



**MILTON ROY**

**Metering Pumps**

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# **Instruction Manual**

**mRoy®**

**Controlled Volume Pump**

**339-0001-000**

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Issued 8/93

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## **MILTON ROY LIMITED WARRANTY METERING PUMP PRODUCTS THIRTY SIX MONTH**

The Flow Control Division of the Milton Roy Company warrants its metering pump products against defects in workmanship or materials for three years under normal use from the date of shipment from our warehouse or the warehouse of our agent. All metering pump components are warranted for three years, except that warranties on equipment and accessories furnished with the pump but manufactured by others are limited to the warranties offered by the manufactures of their respective products. This warranty is not extended to electronic or pneumatic control devices supplied with a Milton Roy metering pump. These items are covered by the warranties offered by the manufacturer or the Milton Roy Warranty for Electronic Controls and Actuators.

All obligations and liabilities under this warranty are limited to refunding, repairing or replacing (at our option), f.o.b. our plant, such allegedly defective units as are returned to our plant, carrier charges prepaid. Repairs or replacements are made subject to factory inspection of returned items.

This warranty does not extend to damage by corrosion or atmosphere. The materials of construction offered are recommendations subject in all cases to verification and acceptance by the customer. These recommendations, based on previous Company experience and best available information, do not constitute guarantees against wear or chemical action.

Expressly excluded from this warranty are defects caused by misuse, abuse, or improper application, employment, or operation of the unit. Expendable items and damage resulting from unauthorized repair are not covered by this warranty. No liability for consequential damages or reinstallation labor is accepted. Milton Roy Company will not assume responsibility for contingent liability for alleged failure of its products.

This warranty is in lieu of all other warranties expressed or implied.



# SECTION 1 GENERAL DESCRIPTION

## INTRODUCTION

The mRoy pump is a highly reliable controlled volume pump of hydraulically actuated diaphragm design.

Pump capacity is adjustable while the pump is running or stopped. Capacity adjustment can be made manually or automatically by signal from remote control instruments.

Repetitive accuracy of the metered discharge volume is maintained within a  $\pm 1\%$  range at constant conditions of pressure, temperature and pump capacity adjustment setting.

## GENERAL INFORMATION

The mRoy pump is a reliable, compact, controlled volume diaphragm pump for normal corrosive or toxic chemicals and light slurries with viscosities up to 200 S.S.U. (40 cps). For higher viscosities, the mRoy "P" series pump is available (to 12,200 cps).

A plunger, reciprocating at a fixed stroke, displaces a fixed volume of hydraulic fluid which actuates a flexible, chemically inert PTFE diaphragm to create pumping action. Double ball check valves are used on the suction and discharge to insure consistent metering accu-

racy. Capacity control is established by adjusting the volume of hydraulic fluid which bypasses the diaphragm cavity.

Metering with repetitive accuracy is possible only if the volume of the hydraulic oil in the displacement chamber is maintained constant for each stroke. This is accomplished by mechanically opening the displacement chamber to the oil reservoir for a short period at the end of every suction stroke and the beginning of each pressure stroke. During this period air or vapor is bled from the system, lost oil is replenished, and allowances are made for the expansion or contraction of the oil due to temperature change.

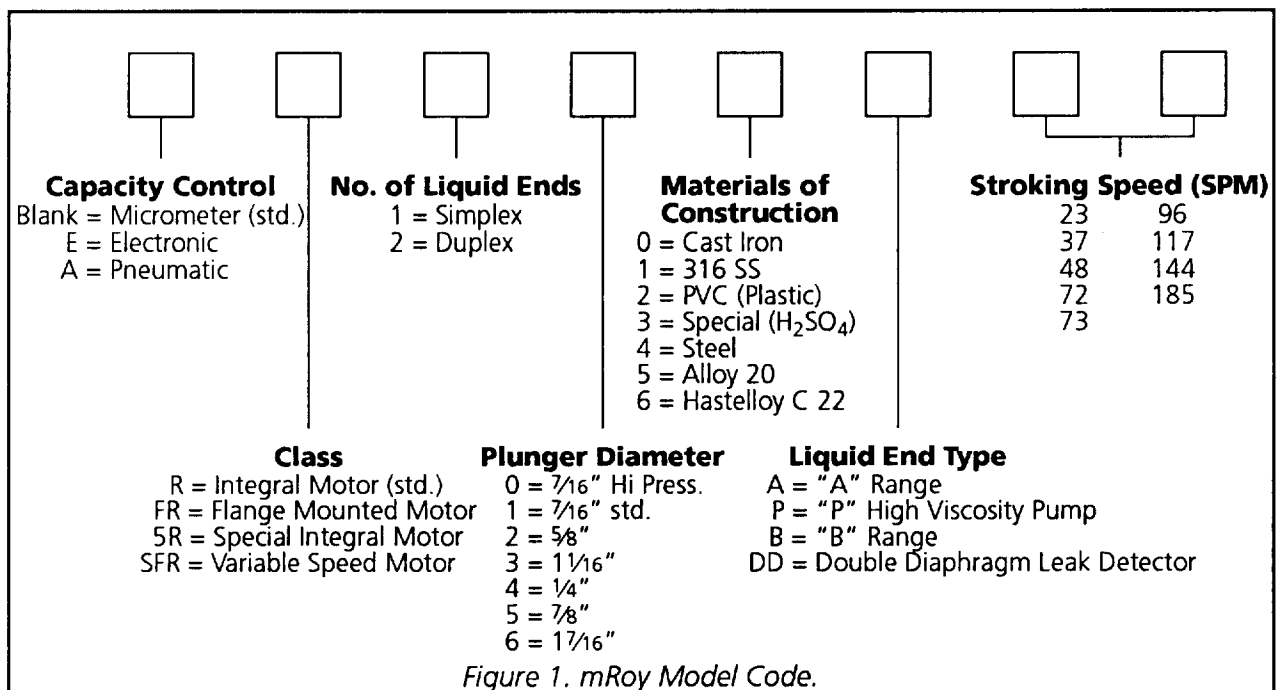
For a detailed description of the principles of operation refer to Section 3.

## PUMP CHARACTERISTICS

For a general description of the mRoy pump you have purchased, compare the model code printed on the pump's nameplate to the Model Code shown in Figure 1.

## PUMP PERFORMANCE

The following charts describe the performance ranges for all mRoy A, B, & P pump models.



**mRoy A & P** Capacities shown are for simplex pump; double capacity for duplex units. For simplex pump, use 1/4 hp motor; for duplex pump, use 1/3 hp motor.

Plunger Dia.	SPM (4)	100 PSI	150 PSI	200 PSI	300 PSI	350 PSI	400 PSI	500 PSI	600 PSI	700 PSI	800 PSI	925 PSI	1000 PSI	1100 PSI	1200 PSI	1400 PSI	1500 PSI	1600 PSI	1800 PSI
<b>Gallons Per Hour at Maximum Stroke Setting (1) and 1725 RPM Motor Speed</b>																			
3/16" Series 110 Series 100 (Hi Press.)	23-Metal	0.57	0.57	0.56	0.55	0.55	0.54	0.53	0.52	0.51	0.50	0.49	0.48	0.47	0.46	0.44	0.43	0.42	0.40
	23-PVC	0.54	0.52																
	37	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
	73	1.7	1.7	1.7	1.6	1.6	1.6	1.6	1.5	1.5	1.5	1.5	1.4	1.4	1.4	1.3	1.3	1.2	1.2
	117	2.8	2.7	2.7	2.6	2.6	2.6	2.6	2.5	2.5	2.4	2.4	2.4	2.4	2.3	2.2	2.1	2.1	2.0
5/8" Series 120	37	1.8	1.7	1.7	1.6	1.6	1.6	1.5	1.4	1.4									
	73	3.8	3.7	3.7	3.6	3.5	3.5	3.4	3.4	3.2	3.2	3.1							
	117	6.2	6.1	6.0	5.9	5.7	5.7	5.6	5.5	5.3	5.2	5.1							
1 1/16" Series 130	37	6.1	6.0	5.9	5.7	5.5													
	73	12.3	12.2	12.1	11.5	11.2													
	117	19.4	19.3	19.2	18.5	18.1													
	185 (2)	30.0	29.5	29.0															

Use 3/16" high press. plunger. Available in Cast Iron, 316SS, & Alloy 20 only.

↓ PVC limited to 150 PSI.

**NOTES**

- Rated capacities are for micrometer stroke adjustment. For electronic or pneumatic stroke control, derate rated capacities as follows; 3/16" & 5/8" plungers, use 95% of capacity; 1 1/16" plunger, use 90% of capacity.
- 185 spm (series 130) available in Cast Iron, 316SS & Alloy 20. 185 spm is not available as a "P" pump.
- Stroke length is 0.7".
- All flow rates are the same for metal and PVC except where otherwise noted.

**mRoy B** Capacities shown are for simplex pump; double capacity for duplex units. Non-shaded ranges use 1/2 hp 3 phase or 3/4 hp 1 phase motors. Shaded ranges use 3/4 hp 3 phase or 1 hp 1 phase motors.

Plunger Dia.	SPM	100 PSI	150 PSI	200 PSI	300 PSI	400 PSI	500 PSI	600 PSI	700 PSI	800 PSI	900 PSI	1000 PSI	1100 PSI	1200 PSI	1300 PSI	1400 PSI	1500 PSI
<b>Gallons Per Hour at Maximum Stroke Setting (1) and 1725 RPM Motor Speed</b>																	
1 9/32" Series 140	48	4.7	4.6	4.6	4.5	4.4	4.3	4.2	4.1	4.0	3.9	3.8	3.7	3.6	3.5	3.4	3.3
	72	7.0	6.9	6.9	6.8	6.7	6.6	6.5	6.4	6.3	6.2	6.1	6.0	5.9	5.8	5.7	5.6
	96	9.5	9.4	9.3	9.1	8.9	8.8	8.6	8.4	8.3	8.1	7.9	7.7	7.6	7.4	7.2	7.1
	144	13.3	13.2	13.1	13.0	12.8	12.7	12.5	12.4	12.3	12.2	12.0	11.9	11.8	11.6	11.5	11.4
7/8" Series 150	48	10.0	9.7	9.4	8.8	8.2	7.6	7.0	6.5	5.9	5.3	4.7					
	72	16.0	15.7	15.4	14.8	14.3	13.7	13.2	12.6	12.1	11.5	11.0					
	96	21.0	20.7	20.4	19.8	19.3	18.7	18.2	17.6	17.1	16.5	16.0					
	144	30.4	30.1	29.9	29.5	28.9	28.5	27.9	27.5	27.0	26.5	25.6					
1 1/16" Series 160	48 (2)	27.0	26.0	25.0	23.0	21.0											
	72 (3)	42.0	41.0	40.0	38.0	36.0											
	96 (3)	57.0	56.0	55.0	53.0	51.0											
	144 (3)	85.0	84.0	83.0	81.0	79.0											

↓ PVC limited to 150 PSI.

**NOTES**

- Rated capacities are for micrometer stroke adjustment. 1 9/32" & 7/8" plungers remain the same for electronic or pneumatic stroke control; derate 1 1/16" plunger to 90% of indicated ratings.
- Duplex 1 1/16" plungers at 48 or 72 spm are limited to 250 psi.
- Duplex 1 1/16" plungers at 96 or 144 spm are limited to 250 psi.
- For motor speeds other than 1725 RPM, change capacity and stroking speed accordingly.
- Stroke length is 1.5".

## SECTION 2 INSTALLATION

### GENERAL

Increased reliability can be expected if pump locations are avoided which are subjected to high ambient temperatures (above 100°F) with poor free-air circulation over the pump assembly.

The mRoy pump can be mounted on any surface which is flat and level for the support feet. Three mounting bolt holes are provided in the support feet for use when the pump is to be firmly anchored to a base surface (See Figure 2).

Support all piping connections to the pump so that no stress is placed on pump fittings. In no case should the piping be sprung to make the connections to the pump. The suction and discharge cartridge pipe connections can be positioned within an arc of approximately 150° to facilitate piping to pump. Refer to Section 3, Operating Instructions for description of adjustment procedures.

Flush and blow out all pipelines before connecting the pump. This eliminates any foreign matter which might seriously damage the internal working parts of the liquid end.

Install a 20 mesh Y-type strainer which is sized to remove foreign particles with minimum pressure drop in the suction line of the pump.

Install shut-off valves, with unions on the pump side of the valves, in the suction and discharge lines to facilitate servicing.

Use extreme care in piping to plastic liquid end pumps with rigid pipe such as PVC. If excessive stresses or vibration is unavoidable, flex-

ible connections are recommended. Note: Many pipe joint compounds are not suitable for use with plastic pipe and, if used, will cause stress cracking at the connection. Use only compounds recommended for use with plastic materials.

Check to be sure that the electrical supply matches the pump motor nameplate electrical characteristics. Motor rotation must be counter clock-wise when viewed from the top end of the motor.

### CAUTION

*On single-phase pump motors the rotation will be determined at the factory and must not be changed. On three-phase pump motors the rotation must be determined at the time of installation and prior to start-up. Operation with the wrong rotation will damage the pump and motor and void the warranty. Shaft rotation can be observed by removing the cover plate over the electrical connections.*

Oil is supplied for the average installation (ambient temperature above 50°F). See recommendation below for lower temperature. Fill pump and gear box by slowly pouring the proper oil through the air bleed reservoir opening until the oil level in the reservoir is level with oil level mark on outside surface of reservoir. Level can also be checked with dipstick on oil reservoir cap.

