



MB Companies, Inc. MSV Multi Service Vehicle

Operation & Maintenance Manual



Hydraulic Rear Dump Box Attachment for M-B Companies' MSV

QUALITY YOU CAN SEE, PEOPLE YOU CAN TRUST™

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Safety

**WARNING:**

Read this manual and any attachment owner's manuals before using this equipment. Failure to do so can result in serious injury or death. Call your dealer if you have any questions.

Hazard Definitions

For your safety, and to assure the long life of your equipment, be sure you understand the following signal words which will be seen throughout this manual:

- **DANGER:** Alerts you to an immediate hazard, which will always result in severe personal injury and possible death if it is not avoided.
- **WARNING:** Alerts you to a hazard which will result in a serious personal injury or possible death in some cases, if not avoided.
- **CAUTION:** Alerts you to a potential hazard which may result in a serious personal injury if not avoided. It also alerts against an unsafe practice that will permanently damage equipment or property.
- **IMPORTANT:** Points out a proper use that will avoid damage to the machine, and/or will extend the life of its parts.
- **NOTE:** Suggests how to use or adjust the equipment for best product results.

Identification of Safety Labels

Safety labels are strategically located around the attachment to prevent potential hazards. The labels are a permanent part of the equipment. If they become separated from the product or illegible, contact M-B Companies Inc. for no-cost replacements. Understand the information the labels are communicating before operating or maintaining the equipment.

See *Parts List* section for safety labels associated with this equipment.





General Safety

- This manual should be available during operation.
- Extra copies of this manual are available for purchase through the M-B Customer Service Department.
- To avoid serious injury or death, do not modify equipment. Any modifications made to equipment can be dangerous and can void equipment warranty.
- Never defeat a safety device to make a task easier.
- Never deface or remove factory-installed safety labels. If a label ever becomes lost, damaged, or illegible, report this condition to a supervisor and obtain a replacement label from the Customer Service department of M-B Companies, Inc.
- Always wear proper apparel when operating equipment; safety glasses, face shield or goggles, ear protection, and dust mask. Tie hair back. Never wear loose clothing or jewelry that could get caught in moving parts.
- Never operate equipment with covers or guards removed. Rotating parts can cause severe injury. Keep hands, feet, hair, jewelry and clothing away from all moving parts.
- Understand operation of hydraulic and pneumatic controls.
- Understand which adjustments are operator and which are maintenance adjustments.
- Always shut OFF equipment when left unattended.
- Never operate or work around equipment if under the influence of alcohol, drugs or medications.

Pre-Start-up Safety

- Install any covers or guards which may have been removed for shipping purposes.
- Before starting equipment, walk around equipment, making a visual inspection that all safety devices are properly installed and secured.
- Check that all hardware, fasteners, hydraulic fittings, etc. are in good condition and properly fastened. Replace any fatigued or damaged items with proper replacements.
- Personnel who are not required to be in the work area should be kept away. Never start the equipment unless you are absolutely certain that everyone in the area is clear of the machine and aware it is being started.
- Follow the manufacturer's recommended start-up procedure.

Pressurized Systems Safety

- Do not disassemble a pressurized system unless properly trained and equipped with adequate tooling.
- Familiarize yourself with the proper method of relieving pressure from pneumatic or hydraulic systems. Never perform maintenance on, or disassemble, pressurized systems without first locking out power to these systems and then relieving pressure to them.
- Oils and fluids can be very hot under pressure. Use caution and allow the system to cool before beginning maintenance work.
- Never operate or pressurize one of these systems with worn or damaged components. Replace hoses, fittings, valves or other components which appear defective.
- Never adjust pressurized systems beyond recommended levels to achieve higher operating pressures.

The Manual

It is the purpose of this manual to provide complete instructions for service, maintenance disassembly, repair, and installation of the mechanical components for the MSV Rear Dump Box attachment.

Directional Reference

All reference to left, right, front, or rear are given from the operator in the operator position and facing the direction of your unit.

Required Operator Training

Original purchaser of this unit was instructed by the seller on safe and proper operation. If unit is to be used by someone other than original purchaser; loaned, rented or sold, ALWAYS provide this manual and any needed safety training before operation.

The Operator Must Understand:

- How to operate all controls
- The functions of all controls
- How to STOP in an Emergency
- Speed Ranges



Work Area

- ALWAYS check overhead and side clearances carefully before operation. ALWAYS be aware of traffic when operating along streets and curbs.
- Keep area of operation clear. Stay alert for hidden hazards.
- DO NOT run engine in an enclosed area. Always provide good ventilation.
- Abnormal Vibrations are a warning of trouble. Striking a foreign object can damage unit. Stop unit and engine. Wait for all moving parts to stop. Inspect unit and make any necessary repairs before restart.
- Protect eyes, face, and head from objects that may be thrown from unit. Wear appropriate hearing protection.
- Avoid Sharp Edges. Sharp edges can cause serious injury. Wear gloves to service unit when handling sharp edges.
- ALWAYS keep hands and feet away from all moving parts during operation. Moving parts can cause serious injury or death.
- Be aware of the surroundings. Look for blind spots from which pedestrians or vehicles may suddenly appear.
- Locate the emergency stop on the vehicle.
- Do not operate in crowded pedestrian areas. This equipment may cause serious injury or death if safety rules are not followed.
- The M-B Multiple Service Vehicle (MSV) uses a level gauge. The gauge helps the operator determine the angle or slope of the surface being driven on. The gauge shows percent of grade.



WARNING:

During normal operation the MSV must not exceed 30% grade to either side. Adding any attachment to the MSV will affect the safe maximum grade. When using the dump box attachment, do not exceed 15%.



Figure 1

Maintenance Safety

- Do not remove guards while operating. After maintenance work, be sure all guards and other safety devices are installed and in proper working order.
- Never clean, lubricate, or adjust equipment while it is moving, has the potential to move or when engine is running.
- Always release pressure from pressurized systems before disassembling.
- Allow ample time for heated components to cool before working on or working close to them. Use temperature sticks or other appropriate devices to test temperatures.
- ALWAYS maintain unit in safe operation condition.
- Check the conditions of the unit at the end of each day and repair any damage or defects.
- Keep all fasteners properly torqued and in safe operating condition.
- Before maintenance, adjustments, or service (except where specifically recommended), shut off engine, and secure from moving.

Storage

ALWAYS clean and lubricate equipment before extended storage. Clean and lubricate equipment every 6 months during prolonged storage.



General Information

Introduction

Thank you for choosing M-B Companies, Inc. as your equipment manufacturer and supplier. As part of our commitment to total customer satisfaction, we have strived to ensure that the information contained within this manual is complete and representative of the equipment you have purchased. The manual cannot, however, anticipate every possible contingency to be met in the installation, operation and maintenance for your equipment. If you require additional information not included in this manual, please contact our Service Department at:

Customer Service Department
c/o M-B Companies, Inc.
1615 Wisconsin Ave.
PO Box 200
New Holstein, WI 53061
Phone: 1-888-558-5801 or 1-800-558-5800
Fax: 920-898-4588

Machine Identification

Each machine manufactured by M-B Companies, Inc. has an identification plate mounted to it as shown in Figure 2. This plate contains the serial number of your M-B equipment. Copy the information from the plate on your equipment into the appropriate space in Figure 2. This information is important to have available when communicating with M-B.



Figure 2



Customer Service

The serial number on your equipment is essential for proper service support. When contacting M-B Companies regarding service support, always provide the product serial number. This number is located on the identification plate mounted on your equipment, and should also have been recorded in the *Machine Identification* section.

Customer Service Department
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Manufacturer's Limited Warranty

The M-B Companies, Inc. warrants all its MSV products to be free from defects in materials and workmanship for 12 months, to begin with the delivery of said product to its original owner. This warranty is not transferable without the written consent of M-B.

