

LIQUI-MOVER® PUMP
LMV-1600 SERIES
HANDBOOK



JOHNSON.

Making the Best Solutions Possible

LMV-1600 Handbook rev. 09.04

THE JOHNSON CORPORATION • Three Rivers, MI USA 49093
tel: 269.278.1715 • fax: 269.279.5980 • www.liquimover.com

What is a Liqui-Mover® Pump?

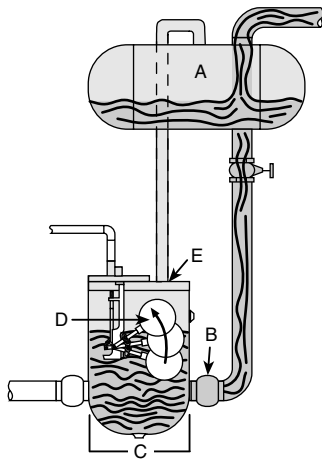
A Liqui-Mover pump is a positive displacement pressure powered pump with a minimum of moving parts. The pumping action is accomplished using a positive pressure to push the liquid from the pump tank into the return line. The Liqui-Mover pump can handle high temperature and high pressure condensate without difficulty.

The float actuated Liqui-Mover pumps are available in 3 basic models. They are available in many configurations, from individual components that are field assembled to complete packaged systems ready for connection to field piping. A basic Liqui-Mover pump consists of a receiver/reservoir, pump tank, inlet and outlet check valves, snap acting float operated level control, and various other fittings.

How a Liqui-Mover Pump Works

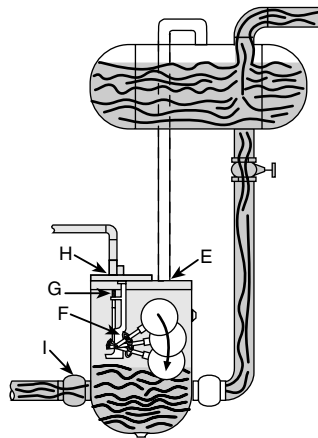
In describing “How a Liqui-Mover Pump Works”, it is best to view it as three distinct stages. These stages are described below:

Float Activated Level Control



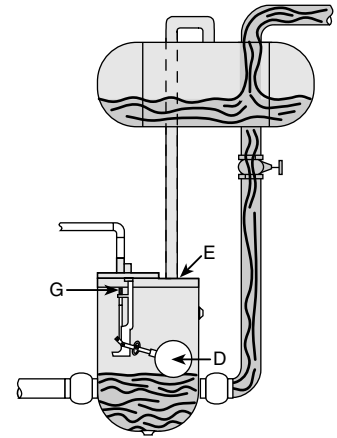
STAGE ONE:

In the fill cycle, fluid flows from the receiving chamber (A) through the inlet check valve (B) into the pumping chamber (C), and raises the float (D). The vent port (E) is open to equalize pressure between the receiving chamber and pumping chamber.



STAGE TWO:

When the float reaches its highest level, a spring assembly (F) activates the linkage (G), which closes the vent port (E) and opens the motive pressure port (H). When the pressure in the pumping chamber exceeds discharge line pressure, the discharge check valve (I) opens, and the discharge cycle begins. As the fluid level goes down, so does the float. During this cycle, incoming fluid is stored in the receiving chamber.



STAGE THREE:

Once the float (D) reaches its lowest position, the linkage (G) closes the motive pressure port and opens the vent port (E) so the two chambers can equalize in pressure to start the cycle again.

Installation

Receipt of Equipment

The float assembly has been adjusted and tested at the factory. Additional items such as the inlet baffle (if supplied), check valves, level gauge glass, cycle counter, and insulation jacket will be packaged separately in a carton shipped with the unit.

Setting the Unit

On LOOO models, the pump tank may be anchored to the floor using the holes in the mounting feet.

On LROO models, you will also need to install a Johnson supplied receiver. The receiver is held in saddles with 'U' bolts supported by (4) pipes on floor flanges. The floor flanges have mounting holes for attachment to the floor.

On LRSM models, the entire skid should be supported. Mounting holes may be drilled through the skid for attachment to the floor.

All tanks should be installed level.

Piping

On LROO and LRSM models, the Johnson supplied receiver will normally have (3) top connections for: condensate inlet, atmospheric vent, and pressure gauge. For 'closed systems' (no atmospheric vent), an air eliminator and safety relief valve will need to be installed. On LOOO models, the condensate is piped directly to the inlet check valve from an existing receiver or pipe accumulator.

Refer to the Johnson assembly drawing that accompanies this product for typical piping diagrams. The inlet baffle (if supplied) must be installed into the pump tank prior to installing the inlet check valve.

The motive gas (normally steam or compressed air) is piped to the float assembly (1/2" npt connection) through a strainer and a pressure reducing valve.

The equalization (vent) connection on top of the pump tank should be connected to the receiver. The equalization line should not be reduced in size and be installed with minimal restrictions. If the equalization line is more than 36" in length, the pipe size should be increased at least three pipe sizes. In cases where a combustible liquid is being handled or the motive used is combustible, the vent must go to a flare or flame.