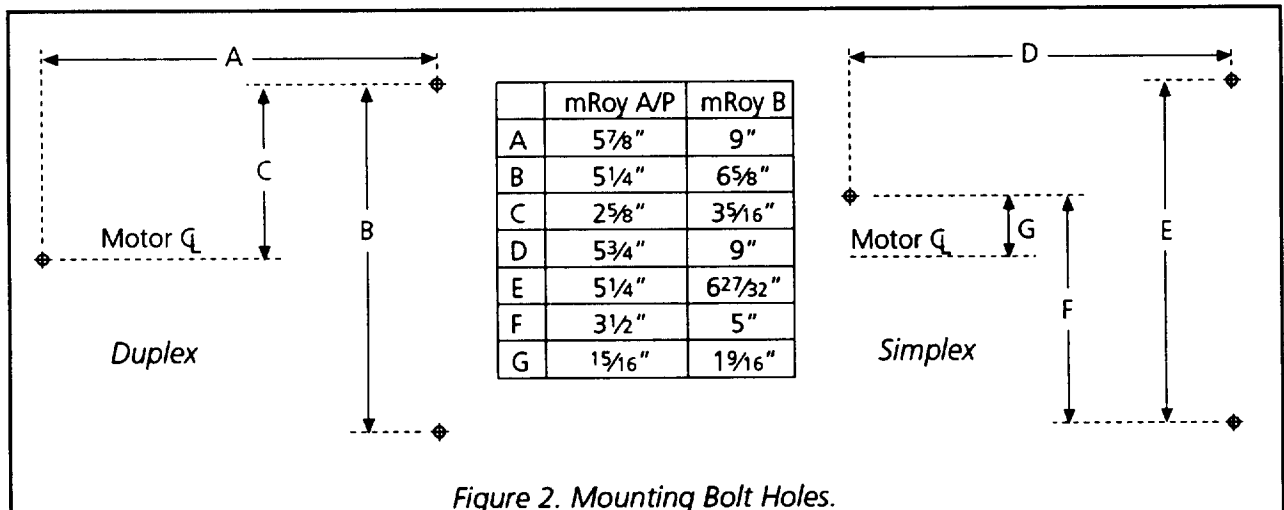


Figure 2. Mounting Bolt Holes.



**CAUTION**

Do not over fill as motor damage can result.

**Recommended Oil**

Any equivalent oil is acceptable.

Oil Type	Ambient Temp 15–50°F	Ambient Temp above 50°F
AGMA Spec	No. 2 EP	No. 5 EP
Zurn Oil Co	No. EP 35	No. EP 95

**Nominal Oil Capacity**

Pump Model	Simplex	Duplex
mRoy A	1 Qt. (.95 liters)	2 Qts. (1.9 liters)
mRoy B	3 Qts. (2.8 liters)	4 Qts. (3.8 liters)

**SUCTION PIPING**

The suction piping must be absolutely tight and leak-free. For mRoy pumps on water-like solutions we recommend that the suction pipe be ¾" minimum diameter and a maximum of 6 feet long. In any event, the piping must be designed to provide an adequate net positive suction head (NPSH). Refer to Section 3 of this manual or request a copy of our NPSH Handbook. Contact Milton Roy's sales/service department if assistance is needed in determining NPSH.

A flooded suction is recommended for optimum service life and maintenance-free operation. However, the mRoy pump can operate with less than flooded suction if necessary, in accordance with the following schedule shown in the chart below.

Refer to Section 3, Operating Instructions, which outlines limiting conditions if suction lift requirements are anticipated.

The supply tank should incorporate a low level switch to cut off the pump motor circuit before the suction intake is exposed to air. Otherwise, the pump may occasionally run dry. Milton Roy Company can supply low-level switches for most standard tanks.

Frame	Model #	Min. NPSH (PSIA)	Max. Lift (Ft. H2O)
A	R-100 to R-113	10	10
A	R-200 to R-213	10	10
A	R-120 to R-123	10	10
A	R-220 to R-223	10	10
A	R-130 to R-133	10	10
A	R-230 to R-233	10	10
B	R-140 to R-144	12.5	5
B	R-240 to R-244	12.5	5
B	R-150 to R-154	12.5	5
B	R-250 to R-254	12.5	5
B	R-160 to R-164	14.0	2
B	R-260 to R-264	14.0	2

Series R & FR have same suction characteristics.

**DISCHARGE PIPING**

For satisfactory metering and capacity control, the discharge pressure at the pump must be 50–70 PSIG minimum. Therefore, when the pump is to discharge into an open system, a back-pressure device must be installed in the pump discharge cartridge or line. A spring is attached to each pump in a small cloth bag for installation in the discharge cartridge to develop the required back pressure on the pump if a separate back pressure valve is not used. (Milton Roy offers a complete line of back pressure valves. Ask for Bulletin AD 4301).

**BACK PRESSURE SPRING INSTALLATION**

The spring is to be installed when the mRoy pump will be discharging into an open tank or other system where discharge back pressure is less than 50 PSIG. Installation of this spring will assure repetitive metering accuracy under these conditions.

After pump has been fully primed, remove the cap from the body and insert spring through the top seat to rest on top of the ball check. Replace cap and tighten until firmly seated on body. Do not over-tighten, as O-ring provides the seal.

Do not insert spring in discharge ball cartridge on remote submerged head assemblies. A separate back pressure valve must be in-

stalled in the discharge line from the remote head cartridge.

**CAUTION**

Take care when inserting the discharge pipe nipple into the ball check cartridge. Nipple should not extend into cavity, causing clamping of the spring and retarding normal operation.

**RELIEF VALVE RESETTING**

The mRoy pump incorporates an internal relief valve which is pre-set at the factory to relieve when the hydraulic fluid pressure exceeds 125 PSIG.

Refer to the parts drawings for a pictorial description of the mechanism.

Examination of these drawings will reveal a small passage connecting the oil side of the diaphragm head cavity with the oil reservoir (See Figure 4). This passage is stopped off by a poppet (212-C) which is held in place by a spring (280-A) secured by a set screw (405-E). 405H is a plastic screw plug which keeps the adjusting threads free of dirt and also acts to prevent oil seepage from the reservoir under relieving conditions.

In operation, the spring-loaded poppet is held against the seat in the housing until the pressure in the oil side of the diaphragm cavity exceeds the pressure for which the valve has

been set. When this occurs, the poppet is forced off its seat, permitting the oil to flow from the diaphragm cavity through the mechanical passage to an opening in the side of the oil reservoir. The resilient material of the poppet permits the relief valve to actuate without erosion of the poppet or seat surface.

Although the relief valves are adjusted at the factory for 100 PSI, they can be readjusted as required for up to the maximum rated pressure of the pump. This can be done as follows:

**Relief Valve Setting**

Pump must be at operational pressure and capacity set at 95%.

1. Remove yellow plastic plug located at top of pump next to the oil fill hole.
2. Using a 3/16 hex. key (mRoy A or P), or a 5/16 hex. key (mRoy B) as required for the different models, turn the adjusting screw clockwise to increase cracking pressure until pump ceases to by-pass through the relief valve at the desired working pressure. When relieving has stopped, adjust the screw to one full turn beyond this point. To determine if relieving is taking place, insert your index figure into the oil reservoir opening and place it against the by-pass opening where the oil pulse from the relief valve can be determined.

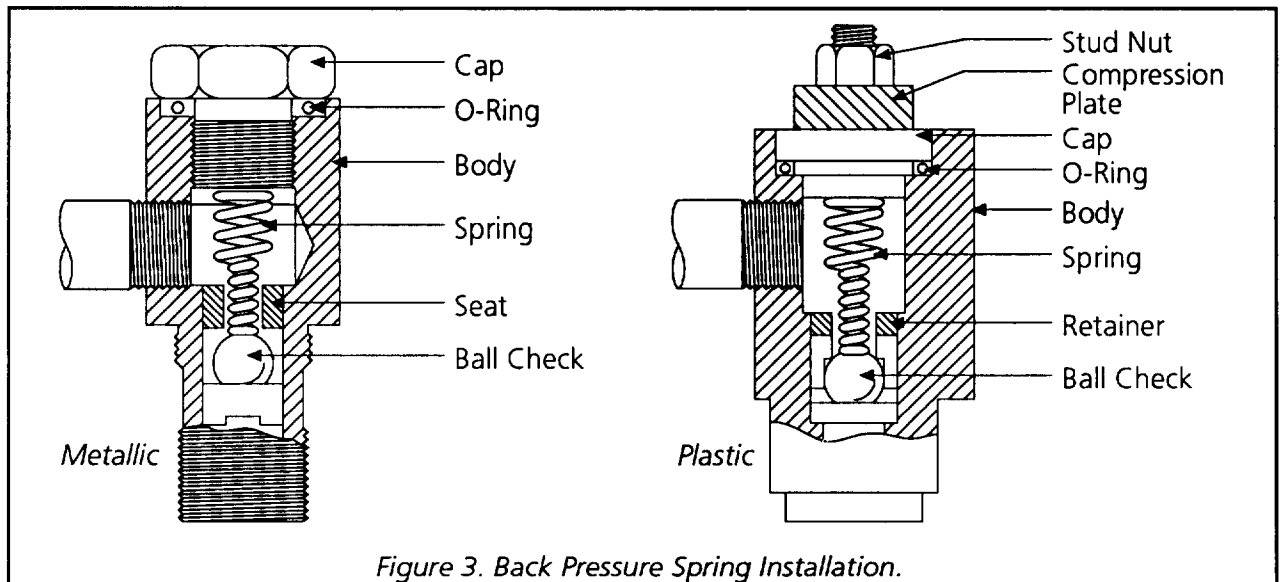


Figure 3. Back Pressure Spring Installation.

**NOTE**

*No moving parts are present in the oil reservoir in this location.*

3. Reinstall the plastic screw plug. If the pump is allowed to operate for long periods with the relief valve relieving, there is a possibility that the poppet will become so eroded that it prevents operating pressure from being attained. If this happens, remove the plastic plug, set screw and spring. The poppet may be removed by "jogging" the motor, causing oil flow through the relief port to float the poppet up and out of the threaded hole, or use a tweezer.

To replace the poppet, temporarily "glue" the poppet into the end of the spring with thick grease, then drop this assembly into place in the threaded hole. Install the set screw until the spring is lightly compressed. (The point at which this happens can be determined by simple measurements). If the pump is now filled to the proper oil level and the motor started, any air bubbles will be allowed to clear and the relief valve may be adjusted for the desired working pressure.

**CAUTION**

*When relieving is taking place, especially on pumps with the large plunger sizes, oil may be ejected at high velocity from the bypass port. Normal precaution should be observed to prevent this from splashing the surrounding area.*

*This relief is intended primarily for pump protection in the event that the discharge or suction system is blocked while the pump is in operation. If the pump is the only source of pressure in the reagent system, the hydraulic*

*system relief valve in the pump will also protect the reagent system. If there are other sources of pressure in the reagent system, a high grade chemical type relief valve should be installed in the pump discharge line as close to the pump as possible, and always between the pump and any shut-off valve. Pipe the outlet of the system relief valve back to the suction tank, with the open end of the pipe visible at all times. In this way, relief valve leakage may be easily detected.*

*For safety reasons, a check valve is recommended for use in the discharge line near the point where the line enters a high-pressure process vessel.*

## **OUTDOOR INSTALLATIONS**

The mRoy pump is designed as a totally enclosed unit suitable for installation either indoors or outdoors. However, for outdoor installations the pump mounting area should be selected to provide protection against environmental extremes:

1. Operation with continuous exposure to tropical or subtropical sunshine with ambient temperatures above 90°F, which would cause higher oil temperatures and affect lubricity should be avoided. Good installation practice would dictate providing a sun shade cover over the pump with open sides to obtain the best air circulation around the pump.
2. Frequent start-up where the pump has been idle in an ambient temperature below 30°F is not recommended. Provide a removable, insulated enclosure over the pump and mounting base with provisions for an electrical heater (100 watt light, heat lamp, heater tape etc.) to maintain the pump oil temperature above 30°F.

## SECTION 3 OPERATING INSTRUCTIONS

### PRINCIPLE OF OPERATION

Pumping action is developed and controlled by four basic components as follows (Figures 4 & 5):

1. The pump plunger "A" reciprocates with a constant stroke length and displaces oil into and out of the diaphragm chamber "C".
2. The flexible diaphragm "X" is a movable partition between the plunger oil and fluid being pumped.
3. An oil by-pass circuit from the diaphragm chamber "C" to the reservoir "D" through passage "E" by-pass port "H" and control valve "F".

4. A by-pass control plunger "G" which moves with and is directly coupled to the pump plunger to correlate by-pass shut off at port "H" to pump plunger position.

In operation, as the pump plunger and by-pass control plunger move forward as shown in Figure 4, the displaced oil is by-passed to the oil reservoir until the control plunger "G" closes the by-pass port "H" as shown in Figure 5. Then the balance of the plunger displacement is imposed on the flexible diaphragm

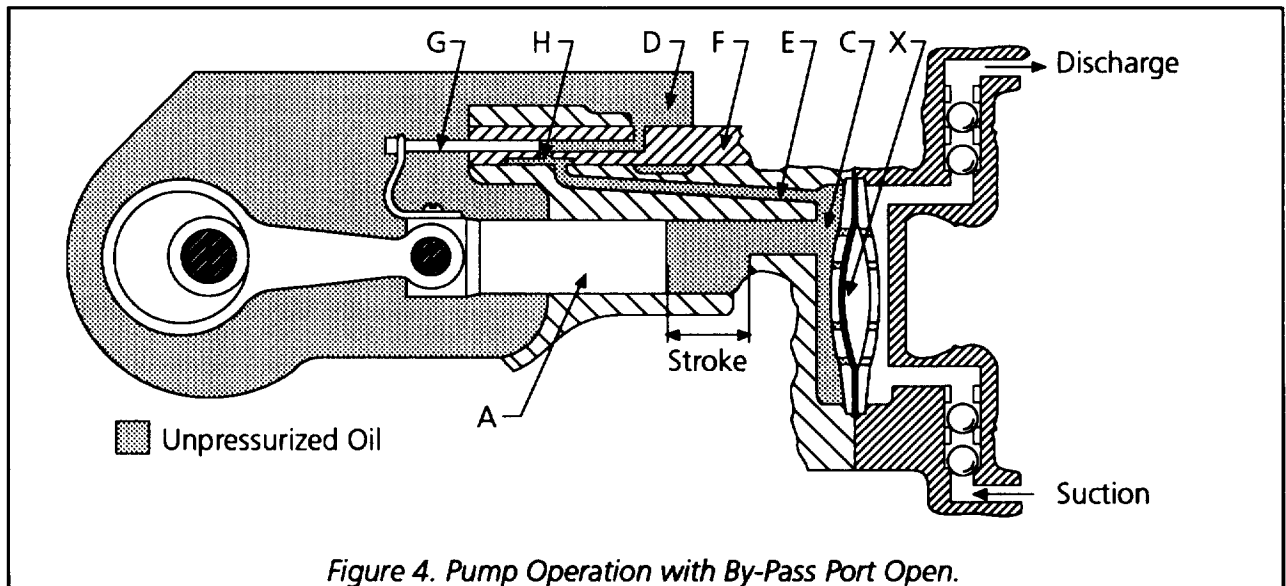


Figure 4. Pump Operation with By-Pass Port Open.

