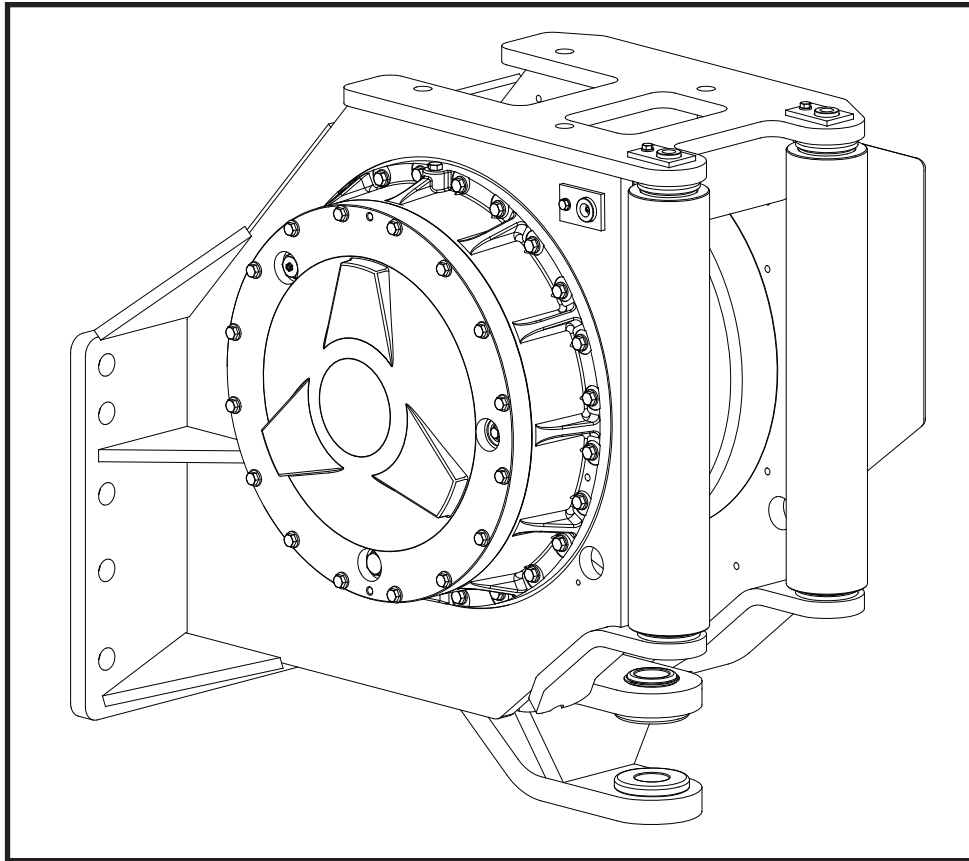


CARCO®

MODEL H90VS SERVICE MANUAL



PACCAR WINCH

P.O. BOX 547 Broken Arrow, OK 74013

Tel 918-251-8511 / Fax 918-259-1575

www.paccarwinch.com

LIT2329 R3
12-2008
Printed in U.S.A.

© 2008 PACCAR Inc
All rights reserved

TABLE OF CONTENTS

FOREWORD.....	2
GLOSSARY OF TERMS.....	4
THEORY OF OPERATION.....	5
PREVENTATIVE MAINTENANCE.....	8
GENERAL SPECIFICATIONS.....	9
RECOMMENDED OIL.....	10
WINCH REMOVAL AND INSTALLATION.....	11
WIRE ROPE INSTALLATION.....	12
TROUBLE SHOOTING.....	13
SERVICE PRECAUTIONS.....	17
WINCH CROSS-SECTION AND PARTS KEY.....	18
FAIRLEAD ASSEMBLY AND PARTS KEY.....	18
WINCH ASSEMBLY EXPLOSION AND PARTS KEY.....	19
BRAKE ASSEMBLY EXPLOSION.....	22
OVERRUNNING CLUTCH EXPLOSION.....	23
CARRIER CLUTCH EXPLOSION.....	23
PLANETARY ASSEMBLY EXPLOSION.....	24
MOTOR ASSEMBLY.....	24
WINCH DISASSEMBLY.....	25
SUBASSEMBLY SERVICE.....	29
A) INTERMEDIATE CARRIER SERVICE	29
B) OUTPUT PLANET CARRIER SERVICE.....	30
C) DRUM CLUTCH SERVICE.....	31
D) BRAKE HOUSING ASSEMBLY SERVICE.....	32
E) BRAKE ASSEMBLY PRESSURE TEST.....	34
F) OVERRUNNING BRAKE CLUTCH SERVICE.....	35
G) CABLE DRUM SERVICE.....	36
WINCH ASSEMBLY.....	37
BRAKE CYLINDER LIFTING FIXTURE.....	40
METRIC CONVERSION TABLE.....	44

FOREWORD

Please read and understand this entire manual BEFORE operating or servicing your CARCO winch. Retain this manual for future reference.

This manual contains instructions for service and repair of CARCO H90VS hydraulic winches built for use on various crawler tractors. Depending on the specific tractor hydraulics, the winches will be configured with either variable displacement piston motors or fixed displacement vane motors. When instructions apply to only one specific winch configuration, that designation (i.e., Variable displacement motor only) will appear at the beginning of the pertinent text. If not identified in this manner, the text applies to ALL H90VS winches.

Some illustrations in this manual may show details or attachments which may be different from your winch. Also, some components may have been removed for clarity.

Continuing product improvement may cause changes in your winch which may not be included in this manual. Whenever questions arise regarding your CARCO winch or this manual, please contact the PACCAR Winch Technical Support Department:

Phone: 918-251-8511, Monday – Friday, 0800 hrs – 1630 hrs CST
FAX: 918-259-1575
Email: winch.service@paccar.com

Provide the complete winch MODEL NUMBER and SERIAL NUMBER when making inquiries.

Please remember, this manual is not a training manual. It cannot tell you everything you need to know about servicing your CARCO winch. If you have not been trained as a heavy equipment mechanic, you should get the proper training before servicing this winch. Only qualified heavy equipment mechanics should service this winch.

NOTE:

The hydraulic motors and selected gear ratios on CARCO H90VS winches are specifically configured for use on the intended tractor. The winch may not be suitable, or advisable, for use on anything other than the intended tractor. Contact the CARCO SERVICE DEPARTMENT with questions regarding retrofitting your winch to other tractors.

Safety and informational callouts used in this manual include:



This emblem is used to warn against potential or unsafe practices which COULD result in personal injury, and product or property damage if proper procedures are not followed.

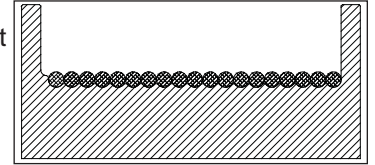


This emblem is used to warn against unsafe practices which COULD result in severe personal injury or death if proper procedures are not followed.

GLOSSARY OF TERMS

Brake Valve - A hydraulic counterbalance valve is usually bolted to the reel-in port of the hydraulic motor. It allows oil to flow freely through the motor in the reel-in direction. When oil pressure tries to rotate the motor in the reel-out direction, the brake valve blocks the flow of oil out of the motor until the internal static brake is released. It then controls reel-out speed based on the load and flow of oil to the motor. All the heat generated by controlling the speed of the load is dissipated by the hydraulic system, not by the internal static brake.

Grooved Drum - A cable drum with grooves on the barrel to ensure the first layer of cable spools properly onto the drum. The grooves can be cast or machined into the drum, or cast or machined into separate pieces that are mechanically fastened to the drum. NOTE: Only one size cable can be used on a grooved drum.

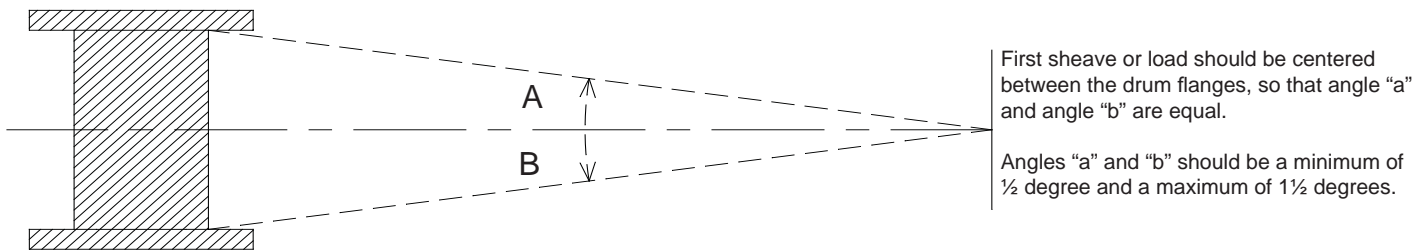


Sprag or Over-Running Clutch - A mechanical one-way clutch on the input shaft of the winch, between the input shaft and the static mechanical brake. The clutch allows the input shaft to turn freely in the direction required to spool cable onto the drum, then immediately locks the hoist gear train to the mechanical brake when the hoist is stopped, holding the load in place.

Static, Mechanical, or Load-Holding Brake - A multi-disc, spring applied, hydraulically released brake that works together with the sprag clutch to hold a load. This brake is not designed to stop a load being reeled-out, but holds the load in place when the winch is not being operated.

First Layer Line Pull Rating - The maximum rated line pull (in pounds or kilograms) on the first layer of cable. The maximum rating for any particular winch is based on maintaining an acceptable structural design factor and service life. Certain combinations of drum, gear ratio, motor and hydraulic pressure, may reduce this rating.

First Layer Line Speed Rating - The maximum rated line speed (in feet or meters per minute) on the first layer of cable. Certain combinations of drum, gear ratio, motor and hydraulic flow may reduce or increase this rating.



Fleet Angle - The angle between the wire rope's position at the extreme end wrap on a drum, and a line drawn perpendicular to the axis of the drum, through the center of the nearest fixed sheave or load attachment point.

Wrap - A single coil of wire rope wound on a drum.

Layer - All wraps of wire rope on the same level between drum flanges.

Freeboard - The amount of drum flange that is exposed radially past the last layer of wire rope. Minimum freeboard varies with the regulatory organization. ASME B30.5 requires $\frac{1}{2}$ in. minimum freeboard.

GENERAL SAFETY RECOMMENDATIONS

Safety for operators and ground personnel is of prime concern. Always take the necessary precautions to ensure safety to others as well as yourself. To ensure safety, the prime mover and hoist must be operated with care and concern for the equipment and a thorough knowledge of the machine's performance capabilities. The following recommendations are offered as a general safety guide. Local rules and regulations will also apply.

WARNING

FAILURE TO OBEY THE FOLLOWING SAFETY RECOMMENDATIONS MAY RESULT IN PROPERTY DAMAGE, INJURY, OR DEATH.

1. Read all warning tag information and become familiar with all controls **BEFORE** operating the winch.

2. **NEVER** attempt to clean, oil or perform any maintenance on the winch with the engine running, unless instructed to do so in this manual.

3. Before starting the tractor, be certain all controls move freely and are placed in the "Brake-On" (neutral) position.

4. **NEVER** operate winch controls unless you are properly seated at the operators station on the tractor and you are sure personnel are clear of the work area.

5. **NEVER** attempt to handle winch cable when the hook end is not free. Keep all parts of body and clothing clear of cable rollers, cable entry area of fairleads and winch drum.

6. Ground personnel should stay in view of tractor operator and clear of winch drum. Do not allow ground personnel near winch line under tension. A safe distance of at least 1 ½ times the working length of the cable should be maintained. **NEVER** allow anyone to stand under a suspended load.

7. Avoid sudden "shock" loads or attempting to "jerk" a load free. This type of operation may cause heavy loads in excess of rated capacity, which may result in failure of cable and/or winch.

8. Use only GENUINE CARCO parts. Do not use parts from other winch manufacturers on your CARCO winch. Do not use CARCO parts on winches from other manufacturers.

9. Use correct size ferrule for cable and pocket in winch drum. Never use knots to secure or attach cable. The cable anchor or ferrule pocket in the cable drum is designed to provide a self release in the event a back-sliding load must be released from the tractor in an emergency situation. The cable anchor or ferrule alone will NOT support rated line pull. Therefore, a minimum of five (5) complete wraps of cable must be maintained on the winch drum.

NOTE: We suggest painting the last five wraps of cable bright red to serve as a visual warning.

Recommended Operating Practices

1. Leather gloves should be used when handling winch cable.

2. Operate the winch to match line speeds to job conditions.

3. Assure that personnel who are responsible for hand signals are clearly visible and that the signals to be used are thoroughly understood by everyone.

4. Inspect winch cable, rigging, winch and tractor at the beginning of each work shift. Defects should be corrected immediately.

5. Position tractor for straightest line of pull to reduce wear on winch cable and ensure even spooling.

6. When winding winch cable on the winch drum, never attempt to maintain tension by allowing winch cable to slip through hands. Always use "hand-over-hand" technique, being careful to keep hands and clothing away from winch drum and fairlead rollers.

7. Be sure of tractor ground stability before winching in a load.

8. Store unused chokers, slings and rigging in a neat and orderly fashion to prevent damage to equipment or injury to personnel.

9. Do not operate the winch under loads that exceed the maximum rated bare drum line pull. If excessive loads are encountered, use a multi-part line and sheave blocks. Any attempt to exceed the capacity of one winch (such as coupling 2 or more tractors together) is extremely hazardous.

10. The factory approved adaptations for CARCO winches are designed and intended for use on specific models of crawler tractors. Changing winches between tractors is not possible in some cases because of differences in tractor models. Some changes cannot be approved by CARCO because of safety limitations. Call a CARCO dealer or the CARCO factory prior to attempting winch modifications or before mounting on a different tractor.

11. CARCO H90 winches are powered by the tractor hydraulic system. Discharge all retained hydraulic system pressure before removing any hydraulic lines or fittings. Personal injury may result from sudden release of oil pressure.

12. To discharge the winch control system pressure, stop the engine and cycle the winch control lever(s) into all positions five (5) times. Refer to the tractor manufacturers operators or service manual for additional information.

13. On machines having hydraulically, mechanically and/or cable controlled equipment, be certain the equipment is either lowered to the ground or blocked securely before servicing, adjusting and/or repairing the winch. Always apply tractor parking brakes and lower equipment before dismounting the tractor.

14. The winches described in this manual are neither designed nor intended for use or application to equipment used in the lifting or moving of persons.

15. Keep equipment in good operating condition. Perform scheduled servicing and adjustments listed in the "Preventive Maintenance" section of this manual. Use recommended lubricants.

16. An equipment warm-up procedure is recommended for all start-ups and essential at ambient temperatures below +40°F (5°C). Refer to "Warm-Up Procedure" listed in the "Preventive Maintenance" section of this manual.

THEORY OF OPERATION

DESCRIPTION OF WINCH

The winch assembly consists of six basic component groups:

1. Winch case
2. Hydraulic motor and piping
3. Brake housing assembly
4. Cable drum
5. Planetary reduction group
6. Carrier clutch group

The winch case is a structural member of welded construction designed specifically for use in tractor winch applications. The case supports the output ring gear and the brake housing assembly. The cable drum rotates on two large tapered roller bearings. The hydraulic motor is bolted to the brake housing, which also supports the right hand cable drum bearings. The output ring gear supports the left hand cable drum bearings.

The planetary reduction group contains three planetary gear sets driven by the primary sun gear shaft, which is coupled to the motor shaft by the inner race of the overrunning brake clutch assembly. With a total reduction of 212:1 or 255:1, the planetary reduction group greatly multiplies the motor torque for high line pulls at maximum efficiency and precise load control.

BASIC WINCH OPERATION

The CARCO H90VS winch contains a hydraulic motor and gear ratio specifically selected to match the winch to the hydraulic power of the specific tractor. This allows the winch to maximize the available hydraulic horsepower.

The winch motor is operated utilizing the full flow of the tractor implement pump via the implement valve, which also controls both the blade and ripper. The ripper section of the implement valve may be used to operate the winch, or in some instances, it may be replaced with a special winch valve to enhance the winch performance capabilities. In any case, the valve used will be a four way, three position valve.

Typically, the winch control valve is connected to the operator's joystick control lever by a series hydraulic hoses. Movement of the control lever directs the oil flow to the winch motor through hydraulic lines. The hydraulic motor converts the flow and pressure of the hydraulic system into the mechanical energy needed to drive the winch gear train.

The tractor can walk away from a winch load to reposition for another pull by releasing the drum clutch. The spring applied, hydraulically released multi-disc clutch locks the clutch carrier to the secondary sun gear through the gear adapter. When released, clearance between the clutch plates allows the secondary sun gear to rotate free of the clutch carrier, so the winch drum is disengaged from the winch static brake. The cable drum drag observed during brake-off (drum clutch release) is caused by the rotating output and secondary planetary gear sets and viscous drag of the friction discs. The brake-off drag force increases as the tractor ground speed increases.

DUAL BRAKE SYSTEM – DESCRIPTION

The dual brake system consists of a dynamic brake system and a static brake system. The dynamic brake system has two operating components:

1. Hydraulic Brake valve assembly
2. Hydraulic motor

The brake valve is similar to a counter-balance valve. It contains a check valve to allow free flow of oil to the motor in the Reel-In direction and a pilot-operated, spring-loaded spool valve which blocks the flow of oil out of the motor when the control valve is placed in neutral. When the control valve is moved into the Reel-Out position, the spool in the brake valve remains closed until sufficient pilot pressure is applied to the end of the spool to shift it against the spring pressure and open a passage. After the spool valve cracks open, the pilot pressure becomes flow dependent

and modulates the spool valve opening which controls the Reel-Out speed.

The static brake system has three operating components:

1. Spring applied, multiple friction disc static brake
2. Sprag-type overrunning brake clutch assembly
3. Hydraulic piston and cylinder

The static brake is released by the brake valve pilot pressure at a pressure lower than that required to open the pilot operated spool valve in the brake valve assembly. This sequence assures that dynamic braking takes place in the brake valve and that little, if any, heat is absorbed by the friction discs.

The friction brake is a load holding brake only and has nothing to do with dynamic braking or the rate of release of a heavy or suspended load.

The overrunning brake clutch is splined to the primary sun gear shaft between the motor and the primary sun gear. It will allow this shaft to turn freely in the direction of Reel-In, and lock up to force the brake discs to turn with the shaft in the direction of Reel-Out.

The hydraulic cylinder, when pressurized, will release the spring pressure on the brake discs, allowing the brake discs to turn freely.

