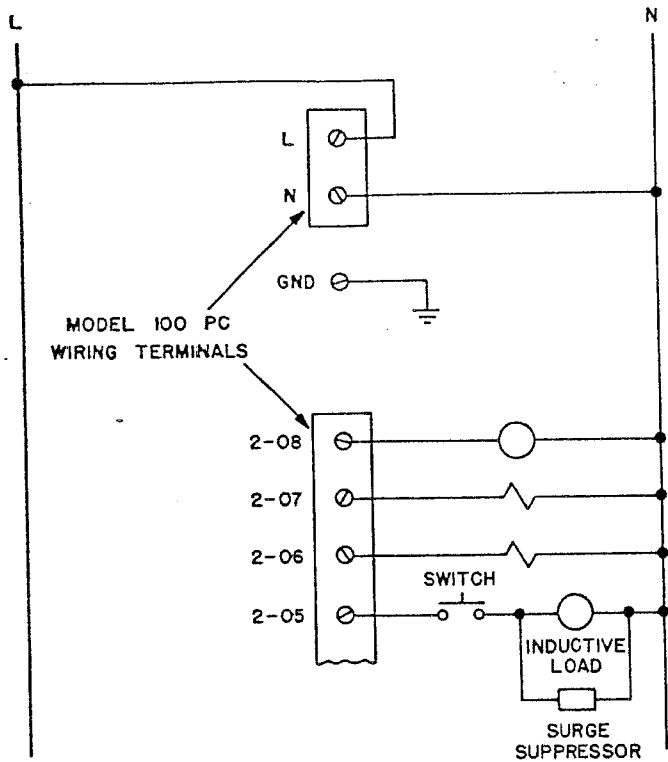


Figure 4.9 - Surge Suppression for Output-Switch in Series with Output (After Output).

TYPE	SQUARE D PART NUMBER	APPLICATION
Bathtub - Solder Terminals	26126-13502	General Purpose
Integrated RC Package - Solder Terminals	26136-13500	General Purpose
Channel Mounting Pressure Wire Connector	Class 9080 Type GT-6	Size 00-2 Starter (Square D Class 8536)
Channel Mounting Pressure Wire Connector	Class 9080 Type GU-6	Size 3-5 Starter (Square D Class 8536)

Figure 4.11 - Recommended Surge Suppressors

4.4.4 PERIPHERAL DEVICE CONNECTION

CRT Programmer

SY/MAX CRT Programmers communicate with the PC over a Class 8010 Type CC-100 (10 ft.-3m) or Type CC-101 (30 Ft.-9.1m) differential cable. One end of the cable connects to the PROCESSOR port on the back of the CRT programmer. The other end of the cable connects to the PROGRAMMER port on the front of the PC. Use the slide clips on the cable connectors to secure the cable to the programmer and processor.

A Class 8010 Type CCK-102 Cable Kit is available for the user to assemble his own cable to the custom length required (10,000 ft - 3,048m maximum). The kit includes all connection hardware required. The required cable (Beldon #8723 or equivalent) is supplied by the user. Refer to the CRT Programmer Instruction Bulletin for pin-out information.

The CRT communication cable should *not* be routed in the same conduit or wire duct with power wires (right angle cross-overs are permitted).

The CRT programmer must be connected to an appropriate grounded power outlet. The Class 8010 Type SPR-200 CRT Programmer operates on 120 VAC 50/60 Hz. The Type SPR-210 CRT Programmer operates on 240 VAC 50/60 Hz. A label on the back of the CRT next to the power cord indicates which voltage level is required.

IMPORTANT: Remove power from the CRT programmer before making or breaking the cable connection between the CRT programmer and the PC. The possibility exists for a potential difference between the ground of the programmer and the ground of the processor (e.g., when separated by a great distance) which could, in some instances, cause component failure when connected or disconnected under power.

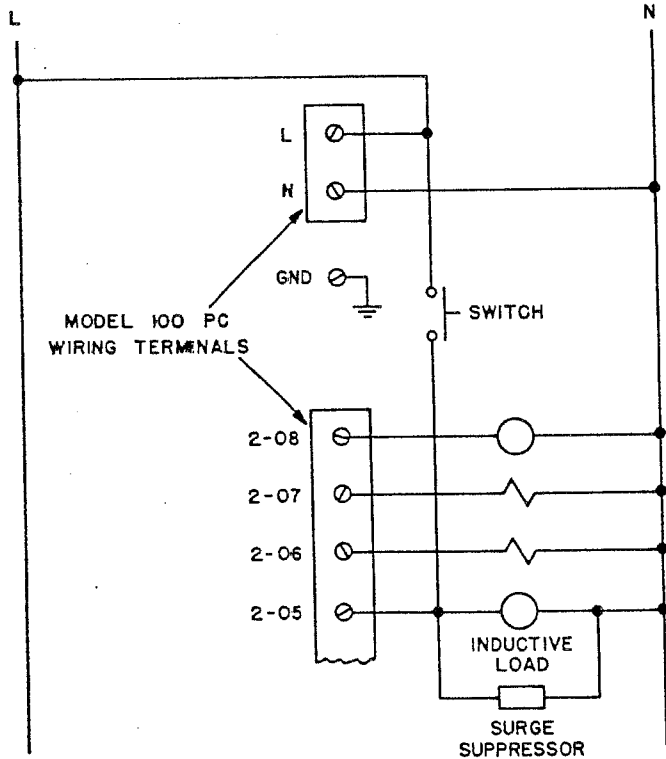


Figure 4.10 - Surge Suppression for Output-Switch in Parallel with Output

A VIDEO OUT port on the back of the CRT programmer allows a video monitor to be connected to the system. Anything displayed on the CRT program screen will also be displayed on the monitor. The cable connected to the VIDEO OUT port must be a Type RC-59, 75 OHM coaxial cable with a BNC female connector.

Hand-Held Programmer

The Class 8010 Type SPR-100 Hand-Held Programmer has a 6 foot (1.8m) communication cable which plugs into the PROGRAMMER port on the front of the processor. No additional cable or power connections are required.

Loader/Monitor

The Class 8010 Type SLM-100 Loader/Monitor has a 10 foot (3m) communication cable which plugs into the PROGRAMMER port on the front of the processor. No additional cable or power connections are required.

Cartridge Tape Loader/Recorder

The Class 8010 Type SLR-100 and Type SLR-110 Cartridge Tape Loader/Recorders permit the recording of programs and register data from the PC or the loading of such information into the PC. The Loader/Recorder may be connected directly to the PC (manual mode) or it can operate through a CRT programmer (automatic mode).

To connect the Loader/Recorder directly to the PC, a Class 8010 Type CC-100 (10 ft-3m) or a CC-101 (30 ft.-9.1m) differential cable is plugged into the DIFFERENTIAL port on the Loader/Recorder and the PROGRAMMER port on the PC. For a longer length cable (in lieu of the Type CC-100 or CC-101 Cable), a custom cable (up to 10,000 ft. or 3,048m) can be made. See Section 4.4.4. - CRT Programmer.

To operate the Loader/Recorder through the CRT programmer, a Class 8010 Type CC-110 (10 ft.-3m) RS-232C cable must be connected to the CASSETTE/PRINTER port on the back of the CRT, and to the RS-232C port on the Loader/Recorder.

The Type SLR-100 Tape Loader/Recorder operates on 120 VAC 50/60 Hz. The Type SLR-110 requires 240 VAC 50/60 Hz.

IMPORTANT: Remove power from the Loader/Recorder before making or breaking the cable connection between the Loader/Recorder and the PC. The possibility exists for a potential difference between the ground of the Loader/Recorder and the ground of the PC (e.g., when separated by a great distance) which could, in some instances, cause component failure when connected or disconnected under power.

4.4.5 CABLES

Figure 4.12 is a listing of cables used with the Model 100 PC.

CLASS	TYPE	DESCRIPTION	LENGTH	WHERE USED
8010	CC-100	9 pin Differential	10 ft (3m)	CRT Programmer to Processor, Cartridge Tape Loader/Recorder to Processor, Processor to Processor
8010	CC-101	9 pin Differential	30 ft(9.1m)	Same as CC-100
8010	CC-110	25 Pin RS-232C	10 ft (3m)	Cartridge Tape Loader/Recorder to CRT Programmer

Figure 4.12 - Cable Listing

5.0 OTHER SY/MAX PRODUCT DIMENSIONS

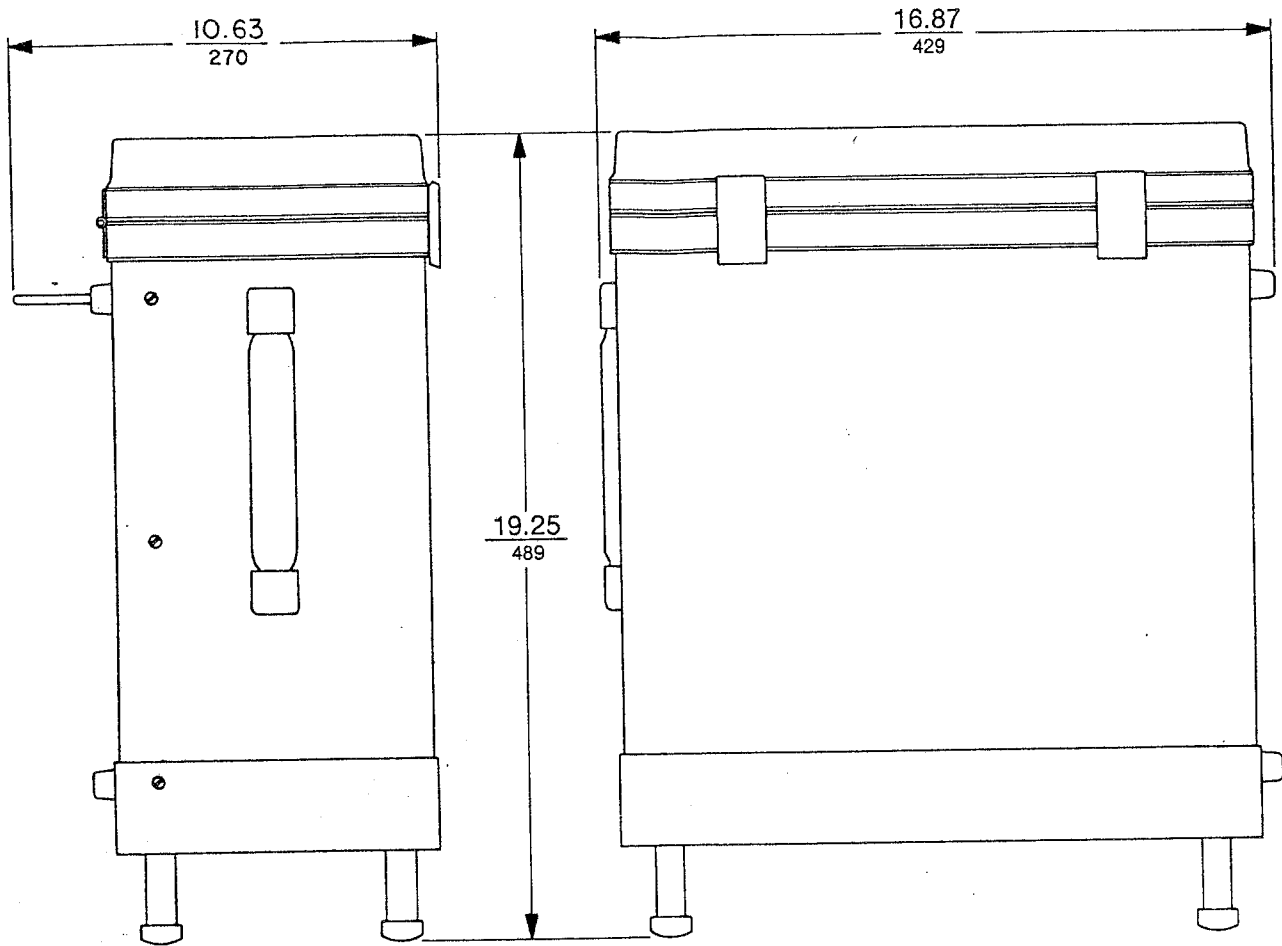


Figure 5.1 - Type SPR-200/210 CRT Programmer

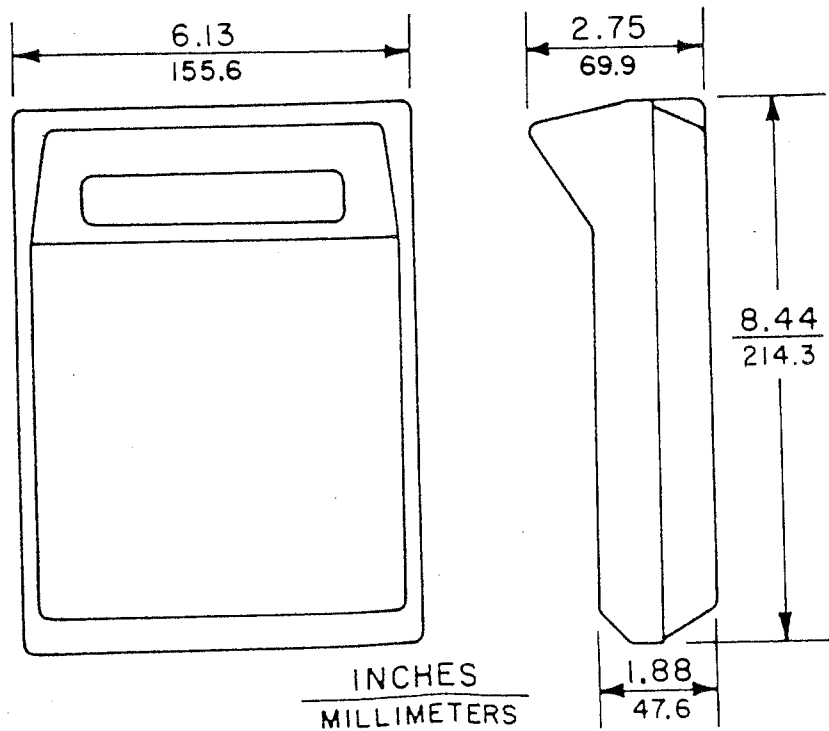


Figure 5.2 - Type SPR-100 Hand-Held Programmer

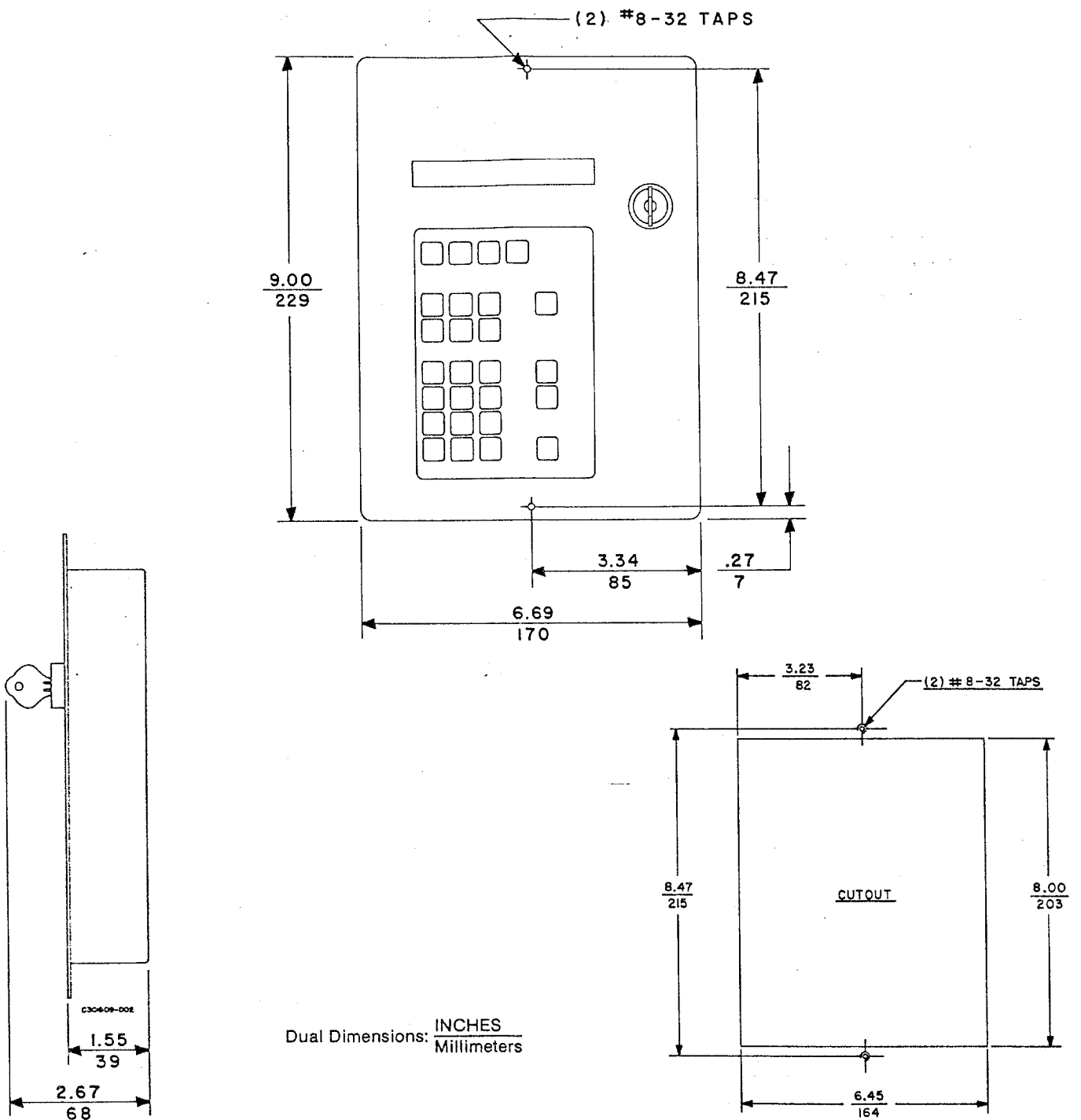


Figure 5.3 - Type SLM-100 Loader/Monitor

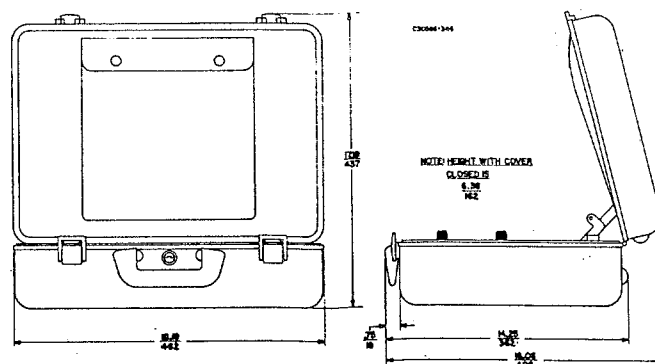


Figure 5.4 - Type SLR-100/110 Cartridge Tape Loader/Recorder

6.0 START-UP CHECKLIST

6.1 Preliminary Checks

6.1.1 MACHINE AND ENVIRONMENT

Prior to initial system start-up, inspect the machinery and/or process being controlled. All such equipment should be in its start-up position, properly lubricated and maintained, and ready to run safely.

6.1.2 PROGRAMMABLE CONTROLLER

Upon completion of the above, prior to system start-up, a visual inspection of the PC programming and peripheral equipment is necessary to determine the following:

1. That all necessary components are present and installed in accordance with this and other applicable Instruction Bulletins.
2. That all necessary electrical connections, including ground connections are properly made with wires and cables routed in accordance with this Instruction Bulletin. This includes all cables being fully inserted in their sockets. Close inspection of plugs and sockets is recommended; all pins must be straight, not bent or pulled out.

CAUTION: When connecting or removing data cables, one or both devices should be powered down as damage may result if both devices have power applied to them.

3. Properly sized fuses should be installed in all fuse locations.
4. Spare parts and fuses should be on hand to back-up the controller for sustained operation.
5. Keyswitch security keys for processor, CRT programmer, and loader/monitor should be available for start-up.
6. Back-up battery (see Section 2.0 - Specifications) should be placed in the memory module.

6.2 Power-up

1. Before applying power to the programmable controller, turn the PC keyswitch to the HALT position. Also make certain that the input devices that activate the machinery being controlled are in the off state.
2. Apply power to the PC. The HALT light should illuminate.

6.3 Initially Programming RAM Memory

1. Using the Hand-Held or CRT Programmer, clear all data in memory.
2. Enter a test program rung consisting of a single input in series with an output coil. Insure that the output address chosen is one that can safely be energized during step 3 below.

3. Turn the PC keyswitch to RUN, then turn the programmed input on. The programmed output should come on, verifying that the system is operational. If this does not occur check all system annunciator lights and/or refer to Section 6.6.

4. Turn the PC keyswitch to HALT, clear the test program from the memory and proceed to program the system or load a program tape.

6.4 Programming UV PROM Memory

1. Before programming the PC, make certain the memory is clear by removing the UV PROM chip(s) and exposing them to ultra-violet light. (See Appendix B).
2. Reinsert the memory chip(s) into the memory module. Reinstall the memory module into the PC.
3. Proceed to program the PC with the Hand-Held or CRT Programmer or by loading a program tape.

6.5 General Start-Up Sequence

1. PC keyswitch in HALT position (all controller power off).
2. All programming and peripheral device power switches in off position.
3. Apply power to the PC, programming and peripheral devices.
4. Verify from input lights that all inputs are in a start-up state.
5. Use programmer to verify that PC contains correct control program. Load correct program if necessary.
6. Check storage registers for correct start-up data. Enter correct data, if necessary.
7. Turn PC keyswitch to DISABLE OUTPUTS. (Memory scan of control program will begin.) Verify operation of program by observing output lights.
8. Close on/off switch or energize master control relay so that power is supplied to the output devices (see Figures 4.5, 4.6, and 4.7).
9. Turn PC keyswitch to RUN. Certain outputs may start, depending on program.
10. Sequentially operate appropriate input devices to cause machine or process to function.

6.6 Troubleshooting

If the system does not start or run properly, an attempt should be made to determine the source of the problem. Test for faulty field I/O devices (pushbuttons, limit switches, motor starters, etc.), faulty control program and faulty programmable controller hardware, in that order. Diagnostic lights on the PC are useful for isolating malfunctions.

In the event of faulty PC I/O operation, immediately remove power from the output devices to reduce potential hazard. The recommended sequence of events is:

1. Remove power from all outputs by opening the on/off switch used to remove power to the output devices (see Figure 4.5) or by de-energizing the external MCR circuit (see Figures 4.6 and 4.7). Do not attempt to service the system in any way without taking this precaution.
2. Turn the PC keyswitch to the HALT position.
3. Debug the system and correct the fault (the application of power to the PC may be necessary for fault determination).
4. Return the PC keyswitch to the DISABLE OUTPUTS position with no power applied to the outputs.
5. Check the operation of the system using the I/O LED indicators.
6. If operation is satisfactory, return power to the outputs and return the PC keyswitch to the RUN position.

7.0 BATTERY MAINTENANCE

A battery is included in both the RAM and the UV PROM memory modules to support the following in the event of power loss to the Model 100 PC:

1. Program information (if RAM Memory Module used).
2. Latch relay status.
3. Storage Register data.

The battery should be replaced upon detection of the red BATTERY LOW LED indication on the front of the PC or after its rated life - whichever ever occurs first. Battery performance characteristics and type are indicated in Section 2.0 - Specifications. Use the following procedure to replace the battery:

1. Have a fresh battery available.
2. Turn the PC keyswitch to HALT and remove power from the PC.
3. Remove the Memory Module from the PC.
4. Install the new battery using the spare terminals.
5. Remove the old battery.
6. Reinsert the memory module in the PC.
7. Follow the Power-up and General Start-up Sequence in Sections 6.2 and 6.3.

APPENDIX A - ADDRESSING FORMAT

A.1 Register Usage

Each Model 100 PC contains a number of "registers". These registers can be used as follows:

1. To represent the on or off status of the inputs and outputs which are connected to the PC (external I/O).
2. To represent control relay equivalents (internal outputs).
3. As a location to store a number (storage register).

When used to indicate the status of I/O's connected to the PC, each register can represent the on or off status of up to 16 inputs or outputs. When used to represent control relay equivalents each register can contain 16 such relay outputs. When used as a storage register, each register may contain a 4 digit positive decimal number from 0 to 9,999. These storage registers can be used to represent timers or counters. They can also be used for shift registers, and compare functions.

Figure A.1 lists the number of registers each model processor contains and their use.

MODEL 100 PROCESSOR		NO. OF REGISTERS	REGISTER ASSIGNMENTS	
CLASS	TYPE		REGISTER NO.	REGISTER USE
8020	SCP-111	44	1	External Inputs (12)
	SCP-112		2	External Outputs (8)
			3-6	Recommended to be used as Internal Relays
			7-44	Recommended to be used as Storage Registers
8020	SCP-121	44	1	External Inputs (12)
				2
8020	SCP-122		3	External Inputs (12)
			4-6	Recommended to be used as Internal Relays
			7-44	Recommended to be used as Storage Registers

Figure A.1 - Model 100 Register Assignments

A.2 Addressing Configuration

All input and output devices connected to the Model 100 PC are assigned input and output address numbers. These address numbers allow the user to reference the I/O in the control program. An I/O address number consists of six digits, the first four of which indicate the I/O group and the last two indicate the I/O within the group. Each I/O group corresponds to a register number (See Figure A.1) and as mentioned before, has the capability of representing up to 16 I/O points.

Figure A.2 shows both a Model 100-20 I/O and a 40 I/O configuration programmable controller and illustrates the addressing scheme. Notice that because of hardware configuration, some address groups contain 8 or 12 I/O rather than 16. When less than 16 I/O are used in an address group, the balance may be used as internal relay equivalents. When displayed on the CRT screen of the CRT programmer, an "I" precedes an input address and an "O" precedes an output address. Register 3 of the 20 I/O PC may be used as internal relay equivalents.

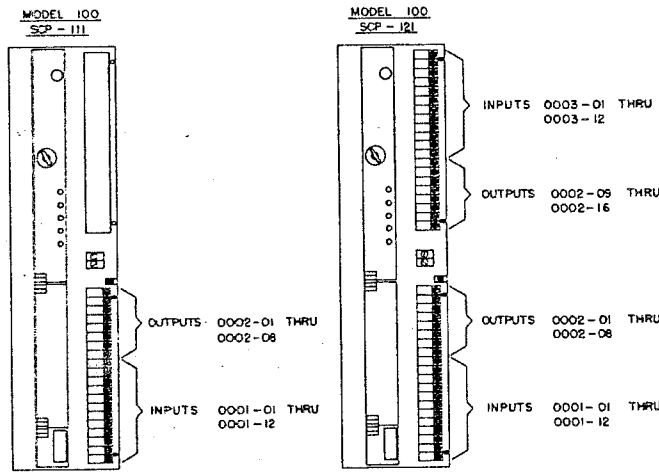


Figure A.2 - Model 100 Addressing Configuration

Like the external I/O addresses, the registers used to represent internal relay equivalents are made up of six digits, the first four representing the address group; and the last two indicate one of the 16 possible relays within the group. When displayed on the CRT screen of the CRT programmer, an "R" precedes the address number to indicate usage as a relay equivalent. The exceptions to this are: 1) addresses 01-12 to 01-16, 2) addresses 02-09 to 02-16 for the 20 I/O PC, and 3) addresses 03-12 to 3-16 for the 40 I/O PC are displayed with an "N".

When a processor register is used for number storage, it is referred to as a storage register. The storage registers are used for timers, counters, number comparisons, and shift registers. The address of a storage register consists of four digits and refers to a specific processor register. Storage registers are preceded by an "S" when displayed on the CRT screen of the CRT programmer.

APPENDIX B - UV PROM VERSION PROGRAMMABLE CONTROLLER

B.1 General

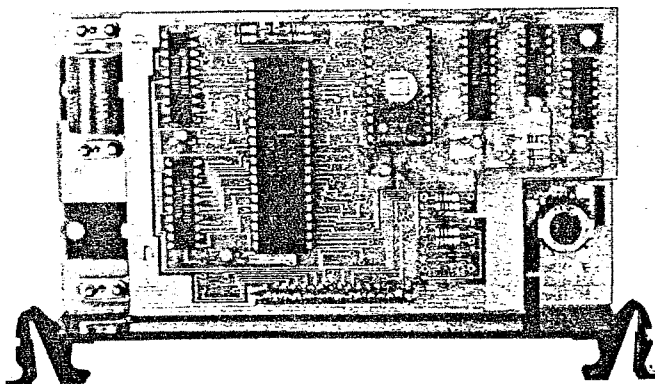


Figure B.1 - UV PROM Memory Module

Some applications require a non-volatile memory for semi-permanent program storage and additional security to prevent unauthorized program changes. For this reason, the Model 100 PC is available with a UV PROM memory. UV PROM is a non-volatile memory (i.e. no battery required) which will retain its program information indefinitely. Once programmed with the Inhibit Rung (see Figure B.3) by the CRT or Hand-Held Programmer, the only way to change the ladder diagram is to erase the entire program by exposing the memory chips to intense ultra-violet light. The memory can then be reprogrammed as long as the security jumper is in place (see Figure B.2). This feature allows the user to program the memory and then, by removing the security jumper and programming the Inhibit Rung as the last rung in memory, can insure that the program cannot be altered. Although the entire program could be erased, no new program could be entered unless the jumper is in place. These features provide additional security against unauthorized changes to safety circuits and other critical programs.

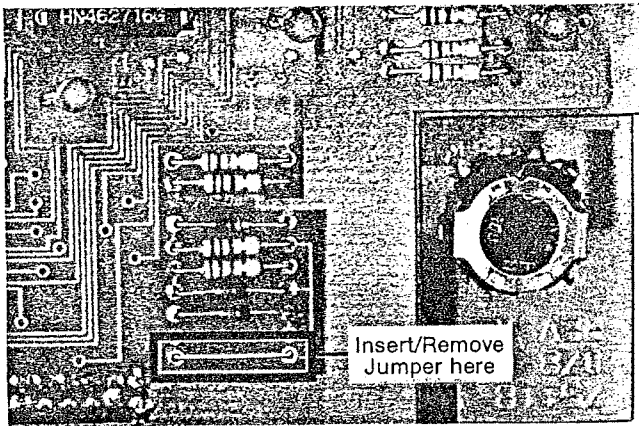


Figure B.2 - UV PROM Security Jumper

B.2 Programming

First, insert the Security Jumper in the UV PROM Memory Module as shown in Figure B.2.

The procedure for programming the UV PROM version PC is the same as for programming the RAM version PC. (Refer to the Programmer Instruction Bulletin for further information). Once the ladder diagram program has been entered, the circuit in Figure B.3 *must* be entered as the last rung of the program.



Figure B.3 - Inhibit Rung

This rung prevents the programming equipment from entering additional rungs. Without this rung, the Model 100 PC will not operate.

Once programming is complete, the security jumper can be removed from the board (see Figure B.2) to prevent any future program changes. Use of the Inhibit Rung and the removal of the security jumper are acceptable means of preventing additional programming of the UV PROM memory.

NOTE: Rungs programmed after these security measures have been instituted will appear to be loaded by the programmers—the rungs will not in fact be loaded into processor memory.

B.3 Handling

The memory chip(s) can be accessed by removing the UV PROM Memory Module from the PC. (NOTE: Power *must* be removed from the PC before removing or inserting the memory module). Figure B.4 illustrates proper UV PROM chip installation/removal.