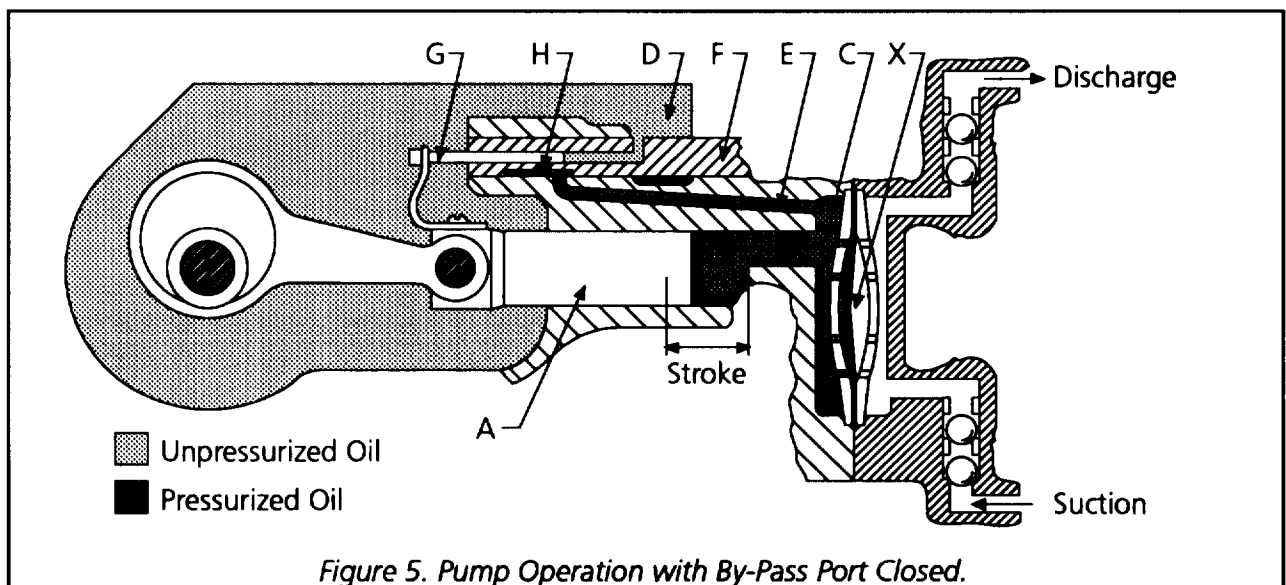


Figure 5. Pump Operation with By-Pass Port Closed.

which moves and displaces the fluid being pumped through the discharge ball checks.

On the suction stroke, the pump plunger pulls oil out of the diaphragm cavity which moves the flexible diaphragm and pulls fluid through the suction ball checks. When the control plunger "G" opens the by-pass port "H" the balance of the plunger oil displacement can be supplied from the reservoir through the by-pass passages.

The discharge capacity is adjusted from 0–100% by rotating the adjustment knob which moves the control valve "F" so that the by-pass port "H" is closed at the desired percentage of the total plunger stroke. When the control valve is adjusted to 100% capacity the by-pass port will be positioned so that it is opened at the very end of the suction stroke. Then on the pressure stroke, the by-pass port is immediately closed so the entire plunger displacement is imposed upon the flexible diaphragm.

With the control valve adjusted for 50% capacity the by-pass port will be positioned so that it is opened when the plungers have completed one-half of the suction stroke. On the next pressure stroke, the oil displaced by the pump plunger will be by-passed through the open port to the reservoir for the first 50% of the stroke before the by-pass port is closed by the control plunger. The remaining 50% of the plunger displacement will then be imposed on the flexible diaphragm so that fluid is discharged for only 50% of the plunger travel. A similar analysis would apply for 0% capacity setting on the control valve where all the plunger oil displacement is by-passed to the reservoir.

### START-UP

Before initial start up of the pump check the following:

1. Oil level in air bleed filler reservoir up to or slightly above the indicated oil level.
2. Set the capacity control knob to approximately 30–40% of maximum capacity.
3. Make certain that the suction line, liquid end and discharge cartridge are filled with water or system fluid.

4. If practical, install a temporary discharge line piped back to the suction tank incorporating a 100 PSI relief valve to facilitate establishing performance during first hours of operation.

On initial start-up, run the pump for 10–20 seconds, then stop for 20–30 seconds. Repeat approximately 15 times in order to fill the diaphragm oil cavity. Check for proper motor rotation as described in general installation instructions. During these short runs listen for any abnormal motor or crank noises, and if present, refer to Section 7, Troubleshooting.

Run pump for ½ to 1½ hours to warm up oil. Check discharge line for indication of flow.

Increase capacity adjustment setting to 100% of capacity and operate for 10–20 minutes

### CAUTION

*Do not set the capacity adjustment knob in excess of 100% because erratic or reduced metering will develop.*

Reduce capacity adjustment setting to 30–40% of maximum capacity and operate for several minutes, then increase capacity adjustment back to 100% for approximately 10 minutes. Repeat several times to insure that the air is bled from the pump displacement chamber and the liquid end. (As a general rule, to bleed air or vapor from the pump oil displacement chamber reduce the capacity adjustment to the 20 to 40% range, and to bleed air or vapor from the liquid end increase capacity to 100%, or if possible reduce the discharge pressure to atmospheric pressure for 30 seconds to one minute.)

The pump is now ready for "on-line" service. Calculate what the desired capacity as a percentage of either the maximum capacity rating on the pump data plate, or the nominal capacity at the required system pressure. As indicated on the "Performance" table, dial to the desired value. Each pump is tested at the factory to confirm that the performance meets these capacity-pressure requirements (when tested with water). (Milton Roy offers a com-

plete line of calibration columns for calibrating the pump. Ask for bulletin AD 4331.)

### **Start-Up with Back Pressure Spring in Discharge Cartridge**

The start-up procedure with the back-pressure spring installed is identical to the above procedure; however, the back-pressure device will hold air in the liquid end. It is necessary to make certain that the liquid end is filled with fluid, either by removing the discharge cartridge and filling liquid end and inlet lines before start up, or by backing out the discharge cartridge cap approximately seven (7) turns to remove the spring load on the ball check permitting the air in the liquid end to be discharged.

### **Start-Up of Plastic Liquid End**

The plastic diaphragm head furnished is fitted with a purging plug (243-A) located on the circumference just behind the discharge cartridge location. This plug may be used to purge air from the head and allow the solution to enter the chamber. A small tube connector (402-C) extending from the lower side of the head can be used to pipe off the solution to a non-hazardous location. Immediately after priming, the knurled plug should be tightened by hand to check the flow from this port.

### **Start-Up after the Suction System has Run Dry**

In applications where the suction tank does not have a low level cut-off inter-connected into the pump motor circuit, the pump may occasionally run dry. *This must be avoided because damage to the pump can result and the service life will be significantly reduced when the pump is allowed to run with a dry liquid end.*

Before restarting a pump which has run dry, provisions should be made for filling the liquid end with liquid by opening the discharge line to atmospheric pressure to either refill liquid end with flooded suction pressure or start pump with open discharge and run for a short period of time (up to 2 minutes) which will 'prime' the liquid end if the ball checks are wet. If these steps

fail, remove the discharge cartridge and fill liquid end with liquid through the top discharge boss. After establishing flow, return to the regular discharge system configuration.

### **OPERATION WITH SUCTION LIFT**

It is desirable that the mRoy pump operate with a flooded suction; however, operation with net positive suction heads (NPSH) less than atmospheric pressure is possible.

NPSH is the head available, above the vapor pressure of the liquid being pumped, to feed the liquid into the pump suction port. NPSH minimum is the head below which the pump cavitates.

Both values are calculated at the suction port of the pump. In controlled volume pump applications, two conditions must be considered in the selection of a pump to meet the NPSH minimum requirements:

1. At the start of the suction stroke, the liquid in the suction line has no velocity and NPSH minimum depends on the force necessary to accelerate the liquid in the suction pipeline.
2. At the peak of the suction stroke there is no acceleration factor and NPSH minimum depends on friction losses as calculated from standard flow equations. With all viscous fluids and in pilot plants and other places where unusual numbers of fittings and valves are used, the second condition which includes friction losses should be considered. For water-like fluids, the first condition will define the limiting configuration.

### **For Static NPSH (Condition 1)**

Available NPSH =  $P_a + P_h - P_v$  (must be equal to or greater than minimum NPSH as listed under Installation Instructions.

$$\text{Required NPSH min} = \frac{\text{Sp. Gr. (.0925) } L_p D}{D_p^2}$$

### **For Dynamic NPSH (Condition 2)**

Available NPSH =  $P_a = P_h - P_f L_e$  (must be equal to or greater than minimum NPSH as listed under Installation Instructions.

D = Plunger Diameter (inches)

D<sub>p</sub> = Pipe Diameter (inches)

L<sub>p</sub> = Actual Length of suction pipe (feet)  
L<sub>e</sub> = Equivalent length of suction pipe including allowance for fittings (feet)  
P<sub>a</sub> = Ambient pressure above liquid (PSIA)  
P<sub>h</sub> = Head of liquid column above (+) or below (-) center line of plunger (PSIA) = Head in feet x (.435) (Sp.Gr.)  
P<sub>v</sub> = Vapor pressure of liquid (PSIA)  
P<sub>f</sub> = Friction loss per foot of pipe calculated from Reynold Number evaluation (PSIA) (Use 3.2 times average velocity for calculating friction losses when referring to a standard pipe losses table.)

Minimum NPSH = Minimum hydraulic pressure at plunger (listed under Installation Instructions).

When operating the pump with a NPSH of less than atmospheric pressure (negative suction head or suction lift), special attention should be given to keep the suction line strainer clean and prevent other system conditions which might inadvertently decrease the NPSH available.

**NOTE**

*Request a copy of Milton Roy's NPSH Handbook for more information about NPSH.*

## SECTION 4 MAINTENANCE

### SPARE PARTS

To avoid excessive downtime in the event of a parts malfunction, the quantities of spare parts shown in the chart below should be maintained in your stores to support each mRoy pump. These parts are available in the form of Routine Preventive Maintenance (RPM) Kits for most models.

Qty*	Description	Dwg. Loc.
1	Diaphragm	298-B
1	Suction Cartridge Assembly	221-B
1	Discharge Cartridge Assembly	221-C
4	Check Valve Cartridge O-Ring	408-B**
8	Spiral Back-Up Rings	408-E†
* Double quantity for duplex pumps. ** Order 408-G for mRoy B pumps. † 408-E is number 408-D on drawing F.		

Parts orders must include the following information:

1. Quantity required (in this manual).
2. Part number (in this manual).
3. Part description (in this manual).
4. Pump model no. (on pump nameplate).
5. Pump serial no. (on pump nameplate).

Always include the serial and model numbers in all correspondence regarding the unit.

### RETURNING UNITS TO THE FACTORY

Pumps will not be accepted for repair without a Return Material Authorization.

All inquiries or parts orders should be addressed to your local Milton Roy representative or sent to:

Parts Department  
 Milton Roy Company  
 Flow Control Division  
 201 Ivyland Road  
 Ivyland, PA 18974-0577  
 Phone: (215) 441-0800  
 FAX (215) 441-8620

### PERIODIC MAINTENANCE

The mRoy pump is designed for reliable service with a minimum amount of maintenance required. In normal operation, a periodic check of the pump is recommended every 24 or 48 hours to visually confirm satisfactory operation by:

1. Observing that the oil level in the air bleed filler reservoir is above the indicated mark.
2. Inspecting the pump liquid end for indication of leakage or seepage.

The oil in the main housing should be drained twice a year, using the drain plug provided, and new oil installed. This can usually be scheduled to coincide with the change from winter to summer grade lubricants and vice versa.

#### NOTE:

*When adding oil, pour in a thin, slow stream to avoid overflow.*

### MOTORS

Adequate power for the standard Frame A mRoy pump is supplied by a totally enclosed non-ventilated, single-phase motor of the capacitor start type, which is assembled as an integral part of the gear reducer.

On the larger Frame B mRoy, the normal temperature rise for these motors is 50°C above ambient temperature, and it can be expected that these motors will appear to operate at higher temperatures than are normally experienced. However, there is no cause for worry if the following precautions are observed:

1. The motor is placed where there is adequate ventilation and is protected against excessive radiation from steam pipes and other heat sources.
2. The overload heater in the starting device should be correctly sized for motor full load current rating as shown on the motor data plate.



## DISASSEMBLY & PARTS REPLACEMENT

Procedures for complete disassembly of the mRoy pump are listed below. Some steps can be omitted depending on which part is replaced.

### Motor Removal

1. Remove oil drain plug and drain oil.
2. Remove four (4) screws from top of motor housing.
3. Remove motor cover. Note that two (2) Belleville washers and one or more flat washers are retained in the top of the motor housing by grease. If these washers should fall out, make sure they are replaced prior to motor assembly.
4. Remove worm assembly.

### Suction & Discharge Cartridge Removal

The suction and discharge check valve cartridges are precision assembled at the factory. Do not attempt to disassemble these cartridges. If they become inoperative, flush them with Safety Solvent, wash them with warm detergent and blow them out with compressed air to remove any foreign matter. If this treatment does not eliminate the trouble, the cartridge assembly should be replaced.

### Metallic Liquid Ends (See Drawings C, D, F & G)

The suction and discharge cartridge assemblies use an SAE straight thread with an O-ring seal to facilitate port alignment with the connecting pipes. To remove the cartridge from the liquid end, first loosen the lock nut one or two times, then remove the cartridge.

To install the cartridge, position the lock nut toward the shoulder of the cartridge so that the recess on the face of the lock nut is adjacent to the O-ring land (thread undercut) in the cartridge.

Make certain the PTFE spiral back-up ring is coiled in a counter-clockwise helix (this is opposite the direction normally employed by suppliers of these rings). Fit this back-up ring in the lock nut recess. Push it firmly down in the recess as completely as possible. Install a new O-ring against the spiral back-up ring.

Screw the cartridge assembly into the liquid end until the O-ring band is approximately level with the top of the spotface in the liquid end, then screw it in one (1) additional turn plus a partial turn as required to align the pipe thread port with connecting pipe.

After completing pipe connection, tighten lock nut securely against spotface so that O-ring is trapped in chamfer of liquid end thread. Make sure that spiral back-up ring is completely contained in its recess and not extending to the outside.

### Plastic Liquid Ends (See drawings E & J)

The suction and discharge cartridges are held in place by the clamping yoke. To remove them, remove clamping yoke and lift them out of pump suction and discharge ports.

