



OPERATION MANUAL

FRONT TANK



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FRONT TANK USE

Hayes Spraying Front Tank Assemblies in most cases will replace a front weight kit for your tractor.

While not in use as a chemical tank, it is advisable to half fill the tank with water to gain the best performance and ride from your tractor.

Please refer to your tractor manual for recommended weights to place on the front of the tractor.

When using the front tank to spray in tandem with a rear tank, you need to empty the front tank last.

This will avoid the tractor becoming tail heavy.

FRONT TANK ASSEMBLY FULL INCLUSIONS

Chassis

Fully welded C section or flat bar construction, painted with chemical resistant two pack paint. The chassis will vary depending on the make and model of the tractor.

Tank Frame

The tank frame is welded or bolted to the chassis and is the same on all models. Attached to the tank frame are the following:

Tank

Tank sizes include the following 650L, 850L, and 900L twin tanks or 1200L, and 1500L single tanks.

Tanks are yellow polyethylene tanks with hinged lid and filling strainer.

Cleanwater Container

20L freshwater container with tap for hand washing.

Pump

Hydraulic driven Hypro centrifugal pump with single or twin tank plumbing.

Filtration System

18 mesh basket filter & 2 x 80 mesh pressure filters

Spotlight Mount

MAINTENANCE

Check the chassis bolts that mount the frame to the tractor after the first 50 hours.

Check every 500 after. If replacing chassis bolts, ensure the bolts are no less than metric grade 10.9.

SETTING UP THE HYPRO HYDRAULIC DRIVE PUMP

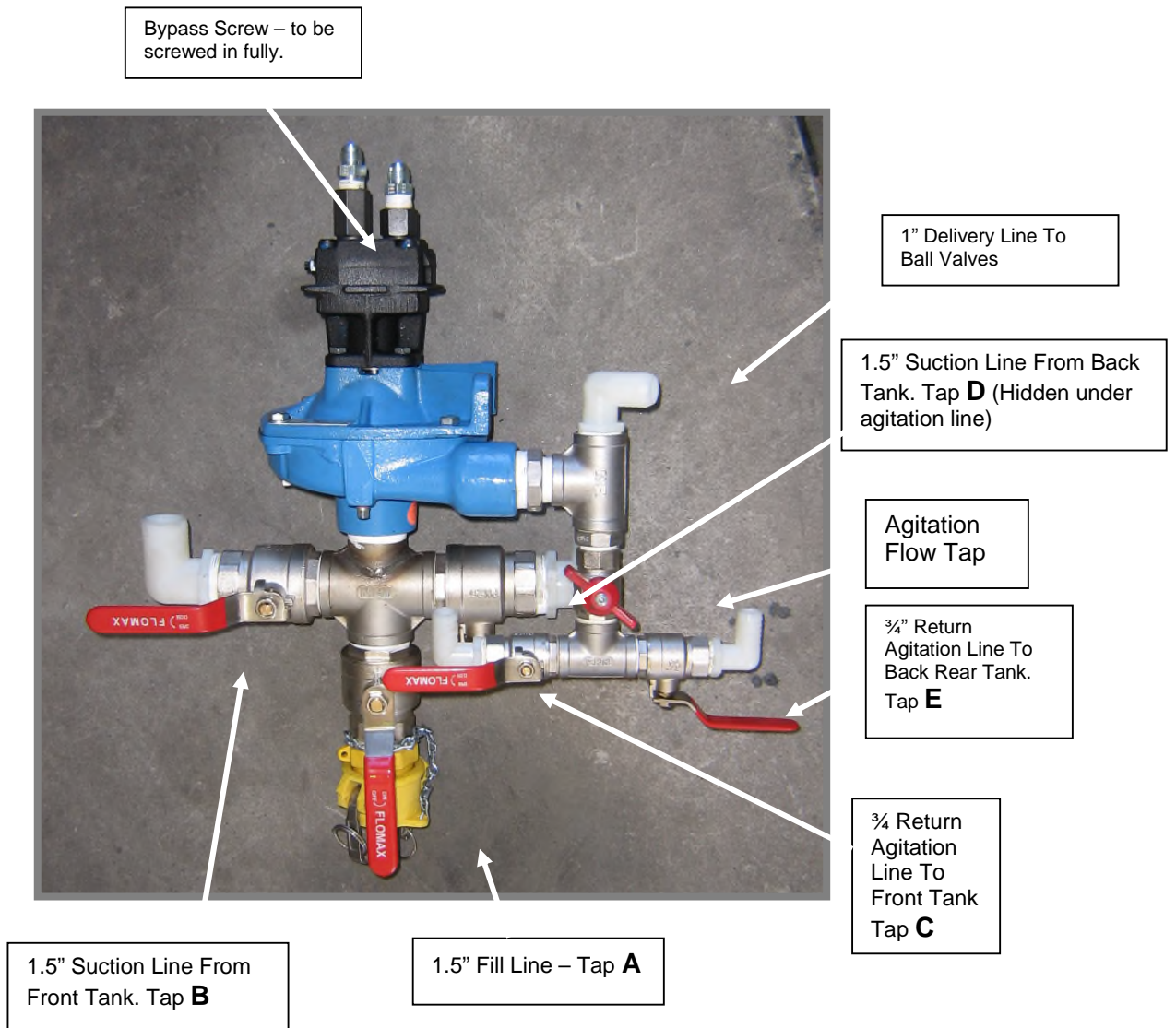
For the best care and ensuring a long life of your Hypro pump please follow the directions as listed. Please note that Hypro pump life will be greatly reduced and higher maintenance required if operated at excessive pressures.

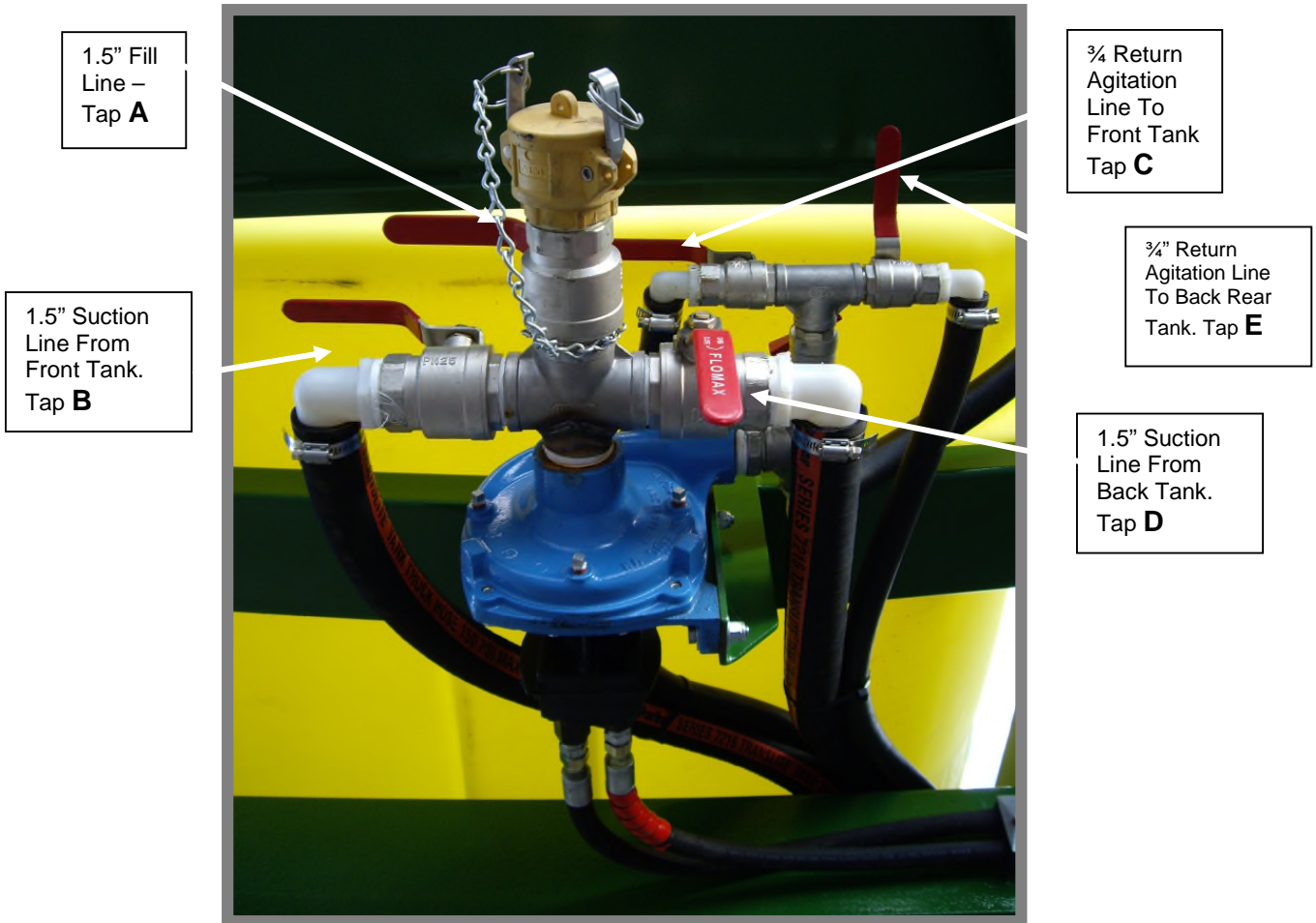
1. The Hypro pump return line hydraulic hose should be connected to a free flow return, not the breakaway couplings. "Tank" is written on the return port of the Hypro pump. The pressure line hydraulic hose is connected to the breakaway couplings and is identified by spiral guard on it.
2. Ensure filters are clean.
3. Set main bypass/ agitation ball valve at pump for the chemical you are using. Eg approx ¼ turn open for glyphosate. This valve should never be fully open or fully closed whilst spraying.
4. Set hydraulics to slow / low flow
5. Turn spray controller on (if fitted) and open regulator valve fully, by pressing console to manual operation and pressing the + key for 7 seconds. Turn all boom sections and master switch on.
6. Engage Hypro pump hydraulics and increase hydraulic flow until desired maximum spray pressure is achieved.
Do not exceed 5 bar pressure when spray nozzles are on or spraying.
Do not exceed 6 bar pressure when the spray nozzles are off.
7. Low pressure warning alarm set up (if installed).
Close the regulator valve by pressing the – key on the controller (spraying pressure will drop) until 12 – 15 psi is displayed on gauge. Next adjust the pressure switch (below & behind pressure gauge) with small screw driver until alarm beeps at approximately 1 bar pressure (12 – 15 psi). Make sure master switch and boom section switches are turned on, check alarm setting by cycling pressure up and down using the + & - keys on the controller in the manual position.
8. The alarm serves to notify the operator that the tank level is low and the pump is starting to suck air.
9. Please note Hypro pumps cannot be run dry or the mechanical seal will be damaged. Shut pump down immediately when pressure drops below 1 bar. Centrifugal pumps need fluid to pump effectively and cannot pump air.
10. Bypass screw is required to be screwed the entire way in so pump has the full flow oil when used with closed centre hydraulic systems.

FILLING THE TANK USING TWIN TANK PLUMBING

1. Connect the 1.5" fill hose to the fill point and turn on Tap A -
2. Fill the front tank - Tap B & C are open and that Taps D & E are shut.
3. Fill the rear tank – Tap D & E are open and Taps B & C are shut.
4. When full close Tap A.
5. Leave Tap D & E open to spray rear tank out first.

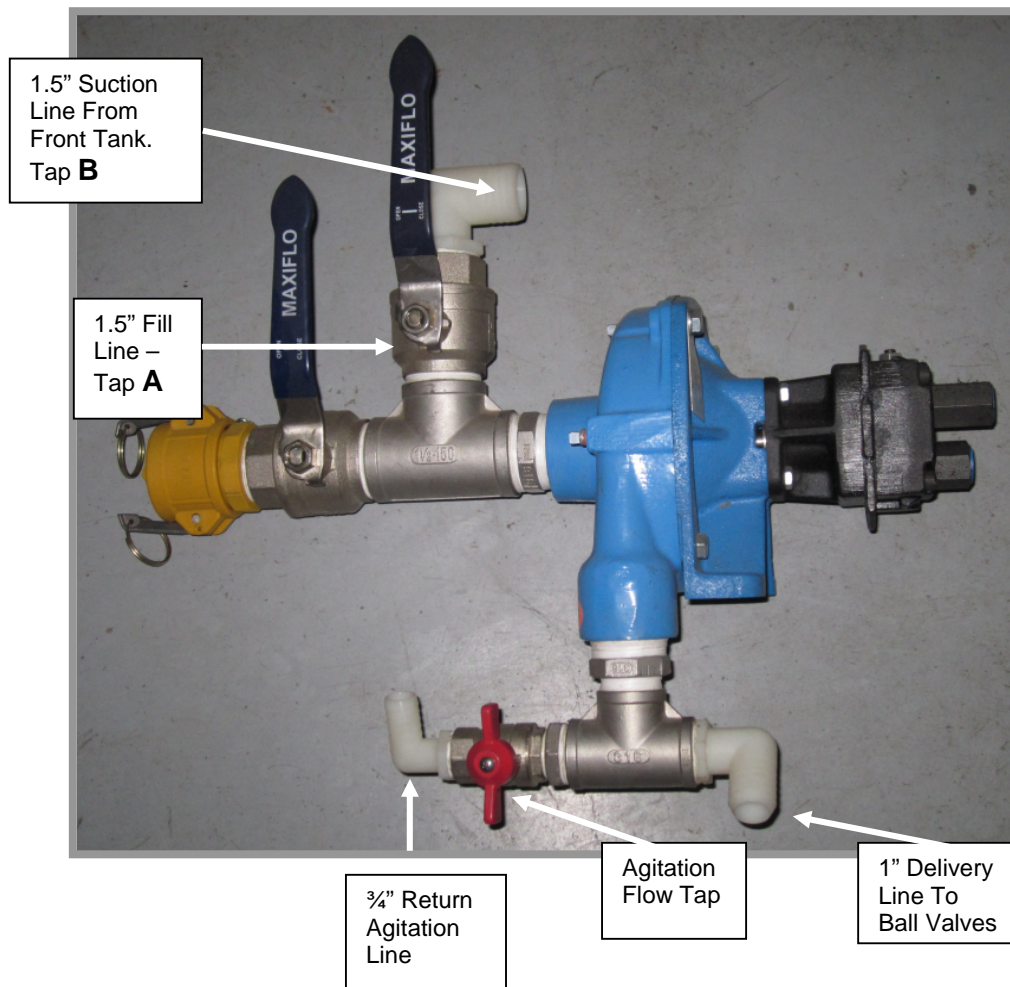
Following are 2 diagrams with different views of the plumbing.





FILLING THE TANK USING SINGLE TANK PLUMBING

1. Connect the 1.5" fill hose to fill camlock and turn on Tap A and B.
2. When full shut Tap A.
3. Leave Tap B open ready for spraying.