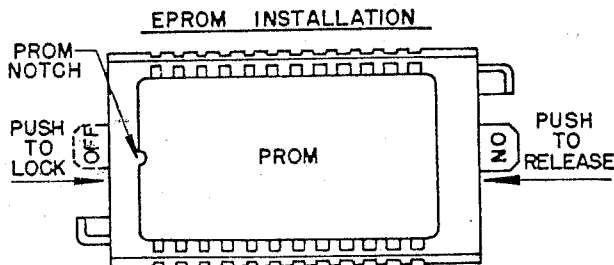


Figure B.4 - UV PROM Chip Installation/Removal Diagram

The PROM chip(s) fit into a 28 pin ZIF (Zero Insertion Force) socket. To remove a chip for erasure or replacement, the following procedure should be followed.

B.4 Removal

1. Remove system power by opening the disconnect switch to the PC.
2. Remove the UV PROM Memory Module from the PC and place on a flat surface with the PROM facing up.
3. Push the ON tab inward to unlock the ZIF socket.
4. Carefully and gently rock the PROM chip out of the socket.
5. Remove *all* opaque material from the transparent window taking care not to leave any residue of dirt or tape adhesive.

CAUTION: Special care in handling the PROMS must be taken so that the pins do not become bent or dirty.

B.5 Erasing

The ladder diagram program can be erased from memory by removing the PROM chips and exposing them to ultra-violet light, window side up. The length of exposure time varies with the intensity of the UV light source. A recommended erasing system is the Class 8010 Type SPR-150 Lamp. Model DE-4 or equivalent lamp by:

Ultra Violet Products
5100 Walnut Grove Ave.
San Gabriel, CA 91778

This system has an intensity of 5000 uW/cm², and would perform a complete memory erasure in approximately 50 minutes. Stronger UV light sources would result in shorter exposure times. The user must insure an adequate exposure use of at least 15 W-SEC/CM². The following formula can be used to calculate exposure times of light sources with different power ratings:

$$X = \frac{15W \text{ SEC/cm}^2}{(A \mu W/\text{cm}^2)}$$

X=Exposure time in seconds
A=Power rating of light source in micro watts per square centimeter³

This formula can be simplified to:

$$\text{Exposure time} = \frac{15 \times 10^6}{A}$$

CAUTION: Once erased, it is recommended that the user cover the transparent window on the PROM with an opaque material (such as electrical tape) to avoid undesirable alteration of memory. Remove tape and expose window for erasure.

UV PROM SPECIFICATIONS	
Programming Temp.	20° to 30° C (68 to 86°F)
Nominal Storage Temp.	-65° to 125° C (-85 to 257°F)
UV exposure dose for erasure.	15 W SEC/cm ² minimum at 253.7 nm
Minimum UV intensity for erasure	5000 m W/cm ² at 253.7 nm

Figure B.5 - UV PROM Specifications

B.6 Installation

Installation is the reverse procedure of Removal.

APPENDIX C - PROCESSOR TO PROCESSOR COMMUNICATION

A SY/MAX Model 100 PC can respond to communication from a Model 300 Processor over a serial communication cable plugged into its PROGRAMMER port. This arrangement allows I/O status and storage register data to be transferred from one processor to the other.

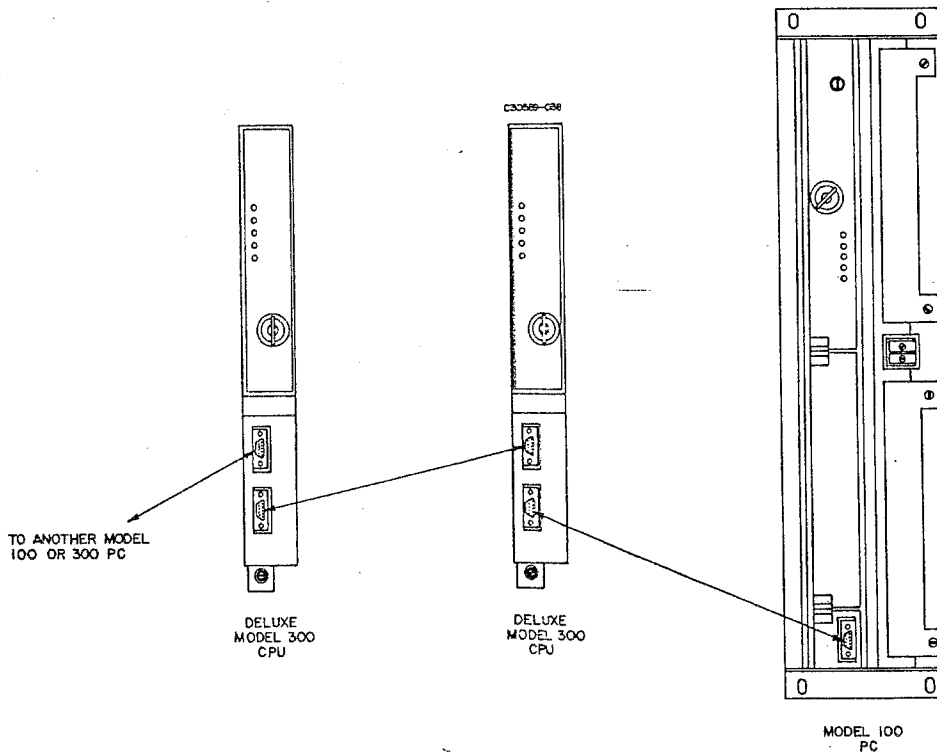


Figure C.1 - Processor to Processor Communication

Communications are initiated by instructions programmed into a Deluxe Model 300 processor. For directions on how to program communication instructions, refer to the "Communication to External Devices" section of the CRT Programmer Instruction Bulletin.

The Type CC-100 (10 ft.-3m) or Type CC-101 (30 ft.-9.1m) Communication Cable may be used for processor to processor communication, or an equivalent cable up to 10,000 ft. (3,048m) can be made. See Section 4.4.4.

In the system shown in Figure C.1 if data were to be sent from Processor 3 to Processor 1, the data would first have to be transferred from Processor 3 to Processor 2 using a READ or WRITE operation. Then, using another READ or WRITE operation, the data would be transferred from Processor 2 to Processor 1.

APPENDIX D - OTHER SY/MAX COMPONENT WEIGHTS

TYPE	DESCRIPTION	APPROXIMATE WEIGHT (lb/kg)
SPR-100	Hand-Held Programmer	1.9/0.86
SPR-200/210	CRT Programmer	30.6/13.88
SLM-100	Loader/Monitor	3.4/1.54
SLR-100	Cartridge Tape Loader/Recorder	13.5/6.12

Figure D.1 - Other SY/MAX Component Weights

APPENDIX E - MODEL 100 PC IN MOTOR CONTROL CENTERS

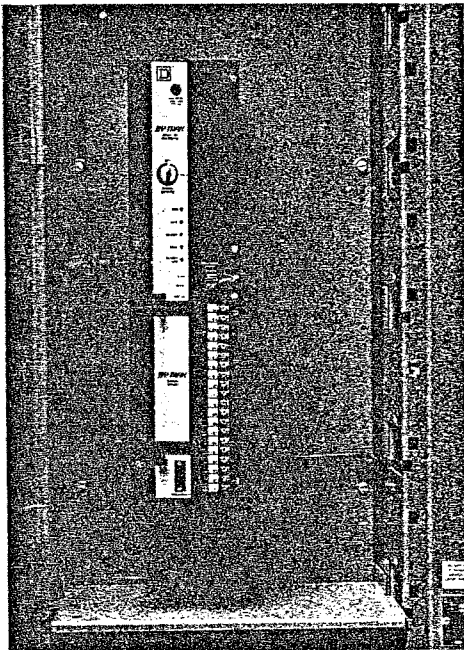


Figure E-1 - Model 100 PC In Motor Control Center

This appendix contains information for mounting a Model 100 PC in a Square D Model 4 SPEED-D Motor Control Center (MCC). NOTE: The I/O of the Model 100 PC share the L-N terminals (which are used for incoming power to the Model 100 PC) as commons. Therefore, the I/O are *not* isolated. For isolated I/O, use the SY/MAX Model 300 PC with Isolated I/O and Isolated Rack Assemblies. See Model 300 Processor Installation Bulletin #30598-173-01.

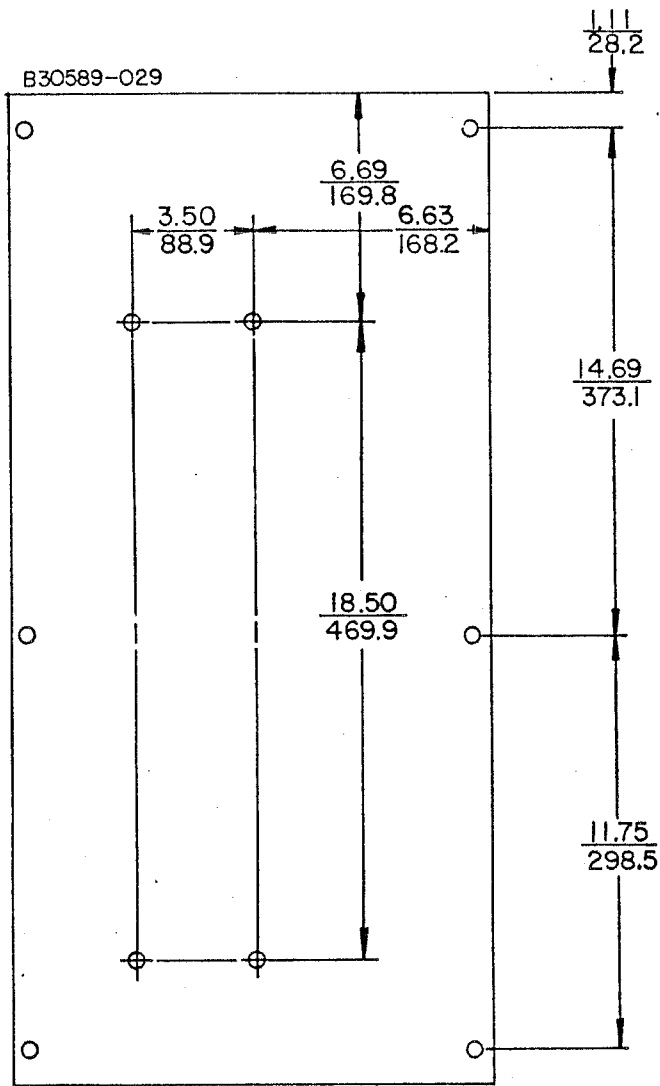
WARNING: The possibility of electrical shock or burn exists whenever working in or around electrical equipment. Turn off power supplying the motor control center before proceeding.

It is recommended that the Model 100 PC be mounted low in the Motor Control Center for a cooler ambient temperature.

The SY/MAX Model 100 PC system with either 20 or 40 I/O, should be mounted vertically in a Class 8998 Type MT-416 unit. An MT-416 occupies 2½ Space Factors (a nominal 30 inches) of vertical height in the MCC and consists of:

- 1 Mounting panel
- 1 Hinged door
- 1 Unit support pan
- 1 Set of hardware (for mounting MT-416 in the MCC)

1. Install the unit support pan in the MCC structure.
2. *Before* installing the mounting panel in the MCC, drill and tap four (4) #10-24 holes in the panel as indicated in Figure E.2.
3. Using the mounting panel as a guide, install tinnerman fasteners on the MCC structure to line up with the standard panel mounting holes.
4. Install the self-retaining unit mounting screws and conical springs in the four corner mounting holes in the panel. Then secure the panel to the MCC structure with these screws.
5. Mount the Model 100 PC on the mounting panel as shown in Figure E.3 with four (4) #10-24 x 1" bolts, using "star" washers to assure good electrical ground. NOTE: mounting bolts and "star" washers supplied by user.
6. Install the hinged door with the remaining MT-416 mounting hardware.



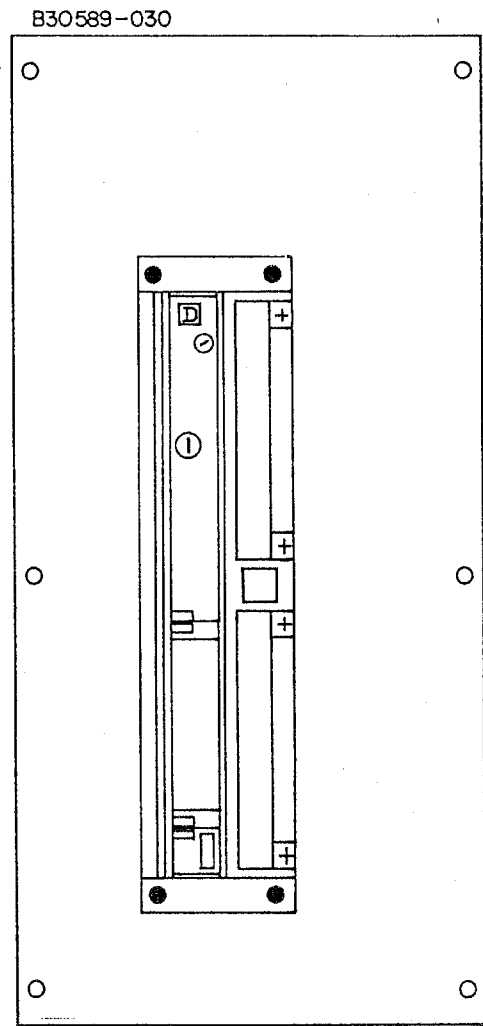
INCHES
MILLIMETER

- — PANEL MOUNTING HOLES (DRILLED BY FACTORY)
- ⊕ — MODEL 100 CONTROLLER MOUNTING HOLES (DRILLED AND TAPPED BY USER)

ALL DIMENSIONS IN INCHES

NOTE: DRILL AND TAP HOLES BEFORE MOUNTING PANEL IN MCC

Figure E.2 - Model 100 System Drilling Dimensions



- — USE MOUNTING HARDWARE SUPPLIED WITH MT-416.
- — USE #10-24 x 1" BOLTS AND STAR WASHERS (SUPPLIED BY USER).

Figure E.3 - Model 100 System Layout

APPENDIX F - CONTROL REGISTERS

In addition to register 1 thru 44, the processor uses another group of 192 registers for control functions. These registers are addressed 8001 thru 8192, and many of them can be accessed by the user. By monitoring and altering these registers, the capabilities of the Model 100 PC are greatly enhanced. Each register contains 32 bits of information. The lower 16 bits are called the data field, while the upper 16 bits are called the status field.

STATUS FIELD																DATA FIELD															
32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Figure F.1 - Control Register Data Field vs Status Field

CONTROL REGISTER ADDRESS	DESCRIPTION																	
8001-8170	Registers 8001 thru 8170 are used internally by the processor and not available for use.																	
8171	Not used.																	
8172	The number in this register represents (in milliseconds) the processor scan time. (i.e., the length of time needed for the processor to scan the users program).																	
8173 End Fence Address	These registers contain the beginning and ending addresses (as entered by user) of the block of registers which will be accessible (unprotected). All other registers will be protected (fenced). The effect of fencing on the storage registers depends upon which device is connected to the PROGRAMMER port and the position of the processor keyswitch. See example in Figure 3.9 and storage register fencing table in Figure 3.11.																	
8174 Begin Fence Address																		
8175	This register contains the last HARDWARE ERROR which occurred. If there is more than one error, then the most serious will be stored (i.e., the higher the error code, the more serious the error). Additional errors called CAPABILITY ERRORS could occur. These errors are associated with a device communicating with the controller: such as CRT, Cartridge tape unit, another controller, etc. CAPABILITY ERRORS are not stored in register 8175 - instead they are sent out to the device which generated the error. (For more information on error codes, refer to the SY/MAX CRT Programmer or Troubleshooting Instruction Bulletins.)																	
8176	<table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse; text-align: center;"> <tr> <td>17</td><td>16</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td> </tr> </table> <p>*8176-1 When this bit is set (equals one) it prevents the PC from scanning the ladder program. The PC can be placed in the HALT mode by putting the PC keyswitch in the HALT position, or by programming and energizing coil 8176-1 in the Ladder diagram program. Toggling the keyswitch into and out of HALT or setting and resetting 8173-3 resets this bit.</p> <p>*8176-2 When this bit is set to 1, the processor operates in the DISABLE OUTPUTS mode (unless the PC keyswitch is in HALT) - as described in Section 3.2.2. The PC can be placed in the DISABLE OUTPUTS mode by putting the PC keyswitch in the DISABLE OUTPUTS position, or by programming and energizing coil 8176-2 in the Ladder diagram program. Turning the PC keyswitch to RUN and de-energizing coil 8176-2 returns the PC to RUN.</p> <p>*8176-3 This bit operates as a remote HALT/RUN switch. 1=Processor Halts, 0=Processor Runs. Note: The HALT condition overrides the RUN condition (i.e., keyswitch in HALT or 8176-3=1 will halt the processor). To put the processor in RUN the keyswitch must be in RUN and 8176-3=0.</p> <p>*8176-4 Not used.</p> <p>*8176-5 Setting BIT five to the 1 state inhibits the forcing of any I/O or storage register. Only the first 16 registers are forceable. 1=force inhibit, 0=forcing allowed. The CRT programmer (when in the OVERRIDE mode) can force any of the first 16 registers regardless of the status of bit 8176-5.</p> <p>*8176-6 In addition to the fencing capabilities of the PC, setting this BIT protects all registers from being altered via the PROGRAMMER port (registers can still be altered by the CRT programmer when in the OVERRIDE mode and the Hand-Held Programmer when the CPU is in HALT. 1=register protect, 0=register accessible.</p> <p>*8176-7-8176-15 Not used.</p> <p>*8176-16 The last rung programmed in PROM version PC must have as it's coil address R8176-16. (See Appendix B)</p> <p>8176-17 Not used.</p>	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1		

Figure F.2 - Control Register Usage

CONTROL REGISTER ADDRESS	DESCRIPTION
8177-8185	Register 8177 thru 8185 are reserved for internal use by the PC.
8186	<div style="text-align: center; border: 1px solid black; width: fit-content; margin: 0 auto; padding: 2px;"> 8 7 6 5 4 3 2 1 </div> <p>8186-1 The HALT/RUN status of the PC is represented by this BIT. 1=HALT, 0=RUN or DISABLE OUTPUTS (HALT LED on).</p> <p>8186-2. This BIT is energized when the PC is scanning the user program but the outputs are disabled. 1=DISABLE OUTPUT, 0=HALT or RUN (RUN LED flashing).</p> <p>8186-3 When BIT 3 is energized, this indicates that the processor is in the RUN mode. 1=RUN, 0=HALT, or DISABLE OUTPUTS (RUN LED on).</p> <p>8186-4 When energized, this indicates that an error has been detected in user memory (MEMORY LED on).</p> <p>8186-5 This BIT is energized when some device is forcing inputs outputs on or off. (FORCE LED on).</p> <p>8186-6 After the PC sends update status to an output or internal register, it reads that status to insure a proper transmission. This BIT is energized when the data read from an output or register does not match the data written into it (i.e. read after write error). 1=Read after write error, 0=transmission valid.</p> <p>8186-7 BIT 7 represents the physical status of the PC keyswitch and will be energized when the keyswitch is in HALT position. 1=keyswitch in HALT, 0=keyswitch not in HALT.</p> <p>8186-8 BIT 8 represents the physical status of the PC keyswitch and will be energized when the keyswitch is in the DISABLE OUTPUTS position. 1=keyswitch in DISABLE OUTPUTS, 0=keyswitch not in DISABLE OUTPUTS.</p> <p>[NOTE: The remaining BITS in register 8186 are reserved for internal use by the PC.]</p>
8187	This register contains the number of rungs entered into memory by the user.
8188	The number contained in this register represents the PC Type and firmware revision. The three most significant digits represent the Type number (See Section 2.1) and the least significant digit represents the firmware revision. Example: A 40 I/O version RAM PC with firmware revision number 1 would have the number 1211 in this register.
8189-8192	These registers are reserved for internal use.

*These registers are reset when a CLEAR ALL command is received from the programming equipment.

Figure F.2 - Control Register Usage

Additional information on Control and Status register can be found in the CRT or Hand-Held Programmer Instruction Bulletin.

Effective 2/1/82
Supersedes 9/1/79

17969 E. RAILROAD ST., INDUSTRY, CALIFORNIA 91749 PHONE: (213) 964-6411
18007 CORTNEY COURT, INDUSTRY, CALIFORNIA 91748 PHONE: (213) 964-6411
4500 E. GRAND RIVER AVE., HOWELL, MICHIGAN 48843 PHONE: (517) 546-4400

INSTRUCTIONS AND REULAND GUARANTEE

RATED OUTPUT — We guarantee that the apparatus manufactured by us will deliver successfully its rated output as indicated on the nameplate, provided such apparatus is properly connected to the power supply stamped on the nameplate with adequate size wire, overload protection, and fused circuits based on the full load ampere rating shown on the nameplate. This guarantee covers our apparatus that is properly installed, maintained and operated under normal conditions with competent supervision. We will not be responsible for any damage resulting from shipment, improper storage or handling, or consequential damage from failure to meet the above conditions.

GUARANTEE PERIOD — The maximum guarantee period is 12 months from date of shipment from our works. We agree to correct by repair or replacement (FOB our factory) any defects of material or workmanship in said apparatus which may develop under normal and proper use during guarantee period when purchaser gives us immediate written notice of such defects and inspection substantiates the claim. Such correction shall constitute a fulfillment of all obligation to the purchaser.

Two alternate procedures for handling such corrections are provided:

1. Order replacement parts or a complete replacement unit from the factory by contacting the nearest Reuland representative or factory. With the aid of modern air freight systems factory replacement with new parts is often faster than local repair.
2. Where time is extremely important, or the repair can be readily accomplished, the unit may be taken to the nearest competent repair shop of the purchaser's choice provided prior authorization is secured from the factory. Quality Assurance, the factory Service Departments or Engineering Supervisors should be contacted for such authorization.

If upon inspection, the service shop determines that the problem resulted from defect or workmanship, a brief description of their findings, along with the motor serial number and itemized invoice, will secure payment when forwarded to our factory. Reuland Electric Company will not accept billing for work performed at rates higher than those considered to be accepted standards for the type of service rendered. Charges made for removal and reinstallation of motors, motoreducers, or brakes, or any charges for overtime, will not be allowed.

In the event of an urgent problem requiring a decision during non-business hours, Reuland will honor warranty claims for service shop repairs under such circumstances. The extent of warranty coverage will be at the discretion of Reuland Electric Company and subject to the above validation from the service shop.

Factory authorization for seeking repairs at a local service shop does not imply acceptance as a warranty claim. Such acceptance will be based on the findings of the service shop after inspection of the unit.

When contacting the Reuland factory, always give complete nameplate data, and particularly the serial number.

Reuland Electric Company takes pride in the design and quality of its product. Great care is taken during manufacture to insure each part against defects in workmanship or material. We would consider it a favor to have cases of unsatisfactory service from Reuland Electric products brought to our attention.

INSTALLATION AND CARE

This Reuland motor has been precision manufactured of high quality materials. With proper installation and maintenance, it will deliver years of trouble-free service.

Check motor carefully to be sure it has not been damaged in shipment. Connect motor to line of proper specification as stamped on motor nameplate; check voltage, frequency, phase etc.

Connection diagram will be found in terminal box or on nameplate except 3-lead polyphase and 2-lead single phase that do not require a diagram.

Provide suitable overload protection based on full load ampere rating shown on nameplate, as recommended by control manufacturer.

Protect wiring circuit with proper size fuses selected according to local code requirements.

The bearings in ball bearing motors have been especially selected according to our policy of precision manufacture. To avoid bearing damage, coupling, pulleys, etc., **SHOULD NOT BE DRIVEN ON MOTOR SHAFT.** A light press fit or light tap fit is recommended.

MOTOREDUCERS APPLICATION

Hollow shaft motoreducers **SHOULD NOT** be forced or pounded onto the driven shaft.

Never rigidly restrain the torque reaction end of the torque arm. Ball-rod and spring-rod mount units must be installed per instructions furnished with the motoreducer. Pulleys or sprockets should be mounted on output shaft as close as practical to the housing. Belt or chain drives should be properly aligned and tensioned. Overly tight belts or chains cause destructive wear and vibration. If the unit is to be direct connected, shim under the motor feet, if necessary, to get true alignment of driving and driven shaft. Foot, face, and flange mounted units must be securely bolted to flat and rigid bases.

It is important that the driven load does not impose a greater torque on the output shaft than the rated output torque of the motoreducer. High inertia loads that are stopped quickly by a braking action on the rotor shaft, or the self-locking characteristics of the higher ratios of worm units can impose a reverse torque many times the capacity of the motoreducer.

REULAND ELECTRIC COMPANY

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Effective 2/1/82
 Supersedes 9/1/79

FLUID SHAFT MOTORS AND FLUID SHAFT MOTOREDUCTERS

GENERAL: This unit has a fluid coupling mounted between the motor and the output shaft or gear unit to obtain special starting characteristics. The fluid coupling has been filled to normal oil level at the factory for operating in ambient temperature above minus 10°F. The oil level should be maintained and the coupling will require no attention under normal operating conditions. Check oil level every three months with unit cool. In case a coupling develops a leak at the shaft seal, the equipment should be stopped and the cause of the leak determined and necessary repairs made.

FLUID COUPLING OIL

AMB. TEMP. °F	FACTORY FILLED	MOBIL OIL	SHELL OIL	CHEVRON	TEXACO
-10°F and above	SAE 10W Straight Mineral Oil	Mobil Fluid 350 or ATF 220 (Dexron II)	Donax T	Chevron GST Oil 32	Havoline Motor Oil SAE 10W
Below -10°F	SAE 5W Straight Mineral Oil	--	--	Chevron AW Machine Oil 10	Torque Fluid Premium SAE 5W

COUPLING ADJUSTMENT: When shipped from factory the fluid coupling will be filled to the normal level to give coupling operation suitable for most applications. No further adjustment will be necessary unless special operating conditions exist.

OPERATION: When a polyphase fluid coupling motor is started the motor should accelerate to approximately 80% of synchronous speed within 5 to 10 seconds. The output shaft of the coupling may require a longer time, as much as 60 to 90 seconds to accelerate. Single phase motors should not require more than 3 to 5 seconds to accelerate to a speed above that at which the short circuiter or cut-out switch operates. The load may take many times this interval to come up to rated operating speed. When the coupling does not cushion the starting shock sufficiently, or if a high inertia load is being started and the motor does not come up to speed quickly, reducing the oil level in the coupling will improve the operation. This level should be reduced until the motor starts and comes up to 80% of synchronous speed quickly (not over 10 seconds) while the load accelerates more slowly. When satisfactory performance has been obtained, the new "Top for Filling" mark should be established by painting the fill number or by marking the coupling housing in some manner. (Note: The fill level must not be lower than that obtained with figure 4 fill.)

The coupling may not operate continuously at a slip of 15-20% without danger of overheating, even though the motor is operating at rated speed. If this condition does exist, increase the oil level unless it is already at the maximum level (No. 1). If the oil is at the maximum level and the slip is still excessive, a larger coupling is indicated.

REULAND ELECTRIC COMPANY

Effective 7/1/82
Supersedes 2/1/82

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Page No. 100-B

LUBRICATION MAINTENANCE

MOTORS: Reuland motors are normally supplied with shielded ball bearings packed by the bearing manufacturer with Chevron SRI-2 grease (-20°F to plus 329°F) and do not require periodic greasing. If the motor is taken apart and the bearings are replaced make sure they are the same type packed with this grease or equivalent. Repack chamber in end bell behind bearing with the same type of grease. Bearings on special application motors may be supplied with grease fittings. These applications require the addition of a small amount of ball bearing grease every 1000 operating hours.

BALL BEARING GREASE

Amb. Temp. °F	Reuland Supplied	Mobil Oil	Shell Oil	Chevron	Texaco
-20° - +329°	Chevron SRI-2	Mobilux EP 2	Dolium Grease R	Chevron SRI-2	Regal AFB 2 or Multifak 2

MOTOREDUCERS: All motoreducers are shipped with the proper amount of oil for the duty and mounting position specified and for ambient temperature of 15°F to 125°F. BEFORE STARTING remove plug from highest hole in gear case and install pressure relief valve furnished with the unit. For other ambient temperatures replace oil with type shown below.

MAINTENANCE: Change oil after 100 operating hours; thereafter, every six months or 2500 hours of normal operation, whichever comes first.

HELICAL GEAR OIL

Amb. Temp. °F	Kendall Refining	Mobil Oil	Shell Oil	Chevron	Texaco
15° - 125°	Kenoil R & O AW100*	Mobilgear 629	--	--	--
50° - 125°	--	--	Tellus Oil 220 Tellus Oil 320	Chevron AW Machine Oil 320	Regal Oil R & O 150
15° - 60°	--	--	Tellus Oil 68	Chevron AW Machine Oil 68	Regal Oil R & O 68
15° and below	ATF	Mobilgear 626	Donax T 6	ATF Dexron II	Texamatic Fluid

WORM AND HELICAL - WORM OIL

Amb. Temp. °F	Kendall Refining	Mobil Oil	Shell Oil	Chevron	Texaco
15° - 125°	Kendall Three Star Gear Lube*	Mobilgear 634	--	--	--
50° - 125°	--	--	Omala Oil 680	Chevron NL Gear Compound 680	Meropa 680 or Honor Cyl. Oil 680△
15° - 60°	--	--	Omala Oil 460	Chevron NL Gear Compound 460	Meropa 220 or Vanguard Cyl. Oil 460△
15° and below	ATF	Mobilgear 629	Donax T 6	--	Texamatic Fluid

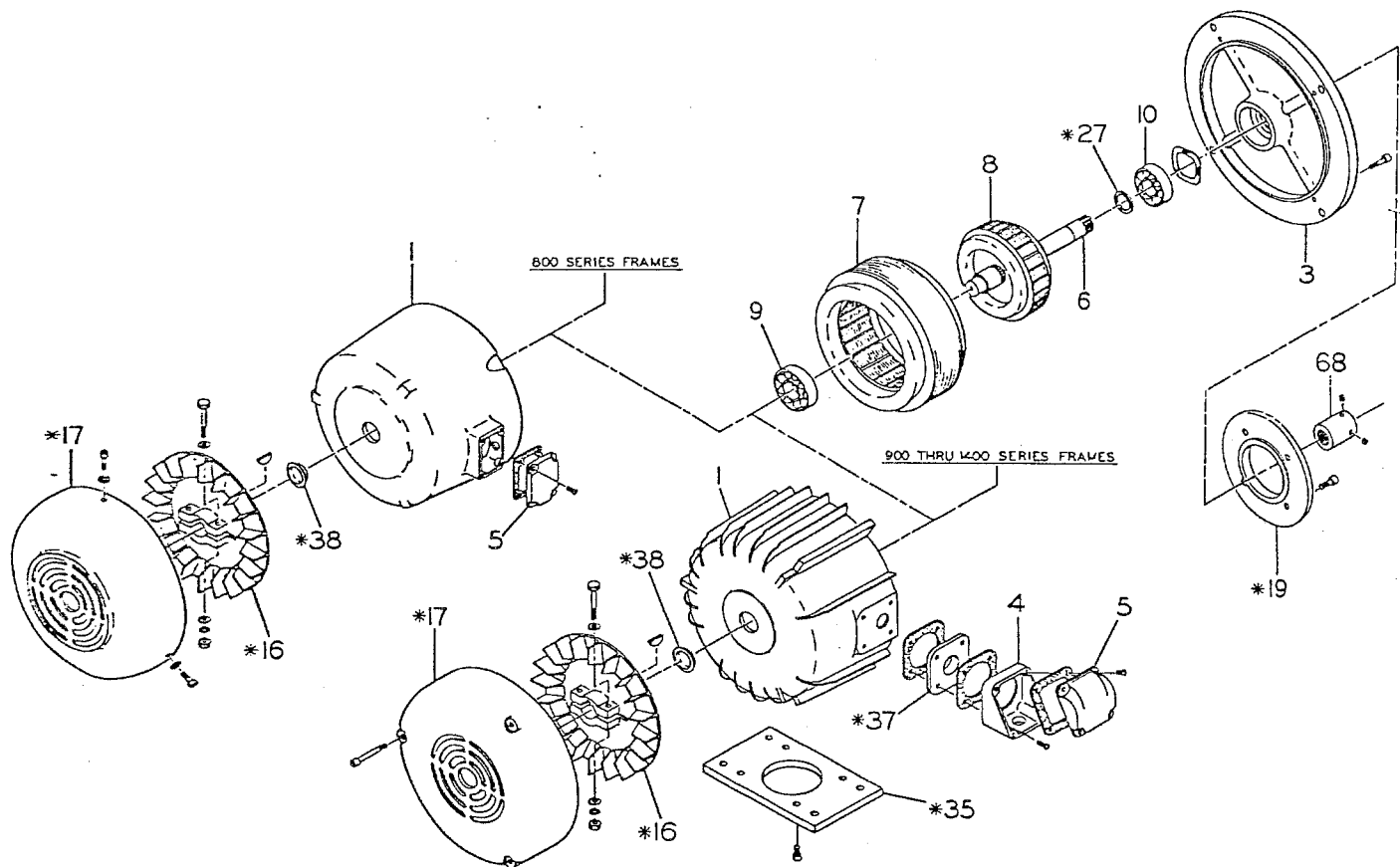
CONE DRIVE GEARS

Amb. Temp. °F	Kendall Refining	AGMA Lubricant Number
15° - 125°	Kendco 155*	AGMA No. 8 Compound

*Available from Reuland Electric Company in one gallon cans.