DUAL BRAKE SYSTEM – OPERATION

When pulling in a load (Reel-In), the overrunning brake clutch, which connects the motor shaft to the primary sun gear, allows free rotation through the gear train to the cable drum. The sprag cams lay over and permit the inner race to turn free of the outer race. The friction brake remains fully applied. The winch, while reeling in a load, is not affected by any braking action.

When the Reel-In operation is stopped, the load attempts to turn the primary sun gear in the opposite direction. This reversed input causes the sprag cams to instantly roll upward and firmly lock the shaft to the fully applied friction brake.

When the winch is powered in reverse, to Reel-Out the load, the motor can not rotate until sufficient pilot pressure is present to open the brake valve. The friction brake within the winch will completely release at a pressure lower than that required to open the brake valve, typically 350 PSI (2,413 kPa) and 600 PSI (4,137 kPa), respectively. The extent to which the brake valve opens will determine the amount of oil that can flow through it and the speed at which the load will Reel-Out. Increasing the flow of oil to the winch motor will cause the pressure to rise and the opening in the brake valve to enlarge, speeding up the release of the load. Decreasing this flow causes the pressure to lower and the opening in the brake valve to decrease, thus slowing the release of the load.

With the control valve shifted to neutral, the pressure will drop and the brake valve will close, stopping the load. The friction brake will reapply and hold the load after the brake has closed.

The friction brake receives very little wear during the Reel-Out operation. Most of the heat generated by the releasing and stopping of the load is absorbed into the hydraulic oil where it can be readily dissipated.

CONTROL OPERATION

BRAKE-ON (NEUTRAL)

When the winch is not in operation, or when the control lever is released, the handle returns to the center, or BRAKE-ON, position by spring force. Any load attached to the winch cable is held firm.

REEL-IN

Moving the control lever in the direction of tractor forward movement provides a signal to direct the oil to the winch motor to pull the cable and load in to the winch. REEL-IN drum speed is proportional to the amount of lever movement. When released, the lever will return to BRAKE-ON and the winch drum will stop and hold the load firm.

REEL-OUT

Moving the control lever in the direction of tractor reverse movement provides a signal to direct the oil to the winch motor to rotate in the direction to power out the cable. **REEL-OUT** drum speed is proportional to the amount of lever movement. When released, the lever will return to **BRAKE-ON** and the winch drum will stop and hold the load firm.

NOTE: When operating in REEL-OUT mode, the pressure compensator within the motor is disabled and the winch will work in high speed mode ONLY. This feature ensures control of loads lowered on hillsides, such as yo-yo operations on pipeline right-of-ways.

DRUM CLUTCH RELEASE (BRAKE-OFF)

Depending on the tractor, the drum clutch is operated by either a switch on the tractor console or by the operator joystick. The switch energizes a solenoid to send pilot oil to the drum clutch piston, and the joystick sends the pilot oil directly to the drum clutch piston. Both operations direct hydraulic oil at pilot pressure to the drum clutch in the carrier clutch assembly which moves the drum clutch piston creating clearance between the friction and steel plates in the carrier clutch. This allows the secondary sun gear to rotate disengaged from the primary gear set and the winch brake. With the drum clutch released, the operator can drive away from a load using the inherent resistance of the two final planetary gear stages to keep a tight wrap of cable on the drum to prevent cable-over-run. When the lever is moved to the **BRAKE-OFF** position, pilot pressure is directed to the drum clutch releasing it until the joystick is returned to brake on.

As long as the **BRAKE-OFF** function is active, an indicator light on the main instrument panel in front of the operator will remain lit.

CAUTION

When using **BRAKE-OFF**, drive away from a stationary load at slow speed, in first gear range only. Driving away from loads at higher tractor speeds may result in over-speed damage to the winch gear train.

WARNING

DO NOT use the drum clutch for controlled reeling out of suspended loads. Sudden release of a load may result in property damage, injury or death. Use **ONLY REEL-OUT** to lower any load.

AUTOSPEED MODE

From the operator's perspective, this is the normal and most simple winch control method.

The winch line speed, or drum rotation speed, may be controlled by moving the control lever a very small distance, or by operating the tractor engine, and therefore the tractor implement pump, at a lower RPM.

NOTE: *Operating the tractor engine at the lowest idle setting while winching may result in erratic winch operation. Always operate the tractor at high engine idle to provide the full range of control from the winch, while guaranteeing smooth operation. Operating the engine at lower settings will NOT provide slower winching.*

The hydraulic motor used with the "autospeed" control system is a variable displacement, piston-type motor with an internal load-sense circuit. This circuit contains a small piston which adjusts the angle of the motor rotating group from minimum to maximum displacement as the pressure on the work ports (A & B) increases due to the load applied to the winch gear train. When there is little or no load on the winch, the motor rotating group will remain at the preset minimum displacement so maximum speed is available. As the winch load increases, the pressure at the motor work ports will increase. This same pressure will also act on the load-sensing piston beneath the "X" and "G" ports. As the load sensing piston moves, it directs oil to the motor rotating group shift cylinder which increases the motor displacement to provide increased torque, or pulling power, at a slower line speed.

In this manner, the motor displacement will automatically adjust to provide the maximum hydraulic horsepower for any given line speed and line pull situation.

LOW-SPEED LOCK MODE (LOW LOCK)

Depressing the button near the top of the control lever or a switch on the console will force the variable displacement motor to shift the piston to the maximum displacement position, which will allow the winch to operate in the maximum line pull, minimum line speed mode, to enhance precise load control. When shifted into LOW-LOCK, an indicator light on the main operator instrument panel will remain lit. To disable LOW-LOCK, and return to autospeed mode, press the button again. The indicator light will be off.

WINCH LOCK-OUT

On some tractors a toggle switch located on the RH operator's console adjacent to the winch control lever may be switched to completely lock out the hydraulic signal to the winch. This can be performed during servicing, or to eliminate the possibility of accidental winch actuation when performing general dozing operations. When activated, an indicator light on the main operator instrument panel will remain lit.

CAUTION

The hydraulic motor and gear ratio is configured to match the hydraulic system of a specific tractor. It may not be possible to mount the winch onto a different tractor model. Installation onto a tractor with a higher flow hydraulic system could result in overspeed damage to the motor and winch gear train. The maximum drum rpm speed in autospeed, no-load, with a piston motor, is listed below:

H90VS - 212:1= 23 rpm; 255:1= 19 rpm

PREVENTIVE MAINTENANCE

A regular program of preventive maintenance for your winch will minimize the need for emergency servicing and promote long product life and trouble-free operation.

The service intervals suggested in this manual will optimize component service life. These intervals may be gradually increased or decreased with experience of a particular lubricant and evaluation of your application.

GEAR CASE OIL

The winch assembly should be visually inspected for leaks at the beginning of each workday. If oil leaks are found, the gear case oil level should be checked. If no leaks are detected, the oil level should be checked once every 250 hours, or monthly. The oil level plug is located near the winch horizontal centerline on the LH end cover, toward the rear of the winch. Position the tractor on a flat, level surface and remove the plug. The oil level should be at the bottom of the level plug port.

Add oil as required through the oil filler plug, which is located near the top of the LH end cover toward the front of the winch. When filling, add oil slowly, as the oil must pass through the gear train and fill the drum cavity.

Refer to the "Recommended Oil" chart for recommendations of the proper oil for use in your application.

TRACTOR HYDRAULIC OIL LEVEL

The tractor hydraulic oil reservoir level should be checked at the sight glass on a daily basis, or in accordance with the tractor manufacturer's recommendations. Use the type and grade of hydraulic oil recommended by the tractor manufacturer.

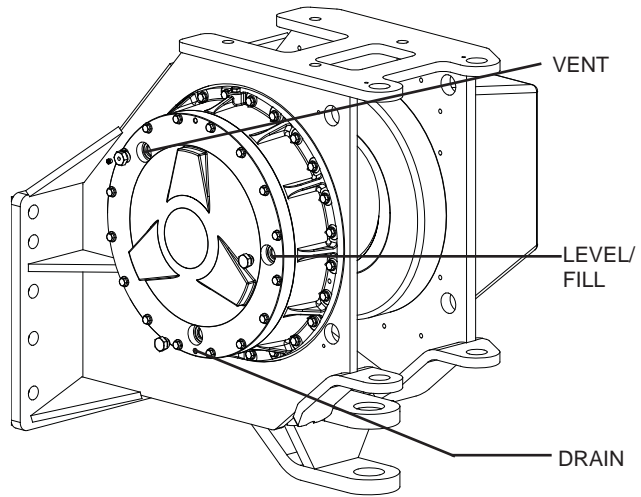
Change the tractor hydraulic oil and filter every 1000 hours during heavy winch use, or in accordance with the tractor manufacturer's recommendations.

⚠ WARNING ⚠

Hot oil can cause injury. Make certain the oil has cooled to a safe temperature (less than 110°F or 43°C) before servicing the winch.

WINCH GEAR CASE OIL CHANGE

Change the winch gear oil after the first 100-250 hours of operation, then every 1000 hours or six (6) months, whichever occurs first.



Remove the drain plug, located at the bottom of the LH end cover. To reduce drain time, also remove the fill plug. Drain the oil into a suitable container and recycle, or dispose of the oil in an environmentally responsible manner. Contact your local environmental agency or government concerning proper disposal methods. Install the drain plug securely after the oil has completely drained.

Refill the winch to the proper level with the recommended oil. Allow at least 15 minutes for the oil to flow completely through the gear train and fill the cable drum cavity before rechecking the level.

⚠ CAUTION ⚠

DO NOT operate the winch while the oil is drained. Serious damage to internal components may result.

VENT PLUG

The gear case vent plug is installed in the oil filler plug, located near the top of the LH end cover. Each time the oil is changed, remove the vent plug, clean in safety solvent and reinstall. In extremely dusty environments, the vent plug may require cleaning more often.

Note: *Do not replace the vent plug with a solid plug. The normal expansion of the gear oil during operation will cause a build-up of pressure within the gear case, which may lead to seal leakage.*

WINCH CABLE (WIRE ROPE)

Inspect the entire length of wire rope, and the hook, in accordance with the rigging manufacturer's recommendations.

MOUNTING FASTENERS

Check and/or tighten all winch mounting fasteners to the recommended torque levels after the first 100-250 hours of operation, then every 1000 hours or six (6) months, whichever occurs first.

WARM-UP PROCEDURE

The tractor engine should be run in accordance with the tractor manufacturer's recommendations to warm the hydraulic system. In colder climates or in winter, use low-temp oil as recommended by the tractor manufacturer.

FAIRLEAD ROLLERS

Grease the fairlead rollers at the start of each workday. Each fairlead roller has two (2) grease fittings, one in each end. Apply grease until a small amount pushes out around the shaft.

Use a high quality, type-12 hydroxy-stearate-lithium based grease, which contains an EP (extreme pressure) additive, such as Moly, and meets or exceeds the NGLI Grade 2 specification.

INSPECTION

The winch should be disassembled, and all wear items inspected thoroughly for excess wear or damage, every 10,000 hours or four (4) years, whichever occurs first.

GENERAL SPECIFICATIONS

Unit Weight (w/o Oil, Cable or Tractor Mtg. Brackets)...Approx. 3,300 lb. (1500 kg)

Overall Gear Ratios Available.....212:1
.....255:1

Cable Drum Dimensions.....Barrel Diameter12.50 in. (318 mm)
.....Flange Diameter24.00 in. (610 mm)
.....Barrel Length 9.09 in. (231 mm)

Cable Drum Storage Capacity

Layer	1-1/8 in. (29 MM) Ferrule Part No. 29428		1 in. (25 mm) Ferrule Part No. 29427	
	ft	M	ft	M
1	25	7	28	8
2	55	16	61	18
3	89	26	98	29
4	127	38	139	41
5	170	50	185	55

To minimize cable (wire rope) cost and maximize both cable life and winch performance, CARCO always recommends installing and using the shortest length of cable required for the intended application.

Installing winch cable that exceeds the published maximum limits dramatically increases the potential loads on the cable drum flanges and may lead to damage to the winch or to the winch cable, or to other possibly hazardous conditions. In the interest of safety the maximum allowable cable diameter for use on the CARCO H90 winch is limited to 1 1/8". Absolute maximum allowable cable lengths for use on the H90 are:

1 1/8" Dia. - 180 feet
1" Dia. - 203 feet
7/8" Dia. - 225 feet

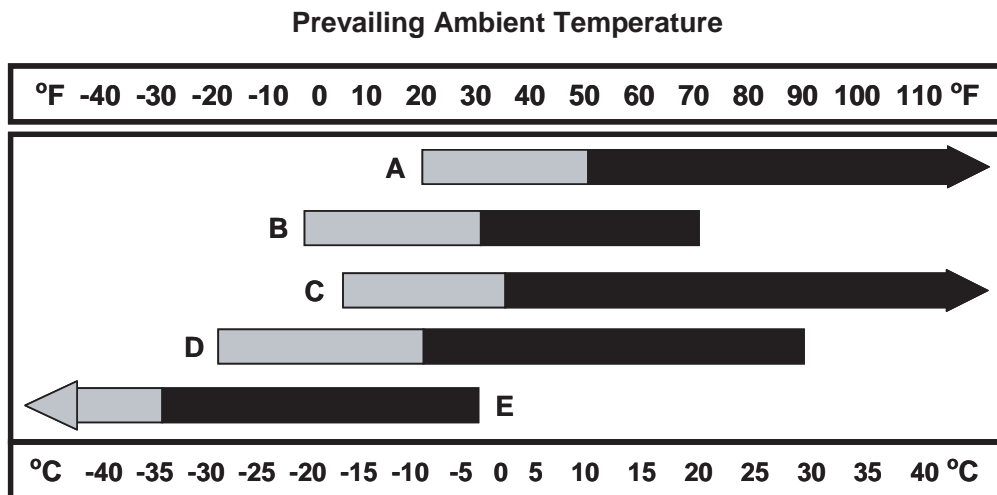
Please note, these maximum cable lengths require perfect cable spooling with tight, even wraps, at all times.

RECOMMENDED OIL

We have published the following specification to help determine which lubricant is best suited to your application.

The oil must possess high temperature oxidation stability, rust and corrosion protection, good dispersant and detergent characteristics, anti-wear additives and remain compatible with nitrile base seals.

Your lubricant supplier should assure you that his product meets this specification. If there is any doubt as to the suitability of a lubricant, contact the Paccar Winch Service Department, providing a copy of the product specifications.



! WARNING !



Cold start-up in this ambient temperature range requires extended equipment warm-up to prevent erratic clutch and brake operation which may result in property damage, injury or death.

Minimum cold startup temp. = Pour Point + 15 to 20 degrees F

- A - SAE 30 – Transmission Drive Train Oil John Deere JD20C, CAT TO4, C4
- B - SAE 10W – Transmission Drive Train Oil John Deere JD20C, CAT TO4, C4
- C - SAE 10W-30 - Transmission Drive Train Oil John Deere JD20C, CAT TO4, C4
- D - SAE 5W-30/5W-20 – Transmission Drive Train Oil John Deere JD20D, CAT TO4, C4
- E - MIL-H-5606A Hydraulic Oil

WINCH REMOVAL AND INSTALLATION

⚠ WARNING ⚠

Before servicing, make sure any trapped oil pressure in the tractor hydraulic system has been relieved. Personal injury can result from a sudden release of oil pressure. Relieve trapped pressure by cycling the blade and winch control levers several times after the tractor engine has been turned off. Relieve any trapped oil pressure in the hydraulic reservoir by opening the cap. Ensure that the tractor's master electrical circuit switch is off.

⚠ WARNING ⚠

Hot oil can cause injury. Make certain the oil has cooled to a safe temperature (less than 110°F or 43°C) before servicing the winch.

Cleanliness around all hydraulic components is of utmost importance. Before starting any repair procedures, be sure to thoroughly clean the parts to be removed, as well as adjacent areas on the tractor, to avoid entry of dirt into the winch and winch control system. Do not leave any ports or access openings exposed to the weather. Seal or cap the openings to prevent entry of dust, moisture, or other foreign material. Cap or plug all exposed hydraulic ports and fittings.

During disassembly, care should be taken not to damage seals and O-rings that are to be reused. Replace any such parts that are damaged or otherwise defective. Certain O-rings and seals specified in the replacement instructions must not be reused. In general, seals and O-rings that work under full operating hydraulic pressures, or that require extensive disassembly to access, should be replaced with new parts at the time of reassembly.

WINCH REMOVAL

⚠ WARNING ⚠

The H90VS winch weighs approximately 3,300 lb (1,500 kg) without oil, cable and tractor mounting brackets. Make certain the lifting equipment has adequate capacity. Attempting to lift the winch with undersized equipment can result in serious injury or damage to the winch or other property.

Place the tractor and winch in a level position and drain the oil from the winch into a suitable container. Install the drain plug securely after the oil has drained completely.

Note: Due to the configuration of the cable drum, a small amount of oil may remain in the drum cavity.

Remove the RH side motor cover. On tractors with the winch control valve mounted on the winch and not in a section of the tractor hydraulic valve stack, remove the hoses from the tractor hydraulics to the valve. Remove the winch motor hoses from the motor and brake valve. Remove the motor shift hose from the motor "X" port. Remove the motor case drain hose from the motor. Remove the drum clutch release hose from the fitting at the drum clutch port, located below the motor.

Support the winch with a suitable hoist or platform, and remove the fasteners securing the winch to the tractor mounting brackets, then carefully move the winch away from the tractor.

WINCH INSTALLATION

Remove dirt, paint and rust from the mounting surfaces of the winch and tractor mounting brackets.

Align the winch mounting holes with the holes in the mounting brackets, and install and tighten all fasteners to the recommended torque. Refer to the winch parts and installation guide.

Attach the winch control hoses to the motor (valve on Deere 850J), as defined in the parts and installation guide.

Fill the winch to the proper level with the recommended oil. Allow 15 minutes for the oil to flow through the gear train and fill the drum cavity before checking the oil level.

Note: It may be necessary to fill the motor case with hydraulic oil before start-up to protect against motor failure due to starting dry.

Start the tractor engine and operate the engine at low RPM. Alternately place the winch control in the REEL-IN and REEL-OUT positions until the winch motor hydraulic circuit is filled with oil and the winch operates smoothly. Check the tractor hydraulic oil reservoir level and fill as required.

WIRE ROPE INSTALLATION

All winches are rated at bare drum line pull. As the cable drum fills, the line pull will decrease (loss of leverage) while the line speed increases (larger circumference). Therefore, it is recommended to install the minimum length of cable possible for use in your application to allow the winch to operate on the lower layers (smaller diameter) and deliver the maximum amount of line pull.