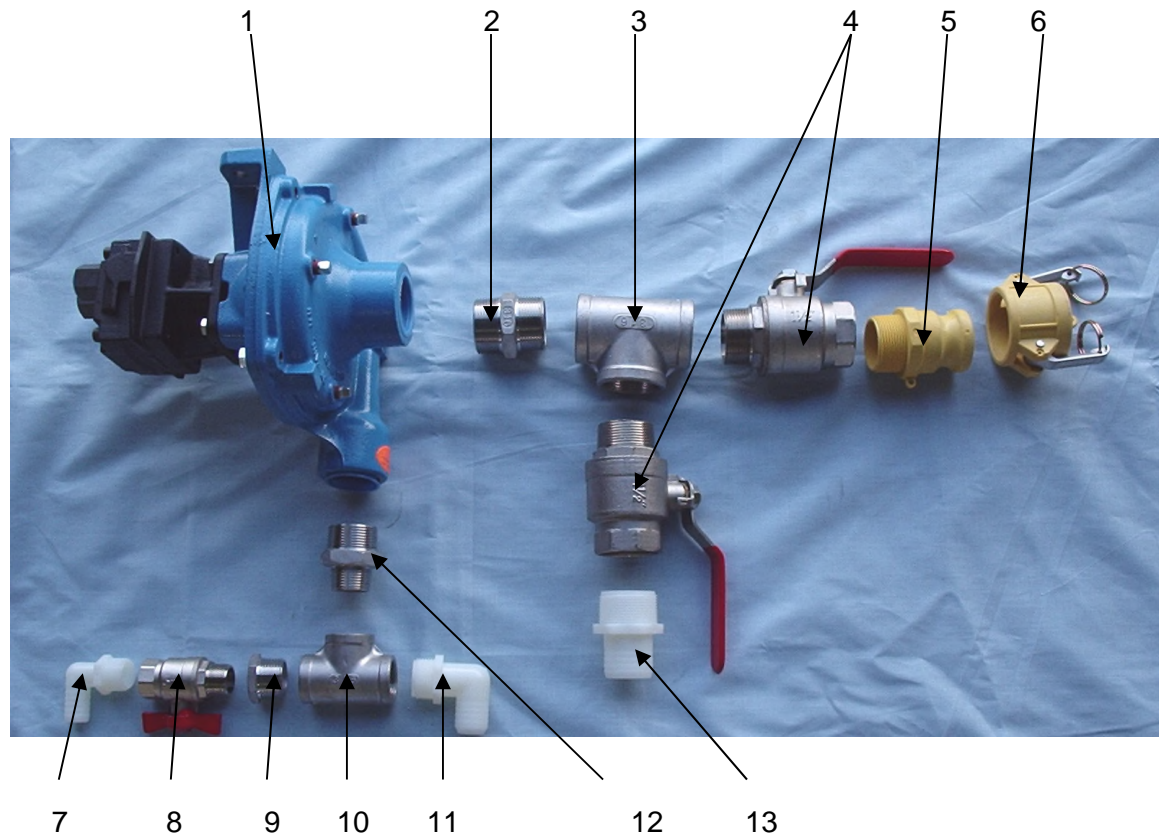


HOSE KIT AND PLUMBING FOR FRONT TANK

For all options, the hydraulic hoses are run along the left side of the tractor; to the remotes and oil dump at the rear.

Single Tank Plumbing

A single 1" pressure line is run along the left side of the tractor to the rear. This goes to the ball valve or regulator valve which is mounted on the tractor. The line goes from these valves to the boomspray.



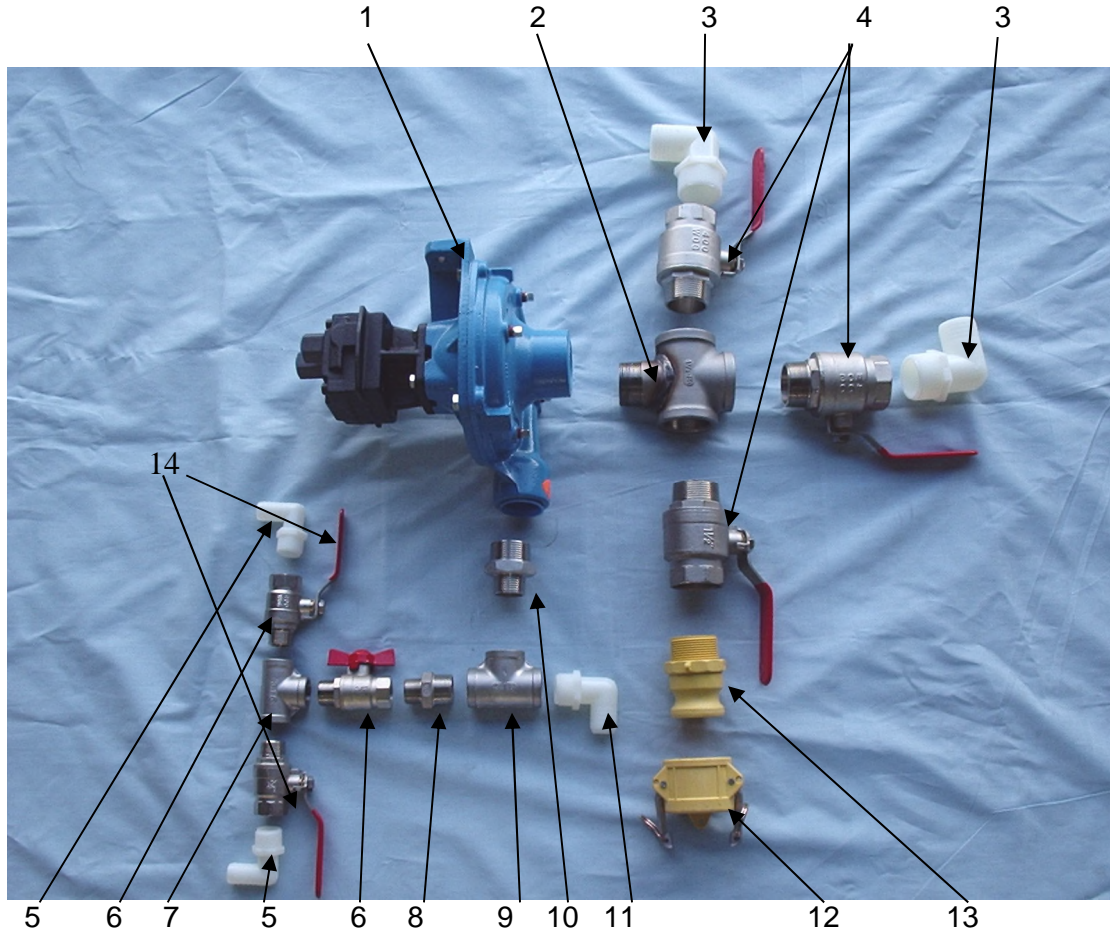
ITEM	PART NO.	DESCRIPTION
1	HP – 9303C-HM4	HYPRO PUMP AND HYDRAULIC MOTOR
2	SF – SS2708	1 ½ NIPPLE S/STEEL
3	SF – SS3508	1 ½ TEE S/STEEL
4	BV – 38MF	1 ½ BALL VALVE M/F NICKEL
5	NY – 40F	1 ½ MALE CAMLOCK MALE BSP
6	NY – 40DC	1 ½ CAMLOCK CAP
7	NF – EL3434	¾ X ¾ HB X BSP ELBOW
8	BV – 20MF	¾ BALL VALVE M/F NICKEL
9	SF – SS2412	1 X ¾ REDUCING BUSH S/STEEL
10	SF – SS3506	1 X TEE S/STEEL
11	NF – EL1010	1 X 1 HB X BSP ELBOW NYL
12	SF – SS7311	1 ¼ X 1 REDUCING NIPPLE S/STEEL
13	NF – A112	1 ½ X 1 ½ HB X BSP NYL

*Item 1. Illustrates a cast iron pump, however a stainless steel pump is preferred.

Twin Tank Plumbing

A single 1" pressure line is run along the left side of the tractor to the rear. This goes to the ball valve or regulator valve which is mounted on the tractor. The line goes from these valves to the boomspray.

There is an additional 1.5" suction / fill line and 3/4" pressure agitation line which is run along the right side of the tractor to the rear. This connects directly to an additional tank mounted on the boomspray. This feature enables the rear tank to be filled and pumped from the front.



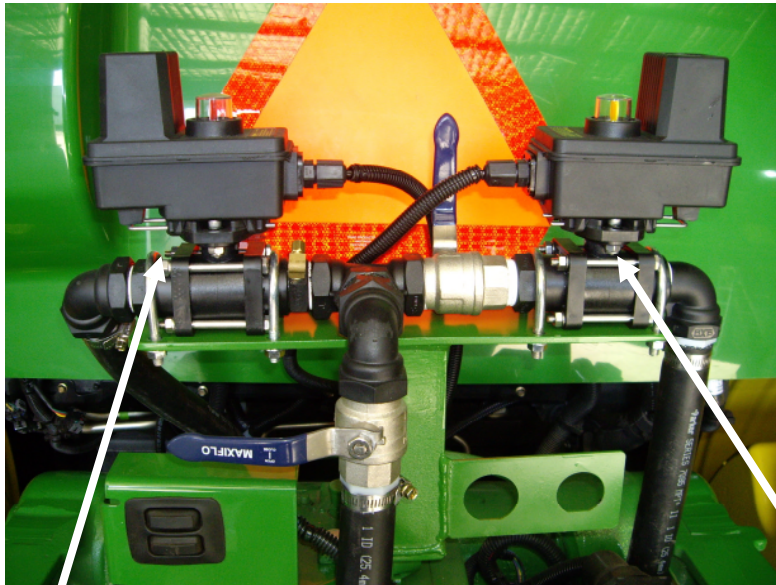
ITEM	PART NO.	DESCRIPTION
1	HP – 9303C-HM4	HYPRO PUMP AND HYDRAULIC MOTOR
2	SF – SS40CRMF	1 ½ CROSS M/F S/STEEL
3	NF – EL112	1 ½ X 1 ½ HB ELBOW NYL
4	BV – 38MF	1 ½ BALL VALVE M/F NICKEL
5	NF – EL3434	¾ X ¾ HB ELBOW NYL
6	BV – T20MF	¾ BALL VALVE M/F NYL T HANDLE
7	SF – SS305	¾ TEE S/STEEL
8	SF – SS7309	1 X ¾ REDUCING NIPPLE S/STEEL
9	SF – SS3506	1 TEE S/STEEL
10	SF – SS7311	1 ¼ X 1 REDUCING NIPPLE S/STEEL
11	NF – EL1010	1 X 1 ELBOW HB NYL
12	NY – 40DC	1 ½ CAMLOCK CAP
13	NY – 40F	1 ½ MALE CAMLOCK MALE BSP
14	BV – 20MF	¾ BALL VALVE MF

*Item 1. Illustrates a cast iron pump, however a stainless steel pump is preferred.

REAR TRACTOR PLUMBING

The control valves for the boomspray are mounted on the rear of the tractor

- **Regulating Valve** (Red Directional Marker) – used to control the pressure given differing speeds.
- **Ball Valve** or On/Off Valve (Yellow Directional Marker)



Ball Valve

Regulating Valve

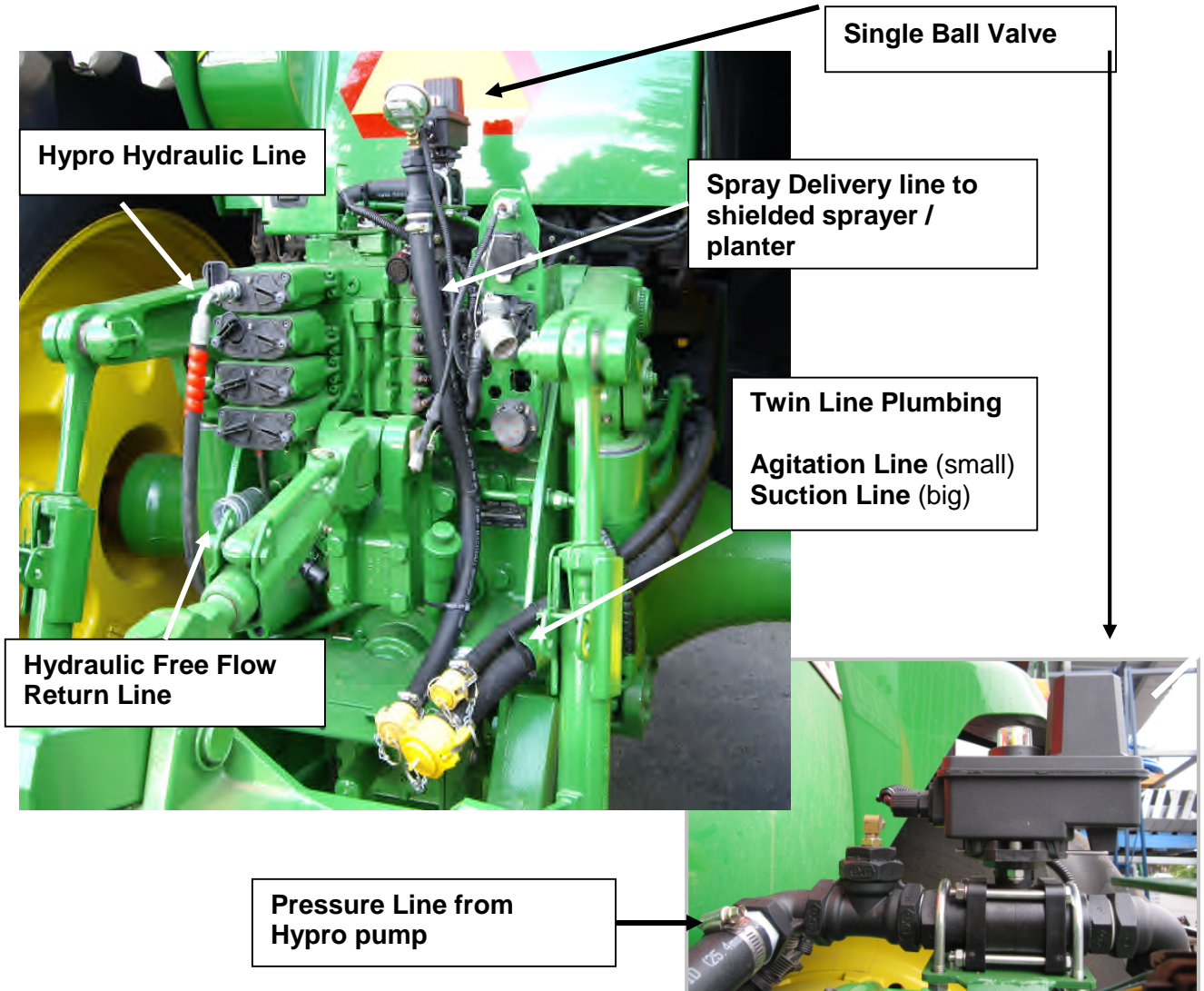
Flow Meters – measures litres per minute (LPM)



When using a Teejet 844-E automatic controller, the flowmeter and regulator valve will be mounted on the rear of the tractor joined to the single 1" pressure line down the left side. The pressure line from the regulation valve connects to the sprayer.

Shielded Sprayer's and Planters – Manual Control

A single ball valve can be mounted for manual control of shielded sprayers or planters. When used for shielded sprayers, the 1" pressure line is connected to the ball valve then to the sprayer. In this case no regulating valve is required to be fitted because hydraulic flow is used to control the pressure (in tractors where hydraulic flow can be controlled in cab).

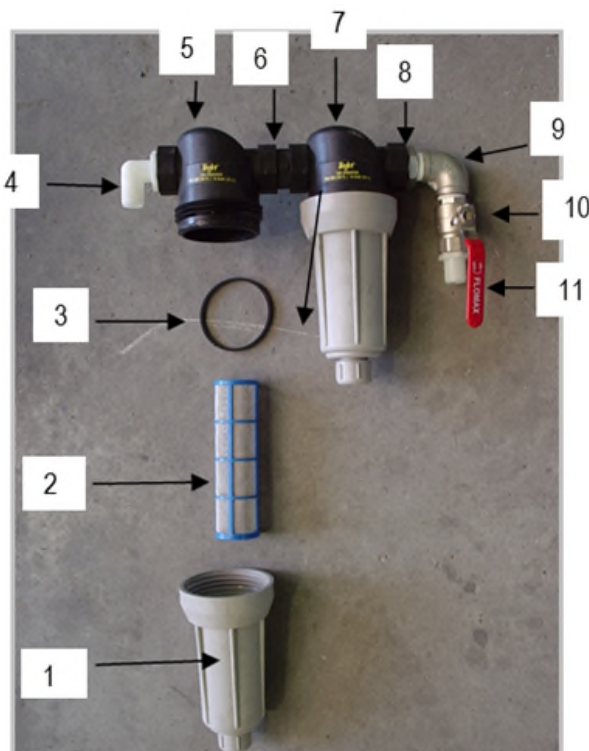


Pressure control is determined by oil flow which is controlled by the tractor hydraulic flow controls.

When using both the automatic and manual control valves together, the hose from the regulation valve is connected to the ball valve and then to the boomspray.