M-B will, at its own expense and without expense to the owner, replace all failed parts for and make all repairs that may be required by reason of workmanship or material in any part of the assembly of the product and associated components.

Upon notice in writing, M-B will promptly repair or replace all defective or damaged items delivered under the contract. The batteries, tires, rubber materials, brushes and material normally consumed in operation, and major components such as engines, air compressors, and hydraulic pumps and motors are excluded from this warranty but shall, in any event, be guaranteed by M-B to the extent of any warranty received from its supplier.

Any components replaced under warranty will be warranted for the remainder of the original warranty. Replaced components do not restart the warranty period.

If requested by M-B, products or parts for which a warranty claim is made are to be returned, transportation prepaid, to M-B's factory. Any improper use, operation beyond capacity, or substitution of parts not approved by M-B, or alteration or repair by others in such a manner as in M-B's judgement materially and/or adversely affects the product shall void this warranty.

This warranty does not apply to defects caused by damage or unreasonable use while in the possession of the owner, including but not limited to: failure to provide reasonable and necessary maintenance, normal wear, routine tune-ups or adjustments, improper handling or accidents, operation at speed or load conditions contrary to published specifications, improper or insufficient lubrication, or improper storage.

The M-B Companies, Inc. shall not be liable for consequential damages of any kind, including, but not limited to, consequential labor costs or transportation charges in connection with the replacement or repair of defective parts, or lost time or expense which may have accrued because of said defect.

THE M-B COMPANIES DO NOT MAKE ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE. THE ONLY WARRANTY MADE BY M-B COMPANIES IS AS SET FORTH HEREIN. THIS WARRANTY CANNOT BE EXTENDED, BROADENED OR CHANGED EXCEPT IN WRITING BY AN AUTHORIZED OFFICER OF M-B COMPANIES, INC.


(M-B's total liability hereunder in no event shall exceed the purchase price of the product.)

Vehicle Information

Introduction

This section provides information that is specific to the M-B MSV. Each sub-section describes a component or system to give the reader a reasonable understanding of the topic. If a more in-depth knowledge is needed, contact M-B Companies Customer Support.

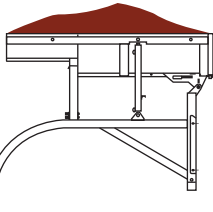
Specification



WARNING:

The end user must have an understanding of material weights. A cubic yard of sand weighs more than a cubic yard of coarse salt. Do not exceed the rated weight capacity of the dump box or the gross vehicle weight rating. Failure to follow this instruction may damage the vehicle or cause injury.

WARNING



UNDERSTAND MATERIAL WEIGHTS. OPERATOR TO NOT EXCEED 2000 LB (907 kg) DUMP BOX CAPACITY AND 12,000 LB (5443 kg) GROSS VEHICLE WEIGHT RATING (GVWR)

390-157896

Model	Hydraulic Dump Box
Height of Box Lowered (Winter Tires)	69-3/4 In (177 cm)
Height of Box Raised (Winter Tires)	115 In (292 cm)
Weight Capacity	2000 lbs (907 kg)
Volume - Material Level with Top	0.63 cu yd (0.48 cu m)
Volume - Material Piled 3 inches Above Top	0.75 cu yd (0.57 cu m)
Operating Weight (Empty) w/Rear Chassis Weight	905 lbs (441 kg)



Type Material	Volume	Estimated Material Weight
Course Salt (Level with Top Rail)	0.63 cu yd (0.48 cu m)	850.5 lbs (386 kg)
Course Salt (Material Piled Above Top Rail)	0.75 cu yd (0.57 cu m)	1012.5 lbs (459 kg)
Fine Salt (Level with Top Rail)	0.63 cu yd (0.48 cu m)	1275.5 lbs (579 kg)
Fine Salt (Material Piled Above Top Rail)	0.75 cu yd (0.57 cu m)	1518.5 lbs (689 kg)
Dry Sand (Level with Top Rail)	0.63 cu yd (0.48 cu m)	1701 lbs (772 kg)
Dry Sand (Material Piled Above Top Rail)	0.75 cu yd (0.57 cu m)	*2025 lbs (919 kg)
Wet Sand (Level with Top Rail)	0.63 cu yd (0.48 cu m)	*2041.2 lbs (925 kg)
Wet Sand (Material Piled Above Top Rail)	0.75 cu yd (0.57 cu m)	*2430 lbs (1102 kg)

*Weight exceeds 2000 lbs (907 kg) Dump Box Weight Rating.

Dimensions

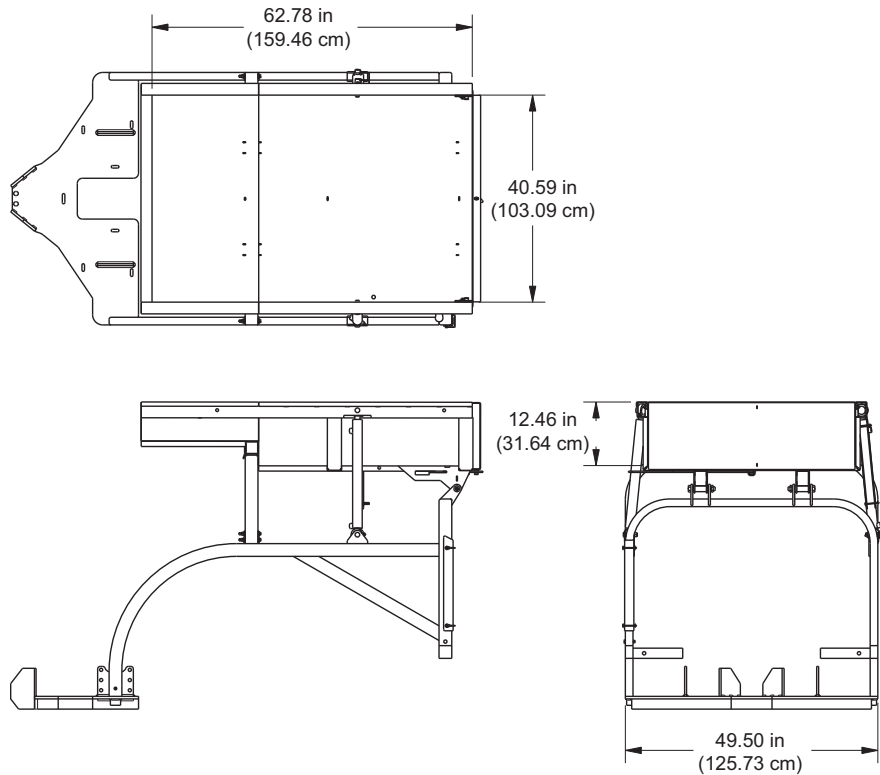
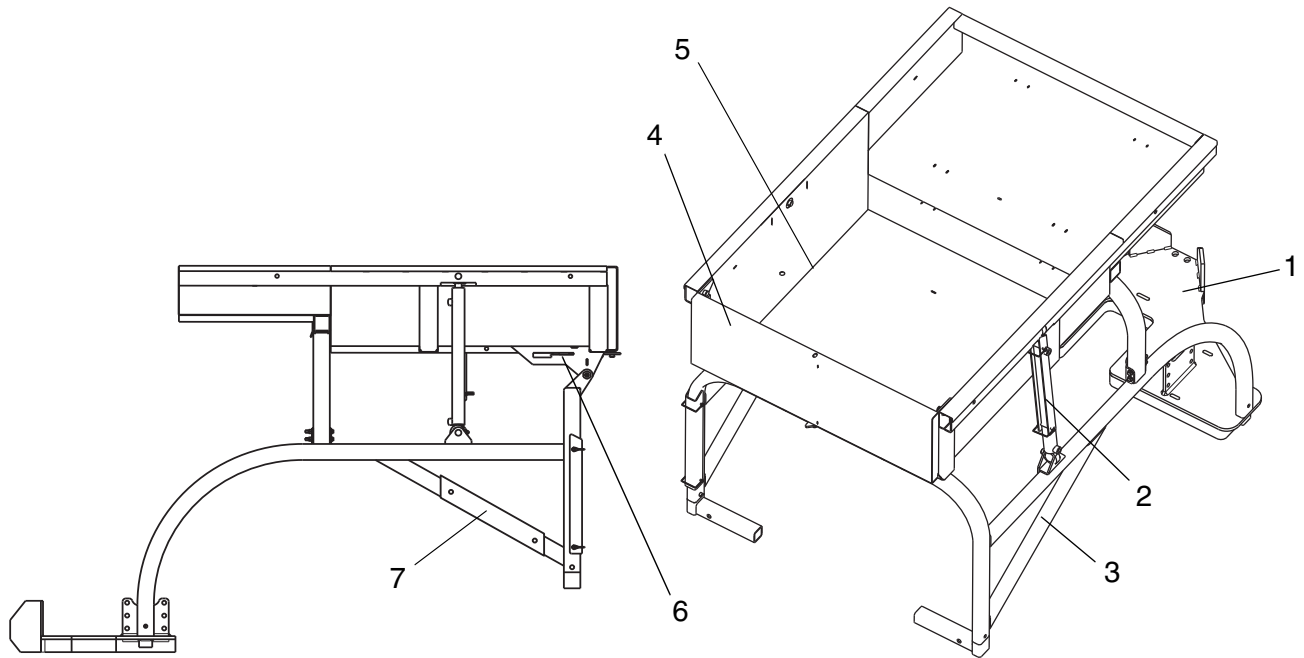