Using larger diameter cable will not always increase strength as the larger cable may be more vulnerable to bending fatigue failure than the smaller rope. Consult your wire rope supplier for their recommendations for the style of wire rope and other rigging best suited to your application.

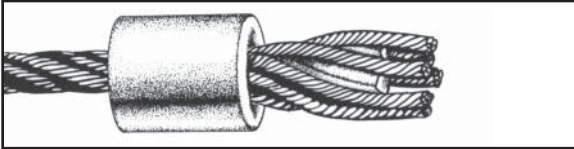
⚠ WARNING ⚠

Winch cable anchors (ferrule and ferrule pocket) are NOT designed to hold full rated load. Winch loads applied directly to the cable anchor may allow the cable to pull free, resulting in the sudden loss of load control and property damage, injury or death. A minimum of five (5) wraps of cable must remain on the drum barrel to achieve full rated load. Do NOT use knots to secure or attach the winch cable. It is suggested that the last five (5) wraps of cable be painted bright red to serve as a visual warning.

INSTALLATION OF SPIRAL FERRULES

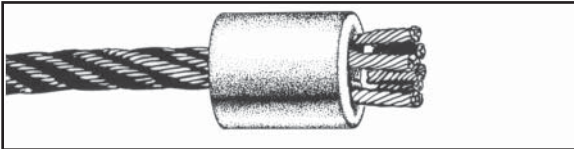
Re-usable, field-installable spiral ferrules are available from the factory or from your wire rope supplier. These ferrules are for use with six (6) strand, IWRC (Independent Wire Rope Core) type wire rope.

Step One



Insert the cable through the small opening and out the large opening of the ferrule. Spread the strands and insert the wedge halves between the strands and over the core. Lay separate strands in the individual grooves in the wedges.

Step Two



Tap the wedges and cable into the ferrule, leaving approximately 3/8 in. (10 mm) extending beyond the ferrule end. The first load applied will seat the cable and wedges securely within the ferrule.

TROUBLESHOOTING

The following troubleshooting section is provided as a general guide. You may also need to contact the Original Equipment Manufacturer (OEM) for additional information.

⚠ WARNING ⚠

If a hoist exhibits any sign of:

- Erratic operation such as poor load control, load creeping down or chattering.
- Unusual noise.
- Gear oil leaks
- A sudden rise in wear particles from oil analysis

The hoist **MUST** be removed from service until the problem has been corrected. If a hoist has been subjected to a sudden heavy load (shock-load) or overload, the hoist must be removed from service, disassembled and all internal components thoroughly inspected for damage. Continued operation with a defect may result in loss of load control, property damage, injury or death.

TROUBLE	PROBABLE CAUSE	REMEDY
<p>A</p> <p>The winch will not smoothly reel-out the load.</p>	<p>1. The problem could be a plugged pilot orifice in the brake valve. A plugged orifice may prevent the spool from moving or prevent the spool from moving smoothly, causing jumping or chattering as the load is released.</p> <p>2. The multi-disc static brake may not be releasing as a result of a defective brake cylinder seal.</p> <p>NOTE: If the brake cylinder seal is defective, you may notice oil leaking from the winch vent plug as hydraulic oil fills the gear cavity.</p> <p>3. The multi-disc static brake will not release as a result of damaged brake discs.</p>	<p>A. Disassemble the brake valve. Clean and inspect all parts. Make certain the .020 in. (0.5 mm) pilot orifice is not obstructed.</p> <p>A. Check the brake cylinder seal as follows:</p> <p>Disconnect the small hose from the brake release port. Connect a hand pump with an accurate gauge and shut-off valve to the -4 fitting in the brake release port.</p> <p>Apply 1000 PSI (70.3 kg/cm²) to the brake. Close the shut-off valve and let stand for five (5) minutes.</p> <p>If there is any loss of pressure during the five (5) minutes, the brake housing assembly should be disassembled for inspection of the brake cylinder and piston sealing surfaces and replacement of the seals. Refer to "Brake Housing Assembly Service" for more information.</p> <p>Disassemble the brake housing assembly to inspect the brake discs. Replace the brake discs as required.</p>

TROUBLE	PROBABLE CAUSE	REMEDY
<p>B</p> <p>Oil leaking from the vent plug.</p>	<p>1. Same as A2.</p> <p>2. Motor seal may be defective as a result of high system back pressure or contaminated oil.</p> <p>3. The drum clutch piston seals may be leaking.</p>	<p>A. Same as A2.</p> <p>A. System back pressure must not exceed 40 PSI (2.8 kg/cm²). Inspect the hydraulic system for a restriction.</p> <p>B. Oil analysis may indicate contamination, which could result in a worn motor shaft seal. Thoroughly flush the entire hydraulic system and install new filters and oil. Install a new motor seal.</p> <p>A. Disconnect the drum clutch release hose from the drum clutch housing. Connect a hand pump with an accurate gauge and shut-off valve to the -6 adapter.</p> <p>B. Apply 500 psi (3.450 kPa) to the drum clutch. Close the shut-off valve and let stand for 5 minutes.</p> <p>C. If there is a loss of pressure during the 5 minutes, the drum clutch housing must be removed and disassembled for inspection of the seals and sealing surfaces. Refer to "Drum Clutch Service" section of this manual for additional information.</p>
<p>C</p> <p>The brake will not hold a load with the control lever in neutral.</p>	<p>1. Excessive system back pressure acting on the brake release port.</p> <p>2. Friction brake will not hold due to worn or damaged brake discs.</p> <p>3. Brake clutch may be slipping.</p> <p>4. If winch was field installed, check to see that the proper stack valve section was used (motor spool required).</p> <p>5. Drum clutch discs may be worn.</p>	<p>A. Same as B2A.</p> <p>A. Same as A3A.</p> <p>A. Improper planetary gear oil may cause the brake clutch to slip. Drain the old gear oil and flush the winch with a mild solvent. Thoroughly drain the cleaning solvent, and refill the winch with the recommended planetary gear oil listed in the "Preventive Maintenance" section of this manual.</p> <p>B. Overrunning brake clutch may be damaged or worn. Disassemble and inspect as described in "Overrunning Brake Clutch Service".</p> <p>A. Disassemble and inspect drum clutch components as described in "Drum Clutch Service" section.</p> <p>A. Same as C4A</p>

TROUBLE	PROBABLE CAUSE	REMEDY
<p>D</p> <p>The winch will not pull the rated load.</p>	<p>1. The hydraulic system relief valve may be set too low. The relief valve may need replacement or repair.</p> <p>2. Be certain the hydraulic system temperature is not more than 200° F (93° C). Excessive hydraulic oil temperatures increase motor and pump internal leakage.</p> <p>3. Winch line pull rating is based on 1st layer of wire rope.</p> <p>4. Same as C5.</p> <p>5. Hydraulic motor locked in high speed, small displacement position.</p>	<p>A. Check system relief pressure as follows:</p> <p>Install an accurate gauge into the tractor pump pressure port per the tractor manual.</p> <p>Apply a stall pull load on the winch while monitoring the pressure.</p> <p>Compare the gauge reading to the winch specifications. Adjust the relief valve as required, if necessary.</p> <p>NOTE: Refer to the tractor service manual for more information regarding the system relief valve.</p> <p>A. Check system relief valve, per D1A.</p> <p>B. Same as E2A.</p> <p>A. Refer to winch performance data for more information.</p> <p>A. Same as C5A.</p> <p>A. Send motor to qualified motor service center.</p>
<p>E</p> <p>The winch runs hot.</p>	<p>1. Be certain the hydraulic system temperature is not more than 200° F (93° C). Excessive hydraulic oil temperatures may be caused by:</p>	<p>A. Same as D2A.</p> <p>B. plugged heat exchanger (where used).</p> <p>Thoroughly clean exterior and flush interior of heat exchanger.</p> <p>C. Too low or too high oil level in hydraulic reservoir.</p> <p>Fill / drain reservoir to proper level.</p> <p>D. Same as D1A.</p> <p>E. Tractor hydraulic pump not operating efficiently.</p> <p>Tractor low on horsepower or RPM. Tune / adjust tractor engine for optimum performance. See tractor service manual for more information.</p>

TROUBLE	PROBABLE CAUSE	REMEDY
<p>TROUBLE “E” CONTINUED FROM PREVIOUS PAGE</p>	<p>2. Excessively worn or damaged internal winch components.</p>	<p>Check suction line for damage.</p> <p>Pump worn or damaged. Inspect / replace pump as needed. See tractor service manual for more information.</p> <p>F. Pressure reducing valve in logic block stuck open.</p> <p>A. Disassemble winch for inspection & replacement of worn or defective components.</p>
<p>F</p> <p>Winch “chatters” while pulling rated load.</p>	<p>1. Same as D1.</p> <p>2. Hydraulic oil flow to motor may be too low.</p> <p>3. Controls being operated too quickly or not smoothly.</p>	<p>A. Same as D1A.</p> <p>A. Same as E1B, C, C and E.</p> <p>A. Conduct operator training as required.</p>
<p>G</p> <p>The wire rope does not spool smoothly on the cable drum.</p>	<p>1. Incorrect wire rope lay being used. There is a distinct advantage in applying wire rope of the proper direction of lay. When the load is slacked off, the remaining coils on the drum will stay closer together and maintain an even layer. If rope of incorrect lay is used, the coils will spread apart each time the load is removed. Then, when reeling in is resumed, the wire rope has a tendency to criss-cross and overlap on the drum. The possible result is flattened and crushed wire rope, ultimately resulting in diminished rope life.</p> <p>2. The winch may have been overloaded, causing permanent set in the wire rope.</p>	<p>A. Consult your wire rope distributor for recommendation of the wire rope best suited for your specific application.</p> <p>A. Replace the wire rope and conduct operator training as required.</p>

SERVICE PRECAUTIONS

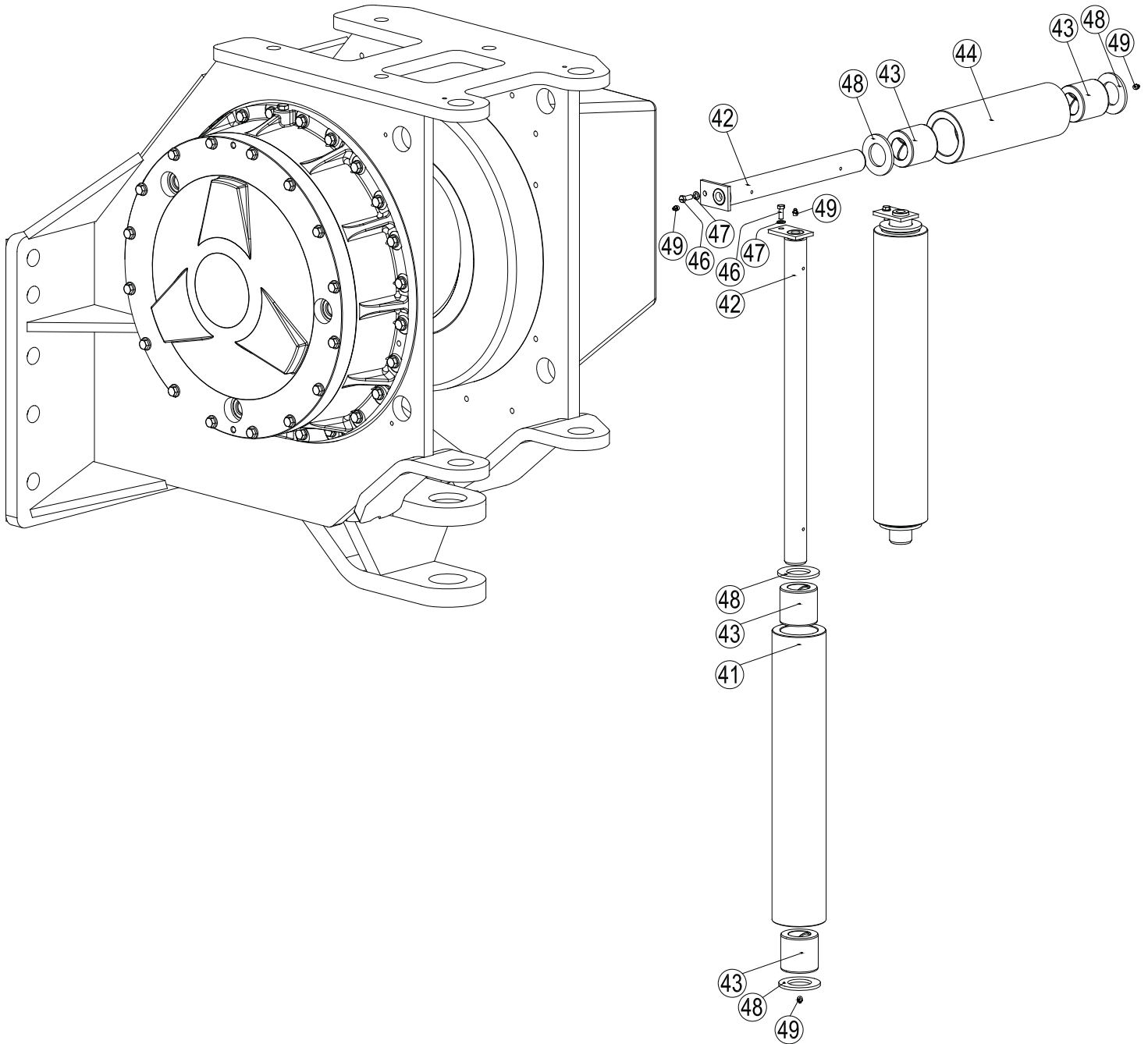
- Before any part is removed from the winch, all service instructions should be read and understood.
- Work in a clean, dust-free area, as cleanliness is of utmost importance when servicing hydraulic equipment.
- Use only genuine factory replacement parts, which may be obtained through your heavy equipment dealer. Never re-use expendable items, such as O-rings.
- Inspect all machined surfaces for excessive wear or damage before reassembly operations start.
- Lubricate all O-rings and oil seals with clean gear oil prior to installation.
- Use a sealing compound on the outside surfaces of oil seals. If using a thread sealant on fasteners or fittings, avoid getting excess sealant inside parts or passages that conduct oil.
- Thoroughly clean all parts in a good grade of safety solvent. Wear protective clothing as required.

After trouble-shooting the winch and its hydraulic system as covered in the “Trouble Shooting” section of this manual, and the problem is determined to be in the winch, use the following procedure to disassemble the winch as needed.

An overall cross-section and explosion of the winch and a parts key is provided for reference on the following pages. Disassembly instructions immediately follow.

H90VS ASSEMBLY EXPLOSION

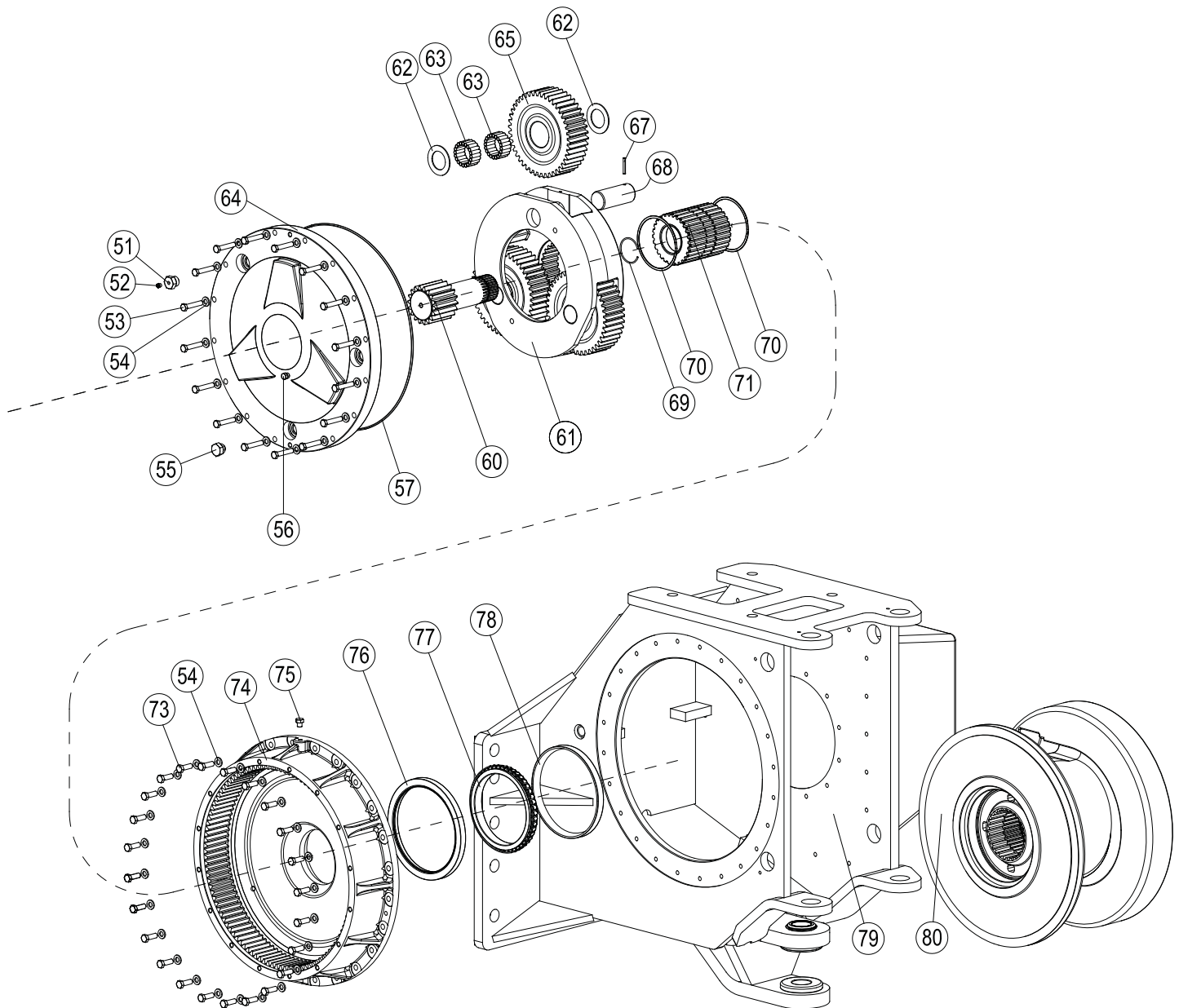
Fairlead Roller Assembly



ITEM #	DESCRIPTION	QTY.	
		3-ROLLER	4-ROLLER
41	VERTICAL ROLLER	2	2
42	VERTICAL SHAFT ASSEMBLY	2	2
43	BUSHING	6	8
44	HORIZONTAL ROLLER	1	2
45	HORIZONTAL SHAFT ASSEMBLY	1	2
46	CAPSCREW (3/8 - 16 X 1 in., GD8, HEX HD)	3	4
47	WASHER, HARD (3/8 in.)	3	4
48	WASHER, HARD (2 in.)	6	8
49	GREASE FITTING	6	8
--	4th ROLLER GROUP (INCLUDES ITEMS 603 - 609 NEEDED FOR ONE COMPLETE ROLLER INSTALLATION)	OPT.	OPT.