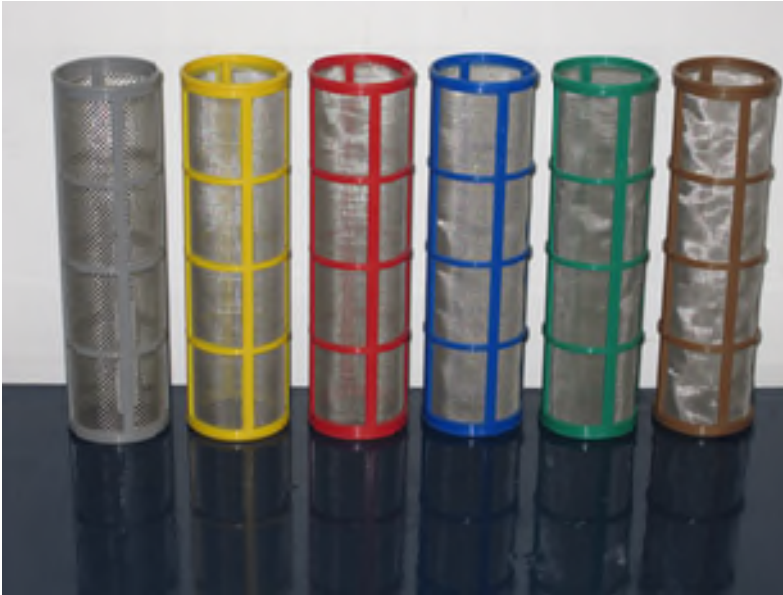
FILTRATION SYSTEM

The filtration system is made up of 2 inline Teejet strainer filters that are plumbed into the delivery line. The strainers come in various colours depicting the size screens. These screens should be cleaned regularly for optimum performance. If the filters are dirty it can affect the water rates and spray line pressures.



1. SS-CP48654-PP Strainer Bowl Grey 126 Series 1-1/4 BSP
2. SS-CP15941-4 Strainer Screen 124NY 80 Mesh (now yellow)
3. SS-CP48656-EPDM Gasket for 126 Filter 1-1/4 & 1-1/2
4. Nf-el1140 Nylon Elbow 1-1/4 BPSM x1 HB
5. SS-CPB63065-1-1 Strainer Head PP 126 Series 1-1/4 BSP
6. BP-SHN32 Poly Nipple BSP 1-1/4
7. SS-AAB126-5-80 Line Strainer 1-1/4 Complete
8. SF-SS2415 Bush Reducing S/Steel 1-1/4x1
9. SF-SS2511 Elbow S/Steel MF 1 BSP
10. BV-25MF Ball Valve Brass MF 1 BSP
11. NF-A1010 Nylon Fitting 1 Male x 1 HB

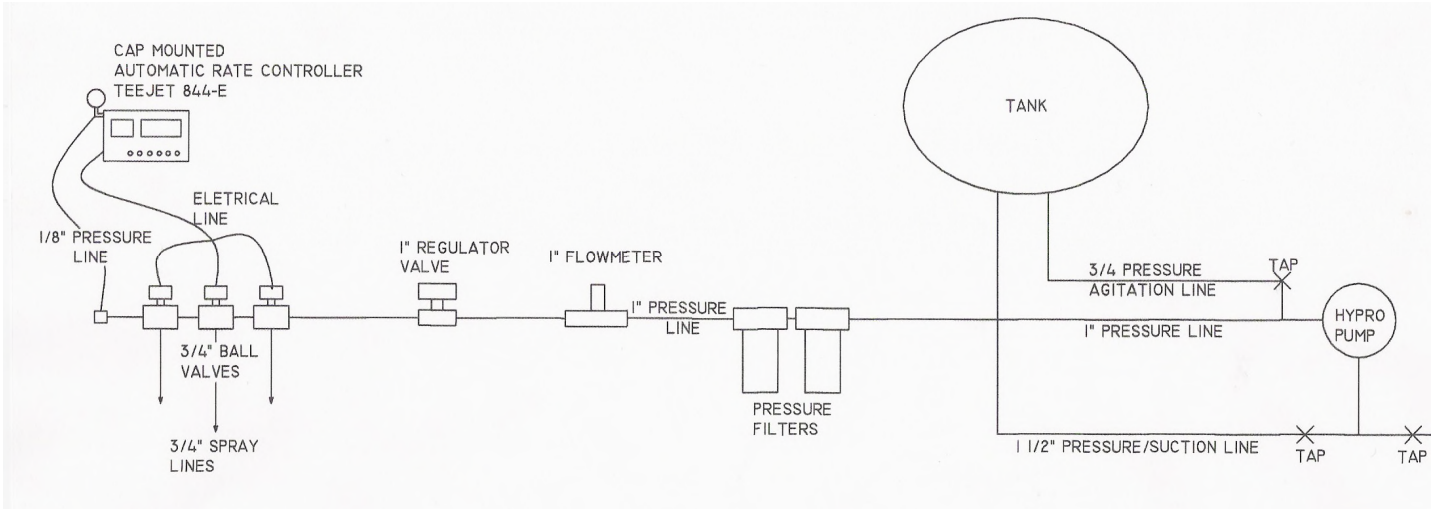
FILTRATION SYSTEM



- Grey – Size 16 Mesh (now brown-red)
- Yellow – Size 30 Mesh (now flame-red)
- Red – Size 50 Mesh (now blue)
- Blue – Size 80 Mesh (now yellow)
- Green – Size 100 Mesh
- Brown – Size 120 Mesh

To keep the pump from running at its optimum level the filters should be checked regularly. When using dirtier water sources they should be checked more frequently. To clean just run them under running water or in a bucket till the screens are clean.

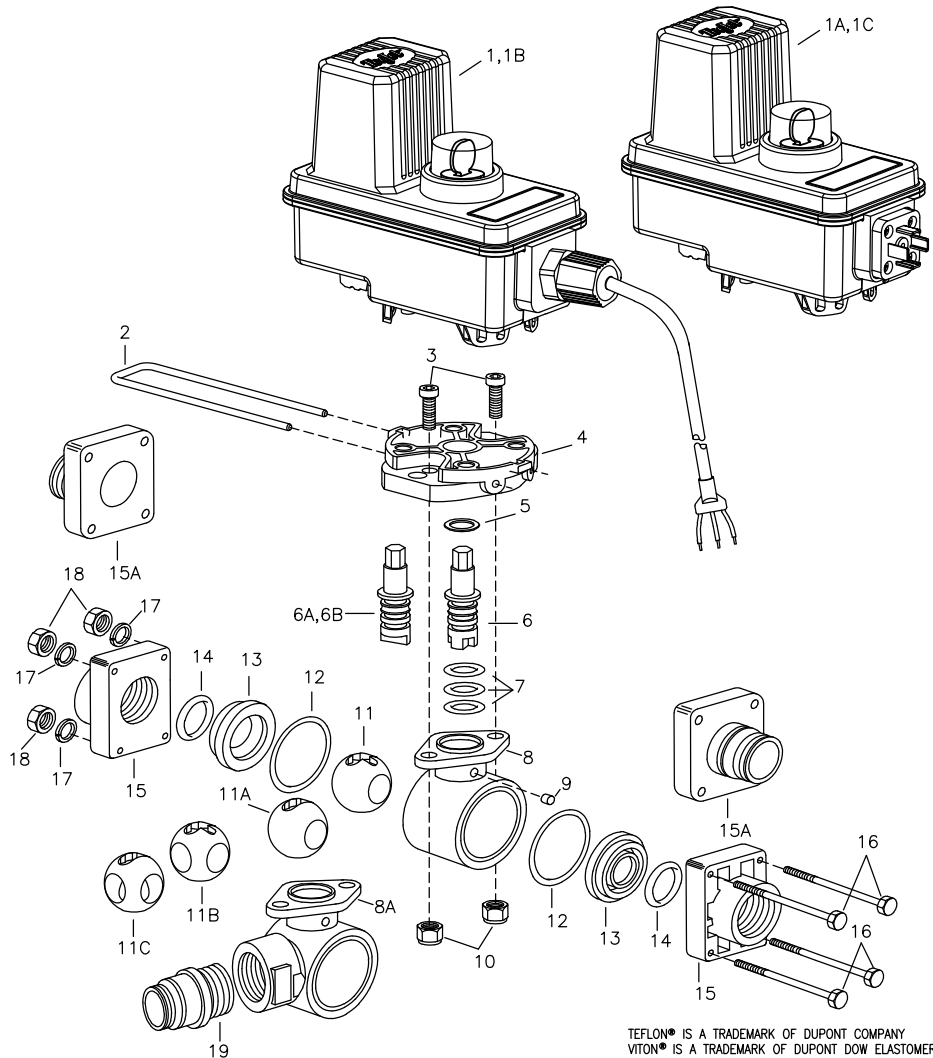
PLUMBING DIAGRAM





APPENDICES

- **Hypro Series 9300 Hydraulically Driven Centrifugal Pumps – L-1526 1/10**
Installation, Operation, Repair and Parts Manual
- **Teejet 344BE & 344BEC Electric Shut Off Valve**
Parts List
- **Teejet 344BRL Electric Regulating Valve**
Parts List
- **Teejet 801 Flow Meter**
Parts List




TEFLON® IS A TRADEMARK OF DUPONT COMPANY
 VITON® IS A TRADEMARK OF DUPONT DOW ELASTOMERS

ITEM	PART NO.	DESCRIPTION		
1	50515-22CP03 ■	BEC MOTOR, 22-RPM (0.7-SEC), 0.3-METER CABLE, POSITIVELY SWITCHED		
	50515-22CP05 ■	BEC MOTOR, 22-RPM (0.7-SEC), 0.5-METER CABLE, POSITIVELY SWITCHED		
	50515-22CP15 ■	BEC MOTOR, 22-RPM (0.7-SEC), 1.5-METER CABLE, POSITIVELY SWITCHED		
	50515-22CP60 ■	BEC MOTOR, 22-RPM (0.7-SEC), 6.0-METER CABLE, POSITIVELY SWITCHED		
1A	50515-22DP ■	BEC MOTOR, 22-RPM (0.7-SEC), DIN CONNECTION, POSITIVELY SWITCHED		
	50533-22C03	BE MOTOR, 22-RPM (0.7-SEC), 0.3-METER CABLE		
1B	50533-22C05	BE MOTOR, 22-RPM (0.7-SEC), 0.5-METER CABLE		
	50533-22C15	BE MOTOR, 22-RPM (0.7-SEC), 1.5-METER CABLE		
	50533-22C60	BE MOTOR, 22-RPM (0.7-SEC), 6.0-METER CABLE		
1C	50533-22D	BE MOTOR, 22-RPM (0.7-SEC), DIN CONNECTION		
2	CP50517-SSPV	RETAINING CLIP, 304 STAINLESS STEEL		
3	CP26197-7/8-SS	SOCKET HEAD CAP SCREW, STAINLESS STEEL (2 REQ'D)		
4	CP50514-PP	MOTOR ADAPTER, POLYPROPYLENE (BLACK)		
*	5	CP20125-TEF	THRUST WASHER, TEFLON	
	6	CP56613-SS	STEM, 303 STAINLESS STEEL (FOR POLYPROPYLENE BALL)	
	6A	CP56615-SS	STEM, 303 STAINLESS STEEL (FOR 2-WAY STAINLESS STEEL BALL)	
	6B	CP56725-SS	STEM, 303 STAINLESS STEEL (FOR 3-WAY STAINLESS STEEL BALL)	
	7	CP7717-M12X2.5-VI	O-RING, VITON (3 REQ'D)	
	8	CP20101-NYB	BODY, NYLON (BLACK) (2-WAY)	
	8A	CP20102-3/4-NYB	BODY, NYLON (BLACK) (3-WAY, 3/4" NPT THREAD)	
		CPB20102-3/4-NYB	BODY, NYLON (BLACK) (3-WAY, 3/4" BSPT THREAD)	
		CP20102-1-NYB	BODY, NYLON (BLACK) (3-WAY, 1" NPT THREAD & QUICK CONNECT)	
		CPB20102-1-NYB	BODY, NYLON (BLACK) (3-WAY, 1" BSPT THREAD)	
*	9	CP20126-FELT	DUST PLUG, FELT	
	10	CP38435-1/4-SSNY	ELASTIC LOCKNUT, STAINLESS STEEL (2 REQ'D)	
	11	CP20106-1-PP	BALL, POLYPROPYLENE (WHITE) (2-WAY)	
	11A	CP19926-SS	BALL, STAINLESS STEEL (2-WAY)	
	11B	CP20109-1-PP	BALL, POLYPROPYLENE (WHITE) (3-WAY)	
	11C	CP45510-1-SS	BALL, STAINLESS STEEL (3-WAY)	
	12	CP20564-VI	GASKET, VITON (2 REQ'D)	
	13	CP20103-TEF	SEAL, TEFLON (2 REQ'D)	
	*	14	CP7717-2-213-VI	O-RING, VITON (2 REQ'D)
		15	CP20104-3/4-NYB	END CAP, NYLON (BLACK) (3/4" NPT THREAD) (2 REQ'D)
CPB20104-3/4-NYB			END CAP, NYLON (BLACK) (3/4" BSPT THREAD) (2 REQ'D)	
CP20104-1-NYB			END CAP, NYLON (BLACK) (1" NPT THREAD) (2 REQ'D)	
CPB20104-1-NYB			END CAP, NYLON (BLACK) (1" BSPT THREAD) (2 REQ'D)	
15A		CP45514-NYB	END CAP, NYLON (BLACK) (QUICK CONNECT) (2 REQ'D)	
16		CP20129-SS	BOLT, 1/4"-20 X 3" HEX, STAINLESS STEEL (4 REQ'D)	
17		CP20128-SS	LOCK WASHER, 1/4", STAINLESS STEEL (4 REQ'D)	
18		CP8535-SS	NUT, 1/4"-20 HEX, STAINLESS STEEL (4 REQ'D)	
19		CP45526-NYB	THREADED QUICK CONNECT ADAPTER, NYLON (BLACK) (3-WAY ONLY)	
20	56601-_-_-_-	VALVE BODY SUB-ASS'Y, SPECIFY OUTLET SIZE & BALL MATERIAL, INCLUDES ITEMS 3-19		
AB344AE-KIT, SPARE PARTS KIT (INCLUDES ALL ITEMS MARKED WITH *)				

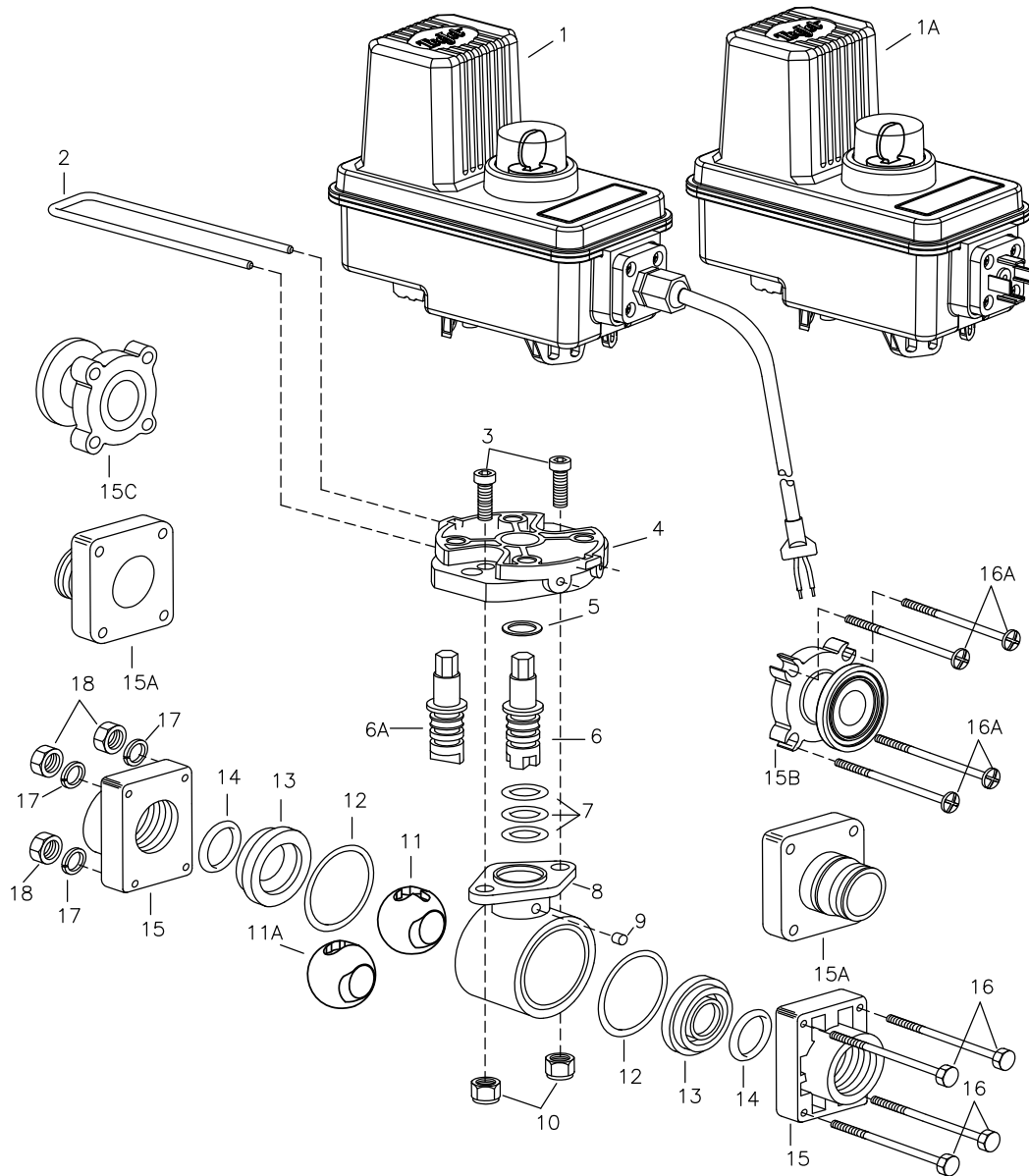
NOTE: (B) IN PART NUMBER INDICATES B.S.P.T INLET AND OUTLET CONNECTIONS
 ■ NOTE: FOR NEGATIVELY SWITCHED MOTORS SPECIFY "N" RATHER THAN "P" IN MOTOR PART NUMBER
 EXAMPLE: 50515-22CN05

