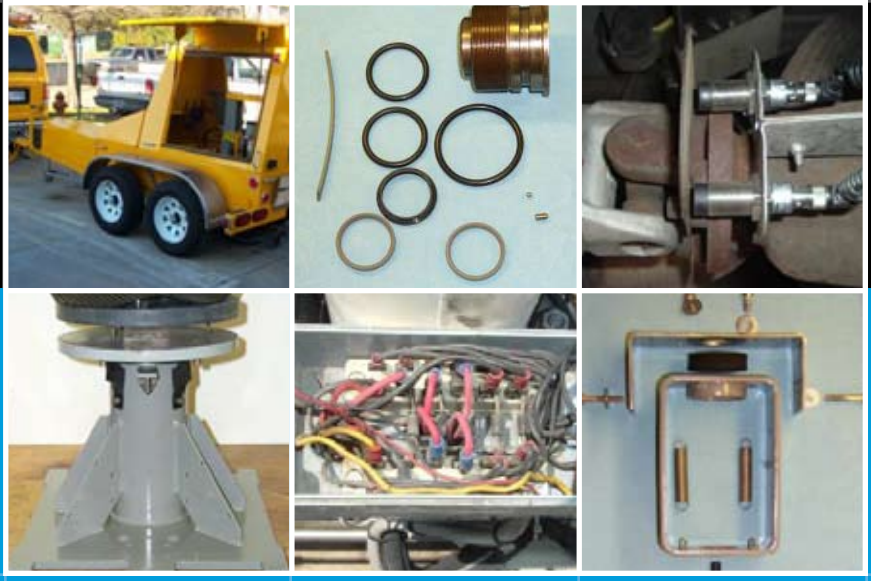
Long-Term Pavement Performance Program

Falling Weight Deflectometer

MAINTENANCE MANUAL



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LTPP

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Foreword

Many pavement engineers rely on falling weight deflectometer (FWD) technology. FWDs "thump" the pavement and record information related to its structural integrity.

FWDs are often preferred over destructive methods of testing because they are much faster than destructive tests and do not entail the removal of pavement materials. In addition, the testing apparatus is easily transportable as a trailer or vehicle-mounted.

The Federal Highway Administration's (FHWA) Long-Term Pavement Performance (LTPP) program operates eight Dynatest® Model 8000 FWDs to collect load and deflection data on in-service pavement test sections across North America. LTPP has collected pavement deflection data in daily operations for 15 years, and in that time, the FWDs have had very little downtime. Continuous preventive maintenance is necessary to keep the complex hydraulic-electrical-mechanical FWDs operating under demanding conditions to collect high quality data and pass rigorous annual reference calibrations. The owner's manual from the manufacturer provides guidance on most repairs, maintenance and troubleshooting; however, eventually FWDs require service beyond routine maintenance—in other words, the time comes for a complete overhaul.

In spring 2003, the LTPP Southern Region support contractor overhauled one of the FWDs operated for the LTPP program. During the overhaul, the contractor documented the process photographically and described the process of disassembling and reassembling the FWD components and subcomponents. This document provides FWD owners, operators, and technicians information as a supplement to the Dynatest 8000 owner's manual. Maintenance guidelines are based on continuous operation of FWDs. Less frequent operation may require adjusting maintenance frequency; however, the owner's manual from the manufacturer should be followed.

Gary L. Henderson
Director, Office of Infrastructure
Research and Development

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16. Abstract

The Federal Highway Administration's (FHWA) Long-Term Pavement Performance (LTPP) program operates eight Dynatest Model 8000 FWDs to collect deflection data on in-service pavement test sections across North America. LTPP has collected pavement deflection data in daily operations for 15 years, and in that time, the FWDs have had very little downtime. Continuous preventive maintenance is necessary to keep the complex hydraulic-electrical-mechanical FWDs operating under demanding conditions to collect high quality data and pass rigorous annual reference calibrations. The owner's manual from the manufacturer provides guidance on most repairs and troubleshooting; however, eventually FWDs require service beyond routine maintenance—in other words, the time comes for a complete overhaul.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	$candela/m^2$	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
^oC	Celsius	1.8C+32	Fahrenheit	^oF
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	$candela/m^2$	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

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CHAPTER 1. INTRODUCTION

BACKGROUND

Understanding why some pavements perform better than others is essential to building and maintaining a cost-effective highway system. Since 1987, the Long-Term Pavement Performance (LTPP) program, a comprehensive 20-year study of in-service pavements, has conducted a series of rigorous long-term field experiments monitoring more than 2,400 asphalt and portland cement concrete pavement test sections across the United States, Puerto Rico and Canada.

Established as part of the Strategic Highway Research Program (SHRP) and now managed by the Federal Highway Administration (FHWA), LTPP was designed as a partnership with the States and Canadian Provinces. LTPP's goal is to help the States and Provinces make decisions based on the performance of existing pavement designs that will lead to better performing and more cost-effective pavements in the future.

One aspect of the LTPP experiments is the long-term and seasonal structural response of pavement. Many pavement engineers rely on falling weight deflectometer (FWD) technology to determine this information. FWDs "thump" the pavement and record information related to its structural integrity.

Falling weight deflectometers are often preferred over destructive methods of testing because they are much faster than destructive tests and do not entail the removal of pavement materials. In addition, the testing apparatus is easily transportable as a trailer, or vehicle-mounted.

The FHWA's LTPP program operates eight Dynatest® Model 8000 FWDs to collect deflection data on in-service pavement test sections across North America. LTPP has collected pavement deflection data in daily operations for 15 years, and in that time, the FWDs have had very little downtime. Continuous preventive maintenance is necessary to keep the complex hydraulic-electrical-mechanical FWDs operating under demanding conditions to collect high quality data and pass rigorous annual reference calibrations. The owner's manual from the manufacturer provides guidance on most repairs and troubleshooting; however, eventually FWDs require service beyond routine maintenance—in other words, the time comes for a complete overhaul.

In spring 2003, the LTPP Southern Region support contractor overhauled one of the FWDs operated for the LTPP program. During the overhaul, the contractor documented the process with photographs and captured illustrations of the FWD components and subcomponents. This document provides FWD owners, operators, and technicians information as a supplement to the Dynatest 8000 owner's manual. Maintenance guidelines are based on continuous operation of FWDs. Less frequent operation may require adjusting maintenance frequency; however, the owner's manual from the manufacturer should be followed.

Maintenance activity frequencies described as "routine" or "periodical" are roughly equivalent to monthly and semiannually, respectfully. Maintenance frequencies described in distance roughly equate to operating time as 1 hour equals 80.47 kilometers (km) (1 hour equals 50 miles (mi)).

ORGANIZATION

This document is divided into six chapters. Chapter 2 discusses the FWD trailer. Chapter 3 covers the subassembly. Chapter 4 discusses the strike plate, load cell, and the raise/lower bar.

Chapter 5 covers the electronics, and chapter 6 is a conclusion. A maintenance log is provided in the appendix at the end of the manual.

CHAPTER 2. FALLING WEIGHT DEFLECTOMETER TRAILER

The FWD in this manual is mounted on a towed trailer, which requires some routine maintenance. This section discusses and illustrates the following trailer parts:

- Frame.
- Accessories.
- Torsion axles.
- Hydraulic braking system and tires.
- Lights.
- Optional covers.

TRAILER FRAME

The trailer frame requires little maintenance. Monthly, a technician should thoroughly check the frame for signs of cracks, corrosion, and missing bolts. Figure 1 shows corrosion on the trailer frame that occurred under the battery box near the battery ground pole. Figure 2 shows a second ground pole, another site of possible corrosion. Figure 3 shows a missing bolt that was drilled out and replaced. The missing bolt was from an optional cover. Damage such as broken bolts can be expected on units with covers, and bolts that attach the covers should be checked monthly.

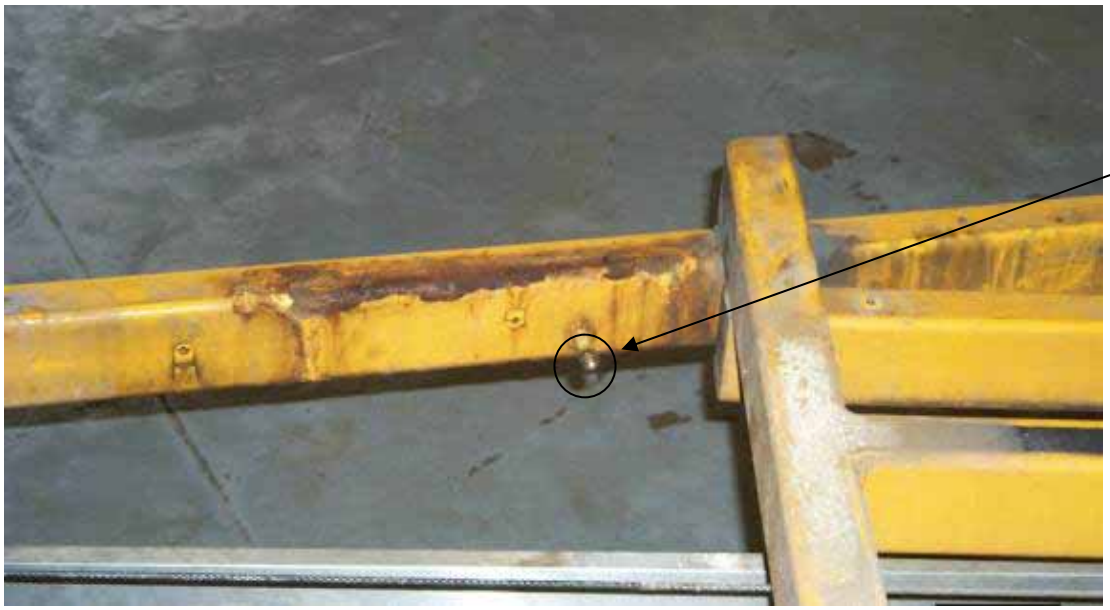


Figure 1. Corrosion caused by battery.

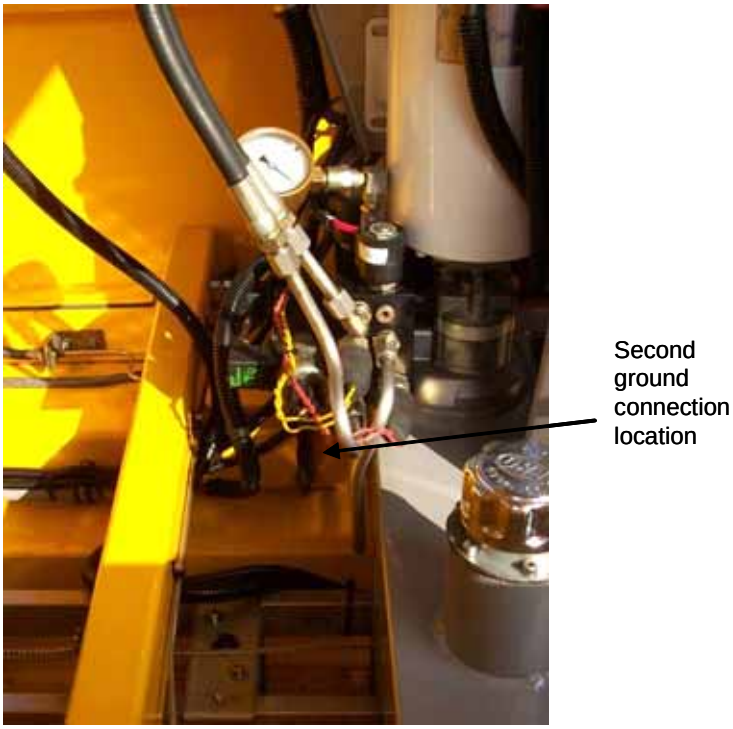


Figure 2. Second battery ground connection.

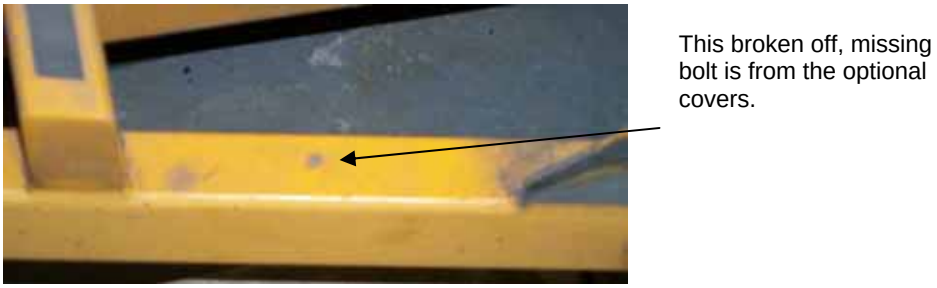


Figure 3. Missing bolt drilled out, tapped, and replaced.

NOTE: The missing bolts that have broken off are from the optional covers. Check the covers monthly and repair or replace missing bolts. This damage is common on units with covers.

Figures 4 and 5 show the trailer after it was stripped of all paint and parts to prepare it for the major overhaul.

Figure 4. Stripped and sandblasted trailer ready to go to powder coat facility.

Figure 5. Rear view of trailer before powder coat was applied.

Figures 6 and 7 show the newly powder-coated trailer.

Figure 6. Front of newly powdered trailer.

Figure 7. Rear of newly powdered trailer.

ACCESSORIES

All eight of the Federal LTPP programs' FWDs have covers (figures 8, 9, and 10). These covers provide some security and help protect sensitive components from outside elements. The covers should be washed and inspected monthly for cracks and dents. Covers should be waxed every 6 months to help prevent scratches caused by dirt and debris. Monthly, all hinges should be lubricated and mounting bolts checked to ensure they are tight.

Figure 8. Lower trailer covers.

Figure 9. Top trailer cover ("dog house").

Figure 10. Front trailer cover.

TORSION AXLES

The torsion axles must be checked for the correct toe settings and camber. The trailer axles are set at the factory and rarely need to be adjusted; however, it is a good idea to check their alignment every 3 months.

To do this, look at the wear on the tires to check them visually or run your hand across the tire surface to feel any abnormal wear such as on the edges or scuffing of the tires. An abnormal amount of wear on the interior or exterior edge of the tire indicates the axles may be out of alignment. Some wear is normal because of the vertical movement in the torsion axle itself.

To help reduce unnecessary wear on the tires, rotate them every 8,047 to 16,093 km (5,000 to 10,000 mi). Excessive wear between rotations may indicate the alignment needs to be corrected. To correct this alignment, take the trailer to a reputable trailer repair facility for service; most are equipped to correct alignment.

Figure 11 shows the torsion axle and mounting plate configuration. During tire rotation, check the rubber inside the tube housing (figure 12). It should be intact with no pieces missing. In some cases, the rubber may separate from the housing. If this occurs, the axle may need to be replaced. Consult a repair facility to help determine this.

Figure 11. Torsion axle and mounting plate.

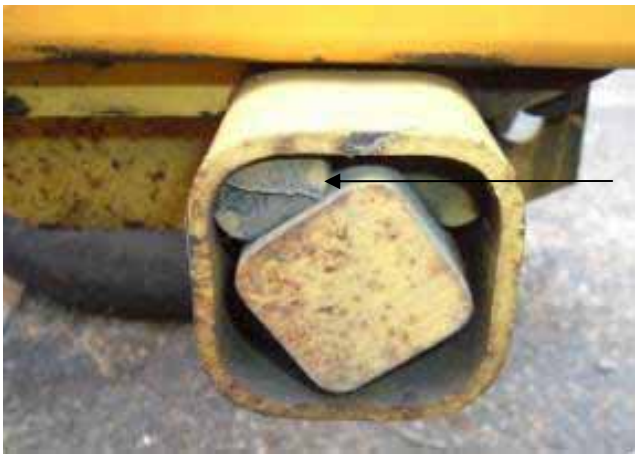


Figure 12. Torsion tube housing.

Figure 13 shows a bird's eye view of the torsion axle and shims. Check wheels for loose bearings and check tires for wear and condition (figure 14).

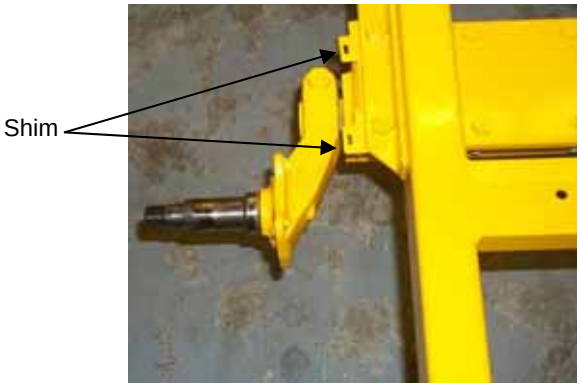


Figure 13. Top view of torsion axle and shims.

Figure 14. Trailer tires.

HYDRAULIC BRAKE SYSTEM

Make the following precautionary checks before any trip:

- Secure all fasteners on the hydraulic hitch assembly. Also check all exposed brake system parts (hydraulic lines, park lock, clamps, and brackets). Check trailer hitch brake fluid and mounting bolts. Figure 15 illustrates parts of the hydraulic brake system.

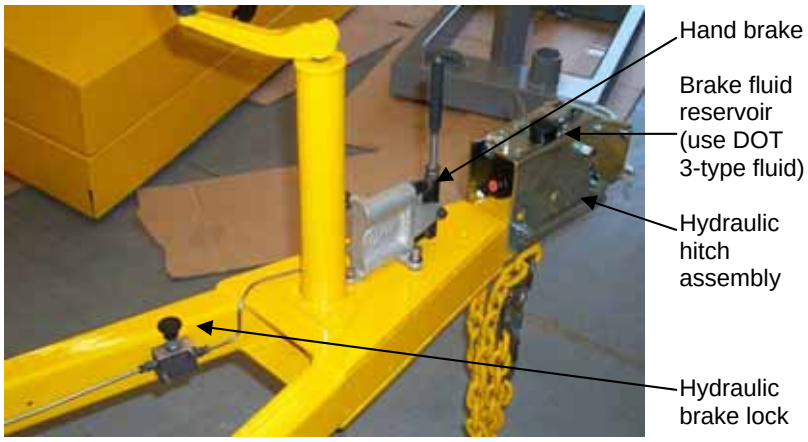


Figure 15. Hydraulic hitch assembly and hand brake.

- Visually inspect brake shoes every 48,280 km (30,000 mi) or at least once a year (figure 16). FWD units in the LTPP program should be checked at 40,234 km (25,000 miles) or 6 months. If brake shoes are worn and need replacing, the drums should be turned or replaced. When new shoes are replaced, verify that the hydraulic wheel cylinder is not leaking or showing signs of seepage. If it is, replace it, and bleed the brakes.

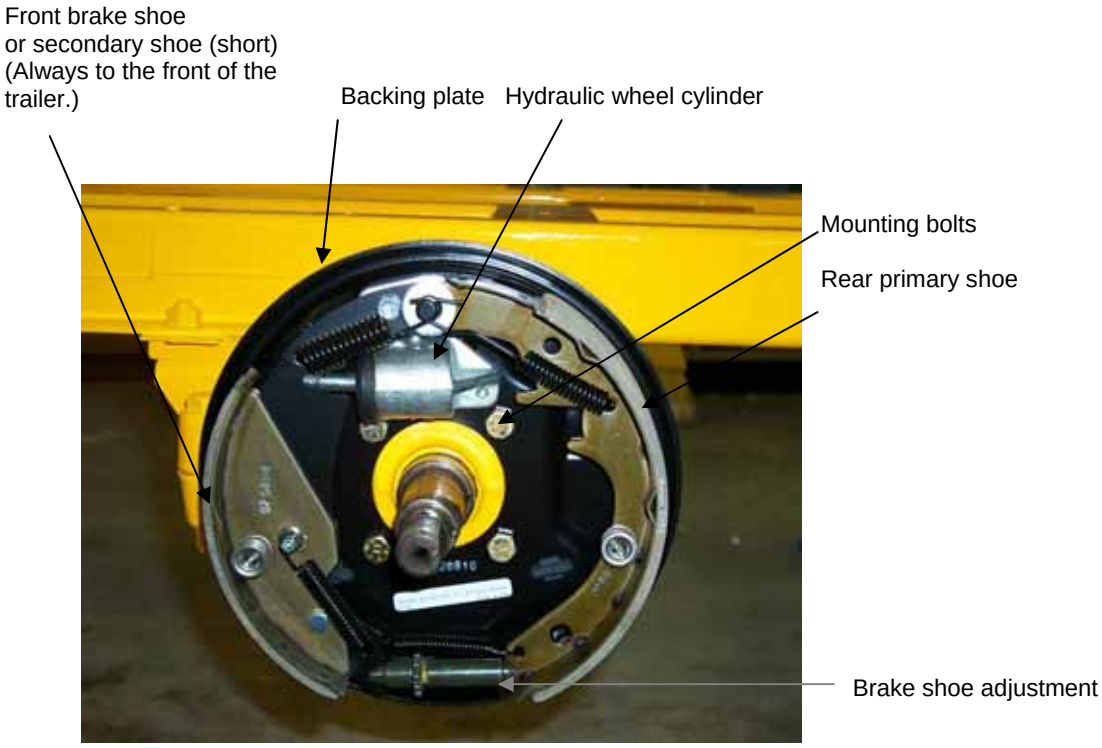


Figure 16. Mounted view of complete brake assembly.