H90VS ASSEMBLY EXPLOSION

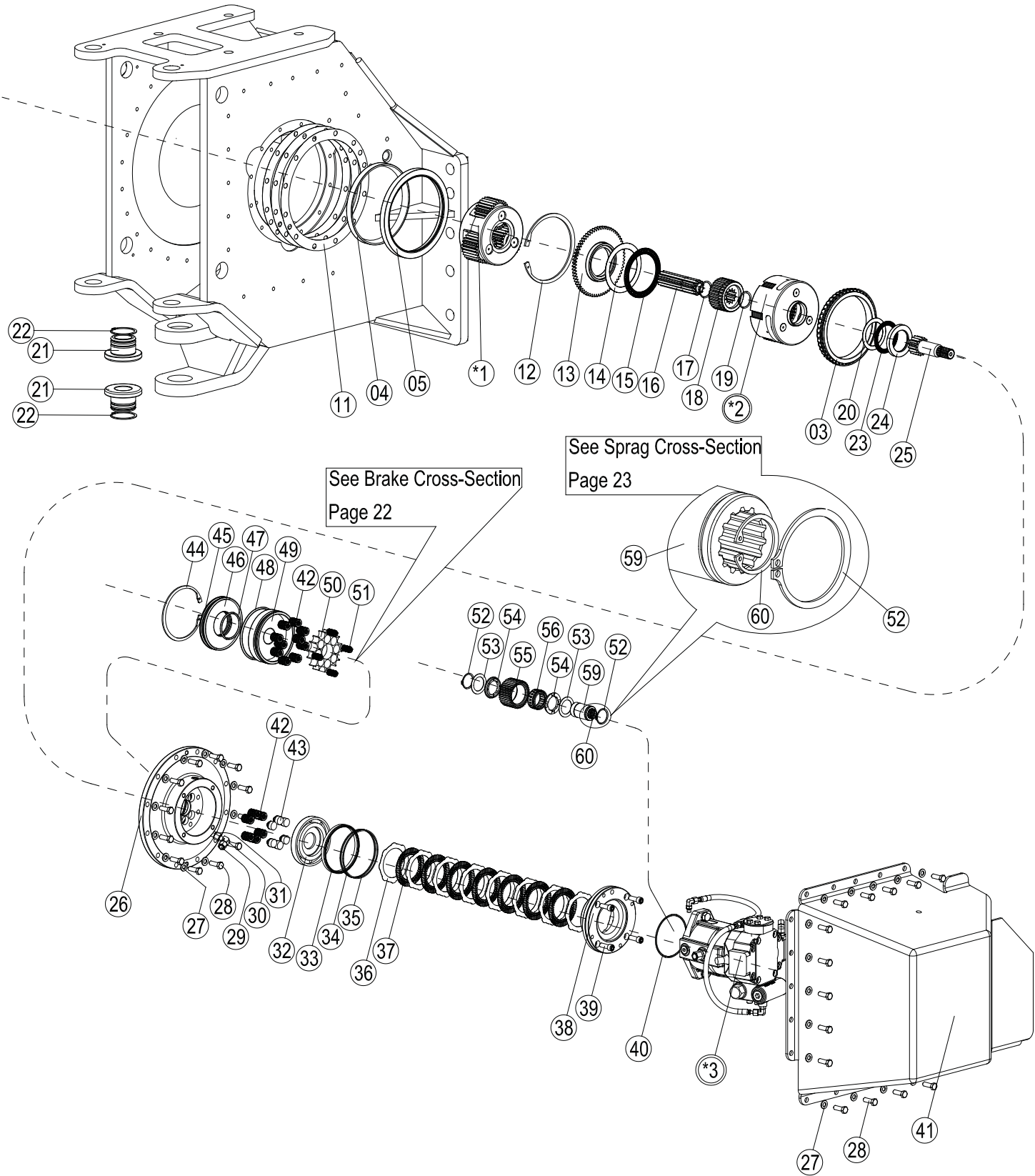
Winch Assembly



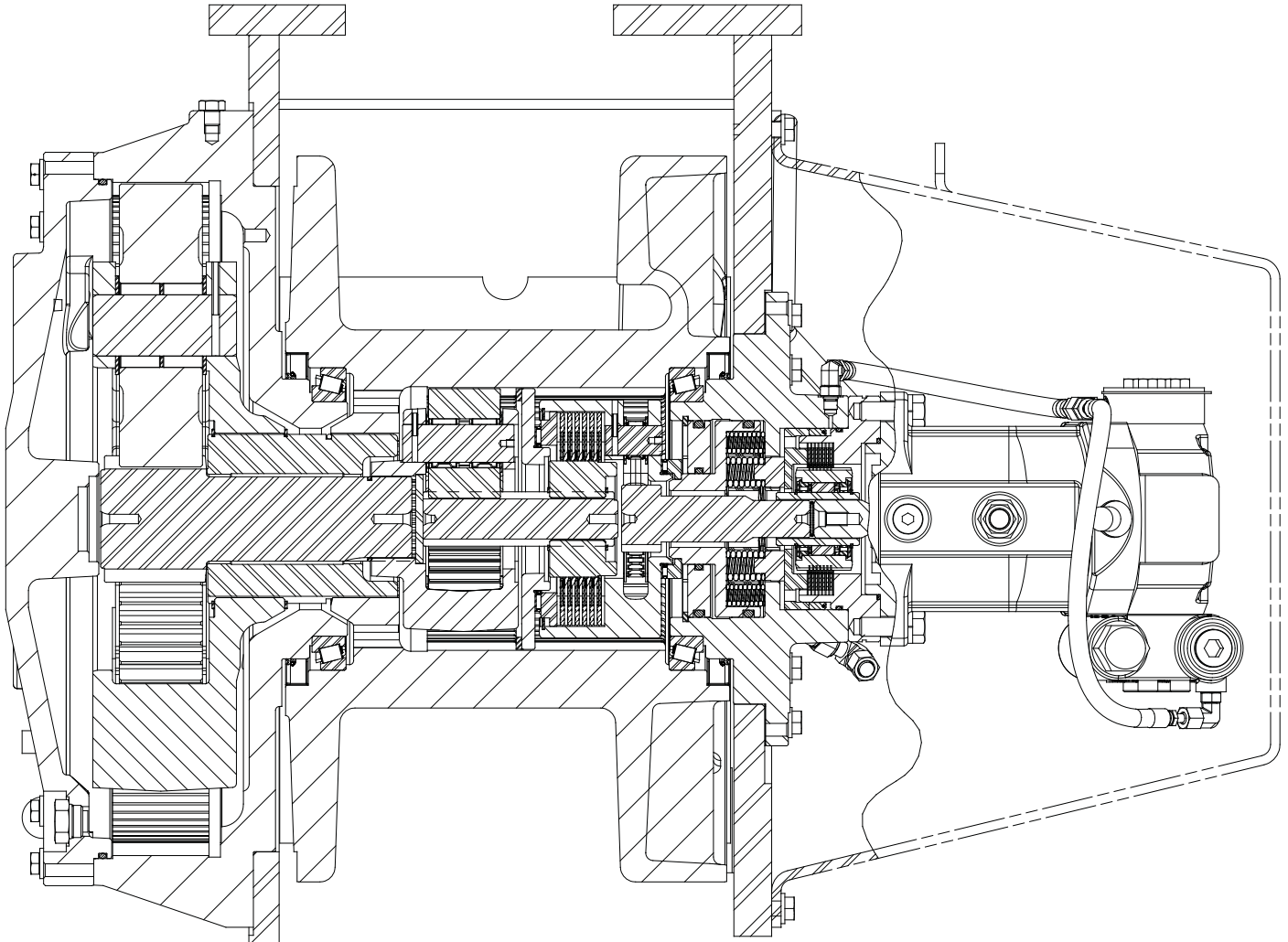
ITEM	DESCRIPTION	QTY	ITEM	DESCRIPTION	QTY
51	FILL- VENT PLUG	1	67	ROLLPIN	3
52	RELIEF VALVE 1-5 PSI	1	69	RETAINING RING	1
53	CAPSCREW (1/2 - 13 X 2 1/2, GD8, HEX HD)	16	70	RETAINING RING	2
54	WASHER, HARD (1/2)	40	71	DRUM SHAFT	1
55	PLUG WITH O-RING, MAGNETIC	1	73	CAPSCREW (1/2 - 13 X 1 1/2, GD8, HEX HD)	24
56	LEVEL PLUG WITH O-RING	1	74	RING GEAR	1
57	O-RING	1	75	PLUG WITH O-RING, MAGNETIC	1
60	OUTPUT SUN GEAR	1	76	OIL SEAL	2
61	OUTPUT PLANET CARRIER ASSEMBLY	1	78	BEARING CUP	2
62	THRUST WASHER	6	79	WINCH HOUSING	1
63	ROLLER	120	79	BEARING CONE	2
64	END COVER	1	80	CABLE DRUM	1
65	PLANET GEAR	3			

H90VS ASSEMBLY EXPLOSION

Winch Assembly

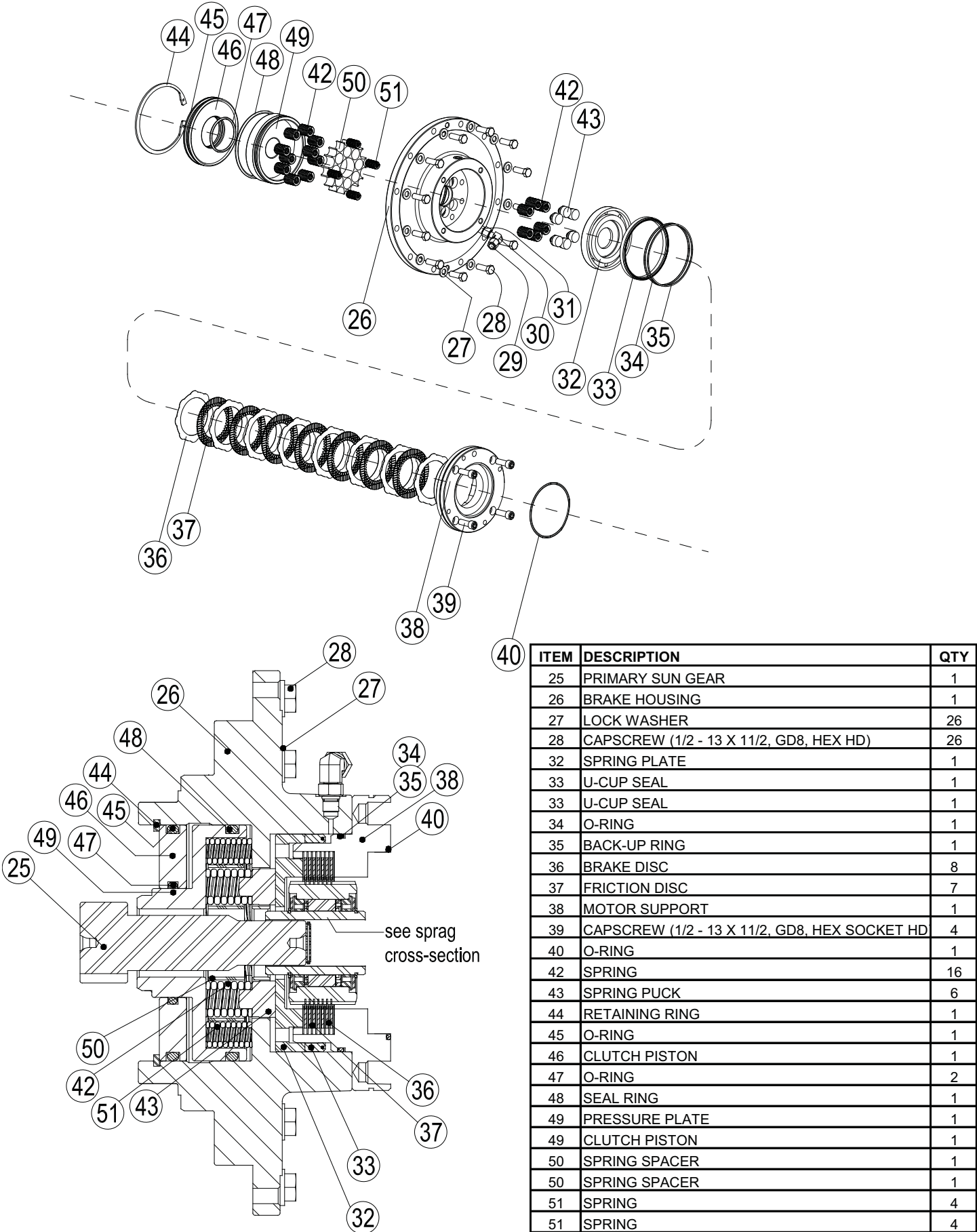


ITEM	DESCRIPTION	QTY	ITEM	DESCRIPTION	QTY
*1	INTERMEDIATE PLANET CARRIER ASSEMBLY	1	33	U-CUP SEAL	1
*2	CARRIER CLUTCH ASSEMBLY	1	34	O-RING	1
*3	HYDRAULIC MOTOR GROUP	1	35	BACK-UP RING	1
3	BEARING CONE	2	49	PRESSURE PLATE	1
4	BEARING CUP	2	36	BRAKE DISC	8
5	OIL SEAL	2	37	FRICTION DISC	7
11	SHIM GASKETS	*	38	MOTOR SUPPORT	1
12	RETAINING RING	1	39	CAPSCREW (1/2 - 13 X 11/2, GD8, HEX SOCKET HD)	4
13	THRUST RING	1	40	O-RING	1
14	THRUST WASHER	1	41	MOTOR COVER	1
15	NEEDLE ROLLER BEARING	1	42	SPRING	16
16	INTERMEDIATE SUN GEAR	1	43	SPRING PUCK	6
17	RETAINING RING	2	44	RETAINING RING	1
18	GEAR ADAPTER	1	45	O-RING	1
19	SNAP RING	1	46	PISTON	1
20	THRUST WASHER	1	47	O-RING	2
21	BUSHING	2	48	SEAL RING	1
22	SNAP RING	2	49	CLUTCH PISTON	1
23	NEEDLE ROLLER BEARING	1	50	SPRING SPACER	1
24	THRUST RACE	1	51	SPRING	4
25	PRIMARY SUN GEAR	1	52	SNAP RING	2
26	BRAKE HOUSING	1	53	THRUST BEARING	2
27	LOCK WASHER	26	54	SPRAG BEARING	1
28	CAPSCREW (1/2 - 13 X 11/2, GD8, HEX HD)	26	55	OUTER BRAKE RACE	1
29	CAP	1	56	SPRAG CLUTCH	1
30	90° ELBOW	1	59	INNER BRAKE RACE	1
31	EXTENSION PIPE	1	60	INTERNAL SNAP RING	1
32	SPRING PLATE	1			



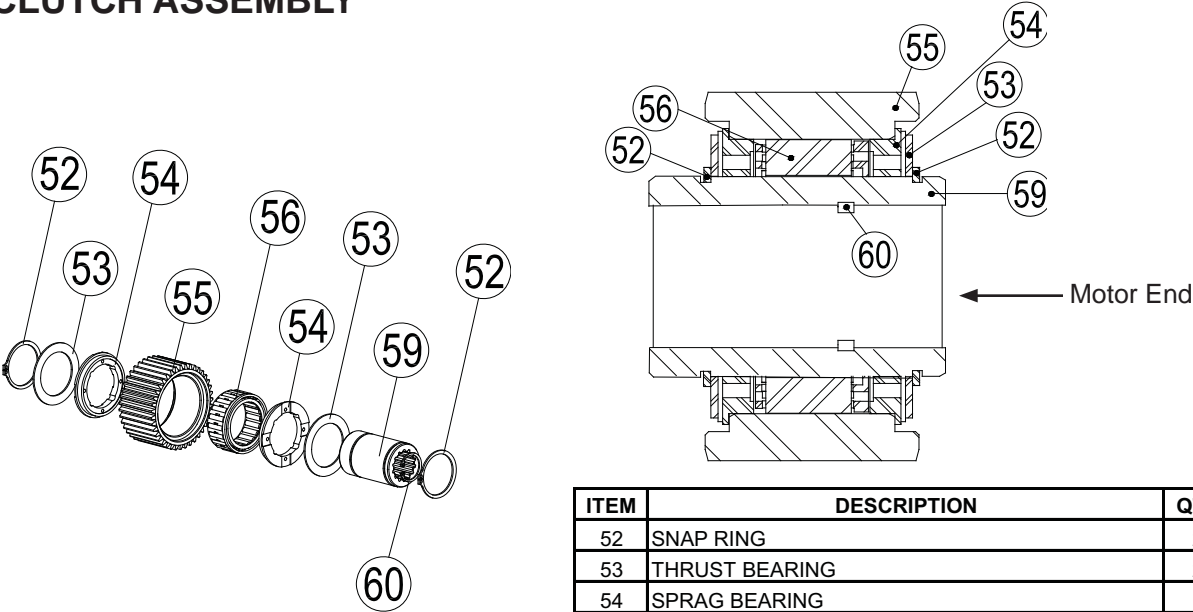
H90VS ASSEMBLY EXPLOSION

BRAKE SUB-ASSEMBLY



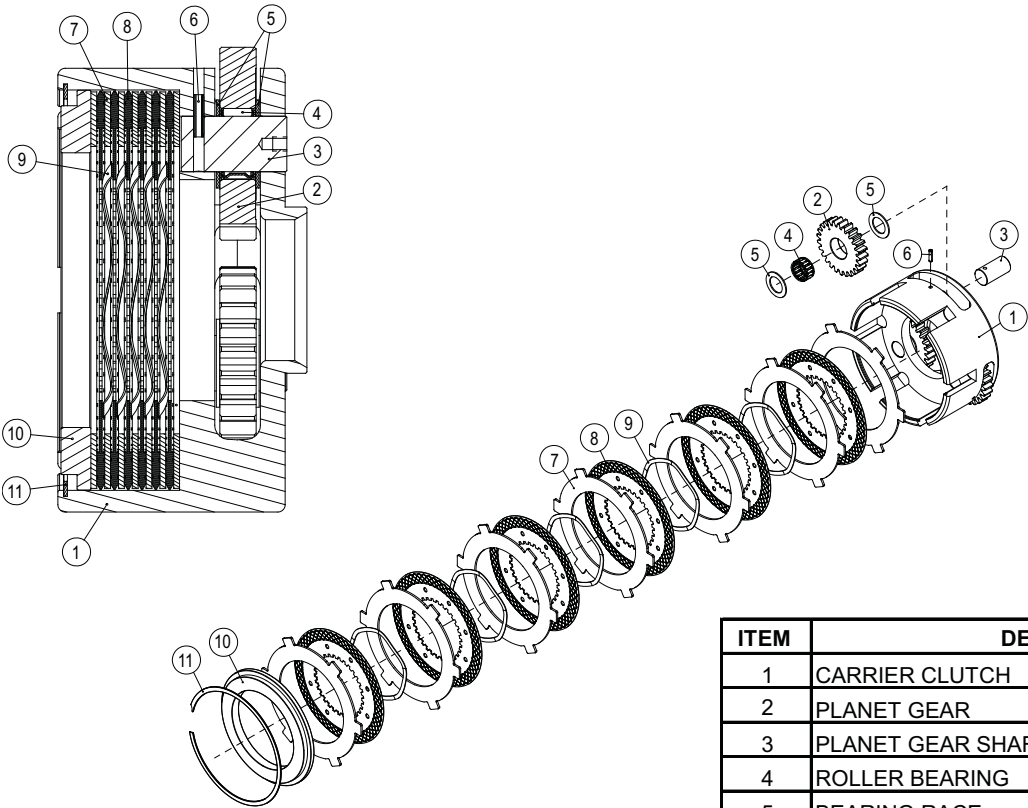
H90VS ASSEMBLY EXPLOSION

SPRAG CLUTCH ASSEMBLY



ITEM	DESCRIPTION	QTY
52	SNAP RING	2
53	THRUST BEARING	2
54	SPRAG BEARING	1
55	OUTER BRAKE RACE	1
56	SPRAG CLUTCH	1
59	INNER BRAKE RACE	1
60	INTERNAL SNAP RING	1