DESCRIPTION:
 344BE AND 344BEC
 DIRECTVALVE®
 ELECTRIC SHUT-OFF
 BALL VALVE



Spraying Systems Co.®
 Spray Nozzles and Accessories
 P.O. Box 7900 - Wheaton, IL 60189-7900

Rev. No. 3	PARTS LIST PL344BEC
Ref.	SHEET OF



ITEM	PART NO.	DESCRIPTION	
1	50516-01C--	REGULATING MOTOR, 1-RPM, (18-SEC), 2-WIRE JACKETED CABLE	
	50516-03C--	REGULATING MOTOR, 3-RPM, (6-SEC), 2-WIRE JACKETED CABLE	
	50516-06C--	REGULATING MOTOR, 6-RPM, (3-SEC), 2-WIRE JACKETED CABLE	
1A	50516-01D	REGULATING MOTOR, 1-RPM, (18-SEC), DIN CONNECTION	
	50516-03D	REGULATING MOTOR, 3-RPM, (6-SEC), DIN CONNECTION	
	50516-06D	REGULATING MOTOR, 6-RPM, (3-SEC), DIN CONNECTION	
2	CP50517-SSPV	RETAINING CLIP, 304 STAINLESS STEEL	
3	CP26197-7/8-SS	SOCKET HEAD CAP SCREW, STAINLESS STEEL (2 REQ'D)	
4	CP50514-PP	MOTOR ADAPTER, POLYPROPYLENE (BLACK)	
*	5	CP20125-TEF	THRUST WASHER, TEFLON
6	CP56613-SS	STEM, 303 STAINLESS STEEL (FOR POLYPROPYLENE BALL)	
6A	CP56615-SS	STEM, 303 STAINLESS STEEL (FOR STAINLESS STEEL BALL)	
*	7	CP7717-M12X2.5-VI	O-RING, VITON (3 REQ'D)
8	CP20101-NYB	BODY, NYLON (BLACK) (2-WAY)	
*	9	CP20126-FELT	DUST PLUG, FELT
10	CP38435-1/4-SSNY	ELASTIC LOCKNUT, STAINLESS STEEL (2 REQ'D)	
11	CP22259-2-PP	RL BALL, POLYPROPYLENE (WHITE) (BRL VALVE)	
11A	CP38441-1-SS	RL BALL, 303 STAINLESS STEEL (BRL VALVE)	
*	12	CP20564-VI	GASKET, VITON (2 REQ'D)
*	13	CP20103-TEF	SEAL, TEFLON (2 REQ'D)
*	14	CP7717-2/213-VI	O-RING, VITON (2 REQ'D)
15	CP20104-3/4-NYB	END CAP, NYLON (BLACK) (3/4" NPT THREAD) (2 REQ'D)	
	CPB20104-3/4-NYB	END CAP, NYLON (BLACK) (3/4" BSPT THREAD) (2 REQ'D)	
	CP20104-1-NYB	END CAP, NYLON (BLACK) (1" NPT THREAD) (2 REQ'D)	
	CPB20104-1-NYB	END CAP, NYLON (BLACK) (1" BSPT THREAD) (2 REQ'D)	
15A	CP45514-NYB	END CAP, NYLON (BLACK) (QUICK CONNECT) (2 REQ'D)	
15B	CP45253-NYB	END CAP, NYLON (BLACK) (FLANGE) (1 REQ'D)	
15C	CP48265-NYB	END CAP, NYLON (BLACK) (FLANGE) (1 REQ'D)	
16	CP20129-SS	BOLT, 1/4"-20 X 3" HEX, STAINLESS STEEL (4 REQ'D) (THD & QC)	
16A	CP45252-2-3/4-SSPV	SCREW, PAN HEAD, STAINLESS STEEL (4 REQ'D) (FLANGE VERSION)	
17	CP20128-SS	LOCK WASHER, 1/4", STAINLESS STEEL (4 REQ'D) (THD & QC)	
18	CP8535-SS	NUT, 1/4"-20 HEX, STAINLESS STEEL (4 REQ'D) (THD & QC)	

AB344AE-KIT, SPARE PARTS KIT (INCLUDES ALL ITEMS MARKED WITH *)

NOTE: (B) IN PART NUMBER INDICATES B.S.P.T INLET AND OUTLET CONNECTIONS

NOTE: FOR JACKETED CABLE MOTORS SPECIFY CABLE LENGTH IN PART NUMBER-- 03 (0.3-METER), 05 (0.5-METER), 15 (1.5-METER) OR 60 (6.0-METER).

DESCRIPTION:
344BRL
DIRECTVALVE®
LINEAR REGULATING
ELECTRIC BALL VALVE



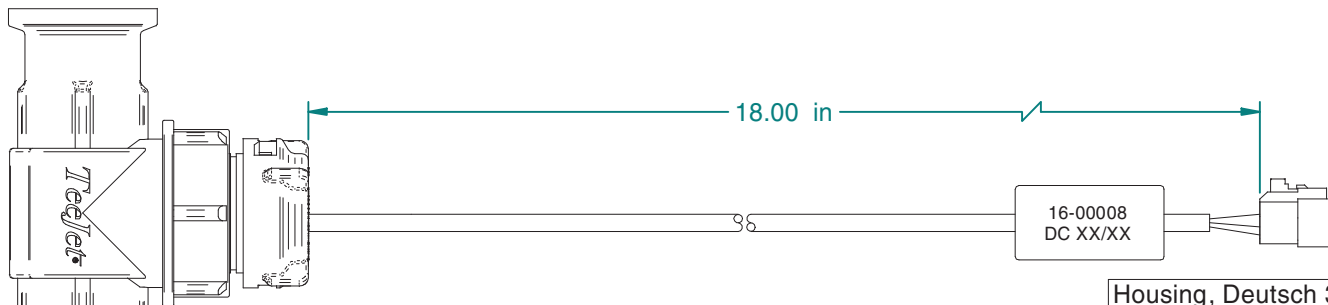
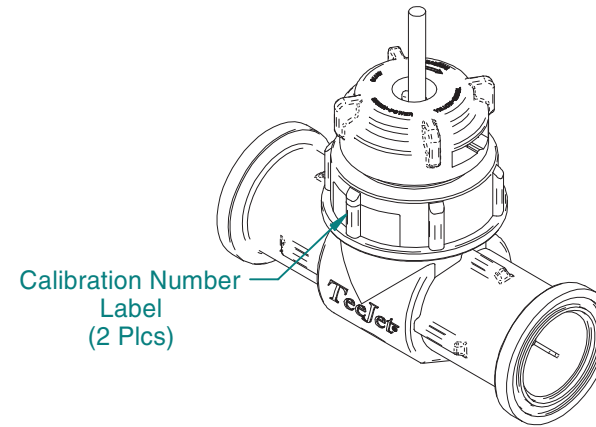
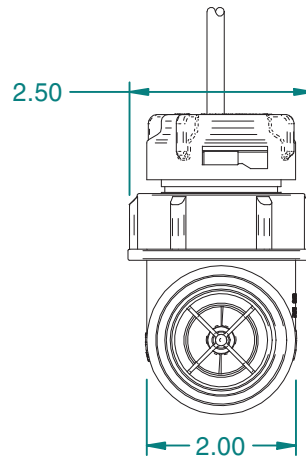
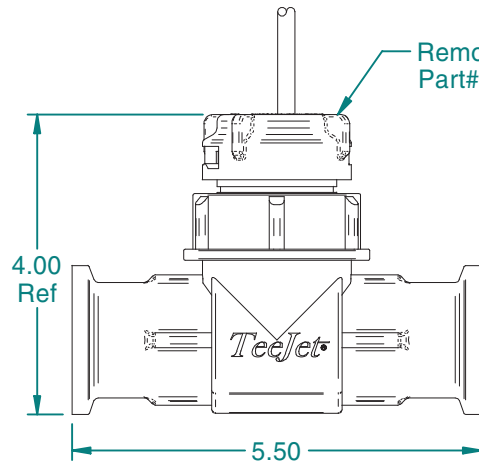
Spraying Systems Co.®

Spray Nozzles and Accessories
 P.O. Box 7900 - Wheaton, IL 60187-7901

Rev. No. 2
 Ref. 11/10/2009

PARTS LIST
PL344BRL
SHEET OF

TeeJet 801 FM Assemblies		Mid-Tech 801 FM Assemblies		Hose Connection Option	
P/N	Description	P/N	Description	P/N	Description
90-50231	801 w/ 3/4" HB	90-02175	801 w/ 3/4" HB	57-10112*	3/4" Hose Barb
90-50230	801 w/ 1" HB	90-02176	801 w/ 1" HB	57-10113*	1" Hose Barb
90-50232	801 w/1_1/4" HB	90-02177	801 w/1_1/4" HB	57-10114*	1_1/4" Hose Barb
90-50233	801 w/1_1/4" NPT (F)	90-02178	801 w/1_1/4" NPT (F)	57-10115*	1_1/4" NPT (F)
Above assemblies include flow meter interface cable 45-05315				(*) 2 Required per 57-10100 flow meter	
Note: Also requires 2 flange clamp (50 series) assemblies 90-50229					



Housing, Deutsch 3 Pos/Skts		
Pin Out	Color	Function
A	Red	(+ 12V)
B	White	Signal
C	Black	Ground

- Material:**
- 303 Stainless Steel
 - 410 Stainless Steel
 - Nylon
 - Polypropylene
 - Ruby
 - Sapphire

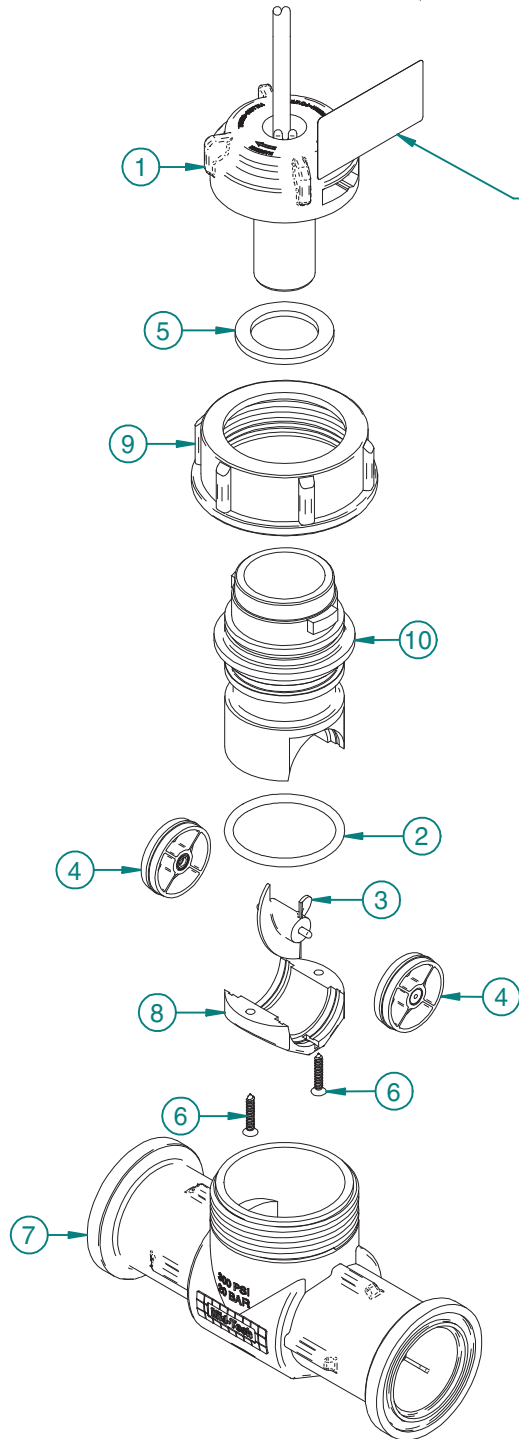
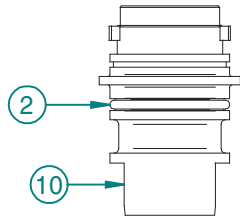
- Features:**
- Efficient helical turbine design
 - Easy access to turbine assembly for cleaning and maintenance
 - Flange mount design for flexible installation options
 - 2.5-60 GPM (10-225 LPM)

Notes:

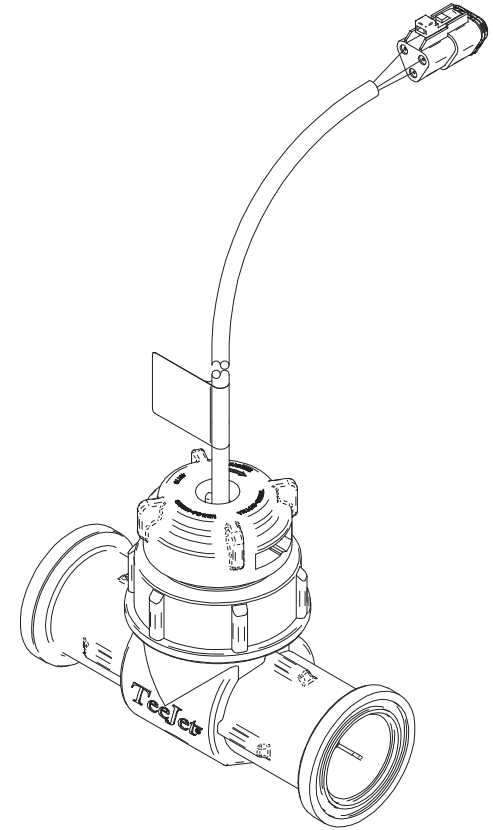
- Approximate calibration #82 pulses/lit - 310 pulses/gal.
- Vertical mounting position recommended
- 12 inches (30cm) of uninterrupted flow required before the flow meter and 6 inches (15cm) of uninterrupted flow required after flow meter.
- 45-05315 Flow meter interface cable required for Mid-Tech controls.

MATERIAL: See Notes		Midwest Technologies Illinois	
FINISH: See Notes		TITLE: Flowmeter, 801	
PROJECTION:	SCALE: 2:1	UNITS: INCH: X METRIC: <input type="checkbox"/>	DRAWN BY: Bryan Reiser
UNLESS OTHERWISE SPECIFIED TOLERANCE:		CHECKED BY: Amy Newbern	
0-1" +/- .1"	10-60" +/- 1"	.XX	APPROVED BY: Scott Leuber
1-5" +/- .25"	60-120" +/- 2"	.XXX	SHEET No: DWG No:
5-10" +/- .5"	120" +/- 3"	<	1of2 C-57-10100
Midwest Technologies IL, LLC. Claims proprietary right in the material disclosed hereon. This document is not to be used in any way detrimental to the interest of Midwest Technologies IL, LLC.			