- Adjust the brake shoe adjuster (figure 17). This will determine the brake drum to brake shoe clearance. It is recommended that shoes be adjusted out until the drum just starts to lightly drag from contact. Do *not* over adjust; doing so may cause the wheels to lock up. If a lockup occurs, reduce the shoe to drum clearance. Depending on the brake drum manufacturer, some adjusting slots are on the front of the brake drum, while some are located on the back plate.

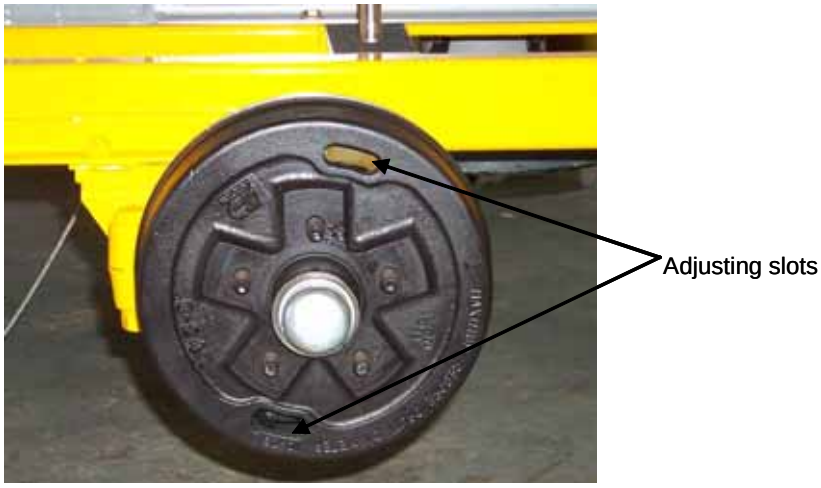


Figure 17. Brake drum with adjusting slot.

- Check the flexible brake lines (figures 18 and 19) for cracks, leaks, or signs of rubbing against the frame that could have occurred during travel.
- Check rigid brake lines for leaks (figure 20).
- Ensure safety chains are crossed and attached to tow vehicle.
- Check the audible backup alarm.

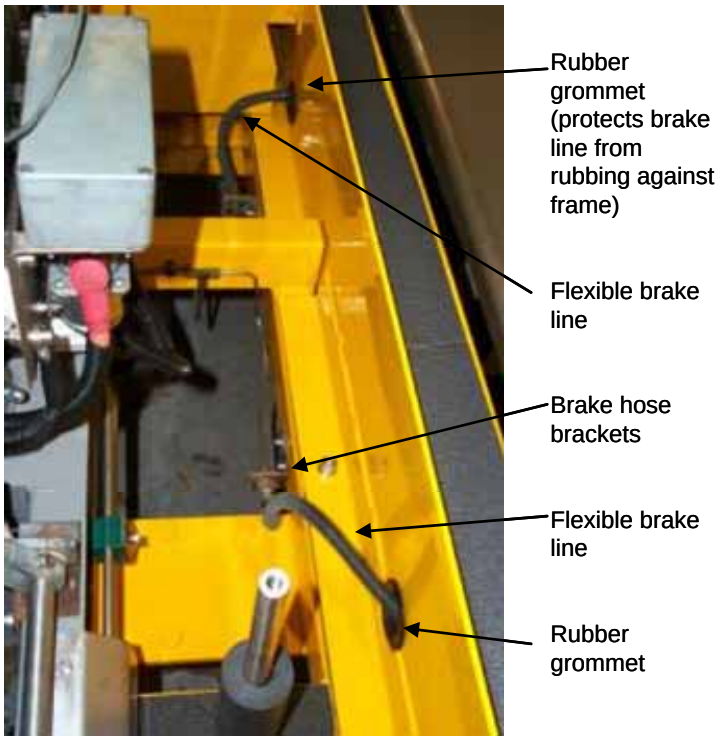


Figure 18. Flexible brake lines.

Figure 19. Flexible brake line behind tire.

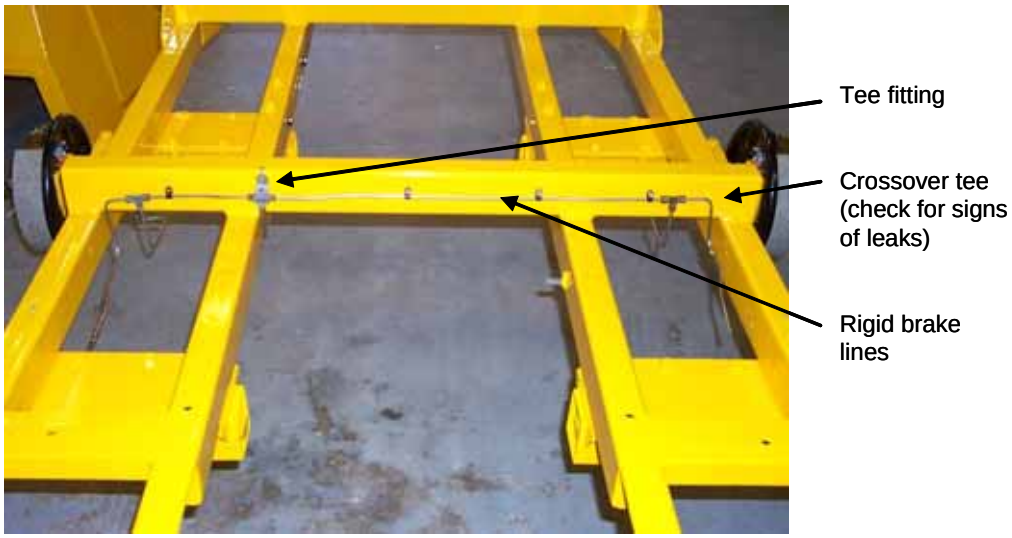


Figure 20. Rigid brake lines.

TIRES AND WHEELS

- Check tire inflation pressure weekly. Consult the tire manufacturer's recommendation for the correct kilopascals (kPa) (pounds per square inch (psi)) inflation. Use tires designed specifically for trailers.
- Daily check wheel lug nuts visually and torque them monthly to 122.2 to 162.7 Newton-meter (N-m) (90 to 120 pound-force per foot (lbf)), depending on lug and stud diameter.
- Check wheel bearings for looseness by feeling for play when the hub is moved up and down, or side to side (figure 21).
- Yearly repack wheel bearings and replace grease seals (figure 22). Remove wheel bearings and races to check for bluing, pitting, or excessive wear. Replace wheel bearings as a complete set, not individually (including inner and outer wheel bearings and races).

Figure 21. Brake drum.

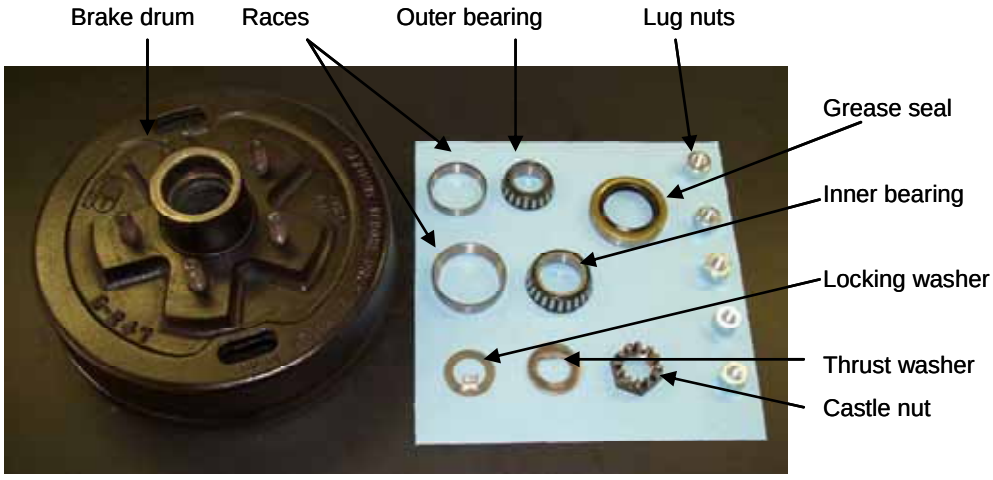


Figure 22. New axle wheel bearings and components.

TRAILER LIGHTS

Check trailer lights before traveling. Daily, check brake lights, turn signal, running lights, and strobes to make sure they are working properly (figures 23 and 24).

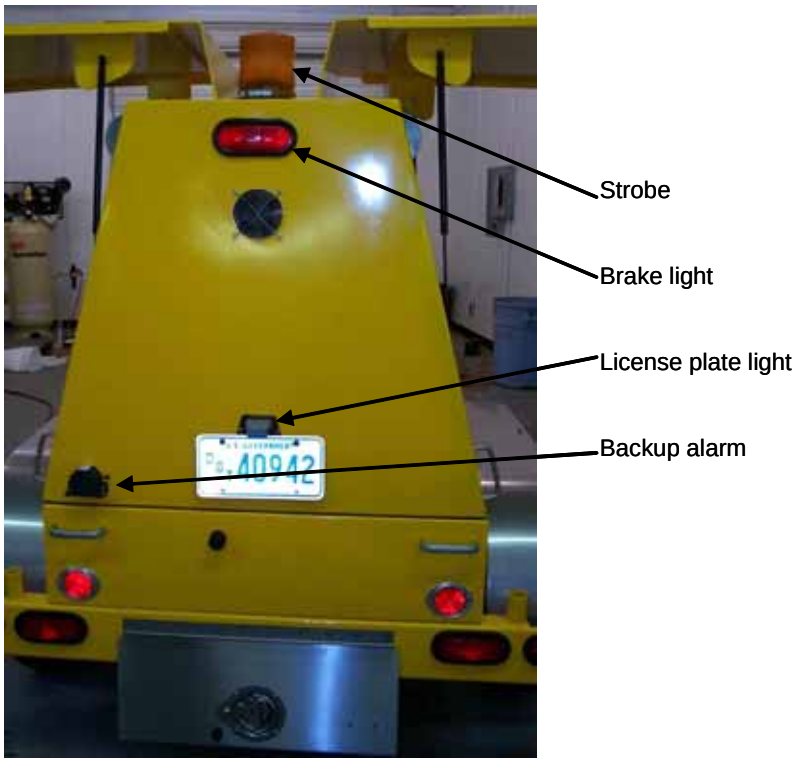


Figure 23. Trailer brake and license plate lights and backup alarm.

Figure 24. Trailer turn signal and brake lights.

CHAPTER 3. SUBASSEMBLY

The subassembly is a rigid component that bolts directly to the trailer frame with four bolts and nylon lock nuts to secure the bolts. The top of the subassembly, or tower bridge, is bolted into place using eight bolts and washers. Use thread locker (medium-strength blue Loctite® or equivalent) to prevent loosening. Every 3 to 6 months, examine all eight bolts, tighten, and replace any missing bolts).

Figure 25 shows the subassembly and figure 26 shows the subassembly mounted on the trailer.

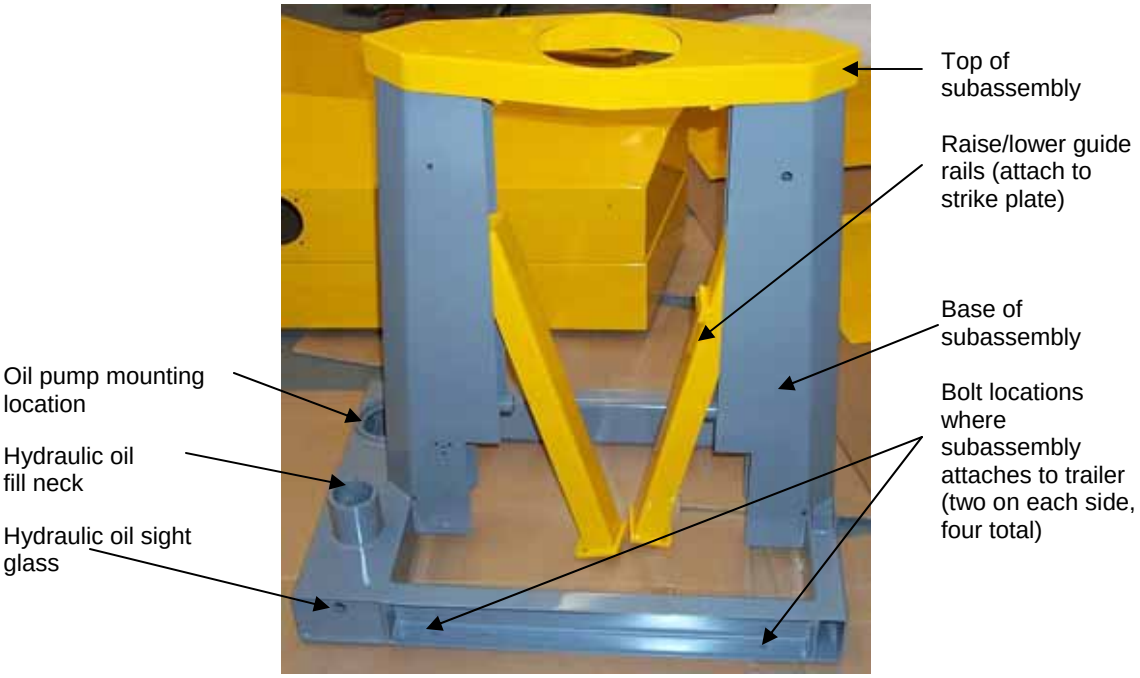


Figure 25. Freshly painted subassembly with joints reinforced.

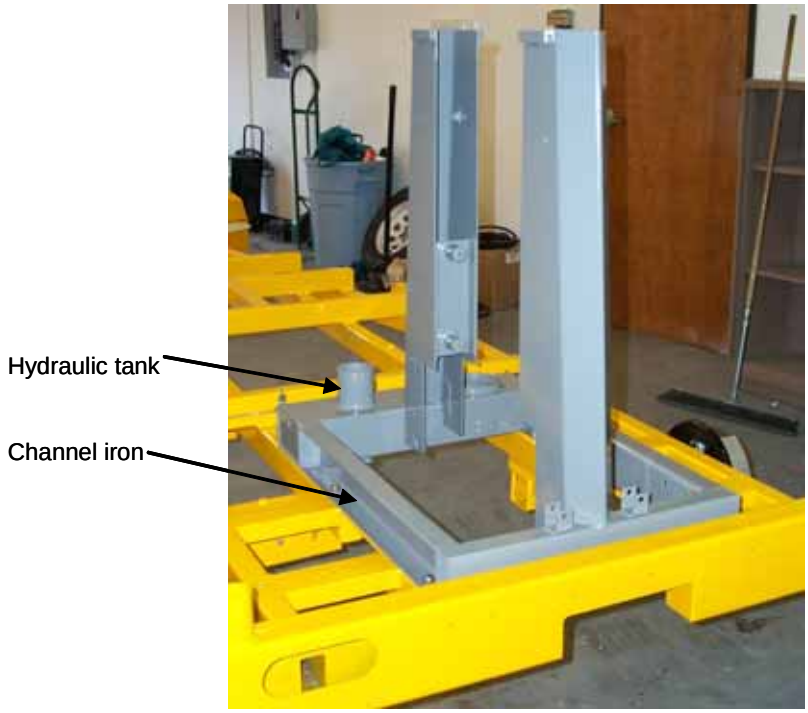


Figure 26. Subassembly mounted on trailer.

SUBASSEMBLY MAINTENANCE

Conduct a visual examination monthly to ensure no cracks develop. The most common points where cracks may develop are the welds between the channel iron and the hydraulic tank (both sides) and at the opposite ends of the channel. Cracking can be caused if only one side of the channel is welded, rather than both sides. This was a common problem on older units.

If cracks develop, a reputable welding shop needs to make the repairs, observing the following four steps:

1. Disconnect the charging plug, light plug, safety chain, and breakaway cable from the tow vehicle (figure 27).

Figure 27. FWD attached to tow vehicle.

2. Raise the trailer hitch completely off the tow vehicle.
3. Disconnect the positive (+) and negative (−) battery terminals (figure 28).
4. Disconnect the multisignal cable from the power control box (figure 29).

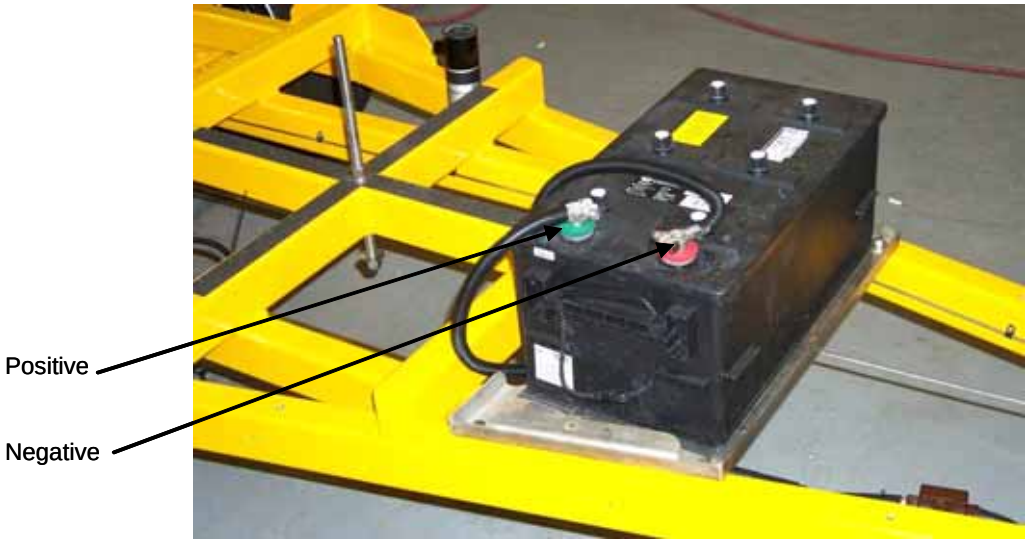


Figure 28. Disconnect battery terminals.

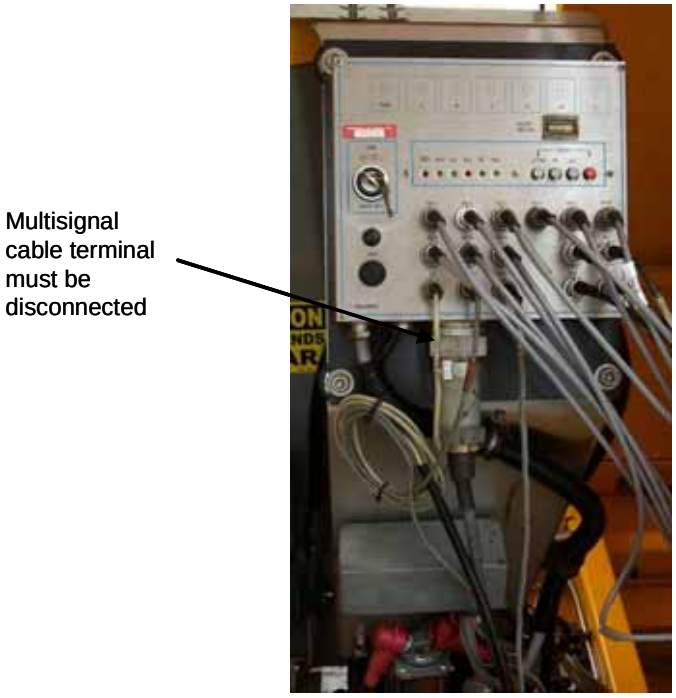


Figure 29. Multisignal connection to control box.

Disconnect all electrical components during the welding to reduce the chance of electrical current flowing through the trailer, which might damage sensitive electronics.

After the repairs are made, the affected area can be cleaned and painted. Figures 30 and 31 show the reinforced welds on the subassembly.

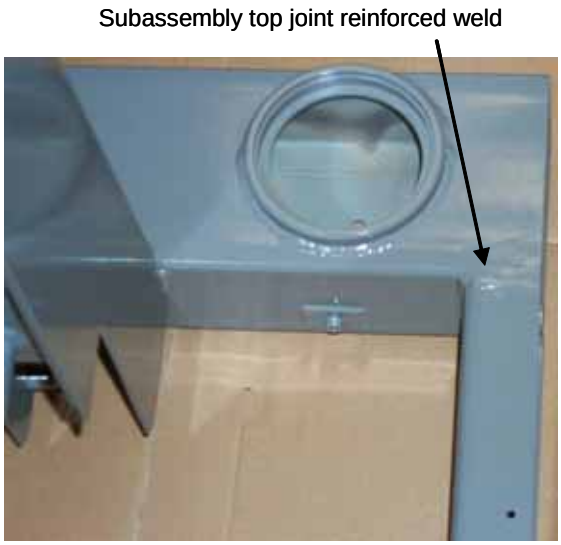


Figure 30. Reinforced weld on top of subassembly.

Figure 31. Reinforced weld on bottom of subassembly.

Guide Profiles

Annual maintenance is recommended on the guide profiles including shimming the rollers for correct alignment. Rails should be checked every 6 months. They may need to be shimmed periodically, depending on the amount of use. Yearly, apply a liberal amount of grease to the guide roller post (figure 32). This requires removing the guide profile rails as seen in figure 25.