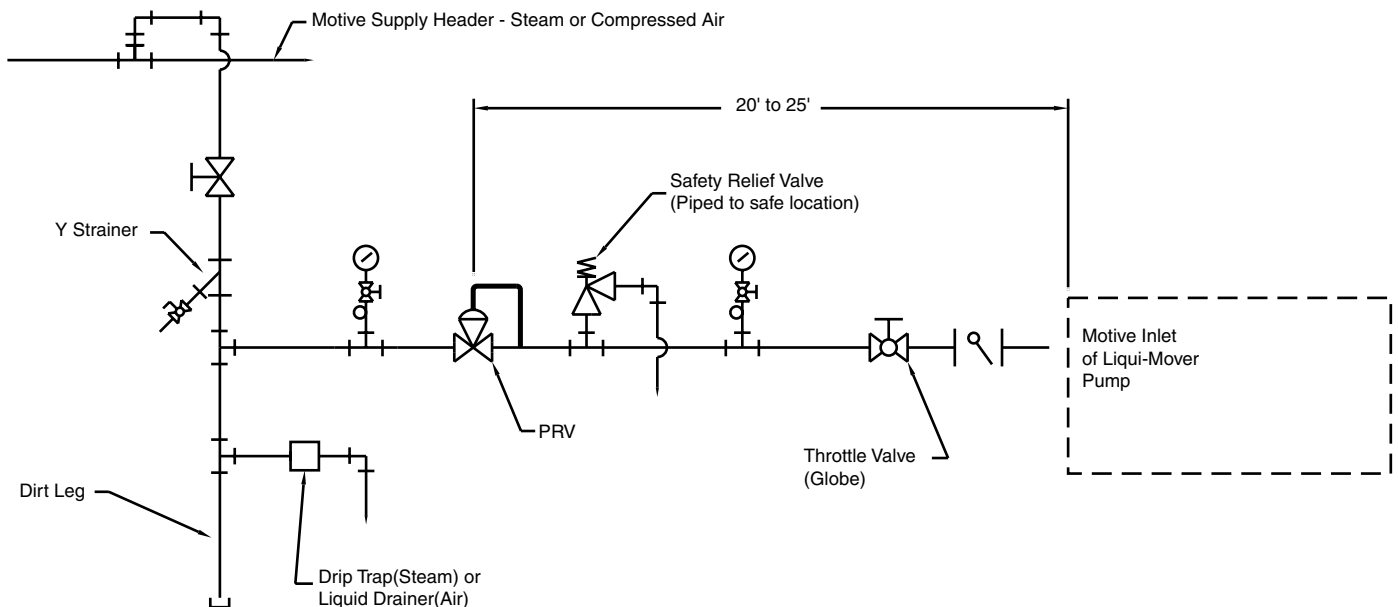
For LROO and LOOO models, friction loss through the piping should be kept to a minimum. Therefore, pipe reducers should not be used and pipe runs kept to a minimum. All hand valves should be full port if at all possible. It is recommended that isolation hand valves be installed to aid in the maintenance of the units. Some suggested locations are: upstream of the inlet check valve, downstream of the outlet check valve, in the motive line ahead of the strainer, in the equalization line between the float assembly and the receiver, and ahead of the pressure reducing valve.

Pressure Reducing Valve Installation

A pressure reducing valve (PRV) should be installed in the motive pressure line to regulate how fast the Liqui-Mover pump discharges the condensate out of the pump tank. Normally the motive pressure setting will be approximately 20 psig higher than the back pressure to achieve a proper discharge time. The discharge time should be a little less than the time it takes to fill the pump tank under maximum condensing load.

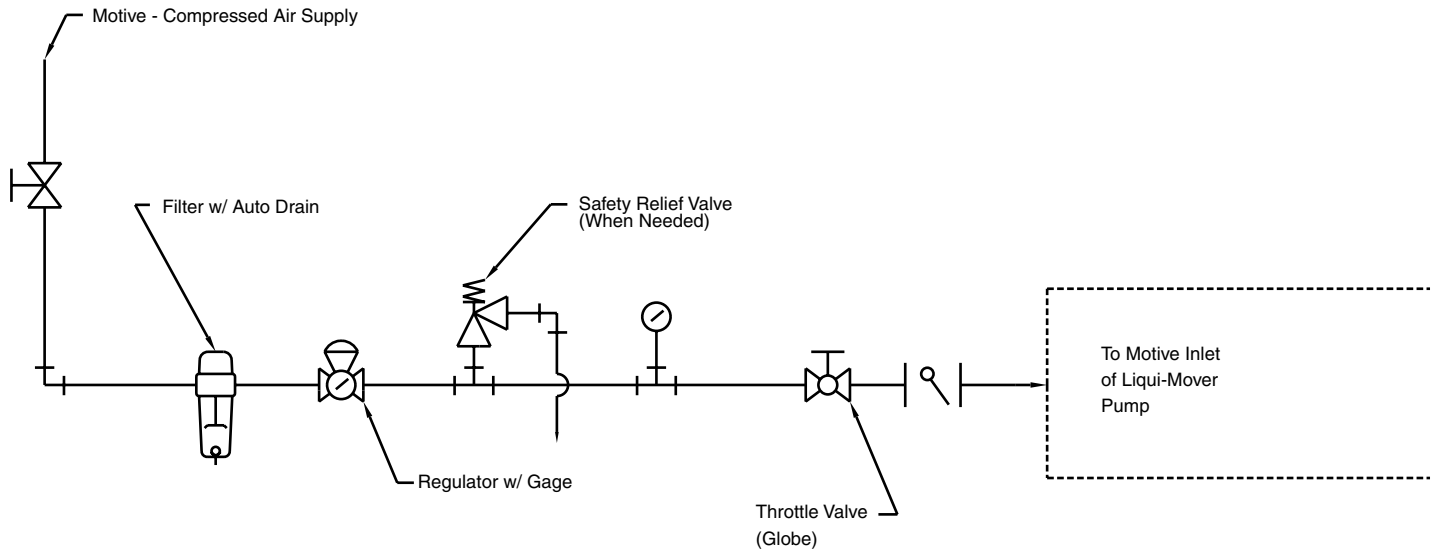
Here are some guidelines to be followed when installing a PRV in conjunction with a Liqui-Mover pump:

1. Never install a PRV immediately adjacent to the Liqui-Mover pump. The shock caused by the sudden opening and closing of the motive valve will ultimately damage the PRV. We recommend a distance of 20-25 feet between the PRV and the Liqui-Mover pump, where the pipe size is the same as the motive inlet connection. A larger diameter pipe of a shorter length that has an equivalent volume is acceptable. The PRV should be sized by a pressure reducing valve manufacturer or representative.
2. A safety relief valve should be installed downstream of the PRV to prevent over-pressurization of the motive medium. The safety relief valve should be sized by a safety relief valve manufacturer or representative.
3. When steam is the motive pressure, a drip trap, dirt leg, and strainer should be installed ahead of the PRV. The drip trap should not be piped to the Liqui-Mover pump. When compressed air is the motive pressure, a liquid drainer, dirt leg, and strainer should be installed ahead of the PRV. The liquid drainer should not be piped to the Liqui-Mover pump.
4. The piping from the PRV outlet to the Liqui-Mover pump should be sized to minimize the pressure drop under 'flow conditions'.
5. A throttling valve should be installed immediately ahead of the Liqui-Mover pump so it can be used in conjunction with the PRV to adjust the Liqui-Mover pump discharge time. Typically the throttling valve is a globe valve.



The above sketch is for reference only. Always consult with the PRV and safety relief valve manufacturer or representative for proper sizing and application of their products.

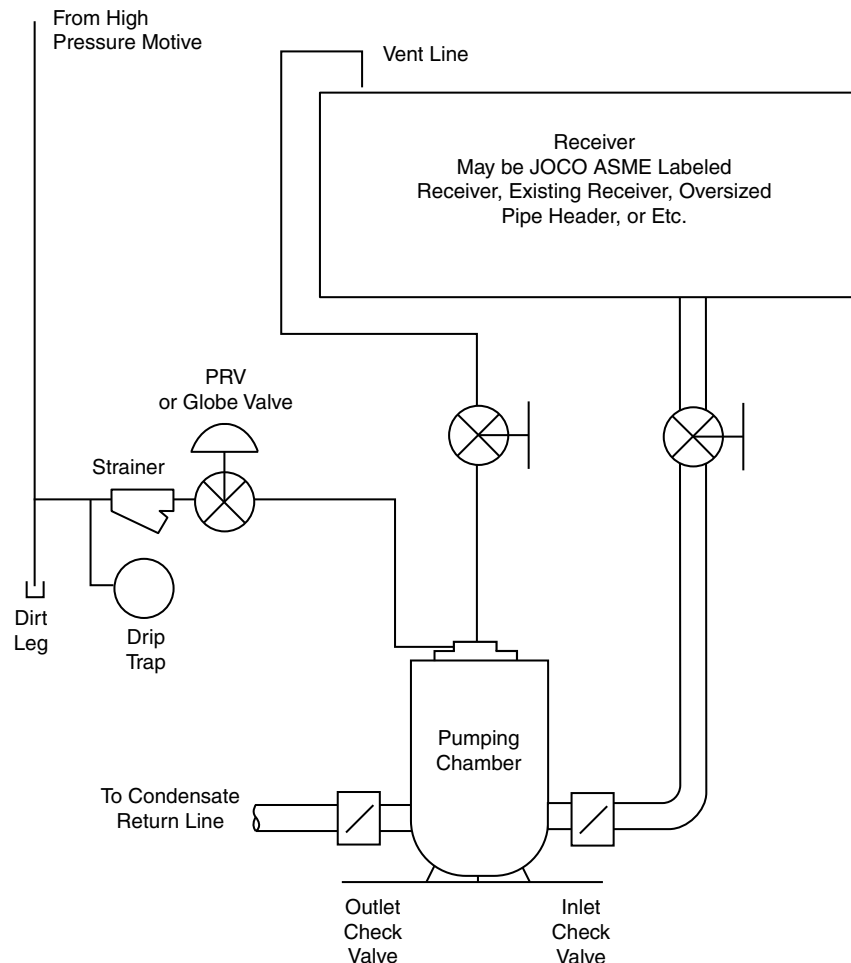
Installation Diagram for Liqui-Mover Pump with Compressed Motive



1. This is the recommended piping for a Liqui-Mover pump with compressed motive.
2. The air should be clean, dry and regulated so that the Liqui-Mover pump discharges in the recommended time.
3. The above parts furnished by customer.