Figure 3

Layout of Machine



- | | |
|-----------------------|------------------------|
| 1. Frame Mount | 5. Box |
| 2. Hydraulic Cylinder | 6. Gate Release Lever |
| 3. Frame | 7. Safety Bar Location |
| 4. Gate | |

Figure 4



Operation

Connecting to the MSV

The Dump Box attachment is connected to the MSV by a frame mounted to the back half of the vehicle.

Joystick Layout - Dump Box

The joystick layout screen in the attachment section of the MDC is used to display all the joystick functions when the Dump Box attachment is used. Use the Attachment Selection screen to change Default to Yes (Figure 5). The joystick functions will perform as shown in Figure 6.

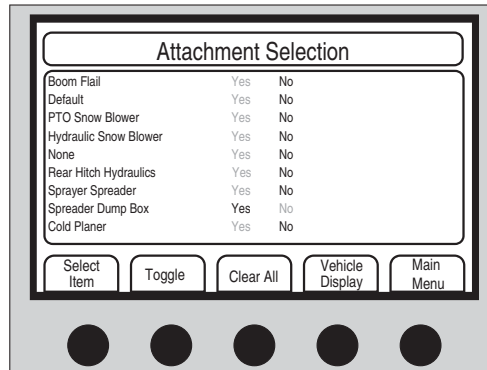


Figure 5

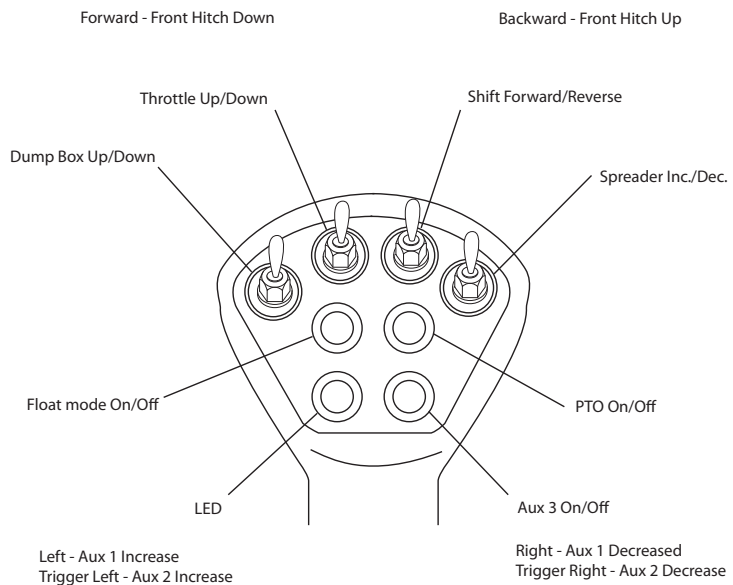


Figure 6

If the Spreader Dump Box will allow the spreader to operate as well. Other attachments may also be used with the Dump Box. The joystick functions will perform as shown in Figure 7 and Figure 8.

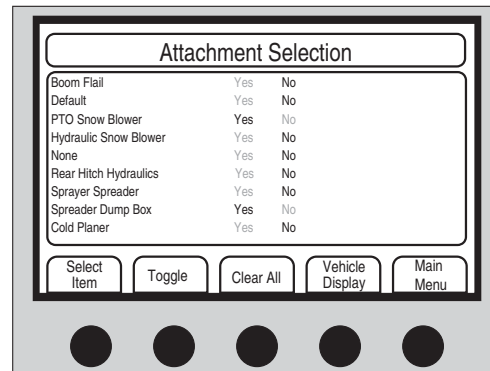


Figure 7

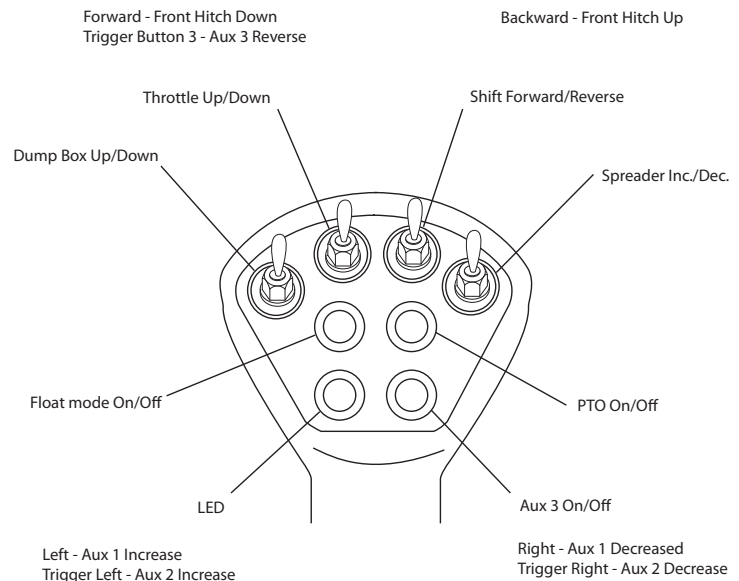


Figure 8

Filler Tube

Before the frame is attached, the fuel tank filler cap should be extended out through the engine hood. This will allow the fuel tank to be filled without lifting the dump box frame and engine hood.

To extend the filler tube:

1. Remove the fuel cap.
2. Use fuel-proof sealant on threads of 2-inch coupling and nipple.
3. Screw the coupling and nipple in place and tighten with a pipe wrench. Replace the fuel cap (Figure 9).



Figure 9

4. Slowly lower the engine hood to rest on the cap.
5. Mark the center of the cap and drill a 5/16-inch hole through the hood.
6. Place the metal flange ring on top of the hood with the drilled hole at the center (Figure 10).