△NOTE: Use these oils only where food, drink or animal feed are concerned.

NOTE: Special application motoreducers that have the gear case packed with Pennzoil No. 704 Moly Lube are suitable for operation in ambient temperatures of 50°F to 130°F. Under normal operating conditions of load and temperature, it is not necessary to change lubricant. The above oil and grease types are based on the oil companies recommendations.



* IF REQUIRED

PARTS ILLUSTRATION

WAFERTHIN HYDRAULIC PUMP MOUNT MOTOR
TYPE E000

WHEN ORDERING REPLACEMENT PARTS YOU MUST GIVE PART NAME,
ALSO TYPE, FRAME, MODEL AND SERIAL NUMBER FROM MOTOR NAMEPLATE.

RENEWAL PARTS LIST

Item	Part Name	Item	Part Name
1	FRAME	68	COUPLING, PUMP
3	END PLATE, REAR		
4	TERMINAL BOX		
5	COVER, TERMINAL BOX		
6	SHAFT, MOTOR		
7	STATOR		
8	ROTOR		
9	BEARING		
10	BEARING		
16	FAN, EXTERNAL		
17	COVER, FAN		
19	ADAPTOR, REAR		
27	WASHER, SPACER		
35	BASE, FRAME		
37	ADAPTOR, TERMINAL BOX		
38	PLUG, END BELL		

REULAND ELECTRIC CO.

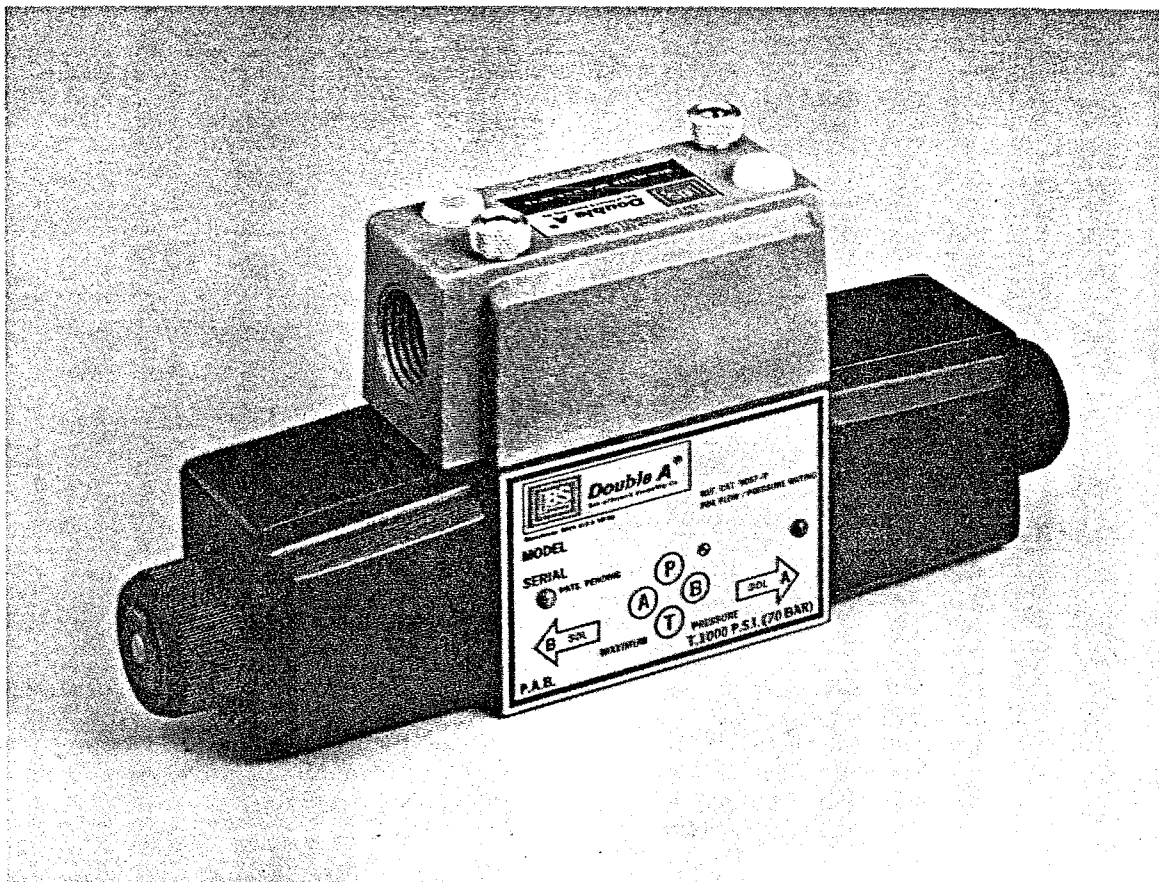
Industry, Calif.
Howell, Mich.

STYLE
AEO, AFO

Revision A
11/14/65

PE-1101

Double A Products



Directional Valves Series 3

Solenoid Operated
10 gpm / 38 l/min
4500 psi / 315 bar

1000 psi / 70 bar for
High Water Base Fluids



Sweetland Company
950 DOOLITTLE DRIVE
SAN LEANDRO, CALIFORNIA 94577 (415) 635-0500

Hydraulics • Pneumatics • Instrumentation
Fluid Conditioning Equipment

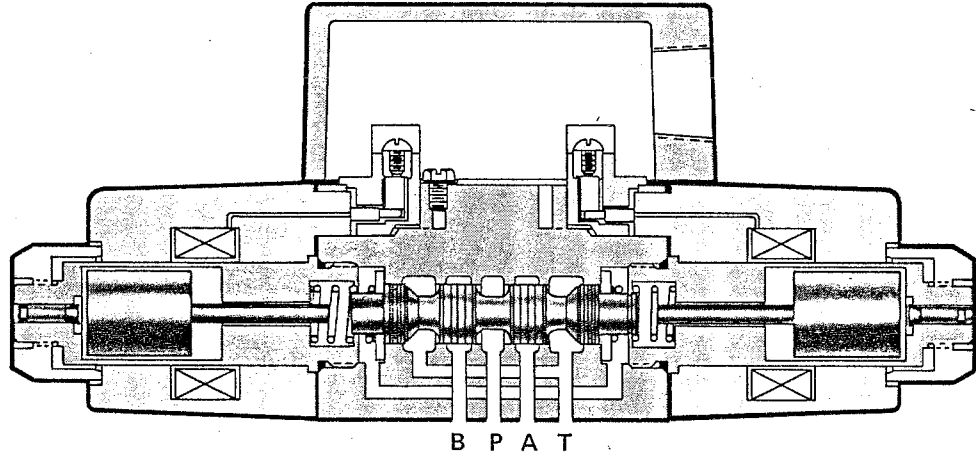


Double A
Division of Brown & Sharpe Mfg. Co.

Design Features

As the name implies, "directional control" valves are used to control the motion of fluid motors and cylinders in hydraulic systems. Series 3 solenoid operated valves are designed to meet the requirements of high performance, precision industrial hydraulic systems operating at pressures to 4500 PSI and flows to 10 GPM. They mount on the ISO size 03 mounting surface and are interchangeable with previous Series 005 directional valves.

trial hydraulic systems operating at pressures to 4500 PSI and flows to 10 GPM. They mount on the ISO size 03 mounting surface and are interchangeable with previous Series 005 directional valves.



The performance of most conventional solenoid operated directional valves is limited by the flow forces acting on the spool in opposition to the solenoids and return springs. Special attention is given to compensating for, or minimizing, these undesirable forces in the design of the series 3 valve.

The resulting benefits include —

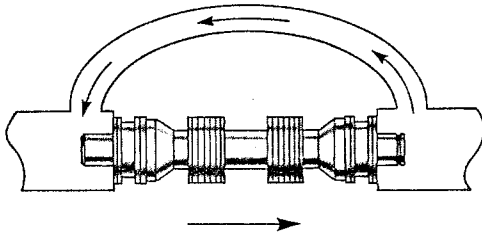
HIGH CAPACITY — up to 10 GPM at 4500 PSI, without malfunction.

RELIABILITY — a high margin of shifting force available to overcome spool friction due to dirt, and other contaminants. Also, a balanced spool with cushioned shift also means less wear and long life.

SERVICEABILITY — plug-in coils and electrical connections simplify maintenance.

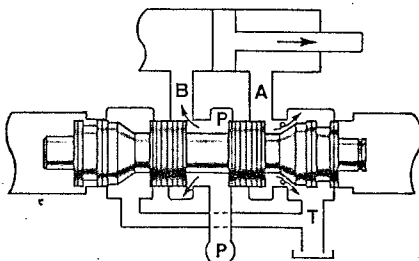
AXIAL SPOOL BALANCE— The key design features associated with the balance of hydraulic forces on the valve spool are illustrated and described below.

SPOOL CUSHIONING PASSAGE — Equalizes hydraulic force on ends of spool, and cushions spool shift.



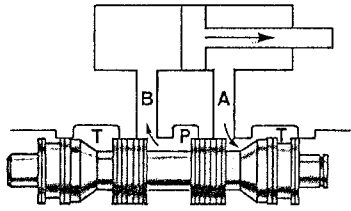
When spool is shifted, the fluid displaced from one end of the spool is transferred to the other end through this passage which is designed to provide a cushioning effect and balance the spool.

SPOOL FORCE-BALANCING CONTOUR — Minimize the hydraulic unbalancing effects of fluid momentum between the cylinder and tank ports.



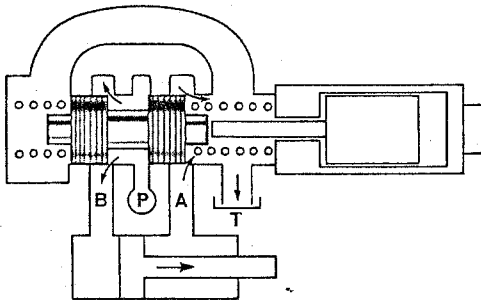
Flow forces that are developed at the conventional square land orifice (P to B) are partially compensated for by the force balancing contour on the outer spool lands (A to T).

SPOOL LAND SEQUENCING — Accurate sequencing of land opening and closing provides maximum axial stability.



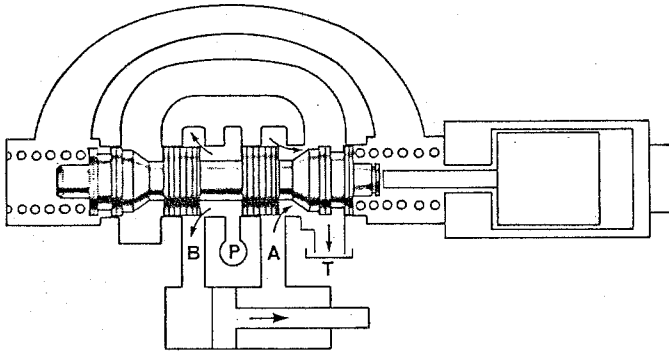
In this example, it is important that flow path A to T is opened before the path P to B to prevent pressure intensification which could upset axial balance and limit valve function.

ISOLATED SOLENOID CHAMBERS — Minimize transient pressure peaks in the solenoid to prevent solenoid tube failure.



TYPICAL 2-LAND SPOOL

Pressure surges can occur within the armature tube of 2 land wet armature valves due to cylinder port decompression. These surges can easily exceed tube pressure rating and result in premature tube failure.



DOUBLE A 4-LAND SPOOL

The armature tube area is isolated from the tank port area by the outboard lands on the 4-land spool. Tank port pressure surges do not reach the armature tube to cause failure.

Other Features and Benefits

- Plug-in solenoid coil for ease of servicing can be replaced without disturbing the hydraulic system or wiring cavity.
- Ductile iron body provides for superior wear characteristics—especially important with 95/5 high water based fluids.
- Wet armature solenoids for quieter operation and long life with no dynamic seals to leak.
- Molded coil construction is impervious to moisture and dirt.
- Larger diameter spool combined with constant area and tangential flow passages results in low pressure drop.
- “U” shaped grooves keep spool centered in the bore for longer spool life and lower leakage.
- Four-land spool permits manufacturing of consistently rounder spool for better balance in the bore and lower spool wear and leakage.
- Optional pin-type or top-side plug-in electrical connectors for easy valve replacement. Reversible to fit any installation need.
- Dual frequency (50/60 HZ) 2-wire coils for lower inventory at the OEM. (See other options.)
- Stainless steel solenoid pin is process hardened for long life.
- Patented detent mechanism for greater reliability and long life.

Specifications & Performance

Rated Fatigue Pressure

PORTS P, A & B
PORT T

315 BAR (4500 PSI)
70 BAR (1000 PSI)

The method of verifying rated fatigue pressure conforms to NFPA recommended standard NFPA/T2.6.1 category 3/90.

Maximum Recommended Flow ** – Liters/Min. (U.S. GPM)

MODEL	SPRING CENTERED																SPRING OFFSET						DETENT							
	SPOOL		C		O		FF		F1		FO1		OP		OP1		FFX		TT		C		O		P		C		O	
SOLENOID	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC
GPM @ 1000	38 (10)	38 (10)	38 (10)	38 (10)	38 (10)	38 (10)	38 (10)	38 (10)	38 (10)	19 (5)	19 (5)	38 (10)	38 (10)	38 (10)	38 (10)	38 (10)	23 (6)	23 (6)	23 (6)	23 (6)	38 (10)	38 (10)	38 (10)	38 (10)	38 (10)	38 (10)	38 (10)	38 (10)	38 (10)	38 (10)
GPM @ 3000	38 (10)	23 (6)	38 (10)	38 (10)	38 (10)	38 (10)	38 (10)	23 (6)	8 (2)	9 (2.5)	38 (10)		38 (10)	38 (10)	38 (10)	23 (6)	23 (6)	23 (6)	38 (10)	38 (10)	38 (10)	38 (10)	11 (3)	23 (6)	38 (10)	30 (8)	38 (10)	38 (10)		
GPM @ 4500		19 (5)	38 (10)	38 (10)		19 (5)	8 (2)	15 (4)	8 (2)	8 (2)	38 (10)		38 (10)	38 (10)	8 (2)	15 (4)			38 (10)	38 (10)	38 (10)	38 (10)	8 (2)	8 (2)	38 (10)	30 (8)	38 (10)	38 (10)		
	38* (10)				38* (10)														38* (10)											

* Voltage @ 100%.

** Data is from a 4 way circuit with cylinder ports looped together and at 90% nominal voltage for AC and DC voltages.

Response Time

VALVE TYPE	AC SOLENOID		DC SOLENOID	
	SOLENOID ENERGIZED	SPRING RETURN	SOLENOID ENERGIZED	SPRING RETURN
SPRING CENTERED	20MS	30MS	50MS	40MS
SPRING OFF-SET	15MS	20MS	50MS	15MS
*DETENT	20MS	—	70MS	—

* Detented models must be actuated with a momentary signal of at least 100MS duration.

Solenoid Data

SERIES 3			
VOLTAGE	INRUSH AMPS (RMS)	HOLDING AMPS (RMS)	HOLDING WATTS
120/60 110/50 (DUAL)	2.40	.69	27.5
	2.40	.78	28.5
240/60 220/50 (DUAL)	1.15	.25	27.5
	1.10	.35	28.5
220/50	1.0	.24	23
240/50	1.2	.25	23
110/50	2.40	.61	23
12 VDC	—	2.73	33
24 VDC	—	1.28	30

Fluids & Seals

Buna-N seals are standard and are compatible with water glycol, water-in-oil emulsions, high water base fluids, and petroleum oils. For phosphate ester fire resistant fluids, viton seals (symbol L) must be specified.

Filtration 25 microns or finer

Operating Temperature Range

0°F to 150°F (-18° to 66°C)

Viscosity Range

75 to 600 SSU (15-128 CST)

Mounting Position

There is no restriction on mounting position of spring centered or spring off-set models. Detented models must be mounted with the spool bore horizontal to reduce the possibility of inadvertent spool shift due to shock and/or vibration.

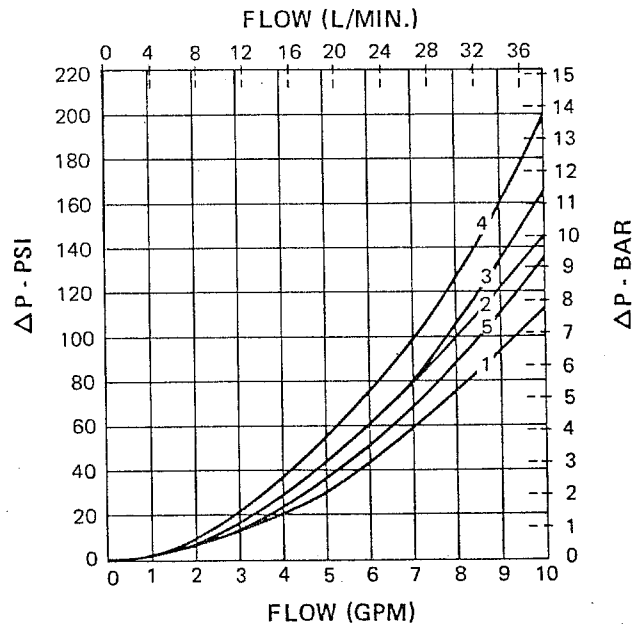
Spool Chart

SPOOL TYPE	VALVE FUNCTION, SYMBOL AND MODEL PREFIX		
	3 POSITION SPRING CENTERED QF-3 Series	2 POSITION SPRING CENTERED SOLENOID B QJF-3 Series	2 POSITION SPRING CENTERED SOLENOID A QGF-3 Series
C			
O			
FF			
F1			
FO1			
OP			
OP1			
FFX			
TT			
	2 POSITION DETENTED QM-3 Series	2 POSITION SPRING OFF-SET TO PORT A QJ-3 Series	2 POSITION SPRING OFF-SET TO PORT B QG-3 Series
C			
O			
P	N/A		

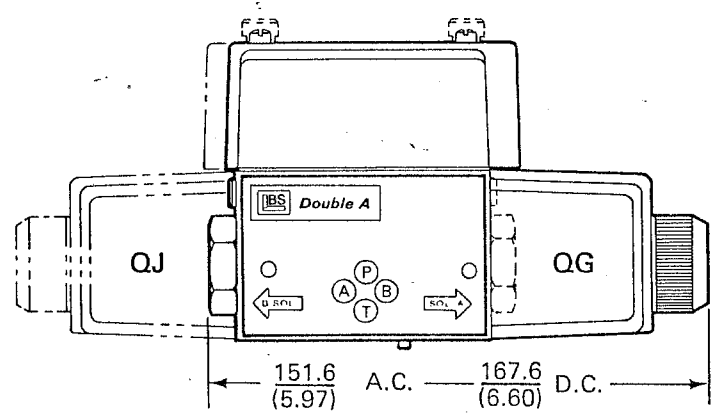
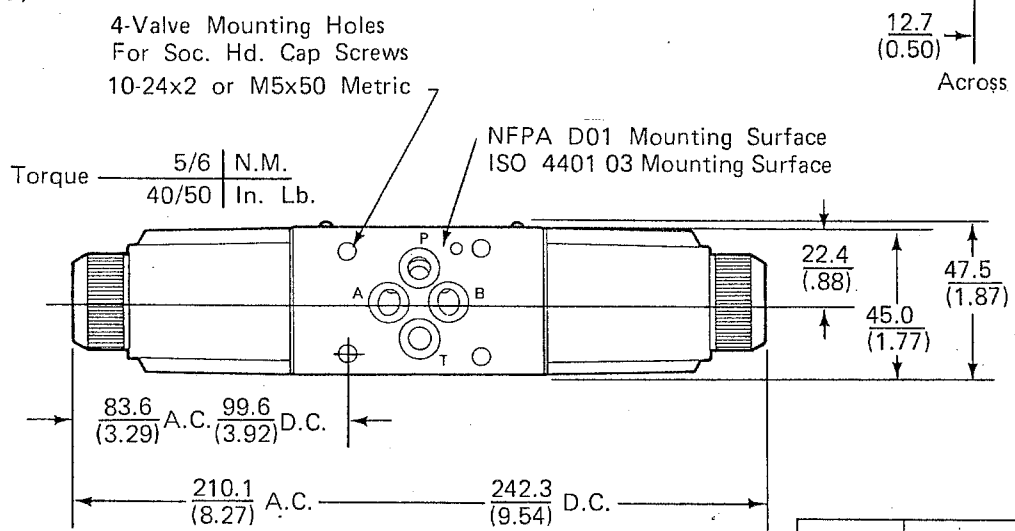
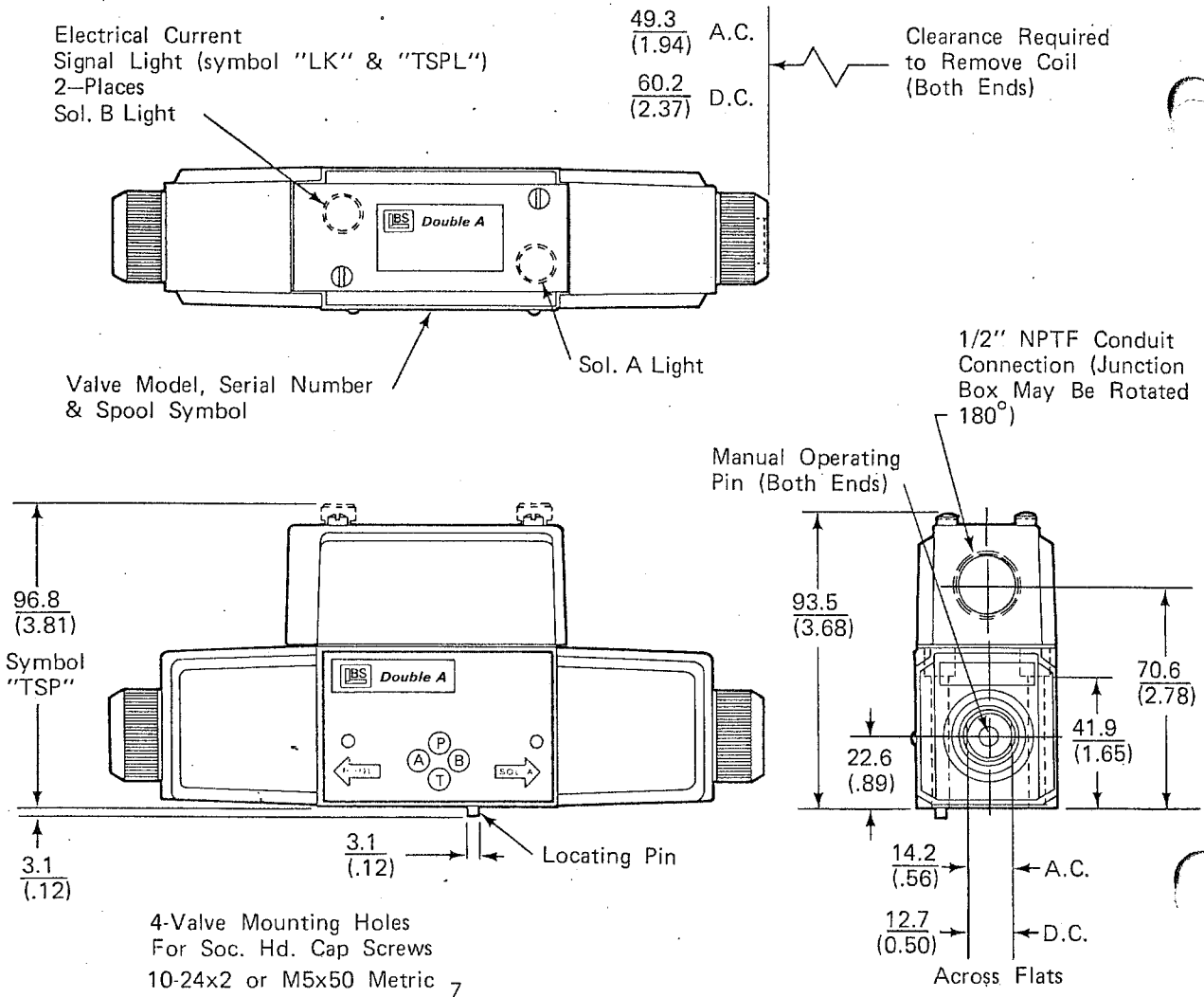
Pressure Drop

(FLUID @ 100 SSU) 21 CST

SPOOL	P A	P B	A T	B T	P T
C	1	1	2	2	—
O	1	1	2	2	1
FF	1	1	2	2	—
F1	1	1	2	2	—
FO1	1	1	2	2	1
OP	1	1	2	2	—
OP1	1	1	2	2	—
FFX	1	1	2	2	—
TT	5	5	4	4	3
P	1	1	—	—	—



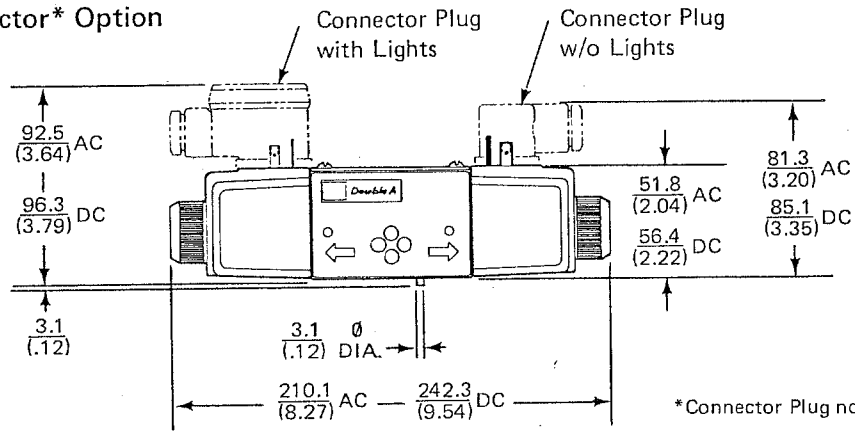
Installation Dimensions



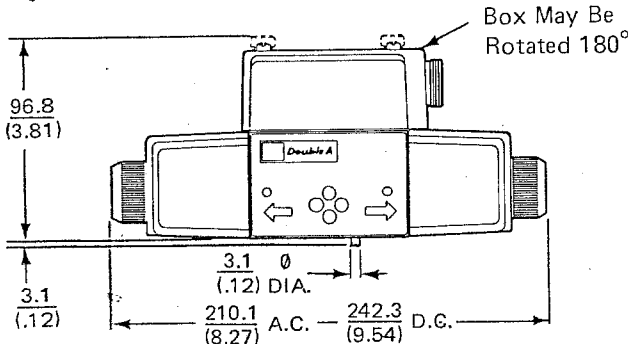
MODEL	APPROX. WT.			
	AC		DC	
	KGS	LBS	KGS	LBS
SINGLE SOL.	1.8	4	2.3	5
DOUBLE SOL.	2.3	5	2.7	6

METRIC (INCHES)

HS DIN 43650 Connector* Option



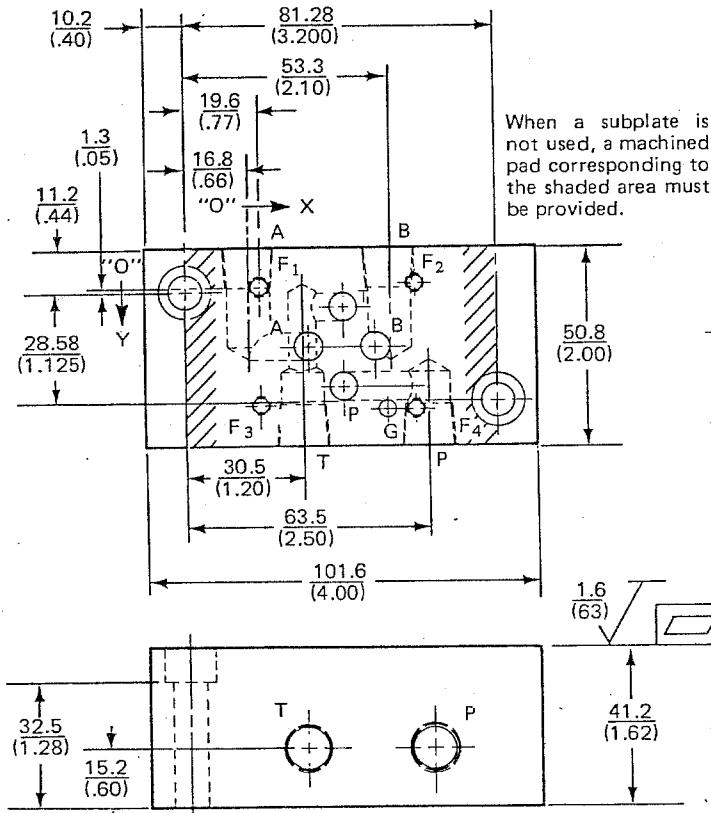
BH Pin Type Connector Option (N.F.P.A. -T3, 5.29)



NUMBER OF SOLENOIDS	NO. OF PINS	OPTION CODE
SINGLE	3	BH
	5	BH5
DOUBLE	5	BH

Double solenoid valves are provided with 5-pin connector. Single solenoid valves are available with 3-pin (BH) or 5-pin (BH5) connectors.

Subplate and Mounting Surface

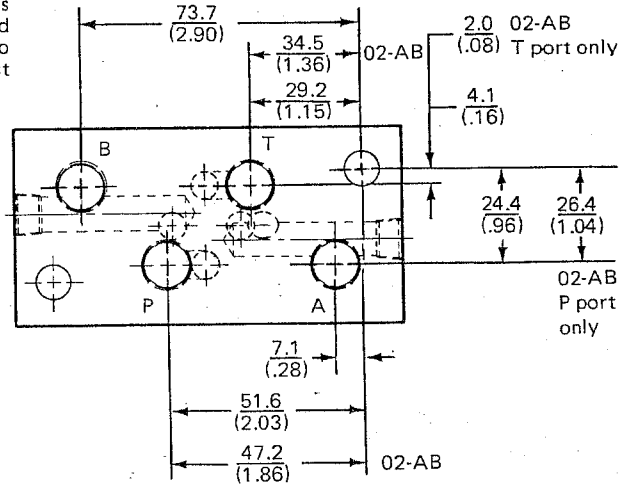


BOLT KITS* Includes (4) directional valve mounting bolts.

MODEL CODES	SIZES	THREAD
BK3-50M	No. 10-24 x 2.0	INCH
BK5M-50M	M5 x 0.8 x 50	METRIC

*Bolt Kits are ordered separately.