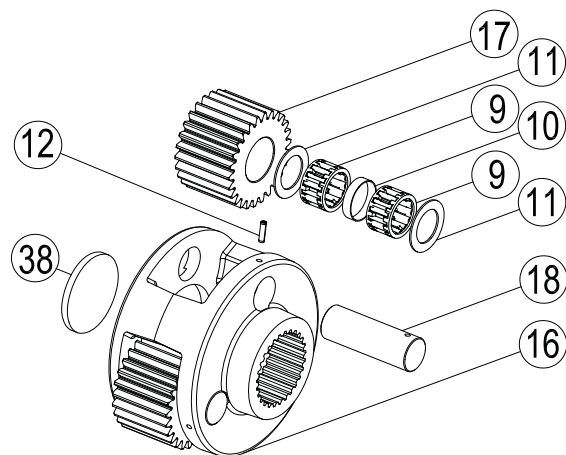
CARRIER CLUTCH ASSEMBLY



ITEM	DESCRIPTION	ITEM
1	CARRIER CLUTCH	1
2	PLANET GEAR	3
3	PLANET GEAR SHAFT	3
4	ROLLER BEARING	3
5	BEARING RACE	6
6	ROLL PIN	3
7	BRAKE PLATE	7
8	FRICTION DISC	6
9	WAVE SPRING	5
10	THRUST RING	1
11	RETAINING RING	1

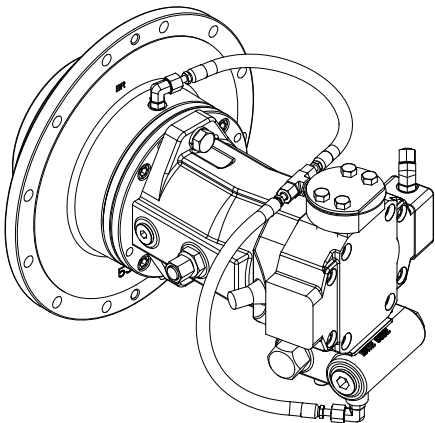
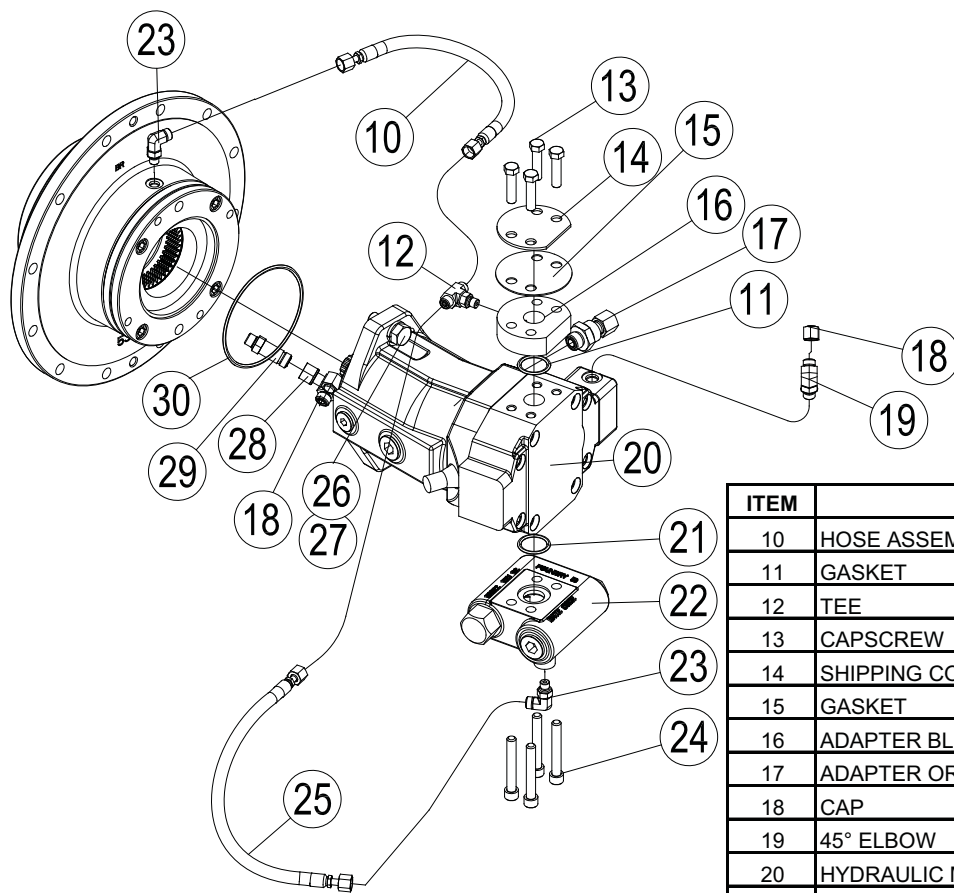
H90VS ASSEMBLY EXPLOSION

PLANETARY ASSEMBLY



ITEM	DESCRIPTION	QTY.
--	INTERMEDIATE PLANET CARRIER ASSEMBLY	1
12	ROLLPIN	3
16	PLANET CARRIER	1
17	PLANET GEAR	3
18	PLANET GEAR SHAFT	3
19	ROLLER BEARING	6
10	BEARING SPACER	3
11	THRUST WASHER	6
38	OUTPUT SPACER	1

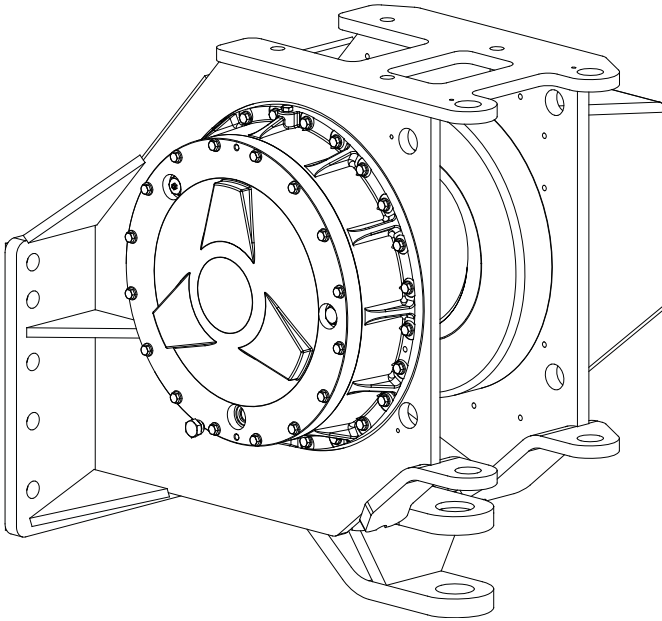
MOTOR ASSEMBLY



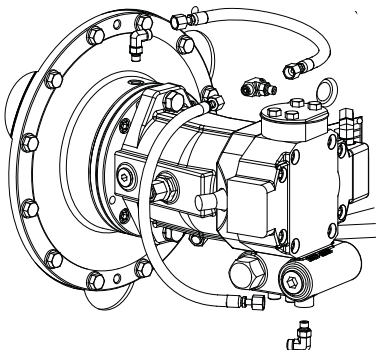
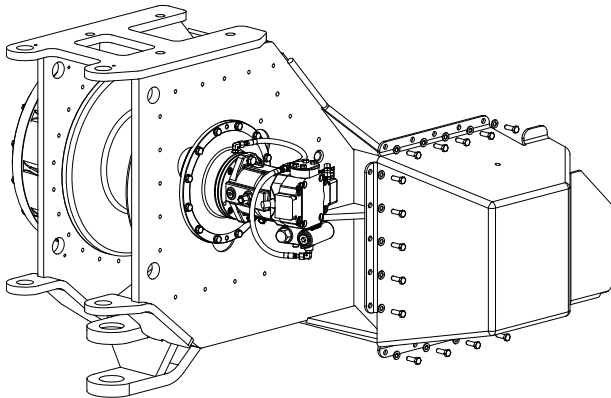
ITEM	DESCRIPTION	QTY
10	HOSE ASSEMBLY, 14-INCH -4 ORFS	1
11	GASKET	1
12	TEE	1
13	CAPSCREW	4
14	SHIPPING COVER	1
15	GASKET	1
16	ADAPTER BLOCK	1
17	ADAPTER ORB/ORFS	1
18	CAP	2
19	45° ELBOW	1
20	HYDRAULIC MOTOR	1
21	O-RING	1
22	BRAKE VALVE ASSEMBLY (PART #82133)	1
23	90° ELBOW	2
24	CAPSCREW	4
25	HOSE ASSEMBLY, 16-INCH -4 ORFS	1
26	CAPSCREW	2
27	LOCKWASHER	2
28	ADAPTER	1
29	EXTENSION PIPE	1
30	O-RING	

WINCH DISASSEMBLY

1. Remove the wire rope from the cable drum BEFORE disconnecting the hydraulic lines from the motor.

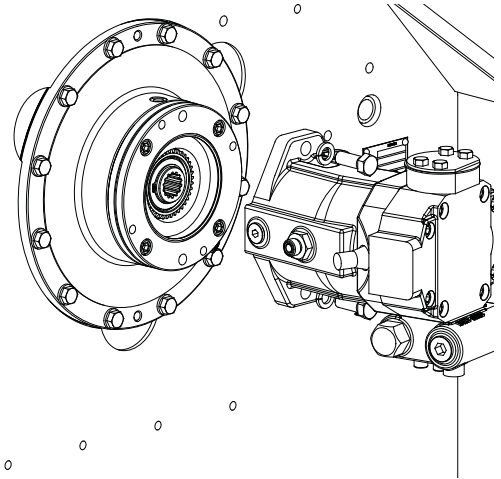


2. Drain the winch gear case oil as described in the "Preventive Maintenance" section of this manual.
3. Remove the motor cover from the RH side of the winch. Remove the two main hoses and the case drain hose from the motor, and disconnect the drum clutch hose from the fitting below the motor. Disconnect the brake release hose from the elbow on the brake housing. *J. Deere tractors has valve mounted on winch; remove hoses from valve body on these units prior to step 4.



CAUTION

The motor cover weighs approx. 150 lb (68 kg). A threaded hole is provided for installing a lifting eye. Use of a hoist or other lifting equipment is recommended to eliminate the possibility of injury. Make certain lifting equipment has adequate capacity.

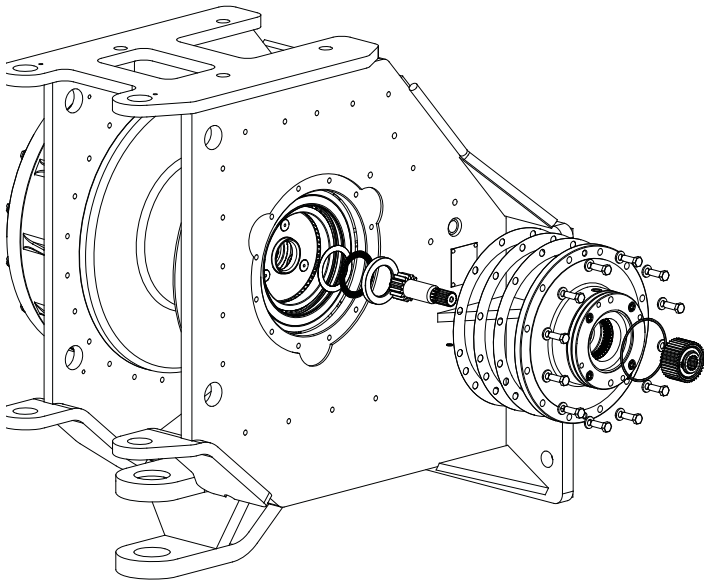


4. Remove the capscrews securing the motor to the brake housing, and carefully remove the motor.

CAUTION

The hydraulic motor assembly weighs approx. 95 lb (43 kg). Use of a hoist or other lifting equipment is recommended to eliminate the possibility of injury. Make certain lifting equipment has adequate capacity.

5. Support the cable drum to the winch case with a suitable hoist and chain. Alternately, use a $\frac{3}{4}$ " diameter or larger woven rope to tie the drum off to the winch case. In either method, it is recommended to support the drum with wooden blocks located under the drum flanges.

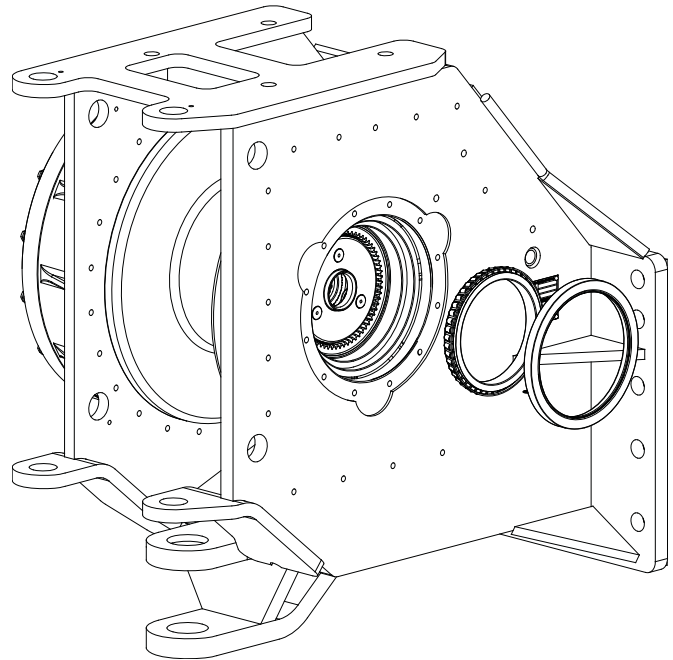


6. Remove the capscrews securing the brake housing to the LH side of the winch case.

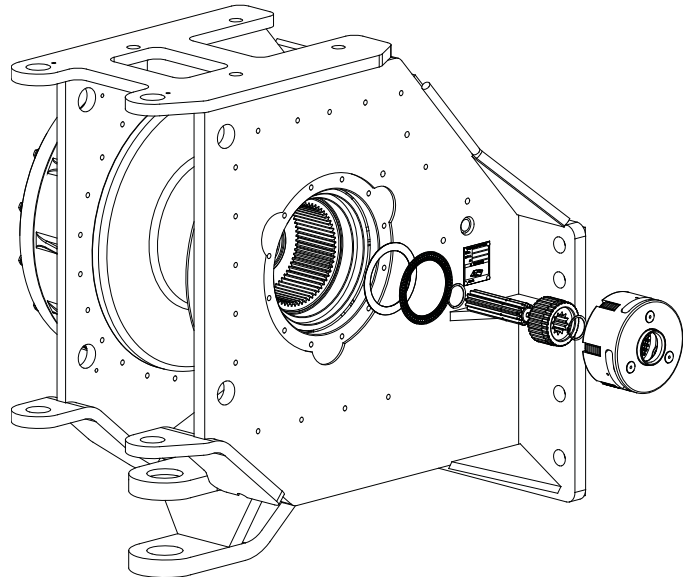
NOTE: To aid removal and handling, it is recommended that brake cylinder lifting fixture be fabricated and used. This fixture would attach to the motor mounting holes on the motor adapter. Alternatively, you can install a ½-13 UNC eyebolt into one of the motor mounting holes and use a guide bar inserted through the center of the brake housing. Two (2) jackscrew holes are provided to aid removal from the bearing. During removal, the shims between the winch case and brake housing may be damaged. These shims will need to be replaced if damaged, or reused if in acceptable condition.

⚠ CAUTION ⚠

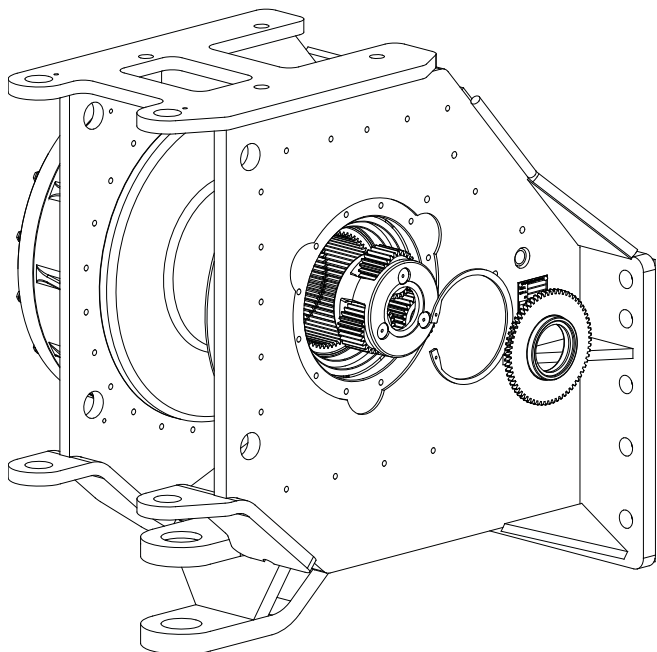
The brake housing assembly weighs approx. 115 lb (52 kg). Use of a hoist or other lifting equipment is recommended to eliminate the possibility of injury. Make certain lifting equipment has adequate capacity.