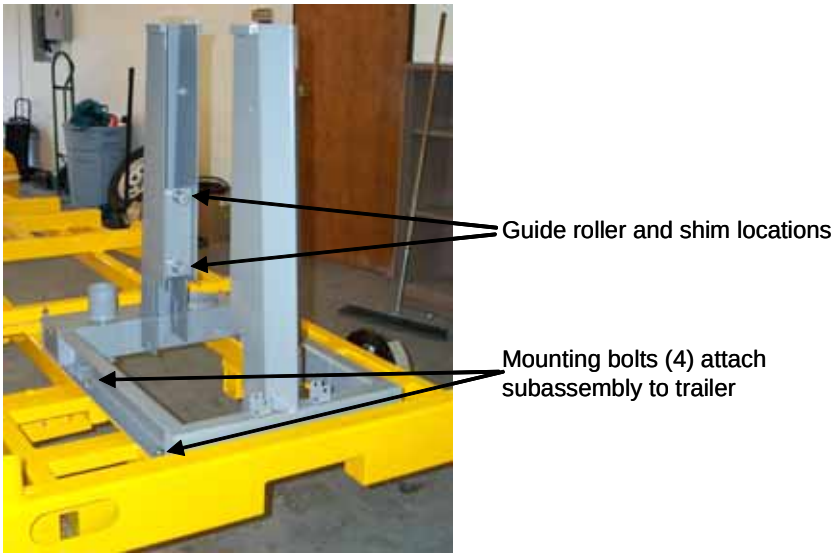


Figure 32. Guide locations on a subassembly.

Although the subassembly frame does not require any specific maintenance, it is recommended that all associated fasteners be checked for tightness every 3 to 6 months. Other components also may require periodic maintenance and repair:

- Main cylinder.
- Hydraulic motor.
- Upper catch assembly.
- Hydraulic pump.
- Side cylinders (two).
- Flow control valves and pressure switches.

Drop Weight Assembly

Minimal maintenance is required on the drop weight assembly:

1. Replace the lift collar semiannually. Unscrew the collar and replace, but *do not* apply thread locker. Use the setscrew to secure the lift collar. Rotate the upper catch daily to ensure equal wear on the collar (figure 33).

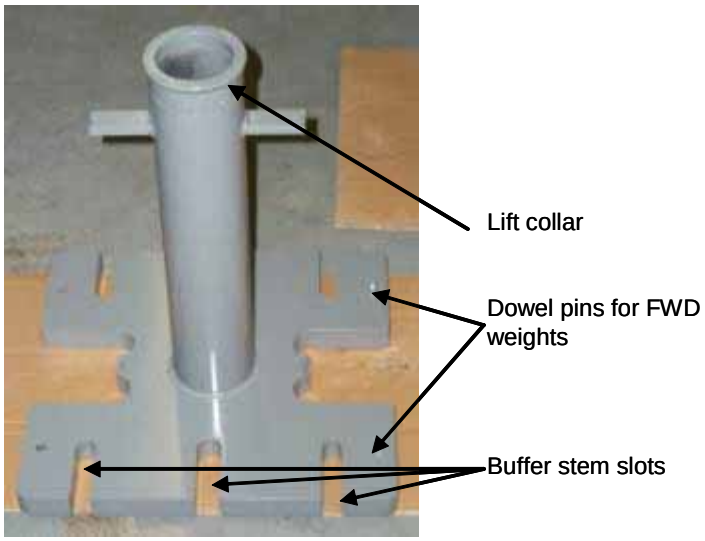


Figure 33. Drop weight assembly.

2. Install the glide ring on the drop weight assembly (a new feature not found on older models). This glide ring prevents metal chaffing from occurring between drop weight package and the main cylinder. After disassembly and during assembly, apply a small amount of grease to the glide ring (figures 34 and 35). Thereafter, lubricate weekly with a spray silicone.

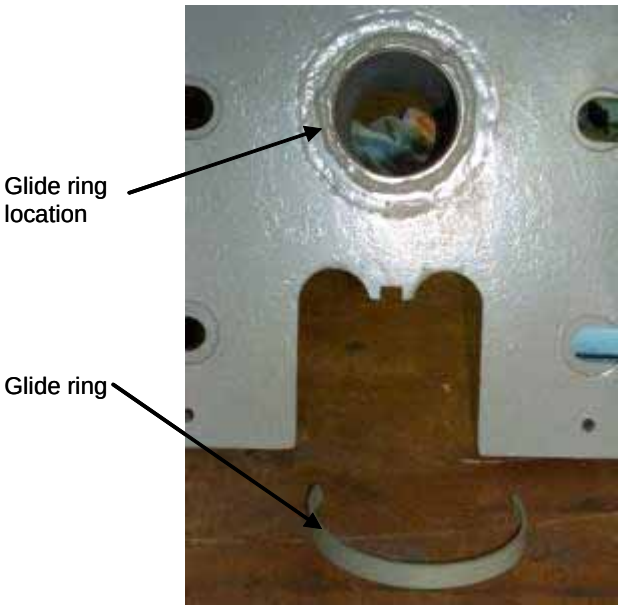


Figure 34. Placement of glide ring, bottom view of weight package.

Figure 35. Closeup view of glide ring.

3. Place four adjustable drop height targets (activators) in a vertical rail on the drop weight. These targets, which are adjustable to various loads, can be selected to determine weight-height target locations (figure 36).

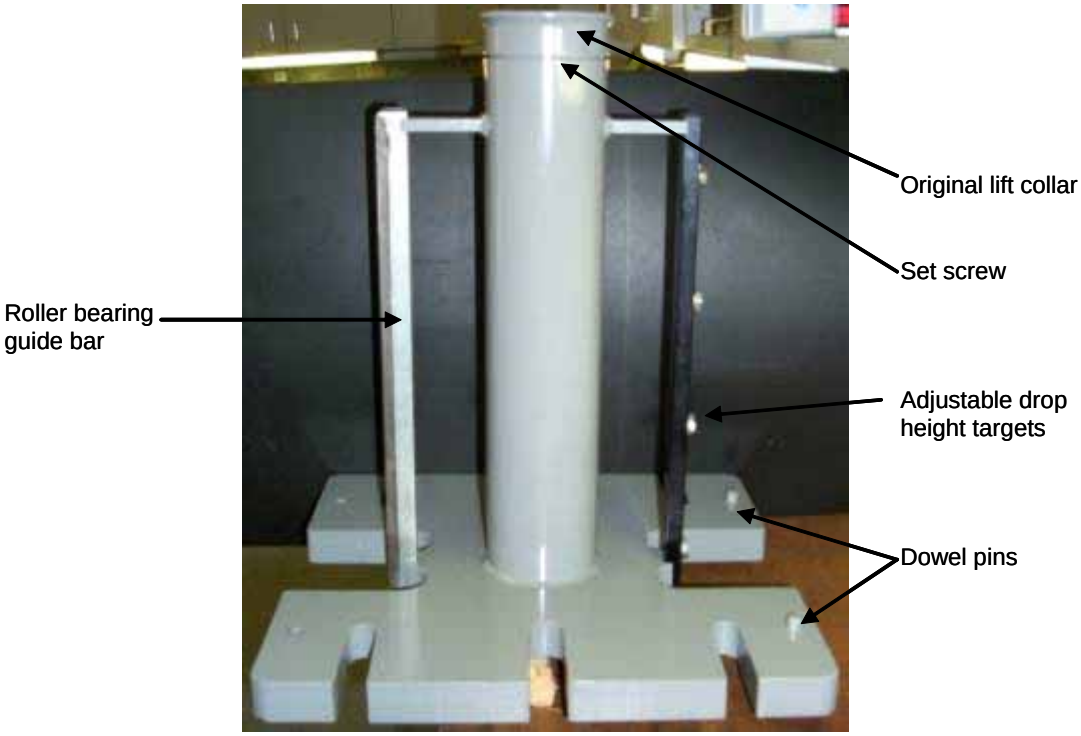


Figure 36. Roller guides mounted to drop plate.

4. Check buffer pads for proper seating and any cracks or splitting (figure 37).

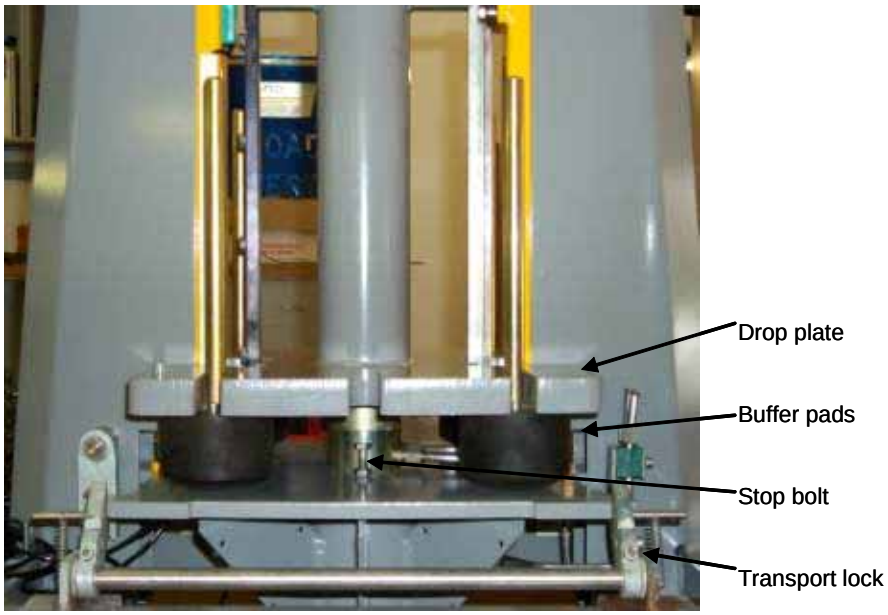


Figure 37. Buffer pads and drop plate in position.

5. Place the lift collar on the drop plate (figure 38).

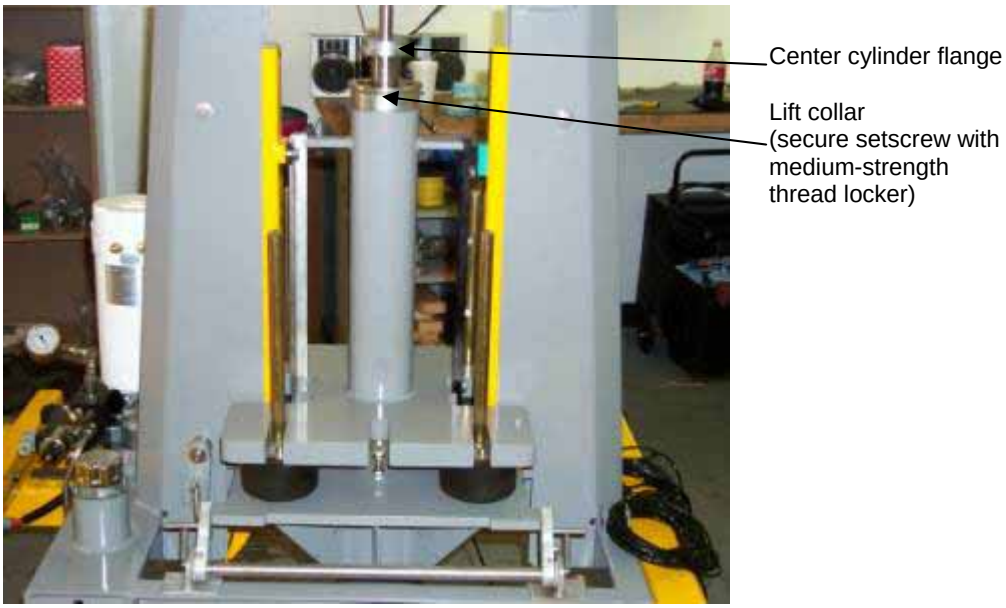


Figure 38. Lift collar.

6. Stack the weights over the buffer plates on the drop plate and tighten securely (figure 39).

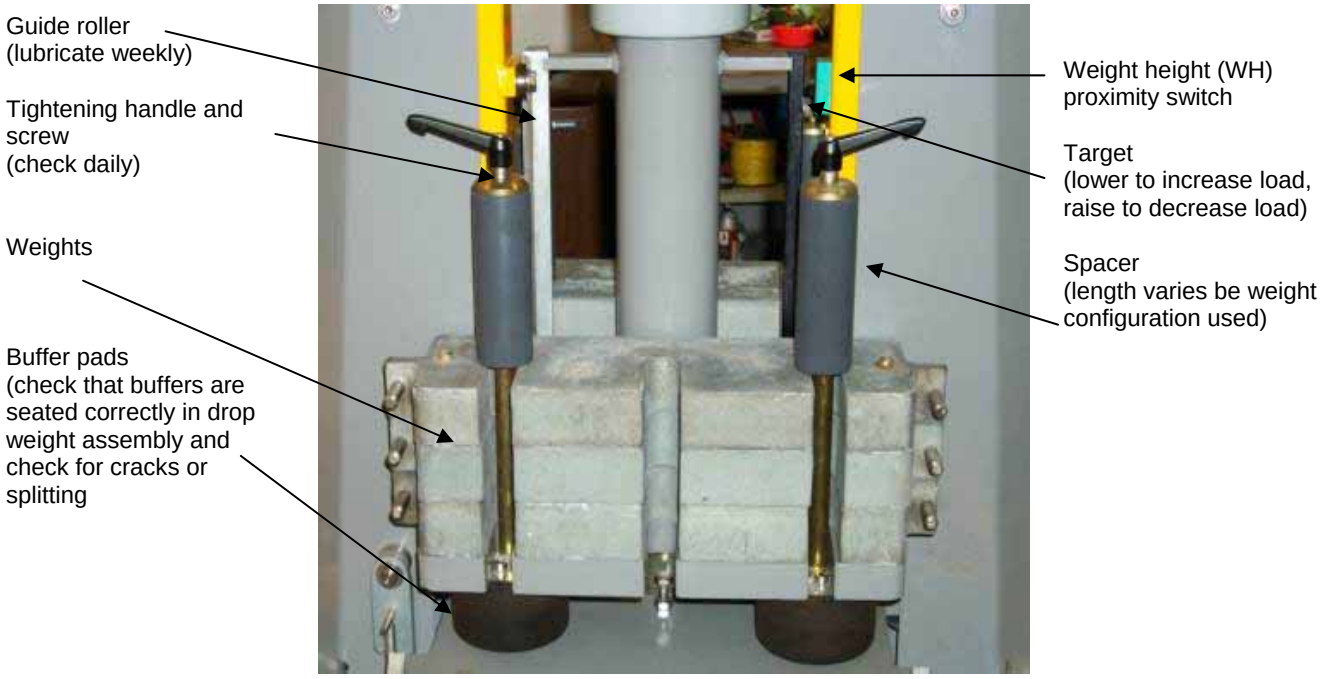


Figure 39. Weights on the drop weight assembly.

HYDRAULIC SYSTEM

The hydraulic system is one of the most important parts on the FWD. It can also be the most complicated to assemble and troubleshoot. The following paragraphs describe and illustrate various components of the hydraulic system.

The hydraulic system incorporates the following main items:

- A hydraulic cylinder ("main cylinder") for raising and lowering the weight catch.
- Two parallel connected cylinders ("side cylinders") for raising and lowering the falling weight subassembly.
- A hydraulic pump (figures 40 and 41) including an adjustable excess pressure valve operated by:
  - A 12 volt (V) direct current motor.
  - A directional control ("DC") valve (also called the "A/B valve") with two-12V direct current coils, denoted "A" and "B."
  - A normally open solenoid valve with a 12 V direct current coil, denoted "C."
  - A normally closed solenoid valve with a 12 V direct current coil denoted "D."
  - A hydraulic oil reservoir (tank), which is an integral part of the falling weight subassembly frame.
  - Two pressure sensitive switches (one normally closed contact and one normally open contact) used in the electronic control circuits.

The modes of operation of the hydraulic system are to raise and lower the load plate, as well as raise and drop the weights. The modes of operation are best explained in a "truth table," as shown in table 1. It is also useful to install a hydraulic pressure gauge to assist in troubleshooting.

Table 1. Truth Table for Hydraulic System Operation.

Mode	A	B	C	D	M[1]	
Raise weight (lower plate)	OFF	**ON**	OFF	OFF	**ON**	(Notes 1, 2, 3)
Drop weight (lower plate)	OFF	**ON**	**ON**	OFF	**ON**	(Notes 1, 3)
Lower catch	**ON**	OFF	**ON**	OFF	**ON**	(Note 4)
Raise plate	**ON**	OFF	**ON**	**ON**	**ON**	–

[1]M is the coil of the motor starting relay.
Note 1: "Plate" means falling weight subassembly.
Note 2: If the weight has dropped, then this will be a "raise catch" mode.
Note 3: This mode will also cause lowering of the plate and will not be fully active until both shafts of the two "raise plate" cylinders (side cylinders) have been pressed out completely to their bottom position.
Note 4: This mode also lowers the catch.

The hydraulic pump is mounted to the top of the hydraulic fluid tank (figures 40 and 41). A single bolt, which runs through the bottom of the tank, holds the pump in place. An O-ring is used to seal the pump to the tank. The pump has proven very reliable. Yearly, remove the hydraulic motor and lubricate the drive coupler with high quality moly-type grease. The only other routine monthly maintenance needed are changing oil and filter, tightening motor to pump bolts, and checking for excess pressure and adjusting if necessary (as explained in the Dynatest Owner's Manual). A drain plug for replacing or adjusting hydraulic fluid is located on the bottom of the hydraulic tank.

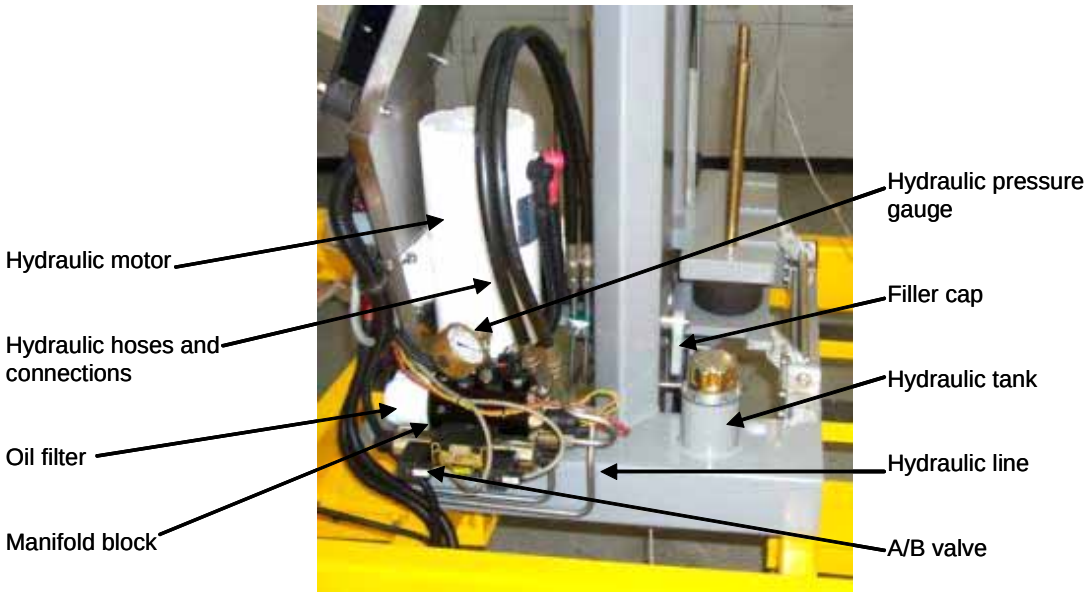


Figure 40. Hydraulic pump, motor, and fluid tank.

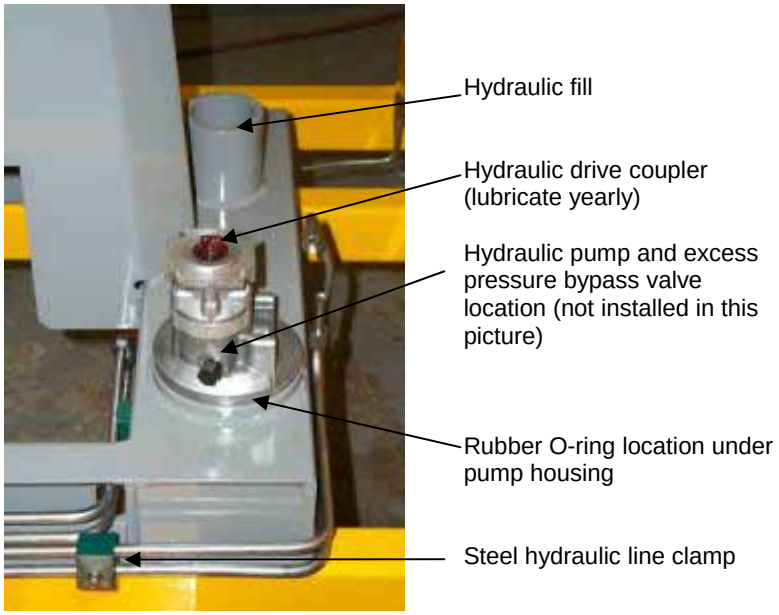


Figure 41. Hydraulic pump.

Semiannually check all steel line clamps. These clamps are used to keep the steel lines from rubbing against each other and from contacting areas where a hole could result. Check the clamps every 6 months and apply a medium-strength thread locker to fasteners.

The hydraulic motor mounts directly to the pump (figure 42). The 12 V-motor is a brand that is equipped with inspection covers, and it has replaceable brushes and brush retainers. Brushes and retainers (figure 43) should be checked every 3 months.