During assembly, the suction and discharge cartridges can be rotated to suit piping conditions by loosening the top stud nuts (405-G). The stud nuts should be re-tightened before the pump is started.

### NOTE

The O-rings and PTFE back-up rings on the suction and discharge cartridges should not be reused. These should be replaced with new parts whenever they are removed from the pump.

### Diaphragm

1. Remove eight (8) bolts from diaphragm head.
2. Remove diaphragm using knife blade.
3. Remove contour plates.

To install diaphragm perform the following:

1. Place pump on its side with diaphragm cavity facing up.
2. Install contour plates.
3. Carefully center diaphragm in shallow recess.
5. Retain diaphragm with thin, flat blade ½" to 1" wide.
6. Install diaphragm head with eight (8) bolts. Remove blade and torque bolts as follows (See Figure 6):

- a. mRoy Model A Metal Diaphragm Heads: 265–275 in. lbs. bolting torque (grade 5 or stronger bolts)
- b. mRoy Model A Plastic Diaphragm Heads: 60–70 in. lbs bolting torque tie down nuts—15 in. lbs.
- c. mRoy Model B Metal Diaphragm Heads: 340–360 in lbs. bolting torque
- d. mRoy Model B Plastic Diaphragm Heads: 75–85 in. lbs. bolting torque tie down nuts—25 in. lbs.

### Control Spool

1. Remove E-ring.
2. Unscrew and remove capacity control knob.
3. Loosen screw in capacity control. Make sure screw end is flush with top of keyway to prevent damage to control spool O-rings.

4. Install tool described above into  $\frac{3}{16}$ " diameter hole connecting the diaphragm chamber with the control spool bore and remove control spool.
5. For mRoy A pumps, fabricate a tool by inserting a  $\frac{3}{16}$ " diameter x 4 in. long soft plastic (e.g. Nylon) solid rod into the  $\frac{3}{16}$ " hole and shaping the end with a  $\frac{7}{16}$ " tapered reamer inserted into the control spool bore. For mRoy B pumps, a tool is not required.
6. When installing control spool, install new O-rings and coat spool and O-rings liberally with grease. Push the control spool into the bore carefully, using tool to guide O-ring across the intersecting passage. This is done to prevent damage to the O-rings. Finally, guide the control piston into the center of the control spool.

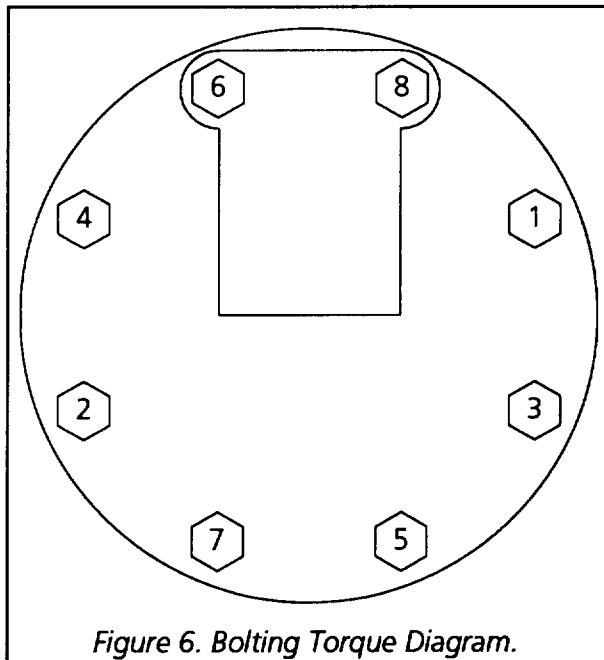


Figure 6. Bolting Torque Diagram.

### Worm Gear

1. Use arbor press and press out gear shaft.
2. Lift worm gear up and out of pump housing.

#### NOTE

Do not remove or change position of spanner nut in pump housing. This is factory set for proper piston alignment in bore.

### Connecting Rod and Piston

1. Lift connecting rod up and back to disengage piston from bore.
2. Use arbor press to remove wrist pin from connecting rod and piston.
3. To assure proper installation, note position of oil hole in wrist pin with respect to connecting rod and piston.



## **SECTION 5 TROUBLESHOOTING**

- Pump motor won't operate. ....
- No power. Supply correct power in accordance with motor nameplate.
  - Blown fuse. Check for short circuit or overload.
  - Open thermal overload device in starter. Reset overload.
  - Broken wire. Locate and repair.
  - Low voltage. Check for too thin wiring.
  - Low liquid level (where low level cut-off is used). Fill tank.
  - Oil is frozen in pump. Thaw out.
  - Bad motor. Replace motor.
- Pump doesn't deliver rated capacity.....
- Starved suction. Replace suction piping with larger size, or increase suction head.
  - Leaky suction piping. Repair or replace defective piping.
  - Excessive suction lift. Rearrange equipment location to reduce suction lift.
  - Liquid too close to boiling point. Lower temperature or increase suction pressure.
  - Air or gas trapped in oil or pumpage. Decrease capacity to 20% for 5 mins. then increase to 100% for 5 mins.
  - Worn or dirty valves or seats. Clean or replace cartridges.
  - Viscosity of liquid too high (cps). Reduce viscosity by heating or other means, or increase size of suction piping, or increase suction pressure.
  - Insoluble materials; crystallization of liquid; settling of solids. Limit solution strength to proper value. Flush and clean solution tank periodically. Suction connection should be 2" to 4" from bottom of solution tank.
  - Low discharge pressure. A minimum discharge pressure of 50–70 PSIG is required to insure proper capacity control.
  - Relief valve being actuated. Refer to symptom marked with an \*.
  - Capacity adjustment set above 100% capacity mark. Reposition adjustment knob to 100% mark.
  - Air in hydraulic or reagent system. Bleed system.
- Pump delivers erratically.....
- Leaky suction line. Repair or replace piping.
  - Worn or dirty valves or seats. Clean or replace cartridges.
  - Excessive excursion of ball valves from seats (indicated by ball chatter). Replace cartridges.
  - Insufficient suction pressure. Increase suction pressure by raising tank level or pressurizing suction tank.
  - Liquid too close to boiling point. Reduce temperature or raise suction pressure.
  - Leaky system relief valve. Repair or replace relief valve.

Motor overheats thermal  
overload switches.....

- Power supply does not match motor characteristics. Check power supply against motor nameplate data.
- Overload caused by operating pump above its discharge pressure. Check operating pressure against pump manufacturer's data plate max. rating and correct the cause of the pressure abnormality.

Noisy operation of pump liquid end. ....

- Pump valves must move to open and close, and they will make a clicking noise as they operate. These noises are sometimes amplified by natural resonances in the piping system. They are usually indications of normal valve functioning.

\*Noisy operating in drive casing  
(pounding noise at high  
discharge pressure).....

- Fluid compressibility causes reversal load on gears at end of pressure stroke. Not considered detrimental. No action needed.
- Pump internal relief valve actuating, caused by excessive suction lift conditions. Lower pump or raise level of liquid.
- Pump internal relief valve actuating, caused by insufficient suction pressure. Correct poor suction condition.
- Pump internal relief valve actuating, caused by clogged or partially blocked filter or strainer in suction line. Clean strainer.
- Pump internal relief valve actuating, caused by clogged or fouled suction or discharge check valves. Clean or replace.
- Pump internal relief valve actuating, caused by blocked discharge line. Remove blockage.
- Pump internal relief valve actuating, caused by insufficient discharge pressure (60 PSIG minimum is required). Install back pressure valve or device to create back pressure at pump discharge connection.

Improper oil level in reservoir  
increases and overflows. ....

- Flexible diaphragm pluctured by foreign material. Replace diaphragm.

Pump delivery is not adjustable. ....

- System pressure too low. Install a back pressure valve in the discharge line (preferred method), or install a back pressure spring (provided) into discharge cartridge.

Pump does not develop  
required pressure. ....

- Refer to symptom marked with an \*, or check to see if system pressure exceeds rated capacity on data plate.
- O-rings on control spool are nicked. Replace O-rings. (Note: you must use a special tool. See section on control spool disassembly.)
- Carefully review causes and remedies for the second and third symptoms listed.



## SECTION 6 PARTS DRAWINGS

To determine which Parts Drawings apply to your particular pump, first obtain the pump model number from the nameplate and refer to the listings below. Apply the Parts Drawing letter indicated to the drawings on the following pages.

### MROY "A" PUMPS

**Integral Motor** (( ) = 0, 1, 2, or 3)

Simplex		Duplex	
Model	Drawing	Model	Drawing
R1( )0A	C	R2( )0A	D
R1( )1A	C	R2( )1A	D
R1( )2A	E	R2( )2A	I
R1( )3A	C	R2( )3A	D
R1( )5A	C	R2( )5A	D

**Flange Mounted Motor** (( ) = 0, 1, 2, or 3)

Simplex		Duplex	
Model	Drawing	Model	Drawing
FR1( )0A	C, F	FR2( )0A	D
FR1( )1A	C, F	FR2( )1A	D
FR1( )2A	E, F	FR2( )2A	I
FR1( )3A	C, F	FR2( )3A	D
FR1( )5A	C, F	FR2( )5A	D

### MROY "P" PUMPS

For "P" pumps with metallic liquid ends, use parts drawing J in conjunction with the above drawings. For "P" pumps with plastic liquid ends, use parts drawing K in conjunction with above drawings.

### MROY "B" PUMPS

**Integral Motor** (( ) = 4, 5, or 6)

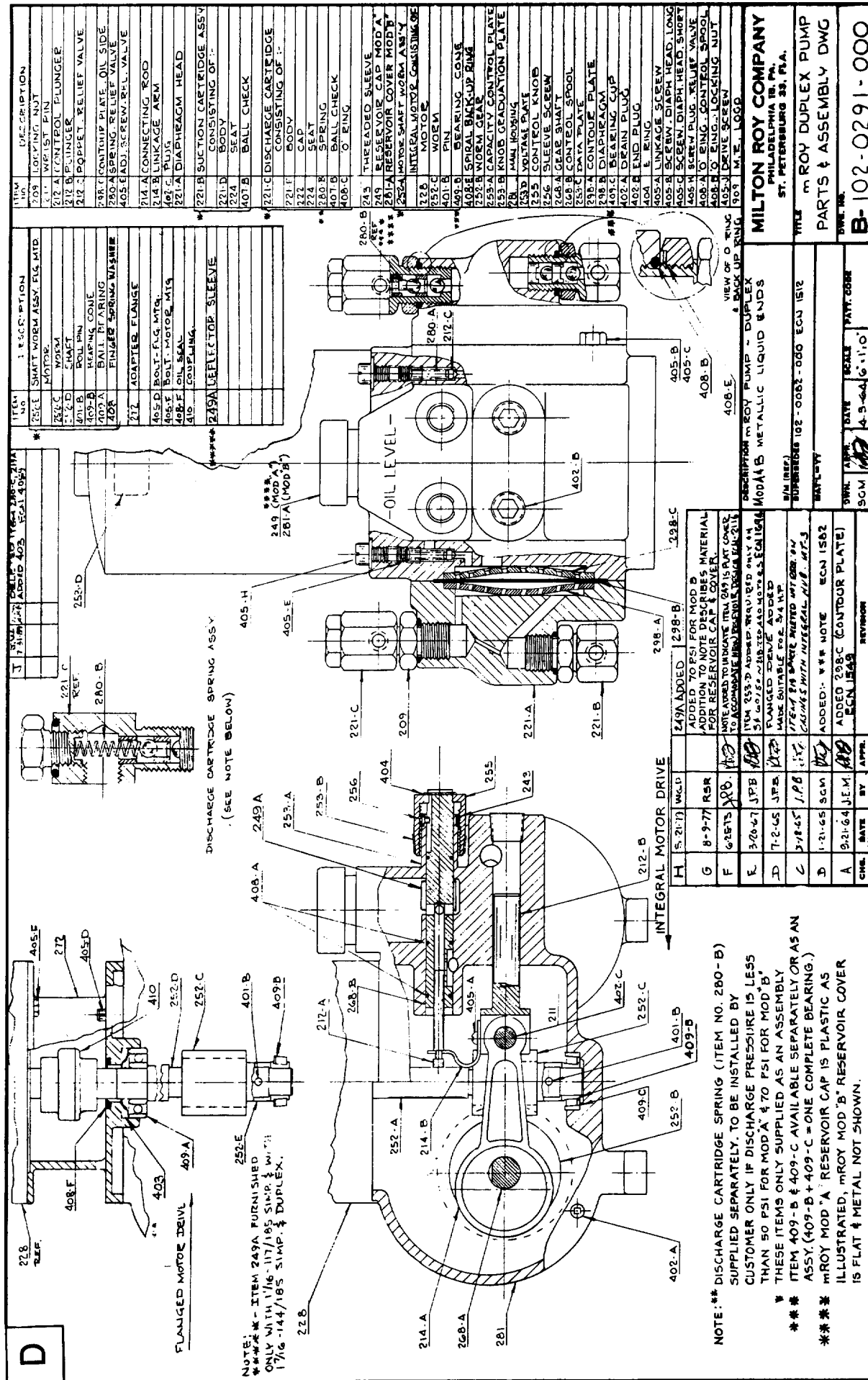
Simplex		Duplex	
Model	Drawing	Model	Drawing
R1( )0A	G	R2( )0A	D
R1( )1A	G	R2( )1A	D
R1( )2A	G	R2( )2A	I
R1( )3A	G	R2( )3A	D
R1( )4A	G	R2( )4A	D
R1( )5A	G	R2( )5A	D

**Flange Mounted Motor** (( ) = 4, 5, or 6)

Simplex		Duplex	
Model	Drawing	Model	Drawing
FR1( )0A	H	FR2( )0A	D
FR1( )1A	H	FR2( )1A	D
FR1( )2A	H	FR2( )2A	I
FR1( )3A	H	FR2( )3A	D
FR1( )4A	H	FR2( )4A	D
FR1( )5A	H	FR2( )5A	D