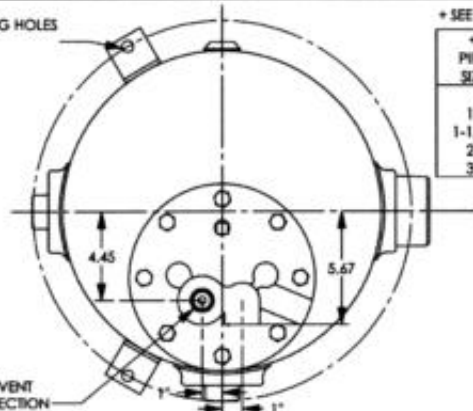
Start-Up Instructions For LMV-1600 Liqui-Mover Pump

1. On systems that are not pre-piped, inspect the inlet and outlet check valves for proper flow direction. Refer to the Liqui-Mover pump assembly drawing and parts list.
2. If the receiver or pumping chamber contains sub-cooled condensate, this needs to be drained prior to start-up.
3. Open any additional maintenance hand valves that were installed.
4. Open any hand valves in the discharge line.
5. To set the discharge cycle time, a PRV is recommended and should be set for approximately 20 psig above the back pressure. If a globe valve is used in conjunction with a PRV, the globe valve should be fully open. If a PRV is not used, the globe valve should be opened only slightly. After the system is operating this valve should be adjusted so the pump time is slightly less than the fill time.
6. Open the vent line hand valve.
7. Open the hand valve(s) that supply condensate to the pumping chamber.
8. When the pumping chamber is full, the level control will automatically close the vent valve and open the high pressure motive valve, allowing motive to enter the pumping chamber and condensate to flow out the discharge line.
9. When the pumping chamber is empty, the level control will automatically close the motive valve and open the vent valve, allowing the pumping chamber to vent into the receiver, equalize pressure, and begin filling.



TYPICAL INSTALLATION SKETCH

(3) 9/16" MOUNTING HOLES ON 19.00" B.C.



+ SEE CHART BELOW FOR PIPE SIZE DESIGNATION

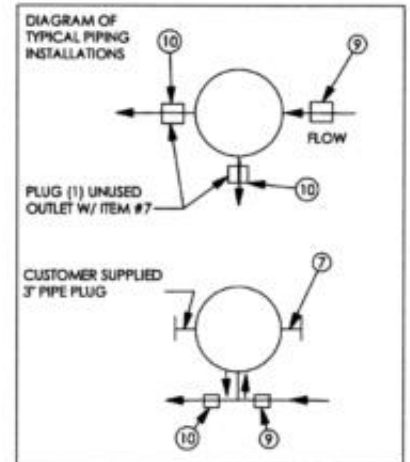
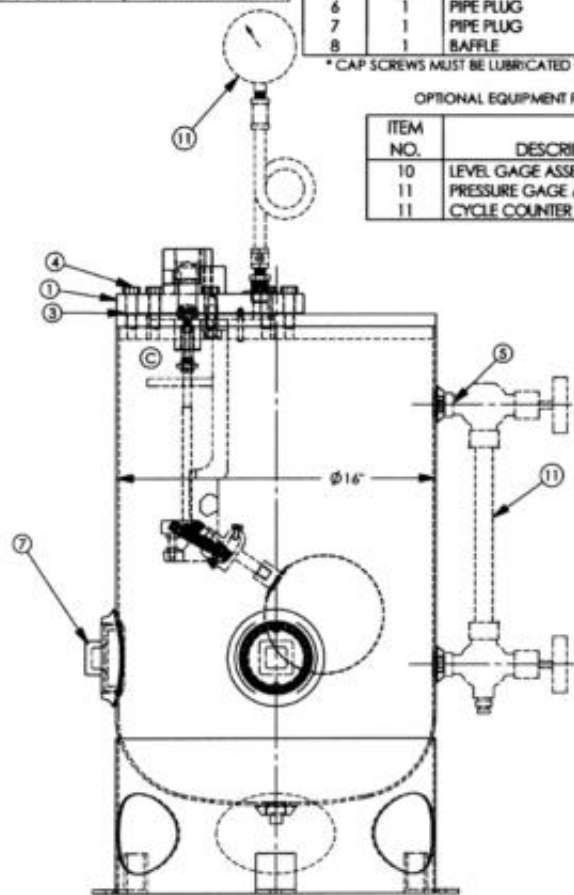
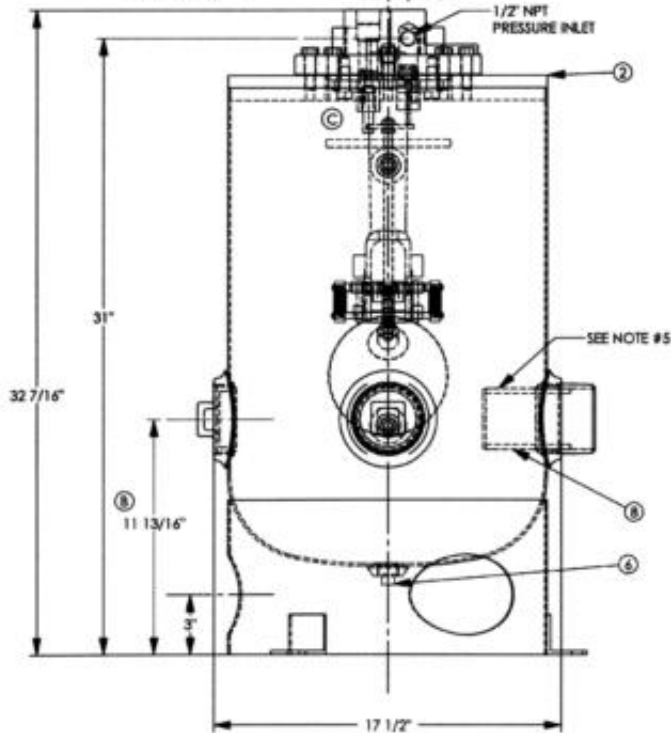
* PIPE SIZE	XX	ITEM #12 INLET CHECK VALVE ASS'Y	ITEM #13 OUTLET CHECK VALVE ASS'Y
00			
1"	10	LMV-A-CKV1-1	LMV-A-CKVO-1
1-1/2"	15	LMV-A-CKV1-2	LMV-A-CKVO-2
2"	20	LMV-A-CKV1-4	LMV-A-CKVO-3
3"	30	CKV-ILF5-700-CIB-2	LMV-A-CKVO-4