Item	Description	Part Number	QTY	U.M.
1	Sensor, PCB Assembly	16-00008	1	EA
2	O-Ring, 35mmx3mm	57-00065	1	EA
3	Turbine Assembly 801 FM	57-10108	1	EA
4	Guide Vane Bearing	57-10109	2	EA
5	Washer, Seat, 801	57-10111	1	EA
6	Screw, #6-5/8" LG Flat Head	60-04031	2	EA
7	Body, 801 Flowmeter	64-50044	1	EA
8	Endcap, 801 Flowmeter	64-50045	1	EA
9	Retaining, Nut 801 FM	64-50046	1	EA
10	Insert, Body 801 FM	64-50047	1	EA



Approximate Calibration #'s
 TeeJet - 82
 Mid-Tech - 310
 2-60 gpm DC:xx/xx



		MATERIAL:	N/A	
		FINISH:	N/A	
		PROJECTION:		DRAWN BY: <i>Bryan Reiser</i> CHECKED BY: <i>Amy Newbern</i> APPROVED BY: <i>Scott Leuber</i>
		SCALE:	2:1	SHEET No: 2of2
		UNITS:	INCH: X METRIC: —	DWG No: C-57-10100
R1	6/15/05	UpDated	UNLESS OTHERWISE SPECIFIED TOLERANCE:	
R0	8/14/02	010117	0-1" +/- .1" — 10-60" +/- 1" — .XX —	
REV.	DATE	NOC. No	1-5" +/- .25" — 60-120" +/- 2" — .XXX —	
			5-10" +/- .5" — 120" +/- 3" — .X —	

Midwest Technologies IL, LLC. Claims proprietary right in the material disclosed hereon. This document is not to be used in any way detrimental to the interest of Midwest Technologies IL, LLC.



Series 9300 Hydraulically-Driven Centrifugal Pumps

Form L-1526
1/10

Installation, Operation, Repair and Parts Manual

Description

Hypro centrifugal pumps are designed for agricultural and industrial spraying and transfer of a variety of fluids: water, insecticides, herbicides, wettable powders, emulsives, liquid fertilizers, etc. Polypropylene centrifugal pumps may also be used to pump acid fertilizer, calcium chloride and other highly corrosive liquids such as sulfuric and phosphoric acids.

Hypro Series 9300 hydraulic motor-driven centrifugal pumps provide smooth performance. They can be conveniently mounted on the tractor or sprayer, becoming part of the vehicle's hydraulic system and freeing the PTO for other uses. The Hypro "close-coupled" design reduces the mounting space required, eliminating long shafts and couplers between the pump and motor.



SERIES 9302C & 9302S
Cast Iron & Stainless Steel
Centrifugal Pumps

Max. Flow Rate:100 gpm
Max. Pressure:120 psi
Ports:1-1/4" NPT Inlet
.....1" NPT Outlet
Hydraulic Ports:1/2" NPT Inlet
.....1/2" NPT Tank



SERIES 9303C & 9303S
Cast Iron & Stainless Steel
Centrifugal Pumps

Max. Flow Rate:147 gpm
Max. Pressure:145 psi
Ports:1-1/2" NPT Inlet
.....1-1/4" NPT Outlet
Hydraulic Ports:1/2" NPT Inlet
.....1/2" NPT Tank



SERIES 9303P
Polypropylene
Centrifugal Pumps

Max. Flow Rate:113 gpm
Max. Pressure:125 psi
Ports:1-1/2" NPT Inlet
.....1-1/4" NPT Outlet
Hydraulic Ports:1/2" NPT Inlet
.....1/2" NPT Tank



SERIES 9303C-SP
Cast Iron Centrifugal Pumps

Max. Flow Rate:122 gpm
Max. Pressure:140 psi
Ports:1-1/2" NPT Inlet
.....1-1/4" NPT Outlet
Hydraulic Ports:1/2" NPT Inlet
.....1/2" NPT Tank



SERIES 9304C
Cast Iron Centrifugal Pumps

Max. Flow Rate:190 gpm
Max. Pressure:130 psi
Ports:2" NPT Inlet
.....1-1/2" NPT Outlet
Hydraulic Ports:1/2" NPT Inlet
.....1/2" NPT Tank



SERIES 9305C-HM3C
Cast Iron Centrifugal Pumps

Max. Flow Rate:190 gpm
Max. Pressure:180 psi
Ports:2" NPT Inlet
.....1-1/2" NPT Outlet
Hydraulic Ports:1/2" NPT Inlet
.....1/2" NPT Tank



**SERIES 9305C-
HM3C-SP, -BSP**
Cast Iron Centrifugal Pumps

Max. Flow Rate:178 gpm
Max. Pressure:154 psi
Ports:2" NPT or BSP Inlet
.....2" NPT or BSP Outlet
Hydraulic Ports:1/2" NPT Inlet
.....1/2" NPT Tank



SERIES 9306C & 9306S
Cast Iron & Stainless Steel
Centrifugal Pumps

Max. Flow Rate:214 gpm
Max. Pressure:150 psi
Ports:2" NPT Inlet
.....1-1/2" NPT Outlet
Hydraulic Ports:1/2" NPT Inlet
.....1/2" NPT Tank

General Safety Information

NOTE

Notes are used to notify of installation, operation, or maintenance information that is important but not safety related.

CAUTION

Caution is used to indicate the presence of a hazard, which will or may cause minor injury or property damage if the notice is ignored.

WARNING

Warning denotes that a potential hazard exists and indicates procedures that must be followed exactly to either eliminate or reduce the hazard, and to avoid serious personal injury, or prevent future safety problems with the product.

DANGER

Danger is used to indicate the presence of a hazard that will result in severe personal injury, death, or property damage if the notice is ignored.

DANGER

Do not pump flammable or explosive fluids such as gasoline, fuel oil, kerosene, etc. Do not use in explosive atmospheres. The pump should be used only with liquids compatible with the pump component materials. Failure to follow this notice may result in severe personal injury and/or property damage and will void the product warranty.

CAUTION

1. Do not pump at pressures higher than the maximum recommended pressure.
2. Maximum liquid temperature is 140° F for Series 9300 centrifugal pumps.
3. Disconnect power before servicing.
4. Release all pressure within the system before servicing any component.
5. Drain all liquids from the system before servicing any component. Flush with water.
6. Secure the outlet lines before starting the pump. An unsecured line may whip, causing personal injury and/or property damage.
7. Check hose for weak or worn condition before each use. Make certain that all connections are tightly secured.
8. Periodically inspect the pump and the system components. Perform routine maintenance as required (See Repair Instructions).
9. Use only pipe, hose and fittings rated for the maximum psi rating of the pump.
10. Do not use these pumps for pumping water or other liquids for human or animal consumption.

Hazardous Substance Alert

CAUTION

1. Always drain and flush pump before servicing or disassembling for any reason.
2. Always drain and flush pumps prior to returning unit for repair.
3. Never store pumps containing hazardous chemicals.
4. Before returning pump for service/repair, drain out all liquids and flush unit with neutralizing liquid. Then, drain the pump. Attach tag or include written notice certifying that this has been done. It is illegal to ship or transport any hazardous chemicals without United States Environmental Protection Agency Licensing.

DANGER

Never use your hand to check the condition of hydraulic lines or hoses. If hydraulic fluid penetrates the skin, get medical help immediately. Failure to get proper medical help may result in loss of limb or life. The safest way to check hydraulic lines or hoses is by holding a piece of cardboard next to the hydraulic line or hose.

WARNING

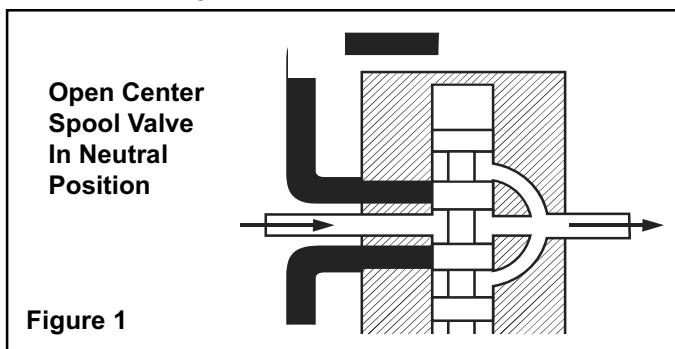
The sound pressure level of the pump is 80dBA. Observe all safety precautions when operating the pump within close proximity for extended periods of time by wearing hearing protectors. Extended exposure to elevated sound levels will result in permanent loss of hearing acuteness, tinnitus, tiredness, stress, and other effects such as loss of balance and awareness.

General Information—Hydraulic Systems

Hydraulic Pumps

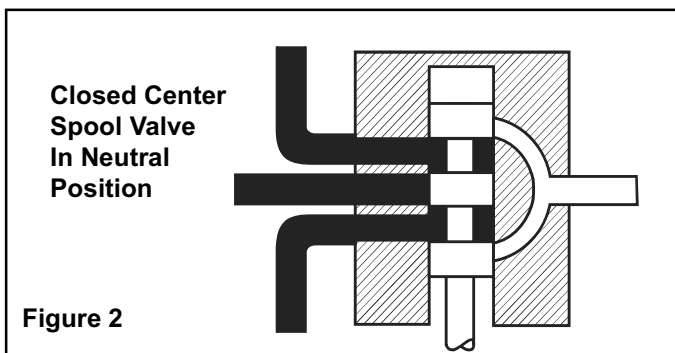
Hydraulic pumps come in two basic types:

- **Constant displacement** - which will continue to put out its rated flow regardless of pressure, until the relief valve bypasses the flow.
- **Variable displacement** - which will produce only the flow needed by the implement until the total pump output is reached. If less than the full pump output is required, an automatic stroke control mechanism decreases the pump output to maintain a constant pressure and flow. The output varies according to demand.



Spool Valves

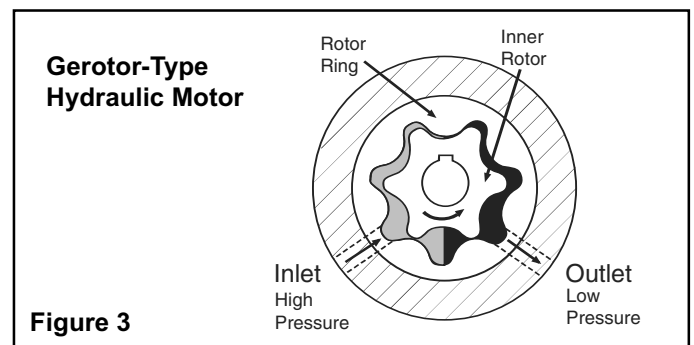
There are two basic types of spool valves used in conjunction with these pumps — Open and Closed Center. In the Open Center Valve (See Figure 1), the flow goes straight through the valve when in the neutral position. This type is used for constant displacement pumps where the flow should never be shut off.



The Closed Center Valve (See Figure 2) is used with variable displacement pumps. The flow is completely shut off in the neutral position, causing the pump stroke to adjust to zero flow. The flow stops, but the pump maintains a static pressure up to the valve.

Hydraulic Motors

Figure 3 shows an internal gear motor (Gerotor) where pressure causes the cavities between the gears to expand on one side, developing torque. The Gerotor type of hydraulic motor is used on Hypro pumps for its superior performance characteristics, including cooler running and higher rpm capabilities.



Three Systems

Fitting these components together and installing a motor, we have one of the three types of systems: Open Center, Closed Center (pressure compensated) and Closed Center Load Sensing (flow and pressure compensated).

Open Center Systems

In an Open Center System, the hydraulic pump puts out a constant flow. If the pump puts out more oil than the motor can use, a portion of the oil must be bypassed around the motor. When the oil is bypassed around a loop and does not work, the energy put into it by the pump turns into heat. Therefore, the amount of oil bypassed should be kept to a minimum. Use the largest motor possible.

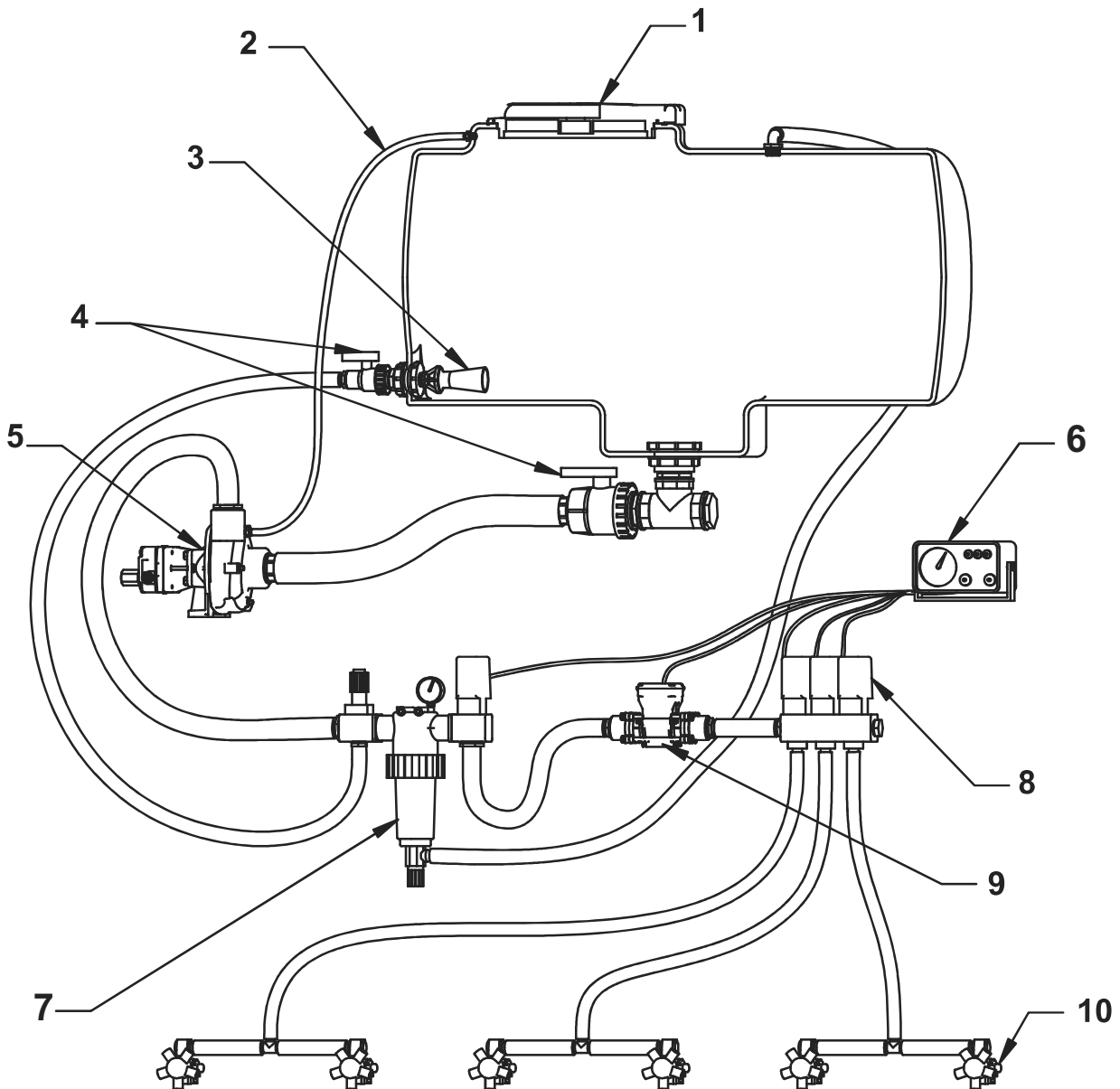
Closed Center (Pressure-Compensated) Systems

The Closed Center Pressure-Compensated system has a variable displacement pump which will deliver flow at the necessary rate to maintain a specified pressure. It is desirable to equip implements with a motor of a low flow range that will cause the pump to operate between 1800 and 2100 psi [124 and 145 BAR]. A motor that requires a large volume to obtain the correct implement speed usually causes the hydraulic pump in a closed center system to operate at a lower pressure than desirable. This low pressure results in unnecessary flow and the generation of heat that lowers the lubricating quality of the oil and may damage transmission parts. Use the smallest motor possible.

Closed Center Load Sensing Systems (Flow and Pressure-Compensating)

The Closed Center Flow-Compensated System is a variation of the pressure-compensated system, designed primarily for more efficient operation and the generation of less heat. It works on the principle of maintaining a constant pressure drop from the pump to the work port of the selector valve. Any variation in demand at the motor will cause a change in flow. The system senses this change in flow due to the change in pressure drop across the valve and causes the pump to compensate by varying the pump flow. No restrictor is used in the pressure line and no oil is bypassed.

Plumbing Installation



Centrifugal Plumbing Hook-up

REF. NO.	DESCRIPTION
1	Tank Lid
2	Vent Line #3430-0456
3	Jet Agitator
4	Shut-off Ball Valves
5	Centrifugal Pump
6	Spray Control Console
7	Centrifugal Pump Control
8	Manifold Boom Valve
9	Electromagnetic Flowmeter
10	Compact Jet Turret Nozzle Body

Installation Instructions

All Models — Open Center Systems

Models include Tank Port Adapter with built-in Check Valve Assembly and Pressure Port Adapter.