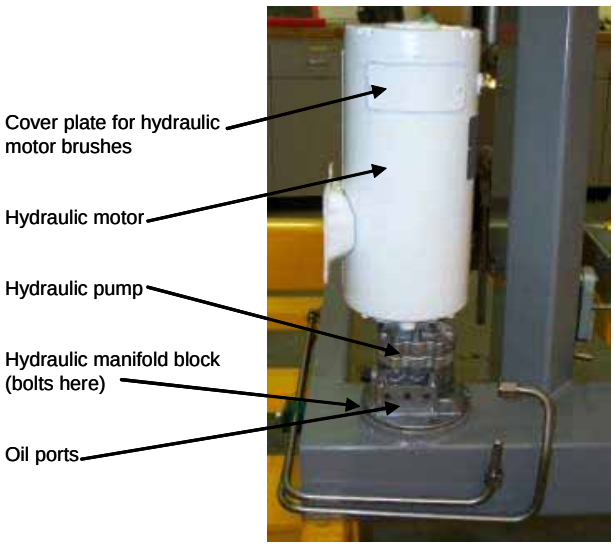


Figure 42. Hydraulic motor.

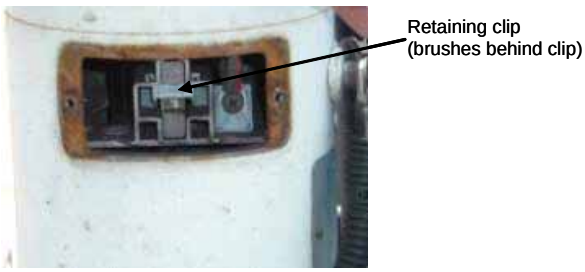


Figure 43. Brushes and retainer.

The manifold block is attached to the pump housing (figure 44). A gauge helps in troubleshooting pressure-related problems. If one is not installed, it is recommended to install one.

Figure 44. Manifold block and A/B valve mounted to hydraulic pump.

NOTE: Rubber O-rings are used to seal the manifold block to the pump and the A/B valve to the manifold (figure 45).

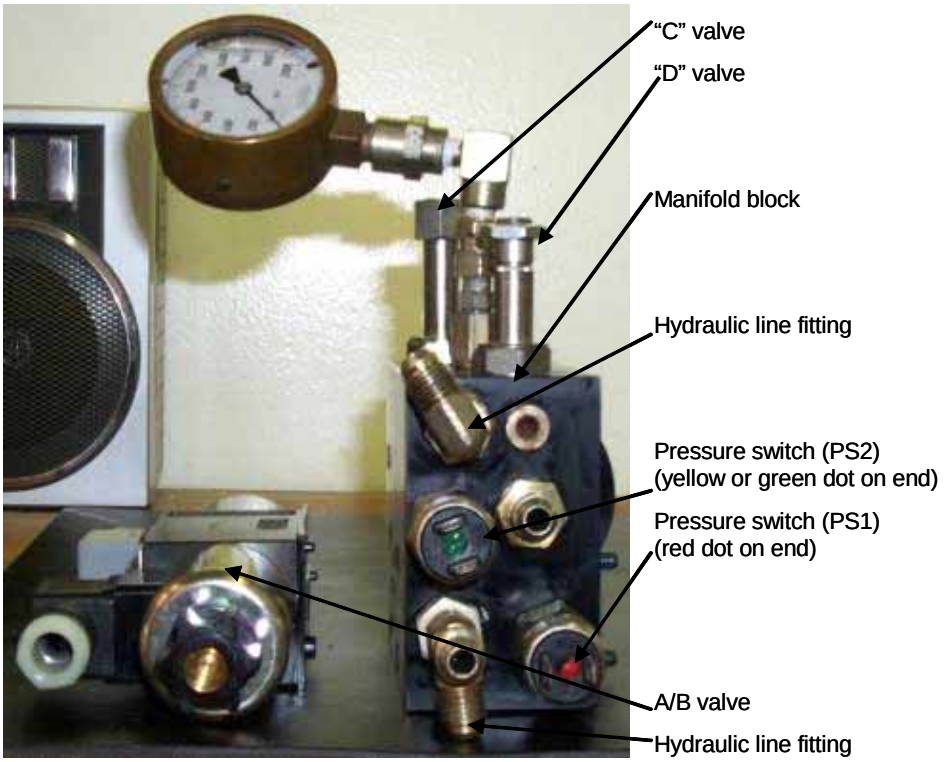


Figure 45. Components of the A/B valve and manifold block.

PS1 and PS2 are pressure sensitive switches (figures 46 and 47). PS1 is a pressure sensitive switch with a normally closed contact that opens when the pump outlet pressure exceeds approximately 40 bar (34.47 to 4,136.85 kPa (5–600 psi)). PS1 is used for excess pressure detection; thus, the (red) PS1 light emitting diodes (LED)must turn *off* at excess pressure.

PS2 is a pressure sensitive switch with a normally open contact, which closes from the pressure in the *return* oil during catch lowering (setting approximate 2 bar (25–30 psi)). PS2 *must stay on* while the catch is moving downward, and it must come *off* when the catch stops at its bottom position. If any of these operations fail, check to see if oil is leaking from the end of the switch. A leak is a good indication the switch has failed.

NOTE: If PS1 or PS2 must be replaced, use Teflon® tape on the threads to ensure a secure, leak-free seal. Take care to *not* over tighten to the point of breaking the fitting or causing thread damage. Over tightening may also damage the manifold block.

Figure 46. PS1 and PS2 switches.

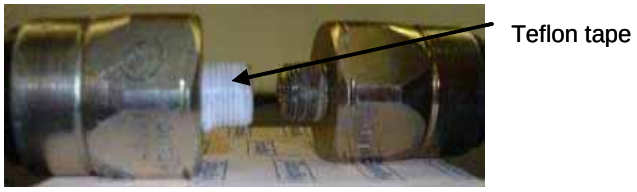


Figure 47. Threads on the PS1/PS2 switch.

The hydraulic motor solenoid switch requires no routine maintenance (figure 48). Periodically check to make sure the connections are tight.

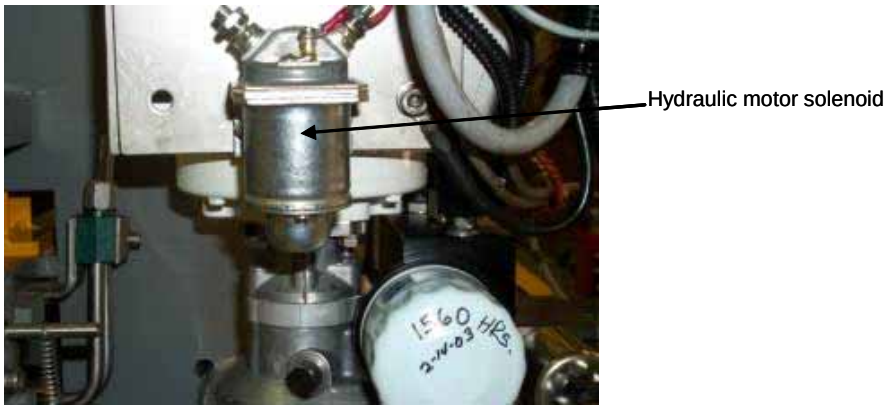


Figure 48. Solenoid mounted to hydraulic motor.

Periodically check the wiring carefully for loose connections (figures 49 and 50). Be careful not to over tighten connections, as damage can occur to terminal lugs. As part of the monthly maintenance, remove A/B wiring plugs and clean with contact cleaner. Also, remove and clean coils on each end of the A/B valve. Remove and clean the stems on C/D valve assembly.

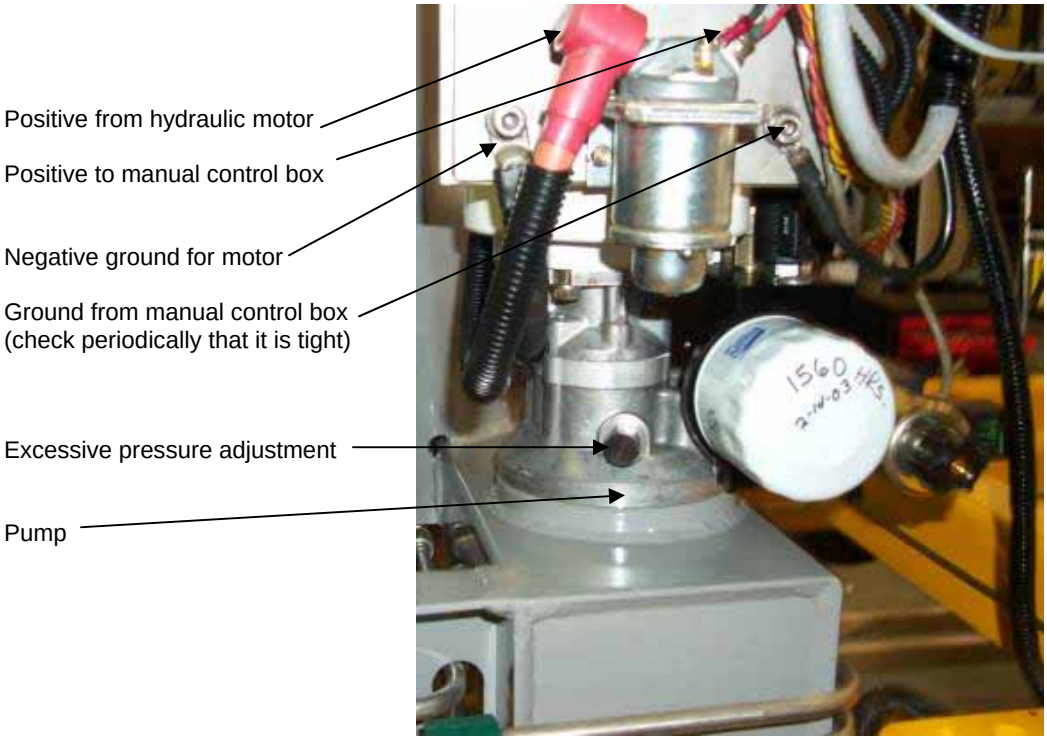


Figure 49. Wiring for Motor and Solenoid.

Figure 50. Electrical wiring for the hydraulic motor.

Main Cylinder

The main cylinder is made up of four major components:

- Center cylinder.
- Main cylinder gland.
- Catch flange and release piston.
- Outer tube.

Figure 51shows the main cylinder partially disassembled. Damaged seals could result in leaking hydraulic fluid or loss of hydraulic pressure.

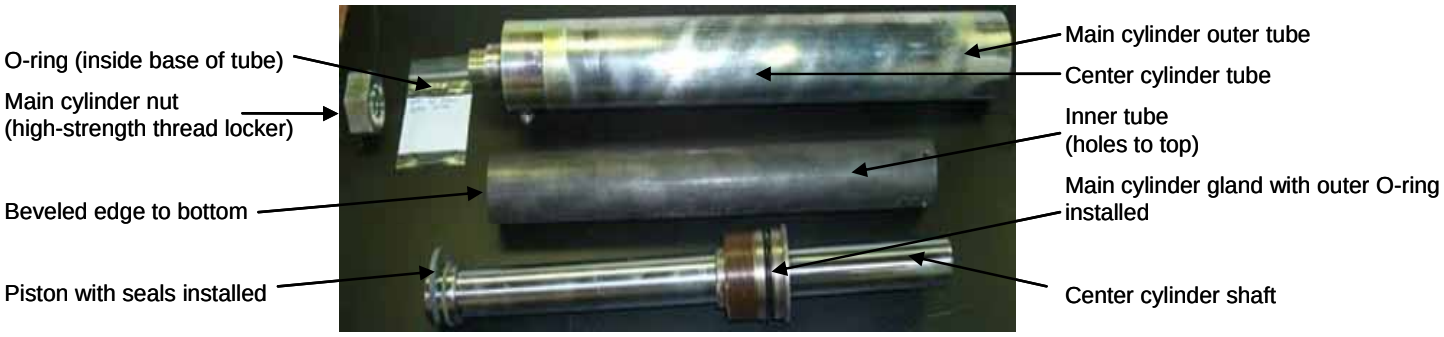


Figure 51. Main cylinder components.

Center Cylinder

The center cylinder shaft is used to raise and lower the weight package catch assembly. The shaft is composed of a piston, two O-rings, seal, guide and wiper seals, and three attaching bolts. The main cylinder gland guides the shaft. The piston moves up and down inside the inner tube (figure 52).

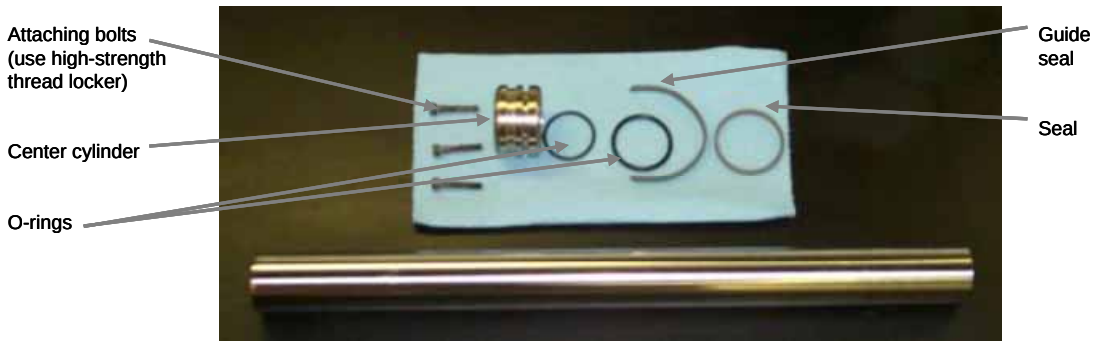


Figure 52. Center cylinder and components.

The shaft should be straight and free of nicks and pitting. The piston, shaft, seals, and O-rings should be examined if there is a problem with piston operation. Figure 53 shows a completed center cylinder after all seals and O-rings have been replaced. Figure 54 shows the oil hole port through which the hydraulic fluid flows to into the cylinder.

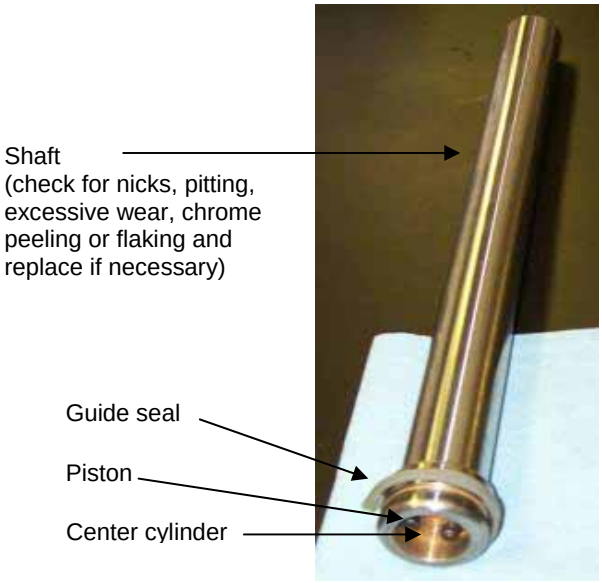


Figure 53. Center cylinder.

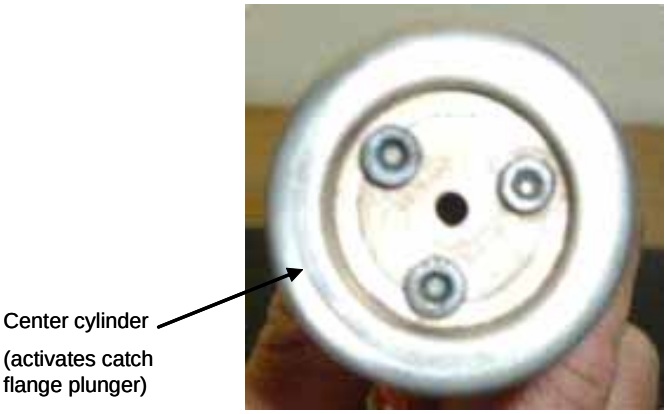


Figure 54. Oil hole port.

Main Cylinder Gland

The main cylinder gland is screwed into the main cylinder tube to guide the center cylinder. It is also equipped with a bleed screw to bleed the hydraulics of excess air. Numerous O-rings and seals may need replacement

Figure 55 shows the main cylinder gland and all necessary seals used in this component. Replacement of these seals is relatively simple. First, remove the old seals. Second, install the O -ring (A), then the internal seals (B) at the same location. Third, install the glide ring seal. (It may be necessary to form this seal first.) Fourth, put the outer O-ring into place. Fifth, install the dust seal. Finally, install the bleed screw and sealing ball (figure 56).

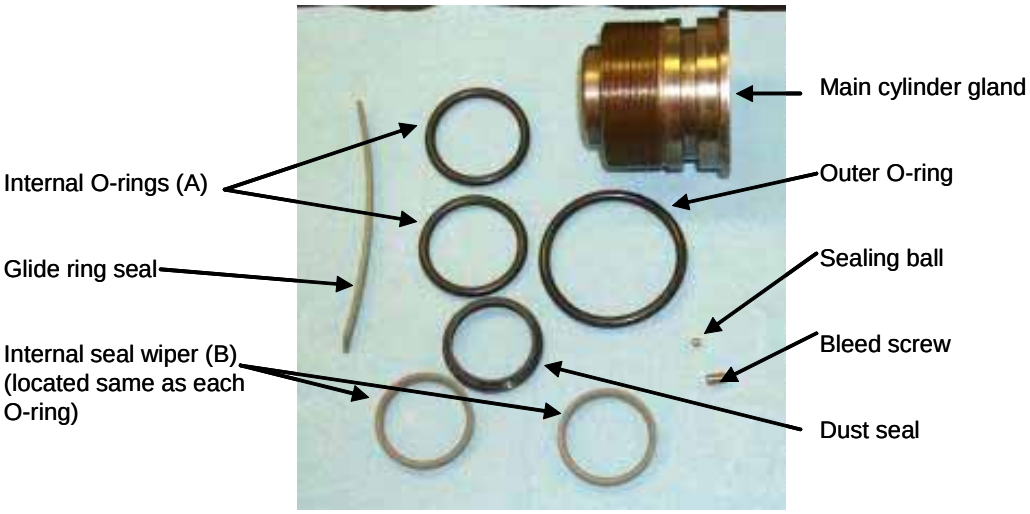


Figure 55. Main cylinder gland and components.

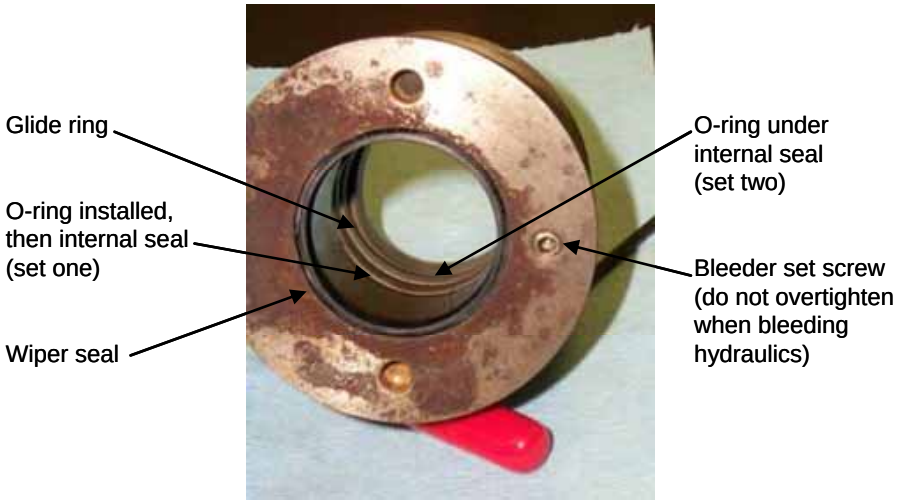


Figure 56. Assembled main cylinder gland.

Catch Flange and Plunger Piston

The catch flange is screwed into the center cylinder and the release plunger freely floats until hydraulic pressure builds up to the release pressure. The upper catch assembly attaches to the catch flange. After the weight package is raised to the target height, the release plunger is forced up and releases the inner catch collar. Figure 57 shows the O-rings and seals required for this component. Figures 58 through 60 show various views of the catch flange.

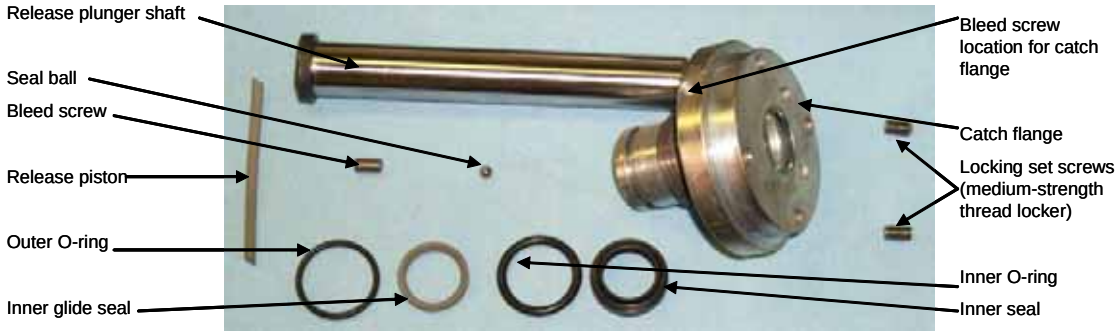


Figure 57. Catch flange, release piston, and plunger shaft.