PARTS LIST					
ITEM NO.	NO. REQ'D	DESCRIPTION	PART NO.	MATERIAL	REMARKS
1	1	LEVEL MECHANISM	SA3V-1000-4	STN. STL. & IRON	
2	1	TANK	LMV-01501-5	STEEL	
3	1	GASKET	CSS816-0644-9	NON-ASBESTOS	
*4	8	HEX HEAD CAP SCREW	1/2-13 X 1-3/4"	STL. SA-325	
5	2	PIPE PLUG	CSP660-0050-1	M. IRON	1/2" NPT
6	1	PIPE PLUG	CSP660-0075-1	M. IRON	3/4" NPT
7	1	PIPE PLUG	CSP660-0300-1	M. IRON	3" NPT
8	1	BAFFLE	SA1027-4	SA1027	STEEL

* CAP SCREWS MUST BE LUBRICATED PRIOR TO INSTALLATION

OPTIONAL EQUIPMENT PER ORDER

ITEM NO.	DESCRIPTION	PART NO.	MATERIAL	REMARKS
10	LEVEL GAGE ASSEMBLY	LMH-A-03003-2	BRASS & GLASS	
11	PRESSURE GAGE ASSEMBLY	LMH-A-06565-2	STEEL & BRASS	
11	CYCLE COUNTER	V-11063-10	STEEL & BRASS	



- (A) 5. INLET BAFFLE ASSEMBLY MUST BE INSTALLED IN INLET.
 4. 3/8" INLET ORIFICE
 3. 3/8" VENT ORIFICE
 2. 1 CUBIC FOOT CONDENSATE PER CYCLE
 1. MAX. DESIGN PRESSURE 150 PSIG

NOTES: ALL REVISIONS SHALL BE MADE IN SOLEWORKS

ASSEMBLY & PARTS LIST FOR SELF ACTUATING LIQUI-MOVER

The Johnson Corporation

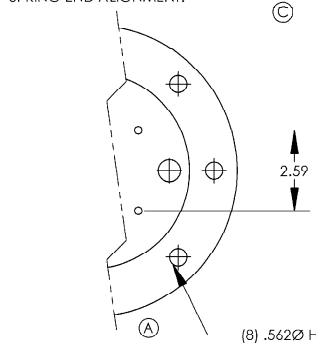
Three Rivers, Michigan / Summerstown, Ontario

LMV-16XX-LOOO-FSA-8

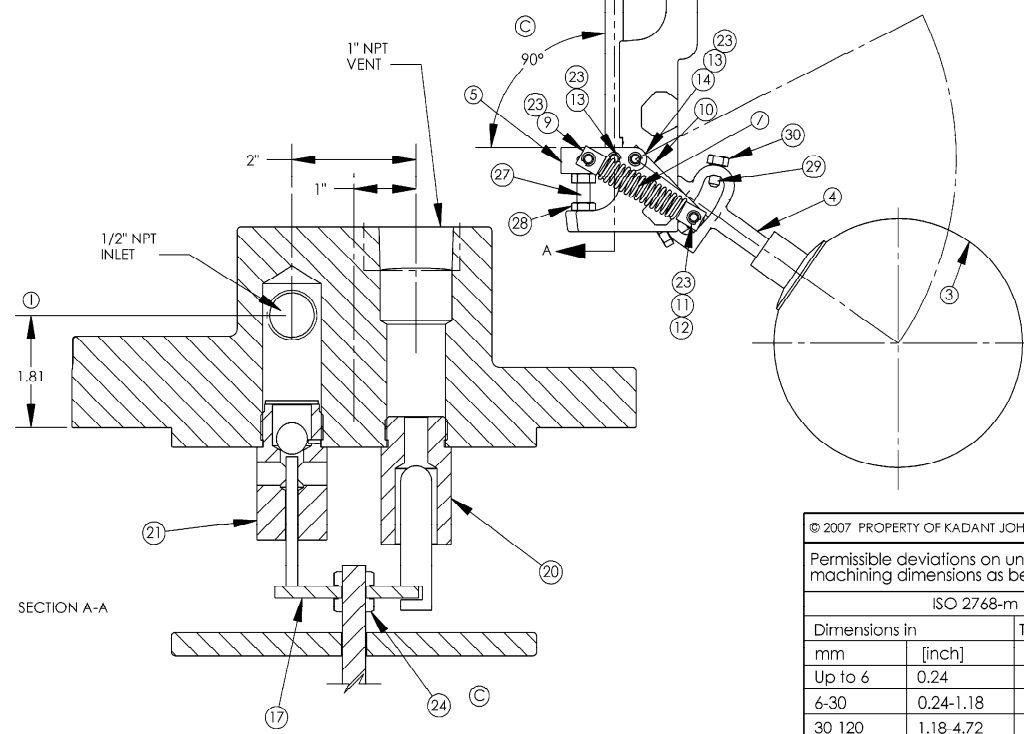
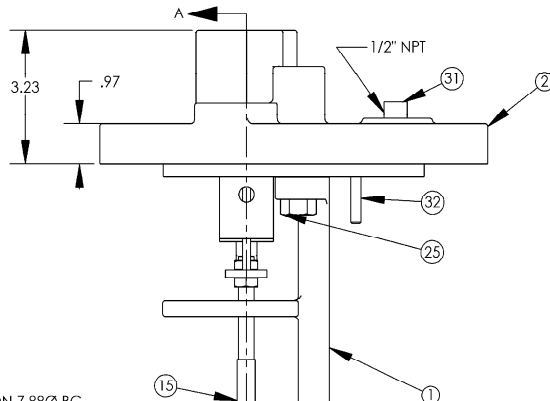
ASSEMBLY DIMENSIONS ARE ±1/8
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3 X 3 X 3 TANK CONN'S.				PP
DATE	5/7/1993	DWN. DWI	DR# 493-71	SYMBOL NO.
SCALE	NONE	CHK. SAB	CHK. TKJ	LMV-16XX-LOOO-FSA-8
			REV	DWG. NO.
			C	AB6011