NOTE: Metric grade 10.9 (SAE grade 8) mounting bolts req.



	A	T	P	B	F ₁	F ₂	F ₃	F ₄	G
X	12.7 (.50)	21.6 (.85)	21.6 (.85)	30.2 (1.19)	0	40.49 (1.594)	0	40.49 (1.594)	33.0 (1.30)
Y	15.5 (.61)	5.1 (.20)	25.9 (1.02)	15.5 (.61)	0	-0.76 (-0.030)	30.99 (1.220)	31.75 (1.250)	31.75 (1.250)
Ø DIA.	7.1 (.28)	7.1 (.28)	7.1 (.28)	7.1 (.28)	M5 (.19)	M5 (.19)	M5 (.19)	M5 (.19)	4.0 (.16)

FOR STANDARD VALVE
PORT SIZE
02-¼" NPTF/BSP
9/16-18 SAE
03-3/8" NPTF/BSP
¾-16 SAE

PORT LOCATION
NO SYMBOL - Back Ports
A - Side Ports
AB - Side and Back Ports †

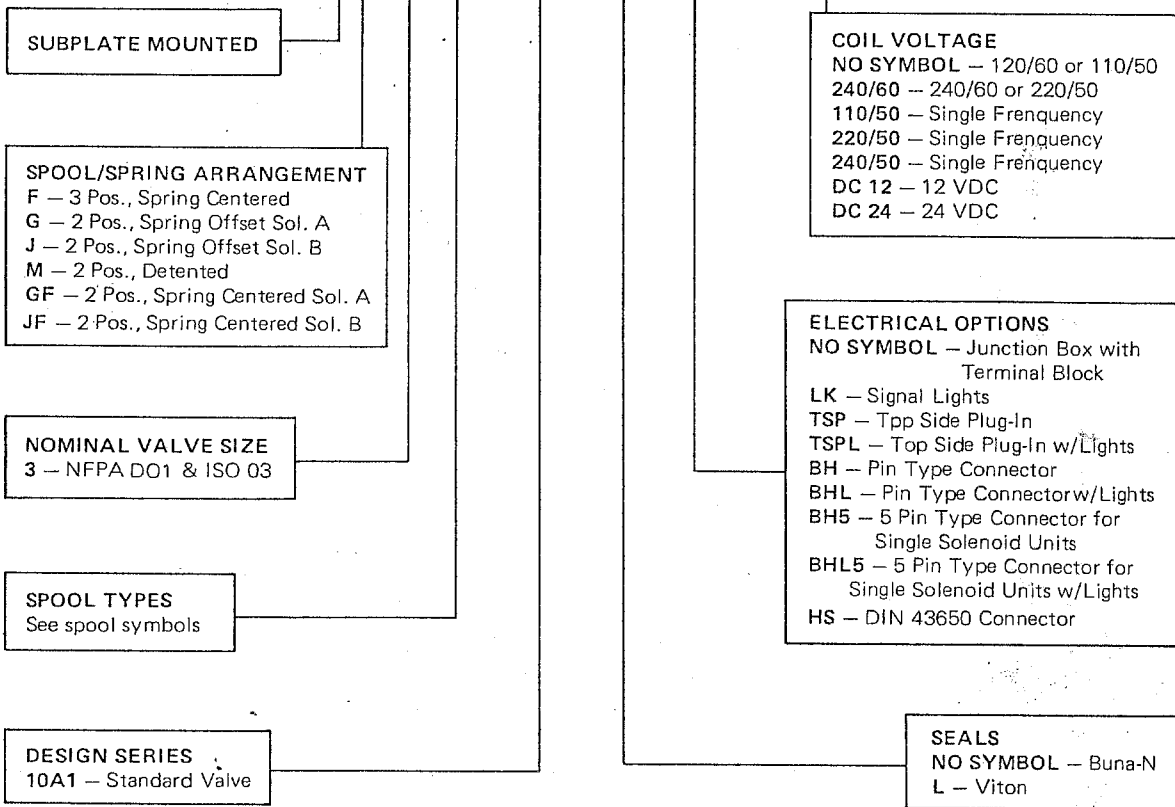
VALVE MOUNTING HOLES
NO SYMBOL - No. 10-24 UNC-2B
M - M5x0.8

THREAD DESIGNATION
NO SYMBOL - Dry Seal
Taper Pipe Thread
S - SAE Straight Thread
O - O-Ring Seal Ports
E - BSP Parallel

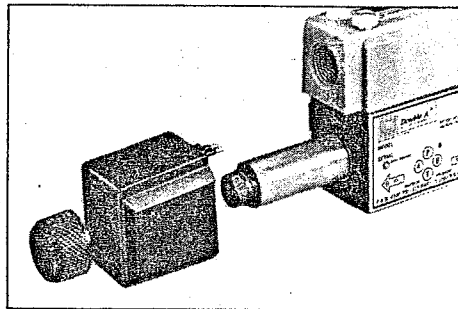
† Only available in 02 size.

Options & Model Code

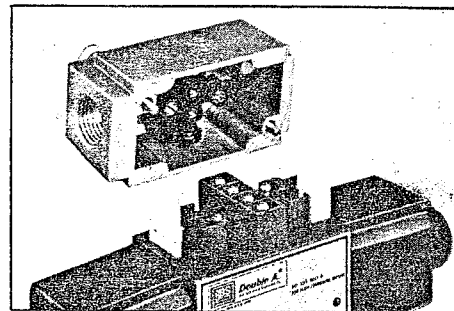
QF-3-C-10A1-L-TSP-DC12



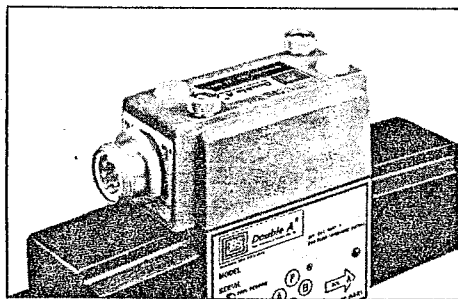
Electrical Features



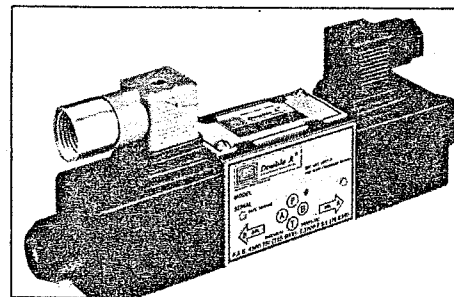
Standard Plug-In Coil Features



Top-Side Plug-In Connector Option

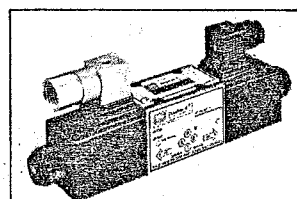
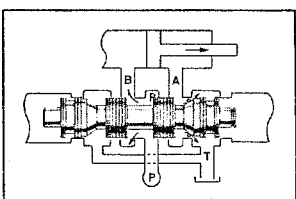
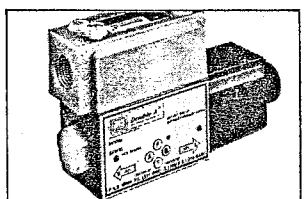
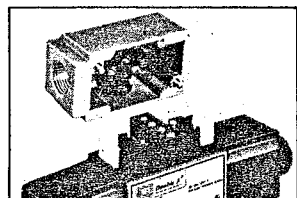
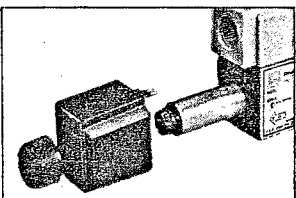
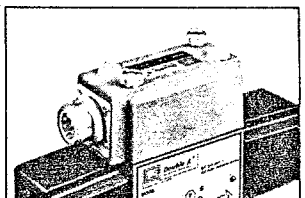
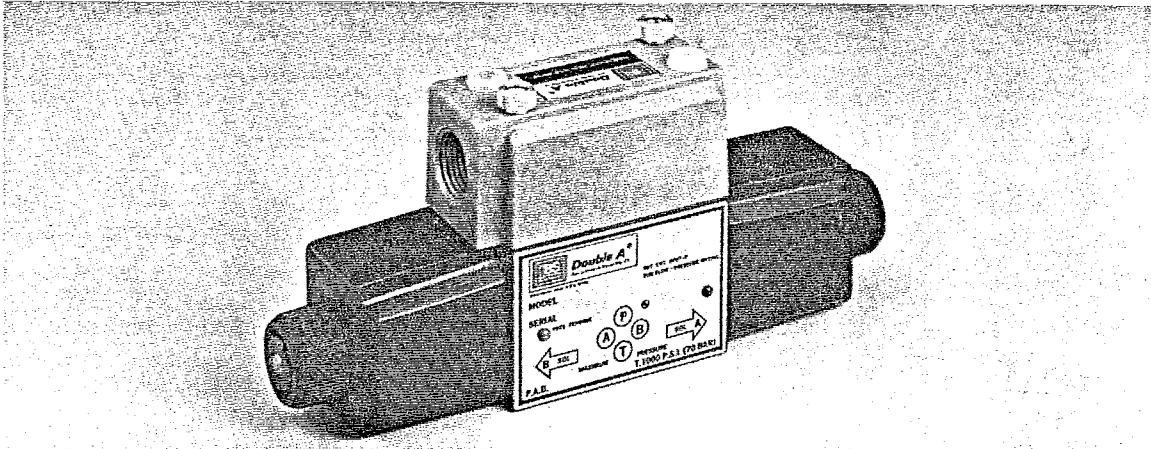


Pin Type Electrical Connector Option



DIN 43650 Electrical Connector Option

Mfg. in: Manchester, Michigan, U.S.A. 48158 □ England □ France □ Germany



Directional Valves Series 3

Solenoid Operated
10 gpm / 38 l/min
4500 psi / 315 bar

1000 psi / 70 bar for
High Water Base Fluids



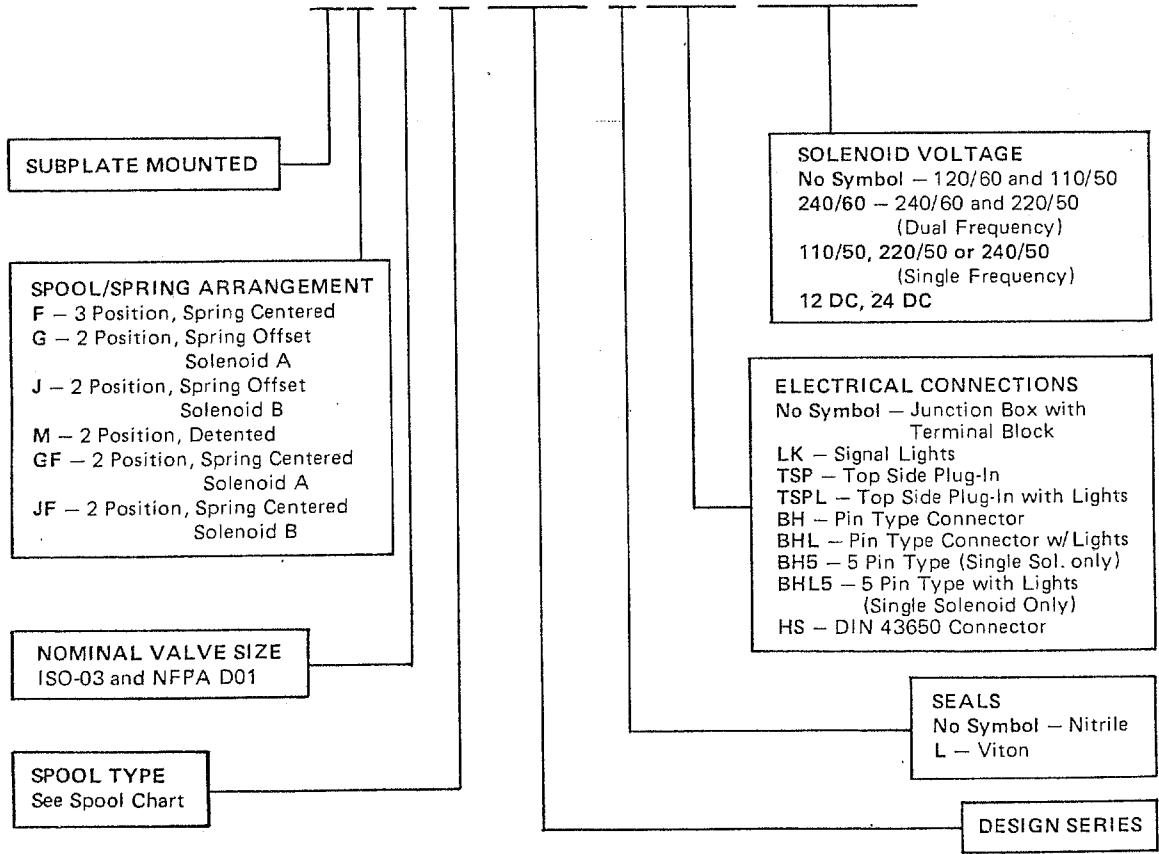
Double A
Division of Brown & Sharpe Mfg. Co.

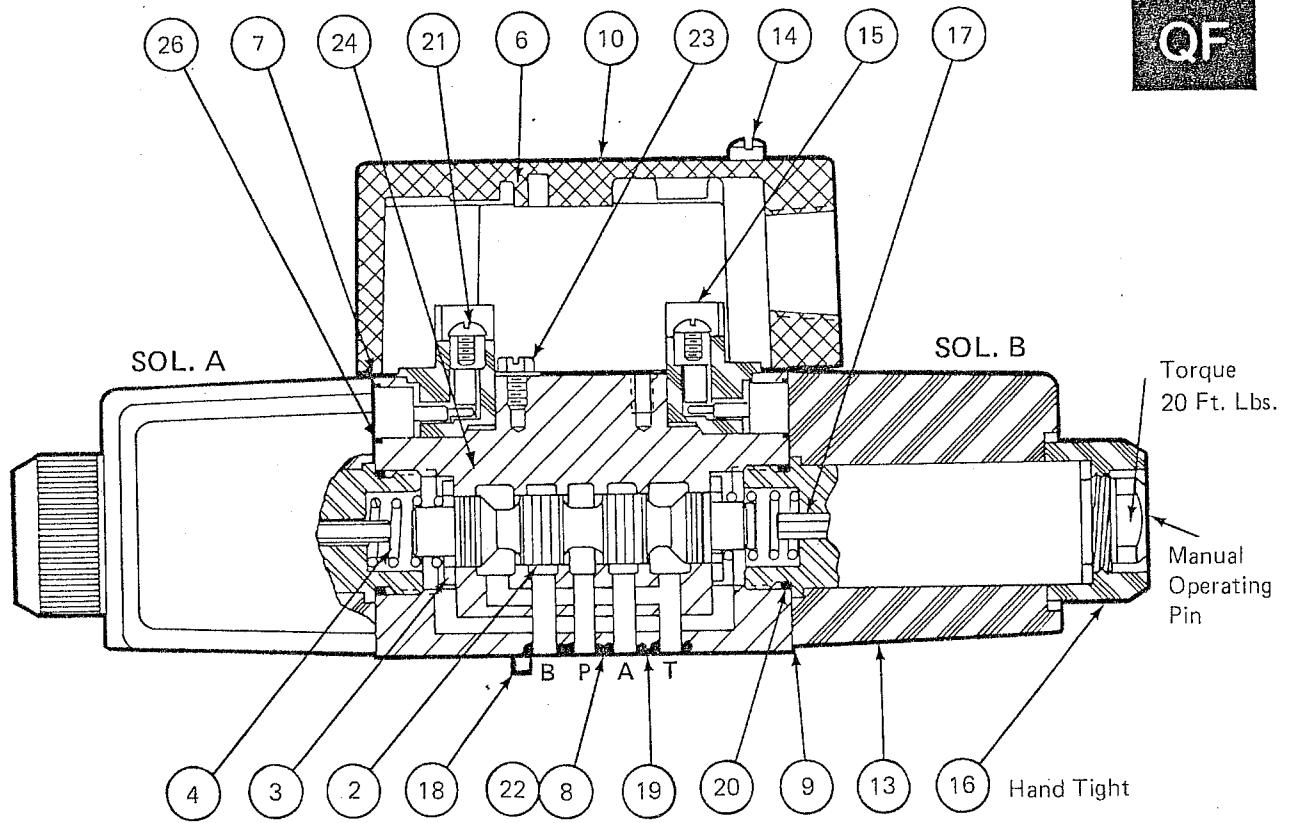
Model Code / Characteristics

Rated Flow at 4500 psi.....	See Spool Table
Maximum Pressure.....	4500 psi
except 'T' port.....	1000 psi
H.W.B.F., All Ports.....	1000 psi
Inrush / Holding Current, Dual Frequency Solenoids	
120 / 60.....	2.4/.69 amps
110 / 50.....	2.4/.78 amps
240 / 60.....	1.15/.25 amps
220 / 50.....	1.10/.35 amps
Single Frequency Solenoids	
110 / 50.....	2.4/.61 amps
220 / 50.....	1.00/.24 amps
240 / 50.....	1.20/.25 amps
D.C. Solenoid Power.....	12 volts—33 watts, 24 volts—30 watts
Maximum Internal Leak Rate at 3000 psi (Mineral Oil)	
QF Centered.....	9 C.I.P.M. (except TT spool)
QM, QJ and QG Shifted.....	9 C.I.P.M. (except TT spool)

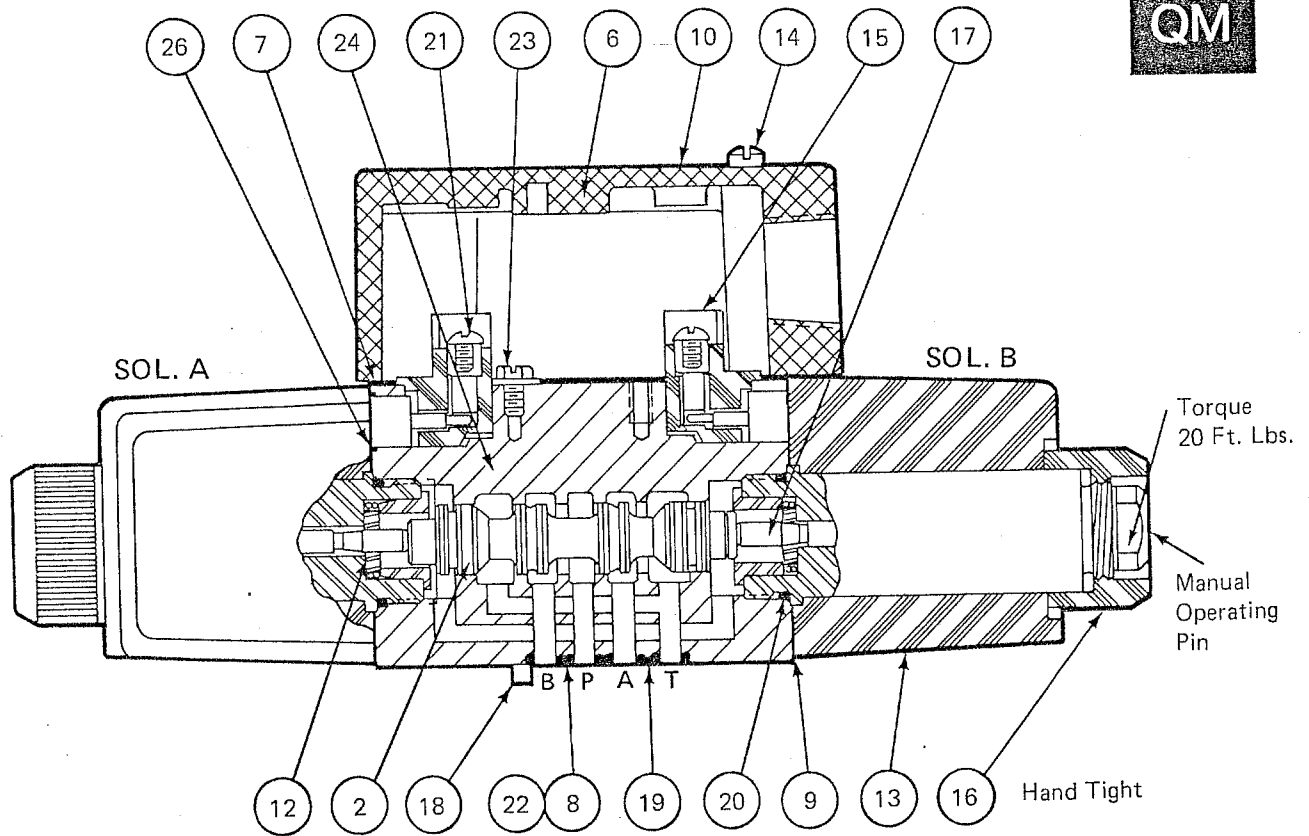
See application bulletin 9065-P for additional performance information. See bulletin 9003-S for troubleshooting and maintenance information. Parts or replacement units may be obtained from your local Double A distributor.

QF·3·C·10A1·L·TSP·240/60



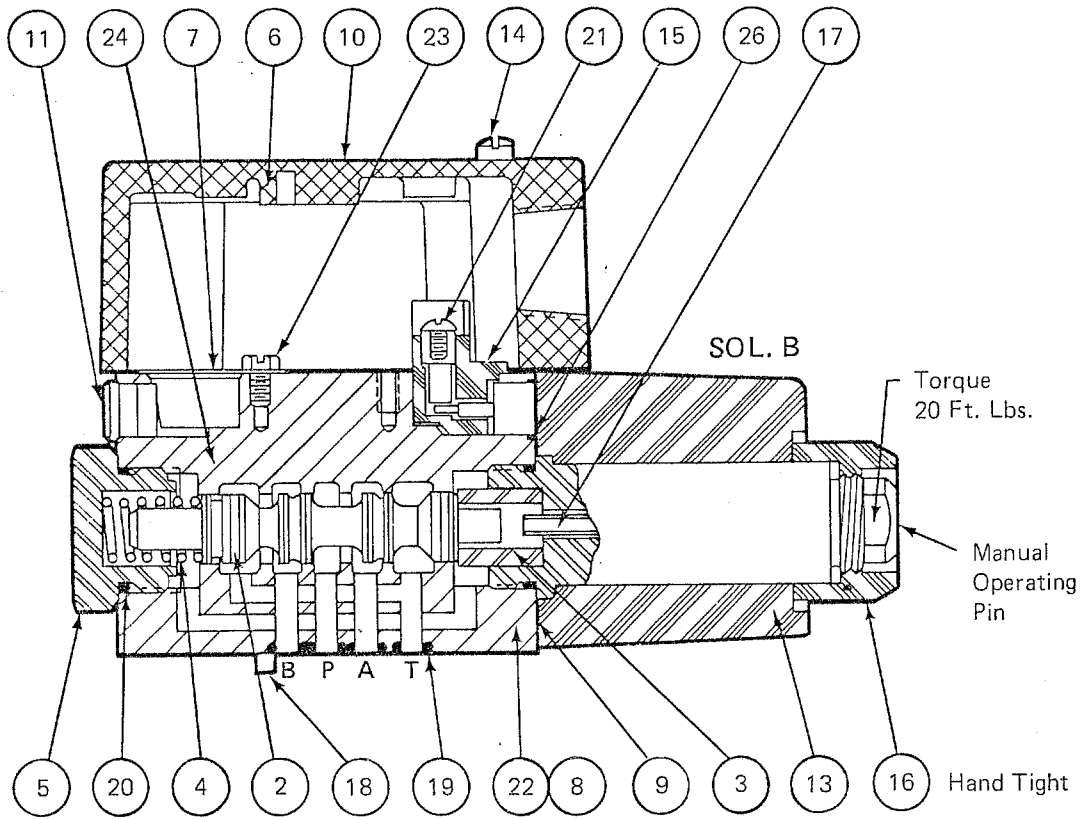


Install spools with notched end on 'A' port end



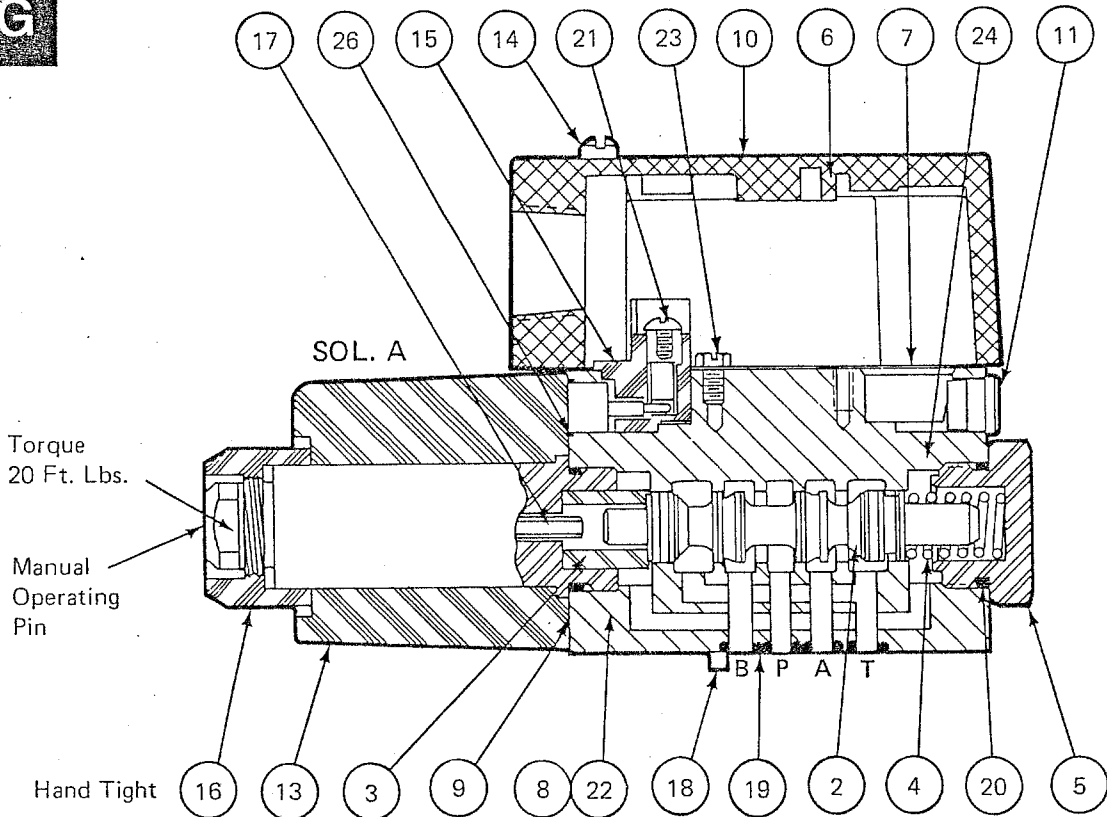
Install spools with notched end on 'A' port end

QJ

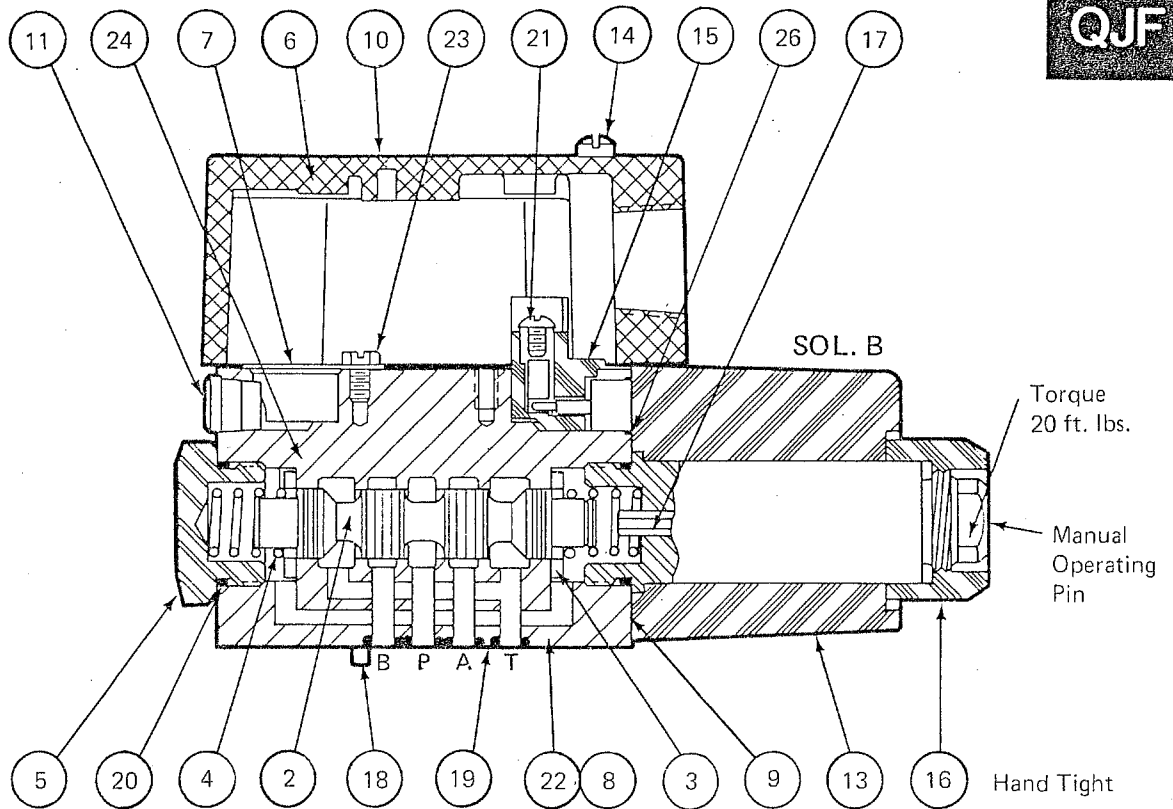


Install spool with small end toward solenoid.

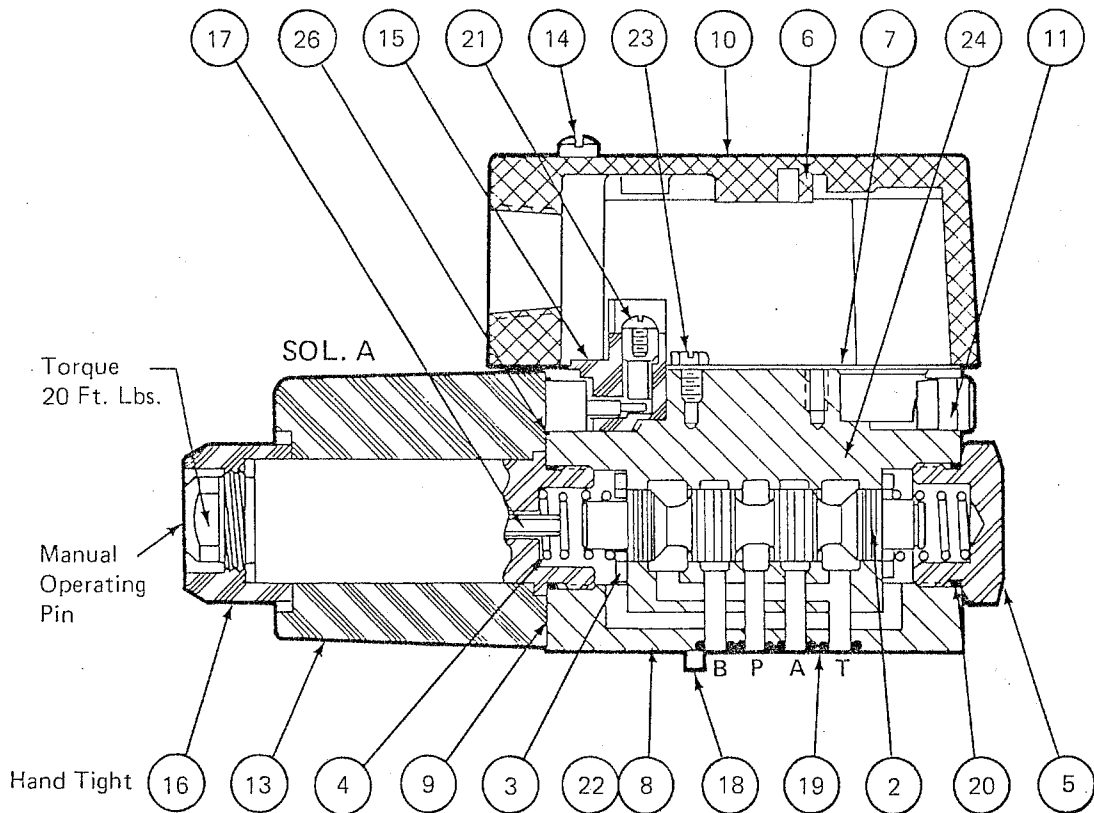
QG



Install spool with small end toward solenoid.