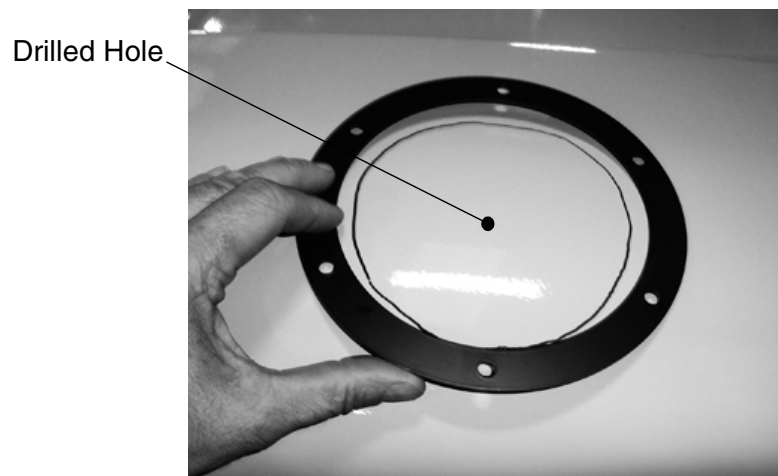


Figure 10

7. Trace the inside diameter of the flange.

NOTE: When cutting out the opening, be certain to lift the hood up to prevent blade contact with the fuel tank or cap. You may cover the painted surface with masking tape to help prevent damage.

8. A jigsaw can be used to cut out the opening in the hood. The cut can be inside the mark by 1/4-inch. This will allow more sheet metal on which to secure the rubber guard and flange.
9. After cleaning the cut edge with a file, place the flange in position to mark and drill the six 5/16-inch holes.
10. Install the rubber guard and the flange using the bolts and nuts (Figure 11).



Figure 11

Connecting the Frame Mounts

The frame of the dump box is connected to the MSV using the rear weight accessory bolted to the frame.

To attach the weight accessory:

1. Slide the weight under the center pivot point of the MSV.
2. Lift into place and secure with bolts and locking nuts (Figure 12).



CAUTION:

The rear weight accessory weighs 450 lbs (240 kg). Use a lifting device such as a pallet jack.

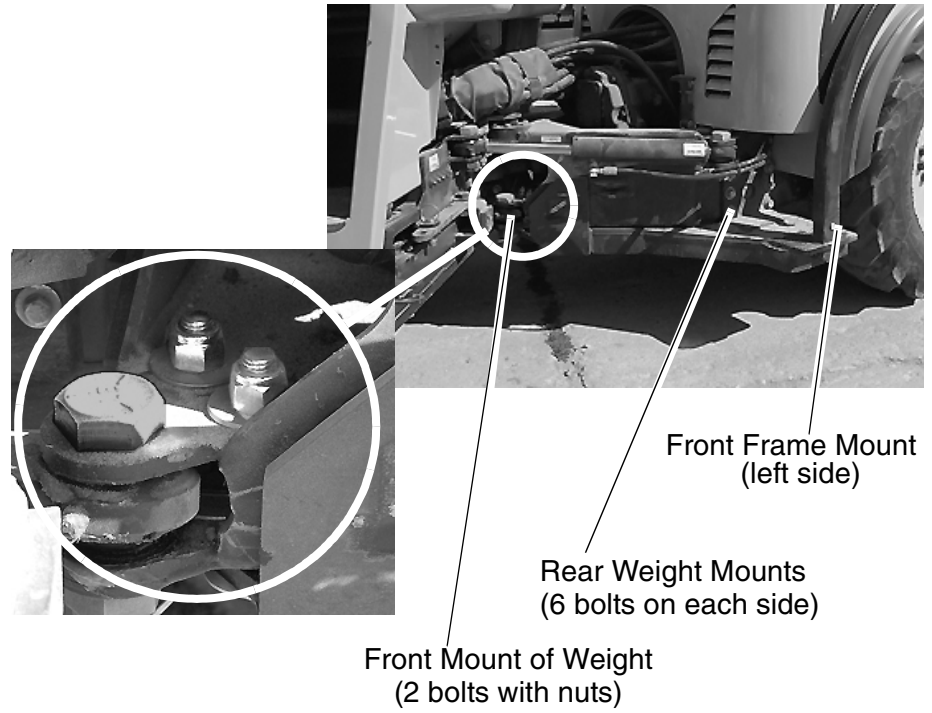


Figure 12

To attach the rear mounting bracket:

1. Slide the mounts into the opening of the rear bumper (Figure 13).
2. Secure with bolt and nut.



Figure 13

Attaching the Dump Box Assembly

**CAUTION:**

When lifting the dump box assembly lift only by using the frame. Do not lift by the dump box because unexpected movement can occur.

The frame for the dump box will be positioned over the engine of the M-B MSV. The four legs will fit over the posts of the frame mounts.

To attach the dump box assembly:

1. Remove the pins from the four legs (Figure 14).
2. Lift the assembly using lift points on the frame.



Pins with clip

Figure 14

**CAUTION:**

When lowering the dump box assembly be certain that hydraulic hoses and electrical wiring is kept away from pinch points.

3. Set the legs over the mounting posts.
4. Insert the safety pins and secure.



Operation of the Dump Box Attachment

The M-B MSV controls the Dump Box Attachment. The motor diagnose control (MDC) display screen in the operators cab will display information regarding the operation of the attachment.

Review the *Operation* section in the *M-B MSV Operators Manual* To become familiar with the controls.

Connect Hydraulic Hoses

The M-B MSV controls the up/down of the dump box using the Aux 5 hydraulic connections. The dump box is directly connected to the Aux 5 manifold which is located on the frame under the M-B MSV engine (Figure 15).

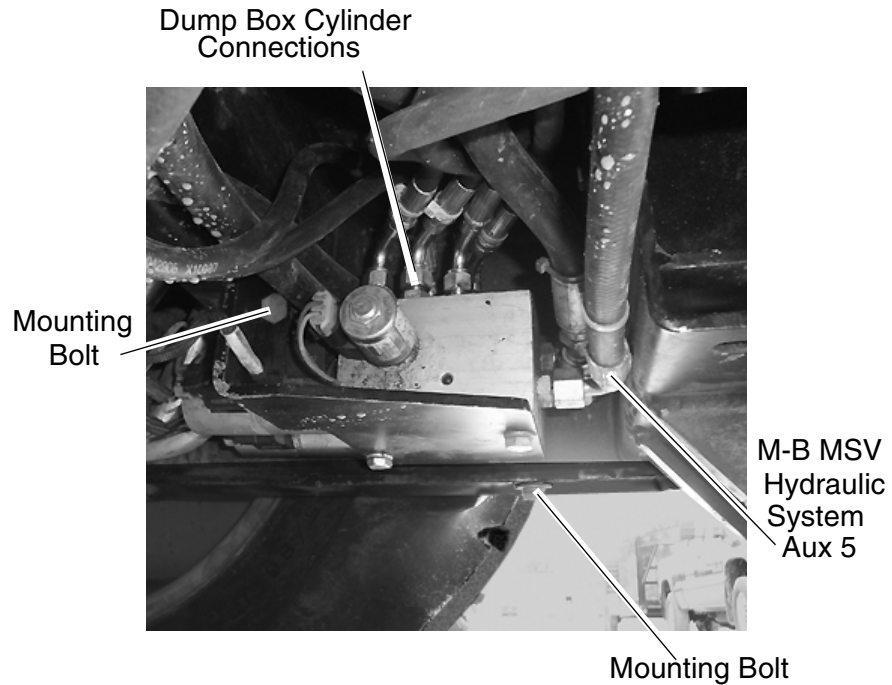


Figure 15



WARNING:

Do not remove any fittings or plugs from the manifold while the M-B MSV engine is running. Turn off the engine and remove keys to prevent personal injury.

1. Connect hydraulic hoses to lift cylinders.
 - a. Install 90 degree elbows with thread sealant to each port on the hydraulic lift cylinders. The fittings should point the hoses to center (Figure 16).