ITEM NO.	DESCRIPTION
219	WASHING NUT
220	WIPER PIN
221-A	CONTROL PLUNGER
221-B	PLUNGER
222	POCKET RELIEF VALVE
223	CONTROL PLATE, OIL SIDE
224	SPRING, RELIEF VALVE
405 (A, D)	SCREW, REL. VALVE
214-A	CONNECTING ROD
214-B	LINKAGE ARM
405-C	PLUG
221-A	DIAPHRAGM HEAD
221-B	SUCTION CARTRIDGE ASSY CONSISTING OF :-
221-C	DISCHARGE CARTRIDGE CONSISTING OF :-
221-F	BODY
222	CAP
224	SEAT
228-B	SPRING
401-B	BALL CHECK
408-C	O RING
245	THREADED SLEEVE
249	RESERVOIR CAP MOD "A"
261-A	RESERVOIR COVER MOD "A"
252-A	MOTOR SHAFT WORK ASSEMBLY
226	MOTOR
252-C	MOTOR
401-B	PIN
405-D	BEARING CONE
408-B	SPIRAL BACK-UP RING
252-B	WORM GEAR
253-A	CAPACITY CONTROL PLATE
253-B	KNOB GRADUATION PLATE
401-B	MAIN HOUSING
253	VOLTAGE PLATE
255	CONTROL KNOB
256	SLEEVE SCREW
228-A	GEAR SHAFT
228-B	CONTROL PLATE
228-C	DIAPHRAGM PLATE
402-A	BEARING CUP
402-B	DRAIN PLUG
404	END BULB
405-A	LINKAGE SCREW
405-B	SCREEN DIAPH HEAD, LONG
405-C	SCREEN DIAPH HEAD, SHORT
405-D	SCREW PLUG, RELIEF VALVE
408-A	O RING, LOCKING NUT
408-B	O RING, LOCKING NUT
408-C	O RING, LOCKING NUT
405-J	DRIVE SCREW
309	M.T.E. LOGO

ITEM NO.	DESCRIPTION
252-E	FLANGED MOTOR DRIVE
252-F	FLANGED MOTOR DRIVE
252-G	FLANGED MOTOR DRIVE
252-H	FLANGED MOTOR DRIVE
252-I	FLANGED MOTOR DRIVE
252-J	FLANGED MOTOR DRIVE
252-K	FLANGED MOTOR DRIVE
252-L	FLANGED MOTOR DRIVE
252-M	FLANGED MOTOR DRIVE
252-N	FLANGED MOTOR DRIVE
252-O	FLANGED MOTOR DRIVE
252-P	FLANGED MOTOR DRIVE
252-Q	FLANGED MOTOR DRIVE
252-R	FLANGED MOTOR DRIVE
252-S	FLANGED MOTOR DRIVE
252-T	FLANGED MOTOR DRIVE
252-U	FLANGED MOTOR DRIVE
252-V	FLANGED MOTOR DRIVE
252-W	FLANGED MOTOR DRIVE
252-X	FLANGED MOTOR DRIVE
252-Y	FLANGED MOTOR DRIVE
252-Z	FLANGED MOTOR DRIVE

ITEM NO.	DESCRIPTION
253-A	DISCHARGE CARTRIDGE SPRING ASSY
253-B	DISCHARGE CARTRIDGE SPRING ASSY
253-C	DISCHARGE CARTRIDGE SPRING ASSY
253-D	DISCHARGE CARTRIDGE SPRING ASSY
253-E	DISCHARGE CARTRIDGE SPRING ASSY
253-F	DISCHARGE CARTRIDGE SPRING ASSY
253-G	DISCHARGE CARTRIDGE SPRING ASSY
253-H	DISCHARGE CARTRIDGE SPRING ASSY
253-I	DISCHARGE CARTRIDGE SPRING ASSY
253-J	DISCHARGE CARTRIDGE SPRING ASSY
253-K	DISCHARGE CARTRIDGE SPRING ASSY
253-L	DISCHARGE CARTRIDGE SPRING ASSY
253-M	DISCHARGE CARTRIDGE SPRING ASSY
253-N	DISCHARGE CARTRIDGE SPRING ASSY
253-O	DISCHARGE CARTRIDGE SPRING ASSY
253-P	DISCHARGE CARTRIDGE SPRING ASSY
253-Q	DISCHARGE CARTRIDGE SPRING ASSY
253-R	DISCHARGE CARTRIDGE SPRING ASSY
253-S	DISCHARGE CARTRIDGE SPRING ASSY
253-T	DISCHARGE CARTRIDGE SPRING ASSY
253-U	DISCHARGE CARTRIDGE SPRING ASSY
253-V	DISCHARGE CARTRIDGE SPRING ASSY
253-W	DISCHARGE CARTRIDGE SPRING ASSY
253-X	DISCHARGE CARTRIDGE SPRING ASSY
253-Y	DISCHARGE CARTRIDGE SPRING ASSY
253-Z	DISCHARGE CARTRIDGE SPRING ASSY

ITEM NO.	DESCRIPTION
214-A	CONNECTING ROD
214-B	LINKAGE ARM
405-C	PLUG
221-A	DIAPHRAGM HEAD
221-B	SUCTION CARTRIDGE ASSY CONSISTING OF :-
221-C	DISCHARGE CARTRIDGE CONSISTING OF :-
221-F	BODY
222	CAP
224	SEAT
228-B	SPRING
401-B	BALL CHECK
408-C	O RING
245	THREADED SLEEVE
249	RESERVOIR CAP MOD "A"
261-A	RESERVOIR COVER MOD "A"
252-A	MOTOR SHAFT WORK ASSEMBLY
226	MOTOR
252-C	MOTOR
401-B	PIN
405-D	BEARING CONE
408-B	SPIRAL BACK-UP RING
252-B	WORM GEAR
253-A	CAPACITY CONTROL PLATE
253-B	KNOB GRADUATION PLATE
401-B	MAIN HOUSING
253	VOLTAGE PLATE
255	CONTROL KNOB
256	SLEEVE SCREW
228-A	GEAR SHAFT
228-B	CONTROL PLATE
228-C	DIAPHRAGM PLATE
402-A	BEARING CUP
402-B	DRAIN PLUG
404	END BULB
405-A	LINKAGE SCREW
405-B	SCREEN DIAPH HEAD, LONG
405-C	SCREEN DIAPH HEAD, SHORT
405-D	SCREW PLUG, RELIEF VALVE
408-A	O RING, LOCKING NUT
408-B	O RING, LOCKING NUT
408-C	O RING, LOCKING NUT
405-J	DRIVE SCREW
309	M.T.E. LOGO

ITEM NO.	DESCRIPTION
252-E	FLANGED MOTOR DRIVE
252-F	FLANGED MOTOR DRIVE
252-G	FLANGED MOTOR DRIVE
252-H	FLANGED MOTOR DRIVE
252-I	FLANGED MOTOR DRIVE
252-J	FLANGED MOTOR DRIVE
252-K	FLANGED MOTOR DRIVE
252-L	FLANGED MOTOR DRIVE
252-M	FLANGED MOTOR DRIVE
252-N	FLANGED MOTOR DRIVE
252-O	FLANGED MOTOR DRIVE
252-P	FLANGED MOTOR DRIVE
252-Q	FLANGED MOTOR DRIVE
252-R	FLANGED MOTOR DRIVE
252-S	FLANGED MOTOR DRIVE
252-T	FLANGED MOTOR DRIVE
252-U	FLANGED MOTOR DRIVE
252-V	FLANGED MOTOR DRIVE
252-W	FLANGED MOTOR DRIVE
252-X	FLANGED MOTOR DRIVE
252-Y	FLANGED MOTOR DRIVE
252-Z	FLANGED MOTOR DRIVE

ITEM NO.	DESCRIPTION
253-A	DISCHARGE CARTRIDGE SPRING ASSY
253-B	DISCHARGE CARTRIDGE SPRING ASSY
253-C	DISCHARGE CARTRIDGE SPRING ASSY
253-D	DISCHARGE CARTRIDGE SPRING ASSY
253-E	DISCHARGE CARTRIDGE SPRING ASSY
253-F	DISCHARGE CARTRIDGE SPRING ASSY
253-G	DISCHARGE CARTRIDGE SPRING ASSY
253-H	DISCHARGE CARTRIDGE SPRING ASSY
253-I	DISCHARGE CARTRIDGE SPRING ASSY
253-J	DISCHARGE CARTRIDGE SPRING ASSY
253-K	DISCHARGE CARTRIDGE SPRING ASSY
253-L	DISCHARGE CARTRIDGE SPRING ASSY
253-M	DISCHARGE CARTRIDGE SPRING ASSY
253-N	DISCHARGE CARTRIDGE SPRING ASSY
253-O	DISCHARGE CARTRIDGE SPRING ASSY
253-P	DISCHARGE CARTRIDGE SPRING ASSY
253-Q	DISCHARGE CARTRIDGE SPRING ASSY
253-R	DISCHARGE CARTRIDGE SPRING ASSY
253-S	DISCHARGE CARTRIDGE SPRING ASSY
253-T	DISCHARGE CARTRIDGE SPRING ASSY
253-U	DISCHARGE CARTRIDGE SPRING ASSY
253-V	DISCHARGE CARTRIDGE SPRING ASSY
253-W	DISCHARGE CARTRIDGE SPRING ASSY
253-X	DISCHARGE CARTRIDGE SPRING ASSY
253-Y	DISCHARGE CARTRIDGE SPRING ASSY
253-Z	DISCHARGE CARTRIDGE SPRING ASSY

**MILTON ROY COMPANY**  
 PHILADELPHIA 18, PA.  
 ST. PETERSBURG 23, FLA.

DESCRIPTION: mROY PUMP - DUPLEX  
 Mod A, B METALLIC LIQUID ENDS

ITEM NO. 102-0082-000 ECU 1512

DATE: 4-5-64

SCALE: 1:1

REV. NO. 0

REV.	DATE	BY	APP.	REVISION
0	4-5-64	SCM		PATY: COR

REV.	DATE	BY	APP.	REVISION
0	4-5-64	SCM		PATY: COR

REV.	DATE	BY	APP.	REVISION
0	4-5-64	SCM		PATY: COR

REV.	DATE	BY	APP.	REVISION
0	4-5-64	SCM		PATY: COR

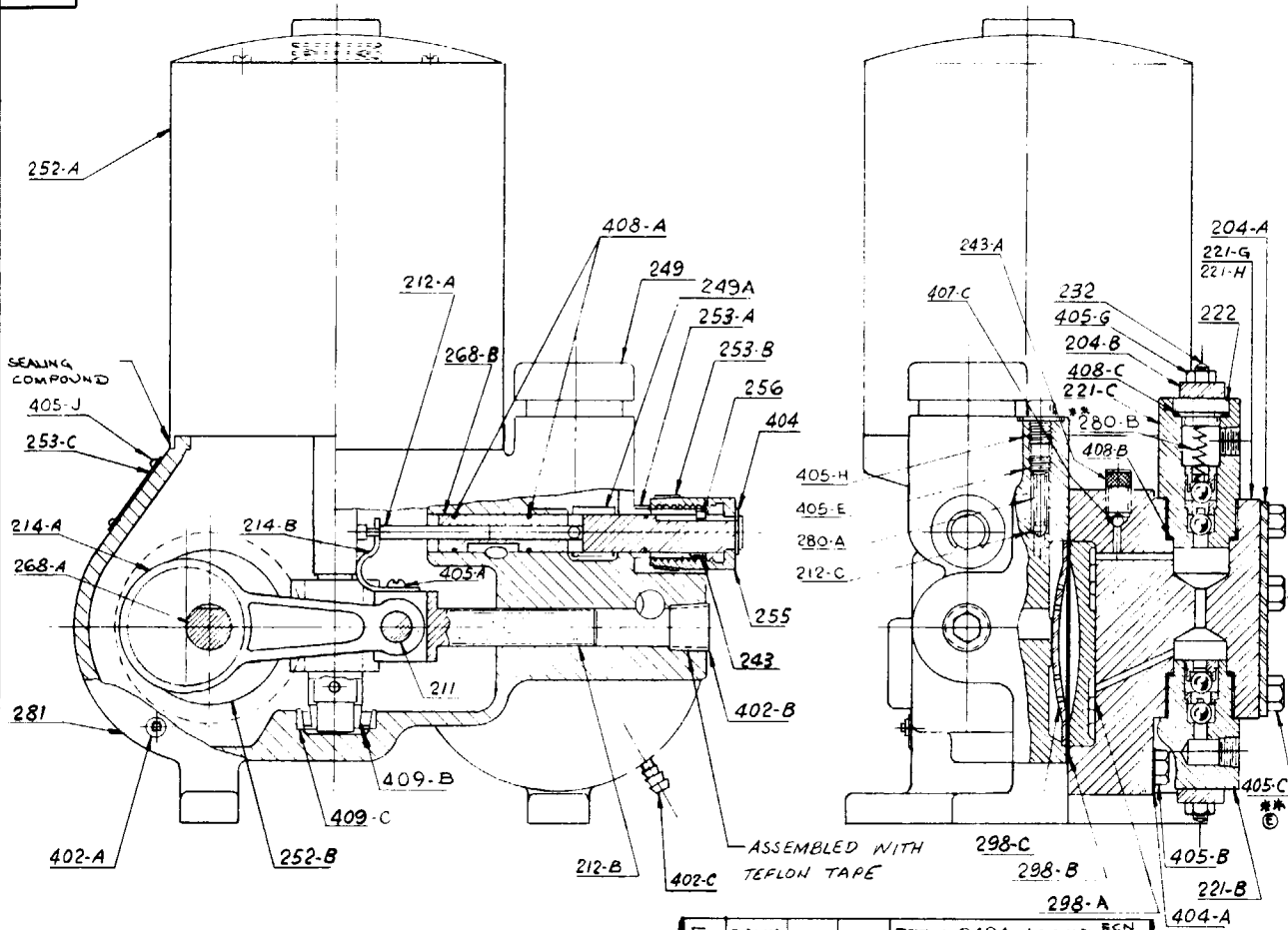
NOTE: \*\* DISCHARGE CARTRIDGE SPRING (ITEM NO. 280-B) SUPPLIED SEPARATELY. TO BE INSTALLED BY CUSTOMER ONLY IF DISCHARGE PRESSURE IS LESS THAN 50 PSI FOR MOD "A" & 70 PSI FOR MOD "B".

\* THESE ITEMS ONLY SUPPLIED AS AN ASSEMBLY

\*\* ITEM 409-B & 409-C AVAILABLE SEPARATELY OR AS AN ASSY (409-B + 409-C = ONE COMPLETE BEARING).

\*\*\* mROY MOD "A" RESERVOIR CAP IS PLASTIC AS ILLUSTRATED, mROY MOD "B" RESERVOIR COVER IS FLAT & METAL NOT SHOWN.