Install spool with notched end on 'A' port end.



Install spool with notched end on 'A' port end.

QF, QJF & QGF SPOOLS

(Flows @ 4500 psi Max. Recommended)

SYMBOL AND PART NUMBER	SPOOL	GRAPHIC SYMBOL
'C' 10-26645-02 10 GPM		
'O' 10-26645-03 10 GPM		
'FF' 10-26645-04 10 GPM		
'F1' 10-26645-05 10 GPM		
'FO1' 10-26645-07 2 GPM		
'OP' 10-26645-09 10 GPM		
'OP1' 10-26645-10 10 GPM		
'FFX' 10-26645-16 10 GPM		
'TT' 10-26645-18 6 GPM		

QM SPOOLS

(Flows @ 4500 psi Max. Recommended)

SYMBOL AND PART NUMBER	SPOOL	GRAPHIC SYMBOL
'C' 10-27087-02 10 GPM		
'O' 10-27087-03 10 GPM		

QJ SPOOLS (Flows @ 4500 psi Max. Recommended)

SYMBOL AND PART NUMBER	SPOOL	GRAPHIC SYMBOL
'C' 10-26646-02 10 GPM		
'O' 10-26646-03 10 GPM		
'P' 10-26646-15 2 GPM		

QG SPOOLS (Flows @ 4500 psi Max. Recommended)

SYMBOL AND PART NUMBER	SPOOL	GRAPHIC SYMBOL
'C' 10-26646-02 10 GPM		
'O' 10-26646-03 10 GPM		
'P' 10-26646-15 2 GPM		

PARTS LIST

ITEM	PART NUMBER	PART NAME	QF	QM	QG QJ	QGF QJF
2	See Table	Spool	1	1	1	1
3	10-26642-02 10-26713-02	Spool Stop	2	-	-	2
4	See Table	Spring (Green)	2	-	-	2
5	10-25155-04 10-25155-05	Plug	-	-	1	-
6	10-26787-02	Junction Box	1	1	1	1
7	10-26900-02 †	Junction Box Gasket	1	1	1	1
8	10-26924-02	Name Plate	1	1	1	1
9	10-26652-03 †	Solenoid Gasket	2	2	1	1
10	10-26805-02	Label	1	1	1	1
11	10-26299-02	Plastic Plug	-	-	1	1
12	PG-27092-02 ⊕	Detent Assy.	-	2	-	-
13	See Table	Coil	2	2	1	1
14	10-26670-03	Fil. Hd. Scr., M4-0.7x6g	2	2	2	2
15	10-26885-03	Terminal Block	2	2	1	1
16	10-26849-02	Solenoid Knob	2	2	1	1
17	See Table	Solenoid Pin	2	-	1	1
18	83-52036-02	Spring Pin	1	1	1	1
19	82-20012-01 * †	O-Ring, 1/16x 3/8x1/2	4	4	4	4
20	82-20018-07 †	O-Ring, 1/16x3/4x7/8	2	2	2	2
21	83-16915-08 †	Rd. Hd. Scr., M 3.5x5	4	4	2	2
22	83-32801-06	Drive Scr., 2x3/16	2	2	2	2
23	83-16919-08 †	Ground Scr., M 4x6	1	1	1	1
24	84-01309-03	Pipe Plug, 1/16	2	2	2	2
26	10-26987-02 †	Seal	2	2	1	1

† Included in Routine Maintenance Kit

* Symbol 'L', use -07

⊕ Use -03 with DC Solenoids.

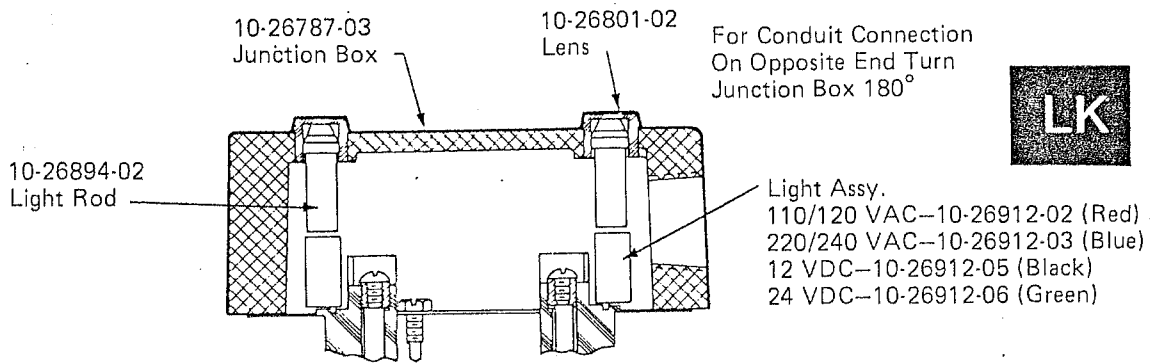
QF SPRING

ITEM	SPOOL TYPES	SPRING
4	O,OP,OP1, TT,FO1	10-26648-02 (Blue)
	C,FF,FFX,F1	10-26724-02 (Copper)

ROUTINE MAINTENANCE KIT
1K-01293-01
(For Viton Rings use 1K-01293-07)

SOLENOID PIN

ITEM	MODEL	PART NO.
17	AC	10-26966-02
	DC	10-27141-02

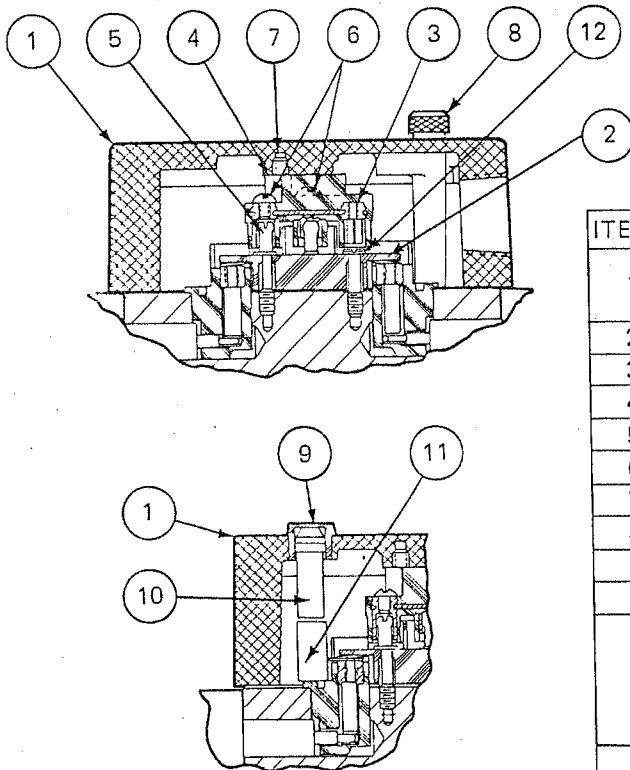


To assemble light, insert lens into junction box then press light rod into lens.

Solenoids and Coils

Plug-In			DIN 43650 Connector		
VOLTS/CYC.	COIL	TUBE	VOLTS/CYC.	COIL	TUBE
120/60 or 110/50	85-50554-32	10-26925-02	120/60 or 110/50	85-50552-32	10-26925-02
240/60 or 220/50	85-50554-42		240/60 or 220/50	85-50552-42	
110/50	85-50554-71		110/50	85-50552-71	
220/50	85-50554-81		220/50	85-50552-81	
240/50	85-50554-41		240/50	85-50552-41	
12 VDC	85-50555-18	10-26926-02	12 VDC	85-50553-18	10-26926-02
24 VDC	85-50555-28		24 VDC	85-50553-28	

Coil may be replaced without removing armature tube. Unscrew knob and pull coil straight back to disengage it. Check voltage and cycles on new coil to insure correct replacement.

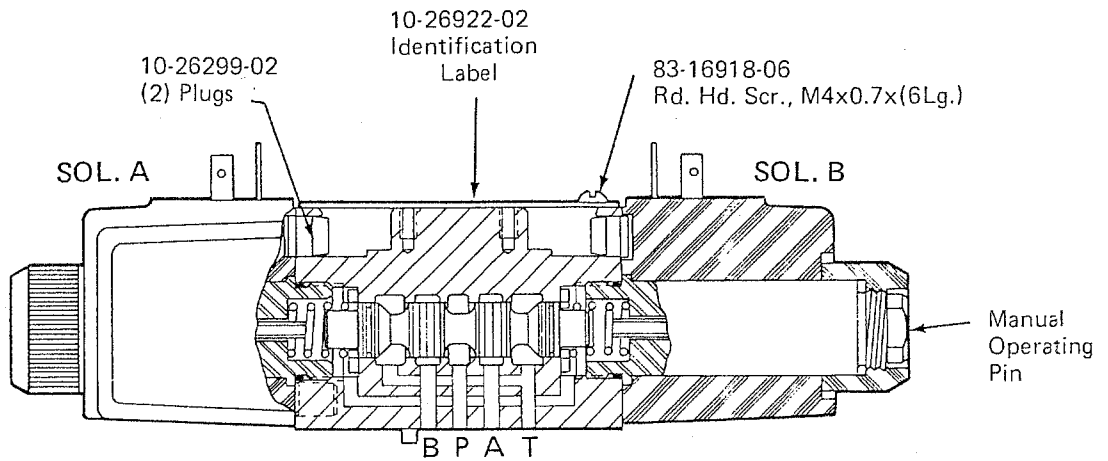


ITEM	PART NUMBER	PART NAME	TSP	TSPL
1	10-26787-02	Junction Box	1	-
	10-26787-03		-	1
2	10-26893-02	Adaptor	1	1
3	10-26930-02	Connector	1	1
4	10-26901-02	Gasket	1	1
5	10-26905-02	Ground Screw	1	1
6	83-16915-08	Rd. Hd. Scr., M3.5x(5Lg.)	5	5
7	83-33022-02	Tapping Scr., 8-32x1/2	2	2
8	10-26671-02	Thumb Screw	2	2
9	10-26801-02	Lens	-	2
10	10-26894-02	Light Rod	-	2
11	10-26912-02	Light-110/120 VAC (Red)	-	2
	10-26912-03	Light-220/240 VAC (Blue)		
	10-26912-05	Light-12 VDC (Black)		
	10-26912-06	Light-24 VDC (Green)		
12	10-26991-02	Screw	1	1

To assemble light, insert lens into junction box then press light rod into lens.



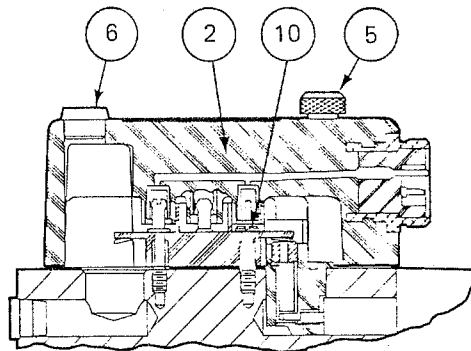
DIN 43650 Connector



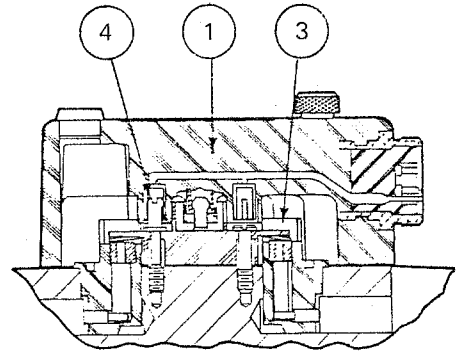
Armature tube torque: 20 ft. lbs.
 Solenoids may be rotated 90 degrees in either direction.
 Unscrew Knob, rotate solenoid coil to position desired and retighten knob.

BH, BHL BH5, BHL5

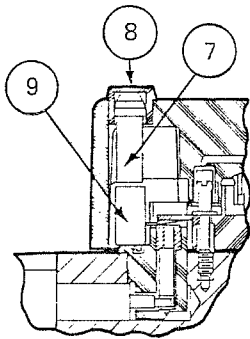
For Electrical Connection
 On Opposite End Turn
 Junction Box 180°



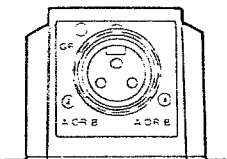
QG and QJ-BH



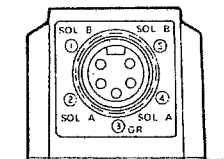
QF and QM-BH



BHL



Single-Solenoid Models



All Models

ITEM	PART NUMBER	PART NAME	BH	BHL
1	10-26592-02	5-Pin Connector	1	1
2	10-26592-03	3-Pin Connector	1	1
3	10-26893-02	Adaptor	1	1
4	10-26905-02	Ground Screw M4	1	1
5	10-26671-02	Thumb Screw	2	2
6	10-26937-02	Plug	2	-
7	10-26894-02	Light Rod	-	2
8	10-26801-02	Lens	-	2
9	10-26912-02	Light-110/120 VAC (Red)	-	2
	10-26912-03	Light-220/240 VAC (Blue)		
	10-26912-05	Light-12 VDC (Black)		
	10-26912-06	Light-24 VDC (Green)		
10	10-26991-02	Screw	1	1

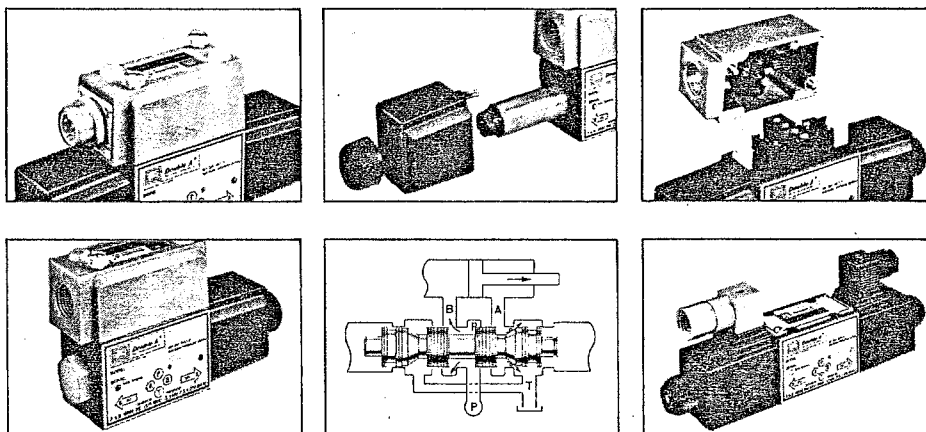
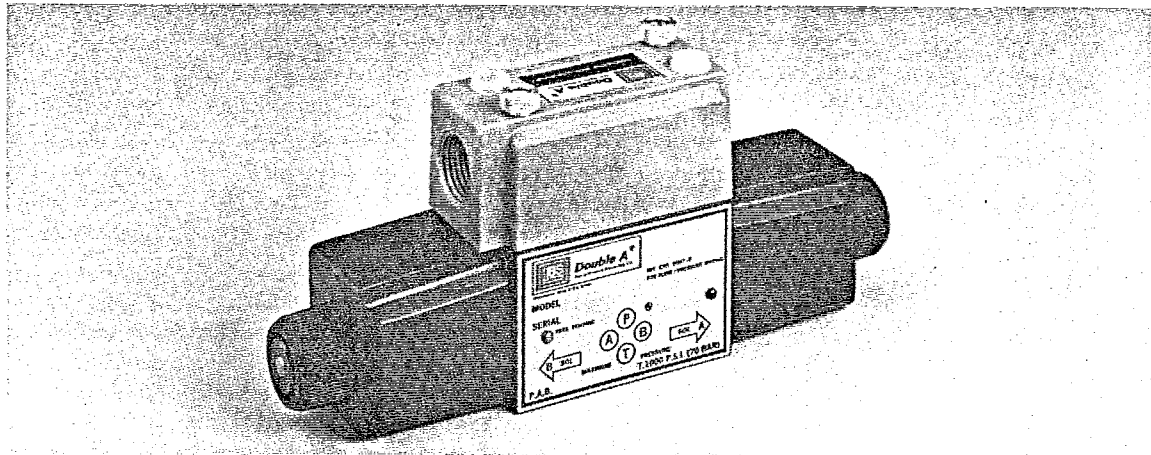
QG, QJ, QGF and GJF are normally supplied with BH and BHL 3-pin connectors. BH5 and BHL5 indicate 5-pin connectors for these models.



Manchester, Michigan 48158
 (313) 428-8311

Mfg. in: Manchester, Michigan, U.S.A. 48158

England France Germany



Directional Valves Series 3

Solenoid Operated
10 gpm / 38 l/min
4500 psi / 315 bar

1000 psi / 70 bar for
High Water Base Fluids



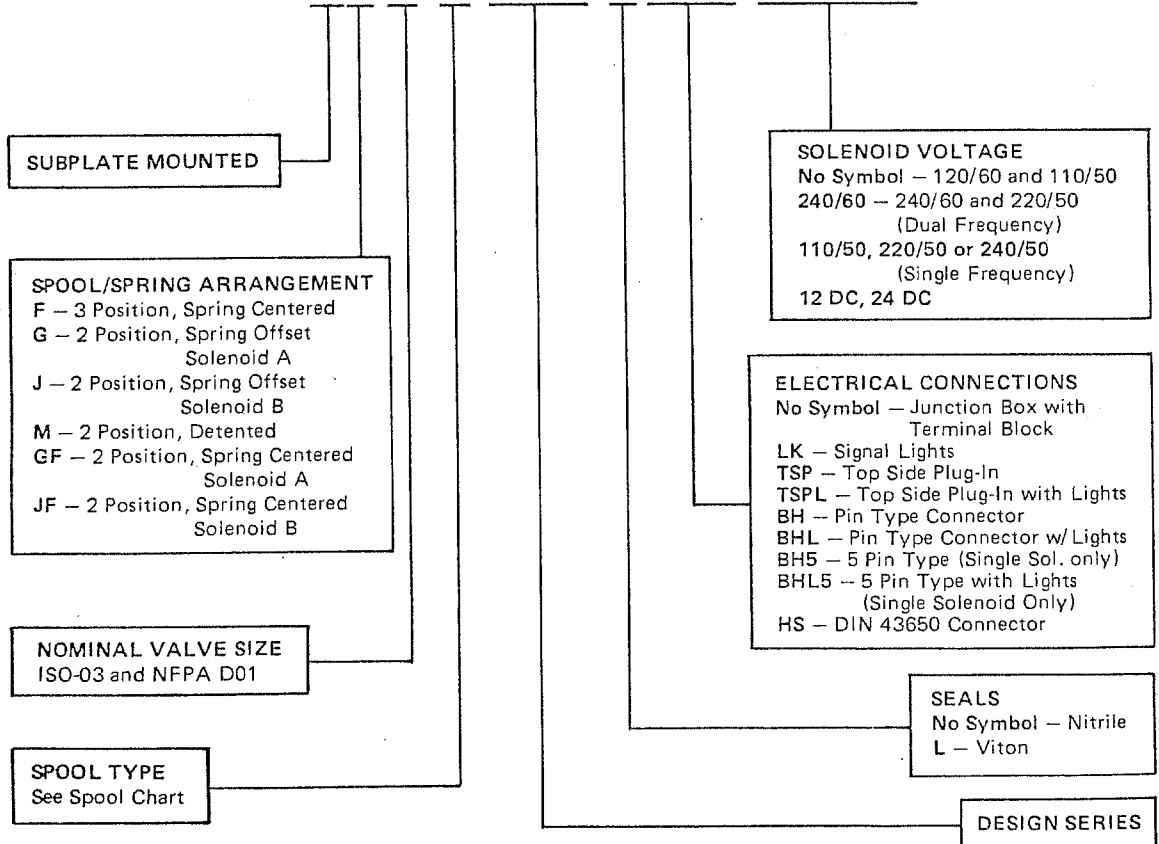
Double A
Division of Brown & Sharpe Mfg. Co.

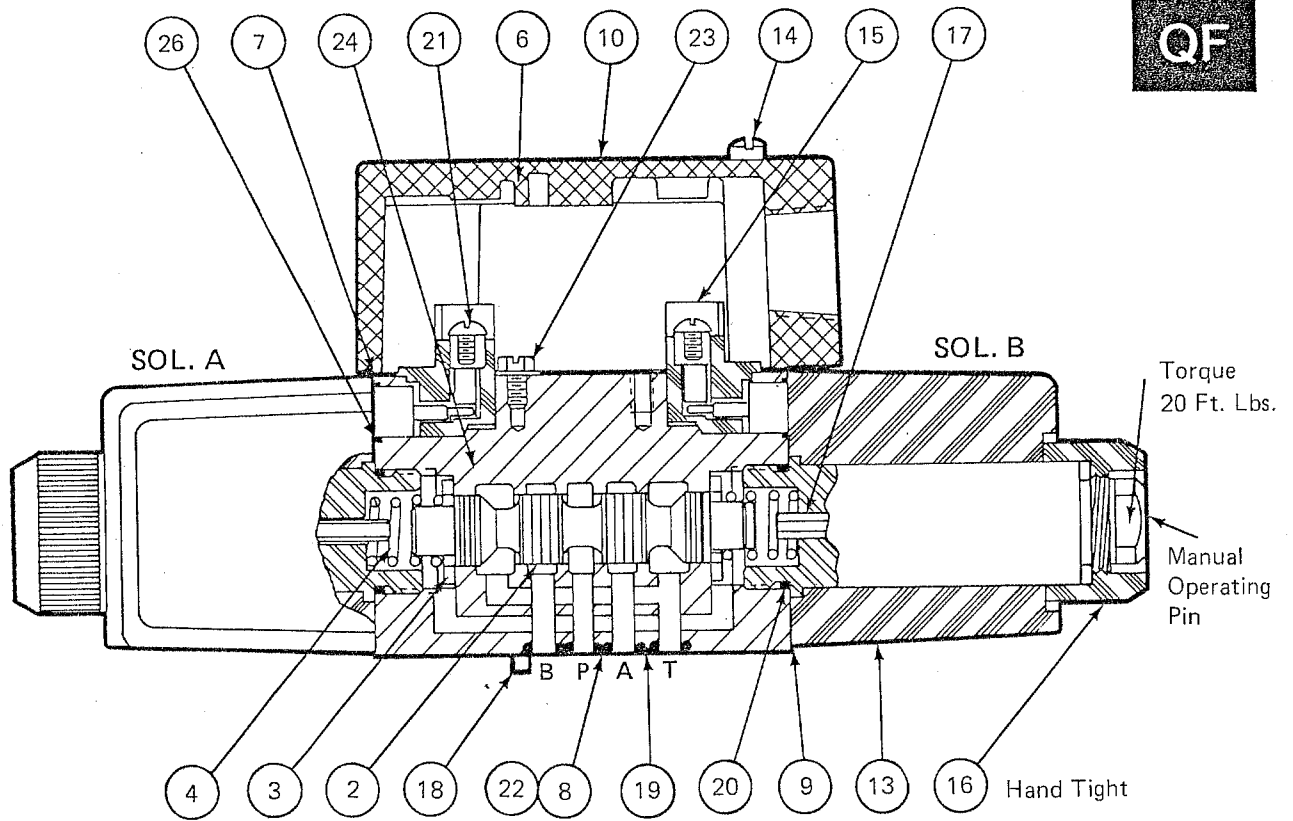
Model Code / Characteristics

Rated Flow at 4500 psi.....	See Spool Table
Maximum Pressure.....	4500 psi
except 'T' port.....	1000 psi
H.W.B.F., All Ports.....	1000 psi
Inrush / Holding Current, Dual Frequency Solenoids	
120 / 60.....	2.4/.69 amps
110 / 50.....	2.4/.78 amps
240 / 60.....	1.15/.25 amps
220 / 50.....	1.10/.35 amps
Single Frequency Solenoids	
110 / 50.....	2.4/.61 amps
220 / 50.....	1.00/.24 amps
240 / 50.....	1.20/.25 amps
D.C. Solenoid Power.....	12 volts—33 watts, 24 volts—30 watts
Maximum Internal Leak Rate at 3000 psi (Mineral Oil)	
QF Centered.....	9 C.I.P.M. (except TT spool)
QM, QJ and QG Shifted.....	9 C.I.P.M. (except TT spool)

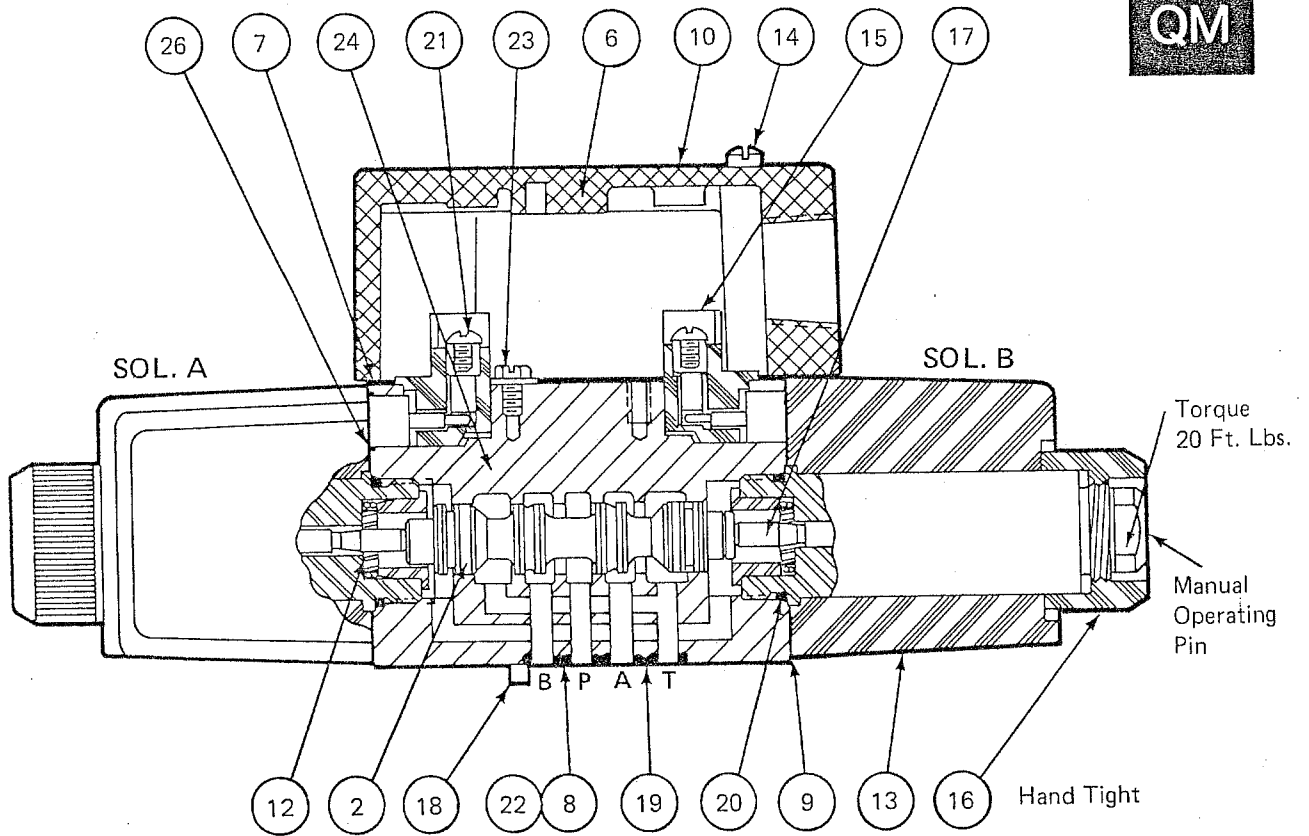
See application bulletin 9065-P for additional performance information. See bulletin 9003-S for troubleshooting and maintenance information. Parts or replacement units may be obtained from your local Double A distributor.