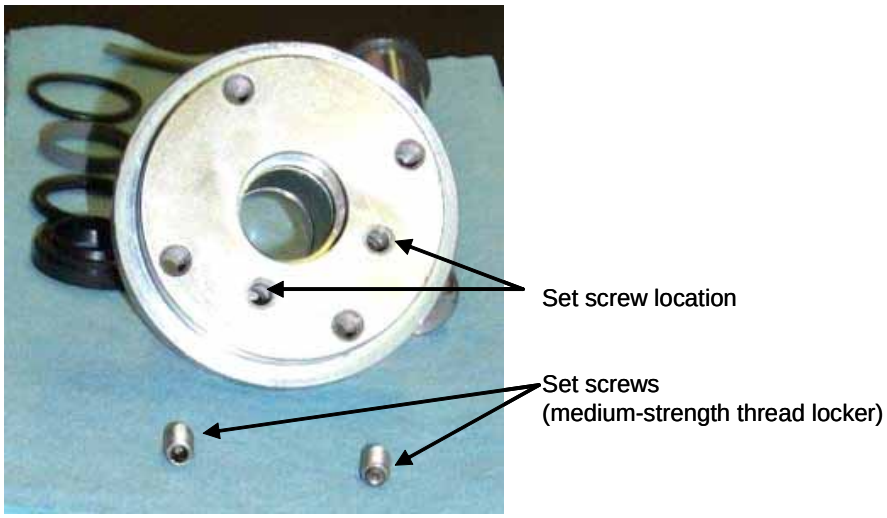


Figure 58. Top view of catch flange.

Figure 59. Assembled catch flange and release piston (bottom view).

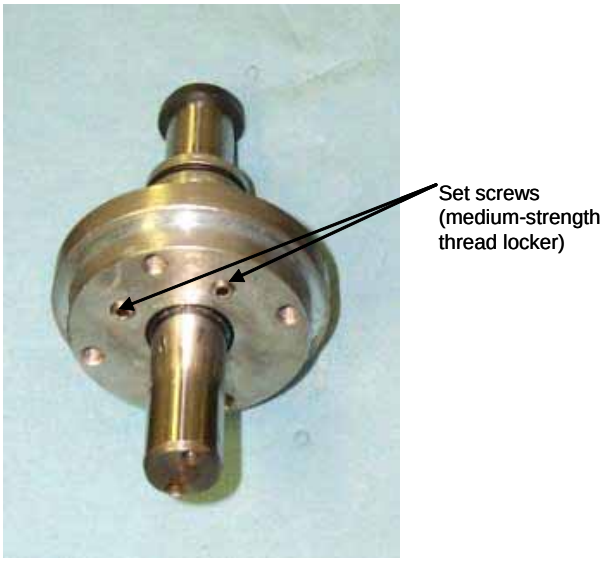


Figure 60. Assembled catch flange and release piston (top view).

When installing this component, do *not* use a thread locker. Setscrews are used to secure this flange. A pipe wrench can be used to tighten flange to the center cylinder; however, great care should be used to avoid marring or damaging the outer surface. This component does not require excess force to tighten.

NOTE: Always install a new outer O-ring if this component has been removed. Also, before reinstalling this component, a fine metal file should be used to remove any dimples caused by the setscrews on the cylinder. This will help ensure a flush surface and reduce the chance of hydraulic leaks.

Bench Assembly Method

To bench-assemble the main cylinder components, follow these steps:

1. Slide the gland over the center cylinder shaft (figure 61).

Figure 61. Center cylinder and gland.

2. Carefully slide the shaft piston into the center tube. Lower both components into the outer tube housing (see figure 51 above and figure 62).

Figure 62. Inner tube.

3. Insert the center cylinder and gland into the inner tube, piston first. After this has been done, these two components can be inserted into the main cylinder (figure 63).

Figure 63. Assembled main cylinder.

4. Insert the inner tube with attached center cylinder and gland into the main cylinder tube. Make sure the O-ring is installed around the hub inside the main cylinder (figure 64). This O-ring is not installed on replacement tubes from the manufacturer.

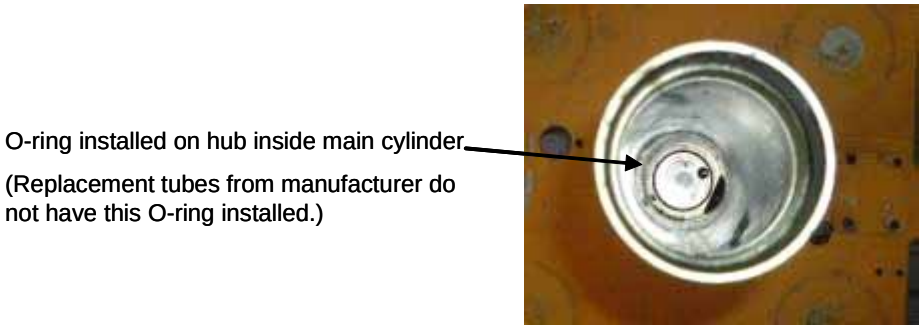
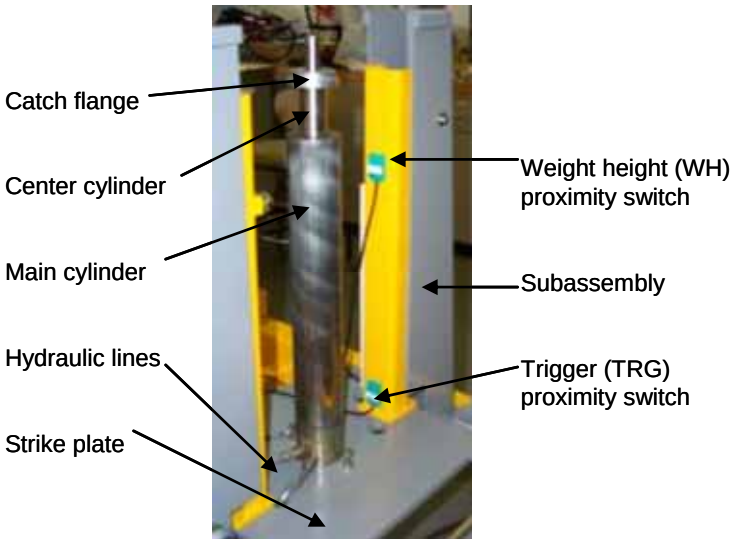


Figure 64. O-ring installed in the main cylinder.

To assemble the main cylinder on the unit, follow these steps, which are similar to those when assembled on a bench:

1. Install inner tube (figure 62) on to the center cylinder tube, beveled to the bottom and holes to the top.
2. Slide the center cylinder shaft piston into the inner tube (figure 63). Slide the shaft down onto the tube until the gland threads are in contact with the outer tube threads.
3. Use a spanner wrench to tighten the gland.
4. Secure the main cylinder to the strike plate by using the main cylinder nut (figure 65). Check the nut annually and torque to 190-230 N-m (140-170 lbf-ft). Apply a high-strength thread locker.



Notice the wear on the outer tube. Newer units use a glide ring to prevent such wear.

Figure 65. Main cylinder attached to strike plate.

Upper Catch Assembly

The upper catch assembly grabs the weight package lift collar so that the weight package can be raised and dropped. The upper catch is equipped with numerous moving components that will wear with use. (figures 66 and 67). It is important to keep all parts lubricated and free of debris, which could cause binding or excessive wear. Clean and inspect the moving components annually. Replace worn components.

NOTE: This repair can be made on the FWD without removing the cylinder shaft.

Figure 66. Upper catch shell and interior components.

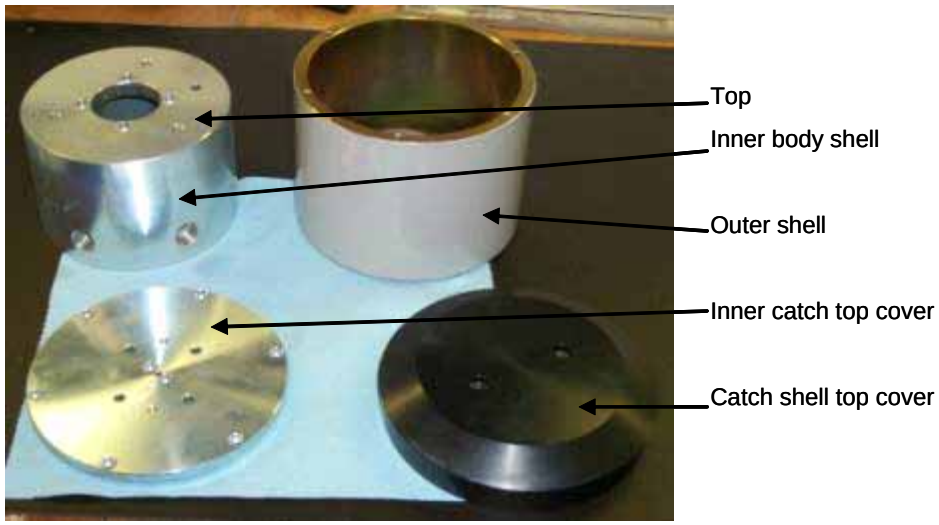


Figure 67. Upper catch shell.

After all components are clean, begin reassembly. Following are the steps to assemble the upper catch:

1. Place the inner shell top down on a workbench (figure 68). Make sure the guide pins are tight. If they are loose, clean pin threads and use a high-strength thread locker (figure 69).

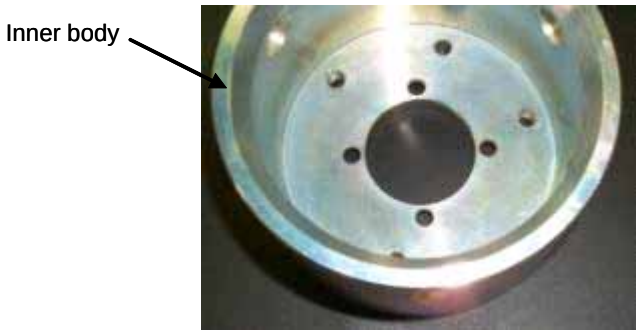


Figure 68. Inner body.

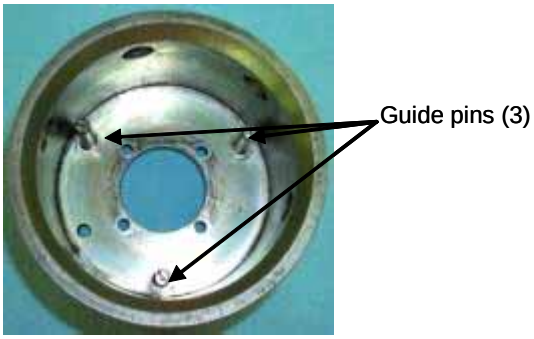


Figure 69. Placement of the guide pins.

2. Put ball bearings in position by placing the outer shell top down on the workbench and turn the inner body top up. Place the six ball bearings in the correct locations, making sure to grease each bearing with a liberal amount of light all-purpose grease. Lower the inner shell into the outer catch shell (figures 70 and 71).

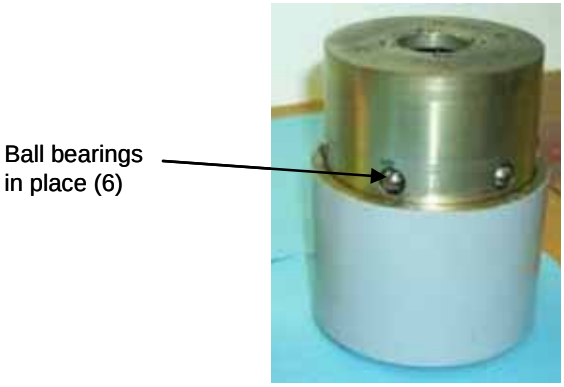


Figure 70. Ball bearings in place on the inner body.

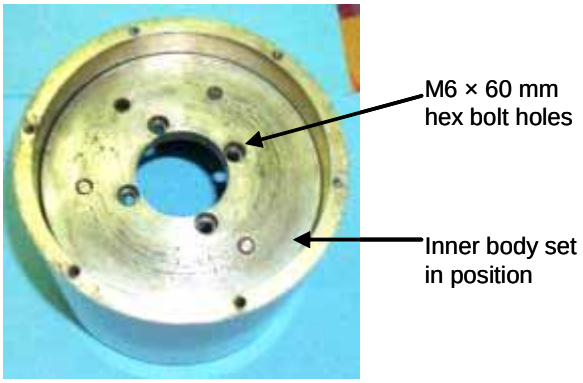


Figure 71. Inner body set in place.

3. Place four M6 × 60 mm hex bolts in the four holes on the top of the inner body (figure 72). These secure the upper catch assembly to the top of the main cylinder.

Figure 72. Inner body and hex bolts.

4. Place the inner catch top cover on the outer shell. Use a medium-strength thread locker on all six M5 × 12 mm hex bolts (figure 73).

Figure 73. Inner catch top cover installed.

5. After the cover is installed, turn the assembly over so the top rests on the workbench (figure 74).

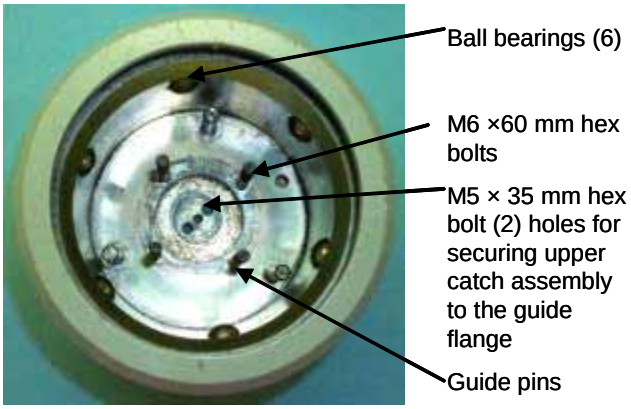


Figure 74. Outer shell, top down, with interior components exposed.

6. Put the three compression springs over the guide pins (figure 75).

Figure 75. Interior of catch assembly with compression springs.

7. Place the inner ring (figure 76) on the three springs. The inner ring has two sets of holes used to rotate the inner ring after it shows signs of wear. Rather than replace the inner ring, it can be rotated to the previously unused set of holes for extended life.

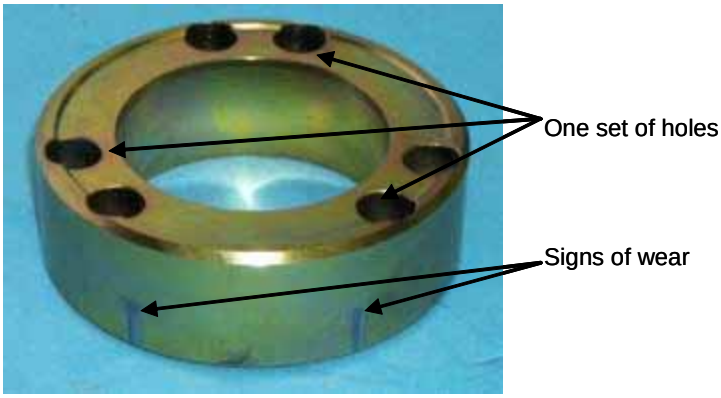


Figure 76. Inner ring.

8. Slide the inner ring in position over the springs by picking up the assembly and turning it upside down. This allows the ball bearings to release the inner rings and slide over the compression springs. The collar then can move to the bottom of the outer shell, allowing the ball bearings to retract enough for the inner ring to reach its lowest possible position (figures 77 and 78).

Inner collar facing up toward outer catch shell top. This is correct orientation.

Figure 77. Outer shell with inner ring in position.

Figure 78. Inner ring in position inside the outer shell.

9. Insert the outer spring retainer over the four M6 × 60 mm hex bolts (figure 79).

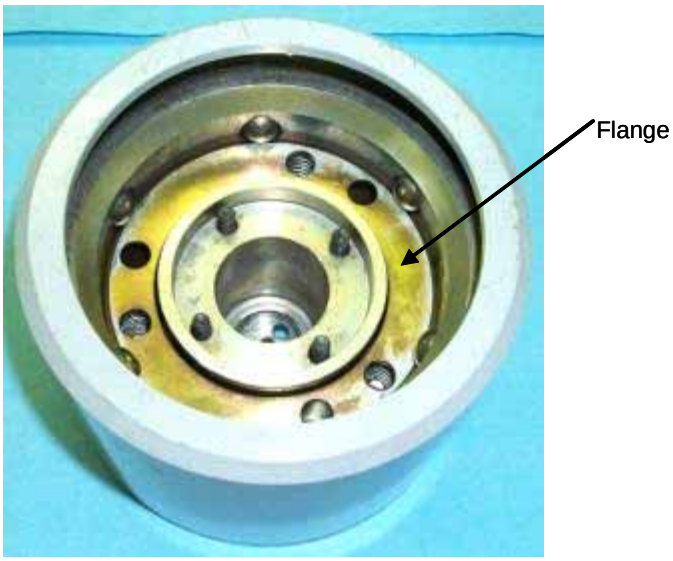


Figure 79. Insert outer flange.

10. Attach the upper catch to the main cylinder; it takes time and practice to accomplish this. With the plunger shaft extended, place the spring guide on top of the plunger. Next, put the plunger spring on top of the spring guide (figure 80). In this picture, the main cylinder is not attached to the FWD to show how the upper catch is attached.

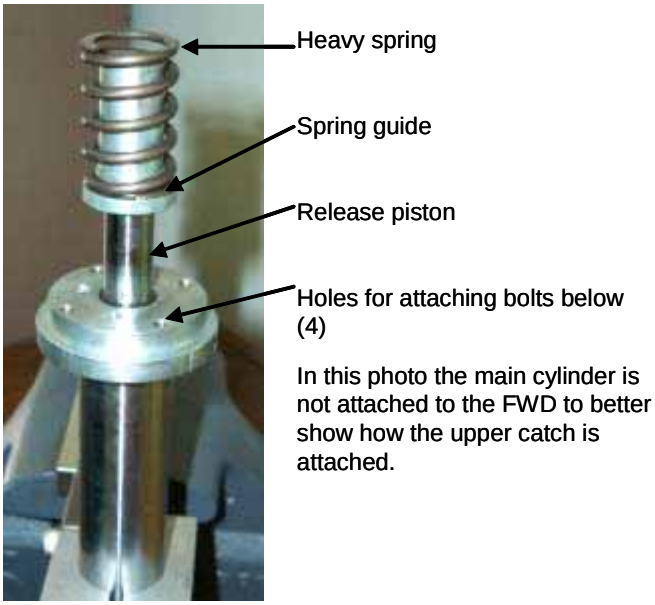


Figure 80. Guide flange and spring.

11. Hold the upper catch in your hands and carefully place your fingers at the base of the outer flange and inner ring (figure 81). Turn the assembly so the top faces up and the outer flange and inner ring slide down. Hold in place until the inner ring is resting on the guide flange with the outer catch shell.

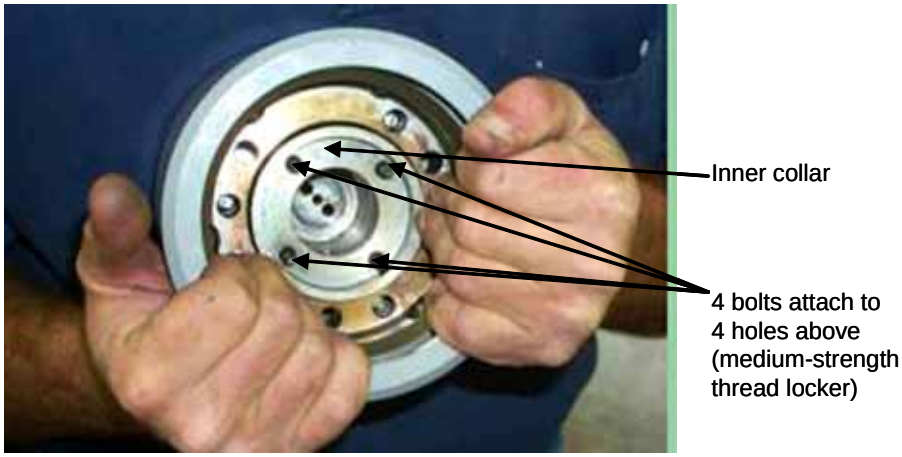


Figure 81. Upper catch.

12. Place the upper catch over the guide flange and spring. The inner collar should help guide the catch over the spring and onto the catch flange.
13. Tighten the four M6 × 60 mm hex bolts on the catch flange and rotate the upper catch until the bolts line up with the threads on the catch flange (figure 82). Do *not* tighten the bolts completely. Next, reach under the catch and collapse it by pushing upward on the collar, which contains the ball bearings.

Figure 82. Attach the upper catch.

14. Using an O-ring pick or similar tool, align the two center holes on the inner catch cover with the holes on the spring guide (figure 83). Use two M5 × 35 mm hex bolts and medium-strength thread locker to secure the top (figure 84). After tightening these two bolts, go back and tighten the four M6 x 60 mm hex bolts.

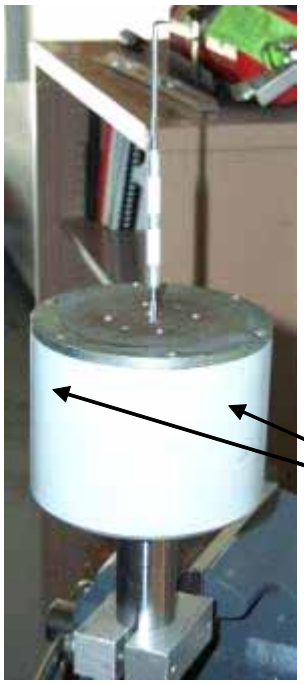


Figure 83. Align top cover.