HM2C and HM4C Models Only — Closed Center and Small Open Center Systems.

Models include Tank Port Adapter with built-in Check Valve Assembly and Pressure Port Adapter with three different size metering orifices for HM4C models. The orifices are not required for use with closed center systems with flow control, such as John Deere closed center systems. Also, do not use for small open center systems with a maximum flow of 8 gpm [30.28 lpm] for HM2C model; 10 gpm [37.85 lpm] for HM4C model. If necessary, the pressure port adapter may be used without a metering orifice installed in any closed center system. For best results, the pressure differential across the motor should be less than 2500 psi (170 bar).

Preliminary to Mounting

Consult the owners manual to determine the type and capacity of the hydraulic system. Make sure the hydraulic system is recommended to operate with a continuous load. Refer to the Pump Selection Guide to confirm you have the proper pump for your hydraulic system.

Check to see that the pump impeller can be turned by hand. (Turn the shaft clockwise using a deep socket wrench on the impeller nut.) If it cannot be turned, open the pump casing to look for obstructions. Clean out any corrosion build up where the casing fits over the eye of the impeller.

Pump Inlet Line

To achieve full capacity from the pump, the inlet line should be at least the same size as the inlet port on the pump. Reducing this line size will restrict the capabilities of the pump. The line must also be free of air leaks. Check all fittings and connections in the suction line for tightness. The introduction of air may affect the priming and pumping capabilities of the pump. Use good quality suction hose that will not be collapsed by suction.

For non self-priming models, the centrifugal pump should be mounted below the liquid level and as near to the liquid source as possible to allow for the shortest suction line practical. To achieve optimal performance, the suction line should slope down into the pump. Avoid rises and humps that could trap air in the line to the pump. The suction line and pump should be filled with liquid prior to starting the pump, and all discharge lines should be open.

Pump Outlet Line

The recommended orientation for the outlet port is pointing straight up. This allows liquid to stay in the pump while it is priming. The outlet line should be the same size as the pressure port on the pump to give the optimal flow. The line should have as few restrictions and elbows as possible to optimize the pump performance and reduce pressure drop from the pump to the spray tips.

Priming the Pump

NOTE

The pump must not be run dry.

Before starting the pump, the inlet line and pump must be filled with liquid and all discharge lines must be open. On self-priming models, only the pump chamber needs to be filled with liquid. The pump must not be run unless it is completely filled with liquid because there is a danger of damaging the mechanical seal, which depends on the liquid for its lubrication.

Non-self-priming models should be mounted below the level of the liquid. The suction line should slope down to the pump and be free of dips and bends. If this cannot be done, a foot valve should be installed in the end of the inlet line so that the line can be completely filled with liquid before starting the pump.

For best priming results, the top vent plug should be removed from the pump casing. A vent line (1/4" [6.35 mm] tubing is sufficient) should be installed running back to the top of the tank. This line prevents air lock and allows the pump to prime itself by bleeding off trapped air. The small stream of liquid that returns to the tank during operation is negligible. The discharge from this line should be positioned in the tank above the high liquid level. Self-priming models can be primed by removing the top vent plug and filling the priming chamber. The priming chamber will fill to the level of the inlet port. After use, the priming chamber should be flushed and drained to avoid chemical corrosion and damage from freezing. Drain by removing the lower drain plug.

Controlling the Pump Flow

The best way to control the flow is by incorporating two control valves in a pipe tee immediately after the strainer in the discharge line. This permits controlling agitation flow independently of nozzle flow.

In any centrifugal pump, it is the large volume of liquid which puts load on the drive. Use only the flow needed to develop the pressure required at the boom and to maintain adequate agitation. Hydraulic motor-driven centrifugal pumps are easily adjusted to the exact flow required, as explained in the Operating Instructions of this manual.

Centrifugal Pump Control

Hypro now offers many different components for spraying systems. The Hypro centrifugal pump control incorporates the electric flow control valve, a self-cleaning line strainer, a visual pressure gauge and a manual agitation control valve.

Flow Control Valve

A high-flow electric proportional valve allows for maximum flow control to the boom valves. It provides smooth, rapid control that can be controlled from either an electronic rate controller or switch box.

Strainers

The recommended placement of the strainer for a centrifugal pump is in the pump outlet line. This will eliminate any possible restriction that the strainer could

Plumbing Installation

create if it were installed in the inlet line. Ensure that the proper strainer size and screen mesh are used to limit the pressure drop and achieve the best filtration. Line strainers can also be installed in the tank fill line to filter liquid as it is loaded into the tank as well as in the boom lines to further filter the solution prior to the spray tips. Tank baskets can also be used to filter material added through the tank lid.

Agitation

The centrifugal pump control contains a manual agitation control valve that can be adjusted to provide the right amount of flow to the jet agitators in the tank to ensure proper mixing within the tank.

Flowmeter

To eliminate the mechanical problems of a turbine flowmeter, we recommend that an electromagnetic flowmeter be used. These flowmeters have no moving parts to wear out and will provide a more consistent and accurate flow reading. They can be input into just about any electronic rate controller or switch box.

Boom Section Valves

For rapid response and reliability, we recommend electric plunger valves be used for boom control. The valves should be sized accordingly to minimize the pressure drop and maximize the flow rate. The boom tubing or hose should be sized accordingly to ensure that a pressure drop in the lines does not occur, causing inconsistent pressures at the nozzles.

Nozzle Bodies

Nozzle bodies with shut-off check valves are recommended to eliminate dripping from the spray tips when the boom valves are shut down.

Hooking Up the Hydraulic Motor to the Tractor Hydraulic System

Hypro Series 9300HMC hydraulic motor-driven pumps can be mounted on either the tractor or sprayer. When hooking up, make sure that no dirt or liquid gets into the hydraulic motor. **Keep all hydraulic connections clean.** Be sure to connect the hydraulic motor into the system correctly by

putting the pressure line to the Pressure Port Adapter and return line to the Tank Port Adapter. The adapters on the hydraulic motor are sized to accommodate 1/2" NPT fittings on the pressure port and 3/4" NPT on the tank port. For maximum performance, the hydraulic lines should also be at least 1/2" [12.7 mm] in size for the pressure line and 3/4" [19.05 mm] for the tank line.

The tank (**OUT**) port adapter with a built-in check valve assembly will guard against reverse operation — allowing you to reverse oil flow to operate other equipment. **This adapter must not be removed.** On HM2C and HM4C model pumps, the pressure (**IN**) port adapter is a two-piece assembly consisting of an open (unrestricted) adapter with three orifices packed loose with the pump. (See the Operations Section.)

When using the HM2C or HM4C unit on any flow-compensated (load sensing) closed center system, or any small open center system with a maximum flow of 8 gpm [30.28 lpm] for HM2C or 10 gpm [37.85 lpm] for HM4C, the metering orifice should be removed from the pressure port adapter. When using these units on flow-compensated systems, connect to the motor priority circuit if your tractor has one.

Standard spool valves, which are found on all tractor hydraulic systems, may cause potentially damaging high peak pressures in the hydraulic system when closed because of abrupt shut-off of oil flow in both the supply and return lines. When shutting off the pump, move the selector to the **FLOAT** position to allow the centrifugal pump to come to a stop gradually.

**For further information
regarding Hypro products,
contact your local dealer or
Hypro directly at
www.hypropumps.com or by
calling 1-800-424-9776.**

Operation

Open Center Systems— All Models Adjusting Centrifugal Pump Output

[NOTE]

HM1C, HM3C & HM5C motors have bypass screw fully closed from the factory. HM2C & HM4C motors have bypass screw set at 1-1/2 turns from fully closed from the factory.

1. Open the bypass adjustment screw 2-1/2 turns from fully closed. Turn the bypass screw in to achieve the flow for the desired gpm and psi.
2. Start the tractor. Leave the directional valve in the neutral position and allow hydraulic oil to circulate for approximately 10 to 15 minutes or until adequately warmed.

3. Prime the centrifugal pump with all valves open (See the Installation Instructions and System Configuration Diagram).
4. Close the agitation line valve and keep the control valve and the boom shut-off valve open. Note the spray pressure.
5. Open the agitation line valve until you have desired circulation in the tank. Recheck the spray pressure. If it is too low, close down the agitation line valve until the desired spray pressure is reached. If the spray pressure is too high, throttle the centrifugal pump by closing down the control valve.

Closed Center (Pressure-Compensated) — HM2C and HM4C Models Only

On a pressure-compensated system, the amount of oil that is allowed to flow through the hydraulic motor is regulated by a metering orifice in the pressure port adapter. Three different sizes of orifices are supplied with the HM2C and HM4C model pumps to allow flexibility in the flow required for individual sprayer needs.

The smaller the orifice, the less hydraulic oil goes through the motor, so the pump will run slower and the flow of liquid pumped and the spray pressure will also be less. As the hydraulic oil flow is increased (by installing a larger orifice), the amount of liquid being pumped and the spray pressure is also increased.

Installing and Removing Metering Orifice

1. Shut off the hydraulic system.
2. Disconnect the line to the pressure port of the hydraulic motor.
3. Remove the adapter from the motor using a 1-1/16" wrench. Make sure the o-ring is on the metering orifice before installing into port adapter.
4. The orifice is removed or installed in the port adapter by tapping either in or out of the adapter.
 - A. To remove — tap the orifice out from the small end of the adapter.
 - B. To install — tap the orifice in from the large end of the adapter. The orifice is seated when a snap sound is heard.

Adjusting Centrifugal Pump Output

1. Open the bypass adjusting screw in the hydraulic motor three (3) turns.
2. Start the tractor and allow the hydraulic oil to circulate for approximately 10 to 15 minutes or until adequately warmed.
3. Close and lock down the bypass adjusting screw in the hydraulic motor.
4. Prime the centrifugal pump with all valves open (See Installation Instructions and System Configuration Diagram).
5. Close the agitation line valve and the control valve; open the boom shut-off valve.
6. With the pump running, open the control valve until the pressure gauge indicates the desired spraying pressure.
7. Open the agitation line valve until sufficient agitation is observed. Then, if spray pressure drops, readjust the control valve to restore to the desired pressure.
8. If a sufficient boom pressure cannot be attained, install the #2 size orifice and repeat Steps 5 through 7.
9. If a sufficient boom pressure still cannot be attained with the #2 size orifice, install the #3 size orifice and repeat Steps 5 through 7.
10. If a sufficient boom pressure still cannot be attained with the #3 size orifice, remove the orifice and repeat Steps 5 through 7.

Closed Center (Load Sensing) — All Models

Many tractors are being introduced with load sensing systems (also referred to as flow and pressure-compensated systems) which simplify system setup and eliminate many of the problems associated with using the wrong size pump motors on a given hydraulic system. Usually, any of Hypro's 9300HMC models may be used on this type of system, provided the hydraulic system produces sufficient oil flow for the hydraulic motor being used (Refer to the Pump Selection Guide).

This system maintains a constant flow of hydraulic oil for a given pressure drop. The flow is adjustable with a flow control valve installed in the hydraulic system (such as the Tortoise/Hare control on John Deere tractors). Because this system has adjustable flow, there is no need to bypass hydraulic oil as in an open center system, or to restrict the flow with orifices as in a closed center pressure-compensated system.

Adjusting Centrifugal Pump Output

1. Make sure the orifice from the pressure port adapter of the hydraulic motor has been removed (HM2C and HM4C models only).
2. Close and lock down the bypass adjusting screw in the hydraulic motor.
3. Set the tractor hydraulic flow control valve for minimum hydraulic oil flow to the remote outlet (Tortoise position).
4. Start the tractor and allow the hydraulic oil to circulate for approximately 10 to 15 minutes or until adequately warmed.
5. Prime the centrifugal pump with all valves open (See the Installation Instructions and System Configuration Diagram).
6. Close the agitation line valve and open the control valve and the boom shut-off valve.
7. Slowly adjust the tractor hydraulic flow control valve until the desired boom pressure is attained.
8. Open the agitation line valve until sufficient agitation is observed. If spray pressure drops, readjust the tractor hydraulic flow control valve to restore it to the desired pressure.

Flush Pump After Use

One of the most common causes for faulty pump performance is gumming or corrosion inside the pump. Flush the pump and entire system with a solution that will chemically neutralize the liquid pumped. Mix this solution according to the manufacturer's directions. This will dissolve most residue remaining in the pump, leaving the inside of the pump clean for the next use.

To Prevent Corrosion

After cleaning the pump as directed above, flush it with a permanent-type automobile antifreeze (Prestone®, Zerex®, etc.) containing a rust inhibitor. Use a 50% solution, half antifreeze and half water. A protective coating will remain on the inner pump surfaces. Save the excess antifreeze for the next application. Plug the ports to keep out air during storage. For short periods of idleness, noncorrosive liquids may be left in the pump, but air must be kept out. Plug the ports or the seal port connections.

Repair Instructions

Hypro Repair Tools:

Tool Box No. 3010-0168 • 1/4" Allen Wrench No. 3020-0008
 Support Bars (2) No. 3010-0064 • Port Brush No. 3010-0066
 1/16" Allen Wrench No. 3020-0009 • Brush Holder No. 3010-0067 •
 Large Retaining Ring Pliers No. 3010-0084 • Small Retaining Ring
 Pliers No. 3010-0167

Shop Tools Needed

Bench Vice • Arbor Press • Air or Hand Drill • Small Knife
 Metal Pipe - 1" dia. x 4" high (Bearing Seating Tool)
 PVC Pipe - 3/4" dia. x 4" - 6" high (Seal Seating Tool)
 12" Crescent Wrench • Two Flat Screwdrivers (approx. 10" long)
 1/2", 9/16", 5/8" and 7/8" sockets • Hammer or Rubber Mallet
 Small Screwdriver (recommended) • Large File (optional)
 1/2" and 9/16" Box End Wrench • Lubricating Spray (WD-40 or LPS)
 Small amount Hydraulic Oil • Cleaning Solvent Tank (recommended)

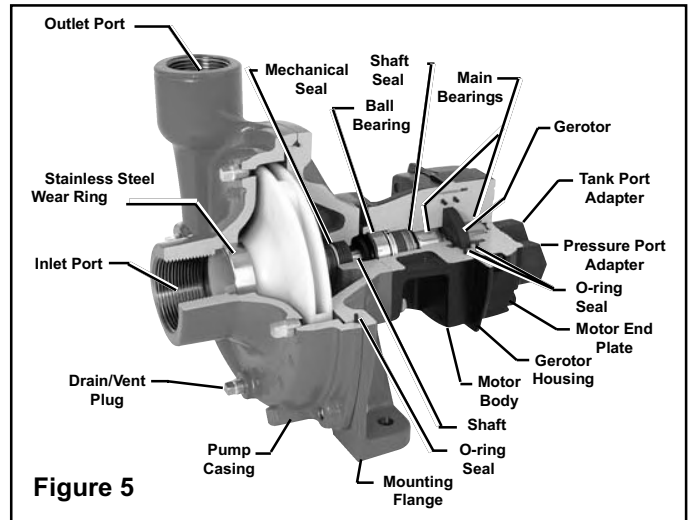


Figure 5

Pump Housing Disassembly

NOTE

Instructions in *italics* describe procedures for the Series 9300P Polypropylene Centrifugal Pumps, when different than the cast iron pumps.

- Using a 9/16" box end wrench, remove the four Hex Head Bolts holding the Pump Casing to the Mounting Flange. (If necessary, tap Pump Casing Outlet Port with rubber mallet or hammer to separate.) [*Using a 1/2" wrench, remove the six bolts from the front. For the two bottom bolts securing the base, you will need to hold the two nuts with another 1/2" wrench. Also remove the 5/16" screw from the rear, near the outlet port.*]
- To remove the Impeller Nut, insert a large screwdriver or file (at least 10" [254 mm] long) into Impeller Vanes to prevent Impeller from turning when loosening nut. Use a 5/8" socket wrench to remove the Impeller Nut by turning it counterclockwise (See Figure 6). [*Use 7/8" deep socket wrench to remove Plastic Seal Nut, then 9/16" deep socket to remove Metal Jam Nut and Washer.*]

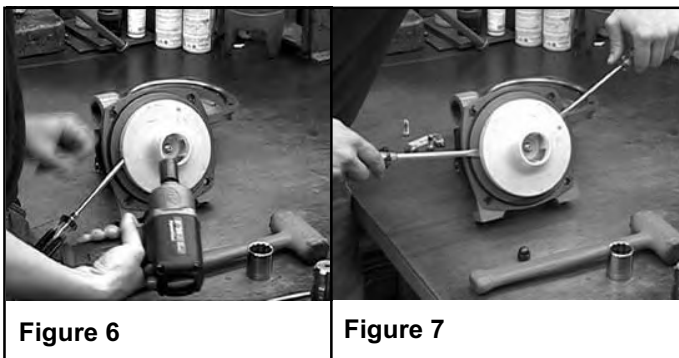


Figure 6

Figure 7

- Once nut [*and washer*] is removed, place a screwdriver on each side behind the Impeller and pry away from the Mounting Flange (See Figure 7). Remove Woodruff Key from the Shaft. Remove O-ring from the Mounting Flange.