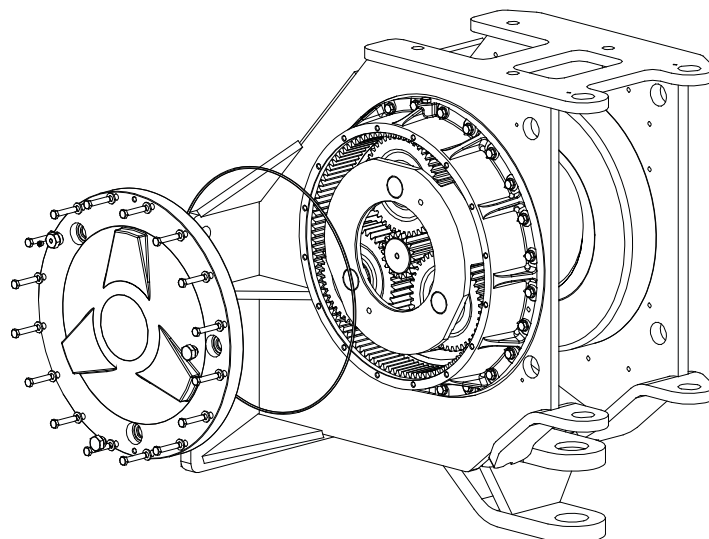
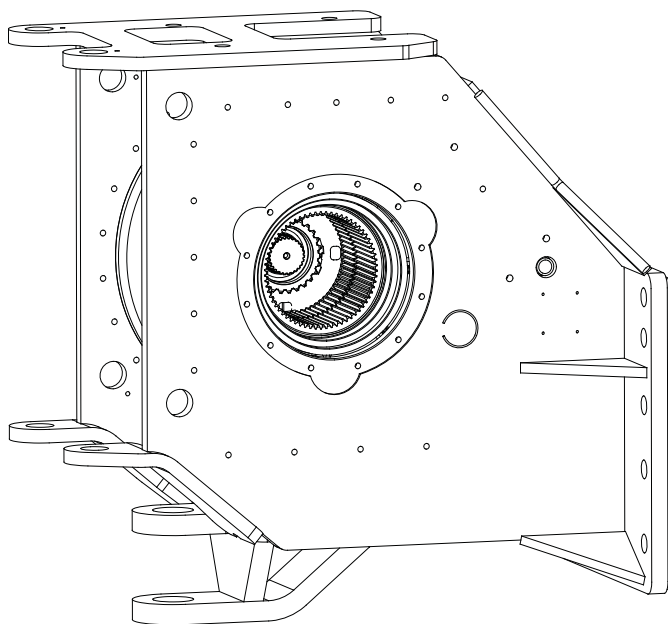
7. Remove drum seal. Remove the LH side drum bearing cone. A new drum seal will be needed for reassembly.



8. Remove the carrier clutch assembly and thrust ring from the drum.



9. Remove the retaining ring from the groove inside the cable drum, then remove the intermediate planetary carrier assembly. Remove retaining ring from intermediate sun gear.

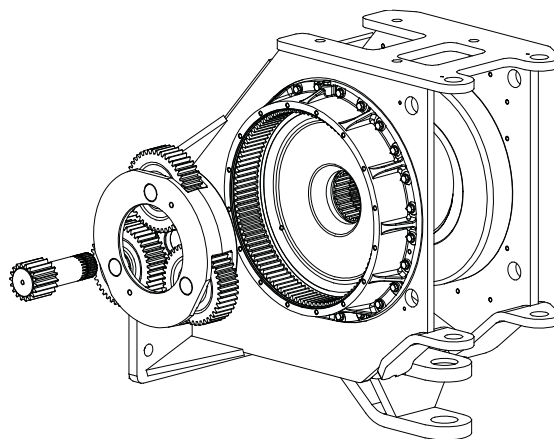


10. Remove the fasteners securing the end cover to the output ring gear on the RH side of the winch and remove the end cover.

⚠ CAUTION ⚠

The end cover weighs approx. 140 lb (63 kg). Use of a hoist or other lifting equipment is recommended to eliminate the possibility of injury. Make certain lifting equipment has adequate capacity.

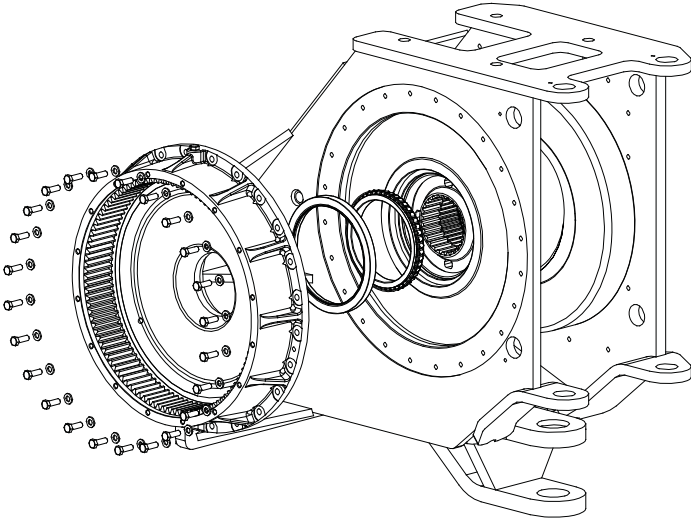
NOTE: To aid handling of the end cover, install a ½ - 13 UNC eyebolt into the upper tapped hole in the face of the cover. Use a long bolt and tube, or a long punch in the lower tapped hole to help guide the part once removed from the winch.



11. Remove the output sun gear.
12. Install a 5/8 – 11 UNC eyebolt into the upper tapped hole of the planet carrier. Remove the planet carrier assembly.

NOTE: To aid handling the planet carrier assembly, insert a sturdy guide rod through the center of the drum shaft. If drum bearing or seal service is required, complete the following steps. Otherwise, stop here and proceed to the pertinent service section of this manual as needed.

13. Support the cable drum with a hoist and lifting strap, remove any supporting rope, and carefully remove the cable drum through the rear of the case.

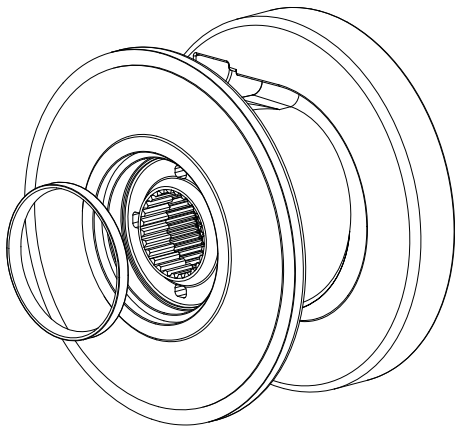


14. Remove the capscrew from top dead center of the output ring gear and install a $\frac{1}{2}$ - 13 UNC eyebolt. Remove the capscrews securing the ring gear to the winch case and remove the ring gear. Use the two (2) jackscrew holes provided to aid removal from the bearing.

⚠ CAUTION ⚠

The output ring gear weighs approx. 265 lb (120 kg). Use of a hoist or other lifting equipment is recommended to eliminate the possibility of injury. Make certain lifting equipment has adequate capacity.

15. Remove the LH side drum bearing cone.



⚠ CAUTION ⚠

The cable drum weighs approx. 490 lb (222 kg). Use of a hoist or other lifting equipment is recommended to eliminate the possibility of injury. Make certain lifting equipment has adequate capacity.

16. Remove the capscrews securing the vertical fairlead roller shafts to the top of the winch case.

17. Carefully raise one vertical fairlead roller shaft through the roller and out the top of the winch case. Remove the roller assembly and spacers at each end. Repeat for the other vertical roller.

NOTE: Each roller must be supported to prevent it from falling out of position once the shaft is removed.

⚠ CAUTION ⚠

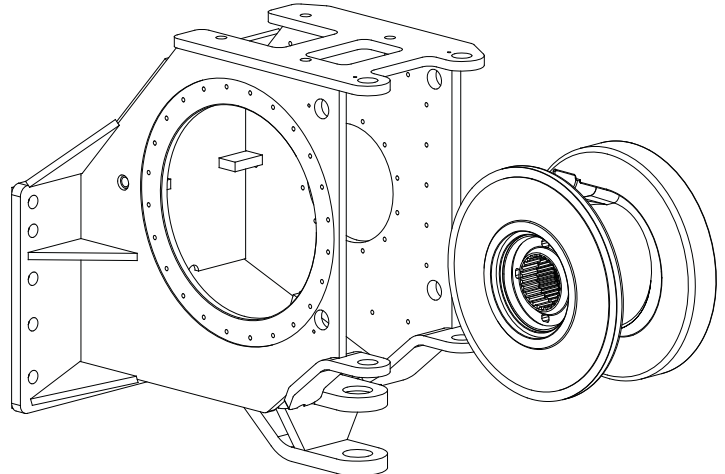
Each vertical roller weighs approx. 85 lb (39 kg). Use of a hoist or other lifting equipment is recommended to eliminate the possibility of injury. Make certain lifting equipment has adequate capacity.

18. Remove the capscrews securing the horizontal fairlead roller shaft(s) to the LH side of the winch case.

19. Support the horizontal roller using a heavy rope, or some other positive retention method. Carefully remove the roller shaft and spacer washers from the winch. Remove the horizontal roller from the winch. Repeat, if required, for the 4th fairlead roller.

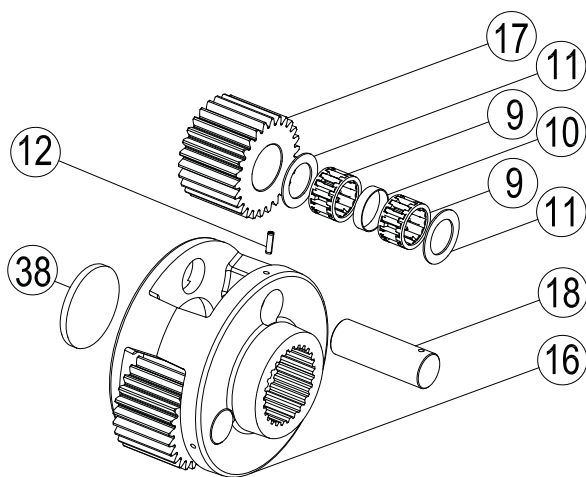
⚠ CAUTION ⚠

Each horizontal roller weighs approx. 41 lb (19 kg). Exercise proper care during handling to prevent injury due to mishandled or dropped parts.



20. Clean and inspect all components and subassemblies at this time. Refer to the appropriate subassembly service section of this manual for specific repair instructions.

INTERMEDIATE PLANET CARRIER SERVICE



ITEM	DESCRIPTION	QTY.
--	INTERMEDIATE PLANET CARRIER ASSEMBLY	1
12	ROLLPIN	3
16	PLANET CARRIER	1
17	PLANET GEAR	3
18	PLANET GEAR SHAFT	3
19	ROLLER BEARING	6
10	BEARING SPACER	3
11	THRUST WASHER	6
38	OUTPUT SPACER	1

DISASSEMBLY

Remove the planet pins by driving the roll pins into the center of the planet shafts.

Slide the planet shaft clear of the carrier wall. Use a punch to drive the pins from the planet shafts. Do NOT reuse the roll pins.

Remove the planet shafts, bearings, spacers, thrust washers and gears. Thoroughly clean all parts and inspect for damage and wear. The bearing rollers should not exhibit any irregularities. If the rollers show any sign of spalling, corrosion, discoloration, material displacement or abnormal wear, the bearing should be replaced. Likewise, the bearing cage should be inspected for unusual wear or deformation, particularly the cage separator bars. If there is any damage that will impair the ability of the cage to separate, retain and guide the rollers properly, the bearing must be replaced. The thrust washer contact areas must be free of any surface irregularities that may cause abrasion or friction. The gears and planet shafts should be inspected for abnormal wear or pitting. Replace as needed.

ASSEMBLY

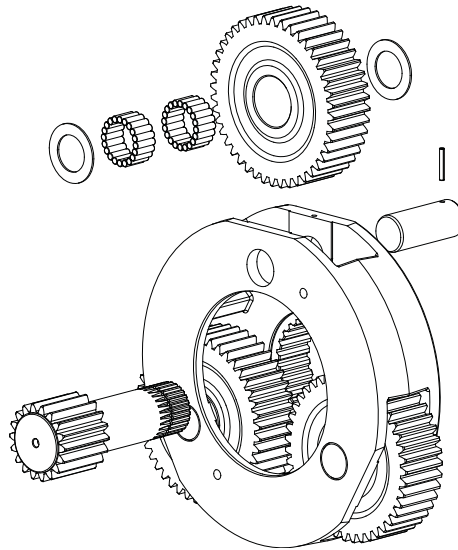
Insert two (2) bearings and a bearing spacer into a gear, locating the spacer between the bearings. Place a thrust washer on each side of the gear, and position the assembly into an opening in the carrier. Slide the planet shaft through the carrier, and into and through the gear and thrust washers.

Carefully align the pin hole in the carrier with the hole in the planet shaft, and drive a new roll pin in place. Always use new roll pins. Approximately $\frac{1}{2}$ of the roll pin should engage the shaft and $\frac{1}{2}$ should engage the carrier.

Note: When properly installed, the roll pin will be slightly recessed in the carrier. Using a center-punch, stake the carrier next to the pin hole. This will distort the material around the hole slightly so the roll pin will not back out.

Repeat these steps for each of the planet gears.

OUTPUT PLANET CARRIER SERVICE



DISASSEMBLY

Remove the planet gear shafts by driving the roll pins into the center of the shafts, then push the shafts out of the planet carrier while supporting the planet gear.

Each gear contains two (2) sets of twenty (20) loose bearing rollers, separated by a bearing spacer. Carefully remove the rollers and spacers for inspection. Thoroughly clean all parts and inspect for damage or abnormal wear, as defined in the "Intermediate Planet Carrier Service" section of this manual.

ASSEMBLY

Support the planet gear on one of the thrust washers and install twenty (20) rollers at the lower end of the bore. A light coating of grease in the bore and on the rollers will aid retention of the bearing rollers in the bore during assembly. Install the bearing spacer, then install the remaining twenty (20) rollers in the upper end of the bore. Repeat this procedure for the remaining planet gears.

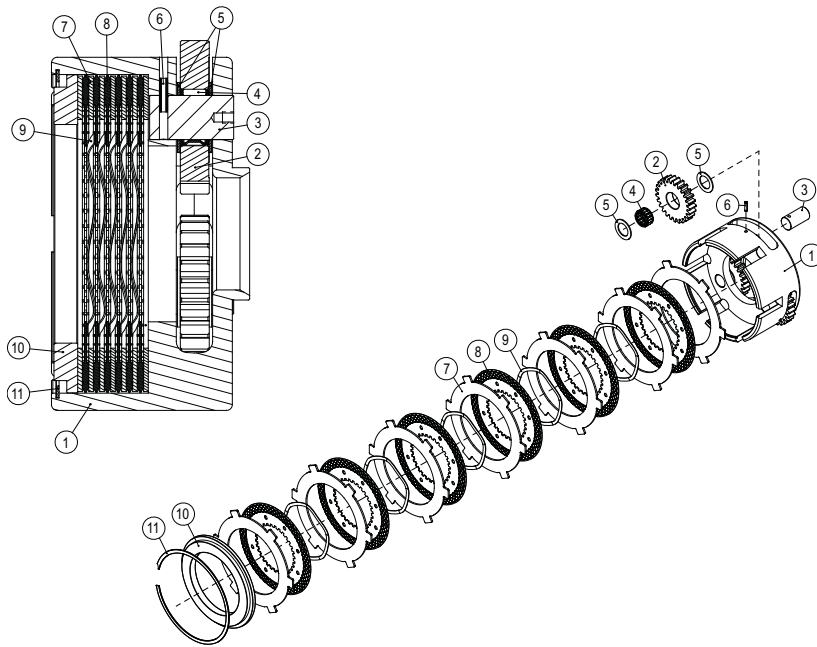
Move the gear assembly and the supporting thrust washer into place in one of the planet gear openings in the carrier. Carefully slide the gear and washer into alignment with the planet shaft bore. Install the second thrust washer on the upper side of the gear.

Slide the planet shaft through the carrier assembly, into and through the gear assembly and thrust washers.

Carefully align the roll pin hole in the carrier with the hole in the planet shaft and drive a new roll pin into place. Always use new roll pins. Approximately $\frac{1}{2}$ of the roll pin should engage the shaft and $\frac{1}{2}$ should engage the carrier.

Make certain the roll pin is slightly recessed in the carrier and stake into place as described in the "Intermediate Planet Carrier Service" section of this manual.

CARRIER CLUTCH SERVICE



ITEM	DESCRIPTION	ITEM
1	CARRIER CLUTCH	1
2	PLANET GEAR	3
3	PLANET GEAR SHAFT	3
4	ROLLER BEARING	3
5	BEARING RACE	6
6	ROLL PIN	3
7	BRAKE PLATE	7
8	FRICTION DISC	6
9	WAVE SPRING	5
10	THRUST RING	1
11	RETAINING RING	1

DISASSEMBLY

Apply light pressure to the thrust ring and remove the retaining ring. Then remove the thrust ring, brake plates, friction discs and wave springs from the carrier.

Remove the planet gear shafts in the same fashion as described in the "Intermediate Planet Carrier Assembly Service" section of this manual.

Remove the planet gears, bearings and thrust washers from the carrier.

Thoroughly clean and inspect all planetary components for damage or abnormal wear, as described in the "Intermediate Planet Carrier Assembly Service" section of this manual.

NOTE: Use care in handling the carrier to prevent damaging the hub on the gear side of the carrier, as this is a bearing surface.