QF·3·C·10A1·L·TSP·240/60



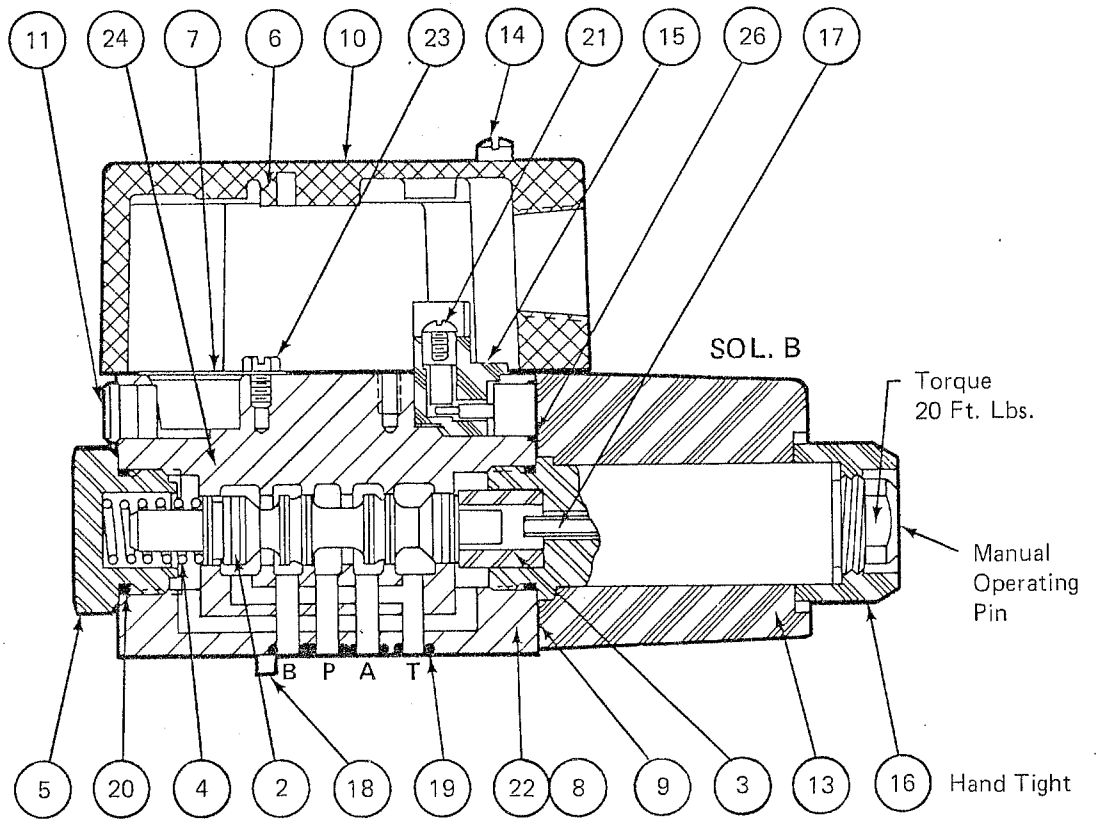


Install spools with notched end on 'A' port end



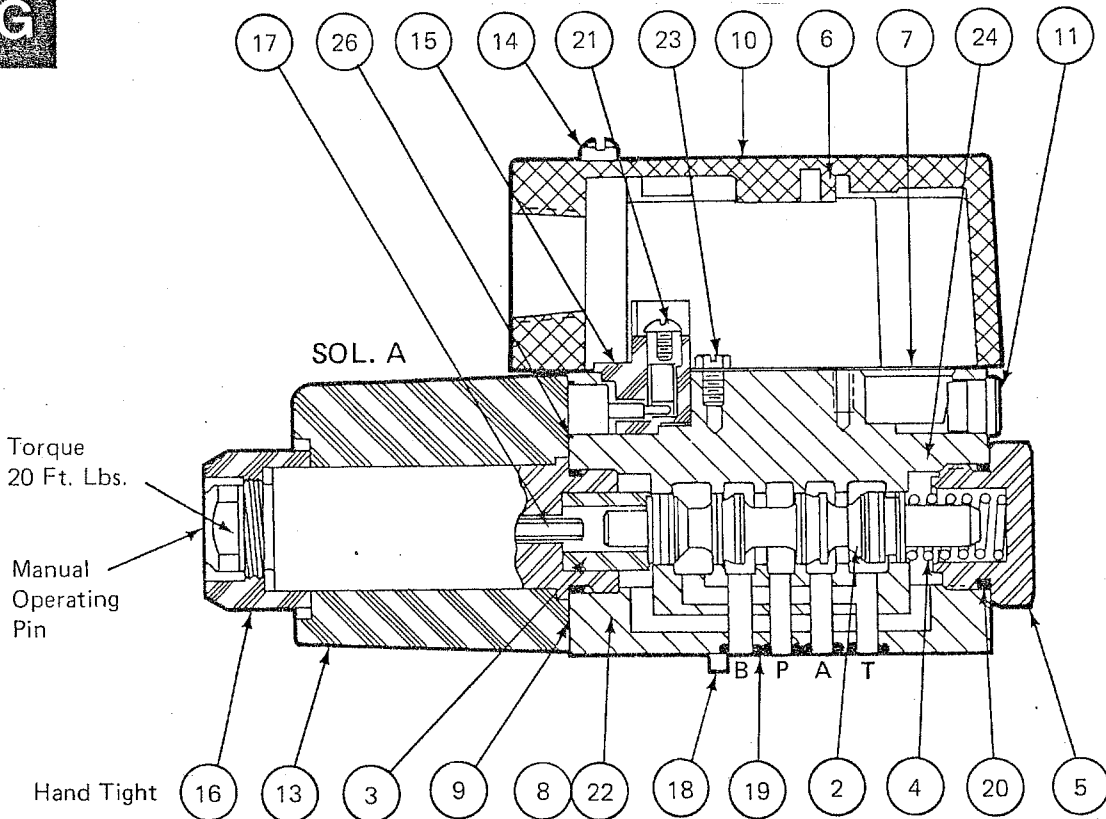
Install spools with notched end on 'A' port end

QJ

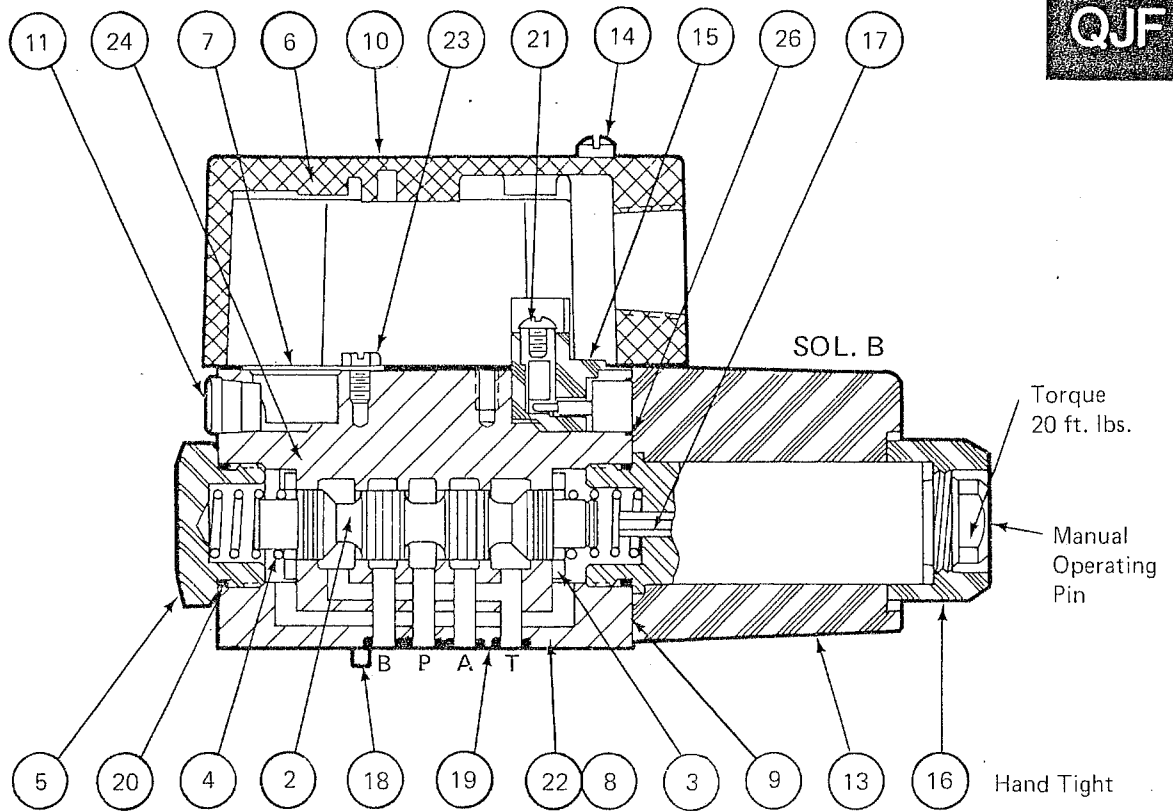


Install spool with small end toward solenoid.

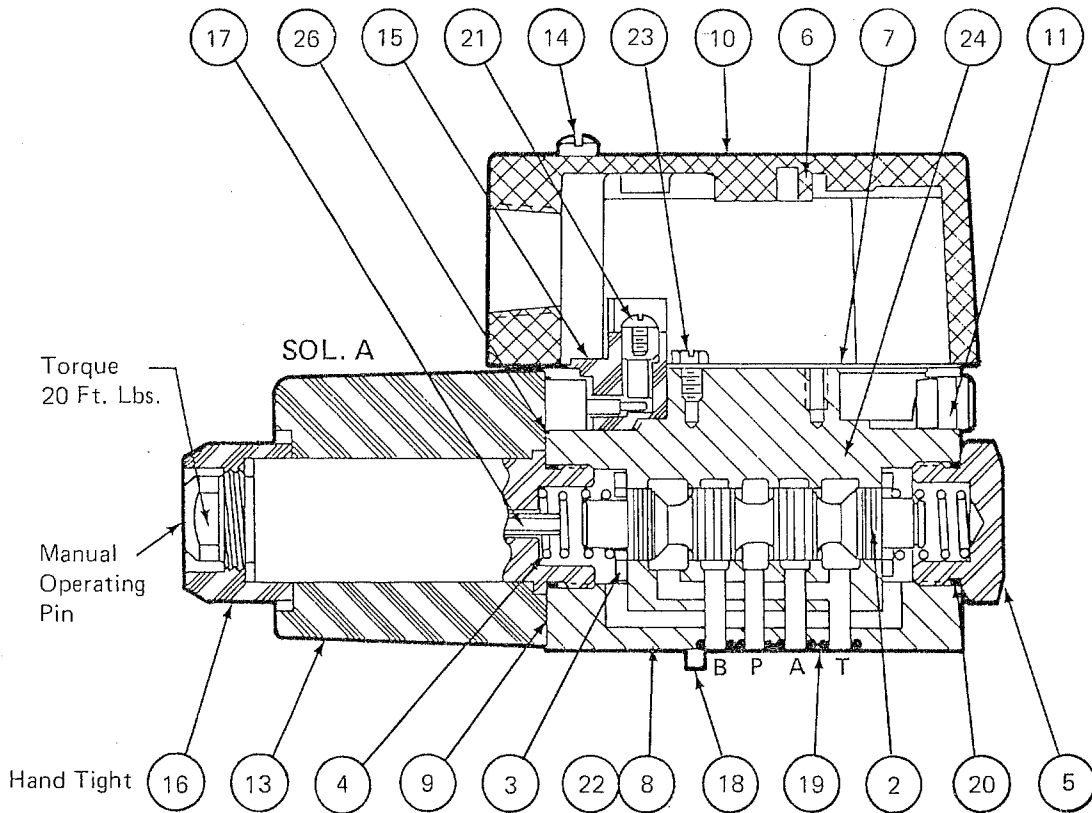
QG



Install spool with small end toward solenoid.



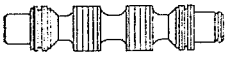
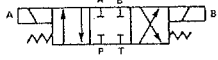
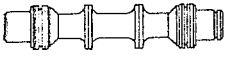
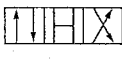
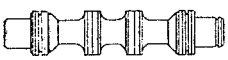

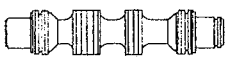



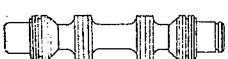




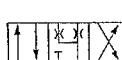
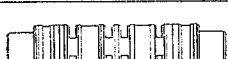
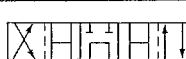
Install spool with notched end on 'A' port end.



Install spool with notched end on 'A' port end.


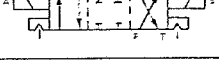


QF, QJF & QGF SPOOLS

(Flows @ 4500 psi Max. Recommended)


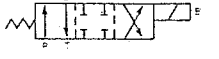
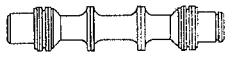
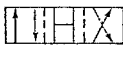
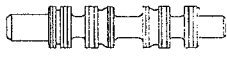
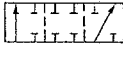
SYMBOL AND PART NUMBER	SPOOL	GRAPHIC SYMBOL
'C' 10-26645-02 10 GPM		
'O' 10-26645-03 10 GPM		
'FF' 10-26645-04 10 GPM		
'F1' 10-26645-05 10 GPM		
'FO1' 10-26645-07 2 GPM		
'OP' 10-26645-09 10 GPM		
'OP1' 10-26645-10 10 GPM		
'FFX' 10-26645-16 10 GPM		
'TT' 10-26645-18 6 GPM		

QM SPOOLS


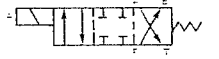
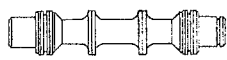

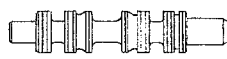
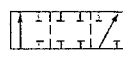
(Flows @ 4500 psi Max. Recommended)

SYMBOL AND PART NUMBER	SPOOL	GRAPHIC SYMBOL
'C' 10-27087-02 10 GPM		
'O' 10-27087-03 10 GPM		

QJ SPOOLS (Flows @ 4500 psi Max. Recommended)

SYMBOL AND PART NUMBER	SPOOL	GRAPHIC SYMBOL
'C' 10-26646-02 10 GPM		
'O' 10-26646-03 10 GPM		
'P' 10-26646-15 2 GPM		

QG SPOOLS (Flows @ 4500 psi Max. Recommended)

SYMBOL AND PART NUMBER	SPOOL	GRAPHIC SYMBOL
'C' 10-26646-02 10 GPM		
'O' 10-26646-03 10 GPM		
'P' 10-26646-15 2 GPM		

PARTS LIST

ITEM	PART NUMBER	PART NAME	QF	QM	QG QJ	QGF QJF
2	See Table	Spool	1	1	1	1
3	10-26642-02 10-26713-02	Spool Stop	2	-	-	2
4	See Table 10-27012-02	Spring (Green)	2	-	-	2
5	10-25155-04 10-25155-05	Plug	-	-	1	-
6	10-26787-02	Junction Box	1	1	1	1
7	10-26900-02 †	Junction Box Gasket	1	1	1	1
8	10-26924-02	Name Plate	1	1	1	1
9	10-26652-03 †	Solenoid Gasket	2	2	1	1
10	10-26805-02	Label	1	1	1	1
11	10-26299-02	Plastic Plug	-	-	1	1
12	PG-27092-02 ⊕	Detent Assy.	-	2	-	-
13	See Table	Coil	2	2	1	1
14	10-26670-03	Fil. Hd. Scr., M4-0.7x6g	2	2	2	2
15	10-26885-03	Terminal Block	2	2	1	1
16	10-26849-02	Solenoid Knob	2	2	1	1
17	See Table	Solenoid Pin	2	-	1	1
18	83-52036-02	Spring Pin	1	1	1	1
19	82-20012-01 * †	O-Ring, 1/16x 3/8x1/2	4	4	4	4
20	82-20018-07 †	O-Ring, 1/16x3/4x7/8	2	2	2	2
21	83-16915-08 †	Rd. Hd. Scr., M 3.5x5	4	4	2	2
22	83-32801-06	Drive Scr., 2x3/16	2	2	2	2
23	83-16919-08 †	Ground Scr., M 4x6	1	1	1	1
24	84-01309-03	Pipe Plug, 1/16	2	2	2	2
26	10-26987-02 †	Seal	2	2	1	1

† Included in Routine Maintenance Kit

* Symbol 'L', use -07

⊕ Use -03 with DC Solenoids.

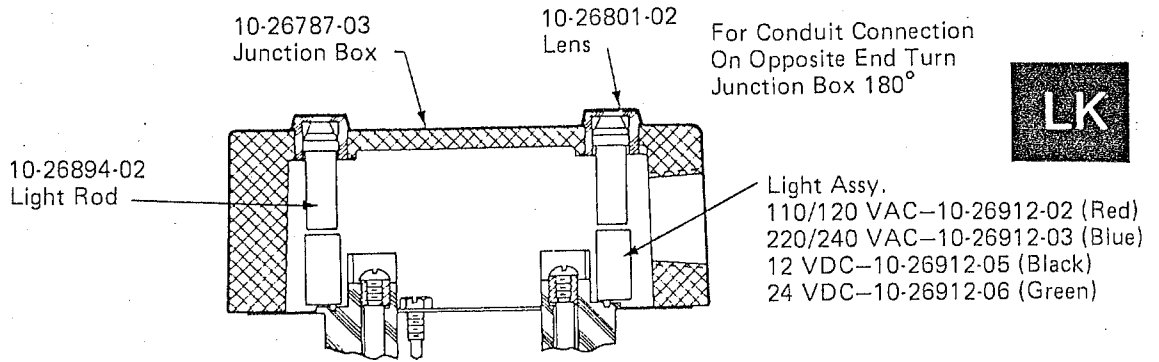
OF SPRING

ITEM	SPOOL TYPES	SPRING
4	O,OP,OP1, TT,FO1	10-26648-02 (Blue)
	C,FF,FFX,F1	10-26724-02 (Copper)

ROUTINE MAINTENANCE KIT
1K-01293-01
(For Viton Rings use 1K-01293-07)

SOLENOID PIN

ITEM	MODEL	PART NO.
17	AC	10-26966-02
	DC	10-27141-02

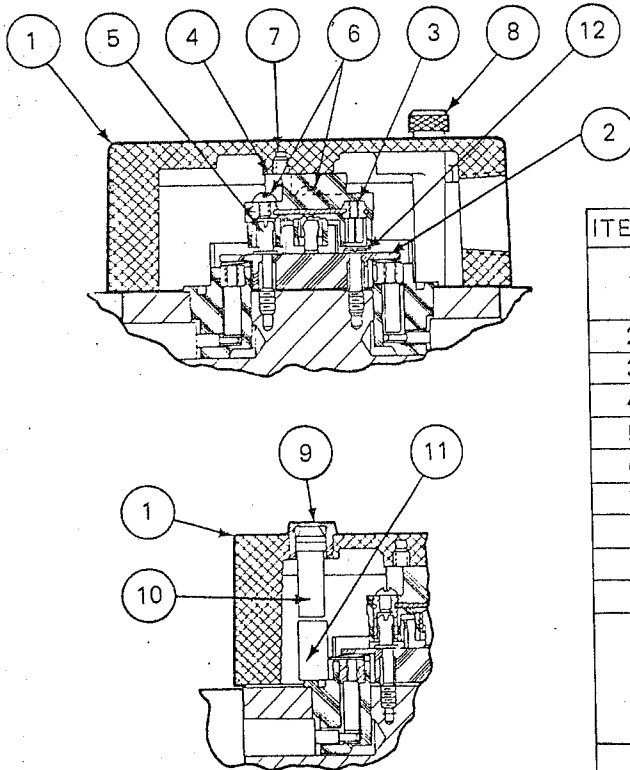


To assemble light, insert lens into junction box then press light rod into lens.

Solenoids and Coils

Plug-In			DIN 43650 Connector		
VOLTS/CYC.	COIL	TUBE	VOLTS/CYC.	COIL	TUBE
120/60 or 110/50	85-50554-32	10-26925-02	120/60 or 110/50	85-50552-32	10-26925-02
240/60 or 220/50	85-50554-42		240/60 or 220/50	85-50552-42	
110/50	85-50554-71		110/50	85-50552-71	
220/50	85-50554-81		220/50	85-50552-81	
240/50	85-50554-41		240/50	85-50552-41	
12 VDC	85-50555-18	10-26926-02	12 VDC	85-50553-18	10-26926-02
24 VDC	85-50555-28		24 VDC	85-50553-28	

Coil may be replaced without removing armature tube. Unscrew knob and pull coil straight back to disengage it. Check voltage and cycles on new coil to insure correct replacement.



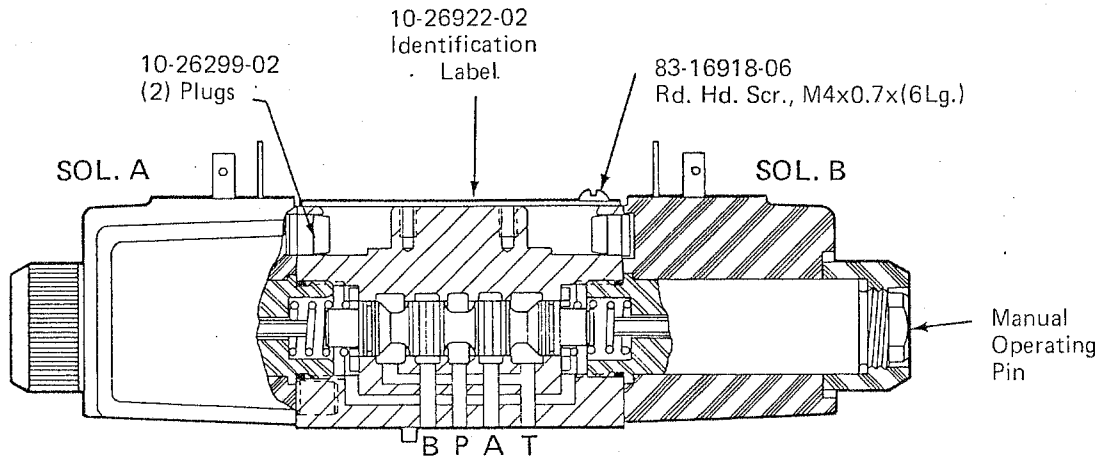
For Conduit Connection
On Opposite End Turn
Junction Box 180°

ITEM	PART NUMBER	PART NAME	TSP	TSPL
1	10-26787-02	Junction Box	1	-
	10-26787-03		-	1
2	10-26893-02	Adaptor	1	1
3	10-26930-02	Connector	1	1
4	10-26901-02	Gasket	1	1
5	10-26905-02	Ground Screw	1	1
6	83-16915-08	Rd. Hd. Scr., M3.5x(5Lg.)	5	5
7	83-33022-02	Tapping Scr., 8-32x1/2	2	2
8	10-26671-02	Thumb Screw	2	2
9	10-26801-02	Lens	-	2
10	10-26894-02	Light Rod	-	2
11	10-26912-02	Light-110/120 VAC (Red)	-	2
	10-26912-03	Light-220/240 VAC (Blue)		
	10-26912-05	Light-12 VDC (Black)		
	10-26912-06	Light-24 VDC (Green)		
12	10-26991-02	Screw	1	1

To assemble light, insert lens into junction box then press light rod into lens.



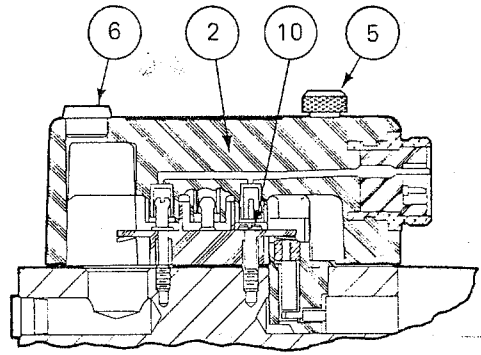
DIN 43650 Connector



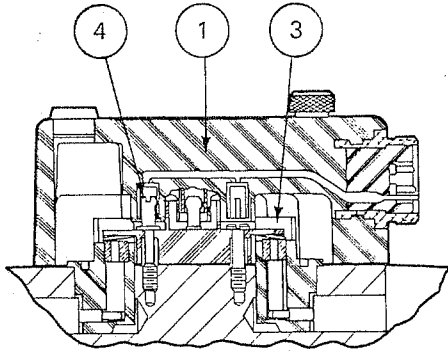
Armature tube torque: 20 ft. lbs.
 Solenoids may be rotated 90 degrees in either direction.
 Unscrew Knob, rotate solenoid coil to position desired and retighten knob.

**BH, BHL
 BH5, BHL5**

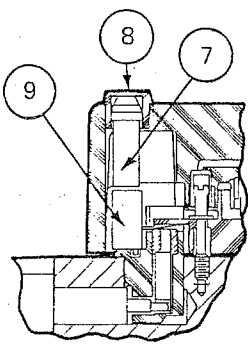
For Electrical Connection
 On Opposite End Turn
 Junction Box 180°



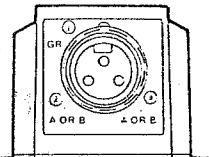
QG and QJ-BH



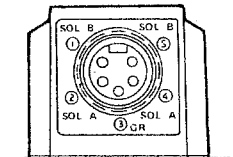
QF and QM-BH



BHL



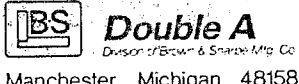
Single-Solenoid Models



All Models

ITEM	PART NUMBER	PART NAME	BH	BHL
1	10-26592-02	5-Pin Connector	1	1
2	10-26592-03	3-Pin Connector	1	1
3	10-26893-02	Adaptor	1	1
4	10-26905-02	Ground Screw M4	1	1
5	10-26671-02	Thumb Screw	2	2
6	10-26937-02	Plug	2	-
7	10-26894-02	Light Rod	-	2
8	10-26801-02	Lens	-	2
9	10-26912-02	Light-110/120 VAC (Red)	-	2
	10-26912-03	Light-220/240 VAC (Blue)		
	10-26912-05	Light-12 VDC (Black)		
	10-26912-06	Light-24 VDC (Green)		
10	10-26991-02	Screw	1	1

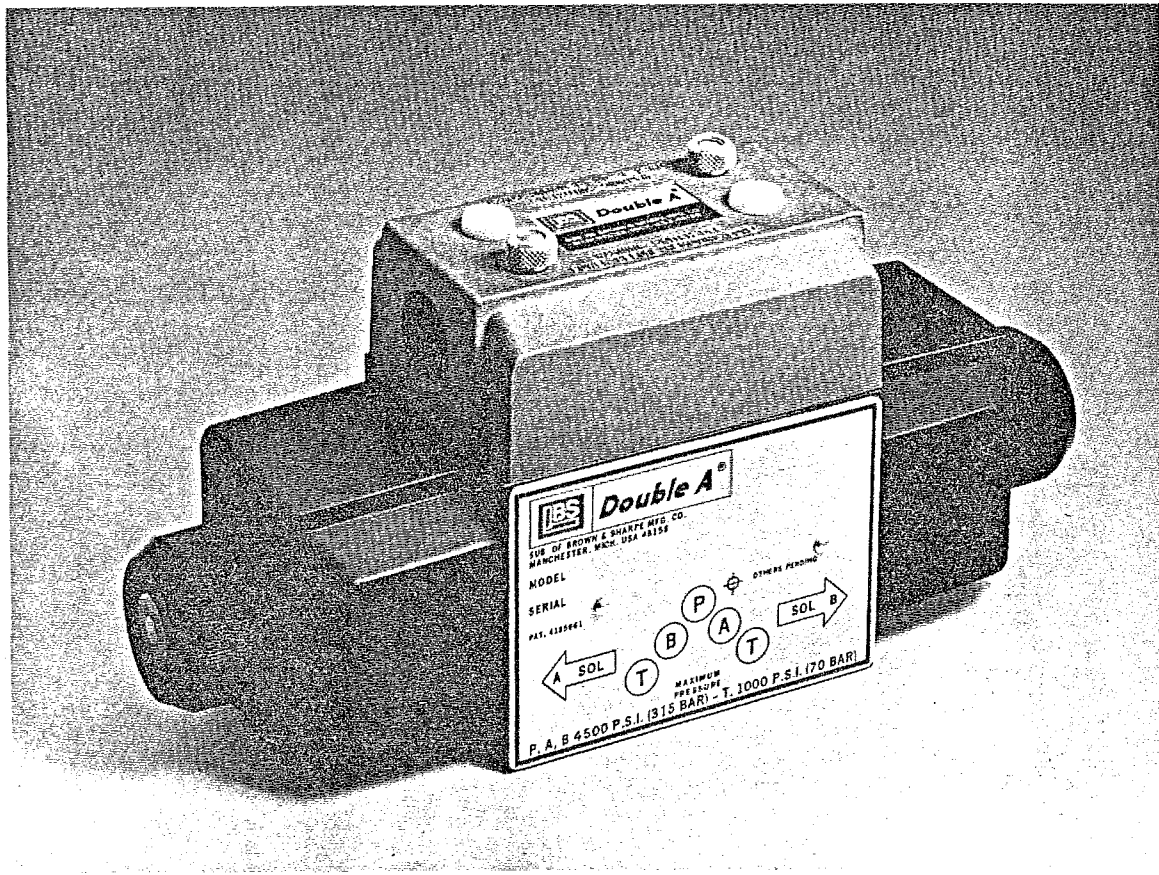
QG, QJ, QGF and GJF are normally supplied with BH and BHL 3-pin connectors. BH5 and BHL5 indicate 5-pin connectors for these models.



(313) 428-8311

Mfg. in: Manchester, Michigan, U.S.A. 48158 England France Germany

Double A Products



Directional Valves Series 5

Solenoid Operated
20 gpm / 76 l/min
4500 psi / 315 bar

1000 psi / 70 bar for
High Water Base Fluids



Sweetland Company
950 DOOLITTLE DRIVE
SAN LEANDRO, CALIFORNIA 94577 (415) 635-0500

Hydraulics • Pneumatics • Instrumentation
Fluid Conditioning Equipment

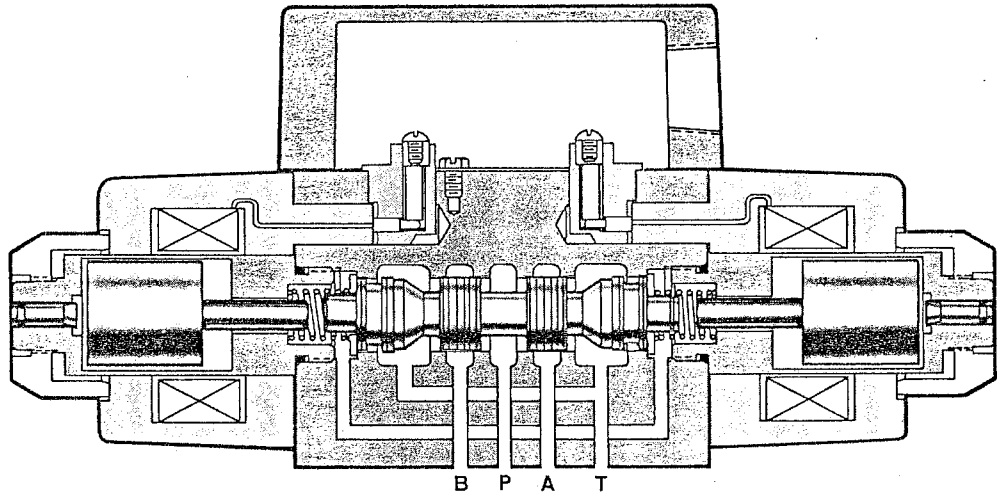


Double A
Division of Brown & Sharpe Mfg. Co.

Design Features

As the name implies, "directional control" valves are used to control the motion of fluid motors and cylinders in hydraulic systems. Series 5 solenoid operated valves are designed to meet the requirements of high performance, precision industrial

hydraulic systems operating at pressures to 4500 PSI and flows to 20 GPM. They mount on the ISO size 05 mounting surface and are interchangeable with previous series 01 directional valves.



The performance of most conventional solenoid operated directional valves is limited by the flow forces acting on the spool in opposition to the solenoids and return springs. Special attention is given to compensating for, or minimizing, these undesirable forces in the design of the series 5 valve.

The resulting benefits include —

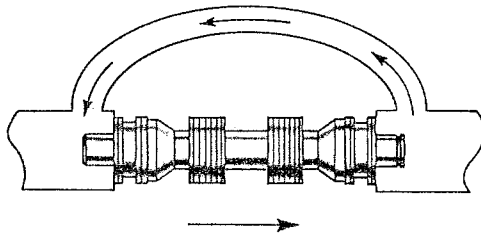
HIGH CAPACITY — up to 20 GPM at 4500 PSI, without malfunction.

RELIABILITY — a high margin of shifting force available to overcome spool friction due to dirt, and other contaminants. Also, a balanced spool with cushioned shift also means less wear and long life.

SERVICEABILITY — plug-in coils and electrical connections simplify maintenance.

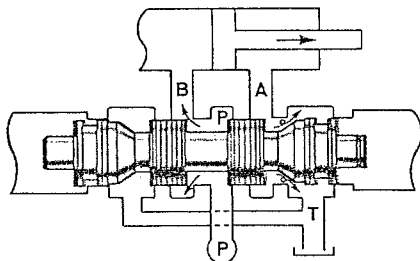
AXIAL SPOOL BALANCE— The key design features associated with the balance of hydraulic forces on the valve spool are illustrated and described below.

SPOOL CUSHIONING PASSAGE — Equalizes hydraulic force on ends of spool, and cushions spool shift.



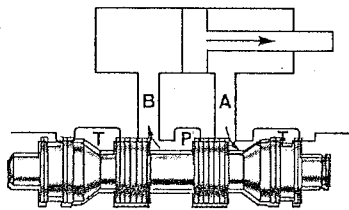
When spool is shifted, the fluid displaced from one end of the spool is transferred to the other end through this passage which is designed to provide a cushioning effect and balance the spool.

SPOOL FORCE-BALANCING CONTOUR — Minimize the hydraulic unbalancing effects of fluid momentum between the cylinder and tank ports.



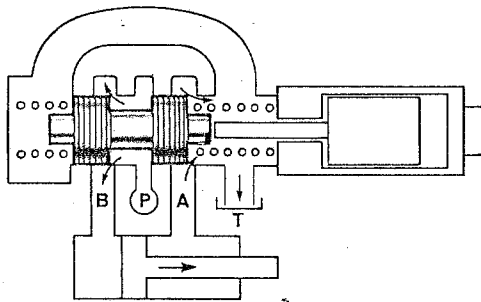
Flow forces that are developed at the conventional square land orifice (P to B) are partially compensated for by the force balancing contour on the outer spool lands (A to T).

SPOOL LAND SEQUENCING – Accurate sequencing of land opening and closing provides maximum axial stability.