It may be necessary to rotate the catch assembly for proper alignment.

Lubricate weekly

Figure 84. Tighten all bolts.

15. Place the top cover on the upper catch assembly and secure with two M6 × 20 mm hex bolts, then use medium-strength thread locker (figure 85).

Figure 85. Complete upper catch assembly with cover.

SIDE CYLINDERS

Two side cylinders (front and rear) raise and lower the load/strike plate (figure 86). They are assembled similar to the main cylinder; therefore, a detailed description of assembly is not necessary.

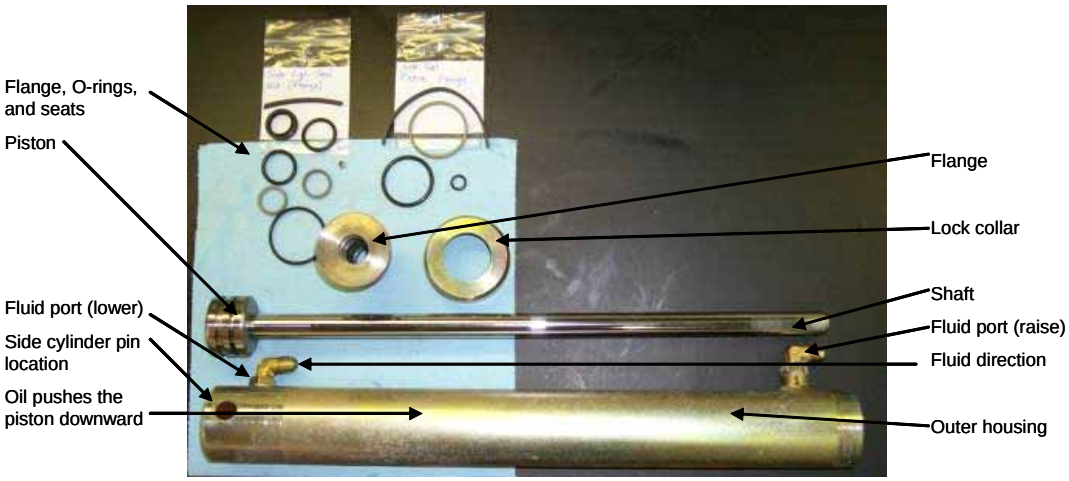


Figure 86. Side cylinder and components.

To install the side cylinders after they have been assembled, follow these steps:

1. Attach hydraulic lines to the fluid ports. The longer line goes to the top fluid port (lower plate) and the shorter line attaches to the bottom fluid port (raise plate) (figure 87).

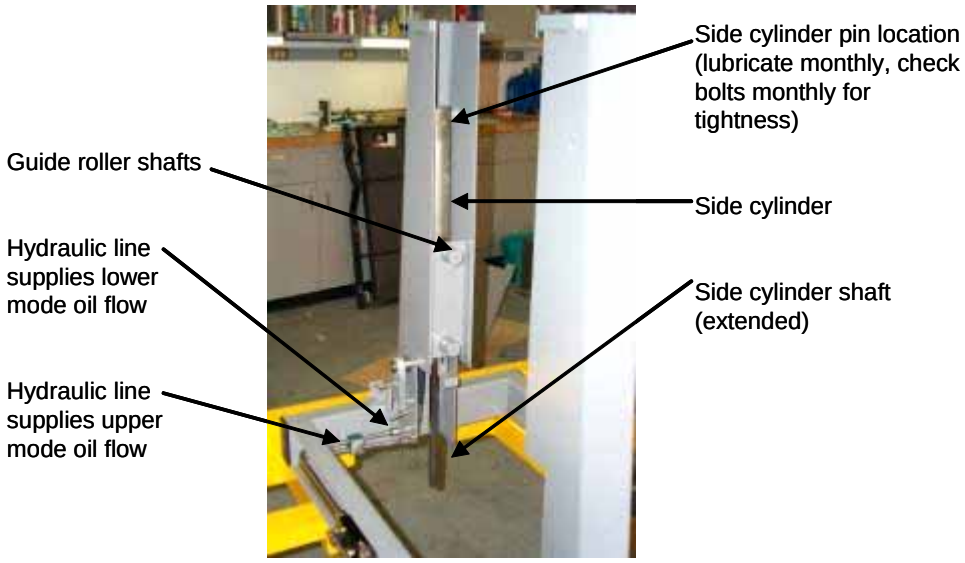


Figure 87. Mounted side cylinder.

2. Put the cylinder into position on the subassembly frame. The top of the cylinder has a hole for the pin to anchor it to the subassembly. Install anchor bolts and apply medium-strength thread locker.
3. Attach the flexible hydraulic lines to the rigid mounted hydraulic lines already in place on the subassembly frame.
4. Put the side cylinder shaft through the strike plate and attach it with a washer and bolt that secures it to the strike plate (figures 88 and 89). Use medium-strength thread locker.

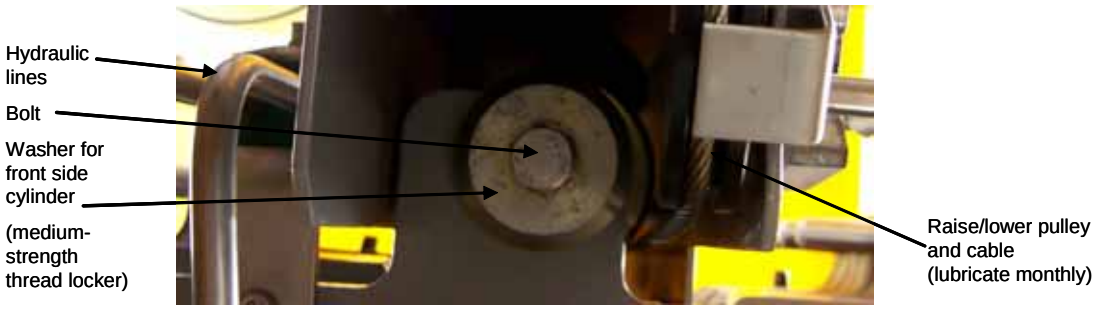


Figure 88. Front side cylinder, looking up, from under FWD.

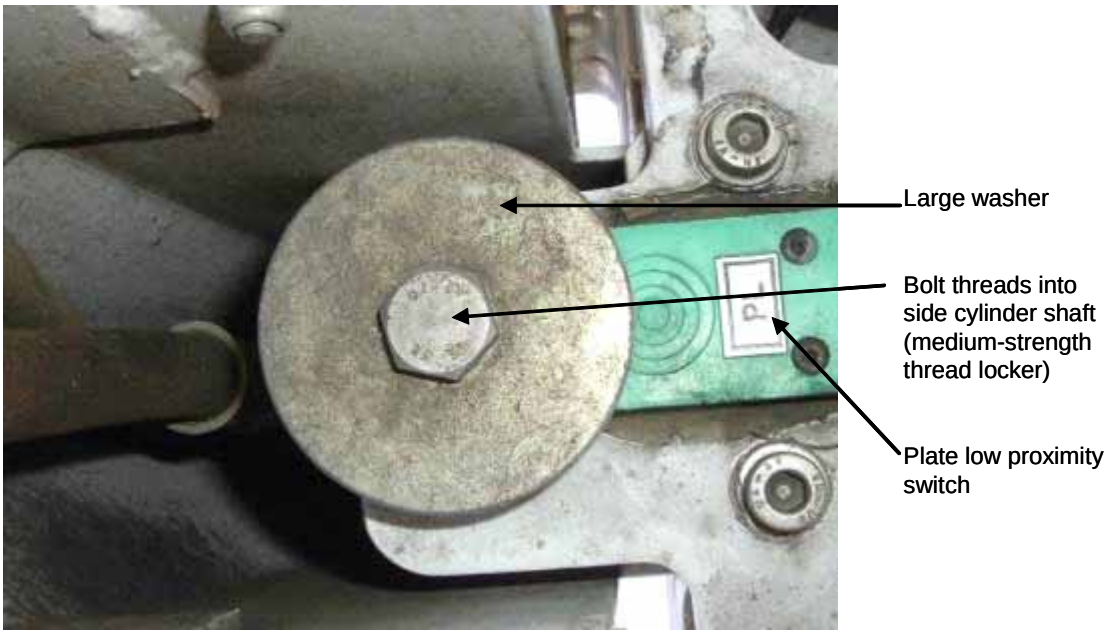


Figure 89. Rear side cylinder looking up from under FWD.

NOTE: The rear-stepped washer is designed to have no contact with the plate low-proximity switch when the cylinder is fully retracted.

5. Attach hydraulic lines.

CHAPTER 4. STRIKE PLATE, LOAD CELL, RAISE/LOWER ASSEMBLY

Figure 90 shows the strike plate, load cell, and the raise/lower assembly.

Figure 90. Load cell mounted to the strike plate.

STRIKE PLATE

The strike plate (figure 91) requires routine cleaning and semiannual visual inspection of the welds. The following components should also be checked annually or as indicated:

- Load cell and mounting bracket.
- Center cylinder mounting nut.
- Hydraulic line mounting clamps.
- Rear raise/lower bar shaft and mounting bracket.
- Guide profile rails. Check cap screws every 3 to 6 months.

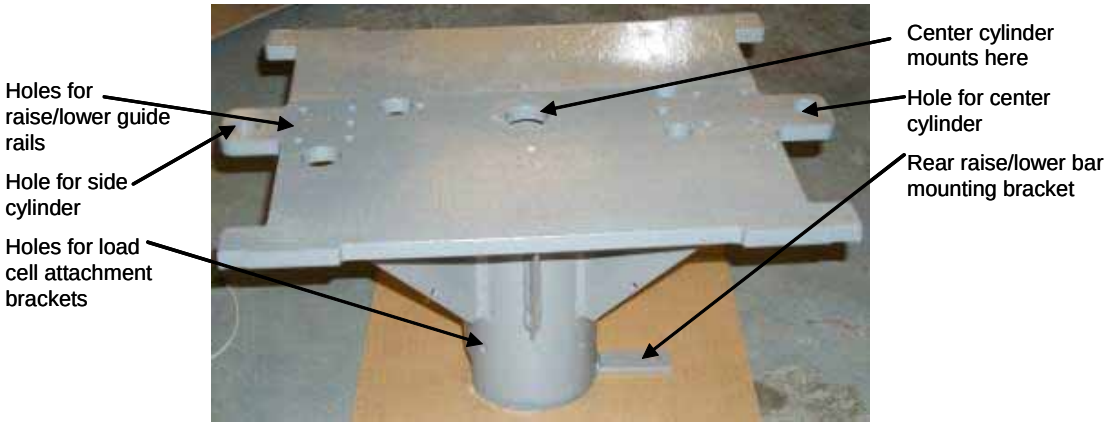


Figure 91. Strike plate.

The load cell swivel and retaining plate are located on the bottom of the strike plate (figure 92). Figure 88 shows a different view of the raise/lower car mounting bracket. Check bolts annually and apply medium-strength thread locker. Annually remove the load cell swivel and clean.

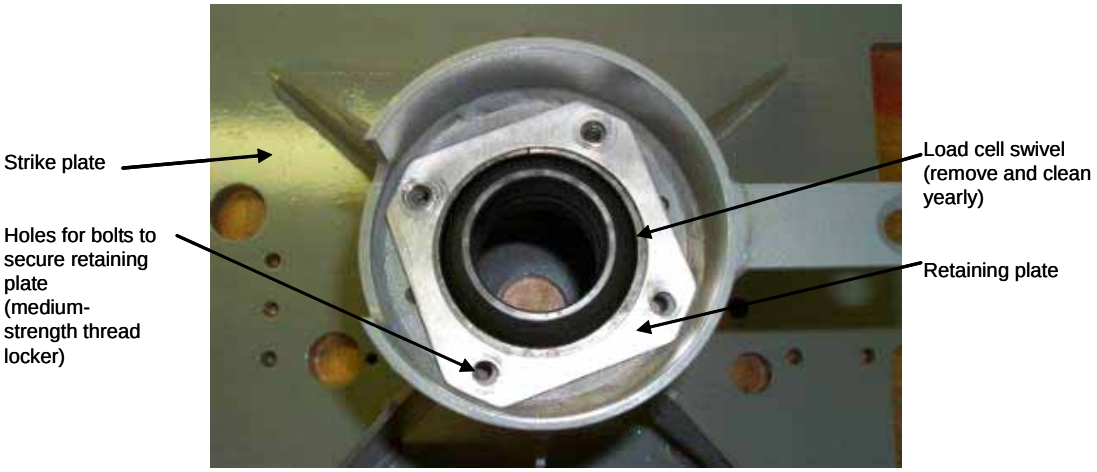


Figure 92. Bottom view of load cell swivel and retaining bracket on strike plate.

LOAD CELL

The load cell attaches to the strike plate, and the load cell swivel is pressed in to fit in the strike plate, making a snug fit. The following illustrations show the steps taken during a major overhaul of a load cell:

1. Place the load cell base down (figure 93).

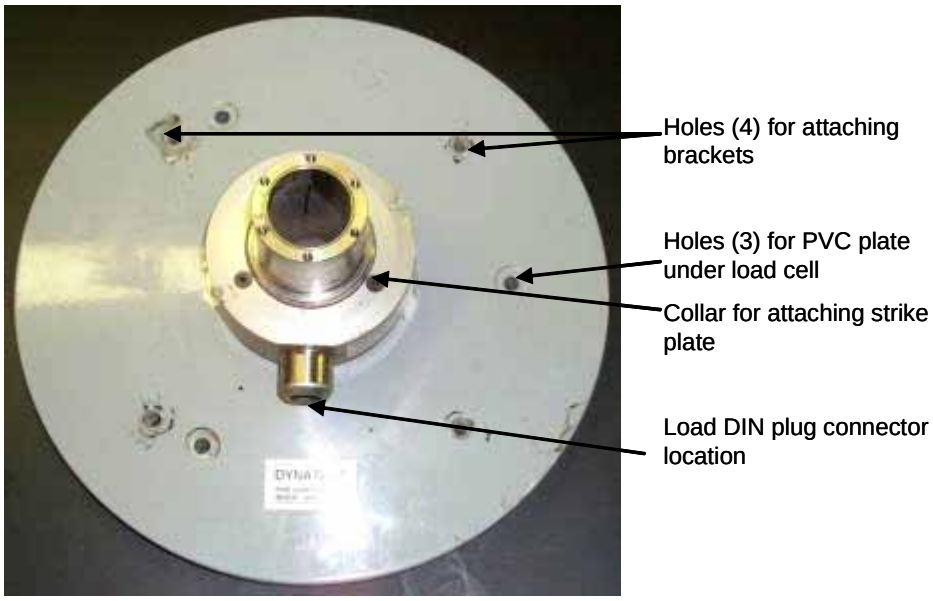


Figure 93. Load plate (base down).

2. Attach the mounting brackets (figures 94 and 95). The brackets should be checked annually. Make sure all bolts are in place and the rubber is not torn.

Figure 94. Load plate with mounting brackets.

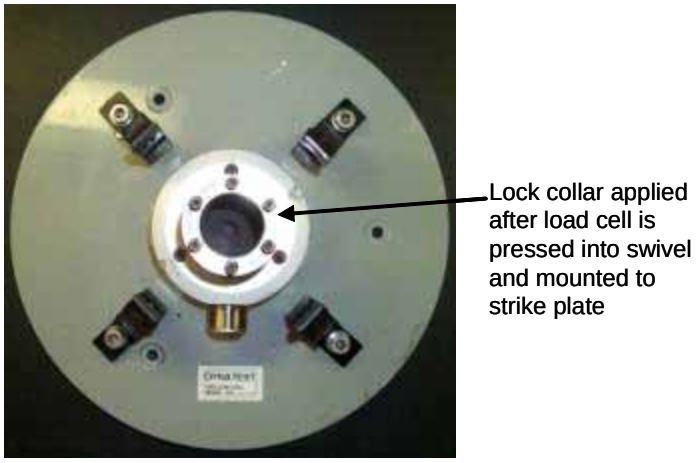


Figure 95. Load cell with brackets mounted.

3. Attach the load cell to the strike plate by using a guide tool to center the load cell on the swivel collar, which is essential for correct alignment (figure 96). Grease the load cell swivel monthly. It does *not* require a large amount of grease; one or two pumps from a hand-held grease gun with high-grade grease are sufficient. Failure to grease the load cell swivel can result in load cell calibration errors.

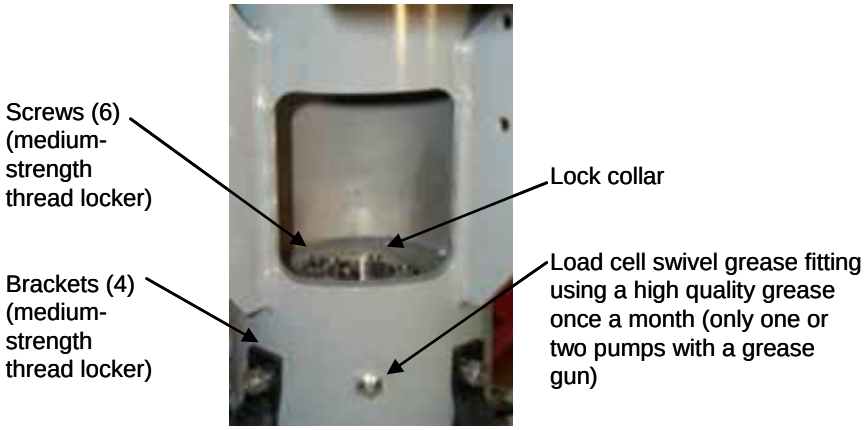


Figure 96. Mounting brackets and lock flange attached to strike plate.

4. Assemble the rubber pad and PVC disk before installing them on the load cell (figure 97). Use a strong adhesive to secure the rubber pad to the PVC disk before screwing the PVC disk to the load cell. Secure the PVC disk and rubber pad to the bottom of the load cell (figure 98).

NOTE: Photos here are part of a major overhaul. It is recommended that if a load cell replacement is necessary that the rubber pad and PVC disk be put together before installing on the load cell. After replacing a load cell, conduct a full, absolute calibration.

5. Attach the rear raise/lower bar guide to the front of the strike plate. The bottom screw tends to work loose; check it annually. Use a high-strength thread locker to secure the screw. The bottom screw can be difficult to remove. It may be necessary to apply heat to the bolt to remove it.

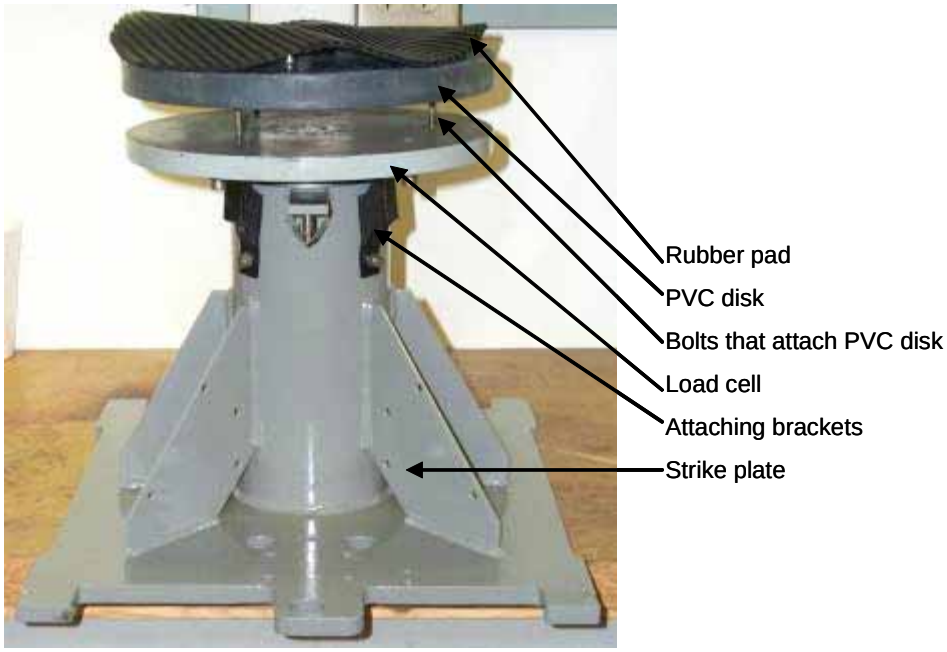


Figure 97. Strike plate with attached load cell and pad (shown inverted).

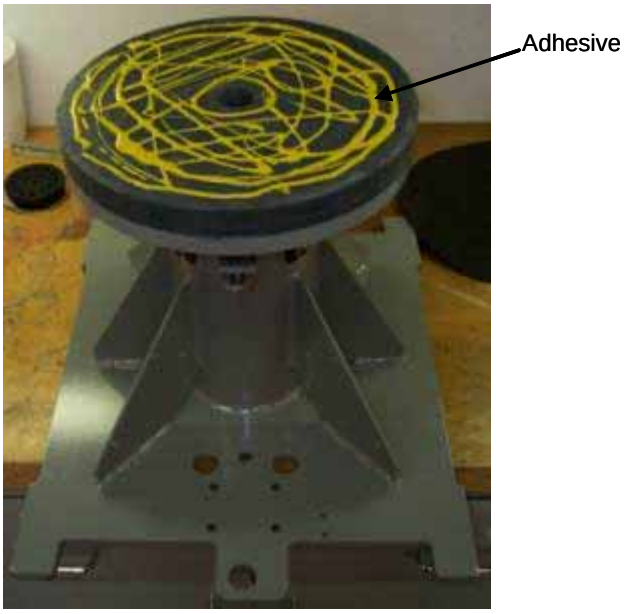


Figure 98. Adhesive applied to PVC disk.