Figure 16

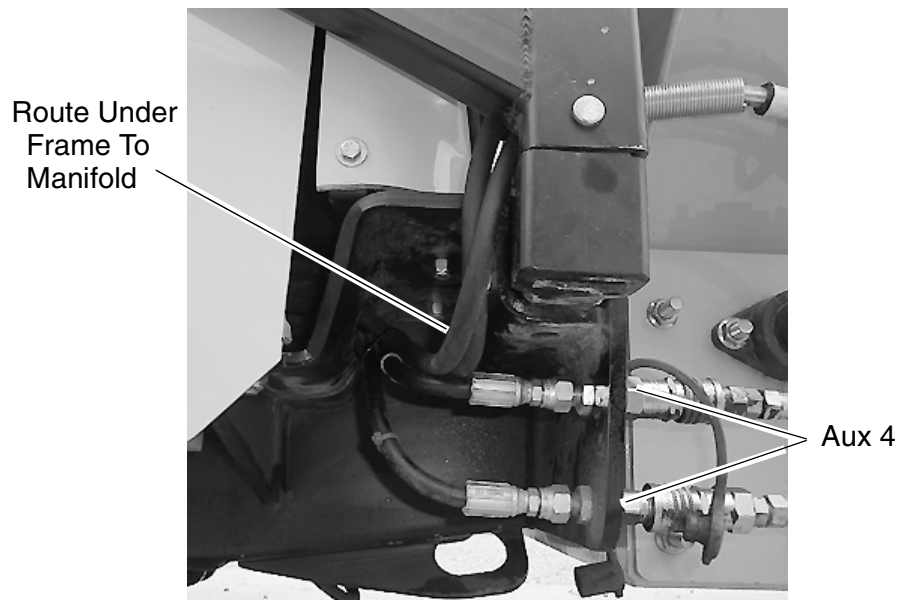


Figure 17

- b. Attach the straight hose connections to the elbows. Route the hoses along the frame and under the M-B MSV engine (Figure 16 and Figure 17). Use stay straps as needed.

2. Connect hydraulic hoses to the manifold.



WARNING:

The M-B MSV engine must be off.

- a. Remove the rear hydraulic manifold from the frame. Figure 15 shows the two mounting bolts.
- b. Remove the four pipe plugs BU and Y (Figure 18).

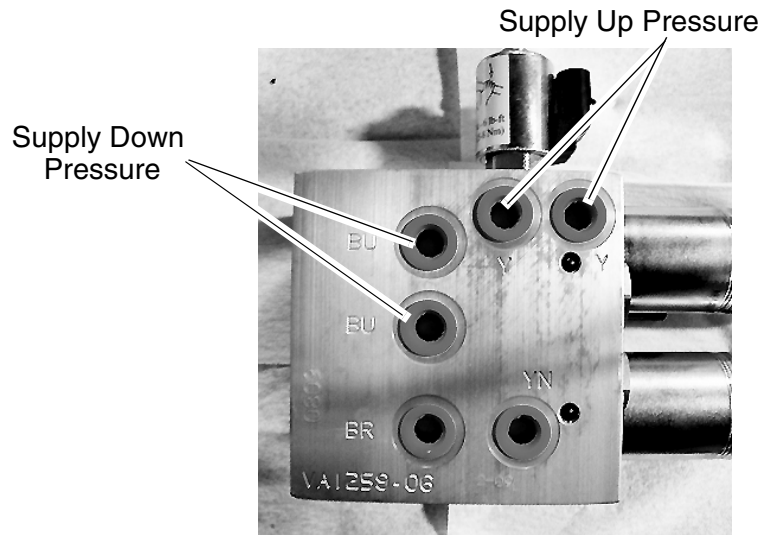


Figure 18

- c. Install the bottom cylinder hoses (Up Pressure) to the ports labeled "Y". Install the ram end cylinder hoses (Down Pressure) to the ports labeled "BU".
- d. The hoses when tightened must be oriented as shown in Figure 19.

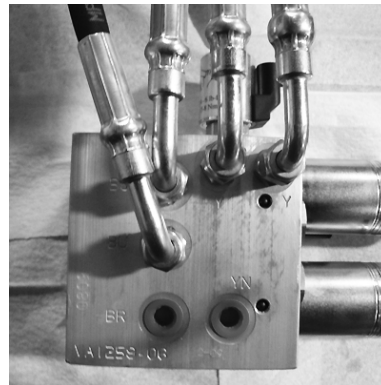


Figure 19

- e. Reattach the hydraulic manifold to the M-B MSV frame. Use stay straps as needed to secure the hoses into the frame.



CAUTION:

To prevent broken hydraulic lines. Do not allow any hydraulic hoses to hang below the M-B MSV frame.



Figure 20

Starting Procedure

To start using the Dump Box:

- The M-B MSV must be running.
- The engine RPM must be below 1250 RPM.



CAUTION:

Material in the dump box will cause pressure on the gate. When opening the gate material may push out quickly.



CAUTION:

If the rear spreader is attached, the cover must be removed before opening the gate or lifting the dump box.

- Open gate by moving lever forward and down into the locked open position.

The joystick will control lift functions.

- Push Aux 5 joystick toggle up to raise dump box.
- Push Aux 5 joystick toggle down to lower dump box.

**CAUTION:**

Before raising dump box check for overhead obstacles. Look for power lines or anything that may contact the dump box.

Safety Bar**WARNING:**

Do not enter the area under the dump box when the box is in the up position. If it is necessary to enter this area always use the safety bar. Failure to use the safety bar can result in serious injury or death.

When the dump box needs to be held in the full up position a safety bar is used to prevent the box from moving. The safety bar is stored on the left side of the dump box frame (Figure 21).

The box will lower with the Aux 5 toggle switch pressed down when the engine is not running and the ignition key is in the run position.



Figure 21

To use the bar:

1. Raise the dump box to the full up position.
2. Remove the two pins holding the safety bar.
3. Place the bar over the top shaft of the hydraulic lift.
4. Use the two pins to hold it in place (Figure 22). The safety bar has an angled cut on one end. This end will match the angle created at the box.

Safety Bar
in Position

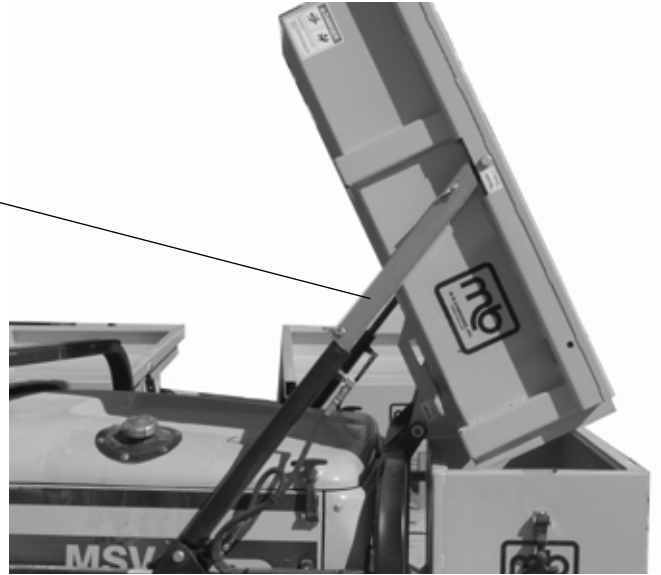


Figure 22



Maintenance

The M-B Rear Dump Box should be kept clean. Pivot points require periodic grease.



WARNING:

To prevent serious injury never perform maintenance on the equipment while the MSV engine is running, or the hydraulic hoses are connected.



Lubrication Points

General Lubrication

IMPORTANT: Wipe Each fitting clean before and after lubrication.

Apply grease to the lube fittings.

Apply oil at all pivot points and pin connections, see Figure 23.

Unit should be lubricated at beginning of season or every 10 operating hours. See *Maintainance Schedule*.