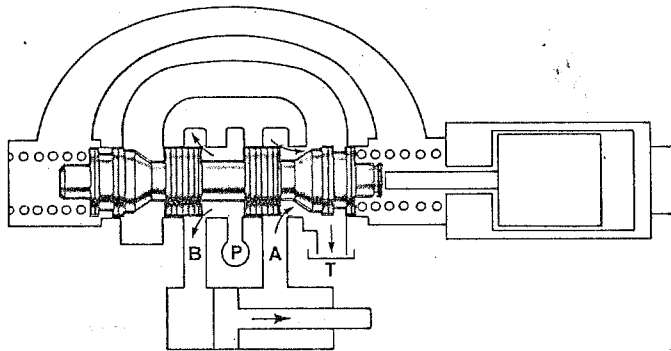
In this example, it is important that flow path A to T is opened before the path P to B to prevent pressure intensification which could upset axial balance and limit valve function.

ISOLATED SOLENOID CHAMBERS – Minimize transient pressure peaks in the solenoid to prevent solenoid tube failure.



TYPICAL 2-LAND SPOOL

Pressure surges can occur within the armature tube of 2 land wet armature valves due to cylinder port decompression. These surges can easily exceed tube pressure rating and result in premature tube failure.



DOUBLE A 4-LAND SPOOL

The armature tube area is isolated from the tank port area by the outboard lands on the 4-land spool. Tank port pressure surges do not reach the armature tube to cause failure.

Other Features and Benefits

- Plug-in solenoid coil for ease of servicing can be replaced without disturbing the hydraulic system or wiring cavity.
- Two solenoid sizes to chose from for optimum performance/cost selection.
- Ductile iron body provides for superior wear characteristics—especially important with 95/5 high water based fluids.
- Wet armature solenoids for quieter operation and long life with no dynamic seals to leak.
- Molded coil construction is impervious to moisture and dirt.
- Larger diameter spool combined with constant area and tangential flow passages results in low pressure drop.
- “U” shaped grooves keep spool centered in the bore for longer spool life and lower leakage.
- Four-land spool permits manufacturing of consistantly rounder spool for better balance in the bore and lower spool wear and leakage.
- Optional pin-type or top-side plug-in electrical connectors for easy valve replacement. Reversible to fit any installation need.
- Dual frequency (50/60 HZ) 2-wire coils for lower inventory at the OEM (optional).
- Stainless steel solenoid pin is process hardened for long life.
- Patented detent mechanism for greater reliability and long life.

Specifications & Performance

Rated Fatigue Pressure

PORTS P,A & B 315 BAR (4500 PSI)
 PORT T 70 BAR (1000 PSI)

The method of verifying rated fatigue pressure conforms to NFPA recommended standard NFPA/T2.6.1 category 3/90.

Maximum Recommended Flow * -Liters/Min. (U.S. GPM)

MODEL	SPRING CENTERED									SPR. OFFSET			DETENT	
	SPOOL	C	O	FF	F1	FO1	OP	OP1	FFX	TT	C	O	P	C
† SIZE 5 @ 315 BAR (4500 PSI)	76 (20)	76 (20)	76 (20)	76 (20)	19 (5)	76** (20)	76** (20)	76 (20)	38** (10)	76 (20)	76 (20)	19 (5)	76 (20)	76 (20)
Size 5 M @ 70 BAR (1500 PSI)	57 (15)	57 (15)	57 (15)	57 (15)	N/A	57 (15)	57 (15)	57 (15)	38 (10)	57 (15)	57 (15)	N/A	57 (15)	57 (15)

* Data is for AC or DC solenoids at 90% nominal voltage in a 4-way circuit with cylinder ports looped together. Nominally reduced performance may result when certain spools are used in 3-way circuits.

** Maximum operating pressure for TT, OP and OP1 spools are 207 BAR (3000 PSI).

† Maximum operating pressure for high water base fluids is 70 BAR (1000 PSI).

Response Time

VALVE TYPE	AC SOLENOID		DC SOLENOID	
	SOLENOID ENERGIZED	SPRING RETURN	SOLENOID ENERGIZED	SPRING RETURN
SPRING CENTERED	10MS	15MS	50MS	80MS
SPRING OFF-SET	15MS	15MS	50MS	50MS
*DETENT	15MS	—	50MS	—

* Detented models must be actuated with a momentary signal of at least 100 ms. duration.

Solenoid Data

SERIES 5			
VOLTAGE	INRUSH AMPS (RMS)	HOLDING AMPS (RMS)	HOLDING WATTS
120/60 110/50 (DUAL)	4.10	.98	37
240/60 220/50 (DUAL)	1.97	.49	37
110/50	3.25	.77	28
220/50	1.55	.42	28
240/50	1.55	.42	28
12 VDC			44
24 VDC			44

SERIES 5M			
VOLTAGE	INRUSH AMPS (RMS)	HOLDING AMPS (RMS)	HOLDING WATTS
120/60 110/50 (DUAL)			
240/60 220/50 (DUAL)			
110/50			
220/50			
240/50			
12 VDC			
24 VDC			

PENDING

Fluids & Seals

Buna-N seals are standard and are compatible with water glycol, water-in-oil emulsions, high water base fluids, and petroleum oils. For phosphate ester fire resistant fluids, viton seals (symbol L) must be specified.

Filtration 25 microns or finer

Operating Temperature Range

0°F to 150°F (-12° to 66°C)

Viscosity Range

75 to 600 SSU (15-128 CST)

Mounting Position

There is no restriction on mounting position of spring centered or spring off-set models. Detented models must be mounted with the spool bore horizontal to reduce the possibility of inadvertent spool shift due to shock and or vibration.

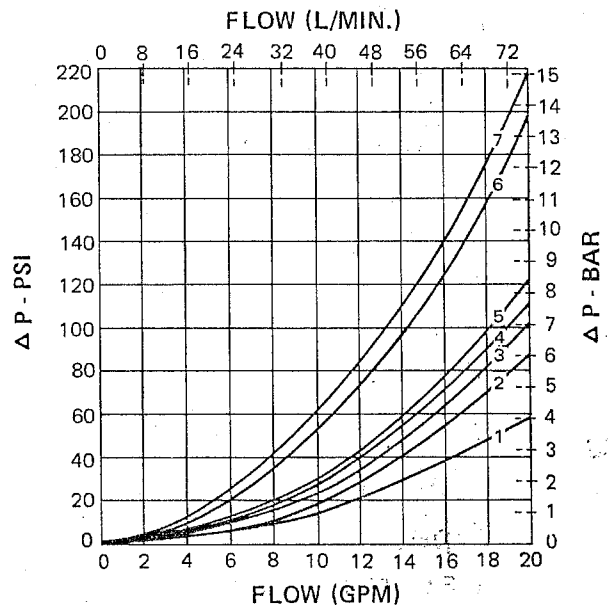
Spool Chart

SPOOL TYPE	VALVE FUNCTION, SYMBOL AND MODEL PREFIX		
	3 POSITION SPRING CENTERED QF-5 Series	2 POSITION SPRING CENTERED SOLENOID B QJF-5 Series	2 POSITION SPRING CENTERED SOLENOID A QG-5 Series
C			
O			
FF			
F1			
FO1			
OP			
OP1			
FFX			
TT			
	2 POSITION DETENTED QM-5 Series	2 POSITION SPRING OFF-SET TO PORT A QJ-5 Series	2 POSITION SPRING OFF-SET TO PORT B QG-5 Series
C			
O			
P	N/A		

Pressure Drop

(FLUID @ 100 SSU) 21 CST

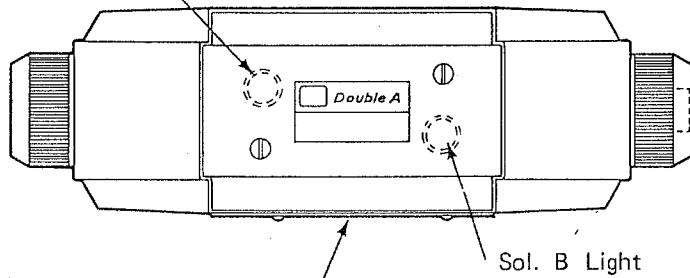
SPOOL	P→A	P→B	A→T	B→T	P→T
C	4	4	3	5	—
O	2	2	2	3	1
FF	4	4	2	3	—
F1	4	4	2	5	—
FO1	2	4	2	5	2
OP	2	2	3	5	—
OP1	2	4	3	5	—
FFX	4	4	3	5	—
TT	6	6	6	7	4
P	3	3	—	—	—



Installation Dimensions

Electrical Current $\frac{46.8}{(1.84)}$ A.C.
 Signal Light (symbol "LK" & "TSPL")
 2-Places
 Sol. A Light $\frac{87.4}{(3.44)}$ D.C.

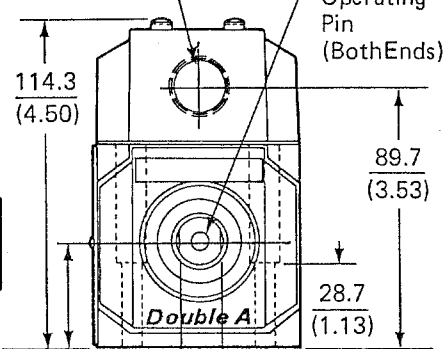
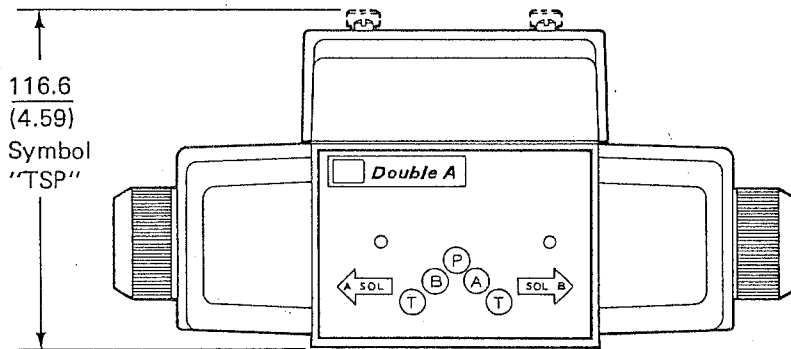
Clearance Required
 to Remove Coil
 (Both Ends)



Valve Model, Serial Number
 & Spool Symbol

$\frac{1}{2}$ " NPTF Conduit
 Connection. Box
 May Be Rotated
 180°

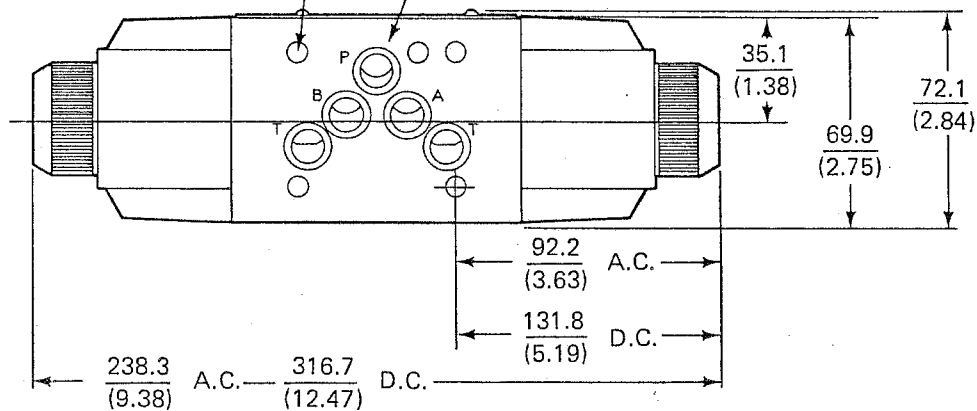
Manual
 Operating
 Pin
 (Both Ends)



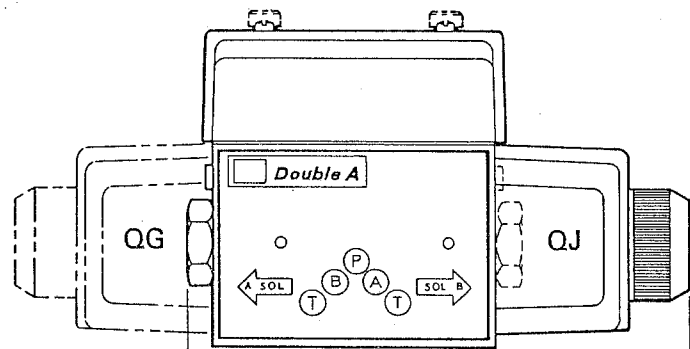
4-Valve Mounting Holes
 For Soc. Hd. Cap Screws
 $\frac{1}{4}$ -20x1- $\frac{1}{2}$ or M6x40 Metric
 Grade 8 or Better

Torque $\frac{12/15}{110/130}$ | N.M. | In. Lb.

NFPA DO2 Mounting Surface
 (ISO 4401-AC-05-4-A)



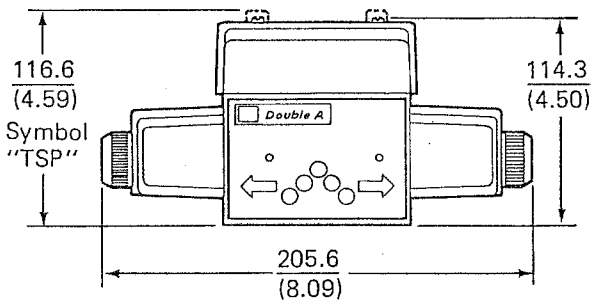
Across Flats
 (Both Ends)



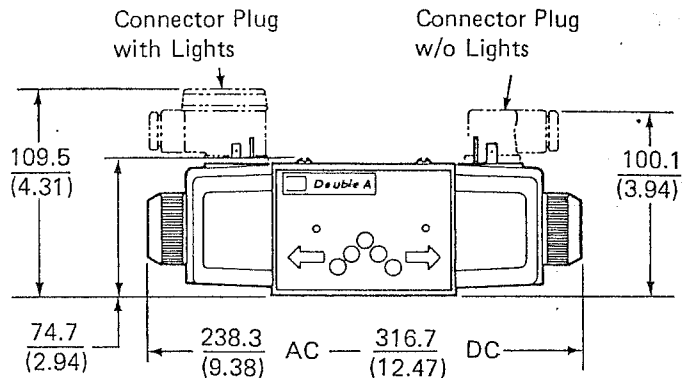
MODEL	APPROX. WT.			
	AC		DC	
	KGS	LBS	KGS	LBS
SINGLE SOL.	4.0	8.8	4.9	10.8
DOUBLE SOL.	4.5	10	6.4	14

METRIC
 (INCHES)

5M Low Power Option

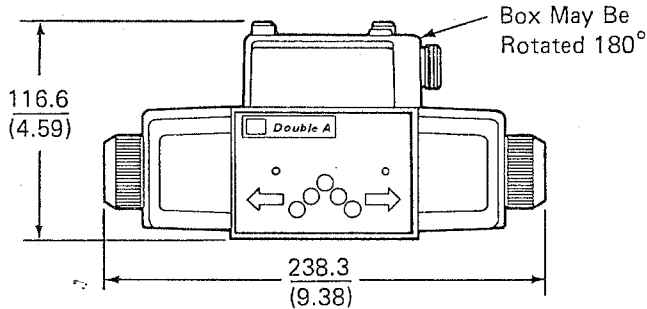


HS DIN 43650 Connector* Option



* Connector Plug not included with valve

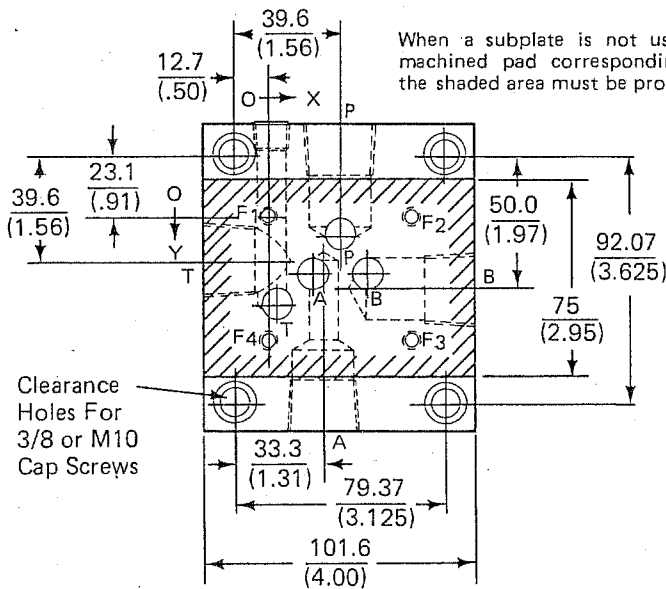
BH Pin Type Connector Option (N.F.P.A. T 3.5.29)



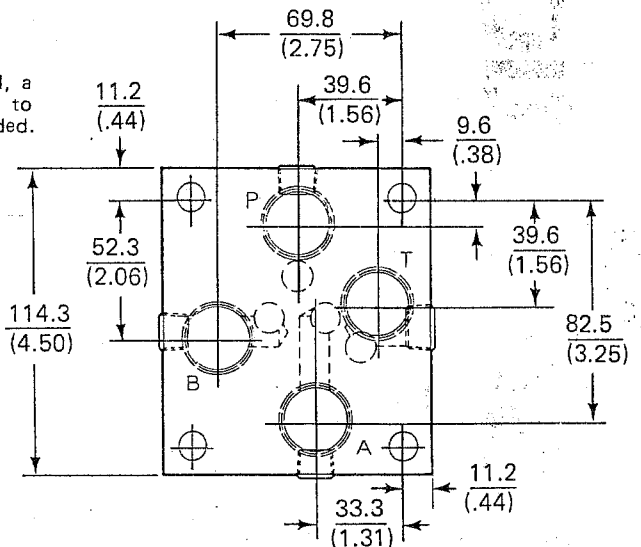
NUMBER OF SOLENOIDS	NO. OF PINS	OPTION CODE
SINGLE	3	BH
	5	BH5
DOUBLE	5	BH

Double solenoid valves are provided with a 5-pin connector. Single solenoid valves are available with 3-pin (BH) or 5-pin (BH5) connectors.

Subplate and Mounting Surface



Clearance Holes For 3/8 or M10 Cap Screws

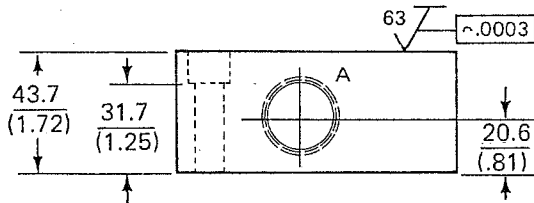


BOLT KITS* Includes (4) directional valve mounting bolts.

MODEL CODES	SIZES	THREAD
BK4-06	1/4-20x1 1/2	INCH
BK6M-40	M6x1x40	METRIC

* Bolt kits are ordered separately.

NOTE: Metric grade 10.9 (SAE grade 8) mounting bolts required.



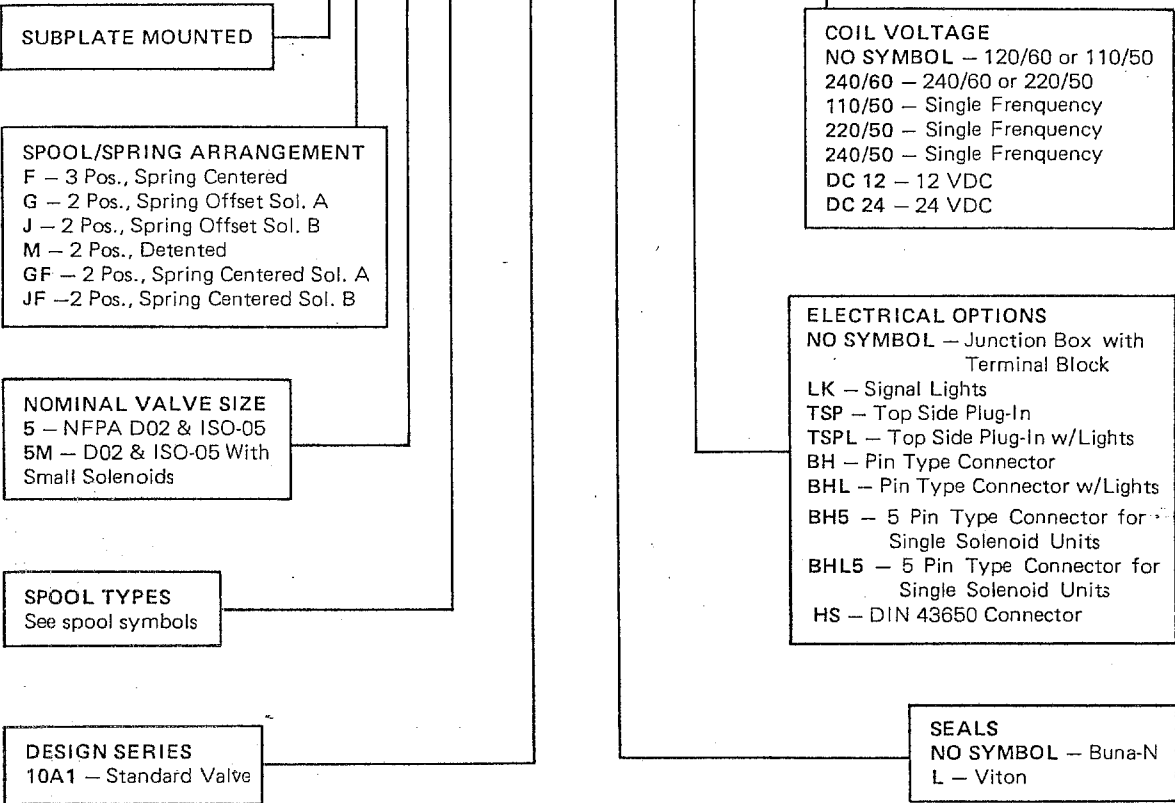
	P	A	T	B	F1	F2	F3	F4
X	27.1 1.06	16.7 0.66	3.2 0.13	37.3 1.47	0 0	54.2 2.125	54.2 2.125	0 0
Y	6.3 0.25	21.4 0.84	32.5 1.28	21.4 0.84	0 0	0 0	46.1 1.812	46.1 1.812
Ø	11.2 0.44 max.	11.2 0.44 max.	11.2 0.44 max.	11.2 0.44 max.	M6 0.25	M6 0.25	M6 0.25	M6 0.25

P214 · 04 · * · * · *

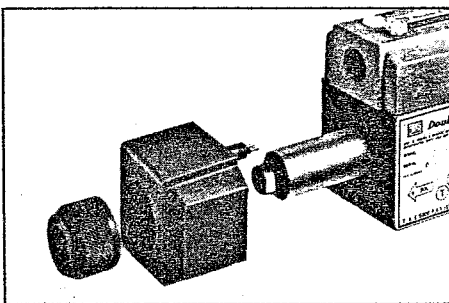
FOR STANDARD VALVE	VALVE MOUNTING HOLES NO SYMBOL - 1/4-20 UNC-2B M - M6x1
PORT SIZE 03 - 3/8" NPTF/BSP 3/4-16 SAE 04 - 1/2" NPTF/BSP 7/8-14 SAE 06 - 3/4" NPTF/BSP 1 1/16-12 SAE	THREAD DESIGNATION NO SYMBOL - Dryseal Taper Pipe Thread S - SAE Straight Thread O-Ring Seal Ports E - BSP Parallel
PORT LOCATION NO SYMBOL - Back Ports A - Side Ports	

Options & Model Code

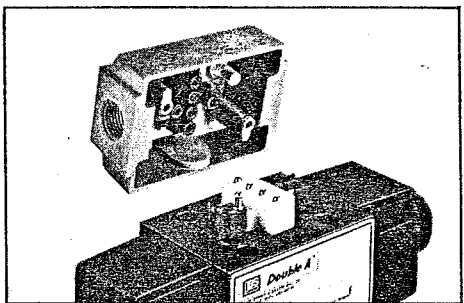
QF-5-C-10A1-L-TSP-DC12



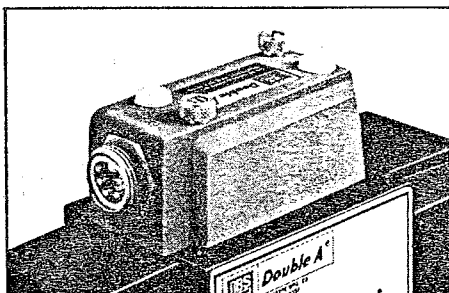
Electrical Features



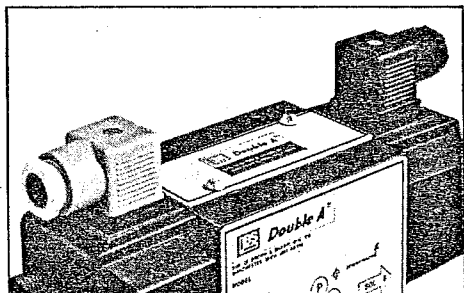
Standard Plug-In Coil Features



Top-Side Plug-In Connector Option

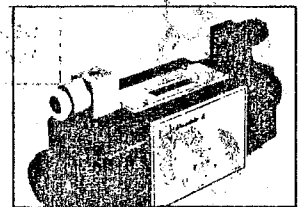
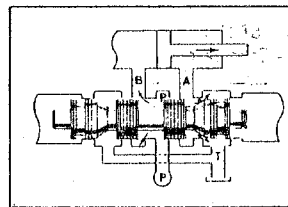
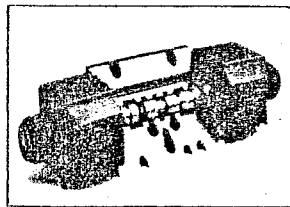
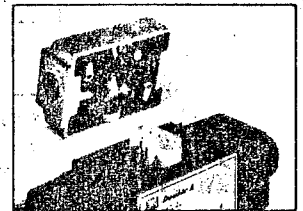
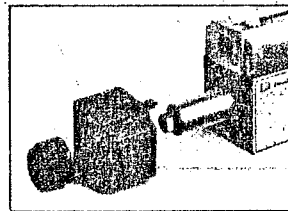
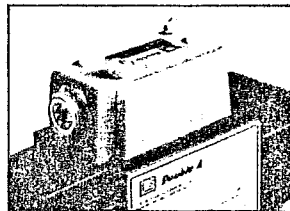
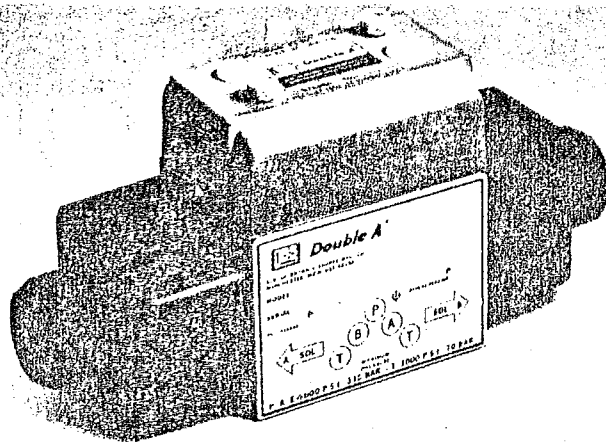


Pin Type Electrical Connector Option



(DIN 43650) Electrical Connector Option

Mfg. in: Manchester, Michigan, U.S.A. 48158 □ England □ France □ Germany



Directional Valves Series 5

Solenoid Operated
20 gpm / 76 l/min
4500 psi / 315 bar

1000 psi / 70 bar for
High Water Base Fluids



Sweetland Company
950 DOOLITTLE DRIVE
SAN LEANDRO, CALIF. 94577 • (415) 635-0500

Hydraulics • Pneumatics • Instrumentation
Fluid Conditioning Equipment



Double A

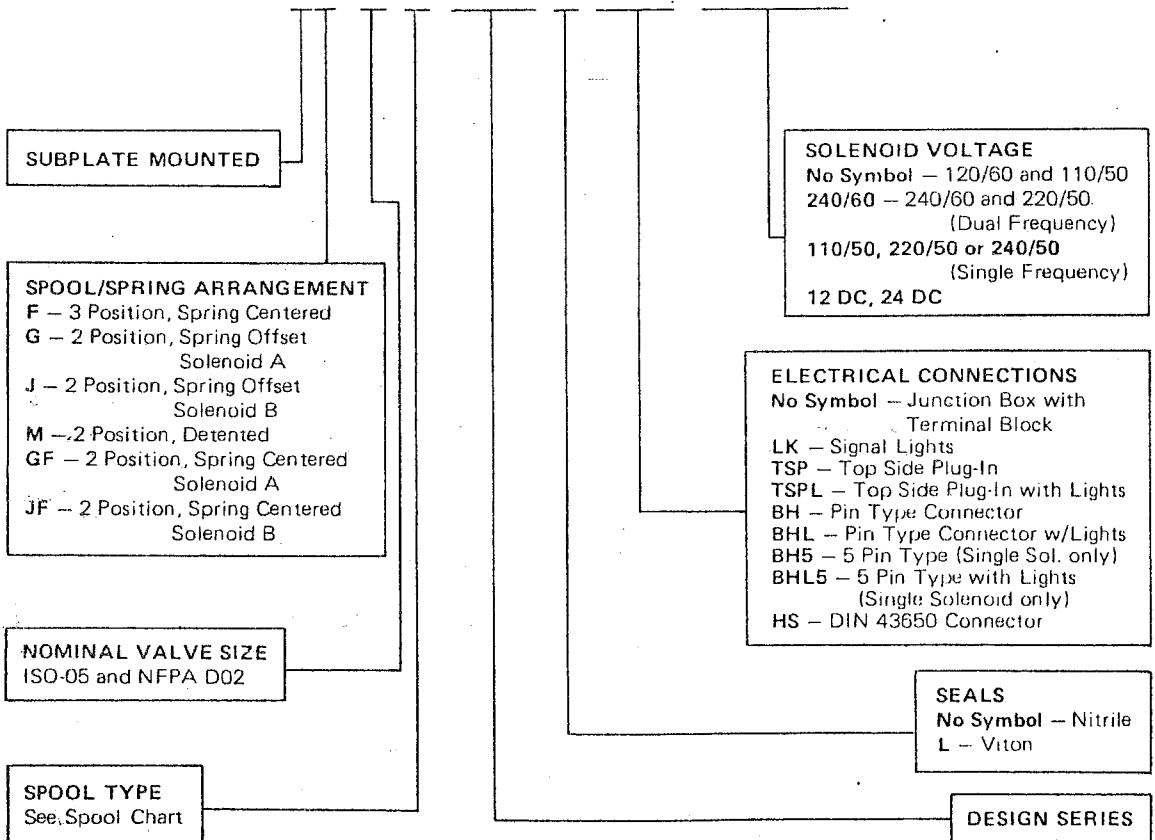
Division of Brown & Sharpe Mfg. Co.