Place each friction disc on a clean, flat surface, and check for distortion using a straightedge. The friction material should appear evenly across the entire surface, with visible grooves. Replace the friction discs if the splines are worn to a point, if the disc is distorted, or if the friction material is worn unevenly.

Place each steel brake plate on a clean, flat surface and check for distortion using a straightedge. Check both surfaces for signs of material transfer or heat. Replace the brake discs if distortion or heat discoloration is present.

Place each wave spring on a clean, flat surface. Check for distortion or damage and replace as required. Check the free height of each spring and replace if the measurement is .19 in. (4.8 mm) or less.

ASSEMBLY

Install the bearing into a planet gear. Place a thrust washer on each side of the gear and insert the gear assembly into an opening in the carrier. Slide the planet shaft through the carrier, and into and through the gear and thrust washers.

Carefully align the pin hole in the carrier with the hole in the planet shaft, and drive a new roll pin into place. The roll pin should be recessed into the carrier to a depth of .53 in. (13.5 mm). Using a center-punch, stake the carrier next to the pin hole as previously described.

Repeat for each of the planet gears.

Position the carrier with the clutch end up. Lubricate the friction discs with new winch oil prior to assembly. Install a steel brake plate in the bottom of the carrier, aligning the tangs on the plate with the slots in the carrier. Next, install a friction disc. After the first friction disc, install parts in the following sequence: steel brake plate, wave disc, friction disc. Install the last steel disc.

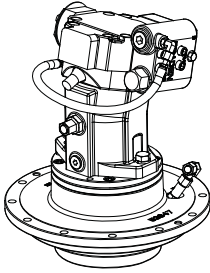
NOTE: In the bottom of the clutch housing, there is no wave spring installed between the first brake plate and friction disc.

Install the thrust ring into the carrier on top of the clutch pack.

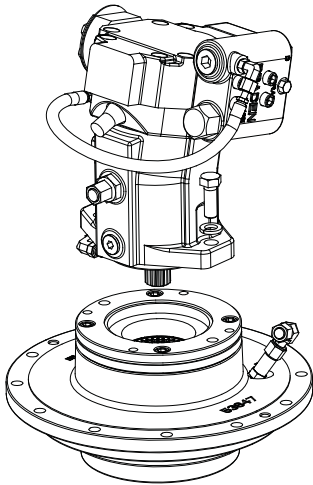
Apply light pressure to the thrust ring and install the retaining ring. Make sure the retaining ring is seated fully in the housing groove.

BRAKE HOUSING ASSEMBLY SERVICE

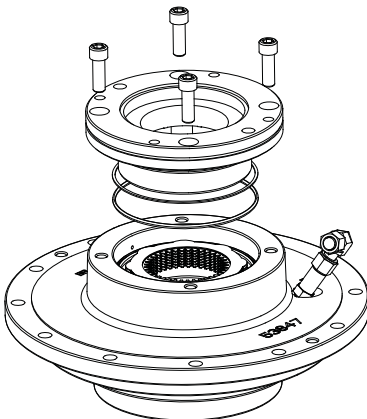
DISASSEMBLY



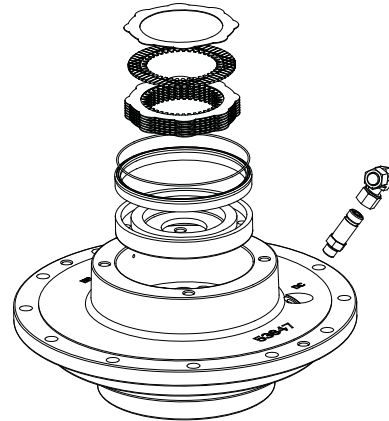
Place the brake housing assembly on a clean work surface with the motor end facing up.



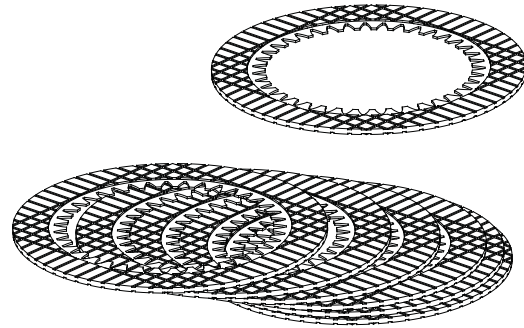
Remove the motor and brake assembly from the motor adapter.



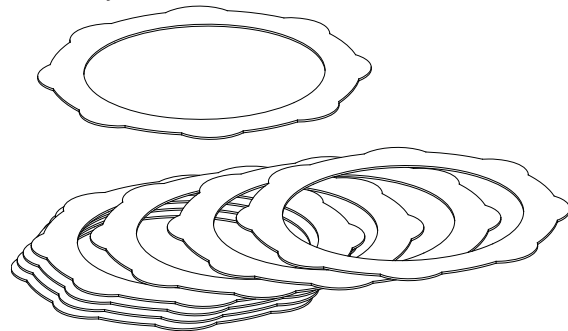
Remove the hex socket head capscrews securing the motor adapter to the brake housing, and remove the motor adapter.



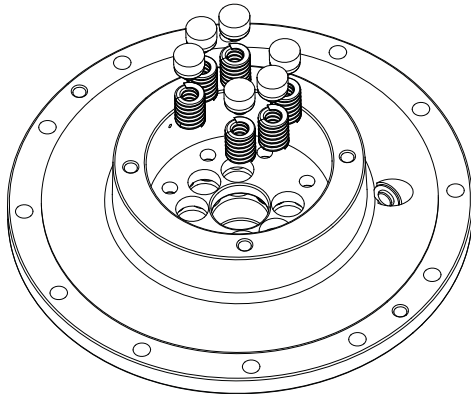
Remove the friction discs and steel brake plates. Remove the Polypak seal and pressure plate. Thoroughly clean all components prior to inspection.



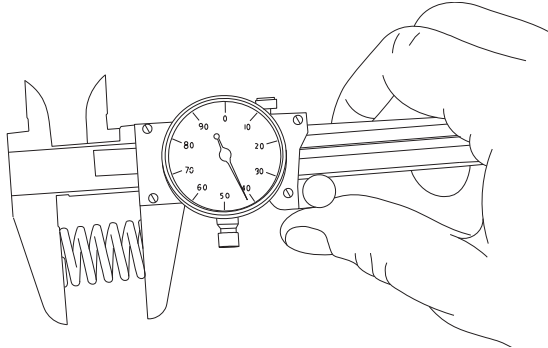
Place each friction disc on a clean, flat surface, and check for distortion using a straightedge. The friction material should appear evenly across the entire surface, with visible grooves. Replace the friction discs if the splines are worn to a point, if the disc is distorted, or if the friction material is worn unevenly.



Place each steel brake plate on a clean, flat surface and check for distortion using a straightedge. Check both surfaces for signs of material transfer or heat. Replace the brake discs if distortion or heat discoloration is present.



Remove the six (6) spring pucks and brake springs.



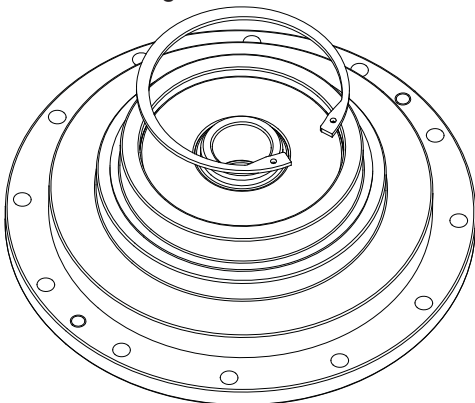
Check the brake spring free length: minimum free length should be 1.43 in. (36.3 mm). Check the springs for any sign of cracking or other failure.

NOTE: If a single spring must be replaced for any reason, then ALL springs must be replaced.

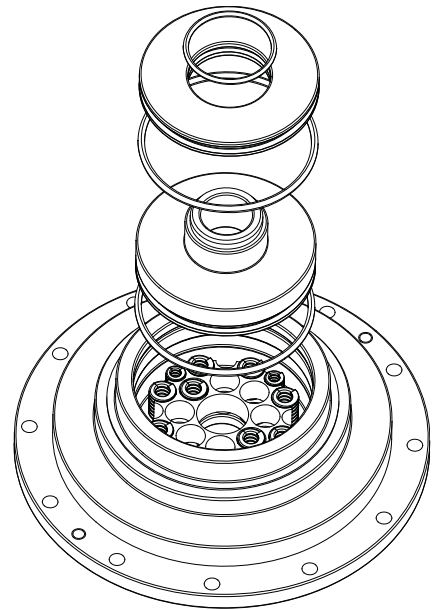
⚠ CAUTION ⚠

Failure to replace the brake springs as a complete set may result in uneven brake application pressure, and accelerated and repeated brake and brake spring failure.

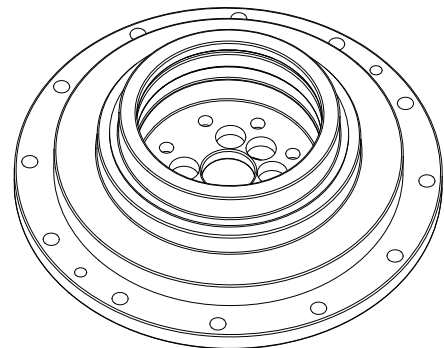
Turn the brake housing over with the motor end down.



Using a hydraulic press, or a spring compressor tool, apply only enough force against the seal ring needed to relieve the spring force acting on the retaining ring, and remove the retaining ring.



Remove the seal ring, clutch piston, spring retainer and clutch springs.



Check the clutch spring free length: minimum free length should be 1.43 in. (36.3 mm). Check the springs for any sign of cracking or other failure.

NOTE: If a single spring must be replaced for any reason, then ALL springs must be replaced.

⚠ CAUTION ⚠

Failure to replace the clutch springs as a complete set may result in uneven clutch application pressure, and accelerated and repeated clutch and clutch spring failure.

Inspect the clutch piston, seal ring and both brake housing bores for scoring, burrs or other irregularities which can damage the seals. Make certain the brake and clutch release ports are free of any contamination.

ASSEMBLY

Place the motor adapter on a clean work surface with the motor mounting surface down. Install a new back-up ring and O-ring in the groove. Locate the back-up ring near the mounting flange with the concave surface toward the O-ring.

Install the brake piston seal over the hub of the motor adapter. Make certain the lip of the seal faces down, toward the mounting flange. Lubricate both the O-ring and back-up ring, and the piston seal with a light coating of grease or petroleum jelly.

Lubricate the friction discs with new winch oil prior to assembly. Place a lobed steel brake plate into the bore of the motor adapter, followed by a friction disc. Continue assembling, alternating steel brake plates and friction discs until the last brake plate is installed. A steel brake plate should be on top. Align the inside splines on the friction discs.

Place the brake housing on a clean work surface with the motor end facing up. The brake and drum clutch release ports will be visible on the top side.

Install the pressure plate into the brake housing. Position the pressure plate with the flat face down.

Carefully raise the motor adapter/ brake plate assembly on its edge. Position your hands to reach through the bore from the motor side and grab the brake plates with your fingers. Lower the assembly into the bore and align the motor adapter such that the motor mounting holes are vertical.

NOTE: Use caution to ensure the brake plates do not fall out of position in the motor adapter. Once in contact with the pressure plate, the brake plates should remain properly positioned.

Secure the motor adapter to the brake housing using the hex socket head capscrews. Torque to 125 lb•ft (170 N•m).

Turn the brake housing over and position on the motor adapter.

Insert the spring pucks through the 1.03 in. (26 mm) bores with the large diameter down resting on the pressure plate.

Install the spring retainer into the brake housing bore, and align the spring bores with the pucks.

Install six (6) large brake springs into the spring retainer over the guide hub on the spring pucks.

Install two (2) large clutch springs into the remaining bores in the spring retainer.

Install the remaining eight (8) large diameter clutch springs in the large slots in the perimeter of the spring retainer.

Install the four (4) small diameter springs equally spaced in the small perimeter slots of the spring retainer.

Install the O-rings into the grooves on the clutch piston and seal ring. Lightly lubricate the O-rings with grease or petroleum jelly.

Install the clutch piston into the brake housing bore with the hub facing up. Carefully slide the piston down the bore allowing it to fully capture the clutch springs.

Install the seal ring.

Using a hydraulic press or spring compressor tool, apply just enough force to provide clearance between the retaining ring groove and seal ring. Install the retaining ring into the groove. Ensure the retaining ring is fully seated into the groove.

Apply pressure to the "BR" port to release the spring force acting on the brake plates and install the brake clutch to align the splines on the brake discs with the brake clutch.

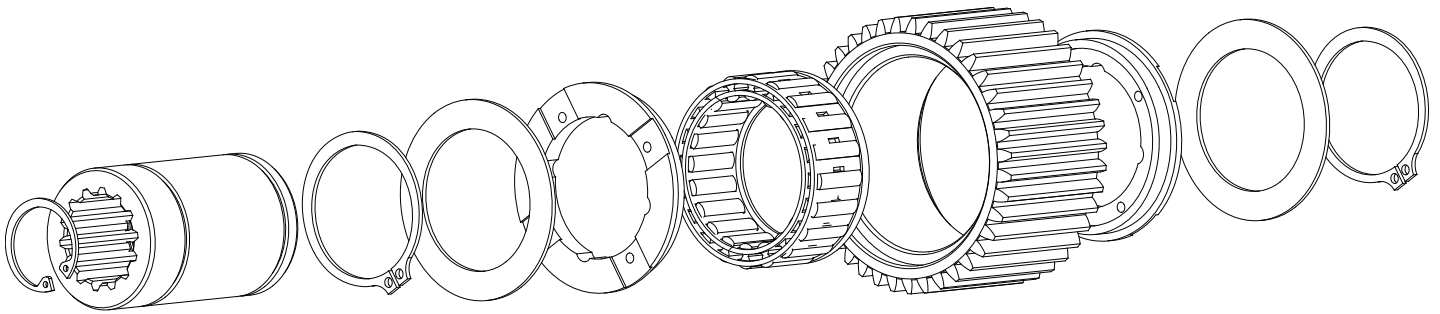
BRAKE HOUSING ASSEMBLY PRESSURE TEST

Install a -4 ORB fitting into the brake release (BR) port. Connect a hand pump with an accurate pressure gauge and shut-off valve. Apply pressure to the brake in the following sequence: 200 PSI, 500 PSI and 1000 PSI. Close the shut-off valve and let the unit stand at each setting for 3 – 5 minutes. If after this time frame, there is any loss of pressure, disassemble the brake housing assembly on the brake side and inspect for cut or nicked piston seals, or damaged sealing surfaces.

Install a -6 ORB fitting into the drum clutch release (DC) port. Connect a hand pump and perform the same test as above. If there is any loss of pressure to the drum clutch, disassemble the brake housing assembly on the clutch side and inspect for cut or nicked piston seals, or damaged sealing surfaces.

If either side requires disassembly for suspect seals, perform the test again after reassembly until the pressure can be held.

OVERRUNNING CLUTCH SERVICE



DISASSEMBLY

1. Remove the snap ring and thrust washers from the inner race. While slowly rotating the inner race within the sprag assembly, pull the inner race free of the outer brake race and sprag assembly.
2. Closely inspect the polished outer surface of the inner race for scoring, rippling, brinelling, wear, discoloration due to excessive heat, or indentions caused by the sprag cams. The entire brake clutch assembly **MUST** be replaced if any damage is found.
3. Remove the bearing from one end of the sprag assembly. Be careful not to damage the inside surface of the bearing. If the inside surface is damaged or shows wear, it should be replaced.
4. Slide the sprag clutches out of the outer brake race. Inspect each sprag clutch closely for abnormal wear, cracks, pitting or corrosion. Check the small clips for breakage or bright spots, which indicate excessive wear. Closely inspect the polished inner surface of the outer brake race for scoring, rippling, brinelling, wear, discoloration due to excessive heat, or indentions caused by the sprag cams. The entire brake clutch assembly **MUST** be replaced if any damage is found. Unless the outer race or remaining sprag bearing is damaged or shows excessive wear, there is no need for further disassembly. If further disassembly is required, remove the remaining sprag bearing as previously described.
5. Thoroughly clean and inspect all brake clutch parts before re-assembly.

ASSEMBLY

1. Press a bronze sprag bearing into one end of the outer brake race, using a mechanical or hydraulic press. A flat plate of approximately the same diameter as the bearing flange outside diameter should be placed between the press and the bearing during installation to protect the bearing. Make sure the bearing flange is located squarely against the shoulder in the outer race.
2. Turn the assembly over and install the two sprag clutches into the bore of the outer race. Slowly rotate the sprag clutch to aid installation.
3. Press the remaining bearing into the outer race. Again, make sure the bearing is located squarely against the shoulder in the outer race.
4. **VARIABLE DISPLACEMENT MOTORS** - Install a thrust washer onto brake shaft against the motor coupling end.
FIXED DISPLACEMENT MOTORS - Install a retaining ring into the groove on the motor end of the brake shaft. Install a thrust washer against the retaining ring.
ALL UNITS - Lubricate the brake shaft outer surface with clean winch oil.
5. Slide the brake shaft through the sprag clutch assembly. Rotate the brake shaft in the freewheeling direction to start it through the sprag assembly. If the brake shaft will not start through the bearings, the bearings may have been damaged and should be replaced.
6. Make sure the **brake clutch is assembled for the correct direction of free rotation**. Hold the outer brake race in your left hand with the motor end toward you. Grasp the motor coupling end of the brake shaft with your right hand, and turn it in a **CLOCKWISE** direction – the same direction the cable drum turns to reel-in wire rope. If the brake shaft will not rotate freely in this direction, the sprag clutch and outer brake race have been installed incorrectly and must be removed, turned over and reinstalled.
7. Once you have verified that the brake clutch has been assembled for the correct rotation, install the remaining thrust washer and the retaining ring.

⚠ WARNING ⚠

The polished surfaces of the races and sprag cams must be perfectly smooth to insure positive engagement of the sprag assembly. Any defect (scoring, rippling, brinelling, wear, discoloration due to excessive heat, or indentions caused by the sprag cams) may reduce the effectiveness of the brake clutch, which could result in loss of load control, property damage, severe personal injury or death. If the brake shaft, sprag clutches or outer brake clutch assembly must be replaced.

CABLE DRUM SERVICE



The cable drum is supported in the winch case by bearings on the output ring gear and brake housing. If either of these components is removed, and the drum is not supported externally as described on page 28, the cable drum may come loose in the case. The cable drum weighs approx. 490 lb (222 kg). Injury to personnel or damage to parts can occur if proper precautions are not taken.