Lubrication Chart

Locations Refer to Figure 23	Number of Locations	Frequency				Lubrication Type			
		Before Each Use	10 Hours of Operation	Daily	Weekly	Monthly	Annually	MOBILUX EP2 Type Grease	Spray Grease
1. Pivot Pins	2		x					x	
2. Hyd Cylinder Pins	4		x					x	

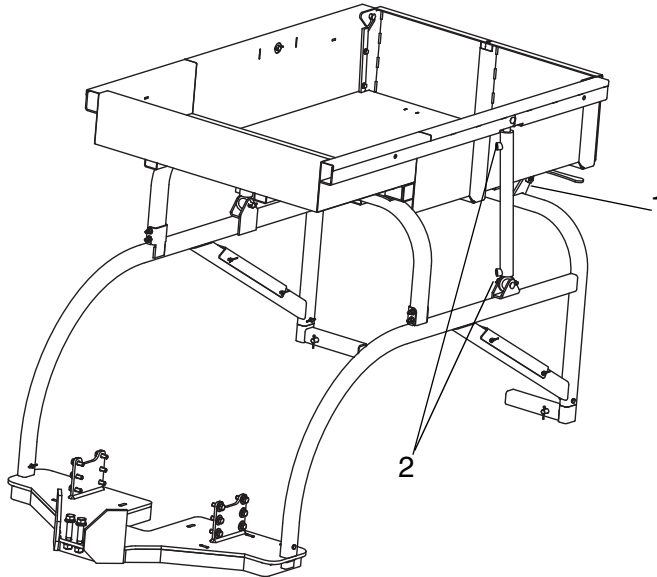


Figure 23

Troubleshooting

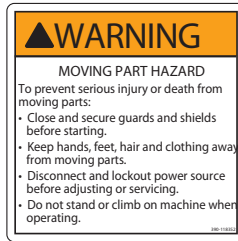
Hydraulic System

Problem	Probable Cause	Corrective Action
Joystick does not operate any components	Low hydraulic oil level	Add oil
Box moves in opposite direction	Hydraulic hoses connected to wrong ports on manifold	Install hoses correctly



Replacement Parts

Replacement Parts



390-118352



390-157201



390-140501



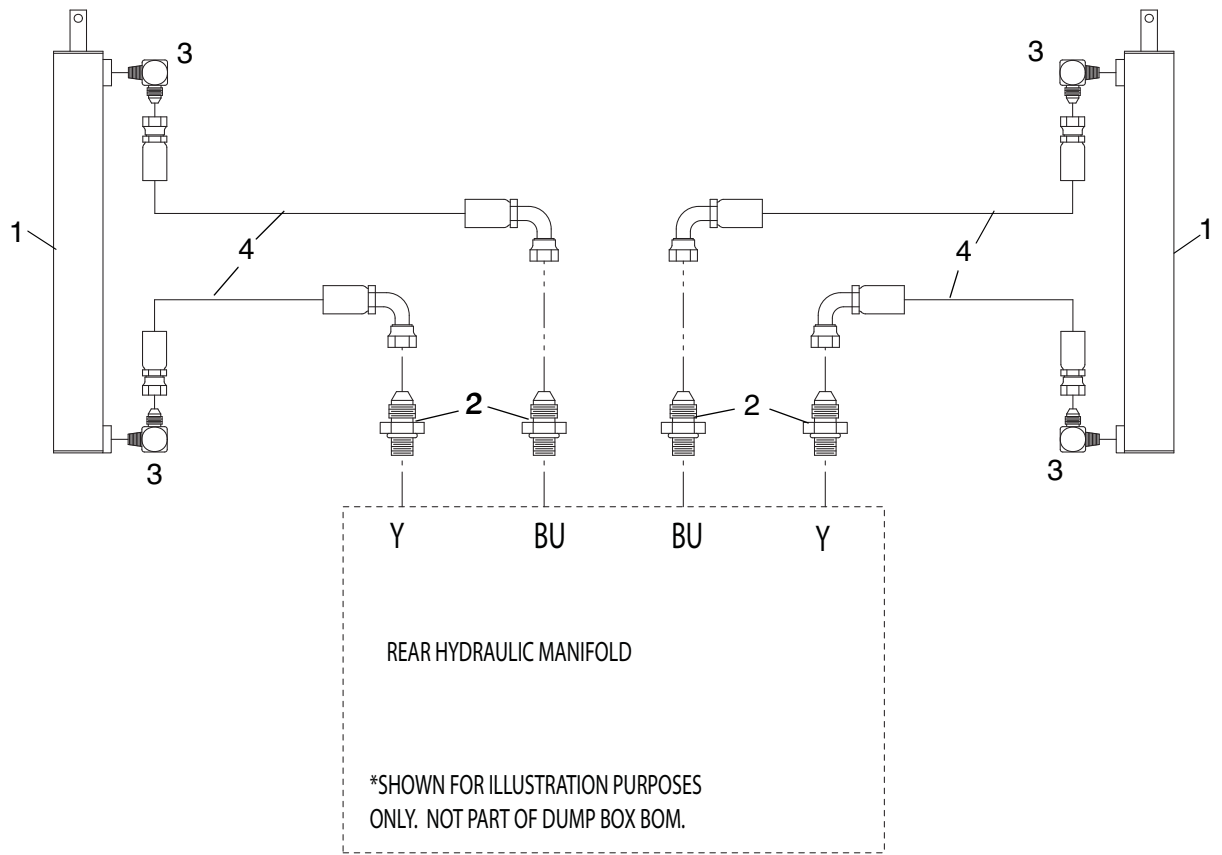
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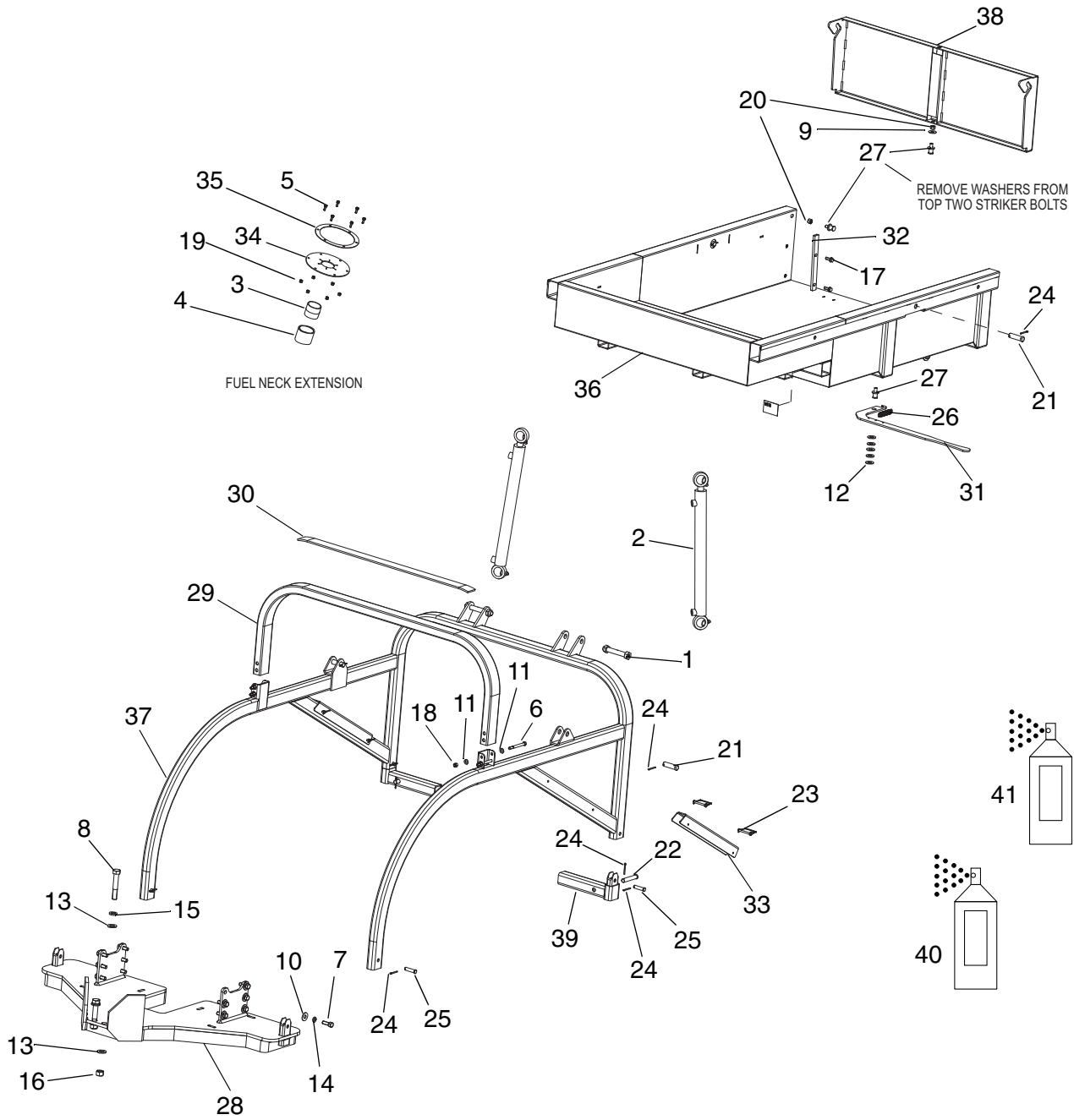
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390-157896