VIEW B-B (BOTTOM VIEW OF MOUNTING FLANGE)
USE GROOVE PINS (32) AS A GUIDE FOR
SPRING END ALIGNMENT.



(8) .562Ø HOLES ON 7.88Ø BC



SECTION A-A

(M) 1. PRESSURE: MAX DIFF. PRESSURE 90 PSIG
MAX OPER. PRESSURE 150 PSIG

NOTES:

SA3V-1000-4

PARTS LIST

ITEM NO.	NO. REQ'D	DESCRIPTION	PART NO.	MATERIAL	REMARKS
1	1	SUPPORT FLANGE	SA1001-1	DUCTILE IRON	PLATED
2	1	MOUNTING FLANGE	SA1002-5	CAST IRON	
3	1	FLOAT	SA1003	STAINLESS STEEL	
4	1	FLOAT ARM	SA1004-2	STAINLESS STEEL	
5	1	LINKAGE YOKE	SA1005-1	STAINLESS STEEL	
7	2	SPRING	SA1007-2	STAINLESS STEEL	
9	4	SPRING END	SA1009-1	STAINLESS STEEL	
10	2	FOLLOWER LINK	SA1010	STAINLESS STEEL	
11	2	RETAINING RING	CSF230-0031-02	STAINLESS STEEL	
12	1	FOLLOWER ROD	SA1012	STAINLESS STEEL	
13	2	PIVOT PIN	SA1013	STAINLESS STEEL	
14	2	PIVOT PIN BUSHING	SA1014	STAINLESS STEEL	
15	1	ACTUATING ROD	SA1015	STAINLESS STEEL	
17	1	WASHER	SA517	STAINLESS STEEL	
20	1	VENT VALVE ASSY.	SA533	STAINLESS STEEL	
21	1	INLET VALVE ASSY.	SA532	STAINLESS STEEL	
23	8	RETAINING RING	CSF230-0018-02	STAINLESS STEEL	
24	2	JAM NUT	3/8-24	STAINLESS STEEL	
25	2	HEX HEAD CAP SCREW	1/2-13 X 1-1/4" LG	STEEL SA-325	
27	1	HEX HEAD CAP SCREW	5/16-18 X 1" LG.	STEEL SA-325	
28	1	JAM NUT	5/16-18	STEEL	
29	2	SOCKET HEAD SET SCREW	1/4-20 X 3/4" LG.	STEEL	
30	2	JAM NUT	1/4-20	STEEL	
31	1	PIPF PLUG	CSP660-0050-15-01	M. IRON	
32	2	GROOVE PINS	CSF229-0250-162-01	STEEL-PLATED	

INSTRUCTIONS: (G)

- INSTALL ONE SPRING END (9) ON EACH END OF BOTH SPRINGS (7) SO THAT WHEN ASSEMBLED THE SPRING END (9) HOLES ARE PARALLEL AND ON 2-19/32" CENTERS AS THE ASSEMBLY IS SITTING ON A BENCH NOT INSTALLED. TWO PINS (32) ARE PROVIDED ON THE BOTTOM SIDE OF THE MOUNTING FLANGE (2) FOR TESTING THE SPRING ASSEMBLY. SCREW THE SPRING ENDS INTO OR OUT OF THE SPRING UNTIL THE ASSEMBLIES EASILY SLIDE ON AND OFF THE TWO TEST PINS (32).
- USING LOCKTITE INSTALL HEX HEAD CAP SCREW (27) AND JAM NUT (28) INTO THE SUPPORT FRAME (1) AND ADJUST THE HEX HEAD CAP SCREW (27) SO THAT THE ACTUATING ROD (15) AND THE LINKAGE YOKE (5) FORM A RIGHT ANGLE.
- USING LOCKTITE INSTALL BOTH JAM NUTS (30) AND BOTH SOCKET HEAD SET SCREWS (29) INTO THE FLOAT (H) ARM (4) WITH 1/16" OF THE SOCKET HEAD SET SCREW (29) EXTENDING OUT OF THE JAM NUT.
- WITH THE FLOAT ARM (4) IN THE TANK EMPTY POSITION, SLOWLY APPLY AIR THRU AN ADAPTER FITTING IN THE 1/2" NPT MOTIVE INLET CONNECTION OF THE MOUNTING FLANGE (2). MOVE BOTH JAM NUTS (24) EITHER CLOSER TO OR FURTHER FROM THE MOUNTING FLANGE (2) SO THAT ABOUT .020" TO .040" CLEARANCE IS OBTAINED BETWEEN THE WASHER (17) AND THE INLET VALVE STEM (21). LOCKTITE AND TIGHTEN BOTH JAM NUTS (24) INTO POSITION MAKING SURE THE WASHER IS CENTERED OVER THE VALVES.
- USF LOCTITE 277 ON ALL THRFADS (C)