RAISE/LOWER BAR

The raise/lower bar guide raises and lowers the geophone rail to the ground. The raise/lower box sleeve in the front of the trailer guides the front end (figure 99).

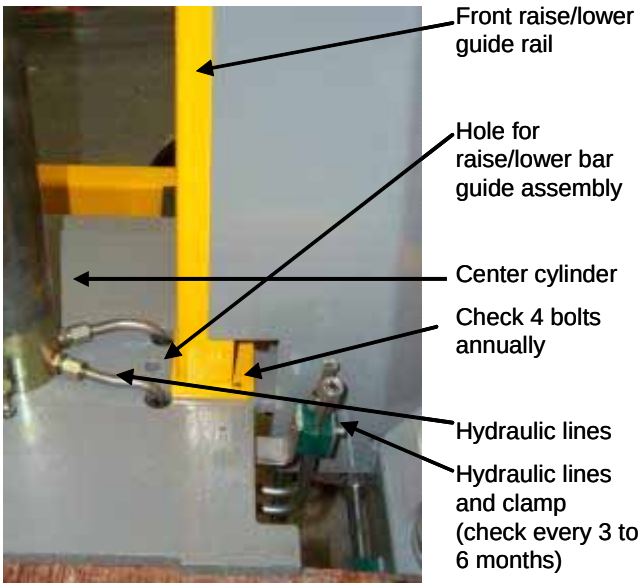


Figure 99. Raise/lower bar guide location before assembly(rear).

The rear end of the raise/lower bar attaches to the rear lift nut (figure 100).

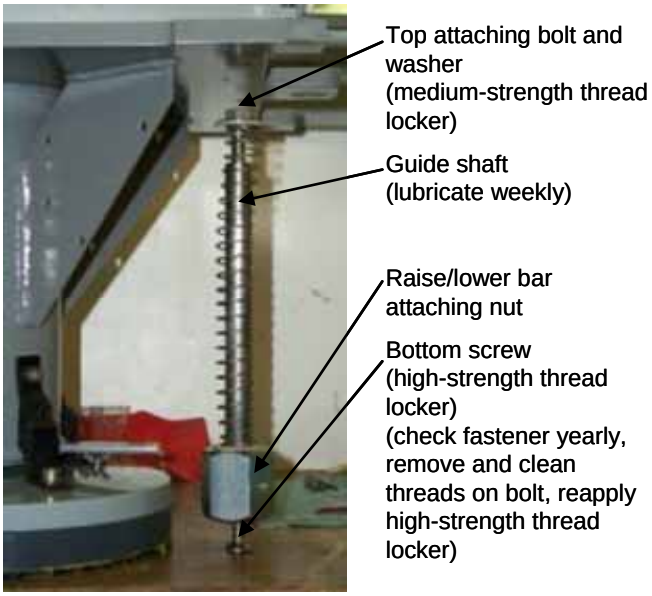


Figure 100. Raise/lower bar guide during assembly.

A steel cable and pulleys raise and lower the bar (figure 101). Lubricate the front raise/lower pulleys monthly and check the cable every 3 to 6 months for damage. Replace it if damaged. Note: The bottom screw tends to work loose so it is a good idea to check annually. Use high strength lock tight to secure the screw.

Figure 101. Raise/lower bar guide in location.

Figure 102 shows the raise/lower bar removed from the FWD, and figure 103 shows the center lift nut and attaching bolts. Little maintenance is required. Yearly, remove the attaching bolts on the rear, clean, and reapply with medium-strength thread locker.

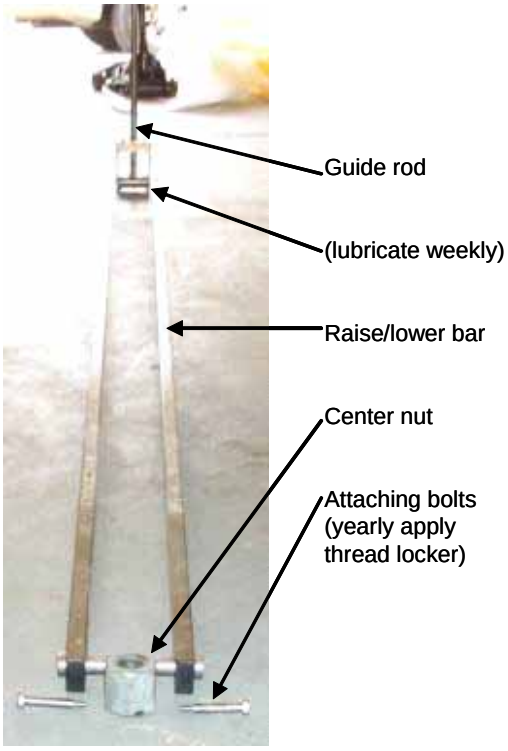


Figure 102. Raise/lower bar.

Figure 103. Center lift nut and attaching bolts.

Following are the steps to assemble the raise/lower bar:

1. Install the center lift nut over the guide shaft. Place the guide shaft between the strike plate and the lower tab as seen in figure 101. After installing this component, assemble the raise/lower bar. Align the hole in the rear bar with the hole in the rear lift nut. Apply medium-strength thread locker to the bolt. Repeat on the opposite side.
2. Attach the cable-pulley configuration to the trailer frame (figures 104). Attach a steel cable and run it through two pulleys (figure 105). Lubricate the pulleys monthly with silicone spray. Periodically remove the cover and inspect components for damage or excess wear, and repair or replace as necessary.

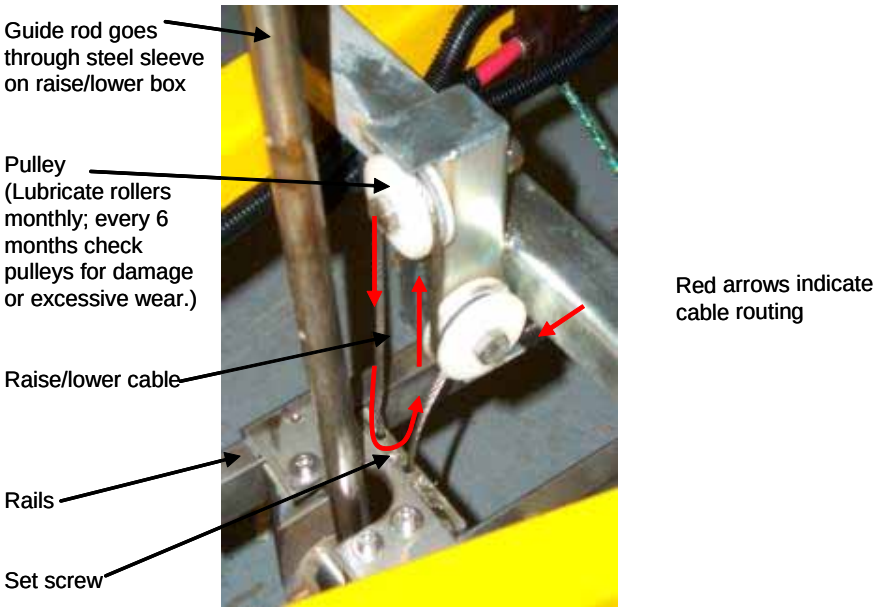


Figure 104. Closeup of cable connection.

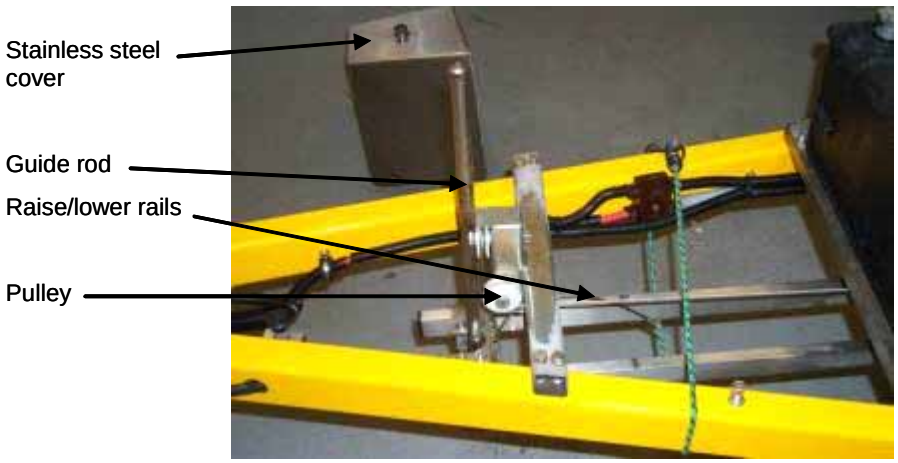


Figure 105. Raise/lower bar, guide rod, and attaching cable.

3. Place stainless steel cover over guide rod (figure 106). Make sure the pin is in place during transport.

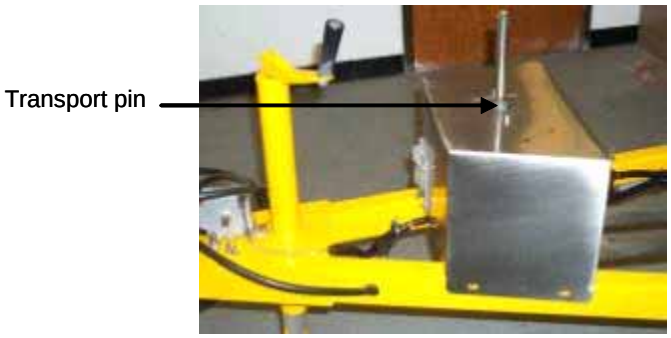


Figure 106. Raise/lower cover.

4. Attach the cable to the top of the rails with straps (figure 107).

Figure 107. Attached cable.

5. Attach the tension spring (figure 108). The tension spring helps take up cable slack on the top of the raise/lower bar when the bar is fully raised.

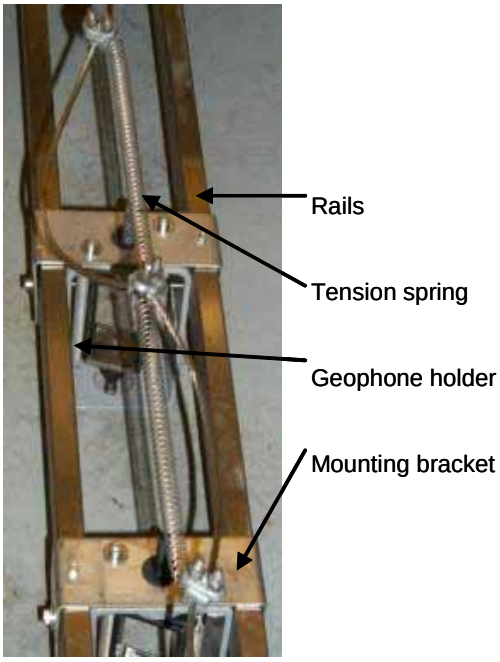


Figure 108. Mounted geophone holders to raise/lower bar.

6. The geophone holders are screwed into specific locations along the rails, although the locations can be adjusted. Mount the geophone holders to the raise/lower bar and adjust position (figures 109 and 110).

Figure 109. Completed assembly of raise/lower bar.

Figure 110. Rear view of raise/lower assembly.

GEOPHONE HOLDER

The geophone holder attaches to the raise/lower bar on the FWD. The purpose of the geophone holder is to provide a means of adjusting the geophones to various distances from the load plate.

Figure 112 shows geophone holder components. Upon inspection, if holder springs are weak or damaged replace only as a set, not individually, to maintain proper seating pressure.

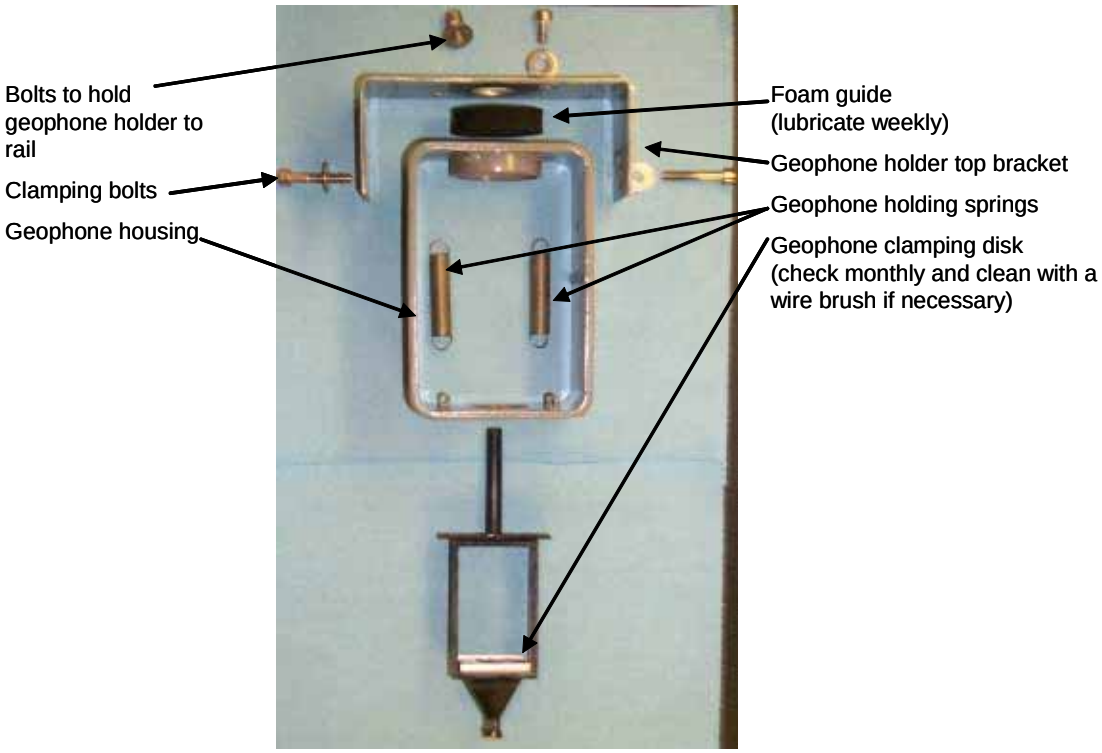


Figure 111. Geophone holder components.

Geophones are preassembled. Figure 112 shows an assembled geophone holder for an 80 mil (2,032 microns) standard geophone.

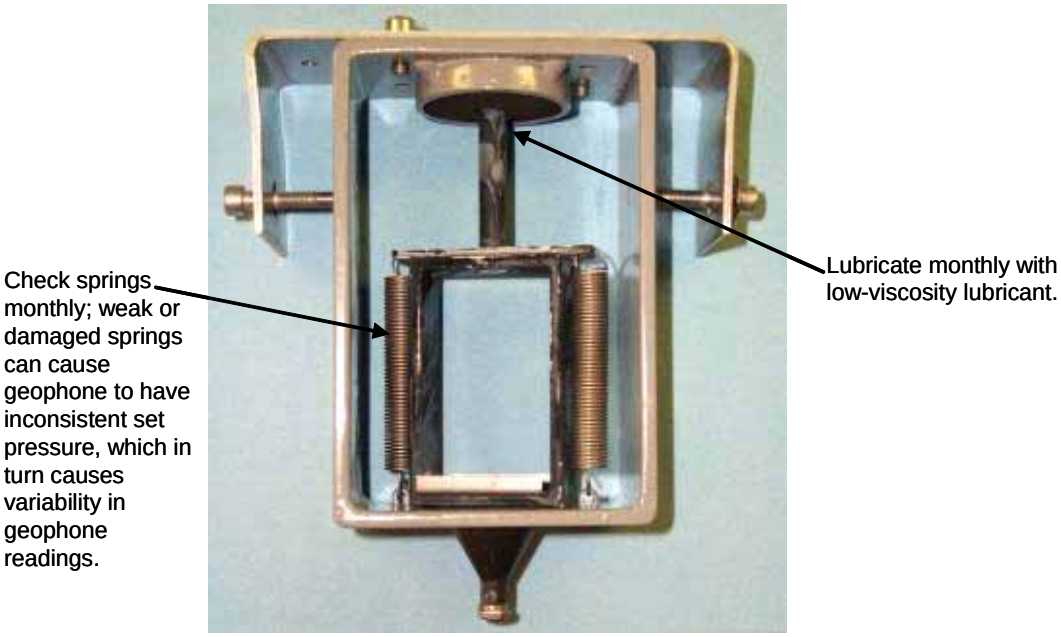


Figure 112. Assembled geophone holder.

Figure 113 shows the components for the geophone.

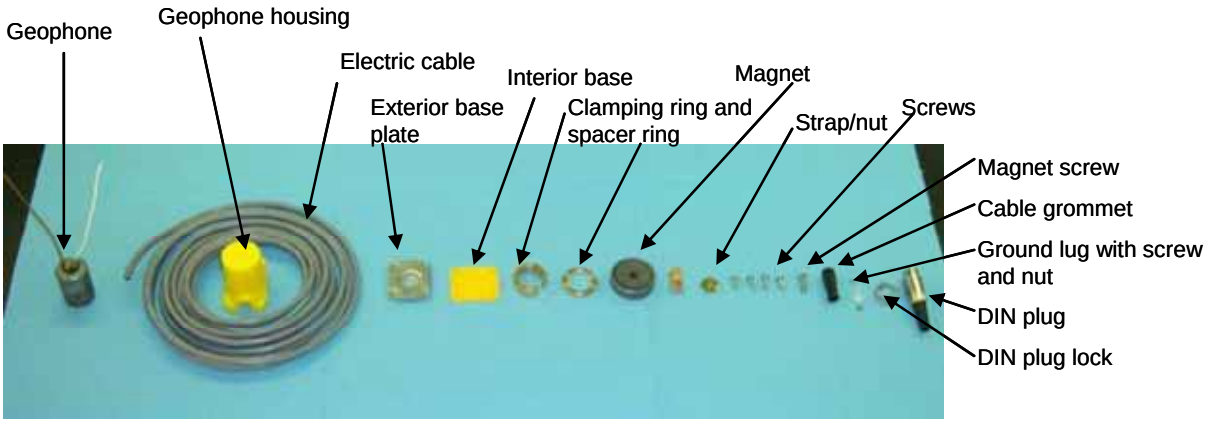


Figure 113. Geophone components.

Use the following steps to assemble your own geophone rather than using a preassembled one:

1. Mount the ground ring to the geophone (figures 114 and 115).

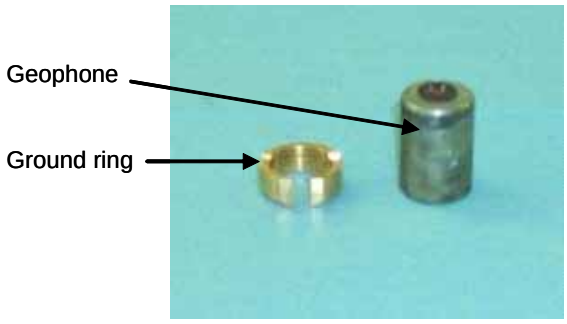


Figure 114. Ground ring and geophone.

Figure 115. Mounted ground ring.

2. Prepare the geophone cable for assembly. Use a sharp art knife to split the two-strand wire and shield. Separate the wires to solder them onto the geophone (figures 116 and 117).

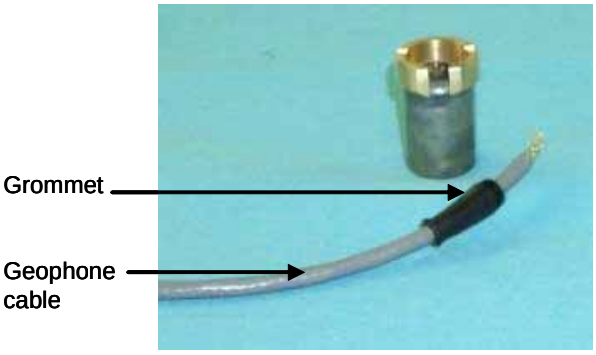


Figure 116. New geophone cable.

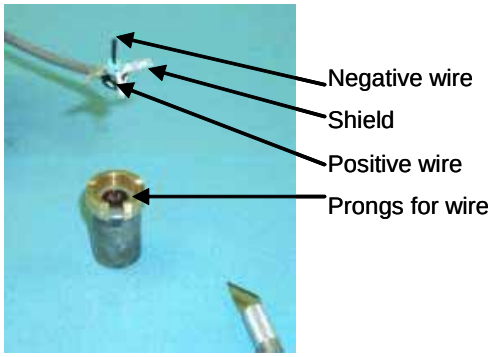


Figure 117. Separated wire.