E



PART NO.	DESCRIPTION	PART NO.	DESCRIPTION
204-A	PLATE HEAD BACK-UP	253-A	CAPACITY CONTROL PLATE
204-B	PLATE COMPRESSION	253-B	KNOB GRADUATION PLATE
211	WRIST PIN	253-C	DATA PLATE
212-A	CONTROL PLUNGER	255	CONTROL KNOB
212-B	PLUNGER	256	SLEEVE SCREW
212-C	POPPET RELIEF VALVE	268-A	GEAR SHAFT
		268-B	CONTROL SPOOL
		280-B	DISCH. CART. SPRING ***
		281	MAIN HOUSING
280-A	SPRING RELIEF VALVE	298-A	CONTOUR PLATE
405-E	ADJ. SCREW REL VALVE	298-B	DIAPHRAGM
		298-C	CONTOUR PLATE
214-A	CONNECTING ROD	243A	DEFLECTION SLEEVE
214-B	LINKAGE ARM		
		402-A	DRAIN PLUG
		402-B	END PLUG
* 221-B	SUCTION CARTRIDGE ASSY CONSISTING OF:	404	'E' RING
		405-A	LINKAGE SCREW
221-D	BODY	405-B	SCREW-DIAPH. HD. SHORT
224	SEAT	405-C	SCREW-DIAPH. HD. LONG
292	RETAINER	405-J	DRIVE SCREW
407-B	BALL CHECK	405-G	NUT-STUD
		405-H	SCREW PLUG-RELIEF VALVE
* 221-C	DISCHARGE CART. ASSY CONSISTING OF:	408-A	'O' RING-CONTROL SPOOL
		408-B	'O' RING-CARTRIDGE
221-E	BODY	409-C	BEARING CUP ***
222	CAP	909	MILTON ROY LOGO
224	SEAT		
292	RETAINER	252-B	WORM GEAR
407-B	BALL CHECK	404-A	WASHER
408-C	'O' RING		
280-B	SPRING-DISCHARGE	221-G	DIAPH. HEAD ASSY CONSISTING OF:
232	STUD		
243	THREADED SLEEVE	221-H	DIAPH. HEAD
249	RESERVOIR CAP	243-A	PURGE PLUG
* 252-A	MOTOR WORM ASSY CONSISTING OF:	407-C	PURGE BALL CHECK
		408-C	TUBE CONNECTOR
228	MOTOR		
252-C	VWORM		
401-B	PIN		
409-B	BEARING CONE		

26

ASSEMBLED WITH  
TEFLON TAPE

\*\*\* FURNISHED ON 1/16-117/185 SPM UNITS ONLY  
 \*\*\* ITEM 409-B & 409-C AVAILABLE SEPARATELY OR AS AN ASSY (409B+409C = ONE COMPLETE BEARING)  
 \*\* DISCHARGE CARTRIDGE SPRING (ITEM NO. 280-B) SUPPLIED SEPARATELY. TO BE INSTALLED BY CUSTOMER ONLY IF DISCHARGE PRESSURE IS LESS THAN 50 PSI

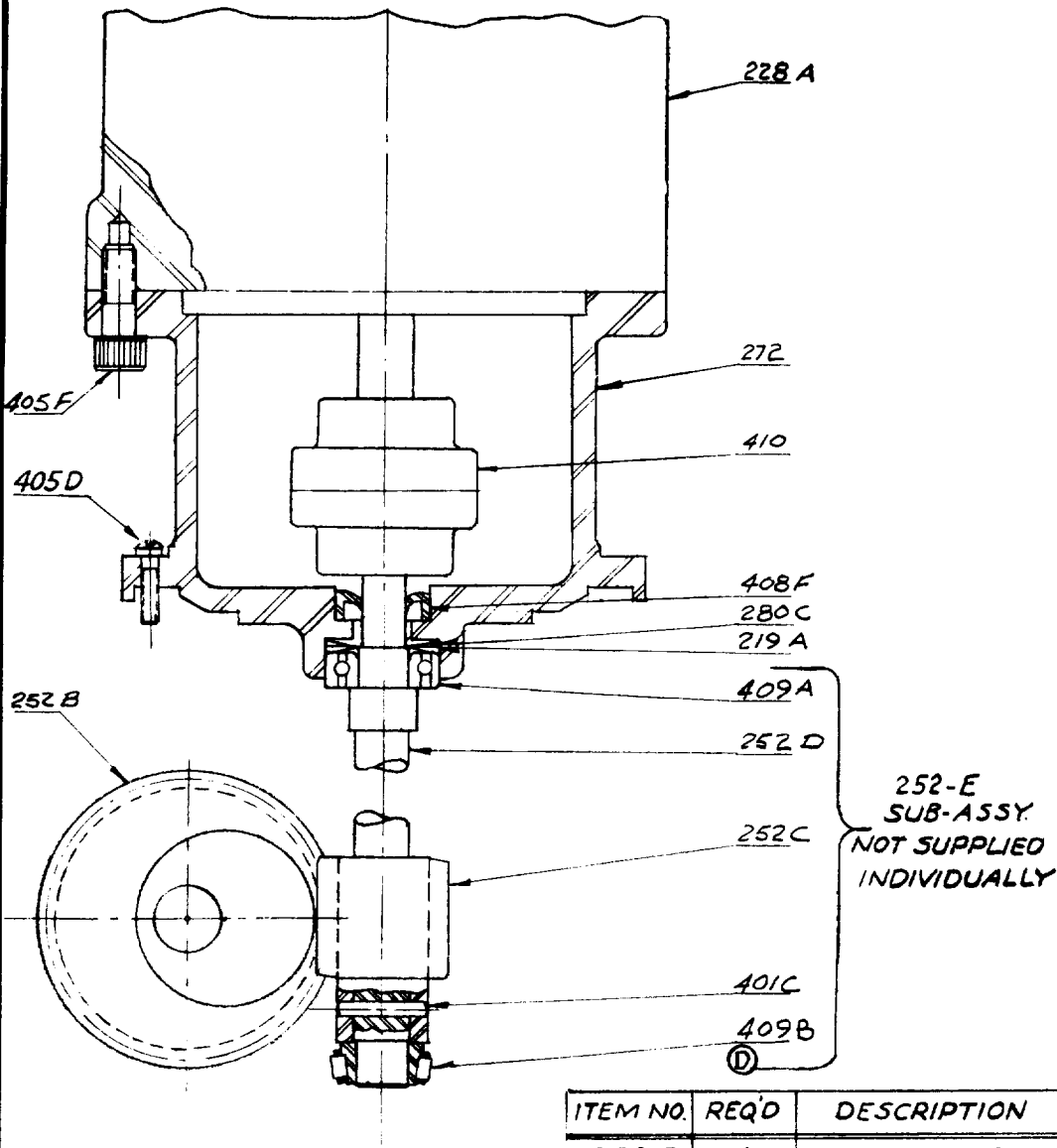
\* THESE ITEMS ONLY SUPPLIED AS AN ASSEMBLY

CHG.	DATE	BY	APPR.	REVISION
F	5-21-79	wed		ITEM 249A ADDED ECN 2335
E	8-1-77	KCC	WMA	ADDED ITEM ***
D	7-25-73	JPB	WMA	REVISED TO ADD PURGING DEVICE ECN 1988
C	9-10-65	JPB		ADDED ITEM 404-A
B	3-18-65	JTD		ITEM 219 SPACER DELETED NOT REQ. ON CASTINGS WITH INTEGRAL HUB MT 3
A	10-24-64	SM		ITEM 252-B WAS UNDER MOTOR ASSY

DESCRIPTION	SUPERSSEDES	DWN.	APPR.	DATE	SCALE	PATT. CODE
MILTON ROY PUMP - SIMPLEX-MOD. A - PLASTIC LIQUID END.	102-0123-000	SGM		4-6-64	~	

MILTON ROY COMPANY	
PHILADELPHIA 18, PA. ST. PETERSBURG 33, FLA.	
TITLE MILTON ROY SIMPLEX PUMP PARTS & ASSEMBLY DWG.	
DWG. NO. B-102-0292-000 (F)	

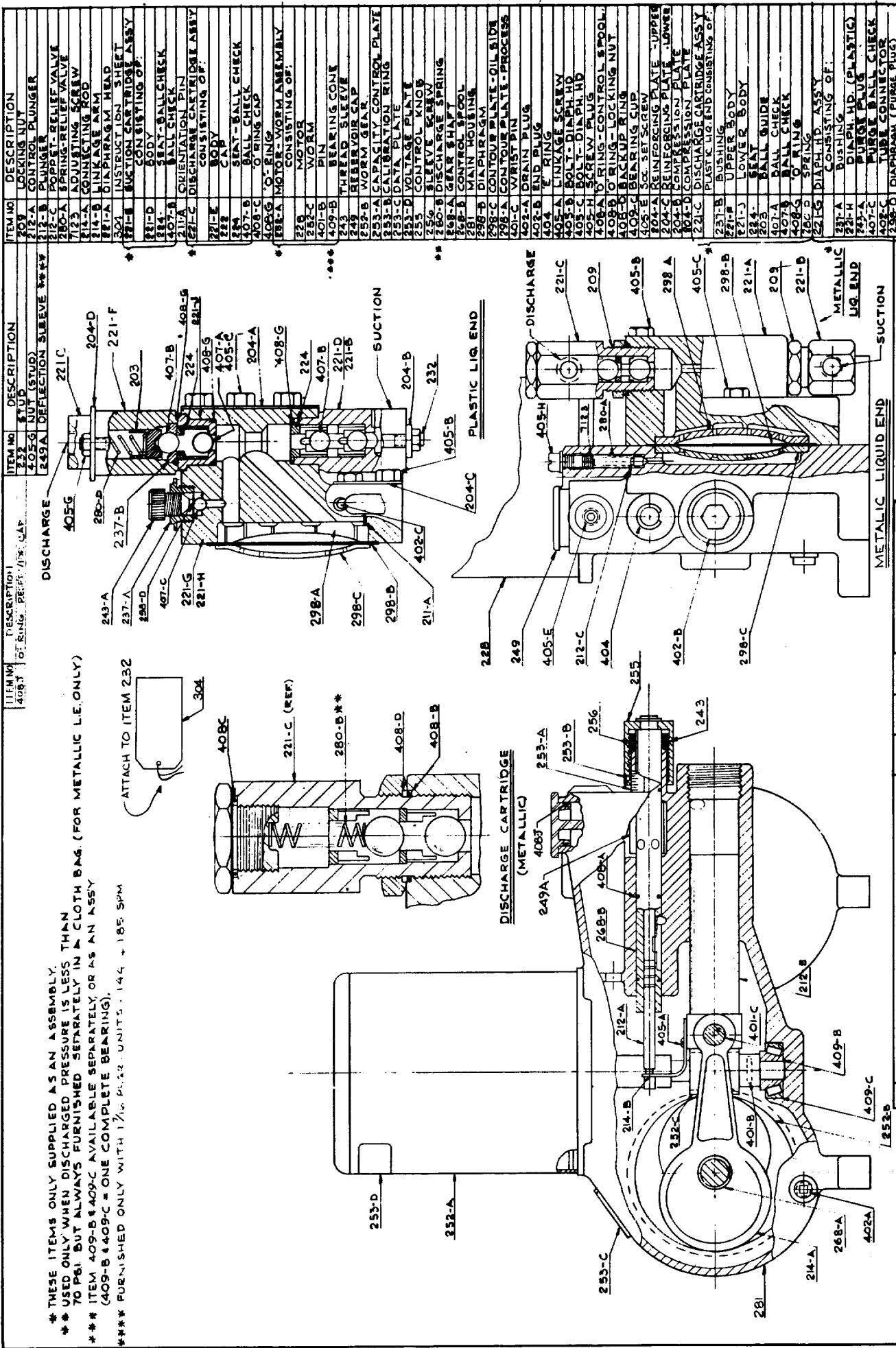
A-102-0086-000



ITEM NO.	REQ'D	DESCRIPTION
252-B	1	WORM GEAR
228 A	1	MOTOR
272	1	ADAPTER
410	1	COUPLING
408 F	1	SEAL
280 C	2	BELLEVILLE WASHER
219 A	1	FLAT WASHER
252 E	1	STUB SHAFT ASS'Y. CONSISTING OF;
252 D	1	DRIVE SHAFT
252 C	1	WORM
401 C	1	PIN
409 A	1	BALL BEARING.
409-B	1	BEARING CONE
405-F	4	BOLT
405-D	4	ADAPTER SCREW

<b>MILTON ROY COMPANY</b> PHILADELPHIA 18, PA. ST. PETERSBURG 33, FLA.		<b>TITLE</b> <i>M RBY FLANGED DRIVE ASSY &amp; PARTS</i> DWG. NO. <b>A-102-0086-000</b>	
DESCRIPTION NEMA 56 C FLANGE MOUNTED MOTORS - M ROY SIMPLEX & DUPLEX.		B/M (REF.) SUPERSEDES D. 102-0086-000 DATED 9-21-62 MAT'LTY	
DWN. /PS	APPR. /DATE	SCALE	PATT. CODE
		1/2" = 1'-0"	HALF
CHANGED TO INCORPORATE NEW MOTOR FLANGE ADAPTER DESIGN ITEM 409 WAS REF A NOT SUPP WITH ASSY.		MADE SUITABLE FOR BOTH SIMPLEX & DUPLEX PUMPS.	
CHG.	DATE	BY	APPR.
D	8-1-77	KCC	KM
C	4-22-69	J.E.M.	
B	10-25-64	GM	
A	3-15-63	J.E.M.	
REVISION			

K & E OF PA. NO. 198L



\* THESE ITEMS ONLY SUPPLIED AS AN ASSEMBLY.  
 \*\* USED ONLY WHEN DISCHARGED PRESSURE IS LESS THAN 70 PSI. BUT ALWAYS FURNISHED SEPARATELY IN A CLOTH BAG. (FOR METALLIC L.E. ONLY)  
 \*\*\* ITEM 409-B & 409-C AVAILABLE SEPARATELY OR AS AN ASSY (409-B & 409-C = ONE COMPLETE BEARING).  
 \*\*\*\* FURNISHED ONLY WITH 1/16 PL. 22 UNITS. 144 + 185. SPM