Pump Seal Removal

- Lightly lubricate the Shaft for easier removal of the Seal. Using two screwdrivers positioned opposite each other, pry the rotary portion of the Seal from the Shaft (See Figure 8).

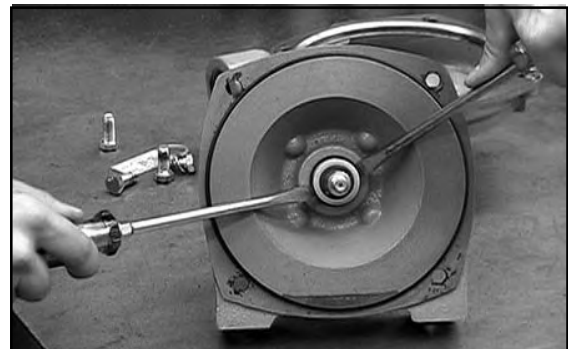


Figure 8

NOTE

In the case of a severe pump seal leak, inspect the Shaft/Bearing Assembly in the hydraulic motor for possible contamination.

- Using a 1/2" box end wrench, remove the four bolts holding the Motor to the Mounting Flange. Remove Motor. [*Remove the Plastic Back Cover flange. Knock the Seal out from back with a hammer and screwdriver. Use a 1/2" socket wrench and 1/2" box end wrench to remove the Mounting Flange from the Hydraulic Motor.*]

- Using a screwdriver and hammer, tap out the stationary portion of the Mechanical Seal from the motor side of the Mounting Flange. (If the motor is not removed, the seal can be pried out with a small screwdriver.)

NOTE

The seal will be damaged by removal in this manner. A new seal must be used when pump is reassembled.

Clean-Up Of Pump Housing

- Using a circular bottle-type wire brush with air or hand drill, clean the Outlet Port, Inlet Port and the sealing areas of the o-ring on the Pump Casing and Mounting Flange. Using the port brush, clean the seal cavity in the Mounting Flange. *[The last step should not be performed on the 9300P.]*
- After wire brush cleaning, it is recommended that the Pump Casing and Mounting Flange be further cleaned in a solvent tank to remove rust and corrosion particles.

Seal Replacement/Pump Housing Reassembly**NOTE**

If the hydraulic motor requires repair, proceed to **Disassembly and Repair of the Hydraulic Motor** in the next column.

- Lubricate the seal cavity in the Mounting Flange with WD-40®, LPS or equivalent. Do not lubricate the shaft.
- Install the stationary portion of the Mechanical Seal by sliding over the Shaft with the ceramic side out.

NOTE

Make sure both the seal cavity and seal are clean and lubricated.

- To seat the seal in the seal cavity, use a piece of 3/4" PVC pipe 4" to 6" [101.6 to 152.4 mm] in length. Lubricate sealing surface on seal after it is seated. Do not lubricate the shaft.
- To install the rotary portion of the mechanical seal, place it over the shaft with the carbon side facing in, and press against the stationary portion (See Figure 9).
- Install rubber gasket 1700-0100 over shaft against rotary portion of seal.

**Figure 9****NOTE**

On Models 9305C-HM3C-SP, 9505C-HM3C-BS and 9305C-HM3C, install the washer on the shaft prior to installing the impeller nut.

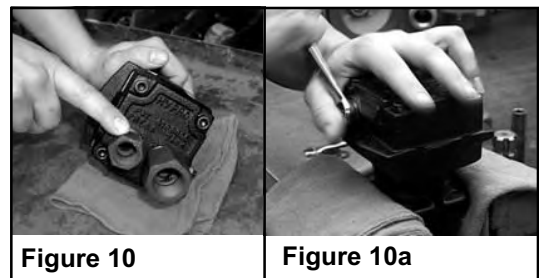
CAUTION

The threads of the Plastic Seal Nut are fine and can be easily cross threaded. To prevent cross threading, turn the Plastic Seal Nut counterclockwise until area of thread engagement is detected; then turn the Plastic Seal Nut clockwise until it is secure. Do not over tighten the Plastic Seal Nut.

- Insert a Woodruff Key into the Shaft key slot; then place the Impeller on the Shaft and align it with the Key and press against the Mechanical Seal Assembly. Apply a blue thread locking compound to the Impeller Nut, and using a 5/8" socket wrench and using a screwdriver to hold the Impeller, install the Impeller Nut. *[On polypropylene models, insert the Woodruff Key into the Shaft key slot. Place the Impeller on the Shaft and align it with the Key; then press against the Mechanical Seal Assembly. Place the Metal Seal Washer on the Shaft. Apply a drop of blue thread locking compound on the Impeller Nut and secure the Impeller to the Shaft as described previously.]*
- Install the o-ring on the mounting flange. Replace the o-ring if worn or damaged.
- Place the pump casing on the mounting flange, insert and tighten the bolts.

Disassembly and Repair of the Hydraulic Motor**NOTE**

The work area and motor should be as clean as possible to prevent contamination of parts.

**Figure 10****Figure 10a**

- Remove the Mounting Flange from the motor body and place Hydraulic Motor in vise.
- Remove Tank Port Adapter and Pressure Port Adapter with large crescent wrench or 1-1/16" and 1-3/8" box end wrench (See Figure 10).
- Using a 9/16" box end wrench, loosen the nut on the Bypass Adjusting Screw (See Figure 10a).
- Using a small screwdriver, remove the Bypass Adjusting Screw from the Motor. (This will remove the Screw, Nut, Washer and Thread-Seal Gasket.)
- Using a 1/4" Allen wrench, remove the Socket Head Cap Screws from the Motor End Plate (See Figure 10).
- If Motor End Plate will not lift off easily, use a small screwdriver to carefully pry apart the boss portion of the End Plate and Gerotor Housing until free (See Figure 11). If Gerotor Housing will not lift off easily, carefully pry

apart the boss area between the Gerotor Housing and the Motor Body. (It may be necessary to alternate sides when prying apart Motor sections.)



Figure 11

7. Remove both parts of the Gerotor.
8. On HM3C models, remove the Woodruff Key from the Shaft. On HM1C, HM2C and HM4C models, remove the Roll Pin from the Shaft.
9. Remove the o-ring from the Motor End Plate and Body with a flat instrument such as a knife blade.
10. Inspect Motor End Plate, Body and Gerotor Housing for wear and/or gouging. If gouging has occurred in both the Motor End Plate and Body, the motor is not repairable. If gouging has occurred in the Motor End Plate, Body or Gerotor Housing, the part that is worn must be replaced. If Gerotor Housing is damaged, Gerotor parts must also be replaced.

To Remove the Shaft Assembly from the Motor Body

1. Remove the Slinger Ring from the Motor Shaft.

⚠ WARNING

Special attention should be exercised when working with retaining rings. Always wear safety goggles when working with spring or tension loaded fasteners or devices.

2. Using the large retaining ring pliers, remove the Retaining Ring next to the Ball Bearing in the Motor Body.

NOTE

If bearing is binding against the retaining ring so that it cannot easily be removed, place the motor body (threaded portion of the shaft up) on arbor press. Using a piece of un-threaded metal pipe (1" dia. x 4" high [254. mm x 101.6 mm high]), slide over the shaft and gently press down with the arbor press just enough to relieve the pressure on the retaining ring.



Figure 12

3. Place body in position on arbor press. Threaded portion of the Shaft should be inside the fixture. Press out shaft assembly with arbor press (See Figure 12).

Hydraulic Motor Shaft Disassembly and Repair

1. Remove Large Retaining Ring from Shaft with a screwdriver. Remove Thrust Bearing Assembly from Shaft (includes the Thrust Bearing and two Thrust Bearing Races) and the Seal Spacer.
2. Remove the Small Retaining Ring next to the Shaft Ball Bearing.
3. To remove the Bearing from the shaft, place the shaft (threaded end up) in the arbor press fixture. Place the two support bars provided in the repair kit opposite each other and between the seal on the shaft and the arbor press fixture. Using an arbor press, press the shaft through the Bearing, Seal Spacer and Seal (See Figure 13).
4. Inspect the sealing area of the shaft for wear. Inspect other Shaft Assembly Components for wear and replace if necessary.



Figure 13

5. While motor is completely disassembled, clean all parts in a solvent bath.

Build Shaft Sub-Assembly

1. To assemble the seal cartridge, remove the old seal from the cartridge by pressing it out. The cartridge is reused by assembling the new seal into cartridge, ensuring the new seal is pressed in with the lip seal on the opposite side as shown in Fig.1.

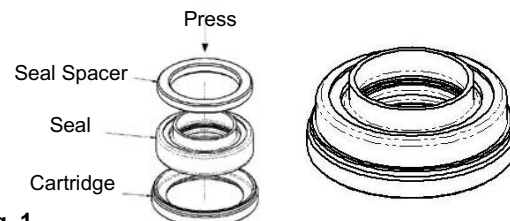


Fig. 1

Important: To prevent damage to the seal lip extending out, use seal spacer as shown to guard lip during assembly.

2. Install the large retaining ring onto large diameter end of shaft.
3. From the small, threaded end of the shaft, install the following parts in this order: thrust bearing race, thrust bearing, 2nd thrust bearing race.

Note: The thrust bearing and races should not be reused if they are showing any signs of wear.

4. Install new type seal spacer (looks like a thick washer, approx .130 inch thick).
5. Before installing the new seal, its lip must be expanded to fit on the shaft. With the seal lip facing out, slide the seal over the threaded end of the shaft and gently push the seal onto the raised area of the shaft. Do not push the seal past the large retaining ring groove on the shaft.

6. Once the seal has been expanded, remove the seal from the shaft.
7. Install seal cartridge assembly: With seal lip facing the large end of the shaft, slide the seal cartridge assembly over the threaded end of the shaft and gently push into the raised area of the shaft. Align the seal lip to enter the center diameter of the seal spacer and push until seal body touches seal spacer.

Important: If the seal lip is longer than the seal spacer's width, please stop the assembly and review parts being used.

8. Assemble two o-rings on the outside body of the new seal cartridge assembly as shown in Fig 2. Install o-rings one at a time and do not roll over each other.

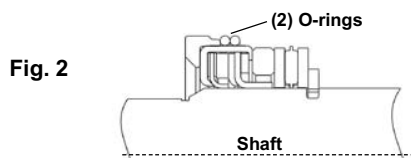


Fig. 2

9. Finished shaft sub-assembly should look like this:



10. Do not press, but place the shaft sub-assembly into the motor body with threaded end of shaft up. Lubricate the two o-rings with hydraulic or mineral oil before assembling.



Figure 14

Install Shaft Sub-Assembly Into Motor Body

Important: Make sure the surface edge of the arbor press fixture is smooth and clean. An unthreaded piece of pipe (1" x 4" high) is needed to support the outer race of the seal cartridge sub-assembly and outer race of the ball bearing during assembly. Place this pipe over the shaft threaded end for assembly of the following steps.

1. Place the body on a support fixture in the arbor press. Using an unthreaded piece of pipe (1" dia. x 4" high), press the shaft subassembly down into the body until it bottoms out. This is a light press fit and should be done slow and easy.

2. Install the new ball bearing onto the threaded end of the shaft. Press down using the 1" x 4" pipe until the retaining ring can be installed in its groove in the bearing core of the motor body. Install the retaining ring.



Figure 15

3. Turn the motor body assembly over (threaded shaft end down) on the arbor press. Press the shaft down into its "final position" until the small retaining ring can be installed in the shaft next to the ball bearing.
4. Install small retaining ring on shaft.
5. Check shaft rotation at this point. It should rotate smoothly with only slight resistance from the seal lip pressure on the shaft. If you feel any gritty or sticking movement, return assembly to the arbor press and lightly press on the threaded end of the shaft to relieve press fit compression on the thrust bearing. **Note:** Don't over do this press. The objective is to move the small outer retaining ring installed in the previous step back to "touching only" the ball bearing inner race.

Important: If gritty or sticky movement persists, it's likely due to re-used parts or the body needle bearing is in need of replacement.

Reassembly of Remaining Hydraulic Motor Parts

1. Place Motor Body in a vise with large end of shaft facing up.
2. Install the o-ring in the body.
3. Install the Roll Pin on the shaft. Place the Inner Gear of the Gerotor onto the shaft making sure Gerotor slot lines up with the key in the shaft.

The Roll Pin can slide up behind the inner gear of the gerotor when the gear is installed. Make sure the key is visible in the slot after the gear is in place.

4. Install the outer portion of the Gerotor, making sure the Gerotor is centered within the o-ring groove on the body.
5. Install the Gerotor Housing, making sure the pins in the Gerotor Housing line up with their respective holes in the body.

6. Lightly lubricate the area between the Inner and Outer Gerotor, the Outer Gerotor, and Gerotor Housing with hydraulic oil or mineral oil.

Special attention should be exercised when working with retaining rings. Always wear safety goggles when working with spring or tension-loaded fasteners or devices.

7. Install o-ring on the motor end plate.
8. Place end plate on gerotor housing, making sure holes in end plate line up with pins in the gerotor housing.
9. Install four Socket Head Cap Screws in Motor End Plate, and using a 1/4" Allen wrench, tighten Cap Screws alternately and evenly in a crisscross pattern to approximately 15 foot pounds [20 Nm] of torque.
10. Install the Thread Seal Gasket on the Bypass Adjusting Screw. Put the Gasket on from the slotted end and turn until four threads on the screw are showing. Install the Washer and the Nut. Install Bypass Adjusting Screw in the motor end plate.
 - A. For closed center hydraulic systems, turn the Bypass Adjusting Screw in until it bottoms out in the End Plate. Tighten nut down with 9/16" box end wrench.

- B. For open center hydraulic systems, turn the Bypass Adjusting Screw in until it bottoms out in the End Plate; then turn back out 1½ full turns. Holding the Bypass Adjusting Screw with a screwdriver, tighten Nut. (Motor will then have to be readjusted to tractor system.)

11. Replace o-ring on both port adapters.
12. Install Pressure Port Adapter and Tank Port Adapter back onto the motor. (For ease of installation, tighten the Pressure Port Adapter first, then the Tank Port Adapter.)
13. Remove Hydraulic Motor from the vise. Turn shaft by hand to check for binding.
14. Install Slinger Ring over Motor Shaft.
15. Install Motor into Pump Mounting Flange. Insert four Hex Head Bolts; then alternately and evenly tighten them. [*For polypropylene models, secure the Hydraulic Motor to the Mounting Flange with four Hex Head Cap Screws and Nuts. The nuts should be visible when the assembly is complete.*]

Troubleshooting

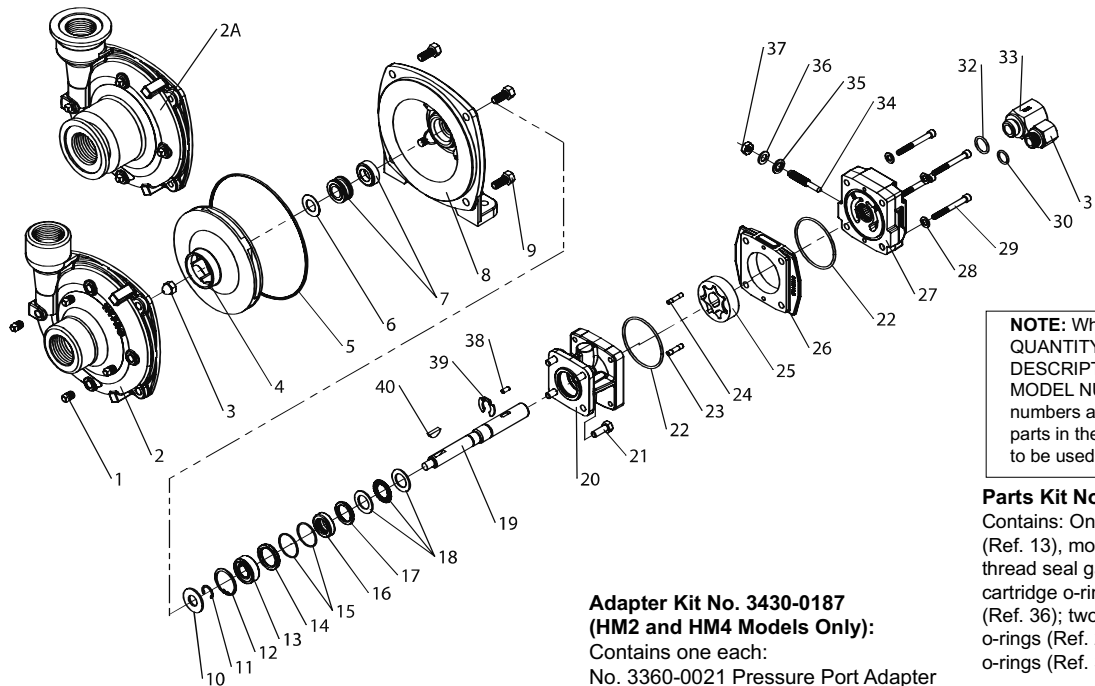
If the proper Hydraulic Pump Unit has been selected according to Hypro recommendations, and the unit has been correctly plumbed into the hydraulic system, operation should be quite satisfactory. If spraying performance is unsatisfactory

or hydraulic system heat is excessive etc., check the following troubleshooting guide for possible problems and solutions.