Replacement Parts List			
Item	Part Number	Description	QTY
1	203-157450	Cylinder, Hydraulic	2
2	211-66901	STR ADPT, 9/16 ORB, 9/16 JIC	4
3	211-75436	Elbow 90, 9/16 ORB, 9/16 JIC	4
4	213-157729	Hose Assy, 1/4 x 100"	4



Replacement Parts List			
Item	Part Number	Description	QTY
1	100-132340	Pin, 3/4" x 4-3/4" w/Zirk and Locknut	2
2	203-157450	Hydraulic Cylinder	2
3	217-92000	Nipple, 2 x Close SCH#40 GALV	1
4	217-97675	CPLG, 2" Full SCH#40 GALV	1
5	311-10750	HHCS .25-20 UNC x 0.750	6
6	311-34000	HHCS 3/8-16 UNC x 4.000	4
7	311-51500	HHCS .50-13 UNC x 1.500	12
8	311-84500	HHCS .75-10 UNC x 4.500	2
9	341-40000	Washer, Flat - 7/16 STD Zinc PL	1
10	341-50000	Washer, Flat - 1/2 STD Zinc PL	12
11	343-30000	Washer, SAE 3/8	8
12	343-70000	Washer, SAE 5/8	5
13	343-80000	Washer, SAE 3/4	4
14	351-50000	Washer, Lock - 1/2 YLW Zinc PL	12
15	351-80000	Washer, Lock - 3/4 YLW Zinc PL	2
16	361-80000	Nut, Hex, UNC, 3/4-10	2
17	370-126977	HHCS, Serrated Flange 3/8-16 x 1 Plated	4
18	371-81297	Nut, Hex, ESNA, 3/8-16 UNC	4
19	371-81299	Nut, Hex, ESNA, 1/4-20 NC	6
20	371-82080	Nut, Hex, ESNA, 7/16-14 UNC	3
21	380-140430	Pin, Clevis, YEL Zinc 3/4 x 2-1/2	4
22	380-140629	Pin, Clevis 5/8 x 3-1/2	2
23	380-157602	Pin, Snap 1/4 x 2-1/4	4
24	380-91744	Pin, Cotter	10
25	380-92039	Pin, 1/2 x 1.75 Zinc Plated	4
26	382-157895	Spring, Trip	1
27	384-92015	Pin, Latch Striker .984 Installed HT	4
28	410-157449	Weldment, Mount, Frame, Front ADB-00002	1
29	401-157455	Tube, Front Support, Box ADB-00002	1



Replacement Parts List			
Item	Part Number	Description	QTY
30	401-157468	Neoprene Rubber, .25"TH, 2"W, 36"L (60a)	1
31	401-157705	Latch, Handle ADB-00004	1
32	401-157706	Stop, Gate ADB-00004	2
33	401-157712	Support, Safety Dump Box	2
34	401-157716	Seal, Fuel Filler Neck MSV	1
35	401-157932	Plate, Fuel Filler Neck MSV	1
36	410-157333	Box 3/4 Yard ADB-00002	1
37	401-157409	Weldment, Frame, ADB-00002	1
38	410-157441	Weldment, Gate ADB-00002	1
39	410-157448	Mount, Rear, Frame ADB-00002	2
40	109-131128	Yellow Touch-UP Paint	
41	249-92005	Primer, Aerosol Can	

Parts listed in bold letters are considered to be a Maintenance, Service or Wear part. These parts will generally be stocked by dealers.



Hydraulic Fitting Installation Torque Recommendation

Table 1: For 37° & 45° (Machined or Flared) and MegaSeal®

Size		Steel				Brass			
Dash	Fractional (In.)	Ft-Lbs.		Newton-Meters		Ft-Lbs.		Newton-Meters	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
-4	1/4	10	11	13	15	5	6	6-3/4	9
-5	5/16	13	15	18	20	7	9	10	13
-6	3/8	17	19	23	26	12	15	17	20
-8	1/2	34	38	47	52	20	24	27-2/3	33
-10	5/8	50	56	69	76	34	40	46-1/3	55
-12	3/4	70	78	96	106	53	60	72-1/3	82
-16	1	94	104	127	141	74	82	100-1/2	111
-20	1-1/4	124	138	169	188	75	83	101-1/2	113
-24	1-1/2	156	173	212	235	79	87	107	118
-32	2	219	243	296	329	158	175	214	237

Table 2: For Flat-Face “O” Ring Seal (Steel)

Size		Ft-Lbs.		Newton-Meters	
Dash	Fractional (In.)	Min.	Max.	Min.	Max.
-4	1/4	10	12	14	16
-6	3/8	18	20	24	27
-8	1/2	32	40	43	54
-10	5/8	46	56	60	75
-12	3/4	65	80	90	110
-14	7/8	65	80	90	110
-16	1	92	105	125	240
-20	1-1/4	125	140	170	190
-24	1-1/2	150	180	200	245



Table 3: For SAE O-Ring Boss (Steel) & Gates Adapterless

Size		Ft-Lbs. Working Pressures 4,000 psi (27.5 Mpa) and below		Newton-Meters Working Pressures 4,000 psi (27.5 Mpa) and below		Ft-Lbs. Working Pressures Above 4,000 psi (27.5 Mpa)		Newton-Meters Working Pressures Above 4,000 psi (27.5 Mpa)	
Dash	Fractional (In.)	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
-3	3/16	—	—	—	—	8	10	11	13
-4	1/4	14	16	20	22	14	16	20	22
-5	5/16	—	—	—	—	18	20	24	27
-6	3/8	24	26	33	35	24	26	33	35
-8	1/2	37	44	50	60	50	60	68	78
-10	5/8	50	60	68	81	72	80	98	110
-12	3/4	75	83	101-1/2	113	125	135	170	183
-14	7/8	—	—	—	—	160	180	215	245
-16	1	111	125	150	170	200	220	270	300
-20	1-1/4	133	152	180	206	210	280	285	380
-24	1-1/2	156	184	212	250	270	360	370	490

Table 4: Maximum Recommended Torque for dry NPTF (Tapered) Pipe Threads*

Size	Ft-Lbs.	Newton-Meters
-2	20	25
-4	25	35
-6	35	45
-8	45	60
-12	55	75
-16	65	90
-20	80	110
-24	95	130
-32	120	160

Table 4: Maximum Recommended Torque for dry NPTF (Tapered) Pipe Threads*

Size	Ft-Lbs.	Newton-Meters
*NOTES:		
1. The torque values obtained from tightening pipe threads can vary considerably depending on thread condition. Adequate sealing can occur at values much lower than the maximum values listed above. Only enough torque to achieve adequate sealing should be used.		
2. When using a male tapered pipe thread with a female straight or parallel pipe thread, maximum values are 50% of those listed in the table.		
3. If threaded sealant is used, maximum values shown should be decreased by 25%		