ASSEMBLY DIMENSIONS ARE ± .13

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Permissible deviations on untoleranced machining dimensions as below		PATTERN NO:	REFERENCE DRAWING:	TREATMENT:	
ISO 2768-m		ANGULAR TOLERANCE:	LOCATION: 111	MATERIAL: SEE PARTS LIST	
Dimensions in		± mm	REQ. NO: US081992-9	:US/CA	
mm	[inch]	± mm	DEBURR:	:NL	
Up to 6	0.24	0.1		:CN	
6-30	0.24-1.18	0.2		:BR	
30-120	1.18-4.72	0.3	DRAWN BY: DCW	TITLE: ASSEMBLY & PARTS LIST OF	
120-400	4.72-15.75	0.5	CHECKED BY: .	SELF-ACTUATING VALVE & LEVEL MECHANISM	
400-1000	15.75-39.37	0.8	DATE: AUG/20/1992	3/8" ORIFICE	
1000-2000	39.37-78.75	1.2		SYMBOL NO: SA3V-1000-4	
2000-4000	78.75-157.5	2		SCALE: PAGE: 1	DRAWING NO: REV: 0
				1/3 OF: 1	AB5831



LIQUI-MOVER® PUMP

REPAIR KITS

RK-LMSA Motive and Vent Valves

ITEM	QTY	PART NAME	PART NUMBER	MATERIAL	REMARKS
17	1	Washer	SA517	Stn. Stl.	
20	1	Vent Valve Assembly	SA533	Stn. Stl.	
21	1	Inlet Valve Assembly	SA532	Stn. Stl.	

RK-SA3V Repair Kit

ITEM	QTY	PART NAME	PART NUMBER	MATERIAL	REMARKS
5	1	Linkage Yoke	SA1005-1	Stn. Stl.	-
7	2	Spring	SA1007-2	Stn. Stl.	-
9	4	Spring End	SA1009-1	Stn. Stl.	-
10	2	Follower Link	SA1010	Stn. Stl.	-
11	2	Snap E Ring	CSF230-0031-02	Stn. Stl.	-
12	1	Follower Rod	SA1012	Stn. Stl.	-
13	2	Pivot Pin	SA1013	Stn. Stl.	-
14	2	Pivot Pin Bushing	SA1014	Stn. Stl.	-
15	1	Actuating Rod	SA1015	Stn. Stl.	-
17	1	Washer	SA517	Stn. Stl.	-
20	1	Vent Valve Assembly	SA533	Stn. Stl.	-
21	1	Inlet Valve Assembly	SA532	Stn. Stl.	-
	1	Gasket	CSS816-0644-9	Non-Asbestos	-
23	8	Retaining Ring	CSF230-0018-02	Stn. Stl.	-

Note: When converting older style LMSA valves to this newer style valve, it may be necessary to tap the vent hole approximately 1 thread deeper with a 1"-14UN straight threaded tap in order for the valve to bottom out properly.

GENERAL TROUBLESHOOTING OF FLOAT ACTUATED LIQUI-MOVER® PUMPS

OBSERVATION	PROBABLE CAUSE	REMEDY	
1. Liqui-Mover pump fails to fill.	1. Increase in liquid level in receiver, possible flood in receiver.	Obstruction in fill line, valve closed, inlet check backwards.	Inspect fill line for closed valve, inlet check in reverse, or obstruction in fill line. Refer to Assembly & Parts List Drawing.
	2. Receiver empty, Liqui-Mover pump level fluctuating.	Receiver pressure greater than pressure in discharge line.	If unit has been in operation for a period of time without problems, check for traps blowing through. If new installation, receiver pressure may be greater than anticipated. Back pressure may be less than anticipated. A 2-Way control valve may be required in discharge line.
2. Liqui-Mover pump fills too slow.	1. No liquid level in receiver.	Load to unit not as great as anticipated.	No action required.
	2. Receiver flooding.	Obstruction or restriction in fill line.	Inspect fill line for partially closed valve or defective check valve. Inspect fill line for proper size fittings and pipe. Refer to Assembly and Parts List Drawing for specific unit.
	3. Receiver flooding.	Restriction in vent line, motive and vent valve assembly out of adjustment.	Inspect vent line for partially closed valve, proper size fittings and pipe. Refer to Assembly and Parts List Drawing.

OBSERVATION		PROBABLE CAUSE	REMEDY
3. Liqui-Mover pump fills very rapidly.	1. Unit cycling almost normally, receiver flooding.	Defective check valve in discharge line and/or fill line. Possible back flow to Liqui-Mover pump.	Inspect discharge line check valve and fill line check valve. Refer to Assembly and Parts List Drawing.
4. Noise in or at fill line check valve.	1. Vibration and water hammer at fill line check valve.	Cold condensate.	Inspect for cold condensate. Throttle flow control valve, ahead of Liqui-Mover Pump assembly. Refer to Assembly and Parts List Drawing, and start-up procedure.
5. Liqui-Mover pump discharges very rapidly.	1. Water hammer in discharge line.	Motive pressure too high.	Throttle flow control valve or install pressure reducing valve. See start-up procedure.
	2. Receiver flooding, rise in receiver pressure during discharge.	Defective check valve in fill line. Discharging condensate back into receiver.	Inspect fill line check valve. Refer to Assembly and Parts List Drawing.
6. Liqui-Mover pump discharge cycle too long.	1. Possible receiver flooding.	Flow control valve throttled too much.	No action required, if receiver not flooding. If receiver flooding, adjust flow control valve for discharge of 10 - 15 seconds (approx.).
	2. Receiver flooding.	Restriction or increase of back pressure in discharge line.	Inspect discharge line for partially closed valve(s), obstructions or change in pressure. A pressure increase may require adjustment of flow control valve to reduce discharge time. Inspect discharge check valve.