Troubleshooting Guide

Symptom	Probable Cause(s)	Corrective Action(s)
Low discharge	Pump not primed.	— Remove top most vent plug from face of pump and run pump to expel trapped air (see Installation Instructions).
	Air leaks in inlet line.	— Check and reseal inlet fittings.
	Blocked or clogged line strainer.	— Inspect strainer and clear any debris from screen.
	Impeller plugged.	— Inspect and clear obstruction.
	Undersize inlet line or collapsed hose.	— Suction line should be the same diameter as inlet port of pump or larger.
	Improperly sized hydraulic motor.	— Refer to Pump Selection Guide to determine proper size hydraulic motor for your hydraulic system.
	Bypass Adjustment Screw not set properly.	— Adjust bypass screw on side of hydraulic motor in until the desired output is attained.
Hydraulic system overheating	Eye of impeller rubbing on volute.	— Remove volute (front cover) and inspect the impeller. If wear detected, sand the impeller eye O.D. with emery cloth.
	Improper hydraulic motor size.	— Refer to Pump Selection Guide to determine proper size for your hydraulic system.
Hydraulic system overheating	Bypass Adjustment Screw set to bypass too much oil.	— Close adjustment screw on side of hydraulic motor to lessen the amount of oil being bypassed.
	Improper metering orifice installed in pressure port.	— Install proper size orifice. Refer to Installation section for proper sizing.
	Insufficient hydraulic hose size.	— Check hydraulic hose size. Hose should be at least 1/2" [12.7 mm] on the pressure port and 3/4" [19.05mm] on the tank port.

All 9303C and 9303S Series Pumps



NOTE: When ordering parts, give QUANTITY, PART NUMBER, DESCRIPTION, and COMPLETE MODEL NUMBER. Reference numbers are used ONLY to identify parts in the drawing and are NOT to be used as order numbers.

Parts Kit No. 3430-0748

Contains: One each ball bearing (Ref. 13), motor shaft seal (Ref. 16), thread seal gasket (Ref. 35), two cartridge o-rings (Ref. 15) and washer (Ref. 36); two each motor housing o-rings (Ref. 22), and port adapter o-rings (Ref. 30 & 32).

Hydraulic Motor Part Nos.

2500-0081C (HM1C Models)
2500-0082C (HM2C Models)
2500-0083C (HM3C Models)
2500-0084C (HM4C Models)
2500-0085C (HM5C Models)

Adapter Kit No. 3430-0187 (HM2 and HM4 Models Only):

Contains one each:
No. 3360-0021 Pressure Port Adapter
No. 3373-0020 (Size #1)
No. 3373-0021 (Size #2)
No. 3373-0022 (Size #3).
No. 1720-0108 Adapter O-ring and
No. 1720-0105 Orifice O-ring (Qty 3).

Repair Parts Kit No. 3430-0332

Contains: One o-ring (Ref. 5), one rubber gasket (Ref. 6), and one mechanical seal (Ref. 7).

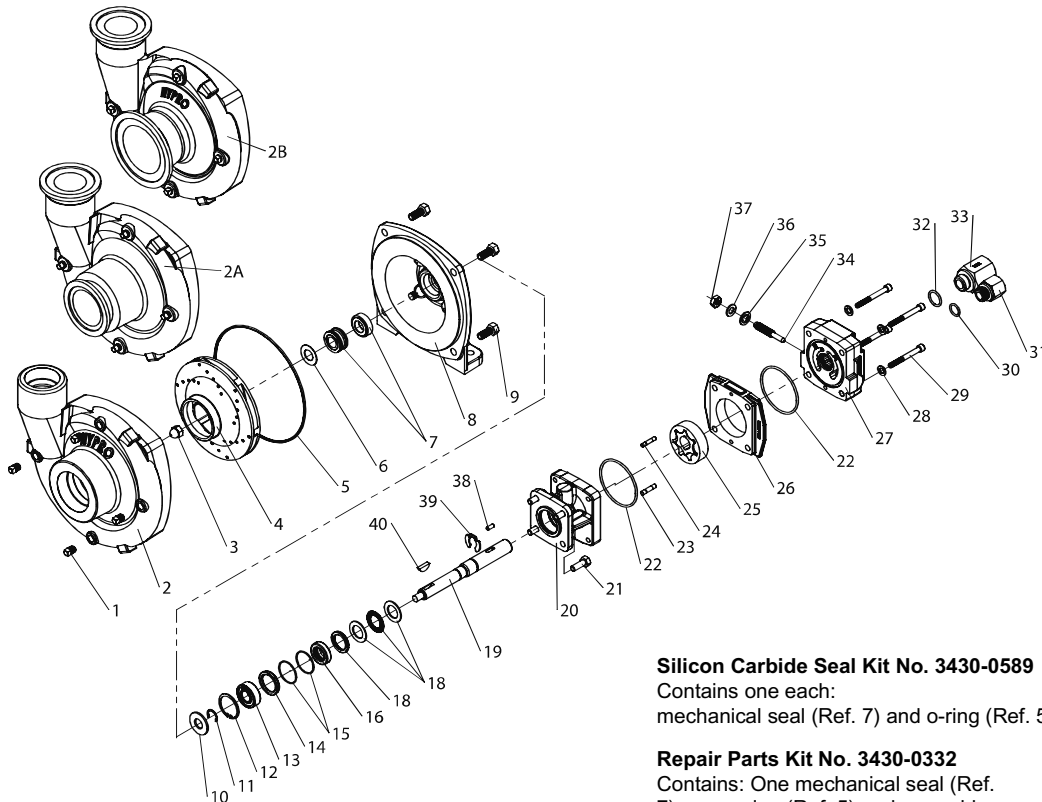
Silicon Seal Kit No. 3430-0589

Contains one each:
1720-0083 o-ring (Ref. 5)
and one mechanical seal (silicon carbide) (Ref.7).

Ref. No.	Qty. Req'd.	Part No.	Description
1	4	2406-0007	Drain/Vent Plug (9303C)
1	4	2406-0016	Drain/Vent Plug (9303S)
2	1	0150-9000C	Pump Casing (Model 9303C)
2	1	0150-9000S	Pump Casing (Model 9303S)
2A	1	0153-9000C	Pump Casing (Universal Flange Model C-U)
3	1	2253-0002	Impeller Nut (9303C)
3	1	2253-0006	Impeller Nut (9303S)
4	1	0401-9100P	Impeller (Nylon Std. 9303C)
4	1	0402-9100P	Impeller (Polypropylene Optional) (Std 9303S)
5	1	1720-0083	O-ring
6	1	1700-0100	Gasket
7	1	2120-0009	Mechanical Seal (Viton/Ceramic) (Std 9303C)
7	1	3430-0589	Mechanical Seal (Silicon Carbide) (Std 9303S)
8	1	0750-9300C	Mounting Flange (9303C)
8	1	0756-9300S	Mounting Flange (9303S)
9	4	2210-0020	Hex Head Cap Screw (9303C)
9	4	2210-0125	Hex Head Cap Screw (9303S)
10	1	1410-0056	Slinger Ring
11	1	1810-0014	Snap Ring
12	1	1820-0013	Retaining Ring
13	1	2000-0010	Ball Bearing
14	1	1410-0131	Cartridge, Front
15	2	1720-0268	O-ring
16	1	2104-0010	Lip Seal
17	1	1410-0130	Seal Spacer
18	1	2029-0014	Thrust Bearing Assembly
19	1	0531-2500	Shaft (HM2C/HM4C)
19	1	0533-2500	Shaft (HM1C/HM5C)
19	1	0536-2500	Shaft (HM3C)
20	1	0150-2500C	Motor Body (includes needle bearing)
21	4	2210-0005	Hex Head Cap Screw
22	2	1720-0110	O-ring
23	1	1600-0045	Dowel Pin (HM2C / HM4C)
23	1	1600-0044	Dowel Pin (HM1C/HM5C)
23	1	1600-0052	Dowel Pin (HM3C)

Ref. No.	Qty. Req'd.	Part No.	Description
24	1	1600-0042	Dowel Pin (HM2C / HM4C)
24	1	1600-0037	Dowel Pin (HM1C/HM5C)
24	1	1600-0068	Dowel Pin (HM3C)
25	1	3900-0022	Gerotor (HM1C)
25	1	3900-0023	Gerotor (HM2C)
25	1	3900-0024	Gerotor (HM3C)
25	1	3900-0025	Gerotor (HM4C)
25	1	3900-0048	Gerotor (HM5C)
26	1	0701-2500C1	Gerotor Housing (HM2C Models) 1/4" wide
26	1	0700-2500C1	Gerotor Housing (HM1C Models) 1/2" wide
26	1	0703-2500C1	Gerotor Housing (HM4C Models) 5/16" wide
26	1	0702-2500C1	Gerotor Housing (HM3C Models) 1" wide
26	1	0704-2500C1	Gerotor Housing (HM5C Models) 5/8" wide
27	1	0254-2500C2	Motor End Plate (includes needle bearing)
28	4	2270-0039	Washer
29	4	2220-0045	Cap Screw (HM2C / HM4C Models)
29	4	2220-0021	Cap Screw (HM1C Models)
29	4	2220-0044	Cap Screw (HM3C Models)
29	4	2220-0032	Cap Screw (HM5C Models)
30	1	1720-0108	O-ring
31	1	3360-0021A	Pressure Port Adapter (includes o-ring)
32	1	1720-0262	O-ring
33	1	3320-0051A	Tank Port Adapter (includes o-ring)
34	1	3220-0029	Bypass Adjusting Screw
35	1	1700-0047	Gasket
36	1	2270-0027	Washer
37	1	2250-0038	Lock Nut
38	1	1610-0032	Roll Pin (HM2C / HM4C)
38	1	1610-0031	Roll Pin (HM1C / HM5C)
38	1	1610-0055	Roll Pin (HM3C)
39	1	1810-0026	Snap Ring
40	1	1610-0012	Woodruff Key (9303C)
40	1	04432	Woodruff Key (9303S)

All 9306C Series



NOTE: When ordering parts, give QUANTITY, PART NUMBER, DESCRIPTION, and COMPLETE MODEL NUMBER. Reference numbers are used ONLY to identify parts in the drawing and are NOT to be used as order numbers.

Parts Kit No. 3430-0748

Contains: One each ball bearing (Ref. 13), motor shaft seal (Ref. 16), thread seal gasket (Ref. 35), two cartridge o-rings (Ref. 15) and washer (Ref. 36); two each motor housing o-rings (Ref. 22), and port adapter o-rings (Ref. 30 & 32).

Silicon Carbide Seal Kit No. 3430-0589

Contains one each: mechanical seal (Ref. 7) and o-ring (Ref. 5).

Repair Parts Kit No. 3430-0332

Contains: One mechanical seal (Ref. 7), one o-ring (Ref. 5) and one rubber gasket (Ref. 6).

Hydraulic Motor Part Nos.

2500-0081C (HM1C Models)
2500-0083C (HM3C Models)
2500-0085C (HM5C Models)

Ref. No.	Qty. Req'd.	Part No.	Description
1	4	2406-0007	Drain/Vent Plug (9306C)
1	4	2406-0016	Drain/Vent Plug (9306S)
2	1	0154-9200C1	Pump Casing (9306C)
2	1	0154-9200S1	Pump Casing (9306S)
2A	1	0157-9200C	Pump Casing (Universal Flange 220x200)
2B	1	0158-9200C	Pump Casing (Universal Flange 300x220 Cast)
2B	1	0158-9200S	Pump Casing (Universal Flange 300x220 S.S.)
3	1	2253-0002	Impeller Nut (9306C)
3	1	2253-0006	Impeller Nut (9306S)
4	1	0401-9200P2	Impeller (Nylon Std. 9306C)
4	1	0405-9100P2	Impeller (Polypropylene Optional) (Std. 9306S)
4	1	0407-9306P	Impeller (GTX Optional)
5	1	1720-0083	O-ring
6	1	1700-0100	Gasket
7	1	2120-0009	Mechanical Seal (Viton/Ceramic) (Std. 9306C)
7	1	3430-0589	Mechanical Seal (Silicon Carbide) (Std. 9306S)
8	1	0750-9300C2	Mounting Flange (9306C)
8	1	0756-9300S	Mounting Flange (9306S)
9	4	2210-0020	Hex Head Cap Screw (9306C)
9	4	2210-0125	Hex Head Cap Screw (9306S)
10	1	1410-0056	Slinger Ring
11	1	1810-0014	Snap Ring
12	1	1820-0013	Retaining Ring
13	1	2000-0010	Ball Bearing
14	1	1410-0131	Cartridge, Front
15	2	1720-0268	O-ring
16	1	2104-0010	Lip Seal
17	1	1410-0130	Seal Spacer
18	1	2029-0014	Thrust Bearing Assembly
19	1	0531-2500	Shaft (HM2C/HM4C)
19	1	0533-2500	Shaft (HM1C/HM5C)
19	1	0536-2500	Shaft (HM3C)
20	1	0150-2500C	Motor Body (includes needle bearing)
21	4	2210-0005	Hex Head Cap Screw
22	2	1720-0110	O-ring

Ref. No.	Qty. Req'd.	Part No.	Description
23	1	1600-0045	Dowel Pin (HM2C / HM4C)
23	1	1600-0044	Dowel Pin (HM1C/HM5C)
23	1	1600-0052	Dowel Pin (HM3C)
24	1	1600-0042	Dowel Pin (HM2C / HM4C)
24	1	1600-0037	Dowel Pin (HM1C/HM5C)
24	1	1600-0068	Dowel Pin (HM3C)
25	1	3900-0022	Gerotor (HM1C)
25	1	3900-0023	Gerotor (HM2C)
25	1	3900-0024	Gerotor (HM3C)
25	1	3900-0025	Gerotor (HM4C)
25	1	3900-0048	Gerotor (HM5C)
26	1	0701-2500C1	Gerotor Housing (HM2C Models) 1/4" wide
26	1	0700-2500C1	Gerotor Housing (HM1C Models) 1/2" wide
26	1	0703-2500C1	Gerotor Housing (HM4C Models) 5/16" wide
26	1	0702-2500C1	Gerotor Housing (HM3C Models) 1" wide
26	1	0704-2500C1	Gerotor Housing (HM5C Models) 5/8" wide
27	1	0254-2500C2	Motor End Plate (includes needle bearing)
28	4	2270-0039	Washer
29	4	2220-0045	Cap Screw (HM2C / HM4C Models)
29	4	2220-0021	Cap Screw (HM1C Models)
29	4	2220-0044	Cap Screw (HM3C Models)
29	4	2220-0032	Cap Screw (HM5C Models)
30	1	1720-0108	O-ring
31	1	3360-0021A	Pressure Port Adapter (includes o-ring)
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33	1	3320-0051A	Tank Port Adapter (includes o-ring)
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38	1	1610-0031	Roll Pin (HM1C / HM5C)
38	1	1610-0055	Roll Pin (HM3C)
39	1	1810-0026	Snap Ring
40	1	1610-0012	Woodruff Key (9306C)
40	1	04432	Woodruff Key (9306S)