Fastener Torque Recommendation

Table 5: Torque for Standard Fasteners

Nominal Dia.	Threads per inch	Grade 2			Grade 5			Grade 8			Grade 9		
		Tightening Torque			Tightening Torque			Tightening Torque			Tightening Torque		
		Lubed	Dry Plated	Dry Plain	Lubed	Dry Plated	Dry Plain	Lubed	Dry Plated	Dry Plain	Lubed	Dry Plated	Dry Plain
(in.)		K = 0.15	K = 0.17	K = 0.20	K = 0.15	K = 0.17	K = 0.20	K = 0.15	K = 0.17	K = 0.20	K = 0.15	K = 0.17	K = 0.20
Unified Coarse Thread Series													
1/4	20	49 in-lbs	59 in-lbs	66 in-lbs	76 in-lbs	86 in-lbs	101 in-lbs	107 in-lbs	122 in-lbs	143 in-lbs	126 in-lbs	143 in-lbs	168 in-lbs
5/16	18	101	122	135	157	178	209	221	251	295	259	294	346
3/8	16	15 ft-lbs	18 ft-lbs	20 ft-lbs	23 ft-lbs	26 ft-lbs	31 ft-lbs	33 ft-lbs	37 ft-lbs	44 ft-lbs	38 ft-lbs	43 ft-lbs	51 ft-lbs
7/16	14	24	29	32	37	42	49	52	59	70	61	70	82
1/2	13	37	44	49	57	64	75	80	90	106	94	106	125
9/16	12	53	63	70	82	92	109	115	130	154	135	153	180
5/8	11	73	87	97	113	126	150	159	180	212	186	211	248
3/4	10	129	155	172	200	227	267	282	320	376	331	375	441
7/8	9	125	160	167	322	365	429	455	615	606	633	604	710
1	8	187	225	250	483	547	644	681	722	909	799	905	1065
1-1/8	7	266	319	354	596	675	794	966	1095	1288	1132	1283	1510
1-1/4	7	375	450	500	840	952	1121	1363	1545	1817	1597	1810	2130
1-1/2	6	652	783	869	1462	1657	1950	2371	2688	3162	2779	3150	3706
Fine Thread Series													
1/4	28	56 in-lbs	68 in-lbs	75 in-lbs	87 in-lbs	99 in-lbs	116 in-lbs	123 in-lbs	139 in-lbs	164 in-lbs	144 in-lbs	163 in-lbs	192 in-lbs
5/16	24	112	135	150	174	197	231	245	278	327	287	325	383







Table 5: Torque for Standard Fasteners

Nominal Dia.	Threads per inch	 Grade 2			 Grade 5			 Grade 8			 Grade 9		
		Tightening Torque			Tightening Torque			Tightening Torque			Tightening Torque		
		Lubed	Dry Plated	Dry Plain	Lubed	Dry Plated	Dry Plain	Lubed	Dry Plated	Dry Plain	Lubed	Dry Plated	Dry Plain
(in.)		K = 0.15	K = 0.17	K = 0.20	K = 0.15	K = 0.17	K = 0.20	K = 0.15	K = 0.17	K = 0.20	K = 0.15	K = 0.17	K = 0.20
3/8	24	17 ft-lbs	20 ft-lbs	23 ft-lbs	26 ft-lbs	30 ft-lbs	35 ft-lbs	37 ft-lbs	42 ft-lbs	49 ft-lbs	43 ft-lbs	49 ft-lbs	58 ft-lbs
7/16	20	27	32	36	41	47	55	58	66	78	68	78	91
1/2	20	41	49	55	64	72	85	90	102	120	105	120	141
9/16	18	59	71	78	91	103	121	126	146	171	151	171	201
5/8	18	82	99	110	127	144	170	180	204	240	211	239	281
3/4	16	144	173	192	223	253	297	315	357	420	369	418	492
7/8	14	138	165	184	355	403	474	502	568	669	588	666	784
1	14	210	252	280	542	614	722	765	867	1020	896	1016	1195
1-1/8	12	298	357	397	668	757	890	1083	1227	1444	1269	1439	1693
1-1/4	12	415	493	553	930	1055	1241	1509	1710	2012	1768	2004	2358
1-1/2	12	734	880	978	1645	1865	2194	2668	3024	3557	3127	3544	4169

Torque values for 1/4 and 5/16-in series are in inch -pounds. All other torque values are in foot-pounds
 Torque values calculated from formulas $T=KDF$, where
 K = 0.15 for "lubricated" conditions
 K = 0.17 for zinc plated and dry conditions
 K = 0.20 for plain and dry conditions
 D = Nominal Diameter
 F = Clamp Load

Table 6: Torque-Tension Relationship for Metric Fasteners

Nominal Dia.	Pitch	 Class 4.6			 Class 8.8			 Class 10.9			 Class 12.9	
		Tightening Torque			Tightening Torque			Tightening Torque			Tightening Torque	
		Lubed	Dry Plated	Dry Plain	Lubed	Dry Plated	Dry Plain	Lubed	Dry Plated	Dry Plain	Lubed	Dry Plain
(mm)		K = 0.15 (ft-lbs)	K = 0.17 (ft-lbs)	K = 0.20 (ft-lbs)	K = 0.15 (ft-lbs)	K = 0.17 (ft-lbs)	K = 0.20 (ft-lbs)	K = 0.15 (ft-lbs)	K = 0.17 (ft-lbs)	K = 0.20 (ft-lbs)	K = 0.15	K = 0.20
3	0.5	0.28	0.32	0.38	0.73	0.82	0.97	1.0	1.2	1.4	1.2	1.6
3.5	0.6	0.44	0.50	0.59	1.1	1.3	1.5	1.6	1.9	2.2	1.9	2.5
4	0.7	0.66	0.74	0.87	1.7	1.9	2.3	2.4	2.7	3.2	2.8	3.8
5	0.8	1.3	1.5	1.8	3.4	3.9	4.5	4.9	5.5	6.5	5.7	7.6
6	1	2.3	2.6	3.0	5.8	6.6	7.7	8.3	9.4	11	9.7	13
6	1.25	2.1	2.3	2.7	5.3	6.0	7.0	7.6	8.6	10	8.8	12
7	1	3.8	4.3	5.0	9.7	11	13	14	16	19	16	22
8	1	5.9	6.6	7.8	15	17	20	22	24	29	25	34
8	1.25	5.5	6.2	7.3	14	16	19	20	23	27	24	31
10	1.25	11	13	15	29	33	39	42	48	56	49	66
10	1.5	11	12	14	28	32	37	40	45	53	47	62
12	1.25	21	23	28	53	60	71	76	86	101	89	119
12	1.5	20	22	26	51	58	68	73	82	97	85	113
12	1.75	19	21	25	49	55	65	70	79	93	81	108
14	1.25	26	29	34	66	75	89	95	106	127	111	148
14	1.5	28	32	37	72	82	96	103	117	138	121	161
14	2	30	34	40	78	88	104	111	126	148	130	173
16	1.5	50	57	67	129	146	171	184	208	245	215	287
16	2	47	53	62	121	137	161	173	196	230	202	269
18	1.5	73	82	97	187	212	249	266	303	357	313	417
18	2.5	65	73	86	167	189	222	239	270	318	279	372
20	2.5	91	104	122	236	267	314	337	382	449	394	525

Clamp load calculated as 75% of the proof load for specified bolts.
 All Torque values are listed in foot-pounds
 Torque values calculated from formulas $T=KDF$, where
 K = 0.15 for "lubricated" conditions
 K = 0.17 for zinc plated and dry conditions
 K = 0.20 for plain and dry conditions
 D = Nominal Diameter
 F = Clamp Load



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