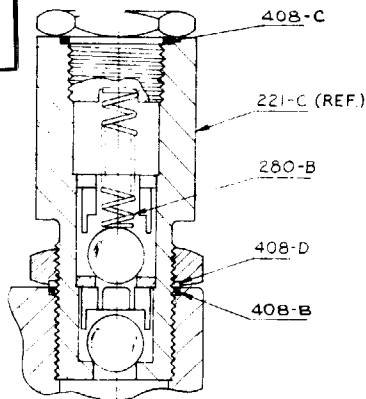
ITEM NO	DESCRIPTION	ITEM NO	DESCRIPTION
203	LINKAGE W/UT	203	LINKAGE W/UT
204	CONTROL PLUNGER	204	CONTROL PLUNGER
205	PLUNGER	205	PLUNGER
206	SPRING-RELIEF VALVE	206	SPRING-RELIEF VALVE
207	ADJUSTING SCREW	207	ADJUSTING SCREW
208	CONNECTING ROD	208	CONNECTING ROD
209	LINKAGE ARM	209	LINKAGE ARM
210	DIAPHRAGM HEAD	210	DIAPHRAGM HEAD
211	INSTRUCTION SHEET	211	INSTRUCTION SHEET
212	SUCTION CARTRIDGE ASSY	212	SUCTION CARTRIDGE ASSY
213	CONSISTING OF:	213	CONSISTING OF:
214	BODY	214	BODY
215	SEAT-BALL CHECK	215	SEAT-BALL CHECK
216	ORIENTATION PIN	216	ORIENTATION PIN
217	DISCHARGE CARTRIDGE ASSY	217	DISCHARGE CARTRIDGE ASSY
218	CONSISTING OF:	218	CONSISTING OF:
219	BODY	219	BODY
220	CAP	220	CAP
221	SEAT-BALL CHECK	221	SEAT-BALL CHECK
222	O-RING	222	O-RING
223	SEAT-BALL CHECK	223	SEAT-BALL CHECK
224	O-RING	224	O-RING
225	SEAT-BALL CHECK	225	SEAT-BALL CHECK
226	O-RING	226	O-RING
227	SEAT-BALL CHECK	227	SEAT-BALL CHECK
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229	SEAT-BALL CHECK	229	SEAT-BALL CHECK
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302	O-RING	302	O-RING
303	SEAT-BALL CHECK	303	SEAT-BALL CHECK
304	O-RING	304	O-RING

PRODUCT: MROY MOD B SIMPLEX PUMP  
 PLASTIC & METALLIC LIQ. END  
 W/ INTEG. MOTOR, PARTS & ASSY  
 DWG. NO. C-102-0988-000  
 SUPERSEDES C-102-0988-000  
 CHECKED: [Signature] DATE: 6-10-81  
 DRAWN: [Signature] DATE: 2/4/81  
 REVIS: [Signature] DATE: 6-10-81

REVISION	DATE	BY	CHKD	DATE
C	7-11-83	WAS		
B	2-11-83	WAS		
A	5-14-84	WAS		
	7-31-85	WAS		

CONFIDENTIAL  
 INFORMATION  
 NOT TO BE COPIED OR USED  
 WITHOUT WRITTEN CONSENT OF  
 MILITONROY COMPANY  
 TOLERANCES  
 UNLESS OTHERWISE SPECIFIED  
 FRACT. DECIMAL ANGULAR  
 + .1 - .04 + .005 - .1  
 DO NOT SCALE DRAWING  
 BREAK ALL SHARP CORNERS

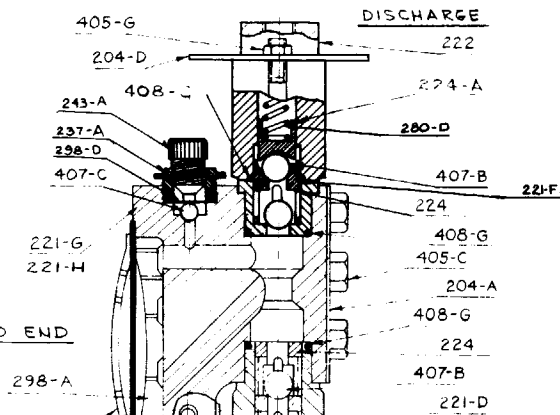
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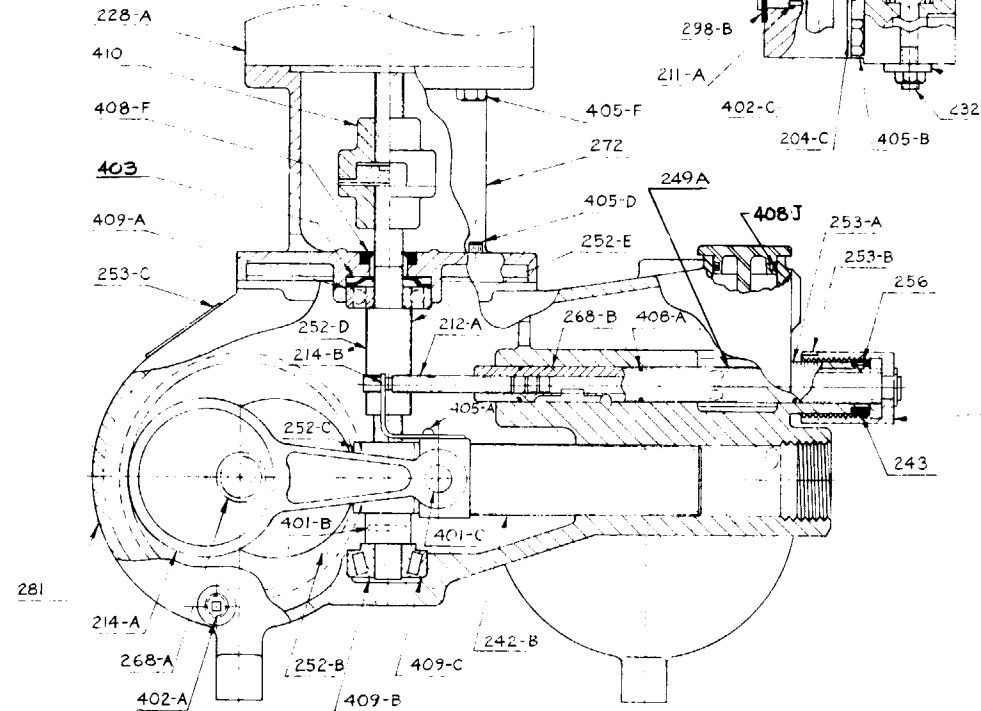
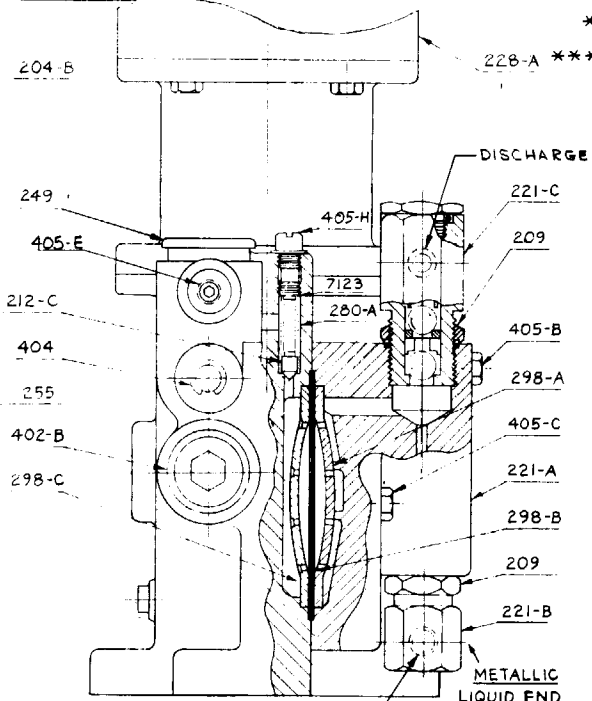
DISCHARGE CARTRIDGE

PLASTIC LIQUID END

DISCHARGE



SUCTION



ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION
* 221-C	DISCHARGE CARTRIDGE ASSY	209	LOCKING NUT
	PLASTIC LIQ. END	212-A	CONTROL PLUNGER
	CONSISTING OF:		
	212-B		PLUNGER
221-F	VALVE CARTRIDGE	212-C	POPPET RELIEF VALVE
222	VALVE CAP	220-A	SPRING RELIEF VALVE
224	SEAT	7123	ADJUSTING SCREW
224-A	BALL GUIDE	314-A	CONNECTING ROD
407-B	BALL CHECK	214-B	LINKAGE ARM
408-G	O'RING	221-A	DIAPHRAGM HEAD (METAL)
405-G	NUT STUD		
408-H	O'RING		
280-D	DISCHARGE SPRING	221-B	SUCTION CARTRIDGE ASSY
237-A	BUSHING		CONSISTING OF:
221-G	DIAPH. HEAD ASSY (PLASTIC)	221-D	BODY
	CONSISTING OF:	224	SEAT
	221-H	407-B	BALLCHECK
	DIAPHRAGM HEAD (PLASTIC)		
221-H	DIAPHRAGM HEAD (PLASTIC)	221-C	DISCH. CART. ASSY.
407-C	PURGE BALL CHECK		CONSISTING OF:
402-C	TUBE CONNECTOR	221-E	BODY
298-D	DIAPHRAGM (PURGE PLUG)	222	SEAT
		222	SEAT
		407-B	BALL CHECK
		408-C	O'RING-CAP
		220-A	MOTOR
		252-E	SHAFT-WORM ASSEMBLY
			CONSISTING OF:
		252-D	SHAFT
		252-C	WORM
		401-B	PIN
		409-B	BEARING CONE
		409-A	BALL BEARING
		403	FINGER SPRING WASHER
		252-B	WORM GEAR
		243	THREADED SLEEVE
		253-A	CAPACITY CONTROL PLATE
		253-B	CALIBRATION RING
		253-C	DATA PLATE
		255	CONTROL KNOB
		256	SLEEVE SCREW
		260-A	GEAR SHAFT
		268-B	CONTROL SPOOL
		272	ADAPTER FLANGE
		249	RESERVOIR CAP
		281	MAIN HOUSING
		280-B	DISCHARGE SPRING **
		298-B	DIAPHRAGM
		298-C	CONTOUR PLATE-OIL SIDE
		298-A	CONTOUR PLATE-PROCESS SIDE
		401-C	WRIST PIN
		402-A	DRAIN PLUG
		402-B	END PLUG
		404	E'RING
		405-H	SCREW PLUG
		405-A	LINKAGE SCREW
		405-B	BOLT-DIAPH. HD.
		405-C	BOLT-DIAPH. HD.
		405-F	BOLT-FLANGE MTG.
		405-P	BOLT-MOTOR MTG.
		408-A	O'RING-CONTROL SPOOL
		408-B	O'RING-LOCKING NUT
		408-D	BACK UP RING
		408-F	OIL SEAL
		409-C	BEARING CUP
		410	COUPLING
		204-A	PLATE-HEAD BACK-UP-UPPER
		204-C	PLATE-HEAD BACK-UP-LOWER
		204-B	PLATE-COMPRESSION
		204-D	DISC-COMPRESSION
		211-A	ORIENTATION PIN
		232	STUD
		249A	DEFLECTION SLEEVE ***
		408-J	O'RING-RESERVOIR CAP
		405-E	LOC. SET SCREW

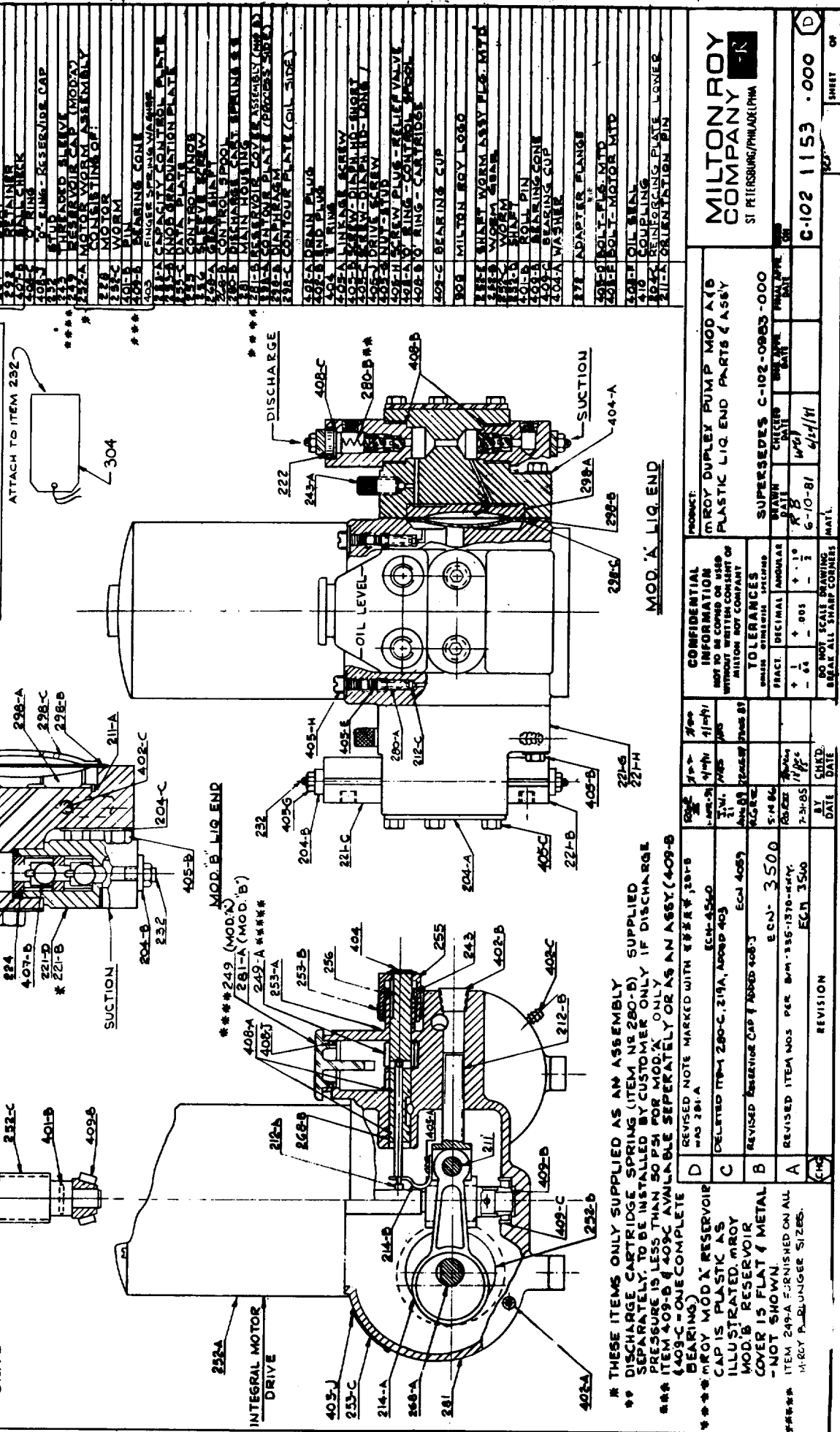
\* THESE ITEMS ONLY SUPPLIED AS AN ASSEMBLY  
 \*\* USED ONLY WHEN DISCHARGE PRESSURE IS LESS THAN 70 P.S.I. BUT ALWAYS FURNISHED. (FOR METALLIC L.E. ONLY)