3. Twist the wire shield and attach to the ground lug (figure 118).

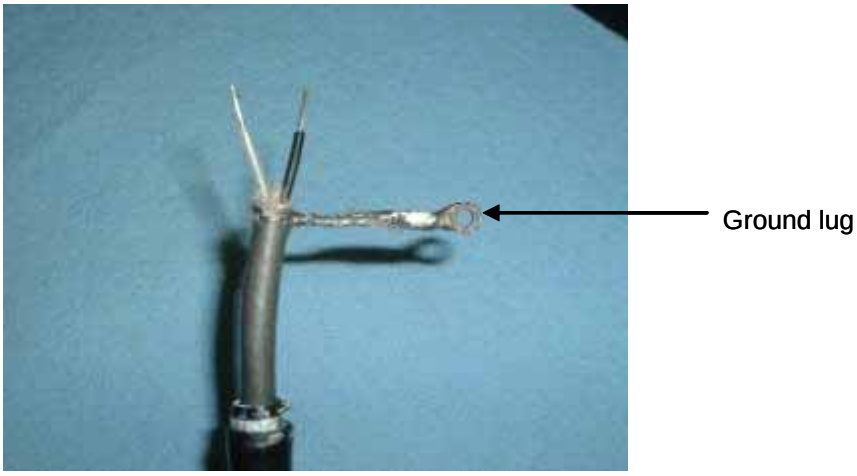


Figure 118. Attached ground lug.

4. Solder the positive and negative wires to the appropriate prongs on the geophone (figure 119). Screw the ground lug into the side to the ground ring.

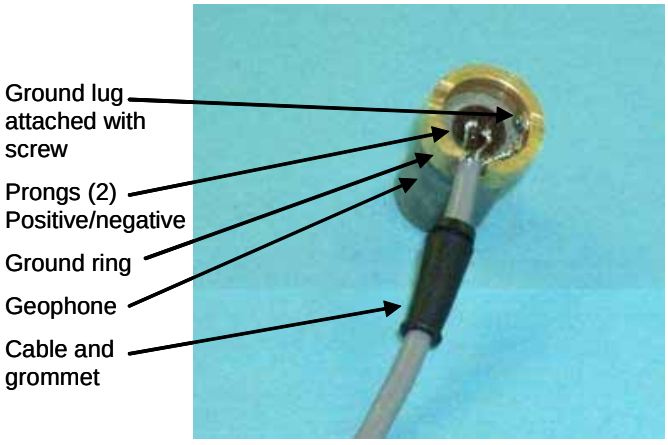


Figure 119. Geophone cable soldered to geophone.

5. Place the geophone in the geophone housing and fill the internal area with electronics-grade silicone (figure 120). Install the strap.

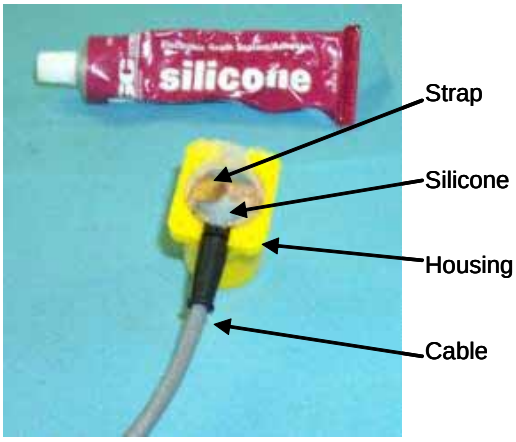


Figure 120. Silicone-filled housing.

6. Place the plastic base cover on the geophone (figure 121).

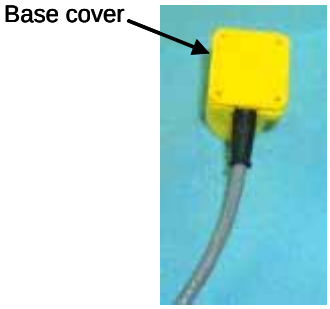


Figure 121. Base cover on housing.

7. Attach the steel base plate, which will secure the magnet to the geophone housing (figure 122).

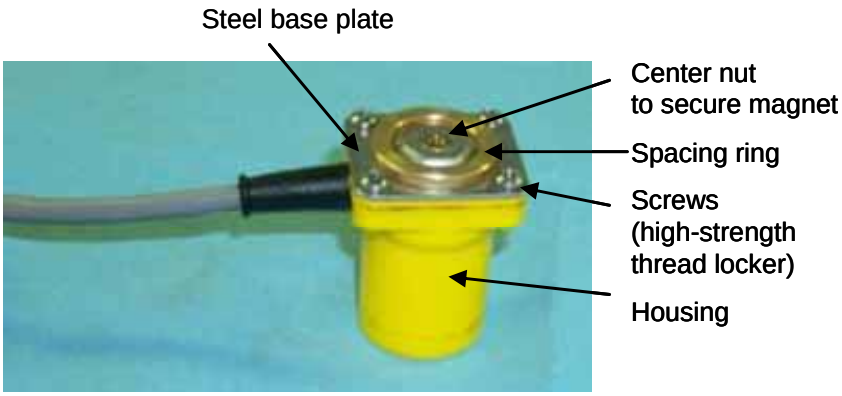


Figure 122. Geophone with base plate attached.

8. Attach the magnet with a screw and medium-strength thread locker (figures 123 and 124).

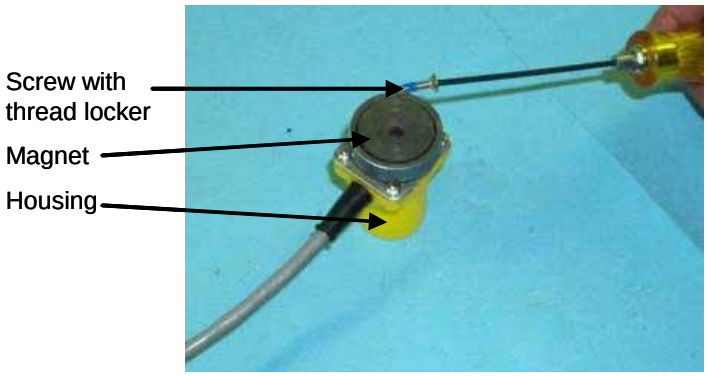


Figure 123. Attached magnet.

Figure 124. Completely assembled geophone.

9. Pay attention to the DIN (Deutsches Institut fur Normung eV) plug connector at the other end of the geophone cable (figure 125). Attach the DIN plug housing to the end of the cable.

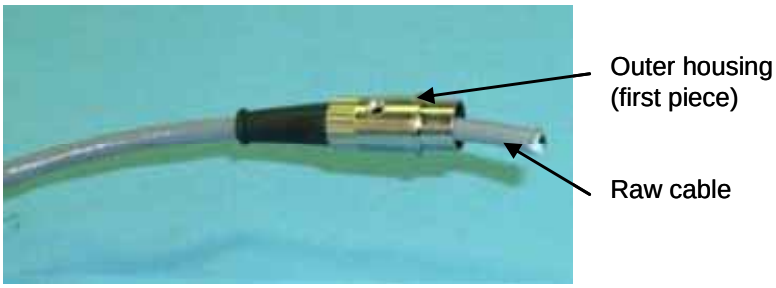


Figure 125. Raw cable and DIN plug housing.

10. Solder wires to the internal component of the DIN plug (figure 126).

Figure 126. Internal view of the DIN plug.

11. Attach the second half of the DIN plug outer housing to the plug (figure 127).

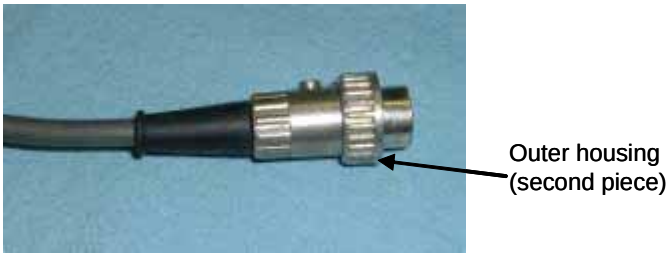


Figure 127. Completed DIN plug.

After the geophone is assembled, plug the geophone into the correct DIN connector and run a drift screen check to ensure they are functioning properly). Follow by conducting a reference calibration.

CHAPTER 5. ELECTRONICS

PROXIMITY SWITCHES

There are four proximity switches (figure 128):

- Weight height (WH) proximity switch sensor is activated by close presence of any of the falling weight stops (located in a rail on the drop weight). The (red) WH LED must turn *on* at each passing of a falling height stop.
- Trigger (TRG) proximity switch sensor is activated when the drop weight is less than 6 to 12 mm (0.25 to 0.50 inch) from its lower, resting position. The (green) TRG LED must be *on* when the weight is low *and* it must turn *off* when the weight has been raised 6 to 12 mm (0.25 to 0.50 inch).
- Plate low (PL) proximity switch sensor is deactivated when the falling weight subassembly is no longer suspended from the tow shafts of the side cylinders. This is normally when the plate has come to rest on the ground, but it may occur if the subassembly is prevented from being lowered, such as if the transport locks have are still locked. The (yellow) PL LED must turn OFF when the plate is low.
- Plate high (PH) proximity switch sensor is activated only when the plate (i.e., the falling weight assembly) is close to its highest position. The (green) PH LED must be *on* when the plate is high. It also must be *on* when the subassembly is resting on the transport locks in either or both sides.

Figure 128. Four types of proximity switches.

ELECTRICAL CONNECTION BOX

Check electrical connections and clean annually (figure 129). Refer to the manufacturers wiring schematics and owner's manual for further information on the wiring diagram.

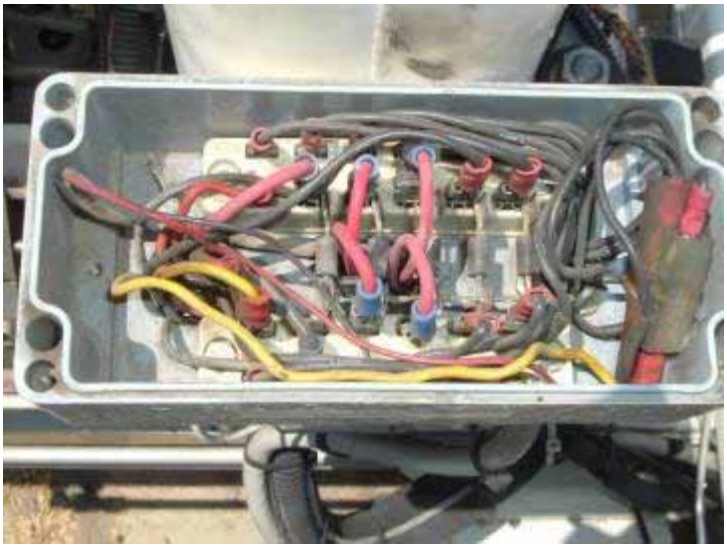


Figure 129. Electronics connection box.

SYSTEM PROCESSOR

Annually remove the system processor (figure 130) and clean all internal components. Periodically check connections in the rear of the processor (figure 131) to make sure they are secure and no strain is put on the cables. Also, check that the processor is securely mounted to the vehicle. Refer to the manufacturer's owner's manual for repairs and maintenance beyond the routine.

Figure 130. System processor.

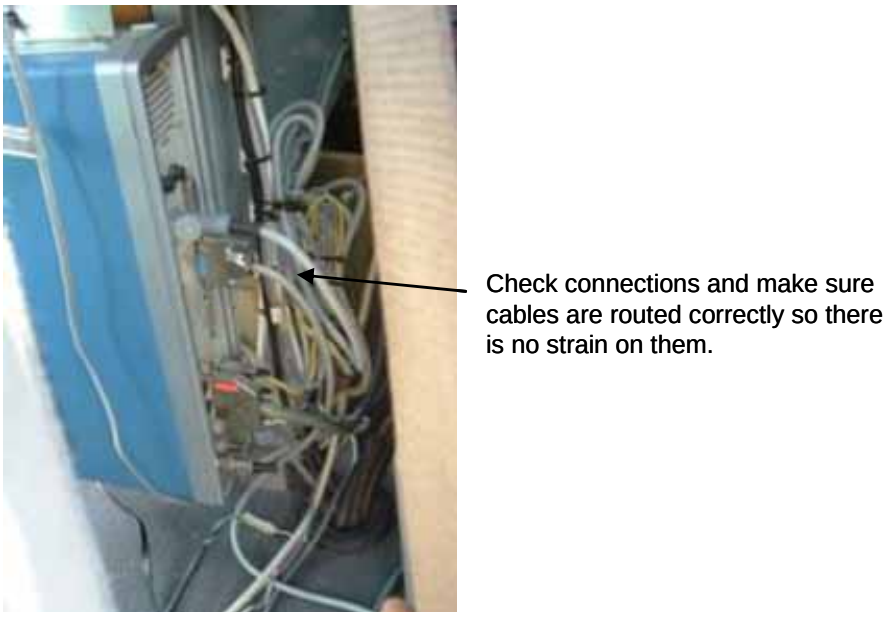


Figure 131. Rear view of vertically mounted system processor.

DMI PROXIMITY SWITCH

The vehicle-mounted proximity switch is a distance-measuring instrument (DMI) (figure 132). It should be checked monthly to make sure the correct air gap is used. Stainless switches can have a sensor gap of up to 8 mm (0.315 inch). The yellow plastic switches can have a gap of up to 5 mm (0.197 inch).

Monthly check the wiring and switches to make sure there is no strain on the cable. Visually check the switch for damage and replace if necessary. Recalibrate after repairs are made.

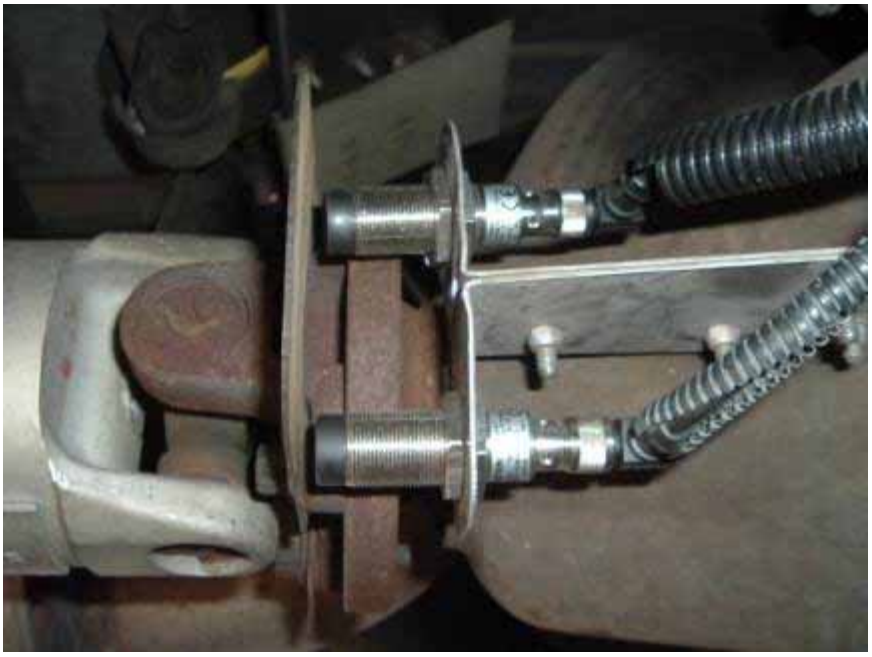


Figure 132. Vehicle-mounted proximity switches.

VEHICLE CHARGE PLUG CONNECTION

Monthly clean the power supply connection between the vehicle and trailer (figure 133). Also, check that the connection is snug to make good contact between the two plugs (figure 134).

Figure 133. Vehicle charge plug.

Figure 134. Trailer-to-vehicle charge plug.

POWER CONTROL BOARD

The power control board is located behind the panel shown in figure 135. Remove the front panel and inspect all connections, making sure they are tight. Clean all connections annually.

Figure 135. Power control box (board behind front panel).

FUSE BLOCKS

Figure 136 shows the trailer fuse block. Two more fuse blocks are located inside the vehicle. All three fuse blocks should be inspected and cleaned monthly.

Figure 136. Trailer fuse block.

ELECTRONICS BATTERY

The electronics battery is located inside the vehicle (figure 137). Check that it is securely mounted to the vehicle floorboard, and check and clean the connections monthly. Also, check the water level inside the battery. If water needs to be added, use distilled water.

Figure 137. Electronics battery inside the vehicle.

CHAPTER 6. CONCLUSION

Maintaining and regularly servicing FWDs is crucial to equipment performance, longevity, and quality of acquired data. Routine maintenance provides insurance against expensive repairs and parts replacement, which can also result in expensive downtime. The information in this document is to help people who are responsible for ownership, management, operation, or service of FWDs. This document is particularly useful to people who use FWDs in highway infrastructure construction, rehabilitation, maintenance, and management.

While the contents of this document directly apply only to the Dynatest Model 8000 in use by the LTPP program, the instructions can also help on some earlier or later models, and even other brands of FWDs. Troubleshooting and maintenance advice for the tow vehicle were excluded from this document. A variety of tow vehicles perform the same function, each having its own variables.

APPENDIX: SCHEDULED MAINTENANCE LOG

SCHEDULED MAINTENANCE LOG FOR FWD TRAILER

(Revised: 12 July 2005)

Date	
Owner	
Model No.	
Serial No.	
Hour meter/Drop counter - Incoming, Outgoing	

Date	Insp. Initls.	Maintenance Required	Maint. Performed	Page No./ Figure No.	Comments
Hydraulic System and Related Components:					
		Change hydraulic oil/filter	Annually	P-26/F-44	
		Inspect rubber pad on load cell	Daily	P-53/F-97	
		Grease load cell	Monthly	P-52/F-96	
		Lubricate guide rollers	Weekly	P-23/F-39	
		Visual inspection of excess pressure	Daily	P-26/F-44	
		Inspect load cell swivel operation	Monthly	P-50/F-92	
		Inspect load cell attaching brackets	Monthly	P-51/F-94	
		Lubricate upper catch assembly	Weekly	P-44/F-84	
		Rotate catch assembly	Daily	P-45/F-85	
		Check hydraulic oil level	Daily	P-15/F-25	
		Check guide profiles and shims	Annually	P-19/F-32	
		Check side cylinder bolts	Every 6 months	P-46/F-87	
		Check center cylinder for leaks	Monthly	P-35/F-65	
		Check A/B valve for leaks	Monthly	P-26/F-44	
		Check hydraulic lines and connections for leaks	Monthly	P-24/F-40	

SCHEDULED MAINTENANCE LOG FOR FWD TRAILER

(Revised: 12 July 2005)

Date	
Owner	
Model No.	
Serial No.	
Hour meter/Drop counter - Incoming, Outgoing	

Date	Insp. Initls.	Maintenance Required	Maint. Performed	Page No./ Figure No.	Comments
Hydraulic System and Related Components (Continued):					
		Inspect side cylinder for leaks	Monthly	P-46/F-86	
		Inspect strike plate hardware	Monthly	P-49/F-90	
		Check center cylinder to strike plate nut	Annually	P-29/F-51	
		Check condition of buffers	Monthly	P-23/F-39	

SCHEDULED MAINTENANCE LOG FOR FWD TRAILER

(Revised: 12 July 2005)

Date	
Owner	
Model No.	
Serial No.	
Hour meter/Drop counter - Incoming, Outgoing	

Electronics/Electrical Components:					
		Inspect trailer battery - Clean terminals/check water level	Monthly	P-18/F-28	
		Inspect electronics battery (in vehicle)	Monthly	P-72/F-137	
		Clean ground terminals (two in trailer)	Monthly	P-3/F-1 and P-4/F-2	
		Inspect four proximity switches	Monthly	P-67/F-129	
		Inspect PS1/PS2 switches	Monthly	P-27/F-46	
		Clean fuse block terminals (trailer)	Every 3 months	P-72/F-137	
		Inspect hydraulic motor brushes	Every 6 months	P-25/F-43	
		Check charging plug from vehicle to trailer connection	Every 3 months	P-70/F-134 and 135	
		Check power control board connections	Every 6 months	P-18/F-29	
		Check seismic sensor connections	Monthly	P-71/F-136	

SCHEDULED MAINTENANCE LOG FOR FWD TRAILER

(Revised: 12 July 2005)

Date	
Owner	
Model No.	
Serial No.	
Hour meter/Drop counter - Incoming, Outgoing	

Electronics/Electrical Components (Continued):					
		Check air and infra-red sensor connections (optional equipment)	Monthly	—	
		Clean and inspect multisignal cable	Every 3 months	—	
		Clean inside of 9000 processor	Annually	P-68-69/ F-131 and 132	Use extreme caution
		Check air-gap vehicle-mounted DMI	Annually	P-70/F-133	
		Clean connectors in electrical control box	Annually	P-68/F-130	
Raise/Lower Bar Assembly:					
		Lubricate front pulley wheels	Monthly	P-57/F-105	
		Lubricate rear pulley wheels	Monthly	P-47/F-88	
		Check rut bar depth - adjust	Annually	P-59/F-109	
		Check geophone holders	Monthly	P-59/F-110	
		Check geophone holder springs	Monthly	P-61/F-113	Replace as a set
		Check geophone clamping disk	Monthly	P-60/F-112	

SCHEDULED MAINTENANCE LOG FOR FWD TRAILER

(Revised: 12 July 2005)

Date	
Owner	
Model No.	
Serial No.	
Hour meter/Drop counter - Incoming, Outgoing	

Date	Insp. Initls.	Maintenance Required	Maint. Performed	Page No./ Figure No.	Comments
Raise/Lower Bar Assembly (Continued):					
		Lubricate foam guide	Monthly	P-60/F-112	
		Raise/lower bar cable (inspect)	Monthly	P-57/F-105	
		Raise/lower bar rear guide and bolt	Annually	P-55/F-102	Re-apply thread locker

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