Model Code / Characteristics

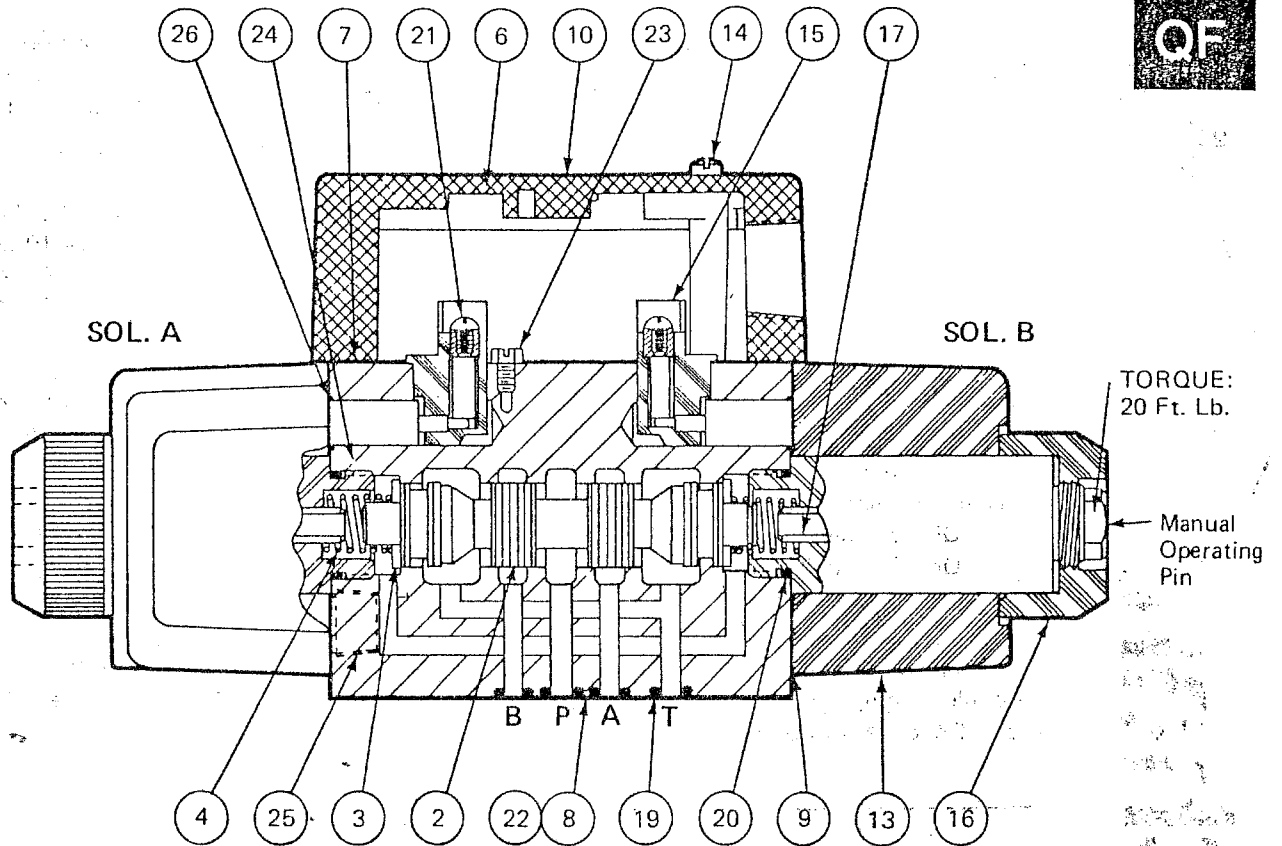
Rated Flow at 4500 PSI	See Spool Table
Maximum Pressure	4500 PSI
except 'T' port	1000 PSI
H.W.B.F., All Ports	1000 PSI
Inrush / Holding Current, Dual Frequency Solenoids	
120 / 60	4.10/.98 amps
110 / 50	4.10/.98 amps
240 / 60	1.97/.49 amps
220 / 50	1.97/.49 amps
Single Frequency Solenoids	
110 / 50	3.25/.77 amps
220 / 50	1.55/.42 amps
240 / 50	1.55/.42 amps
D.C. Solenoid Power	44 watts
Maximum Internal leak Rate at 3000 PSI (Mineral Oil)	
QF Centered	10 C.I.P.M. (except TT spool)
QM, QJ and QG Shifted	16 C.I.P.M. (except TT spool)

See application bulletin 9075-P for additional performance information. See bulletin 9003-S for troubleshooting and maintenance information. Parts or replacement units may be obtained from your local Double A distributor.

QF-5-C-10A1-L-TSP-240/60

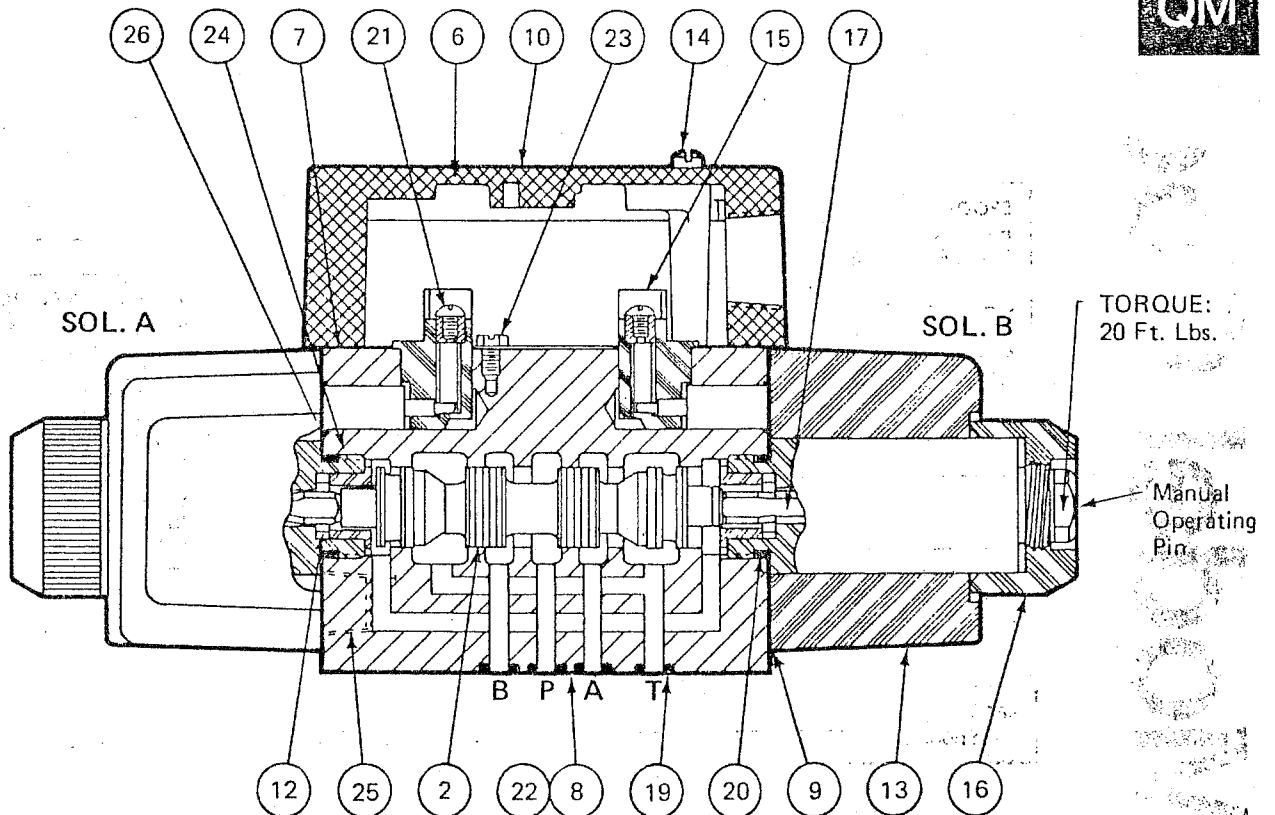


QF

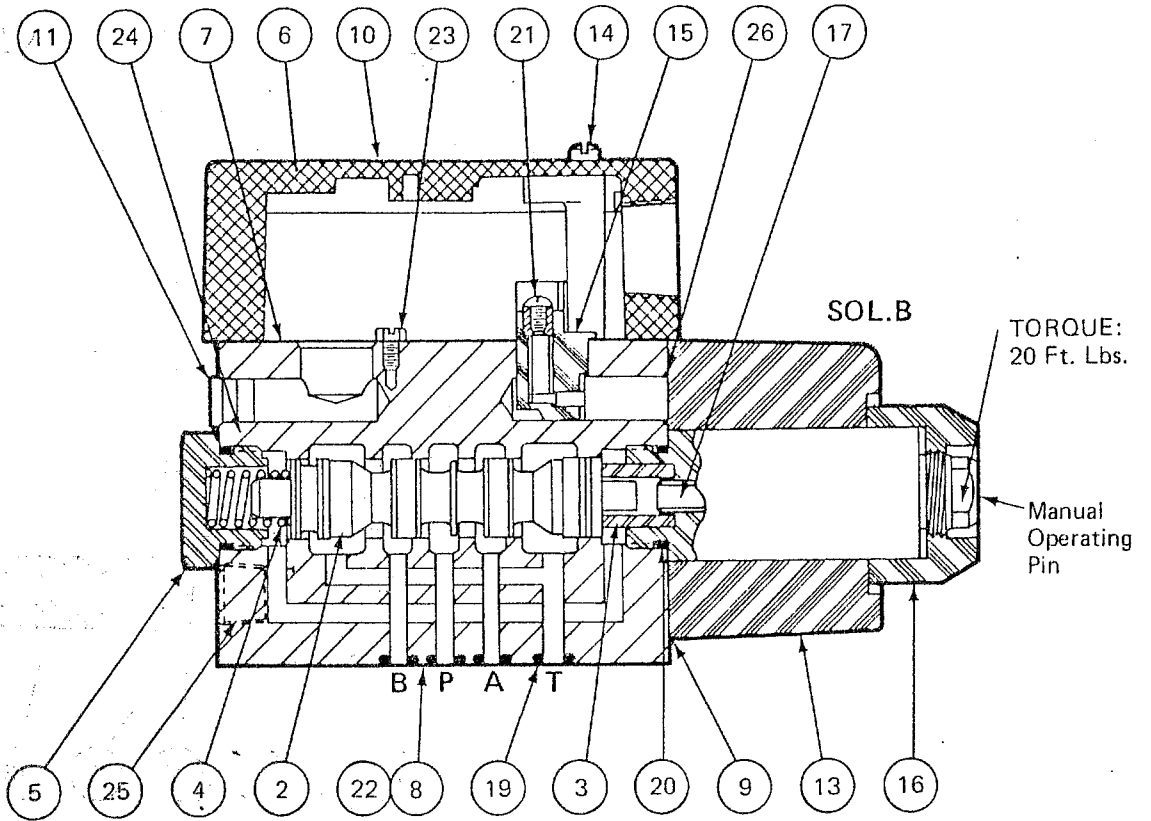


Install spools with notched end on 'A' port end

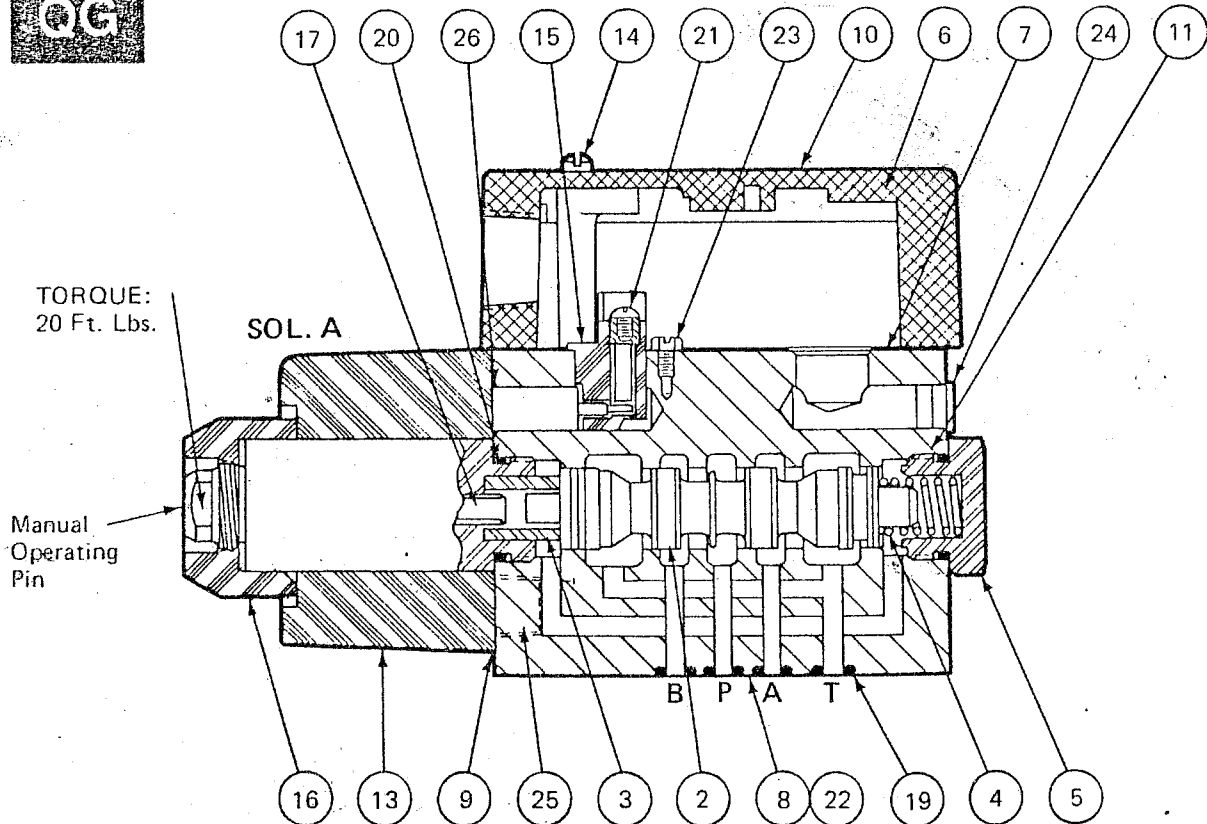
QM



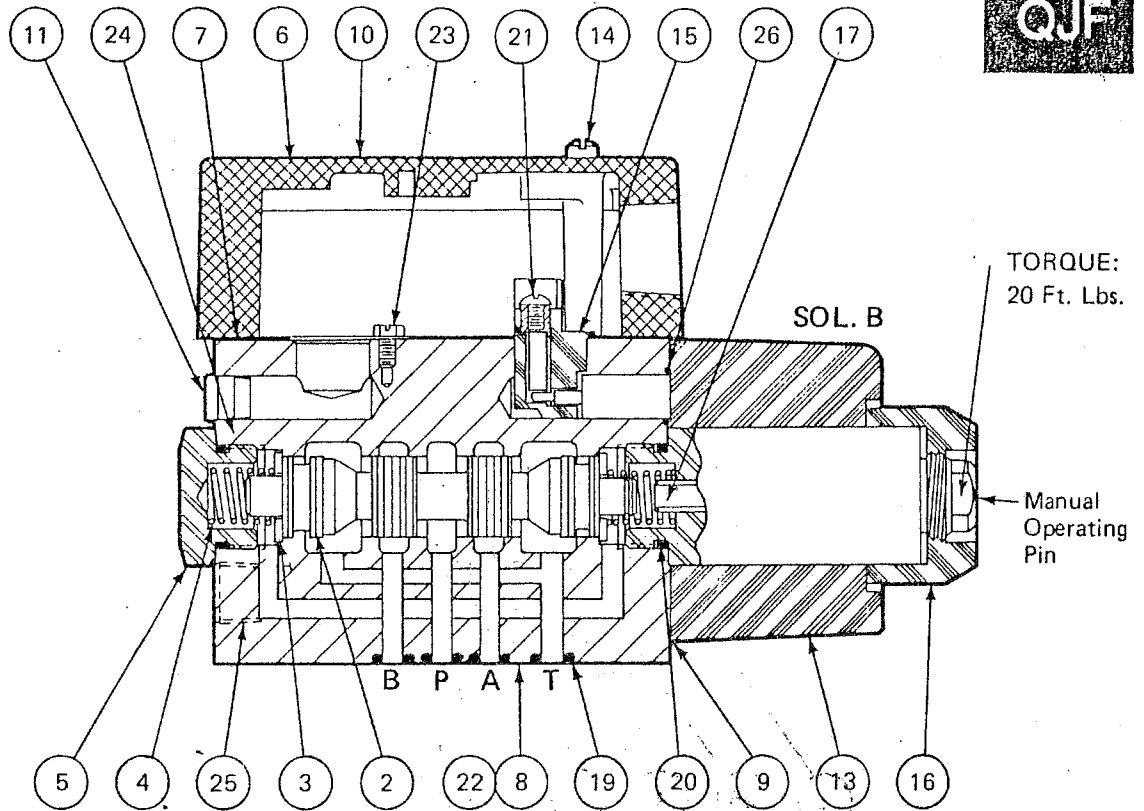
Install spools with notched end on 'A' port end



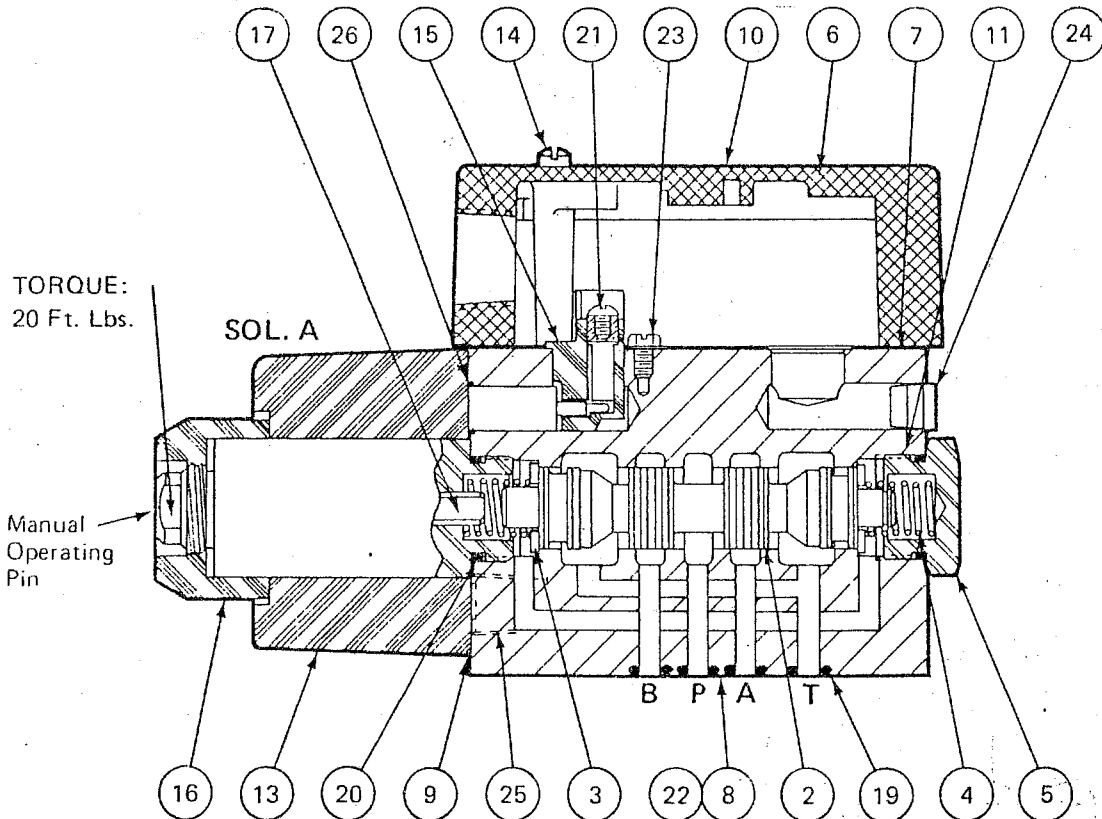
Install spool with small end toward solenoid.



Install spool with small end toward solenoid.



Install spools with notched end on 'A' port end



Install spools with notched end on 'A' port end

QF SPOOLS

(Flows @ 4500 psi Max. Recommended)

SYMBOL AND PART NUMBER	SPOOL	GRAPHIC SYMBOL
'C' 10-26639-02 20 GPM		
'O' 10-26639-03 20 GPM		
'FF' 10-26639-04 20 GPM		
'F1' 10-26639-05 20 GPM		
'FO1' 10-26639-07 5 GPM		
'OP' 10-26639-09 20 GPM		
'OP1' 10-26639-10 20 GPM		
'FFX' 10-26639-16 20 GPM		
'TT' 10-26639-18 10 GPM		

QM, QJF, QGF SPOOLS

(Flows @ 4500 psi Max. Recommended)

SYMBOL AND PART NUMBER	SPOOL	GRAPHIC SYMBOL
'C' 10-26639-02 20 GPM		
'O' 10-26639-03 20 GPM		

QJ SPOOLS (Flows @ 4500 psi Max. Recommended)

SYMBOL AND PART NUMBER	SPOOL	GRAPHIC SYMBOL
'C' 10-26641-02 20 GPM		
'O' 10-26641-03 20 GPM		
'P' 10-26641-15 5 GPM		

QG SPOOLS (Flows @ 4500 psi Max. Recommended)

SYMBOL AND PART NUMBER	SPOOL	GRAPHIC SYMBOL
'C' 10-26641-02 20 GPM		
'O' 10-26641-03 20 GPM		
'P' 10-26641-15 5 GPM		

PARTS LIST

ITEM	PART NUMBER	PART NAME	QF	QM	QG QJ	QGF QJF
2	Charted	Spool	1	1	1	1
3	10-26642-02 10-26713-02	Spool Stop <i>Q1415</i>	2	-	-	2
4	Charted 10-26908-02	Spring	2	-	-	2
5	10-25155-04 10-25155-05	Plug	-	-	1	-
6	10-26290-02	Junction Box	1	1	1	1
7	10-26903-02 †	Junction Box Gasket	1	1	1	1
8	10-26295-02	Name Plate	1	1	1	1
9	10-26653-02 †	Solenoid Gasket	2	2	1	1
10	10-26805-02	Label	1	1	1	1
11	10-26299-02	Plastic Plug	-	-	1	1
12	PG-26946-02 ⊕	Detent Assy.	-	2	-	-
13	Charted	Solenoid, Pg. 6	2	2	1	1
14	10-26670-03	Fil. Hd. Scr., M4-0.7x6g	2	2	2	2
15	10-26885-02	Terminal Block	2	2	1	1
16	10-26655-02	Solenoid Knob	2	2	1	1
17	10-26666-02 10-26338-02	Solenoid Pin	2	-	1	1
19	82-20014-01*†	O-Ring, 1/16x1/2x5/8	5	5	5	5
20	82-20018-07 †	O-Ring, 1/16x3/4x7/8	2	2	2	2
21	83-16915-08 †	Rd. Hd. Scr., M 3.5x5	4	4	2	2
22	83-32801-06	Drive Scr., 2x3/16	2	2	2	2
23	83-16919-08 †	Ground Scr., M4x6	1	1	1	1
24	84-01310-03	Pipe Plug, 1/8	1	1	1	1
25	84-01311-03	Pipe Plug, 1/4	1	1	1	1
26	10-26987-02 †	Seal	2	2	1	1

† Included in Routine Maintenance Kit.

* Symbol 'L', use-07

Note: 10-26338-02 Solenoid pin included in detent assy.

⊕ Use -03 with DC solenoids.

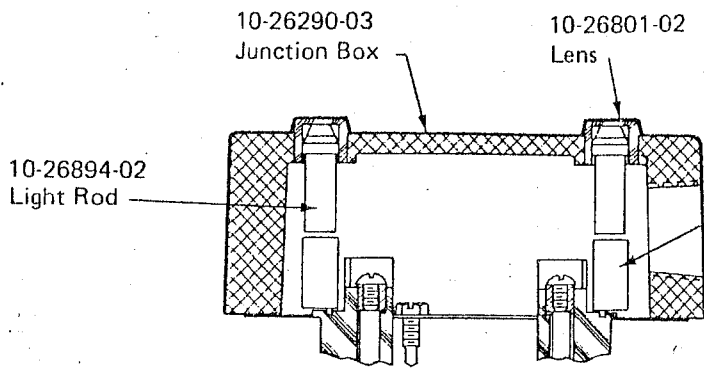
QF SPRING CHART

ITEM	SPOOL TYPES	SPRING
4	O,OP,OP1,TT	10-26936-02
	F1,FO1	
	C,FF,FFX	10-26648-02

ROUTINE MAINTENANCE KIT

1K-01290-01

(For Viton Rings use 1K-01290-07)



For Conduit Connection
On Opposite End Turn
Junction Box 180°



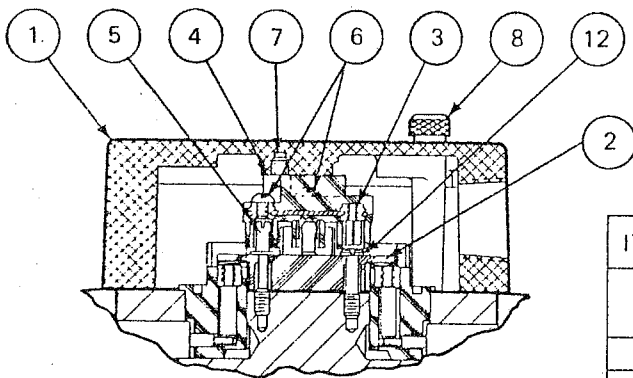
Light Assy.
110/120 VAC - 10-26912-02
220/240 VAC - 10-26912-03
12 VDC - 10-26912-05
24 VDC - 10-26912-06

To assemble insert lens into junction box then press light rod into lens.

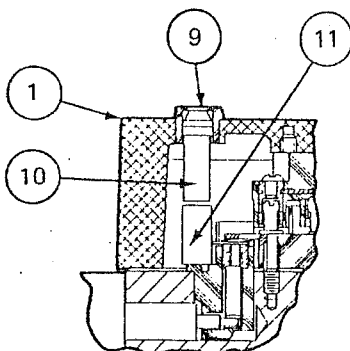
Solenoids and Coils

Plug-In			DIN 43650 Connector		
VOLTS/CYC.	SOLENOID	COIL	VOLTS/CYC.	SOLENOID	COIL
120/60 or 110/50	85-30254-32	85-50254-32	120/60 or 110/50	85-30252-32	85-50252-32
240/60 or 220/50	85-30254-42	85-50254-42	240/60 or 220/50	85-30252-42	85-50252-42
110/50	85-30254-71	85-50254-71	110/50	85-30252-71	85-50252-71
220/50	85-30254-81	85-50254-81	220/50	85-30252-81	85-50252-81
240/50	85-30254-41	85-50254-41	240/50	85-30252-41	85-50252-41
12 VDC	85-30255-18	85-50255-18	12 VDC	85-30253-18	85-50253-18
24 VDC	85-30255-28	85-50255-28	24 VDC	85-30253-28	85-50253-28

Coil may be replaced without removing armature tube. Unscrew knob and pull coil straight back to disengage it. Check voltage and cycles on new coil to insure correct replacement.

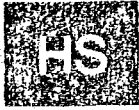


For Conduit Connection
On Opposite End Turn
Junction Box 180°

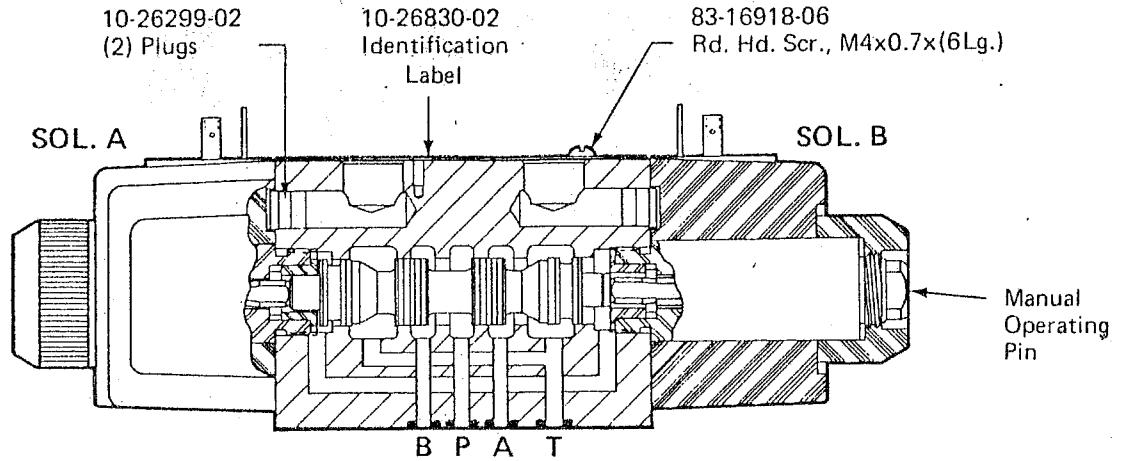


ITEM	PART NUMBER	PART NAME	TSP	TSPL
1	10-26290-02	Junction Box	1	-
	10-26290-03	Junction Box	-	1
2	10-26893-02	Adaptor	1	1
3	10-26930-02	Connector	1	1
4	10-26901-02	Gasket	1	1
5	10-26905-02	Ground Screw	1	1
6	83-16915-08	Rd. Hd. Scr., M3.5x(5Lg.)	5	5
7	83-33809-02	Tapping Scr., M4x(10Lg.)	2	2
8	10-26671-02	Thumb Screw	2	2
9	10-26801-02	Lens	-	2
10	10-26894-02	Light Rod	-	2
11	10-26912-02	Light 110/120 VAC	-	2
	10-26912-03	Light 220/240 VAC		
	10-26912-05	Light 12 VDC		
	10-26912-06	Light 24 VDC		
12	10-26991-02	Screw	1	1

To assemble light, insert lens into junction box then press light rod into lens.



DIN 43650 Connector



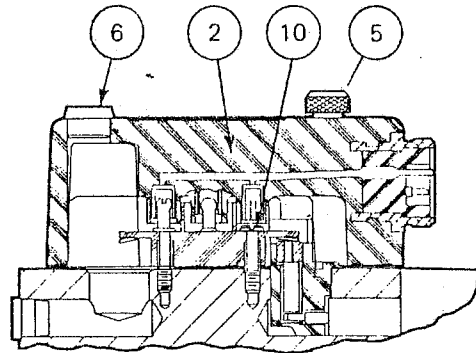
Armature tube torque: 20 ft. lbs.

Solenoids may be rotated 90 degrees in either direction.

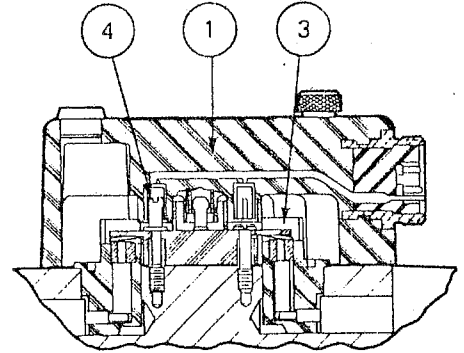
Unscrew Knob, rotate solenoid coil to position desired and retighten knob.



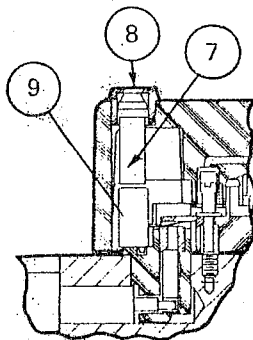
For Electrical Connection
 On Opposite End Turn
 Junction Box 180°



QJ and QJ-BH

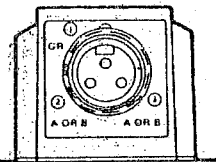


QF and QM-BH

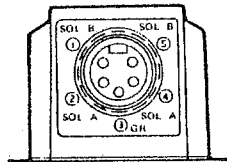


BHL

ITEM	PART NUMBER	PART NAME	BH	BHL
1	10-26592-02	5-Pin Connector	1	1
2	10-26592-03	3-Pin Connector	1	1
3	10-26893-02	Adapter	1	1
4	10-26905-02	Ground Screw M4	1	1
5	10-26671-02	Thumb Screw	2	2
6	10-26937-02	Plug	2	-
7	10-26894-02	Light Rod	-	2
8	10-26801-02	Lens	-	2
9	10-26912-02	Light-110/120 VAC	-	2
	10-26912-03	Light-220/240 VAC		
	10-26912-05	Light-12 VDC		
	10-26912-06	Light-24 VDC		
10	10-26991-02	Screw	1	1



Single-Solenoid Models



All Models

QG, QJ, QGF and QJF are normally supplied with BH and BHL 3-pin connectors. BH5 and BHL5 indicate 5-pin connectors for these models.