\*\*\* ITEM 409-B AND 409-C AVAILABLE SEPARATELY OR AS AN ASSY (401 + 409-C = ONE COMPLETE BEARING)  
 \*\*\*\* FURNISHED ONLY WITH 1 7/16" PLGR UNITS-144 & 1855PM

<p>REVISION</p> <p>BY DATE</p> <p>CHK'D DATE</p> <p>APP'D DATE</p>		<p><b>CONFIDENTIAL INFORMATION</b></p> <p>NOT TO BE COPIED OR USED WITHOUT WRITTEN CONSENT OF MILTON ROY COMPANY</p> <p><b>TOLERANCES</b></p> <p>UNLESS OTHERWISE SPECIFIED</p> <table border="1"> <tr> <th>FRACT</th> <th>DECIMAL</th> <th>ANGULAR</th> </tr> <tr> <td>+ 1/64</td> <td>+ .005</td> <td>+ 10'</td> </tr> <tr> <td>- 0.001</td> <td>- 0.002</td> <td>- 7'</td> </tr> </table> <p>DO NOT SCALE DRAWING          BREAK ALL SHARP CORNERS</p>			FRACT	DECIMAL	ANGULAR	+ 1/64	+ .005	+ 10'	- 0.001	- 0.002	- 7'	<p>PRODUCT: mROY PUMP MOD "B" NEMA 56C FLANGED DR.</p> <p>mROY SIMPLEX PUMP</p> <p>PARTS AND ASSEMBLY DWG.</p> <p>SUPERSEDES C-102-0987-000</p> <table border="1"> <tr> <th>DRAWN DATE</th> <th>CHECKED DATE</th> <th>ENG APPR DATE</th> <th>FINAL APPR DATE</th> <th>USED ON</th> </tr> <tr> <td>RG 6-10-81</td> <td>WJD 6/24/81</td> <td></td> <td></td> <td></td> </tr> </table>		DRAWN DATE	CHECKED DATE	ENG APPR DATE	FINAL APPR DATE	USED ON	RG 6-10-81	WJD 6/24/81				<p><b>MILTON ROY COMPANY</b></p> <p>ST PETERSBURG/PHILADELPHIA</p> <p>C-102-1154-000</p>	
FRACT	DECIMAL	ANGULAR																									
+ 1/64	+ .005	+ 10'																									
- 0.001	- 0.002	- 7'																									
DRAWN DATE	CHECKED DATE	ENG APPR DATE	FINAL APPR DATE	USED ON																							
RG 6-10-81	WJD 6/24/81																										
<p>REVISION</p> <p>BY DATE</p> <p>CHK'D DATE</p> <p>APP'D DATE</p>		<p>ECN 4059</p> <p>J.W. 21 4/30/89</p> <p>HRS 2241689</p> <p>HRS 2241689</p> <p>ECN 3759</p> <p>R.G.R. 10 5-14-80</p> <p>HRS 14116</p>			<p>DELETED ITEM 280-C, 214-A, ADDED 403</p> <p>DELETED ITEM NO. 909, ADDED ITEM NO. 405E</p> <p>REVISED RESERVOIR CAP, ADDED 408-J. REVISED TO COMPLY W/ BM 335-1370-XXY. ECN 3500</p>		<p>SCALE</p> <p>SHEET OF</p>																				

29

ITEM NO.	DESCRIPTION	QUANTITY
201	REINFORCING PLATE UPPER	1
202	COMPRESSION PLATE	1
203	WASHER	2
204	WASHER	2
205	WASHER	2
206	WASHER	2
207	WASHER	2
208	WASHER	2
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349	WASHER	2
350	WASHER	2



\* THESE ITEMS ONLY SUPPLIED AS AN ASSEMBLY  
 \*\* DISCHARGE CARTRIDGE SPRING (ITEM NO 280-B) SUPPLIED SEPARATELY TO BE INSTALLED BY CUSTOMER ONLY IF DISCHARGE PRESSURE IS LESS THAN 50 PSI FOR MOD. A ONLY  
 \*\*\* ITEM 409-B & 409-C AVAILABLE SEPARATELY OR AS AN ASSEMBLY (409-B & 409-C - GASKET COMPLETE)  
 \*\*\*\* MROY MOD. A RESERVOIR CAP IS PLASTIC AS ILLUSTRATED. MROY MOD. B RESERVOIR COVER IS FLAT & METAL - NOT SHOWN.  
 \*\*\*\*\* ITEM 249-A FURNISHED ON ALL MROY PUMP UNITS.

CONFIDENTIAL INFORMATION		TOLERANCES	
DO NOT SCALE DRAWING	USE DIMENSIONS ON DRAWING	FRACTIONAL	DECIMAL
BREAK ALL SHARP CORNERS	USE DIMENSIONS ON DRAWING	+ .005	+ .005
		- .005	- .005

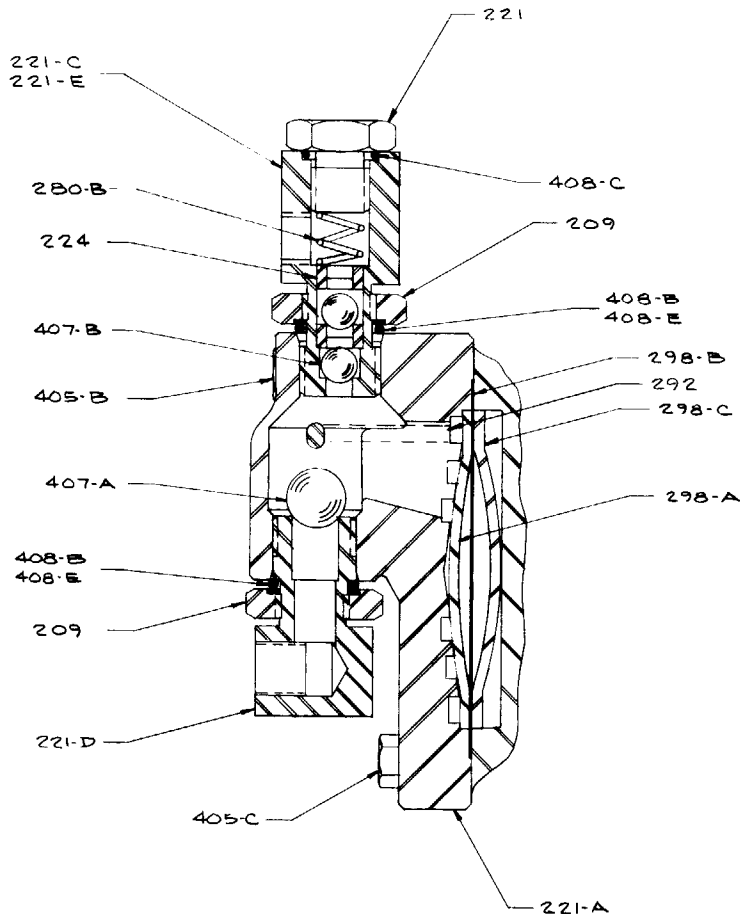
REV.	DATE	BY	CHKD.	DATE
D	5-14-64	WJH	WJH	
C	7-31-65	WJH	WJH	
B	8-2-65	WJH	WJH	
A	7-31-65	WJH	WJH	

REV.	DATE	BY	CHKD.	DATE
D	5-14-64	WJH	WJH	
C	7-31-65	WJH	WJH	
B	8-2-65	WJH	WJH	
A	7-31-65	WJH	WJH	

MILROY PUMP MOD. A-D		SUPERSEDES C-102-0983-000	
PLASTIC LIQ. END PARTS & ASSEMBLY	DATE	DATE	DATE
	6-10-61	4/1/61	

**MILROY COMPANY**  
 ST. PETERSBURG, FLORIDA

J



ITEM	DESCR. DN
209	LOCK NUT
221-A	DIAPHRAGM HEAD
221-C	DISCHARGE CART. ASSY.
221-D	SUCTION CART. BODY
221-E	BODY
222	CAP
224	SEAT
280-B	SPRING
* 292	BALL STOP PIN
298-A	CONTOUR PLATE - PROCESS SIDE
298-B	DIAPHRAGM
298-C	CONTOUR PLATE - OIL SIDE
405-B	BOLT - DIAPH. HD. LONG
405-C	BOLT - DIAPH. HD. SHORT
407-A	BALL CHECK - 5/8
407-B	BALL CHECK - 3/8
408-B	"O" RING - CARTRIDGE
408-C	"O" RING - DISCH. CART. BODY
408-E	SPIRAL RING

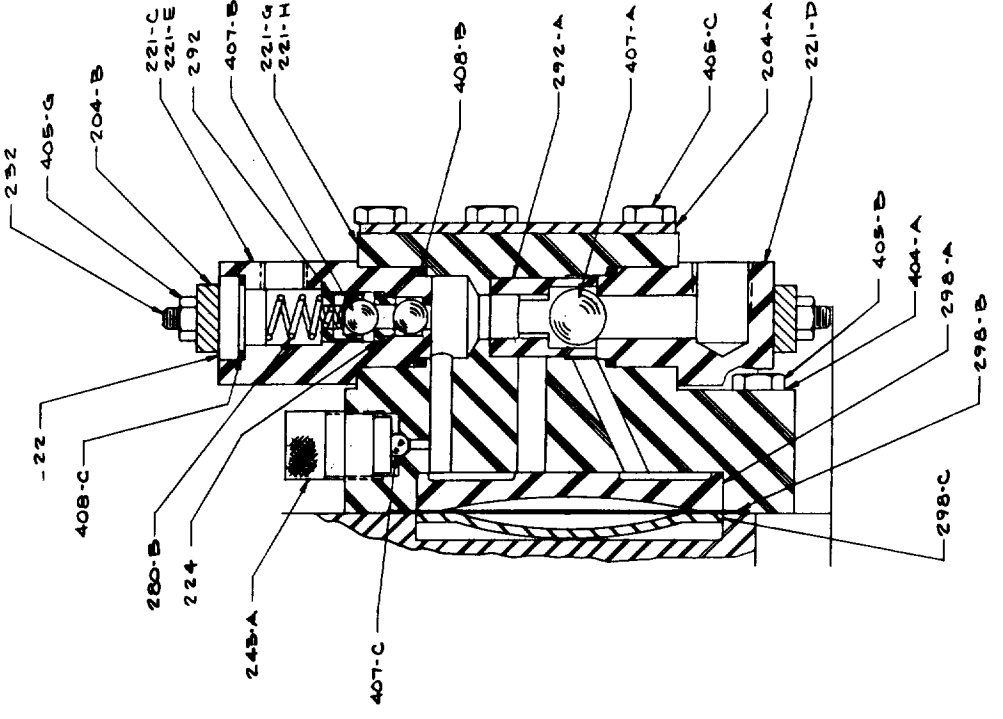
\* ITEM 292 BALL STOP PIN USED ONLY ON CAST IRON HEAD (PIN IS CASTED IN PLACE ON S.S. & CA-20 HEAD)

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				<b>CONFIDENTIAL INFORMATION</b> NOT TO BE COPIED OR USED WITHOUT WRITTEN CONSENT OF MILTON ROY COMPANY			250/ RMS Unless Otherwise Noted			<b>Milton Roy Company</b> Flow Control Division Ivyland, PA	
B REV. DWG. TO MATCH MACHINE PART ECH-4640				J.W. TO JUL 91	R.D. 23 JUL 91	J.P.S. 1-29-91	ASSY. DWG. M ROY A METALLIC "P" PUMP LIQUID END			USED ON C-102-1408-000	
A ISSUED				J.W. 11-2-91			TOLERANCES UNLESS OTHERWISE SPECIFIED	DRAWN DATE J. WILSON 21 MAY 85	CHECKED DATE	ENG APPR DATE	MAT'L
CHG. DESCRIPTION				BY DATE	CHK'D DATE	APP'D DATE	± 1/64    ± .005    ± 1/2°	DO NOT SCALE DRAWING		SCALE	SHEET OF
REVISIONS											B



K



ITEM	DESCRIPTION
204-A	PLATE - HEAD BACK-UP
204-B	PLATE - COMPRESSION
221-C	DISCHARGE CAST. ASS'Y.
221-D	SUCTION CAST. BODY
221-E	BODY
221-G	DIAPHRAGM HEAD ASS'Y.
221-H	DIAPHRAGM HEAD
222	CAP
224	SEAT-BALL CHECK
292	STUD
248-A	PURGE PLUG
280-B	DISCHARGE CAST. SPRING
292	RETAINER
292-A	BALL LIMIT CAGE
298-A	CONTOUR PLATE
298-B	DIAPHRAGM
298-C	CONTOUR PLATE
402-C	TUBE CONNECTOR (NOT SHOWN)
404-A	WASHER
405-B	BOLT-DIAPH. HD. SHORT
405-C	BOLT-DIAPH. HD. LONG
405-G	NUT - STUD
407-A	BALL CHECK - M/B
407-B	BALL CHECK - W/S
407-C	PURGE BALL CHECK
408-B	O'RING - CARTRIDGE
408-C	O'RING - DISCHARGE CAST. BODY

**Milton Roy Company**  
Flow Control Division  
Iryland, PA

ASS'Y. DWG. M ROY A  
PLASTIC PUMP  
LIQUID END

250 / RMB Unless Otherwise Noted	
CHECKED DATE	17 MAY 85
DRAWN DATE	17 MAY 85
APP'D DATE	
BY	

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TOLERANCES UNLESS OTHERWISE SPECIFIED	
FRACT.	ANGULAR
± 1/64	± 1/2°
± .003	

ISSUED	DESCRIPTION
DATE	REVISIONS

DATE	DESCRIPTION	REVISIONS

C-102-1407-000	SCALE	SHEET	OF
4			



# **MILTON ROY**

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Ivyland, PA 18974-0577

(215) 441-0800

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**A Sundstrand Subsidiary**



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