DISASSEMBLY

Remove the cable drum as described on page 28.

Place the cable drum on a suitable work surface. Inspect the bearings for while still inside the drum. If scoring, heat discoloration or any other damage is present, then replace the bearings.

Remove the drum seals.

NOTE: Remove the seals carefully. With the seals removed, the bearings cones will fall free. Unintentional damage to the bearings can occur if the bearings are not captured or otherwise protected during this process.

If the bearing cups require replacement, remove them using either a multi-jaw puller or by welding pulling lugs directly to the cups. If there is no visible damage to the cups, no replacement is necessary.

ASSEMBLY

Place the cable drum on a suitable work surface in an upright position.

If bearing cups were not removed, proceed to the next step. Chill the bearing cups in dry ice to shrink the diameter and aid installation. Install one cup into the drum bearing bore. Use a .002 in. (.05 mm) feeler gauge to make certain the cup is fully seated against the shoulder.

Lubricate the bearing cones with new winch oil. Place one cone in the bearing cup.

Apply non-hardening sealing compound to the outside surface of the seal housing. Properly position the seal in the drum bore. Place a large steel plate over the seal and press or drive into position within the bore.

NOTE: A large plate or mandrel will help to maintain proper alignment and protect the seal from unintentional damage during installation.

Turn the cable drum over and position with the opposite end upright. Repeat the above steps as required to install the bearing and seal for this end.

NOTE: The wire rope anchor pocket is always located on the RH (motor) side of the winch. Lubricate the bearing and seal contact surfaces of the output ring gear and brake housing to aid installation.

Position the cable drum inside the case and support as previously defined.

Install the output ring gear into the LH side of the winch case. Locate the eyebolt as close to top dead center as possible. Ensure the bearing cone is properly positioned on the hub of the ring gear before completing the assembly. Align the mounting holes. Install the fasteners and torque the cap screws to 120 lb•ft (163 N•m).

Refer to the "Winch Assembly Section" of this manual for the remaining steps to complete the winch assembly.

WINCH ASSEMBLY

If the cable drum was removed, support the drum securely between the winch case walls with a suitable chain and hoist. The cable anchor pocket must be located on the RH, or motor, side of the winch.

CAUTION

The cable drum is supported in the winch case by bearings on the output ring gear and brake housing. If either of these components is removed, and the drum is not supported externally as described on page 28, the cable drum may come loose in the case. The cable drum weighs approx. 490 lb (222 kg). Injury to personnel or damage to parts can occur if proper precautions are not taken.

Install the output ring gear into the LH side of the winch case. Locate the eyebolt as close to top dead center as possible. Ensure the bearing cone is properly positioned on the hub of the ring gear before completing the assembly. Align the mounting holes. Install the fasteners and torque the capscrews to 120 lb•ft (163 N•m).

CAUTION

The output ring gear weighs approx. 265 lb (120 kg). Use of a hoist or other lifting equipment is recommended to eliminate the possibility of injury. Make certain lifting equipment has adequate capacity.

Remove the eyebolt from the ring gear and install the capscrew into the eyebolt hole.

Install the output planetary assembly into the ring gear while aligning the planet gear and drum shaft splines.

CAUTION

The output planet carrier assembly weighs approx. 280 lb (127 kg). Use of a hoist or other lifting equipment is recommended to eliminate the possibility of injury. Make certain lifting equipment has adequate capacity.

Install the output sun gear through the drum shaft and into the planet gears.

Install the O-ring into the groove on the end cover pilot. Lubricate the O-ring with a light coating of grease or petroleum jelly and install the end cover onto the ring gear. Torque the capscrews to 120 lb•ft (163 N•m).

CAUTION

The end cover weighs approx. 140 lb (63 kg). Use of a hoist or other lifting equipment is recommended to eliminate the possibility of injury. Make certain lifting equipment has adequate capacity.

Install the retaining ring into the groove on the end of the output sun gear.

Install the intermediate planetary assembly into the cable drum. Align the splines on the planet carrier with the splines on the end of the output sun gear.

Install the retaining ring into the I.D. groove of the cable drum.

Install the thrust ring into the cable drum. Ensure the hub is facing the motor end.

Install the carrier clutch assembly into the cable drum. The intermediate sun gear splines will have to be aligned with the intermediate planet gears.

Apply a thin layer of grease to the hub and face of the clutch carrier. Install the thrust washer, needle roller bearing and thrust race. Ensure the counterbored side of the thrust race is facing the planet gear set. A thin coating of grease on each of these components will aid retention during assembly.

Lubricate the bearing cone with new winch oil. Place the cone in the bearing cup.

Apply non-hardening sealing compound to the outside surface of the seal housing. Properly position the seal in the drum bore. Place a large steel plate over the seal and press or drive into position within the bore.

NOTE: A large plate or mandrel will help to maintain proper alignment and protect the seal from unintentional damage during installation.

Install the primary sun gear into the planet gears.

METHOD FOR SETTING H90VS SHIMSTACK

1. Install bearing cup, bearing cone, and drum seal into output ring gear end of cable drum. Install bearing cup into motor end of cable drum. Do not install the bearing cone or drum seal on the motor end of the drum at this time.
2. Set the cable drum into winch housing and install output ring gear. Rotate winch housing so that the hydraulic motor side is up. Rotate and tap the cable drum so that the drum is fully seated on the output ring gear.
3. Install bearing cone into drum. Do not install drum seal at this time.
4. Lay a 42 in. (10.7 cm) length of 1/8 in. (3.2 mm) solder between the brake housing pilot bore and bolt pattern on the winch housing. Overlap the ends approximately 3 inches (7.6 cm.) Use solid solder or babbitt only.
5. Install the brake housing assembly and tighten bolts with washers as follows: (Do not use an impact wrench)

Hand tighten all the bolts in the numbered order shown and rotate the cable drum. Repeat tightening pattern using a torque wrench to 40 ft-lbs (54 N.m), 65 ft-lbs (88 N.m) and 100 ft-lbs (135 N.m) respectively. Rotate the cable drum between each tightening.

6. Remove bolts, washers, and brake housing assembly.
7. Measure the thickness of the solder using a micrometer in a minimum of 5 places, evenly spaced around the flattened solder, and record the readings. Do not measure within 3 in. (7.6 cm.) of the ends of the solder as the readings are inaccurate.
8. To determine the total thickness of the shim stack, calculate the average thickness and round up to the nearest thousand of an inch. Add .003 in. - .005 in. (.08- .13 mm) to obtain the total shim stack thickness.
9. Remove the bearing cone and install the ratio group.
10. Re-install the bearing cone and install the drum seal into the motor end of cable drum.
11. Install the required combination of shims to equal the total shim stack thickness. Install the brake housing assembly.
12. Install bolts with washers and tighten in the pattern shown to 80 ft-lbs (108 N.m) using a torque wrench (do not use an impact wrench). Rotate the cable drum and check the torque at each bolt.

CAUTION

The brake housing assembly weighs approx. 115 lb (52 kg). Use of a hoist or other lifting equipment is recommended to eliminate the possibility of injury. Make certain lifting equipment has adequate capacity.

Locate the brake release (BR) port at the top. Align the mounting holes. Install the fasteners and torque the cap-screws to 120 lb•ft (163 N•m).

Install the brake clutch into the brake housing with the short end of the inner race toward the motor.

When installed the correctly, the inner race of the brake clutch should turn freely in the SAME direction the cable drum turns in REEL-IN. to verify direction, hold the outer race of the assembly in one hand and turn the inner race with the other hand.

If the brake clutch freewheels in the wrong direction, disassemble the brake clutch and reverse the inner race. Refer to the “Brake Clutch Service” section of this manual for further information.

Install a new O-ring on the motor pilot and lubricate with grease or petroleum jelly.

Install the hydraulic motor assembly into the brake clutch inner race. Ensure the motor seats fully into the pilot bore. Torque the fasteners to 230 lb•ft (312 N•m).

CAUTION

The hydraulic motor assembly weighs approx. 95 lb (43 kg). Use of a hoist or other lifting equipment is recommended to eliminate the possibility of injury. Make certain lifting equipment has adequate capacity.

Attach the brake release hose to the brake release “BR” port on the brake housing.

CAUTION

Each horizontal roller weighs approx. 41 lb (19 kg). Exercise proper care during handling to prevent injury due to mishandled or dropped parts.

Install the horizontal fairlead roller and shaft assemblies. Install the shaft assembly from the LH side of the case. Insert the spacer washers at both ends of the shaft assembly between the roller and the case wall. Torque the bolt to 45 lb•ft (61 N•m).

CAUTION

Each vertical roller weighs approx. 85 lb (39 kg). Use of a hoist or other lifting equipment is recommended to eliminate the possibility of injury. Make certain lifting equipment has adequate capacity.

Install the vertical fairlead roller and shaft assemblies. Install the shaft assembly from the top of the case. Insert the spacer washers at both ends of the shaft assembly between the roller and the case wall. Torque the bolt to 45 lb•ft (61 N•m).

Grease the fairlead rollers as specified in the “Preventive Maintenance” section of this manual.

Refill the winch to the proper level with the recommended oil. Refer to the “Preventive Maintenance” section of this manual for further information.

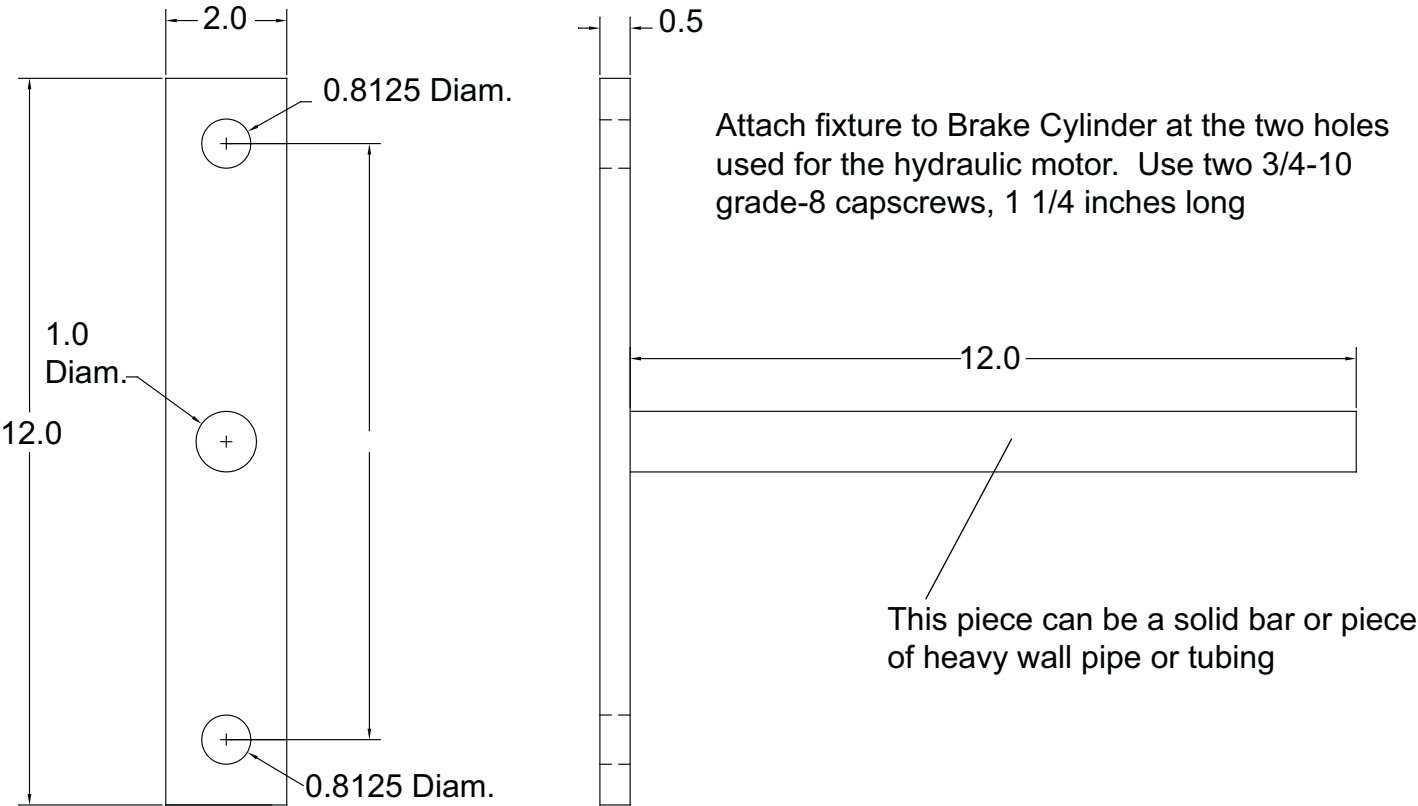
Install the winch onto the tractor. Refer to your “Parts and Installation” manual for the recommended procedure.

Once installed on the tractor, refill the tractor hydraulic reservoir as required. Refer to your tractor maintenance manual for recommendations and proper procedures.

Start the tractor engine and operate the winch with NO LOAD in both directions to purge air from the lines. Check all plumbing for leaks and make any necessary repairs.

Install the motor cover and torque the capscrews to 75 lb•ft (102 N•m).

BRAKE CYLINDER FIXTURE



THIS PAGE INTENTIONALLY LEFT BLANK

THIS PAGE INTENTIONALLY LEFT BLANK

THIS PAGE INTENTIONALLY LEFT BLANK

METRIC CONVERSION TABLE

English to Metric			Metric to English		
LINEAR					
inches (in.)	X 25.4	= millimeters (mm)	millimeters (mm)	X 0.3937	= inches (in.)
feet (ft.)	X 0.3048	= meters (m)	meters (m)	X 3.281	= feet (ft.)
miles (mi.)	X 1.6093	= kilometers (km)	kilometers (km)	X 0.6214	= miles (mi.)
AREA					
inches ² (sq.in.)	X 645.15	= millimeters ² (mm ²)	millimeters ² (mm ²)	X 0.000155	= inches ² (sq.in.)
feet ² (sq.ft.)	X 0.0929	= meters ² (m ²)	meters ² (m ²)	X 10.764	= feet ² (sq.ft.)
VOLUME					
inches ³ (cu.in.)	X 0.01639	= liters (l)	liters (l)	X 61.024	= inches ³ (cu.in.)
quarts (qts.)	X 0.94635	= liters (l)	liters (l)	X 1.0567	= quarts (qts.)
gallons (gal.)	X 3.7854	= liters (l)	liters (l)	X 0.2642	= gallon (gal.)
inches ³ (cu.in.)	X 16.39	= centimeters ³ (cc)	centimeters3 (cc)	X 0.06102	= inches ³ (cu.in.)
feet ³ (cu.ft.)	X 28.317	= liters (l)	liters (l)	X 0.03531	= feet ³ (cu.ft.)
feet ³ (cu.ft.)	X 0.02832	= meters ³ (m ³)	meters3 (m3)	X 35.315	= feet ³ (cu.ft.)
fluid ounce (fl.oz.)	X 29.57	= millileters (ml)	milliliters (ml)	X 0.03381	= fluid ounce (fl.oz.)
MASS					
ounces (oz.)	X 28.35	= grams (g)	grams (g)	X 0.03527	= ounces (oz.)
pounds (lbs.)	X 0.4536	= kilograms (kg)	kilograms (kg)	X 2.2046	= pounds (lbs.)
tons (2000 lbs.)	X 907.18	= kilograms (kg)	kilograms (kg)	X 0.001102	= tons (2000 lbs.)
tons (2000 lbs.)	X 0.90718	= metric tons (t)	metric tons (t)	X 1.1023	= tons (2000 lbs.)
tons (long) (2240 lbs.)	X 1013.05	= kilograms (kg)	kilograms (kg)	X 0.000984	= tons (long) (2240 lbs.)
PRESSURE					
inches Hg (60 °F)	X 3600	= kilopascals (kPa)	kilopascals (kPa)	X 0.2961	= inches Hg (60 °F)
pounds/sq.in. (PSI)	X 6.895	= kilopascals (kPa)	kilopascals (kPa)	X 0.145	= pounds/sq.in. (PSI)
pounds/sq.in. (PSI)	X 0.0703	= kilograms/sq.cm. (kg/cm ²)	kilograms/sq.cm. (kg/cm2)	X 14.22	= pounds/sq.in. (PSI)
pounds/sq.in. (PSI)	X 0.069	= bars	bars	X 14.5	= pounds/sq.in. (PSI)
inches H ₂ O (60 °F)	X 0.2488	= kilopascals (kPa)	kilopascals (kPa)	X 4.0193	= inches H ₂ O (60 °F)
bars	X 100	= kilopascals (kPa)	kilopascals (kPa)	X 0.01	= bars
POWER					
horsepower (hp)	X 0.746	= kilowatts (kW)	kilowatts (kW)	X 1.34	= horsepower (hp)
ft.-lbs./min.	X 0.0226	= watts (W)	watts (W)	X 44.25	= ft.-lbs./min.
TORQUE					
pound-inches (in.-lbs.)	X 0.11298	= newton-meters (N-m)	newton-meters (N-m)	X 8.851	= pound-inches (in.-lbs.)
pound-feet (ft.-lbs.)	X 1.3558	= newton-meters (N-m)	newton-meters (N-m)	X 0.7376	= pound-feet (ft.-lbs.)
pound-feet (ft.-lbs.)	X .1383	= kilograms/meter (kg-m)	kilogram/meter (kg-m)	X 7.233	= pound-feet (ft.-lbs.)
VELOCITY					
miles/hour (m/h)	X 0.11298	= kilometers/hour (km/hr)	kilometers/hour (km/hr)	X 0.6214	= miles/hour (m/h)
feet/second (ft./sec.)	X 0.3048	= meter/second (m/s)	meters/second (m/s)	X 3.281	= feet/second (ft./sec.)
feet/minute (ft./min.)	X 0.3048	= meter/minute (m/min)	meters/minute (m/min)	X 3.281	= feet/minute (ft./min.)
TEMPERATURE					
°Celsius = 0.556 (°F - 32)			°Fahrenheit = (1.8 X °C) + 32		
COMMON METRIC PREFIXES					
mega	(M)	= 1,000,000 or 10 ⁶	deci	(d)	= 0.1 or 10 ⁻¹
kilo	(k)	= 1,000 or 10 ³	centi	(c)	= 0.01 or 10 ⁻²
hecto	(h)	= 100 or 10 ²	milli	(m)	= 0.001 or 10 ⁻³
deka	(da)	= 10 or 10 ¹	micro	(m)	= 0.000.001 or 10 ⁻⁶