OBSERVATION	PROBABLE CAUSE	REMEDY
3. No motive pressure flow. Receiver flooding.	Motive supply failure, obstruction in motive supply line.	Inspect for motive supply pressure, closed valve, or obstruction in motive supply line. Inspect strainer.
4. Inlet Valve noisy.	Condensate in motive supply line.	Inspect motive supply line for condensate. Check drip trap. Refer to Assembly and Parts List Drawing.
5. Receiver pressure increase during discharge.	Valve assembly out of adjustment. Motive pressure leakage into receiver, defective Fill Check Valve.	Refer to Float Mechanism Assembly Drawing.

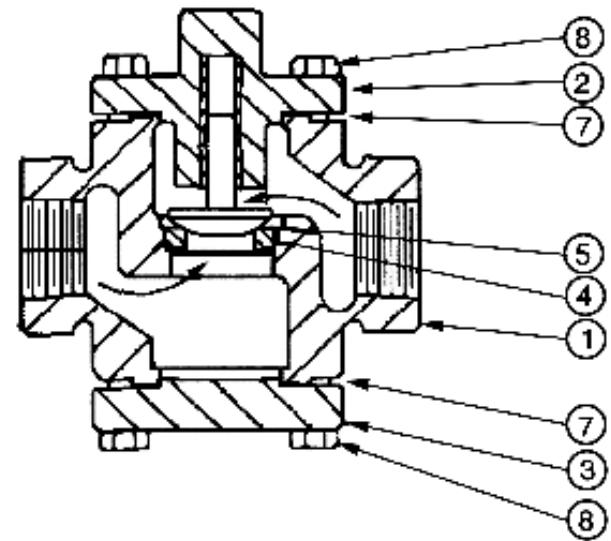
Repair Instructions For Johnson Lift Style Check Valves

REBUILDING

1. Isolate unit, disconnect electricity and close hand valves.
2. Remove Check Valve from piping being cautious of hot liquids.
3. Remove top (2) and bottom (3) caps.
4. Press out old seat (4). Being careful not to mar seating surfaces.
5. Discard old plug (5) and seat (4).
6. Clean the seating surfaces in the body (1) as well as gasket surfaces on the body and caps using a wire brush or scraper – **Do not remachine.**
7. Apply a layer of Permatex to seating surface.
8. Press new seat into body (1) with the sharp edge of I.D. facing up.
9. Once the seat is pressed in, inspect to make sure it is seated firmly in the body and a ring of Permatex has been pressed out around the bottom of the valve seat.
10. Clean off excess Permatex.
11. Apply Lapping Compound to the sealing face of the new plug (5) and lap to the seat for a minimum of five minutes.
12. Remove Lapping Compound and inspect plug (5) for continuous lapped ring mark around the sealing face.
13. If sealing face of plug looks well lapped, then place it on the seat (4) in the body (1).
14. Make sure bushing in top cap (2) is clean.
15. Place top cap (2) with gasket (7) over end of plug (5) and on top of body (1).
16. Attach with cap screws (8) applied with Never Seize and tightening evenly.
17. See Testing Procedure if testing is desired.
18. Attach bottom cap (3) and gasket (7) to bottom of body the same as Step 16.
19. Reconnect to piping.
20. Connect electricity and open hand valves.

TESTING

1. With bottom cap (3) off, connect outlet side of Check Valve to cold water service line (approximately 50 psi).
2. Lift plug (5) with hand and open water line.
3. When water begins to flow through the valve, allow plug (5) to drop to the seat (4) and wait one minute.
4. If valve seals, drips a few drops with no extreme leakage, water spray or continuous water flow, then valve is OK.
5. In case of extreme leakage the top cap (2) can be loosened slightly and shifted around on the body (1). If unsuccessful, the seat may need to be relapped.



- Note:**
- Exert caution when working with Liqui-Mover pumps as unit may be hot.
 - (#) = Item No. per Figure 1.
 - Permatex Part No. 1 C Fast Drying Hard Setting
 - Lapping Compound: Clover-Silicone Carbide Grease Mix 800 Grit Part No. 5A 51803, Grade 5A

LMV-SA

PREVENTATIVE MAINTENANCE

CHECK LIST

HOW OFTEN	CHECK	REFERENCE
1 Year	<ol style="list-style-type: none"> 1. Check anode in receiver tank (if applicable). 2. Clean gauge glass when required. 3. Drain tank and flush to remove residue. 4. Pull internal mechanism and inspect for wear on pins and linkage and for buildup on the float. 	<p>Drain tank – remove anode by unscrewing anode plug on the receiver tank end. If over 60% eaten away, replace.</p> <p>Disassemble and pull clean cloth through glass with cleaning wire.</p> <p>Remove drain plug in the bottom of tank and flush. Replace plug afterwards.</p> <p>Remove cap screws in top flange and remove internal mechanism and inspect.</p>

CAUTION: Before performing any of the above maintenance checks, shut off all steam and condensate lines connected to the unit.